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# Mooka Siding, Level 1 / Targeted Fauna Survey

## Prepared for FAST JV

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# 1. EXECUTIVE SUMMARY

BHP Billiton Iron Ore (BHPBIO) are expanding operations to increase capacity of their Pilbara operations. One such infrastructure component is the construction of a number of passing tracks and associated infrastructure at Mooka Siding. Biologic Environmental Survey was commissioned by FAST JV on behalf of BHPBIO to conduct a Level 1 Fauna Assessment of the proposed Mooka Siding project. The Level 1 survey comprised a desktop assessment, reconnaissance surveys and targeted surveys. These were undertaken in July and November 2010.

During the July survey 58 vertebrate species were recorded consisting of 14 mammal species, 31 bird species and 13 reptile species. An additional 14 fauna species were recorded during the November 2010 survey bringing the total species list for the Mooka area to 72. This comprised 17 mammal species, 40 birds species and 15 reptile species.

Seven fauna habitats are present, of which three were considered of high conservation value; granite outcrops, rocky ridges and isolated rock outcrops.

Conservation significant fauna recorded during the assessment comprised three species listed under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act, the Northern Quoll, *Dasyurus hallucatus*, Oriental Plover, *Charadrius veredus* and Rainbow Bee-eater, *Merops ornatus*) and three species listed as Priority 4 by the Department of Environment and Conservation (DEC, Bush-stone Curlew, *Burhinus grallarius* Australian Bustard, *Ardeotis australis* and Western Pebble-mound Mouse, *Pseudomys chapmani*).

# 2. INTRODUCTION

## 2.1. Background

BHP Billiton Iron Ore (BHPBIO) is one of the world's leading producers of iron ore with several mining operations in the Pilbara region of north-western Australia, producing over 100 million tonnes of iron ore per annum.

A heavy haulage railway is used to carry iron ore from the inland mining operations to Port Hedland, for shipping overseas. The current mainline, from Port Hedland to Newman, consists of a single track with passing sidings spaced at approximately 15-20 km intervals.

BHPBIO is expanding operations to bring on additional capacity from its Pilbara operation. This expansion involves a series of projects associated with port, rail and mines. Rail expansion, and associated infrastructure construction, is being undertaken in a phased approach at a number of locations. One such infrastructure component is the construction of a number of passing tracks and associated infrastructure at Mooka Siding (herein referred to as the Survey Area).

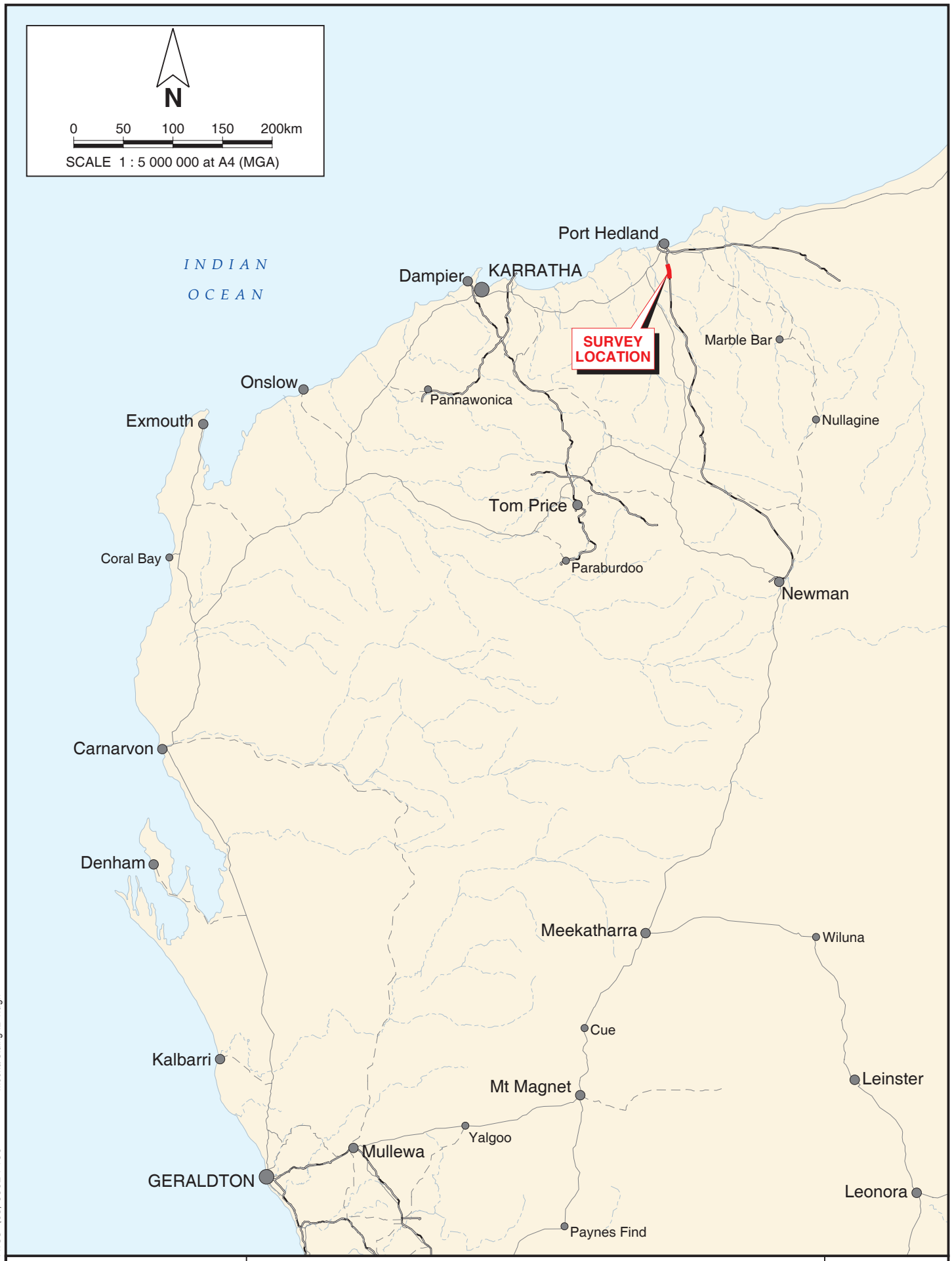
The Mooka Siding Survey Area lies approximately 15km south of Port Hedland in the Pilbara region of Western Australia. The regional location of the project is shown in Figure 2.1 and the Survey Area is shown in Figure 4.1. Biologic Environmental Survey was commissioned by FAST JV to conduct a Level 1 Fauna Assessment of the proposed Mooka Siding Survey Area. The Level 1 survey comprised a desktop review and reconnaissance surveys.

## 2.2. Objectives and Scope

The objective of this fauna assessment was to conduct a survey for the presence of conservation significant fauna and fauna habitats with regard to the proposed works in the Survey Area. In order to achieve this objective the following scope of works was undertaken:

- Conduct a review of background information - a search of all sources for literature, data and map-based information, including a summary of previous fauna survey results, literature search and relevant databases (e.g. Western Australian Museum, Australian Museum, Naturebase and DEC) was undertaken;
- Conduct a targeted opportunistic survey within the Survey Area, for species or habitat likely to support species listed as:
    - Threatened Fauna listed under the Commonwealth Environment Protection and Biodiversity Conservation (EPBC) Act 1999;
    - Scheduled fauna listed under the latest WA Wildlife Conservation (Specially Protected Fauna) Notice 2010;
    - Priority Fauna recognised by DEC; and
    - Short-range Endemic (SRE) invertebrates.

- Undertake selective, low intensity sampling of the fauna and faunal assemblages to further delineate and characterise the fauna and faunal assemblages present within the Survey Area (reconnaissance survey);
- Compile an inventory of vertebrate fauna recorded or expected to occur on the site in the light of fauna habitats present;
- Conduct a comprehensive fauna habitat assessment within the Survey Area, comprising an assessment of the significance of the vegetation as a habitat for fauna and mapping of any significant fauna habitats; and
- Document the characteristics of the fauna assemblage of the site including significance at the international, national, state, regional and local level.

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Fast JV
VERTEBRATE FAUNA SURVEY
MOOKA SIDING

**Figure 2.1**

## REGIONAL LOCATION OF PROJECT

Drawn: M. O'Connell | Date: 7 Dec 2010 | Job: --

PINPOINT CARTOGRAPHICS (08) 9562 7136 Mooka Siding-f2-1.dgn

# 3. BACKGROUND

## 3.1. Site Location

The Survey Area is located approximately 15 km to the south of Port Hedland and extends from railway line chainages[1] 27.5 km to 38.5 km (approximately 10 km, refer to Figure 2.1). The Survey Area extends approximately 400 m west and approximately 1000 m east of the existing rail corridor is approximately 1447 hectares (ha) in size.

## 3.2. Pilbara Bioregion

The Pilbara is a region of high faunal biodiversity with overlapping biogeographic elements from the Kimberley and South-West, as well as contributions from the adjacent desert and Murchison, and a high level of endemism (Kendrick and McKenzie, 2003). McKenzie *et al* (2003) provide a detailed description of special values and features of the region with respect to fauna and environments, including numerous significant species and important wetlands. Special fauna values of the region include: persisting populations of significant species, species-rich ecosystems associated with watercourses and "species-rich, refugial ecosystems associated with gorges, waterfalls and ridge tops".

The Pilbara Bioregion comprises four major components (subregions) including the Hamersley Range, a mountainous area of Proterozoic sedimentary ranges and plateaux; the Fortescue Plains, consisting of alluvial and river frontages; the Chichester Range, comprising Archaean granite and basalt plains; and Roebourne Plains consisting of Quaternary alluvial plains (Australian Natural Resource Atlas, 2008). The Pilbara Bioregion falls within the Bioregion Group 2 classification - "native vegetation that is largely contiguous but is used for commercial grazing." (EPA, 2004).

The Mooka Siding Survey Area lies within the Roebourne Plains subregion. The Roebourne Plains subregion comprises:

"coastal plains with a grass savannah of mixed bunch and hummock grasses, and dwarf shrub steppe of *Acacia stellaticeps* or *A. pyrifolia* and *A. inaequilatera*. Uplands are dominated by *Triodia* hummock grasslands. Ephemeral drainage lines support *Eucalyptus victrix* or *Corymbia hamersleyana* woodlands. Samphire, sporobolus and mangal occur on marine alluvial flats and river deltas. Resistant linear ranges of basalts occur across the coastal plains, with minor exposures of granite" (Kendrick and McKenzie, 2003).

The dominant land use in this region is grazing, with areas of crown reserves, aboriginal lands and reserves, exploration and mining. Only 6.56 % of the sub-region is vested within

[1] Distances on the railway are designated via chainages, as kilometre distances from the zero point at Port Hedland.

conservation reserves (Kendrick and McKenzie, 2003). The subregional area is 9,044,560 ha.

Kendrick and McKenzie (2003) identified several terrestrial fauna species of conservation significance occurring in the Roebourne Plains Subregion. These include:

- Bilby (*Macrotis lagotis*)
- Pilbara Olive Python (*Liasis olivaceus barroni*)
- Saltwater Crocodile (*Crocodylus porosus*)
- Peregrine Falcon (*Falco peregrinus*)
- Flock Bronzewing (*Phaps histrionica*)
- Australian Bustard (*Ardeotis australis*)
- Star Finch (*Neochmia ruficauda subclarescens*)
- Pilbara Leaf-nosed Bat (*Rhinonicteris aurantius*)

### 3.3. Climate

The Pilbara region has a semi-desert to tropical climate with highly variable, mostly summer rainfall. The average rainfall over the broader Pilbara area ranges from about 200 – 350 mm, although rainfall may vary widely from the average from year to year (Australian Natural Resource Atlas, 2008). The Pilbara climate is heavily influenced by tropical cyclones that develop over the Indian Ocean in the north of Australia, cross the northwest coastline, and bring heavy rainfall to inland regions including Newman. Average maximum summer temperatures are typically in the range of 35°C to 40°C and winter maximum temperatures are generally between 22°C and 30°C.

### 3.4. Existing Land Use

Pastoralism and mining are the only major industries in the Pilbara region. Pastoral leases in the area are considered of poor quality in that large areas are required to sustain viable stocks. Recently many pastoral leases have been purchased by mining companies to ensure ease of access to their mining or exploration leases. Mining in the region is of national significance due to the obvious benefits it brings to the country's economy.

### 3.5. Land Systems

Van Vreeswyk *et al* (2004) classified and mapped the Land Systems of the Pilbara including the Port Hedland area. Land types and Land Systems are classified according to similarities in landform, soil, vegetation, geology and geomorphology. Land Systems provide an indication of the fauna habitats present at a site. Two Land Systems are present within the Survey Area and are summarised in Table 3.1:

- Macroy Land System (MAC): Stony Plains and occasional tor fields based on granite supporting hard and soft spinifex grasslands.
- Uaroo Land System (UAR): Broad Sandy Plains supporting shrubby hard and soft spinifex grasslands.

**Table 3.1 Land Systems present within the Survey Area.**

| Landform | Soil | Vegetation |
|---|---|---|
| **MACROY LAND SYSTEM** | | |
| Low Hills and Ridges (5%) | Stony soils and shallow loams | Patchy Hummock grasses *Triodia pungens* (soft spinifex) and *Triodia.* spp. (hard spinifex) with isolated or very scattered shrubs. |
| Stony Plains and Interfluves (70%) | Red Shallow sands | Hummock Grasslands of *Triodia wiseana, T. lanigera, T. pungens*, isolated to scattered *Acacia inaequilatera* and other *Acacia* shrubs. |
| Sandy Plains (10%) | Red Deep Sands | Hummock Grasslands of *Triodia wiseana, T. lanigera* with scattered shrubs *Acacia inaequilatera*, *A. stellaticeps*. |
| Calcrete Plains (3%) | Calcareous Shallow loams | Hummock Grasslands of *Triodia wiseana, T. plurinervata* with isolated *Acacia* shrubs or *Corymbia hamersleyana*. |
| Drainage Floors and Channels (12%) | Red Sandy Earths | Hummock Grasslands of *Triodia* spp, isolated to scattered *Acacia* shrubs and occasional Eucalypt trees. Channels have fringing grassy woodlands of *Eucalyptus camaldulensis* and *Acacia coriacea*. |
| **UAROO LAND SYSTEM** | | |
| Low Hills (<1%) | Stony Soils | Hummock grasslands of *Triodia wiseana, Triodia.* spp. with isolated scattered shrubs. |
| Low Rises (3%) | Red Shallow sands | Hummock grasslands of *Triodia pungens, T. epactia* with very scattered *Acacia* shrubs. |
| Pebbly Plains (8%) | Red shallow sandy soils | Hummock grasslands of *Triodia lanigera, T. plurinervata, T. wiseana* with isolated shrubs such as *Acacia inaequilatera. A. acistrocarpa*. |
| Sandy / Loamy Plains (82%) | Red Sandy Earths | Hummock grasslands or shrubby hummock grasslands of *Triodia pungens, T. epactia, T. schinzii, T. lanigera, T.* spp. with scattered shrubs such as *Acacia stellaticeps, A. inaequilatera, A. tumida*, and occasional Eucalypt trees. |
| Calcrete Plains (1%) | Calcareous shallow loams | Hummock grasslands of *Triodia wiseana, T. lanigera, T. pungens* with isolated scattered *Acacia* shrubs. |
| Tracts receiving sheet flow (6%) | Red deep sandy soils | Hummock grasslands of *Triodia pungens, T.* spp. with isolated to scattered *Acacia* shrubs. Also scattered tall shrublands / woodlands with *Acacia* and Eucalypt species with hummock and tussock grass understoreys. |

## 3.6. Assessment of Conservation Significance

The conservation significance of fauna is classified on a Commonwealth, State and Local level on the basis of various Acts and Agreements (EPA Guidance Statement No. 56, EPA 2004). Table 3.2 outlines the Acts and conservation codes applicable to the Survey Area.

**Table 3.2 Acts and levels of conservation significance (see Appendix 2 for definitions of status codes).**

| Level | Act | Status Codes |
|---|---|---|
| **Conservation significance** | | |
| International | ***International Union for Conservation of Nature (IUCN).*** The IUCN Red List is a comprehensive inventory of the global conservation status of plant and animal species. Animals listed as 'Least Concern' are not considered conservation significant. | Extinct<br>Extinct in the Wild<br>Critically Endangered<br>Endangered<br>Vulnerable<br>Near Threatened<br>Data Deficient |
| International | ***Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).*** Species listed under the following Japan-Australia Migratory Bird Agreement (JAMBA), China-Australia Migratory Bird Agreement (CAMBA) and Convention on the Conservation of Migratory Species of Wild animals (Bonn Convention) | Migratory |
| Federal | ***Environment Protection and Biodiversity Conservation Act 1999***. DEWHA lists Threatened fauna, which are determined by the Threatened Species Scientific Committee according to criteria set out in the EPBC Act. The EPBC Act lists fauna that are considered to be of conservation significance under one of six categories. | Extinct<br>Extinct in the Wild<br>Critically Endangered<br>Endangered<br>Vulnerable<br>Conservation Dependent |
| State | ***WC Act (WC Act)***. At a state level, native fauna species are protected under the WC Act. Specially protected fauna are specified in the *Wildlife Conservation (Specially Protected Fauna) Notice 2010*. | Schedule 1<br>Schedule 2<br>Schedule 3<br>Schedule 4 |
| State | **DEC Priority list**. The DEC produces a list of Priority species and ecological communities (PECs) that have not been assigned statutory protection under the WC Act. This system gives a ranking from Priority 1 to Priority 5. | Priority 1<br>Priority 2<br>Priority 3<br>Priority 4<br>Priority 5 |
| **Local significance** | | |
| Local | Locally significant fauna. Species may be significant for a range of reasons other than those protected by international agreement or treaty, Specially Protected or Priority Fauna. | N/A |

| Level | Act | Status Codes |
|---|---|---|
| | Significant fauna may include short-range endemic species, species that have declining populations or declining distributions, species at the extremes of their range, or isolated outlying populations, or species which may be undescribed. | |

While not listed under specific legislation, conservation significant fauna also includes Short-range Endemic species. Short range endemism refers to those fauna species with highly restricted ranges, which in Western Australia is currently defined as less than 10,000 km2. Most taxa displaying short-range endemism are invertebrates, however in Western Australia can include some species of fish, amphibians and reptiles.

# 4. METHODOLOGY

## 4.1. Desktop Review

A desktop review was undertaken of available published and unpublished reports and databases relevant to the Survey Area. The following databases and reports were accessed to obtain potential species lists for the Survey Area:

- The Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) Protected Matters database (SPRAT, 2010) – to identify species listed under the EPBC Act potentially occurring within the Survey Area;
    - Area Searched: 118°39' 36" E, 20°33' 35" S; Buffer = 50km, accessed July 2010.
- WA Museum's and DEC's NatureMap (DEC, 2010) – to determine vertebrate fauna species lodged in the museum's collection from within or adjacent to the Survey Area and to identify species listed under the *Wildlife Conservation Act 1950*, or those species listed as Priority by the DEC, that have previously been recorded within or adjacent to the Survey Area. This database draws on the same data as the DEC's Threatened Fauna database.
    - Area Searched: 118°39' 36" E, 20°33' 35" S; Buffer = 40km, accessed July 2010.
- Birds Australia's Bird Data Database (Birds Australia, 2010) – To determine birds recorded in the general area as recorded by Birds Australia's volunteers.
    - Area Searched: Bird list for one degree square containing the point 118.65567, -20.55132, accessed July 2010.
- Global Biodiversity Information Facility – encompasses a wide range of databases including all Australian Museums and a number of Australian Biodiversity projects.
    - Area searched: 0.1 degree cell containing the point 118.65567, -20.55132, accessed July 2010.

## 4.2. Field Assessment

BHPBIO commissioned a Level 1 Fauna Assessment of the Mooka Siding area. Two reconnaissance surveys were undertaken to:

1. Verify the accuracy of the background study; and
2. Further delineate and characterise the fauna and faunal assemblages present in the Survey Area (EPA, 2004); and
3. Undertake targeted searches for species identified during the desktop review.

The fauna survey was designed to meet the requirements of the following State and Commonwealth legislation, and was conducted in a manner that was compliant with the Environmental Protection Authority (EPA) requirements for the environmental surveying and reporting of fauna in Western Australia:

- *Environmental Protection Act 1986* (WA) ("EP Act 1986");
- *Wildlife Conservation Act 1950* (WA) ("WC Act 1950");
- *Environment Protection and Biodiversity Conservation Act 1999* (Cth) ("EPBC Act 1999");
- *Environmental Protection of Native Vegetation in Western Australia: Clearing of Native Vegetation with Particular Reference to Agricultural Areas. Position Statement No. 2* (EPA 2000);
- *Terrestrial Biological Surveys as an Element of Biodiversity Protection. Position Statement No. 3* (EPA 2002); and
- *EPA Guidance for the Assessment of Environmental Factors: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia No. 56* (EPA 2004).

The field survey was undertaken by Dr Stewart Ford and Mr Jeff Turpin between the 20th and 26th of July and the 1st and 5th November 2010. Sampling for fauna was undertaken using a range of techniques including systematic bird census, targeted searching for conservation significant fauna, microhabitat sampling for reptiles and short-range endemics, acoustic bat surveys and the use of motion-sensitive cameras. Habitat assessments were conducted to determine the likelihood of the conservation significant fauna occurring within the Survey Area. All major fauna habitats within the Survey Area were sampled using the above techniques.

### 4.2.1. Habitat Assessments

Habitats in the Survey Area were assessed using methodology and terminology adapted from the *Australian Soil and Land Survey Field Handbook* (CSIRO, 2009) and modified to suit the survey requirements. The characteristics recorded during the habitat assessments were:

- Site information, photo and location;

- Landform: slope, relative inclination of slope, morphological type, landform type;
- Vegetation: disturbance, condition, leaf litter %, twig litter %, wood litter (per 2500m$^2$), dead stags (per 2500m$^2$), hollow bearing trees (per 2500m$^2$), broad floristic formation, tree structure (tall, mid and low), shrub structure (tall, mid and low), grass structure (tall, mid and low), dominant trees, shrubs, grasses and herbs;
- Land surface: microrelief, sheet erosion, rill erosion, gully erosion, gully depth, abundance and size of coarse fragments, rock outcropping, waterbodies, comments on nests, burrows, roosts and diggings;
- Soil: texture, colour, water status, strength; and
- Substrate: substrate form, rock type, comments on geology.

Fauna habitats were assessed for their conservation significance and the likelihood that they support conservation significant fauna. All major fauna habitats present within the Survey Area were sampled and scored (High, Medium or Low) according to the criteria shown in Table 4.1 below.

**Table 4.1 Fauna habitat significance assessment criteria**

| Score | Criteria |
|---|---|
| High | 1) Habitat supports EPBC listed Critically Endangered, Endangered or Vulnerable fauna.<br>OR<br>2) Habitat for species listed as above is present in the Survey Area, and there are records of that species within 50km. If limited surveys have been undertaken in the vicinity of the Survey Area then a precautionary approach will be used and the species will be considered likely to be present.<br>OR<br>3) Uncommon habitat is critical habitat for a population of DEC listed Priority fauna. For example, if habitat is limited in the region and the habitat in the Survey Area forms a significant portion of the known habitat for a Priority species, it would be scored as High significance.<br>OR<br>4) Habitat supports (or is considered likely to support) fauna short-range endemic species. |
| Medium | 1) Habitat supports DEC listed Priority fauna that are largely restricted to that habitat type within the Survey Area.<br>OR<br>2) Habitat supports EPBC listed Migratory fauna.<br>OR<br>3) Habitat supports a particularly diverse and uncommon faunal assemblage. Habitat that occurs throughout region, and does not occur in small or isolated areas, is excluded. |
| Low | Habitat is widespread, common, and does not solely support any conservation significant fauna. |

### 4.2.2. Vertebrate Fauna

Survey sites were established in each of the fauna habitats present within the Survey Area. At each site, a 20 minute bird census was undertaken (standardised 20 minutes, 2 ha area search) as well as 20 minutes of targeted searching for conservation significant species, reptiles and small mammals. All fauna species were recorded.

**Birds**

Birds were recorded on a presence / absence basis and were targeted during early morning surveys. Several 20 minute / 2 ha area searches were undertaken at each site. Presence was determined by call identification, visual identification and/or tracks and traces.

**Reptiles**

Reptile surveys were undertaken at each site and comprised looking under bark, under rocks, in wood hollows and in rock cracks for individuals or scats. Large Eucalypt trees with hollows and large fallen timber were targeted for skinks. No habitat was disturbed during the survey.

**Camera Traps**

Two camera traps (Bushnell Trophy Cameras) set to video with a trigger speed of approximately 1 second were established at twelve locations within the Survey Area. These are listed in Table 4.2.

**Acoustic Bat – ANABAT Surveys**

Acoustic surveys for bats were conducted at four locations over four consecutive nights during the survey. Locations are detailed in Table 4.2. Bat echolocation calls were recorded using an Anabat SD-1 device. Calls were then analyzed using ANALOOK and ANALYSE software to determine species identification. ANABAT recordings were verified by Mr Bob Bullen (Bat Call WA Pty Ltd).

**Opportunistic Records**

Opportunistic records of all vertebrate fauna species were made throughout the Survey Area. Secondary evidence was also used to determine the presence of certain species, e.g. burrows and scats.

**Taxonomy and Nomenclature**

The taxonomy and nomenclature used in this report follows that used by the WA Museum in the WA Museum FaunaList (Western Australian Museum, 2009).

### 4.2.3. Conservation Significant Fauna

Targeted surveys were undertaken for conservation significant species identified in the desktop assessment. The following species were specifically targeted; Brush-tailed Mulgara (*Dasycercus blythi*, scats and burrows), Crest-tailed Mulgara (*Dasycercus cristicauda*, scats and burrows), Northern Quoll (*Dasyurus hallucatus*, scats), Pilbara Olive Python (*Liasis olivaceus barroni*, tracks, shed skin), Western Pebble-mound Mouse (*Pseudomys chapmani*, Pebble-Mounds), Australian Bustard (*Ardeotis australis*, tracks), Bush Stone-curlew (*Burhinus grallarius*, tracks), Ghost Bat (*Macroderma gigas*, scats), Greater Bilby (*Macrotis lagotis*, tracks, burrows) and many other species (scats, tracks, shelters etc.).

Fauna Transects:

Fauna transects were traversed (on foot) within habitat deemed suitable to support species of conservation. Along each fauna transect, signs of conservation significant species were targeted, including tracks, burrows, foraging sings and scats.

Fauna transects were traversed by two personnel walking in parallel lines spaced approximately 30m apart. Opportunistic fauna records were also taken along each transect as well as habitat descriptions and assessments.

Habitat Suitability:

At each opportunistic fauna site an assessment of habitat was undertaken. The likelihood of each fauna site or habitat being able to support conservation significant fauna was also assessed. The locations of opportunistic survey sites are listed in Table 4.2 and depicted in Figure 4.1.

Short-range Endemic Invertebrates

Targeted searching for Short-range Endemic species was undertaken during all surveying and also at four specific sites considered likely to support such species. At each site microhabitats that potentially support SRE fauna were sampled. This included searching through leaf litter, under granite rock slabs and within granite depressions supporting water or moist soil. Each site was surveyed for 30 minutes by two personnel.

**Table 4.2 Location of Fauna Survey Sites (Zone 50K, GDA94).**

| Site | Easting | Northing | Survey Technique - Survey duration in minutes (m) or nights (n) | | | | | Habitat / Comments |
|---|---|---|---|---|---|---|---|---|
| | | | Birds Census | Microhabitat Search | ANABAT | Motion Camera | SRE Search | |
| ANABAT 1 | 672664 | 7729722 | | | 1 n | | | Calcrete Rise |
| ANABAT 2 | 672129 | 7729073 | | | 1 n | | | Quarry 1 |
| ANABAT 3 | 673539 | 7720208 | | | 1 n | | | Bore Creek |
| ANABAT 4 | 672679 | 7727411 | | | 1 n | | | Spinifex Plain |
| Motion Camera 1 | 672709 | 7729701 | | | | 2 n | | Calcrete Rise |
| Motion Camera 2 | 672200 | 7729322 | | | | 1 n | | Spinifex Plain |
| Motion Camera 3 | 673455 | 7721152 | | | | 1 n | | Rock Outcrop |
| Motion Camera 4 | 673927 | 7721987 | | | | 1 n | | Rock Outcrop |
| Motion Camera 5 | 672042 | 7730669 | | | | 1 n | | Spinifex Plain |

| Site | Easting | Northing | Survey Technique - Survey duration in minutes (m) or nights (n) | | | | | Habitat / Comments |
|---|---|---|---|---|---|---|---|---|
| | | | Birds Census | Microhabitat Search | ANABAT | Motion Camera | SRE Search | |
| Motion Camera 6 | 673444 | 7720202 | | | | 1 n | | Bore Creek Spinifex |
| Motion Camera 7 | 672681 | 7727412 | | | | 1 n | | Spinifex Plain |
| Opportunistic Site 1 | 672869 | 7729127 | 20 m | 20 m | | | | Granite Outcrop |
| Opportunistic Site 2 | 673032 | 7728261 | 20 m | 20 m | | | | Granite Outcrop |
| Opportunistic Site 3 | 673864 | 7722041 | 20 m | 20 m | | | | Egernia Rock Outcrop |
| Opportunistic Site 4 | 674823 | 7720494 | 20 m | 20 m | | | | Quartz Ridge |
| Opportunistic Site 5 | 673539 | 7720208 | 20 m | 20 m | | | | Bore Creek |
| Opportunistic Site 6 | 672664 | 7729722 | 20 m | 20 m | | | | Calcrete Rise |
| Opportunistic Site 7 | 672129 | 7729073 | 20 m | 20 m | | | | Quarry 1 |
| Opportunistic Site 8 | 673039 | 7722424 | 20 m | 20 m | | | | Stony Plain |

| Site | Easting | Northing | Survey Technique - Survey duration in minutes (m) or nights (n) | | | | | Habitat / Comments |
|---|---|---|---|---|---|---|---|---|
| | | | Birds Census | Microhabitat Search | ANABAT | Motion Camera | SRE Search | |
| Opportunistic Site 9 | 672200 | 7729322 | 20 m | 20 m | | | | Spinifex Plain |
| Opportunistic Site 10 | 672008 | 7730619 | 20 m | 20 m | | | | Spinifex Plain |
| Opportunistic Site 11 | 673749 | 7723924 | 20 m | 20 m | | | | Rocky Outcrop |
| Opportunistic Site 12 | 674089 | 7721580 | 20 m | 20 m | | | | Stony Plain |
| SRE Site 1 | 672869 | 7729127 | | | | | 30 m | Isolated Rock Outcrop |
| SRE Site 2 | 673032 | 7728261 | | | | | 30 m | Isolated Rock Outcrop |
| SRE Site 3 | 673864 | 7722041 | | | | | 30 m | Isolated Rock Outcrop |

N

0 200 400 600 800 1000m

SCALE 1 : 30 000 at A3 (MGA)

**Legend**

- Site Boundary
- Anabat Site (July 2010)
- Anabat Site (November 2010)
- Camera Trap Site (July 2010)
- Camera Trap Site (Novemeber 2010)
- Opportunistic Site (July 2010)
- Opportunistic Site (November 2010)
- Northern Quoll Survey Site (July 2010)
- SRE Site (July 2010)
- SRE Site (November 2010)

672 500mE

675 000mE

7 727 500mN

7 725 000mN

7 722 500mN

7 720 000mN

biologic

Fast JV
VERTEBRATE FAUNA SURVEY
MOOKA SIDING

**LOCATION OF FAUNA SURVEY SITES**

**Figure 4.1**

Drawn: J. Turpin | Date: 7 Dec 2010 | Job: --

### 4.3. Climatic Conditions

Weather observations are recorded daily at the Port Hedland Airport (station 004032, Bureau of Meterology, 2010). During the first survey period (July 2010) conditions were cool and dry. Daily maxima ranged from 26.3°C to 30.8°C (mean of 28.2°C) and daily minima ranged from 13.8°C to 19.0°C (mean 15.9°C) (BOM, 2010). No rainfall was recorded during the July survey period however 51.4 mm of rainfall was recorded in the 15 days prior to the survey (BOM, 2010). During the second survey period (November 2010) conditions were hot and dry. Daily maxima ranged from 34.2°C to 36.8°C (mean of 35.9°C) and daily minima ranged from 20.1°C to 22.6°C (mean 21.4°C) (BOM, 2010). No rainfall was recorded during the survey period (BOM, 2010). A total of 11.6 mm of rainfall was recorded at Port Hedland during the three months prior to the November survey (BOM, 2010).

### 4.4. Limitations

The *EPA Guidance for the Assessment of Environmental Factors: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia No. 56* (EPA 2004) outlines limitations to fauna surveys. They include:

- personnel experience;
- scope (what faunal groups were sampled and whether any constraints affect this);
- proportion of fauna identified;
- sources of information (recent or historic);
- proportion of the task achieved;
- disturbances (e.g. fire or flood);
- intensity of survey;
- completeness of survey;
- resources (e.g. degree of expertise available);
- remoteness or access issues; and
- availability of contextual information.

**Personnel Experience**

The field team has extensive fauna experience in the Pilbara, including prior surveys in the Survey Area.

**Scope**

The survey conducted was a Level 1 reconnaissance survey. Significant species were assessed for their likelihood of occurrence. All habitats in the Survey Area were sampled and assessed for the potential presence of significant species.

All fauna encountered were recorded, however, some small and cryptic fauna (particularly mammals, reptiles and amphibians) are only recorded via trapping and thus were unlikely to be recorded during this survey.

**Proportion of Fauna Identified**

All vertebrate fauna detected was identified to species level. ANABAT recordings were verified by Mr Bob Bullen.

**Sources of Information**

Several fauna surveys have been previously conducted in, and adjacent to, the Survey Area. Database searches returned a substantial number of records suggesting that a number of surveys had taken place within 40 km of the Survey Area.

**Proportion of the Task Achieved**

All habitats in the Survey Area were sampled and assessed for potential presence of significant species.

**Disturbances**

No disturbances occurred during surveying that affected the ability to carry out the methodology. Weather was favourable for a Level 1 survey.

**Intensity / Completeness of Survey and Access to the Area**

The intensity of the Level 1 survey was adequate. All habitats present were assessed for the presence of significant species.

**Availability of Contextual Information**

Biologic conducted a survey of the Mooka Siding area in July 2010. Results from the July survey were used to supplement data collected during the November 2010 survey. The DEC and other fauna consultants have undertaken surveys in the area and these provided comparable data (see Appendix 1, ecologia, 2008a, 2008b).

# 5. RESULTS

## 5.1. Desktop Review

A total of 280 fauna species, comprising eight amphibian, 94 reptile, 133 bird and 45 mammal species (see Appendix 1, Table 5.1), may potentially occur within the Survey Area, based on known species distributions, previous records, and available habitat within the Survey Area. It is unlikely that all of these species would be present within the Survey Area at any one time, as fauna composition is dynamic, and in the Pilbara species distributions are primarily driven by available resources (often driven by the weather, season or fire history). In addition, there are species that are seasonal migrants, which are only present within particular areas at certain times of the year.

Twenty eight species of conservation significance were identified in the desktop review as having been previously recorded within or adjacent to the Survey Area (DEC Threatened Fauna Database, DEC's NatureMap, review of literature) or may potentially occur based on bioclimatic modelling (EPBC Act Species Profile and Threats Database, SPRAT database). Of these, 13 occur, or are likely to occur in the Survey Area (see section 5.4).

**Table 5.1 Fauna Species recorded within and adjacent to the Survey Area. Introduced Species are denoted with an asterisk (*).**

| Source | Mammals | Birds | Reptiles | Amphibians | Total |
|---|---|---|---|---|---|
| Birds Australia | 0 | 129 | 0 | 0 | 129 |
| DEC NatureMap | 25 (3*) | 33 | 64 | 8 | 133 |
| Ecologia Survey – Quarry 1 | 1 | 10 | 9 | 0 | 20 |
| Ecologia Survey – Bing to Walla | 1 | 43 | 10 | 1 | 55 |
| Preliminary Mooka Siding (July 2010) | 12 (4*) | 35 | 10 | 0 | 61 |
| **Mooka Surveys (2010 Surveys combined)** | **13 (4*)** | **40** | **15** | **0** | **72** |
| TOTAL EXPECTED | 38 (7*) | 133 | 94 | 8 | 280 |

Table 5.1 compares species recorded in the Survey Area with previous surveys and database searches. Two Level 1 Fauna surveys have been conducted in the vicinity of the Survey Area (Ecologia 2008a, Ecologia 2008b) and are listed in Table 5.1.

## 5.2. Field Survey - Fauna Habitats

The Mooka Siding Survey Area lies in an area of extensive sandy and stony plains with occasional rocky outcrops, ridges and drainage lines. The Survey Area lies over two major land systems, the Uaroo Land System (UAR) and Macroy Land System; as discussed in section 3.5.

Seven broad fauna habitat types were identified within the Survey Area:

- Sandy Plains with spinifex hummock grasslands and mixed *Acacia* shrublands;
- Stony Plains with open shrubland of *Acacia inaequilatera* and spinifex hummock grasslands;
- Bore Creek: a minor drainage line supporting scattered *Corymbia* sp and fringing mixed *Acacia* shrubland;
- Granite Outcrops: containing boulder piles, seasonal gnamma holes, moist depressions and fringing *Acacia* thickets;
- Rocky Ridges: a series of linear Quartz ridges extend north to south on the eastern and western margins of the Survey Area;
- Low Lying drainage depressions: supporting spinifex grassland with seasonal small waterholes on sandy clay loam;
- Occasional minor rocky outcrops (including Quartz, Calcrete, Silcrete) occurring within the sandy and stony plains.

Additionally two artificial habitats occur within the Survey Area. Quarry 1 comprises a large pit cut into the side of a granite outcrop which contains steep cliff faces, large boulder piles and some seasonal pools of water. Additionally a series of artificial rock piles occur alongside the rail access track. These artificial habitats provide sheltering and breeding opportunities for many rock inhabiting species and evidence (scats) of the Northern Quoll, Echidna and *Egernia depressa* was found within them.

Table 5.2 displays photographs of each habitat type recorded within the Survey Area. Figure 5.2 shows the location of these habitats. A summary of the details recorded during the habitat assessments is given in Appendix 5.

**Table 5.2: Fauna habitat descriptions**

| Habitat type | Distinguishing characteristics | Photo |
|---|---|---|
| **Sandy Plains with spinifex hummock grasslands and mixed *Acacia* shrublands;** | This habitat covers much of the Survey Area., particularly in the northern parts. Vegetation is dominated by *Triodia* spp. hummock grassland and mixed Acacia shrublands. Vegetation is in varying stages of maturity with large areas comprising regenerating vegetation after recent fire events. A widespread habitat in the region. |  |
| **Stony Plains with open shrubland of *Acacia inaequilatera* and spinifex hummock grasslands;** | Stony plains occur in the south of the Survey Area, adjacent to Bore Creek. Vegetation is dominated by *Triodia* hummock grasslands and scattered *Acacia inaequilatera*. Areas of this habitat are also in early regeneration after recent fires. A widespread habitat in the region. |  |

| Habitat type | Distinguishing characteristics | Photo |
|---|---|---|
| **Bore Creek: a drainage line supporting scattered *Corymbia* sp and fringing mixed *Acacia* shrubland;** | One drainage line occurs within the Survey Area (Bore Creek). The creek in fringed by scattered *Corymbia* sp. and *Acacia* thickets and areas of mature spinifex. The creek has a wide sandy bed containing areas retaining water seasonally. Habitat is linear and occurs throughout the region. |  |
| **Granite Outcrops: containing boulder piles, seasonal gnamma holes, moist depressions and fringing *Acacia* thickets;** | Isolated Granite Outcrops occur in the north of the Survey Area. Three large outcrops occur, containing areas holding seasonal water pools. This habitat type occurs in small and isolated areas throughout the local region and occurs at its northern extent near the Survey Area. Other areas of granite outcropping occur outside the Survey Area. Vegetation is sparse on the outcropping itself however the rock outcrops are fringed by areas of *Acacia* shrubland and *Triodia* hummock grassland. |  |

| Habitat type | Distinguishing characteristics | Photo |
|---|---|---|
| **Rocky Ridges: a series of linear Quartz ridges extend north to south on the eastern and western margins of the Survey Area;** | Habitat occurs as linear ridges with areas of outcropping along the crests of the ridge. Outcropping contains large boulder piles with extensive rock crevices. The lower slopes contain an extensive covering of pebbles. This habitat occurs on the margins of the Survey Area with the lower slopes and adjacent stony plains extending within the Survey Area boundaries. Vegetation is sparse in areas affected by fire and includes spinifex grasslands and scattered *Acacia* shrublands. |  |
| **Low Lying drainage depressions: supporting spinifex grassland with seasonal small waterholes on sandy clay loam;** | Low lying drainage depressions occur across parts of the Survey Area. As a result of recent rain prior to the July survey, many areas contained small pools of water. Vegetation is dominated by spinifex grassland over a sandy clay loam substrate. |  |

| Habitat type | Distinguishing characteristics | Photo |
|---|---|---|
| **Occasional minor rocky outcrops (including Quartz, Calcrete, Silcrete) occurring within the sandy and stony plains.** | Small isolated rocky outcrops occur throughout the Survey Area. These include minor areas of granite, Calcrete and other rock types. Some areas contain rock piles and boulders. |  |
| **Quarry 1** | A large granite outcrop previously mined for the construction of the rail. Contains intact granite outcropping as well as disturbed areas (including an open pit with a large pool of water, rock piles, and cleared areas). |  |

| Habitat type | Distinguishing characteristics | Photo |
|---|---|---|
| **Artificial Rock Piles along the Rail Access Track** | Several large artificial rock piles occur along the rail access road. |  |

## 5.3. Field Survey - Vertebrate Fauna

During both surveys 72 vertebrate species were recorded, the majority of which were avian taxa (see Tables 5.3 – 5.5). This comprised 17 mammal (four of these are introduced), 40 Bird and 15 Reptile.

### Mammals

Seventeen mammal species were recorded during both surveys (Tables 5.3) comprising thirteen native and four introduced taxa. Two species, the Common Rock Rat (*Zyzomys argurus*) and Little Red Kaluta (*Dasykaluta rosamondae*) were recorded on the motion sensitive cameras. The Euro (*Macropus robustus*) was observed from several rocky outcrops. Several pebble mounds constructed by the Western Pebble-mound Mouse (*Pseudomys chapmani*) were recorded on hill crests and lower slopes adjacent to the Survey Area. Scats and tracks attributable to the four introduced species, Dog / Dingo (*Canis lupus*), Cattle (*Bos taurus*), Feral Cat (*Felis catus*) and Camel (*Camelus dromedarius*) were recorded.

**Table 5.3 Mammal species recorded during survey**

| Family | Scientific Name | Common Name |
|---|---|---|
| BOVIDAE | *Bos Taurus* | Cattle* |
| CAMELIDAE | *Camelus dromedarius* | Camel* |
| CANIDAE | *Canis lupus dingo* | Dingo* |
| DASYURIDAE | *Dasykaluta rosamondae* | Little Red Kaluta |
| **DASYURIDAE** | ***Dasyurus hallucatus*** | **Northern Quoll** |
| EMBALLONURIDAE | *Saccolaimus flaviventris* | Yellow-bellied Sheath-tailed Bat |
| EMBALLONURIDAE | *Taphozous georgianus* | Common Sheath-tailed Bat |
| FELIDAE | *Felis Catus* | Feral Cat* |
| MACROPODIDAE | *Macropus robustus* | Euro |
| MOLOSSIDAE | *Tadarida australis* | White-striped Mastiff-bat |
| **MURIDAE** | ***Pseudomys chapmani*** | **Western Pebble-mound Mouse** |
| MURIDAE | *Pseudomys hermannsburgensis* | Sandy Inland Mouse |
| MURIDAE | *Zyzomys argurus* | Common Rock-rat |
| TACHYGLOSSIDAE | *Tachyglossus aculeatus* | Echidna |
| VESPERTILIONIDAE | *Chalinolobus gouldii* | Gould's Wattled Bat |
| VESPERTILIONIDAE | *Scotorepens greyii* | Little Broad-nosed Bat |
| VESPERTILIONIDAE | *Vespadelus finlaysoni* | Finlayson's Cave Bat |

(Bold indicates significant species, * indicates introduced species).

**Birds**

Forty bird species were recorded during the surveys (Table 5.4). Most species recorded are widespread throughout the region. Much of the Survey Area had been recently burnt (within the last 5 years) resulting in large areas with little ground cover. Most species recorded occurred throughout the Survey Area however a small number of species (Rainbow Bee-eater, White-plumed Honeyeater) were recorded only along Bore Creek, an ephemeral drainage line. Thirty five bird species were recorded during the initial Mooka Survey in July bringing the total number of species recorded for the area to 40 (see Appendix 1).

**Table 5.4 Bird species recorded during the survey**

| Family | Scientific Name | Common Name |
|---|---|---|
| ACCIPITRIDAE | *Aquila audax* | Wedge-tailed Eagle |
| ACCIPITRIDAE | *Haliastur sphenurus* | Whistling Kite |
| ACCIPITRIDAE | *Hieraaetus morphnoides* | Little Eagle |
| ACCIPITRIDAE | *Milvus migrans* | Black Kite |
| ALAUDIDAE | *Mirafra javanica* | Singing Bushlark |
| ARTAMIDAE | *Artamus cinereus* | Black-faced Woodswallow |
| **BURHINIDAE** | ***Burhinus grallarius*** | **Bush Stone-curlew** |
| CACATUIDAE | *Cacatua roseicapilla* | Galah |
| CACATUIDAE | *Cacatua sanguinea* | Little Corella |
| CAMPEPHAGIDAE | *Coracina novaehollandiae* | Black-faced Cuckoo-shrike |
| CAMPEPHAGIDAE | *Lalage sueurii* | White-winged Triller |
| CHARADRIIDAE | *Charadrius veredus* | Oriental Plover |
| COLUMBIDAE | *Geopelia cuneata* | Diamond Dove |
| COLUMBIDAE | *Geopelia striata* | Peaceful Dove |
| COLUMBIDAE | *Geophaps plumifera* | Spinifex Pigeon |
| COLUMBIDAE | *Ocyphaps lophotes* | Crested Pigeon |
| CORVIDAE | *Corvus orru* | Torresian Crow |
| CUCULIDAE | *Chalchites (Chrysococcyx) basalis* | Horsfield's Bronze Cuckoo |
| CUCULIDAE | *Cuculus pallidus* | Pallid Cuckoo |
| DICRURIDAE | *Grallina cyanoleuca* | Magpie-lark |
| DICRURIDAE | *Rhipidura leucophrys* | Willie Wagtail |
| ESTRILDIDAE | *Taeniopygia guttata* | Zebra Finch |
| FALCONIDAE | *Falco berigora* | Brown Falcon |
| FALCONIDAE | *Falco cenchroides* | Australian Kestrel |
| HALCYONIDAE | *Todiramphus pyrrhopygius* | Red-backed Kingfisher |
| HIRUNDINIDAE | *Hirundo ariel* | Fairy Martin |
| HIRUNDINIDAE | *Hirundo nigricans* | Tree Martin |
| MALURIDAE | *Malurus lamberti* | Variegated Fairy-wren |

| Family | Scientific Name | Common Name |
|---|---|---|
| MALURIDAE | *Malurus leucopterus* | White-winged Fairy-wren |
| MELIPHAGIDAE | *Lichenostomus penicillatus* | White-plumed Honeyeater |
| MELIPHAGIDAE | *Lichenostomus virescens* | Singing Honeyeater |
| MELIPHAGIDAE | *Manorina flavigula* | Yellow-throated Miner |
| **MEROPIDAE** | ***Merops ornatus*** | **Rainbow Bee-eater** |
| MOTACILLIDAE | *Anthus novaeseelandiae* | Richard's Pipit |
| **OTIDIDAE** | ***Ardeotis australis*** | **Australian Bustard** |
| PACHYCEPHALIDAE | *Colluricincla harmonica* | Grey Shrike-thrush |
| PACHYCEPHALIDAE | *Pachycephala rufiventris* | Rufous Whistler |
| PSITTACIDAE | *Nymphicus hollandicus* | Cockatiel |
| SYLVIIDAE | *Cinclorhamphus mathewsi* | Rufous Songlark |
| SYLVIIDAE | *Eremiornis carteri* | Spinifexbird |

(Bold indicates significant species).

**Reptiles**

Fifteen reptile species were recorded from within the Survey Area (Table 5.5 details the reptiles recorded). The majority of species recorded were from observations of a small number of individuals. However, the Pilbara form of *Egernia depressa* was recorded from several locations with a number of colonies (of several individuals) observed from rock crevices amongst both quartz ridges and granite outcrops.

**Table 5.5 Reptiles recorded during the survey.**

| Family | Scientific Name | Common Name |
|---|---|---|
| AGAMIDAE | *Amphibolurus longirostris* | Long-nosed Dragon |
| AGAMIDAE | *Ctenophorus caudicinctus* | Ring-tailed Dragon |
| AGAMIDAE | *Ctenophorus isolepis* | Military Dragon |
| AGAMIDAE | *Ctenophorus nuchalis* | Central Netted Dragon |
| AGAMIDAE | *Pogona minor* | Dwarf Bearded Dragon |
| ELAPIDAE | *Pseudonaja nuchalis* | Gwardar |
| GEKKONIDAE | *Diplodactylus conspicillatus* | Fat-tailed Gecko |
| GEKKONIDAE | *Gehyra punctata* | Spotted Dtella |
| SCINICIDAE | *Ctenotus duricola* | Skink |
| SCINICIDAE | *Ctenotus pantherinus* | Leopard Skink |
| SCINICIDAE | *Ctenotus saxatilis* | Rock Skink |
| SCINICIDAE | *Egernia depressa* | Goldfields Crevice Skink |
| SCINICIDAE | *Morethia ruficauda* | Three Striped Fire-tail Skink |
| VARANIDAE | *Varanus acanthurus* | Ridge-tailed Monitor |
| VARANIDAE | *Varanus eremius* | Pygmy Desert Monitor |

**Amphibians**

No amphibians were recorded during the survey.

## 5.4. Conservation Significant Fauna

Twenty eight species of conservation significance were identified in the desktop review as potentially occurring within the Survey Area. These species are listed in Table 5.8, with details on the likelihood of occurrence within the Survey Area, based on the results of the field survey and available habitats.

Six conservation significant fauna species were recorded during the survey. Conservation significant fauna recorded during the field survey are discussed in Section 5.5. Those species considered likely to occur, but not recorded during the field survey, are discussed in further detail in Section 5.6.

**Table 5.6 Significant species recorded in or around the Survey Area from the DEC's, EPBC's, NatureMap's and Biologic's Database.**

| Class | Scientific Name | Common Name | Local Records | WC Act / DEC Priority | EPBC | Survey Results | Likelihood of Occurrence |
|---|---|---|---|---|---|---|---|
| AVES | *Apus pacificus* | Fork-tailed Swift | Turner River | | M | - | Likely – May fly over |
| AVES | *Ardea alba* | Great Egret | Turner River | | M | - | Potential Visitor – May use artificial water bodies |
| AVES | *Ardea ibis* | Cattle Egret | Yule River | | M | - | Potential Visitor – May use artificial water bodies |
| AVES | *Falco peregrinus* | Peregrine Falcon | Turner River | S4 | | - | Likely Visitor – suitable habitat present (Bore Creek). |
| AVES | *Ardeotis australis* | Australian Bustard | Mooka Siding | P4 | | RECORDED | Regular Visitor – recorded during survey |
| AVES | *Pezoporus occidentalis* | Night Parrot | None | CE | E | - | Unlikely to occur, no local recent records |
| AVES | *Burhinus grallarius* | Bush Stone-curlew | Yule River | P4 | | RECORDED | Likely Resident – recorded during survey |
| AVES | *Charadrius veredus* | Oriental Plover | Turner River | | M | RECORDED | Visitor – recorded during survey |
| AVES | *Falco hypoleucos* | Grey Falcon | Yule River | P4 | | - | Likely Visitor – suitable habitat present (Bore Creek). |
| AVES | *Merops ornatus* | Rainbow Bee-eater | Mooka Siding | | M | RECORDED | Regular Migrant – recorded during survey (breeding habitat occurs along Bore Creek) |
| AVES | *Neochmia ruficauda subclarescens* | Star Finch | Port Hedland | P4 | | - | Unlikely resident – no suitable habitat present |
| AVES | *Actitis hypoleucos* | Common Sandpiper | Port Hedland | | M | - | Potential Visitor – Rare visitor to Survey Area. |
| AVES | *Tringa glareola* | Wood Sandpiper | Port Hedland | | M | - | Potential Visitor – Rare visitor to Survey Area. |
| AVES | *Tringa nebularia* | Common Greenshank | Port Hedland | | M | - | Potential Visitor – Rare visitor to Survey Area. |

| Class | Scientific Name | Common Name | Local Records | WC Act / DEC Priority | EPBC | Survey Results | Likelihood of Occurrence |
|---|---|---|---|---|---|---|---|
| AVES | *Tringa stagnatilis* | Marsh Sandpiper | Port Hedland | | M | - | Potential Visitor – Rare visitor to Survey Area. |
| AVES | *Glareola maldivarum* | Oriental Pratincole | Port Hedland | | M | - | Potential Visitor – Rare visitor to Survey Area. |
| AVES | *Phaps histrionica* | Flock Bronzewing | Port Hedland | P4 | | - | Potential Visitor – nomadic species, suitable habitat present and species recorded nearby |
| MAMMALIA | *Dasyurus hallucatus* | Northern Quoll | Port Hedland | S1 | E | RECORDED | Several resident populations occur in the Project |
| MAMMALIA | *Macroderma gigas* | Ghost Bat | Table Hill | P4 | | - | Unlikely Resident – no suitable roosting habitat within Survey Area. However species likely to forage over Survey Area. |
| MAMMALIA | *Macrotis lagotis* | Greater Bilby | Yule River | S1 | V | - | Potential Visitor – no evidence during survey however, suitable habitat present, species recorded nearby. |
| MAMMALIA | *Dasycercus blythi* | Brush-tailed Mulgara | Port Hedland | P4 | V | - | Potential Resident – no evidence found during field survey however suitable habitat exists in Survey Area and recorded nearby |
| MAMMALIA | *Dasycercus cristicauda* | Crest-tailed Mulgara | Unknown | S1 | V | - | Unlikely Resident – no local records |
| MAMMALIA | *Pseudomys chapmani* | Pebble-mound Mouse | Table Hill | P4 | | RECORDED | Several old inactive mounds recorded and one active mound recorded on the lower slopes of a quartz ridge. Occurs on the margins of the Survey Area. |
| MAMMALIA | *Rhinonicteris aurantia* | Pilbara Leaf-nosed Bat | Table Hill | S1 | V | - | Unlikely Resident – no suitable roosting habitat within Survey Area. However species likely to forage over Survey Area. |

| Class | Scientific Name | Common Name | Local Records | WC Act / DEC Priority | EPBC | Survey Results | Likelihood of Occurrence |
|---|---|---|---|---|---|---|---|
| MAMMALIA | *Sminthopsis longicaudata* | Long-tailed Dunnart | Wodgina | P4 | | - | Possible Resident –suitable habitat occurs in the Survey Area (rocky ridges, granite outcrops). This species is distributed throughout the Pilbara but rarely recorded. |
| MAMMALIA | *Leggadina lakedownensis* | Lakeland Downs Mouse | None | P4 | | | Possible Resident –suitable habitat (spinifex sandplains) occurs in the Survey Area. |
| REPTILIA | *Liasis olivaceus barroni* | Pilbara Olive Python | Ord Range | S1 | V | - | Likely Resident – suitable habitat present (Bore Creek). |
| REPTILIA | *Ramphotyphlops ganei* | | None | P1 | | - | Unlikely Resident –no local records |
| REPTILIA | *Aspidites ramsayi* | Woma | Port Hedland | S4 | | - | Likely Resident – suitable habitat present. |

V – Vulnerable, E – Endangered, S1 – Schedule 1, M – Migratory, P1 – Priority 1, P4 – Priority 4, NT, Near Threatened, CE – Critically Endangered.

## 5.5. Conservation Significant Fauna Species Recorded During the Survey

Six species of conservation significance were recorded during the survey, they were:

- Northern Quoll (*Dasyurus hallucatus*, EPBC Endangered)
- Western Pebble-mound Mouse (*Pseudomys chapmani*, DEC Priority 4)
- Australia Bustard (*Ardeotis australis*, DEC Priority 4)
- Bush Stone-curlew (*Burhinus grallarius*, DEC Priority 4)
- Rainbow Bee-eater (*Merops ornatus*, EPBC Migratory)
- Oriental Plover (*Charadrius veredus*, EPBC Migratory).

Locations of species records are detailed below (see Table 5.8, Figure 5.1 and Appendix 4). Definitions of conservation codes are provided in Appendix 2. Conservation significant fauna recorded from the Survey Area are discussed below.

**Northern Quoll (*Dasyurus hallucatus*)**

The Northern Quoll formerly occurred across much of northern Australia from the Pilbara to Brisbane, but now occurs in a number of fragmented populations across its former range. In Western Australia the Northern Quoll is restricted to the Pilbara and Kimberley regions with substantial population declines recorded in some areas (DSEWPAC, 2010). The Northern Quoll is associated with rocky areas in the Pilbara but also occurs along watercourses, inhabiting rock crevices, tree hollows and termite mounds.

The Northern Quoll is listed as Endangered under the EPBC Act (1999) and Schedule 1 under the WC Act. A number of factors are considered to be threatening to the survival of the Northern Quoll including inappropriate fire regimes, predation following fire and lethal toxic ingestion of Cane Toad toxin (DSEWPAC, 2010). Poisoning as a result of the ingestion of Cane Toad toxin is considered to have had a catastrophic impact on Northern Quoll populations in the Northern Territory and Queensland. The Cane Toad will most likely colonise much of the remainder of the Northern Quoll's natural mainland range over the next 10 – 20 years and it is likely that the species decline will continue (DSEWPAC, 2010).

The Northern Quoll was recorded at two locations during November survey and six locations during the July Mooka survey (see Figure 5.1, Table 5.9). Most records of the Northern Quoll came from within rocky habitats, where large rock piles and deep rock crevices provide sheltering habitat. Several individuals were recorded at Quarry 1, a large granite outcrop (previously mined for the construction of the BHPBIO Rail Network). In this area, Northern Quolls were recorded on motion cameras (at least three individuals) installed both amongst the quarry rock piles and within granite outcropping adjacent to the quarry. Numerous scat piles were also recorded from rock crevices likely to contain den / shelter sites.

Northern Quolls were also recorded from three Granite Outcrops nearby to Quarry 1 (including from two outcrops adjacent to the Survey Area). At these locations extensive granite outcropping occurred with large granite rock piles likely to contain den or shelter sites. Additionally, Northern Quoll scats were recorded from a small calcrete rise containing outcropping and from a rock pile adjacent to the Rail Access Road where large boulders provided shelter habitat.

Numerous Northern Quoll tracks were recorded along Bore Creek during the November 2010 survey. Northern Quoll records are shown in Figure 5.1 and Plates 5.1 – 5.5.

**Plate 5.1 Quarry 1, an abandoned quarry in a granite outcrop with large rock piles.**

**Plate 5.2 Granite Outcrop supporting Northern Quoll den sites.**

**Plate 5.3** **Fresh Northern Quoll scats outside granite rock pile.**

**Plate 5.4** **Artificial rock pile containing Northern Quoll den sites.**

**Plate 5.5** **Screen Shot from Motion Sensitive Camera.**

**Western Pebble-mound Mouse (*Pseudomys chapmani*)**

The Western Pebble-mound Mouse is listed as Priority 4 by the DEC. This species inhabits the lower slopes of rocky hills and undulating stony plains, where it uses small stones to build its distinctive mounds (Van Dyck and Strahan, 2008). The Western Pebble-mound Mouse appears to be confined to the Pilbara.

Five Western Pebble-mound Mouse mounds were located during the November survey (see Table 5.9, Plate 5.6) including one active mound. An additional six mounds were recorded during the July survey. Pebble mounds were found mostly on the margins of the Survey Area on the lower slopes of rocky ridges. Pebble mounds may also occur throughout the Survey Area within the rocky ridges, lower slopes and adjacent stony plains habitats. The majority of Pebble Mounds recorded were old and abandoned with only two active mounds recorded over both surveys. This species is likely to occur at the limit of its range in the area as rocky ridges and stony slopes occur in small and isolated areas. Such habitat is much more extensive to the south of the Survey Area.

**Plate 5.6 Active Western Pebble-mouse mound recorded from the Survey Area.**

**Bush Stone-curlew (*Burhinus grallarius*)**

The Bush Stone-curlew is classified as Priority 4 by DEC and Near Threatened by Garnett and Crowley (2000). In the Pilbara, this species is often associated with woodlands and dense shrublands including along ephemeral or permanent watercourses. Threats to the species include increased predation by foxes and habitat degradation from pastoralism (Garnett and Crowley, 2000).

This species has a widespread distribution, however, has significantly declined south of the Pilbara. Home range studies have not been conducted in the Pilbara however in arid Eastern Australia this species occupies a large, permanent, home range (of about 250–600 ha) which contracts to a much smaller area (10–25 ha) during breeding (DSEWPAC, 2010).

The Bush Stone-curlew was recorded from the Survey Area, with two individuals and numerous tracks observed (see Table 5.9, Figure 5.1). Large numbers of Bush Stone-curlew tracks were observed within the sandy bed of Bore Creek, particularly near small, ephemeral pools of water. Tracks were also observed within spinifex grassland, mostly concentrated near small, seasonal pools of water (see Plate 5.7). The Bush Stone-curlew has been recorded near the Survey Area at the Yule River (J. Turpin, pers. obs). The Survey Area may form a component of the home range of one or several breeding pairs.

**Plate 5.7 Bush Stone-Curlew tracks recorded from the Survey Area.**

**Australian Bustard (*Ardeotis australis*)**

The Australian Bustard is classified as Priority 4 by the DEC and Near Threatened by Garnett and Crowley (2000). This species is associated with a variety of grassland, grassy woodland and shrubland habitats, with the main threats to its survival being a combination of habitat loss/degradation and predation by feral cats and foxes. It is nomadic and may range over very large areas.

Tracks from this species were recorded within the spinifex sandplain habitats during the survey (Table 5.9, Figure 5.1). Australia Bustard tracks were observed to be widespread across the Survey Area. This species is likely to be a regular visitor to the Survey Area.

**Rainbow Bee-eater (Merops ornatus)**

The Rainbow Bee-eater is listed as Migratory under the EPBC Act and under Schedule 3 of the WC Act. The Rainbow Bee-eater occurs year-round in the tropics of northern Australia, with a southward migration, to both south-eastern and south-western Australia, in early spring. Southern birds return north in autumn (Johnstone and Storr 1998). It has a wide range and occurs in the better watered parts of Western Australia, between the Kimberley and south-west of WA, preferring lightly wooded, sandy country near water (Johnstone and Storr, 1998). It nests in burrows dug usually at a slight angle in flat ground, gently elevated slopes, sandy banks or cuttings, and often at the margins of roads or tracks.

When present, *M. ornatus* is common and prominent in both natural and altered environments. Although a species of high conservation significance, it is abundant and versatile in its selection of nest sites.

The Rainbow Bee-eater was recorded along Bore Creek (see Table 5.9, Figure 5.1). This species is likely to nest in the banks of the creek.

**Oriental Plover (*Charadrius veredus*) EPBC MIGRATORY**

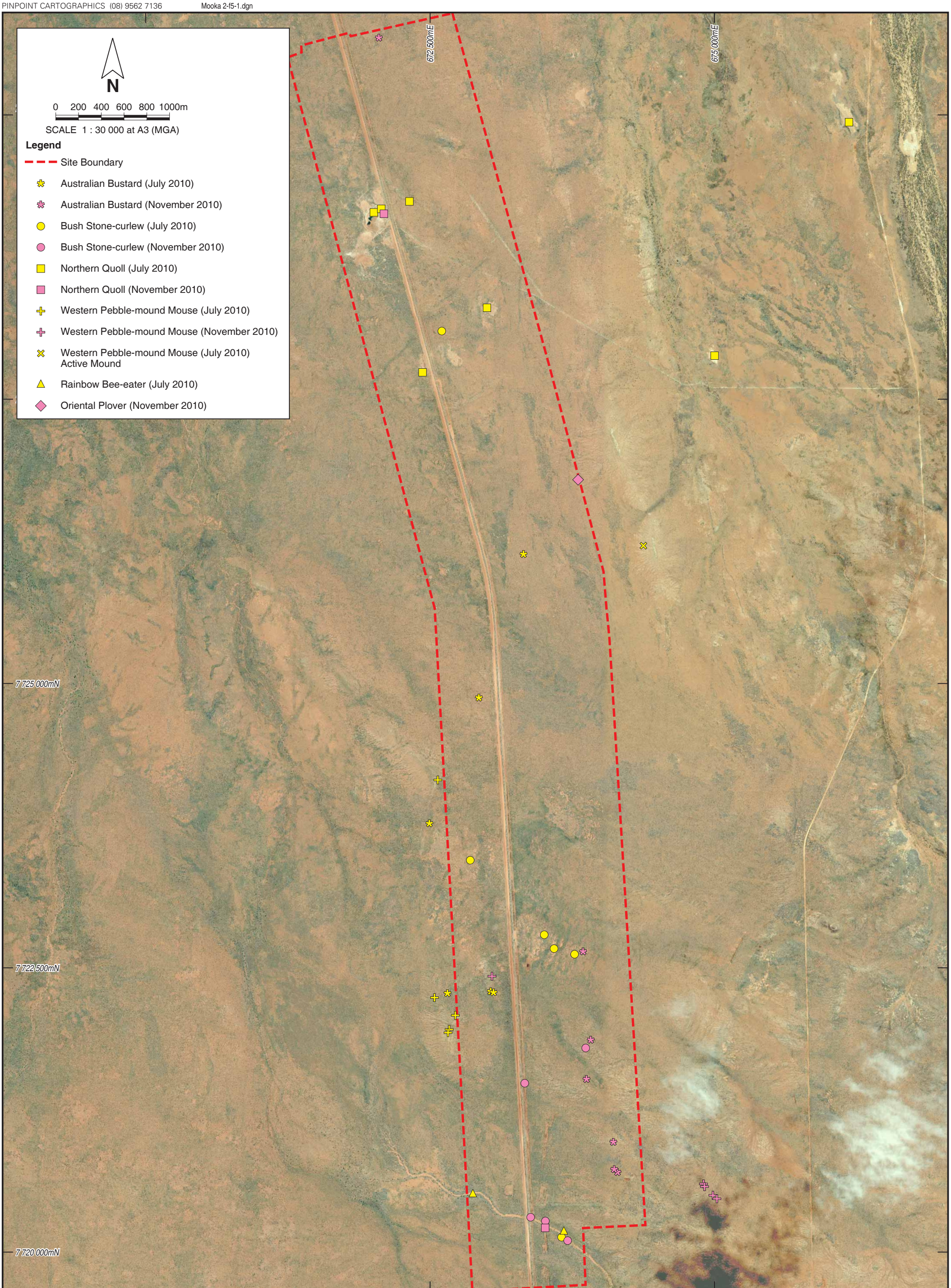
The Oriental Plover is listed as Migratory under the EPBC Act. It is a non-breeding visitor to Australia, where it occurs in both coastal and inland areas. Along the coast the Oriental Plover inhabits estuarine mudflats, beaches and near coastal grasslands. Inland it occurs in flat, open, semi arid or arid grasslands (DSEWPAC, 2010). On migration to Northern Australia (September – November), Oriental Plovers gather in flocks on open, thinly vegetated, grassland plains (Morecombe, 2000).

Seven individuals were observed from the Survey Area. They were recorded from a sparsely vegetated stony plain, roosting on the ground at 673801E, 7726792N (50K GDA 94). The area was subsequently re-visited however the flock had moved on. A record of the Oriental Plover also comes from near the Turner River, approximately 50 km south of the Survey Area (Birds Australia, 2010). This species may be a periodic visitor to the Survey Area.

**Plate 5.8 Sparsely vegetated Stony Plain at the location of the Oriental Plover observation (note two Oriental Plovers in the centre of the image).**

**Table 5.7 Locations of Significant Fauna Recorded during the Mooka Survey.**

| Species | Location / Habitat | Easting | Northing | Record |
|---|---|---|---|---|
| Northern Quoll | Quarry 1 | 672094 | 7729131 | Scats |
| Northern Quoll | Bore Creek | 673512 | 7720235 | Numerous tracks |
| Oriental Plover | Stony Plain | 673801 | 7726792 | 7 individuals seen |
| Western Pebble-mound Mouse | Stony Lower Hill slope | 674986 | 7720499 | Active / recently active |
| Western Pebble-mound Mouse | Stony Lower Hill slope | 675021 | 7720469 | Old inactive mound |
| Western Pebble-mound Mouse | Stony Lower Hill slope | 674903 | 7720600 | Old inactive mound x 2 |
| Western Pebble-mound Mouse | Stony Lower Hill slope | 674912 | 7720576 | Old inactive mound |
| Western Pebble-mound Mouse | Stony Lower Hill slope | 673044 | 7722426 | Old inactive mound |
| Australian Bustard | Spinifex Grassland | 673845 | 7722643 | Tracks |
| Australian Bustard | Spinifex Grassland | 673912 | 7721866 | Tracks |
| Australian Bustard | Spinifex Grassland | 674135 | 7720714 | Tracks |
| Australian Bustard | Spinifex Grassland | 674138 | 7720711 | Tracks |
| Australian Bustard | Spinifex Grassland | 672354 | 7730924 | Tracks |
| Australian Bustard | Spinifex Grassland | 672050 | 7730678 | Tracks |
| Australian Bustard | Spinifex Grassland | 673875 | 7721521 | Tracks |
| Australian Bustard | Spinifex Grassland | 674111 | 7720968 | Tracks |
| Bush Stone-Curlew | Bore Creek | 673512 | 7720235 | Tracks |
| Bush Stone-Curlew | Spinifex Grassland | 673332 | 7721486 | 2 individuals seen |
| Bush Stone-Curlew | Spinifex Grassland | 673385 | 7720306 | Tracks |
| Bush Stone-Curlew | Spinifex Grassland | 673701 | 7720102 | Tracks |
| Bush Stone-Curlew | Spinifex Grassland | 673868 | 7721794 | Tracks |
| Bush Stone-Curlew | Spinifex Grassland | 673881 | 7720280 | Tracks |
| Bush Stone-Curlew | Spinifex Grassland | 673909 | 7721989 | Tracks |
| Bush Stone-Curlew | Spinifex Grassland | 674087 | 7721839 | Tracks |
| Bush Stone-Curlew | Spinifex Grassland | 673826 | 7720867 | Tracks |
| Bush Stone-Curlew | Spinifex Grassland | 673373 | 7728384 | Tracks |
| Bush Stone-Curlew | Spinifex Grassland | 672899 | 7729139 | Tracks |
| Rainbow Bee-eater | Bore Creek | 673188 | 7720323 | Observation |

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**LOCATIONS OF CONSERVATION SIGNIFICANT FAUNA RECORDED DURING THE MOOKA LEVEL 1 FAUNA SURVEY**

**Figure 5.1**

Drawn: J. Turpin | Date: 7 Dec 2010 | Job: --

## 5.6. Conservation Significant Fauna Potentially Occurring in the Survey Area

While not recorded during the survey, eight additional conservation significant species are considered likely to occur within the Survey Area based on local records and the habitats present. These are:

- Pilbara Olive Python (*Liasis olivaceus barroni*);
- Fork-tailed Swift (*Apus pacificus*);
- Peregrine Falcon (Falco peregrinus);
- Grey Falcon (*Falco hypoleucos*);
- Long-tailed Dunnart (*Sminthopsis longicaudata*);
- Lakeland Downs Mouse *(Leggadina lakedownensis);*
- Brush-tailed Mulgara (*Dasyurus blythi*);

Species considered likely to occur within the Mooka Siding Survey Area are discussed below.

**Pilbara Olive Python (*Liasis olivaceus barroni*)** **EPBC VULNERABLE**

The Pilbara Olive Python is listed as Schedule 1 (Vulnerable) under the WC Act and Vulnerable under the Commonwealth's EPBC Act. This subspecies is restricted to ranges within the Pilbara region and is often recorded near waterholes (Wilson and Swann, 2003).

Pilbara Olive Pythons occur in rocky areas such as gorges, caves, and rock crevices, and can also burrow beneath rocks or occur in hollow logs. They are often are associated with water (in search of prey) and also may search for prey in grassy areas surrounding rocky outcrops (DSEWPAC, 2010). Their diet includes rock wallabies, fruit bats, ducks, Spinifex Pigeons and Coucals which are captured by ambush on animal trails or by striking from a submerged position in water holes (DSEWPAC, 2010). The Pilbara Olive Python breeds seasonally usually during June and July, with males moving long distances in search of females. Eggs are laid in November and hatch approximately two months later in mid-January (DSEWPAC, 2010).

The Pilbara Olive Python has been recorded from the Ord Ranges (DEC, 2010) east of Port Hedland. Suitable habitat this species occurs within the Survey Area in the rocky outcrops and along Bore Creek. This species may be present as a permanent resident, or may occasionally support males searching for mates.

**Fork-tailed Swift (*Apus pacificus*)** **EPBC MIGRATORY**

The Fork-tailed Swift is listed as Migratory under the EPBC Act and under Schedule 3 of the Wildlife Conservation Act. The Fork-tailed Swift is an aerial species largely independent of

terrestrial habitats. It has been recorded from the region, including from the Turner River area (Birds Australia, 2010). The Fork-tailed Swift is likely to be present only flying over the Survey Area and is unlikely to use any of the terrestrial habitats present.

**Peregrine Falcon (*Falco peregrinus*)** **DEC SCHEDULE 1**

The Peregrine Falcon is classified as Specially Protected Fauna under Schedule 4 of the WC Act. This species is found in a variety of habitats, including rocky ledges, cliffs, watercourses, open woodland and *Acacia* shrublands. The distribution of the Peregrine Falcon is often tied to the abundance of prey as this species predates heavily on other birds. The Peregrine Falcon lays its eggs in recesses of cliff faces, tree hollows or in large abandoned nests of other birds (Birds Australia, 2010). The Peregrine Falcon mates for life with pairs maintaining a home range of about 20 - 30 km square throughout the year. Blakers *et al* (1984) consider that Australia is one of the strongholds of the species, since it has declined in many other parts of the world.

The Peregrine Falcon has been recorded from Port Hedland, and the De Grey River (approximately 60km east of Port Hedland) and the Turner River (DEC, 2010) and is likely to occur within the Survey Area. Suitable nesting habitat for this species occurs along Bore Creek.

**Grey Falcon (*Falco hypoleucos*)** **DEC Priority 4**

The Grey Falcon is classified as Priority 4 by the DEC and Near Threatened by Garnett and Crowley (2000). This species appears to have a distribution centred around ephemeral or permanent drainage lines (Garnett and Crowley 2000). Although the main threats to this species are not known, regional threats may include habitat degradation through grazing, which may have reduced prey abundance (Garnett and Crowley 2000).

This species is known to inhabit arid drainage systems and has been recorded along the Yule River (approximately 40km from the Survey Area, Birds Australia, 2010). The Grey Falcon may periodically occur within the Survey Area. Potential nesting sites occur along Bore Creek.

**Brush-tailed Mulgara (*Dasyurus blythi*)** **EPBC VULNERABLE**

The Brush-tailed Mulgara is listed as Priority 4 by DEC. The Mulgara was previously grouped as one species, however following recent taxonomic revision, the Brush-tailed Mulgara (*Dasycercus blythi*) has been separated from the Crest-tailed Mulgara (*D. cristicauda*) (Woolley, 2008). This revision has yet to be updated on the EPBC Act which only recognises the original *D. cristicauda* as Vulnerable.

The Brush-tailed Mulgara is widely distributed in arid regions of the central and western parts of Australia (Woolley, 2008). It occurs in scattered populations at fairly low density, but may be locally abundant. The density of Brush-tailed Mulgara fluctuates depending on long-term

climatic conditions. Population may also fluctuate annually, declining during the breeding season (June to October) and increasing following the influx of juveniles in the spring (Woolley, 2008).

This species occupies spinifex (*Triodia* spp.) grasslands, and burrows in flats between sand dunes. It is generally a solitary species that hunts at night, although it is not strictly nocturnal (Woolley 2008). The Brush-tailed Mulgara has a wide ranging diet that includes various types of invertebrates, reptiles, and small mammals (Woolley, 2008).

The Brush-tailed Mulgara has been recorded from near Kangan and Port Hedland (DEC, 2010) and within 20 km of the Survey Area near South Hedland and Pippingarra Creek (DEC, 2010). No evidence (burrows) attributable to this species was recorded from the Survey Area, although extensive areas of suitable habitat were searched. Identifiable burrows may also be difficult to detect when this species occurs at low densities. However due to presence of suitable habitat within the Survey Area and records in the vicinity, the Brush-tailed Mulgara has the potential to occur within the Survey Area.

**Long-tailed Dunnart (*Sminthopsis longicaudata*) DEC Priority 4**

The Long-tailed Dunnart is listed as Priority 4 by the DEC. The species appears to be a specialist of rocky habitats, inhabiting granite outcrops, ironstone ridges and breakaways (Withers and Edward, 1997, Biologic records). Possible threats include habitat alteration due to introduced herbivores e.g. cattle and rabbits, inappropriate fire regimes and invasion by buffel grass; and predation by cats and foxes (Pavey 2006).

This species may occur along the ridges and rocky outcrops within the Survey Area. It has been recorded from an ironstone ridge in the Wodgina area (approximately 70 km south-west of the Survey Area, Biologic records). The Long-tailed Dunnart is rarely recorded during fauna surveys and has a patchy distribution in the Pilbara (Gibson and McKenzie, 2009).

**Lakeland Downs Mouse (*Leggadina lakedownensis*) DEC Priority 4**

The Lakeland Downs Mouse is classified as Priority 4 by the DEC. Populations of the Lakeland Downs Mouse appear to fluctuate dramatically, probably in response to environmental conditions and food availability. The Pilbara population, which may represent a distinct taxon (Strahan 2008), has a preference for sandy and cracking clay/gilgai soils (Biologic records).

Due to the presence of suitable habitat (spinifex sandplain), this species may occur within the Survey Area. However there appear to be few records for this species near the Survey Area.

A number of additional conservation significant species have the potential to occur in the Survey Area. Most of these are wide-ranging, transient species which are unlikely to rely on the Survey Area as core components of their range (such as the migratory birds). However some additional species have been recorded in the vicinity of the Survey Area and may utilise

the area during foraging or dispersal. While the Survey Area is unlikely to contain core habitat, the presence of the following species in the Survey Area is considered possible:

- Ghost Bat (*Macroderma gigas*)
- Pilbara Leaf-nosed Bat (*Rhinonicteris aurantius*)
- Greater Bilby (*Macrotis lagotis*).
- Spectacled Hare-Wallaby (*Lagorchestes conspicillatus*)
- Flock Bronzewing (*Phaps histrionica*);

These species are discussed in the following section. The remaining significant species are listed in Table 5.7 are unlikely to occur in the Survey Area.

**Ghost Bat (*Macroderma gigas*)** **DEC Priority 4**

The Ghost Bat is listed as Priority 4 by the DEC, Vulnerable by the IUCN (International Union for Conservation of Nature), and Lower Risk (near threatened) by Duncan *et al* (1999). The Ghost Bat formerly occurred over a wide area of central, northern and southern Australia however has declined significantly in the southern parts of its range in the last 200 years (DSEWPAC, 2010). It now occurs in only a few highly disjunct sites across northern Australia and in Western Australia is now confined to the Kimberly and Pilbara.

The distribution of Ghost Bats is influenced by the availability of suitable caves and mines for roost sites. The preferred roosting habitats of Ghost Bats in the Pilbara are deep, complex caves beneath bluffs of low rounded hills composed of Marra Mamba geology, Brockman Iron Formations, granite rock piles and abandoned mines (Armstrong and Anstee, 2000). Armstrong and Anstee (2000) note that most caves used by Ghost Bats in bluff caves have narrow entrances (up to less than 0.5m2) that opened into larger chambers. Ghost Bats move between a number of caves seasonally or as dictated by weather changes and roost either individually or in colonies up to 1500 (Churchill, 1998). During breeding, female Ghost Bats congregate into maternity roosts generally selecting very warm caves during pregnancy and lactation (Hutson, *et al* 2001).

No deep complex caves occur within the Survey Area and so no roost sites are expected to occur in the area. As a result this species is not expected to be dependant on habitats within the Survey Area. However Ghost Bats have been recorded east of the Survey Area at Table Hill (a roost occurs approximately 25 km east of the Survey Area) and approximately 8 km south of the Survey Area from a Granite Outcrop (DEC, 2010). The Ghost Bat is likely to periodically occur within the vicinity of the Survey Area during foraging or dispersal. Individuals may also utilise large trees during foraging.

**Pilbara Leaf-nosed Bat (*Rhinonicteris aurantius*)  EPBC VULNERABLE**

The Pilbara Leaf-nosed Bat is classified as Vulnerable by Duncan *et al.* (1999) and under the EPBC and WCA Acts. The Pilbara Leaf-nosed Bat requires very hot (28 – 32 ºC) and very humid (96 – 100%) roost sites in caves and/or mines. This is a result of their limited ability to conserve heat and water (Churchill, 1991; Hall *et al*. 1997; Armstrong, 2001). Such caves are relatively uncommon in the Pilbara (Armstrong and Anstee, 2000; Armstrong, 2001, 2006), which limits the availability of diurnal roosts for this species. The few known roosts of this species are concentrated in five disused mines in the eastern Pilbara, and one gorge system in Barlee Range Nature Reserve (DSEWPAC, 2010), which are thought to contain most of the region's population.

There are also numerous records of bats in flight throughout the region, which indicate the presence of roosts in natural caves. The species is often encountered in flight foraging in gorges and gullies well away from disused underground mines (Armstrong 2001, 2006; K.N. Armstrong unpublished data). The size of colonies in natural roosts is thought to be smaller than those in large, deep mines, but such roosts might be important for maintaining gene flow throughout the region (Armstrong 2001, 2006). Possible threats to the species include a loss of roost sites due to the collapse and flooding of old mines. Disturbances caused by current mining activities may also be an issue (Duncan *et al*. 1999).

The Pilbara Leaf-nosed Bat has been recorded near the Survey Area at Table Hill (a roost occurs approximately 25 km north-east, DEC, 2010). It is unlikely to roost within the Survey Area due to a lack of suitable habitat however may occasionally visit the Survey Area while foraging during favourable conditions.

**Greater Bilby (*Macrotis lagotis*)  EPBC VULNERABLE**

The Greater Bilby is listed as Vulnerable under the EPBC and WCA Acts. The species formerly utilised a wide range of habitat types across the continent. Extant populations are restricted to a variety of "tall shrublands, open woodlands, hummock grasslands and sparse forblands" (Maxwell *et al*, 1996). There appears to be scattered populations across the northern Pilbara, including close to Port Hedland (DEC, 2010). The Bilby may occur in areas of suitable habitat on the plains adjacent to the rocky ridges, especially in sandy areas associated with drainage. No evidence (burrows, diggings, tracks) attributable to this species was recorded from the Survey Area, although extensive areas of suitable habitat were searched.

This species has been recorded near Port Hedland at Kangan and also near the Yule River (DEC, 2010). The Greater Bilby can move over large areas and may periodically occur within the Survey Area.

**Spectacled Hare-Wallaby (*Lagorchestes conspicillatus*)** **DEC Priority 3**

The Spectacled Hare-Wallaby (mainland subsp.) is listed as Priority 3 by the DEC and Lower Risk (near threatened) by Maxwell *et al* (1996). Within Western Australia, this species is now restricted to a few small isolated patches in the Pilbara and Kimberley. Threats to the species may include those that alter habitat, such as altered fire regimes and introduced grazers e.g. cattle and rabbits; and introduced predators e.g. foxes and feral cats (Maxwell et al. 1996). This species was not detected in any database searches however occurs on the southern fringe of the Abydos Plain (Biologic Records). There was no evidence to suggest that this species currently occurs in the Survey Area. Frequent fires in the area suggest it is currently unlikely to be present. Its presence in the future, however, if spinifex is allowed to mature, cannot be ruled out.

**Flock Bronzewing (*Phaps histrionica*)** **DEC Priority 4**

The Flock Bronzewing is listed as Priority 4 by the DEC. This species inhabits treeless or sparsely wooded grassy plains within reach of open water (Garnett and Crowley, 2000). The Flock Bronzewing has been recorded from the Port Hedland area (Birds Australia, 2010) and may be an occasional visitor to the Survey Area.

## 5.7. Short-range Endemic Fauna

Two main habitats were identified within the Survey Area with the potential to contain Short-Range Endemic (SRE) species. These were:

1. Granite Outcrops: occurring as small isolated habitats, containing areas of elevated moisture, seasonal gnamma holes, restricted vegetation and sites of accumulated leaf litter; and
2. Isolated Rocky Ridges: containing rocky outcrops and boulder piles.

Three large granite outcrops occur within the Survey Area, one of which includes Quarry 1. The granite outcrops occur in isolation, contain numerous microhabitats such as extensive rock slabs, rock crevices, boulders and depressions with elevated soil moisture. Some small rock holes contained water as a result of recent rain. Deep layers of leaf litter were observed in some areas protected by wind and fire. The granite outcrops also appear to provide refuge from fire with mature vegetation observed.

Two parallel rocky ridges were recorded on the eastern and western margins of the Survey Area. Both contained isolated areas of quartz outcropping, and may contain areas of elevated moisture. Other habitats occurring within the Survey Area are regionally widespread and are not expected to contain fauna with highly restricted ranges.

Individuals from one group known to display short-range endemism were collected. Five Pseudoscorpions were collected from under granite rocks within a moist depression on one granite outcrop. These specimens were identified by the Western Australian Museum and are not considered to be SRE (Framenau, pers. comm.). A summary of individuals collected is presented in Appendix 6.

## 5.8. Habitat Significance

Each of the fauna habitats identified in Section 5.3 was given a significance score of High, Medium or Low based on criteria outlined in Table 4.3. Details of the assessment are provided in Table 5.10, below. Only Granite Outcrops, and Rocky Ridges were considered to be of High significance because they support or provide core habitat for a number of conservation significant species (see below). Habitats have been mapped in Figure 5.2.

**Table 5.8 Fauna habitat significance scores**

| Fauna habitat | Score | Rationale | Significant Fauna Expected |
|---|---|---|---|
| Granite Outcrop | High | Supports EPBC listed Northern Quoll and is may support invertebrate species with restricted ranges. Also provides areas containing seasonal water (gnamma holes) or moisture supporting local fauna.<br>Northern Quoll den sites (sheltering and breeding habitat) are very likely to occur within the granite outcrops in the Survey Area. Large scat piles were observed within rock crevices and Northern Quolls were recorded on Motion Cameras close to sunset indicating a shelter nearby. | ○ Northern Quoll (den sites)<br>○ Pilbara Olive Python<br>○ Long-tailed Dunnart |
| Rocky Ridges | High | Likely to support the EPBC listed Northern Quoll as quartz outcrops contain rock piles and crevices suitable for den sites. The lower slopes of the rocky ridges also support populations of the DEC Priority 4 Western Pebble-mound Mouse. The species is largely restricted to this habitat type. | ○ Northern Quoll (den sites)<br>○ Pilbara Olive Python<br>○ Long-tailed Dunnart<br>○ Western Pebble-mound Mouse |
| Drainage Depressions (supporting seasonal pools and spinifex grasslands) | Medium | Habitat is used by Australian Bustard and Bush Stone-curlew (DEC Priority 4), but does not support a significant population of the species and the species is not restricted to this habitat type. The Pilbara endemic Little Red Kaluta (*Dasykaluta rosamondae*) was recorded within this habitat type. Although not recorded during the survey, this habitat is suitable for the Brush-tailed Mulgara, Greater Bilby and Spectacled Hare-Wallaby, particularly within areas unaffected by fire, supporting large, mature spinifex. | ○ Bush Stone-curlew<br>○ Australian Bustard<br>Potential for:<br>○ Brush-tailed Mulgara<br>○ Greater Bilby<br>○ Spectacled Hare-Wallaby |
| Minor Drainage Line (Bore Creek) | Medium - High | Several tracks of the DEC Priority 4 Bush Stone Curlew were recorded within this habitat. The EPBC Migratory Rainbow Bee-eater is also likely to nest along the banks of Bore Creek. Possible old nesting sites were recorded within the Survey Area. Habitat is also likely to facilitate the movement of fauna across the landscape. The EPBC listed Northern Quoll may occur within this habitat as several large hollow bearing trees occur. | ○ Bush Stone-curlew<br>○ Australian Bustard<br>○ Rainbow Bee-eater<br>○ Northern Quoll |
| Stony Plain | Low | Much of this habitat had been recently burnt. A widespread habitat type not expected to support species of high conservation significance restricted to this habitat type. The DEC Priority 4 Western Pebble-mound Mouse may occur on this habitat type. The EPBC Migratory Oriental Plover was recorded in this habitat type. | ○ Western Pebble-mound Mouse<br>○ Oriental Plover |
| Sand Plain | Low | A widespread habitat type. Sandplain habitat is used by Australian Bustard (DEC Priority 4), but does not support a significant population of the species and the species is not restricted to this habitat type. Large areas of mature spinifex may support populations of the DEC Priority 4 Brush-tailed Mulgara and there is the potential for the conservation significant Greater Bilby and Spectacled Hare-Wallaby to occur. | Potential for:<br>○ Brush-tailed Mulgara<br>○ Greater Bilby<br>○ Spectacled Hare-Wallaby |
| Isolated Rock Outcrops (including Quartz, Calcrete) | High | There is the potential for isolated rocky outcrops to contain den sites for the EPBC listed Northern Quoll or support invertebrate species with restricted ranges. Evidence of Northern Quoll occupation was found amongst artificial rock piles alongside the rail access road. | ○ Northern Quoll (den sites)<br>○ Long-tailed Dunnart |

A map showing the fauna habitats of the Survey Area is presented in Figure 5.2.

672 500mE

675 000mE

Quarry 1

7 727 500mN

7 725 000mN

7 722 500mN

7 720 000mN

N

0 200 400 600 800 1000m

SCALE 1 : 30 000 at A3 (MGA)

**Legend**

- Site Boundary
- Bore Creek Major Drainage Line
- Major Granite Outcrops
- Rocky Ridges and Isolated Rock Outcrops
- Low Lying Drainage Depression
- Sandy Plain with Patches of Stoney Plain
- Cleared

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**Figure 5.2**

**HABITAT MAP**

Drawn: J. Turpin | Date: 4 Jan 2011 | Job: --

# 6. SUMMARY

A total of 280 fauna species, comprising eight amphibian, 94 reptile, 133 bird and 45 mammal species (see Appendix 1), may potentially occur within the Survey Area, based on known species distributions, previous records, and available habitat. During the July survey 58 vertebrate species were recorded, the majority of which were avian taxa. Fourteen mammal species, 31 bird species and 13 reptile species were recorded during the survey. An additional 14 fauna species were recorded during the November 2010 survey bringing the total species list for the Mooka area to 72. This comprised 15 Reptile, 40 Bird, 13 Native Mammal and four introduced mammal species.

Six species of conservation significance were recorded during the survey, they were:

- Northern Quoll (*Dasyurus hallucatus*, EPBC Endangered)
- Western Pebble-mound Mouse (*Pseudomys chapmani*, DEC Priority 4)
- Australia Bustard (*Ardeotis australis*, DEC Priority 4)
- Bush Stone-curlew (*Burhinus grallarius*, DEC Priority 4)
- Rainbow Bee-eater (*Merops ornatus*, EPBC Migratory)
- Oriental Plover (*Charadrius veredus*, EPBC Migratory).

Some additional conservation significant species have the potential to occur in the Survey Area. Most of these are wide-ranging, transient species which are unlikely to rely on the Survey Area as core components of their range. However some species have been recorded in the vicinity of the Survey Area and may utilise the area during foraging or dispersal.

Five Pseudoscorpions were collected from a granite outcrop within the Survey Area. These specimens were identified by the Western Australian Museum and are not considered to be SRE (Framenau, pers. comm.).

As assessed by the criteria in Section 4.2, three habitats are considered of High Significance. These are granite outcrops, rocky ridges and isolated rock outcrops. While drainage lines and spinifex drainage depressions were assigned a Medium Significance level. Figure 5.2 shows the habitats of the Survey Area.

## 7. STUDY TEAM

The Level 1 Fauna survey was planned, co-ordinated and undertaken by Biologic Environmental Survey Pty Ltd.

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This project was undertaken by:
Mr Jeff Turpin – Principal Zoologist
Dr Stewart Ford – Senior Zoologist

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## Appendix 1 Fauna Species List Comparison

Information from three nearby fauna assessments was used to generate species lists as well as DEC and Birds Australia Databases and Field Guides:

- Fauna Survey – Bing to Walla Siding and Repeater 1 (Ecologia, 2008a).
- Fauna Survey – Quarry 1 (Ecologia, 2008b).
- Fauna Survey – Mooka Siding (Preliminary Level 1 Survey, Biologic, 2010)

**KEY**

**DEC** - NatureMap Database
**BA** - Birds Australia, Bird data custom list
**Lit -** Fauna recorded in field guides and other fauna reports
**BW -** Bing to Walla Siding (Ecologia, 2008a)
**Q1 -** Quarry 1 (Ecologia, 2008b)
**MS 1** - Preliminary Mooka Siding (Biologic Survey July 2010)
**MS 2** - Mooka Siding Survey (present study, November 2010)

| SPECIES NAME | COMMON NAME | DEC | BA | Lit | BW | Q1 | MS 1 | MS 2 |
|---|---|---|---|---|---|---|---|---|
| **AMPHIBIA** | | | | | | | | |
| HYLIDAE | | | | | | | | |
| *Cyclorana australis* | Giant Frog | X | | X | | | | |
| *Cyclorana maini* | Main's Frog | X | | X | | | | |
| *Litoria rubella* | Desert Tree Frog | X | | X | X | | | |
| MYOBATRACHIDAE | | | | | | | | |
| *Limnodynastes spenceri* | Spencer's Frog | X | | X | | | | |
| *Neobatrachus aquilonius* | Northern Burrowing Frog | X | | X | | | | |
| *Notaden nichollsi* | Desert Spadefoot | X | | X | | | | |
| *Uperoleia glandulosa* | Glandular Toadlet | X | | X | | | | |
| *Uperoleia russelli* | Russell's Toadlet | X | | X | | | | |
| | | | | | | | | |
| **TOTAL AMPHIBIANS** | **8** | 8 | 0 | 8 | 1 | 0 | 0 | 0 |
| | | | | | | | | |
| **REPTILIA** | | | | | | | | |
| AGAMIDAE | | | | | | | | |
| *Amphibolurus longirostris* | Long-nosed Water Dragon | X | | X | X | X | X | X |
| *Amphibolurus gilberti* | Gilbert's Dragon | | | X | | | | |
| *Ctenophorus caudicinctus* | Ring-tailed Dragon | X | | X | X | X | X | X |
| *Ctenophorus isolepis* | Military Dragon | X | | X | X | X | X | X |
| *Ctenophorus nuchalis* | Central Netted Dragon | X | | X | X | | | X |
| *Diporiphora winneckei* | Blue-lined Dragon | X | | X | | | | |
| *Pogona minor* | Dwarf Bearded Dragon | X | | X | | | | X |
| *Tympanocryptis cephala* | Earless Pebble Dragon | | | X | | | | |
| BOIDAE | | | | | | | | |
| *Antaresia perthensis* | Pygmy Python | X | | X | | | | |
| *Antaresia stimsoni* | Stimson's Python | X | | X | X | X | | |
| *Aspidites melanocephalus* | Black-headed python | X | | X | | | | |
| *Aspidites ramsayi* | Woma | X | | X | | | | |
| *Liasis olivaceus barroni* | Pilbara Olive Python | | | X | | | | |
| CHELIDAE | | | | | | | | |
| *Chelodina steindachneri* | Steindachner's Turtle | | | X | | | | |
| ELAPIDAE | | | | | | | | |
| *Acanthophis pyrrhus* | Desert Death Adder | X | | X | | | | |
| *Acanthophis wellsi* | Pilbara Death Adder | | | X | | | | |
| *Brachyurophis approximans* | NW Shovel-nosed Snake | | | X | | | | |
| *Demansia psammophis* | Yellow-faced Whipsnake | X | | X | | | | |
| *Demansia rufescens* | Rufous Whipsnake | X | | | | | | |
| *Furina ornata* | Moon Snake | X | | X | | | | |
| *Parasuta monachus* | Hooded Snake | | | X | | | | |

| SPECIES NAME | COMMON NAME | DEC | BA | Lit | BW | Q1 | MS 1 | MS 2 |
|---|---|---|---|---|---|---|---|---|
| *Pseudechis australis* | Mulga Snake | X | | X | | | | |
| *Pseudonaja modesta* | Ringed Brown Snake | X | | X | | | | |
| *Pseudonaja nuchalis* | Gwardar | X | | X | | | X | |
| *Simoselaps anomalus* | Desert Banded Snake | X | | X | | | | |
| *Suta fasciata* | Rosen's Snake | | | | | | | |
| *Suta punctata* | Spotted Snake | X | | X | | | | |
| GEKKONIDAE | | | | | | | | |
| *Crenadactylus ocellatus* | Clawless Gecko | | | | | | | |
| *Diplodactylus conspicillatus* | Fat-tailed Gecko | X | | X | | | | X |
| *Diplodactylus savagei* | A Gecko | | | X | | | | |
| *Gehyra pilbara* | Pilbara Dtella | | | X | | | | |
| *Gehyra punctata* | Spotted Dtella | X | | X | X | X | X | X |
| *Gehyra purpurascens* | Purple Arid Dtella | X | | | | | | |
| *Gehyra variegata* | Tree Dtella | X | | X | | | | |
| *Heteronotia binoei* | Bynoe's Gecko | X | | X | | | | |
| *Heteronotia spelea* | Desert Cave Gecko | | | X | | | | |
| *Lucasium stenodactylum* | Pale-snouted Gecko | X | | X | | | | |
| *Lucasium wombeyi* | A Gecko | | | | | | | |
| *Nephrurus levis* | Pilbara Knob-tailed Gecko | X | | X | | | | |
| *Oedura marmorata* | Marbled Velvet Gecko | | | X | | | | |
| *Rhynchoedura ornata* | Beaked Gecko | X | | X | | | | |
| *Strophurus ciliaris* | Spiny-tailed Gecko | X | | X | | | | |
| *Strophurus elderi* | Jewelled Gecko | X | | X | | | | |
| *Strophurus jeanae* | A gecko | | | X | | | | |
| *Strophurus wellingtonae* | A gecko | | | | | | | |
| PYGOPODIDAE | | | | | | | | |
| *Delma butleri* | A legless lizard | | | X | | | | |
| *Delma haroldi* | A legless lizard | X | | X | | | | |
| *Delma nasuta* | Long-nosed Delma | | | X | | | | |
| *Delma pax* | A legless lizard | X | | X | | | | |
| *Delma tincta* | A legless lizard | X | | X | | | | |
| *Lialis burtonis* | Burton's Snake Lizard | X | | X | | | | |
| *Pygopus nigriceps* | Hooded Scaly-foot | X | | X | | | | |
| SCINCIDAE | | | | | | | | |
| *Carlia munda* | A skink | | | X | | | | |
| *Carlia triacantha* | A skink | X | | X | | | | |
| *Cryptoblepharus buchananii* | Fence Skink | X | | X | | | | |
| *Cryptoblepharus ustulatus* | A skink | | | X | | | | |
| *Ctenotus duricola* | A skink | X | | X | | | X | X |
| *Ctenotus grandis* | A skink | X | | X | | | | |

| SPECIES NAME | COMMON NAME | DEC | BA | Lit | BW | Q1 | MS 1 | MS 2 |
|---|---|---|---|---|---|---|---|---|
| *Ctenotus hanloni* | A skink | X | | X | | | | |
| *Ctenotus helenae* | A skink | X | | X | | | | |
| *Ctenotus pantherinus* | Leopard Skink | X | | X | X | X | X | X |
| *Ctenotus piankai* | Coarse Sands Ctenotus | X | | X | | | | |
| *Ctenotus rufescens* | A skink | X | | X | | | | |
| *Ctenotus rubicundus* | A skink | | | | | | | |
| *Ctenotus saxatilis* | A skink | X | | X | X | X | X | X |
| *Ctenotus serventyi* | A skink | X | | | | | | |
| *Ctenotus schomburgkii* | A skink | | | | | | | |
| *Cyclodomorphus melanops* | Spinifex Slender Skink | | | X | | | | |
| *Egernia depressa* | Pygmy Spiny-tailed Skink | X | | X | | | X | X |
| *Egernia formosa* | Goldfields Crevice Skink | | | X | | | | |
| *Eremiascincus fasciolatus* | Narrow Banded Skink | X | | | | | | |
| *Eremiascincus richardsonii* | Broad Banded Skink | X | | X | | | | |
| *Lerista bipes* | A skink | X | | X | | | | |
| *Lerista clara* | A skink | X | | | | | | |
| *Lerista muelleri* | A skink | | | X | | | | |
| *Lerista jacksoni* | A skink | X | | | | | | |
| *Menetia greyii* | Common Dwarf Skink | X | | X | | | | |
| *Menetia surda* | A skink | | | | | | | |
| *Morethia ruficauda* | Three Striped Fire-tail Skink | X | | X | X | | | X |
| *Notoscincus ornatus* | Ornate Soil-crevice Skink | X | | X | | | | |
| *Proablepharus reginae* | A skink | X | | X | | | | |
| *Tiliqua multifasciata* | Central Blue-tongue | X | | X | | | | |
| TYPHLOPIDAE | | | | | | | | |
| *Ramphotyphlops ammodytes* | A blind snake | X | | X | | | | |
| *Ramphotyphlops grypus* | A blind snake | X | | X | | | | |
| *Ramphotyphlops hamatus* | A blind snake | X | | | | | | |
| *Ramphotyphlops pilbarensis* | A blind snake | X | | | | | | |
| VARANIDAE | | | | | | | | |
| *Varanus acanthurus* | Ridge-tailed Monitor | X | | X | | | X | |
| *Varanus brevicauda* | Short-tailed Monitor | X | | X | | | | |
| *Varanus eremius* | Bush's Pygmy Monitor | X | | X | | X | | X |
| *Varanus giganteus* | Perentie | | | X | X | | | |
| *Varanus gouldii* | Gould's Monitor | X | | X | | X | | |
| *Varanus panoptes* | A goanna | | | X | | | | |
| *Varanus pilbarensis* | Pilbara Rock Monitor | | | X | | | | |
| *Varanus tristis* | Black-headed Monitor | | | X | | | | |
| | | | | | | | | |
| **TOTAL REPTILES** | **94** | 64 | 0 | 79 | 10 | 9 | 10 | 13 |

| SPECIES NAME | COMMON NAME | DEC | BA | Lit | BW | Q1 | MS 1 | MS 2 |
|---|---|---|---|---|---|---|---|---|
| **AVES** | | | | | | | | |
| CASUARIIDAE | | | | | | | | |
| *Dromaius novaehollandiae* | Emu | | X | X | | | | |
| PHASIANIDAE | | | | | | | | |
| *Coturnix pectoralis* | Stubble Quail | | | X | | | | |
| *Coturnix ypsilophora* | Brown Quail | | X | X | | | | |
| ANATIDAE | | | | | | | | |
| *Anas gracilis* | Grey Teal | | X | X | X | | | |
| *Anas superciliosa* | Pacific Black Duck | | X | X | X | X | | |
| *Aythya australis* | Hardhead | | X | | | | | |
| *Dendrocynga eytoni* | Plumed Whistling Duck | | X | X | | | | |
| PHALACROCORACIDAE | | | | | | | | |
| *Phalacrocorax sulcirostris* | Little Black Cormorant | | X | X | | | | |
| *Phalacrocorax melanoleucos* | Little Pied Cormorant | | X | X | X | | | |
| *Phalacrocorax varius* | Pied Cormorant | | X | X | | | | |
| *Phalacrocorax carbo* | Great Cormorant | | X | X | | | | |
| CICONIDAE | | | | | | | | |
| *Ephippiorhynchus asiaticus* | Black-necked Stork | | X | X | | | | |
| ARDEIDAE | | | | | | | | |
| *Ardea ibis* | Cattle Egret | | X | X | | | | |
| *Ardea alba* | Great Egret | | X | X | | | | |
| *Ardea intermedia* | Intermediate Egret | | X | X | | | | |
| *Egretta garzetta* | Little Egret | X | X | X | | | | |
| *Nycticorax caledonicus* | Nankeen Night Heron | | X | X | | | | |
| *Ardea pacifica* | White-necked Heron | | X | X | | | | |
| *Egretta novaehollandiae* | White-faced Heron | | X | X | X | X | | |
| THRESKIORNITHIDAE | | | | | | | | |
| *Threskiornis spinicollis* | Straw-necked Ibis | | X | X | | | | |
| ACCIPITRIDAE | | | | | | | | |
| *Accipiter cirrhocephalus* | Collared Sparrowhawk | | X | X | | | | |
| *Accipiter fasciatus* | Brown Goshawk | | X | X | | | | |
| *Aquila audax* | Wedge-tailed Eagle | | X | X | X | | | X |
| *Circus assimilis* | Spotted Harrier | X | X | X | X | | | |
| *Elanus axillaris* | Black-shouldered Kite | X | X | X | | | | |
| *Haliastur sphenurus* | Whistling Kite | | X | X | X | X | X | |
| *Hamirostra melanosternon* | Black-breasted Buzzard | | | X | | | | |
| *Hieraaetus morphnoides* | Little Eagle | | X | X | X | | X | |
| *Lophoictinia isura a* | Square-tailed Kite | | | X | | | | |
| *Milvus migrans* | Black Kite | | X | | | | | X |
| FALCONIDAE | | | | | | | | |

| SPECIES NAME | COMMON NAME | DEC | BA | Lit | BW | Q1 | MS 1 | MS 2 |
|---|---|---|---|---|---|---|---|---|
| *Falco berigora* | Brown Falcon | | X | X | X | | X | X |
| *Falco cenchroides* | Australian Kestrel | X | X | X | X | | X | X |
| *Falco longipennis* | Australian Hobby | X | X | X | | | | |
| *Falco peregrinus* | Peregrine Falcon | | | X | | | | |
| *Falco hypoleucos* | Grey Falcon | | X | X | | | | |
| OTIDIDAE | | | | | | | | |
| *Ardeotis australis* | Australian Bustard | X | X | X | | | X | X |
| BURHINIDAE | | | | | | | | |
| *Burhinus grallarius* | Bush Stone-curlew | | X | X | | | X | X |
| RECURVIROSTRIDAE | | | | | | | | |
| *Himantopus himantopus* | Black-winged Stilt | | X | X | | X | | |
| TURNICIDAE | | | | | | | | |
| *Turnix velox* | Little Button-quail | X | | X | X | | | |
| SCOLOPACIDAE | | | | | | | | |
| *Actitis (Tringa) hypoleucos* | Common Sandpiper | | X | X | | | | |
| *Tringa glareola* | Wood Sandpiper | | X | X | | | | |
| *Tringa nebularia* | Common Greenshank | | X | X | | | | |
| *Tringa stagnatilis* | Marsh Sandpiper | | X | X | | | | |
| GLAREOLIDAE | | | | | | | | |
| *Stiltia isabella* | Australian Pratincole | | X | X | | | | |
| *Glareola maldivarum* | Oriental Pratincole | | X | X | | | | |
| CHARADRIIDAE | | | | | | | | |
| *Elseyornis melanops* | Black-fronted Dotterel | | X | X | X | | | |
| *Charadrius ruficapillus* | Red-capped Plover | X | X | X | | | | |
| *Charadrius australis* | Inland Dotterel | | | X | | | | |
| *Charadrius veredus* | Oriental Plover | | X | X | | | | X |
| *Erythrogonys cinctus* | Red-kneed Dotterel | | X | X | | | | |
| *Vanellus miles* | Masked Lapwing | | X | X | | | | |
| *Vanellus tricolor* | Banded Lapwing | | X | X | | | | |
| COLUMBIDAE | | | | | | | | |
| *Geopelia cuneata* | Diamond Dove | | X | X | X | | | X |
| *Geopelia striata* | Peaceful Dove | | X | X | X | | X | |
| *Geophaps plumifera* | Spinifex Pigeon | X | X | X | X | | X | X |
| *Ocyphaps lophotes* | Crested Pigeon | X | X | X | X | | X | X |
| *Phaps chalcoptera* | Common Bronzewing | | | X | | | | |
| *Phaps histrionica* | Flock Bronzewing | X | | | | | | |
| CACATUIDAE | | | | | | | | |
| *Cacatua roseicapilla* | Galah | X | X | X | X | | X | X |
| *Cacatua sanguinea* | Little Corella | | X | X | X | | X | X |
| *Nymphicus hollandicus* | Cockatiel | | X | X | X | | X | |

| SPECIES NAME | COMMON NAME | DEC | BA | Lit | BW | Q1 | MS 1 | MS 2 |
|---|---|---|---|---|---|---|---|---|
| PSITTACIDAE | | | | | | | | |
| *Barnardius zonarius* | Australian Ringneck | | X | X | X | | | |
| *Melopsittacus undulatus* | Budgerigar | X | X | X | X | | | |
| *Pezoporus occidentalis* | Night Parrot | | | X | | | | |
| CUCULIDAE | | | | | | | | |
| *Chalchites (Chrysococcyx) basalis* | Horsfield's Bronze Cuckoo | | X | X | | | | X |
| *Chalchites osculans* | Black-eared Cuckoo | | | X | | | | |
| *Cuculus pallidus* | Pallid Cuckoo | | X | X | | | X | |
| *Pheasant Coucal* | Pheasant Coucal | | X | X | | | | |
| STRIGIDAE | | | | | | | | |
| *Ninox connivens* | Barking Owl | | X | X | | | | |
| *Ninox novaeseelandiae* | Southern Boobook | | X | X | | | | |
| TYTONIDAE | | | | | | | | |
| *Tyto alba* | Barn Owl | X | X | X | | | | |
| PODARGIDAE | | | | | | | | |
| *Podargus strigoides* | Tawny Frogmouth | | X | X | | | | |
| CAPRIMULGIDAE | | | | | | | | |
| *Eurostopodus argus* | Spotted Nightjar | | X | X | X | | | |
| AEGOTHELIDAE | | | | | | | | |
| *Aegotheles cristatus* | Australian Owlet-nightjar | | X | X | | | | |
| APODIDAE | | | | | | | | |
| *Apus pacificus* | Fork-tailed Swift | | X | X | | | | |
| HALCYONIDAE | | | | | | | | |
| *Dacelo leachii* | Blue-winged Kookaburra | | X | X | X | | | |
| *Todirhamphus pyrrhopygia* | Red-backed Kingfisher | X | X | X | X | | X | X |
| *Todirhamphus sanctus* | Sacred Kingfisher | | X | x | X | | | |
| MEROPIDAE | | | | | | | | |
| *Merops ornatus* | Rainbow Bee-eater | | X | X | X | | X | X |
| CLIMACTERIDAE | | | | | | | | |
| *Climacteris melanura* | Black-tailed Treecreeper | | X | X | | | | |
| MALURIDAE | | | | | | | | |
| *Amytornis striatus* | Striated Grasswren | | | X | | | | |
| *Malurus lamberti* | Variegated Fairy-wren | X | X | X | | | X | X |
| *Malurus leucopterus* | White-winged Fairy-wren | X | X | X | X | X | X | X |
| *Stipiturus ruficeps* | Rufous-crowned Emu-wren | | | X | | | | |
| PARDALOTIDAE | | | | | | | | |
| *Pardalotus rubricatus* | Red-browed Pardalote | | X | X | | | | |
| *Pardalotus striatus* | Striated Pardalote | | X | X | | | | |
| ACANTHIZIDAE | | | | | | | | |

| SPECIES NAME | COMMON NAME | DEC | BA | Lit | BW | Q1 | MS 1 | MS 2 |
|---|---|---|---|---|---|---|---|---|
| *Gerygone fusca* | Western Gerygone | | X | X | | | | |
| *Smicrornis brevirostris* | Weebill | X | | X | | | | |
| MELIPHAGIDAE | | | | | | | | |
| *Acanthagenys rufogularis* | Spiny-cheeked Honeyeater | | | X | | | | |
| *Certhionyx niger* | Black Honeyeater | | | X | X | | | |
| *Epthianura aurifrons* | Orange Chat | | X | X | | | | |
| *Epthianura tricolor* | Crimson Chat | | X | X | | | | |
| *Lichenostomus keartlandi* | Grey-headed Honeyeater | | X | X | | | | |
| *Lichenostomus penicillatus* | White-plumed Honeyeater | X | X | X | X | | X | X |
| *Lichenostomus virescens* | Singing Honeyeater | X | X | X | X | | X | X |
| *Lichmera indistincta* | Brown Honeyeater | X | X | X | X | | | |
| *Manorina flavigula* | Yellow-throated Miner | X | X | X | | | X | X |
| *Melithreptus gularis laetior* | Black-chinned Honeyeater | | X | X | | | | |
| PETROICIDAE | | | | | | | | |
| *Melanodryas cucullata* | Hooded Robin | | | X | | | | |
| *Petroica goodenovii* | Red-capped Robin | | | X | | | | |
| POMATOSTOMIDAE | | | | | | | | |
| *Pomatostomus temporalis* | Grey-crowned Babbler | | X | X | | | | |
| NEOSITTIDAE | | | | | | | | |
| *Daphoenositta chrysoptera* | Varied Sitella | | | X | | | | |
| PACHYCEPHALIDAE | | | | | | | | |
| *Colluricincla harmonica* | Grey Shrike-thrush | | X | X | | | X | |
| *Oreoica gutturalis* | Crested Bellbird | | X | X | | X | | |
| *Pachycephala rufiventris* | Rufous Whistler | | X | X | | | X | X |
| DICRURIDAE | | | | | | | | |
| *Grallina cyanoleuca* | Magpie-lark | X | X | X | X | | X | X |
| *Rhipidura albiscapa* | Grey Fantail | | X | X | | | | |
| *Rhipidura leucophrys* | Willie Wagtail | X | X | X | X | X | X | X |
| CAMPEPHAGIDAE | | | | | | | | |
| *Coracina maxima* | Ground Cuckoo-shrike | | X | | | | | |
| *Coracina novaehollandiae* | Black-faced Cuckoo-shrike | | X | X | X | | X | X |
| *Lalage sueurii* | White-winged Triller | | X | X | | | X | |
| ARTAMIDAE | | | | | | | | |
| *Artamus cinereus* | Black-faced Woodswallow | X | X | X | X | X | X | X |
| *Artamus leucorhynchus* | White-breasted Woodswallow | X | X | X | | | | |
| *Artamus minor* | Little Woodswallow | | | X | | | | |
| *Artamus personatus* | Masked Woodswallow | | X | X | | | | |
| *Cracticus nigrogularis* | Pied Butcherbird | | X | X | | X | | |
| *Cracticus torquatus* | Grey Butcherbird | | | X | | | | |
| *Gymnorhina (Cracticus) tibicen* | Australian Magpie | | X | X | | | | |

| SPECIES NAME | COMMON NAME | DEC | BA | Lit | BW | Q1 | MS 1 | MS 2 |
|---|---|---|---|---|---|---|---|---|
| CORVIDAE | | | | | | | | |
| *Corvus bennetti* | Little Crow | X | X | X | | | | |
| *Corvus orru* | Torresian Crow | X | X | X | X | | X | X |
| PTILONORHYNCHIDAE | | | | | | | | |
| *Chlamydera guttata* | Western Bowerbird | X | X | X | X | | | |
| ALAUDIDAE | | | | | | | | |
| *Mirafra javanica* | Singing Bushlark | | X | X | X | | X | X |
| MOTACILLIDAE | | | | | | | | |
| *Anthus novaeseelandiae* | Australian Pipit | | X | X | | | X | X |
| PASSERIDAE | | | | | | | | |
| *Emblema pictum* | Painted Finch | | X | X | X | | | |
| *Neochmia ruficauda* | Star Finch | X | X | X | | | | |
| *Taeniopygia guttata* | Zebra Finch | X | X | X | X | | X | X |
| DICAEIDAE | | | | | | | | |
| *Dicaeum hirundinaceum* | Mistletoebird | | X | X | | | | |
| HIRUNDINIDAE | | | | | | | | |
| *Cheramoeca leucosternum* | White-backed Swallow | | X | X | | | | |
| *Hirundo ariel* | Fairy Martin | | X | X | X | X | X | X |
| *Hirundo nigricans* | Tree Martin | | X | X | X | | X | |
| *Hirundo neoxena* | Welcome Swallow | X | X | X | | | | |
| SYLVIIDAE | | | | | | | | |
| *Cinclorhamphus mathewsi* | Rufous Songlark | X | X | X | | | X | |
| *Eremiornis carteri* | Spinifexbird | | X | X | X | | X | X |
| | | | | | | | | |
| **TOTAL BIRDS** | **133** | 33 | 113 | 12 | 43 | 10 | 35 | 31 |
| | | | | | | | | |
| **MAMMALIA** | | | | | | | | |
| TACHYGLOSSIDAE | | | | | | | | |
| *Tachyglossus aculeatus* | Echidna | X | | X | | | X | |
| *Dasyurus hallucatus* | Northern Quoll | X | | X | | X | X | X |
| *Dasycercus blythi* | Brush-tailed Mulgara | X | | X | | | | |
| *Dasycercus cristicauda* | Crest-tailed Mulgara | X | | | | | | |
| *Antechinomys laniger* | Kultarr | X | | | | | | |
| *Dasykaluta rosamondae* | Kaluta | X | | X | | | X | X |
| *Ningaui timealeyi* | Pilbara Ningaui | X | | X | | | | |
| *Planigale sp.* | A Planigale | | | X | | | | |
| *Pseudantechinus roryi* | Rory's Pseudantechinus | | | X | | | | |
| *Pseudantechinus woolleyae* | Woolley's Pseudantechinus | | | | | | | |
| *Sminthopsis macroura* | Stripe-faced Dunnart | | | X | | | | |
| *Sminthopsis youngsoni* | Lesser Hairy-footed Dunnart | X | | X | | | | |

| SPECIES NAME | COMMON NAME | DEC | BA | Lit | BW | Q1 | MS 1 | MS 2 |
|---|---|---|---|---|---|---|---|---|
| PERAMELIDAE | | | | | | | | |
| *Macrotis lagotis* | Bilby, Dalgyte | X | | | | | | |
| MACROPODIDAE | | | | | | | | |
| *Lagostrophus conspicillatus* | Spectacled Hare-wallaby | | | X | | | | |
| *Macropus robustus erubescens* | Euro | X | | X | | | X | X |
| *Macropus rufus* | Red Kangaroo | X | | X | | | | |
| EMBALLONURIDAE | | | | | | | | |
| *Saccolaimus flaviventris* | Yellow-bellied Sheath-tail Bat | | | X | | | | X |
| *Taphozous georgianus* | Common Sheath-tail Bat | X | | X | | | X | X |
| MEGADERMATIDAE | | | | | | | | |
| *Macroderma gigas* | Ghost Bat | X | | X | | | | |
| HIPPOSIDERIDAE | | | | | | | | |
| *Rhinonicteris aurantia* | Pilbara Leaf-nosed Bat | X | | X | | | | |
| MOLOSSIDAE | | | | | | | | |
| *Chaerephon jobensis* | Northern Mastiff-bat | X | | X | | | | |
| *Mormopterus beccarii* | Beccari's Freetail-bat | | | X | | | | |
| *Tadarida australis* | White-striped Mastiff-bat | | | X | | | X | |
| VESPERTILIONIDAE | | | | | | | | |
| *Chalinolobus gouldii* | Gould's Wattled Bat | | | X | | | X | X |
| *Chalinolobus morio* | Chocolate Wattle Bat | | | X | | | | |
| *Nyctophilus bifax* | Eastern Long-eared Bat | | | X | | | | |
| *Nyctophilus geoffroyi* | Lesser Long-eared Bat | X | | X | | | | |
| *Scotorepens greyii* | Little Broad-nosed Bat | | | X | | | X | X |
| *Vespadelus finlaysoni* | Finlayson's Cave Bat | X | | X | | | X | X |
| MURIDAE | | | | | | | | |
| *Leggadina lakedownensis* | Short-tailed Mouse | | | X | | | | |
| *Notomys alexis* | Spinifex Hopping-mouse | X | | X | | | | |
| *Pseudomys chapmani* | Western Pebble-mound Mouse | X | | X | | | X | X |
| *Pseudomys desertor* | Desert Mouse | X | | X | | | | |
| *Pseudomys hermannsburgensis* | Sandy Inland Mouse | X | | X | | | X | |
| *Pseudomys delicatulus* | Delicate Mouse | X | | | | | | |
| *Pseudomys nanus* | Western Chestnut Mouse | X | | | | | | |
| *Zyzomys argurus* | Common Rock-rat | X | | X | | | X | X |
| | | | | | | | | |
| *INTRODUCED MAMMALS* | | | | | | | | |
| **Bos taurus* | Cattle | | | X | X | | X | X |
| **Canis lupus dingo* | Dingo | X | | X | X | | X | X |
| **Felis catus* | Cat | X | | X | | | X | X |
| **Mus musculus* | House Mouse | X | | X | | | | |
| **Oryctolagus cuniculus* | Rabbit | | | | | | | |

| SPECIES NAME | COMMON NAME | DEC | BA | Lit | BW | Q1 | MS 1 | MS 2 |
|---|---|---|---|---|---|---|---|---|
| **Vulpes vulpes* | Fox | X | | X | | | | |
| **Equus asinus* | Donkey | | | X | | | | |
| **Camelus dromedarius* | Camel | | | X | | | X | X |
| | | | | | | | | |
| **TOTAL NATIVE MAMMALS** | **38** | 25 | 0 | 32 | 0 | 1 | 12 | 10 |
| **TOTAL INTRODUCED MAMMALS** | **8** | 3 | 0 | 6 | 2 | 0 | 4 | 4 |

## Appendix 2 Department of Environment and Conservation, Western Australian Wildlife Conservation Act 1950 and Environment Protection and Biodiversity Conservation Act 1999 Categories of Conservation

Categories used in the assessment of conservation status. IUCN categories (based on review by Mace and Stuart 1994) as used for the *Environment Protection and Biodiversity Conservation* (EPBC) *Act 1999* and the *WA Wildlife Conservation Act 1950*.

| Category | Definition |
|---|---|
| **Extinct** | Taxa not definitely located in the wild during the past 50 years. |
| **Extinct in the Wild** | Taxa known to survive only in captivity. |
| **Critically Endangered** | Taxa facing an extremely high risk of extinction in the wild in the immediate future. |
| **Endangered** | Taxa facing a very high risk of extinction in the wild in the near future. |
| **Vulnerable** | Taxa facing a high risk of extinction in the wild in the medium-term future. |
| **Near Threatened** | Taxa that risk becoming Vulnerable in the wild. |
| **Conservation Dependent** | Taxa whose survival depends upon ongoing conservation measures. Without these measures, a conservation dependent taxon would be classed as Vulnerable or more severely threatened. |
| **Data Deficient (Insufficiently Known)** | Taxa suspected of being Rare, Vulnerable or Endangered, but whose true status cannot be determined without more information. |
| **Least Concern** | Taxa that are not Threatened. |

Schedules used in the WA *Wildlife Conservation Act 1950*.

| Category | Definition |
|---|---|
| **Schedule 1**. | Rare and Likely to become Extinct. |
| **Schedule 2** | Extinct. |
| **Schedule 3** | Migratory species listed under international treaties. |
| **Schedule 4** | Other Specially Protected Fauna. |

WA Department of Environment and Conservation Priority species (species not listed under the Conservation Act, but for which there is some concern).

| Category | Definition |
|---|---|
| **Priority 1** | Taxa with few, poorly known populations on threatened lands. |
| **Priority 2** | Taxa with few, poorly known populations on conservation lands; or taxa with several, poorly known populations not on conservation lands. |
| **Priority 3** | Taxa with several, poorly known populations, some on conservation lands. |
| **Priority 4** | Taxa in need of monitoring. Taxa which are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection, but could be if present circumstances change. |
| **Priority 5** | Taxa in need of monitoring. Taxa which are not considered threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years (IUCN Conservation Dependent). |

## Appendix 3 Habitat Photographs

**Plate 1 a & b Sandy Plains with spinifex hummock grasslands and mixed *Acacia* shrublands.**

**Plate 2** **Stony Plains with open shrubland of *Acacia inaequilatera* and spinifex hummock grasslands.**

**Plate 3** **Bore Creek: a minor drainage line supporting scattered *Corymbia* sp and fringing mixed *Acacia* shrubland.**

**Plate 4 a & b Granite Outcrops: containing boulder piles, seasonal gnamma holes, moist depressions and fringing *Acacia* thickets.**

**Plate 5** **Rocky Ridges: a series of linear Quartz ridges extend north – south on the eastern and western margins of the Survey Area.**

**Plate 6 a & b** **Low Lying drainage depressions: supporting spinifex grassland with seasonal small waterholes on sandy clay loam.**

**Plate 7 a & b** **Occasional minor rocky outcrops (including Quartz, Calcrete, Silcrete) occurring within the sandy and stony plains.**

**Plate 8 Quarry 1.**

**Plate 9 Artificial Rock Piles.**

## Appendix 4 Conservation Significant Fauna From the Mooka survey

| Species | Location / Habitat | Easting | Northing | Record |
|---|---|---|---|---|
| *Dasyurus hallucatus* | Quarry 1 | 672006 | 7729143 | Camera, scats |
| *Dasyurus hallucatus* | Quarry 1 | 672071 | 7729174 | Camera |
| *Dasyurus hallucatus* | Granite Outcrop 1 | 673000 | 7728304 | Camera |
| *Dasyurus hallucatus* | Granite Outcrop Small | 675001 | 7727883 | Scats |
| *Dasyurus hallucatus* | Granite Outcrop Large | 676182 | 7729936 | Camera |
| *Dasyurus hallucatus* | Calcrete Outcrop | 672319 | 7729239 | Scats |
| *Dasyurus hallucatus* | Roadside Rock Pile | 672434 | 7727736 | Scats |
| *Pseudomys chapmani* | Stony Lower Hill slope | 672722 | 7722082 | Old inactive mound |
| *Pseudomys chapmani* | Stony Lower Hill slope | 672668 | 7721958 | Old inactive mound |
| *Pseudomys chapmani* | Stony Lower Hill slope | 672539 | 7722238 | Old inactive mound |
| *Pseudomys chapmani* | Stony Lower Hill slope | 672568 | 7724152 | Old inactive mound |
| *Pseudomys chapmani* | Stony Lower Hill slope | 672658 | 7721930 | Old inactive mound |
| *Pseudomys chapmani* | Stony Lower Hill slope | 674375 | 7726212 | Active mound |
| Australian Bustard | Spinifex Grassland | 672494 | 7723769 | Tracks |
| Australian Bustard | Spinifex Grassland | 672653 | 7722276 | Tracks |
| Australian Bustard | Spinifex Grassland | 673033 | 7722292 | Tracks |
| Australian Bustard | Spinifex Grassland | 672929 | 7724875 | Tracks |
| Australian Bustard | Spinifex Grassland | 673321 | 7726137 | Tracks |
| Australian Bustard | Spinifex Grassland | 673058 | 7722283 | Tracks |
| Bush Stone-Curlew | Bore Creek | 673677 | 7720128 | Tracks |
| Bush Stone-Curlew | Spinifex Grassland | 673503 | 7722791 | Tracks |
| Bush Stone-Curlew | Spinifex Grassland | 673771 | 7722619 | Tracks |
| Bush Stone-Curlew | Spinifex Grassland | 673590 | 7722668 | Tracks |
| Bush Stone-Curlew | Spinifex Grassland | 672603 | 7728099 | Tracks |

| Species | Location / Habitat | Easting | Northing | Record |
|---|---|---|---|---|
| Bush Stone-Curlew | Spinifex Grassland | 672853 | 7723446 | Tracks |
| Rainbow Bee-eater | Bore Creek | 673676 | 7720179 | Observation |
| Rainbow Bee-eater | Bore Creek | 672876 | 7720508 | Potential Nest Site |

## Appendix 5 Habitat assessment summary

| | Habitat type | Granite Outcrops | Rocky Ridge | Minor Drainage Line | Spinifex Drainage Depression | Stony Plain | Sand plain | Isolated Rock Outcrops |
|---|---|---|---|---|---|---|---|---|
| | **No. of assessments** | 4 | 3 | 3 | 3 | 4 | 4 | 3 |
| **Landform** | **Slope** | Level to moderately inclined | Gently to moderately inclined | Level to very gently inclined | Level | Level | Level | Level to moderately inclined |
| | **Morphological Type** | Rock Outcrop | Ridge | Flat or open depression | Open Depression | Flat | Flat | Rock Outcrop |
| | **Landform Type** | Rock Platform | Hillslope, low hill or hillcrest | Stream channel | Drainage depression | Plain | Sand plain | Rock Platform |
| | **Relative Percentage of Survey Area (estimate)** | <5 % | <5 % | <5 % | 10 % | 25 % | 50 % | <5 % |
| **Vegetation** | **Disturbance** | Light grazing, clearing | Light grazing, fire damage (1 -5, 5-10 yrs), fire damage (>10 yrs) | Fire damage (1-5 yrs) fire damage (5-10 yrs), Light – Heavy Grazing | Light grazing | Light grazing, fire damage (1-5, 5-10 yrs), fire damage (>10 yrs) | Light grazing, fire damage (1-5, 5-10 yrs), fire damage (>10 yrs) | Light grazing, fire damage (1-5, 5-10 yrs), fire damage (>10 yrs) |
| | **Vegetation Condition** | Uneven to mature phase | Early regeneration to uneven phase | Uneven to mature phase | Mature phase | Early regeneration to uneven phase | Early regeneration to mature phase | Early regeneration to mature phase |
| | **Leaf Litter %** | 3.25 | 3 | 13.3 | 3 | 4.5 | 5 | 8 |
| | **Twig Littler %** | 4 | 1.3 | 6.6 | 2.6 | 2.5 | 5 | 5.5 |
| | **Wood Litter (/2500m2)** | 0.25 | 0.3 | 5 | 0 | 0.5 | 1 | 0.5 |
| | **DeadStags (/2500m2)** | 0.25 | 0 | 4 | 0 | 0 | 0.75 | 0 |
| | **Hollowbearingtrees (/2500m2)** | 0.25 | 0 | 3.3 | 0 | 0 | 0.75 | 0.5 |
| | **Broad floristic formation** | *Acacia colei* shrubland to scattered *Acacia* spp. Over *Triodia* spp. With scattered *Corymbia hamersleyana* | *Acacia inaequilatera* open shrubland over *Triodia* sp. hummock grassland | *Scattered Corymbia sp* with open mixed *Acacia* shrublands and *Triodia pungens* hummock grassland | *Triodia spp.* Hummock grassland | *Acacia inaequilatera* open shrubland over *Triodia* sp. hummock grassland | Scattered *Corymbia hamersleyana* with open mixed *Acacia* shrublands and *Triodia spp.* hummock grassland | Low *Acacia* shrubland over *Triodia* spp. Hummock grasslands |
| | **Tree structure (tall)** | None | None | None | None | None | None | None |
| | **Tree structure (mid)** | None | None | Mostly none to isolated trees | None | None | None | None |

| | Habitat type | Granite Outcrops | Rocky Ridge | Minor Drainage Line | Spinifex Drainage Depression | Stony Plain | Sand plain | Isolated Rock Outcrops |
|---|---|---|---|---|---|---|---|---|
| | **Tree structure (low)** | Isolated clumps of trees | None | Mostly isolated trees to sparse woodland | None | None | Isolated trees | None |
| | **Shrub structure (tall)** | None | None | Mostly none to isolated clumps of shrubs | none | Mostly none to isolated shrubs | None | None |
| | **Shrub structure (mid)** | None to shrubland | None to open shrubland | None to shrubland | none | Isolated shrubs to open shrubland | Open shrubland | Isolated shrubs to open shrubland |
| | **Shrub structure (low)** | Mostly none to sparse shrubland | None to sparse shrubland | None to sparse shrubland | Isolated shrubs | None to open shrubland | Isolated shrubs to sparse shrubland | Isolated shrubs to sparse shrubland |
| | **Grass structure (tall)** | None | None | None | None | None | None | None |
| | **Grass structure (mid)** | Mostly none to open grassland | None to sparse grassland | None to closed grassland | None to grassland | None | None | None |
| | **Grass structure (low)** | None to open grassland | None to open grassland | None to grassland | None to grassland | None to grassland | None to grassland | None to grassland |
| | **Dominant trees** | *Corymbia hamersleyana* | None | *Corymbia sp.* | None | None | *Corymbia hamersleyana* | None |
| | **Dominant shrubs** | *Acacia colei* | *Acacia inaequilatera* | *Acacia* spp. | None | *Acacia* spp. | *Acacia* spp. | *Acacia inaequilatera* |
| | **Dominant grasses** | *Triodia pungens* | *Triodia* spp. | *Triodia* spp., Buffel Grass | *Triodia spp.* | *Triodia spp* | *Triodia spp* | *Triodia spp* |
| **Land Surface** | **Microrelief** | No microrelief | No microrelief | No microrelief | No microrelief | No microrelief | No microrelief | No microrelief |
| | **Sheet erosion** | None to minor | None to Minor | Mostly none | Mainly none, but some minor | Mainly none, but some minor | None | None |
| | **Rill erosion** | None | None | None to moderate | Mainly none, but some minor | Minor rill erosion | None | None |
| | **Gully erosion** | None | None | None to moderate | None | None | None | None |
| | **Gully depth** | None | None | None to 1.5m | None | None | None | None |
| | **Abundance of coarse fragments** | Moderate/many to abundant | Moderate/many to very/abundant | None to very few | None to very few | Mostly common to Moderate | Very slightly/very few | Very / Abundant |

| | Habitat type | Granite Outcrops | Rocky Ridge | Minor Drainage Line | Spinifex Drainage Depression | Stony Plain | Sand plain | Isolated Rock Outcrops |
|---|---|---|---|---|---|---|---|---|
| | **Size of coarse fragments** | All sizes | All sizes | Fine gravel | Fine gravel to large pebbles | Coarse gravel to large pebbles | Medium gravelly | Cobbles to stones |
| | **Abundance of rock outcrop** | Rockland | Rocky | None | None | None | None | Slightly to very rocky |
| | **Water bodies** | Seasonal gnamma holes, depressions containing moist soil | None | None, however evidence of seasonal water bodies | Some small seasonal waterbodies | None | None | None |
| | **Nests, burrows, roosts, diggings** | Numerous rock crevices, den sites amongst boulders, several colonies of Egernia depressa found. | Numerous rock crevices, den sites amongst boulders, several colonies of Egernia depressa found. | Varanid diggings, old nest burrows in creek banks, some tree hollows. | Varanid diggings, large spinifex clumps provide shelter. | Varanid diggings, large spinifex clumps provide shelter. | Varanid diggings, large spinifex clumps provide shelter. | Some rock crevices |
| | **Soil water status** | Dry to Moist | Dry | Dry to Moist | Dry to Moist | Dry | Dry | Dry |
| **Geology** | **Existence of substrate form** | Mostly outcropping | Mostly outcropping | No surface exposure | No surface exposure | No surface exposure | No surface exposure | Vertical exposure (outcropping) |
| | **Rock type** | Granite | Quartz | None | None | None | None | Calcrete, Silcrete, Granite, Quartz |

## Appendix 6 Invertebrate Specimens collected at Mooka Siding and Identified by the Western Australian Museum

| REGNO | ORDER | FAMILY | GENUS | SPECIES | LATITUDE | LONGITUDE |
|---|---|---|---|---|---|---|
| 103378 | Scolopendrida | Scolopendridae | *Scolopendra* | *laeta* | 20°32`24"S | 118°39`23"E |
| 103379 | Pseudoscorpiones | Olpiidae | *Indolpium* | | 20°32`24"S | 118°39`23"E |
| 103380 | Acari | Caeculidae | | | 20°31`42"S | 118°39`27"E |
| 103381 | Acari | Caeculidae | | | 20°32`24"S | 118°40`43"E |
| 103421 | Pseudoscorpiones | Olpiidae | *Austrohorus* | | 20°32`24"S | 118°39`23"E |