



Metals X Limited

Wingellina Nickel Project

Level 1 Terrestrial Fauna Assessment of
the Cobb Depression Borefield and
Pipeline Route

May 2013



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Level 1 Terrestrial Fauna Assessment of the Cobb Depression Borefield and Pipeline Route

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Executive Summary

Metals X Limited (Metals X) is currently evaluating the potential of developing the Cobb Depression Borefield and an associated pipeline route (the Project) as part of the proposed Wingellina Nickel Project. The Project is located approximately 218 km east of Warburton, near the junction of the Western Australia, South Australia and Northern Territory borders.

As part of the initial scoping phase for the Project, Metals X commissioned Outback Ecology to undertake a Level 1 terrestrial fauna assessment (this Assessment) for the Project. The area assessed (the Study Area) overlies miscellaneous licence L69/19 and the Giles-Mulga Park Road, and is located on the Ngaanyatjarra Aboriginal Lands. The Study Area encompasses the proposed Cobb Depression borefield, with a perimeter buffer of 250 m, as well as the Giles-Mulga Park Road between the borefield and the Blackstone-Warburton Road, with a 50 m buffer either side (**Figure 2**). The total size of the Study Area is approximately 14,377 ha.

This Assessment involved a desktop study, comprising database searches and a literature review, and a field reconnaissance survey, which was conducted in March 2013. The purpose of this Assessment was to gather background biological information on the terrestrial fauna and fauna habitats of the Study Area, in order to support future permit and approvals documentation for Metals X. The specific objectives of this Assessment were to:

- undertake a desktop study to develop inventories of terrestrial vertebrate and short-range endemic (SRE) invertebrate species in the Study Area or likely to occur in the Study Area;
- describe broad vertebrate fauna habitats, sensitive habitats and SRE invertebrate habitats expected to occur in the Study Area, based on the outcomes of the desktop study;
- verify the results of the desktop study and map broad fauna habitats present in the Study Area, via a reconnaissance survey;
- assess the findings of the reconnaissance survey in a regional context by making comparisons with available data from other localities within the bioregion; and
- identify the potential impacts of the Project on the terrestrial fauna assemblages and habitat in the Study Area.

A total of five broad fauna habitats was identified within the Study Area, comprising:

- Dense Mulga Woodland;
- Dune Field;
- Hummock Grassland;
- Tussock Grassland; and
- Mulga-Mallee over Hummock Grassland.

A total of 382 vertebrate fauna species was identified by the desktop study as potentially occurring in the Study Area, with 46 species recorded during this survey. This total comprises 12 species of mammal (of which eight are native), 30 species of bird and four species of reptile. No fish or

amphibian species were recorded. The vertebrate fauna species richness was comparable with previous field surveys of similar size and scope within the locality of the Study Area, although reptile abundance and species richness was low due to unexpectedly cool and wet conditions being encountered during the field survey.

During the field survey, three vertebrate species of conservation significance (ie species that are listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and/or the Western Australian *Wildlife Conservation Act 1950* (WC Act), or are on the WA Department of Environment and Conservation (DEC) Priority Fauna list) were recorded:

- Brush-tailed Mulgara (*Dasycercus blythi*; EPBC – VU, DEC – Priority 4);
- Major Mitchell's Cockatoo (*Lophocroa leadbeateri*; WC Act – Schedule 4); and
- Australian Bustard (*Ardeotis australis*; DEC – Priority 4).

The desktop study identified 12 vertebrate species of conservation significance that were not recorded during the field survey component of This Study, but nevertheless are likely to occur or possibly occur in the Study Area. The likelihood of each of these species occurring was determined based on the habitat assessments performed during the field survey, reported data on species distributions and habitat from previous surveys in the wider region, and published knowledge on the biology of individual species. Briefly, these fauna consist of:

- eight species listed as Threatened under the EPBC Act and/or WC Act;
- three species listed by the DEC as being Priority Fauna (including one also listed as Threatened under the EPBC Act); and
- three species of bird listed as Migratory under the EPBC Act and WC Act (including one also listed as Threatened under the EPBC and WC Acts).

The desktop study identified 23 species of fauna of conservation significance that were considered to be unlikely to occur in the Study Area. In total, 38 species of fauna of conservation significance were identified by the desktop study component of this Assessment.

The desktop study also identified several SRE or potential SRE invertebrate taxa that have been collected in the vicinity of the Study Area – the database searches identified 64 records of identified and unidentified taxa of snail, mygalomorph spider and pseudoscorpion, and the literature review identified six species of mygalomorph spider, scorpion and pseudoscorpion. Field collection of SRE invertebrates was outside the scope of this Assessment, but consideration of habitats suggests that the Dense Mulga Woodland and, to a lesser extent, Mulga-Mallee on Hummock Grassland, have potential to support SRE invertebrates. Given this, and the existence of SRE records from the vicinity, it should be considered possible that SRE invertebrates are present in the Study Area.

Habitat clearing represents the greatest potential direct impact of the Project on fauna and fauna habitats. Of the five broad fauna habitats, four were identified as locally significant. Dense Mulga Woodland, Mulga-Mallee over Hummock Grassland, Hummock Grassland and Dune Field are habitat types of particular value to vertebrate and invertebrate fauna within the Study Area, and vegetation

clearing and disturbance within these habitat types should be minimised where possible. From a regional perspective, however, these habitat types are well represented in the broader landscape and are relatively well connected to instances outside the Study Area. Thus, although a Project impact footprint was not available for consideration as part of this Assessment, regional impacts of the Project are not expected to be substantial.

Of the potential indirect impacts of the Project, invasion by weeds is likely to be the most significant. Efforts should be made to ensure that vehicular traffic and other weed transport vectors are managed so as to reduce the risk of transporting invasive plants and their seeds.

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1. INTRODUCTION

1.1. Project Background and Location

Metals X Limited (Metals X) is currently evaluating the potential of developing the Cobb Depression Borefield and an associated pipeline route (the Project) as part of the proposed Wingellina Nickel Project. The Project is located approximately 218 km east of Warburton, near the junction of the Western Australia, South Australia and Northern Territory borders (**Figure 1**). As part of the initial scoping phase for the Project, Metals X commissioned Outback Ecology to undertake a Level 1 terrestrial fauna assessment (this Assessment) for the Project. The area assessed (the Study Area) encompasses miscellaneous licence L69/19 and the Giles-Mulga Park Road, and is located on the Ngaanyatjarra Aboriginal Lands.

The Study Area encompasses the proposed Cobb Depression borefield, with a perimeter buffer of 250 m, and the Giles-Mulga Park Road between the borefield and the Blackstone-Warburton Road, with a 50 m buffer either side (**Figure 2**). The total size of the Study Area is approximately 14,377 ha. The Study Area contains exclusion zones, identified by the Ngaanyatjarra people as areas of cultural significance (**Figure 2**). Outback Ecology did not survey inside these exclusion zones.

1.2. Report Scope and Objectives

The purpose of this Assessment was to gather background biological information on the terrestrial fauna and fauna habitats of the Study Area, in order to support future permit and approvals documentation for Metals X. Short-range Endemic (SRE) invertebrates were considered during the Assessment, in addition to vertebrates, because the Study Area contains habitat heterogeneity consistent with that known to support SRE species, and because previous survey work in the vicinity found invertebrates considered to have potential to be SRE species. The specific objectives of the Assessment were to:

- undertake a desktop study to develop inventories of terrestrial vertebrate and SRE invertebrate species in the Study Area or likely to be present in the Study Area;
- describe broad vertebrate fauna habitats, sensitive habitats and SRE invertebrate habitats expected to occur in the Study Area, based on the outcomes of the desktop study;
- verify the results of the desktop study and map broad fauna habitats present in the Study Area, via a reconnaissance survey;
- assess the findings of the reconnaissance survey in a regional context by making comparisons with available data from other localities within the bioregion; and
- identify the potential impacts of the Project on the terrestrial fauna assemblages and habitat in the Study Area.

The objectives and methods of this Assessment were aligned with:

- Environmental Protection Authority (EPA) and Department of Environment and Conservation (DEC) guidelines and position statements for conducting vertebrate fauna surveys (EPA and DEC 2010, EPA 2002, 2004); and
- EPA guidelines for conducting invertebrate fauna surveys (EPA 2009).

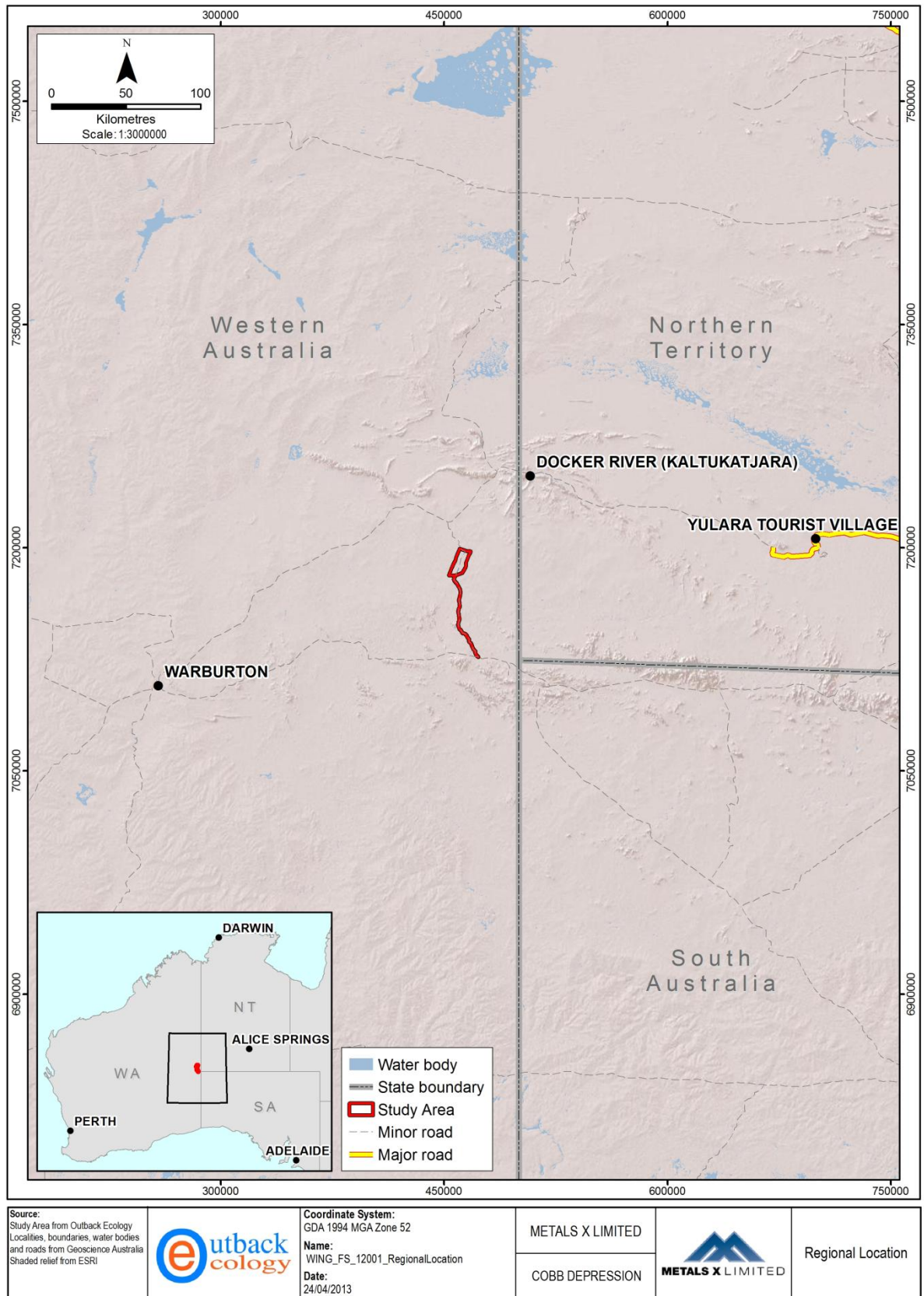


Figure 1: Regional location of the Study Area

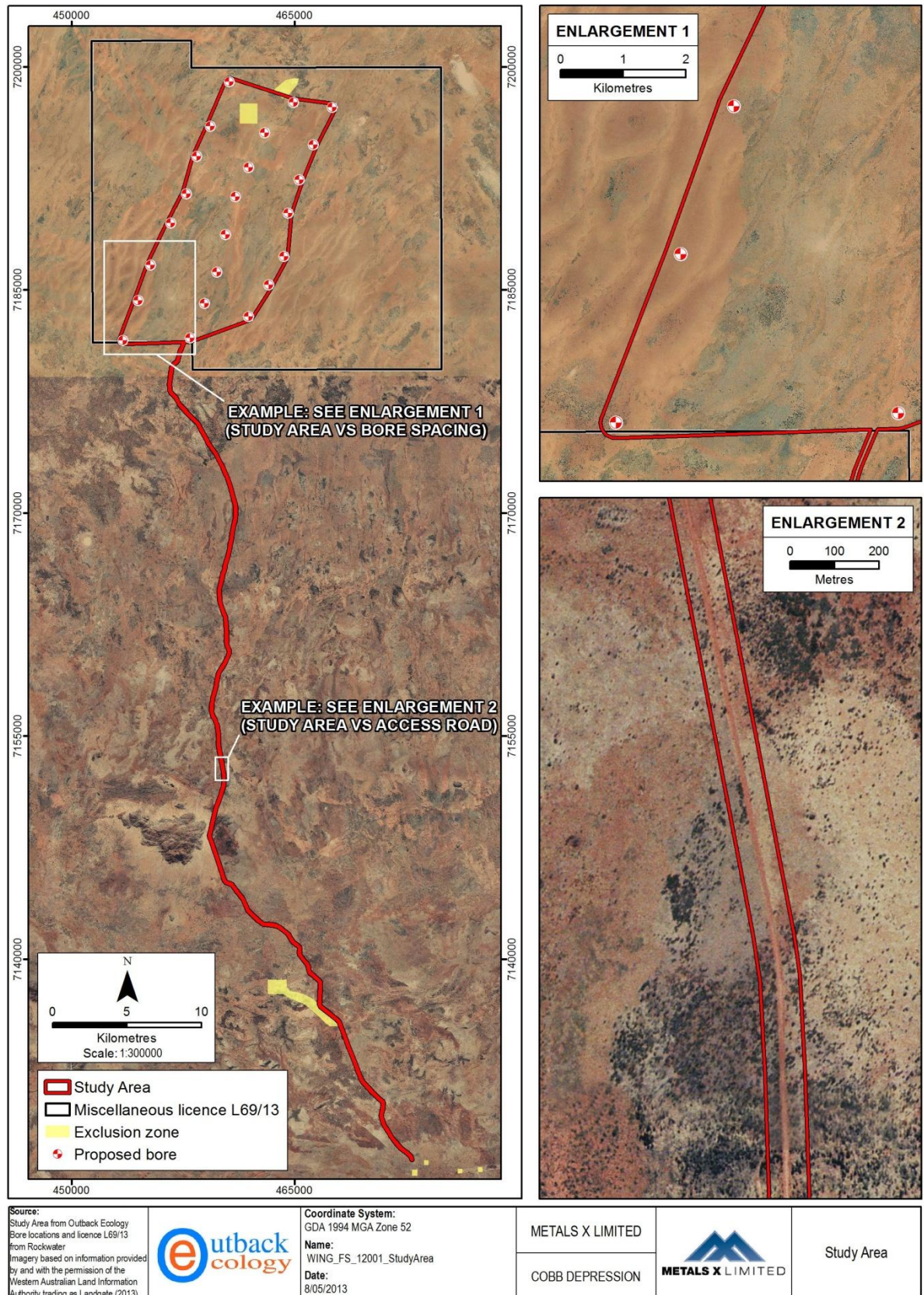


Figure 2: The Study Area and associated exclusion zones

2. EXISTING ENVIRONMENT

2.1. Biogeographic Region

The Study Area occurs in the Central Ranges bioregion, as defined by the Interim Biogeographic Regionalisation for Australia (IBRA) classification system (McKenzie *et al.* 2003) (**Figure 3**). The Central Ranges bioregion encompasses approximately 101,200 km² of land within Western Australia, the Northern Territory and South Australia, and is characterised by the east-west trending rocky ranges of the Petermann, Musgrave and Mann Ranges. The climate is arid, with hot to extremely hot summers during which daytime temperatures can exceed 50°C, but cool to cold winters (ANRA 2009a).

The Central Ranges bioregion has experienced declines in its mammalian fauna, in concert with an increased presence of invasive species. For example, the Black-footed Rock Wallaby (*Petrogale lateralis* MacDonnell Ranges Race ANWC CM15314) and the Brushtail Possum (*Trichosurus vulpecula*) were commonly recorded in the Central Ranges bioregion during the 1930s but by the 1960s were nearly extinct (ANRA 2009a). In contrast, invasive mammals have become well established, and species such as the Rabbit (*Oryctolagus cuniculus*), House Mouse (*Mus musculus*), Camel (*Camelus dromedarius*), Fox (*Vulpes vulpes*), Cat (*Felis catus*) Donkey (*Equus asinus*) and Horse (*Equus caballus*) are widespread.

The Study Area lies within the Mann-Musgrave Block subregion of the Central Ranges bioregion (**Figure 3**). The Mann-Musgrave Block subregion is the largest subregion in the Central Ranges bioregion, with a size of approximately 91,734 km². In Western Australia, the Mann-Musgrave Block subregion is characterised by a high proportion of volcanic and quartzite Proterozoic ranges and derived soil plains, interspersed with red Quaternary sand plains with some Permian exposure (Graham and Cowan 2002). The sand plains support low open woodlands of either Desert Oak (*Allocasuarina decaisneana*) or mulga over hummock grasslands, the ranges are often fringed by low open woodlands of *Acacia estrophiolata* and *Hakea* spp over grasslands, and the ranges themselves typically support mixed *Acacia* spp scrub or *Callitris glaucophylla* woodlands over grasslands (Graham and Cowan 2002).

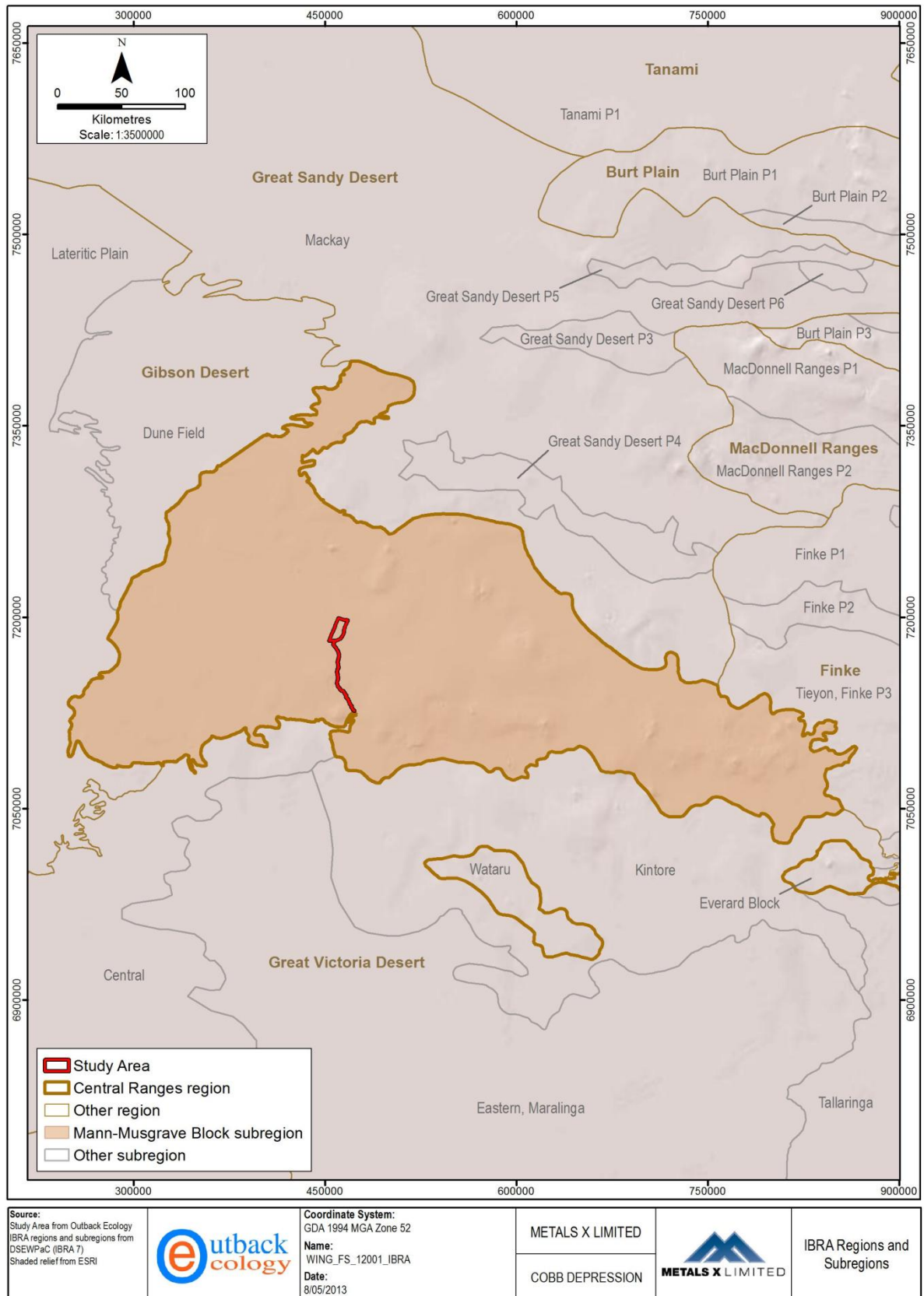


Figure 3: The Study Area with respect to IBRA bioregions and subregions

2.2. Climate

The Central Ranges bioregion is characterised by having an arid climate, with low, variable rainfall (ANRA 2009a). The bioregion is influenced by a northern tropical/summer climatic pattern, with the majority of rain falling during the summer months due to the movement of low-pressure troughs and tropical lows associated with monsoon troughs moving south in the bioregion (ANRA 2009a).

The closest Bureau of Meteorology (BOM) weather station to the Study Area is the Giles Meteorological Office, which is approximately 45 km to the northwest. The Giles Meteorological Office has a long term mean annual rainfall of 285.6 mm, with the bulk of this rain falling between November and March (**Figure 4**). The Giles Meteorological Office experiences a mean of 32 rain days per annum (BOM 2013). The November to March period of maximum rainfall coincides with a period of peak temperatures, with mean maximum temperatures ranging from 20.0°C in July to 37.3°C in January, and mean minimum temperatures ranging from 6.8°C in July to 23.5°C in January (**Figure 4**).

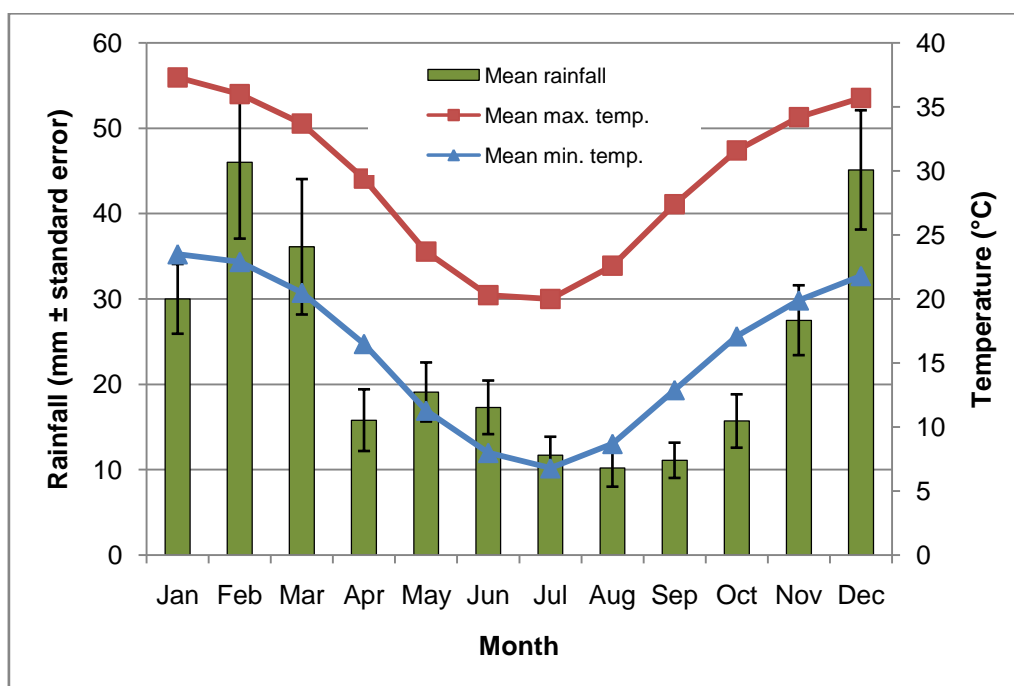


Figure 4: Climate data for Giles Meteorological Office

Source data: BOM (2013), 1956 to 2013

2.3. Soil-landscapes

The most detailed and recent soil mapping for Western Australia's rangelands and arid interior was consolidated in 2006, into a hierarchy of soil-landscape mapping units (Tille 2006). These data were then used to describe land systems for some regions of Western Australia, based on landforms, soil, vegetation, geology and geomorphology (eg see Van Vreeswyk *et al.* 2004). For those parts of the arid interior that include the Study Area, however, the most recent data are still the original field soil survey and aerial photography interpretations from the *Atlas of Australian Soils* (Northcote *et al.* 1960-1968). The Atlas is presented as a soil map, but can be considered a soil-landscape map as the mapping units are associations of soil delineated by landscapes (Tille 2006). These soil-landscape mapping units are treated as analogous to land systems for the purposes of this report.

An assessment of these soil-landscapes can provide additional information on the occurrence and distribution of fauna habitats within and surrounding the Study Area. The Study Area contains instances of five different soil-landscapes (**Table 1**). The vast majority of the Study Area lies within the AB60 soil-landscape, which contains the entire borefield portion of the Study Area (**Figure 5**). The other four soil-landscapes in the Study Area are represented only by relatively small areas, as they are traversed by the Giles-Mulga Park Road (**Figure 5, Table 1**).

Table 1: Characteristics of soil-landscapes of the Study Area

Soil-landscape	Brief description	Extent in Study Area
AB60	Plains with many dunes, which are often short and of irregular shape	14,011 ha (97.5%)
My111	Extensive plains with a few low dunes and occasional, low, stony residuals	118 ha (0.8%)
My112	Extensive plains with numerous dunes, which are often short and of irregular shape and orientation	117 ha (0.8%)
My109	Outwash plains and dissected fan and terrace formations, flanking ranges of sedimentary and some metamorphic, volcanic and granitic rocks	101 ha (0.7%)
BA21	Steep hills and ranges on sedimentary and some metamorphic, volcanic and granitic rocks, with bare, rocky outcrops common and some gorges present	30 ha (0.2%)
Total		14,377 ha (100.0%)

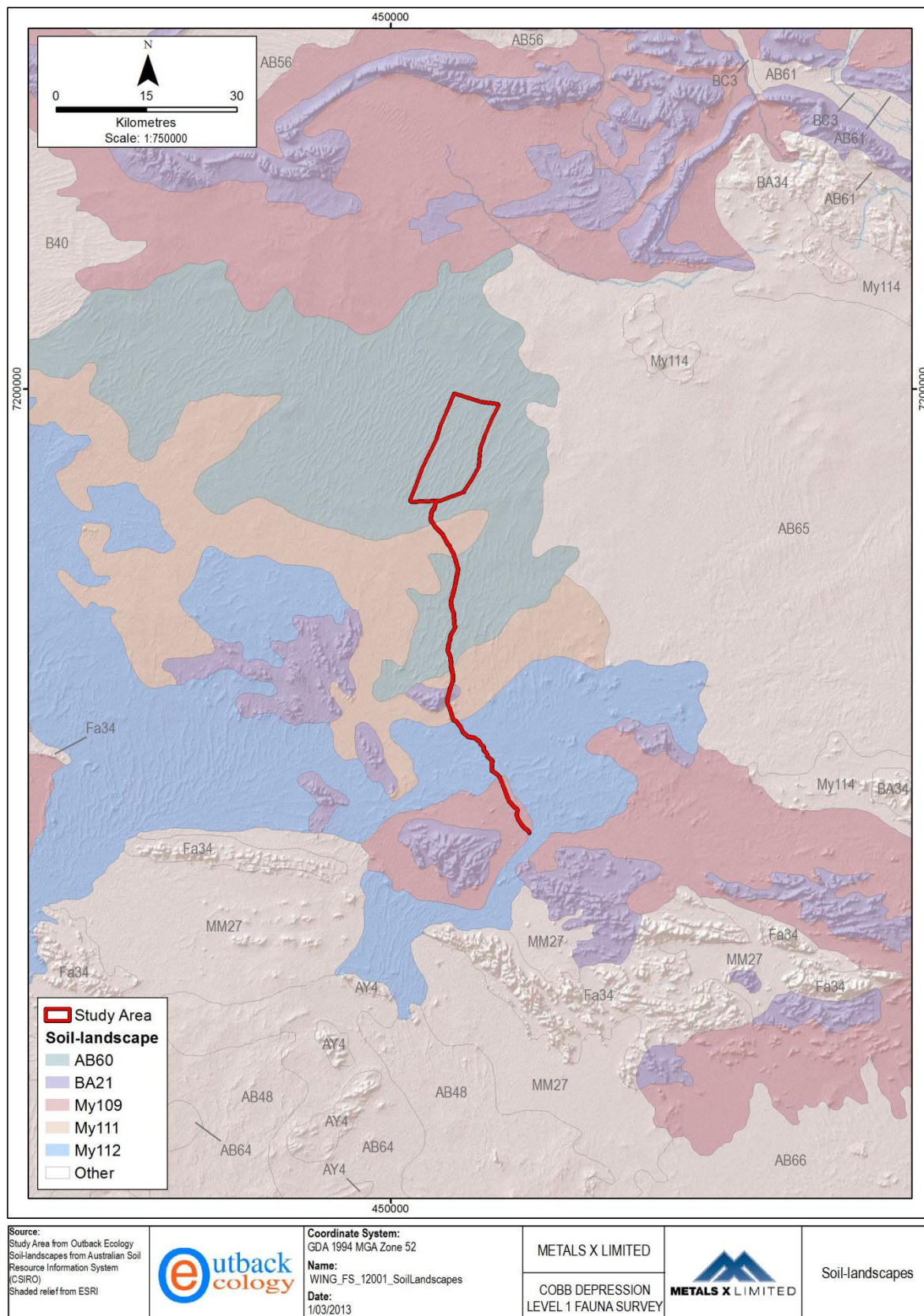


Figure 5: Soil-landscapes of the Study Area

2.4. Land Use

Aboriginal land, including current and proposed Indigenous Protected Areas (IPAs), is the dominant category of land use in and surrounding the Study Area (**Figure 6**). Aboriginal lands occupy the entirety of the Central Ranges bioregion and a large proportion of the surrounding landscape. The largest aboriginal reserves in the vicinity are the Anangu Pitjantjatjara lands and the Ngaanyatjarra lands, with the Study Area located in the latter (**Figure 6**). The Ngaanyatjarra lands have a high level of biodiversity and represent the traditional country of the Yarnangu people, who live on the Lands in 11 autonomous, incorporated communities represented by the Ngaanyatjarra Council (DSEWPac 2012d). The Lands contain the Ngaanyatjarra Lands IPA, declared in August 2002 under World Conservation Union *Category IV – Managed Resource Protected Area: Protected Area Managed Mainly for the Sustainable use of Natural Ecosystems* and currently the largest declared IPA in Australia (DSEWPac 2012d).

Conservation reserves are another major land use in the vicinity of the Study Area. The Gibson Desert, Neale Junction and Great Victoria Desert Nature Reserves, and the Mamungari Conservation Park, are all found within 350 km of the Study Area (**Figure 6**). The majority of the remainder of the land in the vicinity of the Study Area is unallocated crown land (**Figure 6**). Pastoral development has occurred, but has been confined to a few peripheral areas to the far south and east of the Study Area, where water and feed are available in some years. Mineral exploration, also to the far south and east, has been extensive since the 1970s, and seismic shot lines and survey lines persist in the landscape (ANRA 2009b). Immediately to the southeast of the Study Area, the Wingellina Nickel Project lease area (E69/535) was opened for mineral exploration in the 1960s by Inco, and a number of abandoned chrysoprase pits and drill holes are still present in the area. Metals X purchased the tenement from Acclaim Exploration in 2006 (Outback Ecology 2009).

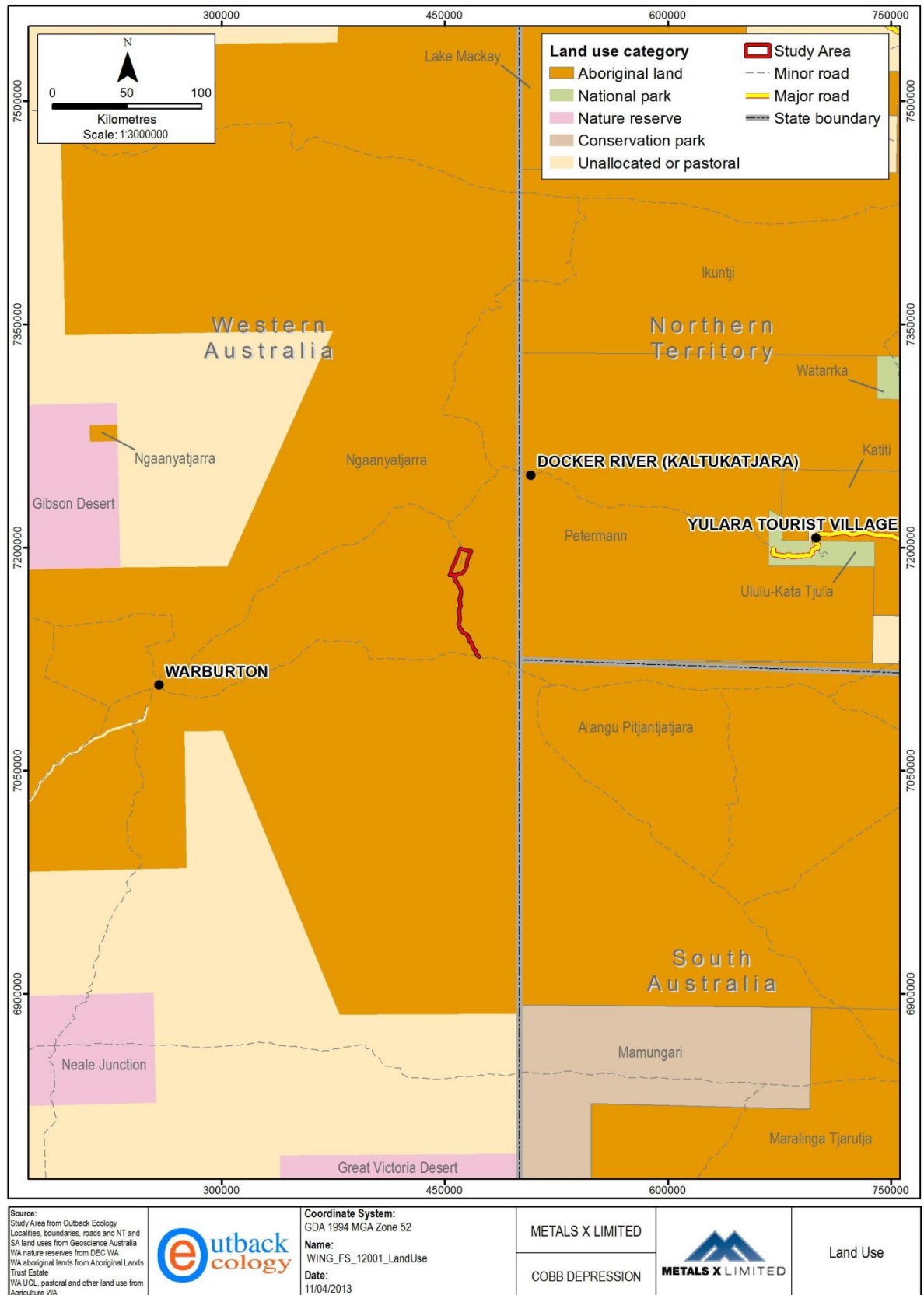


Figure 6: Land use in and around the Study Area

3. DESKTOP STUDY

Database searches and a literature review were undertaken prior to the field survey to identify the vertebrate and invertebrate fauna which potentially occur in the Study Area. Collectively, the database searches and literature review identified a total of 382 species of extant, vertebrate fauna that potentially occur in the Study Area. The key results of the database searches and literature review are presented in **Section 3.1** and **Section 3.2**, and for species of conservation significance the likelihood of their occurring in the Study Area is described in **Section 5.3**. The complete inventory of species generated by the desktop study is presented in **Appendix A**.

3.1. Database Searches

For the purpose of database searching, the Study Area was defined as a central point with coordinates 460667 mE 7188249 mN (GDA 1994, UTM 52J). The databases and search areas used were:

- the WA DEC's NatureMap database (DEC 2013a), with a search area consisting of the central point surrounded by a circular buffer zone of 40 km radius;
- the WA DEC's Threatened and Priority Fauna Database (DEC 2013b), with a search area consisting of the central point surrounded by a circular buffer zone of 135 km radius;
- the BirdLife Australia New Atlas 1998 to 2011 database (Birdlife Australia 2013), with a search area consisting of the central point surrounded by a circular buffer zone of 135 km radius;
- the Protected Matters Search Tool (DSEWPaC 2013), with a search area consisting of a square box of side length 270 km – the box surrounded the central point and was delineated by the coordinates (clockwise, from the north-west corner) 325667 mE 7323249 mN, 595667 mE 7323249 mN, 595667 mE 7053249 mN and 325667 mE 7053249 mN;
- the WA Museum arachnid and myriapod, snail and vertebrate collections (WAM 2013), with a search area consisting of a square box of side length 200 km – the box surrounded the central point and was delineated by the coordinates (clockwise, from the north-west corner) 360667 mE 7288249 mN, 560667 mE 7288249 mN, 560667 mE 7088249 mN and 360667 mE 7088249 mN;
- the NT Department of Land Resource Management Flora and Fauna database (DLRM 2013), with a search area consisting of the central point surrounded by a circular buffer zone of 135 km radius; and
- the NT Natural Resource Management InfoNet database (Northern Territory Government 2013), with a search area consisting of a box delineated by the approximate coordinates (clockwise, from the north-west corner) 500000 mE 7284546 mN, 544863 mE 7284474 mN, 544468 mE 7164108 mN and 500000 mE 7164182 mN.

The database searches for the Study Area reported a total of 261 species of native, extant, vertebrate fauna (**Table 3, Appendix A**), 37 of which are of conservation significance:

- the Night Parrot (*Pezoporus occidentalis*), which is listed as Endangered and Migratory (EPBC Act) and Schedule 1 (WC Act);
- the Crest-tailed Mulgara (*Dasyercus cristicauda*), Northern Marsupial Mole (*Notoryctes caurinus*), Central Marsupial Mole (*Notoryctes typhlops*) and Sandhill Dunnart (*Sminthopsis psammophila*), which are listed as Endangered (EPBC Act) and Schedule 1 (WC Act);
- the Malleefowl (*Leipoa ocellata*) and Australian Painted Snipe (*Rostratula australis*), which are listed as Vulnerable and Migratory (EPBC Act) and Schedule 1 (WC Act);
- the Greater Bilby (*Macrotis lagotis*), Black-flanked Rock-wallaby (*Petrogale lateralis lateralis*), Black-footed Rock-wallaby (*Petrogale lateralis* MacDonnell Ranges race ANWC CM15314) and Great Desert Skink (*Liopholis kintorei*) which are listed as Vulnerable (EPBC Act) and Schedule 1 (WC Act);
- the Brush-tailed Mulgara (*Dasyercus blythi*) and Princess Parrot (*Polytelis alexandrae*), which are listed as Vulnerable (EPBC Act) and Priority 4 (DEC Priority Fauna List);
- the Great Knot (*Calidris tenuirostris*), which is listed as Migratory (EPBC Act) and Schedule 1 (WC Act);
- the Grey Falcon (*Falco hypoleucos*), which is listed as Schedule 1 (WC Act);
- the Major Mitchell's Cockatoo (*Lophochroa leadbeateri*), Peregrine Falcon (*Falco peregrinus*) and Woma (*Aspidites ramsayi*), which are listed as Schedule 4 (WC Act);
- the Long-tailed Dunnart (*Sminthopsis longicaudata*), Bush Stone-curlew (*Burhinus grallarius*), Australian Bustard (*Ardeotis australis*), Striated Grasswren (*Amytornis striatus striatus*) and Flock Bronzewing (*Phaps histrionica*), which are listed as Priority 4 (DEC Priority Fauna List); and
- 14 species of migratory bird, which are listed as Migratory (EPBC Act) and Schedule 3 (WC Act) and are protected under international agreements (see **Appendix A** for full list).

In addition, the database searches identified the Chuditch (*Dasyurus geoffroii*), Red-tailed Phascogale (*Phascogale calura*), Numbat (*Myrmecobius fasciatus*), Golden Bandicoot (*Isodon auratus*), Ghost Bat (*Macroderma gigas*), Burrowing Bettong (*Bettongia lesueur*) and Brush-tailed Bettong (*Bettongia penicillata*) as potentially occurring in the Study Area. These species, although extant and of conservation significance, are considered to have been extinct in central Australia for the past several decades (eg see Churchill 2008, Van Dyck and Strahan 2008). They were therefore not incorporated into the species inventories for this Assessment and are not discussed further.

The database searches also identified 64 records of confirmed or potential SRE invertebrates. These consisted of both identified and unidentified species (**Table 2**).

Table 2: Records of SRE invertebrates returned by database searches

Record type	Taxon type	Taxon	Number of records
Identified	Mygalomorph spider	<i>Aganippe</i> 'MYG190'	1
Identified		<i>Swolnpes morganensis</i>	3
Identified	Pseudoscorpion	<i>Synsphyronus</i> 'PSE013'	1
Identified	Camaenid snail	<i>Basedowena cognata</i>	13
Identified		<i>Basedowena papulankutjana</i>	8
Identified		<i>Basedowena vulgata</i>	10
Identified		<i>Minimelon colmani</i>	13
Identified		<i>Tatemelon musgum</i>	1
Identified		<i>Pleuroxia radiata</i>	4
Unidentified		<i>Basedowena</i> sp	1
Unidentified		<i>Basedowena</i> (?) sp	1
Unidentified		<i>Basedowena</i> (cf) sp	1
Unidentified		<i>Pleuroxia</i> (cf) sp	5
Unidentified		<i>Sinumelon</i> sp	1
Unidentified		Unknown genus	1

3.2. Literature Review

The literature review identified nine previous studies of relevance (**Table 4, Figure 7**). For the studies for which species lists were available, the results were collated to generate an inventory of the vertebrate fauna known to occur in the locality of the Study Area and within the surrounding wider region (**Table 3, Appendix A**).

Previous studies in the vicinity of the Study Area reported a total of 339 species of native, extant, vertebrate fauna (**Table 3, Appendix A**), of which 38 are of conservation significance. All but one of these species of conservation significance were previously identified during the database searches (**Section 3.1**); the single outstanding species is the Western Long-eared Bat (*Nyctophilus major tor*), which is listed as Priority 4 (DEC Priority Fauna List).

Six species of invertebrate with potential to be short-range endemics were also identified during the literature review (**Table 4**):

- eight species of mygalomorph spider (*Aganippe* sp nov 'Wingellina' sp 1, *Aganippe* sp nov 'Wingellina' sp 2, *Aname* sp, *Anidiops* sp, *Kwonkan* sp 1 sp nov, *Kwonkan* sp 2 sp nov, *Cethegus* sp and *Synothele* sp);
- one species of scorpion (*Urodacus yaschenko*) and
- one species of pseudoscorpion (*Synsphyronus* sp. 'Wingellina' – now listed as *Synsphyronus* sp PSE013 in the WAM database, see **Section 3.1**, and the only species from the literature review that was also found by the database searches).

Table 3: Detailed summary of vertebrate fauna species richness from desktop study

Fauna	Literature review									Database searches								Total
	A	B	C	D	E	F	G	H	Total	I	J	K	L	M	N	O	Total	
Native mammals	21	16	-	10	2	10	25	3	36	1	6	12	-	2	18	5	27	44
Introduced mammals	10	5	-	4	1	5	6	1	10	0	-	2	-	-	7	3	7	10
Native birds	130	72	51	31	2	23	176	54	187	41	7	23	127	4	120	7	147	194
Introduced birds	1	0	0	0	0	0	2	0	3	0	-	0	0	-	0	0	0	3
Reptiles	92	54	-	15	1	26	73	9	109	4	1	77	-	1	40	1	83	124
Amphibians	5	1	-	0	0	0	4	0	7	0	-	4	-	-	3	-	4	7
Total native fauna	248	143	51	56	5	59	278	66	339	46	14	116	127	7	181	13	261	369
Total fauna	259	148	51	60	6	64	286	67	352	46	14	118	127	7	188	16	268	382

Key**Surveys considered in literature review**

- A** Anangu Pitjantjatjara Lands Biological Survey – Robinson et al. (2003)
- B** Spinifex Native Title Determined Area Surveys – Brennan et al. (2012)
- C** Birds of the Wingellina Hills – Gole (2002)
- D** Wingellina Nickel Project Level 1 Borefield Fauna Assessment – Outback Ecology (2012b)
- E** Wingellina Nickel Project Proposed Borefield Drill Line Targeted Fauna Assessment – Outback Ecology (2012c)
- F** Wingellina Nickel Project Terrestrial Fauna Assessment – Outback Ecology (2009)

- G** Compilation of Uluru-Kata Tjuta National Park Vertebrate Fauna Checklists – Balding (1996), Balding and Reid (1996)
- H** Wingellina Baseline Biological Survey – HGM Maunsell (2002)

Database searches

- I** NatureMap Database – DEC (2013a)
- J** NRM InfoNet Database – Northern Territory Government (2013)
- K** Vertebrate Fauna Collection Database – WAM (2013)
- L** BirdData: Custom Atlas Bird List – BirdLife Australia (2013)
- M** Threatened and Priority Fauna Database – DEC (2013b)
- N** Flora and Fauna Database – DLRM (2013)
- O** Protected Matters Search Tool – DSEWPac (2013)

Table 4: Key findings of relevant past studies

Code Reference(s)	Survey details	Proximity to Study Area	Methods	Habitats defined or noted	Fauna of conservation significance	Notes
A Robinson et al. (2003)	<p><u>Project:</u> Anangu Pitjantjatjara Lands Biological Survey</p> <p><u>Participants:</u> SA Department of Environment and Heritage, SA Museum, the Anangu people</p> <p><u>Survey type:</u> Major biological survey</p> <p><u>Survey date:</u> 1991 to 2001</p>	<p>This project surveyed a very large (102,650 km²) amount of land.</p> <p>At its closest point the area surveyed is approximately 27 km east of the Study Area. The central point of the area surveyed is approximately 300 km south-east of the Study Area.</p>	<ul style="list-style-type: none"> • Pitfall traps • Elliott traps • Cage traps • Avifauna census • Harp traps • Mist nets • Targeted searches • Spotlighting 	<ul style="list-style-type: none"> • Drainage Lines • Sand plains and dunes • Plains • Mountain ranges and dissected tablelands 	<p><u>Threatened:</u></p> <ul style="list-style-type: none"> • Black-flanked Rock Wallaby • Central Marsupial Mole • Malleefowl • Princess Parrot • Great Desert Skink • Grey Falcon • Major Mitchell's Cockatoo • Peregrine Falcon • Woma Python <p><u>Priority and Migratory:</u></p> <ul style="list-style-type: none"> • Australian Bustard • Flock Bronzewing • Rainbow Bee-eater 	<p>Some results of this survey are of direct relevance due to their proximity to the Study Area, but others are not likely to be so due to distance and the presence of habitats such as mountain ranges that do not occur in the Study Area</p> <p>The survey added two new mammal, eight new bird and 33 new reptile species to the known fauna of the Anangu Pitjantjatjara Lands</p> <p>The Great Desert Skink was thought to be extinct in SA until the discovery of several populations during this survey</p> <p>The vegetation communities encountered were relatively intact, and low incidences of weeds were recorded. A total of 19 vegetation communities were found</p>
B Brennan et al. (2012)	<p><u>Project:</u> Spinifex Native Title Area surveys</p> <p><u>Participants:</u> WA Department of Environment and Conservation, WA Herbarium, Museum Victoria, the Pila Nguru people</p> <p><u>Study type:</u> Two-phase, Level 2</p> <p><u>Survey date:</u> May and October 2010</p>	<p>Approximately 318 km south-west of the Study Area</p>	<ul style="list-style-type: none"> • Pitfall traps (standard and extra-deep) • Elliott traps • Funnel traps • Tracking and hand-capture • Motion-sensor cameras • Spotlighting • Opportunistic recording • Scat analysis • AnaBat recordings • Survey trenching 	<ul style="list-style-type: none"> • Three different vegetation communities on sand dunes • Rocky rise with low open woodland • Sand plain with low woodland • Dune swale with low <i>Acacia</i> woodland • Gravelly rise with low <i>Acacia</i> and <i>Eucalyptus</i> woodland • Sand plain adjacent to rocky rise 	<p><u>Threatened:</u></p> <ul style="list-style-type: none"> • Central Marsupial Mole • Malleefowl • Princess Parrot • Major Mitchell's Cockatoo • Brush-tailed Mulgara <p><u>Priority and Migratory:</u></p> <ul style="list-style-type: none"> • Australian Bustard • Rainbow Bee-eater 	<p>Despite its distance from the Study Area, habitats in this study are comparable to those in the Study area</p> <p>Extra deep (1 m deep) pitfall traps were used to maximise the chance of catching Mulgaras and Sandhill Dunnarts</p> <p>Three new species of plant were identified, and only a single individual of one weed species was recorded during the habitat surveys</p> <p>Damage to mulga habitat by camels was reported</p> <p>The report for this survey lists the Pila Nguru names for fauna encountered</p>
C Gole (2002)	<p><u>Project:</u> Birds of the Wingellina Hills</p> <p><u>Client:</u> Not applicable</p> <p><u>Study type:</u> Casual survey</p> <p><u>Survey date:</u> December 2001</p>	<p>Approximately 50 km south-east of the Study Area</p>	<ul style="list-style-type: none"> • Avifauna census (standard BirdLife Australia Atlas surveys; see Barrett <i>et al.</i> 2003) 	<ul style="list-style-type: none"> • Spinifex habitat • Sparse to moderately dense mallee and <i>Acacia</i> woodlands with patches of <i>Eremophila</i> spp. • Recent fire scars with green herbage • Older fire scars with tufty grasses below dead <i>Acacia</i> spp. • Thinly vegetated creek lines of limited extent 	<ul style="list-style-type: none"> • None recorded 	<p>The Wingellina Hills were noted to consist of a series of low, north-west to south-east trending ridges with a few higher and steeper hills</p> <p>31 Atlas surveys were performed over two weeks in a 20 km² area of the Hills</p> <p>A species accumulation curve suggests that the survey recorded the bulk of the avifauna present in the area surveyed, but additional surveys at different times of year were recommended</p> <p>The relatively low species count may reflect the relatively small area surveyed and the restricted habitats of the Hills themselves</p>

Code Reference(s)	Survey details	Proximity to Study Area	Methods	Habitats defined or noted	Fauna of conservation significance	Notes
D Outback Ecology (2012b)	<p><u>Project:</u> Level 1 Borefield Fauna Assessment</p> <p><u>Client:</u> Metals X Limited</p> <p><u>Survey type:</u> Level 1</p> <p><u>Survey date:</u> October 2011</p>	Immediately adjacent to the Study Area, to the south	<p><u>Methods:</u></p> <ul style="list-style-type: none"> • Systematic/targeted searching • Spotlighting • Avifauna census • SM2BAT recordings • Motion-sensor cameras • Opportunistic recording <p><u>Invertebrates:</u></p> <ul style="list-style-type: none"> • Systematic/targeted searching • Opportunistic recording 	<ul style="list-style-type: none"> • Dense Mulga Woodland • Mulga over Hummock Grassland • Mulga over Tussock Grassland • Mulga-Mallee over Hummock Grassland • Drainage Line • Scattered Eucalypts over Mixed Shrubland 	<p><u>Priority and Migratory:</u></p> <ul style="list-style-type: none"> • Western Long-eared Bat • Australian Bustard • Rainbow Bee-eater <p><u>Invertebrates with SRE potential:</u></p> <ul style="list-style-type: none"> • three species of mygalomorph spider (<i>Synothele</i> sp, <i>Anidiops</i> sp and <i>Aname</i> sp) • one species of scorpion (<i>Urodacus yaschenko</i>) 	<ul style="list-style-type: none"> • Large marble gums in the south of the area surveyed were considered to represent potential habitat for the Princess Parrot • The desktop study component identified seven SRE mygalomorph spiders, all with potential to occur in the area surveyed • Dense Mulga Woodland, Mulga-Mallee over Hummock Grassland and Scattered Eucalypts over Mixed Shrubland were identified as habitat types of particular value to fauna in the area surveyed
E Outback Ecology (2012c)	<p><u>Project:</u> Wingellina Nickel Project Proposed Borefield Drill Line Targeted Fauna Assessment</p> <p><u>Client:</u> Metals X Limited</p> <p><u>Survey type:</u> Targeted survey</p> <p><u>Survey date:</u> October 2011</p>	Approximately 112 km south of the Study Area	<ul style="list-style-type: none"> • Targeted searching for burrows and tracks • Motion-sensor cameras • Opportunistic recording 	<ul style="list-style-type: none"> • Not applicable 	<p><u>Threatened:</u></p> <ul style="list-style-type: none"> • Brush-tailed Mulgara <p><u>Priority and Migratory:</u></p> <ul style="list-style-type: none"> • Rainbow Bee-eater 	<ul style="list-style-type: none"> • This targeted survey was performed to detect the Mulgara, Greater Bilby and Great Desert Skink • Two records of live Brush-tailed Mulgara were obtained via motion-sensor camera, both immediately adjacent to the Study Area • No burrows of Mulgara or Great Desert Skink were recorded
F Outback Ecology (2009)	<p><u>Project:</u> Wingellina Nickel Project Terrestrial Fauna Assessment</p> <p><u>Client:</u> Metals X Limited</p> <p><u>Survey type:</u> Single-phase, Level 2</p> <p><u>Survey date:</u> April 2008</p>	Approximately 55 km south-east of the Study Area	<p><u>Vertebrates:</u></p> <ul style="list-style-type: none"> • Pitfall traps • Elliott traps • Funnel traps • Cage traps • Targeted searching • Spotlighting • AnaBat recordings • Avifauna census <p><u>Invertebrates:</u></p> <ul style="list-style-type: none"> • Soil sieving • Pitfall trapping • Targeted searching 	<ul style="list-style-type: none"> • Sparse mulga woodland/grasses • Open mulga woodland • Open mallee woodland • Rocky escarpment • Sparse mulga woodland/grasses • Open dead mulga woodland 	<p><u>Threatened:</u></p> <ul style="list-style-type: none"> • Australian Bustard (WA – P4) <p><u>Invertebrates with SRE potential:</u></p> <ul style="list-style-type: none"> • five species of mygalomorph spider (<i>Aganippe</i> sp. nov. 'Wingellina' sp. 1, <i>Aganippe</i> sp. nov. 'Wingellina' sp. 2, <i>Kwonkan</i> sp. 1 sp. nov., <i>Kwonkan</i> sp. 2 sp. nov. and <i>Cethegus</i> sp.) • one species of pseudoscorpion (<i>Synsphyronus</i> sp. 'Wingellina' – this specimen now listed as <i>Synsphyronus</i> sp PSE013 in the WAM database, see Section 3.1) 	<ul style="list-style-type: none"> • Fauna habitats in the area surveyed were widely distributed in the surrounding region • Three of the six invertebrate taxa with SRE potential were recorded from rocky escarpment habitats, and it was considered likely that they have a limited geographic range, within this habitat type

Code Reference(s)	Survey details	Proximity to Study Area	Methods	Habitats defined or noted	Fauna of conservation significance	Notes
G Balding (1996) and Balding and Reid (1996)	<p><u>Project:</u> Compilation of vertebrate fauna checklists for Uluru-Kata Tjuta National Park</p> <p><u>Participant:</u> Australian Government Director of National Parks</p> <p><u>Survey type:</u> Desktop study</p> <p><u>Survey date:</u> 1996</p>	Approximately 245 km east of the Study Area	<ul style="list-style-type: none"> • Desktop studies only; no field methods used 	<ul style="list-style-type: none"> • Rock outcrops, boulders, scree slopes and associated watercourses • Creeks (usually dry) and outwash plains • Low shrublands on alluvial fans, dominated by cassias • Claypans occasionally inundated with water • Shrublands on red loamy soil, usually dominated by mulga • Sandy country dominated by <i>Eucalyptus mallee</i> • Open habitat of soft grasses, often associated with mature mulga • Sand plain country which has been burnt in the last five years (approximately) • Sand plains and lower slopes of dunes, usually dominated by spinifex grass and/or desert oak • Sand dune crests and upper slopes • Stony plains and low hills with little vegetation 	<p><u>Threatened:</u></p> <ul style="list-style-type: none"> • Central Marsupial Mole • Crest-tailed Mulgara • Princess Parrot • Grey Falcon • Peregrine Falcon • Great Desert Skink • Major Mitchell's Cockatoo <p><u>Priority and Migratory:</u></p> <ul style="list-style-type: none"> • Woma Python • Australian Bustard • Bush Stone-curlew • 14 species of Migratory bird 	<ul style="list-style-type: none"> • Some results of this survey are of direct relevance due to their proximity to the Study Area, but others are not likely to be so due to distance and the presence of habitats such as mountain ranges that do not occur in the Study Area • The animal checklist represents all non-avifauna species recorded in Uluru-Kata Tjuta National Park • Although Crest-tailed Mulgara are reported, the species occurring is more likely to be the Brush-tailed Mulgara (see Section 5.3.1) • The avifauna checklist represents all species of bird reliably recorded in the Park • Both checklists provide the Anangu names for the fauna encountered
H HGM Maunsell (2002)	<p><u>Project:</u> Wingellina Baseline Biological Survey</p> <p><u>Client:</u> Acclaim Exploration NL</p> <p><u>Survey type:</u> Level 1</p> <p><u>Survey date:</u> April 2002</p>	Approximately 55 km south-east of the Study Area	<ul style="list-style-type: none"> • Elliott traps • Avifauna census • Targeted searches • Spot lighting • Opportunistic recording 	<ul style="list-style-type: none"> • Upland rocky ridges, hill slopes and boulders • Lower and mid-slope scree and low stony rises • Lowland grasses and forbs in valleys and on flats 	<ul style="list-style-type: none"> • None recorded 	<ul style="list-style-type: none"> • The area surveyed was found to be substantially disturbed as a result of mineral exploration, mining, altered fire regimes, vehicles and other human activities • Historical exploration issues and fire were identified as having had the largest impact on ecosystems within the area surveyed • There was minimal evidence of grazing in the area surveyed
I Pearson <i>et al.</i> (2007)	<p><u>Project:</u> Ngaanyatjarra Lands Survey</p> <p><u>Participants:</u> WA Museum, WA Department of Environment and Conservation, SA Museum, SA Department of Environment and Heritage, the Ngaanyatjarra people</p> <p><u>Study type:</u> Single-phase, Level 2</p> <p><u>Survey date:</u> October 2006</p>	<p><u>First survey area:</u> The general vicinity of the Rawlinson and Walter James Ranges, approximately 83 and 118 km north of the Study Area, respectively</p> <p><u>Second survey area:</u> The general vicinity of the Morgan Range, approximately 30 km west of the Study Area</p>	<p><u>Vertebrates:</u></p> <ul style="list-style-type: none"> • Pitfall traps • Elliott traps • Funnel traps • Tracking and hand-capture • Spot lighting • Opportunistic recording <p><u>Invertebrates:</u></p> <ul style="list-style-type: none"> • Aquatic dip-netting • Stygofauna sampling • Light-trapping • Spot lighting (including UV) 	<ul style="list-style-type: none"> • Black dolerite ranges • Quartzite ranges • Sand dunes • Mulga • Isolated granite outcrops 	<ul style="list-style-type: none"> • Species list not available 	<ul style="list-style-type: none"> • Survey recorded 720 plant species, of which 37 were new records for the region or substantial range extensions • Range extensions were documented for several species of gecko • One hundred species of spider identified within the survey are thought to be undescribed • A new species of stygofauna was recorded, an aquatic beetle, most likely endemic to the Central Ranges • A new species of snake was recorded – the Central Ranges Taipan (<i>Oxyuranus temporalis</i>)

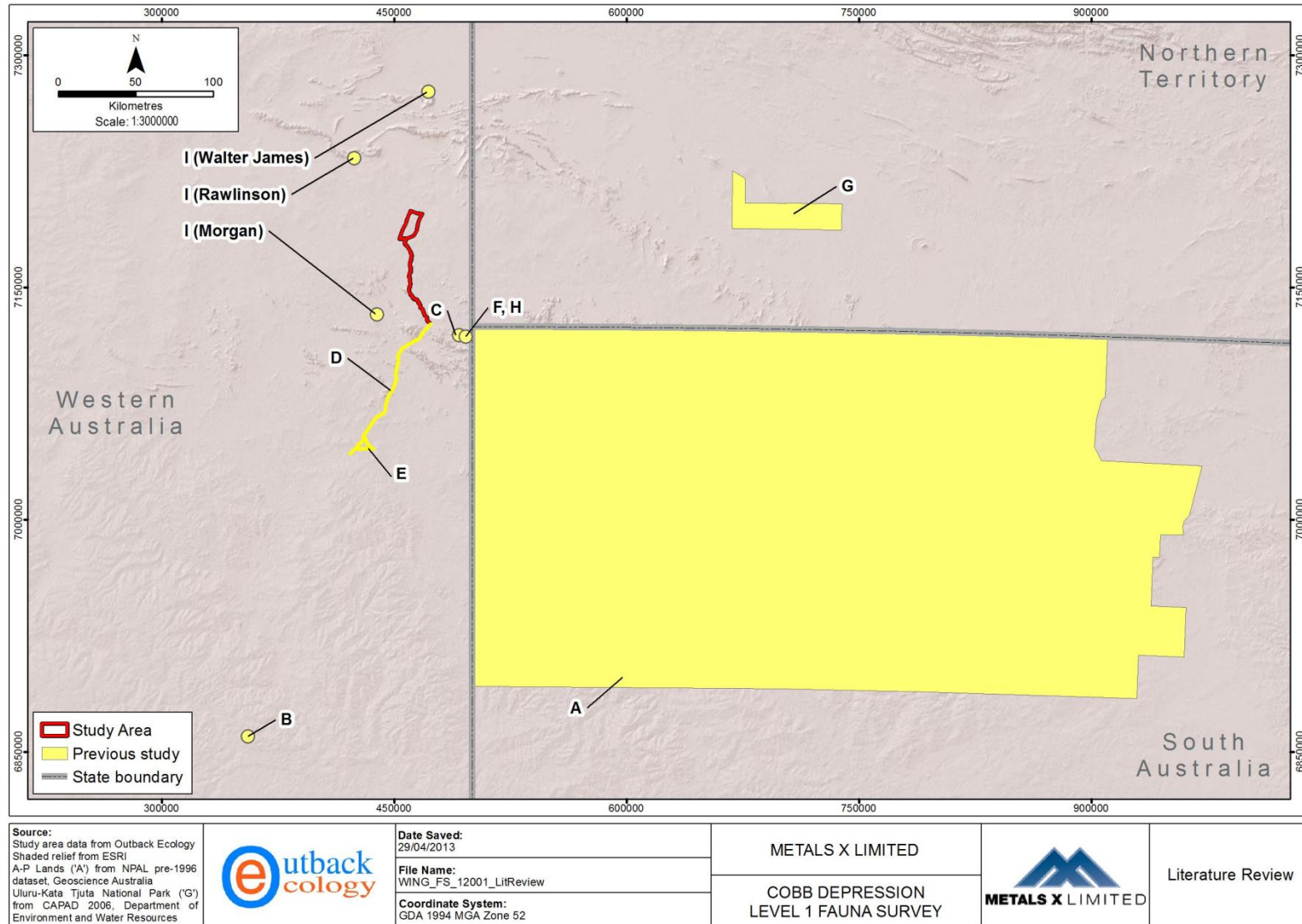


Figure 7: The location of previous surveys in the vicinity of the Study Area

(see Table 3 or Table 4 for key to location codes)

4. FIELD SURVEY METHODS

4.1. Background Information

4.1.1. Survey Timing and Weather

The survey was conducted between 25 and 31 March 2013. The weather was appropriate for a Level 1 survey, though the cool and wet conditions were not optimal for documenting reptiles. Maximum and minimum temperatures at Wingellina during the period were 35.3°C and 11.5°C, respectively, and mean maximum and minimum temperatures were 23.3°C and 15.4°C (Table 5). Total rainfall at Giles Meteorological Office in the six months prior was 150.4 mm, which is lower than the long-term average total of 200.4 mm for this period (Figure 8). March received substantially more rain than the average, but the other months received less (Figure 8); such variability is typical of rainfall patterns for the area (Section 2.2). Total rainfall at Wingellina during the survey was 78.2 mm (Table 5).

Table 5: Daily weather observations at Wingellina, for the survey period

Date	Temperature (°C)		Rainfall (mm)	Relative humidity (%)	
	Min	Max		9.00 am	3.00 pm
25/03/2013	18.0	32.0	0.0	52	31
26/03/2013	20.9	35.3	20.2	29	25
27/03/2013	18.1	21.0	4.2	63	83
28/03/2013	14.9	17.8	0.0	68	64
29/03/2013	11.5	15.7	53.8	93	97
30/03/2013	12.4	18.8	0.0	97	74
31/03/2013	12.3	22.3	0.0	81	53

Source data: Metals X Wingellina weather station (R Coles, pers comm)

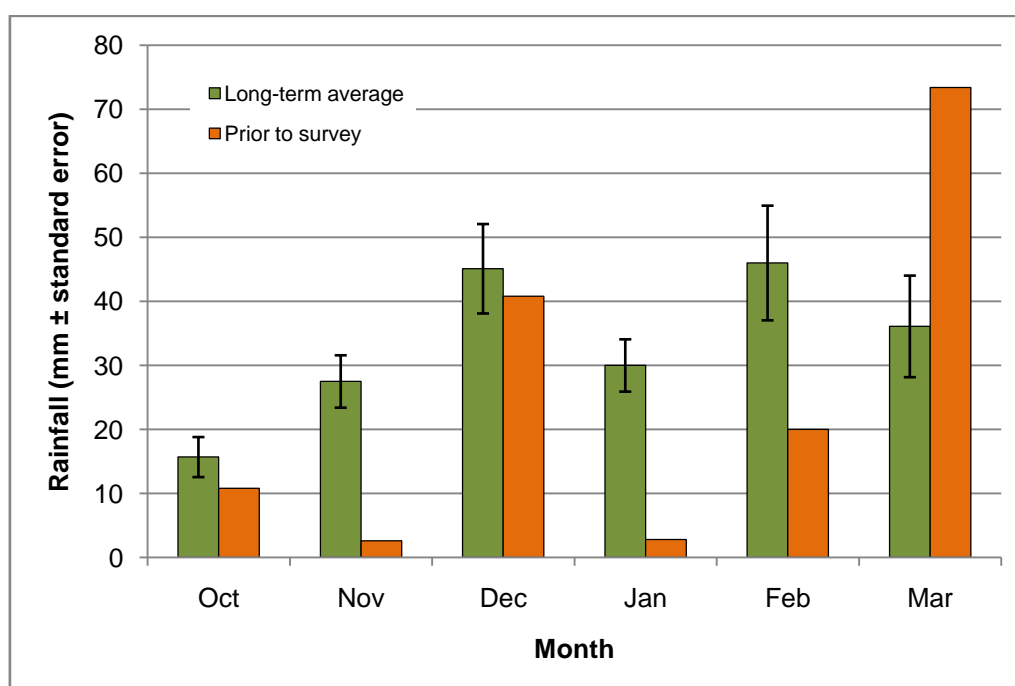


Figure 8: Long-term rainfall and rainfall for six months prior to the survey, at Giles

Source data: BOM (2013), 1956 to 2013

4.1.2. Study Team And Licensing

The field survey of the Study Area was conducted by Outback Ecology (**Table 6**). Bat echolocation recordings from SM2BATs were analysed by Bob Bullen, a bat specialist from Bat Call WA. The field survey was conducted under a Licence to Take Fauna for Scientific Purposes (DEC Regulation 17 Licence) with details as follows:

- licence number SF009030;
- issue date 31 December 2012; and
- valid from 6 January to 31 March 2013.

Table 6: Study team for the field survey

Person	Discipline	Qualifications	Position
Mike Young	Zoologist	BSc (Mar Sci) (Hons Zool) PhD (Evol Biol)	Outback Ecology Senior Environmental Scientist

4.2. Habitat Assessment And Site Selection

Broad habitat types within the Study Area were identified in the field and representative areas were chosen for habitat assessments. The purpose of the habitat assessments was to characterise the quality and complexity of habitat provided for fauna, with a focus on species of conservation significance. The following parameters were considered:

- landscape and soil features;
- the presence or absence of logs or other habitat structures;
- vegetation cover, condition and species composition;
- estimate of leaf litter cover percentage and type;
- the presence or absence of water; and
- types of disturbance and levels of disturbance.

Each of the representative areas was given a rating of excellent, very good, good, moderate, degraded or completely degraded based on the overall condition of the habitat for fauna. Once the broad habitat types were identified, sites for systematic fauna searches were identified. Subsequent to the field survey, the habitat information was used in conjunction with aerial photography and topographic maps to produce habitat maps for the Study Area.

4.3. Fauna Surveying

4.3.1. Systematic Searching

Based on habitat characteristics, eight locations were selected to conduct systematic searches for vertebrates (**Figure 9**). Each search was performed by one person for a minimum of 30 minutes, and the total systematic search effort for This Study was 8.25 person-hours. Each systematic search involved:

- observation and documentation of all vertebrate fauna seen or heard, or whose presence was inferred from tracks, scats or burrows; and

- active hand-searching for cryptic species by overturning logs and stones, and searching beneath leaf litter and the bark of dead trees.

4.3.2. Spotlighting

Spotlighting was not performed, as the cool and wet conditions meant that nocturnal species were unlikely to be active and hence unlikely to be readily detected in this manner.

4.3.3. Motion-Sensor Cameras

Based on habitat characteristics, seven locations were chosen to deploy motion-sensor cameras (**Figure 9**). The cameras (Bushnell TrophyCam XLT Viewer) were baited using a mixture of rolled oats, peanut butter and sardines, and were intended to record the activities of macropods, small mammals such as dasyurids and rodents, and nocturnally active reptiles such as geckos. Depending on the performance of each camera on its first night, cameras were either moved or redeployed for consecutive nights at the same location (**Table 7**). The total effort for camera trapping was 15 trap-nights.

Table 7: Motion-sensor camera trapping effort

Trap location	Trap nights
CAM1 130326	2
CAM4 130326	2
CAM3 130326	2
CAM2 130327	3
CAM1 130328	2
CAM3 130328	2
CAM4 130328	2
Total	15

4.3.4. Bat Echolocation Recording

SongMeter 2 Bat Echolocation Recorders (SM2BATs; Wildlife Acoustics) were deployed in locations with habitats and features likely to support bat fauna. Each deployment was for two nights, and four locations were chosen for deployment (**Figure 9**). Subsequent to the field survey the recordings for two locations (SM23 130326; SM24 13032) were analysed by Bat Call WA, providing a species list for each deployment location (**Appendix B**). No bat echolocation data was recorded during the other two deployments (SM23 130328; SM24 1303028) and is therefore not presented within **Appendix B**. The total effort for bat echolocation recording was eight trap-nights.

4.3.5. Opportunistic Searching

Within the Study Area and survey period, vertebrate fauna that were observed outside of the systematic sampling and targeted search programmes were documented and the resulting records were classified as 'opportunistic'. Opportunistic records supplement those obtained during the systematic sampling and other search programmes, and may have been generated as a result of direct or indirect fauna observations made:

- before or after the fixed-time searches;

- while habitat mapping or travelling to and from search sites; and
- at any other time whilst working in or travelling within the Study Area.

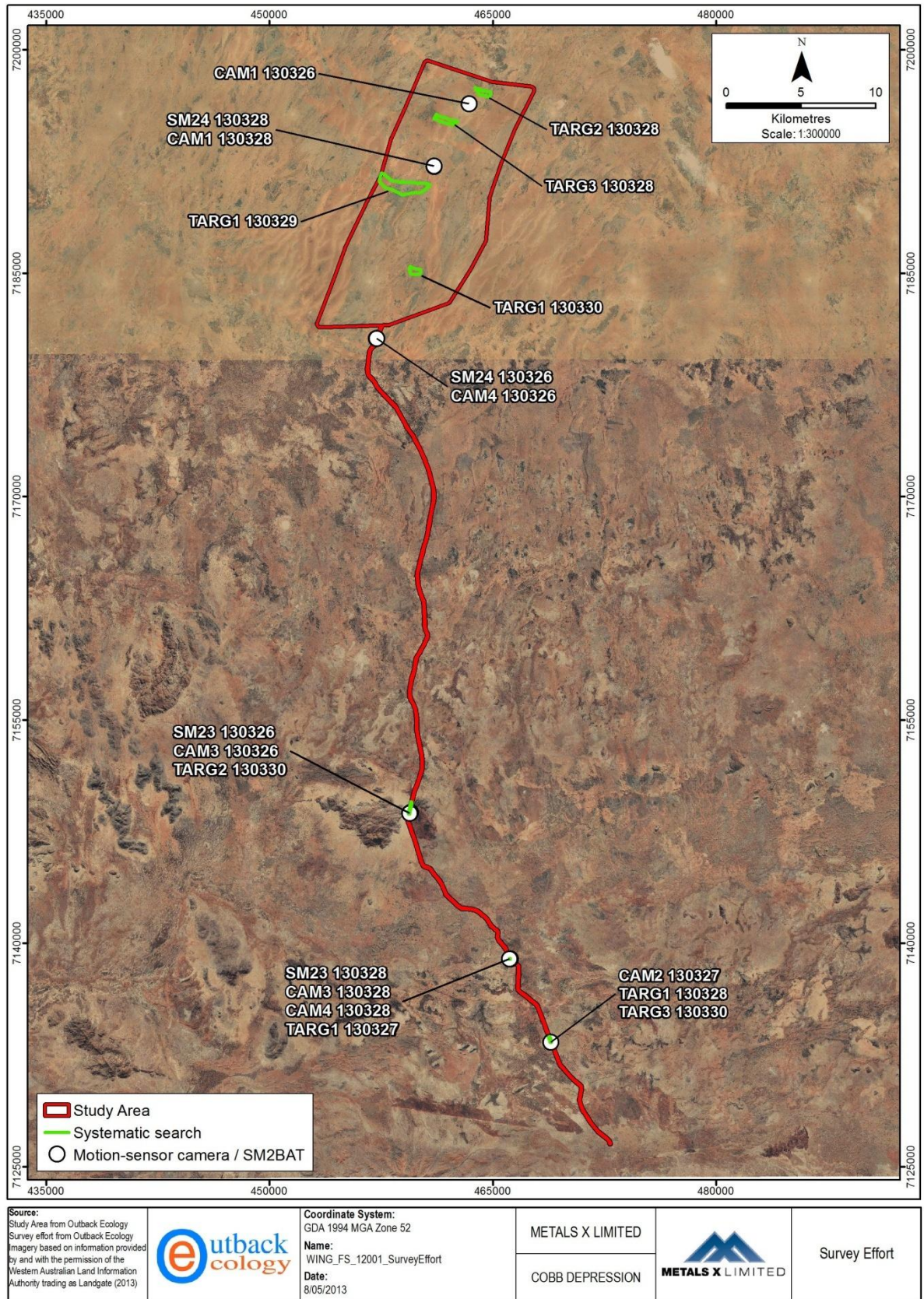


Figure 9: Location of survey activities within the Study Area

4.4. Taxonomy and Nomenclature

The nomenclature and taxonomy of all mammals, reptiles and amphibians in this report follow the *Checklist of the Vertebrates of Western Australia* (WAM 2009), and those of all birds follow the *Birds Australia Checklist of Australian Birds* (based on Christidis and Boles 2008). Relevant texts, from which information on more recent taxonomic updates and general patterns of distribution are available, were also considered for:

- non-volant mammals (Menkhorst and Knight 2010, Van Dyck and Strahan 2008);
- bats (Churchill 2008);
- birds (Johnstone and Storr 1998, 2004, Morcombe 2003, Pizzey and Knight 2007);
- reptiles (Cogger 2000, Storr *et al.* 1999, 2002, Wilson and Swan 2008, Wilson and Swan 2010); and
- amphibians (Cogger 2000, Tyler and Doughty 2009).

4.5. Limitations and Constraints

There are a number of possible limitations and constraints that can impinge on the adequacy of fauna surveys (EPA 2004). These are discussed below, with respect to the March 2013 survey of the Study Area (**Table 8**). All fauna surveys are limited to some degree by time and seasonal factors, and ideally multiple surveys of an area would be undertaken over a number of years and within a number of different seasons.

Table 8: Discussion of the potential limitations and constraints of this Assessment

Factor	Constraint	Comments
Competency and experience of consultants	No	The surveyor was a fauna specialist employed by Outback Ecology, with post-graduate qualifications and several years of experience undertaking fauna surveys of this nature
Scope	No	Fauna groups were surveyed using standardised and well-established techniques, and previous surrounding the Study Area was reviewed. Bat echolocation recordings were analysed by Bob Bullen of Bat Call WA
Proportion of fauna identified	No	The desktop and field species inventories are comparable to counts obtained during previous surveys of a similar size and scope (HGM Maunsell 2002, Outback Ecology 2009, 2012a, c). Although the database searches and some studies in the wider region recorded substantially more species, these were performed over larger areas with many more habitat types
Information sources (eg historic or recent)	Partial Constraint	The Study Area is located in a relatively poorly-surveyed region, and although the results of past surveys were included during the literature review these surveys were few in number and most were substantial distances from the Study Area.
Proportion of task achieved, and further work which might be needed	No	Planned survey works were largely conducted according to scope. Spotlighting was not performed, but it is unlikely that the outcomes of this Assessment would have been substantially different should it have occurred
Timing / weather / season / cycle	No	This report details the results of an autumn survey. Conditions during the field survey were cool and wet, which is not ideal for documenting reptilian fauna assemblages; nonetheless, this Assessment satisfies the requirements for a Level 1 assessment (EPA 2004)
Disturbances	No	Although disturbances was present in the Study Area (the Giles-Mulga Park Road and road reserve, and associated edge effects) these are unlikely to have affected the results of This Study
Intensity	No	The Study Area was sampled for a total of 23 trap nights (motion-sensor cameras and SM2BAT recorders), with a total of 8.25 person hours spent systematic searching. This level of field survey effort is appropriate for a Level 1 assessment
Completeness	No	The survey was complete. Search effort was distributed effectively among habitat types and with appropriate geographical spread
Resources	No	Resources were adequate to carry out the survey satisfactorily, and the survey participants were competent in identification of species present
Remoteness / access problems	No	Access to most of the Study Area was good and adequate survey coverage was achieved
Availability of contextual information	No	Data were available for the Central Ranges bioregion from several sources (ANRA 2009a, Birdlife Australia 2013, DEC 2013a, 2013b, DLRM 2013, DSEWPaC 2013, Northern Territory Government 2013, WAM 2013)

5. FIELD SURVEY RESULTS AND DISCUSSION

5.1. Fauna Habitats

5.1.1. Fauna Habitats in the Study Area

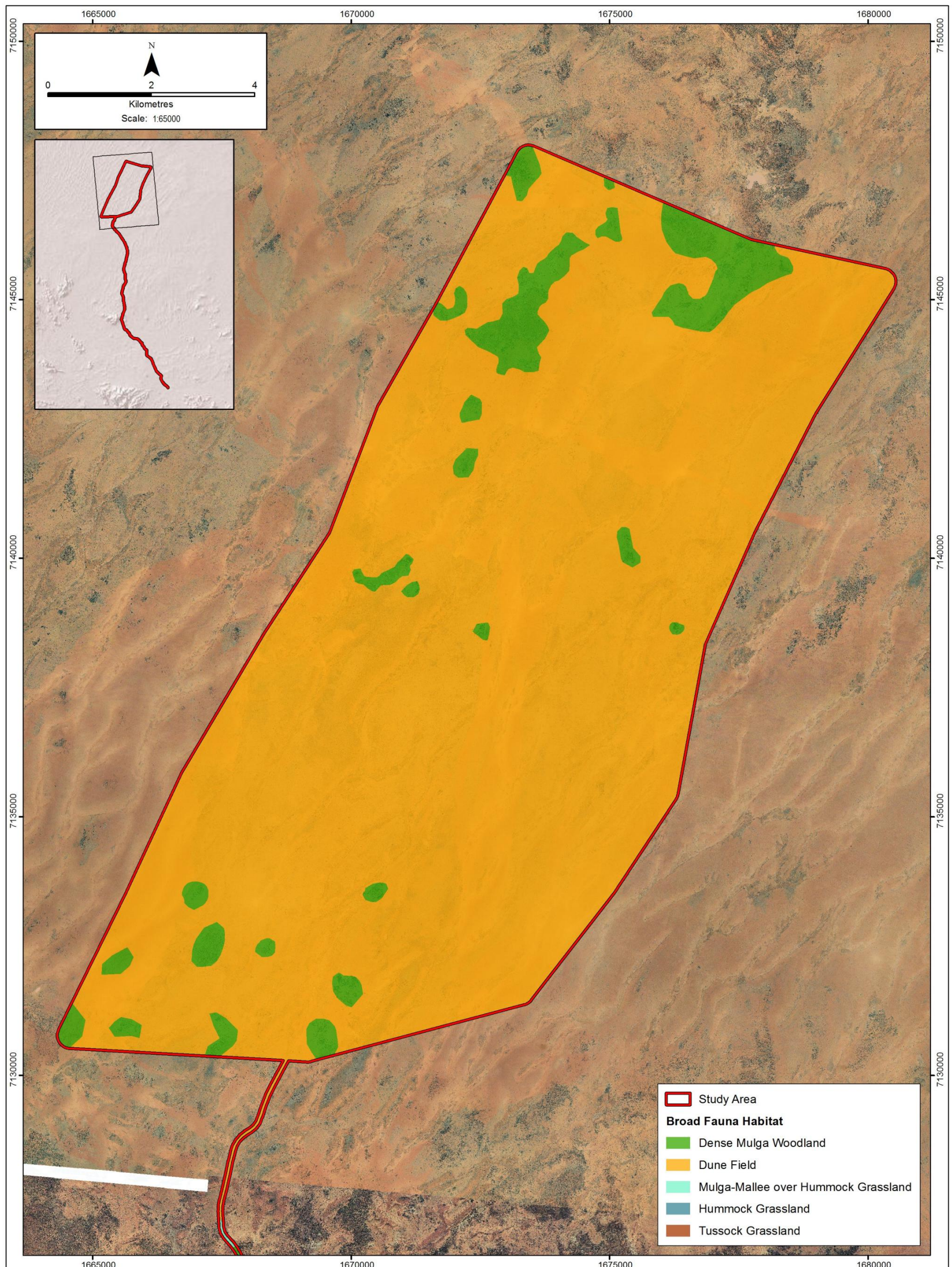
Five broad fauna habitats were identified within the Study Area (**Table 8**):

- Dense Mulga Woodland;
- Dune Field;
- Hummock Grassland;
- Tussock Grassland; and
- Mulga-Mallee over Hummock Grassland.

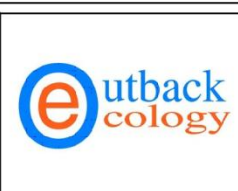
The habitats present in the Study Area are relatively well-represented outside of the Study Area. Four habitat types, Dense Mulga Woodland, Dune Field, Hummock Grassland and Mulga-Mallee over Hummock Grassland were identified as significant fauna habitats within the localized context of the Study Area (**Section 5.1.2**). Other features of significance identified in the Study Area were large sand dunes (**Section 5.1.3**).

Table 9: Habitat types in the Study Area

Fauna habitat	Survey effort	Reference	Vegetation features			Physical features	Other comments	Approximate extent
			Upper stratum	Middle stratum	Lower stratum			
Dune Field	Three systematic searches Two SM2BATs and two motion-sensor cameras	Figure 10 to Figure 16 Plate 2	Occasional <i>Acacia</i> spp (<i>aneura</i> -type) and <i>Eucalyptus</i> spp (mallee form) trees 2 to 3 m high, with up to 20% cover. In the northern portion of the Study Area, Desert Oaks (<i>A. decaisneana</i>) can be the main tree species present in habitat patches	Very sparsely distributed <i>Acacia</i> spp small trees and shrubs up to 1 m high, in isolated patches, with up to 20% cover. Extensive, dense populations of <i>Aluta maisonneuvei</i> on lower slopes of dunes	Hummock (hard <i>Triodia</i> spp) grasses up to 0.5 m high, with up to 50% cover, throughout. Some tussock grasses present, but predominantly in association with dunes. Herbaceous annuals present throughout, in low abundances	Predominantly red sandy soils, although some red loams present, with good drainage due to sandy substrate. Land form consists of extensive flat plains interspersed with linear sand dunes approximately 5 to 15 m in height	Habitat is in excellent condition, with little evidence of damage by grazing camels and the principal disturbance being fragmentation by the Giles-Mulga Park Rd. As with all habitats in the Study Area a complex fire history is present, and individual patches of this habitat type vary in their time since fire. Due to extensive plains of well-connected, sandy substrates covered by old-growth spinifex in a burnt/unburnt mosaic, this habitat type is important for sandplain fauna assemblages	12,873 ha 89.5%
Dense Mulga Woodland	One systematic search One motion-sensor camera	Figure 10 to Figure 16 Plate 1	Dense <i>Acacia</i> spp (<i>aneura</i> -type) trees up to 5 m high, sometimes with Desert Oak (<i>Allocasuarina decaisneana</i>) on periphery of stands, with up to 40% cover	Little middle stratum – when present, usually <i>Acacia</i> spp small trees and shrubs up to 1 m high, with up to 20% cover	Predominantly hummock (hard <i>Triodia</i> spp) grasses up to 0.5 m high, with up to 70% cover, but less dense (ca 30%) under mulga. Some tussock grasses and herbaceous annuals (eg <i>Ptilotus</i> , <i>Asteraceae</i> spp) also present	Red sandy-loam soils, with winter-wet drainage (moisture may accumulate on surface following heavy rain). Land form typically flat to slightly undulating plain, but habitat type also occurs interspersed among dune swales.	Habitat is bisected in parts by the Giles-Mulga Park Rd, but otherwise is in good condition. Habitat is somewhat discontinuous and promotes accumulation of relatively large amounts of leaf litter, thus may have good potential for hosting SRE invertebrates. Patches are often limited in extent and have been subject to grazing by camels. As with all habitats in the Study Area a complex fire history is present, and individual patches of this habitat type vary in their time since fire.	1,042 ha 7.2%
Tussock Grassland	One targeted search One SM2BAT and one motion-sensor camera	Figure 10 to Figure 16 Plate 4	Very sparsely distributed <i>Acacia</i> spp (<i>aneura</i> -type) and, rarely, <i>Eucalyptus</i> spp (mallee form) trees up to 3 m high, with up to 5% cover	Little middle stratum – when present, usually <i>Acacia</i> spp small trees and shrubs up to 1 m high, with up to 5% cover	Predominantly tussock grasses up to 0.4 m high, with up to 75% cover. Herbaceous annuals also abundant (eg <i>Ptilotus</i> , <i>Asteraceae</i> spp), but <i>Triodia</i> spp largely absent	Red loamy soils with clays present, with winter-wet drainage (moisture may accumulate on surface following heavy rain). Land form typically flat	Habitat is in moderate to degraded condition, with evidence of extensive camel presence and grazing damage. Weeds are present in road reserve. As with all habitats in the Study Area a complex fire history is present, and individual patches of this habitat type vary in their time since fire.	386 ha 2.8%
Mulga-Mallee over Hummock Grassland	One targeted search One SM2BAT and two motion-sensor cameras	Figure 10 to Figure 16 Plate 5	Occasional <i>Acacia</i> spp (<i>aneura</i> -type) and <i>Eucalyptus</i> spp (mallee form) trees 2 to 3 m high, with up to 20% cover. In the northern portion of the Study Area, Desert Oaks (<i>A. decaisneana</i>) can be the main tree species present in habitat patches	A sparse middle stratum of <i>Acacia</i> spp shrubs and small <i>Eucalyptus</i> spp trees present up to 2m high and 30% cover; few other middle storey species	Predominantly hummock (hard <i>Triodia</i> spp) grasses up to 0.6 m high, with up to 75% cover, but less dense (ca 30%) around trees. Some tussock grasses and herbaceous annuals (eg <i>Ptilotus</i> , <i>Asteraceae</i> spp) also present in low numbers	Red sandy-loam soils, with a soil surface layer of small silcrete stones in very rare instances. Winter-wet drainage (moisture may accumulate on surface following heavy rain). Land form typically flat to slightly undulating plain	Habitat is potentially good for hosting grassland fauna assemblages, although camel grazing and fire damage has reduced its suitability in parts. This habitat type is in good to moderate condition, overall. As with all habitats in the Study Area a complex fire history is present, and individual patches of this habitat type vary in their time since fire. Where fire has been recent, damage is extensive with only large mulga left alive and other vegetation burnt to bare soil.	55 ha 0.4%
Hummock Grassland	Two systematic searches One motion-sensor camera	Figure 10 to Figure 16 Plate 3	Very sparsely distributed <i>Acacia</i> spp (<i>aneura</i> -type) and, rarely, <i>Eucalyptus</i> spp (mallee form) trees up to 3 m high, with up to 5% cover	Very sparsely distributed <i>Acacia</i> spp small trees and shrubs up to 1 m high, in isolated patches, with up to 5% cover. Occasionally, small but dense clumps of <i>Aluta maisonneuvei</i> on periphery of habitat	Dense, predominantly old-growth hummock (<i>Triodia</i> spp) grasses up to 0.6 m high, with up to 75% cover. Some herbaceous annuals also present throughout	Predominantly red sandy soils, although some red loams present, with good drainage due to sandy substrate. Land form typically flat	Habitat in excellent condition, despite evidence of camels present and fragmentation (bisection) of habitat patch by the Giles-Mulga Park Rd. This habitat type has very good potential to support assemblages of fauna associated with spinifex-dominated sandy plains. As with all habitats in the Study Area a complex fire history is present, and individual patches of this habitat type vary in their time since fire.	21 ha 0.1%



Source:
 Study Area from Outback Ecology
 Broad fauna habitats from Outback Ecology
 Imagery based on information provided by
 and with the permission of the Western
 Australian Land Information Authority
 trading as Landgate (2013)



File Name:
 WING_FS_12001_Habitat01
 Date Created:
 8/05/2013
 Coordinate System:
 GDA 1994 MGA Zone 50

METALS X LIMITED
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Broad Fauna Habitat
 1 of 7

Figure 10: Fauna habitats in the Study Area - Map 1 of 7

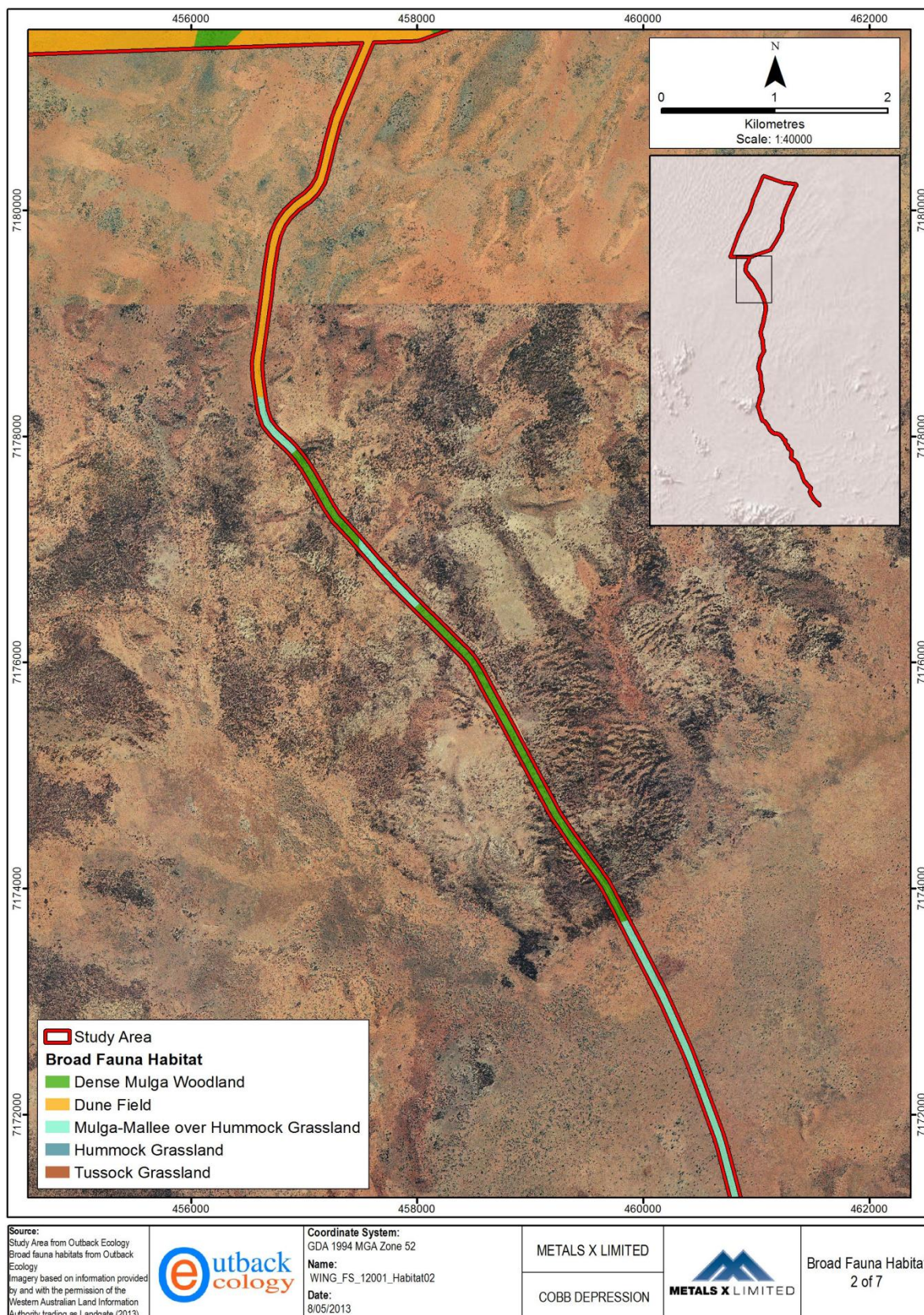


Figure 11: Fauna habitats in the Study Area - Map 2 of 7

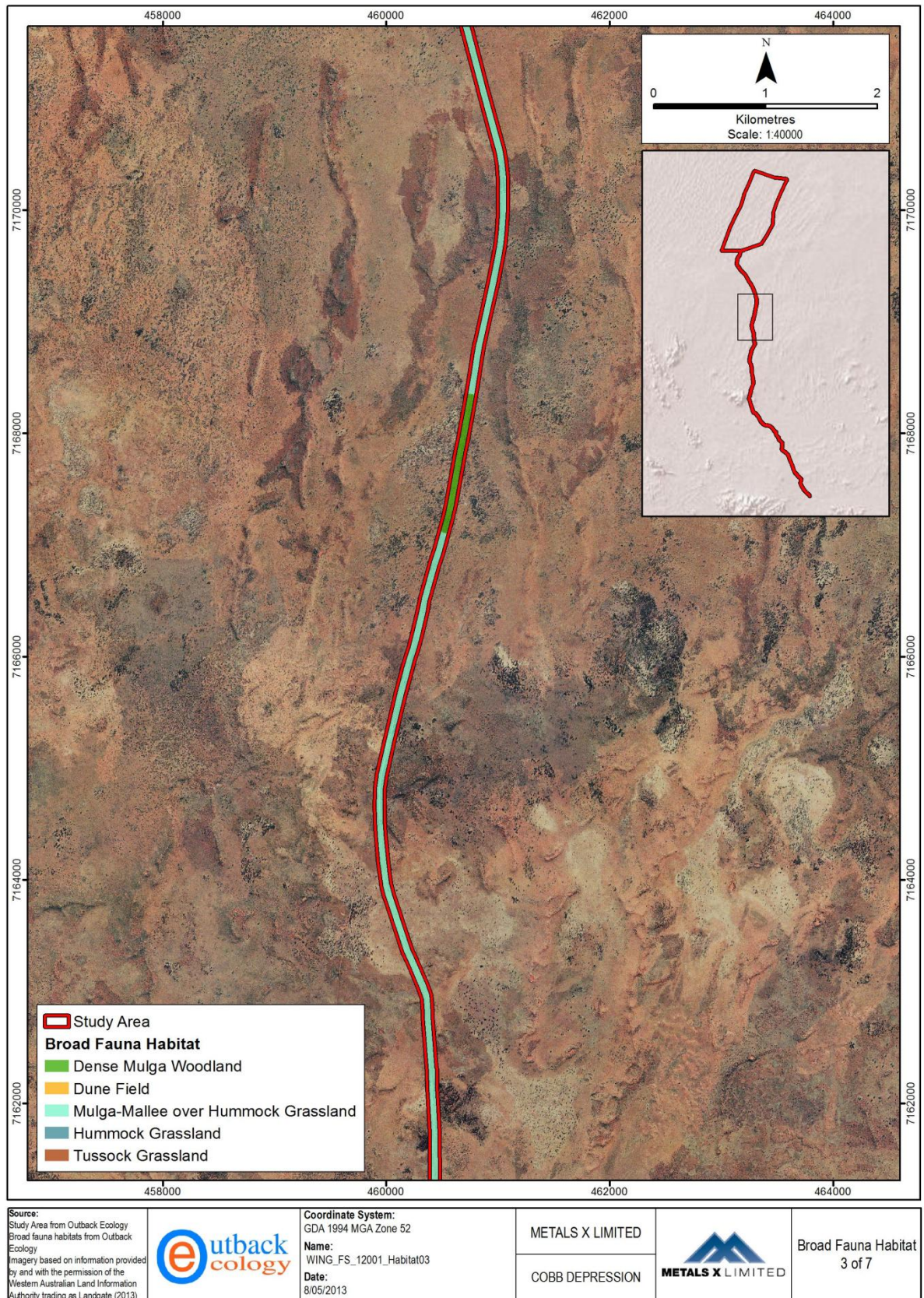


Figure 12: Fauna habitats in the Study Area - Map 3 of 7

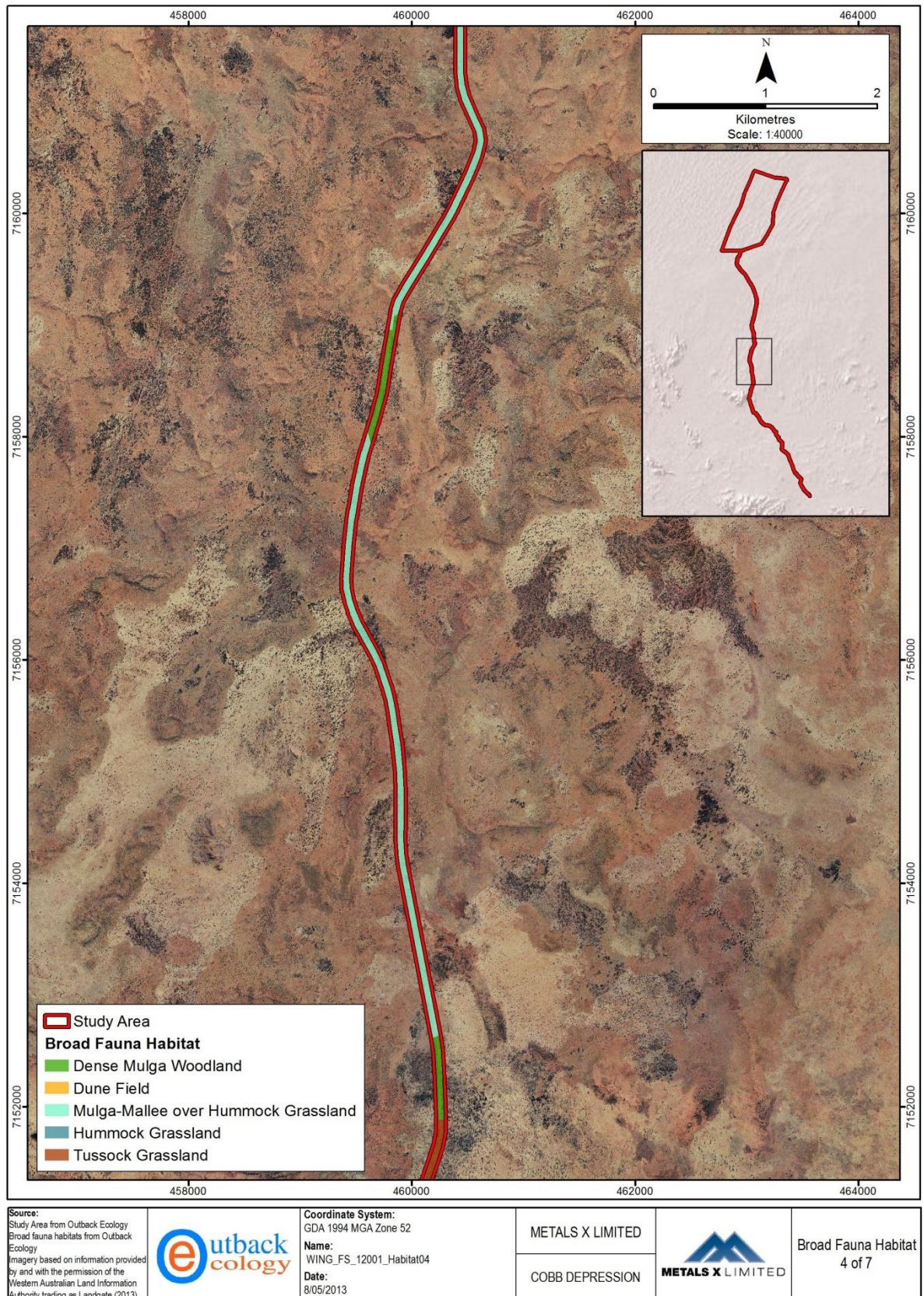


Figure 13: Fauna habitats in the Study Area - Map 4 of 7

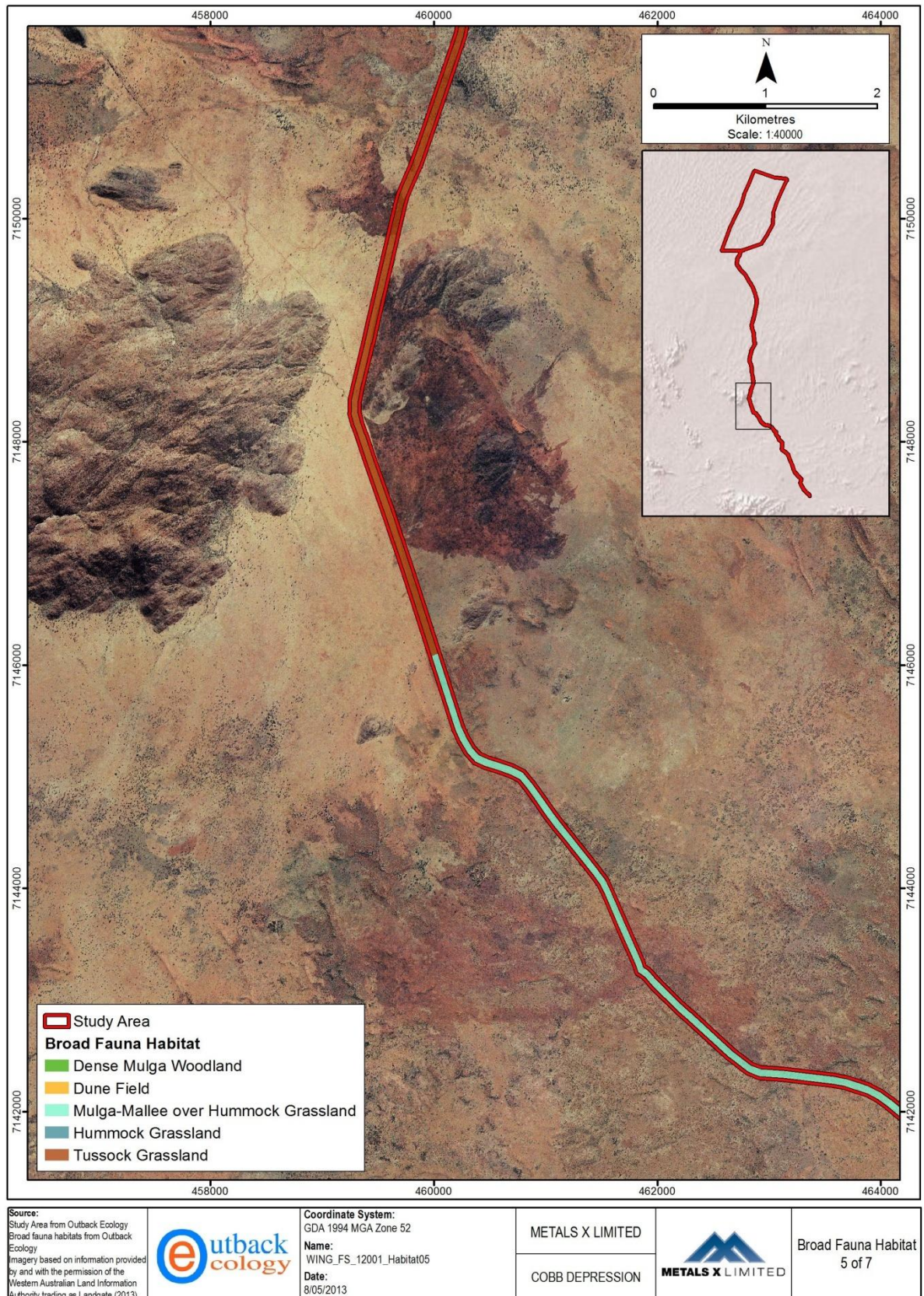


Figure 14: Fauna habitats in the Study Area - Map 5 of 7

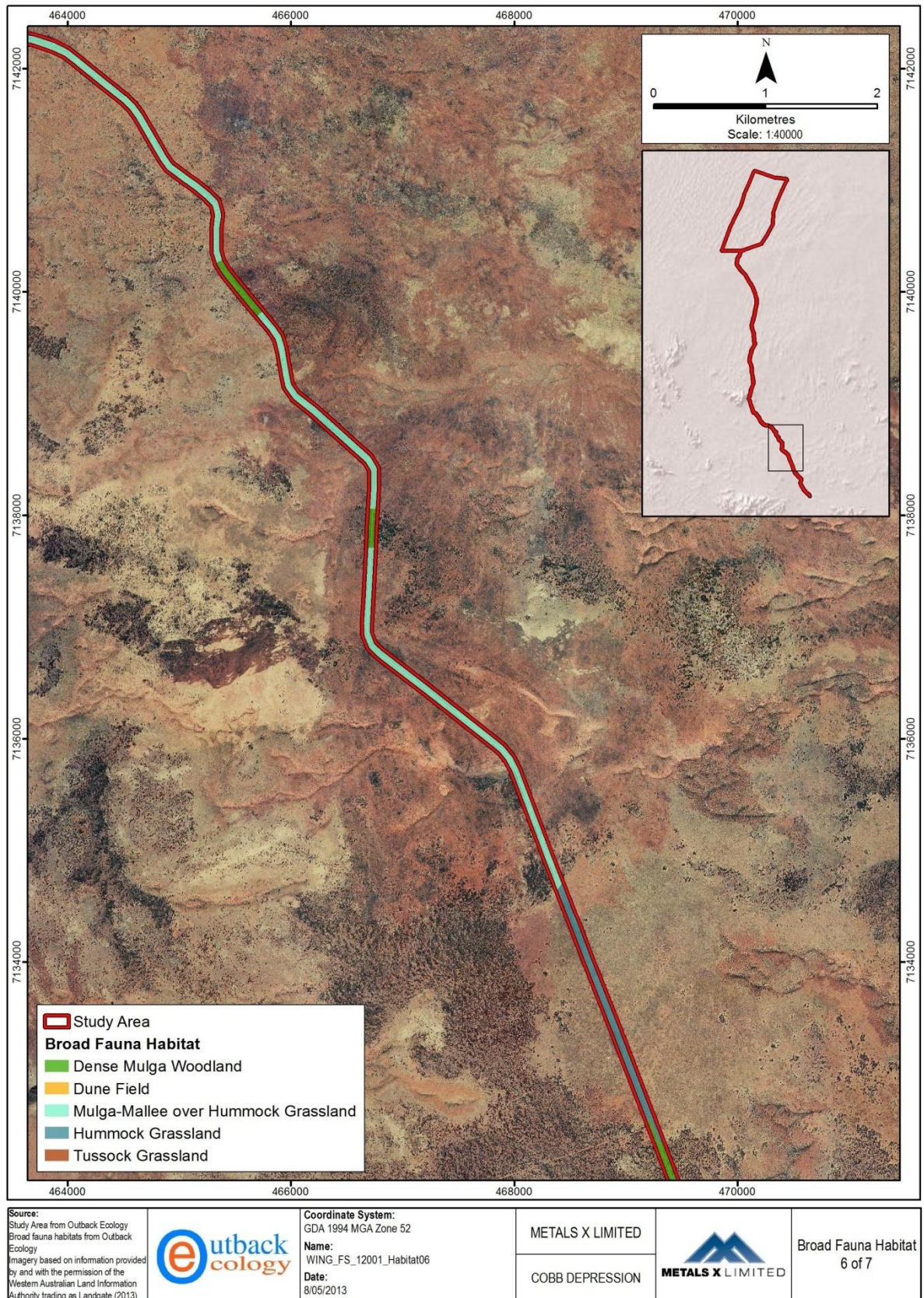


Figure 15: Fauna habitats in the Study Area - Map 6 of 7

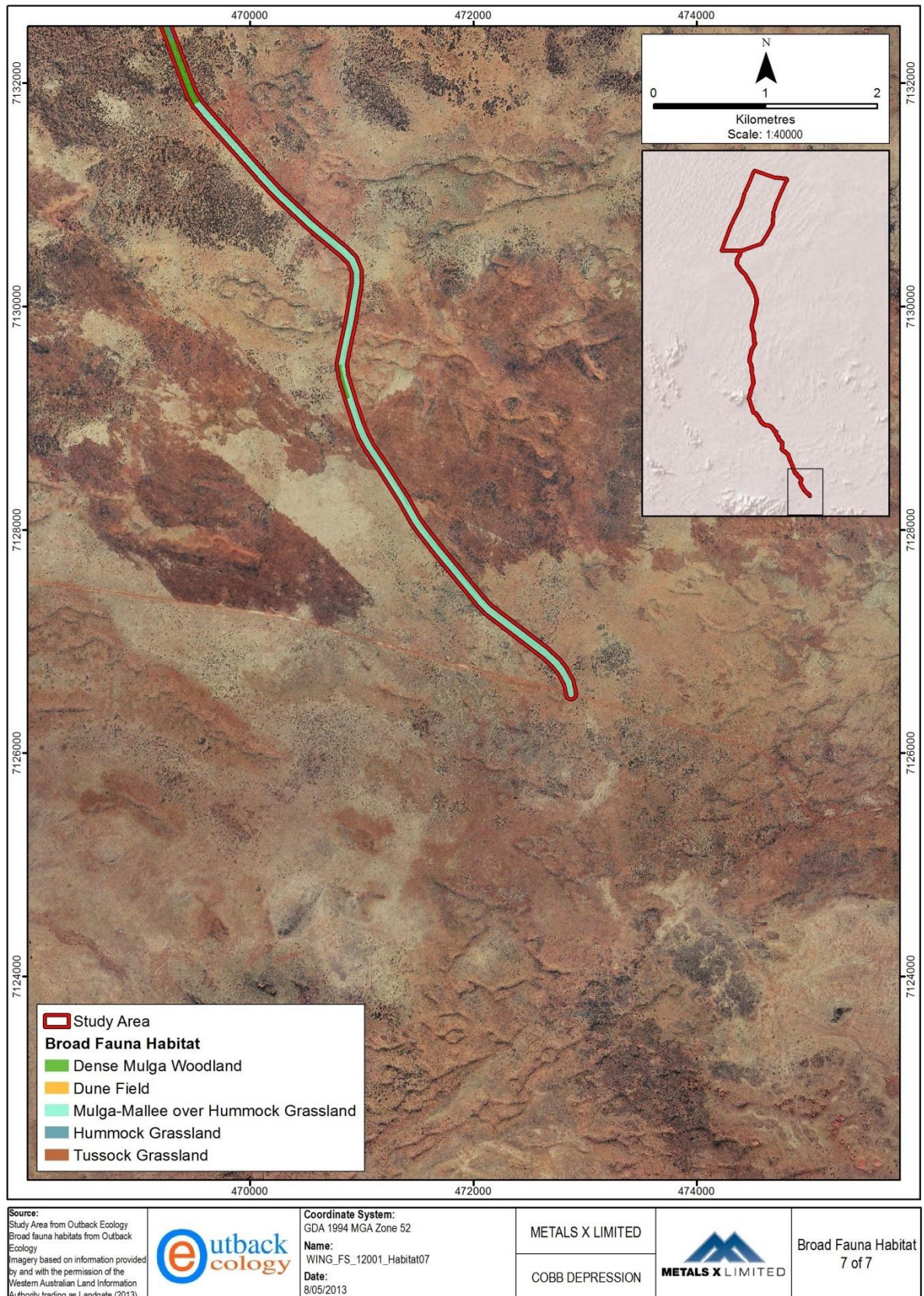


Figure 16: Fauna habitats in the Study Area - Map 7 of 7



Plate 1: Dense Mulga Woodland habitat type



Plate 2: Dune Field habitat type



Plate 3: Hummock Grassland



Plate 4: Tussock Grassland



Plate 5: Mulga-Mallee over Hummock Grassland habitat type

5.1.2. Significant Fauna Habitats in the Study Area

Four significant fauna habitats were identified within the Study Area:

- Dense Mulga Woodland (**Plate 1**);
- Dune Field (**Plate 2**);
- Hummock Grassland (**Plate 3**); and
- Mulga-Mallee over Hummock Grassland (**Plate 5**).

Dense Mulga Woodland is considered a locally significant habitat type due to it supporting a more favourable microclimate for fauna in comparison to other habitats in the Study Area. Dense stands of mulga provide substantial shade and often produce thick leaf litter; the resulting shelter makes the Dense Mulga Woodland habitat type more likely to support species of SRE invertebrate. Mygalomorph spiders and to a lesser extent scorpions, of which both groups contain taxa prone to short-range endemism, were common in Dense Mulga Woodland in surveys immediately to the south of the Study Area (Outback Ecology 2012b). In some areas of Dense Mulga Woodland found during this Assessment, mygalomorph spider burrows that had been excavated by monitor lizards were numerous. Dense Mulga Woodland occupies only 7.2% of the Study Area (**Table 8**); however, it is widespread in the vicinity and wider region. Given this, the instances of Dense Mulga Woodland habitat present in the Study Area are not considered to be significant at a regional scale.

The Dune Field and Hummock Grassland habitat types are considered locally significant habitat types due to their potential to host the burrowing fauna of conservation significance that are associated with arid-zone sandplains vegetated by old-growth spinifex. For example, the Brush-tailed Mulgara was recorded in each of these habitat types during the field survey component of this Assessment. Other fauna that may be present in these habitat types include, but are not limited to, the Great Desert Skink and Central Marsupial Mole. Although locally significant, these habitats occupy a large amount of the Study Area (89.6% collectively). Further, they are widespread in the vicinity and wider region, and occurrences in the Study Area are well connected to those outside the Study Area. Given this, the instances of Hummock Grassland and Dune Field habitat types in the Study Area are not considered to be significant in a regional context.

Mulga-Mallee over Hummock Grassland is considered a locally significant habitat type due to its heterogeneity and its consequent ability to support a variety of fauna assemblages. The ability of this habitat type to support fauna is closely related to its fire history; areas retaining a mosaic of fire ages are thought to provide the best habitat because newly burnt areas may be used for foraging, whereas long unburnt areas may be used for shelter and breeding (Parr and Andersen 2006, Southgate *et al.* 2007, Woinarski 1999). Spinifex provides important shelter given its ability to buffer temperatures in the face of harsh external conditions, while also providing a protective refuge for small native mammals (Van Dyck and Strahan 2008). Generally, this kind of habitat has potential to support populations of burrowing fauna of conservation significance, such as Mulgara (Körtner *et al.* 2007, Masters 2003). This habitat type differs from other hummock grassland habitats in the Study Area, in that mallee eucalypts are more common; this promotes habitat heterogeneity by promoting

accumulation of dispersed patches of leaf litter. Mulga-Mallee over Hummock Grassland habitat may therefore contain habitat patches for SRE invertebrates. Mulga-Mallee over Hummock Grassland occupies only 0.4% of the Study Area; however, this habitat type is widespread in the vicinity and wider region, and occurrences in the Study Area are well connected to those outside the Study Area. Given this, the instances of Hummock Grassland and Dune Field habitat types in the Study Area are not considered to be significant at a regional scale.

5.1.3. Other Significant Habitat Features in the Study Area

An extensive network of large sand dunes is present in the Study Area. Although dunes can be found along the length of the Study Area, they are most common in the Dune Field habitat that occupies the majority of the northern borefield portion (they are readily seen in **Figure 10**). It is possible that the heterogeneity of habitats in the northern portion of the Study Area is important for mammalian fauna, given that it offers close proximity of foraging habitat (amongst the stands of Dense Mulga Woodland) to diurnal shelter (amongst the dune vegetation and associated hummock grasslands found in the Dune Field habitat type). Furthermore, it is thought that sand dune systems, specifically the crests and slopes within, are preferred habitat for the Central Marsupial Mole, a species of conservation significance.

5.2. Vertebrate Fauna

A total of 382 vertebrate species – 54 mammals (including ten introduced), 197 birds (including three introduced), 124 reptiles and seven amphibians – was identified by the database searches and the literature review as potentially occurring in the Study Area (**Attachment A**). The previous surveys and database searches encompassed a wider range of habitat types than those present within the Study Area, and many of the previous surveys incorporated intensive sampling programmes; hence, lower species diversity was expected to be recorded during This Study. This Study recorded a total of 46 species. This Study therefore recorded approximately 12% of the total number of species identified by the literature review and database searches as potentially occurring in the Study Area.

5.2.1. Mammals

Twelve species of mammal were recorded during the field survey – one dasyurid (carnivorous marsupial), one rodent, two macropods, four bats and four introduced species (**Table 10**). Only one of these species, the Brush-tailed Mulgara, is of conservation significance (**Plate 6** and **Plate 7**, and see **Section 5.3** for more information on these records). Of the four bat species recorded, only Finlayson's Cave Bat (*Vespadelus finlaysoni*) is not known to roost in tree hollows or burrows; thus, while the Study Area may represent foraging habitat only for Finlayson's Cave Bat (which most likely roosts in cave systems outside of the Study Area, for example in the vicinity of Mt Fanny), the other species recorded may have roost sites within the Study Area itself.



Plate 6: Brush-tailed Mulgara photographed in the Study Area using a motion-sensor camera



Plate 7: Brush-tailed Mulgara photographed in the Study Area using a motion-sensor camera

The total number of mammals recorded during this Assessment is comparable to counts obtained during previous surveys in the vicinity with of the Study Area of a similar size and scope (HGM Maunsell 2002, Outback Ecology 2009) (**Section 3.2**). All records were obtained by SM2BAT recordings, interpretation of scats and tracks or motion-sensor cameras – only the Camel (*Camelus dromedarius*) and the Dingo/Dog (*Canis lupus*) were directly sighted during daylight searches.

Table 10: Mammals recorded in the Study Area during the field survey

Common name	Species name	Conservation status	
		EPBC	In WA
Gould's Wattled Bat	<i>Chalinolobus gouldii</i>		
Chocolate Wattled Bat	<i>Chalinolobus morio</i>		
Brush-tailed Mulgara	<i>Dasyercus blythei</i>	VU	P4
Common Wallaroo	<i>Macropus robustus</i>		
Red Kangaroo	<i>Macropus rufus</i>		
Spinifex Hopping-mouse	<i>Notomys alexis</i>		
Lesser Long-eared Bat	<i>Nyctophilus geoffroyi</i>		
Inland Cave Bat	<i>Vespadelus finlaysoni</i>		
Camel	<i>Camelus dromedarius</i> *		
Dingo/Dog	<i>Canis lupus</i> *		
Cat	<i>Felis catus</i> *		
Rabbit	<i>Oryctolagus cuniculus</i> *		

*, introduced species; EPBC, status under EPBC Act; In WA, status under WC Act or DEC Priority List

5.2.2. Birds

A total of 30 species of bird was recorded during the field survey (**Table 11**). Only two of these species – the Australian Bustard (*Ardeotis australis*) and Major Mitchell's Cockatoo (*Lophochroa leadbeateri*) – are of conservation significance (see **Section 5.3** for more information on these records). Introduced avifauna could potentially occur in the Study Area (**Appendix A**), but none was recorded during this Assessment.

The total number of birds recorded during This Study is comparable to counts obtained during previous surveys in the vicinity of the Study Area, of a similar size and scope (Gole 2002, HGM Maunsell 2002, Outback Ecology 2009) (**Section 3.2**). Nearly all avifauna records were obtained during daytime searches, except for the Little Crow (*Corvus bennetti*; recorded using a motion-sensor camera). Overall, the avifauna assemblage encountered during this Assessment was typical of the bioregion and the specific habitats encountered.

Table 11: Birds recorded in the Study Area during the field survey

Common name	Species name	Conservation status	
		EPBC	In WA
Inland Thornbill	<i>Acanthiza apicalis</i>		
Banded Whiteface	<i>Aphelocephala nigrincincta</i>		
Australian Bustard	<i>Ardeotis australis</i>		P4
Black-faced Woodswallow	<i>Artamus cinereus</i>		
Masked Woodswallow	<i>Artamus personatus</i>		
Australian Ringneck	<i>Barnardius zonarius</i>		
Brown Songlark	<i>Cincloramphus cruralis</i>		
Rufous Songlark	<i>Cincloramphus mathewsi</i>		
Spotted Harrier	<i>Circus assimilis</i>		
Little Crow	<i>Corvus bennetti</i>		
Pied Butcherbird	<i>Cracticus nigrogularis</i>		
Australian Magpie	<i>Cracticus tibicen</i>		
Crimson Chat	<i>Epthianura tricolor</i>		
Brown Falcon	<i>Falco berigora</i>		
Nankeen Kestrel	<i>Falco cenchroides</i>		
Whistling Kite	<i>Haliastur sphenurus</i>		
Singing Honeyeater	<i>Lichenostomus virescens</i>		
Major Mitchell's Cockatoo	<i>Lophochroa leadbeateri</i>		S4
White-winged Fairy-wren	<i>Malurus leucopterus</i>		
Yellow-throated Miner	<i>Manorina flavigula</i>		
Budgerigar	<i>Melopsittacus undulatus</i>		
Crested Pigeon	<i>Ocyphaps lophotes</i>		
Crested Bellbird	<i>Oreoica gutturalis</i>		
Rufous Whistler	<i>Pachycephala rufiventris</i>		
Red-browed Pardalote	<i>Pardalotus rubricatus</i>		
Mulga Parrot	<i>Psephotus varius</i>		
Redthroat	<i>Pyrrholaemus brunneus</i>		
Willie Wagtail	<i>Rhipidura leucophrys</i>		
Weebill	<i>Smicromnis brevirostris</i>		
Zebra Finch	<i>Taeniopygia guttata</i>		

EPBC, status under EPBC Act; In WA, status under WC Act or DEC Priority List

5.2.3. Reptiles

A total of four species of reptile was recorded during the field survey – two elapid snakes and two monitor lizards (**Table 12**). None of these species is of conservation significance, and each species was represented by only a single record. The total number of reptiles recorded during This Study is substantially lower than counts obtained by previous surveys in the vicinity of the Study Area, of a similar size and scope (HGM Maunsell 2002, Outback Ecology 2009) (**Section 3.2**). The relatively

low number of reptiles observed during this Assessment is due to the cool and wet conditions that were unexpectedly encountered during the field survey, and not due to any lack of ability of the habitats in the Study Area to support reptile and amphibian assemblages.

The Study Area is well suited to host burrowing herpetofauna, due to the prevalence of sandy soils. For example, monitor lizards (*Varanus* spp) were a frequently encountered reptile group in the Study Area, with their diggings and tracks being evident at all locations visited.

Table 12: Reptiles recorded in the Study Area during the field survey

Common name	Species name	Conservation status	
		EPBC	In WA
King Brown Snake	<i>Pseudechis australis</i>		
Mengden's Brown Snake	<i>Pseudonaja mengdeni</i>		
Perentie	<i>Varanus giganteus</i>		
Gould's Goanna	<i>Varanus gouldii</i>		

EPBC, status under EPBC Act; In WA, status under WC Act or DEC Priority List

5.3. Fauna of Conservation Significance

Three species of fauna of conservation significance were encountered during the field survey component of this Assessment – the Brush-tailed Mulgara, Australian Bustard and Major Mitchell's Cockatoo (**Table 13**). The Brush-tailed Mulgara was recorded at six locations, five of which are closely clustered together along the Giles-Mulga Park Rd, and the Australian Bustard and Major Mitchell's Cockatoo were recorded at a single location each (**Figure 17**). The Brush-tailed Mulgara was recorded using motion-sensor cameras and its burrows were recorded during systematic searches. The Australian Bustard and Major Mitchell's Cockatoo were recorded opportunistically.

The literature review and database searches identified 38 species of conservation significance which potentially occur in the Study Area and include those found in the Study Area during the field survey. (**Attachment A**). Of these:

- 18 species are listed as Threatened under the EPBC Act and/or the WC Act (**Section 5.3.1**);
- eight species, including two species also listed under the EPBC Act, are recognised by DEC as Priority Fauna, (**Section 5.3.2**); and
- 18 species, including four species also listed as Threatened under the EPBC and WC Acts, are birds listed as Migratory under the EPBC Act, due to their being subject to international agreements such as the Japan-Australia Migratory Bird Agreement (JAMBA), the China-Australia Migratory Bird Agreement (CAMBA), the Republic of Korea Australia Migratory Bird Agreement (ROKAMBA) and the Bonn Convention (The Convention on the Conservation of Migratory Species of Wild Animals) (**Section 5.3.3**).

Table 13: Fauna of conservation significance recorded during the field survey

Common name (Species name)	Conservation status		WGS84 UTM 52J		Date	Time	Record
	EPBC	In WA	Easting	Northing			
Australian Bustard (<i>Ardeotis australis</i>)		P4	460256	7151894	29/03/13	1353	3 individuals seen
Major Mitchell's Cockatoo (<i>Lophochroa leadbeateri</i>)		S4	459772	7150326	26/03/13	1837	16 individuals seen
Brush-tailed Mulgara (<i>Dasyercus blythi</i>)	VU	P4	468869	7133341	27/03/13	-	3 burrows found
			468887	7133362	28/03/13	-	1 burrow found
			468883	7133351	28/03/13	-	1 burrow found
			468882	7133338	27/03/13	2134	1 camera-trapped
						2247	1 camera-trapped
					28/03/13	0139	1 camera-trapped
						0411	1 camera-trapped
						0542	1 camera-trapped
						0614	1 camera-trapped
			2028	1 camera-trapped			
468880	7133345	28/03/13	-	2 burrows found			
460139	7185230	30/03/13	-	9 burrows found			

EPBC, status under EPBC Act; In WA, status under WC Act or DEC Priority List

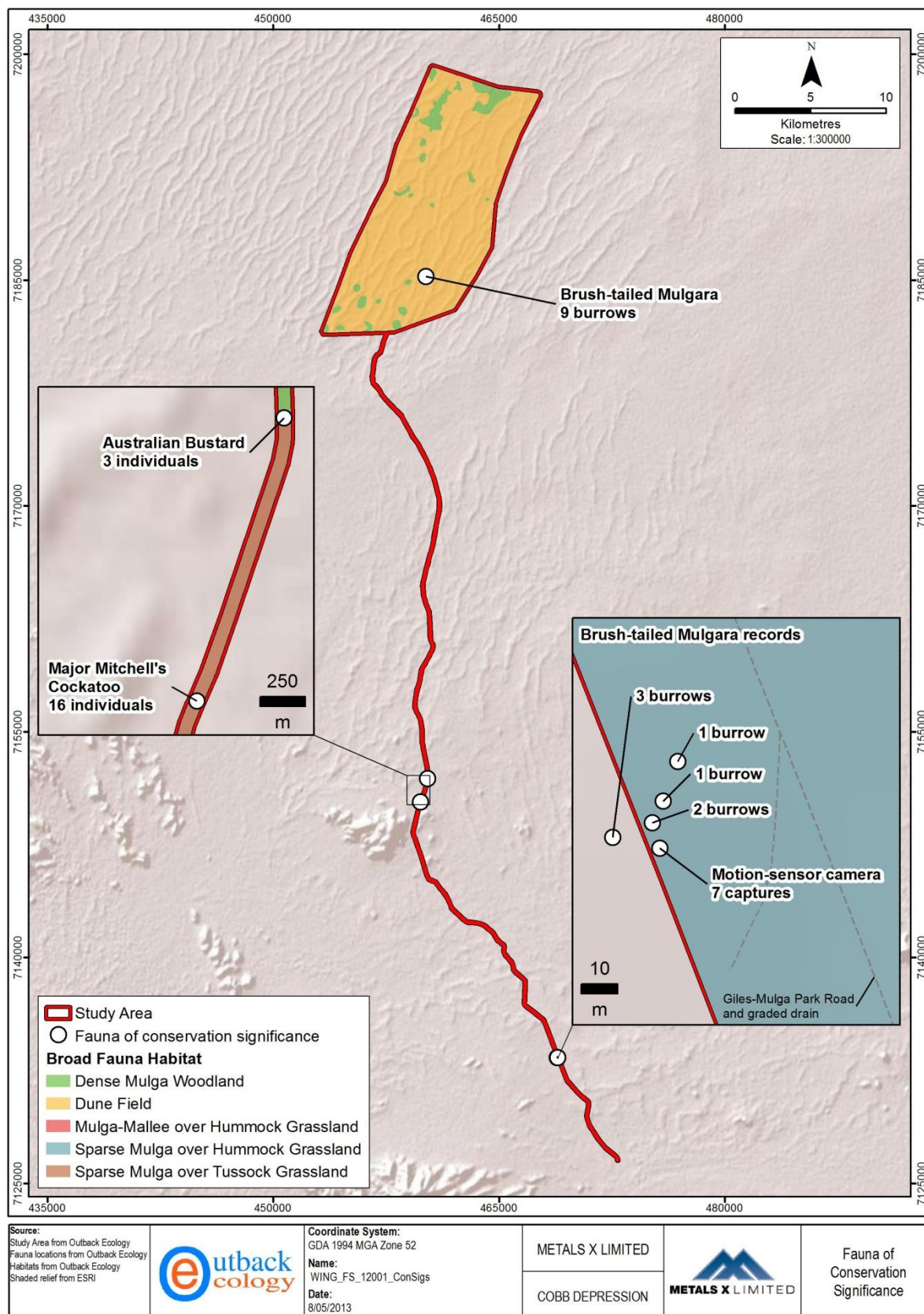


Figure 17: Locations of fauna of conservation significance recorded during the field survey

In **Section 5.3.1** to **Section 5.3.3**, the likelihood of each of these species of conservation significance occurring in the Study Area has been assessed and ranked. The rankings were assigned using the following definitions:

Confirmed – the presence of the species in the Study Area has been recorded unambiguously during the last ten years (ie during recent surveys of the Study Area or from recent records obtained via database searches);

Very likely – the Study Area lies within the known distribution of the species and contains suitable habitat(s), plus the species generally occurs in suitable habitat and has been recorded nearby within the last 20 years;

Likely – the Study Area lies within the known distribution of the species and the species has been recorded nearby within the last 20 years; however, either:

- a. the Study Area contains only a small area of suitable habitat, or habitat that is only marginally suitable; or
- b. the species is generally rare and patchily distributed in suitable habitat;

Possible – there is an outside chance of occurrence, because:

- a. the Study Area is just outside the known distribution of the species, but it does contain suitable and sufficient habitat (the species may be common, rare, or patchily distributed); or
- b. the Study Area lies within the known distribution of the species, but the species is very rare and/or patchily distributed; or
- c. the Study Area lies on the edge of, or within, the known distribution and has suitable habitat, but the species has not been recorded in the area for over 20 years; or

Unlikely – the Study Area lies outside the known distribution of the species, the Study Area does not contain suitable habitat, and the species has not been recorded in the area for over 20 years.

5.3.1. Threatened Fauna

Legislation has been developed at a Commonwealth (EPBC Act) and State (WC Act) level to protect fauna species that have been formally recognised as rare, threatened with extinction or having high conservation value. For the full definitions of conservation significance under these Acts, see **Appendix C**. The database and literature searches identified 16 threatened species that could potentially occur within the Study Area (**Attachment A**), two of which were recorded during this survey (**Table 15**).

Table 14: Threatened fauna potentially occurring in the Study Area

Common name (species name)	Conservation status		Number of		Likelihood of occurrence
	EPBC	WC	Surveys	Databases	
Sandhill Dunnart (<i>Sminthopsis psammophila</i>)	EN	S1	0	1	Unlikely
Northern Marsupial Mole (<i>Notoryctes caurinus</i>)	EN	S1	0	2	Unlikely
Central Marsupial Mole (<i>Notoryctes typhlops</i>)	EN	S1	3	2	Likely
Crest-tailed / Brush-tailed Mulgara (<i>Dasyercus cristicauda</i> /	EN / VU	S1 / P4	1 / 2	1 / 3	Unlikely / confirmed [†]
Night Parrot (<i>Pezoporus occidentalis</i>)	EN, M	S1	0	1	Unlikely
Malleefowl (<i>Leipoa ocellata</i>)	VU, M	S1	2	3	Possible
Australian Painted Snipe (<i>Rostratula australis</i>)	VU, M	S1	0	1	Unlikely
Black-flanked Rock-wallaby (<i>Petrogale lateralis lateralis</i>)	VU	S1	1	0	Unlikely
MacDonnell Ranges Black-footed Rock-wallaby (<i>Petrogale lateralis</i> ssp ANWC CM15314)	VU	S1	0	4	Unlikely
Greater Bilby (<i>Macrotis lagotis</i>)	VU	S1	0	3	Possible
Great Desert Skink (<i>Liopholis kintorei</i>)	VU	S1	2	4	Possible
Princess Parrot (<i>Polytelis alexandrae</i>)	VU	P4	3	2	Possible
Great Knot (<i>Calidris tenuirostris</i>)		S1	1	0	Unlikely
Grey Falcon (<i>Falco hypoleucos</i>)		S1	2	2	Possible
Woma (<i>Aspidites ramsayi</i>)		S4	2	1	Likely
Major Mitchell's Cockatoo (<i>Lophochroa leadbeateri</i>)		S4	3	2	Confirmed
Peregrine Falcon (<i>Falco peregrinus</i>)		S4	2	2	Possible

[†] the species confirmed to be present is most likely to be the Brush-tailed Mulgara, *Dasyercus blythi*, but see Section 5.3.1 for a discussion of Mulgara taxonomy; EPBC, status under EPBC Act; WC, status under WC Act or DEC Priority List;

- **Sandhill Dunnart (*Sminthopsis psammophila*)**

The Sandhill Dunnart is a little-known, small marsupial carnivore weighing less than 40 g. Its habitat requirements are not well understood, but it is thought to utilise a range of *Triodia* spp and open xeric woodland habitats growing on sandy substrates. The Sandhill Dunnart may have an association with areas of long-unburnt vegetation, and suitable habitat for the Sandhill Dunnart may exist in the Study Area. However, considering the lack of collection records in the wider region for the past 100 years and its absence from recent surveys near the Study Area, the presence of the species in the Study Area is considered to be unlikely.

- **Northern Marsupial Mole (*Notoryctes caurinus*)**

The Northern Marsupial Mole is an extremely poorly-known, small carnivorous marsupial. The current distribution of the species is thought to be largely confined to north-western WA, where suitable habitat exists, such as in the Tanami, Gibson and Great Sandy Deserts (DSEWPaC 2012b). The Northern Marsupial Mole is extremely specialised for burrowing through sand, and has an unmistakable mole-like tubular body with a cone-shaped head, short limbs and no functional eyes (Menkhorst and Knight 2010). Its preferred habitat is thought to be sandy desert country, including dune fields and river flats, where it tunnels through soft sand and creates deep burrow systems (Menkhorst and Knight 2010).

The Northern Marsupial Mole was not recorded during This Study and has not been recorded in previous surveys of the wider region, and although the Protected Matters database suggested the species may occur in the vicinity of the Study Area, there are no specific collection records associated. The only other database record for the species is from Lake Mackay, over 300 km to the north of the Study Area and much further within the accepted distribution of this species. Currently, the available data suggest that the distribution of the Northern Marsupial Mole is to the north-west of the Study Area. Given this, it is considered unlikely that this species occurs in the Study Area.

- **Central Marsupial Mole (*Notoryctes typhlops*)**

The Central Marsupial Mole, like its congener the Northern Marsupial Mole, is a small carnivorous marsupial highly adapted to life burrowing amongst sand dunes and sandy plains (Menkhorst and Knight 2010, Van Dyck and Strahan 2008). The Central Marsupial Mole, however, has been recorded slightly more often and consequently more is known about its ecology. The species tunnels through lightly cemented sand, and backfills as it proceeds; the tunnels are not thought to be re-used, and may persist in the soil profile for lengthy amounts of time (Van Dyck and Strahan 2008). The Central Marsupial Mole feeds on a range of subterranean prey, including termites and insect larvae (Menkhorst and Knight 2010), but is also known to be capable of taking arthropods and small vertebrates such as geckos (Van Dyck and Strahan 2008).

The Study Area is well within the currently accepted distribution of the Central Marsupial Mole (Van Dyck and Strahan 2008), and the sandy habitats within the Study Area – particularly those associated with extensive dune systems (**Section 5.1**) – are capable of supporting this species. Two of the

database searches and three of the previous surveys in the vicinity of the Study Area have recorded this species (**Appendix A**), and it has also been suggested that this species is more widespread and common than previously thought (Van Dyck and Strahan 2008). It is therefore considered likely that the Central Marsupial Mole occurs in the Study Area.

- **Crest-tailed Mulgara (*Dasyercus cristicauda*) / Brush-tailed Mulgara (*Dasyercus blythi*)**

Until recently the Brush-tailed Mulgara, *Dasyercus blythi*, was considered the same species as the Crest-tailed Mulgara, *Dasyercus cristicauda*; see Van Dyck and Strahan (2008). The Crest-tailed Mulgara is currently listed under the EPBC Act as Endangered using a now defunct taxonomic pseudonym *Dasyercus hillieri*, and as Schedule 1 under the WC Act using the current name *Dasyercus cristicauda*. The Brush-tailed Mulgara is currently listed under the EPBC Act as Vulnerable using the old name for this species *Dasyercus cristicauda*, and as Priority 4 by the DEC using the current name *Dasyercus blythi* (**Table 14**).

The current distribution of both species of Mulgara is uncertain and can only be confirmed following the correct identification and analysis of museum specimens (Pavey *et al.* 2012). Current knowledge suggests that the vast majority of Mulgara captured in Western Australia are the Brush-tailed Mulgara, *Dasyercus blythi*, and not the Crest-tailed Mulgara (Ric How, WA Museum, pers comm), though it is possible that Crest-tailed Mulgara still occur in WA (Pavey *et al.* 2012). It is considered unlikely that the Crest-tailed Mulgara occurs in the Study Area, which does not lie within the currently estimated range of this species.

Introduced grazers, namely cattle and rabbits, altered fire regimes and predation by cats and foxes have contributed to the population declines of both species of Mulgara (Maxwell *et al.* 1996, Van Dyck and Strahan 2008). The Study Area is located inside the estimated range of the Brush-tailed Mulgara and contains ample habitat suitable for this species. Images of Mulgara were captured using motion-sensor cameras during the field survey component of this Assessment, and burrows of Mulgara were recorded from several locations in the Study Area (**Figure 17**). It is therefore confirmed that the Mulgara, most likely the Brush-tailed Mulgara, occurs within the Study Area.

- **Night Parrot (*Pezoporus occidentalis*)**

The Night Parrot is likely to be a nomadic species, with confirmed and unconfirmed records occurring across much of arid Australia (2012c). The species is rarely sighted. The most recent sighting of the Night Parrot was of three individuals at Minga Well in the Pilbara region, in 2005 (Bamford Consulting Ecologists 2005). The majority of sightings of the species are from hummock grasslands and chenopod shrublands (Higgins 1999). It is thought that Night Parrots may persist in chenopod shrublands during dry, harsh periods and then move to utilise spinifex hummock grasslands after rainfall events cause the grasses to set seed (Parker 1980).

Very little is known about the biology, ecology and movement patterns of this species (Pizzey and Knight 2007). The Night Parrot is thought to have undergone substantial population decline as a

result of predation by foxes and feral cats, alteration of fire regimes, clearing of habitat and degradation of habitat by introduced livestock and rabbits (Garnett and Crowley 2000).

The Study Area contains no areas of chenopod shrubland, which is thought to be the preferred habitat of this species, and in general the Night Parrot is considered to be very rare and patchily distributed. Although the NRM InfoNet database suggested the species may occur in the vicinity of the Study Area (**Appendix A**), there are no specific collection records associated. Considering the lack of collection records in the wider region, its absence from recent surveys near the Study Area and a lack of suitable habitat, the presence of the species in the Study Area is considered to be unlikely.

- **Malleefowl (*Leipoa ocellata*)**

The Malleefowl is a ground-dwelling bird that builds large and distinctive mounds of soil and litter, which it uses to incubate its eggs. The distribution of Malleefowl is fragmented and scattered through semi-arid rangelands across southern Australia. Their primary habitat consists of Mallee and semi-arid shrublands, with sandy or gravel soils (Garnett and Crowley 2000). Malleefowl sparsely populate the Watarru Indigenous Protected Area, which is in the Anangu Pitjantjatjara Lands to the east of the Study Area adjacent to the South Australia-Western Australia border (Benshemesh 2007, Robinson *et al.* 2003). Habitat apparently similar to that utilised by Malleefowl on the Watarru IPA occurs within the Study Area. The Study Area is just outside of the known distribution of the species, but given that suitable habitat is present it is considered possible that the Malleefowl occurs within the Study Area.

- **Australian Painted Snipe (*Rostratula australis*)**

The Australian Painted Snipe is a relatively small marsh bird sparsely distributed over the better-watered regions of Australia (Johnstone and Storr 1998). The species was evidently not uncommon in northern swampy plains prior to their degradation by cattle, but since the early 1900s has been recorded only a few times in the northwest – single birds have been seen during summer months at man-made ponds in the Hamersley and Ophthalmia Ranges, and at Carnarvon (Johnstone and Storr 1998).

No suitable habitat for the Australian Painted Snipe was observed in the Study Area, and none of the surveys local or regional to the Study Area has recorded this species (**Appendix A**). Although the NRM InfoNet database suggested the species may occur in the vicinity of the Study Area (**Appendix A**), there are no specific collection records associated. The Australian Painted Snipe is considered unlikely to occur within the Study Area.

- **Black-flanked Rock-wallaby (*Petrogale lateralis lateralis*)**

The Black-flanked Rock-wallaby is a small, agile rock-wallaby that specialises in arid and semi-arid range, gorge and cliff environments. *P. l. lateralis* is the western subspecies of the *P. lateralis* complex. Its habitat is steep rocky areas with caves or rocks in which it shelters during the day, and it feeds nocturnally on vegetation at the foot of cliffs, in gorges and on ridge tops. The Black-flanked Rock-wallaby is very sedentary, and its range has contracted dramatically during the last century; the species is now not considered to occur in modern times in the wider vicinity of the Study Area (Van

Dyck and Strahan 2008). Furthermore, suitable habitat does not occur in the Study Area. It is therefore considered unlikely that the Black-flanked Rock-wallaby occurs within the Study Area.

- **MacDonnell Ranges Black-footed Rock-wallaby (*Petrogale lateralis* ssp ANWC CM15314)**

The MacDonnell Ranges Black-footed Rock-wallaby is an un-described central Australian subspecies within the *P. lateralis* complex. Its habitat preferences and behaviour are similar to those of the Black-flanked Rock-wallaby (see above). The range of the Black-footed Rock-wallaby has contracted significantly during the last century, and today few populations remain outside of the Northern Territory (Van Dyck and Strahan 2008). The nearest known population to the Study Area is approximately 40 km away, but suitable habitat does not occur within the Study Area itself. It is therefore considered unlikely that the Black-footed Rock-wallaby occurs within the Study Area.

- **Greater Bilby (*Macrotis lagotis*)**

The Greater Bilby was formerly associated with a variety of inland habitats, including desert sandplains, dune fields with hummock grasslands, and massive red earths and *Acacia* shrublands (Maxwell *et al.* 1996). The species has undergone a widespread population decline, however, as a result of altered fire regimes, grazing pressure from introduced herbivores and livestock, and predation by the European Red Fox (*Vulpes vulpes*) and the Feral Cat (*Felis catus*). Bilbies are not reliant on surface water and receive most of their water requirements from food sources. Their diet consists of insects, larvae, seeds, bulbs, fruit and fungi (Van Dyck and Strahan 2008).

Bilbies dig large burrows in sandy substrates, which can reach up to 3 m long and 1.8 m deep (Van Dyck and Strahan 2008). The Greater Bilby was reported by three database searches as potentially occurring within the Study Area (**Table 13**), with the available records being from Docker River, approximately 80 km north-west of the Study Area. Although these records are not recent, and the Greater Bilby was not recorded during any of the previous surveys in the vicinity of the Study Area, the presence of extensive swathes of suitable habitat within makes it possible that the Greater Bilby occurs in the Study Area.

- **Great Desert Skink (*Liopholis kintorei*)**

The Great Desert Skink is a large, smooth bodied lizard that measures, on average, 200 mm long and up to 350 g in body mass (Pavey 2006). The species lives communally in warren systems with multiple entrances, dug amongst spinifex grasslands in sandy soils (Moseby *et al.* 2009). The Great Desert Skink is thought to forage nocturnally (Wilson and Swan 2010), consuming a wide variety of invertebrates and small vertebrates, as well as the leaves, flowers and fruits of plants (Pavey 2006). This species is known to occur amongst Spinifex hummocks over arid red sand flats or loamy clay soils (Wilson and Swan 2010).

The current distribution of the Great Desert Skink is thought to consist of seven isolated populations in Australia (DSEWPaC 2012a). Three of these populations occur in the eastern interior of Western Australia in the Gibson and Great Sandy Desert at Patjarr, Lake Mackay and Rudall River National Park. In the Northern Territory, populations persist in the Tanami Desert, Uluru-Kata Tjuta National

Park and the Yulara lease lands, while in South Australia one population is known to exist at Watarru on the Anangu Pitjantjatjara Lands. The habitats within the Study Area are capable of supporting the Great Desert Skink, and two previous surveys and four database searches in the wider region of the Study Area have recorded this species (**Table 14**). It is therefore considered possible that the Great Desert Skink occurs in the Study Area.

- **Princess Parrot (*Polytelis alexandrae*)**

The Princess Parrot is a granivorous, tree hollow-nesting arid zone parrot with both nomadic and irruptive habits. The species is poorly known but is thought to be heavily dependent on the presence of mature eucalypts, especially Marble Gum (*Eucalyptus gongylocarpa*), for breeding habitat. The stronghold of the species is believed to be a few sites in the Great Sandy Desert, but they are irregular visitors to other sites in their range at intervals of up to 20 years. These irruptive movements are linked to rainfall events (Garnett and Crowley 2000).

The Princess Parrot was not seen during This Study but it was recorded by three surveys in the wider region and appeared in two of the databases searches. Records for this species occur to the west and east of the Study Area from recent years. Mature Marble Gums do not occur in the Study Area, but they are known from locations immediately to the south (Outback Ecology 2012a, b). This, combined with the bird's irruptive and nomadic nature, makes the presence of Princess Parrots in the Study Area possible.

- **Great Knot (*Calidris tenuirostris*)**

The Great Knot is a coastal wading bird, reported in Central Australia as an occasional vagrant. There is no suitable habitat for this species present in the Study Area, and the sole record obtained during the desktop study was from Uluru-Kata Tjuta National Park (over 200 km from the Study Area). Although no information on this record is available, it is most likely that this observation was made at the town sites sewage ponds or water treatment facilities, and not in a natural environment. It is considered unlikely that the Great Knot occurs in the Study Area.

- **Grey Falcon (*Falco hypoleucos*)**

The Grey Falcon is a tree-nesting, predatory bird which principally takes aerial prey. It mainly occurs around inland ephemeral and permanent drainage systems where annual rainfall is less than 500 mm (Garnett and Crowley 2000). The Grey Falcon inhabits lightly wooded countryside, especially stony plains and *Acacia* scrublands (Garnett and Crowley 2000, Morcombe 2003). This species can be rare, resident or nomadic but is distributed throughout most of the semi-arid interior of Western Australia.

The Grey Falcon was not recorded during this survey but was recorded in two previous surveys from the wider region (**Appendix A**). It was also recorded in two of the database searches as occurring within the region (**Appendix A**). Given the wide distribution of the species, its nomadic nature, and that Mulga-Mallee over Hummock Grassland within the Study Area represents suitable habitat, it is considered possible that the Grey Falcon occurs in the Study Area.

- **Woma (*Aspidites ramsayi*)**

The Woma occurs in arid zones of Western Australia. Although the species itself is of conservation significance, it is the south-western (Wheatbelt) population which appears to be threatened, as opposed to the northern populations (Storr *et al.* 2002). The DEC Priority Fauna List does not make this distinction. The species is patchily distributed, and occurs in woodland habitats, heathland and shrubland habitats often containing spinifex, and shelters mainly in abandoned burrows and soil cracks (Wilson and Swan 2010). The species is thought to prey upon both mammals and reptiles, and consume them within the confines of the burrows and crevices in which it shelters (Bush and Maryan 2011).

With the exception of the Dense Mulga Woodland habitat type, the habitats observed within the Study Area are largely suitable for this species, and it has been recorded in the wider region of the Study Area in Uluru-Kata Tjuṯa National Park and surveys of the Anṅangu Pitjantjatjara Lands (**Appendix A**). Consequently, it is considered likely that the Woma occurs within the Study Area.

- **Major Mitchell's Cockatoo (*Lophochroa leadbeateri*)**

Major Mitchell's Cockatoo is a conspicuous, seed-eating cockatoo which is unevenly distributed across arid Australia. The species has sedentary habits but may be locally nomadic at times, and nests in hollows of mature Eucalypts within ephemeral riverine habitats. Major Mitchell's Cockatoo feeds in open *Acacia* woodlands and shrublands, and mixed woodlands. Its presence is recorded in three past surveys of the wider region and multiple records for it appear in one of the database searches (Birdlife Australia 2013). Suitable feeding habitat for Major Mitchell's Cockatoo occurs in the Study Area and it was observed at one location during the field survey component of this Assessment. It has therefore been confirmed to be present in the Study Area.

- **Peregrine Falcon (*Falcon peregrinus*)**

The Peregrine Falcon is an aerial carnivore, which in the Australian arid zone nests on cliffs and steep-sided rocky outcrops. In central Australia, Peregrine Falcons are sparsely distributed and closely associated with waterholes, range and gorge environments, although they do range widely over riverine and *Acacia* woodland habitats when hunting (Aumann 2001, Garnett and Crowley 2000). This species was not recorded during This Study, but was found during two surveys in the wider vicinity of the Study Area, and was reported by two database searches as occurring. Potential habitat for Peregrine Falcons occurs immediately adjacent to some parts of the Study Area, and much of the Study Area contains habitat suitable for foraging; therefore; it is considered possible that this species occurs in the Study Area.

5.3.2. Priority Fauna

The WA DEC recognises several species that are not listed under the WC Act or the EPBC Act but for which there is some conservation concern, and has produced a supplementary list of Priority Fauna. For the full definitions of Priority Fauna rankings, see **Appendix C**. The database and literature

searches identified eight species of Priority Fauna that potentially occur within the Study Area (**Appendix A**), one of which was recorded during This Study (**Table 15**).

The Brush-tailed Mulgara and Princess Parrot are Priority species, but as they are also listed under the EPBC Act these were discussed in **Section 5.3.1**.

Table 15: Priority fauna potentially occurring in the Study Area

Common name (species name)	Conservation status		Number of		Likelihood of occurrence
	EPBC	WC	Surveys	Databases	
Princess Parrot (<i>Polytelis alexandrae</i>)	VU	P4	3	2	Possible
Brush-tailed Mulgara (<i>Dasyercus blythi</i>)	VU	P4	2	3	Confirmed
Long-tailed Dunnart (<i>Sminthopsis longicaudata</i>)		P4	0	1	Unlikely
Western Long-eared Bat (<i>Nyctophilus major tor</i>)		P4	1	0	Likely
Bush Stone-curlew (<i>Burhinus grallarius</i>)		P4	1	1	Unlikely
Australian Bustard (<i>Ardeotis australis</i>)		P4	5	4	Confirmed
Striated Grasswren (<i>Amytornis striatus striatus</i>)		P4	0	3	Likely
Flock Bronzewing (<i>Phaps histrionica</i>)		P4	1	1	Unlikely

EPBC, status under EPBC Act; WC, status under WC Act or DEC Priority List

- **Long-tailed Dunnart (*Sminthopsis longicaudata*)**

The Long-tailed Dunnart is a rock-dwelling specialist (Freeland *et al.* 1988). It typically occurs in arid, rocky areas and has been recorded from flat-topped hills, plateaux and rocky scree slopes (Van Dyck and Strahan 2008). Records come from widely scattered locations in the Australian arid zone, including the Gibson Desert, Murchison, southern Carnarvon Basin and Pilbara region (Van Dyck and Strahan 2008).

The long, mobile tail of the Long-tailed Dunnart is thought to aid its agility and movement amongst rocks by providing greater balance (Menkhorst and Knight 2010). The Long-tailed Dunnart feeds on invertebrates and may become torpid over the colder months (Van Dyck and Strahan 2008).

The preferred habitat types of the Long-tailed Dunnart are absent from the Study Area. Although the NRM InfoNet database suggested the species may occur in the vicinity of the Study Area (**Appendix A**), there are no specific collection records associated. Considering the lack of collection records in

the wider region, its absence from recent surveys near the Study Area and a lack of suitable habitat, the presence of the species in the Study Area is considered to be unlikely.

- **Western Long-eared Bat (*Nyctophilus major tor*)**

The Western Long-eared Bat is the newly re-described southern subspecies of the Long-eared Bat (*Nyctophilus major*), which itself is a newly re-described species resulting from a recent revision of the Greater Long-eared Bat (*N. timoriensis*) species group (Parnaby 2009). Thus, any records of the Western Long-eared Bat (*N. major tor*) from central Australia should be considered as equivalent to records of the central form of the Greater Long-eared Bat (*N. timoriensis* 'Central Form'), which is listed as Priority 4 Fauna (Outback Ecology 2012b). The Western Long-eared Bat can be found in a range of dry woodland and shrubland communities in arid and semi-arid areas, and is known from the goldfields and the woodlands in the areas north of the Nullarbor Plain (Parnaby 2009). *Nyctophilus major tor* forages low amongst the canopy and shrub layers to take arthropods from foliage, ground and in flight, predominantly roosting in tree hollows (Menkhorst and Knight 2004).

Echolocation recordings of *Nyctophilus major tor*, at low activity levels, were made in a habitat type equivalent to the Dense Mulga Woodland in the Study Area, during a previous fauna survey immediately to the south (Outback Ecology 2012b). Given the proximity and recentness of this record, and the presence of the same habitat type in the current Study Area, it is considered likely that the Western Long-eared Bat occurs in the Study Area.

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

The Bush Stone-curlew is found in open woodland and forest, particularly near water courses and swampy areas (Geering *et al.* 2007). The species is active at night, when it calls with a distinctive, eerie whistle. In arid environments it is associated with significant ephemeral drainage courses with unburnt, marginal scrub to provide roosting cover. The nocturnal and cryptic habits of the Bush Stone-curlew make it difficult to locate, particularly in arid environments where the birds are sparsely distributed (Pizzey and Knight 2007). The only database and survey records for this species are located over 100 and 200 km away from the Study Area, respectively. Given this, and as no suitable habitat for Bush Stone-curlew occurs in the Study Area, its occurrence in the Study Area is considered unlikely.

- **Striated Grasswren (*Amytornis striatus striatus*)**

The *striatus* subspecies of the Striated Grasswren (*Amytornis striatus striatus*) can be locally common but is generally scarce (Johnstone and Storr 2004). It typically occurs in the arid interior, within tall, dense *Triodia* spp hummock grasslands. The main threat to this subspecies is alteration of fire regimes, which affects the height and density of hummock grasslands.

The *striatus* subspecies of the Striated Grasswren was not reported from any of the reviewed fauna surveys in the vicinity of the Study Area (**Appendix A**). Nonetheless, three database searches each returned collection records for this species from within 135 km. Given this, and the fact that the Study Area contains large amounts of suitable habitat for this species (although degraded in parts by recent

fire), it is considered likely that the *striatus* subspecies of the Striated Grasswren occurs in the Study Area.

- **Flock Bronzewing (*Phaps histrionica*)**

A long-winged, flock-forming granivorous pigeon, the Flock Bronzewing has irruptive and nomadic habits. The core range of this species encompasses the semi-arid, grassed plains of northern Australia, but during years of favourable climatic conditions this extends to the northern edges of the Simpson Desert or the western end of the Tanami Desert. Destination habitats during these times are wide areas of thick native pastoral grasses in treeless plains, with open water nearby for drinking; however, other marginal habitats such as open *Acacia* woodland with tussock grass understorey may be used during passage (Johnstone and Storr 1998).

The Flock Bronzewing was not observed during This Study, and only one of the database searches indicated it has been found in the wider vicinity of the Study Area. There is a single record of this species at a site over 400 km from the Study Area (Robinson *et al.* 2003). Given the paucity of observations in the wider region and the lack of suitable habitat within the Study Area, it is considered unlikely that the Flock Bronzewing occurs within the Study Area.

5.3.3. Migratory Birds

Many species of migratory bird are listed under the EPBC Act, the WC Act and international agreements including the Japan-Australia Migratory Bird Agreement, the China-Australia Migratory Bird Agreement, Republic of Korea Australia Migratory Bird Agreement and the Bonn Convention (The Convention on the Conservation of Migratory Species of Wild Animals).

The database searches and literature review identified 18 listed migratory species that have the potential to occur in the Study Area and its surrounds, one of which was recorded during This Study (**Table 16**). Of the 18 species, those that possibly occur are discussed briefly below. Those considered unlikely to occur within the Study Area are excluded from further consideration (but see **Table 16** for justification of their likelihood of occurrence within the Study Area). Broadly speaking, the occurrence of migratory waterbirds in arid Australia is highly sporadic and many species are only likely to be present in favourable seasons when water is plentiful (Halse *et al.* 1998, Kingsford and Norman 2002, Kingsford *et al.* 2010). As no major wetlands or substantial, natural water bodies occur within the Study Area, the occurrence of most migratory waterbirds would be occasional only, and these are unlikely to be dependent on the habitats present.

The Night Parrot, Malleefowl, Australian Painted Snipe and Great Knot are listed as Migratory under the EPBC Act, but were discussed in **Section 5.3.1** and are not considered further here.

Table 16: Migratory birds potentially occurring in the Study Area

Common name (species name)	Conservation status		Number of		Likelihood of occurrence	Reasons for likelihood
	EPBC	WC	Surveys	Databases		
Night Parrot (<i>Pezoporus occidentalis</i>)	EN, M	S1	0	1	Unlikely	See Section 5.3.1
Malleefowl (<i>Leipoa ocellata</i>)	VU, M	S1	2	3	Possible	See Section 5.3.1
Australian Painted Snipe (<i>Rostratula australis</i>)	VU, M	S3	0	1	Unlikely	See Section 5.3.1
Great Knot (<i>Calidris tenuirostris</i>)	M	S1	1	0	Unlikely	See Section 5.3.1
Red-necked Stint (<i>Calidris ruficollis</i>)	M	S3	1	0	Unlikely	Wading bird. Small numbers overwinter in Central Australia. No suitable habitat in Study Area. Literature review report is from Uluru-Kata Tjuta National Park (UKTNP), over 200 km away with suitable habitat.
Common Greenshank (<i>Tringa nebularia</i>)	M	S3	1	0	Unlikely	Wading bird. Small numbers overwinter in Central Australia. No suitable habitat in Study Area. Literature review report is from UKTNP, over 200 km away with suitable habitat.
Wood Sandpiper (<i>Tringa glareola</i>)	M	S3	1	0	Unlikely	Wading bird. Moderate numbers overwinter in Central Australia. No suitable habitat in Study Area. Literature review report is from UKTNP, over 200 km away with suitable habitat.
Broad-billed Sandpiper (<i>Limicola falcinellus</i>)	M	S3	1	0	Unlikely	Coastal wading bird. Rare in Central Australia. No suitable habitat in Study Area. Literature review report is from UKTNP, over 200 km away with suitable habitat.

Common name (species name)	Conservation status		Number of		Likelihood of occurrence	Reasons for likelihood
	EPBC	WC	Surveys	Databases		
Oriental Pratincole (<i>Glareola maldivarum</i>)	M	S3	1	1	Unlikely	Wading bird with terrestrial habits (savannah/steppe, salt pans or coasts). Overwintering migrant. No suitable habitat in Study Area. Literature review report is from UKTNP, over 200 km away with suitable habitat.
Marsh Sandpiper (<i>Tringa stagnatilis</i>)	M	S3	1	0	Unlikely	Wading bird. Moderate numbers overwinter in Central Australia. No suitable habitat in Study Area. Literature review report is from UKTNP, over 200 km away with suitable habitat.
Common Sandpiper (<i>Actitis hypoleucos</i>)	M	S3	1	0	Unlikely	Wading bird. Moderate numbers overwinter in Central Australia. No suitable habitat in Study Area. Literature review report is from UKTNP, 200 km away with suitable habitat. Database report is a single BirdLife Australia record from Warburton sewage ponds, 170 km away.
Rainbow Bee-eater (<i>Merops ornatus</i>)	M	S3	5	4	Very likely	See below.
Glossy Ibis (<i>Plegadis falcinellus</i>)	M	S3	1	0	Unlikely	Wetland ibis species. Small numbers overwinter in Central Australia. No suitable habitat in study area. Literature review report is from UKTNP, over 200 km away with suitable habitat.
White-winged Black Tern (<i>Chlidonias leucopterus</i>)	M	S3	1	0	Unlikely	Wetland tern species. Small numbers overwinter in Central Australia. No suitable habitat in study area. Literature review report is from UKTNP, over 200 km away with suitable habitat.

Common name (species name)	Conservation status		Number of		Likelihood of occurrence	Reasons for likelihood
	EPBC	WC	Surveys	Databases		
Sharp-tailed Sandpiper (<i>Calidris acuminata</i>)	M	S3	2	0	Unlikely	Wading bird. Moderate numbers overwinter in Central Australia. No suitable habitat in study area. One literature review report is from UKTNP, over 200 km away with suitable habitat. The other was from the Anangu Pitjantjatjara Lands, opportunistically recorded, most likely from sewage ponds.
Oriental Plover (<i>Charadrius veredus</i>)	M	S3	1	2	Unlikely	Wading bird with terrestrial habits (savannah/steppe specialist). Overwintering migrant. No suitable habitat in study area. Literature review report is from UKTNP, over 200 km away with suitable habitat.
Eastern Great Egret (<i>Ardea modesta</i>)	M	S3	1	1	Unlikely	Wading bird. Overwintering migrant. No suitable habitat in Study Area. Literature review report is from UKTNP, over 200 km away with suitable habitat.
Fork-tailed Swift (<i>Apus pacificus</i>)	M	S3	1	1	Possible	See below.

EPBC, status under EPBC Act; WC, status under WC Act or DEC Priority List

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

The Rainbow Bee-eater occupies numerous habitats, including open woodlands, sandpits, riverbanks, road cuttings, beaches, cliffs, mangroves and rain forests (Pizzey and Knight 2007). In Central Australia the Rainbow Bee-eater is a breeding migrant and passage migrant (Pizzey and Knight 2007), and nests in burrows dug at a slight angle in sandy banks and margins of drainage lines, roads and tracks, as well as in flat ground (Johnstone and Storr 1998). The Rainbow Bee-eater is known to be common and widespread across much of Australia.

This species was recorded during five previous surveys in the wider region of the Study Area, and was identified by four database searches as potentially occurring within the Study Area (**Appendix A**). The Rainbow Bee-eater was recorded during a previous fauna survey immediately to the south (Outback Ecology 2012b). Given the proximity and recentness of this record, and the wide distribution of this species across multiple habitat types, it is considered very likely that the Rainbow Bee-eater occurs in the Study Area.

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

The Fork-tailed Swift is a nomadic species that may be seen before and after storm fronts or tropical cyclonic events that are associated with an increase in volant insect activity, and hence with greater food availability (Johnstone and Storr 1998). It is almost entirely aerial, and can be seen over any open country within Australia (Pizzey and Knight 2007).

This species was recorded at Uluru-Kata Tjuṯa National Park and appears in the Protected Matters database as potentially occurring within the Study Area. Given this, and its broad distribution over multiple habitat types, it is considered possible that the Fork-tailed Swift occurs within the Study Area (during conducive weather events). The nature of its behaviour means that it may fly over the Study Area without alighting within, but the species may still derive benefit from the Study Area as a source of volant insects.

6. POTENTIAL IMPACTS

The primary objectives of this section are to describe the relevant threatening processes associated with the proposed Project (**Section 6.1**), and to examine the likely impact of these threatening processes on fauna habitat (**Section 6.2**) and fauna assemblages (**Section 6.3**).

6.1. Threatening Processes

Threatening processes relevant to the Central Ranges bioregion include inappropriate fire regimes, feral predators and grazing and habitat damage by introduced herbivores, but otherwise the bioregion is relatively undisturbed due largely to its inaccessibility (ANRA 2009a). Threatening processes specifically associated with Project activities in the Study Area are categorised as either direct or indirect impacts. Direct impacts of the Project may include habitat clearing/modification, ground disturbance, fire and collision with vehicles (**Section 6.1.1** to **Section 6.1.4**), while indirect impacts of the project may include noise and vibration, light, dust, introduced flora and introduced fauna (**Section 6.1.5** to **Section 6.1.9**). These are discussed in further detail below.

6.1.1. Habitat Clearing/Modification

The development of the Project will result in the removal of habitat via land clearance and also by the construction of pipeline infrastructure. Land clearing is a necessary part of the Project development, and represents the most direct impact on habitats and fauna assemblages present within the Study area. Land clearance will result in increased edge effects, habitat contraction and potentially fragmentation of habitat within the Study area. The Mulga-Mallee over Hummock Grassland, Dense Mulga Woodland, Dune Field and Hummock Grassland habitat types described during this Assessment have been identified as significant within the Study Area, and efforts to minimise clearing within these habitat types should be made. Pre-clearance inspections are recommended for any proposed clearing in the vicinity of existing Brush-tailed Mulgara burrows or habitats considered likely to support populations of this species.

For vertebrate fauna, clearing of vegetation can sometimes be conducted in a manner that minimises impact by considering the timing of clearance activities, progressively clearing over time to allow animals to disperse to other suitable areas, and also by retaining corridors or linkages so that individuals can move between remaining habitat patches. SRE invertebrate fauna, however, typically have poor powers of dispersal and are therefore unable to emigrate from land as it is being cleared. Land clearing is likely to result in the loss of SRE species populations that occur within the Project disturbance area. Clearing of the Dense Mulga Woodland habitat type, which has the greatest potential to support SRE species, should be minimised where practicable.

6.1.2. Ground Disturbance

Excavation and trenching works, if the proposed borefield pipeline is to be partially or completely buried, may directly trap vertebrate and invertebrate fauna. Depending on season and weather conditions, invertebrate fauna and small vertebrate fauna may become trapped in exposed trenches. Any such exposed trenches should be constructed to not have sheer sides or plastic sheeting,

wherever possible. The length of time that trenches and pits are left open or unsealed should be minimised. If trenches are to be dug it may be advantageous to examine trench walls for evidence of Central Marsupial Mole burrows, so as to provide additional data pertaining to the likelihood of this species occurring within the Study Area.

6.1.3. Fire

The development and operation of the Project may alter the fire regime of the Study Area, through the introduction of unplanned fire as a result of vehicle movements and/or as a result of Project activities (eg welding). Fire may impact vertebrate and invertebrate fauna via direct contact between fire and small vertebrates or SRE invertebrates, or indirectly by long-term habitat modification brought about by inappropriate fire frequency and intensity. The value of many habitats to fauna lies in the mosaic of ages since fire that exist in those habitats as a result of traditional land management practices and/or natural fire regimes (Parr and Andersen 2006, Southgate *et al.* 2007, Woinarski 1999). Introduction of too frequent, hot or extensive fires can eliminate this mosaic, and reduce the capacity of these habitats to support diverse vertebrate and invertebrate fauna. The impact of inappropriate fire regimes may be reduced through the implementation of an appropriate fire management plan.

6.1.4. Collision With Vehicles

Vehicle collisions can have a considerable impact on some fauna assemblages. Although incidents typically only involve individuals, the cumulative effect they may have on populations can be considerable. The proposed Project would dissect relatively open habitats such as Hummock Grassland, Tussock Grassland, Mulga-Mallee over Hummock Grassland and Dune Field. Species that typically forage at night within these habitats (including, but not limited to, species of conservation significance such as the Brush-tailed Mulgara, Greater Bilby and Woma) may be at risk when following or crossing any transport routes. Furthermore, a variety of avifauna may be at risk from vehicle collision during the hours surrounding dawn and dusk (including, but not limited to, species of conservation significance such as the Princess Parrot and the Australian Bustard).

Should it be necessary for large numbers of vehicles to travel along transport and infrastructure corridors at high frequency, collisions can be directly addressed by reducing the speed at which vehicles travel and restricting the times during which it is permissible to do so. Any collisions or incidents that result in the injury or death of species of conservation significance should be reported to the DEC and specimens should be retained (ie stored in a freezer) for further examination by DEC or the Western Australian Museum.

6.1.5. Noise And Vibration

During construction, development of the Project is likely to generate noise and vibration due to the general operation of machinery and vehicles, as well as the general presence of people. This may impact on vertebrate fauna, although after construction the nature of the Project means that ongoing noise and vibration impacts may be negligible in most parts of the Study Area. The adverse effects of noise on vertebrate fauna have been well studied, although responses vary depending on the species and on the age and sex of the individual animal (for comprehensive summaries, see Larkin *et al.*

1996, Radle 2007). General responses to noise across a wide variety of vertebrate species range from interruptions in feeding and resting behaviour to complete abandonment of an area. Noise may lead to reduced population densities in small mammals, nest failure and decreased population densities in birds (Slabbekoorn and Ripmeester 2008), and abandoning of roost sites and a reduced hunting efficiency in bats due to disturbance of their echolocation system. Constant levels of noise also affect species communication via acoustic interference (Parris and Schneider 2009).

Information on the potential effects of noise and vibration on SRE invertebrate fauna is limited. A trial that tested the effect of exploration drilling on the SRE Shield-backed Trapdoor Spider (*Idiosoma nigrum*) was conducted at Jack Hills in the Murchison, by Crosslands Resources (DMP 2010). In this trial, spiders were observed in their burrows while vibration simulating drilling was produced. Preliminary results suggest that the effects of vibration on spiders may be limited. Conversely, it has also been suggested that vibrations created by mining activities and heavy earthmoving equipment may actually attract spiders and other arachnids, which subsequently places these individuals at risk of direct contact with operations (Raven 2008). Without further research, it is not possible to predict and quantify the potential noise and vibration impacts of the Project on SRE invertebrate fauna.

6.1.6. Artificial Light

During construction, development of the Project is likely to result in an increase in exposure of fauna to artificial light. This may impact on vertebrate fauna, although after construction the nature of the Project means that ongoing exposure of fauna to artificial light may be negligible in most parts of the Study Area.

Artificial light from Project activities may have detrimental effects on resident vertebrate and invertebrate fauna species as it may interfere with biological and behavioural activities that are governed by the length of day or photoperiod. Such activities include reproduction, dormancy, foraging and migration (Bradshaw and Holzapfel 2007, Le Corre *et al.* 2002). For example, nocturnal mice exposed to artificial light have been observed to exploit fewer food patches compared to mice exposed to areas of less light (Bird *et al.* 2004), while nocturnal frogs exposed to artificial light have been known to suspend normal feeding and reproductive behaviour (Harder 2002). Light pollution has also been shown to interfere with timing of songbird choruses, potentially leading to reduction in breeding success or survival (Miller 2006). It is likely that excessive light can also alter the natural foraging behaviour of bats.

To reduce the impact of artificial light on faunal communities, particularly during night-time hours, lights should be designed to illuminate designated areas such as pathways and roads, rather than inadvertently illuminating the night sky or the surrounding landscape. Further, it is recommended that lighting only be used in areas required for operations and/or security, that operational areas are served by directional lighting with low vertical aiming angle, and that light shields are installed where required.

6.1.7. Dust

During construction, the Project may result in an increase in dust pollution as a consequence of excavation and earthworks, the general traffic activities of light and heavy vehicles, the general use of equipment on site and the clearing of covering vegetation. Dust pollution may interfere with plant metabolic processes and high levels may reduce plant growth, resulting in the degradation of the overall ecosystem and the increased risk of disease in plants. In turn, this may impact the quality of fauna habitats and both vertebrate and invertebrate faunal assemblages within the Project area due to reduction in food resource and shelter availability. During construction, and following construction if necessary, adequate dust suppression measures should be implemented to reduce the effects of dust on vegetation and hence fauna habitats and assemblages.

6.1.8. Introduced Flora

Weeds may be brought in by mobile mining and construction equipment. Weed invasion is widely recognised as having a negative impact on vertebrate fauna species as it can fundamentally alter the composition and structure of native vegetation communities (Cowie and Werner 1993, Gordon 1998).

Invasion by non-native species typically results in declines in native plant species richness, but the response of fauna may be more complicated with individual invasions potentially resulting in increase, decrease or no-change scenarios for different assemblages (Grice 2006). For example, even at low densities, Buffel Grass (*Cenchrus ciliaris*) has been seen to affect the composition of ground vegetation, birds and ant fauna, leading to declines in some species (Binks *et al.* 2005, Smyth *et al.* 2009). The invasion of weeds may have a negative impact on SRE invertebrate fauna (EPA 2009).

Currently the Study Area is largely weed-free, with weeds predominantly concentrated in few small patches and road verges. It is therefore important to implement management strategies to reduce the occurrence and spread of weeds as a result of Project operations. The potential spread of Buffel Grass has previously been identified as a significant threat to vegetation in the general vicinity of the Project area (Outback Ecology 2012a), and management priorities should recognise this.

6.1.9. Introduced Fauna

Introduced fauna (both herbivorous and predatory) cause fundamental changes to ecosystems, and have led to the decline and extinction of many species in Australia (Abbott 2002, Burbidge and McKenzie 1989, Short and Smith 1994). Predation by the Red Fox and predation by the Feral Cat are listed as key threatening processes to native fauna, under the EPBC Act. Introduced herbivores have been responsible for the widespread degradation of much of semi-arid Australia due to overgrazing (Morton 1990). Such habitat degradation can potentially impact both vertebrate and invertebrate fauna. The introduced Camel is present throughout the Study Area, and evidence of grazing damage from this species is present in the Dense Mulga Woodland habitat type.

Development of the Project may provide additional resources or habitat that attract and support a greater abundance of feral animals in the area, which in turn may adversely impact on populations of native fauna. It is suggested that monitoring and control of feral animals be conducted, in

participation with surrounding land managers. Management measures to prevent the increase of feral species numbers and control the attraction of any new feral species include proper hygiene practices, appropriate disposal of wastes and control programs.

6.2. Impacts on Fauna Habitats

Vertebrate fauna habitat loss as a direct result of land clearing and excavation for the development of the Project is considered the primary impact on terrestrial vertebrate and SRE invertebrate fauna. Further, loss of habitat is listed as a key threatening process under the EPBC Act, although it is recognised as a necessary component of developing a resources project. It is likely that sedentary fauna currently residing within areas to be cleared would be lost and more mobile fauna would be displaced.

In the absence of project disturbance footprints, it is recommended that where possible, clearing should be minimised wherever practicable. The Mulga-Mallee over Hummock Grassland, Dense Mulga Woodland, Dune Field and Hummock Grassland habitat types described during this Assessment have been identified as significant within the Study Area, and efforts to minimise clearing within these habitat types should be made. Pre-clearance inspections are recommended for any proposed clearing in the vicinity of existing Brush-tailed Mulgara burrows or habitats considered likely to support populations of this species.

6.3. Impacts on Fauna Assemblages

Land clearance is likely to result in the direct loss of individuals during initial clearance activities. Faunal assemblages most likely to be impacted by the Project are those dependent on specific habitats or those with restricted ranges. As most of the habitats within the Study Area are represented outside of the Study Area, however, land clearance is not likely to have substantial impacts on fauna populations at a regional scale.

Impacts to vertebrate fauna assemblages may be reduced by considering the timing of land clearing activities and other developmental proposed works, and by performing pre-clearance surveys for burrowing species, such as Mulgara, where necessary. SRE invertebrate fauna, however, typically have poor powers of dispersal and are therefore unable to emigrate from land as it is being cleared. Land clearing is likely to result in the loss of any SRE species populations that occur within the Project disturbance area. Consequently, clearing of the Dense Mulga Woodland habitat type, which has the greatest potential to support SRE species, should be minimised where practicable.

7. CONCLUSIONS

The inventory of fauna recorded during This Study is consistent with those obtained in previous surveys of similar scope in the locality of the Study Area. Although the desktop study suggested that more species potentially occur in the Study Area (382, versus 46 observed in This Study), these records were obtained from large search areas with greater diversity of habitats and thus include some species unlikely to occur in the Study Area.

The Project will impact on vertebrate faunal assemblages on a local scale through direct loss of fauna during land clearing, loss of habitat and indirect impacts. Of the indirect impacts, the spread of invasive weeds is possibly the most likely to alter the faunal assemblages of the Study Area. The length of the proposed pipeline route and the volume of vehicular traffic necessary for development of the Project will impose high risk of transport of invasive weeds and their seeds. As vegetation communities in the Study Area are largely in excellent condition, measures should be taken to limit spread of weeds. Of the direct impacts of the Project, direct loss of fauna habitat via clearing of native vegetation is likely to have the greatest impact on fauna habitats and assemblages. If possible, use of the existing Giles-Mulga Park Road as an access and infrastructure corridor should be promoted and further clearing of vegetation for vehicular access and infrastructure should be minimised.

Most habitats found in the Study Area were consistent with habitats known to occur elsewhere in the Central Ranges bioregions. The Hummock Grassland habitat type was of limited extent within the Study Area, but is well connected to and represented in the surrounding landscape. The concentration of Brush-tailed Mulgara records in this habitat type within the Study Area, however, necessitates caution if disturbance to this habitat type is proposed. Depending on the future requirements of the Project, it may be advantageous to better define the status of local populations of the Brush-tailed Mulgara in the Study Area. Pre-clearance surveys for this species are recommended if clearing is to be undertaken in the vicinity of its known burrows and preferred habitats. In general, vertebrate fauna of conservation significance are not likely to be bound tightly to particular habitat patches within the Study Area, and the regional impacts of the Project on species of conservation significance are likely to be small.

Three other habitat types, Mulga-Mallee over Hummock Grassland, Dense Mulga Woodland and Dune Field are also significant habitat types within the Study Area and care should be taken to minimise their disturbance wherever possible. These habitat types are regionally widespread, however, and land clearing within these areas is less likely to influence vertebrate fauna in this broader context. Individuals of any SRE invertebrate species that occur within Dense Mulga Woodland habitat are likely to be lost as a result of disturbance to this habitat type. However, the occurrence of this habitat outside the Study Area suggests that regional impacts to such species as a result of the Project are likely to be limited.

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Appendix A

Vertebrate Fauna Recorded in the Cobb Depression Study Area and/or Surrounds

Abbreviations and symbols:

- * Introduced species.
 - Recorded during a field survey, or as part of a database or regional information search.
- EPBC Entries in this column indicate the status of each species under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (EPBC Act): CR, Critically Endangered; E, Endangered; VU, Vulnerable; and M, Migratory. If a cell is empty, the species is not listed as Threatened under the EPBC Act.
- In WA Entries in this column indicate the status of each species in Western Australia. If a species is listed as Threatened under Schedule 1, 3 or 4 of the *Wildlife Conservation Act 1950* (WA) (WC Act), the Schedule on which it is listed is provided: S1, Schedule 1, Fauna that is rare or is likely to become extinct; S3, Schedule 3, Migratory birds protected under an international agreement; and S4, Schedule 4, Other specially protected fauna. Species not listed under the WC Act may be listed on the Department of Environment and Conservation's list of Priority Fauna. In these cases, their rankings are provided: P1, Priority 1; P2, Priority 2; P3, Priority 3; and P4, Priority 4.

Surveys considered in literature review

- A Anangu Pitjantjatjara Lands Biological Survey – Robinson et al. (2003)
- B Spinifex Native Title Determined Area Surveys – Brennan et al. (2012)
- C Birds of the Wingellina Hills – Gole (2002)
- D Wingellina Nickel Project Level 1 Borefield Fauna Assessment – Outback Ecology (2012b)
- E Wingellina Nickel Project Proposed Borefield Drill Line Targeted Fauna Assessment – Outback Ecology (2012c)
- F Wingellina Nickel Project Terrestrial Fauna Assessment – Outback Ecology (2009)
- G Compilation of Uluru-Kata Tjuta National Park Vertebrate Fauna Checklists – Balding (1996), Balding and Reid (1996)
- H Wingellina Baseline Biological Survey – HGM Maunsell (2002)

Database searches

- I NatureMap Database – DEC (2013a)
- J NRM InfoNet Database – Northern Territory Government (2013)
- K Vertebrate Fauna Collection Database – WAM (2013)
- L BirdData: Custom Atlas Bird List – BirdLife Australia (2013)
- M Threatened and Priority Fauna Database – DEC (2013b)
- N Flora and Fauna Database – DLRM (2013)
- O Protected Matters Search Tool – DSEWPaC (2013)

Species name	Common name	Conservation status		This Assessment	Literature review								Database searches					
		EPBC	In WA		A	B	C	D	E	F	G	H	I	J	K	L	M	N
<i>Felis catus</i> *	Cat			•	•	•		•	•	•	•						•	•
LEPORIDAE																		
<i>Oryctolagus cuniculus</i> *	Rabbit			•	•	•		•		•	•						•	•
MACROPODIDAE																		
<i>Lagorchestes conspicillatus</i>	Spectacled Hare-wallaby																•	
<i>Lagorchestes hirsutus</i>	Rufous Hare-wallaby																•	
<i>Macropus fuliginosus</i>	Western Grey Kangaroo					•												
<i>Macropus robustus</i>	Common Wallaroo			•	•	•		•		•	•	•					•	
<i>Macropus rufus</i>	Red Kangaroo			•	•	•		•		•							•	
<i>Petrogale lateralis lateralis</i>	Black-flanked rock-wallaby	VU	S1		•													
<i>Petrogale lateralis</i> MacDonnell Ranges Race ANWC CM15314	Black-footed Rock-wallaby	VU	S1										•	•			•	•
MOLOSSIDAE																		
<i>Austronomus australis</i>	White-striped Freetail-bat																•	
<i>Mormopterus planiceps</i>	Little Mastiff-bat										•							
<i>Tadarida australis atratus</i>						•					•	•				•		
MURIDAE																		
<i>Leggadina forresti</i>	Forrest's Mouse				•												•	
<i>Mus musculus</i> *	House Mouse				•					•	•	•					•	
<i>Notomys alexis</i>	Spinifex Hopping-mouse			•	•	•		•	•	•	•	•	•				•	
<i>Pseudomys desertor</i>	Desert Mouse				•						•						•	
<i>Pseudomys hermannsburgensis</i>	Sandy Inland Mouse				•	•					•						•	
<i>Rattus villosissimus</i>	Long-haired Rat										•							
NOTORYCTIDAE																		
<i>Notoryctes caurinus</i>	Northern Marsupial Mole	EN	S1														•	•
<i>Notoryctes typhlops</i>	Central Marsupial Mole	EN	S1		•	•					•			•				•
PHALANGERIDAE																		
<i>Trichosurus vulpecula</i>	Common Brushtail Possum				•									•			•	
TACHYGLOSSIDAE																		
<i>Tachyglossus aculeatus</i>	Short-beaked Echidna				•	•					•						•	
THYLACOMYIDAE																		
<i>Macrotis lagotis</i>	Greater Bilby	VU	S1										•				•	•

Species name	Common name	Conservation status		This Assessment	Literature review								Database searches					
		EPBC	In WA		A	B	C	D	E	F	G	H	I	J	K	L	M	N
VESPERTILIONIDAE																		
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat			•	•	•		•		•	•					•		•
<i>Chalinolobus morio</i>	Chocolate Wattled Bat			•	•			•			•							
<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat			•	•			•		•	•					•		•
<i>Nyctophilus major tor</i>	Western Long-eared Bat		P4					•										
<i>Scotorepens balstoni</i>	Inland Broad-nosed Bat					•				•								
<i>Scotorepens greyii</i>	Little Broad-nosed Bat										•							
<i>Vespadelus baverstocki</i>	Inland Forest Bat										•							
<i>Vespadelus finlaysoni</i>	Inland Cave Bat			•	•			•		•	•					•		
<i>Vespadelus regulus</i>	Southern Forest Bat					•												
Birds																		
ACANTHIZIDAE																		
<i>Acanthiza apicalis</i>	Inland Thornbill			•	•	•					•		•			•		•
<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill				•						•	•	•			•		•
<i>Acanthiza robustirostris</i>	Slaty-backed Thornbill				•	•					•					•		•
<i>Acanthiza uropygialis</i>	Chestnut-rumped Thornbill				•	•					•	•	•			•		•
<i>Aphelocephala leucopsis</i>	Southern Whiteface				•		•			•	•	•	•			•	•	•
<i>Aphelocephala nigrinicta</i>	Banded Whiteface			•	•						•		•			•		
<i>Aphelocephala pectoralis</i>	Chestnut-breasted Whiteface				•													
<i>Gerygone fusca</i>	Western Gerygone				•						•					•		•
<i>Pyrrholaemus brunneus</i>	Redthroat			•	•	•					•					•		•
<i>Smicromis brevirostris</i>	Weebill			•	•	•					•	•				•		•
ACCIPITRIDAE																		
<i>Accipiter cirrocephalus</i>	Collared Sparrowhawk				•						•	•				•		•
<i>Accipiter fasciatus</i>	Brown Goshawk				•	•	•				•	•				•		•
<i>Aquila audax</i>	Wedge-tailed Eagle				•	•				•	•	•				•		•
<i>Circus approximans</i>	Swamp Harrier				•											•		
<i>Circus assimilis</i>	Spotted Harrier			•	•		•				•		•			•		•
<i>Elanus axillaris</i>	Black-shouldered Kite				•		•				•	•				•		•
<i>Elanus scriptus</i>	Letter-winged Kite										•							
<i>Haliastur sphenurus</i>	Whistling Kite			•	•	•					•					•		•
<i>Hamirostra melanosternon</i>	Black-breasted Buzzard				•	•					•					•		•

Species name	Common name	Conservation status		This Assessment	Literature review								Database searches					
		EPBC	In WA		A	B	C	D	E	F	G	H	I	J	K	L	M	N
<i>Hieraaetus morphnoides</i>	Little Eagle				•	•					•					•	•	
<i>Lophoictinia isura</i>	Square-tailed Kite										•							
<i>Milvus migrans</i>	Black Kite				•					•	•	•				•	•	
AEGOTHELIDAE																		
<i>Aegotheles cristatus</i>	Australian Owlet-nightjar				•	•	•				•		•			•	•	
ANATIDAE																		
<i>Anas gracilis</i>	Grey Teal				•						•					•	•	
<i>Anas superciliosa</i>	Pacific Black Duck										•					•		
<i>Aythya australis</i>	Hardhead										•					•		
<i>Chenonetta jubata</i>	Australian Wood Duck				•						•					•		
<i>Cygnus atratus</i>	Black Swan										•					•		
<i>Dendrocygna eytoni</i>	Plumed Whistling-Duck										•							
<i>Malacorhynchus membranaceus</i>	Pink-eared Duck				•						•					•	•	
<i>Tadorna tadornoides</i>	Australian Shelduck						•											
ANHINGIDAE																		
<i>Anhinga novaehollandiae</i>	Australasian Darter										•					•		
APODIDAE																		
<i>Apus pacificus</i>	Fork-tailed Swift	M	S3								•							•
ARDEIDAE																		
<i>Ardea modesta</i>	Eastern Great Egret	M	S3								•							•
<i>Ardea pacifica</i>	White-necked Heron				•						•					•		
<i>Egretta garzetta</i>	Little Egret										•							
<i>Egretta novaehollandiae</i>	White-faced Heron				•						•					•	•	
<i>Ixobrychus flavicollis</i>	Black Bittern										•							
<i>Nycticorax caledonicus</i>	Nankeen Night Heron										•							
ARTAMIDAE																		
<i>Artamus cinereus</i>	Black-faced Woodswallow			•	•	•	•	•		•	•	•	•			•	•	
<i>Artamus leucorhynchus</i>	White-breasted Woodswallow										•							
<i>Artamus minor</i>	Little Woodswallow				•						•		•			•	•	
<i>Artamus personatus</i>	Masked Woodswallow			•	•		•	•			•	•	•			•	•	
<i>Artamus superciliosus</i>	White-browed Woodswallow				•						•					•	•	
<i>Cracticus nigrogularis</i>	Pied Butcherbird			•	•	•	•	•		•	•	•	•			•	•	

Species name	Common name	Conservation status		This Assessment	Literature review								Database searches					
		EPBC	In WA		A	B	C	D	E	F	G	H	I	J	K	L	M	N
<i>Cracticus tibicen</i>	Australian Magpie			•	•	•	•	•		•	•	•	•	•	•	•	•	•
<i>Cracticus torquatus</i>	Grey Butcherbird				•	•	•				•	•	•			•		•
<i>Strepera versicolor</i>	Grey Currawong												•	•				•
BURHINIDAE																		
<i>Burhinus grallarius</i>	Bush Stone-curlew		P4								•					•		
CACATUIDAE																		
<i>Cacatua sanguinea</i>	Little Corella				•						•					•		•
<i>Calyptorhynchus banksii</i>	Red-tailed Black-Cockatoo										•							•
<i>Eolophus roseicapillus</i>	Galah				•	•		•			•	•			•	•		•
<i>Lophochroa leadbeateri</i>	Major Mitchell's Cockatoo		S4	•	•	•					•					•		•
<i>Nymphicus hollandicus</i>	Cockatiel				•	•	•				•		•			•		•
CAMPEPHAGIDAE																		
<i>Coracina maxima</i>	Ground Cuckoo-shrike				•	•	•				•	•				•		•
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike				•	•	•	•			•	•	•			•		•
<i>Lalage sueurii</i>	White-winged Triller				•	•	•				•					•		•
CASUARIIDAE																		
<i>Dromaius novaehollandiae</i>	Emu				•	•					•			•		•		•
CHARADRIIDAE																		
<i>Charadrius australis</i>	Inland Dotterel				•						•							
<i>Charadrius ruficapillus</i>	Red-capped Plover										•							
<i>Charadrius veredus</i>	Oriental Plover	M	S3								•							•
<i>Elsayornis melanops</i>	Black-fronted Dotterel				•						•					•		•
<i>Erythronyx cinctus</i>	Red-kneed Dotterel										•					•		
<i>Vanellus miles</i>	Masked Lapwing				•						•							
<i>Vanellus tricolor</i>	Banded Lapwing				•	•					•							
CICONIIDAE																		
<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork										•							
CLIMACTERIDAE																		
<i>Climacteris affinis</i>	White-browed Treecreeper				•						•					•		•
COLUMBIDAE																		
<i>Columba livia</i> *	Rock Dove										•							
<i>Geopelia cuneata</i>	Diamond Dove				•		•	•			•	•				•		•

Species name	Common name	Conservation status		This Assessment	Literature review								Database searches						
		EPBC	In WA		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
<i>Glareola maldivarum</i>	Oriental Pratincole	M	S3									•							•
<i>Stiltia isabella</i>	Australian Pratincole					•						•							
HALCYONIDAE																			
<i>Todiramphus pyrrhopygius</i>	Red-backed Kingfisher				•	•	•	•				•					•		•
<i>Todiramphus sanctus</i>	Sacred Kingfisher				•							•							•
HIRUNDINIDAE																			
<i>Cheramoeca leucosterna</i>	White-backed Swallow				•	•	•					•	•				•		•
<i>Hirundo neoxena</i>	Welcome Swallow				•							•							
<i>Petrochelidon ariel</i>	Fairy Martin				•							•					•		•
<i>Petrochelidon nigricans</i>	Tree Martin				•		•					•					•		•
LARIDAE																			
<i>Chlidonias hybrida</i>	Whiskered Tern											•							
<i>Chlidonias leucopterus</i>	White-winged Black Tern	M	S3									•							
<i>Chroicocephalus novaehollandiae</i>	Silver Gull											•							
<i>Gelochelidon nilotica</i>	Gull-billed Tern																	•	
MALURIDAE																			
<i>Amytornis purnelli</i>	Dusky Grasswren				•		•					•	•				•	•	•
<i>Amytornis striatus</i>	Striated Grasswren				•	•						•							
<i>Amytornis striatus striatus</i>	Striated Grasswren		P4														•	•	•
<i>Malurus lamberti</i>	Variiegated Fairy-wren				•	•	•					•	•	•			•	•	•
<i>Malurus leucopterus</i>	White-winged Fairy-wren				•							•	•				•		•
<i>Malurus splendens</i>	Splendid Fairy-wren				•	•						•					•	•	•
<i>Stipiturus ruficeps</i>	Rufous-crowned Emu-wren											•	•				•		
MEGALURIDAE																			
<i>Cincloramphus cruralis</i>	Brown Songlark				•		•					•		•			•		•
<i>Cincloramphus mathewsi</i>	Rufous Songlark				•		•					•	•				•		•
<i>Eremiornis carteri</i>	Spinifexbird				•												•		
<i>Megalurus gramineus</i>	Little Grassbird											•							
MEGAPODIIDAE																			
<i>Leipoa ocellata</i>	Malleefowl	VU, M	S1		•	•											•		•
MELIPHAGIDAE																			
<i>Acanthagenys rufogularis</i>	Spiny-cheeked Honeyeater				•	•	•	•			•	•	•	•			•		•

Species name	Common name	Conservation status		This Assessment	Literature review								Database searches						
		EPBC	In WA		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
<i>Certhionyx variegatus</i>	Pied Honeyeater				•	•					•		•		•				
<i>Conopophila whitei</i>	Grey Honeyeater					•					•					•		•	
<i>Epthianura aurifrons</i>	Orange Chat				•						•							•	
<i>Epthianura tricolor</i>	Crimson Chat			•	•	•	•				•	•	•			•		•	
<i>Lichenostomus keartlandi</i>	Grey-headed Honeyeater				•			•		•	•		•		•	•		•	
<i>Lichenostomus penicillatus</i>	White-plumed Honeyeater				•						•	•			•	•		•	
<i>Lichenostomus plumulus</i>	Grey-fronted Honeyeater				•	•	•				•	•				•		•	
<i>Lichenostomus virescens</i>	Singing Honeyeater			•	•	•	•			•	•	•	•			•		•	
<i>Lichmera indistincta</i>	Brown Honeyeater				•						•					•		•	
<i>Manorina flavigula</i>	Yellow-throated Miner			•	•	•	•			•	•	•	•		•	•		•	
<i>Purnella albifrons</i>	White-fronted Honeyeater				•	•					•	•				•		•	
<i>Sugomel niger</i>	Black Honeyeater										•					•		•	
MEROPIDAE																			
<i>Merops ornatus</i>	Rainbow Bee-eater	M	S3		•	•		•	•		•					•	•	•	•
MONARCHIDAE																			
<i>Grallina cyanoleuca</i>	Magpie-lark				•						•	•				•		•	
MOTACILLIDAE																			
<i>Anthus novaeseelandiae</i>	Australasian Pipit				•		•			•	•	•				•		•	
NECTARINIIDAE																			
<i>Dicaeum hirundinaceum</i>	Mistletoebird				•						•	•				•		•	
NEOSITTIDAE																			
<i>Daphoenositta chrysoptera</i>	Varied Sittella				•	•					•		•		•	•		•	
OTIDIDAE																			
<i>Ardeotis australis</i>	Australian Bustard		P4	•	•	•		•		•	•			•		•	•	•	
PACHYCEPHALIDAE																			
<i>Colluricincla harmonica</i>	Grey Shrike-thrush				•	•	•			•	•	•	•		•	•		•	
<i>Oreoica gutturalis</i>	Crested Bellbird			•	•	•	•			•	•	•	•			•		•	
<i>Pachycephala inornata</i>	Gilbert's Whistler					•													
<i>Pachycephala rufiventris</i>	Rufous Whistler			•	•	•	•				•	•	•			•		•	
PARDALOTIDAE																			
<i>Pardalotus rubricatus</i>	Red-browed Pardalote			•	•			•			•	•	•			•		•	
<i>Pardalotus striatus</i>	Striated Pardalote				•	•					•					•		•	

Species name	Common name	Conservation status		This Assessment	Literature review								Database searches					
		EPBC	In WA		A	B	C	D	E	F	G	H	I	J	K	L	M	N
ELAPIDAE																		
<i>Brachyuropis fasciolatus</i>	Narrow-banded Snake				•	•					•							
<i>Brachyuropis roperi</i>	Northern Shovel-nosed Snake																	•
<i>Brachyuropis semifasciatus</i>	Southern Shovel-nosed Snake				•						•				•			•
<i>Demansia psammophis</i>	Yellow-faced Whip Snake					•					•				•			•
<i>Demansia reticulata</i>	Desert Whipsnake				•													
<i>Oxyuranus temporalis</i>	Central Ranges Taipan						•								•			
<i>Parasuta monachus</i>	Monk Snake				•	•		•			•							
<i>Pseudechis australis</i>	King Brown Snake			•	•	•					•				•			•
<i>Pseudonaja mengdeni</i>	Mengden's Brown Snake			•											•			
<i>Pseudonaja modesta</i>	Ringed Brown Snake				•	•					•				•			•
<i>Pseudonaja nuchalis</i>	Western Brown Snake				•						•							
<i>Simoselaps anomalus</i>	Desert Banded Snake				•	•					•				•			
<i>Simoselaps bertholdi</i>	Jan's Banded Snake				•													
GEKKONIDAE																		
<i>Crenadactylus ocellatus</i>	Clawless Gecko				•													
<i>Diplodactylus conspicillatus</i>	Fat-tailed Diplodactylus				•	•		•		•	•				•			
<i>Diplodactylus tessellatus</i>	Tessellated Gecko				•													
<i>Diplodactylus wiru</i>						•												
<i>Gehyra montium</i>	Centralian Dtella				•						•				•			
<i>Gehyra nana</i>	Northern Spotted Rock Dtella																	•
<i>Gehyra purpurascens</i>	Purplish Dtella				•	•				•	•		•		•			•
<i>Gehyra variegata</i>	Tree Dtella				•	•		•		•	•	•	•		•			•
<i>Heteronotia binoei</i>	Bynoe's Gecko				•	•				•	•	•			•			•
<i>Lucasium damaeum</i>	Beaded Gecko				•	•												•
<i>Lucasium stenodactylum</i>	Crowned Gecko				•					•	•				•			
<i>Nephrurus amylae</i>	Centralian Knob-tailed Gecko														•			
<i>Nephrurus laevissimus</i>	Smooth Knob-tail				•	•		•			•							
<i>Nephrurus levis</i>	Three-lined Knob-tail				•	•				•	•				•			•
<i>Rhynchoedura ornata</i>	Beaked Gecko				•	•		•			•				•			•
<i>Strophurus ciliaris</i>	Spiny-tailed Gecko				•					•	•				•			•
<i>Strophurus elderi</i>	Jewelled Gecko				•	•				•	•				•			•

Species name	Common name	Conservation status		This Assessment	Literature review								Database searches						
		EPBC	In WA		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
<i>Ctenotus leonhardii</i>	Leonhardi's Ctenotus				•	•				•	•	•			•			•	
<i>Ctenotus nasutus</i>	Nasute Finesnout Ctenotus														•				
<i>Ctenotus pantherinus</i>	Leopard Ctenotus				•	•				•	•				•				
<i>Ctenotus piankai</i>	Coarse Sands Ctenotus				•						•				•				
<i>Ctenotus quattuordecimlineatus</i>	Fourteen-lined Ctenotus				•	•		•			•				•				
<i>Ctenotus regius</i>	Pale-rumped Ctenotus				•	•													
<i>Ctenotus saxatilis</i>	Stony-soil Ctenotus				•													•	
<i>Ctenotus schomburgkii</i>	Barred Wedgesnout Ctenotus				•	•			•		•				•			•	
<i>Ctenotus septenarius</i>	Massive-gibber Ctenotus				•						•				•				
<i>Cyclodomorphus melanops</i>	Spinifex Slender Blue-tongue				•	•				•	•	•	•		•				
<i>Egernia depressa</i>	Pygmy Spiny-tailed Skink														•			•	
<i>Eremiascincus fasciolatus</i>	Narrow-banded Sand-swimmer				•						•				•			•	
<i>Eremiascincus richardsonii</i>	Broad-banded Sand-swimmer				•				•						•				
<i>Lerista bipes</i>	North-western Sandslider				•	•				•	•				•				
<i>Lerista desertorum</i>	Central Deserts Robust Slider				•	•					•				•				
<i>Lerista elongata</i>	Wide-striped Mulch Slider				•														
<i>Lerista ips</i>	Robust Duneslider														•				
<i>Lerista labialis</i>	Southern Sandslider				•						•				•			•	
<i>Lerista muelleri</i>	Wood Mulch-slider				•				•						•				
<i>Lerista taeniata</i>	Ribbon Slider				•														
<i>Lerista xanthura</i>	Yellow-tailed Plain Slider										•				•			•	
<i>Liopholis inornata</i>	Desert Skink				•	•		•			•				•				
<i>Liopholis kintorei</i>	Great Desert Skink	VU	S1		•						•		•	•	•		•		•
<i>Liopholis margaretae</i>	Centralian Ranges Rock-skink				•														
<i>Liopholis striata</i>	Nocturnal Desert-skink				•	•					•				•			•	
<i>Menetia greyii</i>	Common Dwarf Skink				•						•				•				
<i>Morethia adelaidensis</i>	Saltbush Morethia Skink					•													
<i>Morethia boulengeri</i>	South-eastern Morethia Skink				•														
<i>Morethia butleri</i>	Woodland Morethia Skink				•	•													
<i>Morethia ruficauda</i>	Lined Firetail Skink				•						•	•			•				
<i>Notoscincus ornatus</i>	Ornate Soil-crevice Skink										•								
<i>Proablepharus reginae</i>	Western Soil-crevice Skink														•				

Species name	Common name	Conservation status		This Assessment	Literature review								Database searches						
		EPBC	In WA		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
<i>Proablepharus tenuis</i>	Northern Soil-crevice Skink									•									
<i>Tiliqua multifasciata</i>	Centralian Blue-tongue				•						•				•			•	
<i>Tiliqua occipitalis</i>	Western Blue-tongue				•						•				•				
<i>Tiliqua scincoides</i>	Eastern Blue-tongue				•														
TYPHLOPIDAE																			
<i>Ramphotyphlops bituberculatus</i>	Prong-snouted Blind Snake										•								
<i>Ramphotyphlops endoterus</i>	Interior Blind Snake				•	•					•				•				
<i>Ramphotyphlops grypus</i>	Long-beaked Blind Snake										•								
<i>Ramphotyphlops waitii</i>	Beaked Blind Snake				•														
VARANIDAE																			
<i>Varanus brevicauda</i>	Short-tailed Pygmy Monitor				•						•								
<i>Varanus eremius</i>	Pygmy Desert Monitor				•	•		•			•				•				
<i>Varanus giganteus</i>	Perentie			•	•		•				•	•							
<i>Varanus gilleni</i>	Pygmy Mulga Monitor				•	•				•	•				•			•	
<i>Varanus gouldii</i>	Gould's Goanna			•	•	•	•			•	•	•			•			•	
<i>Varanus tristis</i>	Black-headed Monitor				•	•					•				•			•	
Amphibians																			
HYLIDAE																			
<i>Cyclorana maini</i>	Main's Frog				•						•				•			•	
LIMNODYNASTIDAE																			
<i>Neobatrachus centralis</i>	Trilling Frog				•						•								
<i>Neobatrachus sudelli</i>	Sudell's Frog					•													
<i>Neobatrachus sutor</i>	Shoemaker Frog				•						•				•			•	
<i>Notaden nichollsi</i>	Desert Spadefoot Toad										•								
<i>Platyplectrum spenceri</i>	Spencer's Burrowing Frog				•										•			•	
MYOBATRACHIDAE																			
<i>Pseudophryne occidentalis</i>	Orange-crowned Toadlet				•										•				
Total species per survey or database search				46	259	148	51	60	6	64	286	67	46	14	118	127	7	188	16
Combined total of actual and potential species recorded over this Assessment, all previous surveys and all database searches																			382

Appendix B**Bat Call WA Identification Report for the Cobb Depression Study Area**

The attached report presents a detailed analysis of SM2BAT echolocation data obtained during the March 2013 survey of the Cobb Depression Study Area. The analysis was performed by Bob Bullen of Bat Call WA.

**Wingellina Cobb Depression WA,
March 2013**

Echolocation Survey of Bat Activity.

Prepared for Outback Ecology

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Issue 1
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13 May 2013

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Background

Bat species presence, with an estimate of activity level, is presented for a study area near Wingellina in the Great Victoria Desert, WA. Outback Ecology carried out an echolocation based survey using full spectrum Songmeter SM2 bat detectors during March 2013. Bat Call WA has reviewed the recordings made and provided species lists for the bats present.

Habitats

The sites for the Chiroptera survey were chosen by Outback Ecology. One was a stand of Mulga shrubland with rocky ridges close by. The second was a stand of Desert Oak near a dune system. Recordings from one night at each site were collected and analysed.

Site specific details are presented in Table 1.

Bat Fauna

A microbat list of four insectivorous species was confirmed as present by their echolocation calls. Characteristics of the calls recorded are presented in Table 2. Results are presented in Table 3. Three of the species are common in the area. One, *Chalinolobus morio* is known from the region but is considered uncommon.

An isolated population of *Chalinolobus morio* is known from the Central Ranges spanning Surveyor General's Corner and the ranges to the east (Reardon and Flavel 1987). The results of this study probably indicate the western most extent of that population.

Survey Timing, Moon Phase and Weather

The echolocation survey was conducted on the 26th March 2013. The survey was conducted in a cool and wet period. Minimum overnight temperatures were cool with temperatures around 20^oC. The moon in this period was at first quarter. These conditions would typically result in lower than average bat activity and echolocation call detections.

Survey Team

The bat sampling work was conducted by staff of Outback Ecology. No activities were conducted that directly impacted upon the bat fauna present.

R.D. Bullen of Bat Call WA completed analysis of echolocation recordings.

Systematic Sampling

The two overnight recordings analysed were made with SM2BAT detectors (Wildlife Acoustics, USA). The jumper and audio settings used for the SM2BAT followed the manufacturers recommendations for bat detection contained in the user manual (Wildlife Acoustics 2010), Table 4. Selectable filters and triggers were also set using the manufacturers recommendations.

For all recordings, once reformatted as .wav files, COOL EDIT 2000 (Now available as AUDITION from Adobe Systems Inc.) was used to display each “continuous call” sequence (EPA and DEC 2010) for identification. Only good quality call sequences were used. Details of calls analysed are provided in Table 2 as recommended by Australasian Bat Society (ABS 2006). Reference data for the species identified are available in Bullen and McKenzie 2002, McKenzie and Bullen 2003 and McKenzie and Bullen 2009.

Bat activity was then characterised as “Low”, “Medium” or “High” based on the rate of call sequences recorded.

- Low species activity is referred when a species is recorded with call spacing less often than ten minutes,
- Medium species activity refers to call recordings more often than 10 minutes but less often than two minutes apart for a significant time period followed by sporadic records for the remainder of the session.
- High species activity refers to call recording more often than two minutes apart for significant periods followed by reasonably regular records for the remainder of the session.

Further details of the calls analysed including graphical presentations are available from Bat Call WA on request.

Survey Limitations

The sites surveyed were accessible on foot and the recorders were set at ground level with the antenna horizontal. The omni antenna fitted to the SM2 detector will successfully record all bats that pass within range under these conditions. Bat sound recordings began at sunset and continued until sunrise.

Bat species density is impossible to estimate from echolocation records. Bat activity is therefore substituted as an approximate guide to the relative numbers of each species using the study area.

References

ABS (2006). Recommendations of the Australasian Bat Society Inc for reporting standards for insectivorous bat surveys using bat detectors. *The Australasian Bat Society Newsletter* 27: 6-9.

Bullen R.D. and McKenzie N.L. (2002). Differentiating Western Australian *Nyctophilus* (Chiroptera: Vespertilionidae) echolocation calls. *Australian Mammalogy*. 23: 89-93

EPA and DEC (2010). Technical guide – terrestrial vertebrate fauna surveys for environmental impact assessment (eds B.M. Hyder, J. Dell and M.A. Cowan). Environmental Protection Authority and Department of Environment and Conservation, Perth Western Australia.

McKenzie N.L. and Bullen R.D. (2003). Identifying Little Sandy Desert bat species from their echolocation calls. *Australian Mammalogy* 25: 73-80.

McKenzie, N.L. and Bullen R.D. (2009). The echolocation calls, habitat relationships, foraging niches and communities of Pilbara microbats. *Records of the Western Australian Museum (Supplement)* 78: 123-155.

Reardon, T.B. and Flavel, S.C. (1987). A Guide to the Bats of South Australia. South Australian Museum: Adelaide.

Wildlife Acoustics (2010). Song Meter User Manual, Model SM2, with Song Meter SM2BAT 192kHz Stereo or 384kHz Mono Ultrasonic Recorders addendum.

Table 1 Site Specific details.

Location	Site description	Easting	Northing
SM23 130326	Mulga stand near ranges	459410	7148734
SM24 130326	Desert Oak stand near dunes	457183	7180607

Sites are in zone 52J

Table 2: Summary of Echolocation call characteristics for microbat species present.

Genus species Authority	Common name	Typical F_{peakC} kHz	Ave. Q	Typical Duration msec	Typical Call Shape
<i>Chalinolobus gouldii</i> (Grey 1841)	Gould's wattled bat	32	10	7 - 11	FM
<i>Chalinolobus morio</i> (Grey 1841)	Chocolate wattled bat	50	10	7	FM
<i>Nyctophilus geoffroyi</i> Leach 1821	Lesser long-eared bat	45	3	5	Steep FM
<i>Vespadelus finlaysoni</i> (Kitchener, Jones and Caputi 1987)	Inland cave bat	55	14	4 - 8	FM

Note: F_{peakC} and Q are defined in McKenzie and Bullen 2003, 2009.

Table 3. Microbat lists obtained

Date	Site	Detector/Recorder	<i>Chalinolobus gouldii</i>	<i>Chalinolobus morio</i>	<i>Nyctophilus geoffroyi</i>	<i>Vespadelus finlaysoni</i>
26 March	SM23 130326	One overnight recording using SM2BAT detector OB03	Low	Low	Low	Low
26 March	SM24 130326	One overnight recording using SM2BAT detector OB04	Low		Low	

Note 1: Low activity refers to call spacing that repeat less often than 10 minutes.

Med activity refers to call records that repeat more often than 10 minutes but less often than 2 minutes for significant periods of time then sporadically for the duration of the recording.

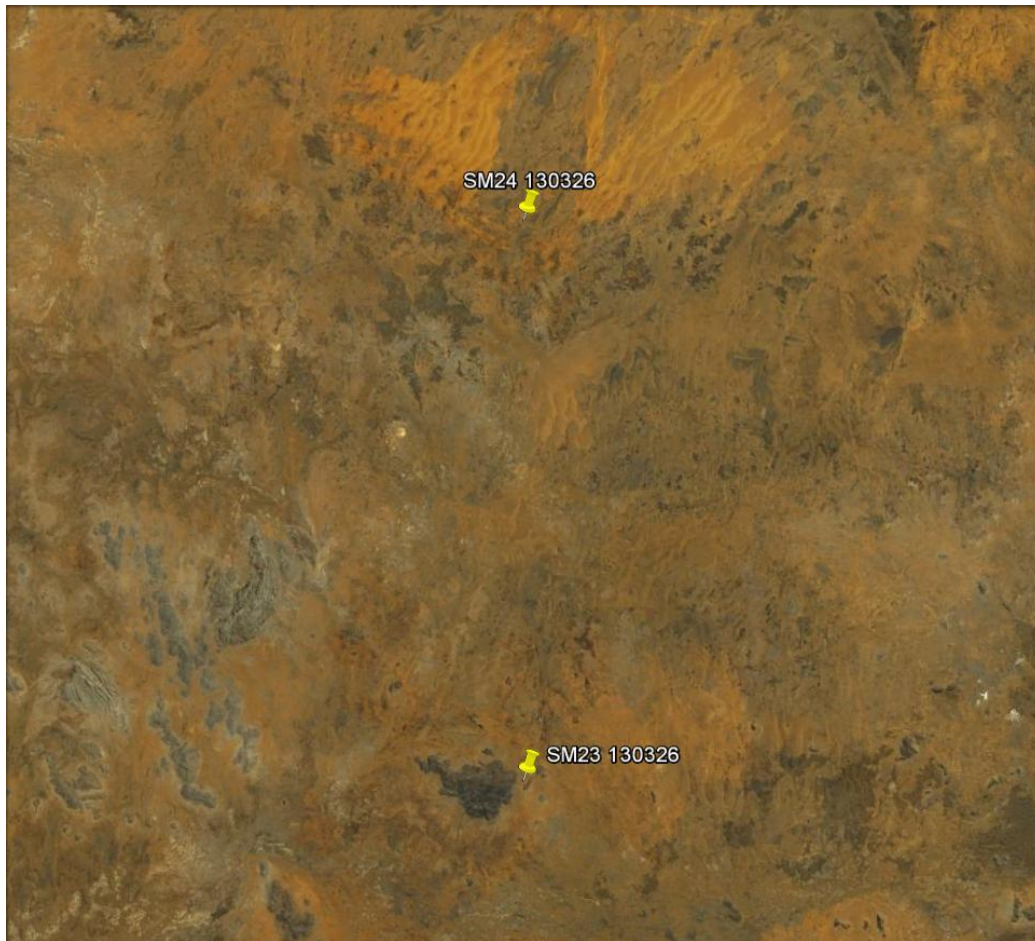
High activity refers to calls that repeat more often than 2 minutes for significant periods of time then periodically for the duration of the recording.

Table 4 SM2 Audio settings used during survey.

Parameter	Setting
Sample rate	Fs = 384,000 kHz
Channel used	Left
Compression protocol	WAC4 (12 bit audio samples)
Gain - left channel	0.00
Digital high pass filter Left channel	Fs / 48
Digital low pass filter Left channel	Off
Triggering level Left channel	8SNR (adaptive +8 dB triggering)
Triggering window Left channel	2.0 sec.

Note: These settings are as recommended in Wildlife Acoustics (2010) except the high pass filter. This is set at 8 kHz to record any *Tadarida australis* that may be present

Figure 1. Location of study area sites in relation to local features



Appendix C

Codes and Terms Used to Describe Conservation Significance

Fauna may be accorded legislative protection by being listed under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwth) (EPBC Act) and/or the *Wildlife Conservation Act 1950* (WA) (WC Act), or by being listed on the WA Department of Environment and Conservation's *Priority Species List*. This table presents a summary of the different rankings and listings used to describe conservation status. Some categories, such as 'extinct', 'extinct in the wild' and 'conservation dependent' (EPBC Act) are not presented here, as the table includes only the information needed to fully understand the codes presented in the preceding report. Refer to the relevant legislation for a full description of all codes in use, as well as their associated criteria.

Codes and Terms Used to Describe Conservation Significance Status

Status	Code	Description
Categories used under the EPBC Act		
Critically Endangered	CR	Fauna that is considered to be facing an extremely high risk of extinction in the wild in the immediate future
Endangered	EN	Fauna that is considered to be facing a very high risk of extinction in the wild in the near future
Vulnerable	VU	Fauna that is considered to be facing a high risk of extinction in the wild in the medium-term future
Migratory	M	Species that migrate to, over and within Australia and its external territories.
Schedules used under the WC Act		
Schedule 1	S1	Fauna that is rare or likely to become extinct. Threatened fauna listed under Schedule 1 of the WC Act are further ranked by the DEC, according to the level of threat facing each species. The ranks are CR, EN and VU.
	CR	Critically endangered: considered to be facing an extremely high risk of extinction in the wild
	EN	Endangered: considered to be facing a very high risk of extinction in the wild
	VU	Vulnerable: considered to be facing a high risk of extinction in the wild
Schedule 2	S2	Fauna that is presumed to be extinct
Schedule 3	S3	Birds that are subject to an agreement between the governments of Australia and Japan relating to the protection of migratory birds
Schedule 4	S4	Fauna that is in need of special protection, other than for reasons mentioned above
DEC Priority Fauna List		
Priority 1	P1	Taxa with few, poorly known populations on threatened lands. These are known from few specimens or sight records from one or a few localities on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, active mineral leases. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
Priority 2	P2	Taxa with few, poorly known populations on conservation lands. These are known from few specimens or sight records from one or a few localities on lands not under immediate threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
Priority 3	P3	Taxa with several, poorly known populations, some on conservation lands. These are known from few specimens or sight records from several localities, some of which are on lands not under immediate threat of habitat destruction or degradation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
Priority 4	P4	Taxa in need of monitoring. These 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. These taxa are usually represented on conservation lands.
Priority 5	P5	Taxa in need of monitoring. These are not considered threatened but are subject to a specific conservation programme, the cessation of which would result in the species becoming threatened within five years.