CAPE PERON

FAUNA ASSESSMENT

JULY 2011

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Prepared for

STRATEGEN

Prepared by

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EXECUTIVE SUMMARY

ENV.Australia Pty Ltd was commissioned in November 2009 by Strategen to undertake a terrestrial fauna assessment of the Mangles Bay area of Cape Peron, Rockingham ('survey area'). The assessment was undertaken as part of the concept planning process for the development of the marina-based tourist precinct.

The survey area covers 93.55 ha of bushland on Cape Peron, and an additional 26.6 ha of bushland surrounding Lake Richmond and is located approximately 39 kilometres to the south-west of Perth in the Swan Coastal Plain region of Western Australia. The survey area is one of a number of woodland remnants persisting on the Swan Coastal Plain. Many birds and mammals have become extinct in this bioregion because of habitat loss and alteration, fragmentation and isolation since European settlement.

Four broad fauna habitat types based on landform and vegetation structure were recorded within the survey area, namely Shoreline, Coastal Heath, Woodland and Wetland. The Shoreline, Coastal Heath and Woodland habitat types were deemed as having moderate habitat value and the Wetland habitat type was deemed as having high habitat value.

The vertebrate fauna trapping programme included a total of 1,645 trap nights and over 50 hours of diurnal and nocturnal searching. This resulted in a total of 96 fauna taxa being recorded including five amphibian species, 19 reptile species, 66 avifauna species (three of which were introduced) and six mammal species (three introduced). The faunal composition of Cape Peron is considered typical, in terms of species composition and species richness, of small woodland remnants on the Swan Coastal Plain.

The expected species richness of Cape Peron for herpetofaunal (amphibian and reptile species combined) species, by analysing the rate at which new species were recorded in systematic site data. A species accumulation curve approached an asymptote for the herpetofauna with the 19 herpetofauna species comprising 97.5% of the expected species richness (19.9 species) indicating a relatively complete herpetofaunal survey. The same analyses could not be applied to bird or mammal data due to methods of data collection and the limited number of mammal species recorded.

Seven fauna species of conservation significance (listed under the *Environment Protection and Biodiversity Conservation Act 1999*, the *Wildlife Conservation Act 1950* or occurring on the Department of Environment and Conservation Priority list) were recorded within the survey area. Six species, namely the Eastern Great Egret, Eastern Osprey, Common Sandpiper, Bridled Tern, Rainbow Bee-eater and Australian Reed-warbler are listed as Migratory under the *Environment Protection and Biodiversity Conservation Act 1999*. One species, the Lined Skink (*Lerista lineata*), is listed as Priority on the Department of Environment and Conservation Priority list.

An additional 34 conservation significant fauna species potentially occur in the survey area. It is noted that no evidence of the Quenda or South-west Carpet Python was recorded during the survey. Conservation significant black cockatoo species, or migratory waders also went unrecorded.

The survey area already exhibits a moderate to high level of disturbance due to existing infrastructure, an influx of weed species and other anthropogenic effects such as clearing and rubbish dumping. The survey area also exhibits disturbance from an existing caravan park and boat-yards in the developed areas to weed infestations and anthropogenic effects in the vegetated areas.

The main impact of the proposed development will be vegetation clearing which is likely to affect local populations of ground dwelling fauna species. This applies particularly to the Priority 3 listed Skink *Lerista lineata* which was recorded within the impact area. However, no net effects are expected upon this species' conservation status within the local area and region as preferred habitat will continue to exist within the larger survey area.

The main impact of the proposed scope of works will be vegetation clearing which is likely to affect local populations of ground dwelling fauna species. However, given the small scale of impact, the commonality of the habitat within the survey area and wider surrounds, no net regional impacts are expected.

1 INTRODUCTION

ENV.Australia Pty Ltd (ENV) was commissioned in November 2009 by Strategen to undertake a terrestrial fauna assessment of the Mangles Bay area of Cape Peron, Rockingham ('survey area'). The assessment is to be undertaken as part of the concept planning process for the development of the marina-based tourist precinct.

This fauna assessment was prepared in consideration of the Western Australian Environmental Protection Authority's (EPA) Guidance Statement No. 56 *Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia* (EPA 2004).

The objectives of the vertebrate fauna assessment were to:

- conduct a comprehensive fauna database/literature review for the survey area;
- conduct a terrestrial vertebrate fauna survey within the survey area;
- conduct a habitat assessment of the survey area documenting general habitat types;
- identify terrestrial vertebrate fauna of conservation significance that may occur in the survey area;
- identify terrestrial invertebrate fauna of conservation significance that may occur in the survey area; and
- prepare a report for an environmental assessment document.

1.1 LOCATION

The survey area is located approximately 39 km to the south-west of Perth's Central Business District in the Swan Coastal Plain region of Western Australia (Figure 1) and lies within the suburbs of Peron and Shoalwater on the shores of Mangles Bay, Rockingham. The survey area includes Lake Richmond (Figure 2) and the Core Project Area for the Cape Peron marina-based tourist precinct development (impact area) (Figure 2). The area of woodland remnants is 93.5 ha (Cape Peron and adjacent bushland) and 26.5 ha for Lake Richmond and surrounds.

1.2 REGIONAL SETTING

The site is in the Swan Coastal Plain Bioregion (Thackway and Cresswell 1995). In terms of flora and vegetation characteristics, the site is in the Darling Botanical District and in the Swan Coastal Plain Sub region in the Drummond Botanical Sub district (Beard 1990). The Drummond Botanical Sub district consists mainly of the following vegetation communities:

- *Banksia* Low Woodland on leached sands and *Melaleuca* Swamps in poorly-drained areas;
- Woodland of Tuart (*Eucalyptus gomphocephala*); and
- Jarrah (*Eucalyptus marginata*) and Marri (*Corymbia calophylla*) on the less leached soils (Beard 1990).

1.3 CLIMATE

The survey area is located in the Swan Coastal Plain region of Western Australia. This region experiences a warm Mediterranean climate which is characterised by hot dry summers and mild wet winters.

The nearest Bureau of Meteorology (BoM) weather station is located at Garden Island, approximately 5 km north of the study area. The nearest long-term average weather station is located at Kwinana BP Refinery, approximately 8 km to the north-west of the survey area.

There is very little rainfall in summer with most of the rainfall occurring in winter. Average annual rainfall is 754.3 millimetres (mm) (data extracted between years 1955 and 2009) and a range of temperatures. In summer, maximum temperatures may reach 29.3°C (February), whilst in winter, minimum temperatures may fall to 10.6°C (July) (BoM 2009) (Figure 3).

Significant variation in rainfall is noted across the region, and as such, data is provided as a guide only.

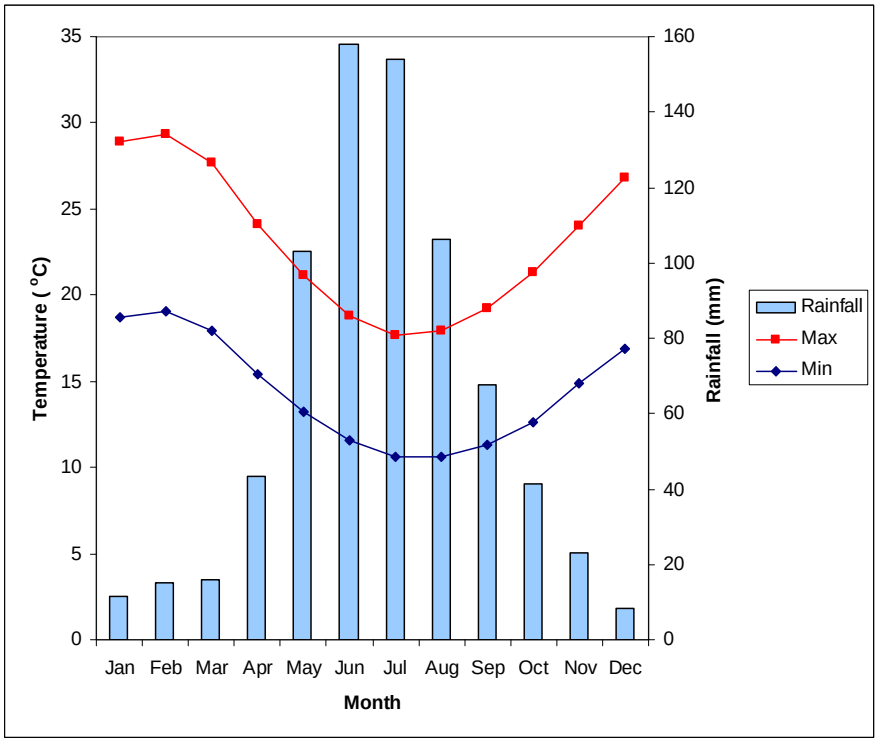

Figure 3: Average Monthly Rainfall and Maximum and Minimum Temperatures at Kwinana BP Refinery (1955-2009) (BoM 2009).

1.4 PREVIOUS BIOLOGICAL STUDIES

There has been only a limited amount of biological survey work undertaken within the vicinity of Cape Peron. However, several major studies have examined the vertebrate fauna of the Swan Coastal Plain (e.g. How and Dell 2000) and have demonstrated how small and isolated predominantly woodland bushland patches have been unable to maintain viable populations of many vertebrate species, as evidenced by numerous local extinctions.

The most recent surveys within 10 km of Cape Peron have been:

- Fauna Assessment of Bush Forever Site 355 (Point Peron and adjacent bushland) (Bamford 2005), a desktop study that predicted which fauna species were likely to occur at Cape Peron. This study is of value for comparison of what was actually recorded with what was predicted to occur;
- Fauna Assessment of a Portion of the Sepia Depression Ocean Outlet Landline, Lake Richmond (ENV 2005);
- Fauna Survey (Level 1) East Rockingham WWTP Site (Harewood 2008);
- Fauna Survey (Level 2) East Rockingham WWTP Site (Harewood 2009); and

- Fauna Survey (Level 2 equivalent) Jandakot Airport Site (Bamford *et al.* 2003).

The impact of urbanisation and of subsequent habitat fragmentation on mammals, reptiles and amphibians has been examined for many sites on the Swan Coastal Plain (e.g. How 1998, How and Dell 2000). The results of these studies, as well as those listed above, provide background context for understanding community patterns and the impact of fragmentation on the ground-dwelling fauna of Cape Peron in comparison with similar-sized bushland fragments on the Swan Coastal Plain.

1.5 LAKE RICHMOND

Lake Richmond is situated on the extreme western margin of the central part of the Swan Coastal Plain. The Swan Coastal Plain Bioregion (SWA) was classified as part of the Interim Biogeographical Regionalisation for Australia. The SWA bioregion is described as being a:

"Low lying coastal plain mainly covered with Woodlands. It is dominated by Banksia or Tuart on sandy soils, Allocasuarina obesa on outwash plains, and paperbark in swampy areas. In the east, the plain rises to duricrusted Mesozoic sediments dominated by Jarrah Woodland. Warm Mediterranean. Three phases of marine sand dune development provide relief. The outwash plains, once dominated by A. obesa – Marri Woodlands and Melaleuca shrublands, are extensive only in the south." (Thackway and Cresswell 1995, DEWHA 2009a).

Lake Richmond is:

- identified as Bush Forever Site 358 and forms part of the Rockingham Lakes Regional Park. The site includes approximately 28.7ha of bushland in addition to open water. Site 358 is classified as having 'existing protection' and is defined as land currently reserved in the Metropolitan Region Scheme (MRS) for Parks and Recreation;

- listed under the 1992 Environmental Protection (Swan Coastal Plain Lakes) Policy; and

- classified as a Conservation Category Wetland.

The site contains representatives of two threatened ecological communities – Thrombolite (microbial) community of coastal freshwater lakes and Sedgelands in Holocene dune swales of the southern Swan Coastal Plain (ENV 2005).

2 METHODOLOGY

2.1 BACKGROUND TO SURVEY METHODOLOGY

All fauna surveys undertaken by ENV are designed to be compliant with the Environmental Protection Authority (EPA) requirements for the environmental surveying and reporting of fauna surveys in Western Australia, as set out in the following documents:

- *Terrestrial Biological Surveys as an Element of Biodiversity Protection. Position Statement No. 3* (EPA 2002)*; and*
- *Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia. Guidance Statement No. 56* (EPA 2004)*.*

2.1.1 EPA Guidance Statement No. 56

A baseline field fauna survey for environmental impact assessment should at the very least provide a comprehensive list of species within a given area. There are two levels of fauna survey as delineated by the EPA:

- ***Level One***: desktop study to collate historical knowledge, in conjunction with a reconnaissance survey (site inspection); and
- ***Level Two***: trapping and opportunistic field survey to characterise the fauna present, combined with a Level One survey.

The methodology of the survey, a Level Two survey, was developed in consideration of the EPA *Guidance Statement No. 56 (*EPA 2004). Results of surveys are reported with particular regard to the provisions of Commonwealth and State legislation.

2.1.2 Fauna of Conservation Significance

Species are protected formally by legislative measures and informally by various non-legislative and policy measures, which are outlined below.

Legislative Protection

- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)*;*
- *Wildlife Conservation Act 1950* (WC Act)*; and*
- *Environmental Protection Act 1986* (EP Act)*.*

Non-Legislative Protection

- Department of Environment and Conservation (DEC) Priority lists; and
- Recognition of fauna species of interest by the DEC.

A short description of these legislative and non-legislative measures is given below, and definitions of the species conservation codes and ecological community categories they use, and those used by the DEC, are provided in Appendix A.

EPBC Act

The Federal EPBC Act aims to protect matters of national environmental significance, which are detailed in Appendix A. Under the EPBC Act, the Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) lists threatened species and Threatened Ecological Communities (TECs) in certain categories determined by criteria set out in the Act. Projects likely to cause impacts on matters of national environmental significance should be referred to SEWPaC for assessment under the Act.

WC Act

The State WC Act lists taxa identified by the DEC as protected, which are classified as Schedule 1 to Schedule 4 according to their need for protection (see Appendix A).

The Act makes it an offence to 'take' threatened species without an appropriate licence.

EP Act

Under the Western Australian EP Act, the *Environmental Protection* (Clearing of Native Vegetation) *Regulations 2004* contains ten principles by which applications to clear native vegetation are assessed. Significant habitat necessary for the maintenance of indigenous fauna species is one of these principles. In addition, TECs include fauna assemblages / communities, and TECs have special status as Environmentally Sensitive Areas (ESAs) under the Act.

DEC Priority Lists

The DEC produces a list of Priority species that have not been assigned statutory protection under the WC Act. Priority Fauna are under consideration as 'Scheduled' fauna, but are in urgent need for further survey or require regular monitoring, and although not currently threatened may become so in the future. Appendix A provides definitions of Priority codes.

In addition, the DEC maintains a list of Priority Ecological Communities (PECs) which identifies those communities that need further investigation before possible nomination for TEC status.

Although DEC Priority species and communities have no formal legal protection, they are under consideration for protection under the WC Act or as ESAs under the EP Act.

Informal Recognition of Fauna of Interest

Certain populations or communities may be of interest to the DEC because of their patterns of distribution and abundance. For example, fauna may be of interest because they are range extensions to the previously known distribution or are newly discovered taxa (and therefore have the potential to be of more than local significance). In addition, many species are in decline as a result of threatening processes (primarily land clearing), and relict populations of such species are sometimes considered to be of local importance for the DEC. It is not uncommon for the DEC to make comment on these species of interest.

2.2 DATABASE AND LITERATURE REVIEW

The purpose of the desktop review was to gather background information on the survey area and the fauna that it may support. This involved a search of the following sources:

- Western Australian Museum's (WAM) and DEC combined biological database NatureMap (DEC 2009a);
- DEC Threatened and Priority Fauna database (DEC 2009b);
- DEWHA Protected Matters Search Tool (DEWHA 2009b), also known as an EPBC search;
- previous fauna surveys (e.g. previous consultants reports, DEC reports);
- publications that provide information on terrestrial vertebrate distributions (e.g. How and Dell 2000); and
- discussions with personnel from State wildlife agencies and relevant non-government organisations.

Collectively, these sources were used to compile a list of species that have been previously recorded in the region (Appendix B) and to place the results of the survey in a regional context.

Appendix B will include species that do not occur in the survey area, because some fauna species have a limited or patchy distribution, high level of habitat specificity, are locally extinct or were erroneously identified in previous surveys. Some records were excluded from this list, such as extinct species and clearly erroneous records.

2.3 FIELD SURVEY METHODOLOGY

2.3.1 Sampling Methodology

The purpose of the field survey was to verify the accuracy of the desktop survey and to further delineate and characterise the fauna species and faunal assemblages in the survey area. The fauna field survey consisted of:

- a fauna habitat assessment;
- a trapping program;
- diurnal and nocturnal searches;
- an ornithological census;
- bat recordings;
- targeted conservation significant species search; and
- opportunistic observations.

These components are described below.

Fauna Habitat Assessment

During the field survey, broad fauna habitats were identified based on vegetation structure and landforms. These fauna habitats were then assessed for their potential to support species of conservation significance and the quality of habitat they provide to a wider suite of fauna. Habitats were rated as high, moderate or low on the basis of their complexity, the presence of microhabitats, including significant trees with hollows, loose bark, fallen hollow logs and leaf litter, and their representation in the region and survey area.

Trapping Program

Six vertebrate fauna trapping sites were established within the survey area. The location and habitat details of each site are presented in Appendices C1 and C2 and in Figure 4.

The six trapping sites each contained ten trap lines, which consisted of seven-metre long net fences with one pit trap (20L) (29cm diameter, 35cm deep) in the centre of the 7m drift fence, and a funnel trap ('fish-bait trap'-style folding synthetic mesh traps) at each end. Each trap line was positioned approximately 30m apart, with one ground Elliott trap per trap line (9 X 9 X 32cm) and five hair tube traps (with synthetic wafers) and two cage traps (25 X 25 X 70cm) at each trapping site (Appendix C3).

The trapping program was conducted from 20 to 27 November 2009, with traps being open for up to six nights. The trapping sites were subjected up to 12 trap-nights for cage traps, up to 30 trap-nights for hair tubes, 60 trap-nights for bucket, and Elliott traps, and 120 trap-nights for funnel traps (Appendix C4).

The hair tube wafers were collected and the contents were identified by Ms Barbara Triggs (Consultant Mammologist).

Diurnal and Nocturnal Searches

Diurnal searches for fauna species were undertaken in the survey area. Searches included:

- investigating burrows;
- investigating rock crevices;
- investigating scats, tracks and other traces;
- splitting exfoliated rock;
- turning rocks, fallen timber and debris;
- opening standing timber crevices; and
- raking leaf litter.

The total time spent on the above activities was 12 hours, with details of diurnal census presented in Appendix D1.

Nocturnal searches consisted of 'spotlighting' the survey area on foot with the aid of spotlighting equipment (Figure 5). A total of 16.5 hours were spent spotlighting the survey area (full survey details can be seen in Appendix D2).

Ornithological Census

Ornithological diurnal surveys were undertaken throughout the survey area. Census locations were not limited to trap site locations, but rather the majority of the survey area was surveyed resulting in approximately 22 hours being

undertaken. Details of the ornithological census are presented in Figure 6 and in Appendix E.

Bat Echolocation Recordings

Bat echolocation recordings were undertaken at night, using AnaBat SD1 recording units to document bat species in the area. AnaBat SD1 units were set on a timer to turn on at dusk and off at dawn (recording all night), and were left in place for up to six nights. The recording units convert ultrasonic echolocation signals produced by bats into audible electronic signals, which are later analysed for species-specific calls. Anabats were set close to tree hollows identified as potential roosting locations or surface water (Lake Richmond) where species may congregate to forage. Bat survey locations and details are presented in Figure 7 and in Appendix F.

Targeted Conservation Significant Species Searches

Transects were conducted 100 m apart across the proposed impact area, searching for signs of conservation significant fauna. Particular attention was made on potential signs of or habitat for the Quenda (*Isoodon obesulus fusciventer*), Black Cockatoo species and Graceful Sun Moth (*Synemon gratiosa*). Field staff investigated for signs or scats, tracks, burrows and other traces of these species as well mapping the locations and density of preferred habitat. For example identifying habitat trees containing breeding hollows for Black Cockatoo species and mapping of *Lomandra maritima* an important plant species critical for the life cycle of the Graceful Sun Moth (DEC 2009c) were undertaken. Mapping of the density of *Lomandra maritima* was undertaken within a preliminary impact area available at the time of survey and can be seen in Figure 8.

Opportunistic Observations

At all times, while walking or driving around the survey area, fauna was opportunistically observed and recorded. Field staff also investigated scats, tracks, burrows and other traces of animals throughout the entire survey. Where conservation-significant species were found, GPS coordinates were recorded.

2.3.2 Taxonomy

For species identified in the Desktop Assessment where there is doubt to their true taxonomy (through subsequent name changes or taxonomic reviews) an effort was made to determine the current scientific name for each taxon. However, in some cases, old scientific names may be presented. Some taxa names may be followed by 'sp.', meaning that the species name was not given in the data source or the taxonomy is in doubt. Where there are previously

recorded taxa such as those that have the potential to be a conservation significant species, they will be discussed specifically in the results section.

In the field, fauna species captured and or opportunistically observed were identified using relevant field guides. In particular Tyler (1997), Tyler *et al.* (2000) and Cogger (2000) were used to identify frogs. Wilson and Swan (2008), Storr *et al.* (1999, 2002) and Cogger (2000) were used to identify reptiles. Pizzey and Knight (1997) and Simpson and Day (2004) were used to identify birds. Menkhorst and Knight (2004), van Dyck and Strahan (2008) and Churchill (2008) were used to identify mammals, while Triggs (1996) was used to identify mammal scats, tracks and traces.

Taxonomy and nomenclature in this report follows the WAM fauna species listing for amphibians and reptiles by Aplin and Smith (2001), and mammals by (van Dyck and Strahan 2008). The Bird species listing is consistent with Birds Australia nomenclature by Christidis and Boles (2008).

2.4 STATISTICAL ANALYSIS

In order to assess the adequacy of the field survey, a species accumulation curve was generated for herpetofauna (amphibians and reptiles combined). In the analysis each day was treated as a sample. Note that this was done on systematic site data, but some additional species were recorded outside the sites (opportunistically or incidentally) but within the project area. The species accumulation curve is concerned with accumulation rates of new species over the sampled area. That is, as the number of trap nights/effort increases, the number of species should increase until the accumulation of species plateaus (the graph reaches an asymptote), indicating that an area has been relatively adequately surveyed. Species accumulation curves can be useful in estimating total species richness and is a quantitative method of determining what proportion of available species was actually recorded during a survey.

The relative rates of species accumulation (beta diversity) was evaluated with non-parametric species richness estimators (generated using EstimateS version 8.0: Colwell 2005), and a species rarefaction graph prepared (using Cole rarefaction estimator). The mean of eight different estimators (Abundance-based Coverage Estimator of species richness, Incidence-based Coverage Estimator of species richness, the incidence-based estimator Chao1, Chao2 richness estimator, First-order Jackknife richness estimator, Second-order Jackknife richness estimator, and Michaelis–Menten model based estimator) was used to generate 'expected' species richness. 'Expected' species richness is then compared to the actual or 'observed' species richness.

The bird data was collected by way of timed area searches, but not in a manner suitable for statistical analysis. Due to the lack of mammals recorded, this too is not suitable for statistical analysis.

2.5 INVERTEBRATE FAUNA

Subterranean Ecology was commissioned by ENV to conduct an invertebrate fauna species and fauna habitat assessment of the survey area, particularly for Stygofauna, Short-range Endemic Fauna (SRE) and Troglofauna (Subterranean Ecology 2010a, b, c). Phase I of these invertebrate surveys involved a desktop review a preliminary site inspection and habitat assessment. The purpose of the desktop review and site inspection was to evaluate the likelihood of these groups of animals occurs within the survey area, including any recommendations for any follow-up field surveys if required. Invertebrate fauna has subsequently been assessed and is reported separately from this study.

3 RESULTS

3.1 VARIABLES INFLUENCING THE FAUNA SURVEY

As per *Guidance Statement 56* (EPA 2004), the limitations and constraints associated with a survey need to be documented. These variables are detailed in Table 1.

Table 1: Variables Associated with the Cape Peron Fauna Assessment

Variable	Impact on Survey Outcomes
Experience levels/Resources	The biologists who conducted the current survey were practitioners suitably qualified in their respective fields. • Mr Matthew Love – Senior Zoologist • Mr Mike Brown – Zoologist • Mr John Trainer – Zoologist • Ms Barbara Triggs – Consultant Mammologist
Permit	The current survey was conducted under the DEC Licence to Take Fauna for Scientific Purposes Licence No. SF007163.
Scope: sampling methods/ Intensity	The survey carried out was a Level Two survey under EPA *Guidance Statement No. 56*, comprising of a desktop survey and a site visit that included a habitat assessment, trapping program, and opportunistic observations.
Proportion of fauna recorded/ completeness	The current field survey recorded 96 fauna species, comprising of five amphibian, 19 reptile, 66 bird (including three introduced species) and six mammal species (three introduced species). Previous fauna surveys of the area (ENV 2005, Bamford 2005, Harewood 2008, 2009) recorded 73 fauna species, comprising of 17 reptile, 44 bird and 12 mammal species. At Jandakot Airport 84 fauna species were recorded comprising three amphibian, 21 reptile, 46 bird and 14 mammal species (Bamford *et al*. 2003). A total of 311 fauna species have been previously been recorded within the vicinity (20 km buffer) of Cape Peron including eight amphibian species, 51 reptile species, 221 bird species and 31 mammal species. This includes records from NatureMap, Birds Australia, DEC threatened fauna database and previous surveys as well as publications on known terrestrial vertebrate distributions within the surrounds of the current survey area.

Variable	Impact on Survey Outcomes
Sources of Information	ENV and Bamford conducted Level One fauna surveys of Bush Forever Site 355 around Point Peron and its adjacent bushland (ENV 2005, Bamford 2005). Harewood conducted a Level One and Level Two Fauna Survey of East Rockingham WWTP Site in 2008 and 2009 respectively (Harewood 2008, 2009).
Proportion of task completed	Trapping data was done during 20-27 November 2009, 2009 during the south-west spring season, with up to six survey nights. In addition, 12 hours of diurnal searching, 16.5 hours of nocturnal spotlighting and 22 hours of ornithological census occurred within the survey area.
Timing, weather, season.	The area had received 178.9 mm of rainfall in the three months preceding the survey (BoM 2009). Daytime temperatures were 18.7^{o}C to 29.5^{o}C, with night temperatures ranging between 11.8^{o}C and 15.7^{o}C (BoM 2009). These climatic conditions were not expected to affect the level of activity of fauna species of the survey area. The warm sunny conditions of the day resulted in a high activity of ground dwelling reptiles which rely on warm ambient conditions.
Disturbances	The survey area has been highly impacted by anthropogenic activities including roads, housing, caravan parks and industry as well as other activities on vegetated areas such as clearing, rubbish and weed infestations.
Access problems	No access problems affected the outcome of the fauna survey.

3.2 VERTEBRATE FAUNA HABITATS

Habitats present within the survey area were ranked as having a high, moderate, or low value in accordance with fauna and fauna of conservation significance present. The survey area consists of four habitat types: Shoreline, Coastal Heath, Woodland and Wetland. Cleared/Developed areas also are found within the confines of the survey area and do not represent true fauna habitats as they provide limited value for native fauna. Fauna habitat types and Cleared/Developed areas are mapped in Figure 9.

Shoreline Habitat

The Shoreline habitat type fringes the coastline and consists of tidal reef platforms, limestone outcropping and sandy bays. The vegetation within this habitat type consists of an open heath of *Frankenia pauciflora* and scattered

Sarcocornia blackiana. The soils in this habitat type are dominated by yellow to light brown sand on the rocky outcropping to white beach sand within the bays. This habitat type has a minor representation within the survey area and forms only a small portion of the proposed impact area.

This habitat provides shelter and foraging opportunities for a number of different species including migratory waders and marine birds on the sandy bays and headlands, and small ground dwelling reptiles and mammals in the outcropping rocky limestone. Pied Cormorants and Silver Gulls can be found roosting on the outcropping rocky limestone. Furthermore Pied Oystercatchers and Common Sandpipers are also known to forage within the exposed rocky limestone and reef platforms. The Shoreline habitat type can provide foraging opportunities for conservation significant waders such as the Black-tailed and Bar-tailed Godwits and as well as nesting opportunities for Sooty and Bridled Terns.

The Shoreline habitat type was generally in Excellent condition as per the Keighery condition scale used in Bush Forever (Government Western Australia 2000). The Shoreline habitat type was deemed as having a moderate habitat value for fauna species within the survey area.

Coastal Heath Habitat

The Coastal Heath habitat type forms the coastal and near-coastal areas of the survey area. The vegetation within this habitat type consists of a closed to open heath of *Acacia rostellifera* and *Olearia axillaris* over a closed mixed grassland of *Lomandra maritima* and introduced species. The soils in this habitat type are dominated by light brown sand in the near-coastal areas to cream to white sand within the coastal areas. This habitat type was the most dominant habitat type within the survey area and forms a major portion of the proposed impact area.

This habitat provides shelter and foraging opportunities for a number of different species including ground-dwelling reptiles and mammals in the near-coastal and coastal areas. For example the South-western Cool Skink and Dugite can be found foraging within this habitat type along with Silver-eyes and Splendid Fairy-wrens. The Coastal Heath habitat type can provide foraging opportunities for conservation significant reptiles such as the Jewelled Skink and Carpet Python and as well as foraging opportunities for the Southern Brown Bandicoot.

The Coastal Heath habitat type was deemed to be in Very Good - Good condition as per the Keighery condition scale (Government Western Australia 2000). There were obvious signs of disturbance from clearing and development along with an associated strong influx of weed species. The Coastal Heath habitat type was

deemed as having a moderate habitat value to fauna species within the survey area.

Woodland Habitat

The Woodland habitat type forms only small isolated pockets of dense vegetation within the survey area. The vegetation within this habitat type consists of an open forest of *Eucalyptus gomphocephala* and *Agonis flexuosa* over a closed shrubland of *Acacia rostellifera* and mixed grassland of introduced species. The soils in this habitat type are dominated by light brown sand. This habitat type was the least dominant habitat type within the survey area and forms only a relatively minor portion of the proposed impact area.

This habitat provides shelter and foraging opportunities for a number of different species including arboreal reptiles and mammals and a number of different avian species. Burrowing frogs can be found in this habitat type as the dense vegetation provides comparatively moist conditions suitable for frogs. For example the Moaning Frog and Motorbike Frog will emerge from their burrows during the right conditions to forage for small insects. The Grey Fantail and South-western Spiny-tailed Gecko can be found foraging and defending territories within this habitat type. The Woodland habitat type can provide foraging and roosting opportunities for conservation significant birds such as the Peregrine Falcon and Carnaby's Cockatoo. However, the Tuarts within this habitat type did not contain any breeding hollows suitable for nesting black cockatoo species and only provide a minor amount of roosting potential.

The Woodland habitat type was deemed to be in Good condition as per the Keighery condition scale (Government Western Australia 2000). There were obvious signs of disturbance through clearing and development along with an associated strong influx of weed species. The Tuarts appear to have been planted and are not part of a complete vegetation structure, i.e. the habitat lacked a mid-storey level. The Woodland habitat type was deemed as having a moderate habitat value to fauna species within the survey area.

Wetland Habitat

The Wetland habitat type contains Lake Richmond which is a permanent freshwater lake. The water depth is up to 15 m and fluctuates seasonally according to rainfall. The lake is bordered by flats devoid of permanent vegetation surrounded by sedges at the base of surrounding coastal dunes. The sedgeland is several metres wide and is underlain by peaty soil. It is dominated by *Baumea juncea*, *Scirpus validus* and clumps of the bulrush *Typha orientalis*. This habitat type forms a dominant habitat type within the survey area and but is not located within the proposed impact area.

This Wetland habitat provides shelter and foraging opportunities for a number of different species including wetland waders and ducks on the fringes of the lake to small ground dwelling reptiles and mammals in the associated fringing vegetation. Hoary-headed Grebes and Eurasian Coots can be found foraging on the lake and Easter Great Egrets and White-faced Herons foraging within the sedges and reeds within the lake's margins. Furthermore Swamp Harriers and Whistling Kite will often be found hunting overhead around Lake Richmond. Frog species can be found at Lake Richmond as this site obviously provides a permanent freshwater system in which frogs can carry out their life cycle. The Wetland habitat type can provide foraging opportunities for conservation significant waders such as the Marsh Sandpiper and Sanderling and as well as nesting and foraging opportunities for the Rainbow Bee-eater and Water Rat.

The Wetland habitat type was generally in Excellent condition as per the Keighery condition scale (Government Western Australia 2000). The Wetland habitat type was deemed as having a high habitat value for fauna species within the survey area.

3.3 VERTEBRATE FAUNA SPECIES RECORDED

Ninety-six vertebrate fauna species were recorded within the survey area, consisting of five amphibian species, 19 reptile species, 66 bird species (three introduced), and six mammal species (three introduced).

Previous fauna surveys of the area (ENV 2005, Bamford 2005, Harewood 2008, 2009) recorded 73 vertebrate fauna species, comprising of 17 reptile, 44 bird and 12 mammal species. Five new species for the Cape Peron area were recorded during the current survey, including one amphibian species, one reptile species, one bird species and two mammal species.

A total of 311 fauna species have been previously been recorded within the vicinity of Cape Peron including eight amphibian species, 51 reptile species, 221 bird species and 31 mammal species. This includes records from NatureMap, Birds Australia, DEC threatened fauna database and previous surveys as well as publications on known terrestrial vertebrate distributions within the surrounds of the current survey area.

3.3.1 Amphibians

Five amphibian species were recorded from two families during the survey (Appendix B1) with several of these likely to have been recorded because of the water availability in Lake Richmond. Two species were recorded from the Hylidae family and three species from the Myobatrachidae family.

The most commonly recorded species were the Motorbike Frog (*Litoria moorei*) and the Moaning Frog (*Heleioporus eyrei*) (Appendix G). These were recorded from 3 of 27 and 13 of 27 woodland patches respectively, during a survey of woodland remnants on the Swan Coastal Plain (How and Dell 2000). No conservation significant amphibian species were recorded during the survey.

A total of five amphibian species have previously been recorded within the surrounds of Cape Peron, with the current survey recording one new species for the area. The Glauert's Froglet (*Crinia glauerti*) is a commonly recorded frog in the major wetlands of Perth, and was for example, recorded from 5 of 27 woodland remnants during the study by How and Dell (2000).

3.3.2 Reptiles

Nineteen reptile species from seven separate families were recorded during the survey (Appendix B2). The most frequently represented family was Scincidae with nine species followed by Pygopodidae with three species. Three families, Chelidae (Turtles), Typhlopidae (Blind Snakes) and Elapidae (Front-fanged Snakes), were represented by only one species. The most commonly recorded species was the Southwestern Cool Skink (*Acritoscincus trilineatum*), the Two-toed Earless Skink (*Hemiergis quadrilineata*) and the Bobtail (*Tiliqua rugosa*) (Appendix G).

A species accumulation curves for herpetofauna species is illustrated in Figure 10. The species accumulation curve was approaching an asymptote for the herpetofauna (Figure 10). The number of herpetofauna species recorded (19 species) was 97.5% of the expected species richness (19.9 species). This is based on the mean of seven species richness accumulators and indicates a relatively complete herpetofaunal survey.

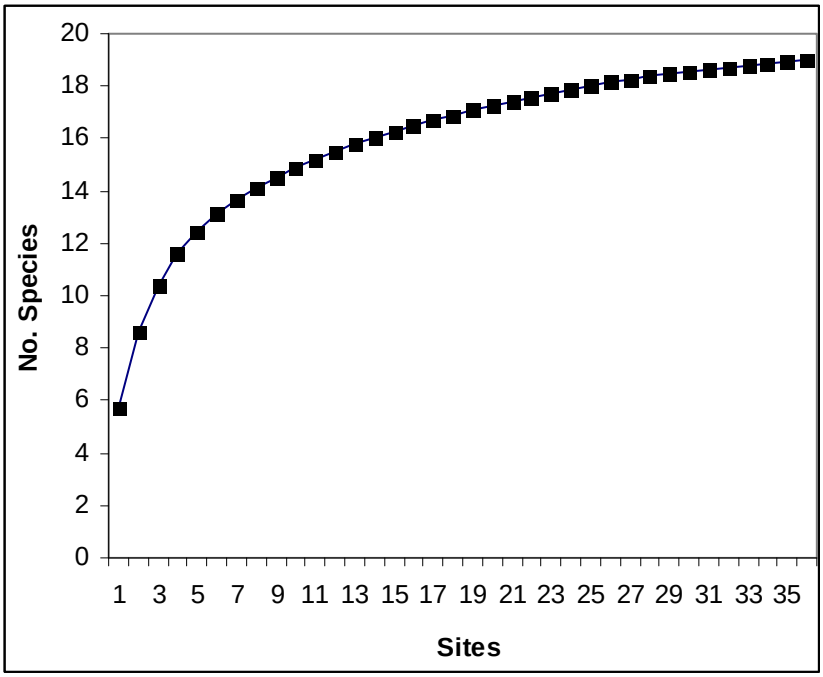

Figure 10. Species accumulation curve for amphibians and reptiles combined, captured at the systematic sites at Cape Peron.

A total of 51 reptile species have previously been recorded within the surrounds of Cape Peron, with the current survey recording only one new species for the area. The Oblong Turtle (*Chelodina oblonga*) is a commonly found turtle in wetlands on the Swan Coastal Plain.

One species of conservation significance, the Lined Skink (*Lerista lineata*), was recorded in the survey area. The Lined Skink is listed as Priority 3 by the DEC. The Lined Skink was recorded thirty-one times, at all six sites within the survey area. The coastal heath of the survey area is ideal habitat for this skink.

All of the reptiles, except the Oblong Turtle *Chelodina oblonga* were recorded by How and Dell (2000) in their survey of Swan Coastal Plain woodland remnants. Most of the reptiles recorded at Cape Peron were frequently recorded during the How and Dell (2000) study being recorded from nine of more of the 27 (33%) woodland remnants surveyed. However, the Western Heath Dragon, Side-barred Delma, Southwestern Cool Skink, Lined Skink, and *Morethia lineoocellata* were less common and were recorded from only four (15%), three (11%), three (11%), four (15%), three (11%) and four (15%) woodland remnants, respectively.

3.3.3 Birds

Sixty-six bird species (three introduced) from 29 different families were recorded during the survey (Appendix B3). The most frequently represented family was Anatidae (ducks) with six species followed by Meliphagidae (honeyeaters) with five species. The most commonly recorded upland species were the Domestic Pigeon (**Columba livia*) and Welcome Swallow (*Hirundo neoxena*). The most commonly recorded shoreline species were the Silver Gull (*Larus novaehollandiae*) and Pied Cormorant (*Phalacrocorax varius*). The most commonly recorded wetland species were the Pelican (*Pelecanus conspicillatus*) and Eurasian Coot (*Fulica atra*) (Appendix G).

A total of 271 bird species have previously been recorded within the surrounds of Cape Peron. The current survey recorded one new species for the area, the White-faced Heron (*Ardea novaehollandiae*) which is a commonly found waterbird in wetlands on the Swan Coastal Plain of Western Australia.

Three introduced bird species were recorded, the Domestic Pigeon (**Columba livia*), the Laughing Turtle-dove (**Streptopelia senegalensis*) and Laughing Kookaburra (**Dacelo novaeguineae*). These species are widespread across much of the south-west of the State often out-competing and/or preying upon native bird species (Johnstone and Storr 1998).

3.3.4 Mammals

Six mammal species from five separate families were recorded during the current survey (Appendix B4). The most frequently represented family was Muridae with two species, the remaining four families were represented by only one species. The most commonly recorded mammalian species was the introduced House Mouse (**Mus musculus*) (Appendix G)

A total of 31 mammal species have previously been recorded within the surrounds of Cape Peron, with the current survey recording two new species for the area, the White-striped Freetail-bat (*Austrononus australis*) and Western Bush Rat (*Rattus fuscipes*). Both species are found within the South-west of the State and are commonly recorded in biological surveys. These two species were unrecorded during the survey of Swan Coastal Plain woodland remnants (as well as Gould's Wattled Bat *Chalinolobus gouldii*), though How and Dell (2000) focussed on the ground fauna and did not include bat survey.

Three introduced mammal species were recorded, the House Mouse (**Mus musculus*), the Fox (**Vulpes vulpes*) and Rabbit (**Oryctolagus cuniculus*). These species were among the most common mammals recorded during a survey of Swan Coastal Plain woodland remnants (How and Dell 2000) and they are widespread across much of Australia, occurring in an extensive range of habitats (van Dyck and Strahan 2008). These species, in particular the Fox are, known to

spread rapidly occupying a variety of surroundings, preying on and competing with native species (van Dyck and Strahan 2008).

3.4 CONSERVATION SIGNIFICANT VERTEBRATE FAUNA

Of all the conservation significant fauna species previously recorded in the region, some will not occur in the survey area because they have a limited or patchy distribution, high level of habitat specificity, are locally extinct, or were erroneously reported as occurring in previous surveys. Appendix H lists all previously recorded conservation significant fauna, their distribution and ecology, and discusses the likelihood of them occurring in the survey area, based on the habitat present.

Seven conservation significant species was recorded during the survey and a further 34 species potentially occur in the survey area based on the habitat present and are summarised in Table 2. No conservation significant amphibians potentially occur in the survey area.

Table 2: Conservation Significant Fauna Species Recorded and Potentially Occurring in the Survey Area

COMMON NAME	SCIENTIFIC NAME	EPBC Act	WC Act	DEC	Recorded
REPTILES					
Jewelled Ctenotus	*Ctenotus gemmula*			P3	
Lined Skink	*Lerista lineata*			P3	x
Carpet Python	*Morelia spilota imbricata*		S4	P4	
Black-striped Snake	*Neelaps calonotos*			P3	
BIRDS					
Eastern Great Egret	*Ardea modesta*	Mi			x
Eastern Reef Egret	*Ardea sacra*	Mi			
Cattle Egret	*Ardea ibis*	Mi			
Glossy Ibis	*Plegadis falcinellus*	Mi			
Eastern Osprey	*Pandion cristatus*	Mi			x
White-bellied Sea-eagle	*Haliaeetus leucogaster*	Mi			
Peregrine Falcon	*Falco peregrinus*		S4		
Black-tailed Godwit	*Limosa limosa*	Mi			
Bar-tailed Godwit	*Limosa lapponica*	Mi			
Whimbrel	*Numenius phaeopus*	Mi			
Eastern Curlew	*Numenius madagascariensis*	Mi		P4	
Marsh Sandpiper	*Tringa stagnatilis*	Mi			
Common Greenshank	*Tringa nebularia*	Mi			
Wood Sandpiper	*Tringa glareola*	Mi			

Terek Sandpiper	*Xenus cinereus*	Mi			
Common Sandpiper	*Actitis hypoleucos*	Mi			x
Grey-tailed Tattler	*Tringa brevipes*	Mi			
Ruddy Turnstone	*Arenaria interpres*	Mi			
Red Knot	*Calidris canutus*	Mi			
Great Knot	*Calidris tenuirostris*	Mi			
Sanderling	*Calidris alba*	Mi			
Red-necked Stint	*Calidris ruficollis*	Mi			
Long-toed Stint	*Calidris subminuta*	Mi			
Sharp-tailed Sandpiper	*Calidris acuminata*	Mi			
Curlew Sandpiper	*Calidris ferruginea*	Mi			
Ruff	*Philomachus pugnax*	Mi			
Grey Plover	*Pluvialis squatarola*	Mi			
Pacific Golden Plover	*Pluvialis fulva*	Mi			
Lesser Sand Plover	*Charadrius mongolus*	Mi			
Greater Sand plover	*Charadrius leschenaultii*	Mi			
Bridled Tern	*Sterna anaethetus*	Mi			x
Carnaby's Cockatoo	*Calyptorhynchus latirostris*	EN	S1		
Fork-tailed Swift	*Apus pacificus*	Mi			
Rainbow Bee-eater	*Merops ornatus*	Mi			x
Australian Reed-warbler	*Acrocephalus australis*	Mi			x
MAMMALS					
Southern Brown Bandicoot, Quenda	*Isoodon obesulus fusciventer*			P5	
Water Rat	*Hydromys chrysogaster*			P4	

Key: EPBC= Environment Protection and Biodiversity Conservation Act 1999, WC= Wildlife Conservation Act 1950, DEC= Department of Conservation Priority Code. See Appendix A for and explanation of conservation codes and Appendix B for complete list of species scientific and common names.

3.4.1 Reptiles

One conservation significant reptile species was recorded in the survey and a further three species potentially occur in the survey area (Table 2), and are discussed below.

Jewelled Ctenotus (*Ctenotus gemmula*)

The skink *Ctenotus gemmula* occurs in two disjunct populations, one in the southern section of the Swan Coastal Plain, the other along the south coast from Albany to Bremer Bay. It inhabits heathland located over pale sand-plains that are associated with *Banksia* or Mallee woodlands (Wilson and Swan 2008). It is possible that the Jewelled Ctenotus resides within the survey area as suitable

habitat exists and the project area is within this species' known distribution. None were recorded during the survey.

Lined Skink (*Lerista lineata*)

Lerista lineata occurs in sandy coastal heath and shrubland areas in disjunct and isolated populations in the south-west and mid-west coast of Western Australia (Wilson and Swan 2008). This burrowing species is found in loose soil or sand beneath logs and termite mounds, where it feeds on termites and other small insects (Cogger 2000). The Lined Skink (*Lerista lineata*) was recorded thirty one times, at all six sites within the survey area. The coastal heath and loose sand of the survey area is ideal habitat for this skink.

Carpet Python (*Morelia spilota imbricata*)

The south-western population of the Carpet Python has a wide distribution in the south-west, but is generally uncommon, having been recorded from semi-arid coastal and inland habitats, *Banksia* woodland, eucalypt woodlands, and grasslands. It commonly utilises hollow logs for shelter (Wilson and Swan 2008). Local populations in the south-west have suffered because of extensive clearing and removal of its habitat. Lack of habitat makes the species vulnerable to predation and severely limits the potential for radiation. The Carpet Python has been recorded in coastal areas similar to that found within the survey area and there is also a population on Garden Island. It is possible that the carpet python resides in the survey area. However, none were recorded during the survey.

Black-striped Snake *(Neelaps calonotos*)

The Black-striped Snake is typically found in sandplain habitat in association with *Banksia* species, having a very limited distribution exclusive to the Swan Coastal Plain. This taxon is particularly difficult to locate, and is infrequently collected during biological surveys on the Swan Coastal Plain. The survey area contains preferred habitat and lies within this species' known distribution, therefore this species may occur.

3.4.2 Birds

Six conservation significant bird species were recorded in the survey and a further twenty-nine species potentially occur in the survey area (Table 2), and are discussed below.

Eastern Great Egret (*Ardea modesta*)

The Eastern Great Egret inhabits mostly shallow fresh lakes, pools in rivers, lagoons, lignum swamps, claypans and samphire flats, large dams and sewage ponds (Johnstone and Storr 1998). It also inhabits shallow saltwater habitat such

as mangrove creeks, tidal pools, samphire swamps and salt work ponds. It breeds colonially at wooded swamps and river pools, nesting in various riparian trees (Johnstone and Storr 1998). The Eastern Great Egret was recorded during the survey a number of times forging at Lake Richmond.

Eastern Reef Egret (*Ardea sacra)*

The Eastern Reef Egret occurs in coastal areas along the entire Western Australia coast, although it is more common in the warmer regions to the north. The species inhabits beaches, rocky shores, tidal rivers and inlets, mangroves, and exposed coral reefs. Although it is listed as migratory, the Eastern Reef Egret is largely sedentary in nature (Johnstone and Storr 1998). The beaches and rocky shores of the survey area are typical habitat for this bird and it is likely to occur there.

Cattle Egret (*Ardea ibis*)

The Cattle Egret occurs in the wetter parts of Western Australia, in particular the Kimberley and the south-west. The species inhabits short grass, in particular damp pastures and wetlands, usually in the company of cattle and occasionally other livestock. In Western Australia it is an irregular visitor, occurring mostly in autumn, and is not thought to breed within the State (Johnstone and Storr 1998). Suitable habitat exists in the survey area in particular at Lake Richmond where this species may be found foraging.

Glossy Ibis *(Plegadis haliaetus)*

The Glossy Ibis is listed as Migratory under the EPBC Act and inhabits areas of freshwater wetlands, estuaries and creeks, with occasional foraging in dry grasslands. This species is generally uncommon, but has a widespread and erratic distribution. The area surrounding Lake Richmond contains suitable foraging habitat for the Glossy Ibis and it is likely to reside there from time to time.

Eastern Osprey *(Pandion haliaetus)*

The Osprey is distributed along the coast, islands and lower river courses of Western Australia. They feed on fish and other marine animals (Johnstone and Storr 1998), nesting in trees, cliffs and sometimes structures such as radio towers, often close to the water. A single Eastern Osprey was recorded during the survey at different locations throughout the survey area. A nest was also located on a small rocky island in Shoalwater Bay which is off the southern side of the survey area.

White-bellied Sea Eagle (*Haliaeetus leucogaster)*

The White-bellied Sea Eagle is distributed along the coast, islands and estuaries of Western Australia (Johnstone and Storr 1998). They feed on fish, sea snakes and nesting seabirds. Nests are usually placed on high ground such as rock pinnacles, rigid shrubs or in tall trees. Due to the suitable wetlands and coastline around the survey area the White-bellied Sea Eagle may be present.

Peregrine Falcon (*Falco peregrinus*)

The Peregrine Falcon occurs mainly along coastal cliffs, rivers and ranges as well as wooded watercourses and lakes (Johnstone and Storr 1998). The Peregrine Falcon nests primarily on cliffs, granite outcrops and quarries, and feeds mostly on birds (Johnstone and Storr 1998). The coastal cliffs provide some potential nesting habitat and there is plentiful supply of prey items in the area. However, the Peregrine Falcon is likely to only forage within the survey area and only as part of a larger home range.

Black-tailed Godwit (*Limosa limosa)*

The Black-tailed Godwit is an uncommon summer non-breeding migratory shorebird that occurs along most of the coast of Western Australia (Geering, Agnew and Harding 2007). It inhabits fresh and brackish wetlands as well as intertidal mudflats (Geering, Agnew and Harding 2007). The fresh water and intertidal regions of the survey area provide an adequate habitat for this species and it is likely to occur during its migration.

Bar-tailed Godwit (*Limosa lapponica*)

The Bar-tailed Godwit is a relatively common summer non-breeding migratory shorebird that occurs along most of the coast of Western Australia, including Garden Island which is situated just north of the survey area. It inhabits mudflats, sandy and seaweedy beaches (Johnstone and Storr 1998). The habitat around the survey area is well suited for the Bar-tailed Godwit and it is likely to occur there during its migration.

Whimbrel (*Numenius phaeopus)*

The Whimbrel is a large non-breeding migratory shorebird, found commonly along the north coast of Western Australia and intermittently found on the south coast (Johnstone and Storr 1998). It inhabits mudflats of estuaries or lagoons, particularly those with Mangroves where it often roosts (Geering, Agnew and Harding 2007). The survey area contains habitat suitable for the Whimbrel and as such it is possible the Whimbrel may be found in this area on its migratory route.

Eastern Curlew *(Numenius madagascariensis)*

The Eastern Curlew is a large non-breeding migratory shorebird, found commonly along the north coast of Western Australia, but is known to migrate south to Bunbury along the South Coast (Johnstone and Storr 1998). It inhabits a range of coastal habitats, but primarily intertidal mudflats, particularly on exposed seagrass beds or mudflats with burrowing crabs or shrimps (Geering, Agnew and Harding 2007). The survey area does contain habitat suitable for the Eastern Curlew and it is possible the Eastern Curlew may be found in this area on its migratory route.

Marsh Sandpiper (*Tringa stagnatilis)*

The Marsh Sandpiper is a summer non-breeding migratory shorebird that occurs in Western Australia along the coast, coastal plains, and less frequently inland (Johnstone and Storr 1998). It inhabits freshwater or saltwater wetlands but avoids open beaches and mudflats unless well protected (Geering, Agnew and Harding 2007). The marine and freshwater environments of the survey area are possible habitats for the Marsh Sandpiper during its migratory routes.

Common Greenshank (*Tringa nebularia)*

The Common Greenshank is a non-breeding migratory shorebird, common along most of the coast of Western Australia (Geering, Agnew and Harding 2007). It inhabits intertidal mudflats, as well as fresh and saltwater wetlands of the coast or inland (Geering, Agnew and Harding 2007). The inland lake and shorelines of the survey area are a suitable habitat for the Common Greenshank. As such it is likely to inhabit this area on its migratory route.

Wood Sandpiper (*Tringa glareola*)

The Wood Sandpiper is a summer non-breeding migratory shorebird that occurs along the coastal as well as inland regions of Western Australia (Geering, Agnew and Harding 2007). It primarily inhabits freshwater wetlands and rarely on intertidal mudflats (Geering, Agnew and Harding 2007). The inland lake of the survey area is a suitable habitat for the Wood Sandpiper. As such it may inhabit this area on its migratory route

Terek Sandpiper (*Xenus cinereus)*

The Terek Sandpiper is a summer non-breeding migratory shorebird that occurs along the north coast of Western Australia, but intermittently found as far south as Bunbury and Albany (Johnstone and Storr 1998). It inhabits exposed seagrass beds in estuaries and bays or on intertidal mudflats fringed by mangroves (Geering, Agnew and Harding 2007). The sandy beaches around the survey area

are a suitable habitat for the Terek Sandpiper. As such it may inhabit this area on its migratory route.

Common Sandpiper (*Tringa hypoleucos)*

The Common Sandpiper occurs along the coast of Western Australia, and in much of the interior. It inhabits sheltered salt and fresh waters such as estuaries, mangrove creeks, rocky coasts, salt lakes, river pools, lagoons, claypans, drying swamps, flood waters, dams and sewage ponds (Johnstone and Storr 1998). They occasionally occur inland in a variety of wetlands (Geering, Agnew and Harding 2007). They are a non-breeding migrant to Western Australia occurring at any time of year, but mostly September to March in the south-west (Johnstone and Storr 1998). The rocks and sandy beaches of the survey area are the preferred habitat for the Common Sandpiper. It was recorded in the survey area during an opportunistic search.

Grey-tailed Tattler (*Tringa brevipes)*

The Grey-tailed Tattler, is a non-breeding migratory shorebird, common on the north and west coasts of Western Australia, rare on the south coast. It has been recorded on Garden Island which is situated just north of the survey area (Johnstone and Storr 1998). It inhabits sheltered coasts with reef and rock platforms or with intertidal mudflats (Morcombe 2000). It often roosts in mangroves or artificial structures such as piers and breakwaters (Geering, Agnew and Harding 2007). The survey area only has small areas of rocky coast suitable for the Grey-tailed Tattler, as such it may inhabit this area on its migratory route.

Ruddy Turnstone (*Arenaria interpres)*

The Ruddy Turnstone is a summer non-breeding migratory shorebird that occurs on the coast of Western Australia and has been recorded on Penguin Island which is situated just south of the survey area (Johnstone and Storr 1998). It occurs primarily on rocky coasts and rocky reefs, as well as tidal mudflats and beaches and pebbly shores of near-coastal salt lakes and salt-work ponds (Johnstone and Storr 1998). The survey area only has small areas of rocky coast with seaweed, suitable for the Ruddy Turnstone. As such it may inhabit this area on its migratory route.

Red Knot (*Calidris canutus)*

The Red Knot is a summer non-breeding migratory shorebird that occurs along most of the coast of Western Australia with records from Garden Island which is situated just north of the survey area (Johnstone and Storr 1998). It inhabits larger intertidal mud and sand flats (Geering, Agnew and Harding 2007). The

tidal sands of the survey area are a suitable habitat for the Red Knot. As such it is likely to inhabit this area on its migratory route.

Great Knot (*Calidris tenuirostris)*

The Great Knot is a summer non-breeding migratory shorebird that occurs along most of the coast of Western Australia with records from Garden Island which is situated just north of the survey area (Johnstone and Storr 1998). It inhabits larger intertidal mud and sand flats (Geering, Agnew and Harding 2007). The tidal sands of the survey area are a suitable habitat for the Great Knot. As such it may inhabit this area on its migratory route.

Sanderling (*Calidris alba)*

The Sanderling is a summer non-breeding migratory shorebird that occurs along most of the coast of Western Australia with records from Garden Island which is situated just north of the survey area (Johnstone and Storr 1998). This species inhabits sandy beaches, inlets, estuaries and coastal salt lakes (Johnstone and Storr 1998). The sandy coastal beaches of the survey area are suitable habitats for the Sanderling. As such it may inhabit this area on its migratory route.

Red-necked Stint (*Calidris ruficollis)*

The Red-necked Stint is a summer non-breeding migratory shorebird that occurs along most of the coast of Western Australia with records from Penguin Island which is situated just south of the survey area (Johnstone and Storr 1998). It inhabits a wide range of fresh and saltwater habitats (Geering, Agnew and Harding 2007). The coastal waters of the survey area are suitable habitat for the Red-necked Stint. As such it may inhabit this area on its migratory route.

Long-toed Stint (*Calidris subminuta*)

The Long-toed Stint is a summer non-breeding migratory shorebird that occurs along the mid West coast of Western Australia as far south as Busselton (Johnstone and Storr 1998). This species prefers coastal and inland swamps for habitat (Simpson and Day 2004). Lake Richmond found in the survey area is suitable habitat for the Long-toed Stint. As such it may inhabit this area on its migratory route.

Sharp-tailed Sandpiper (*Calidris acuminata*)

The Sharp-tailed Sandpiper is a summer non-breeding migratory shorebird that occurs along most of the coast of Western Australia as far south as Busselton, and in well-watered parts of the interior and casually in the arid east south of Lake Gregory (Johnstone and Storr 1998). It inhabits both coastal and inland areas but prefers non-tidal fresh or brackish wetlands (Geering, Agnew and

Harding 2007). The coastal wetland of the survey area is a suitable habitat for the Sharp-tailed Sandpiper. As such it may inhabit this area on its migratory route.

Curlew Sandpiper *(Calidris ferruginea)*

The Curlew Sandpiper is a summer non-breeding migratory shorebird that occurs along most of the coast of Western Australia (Geering, Agnew and Harding 2007). It inhabits exposed tidal mudflats, and less frequently on inland freshwater wetlands (Geering, Agnew and Harding 2007). The coastal wetlands of the survey area are suitable habitats for the Curlew Sandpiper. As such it may inhabit this area on its migratory route.

Ruff (*Philomachus pugnax*)

The Ruff is a summer non-breeding migratory shorebird that occurs along the south-west coast of Western Australia (Johnstone and Storr 1998). It inhabits tidal mudflats, sewerage farms and fresh water wetlands (Pizzey and Knight 2007). The wetland of the survey area is a suitable habitat for the Ruff. As such it may inhabit this area on its migratory route.

Grey Plover (*Pluvialis squatarola)*

The Grey Plover is a summer non-breeding migratory shorebird that occurs along the coast of Western Australia with records from Penguin Island which is situated just south of the survey area (Johnstone and Storr 1998). The Grey Plover inhabits coastal areas, preferring marine shores of estuaries or lagoons on broad open mudflats, sandy bars or beaches and rocky coasts as well as coastal salt lakes and swamps (Morcombe 2000). They occasionally are found in drying freshwater lakes (Johnstone and Storr 1998). The beaches and rocky areas of the survey area are suitable habitats for the Grey Plover. As such it may inhabit this area on its migratory route.

Pacific Golden Plover (*Pluvialis fulva)*

The Pacific Golden Plover is a summer non-breeding migratory shorebird that occurs along the coast of Western Australia (Johnstone and Storr 1998). The Pacific Golden Plover inhabits marine waters such as beaches, mudflats and among rocky areas, sometimes inland (Simpson and Day 2004). The beaches and rocky areas of the survey area are suitable habitats for the Pacific Golden Plover. As such it may inhabit this area on its migratory route.

Lesser Sand Plover (*Charadrius mongolus)*

The Lesser Sand Plover is a summer non-breeding migratory shorebird that occurs on the north and west coast of Western Australia as far south as Albany

(Johnstone and Storr 1998). It inhabits exposed sand and mud flats and often intermingles with flocks of the Greater Sand Plover (Geering, Agnew and Harding 2007). The exposed sand of the survey area is suitable habitat for the Lesser Sand Plover. As such it may inhabit this area on its migratory route.

Greater Sand Plover (*Charadrius leschenaultia)*

The Greater Sand Plover is a summer non-breeding migratory shorebird that occurs along the coast of Western Australia (Johnstone and Storr 1998). It inhabits exposed sand and mud flats (Geering, Agnew and Harding 2007). The exposed sand of the survey area is suitable habitat for the Greater Sand Plover. As such it may inhabit this area on its migratory route.

Bridled Tern *(Sterna anaethetus)*

The Bridled Tern is a migratory shore bird that breeds off the Western Australian coast from September to May. It inhabits blue water seas generally close to breeding sites, which are located on the many small rocks islands around Cape Peron (Johnstone and Storr 1998). The coastal islands around the survey area are suitable breeding habitat for the Bridled Tern during its migration. It was recorded as part of an opportunistic survey during the current survey out at the very tip of Cape Peron.

Carnaby's Cockatoo (*Calyptorhynchus latirostris*)

The Carnaby's Cockatoo is endemic to south-west Western Australia, and is distributed from the Murchison River to Esperance and inland to Coorow, Kellerberrin and Lake Cronin (Cale 2003). Although the site is situated within the range of this species it is unlikely to occur there on a frequent basis. The survey area has no *Banksia*, Marri or Jarrah trees which the Carnaby's Cockatoo forages on and no suitable breeding hollows were present. The only suitable habitat would be Tuart trees as possible roosting sites.

Fork-tailed Swift (*Apus pacificus*)

The Fork-tailed Swift is a summer migrant (October-April) to Australia, that has not been recorded breeding in Australia (Barrett *et al*. 2003). This species is an aerial species, which forages high above the tree canopy and rarely lower so it is independent of terrestrial habitats in Australia (Johnstone and Storr 1998). It usually occurs in flocks of up to 2000 and is often seen accompanying Tree Martins and Masked Woodswallows (Johnstone and Storr 1998). It is likely that this species forages over the site from time to time, high in the airspace.

Rainbow Bee-eater (*Merops ornatus*)

The Rainbow Bee-eater migrates to south-western Australia to breed in spring and summer (Johnstone and Storr 1998). The Rainbow Bee-eater is a common and widespread species in Western Australia (Johnstone and Storr 1998). It occurs in lightly wooded, often sandy country, preferring areas near water. The Rainbow Bee-eater feeds on airborne insects, and nests throughout its range in Western Australia in burrows excavated in sandy ground or banks, often at the margins of roads and tracks (Johnstone and Storr 1998). During the survey it was recorded near Lake Richmond, and this is where it is most likely to forage. Contrary to the EPBC listing, this species is not included as a migratory species on the JAMBA agreement between the government of Australia and Japan.

Australian (Clamorous) Reed Warbler (*Acrocephalus australis*)

The Australian Reed Warbler is a sedentary and migratory species that inhabits tall dense vegetation such as bulrushes, sedges, rushes, reeds and long grass at the edges of lakes, springs, streams, claypans and dams, as well as sewage ponds and other artificial freshwater wetlands (Johnstone and Storr 1998). The Australian Reed-warbler was recorded during this survey. The bulrushes (*Typha* sp.) and reeds along the edge of Lake Richmond are typical habitat for this species.

3.4.3 Mammals

Two conservation significant mammal species potentially occur in the survey area (Table 2), and are discussed below.

Quenda (Southern Brown Bandicoot) (*Isoodon obesulus fusciventer*)

The Quenda (Southern Brown Bandicoot) occurs in forest, heath or coastal scrub and has a distribution along the coast of south-western Western Australia from Moore River mouth to approximately Israelite Bay (Menkhorst and Knight 2001). Quenda typically seek daytime refuge from predators in very thick ground-storey vegetation, often associated with swamps or damplands, and forage by night in more open areas, leaving distinctive conical feeding holes in the ground. The Quenda is threatened by clearing and fragmentation of its preferred habitat.

This species was recorded by Harewood (2009) in a site adjacent to the survey area. No traces or signs of this species were recorded during the current survey of the survey area. However, the coastal heath and scrub is suitable habitat and the Quenda is likely to occur.

Water Rat (*Hydromys chrysogaster*)

The Water Rat occupies a wide variety of freshwater habitats, from sub-alpine streams and other inland waterways to lakes, drainage lines, swamps and farm dams (Van Dyck and Strahan 2008). It favours areas close to water with thick vegetation cover. The species is widespread in south-western and northern Western Australia, and is also found on various offshore islands.

Lake Richmond and its associated drainage line both have suitable habitat for the Water Rat. It is possible that it may reside within the survey area.

3.5 CONSERVATION SIGNIFICANT INVERTEBRATE FAUNA

Graceful Sun Moth (*Synemon gratiosa*)

The Graceful Sun-moth (GSM) is a small day-flying moth endemic to south-west Western Australia and distributed from Preston Beach in the south to Leeman in the north (Bishop *et al*. 2010).

The Graceful Sun Moth is listed as Endangered under the EPBC Act and is declared specially protected fauna under the WC Act as it is rare or likely to become extinct.

The Graceful Sun Moth has a life cycle that takes one to three years to complete (DEC 2009c). The adult Graceful Sun Moth is only active during a short period of time each year specifically in the month of March (DEC 2009c). During this time the adults will mate and the females will lay eggs in only a few closely related species of plants (DEC 2009c). Specifically the Graceful Sun moths favours *Lomandra* species (mat rushes) in which to lay their eggs and which provide a food source for larvae (DEC 2009c).

Lomandra maritima (Plate 1) is abundant in the near coastal vegetation north and south of Perth, and was recorded within the current survey area and more importantly within the proposed impact area.

Plate 1: *Lomandra maritima* present in the Cape Peron Survey Area

No adult Graceful Sun Moths were recorded during the survey; this was expected given the timing of the survey as adult Graceful Sun Moths are only active annually during March. However, *Lomandra maritima* was recorded across the survey area and within the proposed impact area. *Lomandra maritima* is critical in the life cycle of Graceful Sun Moths and the density of this species in the proposed impact area at the time of survey can be seen in Figure 8.

Within the western portion of the proposed impact area this species was recorded as being greater than 5 plants per 2 m^2, within the central portions the density was mapped at 2 - 5 plants per 2m^2, and within the eastern portion the density was mapped at less than 2 plants per 2 m^2. This may be a reflection of moving further away from the coastline in an easterly direction. In terms of the Graceful Sun Moth the western section obviously forms a more important habitat given the higher density recorded.

The proposed impact area has altered since the time of survey and hence the mapping undertaken differs from the current impact area boundary. However, it has been established that the project and impact area contains habitat suitable for the Graceful Sun Moth and this matter has been addressed through GSM specific survey effort and reporting (ENV 2010, 2011).

4 DISCUSSION

4.1 EPA / DEC TECHNICAL GUIDE

In September 2010, after the Cape Peron survey was completed, the EPA and DEC released a Technical Guide on terrestrial vertebrate fauna surveys as a supplement to Guidance Statement 56 (Hyder *et al*. 2010). The Guide provides additional information on sampling techniques and methodologies, as well as analysis, interpretation and reporting requirements for environmental impact assessment.

For Level 2 surveys, the guide suggests systematic vertebrate survey uses techniques such as pitfall traps, funnel traps, aluminium box traps, cage traps, observation, spotlighting/headtorches, active searching, searching for tracks and signs, bird surveys and bat detector surveys. All of these survey methods were used during the Cape Peron survey. Additionally, supplementary techniques (Hyder *et al.* 2010) including hair-tube assessment was also used in the survey.

4.2 SAMPLING ADEQUACY

A total of 96 terrestrial vertebrate fauna were recorded during the survey, including five amphibian species, 19 reptile species, 66 bird species and six mammal species. Seven fauna species of conservation significance were recorded within the survey area. The patterns of species accumulation was analysed to estimate species richness and sampling adequacy for reptiles and amphibians combined. This showed that a high proportion (97.5%) of the herpetofauna was actually recorded on the surveyed sites.

Six of these species, namely the Eastern Great Egret (*Ardea modesta*), Eastern Osprey (*Pandion cristatus*), Common Sandpiper (*Actitis hypoleucos*), Bridled Tern (*Sterna anaethetus*), Rainbow Bee-eater (*Merops ornatus*) and Australian Reed-warbler (*Acrocephalus australis*) are listed as Migratory under the EPBC Act. One species the Lined Skink (*Lerista lineata*) is listed as Priority 3 on the DEC Priority list.

Thirty-four conservation significant species potentially occur within habitat found within the survey area and despite the significant survey effort during the fauna survey these species were not recorded.

Every effort was made to search for migratory waders, for example conducting dusk and dawn ornithological census along the coastline. A survey during the summer months may have recorded more migratory wader species. Ornithological censuses were carried out within the Woodland habitat searching for any evidence of black cockatoo species, in particular the Carnaby's Cockatoo.

No foraging or breeding habitat and very little roosting potential exists in the survey area.

Another species that was targeted was the Quenda. Approximately 175 hair-tube trap nights and 100 m transects across the impact area failed to record any presence of this species. This species was previously recorded in the region and has a historical presence. This was replicated in the active search effort made for Brush-tailed Phascogales. A previous record was made in 2001 at Peron and therefore, Tuarts were specifically targeted with Tree-mounted Elliott traps. However, given the lack of tree hollows suitable for breeding and shelter, no individuals would be expected to occur at Cape Peron.

Due to the survey being conducted during the 'spring' season of the Swan Coastal Plain the number of recorded species was acceptable, compared to the potential number recorded in other times of the year. The warm climatic conditions at the time of the survey resulted in a good representation of ground dwelling reptiles and mammals being recorded. As reptiles are ectothermic they rely on warm temperatures to forage and for breeding purposes. The five previously recorded frog species were also all recorded within the confines of Lake Richmond as well as dense moist woodlands of the survey area. In terms of migratory waders only one species, the Common Sandpiper, was recorded. This is a reflection of the timing of the survey as these species migrate up and down the coast of Western Australia according to season. A summer survey is likely to have resulted in a greater number of migratory waders being recorded. The other migratory species recorded were freshwater waders and upland species. Considering Lake Richmond is a permanent freshwater lake these species would have been expected to occur. The influx of weed species in the survey area may have influenced the ground dwelling mammal fauna. For example, as the weeds change the abundance of food sources (grasses) available for these species, and consequently there is a reduction of mammal population densities, particularly granivores.

Only a limited number of baseline surveys have been performed in the vicinity of the survey area. Without a significant increase in fauna surveys occurring it can be assumed that many of the species not identified as conservation significant listed in Appendix B occur in the survey area or its immediate vicinity. Bamford (2005) provided a Level 1 desktop review of the available fauna data using broad-scale field guide map data, local field naturalist and Western Australian Museum publications, and is useful in comparing the expected versus observed vertebrate fauna (Table 2). The review produced a list of 187 vertebrate species that would be expected for Cape Peron and adjacent bushland. About half of the fauna species expected to be present by Bamford (2005) were recorded during the present survey.

Table 3. Comparison of the expected (Bamford 2005) vertebrate fauna of Cape Peron versus the actual field results recorded during the current study.

	Cape Peron (Bamford 2005)	Cape Peron this (ENV, survey)
Amphibians	7 (5)	5
Reptiles	42 (16)	19
Birds	121 (50)	65
Mammals	17 (5)	6
TOTAL	187 (76)	95

Values in parentheses indicate the number of species in each fauna group, or overall, shared with the ENV Cape Peron field survey.

A small bushland remnant of only 28.7 ha would not be able to maintain viable populations of many fauna species, and undoubtedly many species that once occurred at Cape Peron, have become locally extinct since European settlement following habitat fragmentation and isolation (*cf*. How and Dell 2000). Furthermore, the expected occurrences of many species listed by Bamford (2005) were based on crude distribution maps provided within national-level fieldguides, and some may never have occurred in the study area. A total of 18 fauna species not anticipated by Bamford (2005) were recorded. Perhaps the most notable addition was the record of Western Bush-rat *Rattus fuscipes*, which was unrecorded during woodland surveys in the Swan Coastal Plain (How and Dell 2000), at Jandakot Airport (Bamford *et al*. 2003), or at East Rockingham (Harewood 2009). Not surprisingly most of the additional unanticipated bird species (11 species) were waterbirds which form temporally and spatially variable 'communities' about wetlands.

4.3 REGIONAL CONTEXT OF FAUNA ASSEMBLAGES

Using the baseline surveys of How and Dell (2000) as background context, the faunal composition of Cape Peron is typical (in terms of species amphibian, reptile and mammal composition and richness) of small woodland remnants on the Swan Coastal Plain. Only the Oblong Turtle *Chelodina oblonga* and Western Bush-rat, were unrecorded by How and Dell (2000) during their broader survey of 27 remnant areas. Most amphibian, reptile and mammal species recorded at Cape Peron were also commonly recorded (>33% of remnant patches) in the broader Swan Coastal Plain study by How and Dell (2000).

To further understand the context of the results comparisons have been made with other sites of similar habitat type and of a similar patch size. Comparisons with two neighbouring sites (Jandakot Airfield: Bamford *et al.* 2003, and East Rockingham: Harewood 2009) and two bushland patches in the Perth region of a similar patch size: Norman Road, 130 ha (How and Dell 2000) and Talbot Road, 90 ha (How and Dell 2000) are made and are summarised in Table 4.

similar patch size: Norman Road, 130 ha (How and Dell 2000) and Talbot Road, 90 ha (How and Dell 2000) are made and are summarised in Table 4.

Table 4. Faunal comparison (number of species) of Cape Peron with total lists for Swan Coastal Plain, Jandakot Airport, East Rockingham, Norman Road and Talbot Road Bushland.

Location	Overall	Amphibians	Reptiles	Birds	Mammals
Swan Coastal Plain	**c.421**	**13**	**64**	**311**	**33 native**
Cape Peron (ENV, this survey)	95	5	19	65	6
Jandakot Airport, 100ha (Bamford *et al.* 2003)	84 (49)	3 (2)	21 (13)	46 (29)	14 (5)
East Rockingham, 35ha (Harewood 2009)	73 (46)	0 (0)	17 (12)	44 (30)	12 (4)
Norman Road, 130ha (How and Dell 2000)	21 (13)	4 (2)	12 (9)	N/A	5 (2)
Talbot Road, 90ha (How & Dell 2000)	24 (14)	7 (3)	13 (10)	N/A	4 (1)

Values in parentheses are the number of species in each fauna group, or overall, shared with the ENV Cape Peron field survey.

There is a high degree of similarity between the fauna of two neighbouring sites (Jandakot Airport and East Rockingham) which share more than 50% of their fauna with Cape Peron (Table 3). There is a particularly high degree of similarity in the composition of passerine birds (songbirds): 87.5% (21 of 24 species shared with Cape Peron). Norman Road and Talbot Road share more than 75% of their reptile faunas with Cape Peron, but Norman Road maintained a richer native mammal fauna.

There is a high degree of similarity (>50%) between the reptile fauna and avifauna of two neighbouring sites (Jandakot Airport and East Rockingham) to Cape Peron, which relates to the relatively high proximity of these sites, and the woodland remnants being of a similar size. The passerine (songbird) faunas of these three sites were almost identical. The East Rockingham site includes populations of Southern Brown Bandicoot, Western Grey Kangaroo, and additional bats (Harewood 2009) that were unrecorded from Cape Peron. Although Norman Road and Talbot Road maintained similar sized woodland patches to Cape Peron, more reptile species were recorded at Cape Peron. Norman Road maintained a richer native mammal fauna compared to Cape Peron, which included Mardo, Quenda and Western Pygmy Possum.

Many fauna species have specific area requirements (for food, shelter, reproduction) to maintain viable populations, and apparently undergo local extinctions in small woodland fragments. Habitat conversion in the Cape Peron area since European settlement has undoubtedly caused the local extinction of a suite of reptiles, birds and mammals that require larger woodland patches, or greater connectivity to adjacent patches to maintain viable populations.

4.4 SIGNIFICANCE OF FAUNA HABITAT IN THE SURVEY AREA

Four fauna habitats based on landform and vegetation structure was identified in the survey area; Shoreline, Coastal Heath, Woodland and Wetland.

The Shoreline habitat is important in providing foraging and nesting opportunities to conservation significant species such as coastal seabirds. These species perform an annual migration up and down the Western Australian coast and will only been found foraging in coastal areas particularly at low tide during the summer period. The shoreline also contains exposed rocky limestone which is important for nesting opportunities for terns, gulls and cormorants. This habitat type covers 4.1 ha and is underrepresented within the survey area as well as the general vicinity as it only forms a small fringe of the coast.

The Coastal Heath habitat type is important for ground-dwelling reptiles and mammals and in particular conservation significant species such as the Jewelled Ctenotus, Lined Skink and Carpet Python. These species utilise micro-niches (i.e. logs and leaf litter) within this habitat type for shelter, foraging and potentially breeding. The Coastal Heath is significant for bird species such as the Splendid Fairy-wren and Silver-eye which was commonly recorded. This habitat type covers 113.5 ha of the survey area, giving it the greatest representation in the survey area as well as the impact area. This habitat is significant as it supports a diverse range of herpetofaunal species.

The Woodland habitat type is important for roosting by conservation significant species such as the Peregrine Falcon and Carnaby's Cockatoo. No tree hollows were recorded in any of the Tuarts of this habitat therefore only providing limited foraging and roosting potential. The habitat is disjunct and isolated with other Woodland habitats of the survey area further reducing the habitats' value. The Woodland habitat did not contain any Jarrah or Marri, the preferred feeding resource for black cockatoo species therefore reducing the site's importance as a foraging resource for these threatened species. This habitat provides a range of micro-niches for arboreal and ground dwelling reptiles and mammals. This habitat type had only a small representation of 19.5 ha within the survey area. Although this habitat provides limited resources for fauna, its small size and location provide significance as restricted habitat type in area..

The Wetland habitat type is significant as it contains Lake Richmond, a permanent freshwater lake. This habitat type is important in providing foraging and breeding opportunities for freshwater waders and ducks and marine birds. The Wetland habitat is also significant for wetland species such as the Purple Swamphen and conservation significant Australian Reed-warbler. As surface water is scarce in the general vicinity this site had added importance. The permanent freshwater lake is also important in providing habitat for frog species in which to carry out their life cycle. A number of species were also recorded roosting for the night at Lake Richmond including Pelicans and Silver gulls. This habitat type covered 17 ha of the survey area, forming a moderate proportion, but is underrepresented within the general vicinity. Lake Richmond is a regionally significant wetland and habitat type.

4.5 ECOLOGICAL CONNECTIVITY

Of the 140 bird species that were once resident in the Swan Coastal Plain, about 40% of the 94 non-passerine species and almost 50% of the passerine birds have declined since European settlement (Government of Western Australia 2000). Originally the Swan Coastal Plain provided habitat for 33 native mammals but modern surveys have recorded only 18 species. Most of the 64 reptiles and 13 amphibians recorded on the Swan Coastal Plain have also declined since European settlement (Government of Western Australia 2000) though the historical baseline for these groups is highly limited. The main drivers of these changes in faunal status have been habitat conversion, which has reduced the extent of habitat (habitat fragmentation) and increased the degree of isolation between woodland remnants.

Ecological connectivity is a key process that facilitates many life-history functions of fauna species and in particular fauna species of the survey area. The ability to utilise this diversity of connected habitats is integral to the life histories of a broad spectrum of species, with connectivity between habitats being crucial to important functions like breeding. A loss of habitat through clearing obviously reduces the ability for habitats to be connected and therefore provides further pressure on species' survival. For example isolated populations are prone to increased levels of decline due to inbreeding, population fluctuations due to overexploitation of their habitat, and sudden removal from the area due to significant events such as fire. The reduced richness of reptile and mammal faunas from small remnant woodland patches on the Swan Coastal Plain highlights that local extinction is a typical result when woodlands are reduced in area (fragmented) and become more isolated from neighbouring remnants (How and Dell 2000).

The survey area is already isolated from other woodland remnants, in particular for ground–dwelling amphibians, reptiles and mammals. Therefore, the only regional connectivity would apply to highly mobile species such as birds and for

conservation significant species such as the Carnaby's Cockatoo. The reduction of habitat within the survey area may place added pressure on Carnaby's Cockatoo to migrate from one disjointed habitat to the next, as disjunct habitats are used as 'stepping stones' between one another.

The local ecological connectivity i.e. within the confines of the survey area will be compromised by the proposed scope of works. The clearing of the impact area will further isolate the habitat at the end of the survey area with other areas towards the south such as Lake Richmond. This mainly applies to ground-dwelling amphibians, reptiles and mammals which are typically less mobile than for bird species. The proposed clearing of the impact area would in effect isolate species at either end of the survey area. For example the Priority listed skink, *Lerista lineata* was recorded 31 times within the survey area, at all six trap sites. Therefore the proposed disturbance would in effect isolate the population at Cape Peron with the populations further south-east of the Cape and particularly the ones found in the Rockingham Regional Park. This places added pressure on maintaining breeding activities and gene flow between populations.

5 IMPACT ASSESSMENT

This assessment aims to identify potential impacts of the proposed development, and to explore measures to minimise these impacts. The net impact on fauna is discussed, with particular focus on conservation significant species.

5.1 POTENTIAL IMPACTS FROM THE PROPOSED DEVELOPMENT

The survey area is approximately 253.6 ha. The area to be impacted (approximately 61 ha) will be significantly less due to the proposed scope of works. Only a small area of Shoreline (approximately 2 ha) and Woodland (approximately 2.5 ha) habitat is expected to be cleared for the tourist precinct and a minor amount (approximately 33 ha) of Coastal Heath habitat may be lost for the associated land developments.

The major impact upon fauna habitat from the development will be land clearing and disturbance. This is likely to slightly reduce the area of potential habitat for local fauna, and may reduce the population size of local, ground-dwelling fauna such as amphibians, reptiles and small mammals. Previous studies on the amphibian and reptile faunas of the Swan Coastal Plain have found that population viability of many species is not maintained in small remnant patches of woodland, and that many species have declined while others have become locally extinct (How and Dell 2000). Indirectly the fauna species may be impacted through a sudden fire event, and an increase in weed infestations, disruption to fauna through loss of ecological connectivity, increased noise and dust pollution, and an increase in predation pressure through feral fauna activities.

As with most developments that involve the clearing of land, weeds could be potentially introduced or spread by the proposed development. This has the potential to affect fauna habitat by modifying the foraging habitat available for herbivorous species, or from secondary affects that weeds may have upon the ecology of the habitat.

5.2 SIGNIFICANCE OF IMPACTS UPON CONSERVATION SIGNIFICANT FAUNA

Seven fauna species of conservation significance were recorded within the survey area, six migratory listed bird species and one Priority listed reptile.

As well as the seven recorded species, 34 other conservation significant species potentially occur within the survey area. No major net effects are expected upon any of these species from the proposed development given the small scale of impact proposed. It is possible that some of the conservation significant birds, like the Peregrine Falcon, Osprey and White-bellied Sea-eagles, may lose some potential foraging habitat but being wide-ranging species with large home

ranges, this is unlikely to be significant. The impact area will reduce (0.4 ha) of Shoreline habitat for conservation significant migratory waders. However, this level of impact is negligible to the amount of foraging habitat and roosting potential for these species in Cockburn Sound and Shoalwater Bay.

The only impact expected upon conservation significant species will be upon ground dwelling reptiles or mammals. This is because they are unable to disperse and mobilise as easily as bird species. In particular this applies to the priority listed Lined Skink. The proposed clearing has the potential to cause local mortalities as well as isolate habitats thereby affecting breeding activities. However, no net effects are expected upon this species' representation within the local area and region as preferred habitat will continue to exist within the larger survey area.

6 CONCLUSION

The Level Two fauna survey as per EPA Guidance Statement No. 56 recorded 96 terrestrial vertebrate fauna species, including five amphibian species, 19 species of reptile, 66 bird species, six mammal species and placed these results into a regional context.

Seven fauna species of conservation significance were recorded within the survey area. Six species, namely the Eastern Great Egret (*Ardea modesta*), Eastern Osprey (*Pandion cristatus*), Common Sandpiper (*Actitis hypoleucos*), Bridled Tern (*Sterna anaethetus*), Rainbow Bee-eater (*Merops ornatus*) and Australian Reed-warbler (*Acrocephalus australis*) are listed as Migratory under the EPBC Act. One species the Lined Skink (*Lerista lineata*) is listed as Priority on the DEC Priority list. The Lined Skink is listed as Priority 3 by the DEC. A further 34 conservation significant fauna species potentially occur in the survey area.

The survey area has experienced a moderate to high level of disturbance due to clearing and development for housing and industry infrastructure, to weed infestations, rubbish and vegetation clearing. For the size of the bushland remnant, Cape Peron maintains a reasonably rich herpteofauna. The level of habitat disturbance from the proposed development is likely to be low in a regional context due to the small scale of proposed vegetation clearing.

The main impact of the proposed scope of works will be vegetation clearing which is likely to affect local populations of ground dwelling fauna species. However, given the small scale of impact, the commonality of the habitat within the survey area and wider surrounds no net regional impacts are expected.

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STATEMENT OF LIMITATIONS

Scope of Services

This environmental site assessment report ('the report') has been prepared in accordance with the scope of services set out in the contract or as otherwise agreed between the Client and ENV.Australia Pty Ltd (ENV) (the 'scope of services'). In some circumstances the scope of services may have been limited by factors such as time, budget, access and/or site disturbance constraints.

Reliance on Data

In preparing the report, ENV has relied on data, surveys, analyses, designs, plans and other information provided by the Client and other individuals and organisations ('the data'), most of which are referred to in the report. Except as otherwise stated in the report, ENV has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report ('conclusions') are based in whole or in part on the data, those conclusions are dependent on the accuracy and completeness of the data. ENV will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, unavailable, withheld, unavailable, misrepresented or otherwise not fully disclosed to ENV.

Environmental Conclusions

In accordance with the scope of services, ENV has relied on the data and has conducted environmental field monitoring and/or testing in the preparation of the report. The nature and extent of monitoring and/or testing conducted is described in the report.

Within the limitations imposed by the scope of services, the monitoring, testing, sampling and preparation of this report have been undertaken and performed in a professional manner, in accordance with generally accepted practices and using a degree of skill and care ordinarily exercised by reputable environmental consultants under similar circumstances. No other warranty, express or implied, is made.

Report for Benefit of Client

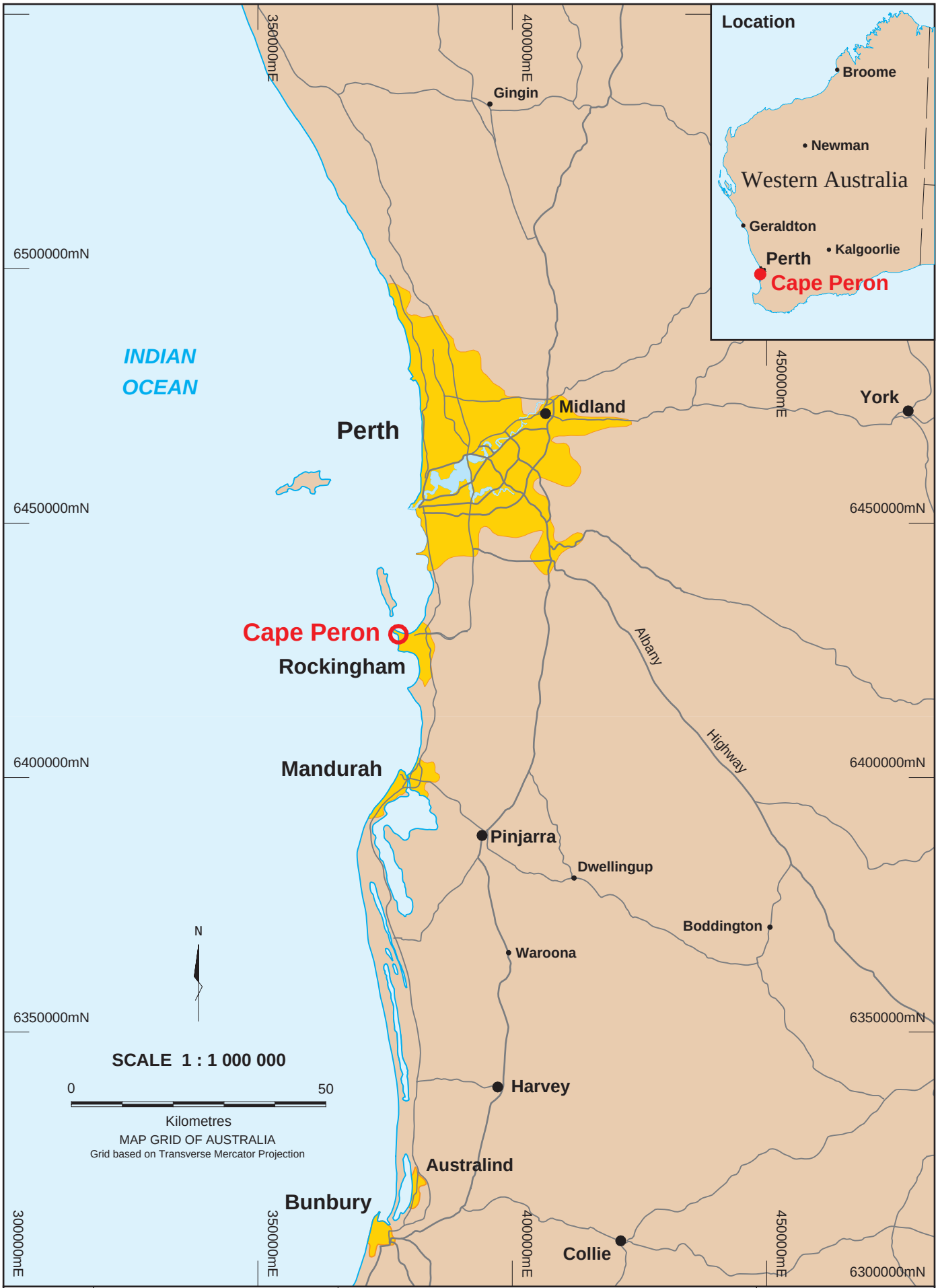
The report has been prepared for the benefit of the Client and for no other party. ENV assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report (including, without limitation, matters arising from any negligent act or omission of ENV or for any loss or damage suffered by any other party relying on the matters dealt with or conclusions expressed in the report).

Other parties should not rely on the report or the accuracy or completeness of any conclusions, and should make their own enquiries and obtain independent advice in relation to such matters.

Other Limitations

ENV will not be liable to update or revise the report to take into account any events occurring, or circumstances or facts becoming apparent, after the date of the report.

FIGURES



env Australia	Client: STRATEGEN	REGIONAL LOCATION	Date: 26 January 2010
	Project: CAPE PERON FAUNA ASSESSMENT		Scale: 1:1 Million
			Author: M.L. / S.C.
			Figure No. 1
		09.242 A4	Plan No. CP-001

	Author: M.Love	Client: STRATEGEN		Date: 19 February 2010
	Drawn: S.Coleman	Project: CAPE PERON FAUNA ASSESSMENT	SITE LOCATION	Scale: 1:12 000
	Status:			Figure No. 2
	Job Number: 09.242		A3	Plan No. CP-002

Legend

☐ **S1** Trap Locations Site

Author: M.Love	Client: STRATEGEN	TRAP LOCATIONS	Date: 26 January 2010
Drawn: S.Coleman	Project: CAPE PERON FAUNA ASSESSMENT		Scale: 1:12 000
Status:			Figure No. 4
Job Number: 09.242		A3	Plan No. CP-004

Legend

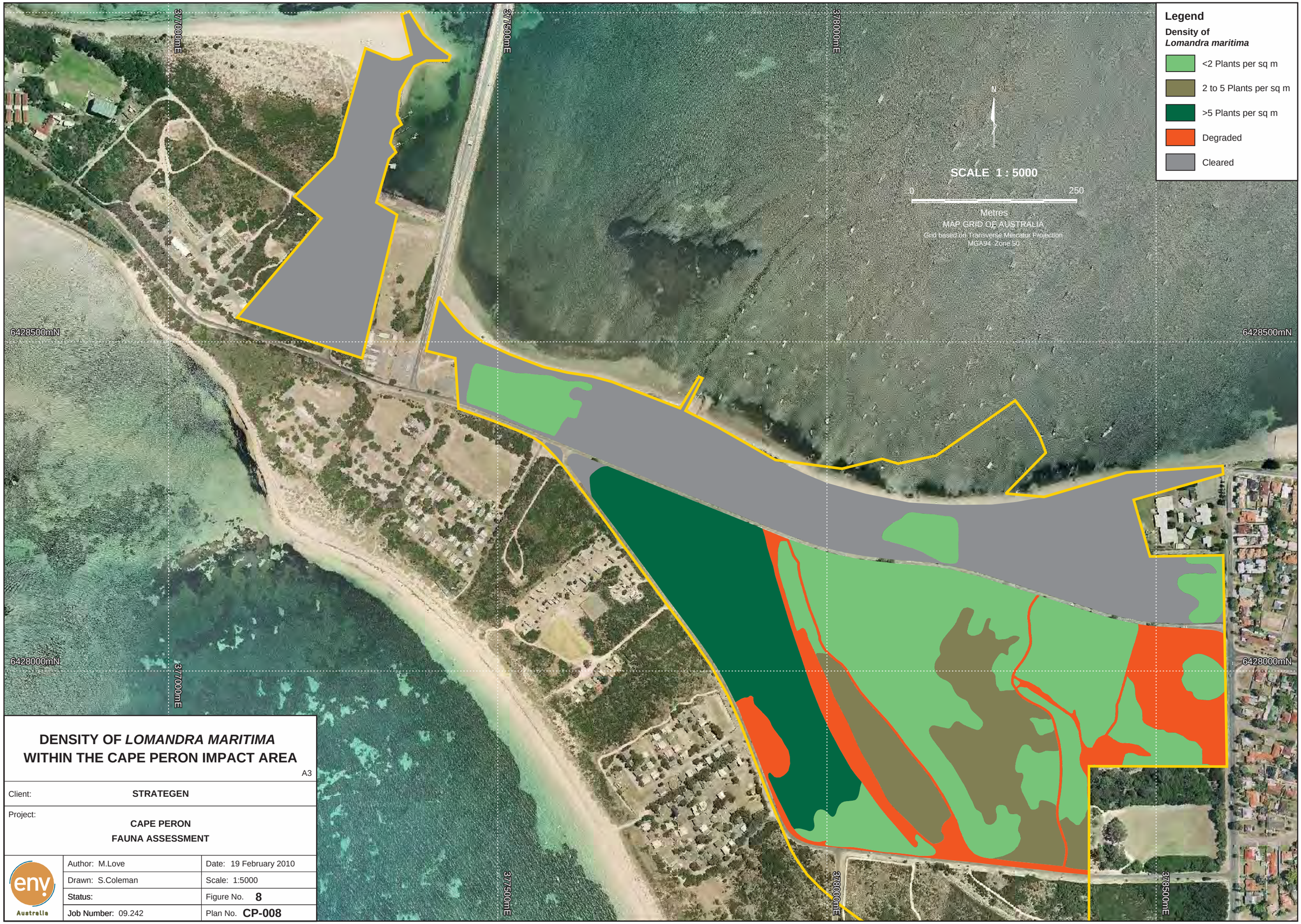
- Nocurnal Spotlighting Route - 25rd November 2010
- Nocurnal Spotlighting Route - 24rd November 2010
- Nocurnal Spotlighting Route - 23rd November 2010

Author: M.Love	Client: STRATEGEN	NOCTURNAL SPOTLIGHTING LOCATIONS FOR THE CAPE PERON PROJECT AREA	Date: 26 January 2010
Drawn: S.Coleman	Project: CAPE PERON FAUNA ASSESSMENT		Scale: 1:12 000
Status:		A3	Figure No. 5
Job Number: 09.242			Plan No. CP-005

Legend

△ Bat Recording Locations

Author: M.Love	Client: STRATEGEN	BAT RECORDING LOCATIONS FOR THE CAPE PERON PROJECT AREA	Date: 26 January 2010
Drawn: S.Coleman	Project: CAPE PERON FAUNA ASSESSMENT		Scale: 1:12 000
Status:			Figure No. 7
Job Number: 09.242		A3	Plan No. CP-007



DENSITY OF *LOMANDRA MARITIMA* WITHIN THE CAPE PERON IMPACT AREA

A3

Client: **STRATEGEN**

Project:

CAPE PERON

FAUNA ASSESSMENT

env Australia	Author: M.Love	Date: 19 February 2010
	Drawn: S.Coleman	Scale: 1:5000
	Status:	Figure No. **8**
	Job Number: 09.242	Plan No. **CP-008**

FAUNA HABITAT

A3

Client:	**STRATEGEN**
Project:	**CAPE PERON** **FAUNA ASSESSMENT**

env Australia	Author: M.Love	Date: 22 February 2010
	Drawn: S.Coleman	Scale: 1:5000
	Status:	Figure No. **9a**
	Job Number: 09.242	Plan No. **CP-009**

377000mE
377500mE
378000mE
378500mE
6428500mN
6428000mN
6427500mN

N

SCALE 1 : 5000

0 250

Metres

MAP GRID OF AUSTRALIA
Grid based on Transverse Mercator Projection
MGA94 Zone 50

Legend

- Shoreline
- Coastal Heath
- Woodland
- Wetland
- Cleared / Degraded

Location

a
b
c

FAUNA HABITAT

A3

Client: **STRATEGEN**

Project:
CAPE PERON
FAUNA ASSESSMENT

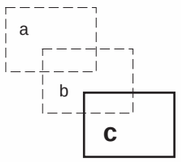
env Australia

Author: M.Love	Date: 22 February 2010
Drawn: S.Coleman	Scale: 1:5000
Status:	Figure No. **9b**
Job Number: 09.242	Plan No. **CP-010**

Legend

- Shoreline
- Coastal Heath
- Woodland
- Wetland
- Cleared / Degraded

Location



FAUNA HABITAT

A3

Client: **STRATEGEN**

Project:

CAPE PERON
FAUNA ASSESSMENT

Author: M.Love	Date: 22 February 2010
Drawn: S.Coleman	Scale: 1:5000
Status:	Figure No. **9c**
Job Number: 09.242	Plan No. **CP-011**

env Australia

APPENDIX A

DEFINITIONS OF CONSERVATION CODES FOR FAUNA OF CONSERVATION SIGNIFICANCE

CAPE PERON FAUNA ASSESSMENT

APPENDIX A

DEFINITIONS OF CONSERVATION CODES FOR FAUNA OF CONSERVATION SIGNIFICANCE

Environment Protection and Biodiversity Conservation Act 1999 (*Cth*): Threatened Species and Threatened Ecological Communities Codes

The EPBC Act prescribes seven matters of national environmental significance:-

- World Heritage properties;
- National Heritage places;
- Wetlands of international importance;
- Threatened species and ecological communities;
- Migratory species;
- Commonwealth marine areas; and
- Nuclear actions (including uranium mining).

Species in the categories ExW, CE, E, V and M (see below), and *Threatened Ecological Communities* in the CE and E categories are protected as matters of national environmental significance under the EPBC Act.

Category	Code	Category
Extinct	**Ex**	Taxa for which there is no reasonable doubt that the last member of the species has died.
Extinct in the Wild	**ExW**	Taxa known to survive only in cultivation, in captivity or as a naturalised population well outside its past range; or not recorded in its known and/or expected habitat at appropriate seasons anywhere in its past range despite exhaustive surveys over a timeframe appropriate to its life cycle and form.
Critically Endangered	**CE**	Taxa facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
Endangered	**E**	Taxa not critically endangered and facing a very high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
Vulnerable	**V**	Taxa not critically endangered or endangered and facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria**.**
Conservation Dependent	**CD**	Taxa which are the focus of a specific conservation program, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within five years.

Category	Code	Category
Migratory	**Mi**	Taxa that migrate to Australia and its external territories, or pass through or over Australian waters during their annual migrations, that are included in an international agreement approved by the Minister for the Environment, Heritage and the Arts and that have been placed on the national List of Migratory Species under the provisions of the EPBC Act. At present there are four such agreements: • the Bonn Convention • the China-Australia Migratory Bird Agreement (CAMBA) • the Japan-Australia Migratory Bird Agreement (JAMBA) • the Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA)
Marine	**Ma**	Taxa protected in a Commonwealth Marine Protected Area by virtue of section 248 of the EPBC Act. These taxa include certain seals, crocodiles, turtles and birds, as well as various marine fish. Commonwealth marine areas are matters of national environmental significance under the EPBC Act. An action will require approval if the: • action is taken in a Commonwealth marine area and the action has, will have, or is likely to have a significant impact on the environment, or • action is taken outside a Commonwealth marine area and the action has, will have, or is likely to have a significant impact on the environment in a Commonwealth marine area[1] The Commonwealth marine area is any part of the sea, including the waters, seabed, and airspace, within Australia's exclusive economic zone and/or over the continental shelf of Australia, that is not State or Northern Territory waters. The Commonwealth marine area stretches from 3 to 200 nautical miles (approximately 5-370 km) from the coast. Marine protected areas are marine areas which are recognised to have high conservation value.

Western Australian Threatened Fauna Categories

Wildlife Conservation Act 1950 (WA)

Category	Code	Description
Schedule 1	S1	Rare or likely to become extinct.
Schedule 2	S2	Presumed extinct.
Schedule 3	S3	Birds subject to an agreement between the governments of Australia and Japan, the People's Republic of China & the Republic of Korea relating to the protection of migratory birds and birds in danger of extinction.
Schedule 4	S4	Other specially protected fauna.

Department of Environment and Conservation Fauna Priority Codes

Category	Code	Description
Priority 1	P1	Taxa with few, poorly known populations on threatened lands.
Priority 2	P2	Taxa with few, poorly known populations on conservation lands.
Priority 3	P3	Taxa with several, poorly known populations, some on conservation lands.
Priority 4	P4	Taxa in need of monitoring: not currently threatened or in need of special protection, but could become so. Usually represented on conservation lands.
Priority 5	P5	Taxa in need of monitoring: not considered threatened, but the subject of a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

APPENDIX B

FAUNA SPECIES PREVIOUSLY RECORDED IN THE SURVEY AREA AND WITHIN THE WIDER SURROUNDS

APPENDIX B

FAUNA SPECIES PREVIOUSLY RECORDED IN THE SURVEY AREA AND WITHIN THE WIDER SURROUNDS

Appendix B1 - Amphbian Species

Key: EPBC = Environmental Protection and Biodiversity Conservation Act 1999, WC = Wildlife Conservation Act 1950, DEC = Department of Conservation Priority Code, A = Listed in Naturemap, B = Listed by Birds Australia, C = Previous fauna surveys records (<10km), D = Current Survey

Note: For Definitions of Conservation Codes see Appendix A.

AMPHIBIANS		**Conservation Codes**						
Scientific Name	**Common Name**	**EPBC**	**WC**	**DEC**	**A**	**B**	**C**	**D**
Family HYLIDAE								
Litoria adelaidensis	Slender Tree Frog				x			x
Litoria moorei	Motorbike Frog, Bell Frog				x			x
Family MYOBATRACHIDAE								
Crinia glauerti	Glauert's Froglet							x
Crinia insignifera	Squelching Froglet				x			
Heleioporus eyrei	Moaning Frog				x			x
Limnodynastes dorsalis	Bullfrog or Banjo Frog				x			x
Myobatrachus gouldii	Turtle Frog							
Pseudophryne guentheri	Crawling Frog or Günther's Toadlet							

[X] fauna species recorded from the survey area.

APPENDIX B

FAUNA SPECIES PREVIOUSLY RECORDED IN THE STUDY AREA AND WITHIN THE WIDER SURROUNDS

Appendix B2 - Reptile Species

Key: EPBC = Environmental Protection and Biodiversity Conservation Act 1999, WC = Wildlife Conservation Act 1950, DEC = Department of Conservation Priority Code, A = Listed in Naturemap, B = Listed by Birds Australia, C = Previous fauna surveys records (<10km), D = Current Survey

Note: For Definitions of Conservation Codes see Appendix A.

REPTILES		**Conservation Codes**						
Scientific Name	**Common Name**	**EPBC**	**WC**	**DEC**	**A**	**B**	**C**	**D**
Family CHELUIDAE								
Chelodina oblonga	Oblong Turtle							x
Family AGAMIDAE								
Pogona minor	Bearded Dragon				x		x	x
Ctenophorus adelaidensis	Western Heath Dragon				x			x
Family GEKKONIDAE								
Christinus marmoratus	Marbled Gecko				x		x	x
Crenadactylus ocellatus	Clawless Gecko							
Lucasium alboguttatum	White-spotted Ground Gecko							
Nephrurus milii	Barking Gecko							
Strophurus spinigerus spinigerus	Southwestern Spiny-tailed Gecko				x		x	x
Family PYGOPODIDAE								
Delma concinna	Javelin Legless Lizard							
Aprasia repens	Sand-plain Worm-lizard				x			x
Delma fraseri	Fraser's Delma				x		x	
Delma grayii	Side-barred Delma				x			x
Lialis burtonis	Burrton's Legless Lizard				x		x	x
Pletholax gracilis	Keeled Legless Lizard				x			
Pygopus lepidopodus	Common Scaly-foot				x			
Family SCINCIDAE								
Acritoscincus trilineatum	Southwestern Cool Skink				x			x
Cryptoblepharus buchananii					x		x	x
Cryptoblepharus plagiocephalus								
Ctenotus australis					x		x	
Ctenotus fallens					x		x	x
Ctenotus gemmula	Jewelled Ctentous			P3				
Ctenotus impar	Odd-striped Skink							
Egernia kingii	King's Skink				x			
Egernia luctuosa	Glossy Swamp Skink							
Egernia napoleonis	Southwestern Crevice Skink							
Hemiergis quadrilineata	Two-toed Earless Skink				x		x	x
Lerista elegans					x		x	x
Lerista lineata	Lined Skink			P3	x			x
Lerista lineopunctulata								
Lerista praepedita					x			
Menetia greyii	Common Dwarf Skink				x		x	x
Morethia lineoocellata					x		x	x
Morethia obscura	Woodland Flecked Skink				x		x	
Tiliqua occipitalis	Western Blue-tongue				x		x	
Tiliqua rugosa	Southwestern Bobtail				x		x	x

APPENDIX B

FAUNA SPECIES PREVIOUSLY RECORDED IN THE STUDY AREA AND WITHIN THE WIDER SURROUNDS

Appendix B2 - Reptile Species

REPTILES		Conservation Codes						
Scientific Name	**Common Name**	**EPBC**	**WC**	**DEC**	**A**	**B**	**C**	**D**
Family VARANIDAE								
Varanus gouldii	Gould's Sand Monitor				x			
Varanus rosenbergi	Heath Monitor							
Varanus tristis	Black-headed Monitor				x		x	
Family TYPHLOPIDAE								
Ramphotyphlops australis	Southern Blind Snake				x			x
Family BOIDAE								
Morelia spilota imbricata	Carpet Python		S4	P4	x			
Family ELAPIDAE								
Brachyurophis fasciolata	Narrow-banded Shovel-nosed Snake							
Brachyurophis semifasciata	Southern Shovel-nosed Snake				x			
Demansia psammophis	Yellow-faced Whipsnake							
Echiopsis curta	Bardick							
Elapognathus coronatus	Crowned Snake				x			
Neelaps bimaculatus	Black-naped Snake							
Neelaps calonotos	Black-striped Snake			P3	x			
Notechis scutatus	Tiger Snake				x			
Parasuta gouldii	Gould's Snake				x			
Pseudonaja affinis	Dugite				x		x	x
Simoselaps bertholdi	Jan's Banded Snake				x			

[X] fauna species recorded from the survey area.
[*] denotes introduced species.

APPENDIX B

FAUNA SPECIES PREVIOUSLY RECORDED IN THE STUDY AREA AND WITHIN THE WIDER SURROUNDS

Appendix B3 - Bird Species

Key: EPBC = Environmental Protection and Biodiversity Conservation Act 1999, WC = Wildlife Conservation Act 1950, DEC = Department of Conservation Priority Code, A = Listed in Naturemap, B = Listed by Birds Australia, C = Previous fauna surveys records (<10km), D = Current Survey

Note: For Definitions of Conservation Codes see Appendix A.

BIRDS		**Conservation Codes**						
Scientific Name	**Common Name**	**EPBC**	**WC**	**DEC**	**A**	**B**	**C**	**D**
Family CASUARIIDAE								
Dromaius novaehollandiae	Emu					x		
Family PHASIANIDAE								
Coturnix pectoralis	Stubble Quail	Ma				x		
Coturnix ypsilophora	Brown Quail				x	x		
**Phasianus colchicus*	Common Pheasant					x		
**Pavo cristatus*	Common Peafowl (Indian Peafowl)					x		
Family ANATIDAE								
Oxyura australis	Blue-billed Duck				x	x		x
Biziura lobata	Musk Duck	Ma				x		x
Stictonetta naevosa	Freckled Duck					x		
Cygnus atratus	Black Swan					x		x
Tadorna tadornoides	Australian Shelduck					x		
Chenonetta jubata	Australian Wood Duck					x		
Anas gracilis	Grey Teal					x		x
Anas castanea	Chestnut Teal					x		
**Anas platyrhynchos*	Mallard					x		
Anas superciliosa	Pacific Black Duck					x		x
Anas rhynchotis	Australasian Shoveler					x		
Malacorhynchus membranaceus	Pink-eared Duck					x		
Aythya australis	Hardhead					x		x
Family PODICIPEDIDAE								
Tachybaptus novaehollandiae	Australasian Grebe					x		x
Poliocephalus poliocephalus	Hoary-headed Grebe					x		x
Podiceps cristatus	Great Crested Grebe					x		x
Family SPHENISCIDAE								
Eudyptula minor	Little Penguin	Ma			x	x		
Family SULIDAE								
Sula serrator	Australasian Gannet	Ma			x	x		
Family ANHINGIDAE								
Anhinga melanogaster	Darter					x		
Family PHALACROCORACIDAE								
Phalacrocorax carbo	Great Cormorant					x		x
Phalacrocorax varius	Pied Cormorant				x	x		x
Phalacrocorax sulcirostris	Little Black Cormorant					x		x
Phalacrocorax melanoleucos	Little Pied Cormorant					x		x
Family PELECANIDAE								
Pelecanus conspicillatus	Australian Pelican	Ma				x		x
Family ARDEIDAE								
Ardea pacifica	White-necked Heron					x		
Ardea novaehollandiae	White-faced Heron							x
Ardea modesta	Eastern Great Egret	Mi, Ma				x		x
Ardea garzetta	Little Egret	Ma				x		

APPENDIX B

FAUNA SPECIES PREVIOUSLY RECORDED IN THE STUDY AREA AND WITHIN THE WIDER SURROUNDS

Appendix B3 - Bird Species

BIRDS		**Conservation Codes**						
Scientific Name	**Common Name**	**EPBC**	**WC**	**DEC**	**A**	**B**	**C**	**D**
Ardea sacra	Eastern Reef Egret	Mi, Ma				x		
Ardea ibis	Cattle Egret	Mi, Ma				x		
Nycticorax caledonicus	Rufous Night Heron	Ma			x	x		
Ixobrychus minutus	Little Bittern			P4	x	x		
Family THRESKIORNITHIDAE								
Plegadis falcinellus	Glossy Ibis	Mi, Ma				x		
Threskiornis molucca	Australian White Ibis	Ma				x		x
Threskiornis spinicollis	Straw-necked Ibis	Ma				x		
Platalea regia	Royal Spoonbill					x		
Platalea flavipes	Yellow-billed Spoonbill				x	x		x
Family ACCIPITRIDAE								
Pandion cristatus	Eastern Osprey	Mi, Ma				x		x
Elanus axillaris	Black-shouldered Kite				x	x	x	x
Lophoictinia isura	Square-tailed Kite					x		
Milvus migrans	Black Kite					x		
Haliastur sphenurus	Whistling Kite	Ma			x	x	x	x
Accipiter fasciatus	Brown Goshawk	Ma			x	x	x	
Accipiter cirrocephalus	Collared Sparrowhawk				x	x	x	
Aquila morphnoides	Little Eagle				x	x	x	
Aquila audax	Wedge-tailed Eagle					x		
Haliaeetus leucogaster	White-bellied Sea-Eagle	Mi, Ma			x	x		
Circus assimilis	Spotted Harrier					x		
Circus approximans	Swamp Harrier	Ma				x		x
Family FALCONIDAE								
Falco berigora	Brown Falcon							
Falco cenchroides	Australian Kestrel	Ma			x	x	x	x
Falco longipennis	Australian Hobby				x	x	x	x
Falco peregrinus	Peregrine Falcon		S4			x	x	
Family RALLIDAE								
Gallirallus philippensis	Buff-banded Rail	Ma			x	x		
Porzana pusilla	Baillon's Crake					x		
Porzana fluminea	Australian Spotted Crake					x		
Porzana tabuensis	Spotless Crake	Ma			x	x		
Porphyrio porphyrio	Purple Swamphen	Ma				x		x
Tribonyx ventralis	Black-tailed Native-hen					x		
Gallinula tenebrosa	Dusky Moorhen				x	x		x
Fulica atra	Eurasian Coot				x	x		x
Family TURNICIDAE								
Turnix varia	Painted Button-quail					x		
Family SCOLOPACIDAE								
Limosa limosa	Black-tailed Godwit	Mi, Ma				x		
Limosa lapponica	Bar-tailed Godwit	Mi, Ma				x		
Numenius phaeopus	Whimbrel	Mi, Ma				x		
Numenius madagascariensis	Eastern Curlew	Mi, Ma		P4		x		
Tringa stagnatilis	Marsh Sandpiper	Mi, Ma				x		
Tringa nebularia	Common Greenshank	Mi, Ma				x		
Tringa glareola	Wood Sandpiper	Mi, Ma				x		
Xenus cinereus	Terek Sandpiper	Mi, Ma				x		
Actitis hypoleucos	Common Sandpiper	Mi, Ma				x		x
Tringa brevipes	Grey-tailed Tattler	Mi, Ma				x		
Arenaria interpres	Ruddy Turnstone	Mi, Ma				x		
Calidris canutus	Red Knot	Mi, Ma				x		
Calidris tenuirostris	Great Knot	Mi, Ma			x	x		
Calidris alba	Sanderling	Mi, Ma				x		
Calidris ruficollis	Red-necked Stint	Mi, Ma			x	x		

APPENDIX B

FAUNA SPECIES PREVIOUSLY RECORDED IN THE STUDY AREA AND WITHIN THE WIDER SURROUNDS

Appendix B3 - Bird Species

BIRDS		**Conservation Codes**						
Scientific Name	**Common Name**	**EPBC**	**WC**	**DEC**	**A**	**B**	**C**	**D**
Calidris minuta	Little Stint	Mi, Ma				x		
Calidris subminuta	Long-toed Stint	Mi, Ma				x		
Calidris acuminata	Sharp-tailed Sandpiper	Mi, Ma				x		
Calidris ferruginea	Curlew Sandpiper	Mi, Ma				x		
Limicola falcinellus	Broad-billed Sandpiper	Mi, Ma				x		
Philomachus pugnax	Ruff	Mi, Ma				x		
Phalaropus lobatus	Red-necked Phalarope	Mi, Ma				x		
Family BURHINIDAE								
Burhinus grallarius	Bush Stone-curlew			P4		x		
Family HAEMATOPODIDAE								
Haematopus longirostris	Pied Oystercatcher					x		x
Haematopus fuliginosus	Sooty Oystercatcher					x		
Family RECURVIROSTRIDAE								
Himantopus himantopus	Black-winged Stilt	Ma				x		x
Cladorhynchus leucocephalus	Banded Stilt					x		
Recurvirostra novaehollandiae	Red-necked Avocet	Ma				x		
Family CHARADRIIDAE								
Vanellus miles	Masked Lapwing					x		
Vanellus tricolor	Banded Lapwing					x		
Pluvialis squatarola	Grey Plover	Mi, Ma				x		
Pluvialis fulva	Pacific Golden Plover	Mi, Ma				x		
Charadrius dubius	Little Ringed Plover	Mi, Ma				x		
Charadrius ruficapillus	Red-capped Plover	Ma			x	x		
Charadrius mongolus	Lesser Sand Plover	Mi, Ma				x		
Charadrius leschenaultii	Greater Sand Plover	Mi, Ma				x		
Charadrius melanops	Black-fronted Dotterel					x		
Charadrius rubricollis	Hooded Plover	Ma		P4		x		
Erythrogonys cinctus	Red-kneed Dotterel					x		
Family GLAREOLIDAE								
Glareola maldivarum	Oriental Pratincole	Mi, Ma						
Family LARIDAE								
Chlidonias hybridus	Whiskered (Marsh) Tern	Ma						
Chlidonias leucopterus	White-winged Black tern	Mi, Ma						
Stercorarius pomarinus	Pomarine Jaeger	Mi, Ma				x		
Stercorarius parasiticus	Arctic Jaeger	Mi, Ma				x		
Larus pacificus	Pacific Gull	Ma				x		
Larus novaehollandiae	Silver Gull	Ma			x	x		x
Sterna nilotica	Gull-billed Tern	Ma				x		
Sterna caspia	Caspian Tern	Ma			x	x		x
Sterna bergii	Crested Tern	Ma			x	x		x
Sterna dougallii	Roseate Tern	Ma			x	x		
Sterna paradisaea	Arctic Tern	Mi, Ma				x		
Sterna nereis	Fairy Tern	Ma			x	x		
Sterna anaethetus	Bridled Tern	Mi, Ma			x	x		x
Sterna fuscata	Sooty Tern	Ma			x			
Anous stolidus	Common Noddy	Mi, Ma				x		
Family COLUMBIDAE								
**Columba livia*	Domestic Pigeon					x		x
**Streptopelia senegalensis*	Laughing Turtle-Dove				x	x	x	x
**Streptopelia chinensis*	Spotted Turtle Dove					x		
Phaps chalcoptera	Common Bronzewing				x	x	x	
Phaps elegans	Brush Bronzewing					x		
Ocyphaps lophotes	Crested Pigeon					x		

APPENDIX B

FAUNA SPECIES PREVIOUSLY RECORDED IN THE STUDY AREA AND WITHIN THE WIDER SURROUNDS

Appendix B3 - Bird Species

BIRDS		Conservation Codes						
Scientific Name	Common Name	EPBC	WC	DEC	A	B	C	D
Family PSITTACIDAE								
Calyptorhynchus banksii naso	Forest Red-tailed Black Cockatoo	VU	S1			x		
Calyptorhynchus latirostris	Carnaby's Cockatoo	EN	S1			x	x	
Calyptorhynchus baudinii	Baudin's Cockatoo	VU	S1		x	x		
Cacatua roseicapilla	Galah				x	x	x	x
**Cacatua tenuirostris*	Eastern Long-billed Corella				x	x		
Cacatua pastinator	Western Long-billed Corella					x		x
**Cacatua galerita*	Sulphur-crested Cockatoo					x		
Nymphicus hollandicus	Cockatiel					x		
**Trichoglossus haematodus*	Rainbow Lorikeet					x		
Glossopsitta porphyrocephala	Purple-crowned Lorikeet					x		
Polytelis anthopeplus	Regent Parrot					x		
Platycercus zonarius zonarius	Australian Ringneck; Western Ringneck				x	x	x	x
Platycercus zonarius semitorquatus	Twenty-eight Parrot; Australian Ringneck				x			
Platycercus spurius	Red-capped Parrot				x	x	x	
Platycercus icterotis	Western Rosella					x		x
Neophema elegans	Elegant Parrot					x		
Neophema petrophila	Rock Parrot	Ma				x		
Family CUCULIDAE								
Cuculus pallidus	Pallid Cuckoo	Ma				x		
Cacomantis flabelliformis	Fan-tailed Cuckoo	Ma				x		
Chrysococcyx basalis	Horsfield's Bronze Cuckoo	Ma			x	x	x	
Chrysococcyx lucidus	Shining Bronze Cuckoo	Ma			x	x		
Family STRIGIDAE								
Ninox novaeseelandiae	Boobook Owl	Ma			x	x		
Family TYTONIDAE								
Tyto novaehollandiae	Masked Owl					x		
Tyto javanica	Eastern Barn Owl				x	x	x	
Family PODARGIDAE								
Podargus strigoides	Tawny Frogmouth				x	x		
Family CAPRIMULGIDAE								
Eurostopodus argus	Spotted Nightjar	Ma			x	x		
Family AEGOTHELIDAE								
Aegotheles cristatus	Australian Owlet-nightjar					x		
Family APODIDAE								
Apus pacificus	Fork-tailed Swift	Mi, Ma				x		
Family HALCYONIDAE								
**Dacelo novaeguineae*	Laughing Kookaburra				x	x	x	x
Todiramphus sanctus	Sacred Kingfisher	Ma				x		
Family MEROPIDAE								
Merops ornatus	Rainbow Bee-eater	Mi, Ma			x	x	x	x
Family MALURIDAE								
Malurus splendens	Splendid Fairy-wren				x	x	x	x
Stipiturus malachurus	Southern Emu-wren					x		
Family PARDALOTIDAE								
Pardalotus punctatus	Spotted Pardalote				x	x		
Pardalotus striatus	Striated Pardalote				x	x	x	x

APPENDIX B

FAUNA SPECIES PREVIOUSLY RECORDED IN THE STUDY AREA AND WITHIN THE WIDER SURROUNDS

Appendix B3 - Bird Species

BIRDS		Conservation Codes						
Scientific Name	**Common Name**	**EPBC**	**WC**	**DEC**	**A**	**B**	**C**	**D**
Family ACANTHIZIDAE								
Sericornis frontalis	White-browed Scrubwren				x	x	x	x
Smicrornis brevirostris	Weebill				x	x	x	x
Gerygone fusca	Western Gerygone				x	x	x	x
Acanthiza apicalis	Broad-tailed Thornbill (Inland Thornbill)				x	x	x	x
Acanthiza inornata	Western Thornbill				x	x	x	x
Acanthiza chrysorrhoa	Yellow-rumped Thornbill					x		
Family MELIPHAGIDAE								
Lichmera indistincta	Brown Honeyeater				x	x	x	x
Lichenostomus virescens	Singing Honeyeater				x	x	x	x
Lichenostomus ornatus	Yellow-plumed Honeyeater					x		
Melithreptus chloropsis	Western White-naped Honeyeater					x		
Phylidonyris novaehollandiae	New Holland Honeyeater				x	x	x	x
Phylidonyris nigra	White-cheeked Honeyeater					x		x
Phylidonyris melanops	Tawny-crowned Honeyeater					x		
Acanthorhynchus superciliosus	Western Spinebill					x		
Manorina flavigula	Yellow-throated Miner					x		
Anthochaera lunulata	Western Little Wattlebird					x		
Anthochaera carunculata	Red Wattlebird				x	x	x	x
Epthianura albifrons	White-fronted Chat					x		
Family PETROICIDAE								
Petroica multicolor	Scarlet Robin				x	x	x	
Petroica goodenovii	Red-capped Robin					x		
Petroica cucullata	Hooded Robin					x		
Eopsaltria griseogularis	Western Yellow Robin					x		
Family NEOSITTIDAE								
Daphoenositta chrysoptera	Varied Sittella				x	x	x	
Family PACHYCEPHALIDAE								
Pachycephala pectoralis	Golden Whistler				x	x		
Pachycephala rufiventris	Rufous Whistler				x	x	x	x
Colluricincla harmonica	Grey Shrike-thrush				x	x	x	
Family DICRURIDAE								
Myiagra inquieta	Restless Flycatcher					x		
Rhipidura fuliginosa	Grey Fantail				x	x	x	x
Rhipidura leucophrys	Willie Wagtail				x	x	x	x
Grallina cyanoleuca	Magpie-lark	Ma			x	x	x	x
Family CAMPEPHAGIDAE								
Coracina novaehollandiae	Black-faced Cuckoo-shrike	Ma			x	x	x	x
Lalage tricolor	White-winged Triller					x		
Family ARTAMIDAE								
Artamus personatus	Masked Woodswallow							
Artamus cinereus	Black-faced Woodswallow					x		
Artamus cyanopterus	Dusky Woodswallow					x		
Family CRACTICIDAE								
Cracticus torquatus	Grey Butcherbird				x	x	x	x
Cracticus nigrogularis	Pied Butcherbird					x		x
Cracticus tibicen	Australian Magpie				x	x	x	x
Strepera versicolor	Grey Currawong					x		
Family CORVIDAE								
**Corvus splendens*	House Crow				x			
Corvus bennetti	Little Crow					x		

APPENDIX B

FAUNA SPECIES PREVIOUSLY RECORDED IN THE STUDY AREA AND WITHIN THE WIDER SURROUNDS

Appendix B3 - Bird Species

BIRDS		Conservation Codes						
Scientific Name	**Common Name**	**EPBC**	**WC**	**DEC**	**A**	**B**	**C**	**D**
Corvus coronoides	Australian Raven				x	x	x	x
Family STURNIDAE								
**Sturnus vulgaris*	Common Starling				x			
Family HIRUNDINIDAE								
Cheramoeca leucosternus	White-backed Swallow					x		
Hirundo neoxena	Welcome Swallow	Ma			x	x	x	x
Hirundo nigricans	Tree Martin	Ma			x	x	x	
Hirundo ariel	Fairy Martin					x		
Family PYCNONOTIDAE								
**Pycnonotus jocosus*	Red-whiskered Bulbul				x			
Family ZOSTEROPIDAE								
Zosterops lateralis	Silvereye	Ma			x	x	x	x
Family SYLVIIDAE								
Acrocephalus australis	Australian Reed-warbler	Mi, Ma				x		x
Megalurus gramineus	Little Grassbird					x		
Cincloramphus mathewsi	Rufous Songlark					x		
Cincloramphus cruralis	Brown Songlark					x		
Family DICAEIDAE								
Dicaeum hirundinaceum	Mistletoebird					x		
Family PASSERIDAE								
**Passer domesticus*	House Sparrow					x		
**Passer montanus*	Eurasian Tree Sparrow				x			
Family MOTACILLIDAE								
Anthus australis	Australian Pipit; Richard's Pipit				x	x	x	
Family FRINGILLIDAE								
**Carduelis carduelis*	Goldfinch (European Goldfinch)					x		

[X] fauna species recorded from the survey area.
[*] denotes introduced species.

APPENDIX B

FAUNA SPECIES PREVIOUSLY RECORDED IN THE STUDY AREA AND WITHIN THE WIDER SURROUNDS

Appendix B4 - Mammal Species

Key: EPBC = Environmental Protection and Biodiversity Conservation Act 1999, WC = Wildlife Conservation Act 1950, DEC = Department of Conservation Priority Code, A = Listed in Naturemap, B = Listed by Birds Australia, C = Previous fauna surveys records (<10km), D = Current Survey

Note: For Definitions of Conservation Codes see Appendix A.

MAMMALS		**Conservation Codes**						
Scientific Name	**Common Name**	**EPBC**	**WC**	**DEC**	**A**	**B**	**C**	**D**
Family TACHYGLOSSIDAE								
Tachyglossus aculeatus	Echidna							
Family DASYURIDAE								
Antechinus flavipes leucogaster	Yellow-footed Antechinus, Mardo							
Dasyurus geoffroii	Western Quoll, Chuditch	VU	S1					
Phascogale tapoatafa ssp. (WAM M434)	Wambenger, Southern Brush-tailed Phascogale		S1		x			
Sminthopsis griseoventer	Grey-bellied Dunnart							
Family PERAMELIDAE								
Isoodon obesulus fusciventer	Southern Brown Bandicoot, Quenda			P5	x		x	
Family MACROPODIDAE								
Macropus eugenii derbianus	Tammar Wallaby			P5	x			
Macropus fuliginosus	Western Grey Kangaroo						x	
Macropus irma	Western Brush Wallaby			P4				
Setonix brachyurus	Quokka	VU	S1					
Family PHALANGERIDAE								
Trichosurus vulpecula vulpecula	Common Brushtail Possum							
Family BURRAMYIDAE								
Cercartetus concinnus	Western Pygmy-possum, Mundarda							
Family TARSIPEDIDAE								
Tarsipes rostratus	Honey Possum, Noolbenger							
Family VESPERTILIONIDAE								
Chalinolobus gouldii	Gould's Wattled Bat				x		x	x
Chalinolobus morio	Chocolate Wattled Bat							
Falsistrellus mackenziei	Western False Pipistrelle			P4				
Nyctophilus geoffroyi	Lesser Long-eared Bat							
Nyctophilus gouldi	Gould's Long-eared Bat							
Nyctophilus timoriensis timoriensis	Greater Long-eared Bat						x	
Vespadelus regulus	Southern Forest Bat						x	
Family MOLOSSIDAE								
Mormopterus planiceps	Southern Freetail-bat						x	
Austrononus australis	White-striped Freetail-bat							x
Family MURIDAE								
Hydromys chrysogaster	Water-rat			P4				
**Mus musculus*	House Mouse				x		x	x
Rattus fuscipes	Western Bush Rat							x
**Rattus norvegicus*	Brown Rat							
**Rattus rattus*	Black Rat				x		x	

APPENDIX B

FAUNA SPECIES PREVIOUSLY RECORDED IN THE STUDY AREA AND WITHIN THE WIDER SURROUNDS

Appendix B4 - Mammal Species

MAMMALS		**Conservation Codes**						
Scientific Name	**Common Name**	**EPBC**	**WC**	**DEC**	**A**	**B**	**C**	**D**
Family LEPORIDAE								
**Oryctolagus cuniculus*	Rabbit						x	x
Family CANIDAE								
**Canis lupus familiaris*	Dog						x	
**Vulpes vulpes*	Red Fox						x	x
Family FELIDAE								
**Felis catus*	Cat				x		x	

[X] fauna species recorded from the survey area.
[*] denotes introduced species.

APPENDIX C

TRAPPING PROGRAM

CAPE PERON FAUNA ASSESSMENT

APPENDIX C

TRAPPING PROGRAM

Appendix C1 – Trap Site Locations

Trap Number	#GPS Coordinates	
	Easting	Northing
S1.01	376542	6429013
S1.02	376530	6429014
S1.03	376520	6429016
S1.04	376524	6429003
S1.05	376511	6429000
S1.06	376509	6429018
S1.07	376500	6429005
S1.08	376484	6428995
S1.09	376466	6428980
S1.10	376456	6428988
S2.01	378406	6427978
S2.02	378406	6427962
S2.03	378400	6427965
S2.04	378414	6427925
S2.05	378425	6427938
S2.06	378426	6427962
S2.07	378425	6427969
S2.08	378426	6427982
S2.09	378432	6428006
S2.10	378443	6428016
S3.01	378196	6427797
S3.02	378187	6427789
S3.03	378185	6427806
S3.04	378164	6427811
S3.05	378177	6427824
S3.06	378180	6427833
S3.07	378156	6427820
S3.08	378161	6427848
S3.09	378140	6427846
S3.10	378154	6427870
S4.01	377982	6428101
S4.02	377982	6428090
S4.03	377992	6428073
S4.04	377993	6428068
S4.06	377993	6428071
S4.05	377998	6428051
S4.07	378009	6428036

Trap Number	#GPS Coordinates	
	Easting	Northing
S4.08	378019	6428024
S4.09	378029	6428015
S4.10	378038	6428004
S5.01	378119	6427672
S5.02	378121	6427650
S5.03	378119	6427640
S5.04	378128	6427622
S5.05	378110	6427613
S5.06	378122	6427592
S5.07	378128	6427581
S5.08	378101	6427570
S5.09	378100	6427563
S5.10	378113	6427541
S6.01	378442	6427824
S6.02	378450	6427818
S6.03	378467	6427829
S6.04	378488	6427839
S6.05	378488	6427839
S6.06	378500	6427848
S6.07	378514	6427856
S6.08	378525	6427884
S6.09	378518	6427887
S6.10	378515	6427904
TME 1	378381	6427891
TME 2	378402	6427899
TME 3	378436	6427892
TME 4	378466	6427881
TME 5	378442	6427889
TME 6	378404	6427885
TME 7	378391	6427886
TME 8	378399	6427892
TME 9	378401	6427899
TME 10	378410	6427895

Australian Geocentric 1994 (GDA94) Zone 50K

Appendix C2 – Major Trap Sites Habitat Type and Vegetation Descriptions

Site Number	Habitat Type	Vegetation Description
S1	Coastal Heath	
		Closed Tall Scrub to Open Heath of *Acacia rostellifera* and *Olearia axillaris* over an Open Low Heath of mixed species or a Closed Grassland of introduced species.
S2	Woodland	
		Open Forrest of *Eucalyptus gomphocephala* over Low Open Forest of *Agonis flexuosa* var *flexuosa, Callitris preissii* and *Melaleuca lanceolata* over a Herbland of introduced species in grey sand.

Site Number	Habitat Type	Vegetation Description
S3	Coastal Heath	
		Closed Tall Scrub to Open Heath of *Acacia rostellifera* and *Olearia axillaris* over an Open Low Heath of mixed species or a Closed Grassland of introduced species.
S4	Coastal Heath	
		Closed Tall Scrub to Open Heath of *Acacia rostellifera* and *Olearia axillaris* over an Open Low Heath of mixed species or a Closed Grassland of introduced species.
S5	Coastal Heath	

Site Number	Habitat Type	Vegetation Description
		Closed Tall Scrub to Open Heath of *Acacia rostellifera* and *Olearia axillaris* over an Open Low Heath of mixed species or a Closed Grassland of introduced species.
S6	Woodland	
		Open Forrest of *Eucalyptus gomphocephala* over Low Open Forest of *Agonis flexuosa* var *flexuosa, Callitris preissii* and *Melaleuca lanceolata* over a Herbland of introduced species in grey sand.

Appendix C3 – Traps and Number of Replicates Used at Each Site

Site Number	# Cage Traps	# Elliott Traps	# Funnel Traps	# Hair Tubes	# Bucket Traps	Total
S1	2	10	20	5	10	**47**
S2	2	10	20	5	10	**47**
S3	2	10	20	5	10	**47**
S4	2	10	20	5	10	**47**
S5	2	10	20	5	10	**47**
S6	2	10	20	5	10	**47**
TME	-	10	-	-	-	**10**
TOTAL	**12**	**70**	**120**	**30**	**60**	**292**

Appendix C4 – Systematic Trapping Program

Site Number	# trap-nights for Cage Traps	# trap-nights for Elliott Traps	# trap-nights for Funnel Traps	# trap-nights for Hair Tubes	# trap-nights for Bucket Traps	Total # nights
S1	12	60	120	30	60	**282**
S2	12	60	120	30	60	**282**
S3	12	60	120	30	60	**282**
S4	12	60	120	30	60	**282**
S5	12	60	120	30	60	**282**
S6	10	50	100	25	50	**235**
TME	-	30	-	-	-	**30**
TOTAL	**70**	**370**	**700**	**175**	**350**	**1645**

APPENDIX D

DIURNAL AND NOCTURNAL CENSUS

CAPE PERON FAUNA ASSESSMENT

APPENDIX D

DIURNAL AND NOCTURNAL CENSUS

Appendix D1 – Details of Diurnal Census

Date	Location	Duration (Person hours)
24 November 2009	Lake Richmond	3 hrs
25 November 2009	Woodland at Lake Richmond	9 hrs
TOTAL		**12 hrs**

Appendix D2 – Details of Nocturnal Census

Date	Location	Duration (Person hours)
23 November 2009	Lake Richmond	7.5 hrs
24 November 2009	Woodland and Coastal Heath near Site 2	6 hrs
25 November 2009	Cape Peron Hedland	3 hrs
TOTAL		**16.5 hrs**

APPENDIX E

ORNITHOLOGICAL CENSUS

CAPE PERON FAUNA ASSESSMENT

APPENDIX E

ORNITHOLOGICAL CENSUS

Date	#Easting	#Northing	Duration
22 November 2009	376645	6429083	1.5 hrs
22 November 2009	376520	6428907	1 hr
23 November 2009	379425	6426916	5 hrs
24 November 2009	378425	6427938	3 hrs
24 November 2009	378396	6427821	1 hr
24 November 2009	377765	6428380	0.5 hr
24 November 2009	379425	6426916	4.5 hrs
25 November 2009	377464	6428495	0.5 hr
25 November 2009	377283	6428290	0.5 hr
26 November 2009	376399	6428819	1.5 hrs
26 November 2009	378165	6427358	1 hr
26 November 2009	379066	6427389	2 hrs
TOTAL			**22 hrs**

[#] Australian Geocentric 1994 (GDA94) Zone 50K

APPENDIX F

BAT RECORDING DETAILS

CAPE PERON FAUNA ASSESSMENT

APPENDIX F

BAT RECORDING DETAILS

Appendix F – AnaBat Recording Details and Locations

Date	#GPS Coordinates		Nights	Habitat / Location
	Easting	Northing		
22 November 2009	378491	6427885	4	Woodland
24 November 2009	377283	6428290	1	Camp
26 November 2009	379335	6427296	1	Lake Richmond

#Australian Geocentric 1994 (GDA94) Zone 50K

APPENDIX G

SITE SPECIFIC DATA

CAPE PERON FAUNA ASSESSMENT

APPENDIX G

SITE SPECIFIC DATA

Cape Peron Fauna **Site** 1

Described by J.T. **Date:** 26/11/2009 **Type:** Fauna Trap Site

Season Spring
Location East: 50H 37 6542 North: 6429015
MGA Zone **mE** **mN**
Habitat Coastal Heath
Soil White beach sandy to yellow cream sand
Rock Type Nil
Vegetation Closed Tall Scrub to Open Heath of *Acacia rostellifera* and *Olearia axillaris* over an Open Low Heath of mixed species or a Closed Grassland of introduced species.
Vegetation Condition Very Good - Good
Fire Age Old
Notes Nil
Habitat type Coastal Heath

Logs: 2% **Leaves:** 93% **Twigs:** 5% **Rocks:** 0% **Rock sheet:** 0% **Litter:** 95% **Bare:** 5%

Species List: Number of individuals by Observed:

Name	Pit	Pot	Ca	Ell	Fu	Net	No	Opp
Mammals								
Mus musculus								
Oryctolagus cuniculus								
Rattus fuscipes								
Reptiles								
Acritoscincus trilineatum								
Ctenotus fallens								
Delma grayii								
Hemiergis quadrilineata								
Lerista lineata								
Lialis burtonis								
Menetia greyii								
Morethia lineoocellata								
Pseudonaja affinis								
Strophurus spinigerus								
Tiliqua rugosa								

Cape Peron Fauna Site 2

Described by M.B. **Date:** 26/11/2009 **Type:** Fauna Trap Site

Season Spring
Location East: 50H 378434 North: 6427929
MGA Zone **mE** **mN**
Habitat Woodland
Soil White loam - grey sand with hummus
Rock Type Nil
Vegetation Open Forrest of *Eucalyptus gomphocephala* over Low Open Forest of *Agonis flexuosa* var *flexuosa, Callitris preissii* and *Melaleuca lanceolata* over a Herbland of introduced species in grey sand.
Vegetation Condition Good
Fire Age Old
Notes Nil
Habitat type Woodland

Logs: 5% **Leaves:** 91% **Twigs:** 4% **Rocks:** 0% **Rock sheet:** 0% **Litter:** 99% **Bare:** 1%

Species List: Number of individuals by Observation Type:

Name	Pit	Pot	Ca	Ell	Fu	Net	No	Opp
Amphibia								
Heleioporus eyrei					2			
Litoria moorei								
Reptiles								
Acritoscincus trilineatum					4			
Aprasia repens								
Christinus marmoratus								
Ctenotus fallens								
Hemiergis quadrilineata								
Lerista lineata								
Menetia greyii								
Pseudonaja affinis								
Tiliqua rugosa								

Cape Peron Fauna Site 3

Described by M.B. **Date** **Type:** Fauna Trap Site

Season Spring
Location East: 50H 377982 North: 6428104
MGA Zone **mE** **mN**
Habitat Coastal Heath
Soil White – grey sand
Rock Type Nil
Vegetation Closed Tall Scrub to Open Heath of *Acacia rostellifera* and *Olearia axillaris* over an Open Low Heath of mixed species or a Closed Grassland of introduced species.
Vegetation Condition Good
Fire Age Old
Notes Nil
Habitat type Coastal Heath

Logs: 3% **Leaves:** 93% **Twigs:** 4% **Rocks:** 0% **Rock sheet:** 0% **Litter:** 95% **Bare:** 5%

Species List: Number of individuals by Observation Type:

Name	Pit	Pot	Ca	Ell	Fu	Net	No	Opp
Amphibia								
Heleioporus eyrei								
Litoria moorei								
Mammals								
Mus musculus								
Reptiles								
Acritoscincus trilineatum								
Ctenophorus adelaidensis								
Ctenotus fallens								
Hemiergis quadrilineata								
Lerista lineata								
Lialis burtonis								
Pseudonaja affinis								
Strophurus spinigerus								
Tiliqua rugosa								

Cape Peron Fauna Site 4

Described by M.B. **Date** 26/11/2009 **Type:** Fauna Trap Site

Season Spring
Location East: 50H 378176 North: 6427806
MGA Zone **mE** **mN**
Habitat Coastal Heath
Soil White – grey sand
Rock Type Nil
Vegetation Closed Tall Scrub to Open Heath of *Acacia rostellifera* and *Olearia axillaris* over an Open Low Heath of mixed species or a Closed Grassland of introduced species.
Vegetation Condition Good
Fire Age Old
Notes Nil
Habitat type Coastal heath

Logs: 2% **Leaves:** 93% **Twigs:** 5% **Rocks:** 0% **Rock sheet:** 0% **Litter:** 95% **Bare:** 5%

Species List: Number of individuals by Observation Type:

Name	Pit	Pot	Ca	Ell	Fu	Net	No	Opp
Amphibia								
Heleioporus eyrei					2			
Litoria moorei								
Mammals								
Mus musculus								
Reptiles								
Acritoscincus trilineatum								
Aprasia repens								
Ctenophorus adelaidensis								
Ctenotus fallens								
Hemiergis quadrilineata								
Lerista elegans								
Lerista lineata								
Menetia greyii								
Pogona minor								
Pseudonaja affinis								
Ramphotyphlops australis								
Strophurus spinigerus								
Tiliqua rugosa								

Cape Peron Fauna Site 5

Described by M.B. **Date** 26/11/2009 **Type:** Fauna Trap Site

Season Spring
Location East: 50H 378112 North: 6427673
MGA Zone **mE** **mN**
Habitat Coastal Heath
Soil White – grey sand
Rock Type Nil
Vegetation Closed Tall Scrub to Open Heath of *Acacia rostellifera* and *Olearia axillaris* over an Open Low Heath of mixed species or a Closed Grassland of introduced species.
Vegetation Condition Good
Fire Age Old
Notes Nil
Habitat type Coastal Heath

Logs: 2% **Leaves:** 94% **Twigs:** 4% **Rocks:** 0% **Rock sheet:** 0% **Litter:** 90% **Bare:** 10%

Species List: Number of individuals by Observation Type:

Name	Pit	Pot	Ca	Ell	Fu	Net	No	Opp
Amphibia								
Heleioporus eyrei								
Litoria moorei								
Mammals								
Mus musculus								
Reptiles								
Acritoscincus trilineatum								
Ctenotus fallens								
Delma grayii								
Hemiergis quadrilineata								
Lerista lineata								
Lialis burtonis								
Pogona minor								
Pseudonaja affinis								
Strophurus spinigerus								
Tiliqua rugosa								

Cape Peron Fauna Site 6

Described by J.T. **Date** 26/11/2009 **Type:** Fauna Trap Site

Season Spring
Location East: 50H 378488 North: 6427839
MGA Zone **mE** **mN**
Habitat Woodland
Soil Loamy grey sand
Rock Type Nil
Vegetation Open Forrest of *Eucalyptus gomphocephala* over Low Open Forest of *Agonis flexuosa* var *flexuosa*, *Callitris preissii* and *Melaleuca lanceolata* over a Herbland of introduced species in grey sand.
Vegetation Condition Good
Fire Age Old
Notes Nil
Habitat type Woodland

Logs: 5% **Leaves:** 90% **Twigs:** 5% **Rocks:** 0% **Rock sheet:** 0% **Litter:** 90% **Bare:** 10%

Species List: Number of individuals by Observation Type:

Name	Pit	Pot	Ca	Ell	Fu	Net	No	Opp
Amphibia								
Heleioporus eyrei								
Litoria moorei								
Reptiles								
Acritoscincus trilineatum					6			
Ctenotus fallens								
Hemiergis quadrilineata								
Lerista lineata								
Menetia greyii								
Morethia lineoocellata								
Pseudonaja affinis								
Ramphotyphlops australis								
Tiliqua rugosa								

Cape Peron Fauna **Site** Opportunistic

Described by M.L. **Date** 26/11/2009 **Type:** Opportunistic Sightings

Season Spring
Location
MGA Zone **mE** **mN**
Habitat
Soil
Rock Type
Vegetation
Vegetation Condition
Fire Age Old
Notes

Habitat type: **Logs:** **Leaves:** **Twigs:** **Rocks:** **Rock sheet:** **Litter:** **Bare:**

Effort:

Species List: Number of individuals by Observation Type:

Name	Pit	Pot	Ca	Ell	Fu	Net	No	Opp
Amphibia								
Crinia glauerti								
Heleioporus eyrei								
Limnodynastes dorsalis								
Litoria adelaidensis								
Litoria moorei								
Birds								
Acanthiza apicalis								
Acanthiza inornata								
Acrocephalus australis								
Anas gracilis								
Anas superciliosa								
Anthochaera carunculata								
Ardea alba								
Ardea novaehollandiae								
Aythya australis								
Biziura lobata								
Cacatua pastinator								
Cacatua roseicapilla								
Circus approximans								
Columba livia								
Coracina novaehollandiae								
Corvus coronoides								
Cracticus nigrogularis								
Cracticus tibicen								
Cracticus torquatus								
Cygnus atratus								
Dacelo novaeguineae								
Elanus caeruleus								
Falco cenchroides								
Falco longipennis								
Fulica atra								
Gallinula tenebrosa								
Gerygone fusca								
Grallina cyanoleuca								
Haematopus longirostris								
Haliastur sphenurus								
Himantopus himantopus								
Hirundo neoxena								
Larus novaehollandiae								
Lichenostomus virescens								
Lichmera indistincta								
Malurus splendens								
Merops ornatus								
Oxyura australis								
Pachycephala rufiventris								

Pandion haliaetus
Pardalotus striatus
Pelecanus conspicillatus
Phalacrocorax carbo
Phalacrocorax melanoleucos
Phalacrocorax sulcirostris
Phalacrocorax varius
Phylidonyris nigra
Phylidonyris novaehollandiae
Platalea flavipes
Platycercus icterotis
Platycercus zonarius
Podiceps cristatus
Poliocephalus poliocephalus
Porphyrio porphyrio
Rhipidura fuliginosa
Rhipidura leucophrys
Sericornis frontalis
Smicrornis brevirostris
Sterna anaethetus
Sterna bergii
Sterna caspia
Streptopelia senegalensis
Tachybaptus novaehollandiae
Threskiornis molucca
Tringa hypoleucos
Zosterops lateralis

Mammals

Chalinolobus gouldii
Mus musculus
Oryctolagus cuniculus
Tadarida australis
Vulpes vulpes

Reptiles

Acritoscincus trilineatum
Chelodina oblonga
Cryptoblepharus buchananii *1*
Ctenophorus adelaidensis
Hemiergis quadrilineata
Lialis burtonis
Pogona minor
Pseudonaja affinis
Strophurus spinigerus
Tiliqua rugosa

APPENDIX H

CONSERVATION SIGNIFICANT FAUNA SPECIES PREVIOUSLY RECORDED IN THE SURVEY AREA AND WITHIN THE WIDER SURROUNDS

CAPE PERON VERTEBRATE FAUNA ASSESSMENT

APPENDIX H

CONSERVATION SIGNIFICANT FAUNA SPECIES PREVIOUSLY RECORDED IN THE SURVEY AREA AND WITHIN THE WIDER SURROUNDS

Conservation Significant Species	Conservation Status	Distribution and Ecology	Habitat Relevance	Likelihood
REPTILES				
Jewelled *Ctenotus*	P3	The Swan Coastal Plain population of Jewelled *Ctenotus* (*Ctenotus gemmula*) occurs in coastal heaths and semi-arid woodlands. This species has a patchy distribution along the coastal plains and adjacent interior of the south west (Wilson and Swan 2008). This species is particularly difficult to locate, and is infrequently collected in biological surveys.	The Jewelled *Ctenotus* inhabits areas that contain coastal heath along the swan coastal plain.	Possible
Lined Skink	P3	The Lined Skink (*Lerista lineata*) occurs in sandy coastal heath and shrubland areas in isolated populations in the south-west and mid-west coast of Western Australia and in disjunct and isolated populations (Wilson and Swan 2008). This burrowing species is found in loose soil or sand beneath logs and termite mounds, where it feeds on termites and other small insects (Cogger 2000).	The Lined Skink (Lerista lineata) was recorded thirty one times, at all six sites within the survey area. The coastal heath of the survey area is ideal habitat for this skink.	Recorded
Carpet Python	S4, P4	The south-western population of the Carpet Python has a wide distribution in the south-west, but is generally uncommon, having been recorded from semi-arid coastal and inland habitats, *Banksia* woodland, eucalypt woodlands, and grasslands. It commonly utilises hollow logs for shelter (Wilson and Swan 2008). Local populations in the south-west have suffered because of extensive clearing and removal of its habitat.	The Carpet Python has been recorded to inhabit coastal areas similar to that found within the survey area. There is a population living on Garden Island and it is possible the carpet python resides in the survey area.	Possible
Black-striped Snake	P3	The Black-striped Snake is typically found in sandplain habitat in association with *Banksia* species, having a very limited distribution exclusive to the Swan Coastal Plain. This taxon is particularly difficult to locate, and is infrequently collected during biological surveys on the Swan Coastal Plain.	The Black-striped Snake could possibly occur in the survey area as it resides within the distribution of the species. The lack of Banksia species in the site suggests that the habitat is not suitable.	Possible
BIRDS				
Eastern Great Egret	Mi	The Eastern Great Egret occurs in the Kimberley, Pilbara, and on the west coast from the Murchison River south, throughout the south-west, and east to Cape Arid. This species is considered common to very common in the Kimberley, and scarce to moderately common elsewhere (Johnstone and Storr 1998). It inhabits mostly shallow fresh lakes, pools in rivers, lagoons, lignum swamps, clay pans and samphire flats, large dams and sewage ponds. It also inhabits shallow saltwater habitat such as mangrove creeks, tidal pools, samphire swamps and salt work ponds. It breeds colonially at wooded swamps and river pools, nesting in riparian trees.	The Eastern Great Egret prefers areas of shallow fresh water lakes, shallow saltwater habitats and tidal pools. This species was recorded in an opportunistic survey of the area showing that the survey area contains its preferred habitat.	Recorded

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CONSERVATION SIGNIFICANT FAUNA SPECIES PREVIOUSLY RECORDED IN THE SURVEY AREA AND WITHIN THE WIDER SURROUNDS

Conservation Significant Species	Conservation Status	Distribution and Ecology	Habitat Relevance	Likelihood
Eastern Reef Egret	Mi	The Eastern Reef Egret occurs in coastal areas along the entire WA coast, although it is more common in the warmer regions to the north. The species inhabits beaches, rocky shores, tidal rivers and inlets, mangroves, and exposed coral reefs. Although it is listed as migratory, the Eastern Reef Egret is largely sedentary in nature (Johnstone and Storr 1998).	The Eastern Reef Egret is likely to be found within the survey area as it contains the preferred habitat for this species.	Likely
Cattle Egret	Mi	The Cattle Egret occurs in the wetter parts of Western Australia, in particular the Kimberley and the south-west. The species inhabits short grass, in particular damp pastures and wetlands, usually in the company of cattle and occasionally other livestock. In WA it is an irregular visitor, occurring mostly in autumn, and is not thought to breed regularly in WA (Johnstone and Storr 1998).	The Cattle Egret is known to inhabit areas through-out the south-west and it is possible to occur in the survey area. The lack of cattle and other livestock in the area does diminish the chances of the Cattle Egret occurring.	Possible
Little Bittern	P4	The Little Bittern occurs north to Moora and south-east to Two Peoples Bay (Johnstone and Storr 1998). It is usually recorded on dense vegetation beds of freshwater pools, swamps and lagoons, well screened with trees. This species often shelters in dense beds of Typha ssp., Baumea ssp., and tall rushes in freshwater swamps around lakes and along rivers (Johnstone and Storr 1998).	Although a historical record of the Little Bittern has occurred in the area it is unlikely to still persist. The Little Bittern requires dense reed beds and substantial areas of *Melaleuca* that do not occur in large densities around Lake Richmond.	Unlikely
Glossy Ibis	Mi	The Glossy Ibis inhabits areas of freshwater wetlands, irrigated areas, margins of dams, floodplains, brackish and saline wetlands, tidal mudflats, pastures, lawns and public gardens (Simpson and Day 2004).	The Glossy Ibis is likely to occur in the survey area as there is suitable habitat. Its preferred habitats of freshwater wetlands, pastures, lawns and public gardens are well represented in the survey area.	Likely
Eastern Osprey	Mi	The Eastern Osprey is distributed along the coast, islands and lower river courses of Western Australia (Simpson and Day 2004). They feed on fish and other marine animals (Johnstone and Storr 1998). They nest in trees, cliffs and sometimes structures such as radio towers, often close to the water.	The Eastern Osprey was recorded in the survey area, with a nest observed on a rocky outcrop in shoalwater bay. The small islands and bays of the area are suitable habitat for this species.	Recorded
White-bellied Sea-eagle	Mi	The White-bellied Sea Eagle is distributed along the coast, islands and estuaries of WA but not the lower west and south-west or far east (Johnstone and Storr 1998). They feed on fish, sea snakes and nesting seabirds. Nests are usually placed on high ground such as rock pinnacles, rigid shrubs or in tall trees (Simpson and Day 2004).	Due to the proximity to the coastline and other wetlands, the White-bellied Sea-eagle is likely to occur in the survey area.	Likely

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CONSERVATION SIGNIFICANT FAUNA SPECIES PREVIOUSLY RECORDED IN THE SURVEY AREA AND WITHIN THE WIDER SURROUNDS

Conservation Significant Species	Conservation Status	Distribution and Ecology	Habitat Relevance	Likelihood
Peregrine Falcon	S4	The Peregrine Falcon occurs mainly along coastal cliffs, rivers and ranges as well as wooded watercourses and lakes (Johnstone and Storr 1998). The Peregrine Falcon nests primarily on cliffs, granite outcrops and quarries, and feeds mostly on birds (Johnstone and Storr 1998).	The coastal cliffs and lakes of the survey area are suitable habitat for the Peregrine Falcon. As such it may possibly occur in this area.	Possible
Black-tailed Godwit	Mi	This Migratory bird breeds off the coast of Mongolia and Siberia. It migrates to Australian waters in September to May (Pizzey and Knight 2007). It is moderately common in the coastal areas around Perth and Mandurah. This species prefers tidal flats and inland wetlands (Simpson and Day 2004).	The tidal flats and inland wetlands of the survey area are suitable habitat for the Black-tailed Godwit. As such it is likely to inhabit this area on its migratory route.	Likely
Bar-tailed Godwit	Mi	This Migratory bird breeds off the coast of Siberia and Alaska. It migrates to Australian waters in September to May (Pizzey and Knight 2007). It is commonly found in the coastal areas around Perth and Mandurah. This species requires marine waters for habitat such as intertidal flats and sand banks, rarely inland in Western Australia (Simpson and Day 2004).	The intertidal flats and sand banks of the survey area are suitable habitat for the Bar-tailed Godwit. As such it is likely to inhabit this area on its migratory route.	Likely
Whimbrel	Mi	This Migratory bird breeds off the coast of Siberia and migrates to Australian waters in August to April (Pizzey and Knight 2007). It is moderately common in the coastal areas around Perth and Mandurah. This species prefers coastal estuaries, mudflats and mangroves (Simpson and Day 2004).	The survey area does not have the Whimbrels preferred habitat, but surrounding areas do. As such it is possible the Whimbrel may be found in this area on its migratory route.	Possible
Eastern Curlew	Mi, P4	This Migratory bird breeds off the coast of Asia and migrates to Australian waters in August to May (Pizzey and Knight 2007). It is moderately common to uncommon around Perth and Mandurah. This species prefers coastal estuaries, mudflats, mangroves and sandspits (Simpson and Day 2004).	The survey area does not have the Eastern Curlews' preferred habitat, but surrounding areas do. As such it is possible the Eastern Curlew may be found in this area on its migratory route.	Possible
Marsh Sandpiper	Mi	This Migratory bird breeds from Austria to Mongolia and migrates to Australian waters in August to May (Pizzey and Knight 2007). It is moderately common to uncommon around Perth and Mandurah. This species can habit fresh or saltwater environments (Simpson and Day 2004).	The marine and freshwater environments of the survey area are possible habitats for the Marsh Sandpiper during its migratory routes.	Possible

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CONSERVATION SIGNIFICANT FAUNA SPECIES PREVIOUSLY RECORDED IN THE SURVEY AREA AND WITHIN THE WIDER SURROUNDS

Conservation Significant Species	Conservation Status	Distribution and Ecology	Habitat Relevance	Likelihood
Common Greenshank	Mi	This Migratory bird breeds from Scotland to Siberia and migrates to Australian waters in September to April (Pizzey and Knight 2007). It is commonly found around Perth and Mandurah. This species prefers estuaries, inland lakes and open swamps (Simpson and Day 2004).	The inland lake of the survey area is a suitable habitat for the Common Greenshank. As such it is likely to inhabit this area on its migratory route.	Likely
Wood Sandpiper	Mi	This Migratory bird breeds from Eurasia to Siberia and migrates to Australian waters in September (Pizzey and Knight 2007). It is moderately common to uncommon around Perth and Mandurah. This species is mainly found in freshwater habitats, sometimes brackish (Simpson and Day 2004).	The inland lake of the survey area is a suitable habitat for the Wood Sandpiper. As such it may inhabit this area on its migratory route.	Possible
Terek Sandpiper	Mi	This Migratory bird breeds from Finland to Siberia and migrates to Australian waters in August to April (Pizzey and Knight 2007). It is moderately common to uncommon around Perth and Mandurah. This species prefers mudflats and beaches for habitat and is rarely found inland (Simpson and Day 2004).	The sandy beaches of the survey area a suitable habitat for the Terek Sandpiper. As such it may possibly inhabit this area on its migratory route.	Possible
Common Sandpiper	Mi	This Migratory bird breeds from the British isles to Siberia and Japan. It migrates to Australian waters in August to May (Pizzey and Knight 2007). It is moderately common to uncommon around Perth and Mandurah. This species requires marine waters for habitat such as banks, rocks, and sandy beaches (Simpson and Day 2004).	The rocks and sandy beaches of the survey area are the preferred habitat for the Common Sandpiper. It was recorded in the survey area during an opportunistic search.	Recorded
Grey-tailed Tattler	Mi	This Migratory bird breeds in Siberia and migrates to Australian waters in September to April (Pizzey and Knight 2007). It is a common species around Perth and Mandurah. This species requires marine waters for habitat such as estuaries, mangroves, rocky coasts and reefs (Simpson and Day 2004).	The survey area only has small areas of rocky coast suitable for the Grey-tailed Tattler. As such it may inhabit this area on its migratory route.	Possible
Ruddy Turnstone	Mi	This Migratory bird breeds in the Arctic and migrates to Australian waters in August to April (Pizzey and Knight 2007). It is moderately common around Perth and Mandurah. This species requires marine waters for habitat preferably rocky shores with seaweed (Simpson and Day 2004).	The survey area only has small areas of rocky coast with seaweed, suitable for the Ruddy Turnstone. As such it may inhabit this area on its migratory route.	Possible

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CONSERVATION SIGNIFICANT FAUNA SPECIES PREVIOUSLY RECORDED IN THE SURVEY AREA AND WITHIN THE WIDER SURROUNDS

Conservation Significant Species	Conservation Status	Distribution and Ecology	Habitat Relevance	Likelihood
Red Knot	Mi	This Migratory bird breeds in the Arctic and migrates to Australian waters in August to April (Pizzey and Knight 2007). It is common around Perth and Mandurah. This species requires marine waters for habitat such as tidal sands and mudflats, rarely inland (Simpson and Day 2004).	The tidal sands of the survey area are a suitable habitat for the Red Knot. As such it is likely to inhabit this area on its migratory route.	Likely
Great Knot	Mi	This Migratory bird breeds in Siberia and migrates to Australian waters in September to March (Pizzey and Knight 2007). It is moderately common to uncommon around Perth and Mandurah. This species requires marine waters for habitat such as tidal sands and mudflats, rarely inland (Simpson and Day 2004).	The tidal sands of the survey area are a suitable habitat for the Great Knot. As such it may inhabit this area on its migratory route.	Possible
Sanderling	Mi	This Migratory bird breeds in the Arctic and migrates to Australian waters in September to May (Pizzey and Knight 2007). It is moderately common around Perth and Mandurah. This species requires marine waters for habitat for example sandy coastal beaches, rarely inland (Simpson and Day 2004).	The sandy coastal beaches of the survey area are suitable habitats for the Sanderling. As such it may inhabit this area on its migratory route.	Possible
Red-necked Stint	Mi	This Migratory bird breeds in Siberia and Alaska and migrates to Australian waters in August to April (Pizzey and Knight 2007). It is abundant to common around Perth and Mandurah. This species requires marine waters for habitat such as coastal and inland shores (Simpson and Day 2004).	The marine waters of the survey area are suitable habitats for the Red-necked Stint. As such it may inhabit this area on its migratory route.	Possible
Little Stint	Mi	This Migratory bird breeds in Arctic Eurasia and migrates to Australian waters in September to March (Pizzey and Knight 2007). It is uncommon around Perth and Mandurah. This species requires marine waters for habitat such as coastal and inland shores (Simpson and Day 2004).	Although the survey area has suitable habitat for the Little Stint the fact that it is locally uncommon makes it unlikely to occur during its migration.	Unlikely
Long-toed Stint	Mi	This Migratory bird breeds in Siberia to the North Pacific and migrates to Australian waters in August to April (Pizzey and Knight 2007). It is uncommon around Perth and Mandurah. This species prefers coastal and inland swamps for habitat (Simpson and Day 2004).	The coastal swamp in the survey area is suitable habitat for the Long-toed Stint. As such it may inhabit this area on its migratory route.	Possible

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CONSERVATION SIGNIFICANT FAUNA SPECIES PREVIOUSLY RECORDED IN THE SURVEY AREA AND WITHIN THE WIDER SURROUNDS

Conservation Significant Species	Conservation Status	Distribution and Ecology	Habitat Relevance	Likelihood
Sharp-tailed Sandpiper	Mi	This Migratory bird breeds in Siberia and migrates to Australian waters in August to April (Pizzey and Knight 2007). It is common around Perth and Mandurah. This species is found widespread in coastal and interior wetlands (Simpson and Day 2004).	The coastal wetlands of the survey area is a suitable habitats for the Sharp-tailed Sandpiper. As such it may inhabit this area on its migratory route.	Possible
Curlew Sandpiper	Mi	This Migratory bird breeds in Siberia and migrates to Australian waters in August to April (Pizzey and Knight 2007). It is abundant to common around Perth and Mandurah. This species is found in coastal and inland mudflats, sometimes saltworks (Simpson and Day 2004).	The coastal wetlands of the survey area are suitable habitats for the Curlew Sandpiper. As such it may inhabit this area on its migratory route.	Possible
Broad-billed Sandpiper	Mi	This Migratory bird breeds in Arctic Eurasia and migrates to Australian waters in September to April (Pizzey and Knight 2007). It is moderately common to uncommon around Perth and Mandurah. This species requires coastal mudflats for habitat, sometimes inland (Simpson and Day 2004).	Although the survey area has some suitable habitat for the Broad-billed Sandpiper the fact that it is locally uncommon makes it unlikely to occur during its migration.	Unlikely
Ruff	Mi	This Migratory bird breeds in France to Siberia and migrates to Australian waters in September to April (Pizzey and Knight 2007). It is uncommon around Perth and Mandurah. This species is found on inland wetlands rarely coastal (Simpson and Day 2004).	The wetland of the survey area is a suitable habitat for the Ruff. As such it may inhabit this area on its migratory route.	Possible
Red-necked Phalarope	Mi	This Migratory bird breeds in the Arctic and migrates to Australian waters in August to April (Pizzey and Knight 2007). It is rare to uncommon around Perth and Mandurah. This species is found in coastal areas such as bays, as well as lakes and swamps (Simpson and Day 2004).	Although the survey area has suitable habitat for the Red-necked Phalarope the fact that it is locally rare to uncommon makes it unlikely to be seen during its migration.	Unlikely
Bush Stone-curlew	P4	The Bush Stone-curlew inhabits dry open woodlands with groundcover of small sparse shrubs, grass or litter of twigs. It tends to avoids dense forest, closed-canopy habitats (Morcombe 2000). The species generally occurs near a watercourse or swamp (Geering, Agnew and Harding 2007). Bush Stone-curlews are locally rare because of predation by foxes, the main concern for their regional decline (Johnstone and Storr 1998).	The Bush Stone-curlew has been locally extinct through-out the metropolitan area for some time. It is unlikely that the Bush Stone-curlew will occur in the survey area as the remaining populations are found further inland.	Unlikely

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CONSERVATION SIGNIFICANT FAUNA SPECIES PREVIOUSLY RECORDED IN THE SURVEY AREA AND WITHIN THE WIDER SURROUNDS

Conservation Significant Species	Conservation Status	Distribution and Ecology	Habitat Relevance	Likelihood
Grey Plover	Mi	This Migratory bird breeds in the Arctic and migrates to Australian waters in August to April (Pizzey and Knight 2007). It is moderately common around Perth and Mandurah. This species requires marine waters for habitat such as beaches, mudflats and among rocky areas; sometimes inland (Simpson and Day 2004).	The beaches and rocky areas of the survey area are suitable habitats for the Grey Plover. As such it may inhabit this area on its migratory route.	Possible
Pacific Golden Plover	Mi	This Migratory bird breeds in Siberia and Alaska and migrates to Australian waters in August to April (Pizzey and Knight 2007). It is moderately common around Perth and Mandurah. This species requires marine waters for habitat such as beaches, mudflats and among rocky areas; sometimes inland (Simpson and Day 2004).	The beaches and rocky areas of the survey area are suitable habitats for the Pacific Golden Plover. As such it may inhabit this area on its migratory route.	Possible
Little Ringed Plover	Mi	This Migratory bird breeds across Eurasia form Spain to Japan and migrates to Australian waters in September to March (Pizzey and Knight 2007). It is rare to uncommon around Perth and Mandurah. This species requires marine waters for habitat such as shores and marshes (Simpson and Day 2004).	Although the survey area has suitable habitat for the Little Ringed Plover the fact that it is locally rare to uncommon makes it unlikely to be seen during its migration.	Unlikely
Lesser Sand Plover	Mi	This Migratory bird breeds in Siberia and migrates to Australian waters in August to May (Pizzey and Knight 2007). It is moderately common around Perth and Mandurah. This species requires coastal marine waters for habitat, rarely inland (Simpson and Day 2004).	The coastal waters of the survey area are suitable habitat for the Lesser Sand Plover. As such it may inhabit this area on its migratory route.	Possible
Greater Sand Plover	Mi	This Migratory bird breeds from Turkey to Siberia and migrates to Australian waters in August to May (Pizzey and Knight 2007). It is uncommon to moderately common around Perth and Mandurah. This species requires coastal marine waters for habitat, rarely inland (Simpson and Day 2004).	The coastal waters of the survey area are suitable habitat for the Greater Sand Plover. As such it may inhabit this area on its migratory route.	Possible

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CONSERVATION SIGNIFICANT FAUNA SPECIES PREVIOUSLY RECORDED IN THE SURVEY AREA AND WITHIN THE WIDER SURROUNDS

Conservation Significant Species	Conservation Status	Distribution and Ecology	Habitat Relevance	Likelihood
Hooded Plover	P4	The Hooded Plover is an Australian endemic shorebird that inhabits sandy beaches, coastal and inland lakes in south-west Western Australia (Simpson and Day 2004; Geering, Agnew and Harding 2007). It occurs in Western Australia from around Geraldton, to Lake Moore, Lake Cowan and Esperance, and along the coast to Eyre (Johntone and Storr 1998). The Hooded Plover is a uncommon to rare resident on southern sea beaches and inlets, a scarce to moderately common breeding visitor (mostly in winter and spring) to inland saltlakes, and a scarce to common non-breeding visitor (mostly in summer and autumn) to beaches, estuaries and coastal saltlakes (Johnstone and Storr 1998). This species is thought to be locally extinct within the Perth metropolitan area.	Although the survey area has suitable habitat for the Hooded Plover the fact that it is locally extinct in the metropolitan area makes it unlikely to occur.	Highly Unlikely
Oriental Pratincole	Mi	This Migratory bird breeds in Pakistan, India and South East Asia and migrates to Australian waters in November to February (Pizzey and Knight 2007). It is locally abundant to uncommon around Perth and Mandurah. This species is found on open plains and bare ground around swamps (Simpson and Day 2004).	The survey area does not have the preferred habitat of the Oriental Pratincole. As such it is unlikely to occur in the area during its migration.	Unlikely
Pomarine Jaeger	Mi	This Migratory bird breeds from Finland to Siberia, Alaska, Canada and Greenland. It migrates to Australian waters in October to May (Pizzey and Knight 2007). The Pomarine Jaeger is usually a summer migrant to the region however some possibly over-winter in Australia. This species is mainly oceanic however can sometimes be found in coastal bays, rarely in large sub-coastal wetlands (Simpson and Day 2004).	The Pomarine Jaeger is an oceanic species spending most of its time out at sea. It occasionally comes into coastal bays and is unlikely to be seen during its migration.	Unlikely
Arctic Jaeger	Mi	This Migratory bird breeds throughout the Arctic and migrates to Australian waters in October to April (Pizzey and Knight 2007). The Arctic Jaeger is a summer migrant to the region. This species is oceanic as well as well as coastal bays, rarely in large sub-coastal wetlands (Simpson and Day 2004).	The Arctic Jaeger is an oceanic species spending most of its time out at sea. It occasionally comes into coastal bays and is unlikely to be seen during its migration.	Unlikely
Arctic Tern	Mi	This Migratory bird breeds across the Northern Hemisphere and may sometimes stay for several seasons (Pizzey and Knight 2007). It is uncommon around Perth and Mandurah. This is oceanic as well as found in coastal regions (Simpson and Day 2004).	Although the survey area has suitable habitat for the Arctic Tern the fact that it is locally uncommon makes it unlikely to be seen during its migration.	Unlikely

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CONSERVATION SIGNIFICANT FAUNA SPECIES PREVIOUSLY RECORDED IN THE SURVEY AREA AND WITHIN THE WIDER SURROUNDS

Conservation Significant Species	Conservation Status	Distribution and Ecology	Habitat Relevance	Likelihood
Bridled Tern	Mi	This Migratory bird breeds off the coast of West, North and East Australia (Pizzey and Knight 2007). It is common around Perth and Mandurah. This species is oceanic as well as found in coastal regions usually on coastal islands (Simpson and Day 2004).	The coastal islands around the survey area are suitable habitat for the Bridled Tern during its migration. It was recorded as part of an opportunistic survey.	Recorded
Common Noddy	Mi	This Migratory bird breeds of the coast of West, North and East Australia (Pizzey and Knight 2007). It is abundant in the north of the state with uncommon records occurring around Perth and Mandurah. This is oceanic in tropical seas as well as found in coastal regions such as islands (Simpson and Day 2004).	Although the survey area has suitable habitat for the Common Noddy the fact that it is locally uncommon makes it unlikely to be seen during its migration.	Unlikely
White-winged Black Tern	Mi	The White-winged Black Tern is a non-breeding migratory Tern that is occurs regularly in northern Western Australia and rarely in southern half of Western Australia (Barrett *et al.* 2003). It inhabits coastal marine habitats (such as estuaries, lagoons and harbours) and near-coastal freshwater wetlands (such as river pools, billabongs and inundated floodplains) (Morcombe 2000).	Although the survey area has suitable habitat for the White-winged Black Tern the fact that it is locally uncommon makes it unlikely to be seen during its migration.	Unlikely
Forest Red-tailed Black-Cockatoo	VU, S1	The Forest Red-tailed Black Cockatoo is distributed through the humid and sub-humid south-west of Western Australia from Gingin through the Darling Ranges to the southwest from approximately Bunbury to Albany (Johnstone and Storr 1998).	Although the site is situated within the range of this species it is unlikely to occur there. The survey area has no Banksia, Marri or Jarrah trees which the Cockatoo forages on and no suitable breeding hollows.	Unlikely
Carnaby's Cockatoo	EN, S1	Carnaby's Cockatoo is endemic to south-west Western Australia, and is distributed from the Murchison River to Esperance and inland to Coorow, Kellerberrin and Lake Cronin (Cale 2003). The species was once common, but the population has declined significantly in the last half century (Johnstone and Storr 1998).	Although the site is situated within the range of this species it has low likelihood of occurring. The survey area has no Banksia, Marri or Jarrah trees which the Cockatoo forages on and no suitable breeding hollows. The only suitable habitat would be Tuart trees as possible roosting sites.	Possible
Baudin's Cockatoo	VU, S1	Baudin's Cockatoo is distributed through the south-western humid and sub-humid zones, from the northern Darling Range and adjacent far east of the Swan Coastal Plain (south of the Swan River), south to Bunbury and across to Albany (Johnstone and Storr 1998). Baudin's Cockatoo rarely occurs near the coast north of Mandurah, and rarely occurs north of the Swan River (Johnstone and Kirkby 2008, Johnstone and Storr 1998).	Although the site is situated within the range of this species it is unlikely to occur there. The survey area has no Banksia, Marri or Jarrah trees which the Cockatoo forages on and no suitable breeding hollows.	Unlikely

APPENDIX H

CONSERVATION SIGNIFICANT FAUNA SPECIES PREVIOUSLY RECORDED IN THE SURVEY AREA AND WITHIN THE WIDER SURROUNDS

Conservation Significant Species	Conservation Status	Distribution and Ecology	Habitat Relevance	Likelihood
Fork-tailed Swift	Mi	The Fork-tailed Swift is a summer migrant (October-April) to Australia, that has not been recorded breeding in Australia (Barrett *et al.* 2003). This species is an aerial species, which forages high above the tree canopy and rarely lower so is independent of terrestrial habitats in Australia (Johnstone and Storr 1998). It usually occurs in flocks of up to 2000 and is often seen accompanying Tree Martins and Masked Woodswallows (Johnstone and Storr 1998).	It is likely that this species forages over the site from time to time, high in the airspace.	Possible
Rainbow Bee-eater	Mi	The Rainbow Bee-eater is a common breeding migrant that occurs in Western Australia in the Kimberley, and Pilbara through to the South-west (Johnstone and Storr 1998). It generally breeds in summer in the greater south-west and occurs as a passage migrant or visitor in the northern part of its range throughout the rest of the year (Johnstone and Storr 1998, Barrett *et al.* 2003). It occurs in lightly wooded, often sandy country, preferring areas near water. The Rainbow Bee-eater feeds on airborne insects, and nests in burrows excavated in sandy ground or banks, often at the margins of roads and tracks (Johnstone and Storr 1998).	The Rainbow Bee-eater was recorded during this survey. The wetland area of Lake Richmond is typical habitat for the Rainbow Bee-eater to forage in.	Recorded
Australian Reed-warbler	Mi	The Australian Reed-warbler is a sedentary and migratory species that inhabits tall dense vegetation such as bulrushes, sedges, rushes, reeds and long grass at the edges of lakes, springs, streams, claypans and dams, as well as sewage ponds and other artificial freshwater wetlands (Johnstone and Storr 1998).	The Australian Reed-warbler was recorded during this survey. The bulrushes and reeds along the edge of Lake Richmond are typical habitat for the Australian Reed-warbler.	Recorded

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CONSERVATION SIGNIFICANT FAUNA SPECIES PREVIOUSLY RECORDED IN THE SURVEY AREA AND WITHIN THE WIDER SURROUNDS

Conservation Significant Species	Conservation Status	Distribution and Ecology	Habitat Relevance	Likelihood
MAMMALS				
Chuditch	VU, S1	The Chuditch (Western Quoll) previously occurred over 70% of Australia, but now only occurs in the south-west of Western Australia. Being a relatively large predator, it occurs at low densities. Adult females inhabit a core area of 55-200 hectares around their den, while the corresponding figure for males is 400 hectares or more (Van Dyck and Strahan 2008). The Chuditch is now only found in sclerophyll forest, woodland and mallee shrubland (Van Dyck and Strahan 2008, Menkhorst and Knight 2001). It is highly mobile, and appears able to utilise bush remnants and corridors. Numbers have decreased because of habitat alteration, removal of suitable den logs and dens, and competition for food and predation by foxes and cats (Van Dyck and Strahan 2008). The Chuditch has been locally extinct through-out the metropolitan area for some time.	The lack of suitable habitat suggests this species should not occur within the survey area. The Chuditch needs large logs as den sites which are not found in this area. The Chuditch has a large home range and there is no connectivity with surrounding bushland sufficient enough to support this species. It is highly unlikely to occur in the survey area as it is presumed locally extinct.	Highly Unlikely
Southern Brush-tailed Phascogale	S1	The Wambenger (Phascogale tapoatafa ssp. [WAM M434]) is an undescribed subspecies of the Brush-tailed Phascogale (Phascogale tapoatafa) that occurs in south-west Western Australia (van Dyck and Strahan 2008, Peter Mawson pers. com. [DEC]). The Wambenger's distribution is believed to have been reduced to approximately 50% of its former range (DEC 2006). It is restricted to the extreme south-west, and its characteristic low population densities make it vulnerable to localised extinction (van Dyck and Strahan 2008). This subspecies has been observed in dry sclerophyll forests and open woodlands containing hollow-bearing trees but a sparse ground cover. Habitat destruction, in particular, the loss of hollow-bearing trees and predation by feral animals, are thought to be the major threats to surviving populations (DEC 2006).	Although a deceased Southern Brush-tailed Phascogale was recorded in Point Peron in 2001 it is highly unlikely to occur in the survey area. The site contains only very small pockets of woodlands and has limited suitable tree hollows.	Highly Unlikely
Southern Brown Bandicoot, Quenda	P5	The Quenda (Southern Brown Bandicoot) occurs in forest, heath or coastal scrub and occurs along the coast of south-western WA from Moore River mouth to approximately Israelite Bay (Menkhorst and Knight 2001). They typically seek daytime refuge from predators in very thick ground-storey vegetation, often associated with swamps or damplands, and forage by night in more open areas, leaving distinctive conical feeding holes in the ground. The Quenda is threatened by clearing and fragmentation of its preferred habitat (van Dyck and Strahan 2008).	This species was recorded by Harewood (2009) in a site adjacent to the survey area. The coastal heath and scrub is suitable habitat and the Quenda is likely to occur.	Likely

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Conservation Significant Species	Conservation Status	Distribution and Ecology	Habitat Relevance	Likelihood
Tammar Wallaby	P5	In south-western Western Australia numbers of the Tammar Wallaby have been reduced through land clearing (van Dyck and Strahan 2008). The Tammar requires dense low vegetation for daytime shelter and open grassy areas for foraging (van Dyck and Strahan 2008). This species inhabits coastal scrub, heath, dry sclerophyll forest and thickets in mallee woodland (van Dyck and Strahan 2008).	The Tammar was once widely distributed across the region but have now retracted to nine mainland sites and coastal islands. One such island is Garden island which is located directly north of the survey area, although dispersal is unlikely.	Unlikely
Western Brush Wallaby	P4	The Western Brush Wallaby occurs in open forest or woodland, particularly where there are grassy understoreys and scrubby thickets present (Menkhorst and Knight 2001). It is found only in south-western Western Australia, where it appears to be in decline, probably as a result of an increase in the numbers of foxes.	Due to unsuitable habitat in the survey area it is unlikely that the Western Brush Wallaby would occur. Only small areas of suitable habitat are present and are disjunct from other bushland so dispersal is unlikely.	Unlikely
Quokka	VU, S1	The Quokka is found in the south-west regions of Western Australia, from south of Perth in Jarrah, Marri and Karri Forest to Two People's Bay (Menkhorst and Knight 2001). It mostly occurs in densely vegetated swamps, tea tree thickets on sandy soils along creek lines and dense heath on slopes (van Dyck and Strahan 2008). Quokka numbers have declined because of predation by foxes and the clearing and burning of swamp habitats.	Although there is suitable habitat in the survey area it is unlikely that the Quokka would occur. The Quokka occurs in only small pockets on the mainland and is considered locally extinct.	Highly Unlikely
Western False Pipistrelle	P4	The Western False Pipistrelle prefers Karri forest, wetter stands of Jarrah and Tuart, and Corymbia woodlands. The Western False Pipistrelle roosts in tree hollows and forages mainly at canopy level (van Dyck and Strahan 2008). The major threat to this species is the loss of feeding grounds and suitable habitat to forestry and clearing for agriculture.	There are small thickets of Tuarts in the survey area but these do not contain the necessary hollows for the Western False Pipistrelle. It is highly unlikely to reside in the survey area.	Highly Unlikely

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CONSERVATION SIGNIFICANT FAUNA SPECIES PREVIOUSLY RECORDED IN THE SURVEY AREA AND WITHIN THE WIDER SURROUNDS

Conservation Significant Species	Conservation Status	Distribution and Ecology	Habitat Relevance	Likelihood
Water Rat	P4	The Water Rat occupies a wide variety of freshwater habitats, from sub-alpine streams and other inland waterways to lakes, drainage lines, swamps and farm dams (van Dyck and Strahan 2008). It favours areas close to water with thick vegetation cover. The species is widespread in south-western and northern WA, and is also found on various offshore islands.	Lake Richmond and its associated drainage line both have suitable habitat for the Water Rat. It is possible that it may reside within the survey area.	Possible

KEY:

Recorded	**Recorded during the field survey or site reconnaissance.**
Likely	**Suitable habitat is present in the survey area and the survey area is in the species' known distribution.**
Possible	**Limited or no suitable habitat is present in survey area but is nearby, the species has good dispersal abilities and is known from the general area.**
Unlikely	**No suitable habitat is present in survey area but is nearby, the species has poor dispersal abilities, but is known from the general area; or suitable habitat is present, however the survey area is outside of the species' known distribution.**
Highly Unlikely	**The species has poor dispersal abilities, no suitable habitat is present, and the species is uncommon; or the species is thought to be locally extinct.**