

Evolution Mining Limited Edna May and Greenfinch Projects

Level 1 Fauna Assessment

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Edna May and Greenfinch Projects: Level 1 Fauna Assessment

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Executive Summary

Evolution Mining is currently evaluating the potential of developing the Edna May and Greenfinch Project (the Project). The Project consists of an open cut gold mine which has a current mine life of 9 years and is located immediately north of the town of Westonia, approximately 60 km west of Southern Cross in the Wheatbelt region of Western Australia. Evolution Mining commissioned Outback Ecology to undertake a level 1 fauna assessment of the Project (this Assessment). The results of this assessment are intended to be reviewed by government regulators in advance of any changes in mine planning. This is intended to reduce lag times between decision making and implementing changes. The area assessed (the Study Area) consists of a 166 hectare portion of land adjacent to Evolution Mining's existing Edna May operations.

The specific objectives of the Assessment were to:

- undertake a desktop study to develop inventories of terrestrial vertebrate and SRE invertebrate species previously identified in the Study Area, or likely to be present in the Study Area;
- provide a description of broad vertebrate fauna habitats, sensitive habitats and terrestrial SRE invertebrate fauna habitats expected to occur within the Study Area, based on the outcomes of the desktop study;
- verify the results of the desktop study through low level sampling of fauna assemblages and mapping of broad fauna habitats present within the Study Area via a reconnaissance survey;
- undertake targeted searches for vertebrate fauna species of conservation significance (including the Malleefowl, *Leipoa ocellata*), SRE invertebrate fauna and invertebrate fauna of conservation significance (i.e. the Shield-backed Trapdoor Spider, *Idiosoma nigrum*, and Tree-stem Trapdoor Spider, *Aganippe castellum*), or habitat likely to support these;
- 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 area.

Survey methodology consisted of targeted and opportunistic searching, habitat assessments and the deployment of baited motion-sensor cameras and SM2BAT+ units. Based on habitat characteristics, five locations were chosen to deploy baited motion-sensor cameras (Reconyx Hyperfire HC600). Additionally, a SM2BAT+ recorder was deployed at four locations within the Study Area for a single night to recorded bat activity in the Study Area.

Four broad fauna habitat types were identified within the Study Area comprising, Mixed Shrubland, *Eucalyptus longicornis* Woodland, mixed Mallee Woodland and *Eucalyptus salubris* Woodland. These habitats within the Study Area were in good to very good condition, with the exception of areas previously disturbed by mining activities. As the Study Area encompasses a large area of remnant native vegetation, which is important in a sub-regional context, all habitat types are considered to be significant to vertebrate fauna. The Study Area lies within a 2,418 ha portion of remnant native

vegetation, which is the 30th largest portion of remnant native vegetation within the subregion (i.e. 99.87% of remnant native vegetation that occurs in the subregion occurs in portions smaller than the portion of remnant native vegetation in which the Study Area is located).

A total of 37 species (34 native species) were recorded in this assessment comprising, 23 native birds, 8 native mammals, 3 reptiles and 3 introduced species. None of these species are of conservation significance and all were identified by the database searches as potentially occurring in the Study Area.

The desktop study identified 29 species of conservation significance that potentially occur in the Study Area. Of these, the Western Spiny-tailed Skink (*Egernia stokesii badia*) and the Rainbow Bee-eater (*Merops ornatus*) and snails of the Short-range Endemic genus *Bothriembryon* were considered Very Likely to occur within the Study Area. The Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*), Carpet Python (*Morelia spilota imbricata*), Bush Stone-curlew (*Burhinus grallarius*) and Brush Bronzewing (*Phaps elegans*) were considered Likely to occur and the Malleefowl (*Leipoa ocellata*), Shield-backed Trapdoor Spider (*Idiosoma nigrum*), Tree-stem Trapdoor Spider (*Aganippe castellum*), Chuditch (*Dasyurus geoffroi*), Red-tailed Phascogale (*Phascogale calura*) and Australian Bustard (*Ardeotis australis*) were considered to Possibly occur within the Study Area. The remaining 16 species were considered Unlikely to occur in the Study Area due to a lack of suitable habitat or the Study Area occurring outside of the species known distribution.

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1. INTRODUCTION

1.1. Project Background and Location

Evolution Mining is currently evaluating the potential of developing the Edna May and Greenfinch Project (the Project). The Project consists of an open cut gold mine which has a current mine life of 9 years and is located immediately north of the town of Westonia, approximately 60 km west of Southern Cross in the Wheatbelt region of Western Australia (WA) (**Figure 1**). Evolution Mining commissioned Outback Ecology to undertake a level 1 fauna assessment of the Project (this Assessment). The results of this assessment are intended to be reviewed by government regulators in advance of any changes in mine planning. The area assessed (the Study Area) consists of a 166 hectare (ha) portion of land adjacent to Evolution Mining's existing Edna May operations (**Figure 2**).

1.2. Report Scope and Objectives

The purpose of this Assessment was to gather background biological information on the terrestrial vertebrate fauna, short-range endemic (SRE) invertebrate fauna and fauna habitats of the Study Area, in order to support future permit and approvals documentation for Evolution Mining. To this end, the specific objectives of the Assessment were to:

- undertake a desktop study to develop inventories of terrestrial vertebrate and SRE invertebrate species previously identified in the Study Area, or likely to be present in the Study Area;
- provide a description of broad vertebrate fauna habitats, sensitive habitats and terrestrial SRE invertebrate fauna habitats expected to occur within the Study Area, based on the outcomes of the desktop study;
- verify the results of the desktop study through low level sampling of fauna assemblages and mapping of broad fauna habitats present within the Study Area via a reconnaissance survey;
- undertake targeted searches for vertebrate fauna species of conservation significance (including the Malleefowl, *Leipoa ocellata*), SRE invertebrate fauna and invertebrate fauna of conservation significance (ie the Shield-backed Trapdoor Spider, *Idiosoma nigrum*, and Tree-stem Trapdoor Spider, *Aganippe castellum*), or habitat likely to support these;
- 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 area.

The objectives and methods of this Assessment were aligned with the following regulatory guidelines:

- Environmental Protection Authority (EPA) *Position Statement 3 Terrestrial Biological Surveys as an Element of Biodiversity Protection* (2002);
- EPA Guidance 56 *Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia* (EPA: Environmental Protection Authority 2004);
- EPA and Department of Environment and Conservation (DEC) *Technical Guide: Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (EPA and DEC: Environmental Protection Authority and Department of Environment and Conservation 2010);
- Environmental Protection Authority *Guidance No. 20, Sampling of Short Range Endemic Invertebrate Fauna for Environmental Impact Assessment in Western Australia* (EPA: Environmental Protection Authority 2009); and
- *National Manual for the Malleefowl Monitoring System: Standards, Protocols and Monitoring Procedures, National Malleefowl Monitoring Project* (Natural Heritage Trust 2007).

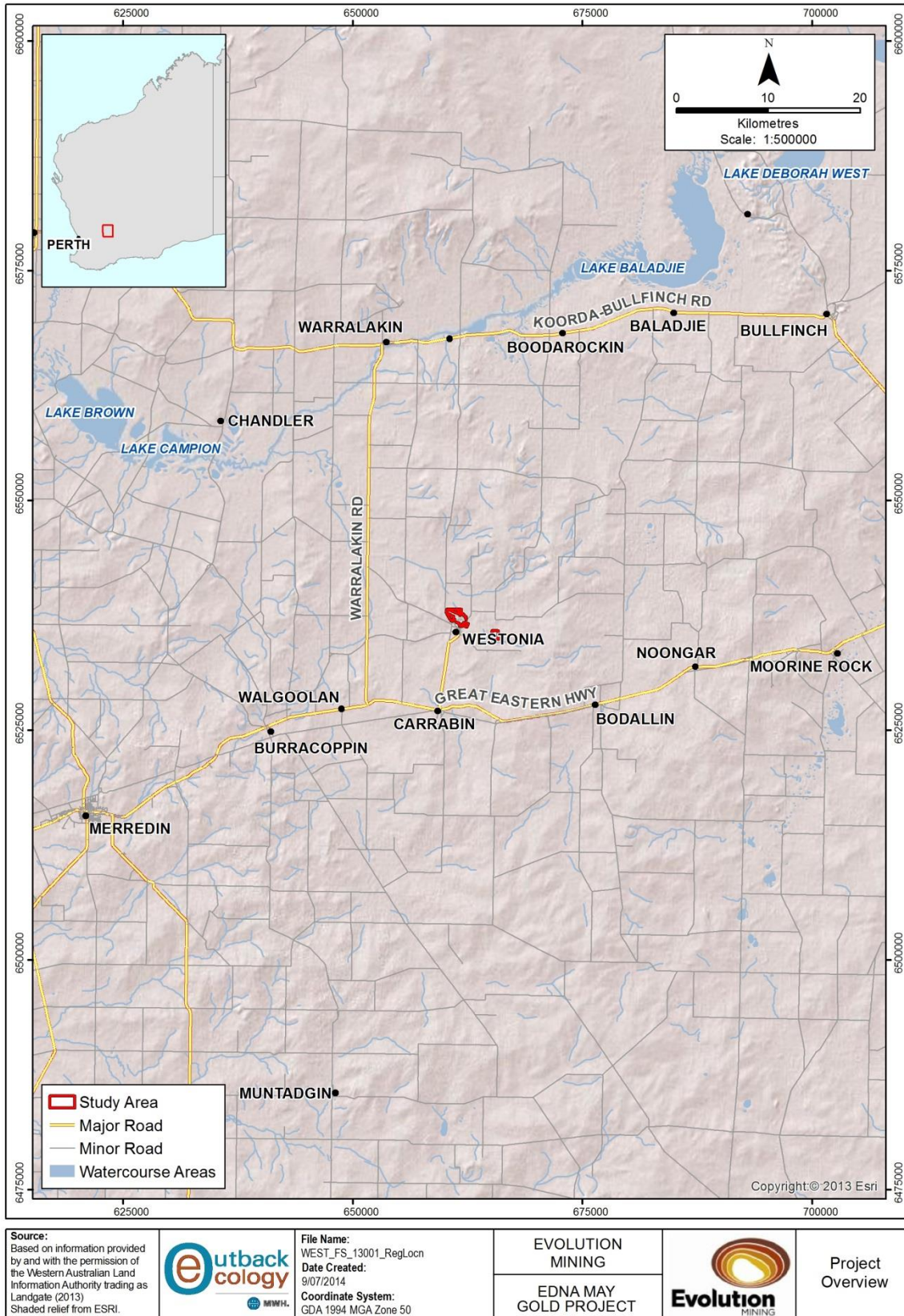


Figure 1: Regional location of the Study Area

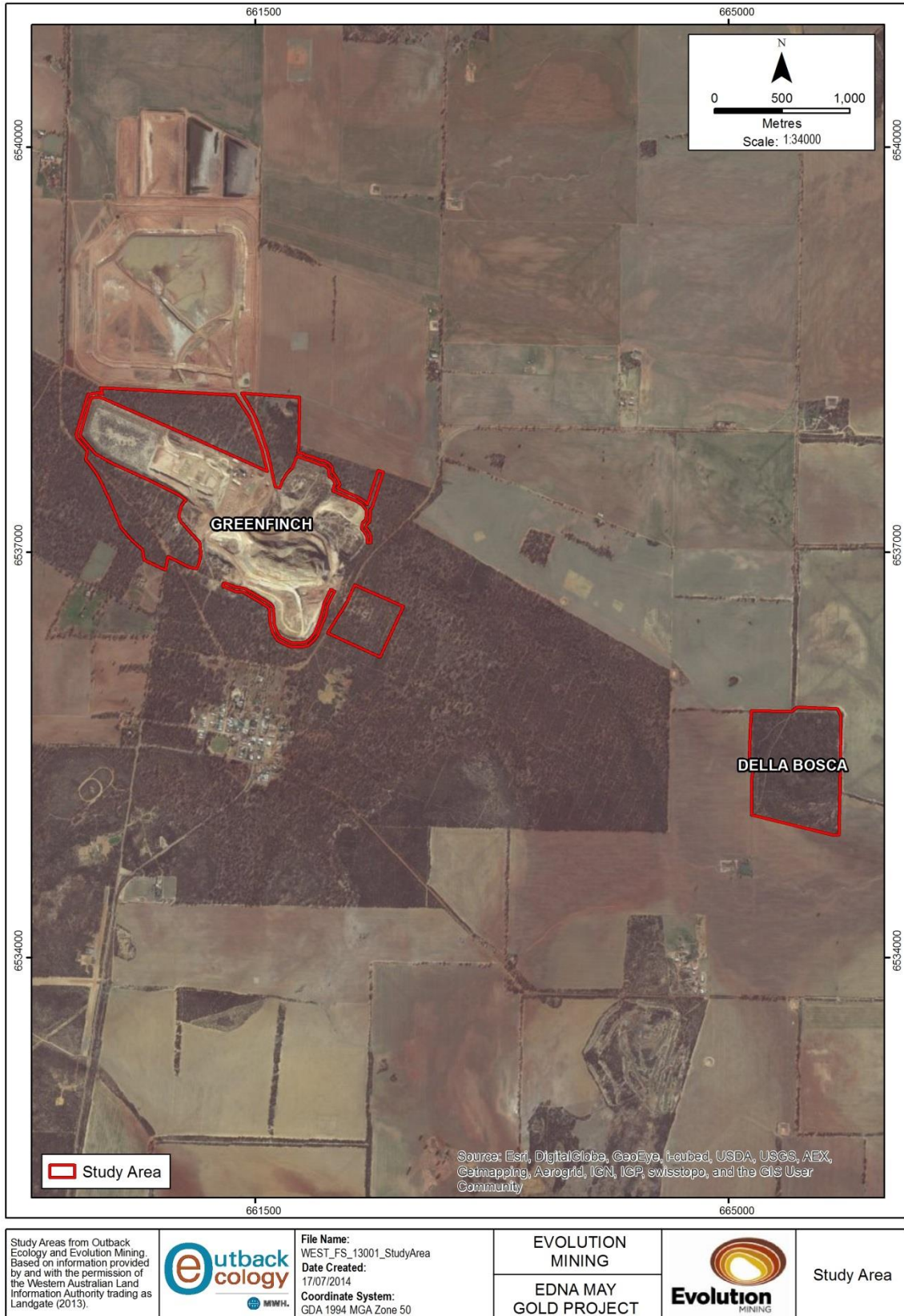


Figure 2: Location of the Study Area

2. EXISTING ENVIRONMENT

2.1. Biogeographic Region

The Study Area occurs in the Avon Wheatbelt bioregion, as defined by the Interim Biogeographic Regionalisation for Australia (IBRA) classification system (McKenzie *et al.* 2003) (**Figure 3**). The Avon Wheatbelt biogeographic region encompasses 9,578,999 ha of land and has a semi-arid warm Mediterranean climate. There is little connected drainage in the bioregion with salt lake chains occurring as remnants of ancient drainage systems that only function in very wet years.

Land uses are primarily dryland agriculture and grazing. Smaller areas include Crown reserves (mainly conservation estate), mining operations and rural residential communities. The region has been extensively cleared for agriculture and grazed by stock, and consequently has numerous environmental problems, threatened ecological communities and species at risk (Beecham 2001). Remnant vegetation, wetlands, riparian systems, populations of species and ecosystems at risk are in poor condition, with the trend expected to decline. Extensive clearing of native vegetation has led to salinity problems being experienced throughout the bioregion. The Avon Wheatbelt bioregion has experienced declines in its mammalian fauna, in concert with an increased presence of invasive species (Beecham 2001). Small mammals (35 – 7,000g weight range) are particularly threatened by fox predation.

The region is divided into two major components: the Avon Wheatbelt 1 (AW1 – Ancient Drainage) subregion and the Avon Wheatbelt 2 subregion (AW2 – Re-juvenated Drainage). The Study Area lies within the Avon Wheatbelt 1 subregion which encompasses 6,566,022 ha and broadly comprises gently undulating landscapes of low relief; proteaceous scrub heaths on residual lateritic uplands and mixed woodlands on quaternary alluvial soils. The Study Area is dominated by mixed woodland of Mallee and *Eucalyptus* species. There are eight Threatened Ecological Communities (TEC's) within the Avon Wheatbelt 1 subregion with a further five ecosystems listed as being 'at risk', and three wetlands of subregional significance (Beecham 2001). No TEC's or wetlands of subregional significance occur within the Study Area.

2.2. Climate

The Avon Wheatbelt bioregion climate is semi-arid warm Mediterranean and is characterised by hot dry summers and wet winters. Climate is controlled primarily by 'southern oscillation of the anticyclonic belt' with relatively small influence of the 'El Nino' effect. The closest Bureau of Meteorology (BOM) weather station providing long-term data is located at Merredin (BOM station: 010092), approximately 42 km to the south-west. The Merredin BOM station has a long term mean annual rainfall of 325.8 millimetres (mm), with the majority of this rain falling between May and August (**Figure 4**). Approximately 70% of annual rainfall falls during the 5-month growing period (May-September) and is of relatively low variability. Long-term statistics indicate that the monthly mean maximum temperatures range from 19° C in July to 37.4 ° C in January, and mean minimum temperatures range between 14.2 ° C in July to 30.9° C in January (BOM 2014).

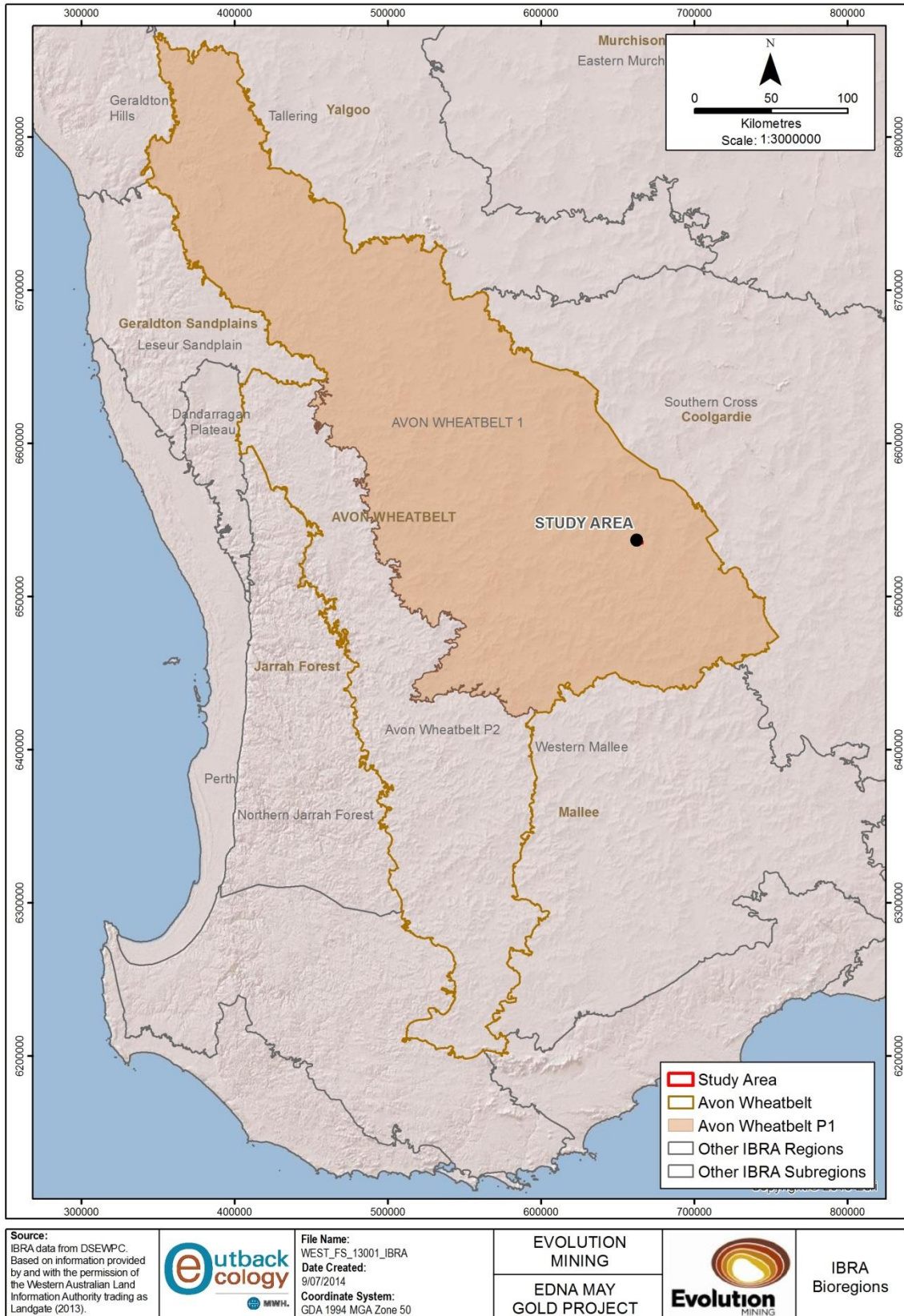


Figure 3: The Study Area with respect to IBRA bioregions and subregions

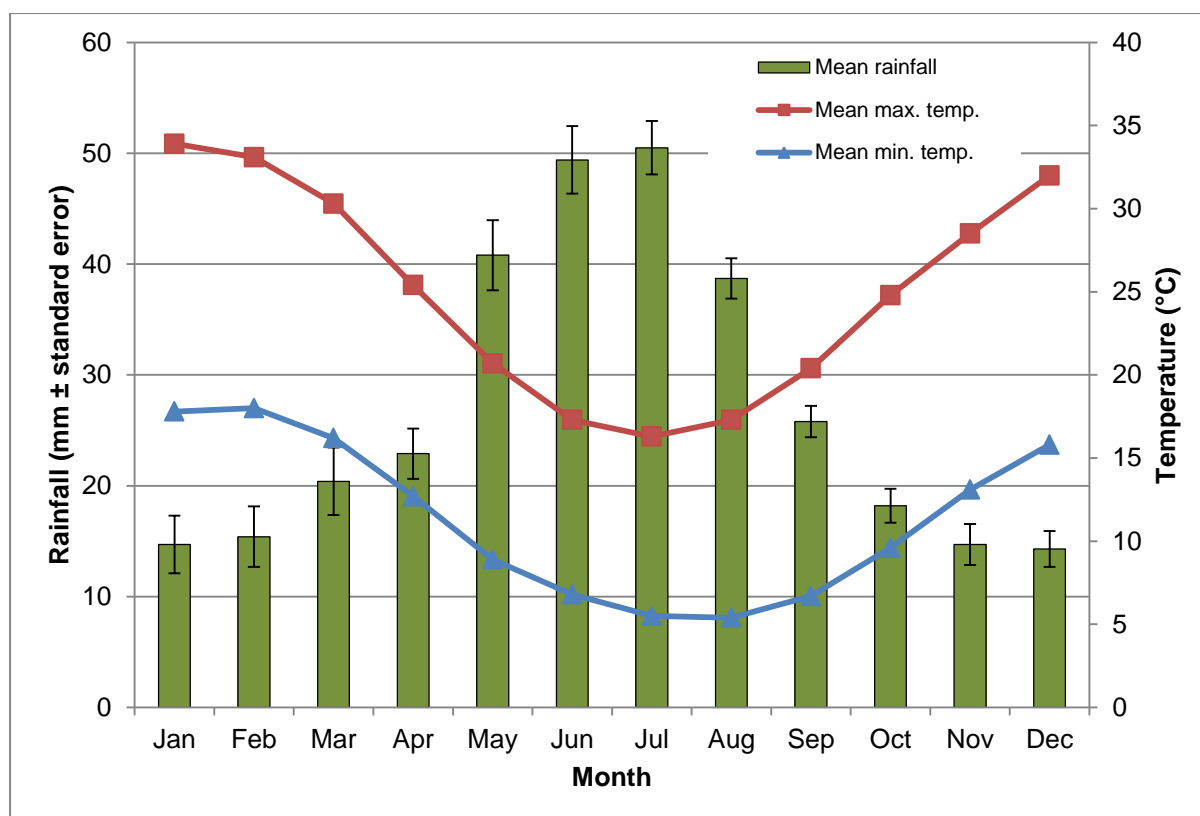


Figure 4: Climate data for Merredin BOM station (BOM station number: 010092)

Source data: (BOM 2014) 1903 - 2014

2.3. Soil Landscapes

The Department of Agriculture in Western Australia, with support from the National Soil Conservation Program (NSCP), National Landcare Program (NLP) and Natural Heritage Trust (NHT), has completed a 15-year mapping program to provide a soil and land resource inventory for approximately 25 million hectares in the south-west agricultural areas of Western Australia. This report provides an overview of the soil-landscape mapping program for south-western Australia.

An assessment of these soil landscapes provides an indication of the occurrence and distribution of broad scale fauna habitats within and surrounding the Study Area. The Study Area contains six soil landscapes (**Figure 5, Table 1**). Of these, five are associated with naturally occurring soil landscapes and the sixth, Holleton Mine Phase, is related to disturbed lands associated with mining activities.

2.4. Land Use

The Study Area lies within the Avon Wheatbelt 1 subregion which is dominated by dryland agriculture and grazing on improved pastures with lesser areas of Unallocated Crown Land (UCL) and Crown Reserves, rural residential land and mining areas (**Figure 6**).

Conservation reserves in the vicinity of the Study Area include the Carrabin Nature Reserve and the Sandford Rocks Nature Reserve, approximately 13 km to the south and ten km to the north-east

respectively. Both reserves and other remnant vegetation (**Figure 6**) contain important refuge habitat for terrestrial fauna including granite outcrops, permanent water pools and various scrub and woodlands.

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

Soil Landscape	Landform Description	Soil Description	Vegetation Description	Extent in Study Area (ha)
Holleton Mine Phase	Disturbance by Mining			41
Tandegin 1	Crestal and upper slope sandplain with weakly expressed, weakly indurated breakaways and colluvial backslopes comprising gravelly yellow sands, earths and gravels with Tammar and Kwongan heath.	Shallow sandy and loamy gravels on crests and breakaways, yellow sandy earths on backslopes, grading to deep yellow sands with Fe nodulation at depth	<i>Kwongan with mixed low open woodland dominated by Acacia, Allocasuarina, Proteaceae and Melaleuca species</i>	33
Baladjie 3	Saline playa lake & surrounding lunettes. Salt lake soils with salt & gypsum crystal rich surfaces, pale deep sands & calcareous loamy earths	Lacustrine Tertiary sediment deposits with aeolian deposits around the margins of lakes	Salt lake soil associated calcareous loamy earths	33
Tandegin 2	Very smoothly undulating sandy aeolian deposits on uplands located directly south east of valley sources, comprising deep yellow sands and earths with gravels forming from recent lateritisation, typically vegetated by Banksia woodland.	Deep yellow sands and gravelly sands. Shallow gravels and duricrust may be exposed on crests	<i>Kwongan with mixed low open woodland dominated by Acacia, Allocasuarina, Proteaceae & Melaleuca species</i>	23
Holleton 3d	Dolerite rock and soil	N/A	N/A	23
Holleton 3 Granite Phase	Irregular undulating rises to undulating low hills with shallow soils and fresh rock outcrop.	Mainly alkaline to neutral sandy duplexes with gritty gradational soils fringing small rock outcrops, minor loams & loamy duplexes	Complex associations containing York Gum, <i>Acacia acuminata</i> , <i>A. lasiocalyx</i> , <i>Allocasuarina campestris</i> & shrubby understorey, & Mallee	8
Baladjie 2	Level to very gently inclined plains, including some very gently inclined valley slopes. Dominant soils Calcareous loamy earths and Alkaline red shall	Quaternary and Tertiary sedimentary deposits	Salmon gum-gimlet-morrel woodland	2
Holleton 2 Sand Plain Phase	Isolated low hills and rises with yellowish red sandplain and red duplexes	Mafic ironstone gravelly soils grading downslope to yellow loamy earths, bordered by acid shallow and sandy duplexes and interspersed with alkaline re	<i>Proteaceae</i> and <i>Casuarinaceae</i> on ironstone gravelly soils, <i>acacia</i> species with minor <i>Proteaceae</i> on yellow earths and Mallee	3
Total				166 ha (100.0%)

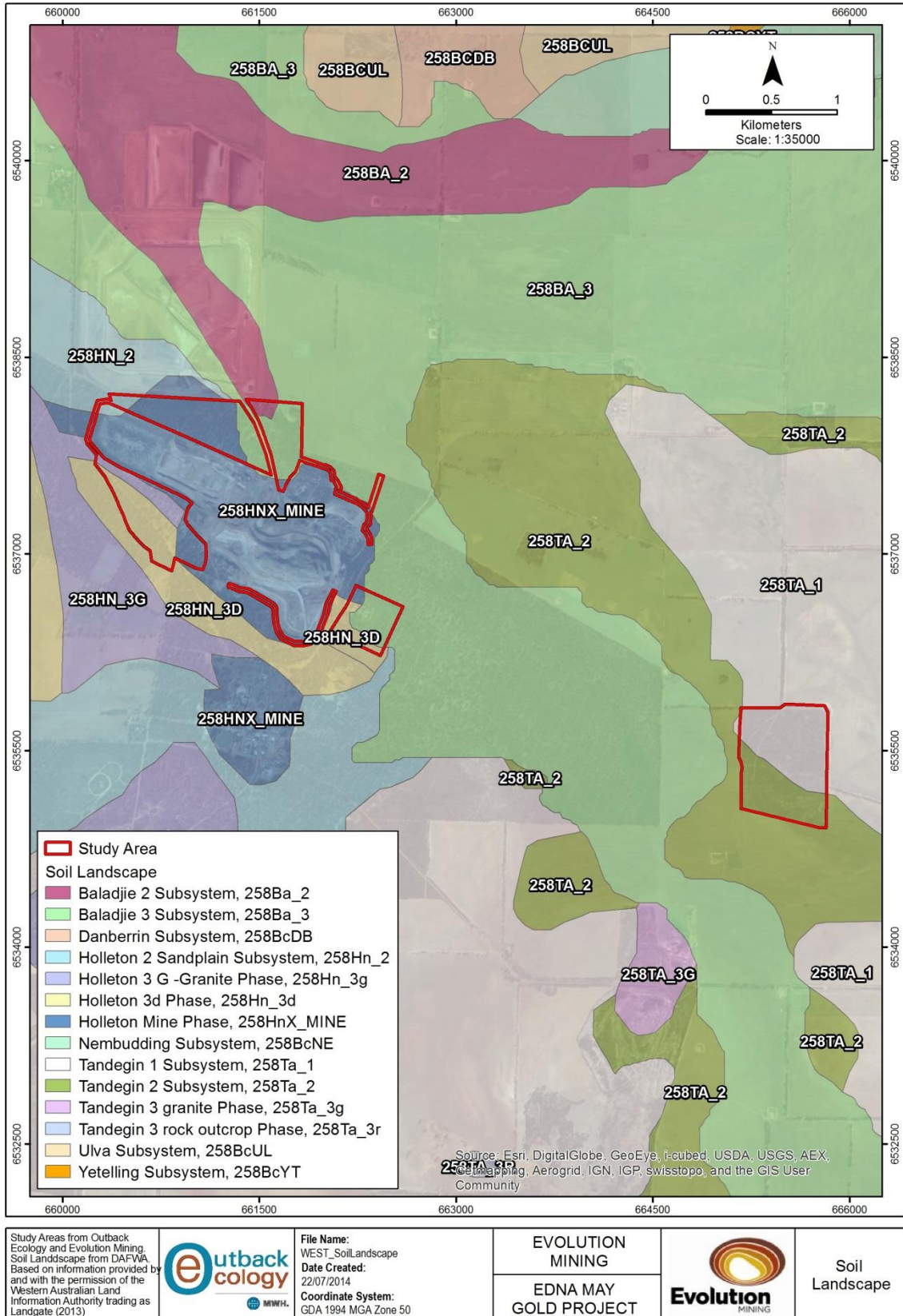


Figure 5: Soil landscapes of the Study Area

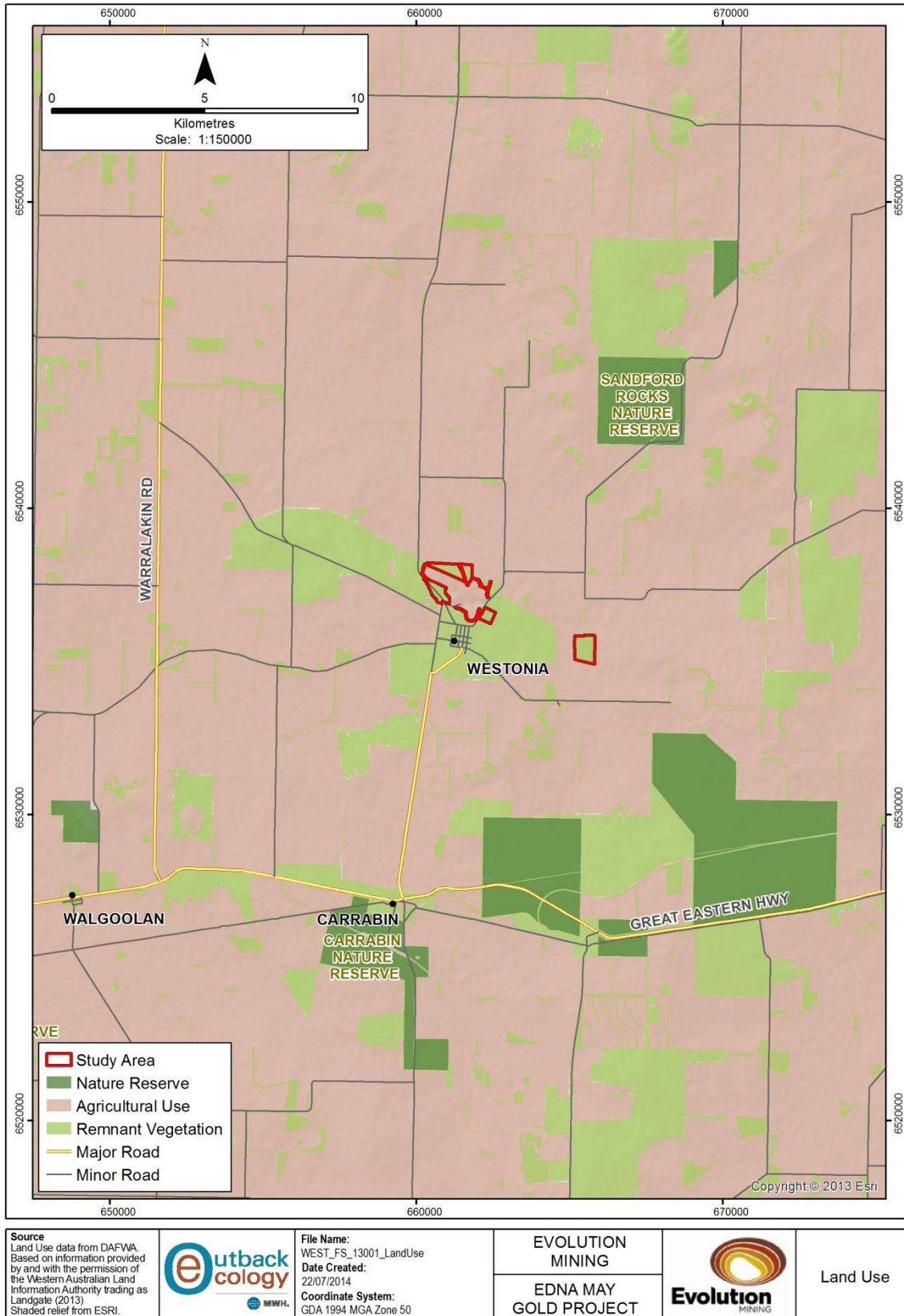


Figure 6: Land use and locations of native remnant vegetation in and around the Study Area

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 236 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 either a central point with coordinates 661157 mE 6537514 mS (GDA 1994, UTM 50J) or a polygon comprising the Study Area. The databases and search areas used were:

- the WA DEC's NatureMap database (DEC: Department of Environment and Conservation 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: Department of Environment and Conservation 2013b), with a search area consisting of the Study Area with a buffer of 75 km;
- the BirdLife Australia Atlas database (Birdlife Australia 2013), with a search area consisting of the Study Area with a buffer of 75 km;
- the Protected Matters Search Tool (DSEWPaC: Department of Sustainability 2013a), with a search area consisting of the central point surrounded by a circular buffer zone of 75 km radius; and
- the WA Museum arachnid, myriapod and mollusc collections (WAM: Western Australian Museum 2013), with a search area consisting of the central point surrounding by a square box with side of 100 km.

The database searches for the Study Area reported a total of 225 vertebrate fauna species (218 native species) (**Appendix A**), of which 27 are of conservation significance (**Section 6.3**), including:

- 15 threatened species; i.e. those species listed as Endangered or Vulnerable under the *EPBC Act* and/or Schedule 1 and/or Schedule 4 under the *WA Wildlife Conservation Act 1950 (WC Act)*;
- three priority species; i.e. those species on DEC's Priority Fauna Species list; and
- ten migratory species (including 2 species listed as "threatened" species"); i.e. those species listed as Migratory under the *EPBC Act* and/or as Schedule 3 under the *WC Act*.

3.2. Literature Review

The literature review identified two previous studies of relevance (**Table 3**). For these studies, 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 (**Appendix A**).

A detailed summary of vertebrate fauna species richness from the desktop study is presented in **Table 2**. Previous studies in the vicinity of the Study Area reported a total of 68 vertebrate fauna species (67 native species), of which one, the Rainbow Bee-eater (*Merops ornatus*) is listed as a “migratory” species.

The key findings of relevant past studies are presented in **Table 3**.

Table 2: Detailed summary of vertebrate fauna species richness from desktop study

Taxa	This Study	Literature Review			Database searches					Total
		A	B	Total	C	D	E	F	Total	
Amphibians	0	0	0	0	0	0	5	0	5	5
Native Birds	22	43	42	61	16	140	95	7	152	157
Introduced Birds	0	0	0	0	0	3	3	0	3	3
Native Mammals	8	2	0	2	8	0	12	1	17	22
Introduced Mammals	3	1	0	1	0	0	4	0	4	5
Reptiles	3	4	0	4	2	0	41	1	44	44
Total Native Species	33	49	42	67	26	140	153	9	218	228
Total Species	36	50	42	68	26	143	160	9	225	236

Surveys considered in Literature Review

- A** Vertebrate Fauna of the Westonia Mine Lease
B Avian Fauna of the Westonia Commons and Waste Rock Dumps

Database Searches

- C** Threatened and Priority Fauna Database – DEC (2013b)
D BirdData: Custom Atlas Bird List – BirdLife Australia (2013)
E NatureMap Database – DEC (2013a)
F Protected Matters Search Tool – DSEWPac (2013a)

Table 3: Key findings of relevant past studies

Code Reference(s)	Survey details	Proximity to Study Area	Methods	Habitats defined or noted	Vertebrate fauna assemblage found	Fauna of conservation significance	Notes
A Bamford Consulting Ecologists (2002)	<p><u>Project:</u> Vertebrate Fauna of the Westonia Mine Lease</p> <p><u>Client:</u> Knight Piesold Consulting</p> <p><u>Survey type:</u> Level 1 Assessment</p> <p><u>Survey date:</u> October 2002</p>	Coincident with and adjacent to the Study Area	<ul style="list-style-type: none"> • Avifauna census • Targeted searches • Spotlighting 	<ul style="list-style-type: none"> • Open paddock • Eucalypt woodland • Mixed mulga shrubland • Revegetation areas 	<p><u>51 species:</u></p> <ul style="list-style-type: none"> • 2 native mammal • 1 introduced species • 44 bird • 4 reptile 	<p><u>Priority and Migratory:</u></p> <ul style="list-style-type: none"> • Rainbow Bee-eater 	<p>As the site had been logged in the past, there was little evidence of significant hollows that would be used by cockatoos (e.g. Red-tailed Black Cockatoo or Carnaby's Cockatoo) for breeding. Narrow hollow stumps (20-30cm diameter) standing throughout the site.</p> <p>No night birds were recorded during spotlighting, possibly due to the lack of nesting hollows or the lack of prey.</p> <p>Eucalypt woodland and Mixed Mulga shrublands are known to occur within the Study Area. Fauna identified during this assessment within these habitats are likely to occur within the Study Area</p>
B Simmons (2002)	<p><u>Project:</u> Avian Fauna of the Westonia Commons and Waste Rock Dumps</p> <p><u>Study type:</u> Avifauna Survey</p> <p><u>Survey date:</u> Autumn 2001 and 2002</p>	Coincident with and adjacent to the Study Area	<ul style="list-style-type: none"> • Avifauna Census • Opportunistic recording 	<ul style="list-style-type: none"> • Remnant vegetation • Revegetation areas • Disturbed habitat (Mine and Waste Rock Dump (WRD)) 	<p><u>37 species:</u></p> <ul style="list-style-type: none"> • 37 bird 	<p><u>Priority and Migratory:</u></p> <ul style="list-style-type: none"> • Rainbow Bee-eater 	<p>Some species that were present reflect relatively undisturbed natural vegetation, adjacent to the Waste Rock Landforms (WRLs)</p>

4. SURVEY METHODOLOGY

4.1. Survey Timing and Weather

The survey of the Study Area was conducted in two phases; the first phase covered the Greenfinch area from the 7 to 11 October 2013 and the second phase covered the Della Bosca area on 25 June 2014 (**Figure 2**). The weather was appropriate for both phases of the Level 1 survey, although it should be noted that wet conditions experienced from 8 to 10 October 2013 may not have been optimal for documenting reptiles or bats (**During the** second phase survey in June, maximum and minimum temperatures at Merredin BOM station (number: 010092) were 18.4°C and 0.5°C, respectively (BOM 2014). No rainfall was experienced within the Study Area during the survey period, however a total of 13.4 mm of rainfall was received at the Westonia Meteorology Station in the five days prior to the survey (BOM 2014). Low temperatures experienced during the survey period may not have been optimal for the documenting of reptiles and bats.

Table 4). During the first phase in October, maximum and minimum temperatures at Merredin BOM station (number: 010092) during the period were 29.9°C and 5.4°C, respectively. Mean maximum and minimum temperatures were 24.0°C and 6.8°C and total rainfall at Westonia Meteorological Station (less than 1 km south of the Study Area) during the survey was 6.0 mm (**Table 4**). Total rainfall at Westonia Meteorological Station, in the six months prior to the first phase was 178.7 mm, which is below the long-term average total of 227.35 mm for this period (**Figure 7**). However, in the three months leading up to the survey period, slightly above average rainfall was experienced when compared to the long-term averages (**Figure 7**).

During the second phase survey in June, maximum and minimum temperatures at Merredin BOM station (number: 010092) were 18.4°C and 0.5°C, respectively (BOM 2014). No rainfall was experienced within the Study Area during the survey period, however a total of 13.4 mm of rainfall was received at the Westonia Meteorology Station in the five days prior to the survey (BOM 2014). Low temperatures experienced during the survey period may not have been optimal for the documenting of reptiles and bats.

Table 4: Daily weather observations at Merredin, for the October and June survey phases

Date	Temperature (°C)		Relative humidity (%)	
	Min	Max	9.00 am	3.00 pm
7/10/2013	5.4	29.9	54	13
8/10/2013	6.8	28.0	70	28
9/10/2013	11.0	16.1	88	60
10/10/2013	5.6	22.2	61	39
11/10/2013	5.5	24.0	69	36
25/06/2014	0.5	18.4	95	42

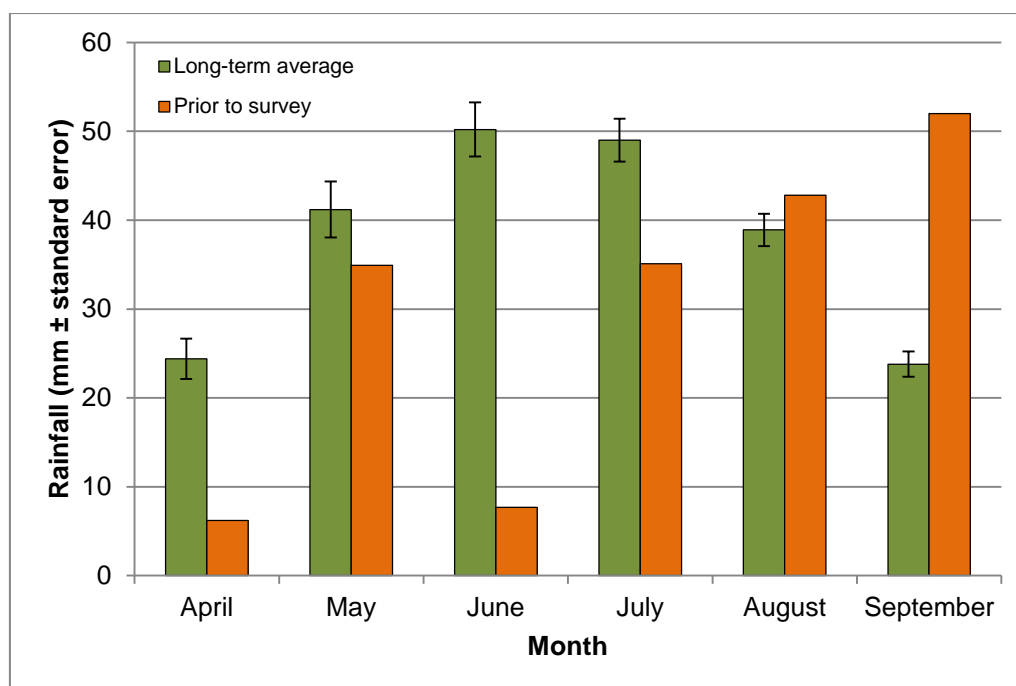


Figure 7: Long-term rainfall prior to the survey, at Westonia Weather Station

Source data: (BOM 2014) 1915 – 2014

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 assessment (**Figure 8, Figure 9, Appendix C**). The purpose of the habitat assessments was to characterise the quality and complexity of habitat for terrestrial fauna (including SRE species), with a focus on species of conservation significance. The following parameters were considered:

- vegetation cover, condition and species composition;
- estimate of leaf litter cover percentage and type;
- presence or absence of logs or other habitat structures;
- presence or absence of water; and
- type and level 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 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. Targeted Searching

Based on habitat characteristics and to provide spatial coverage of the Study Area, habitats with the potential to support fauna species of conservation significance (those listed under the *EPBC Act*, the *WC Act* or DEC's Priority Fauna List) were identified during the desktop study and during field reconnaissance of the Study Area (**Figure 9, Figure 10**). Each search was performed by one

zoologist, and the total systematic search effort for this Study was 16 person-hours. Each targeted search involved:

- observation and documentation of all vertebrate fauna seen or heard, or whose presence was inferred from tracks, scats or burrows;
- active hand-searching for cryptic species by overturning logs and stones, and searching beneath leaf litter and the bark of dead trees; and
- active visual and hand-searching for invertebrate species of conservation significance, Shield-backed Trapdoor Spider (*Idiosoma nigrum*) and the Tree-stem Trapdoor Spider (*Aganippe castellum*), by searching for evidence of distinctive trapdoor spider burrow entrances, raking and searching beneath leaf litter.

4.4. Opportunistic Searching

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

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

4.5. Motion Sensor Cameras

Based on habitat characteristics and to ensure spatial coverage of the Study Area, five locations were chosen to deploy motion-sensor cameras (**Figure 11, Table 5**). The cameras (Reconyx Hyperfire HC600) were baited with a mixture of peanut butter, rolled oats, honey and sardines in oil. Bait was checked on the second day following deployment and replenished where it had been taken. The cameras were intended to record the activities of diurnal and nocturnally active species including macropods, small mammals such as dasyurids and rodents, reptiles and bird species. The total effort for camera trapping was 18 trap-nights.

4.6. Bat Echolocation Recording

An SM2BAT+ (SM2) recorder, manufactured by Wildlife Acoustics USA was deployed at four locations within the Study Area for a single night (**Figure 11, Table 5**). The SM2 was deployed in locations with habitats features likely to support bat fauna (i.e. in close proximity to a historical mine shaft). Subsequent to the field survey all recordings were analysed by Bat Call WA, providing a species list for each deployment location. The total effort for bat echolocation recording was four SM2 nights.

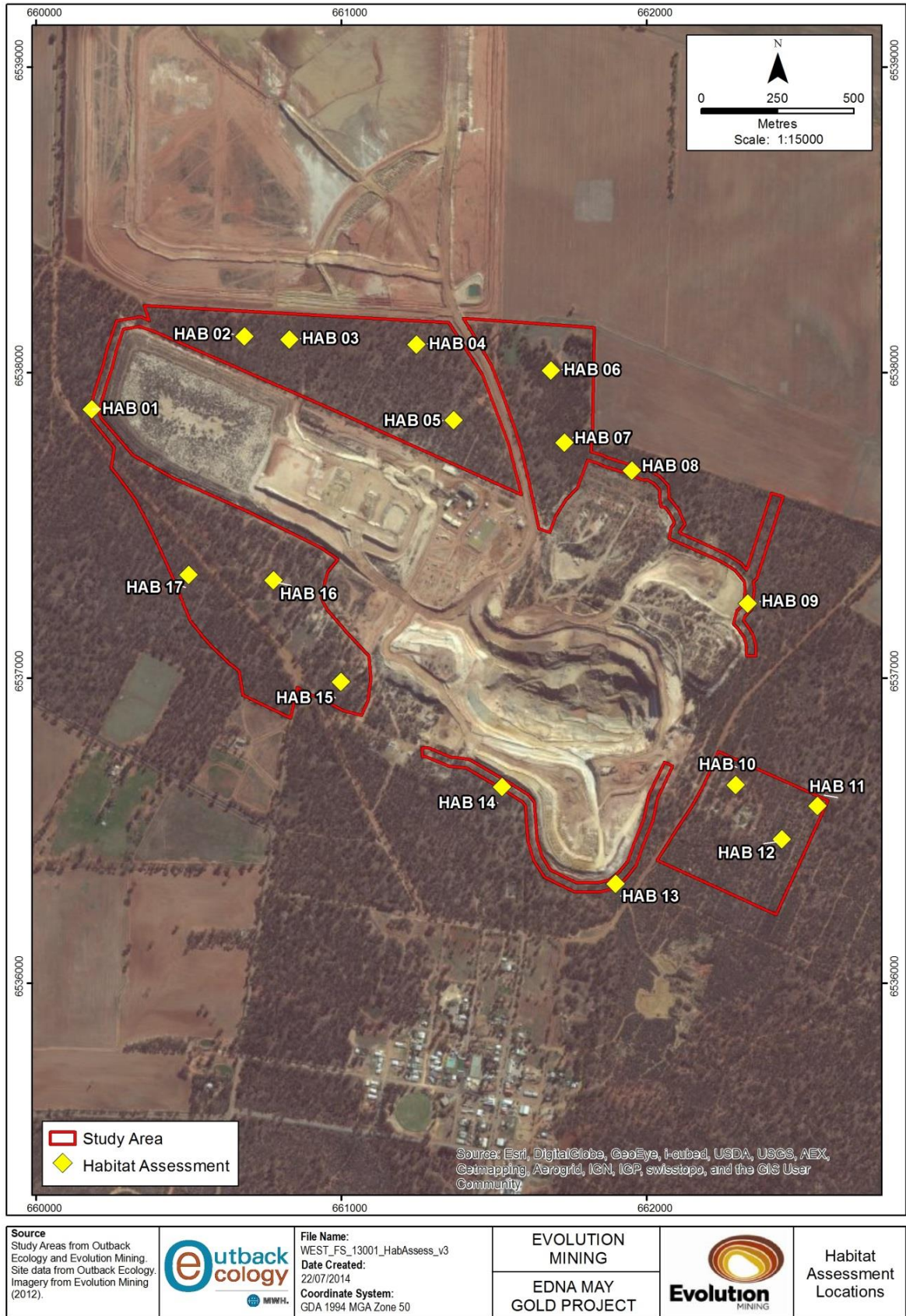


Figure 8: The location of habitat assessments within the component of the Study Area surrounding Greenfinch

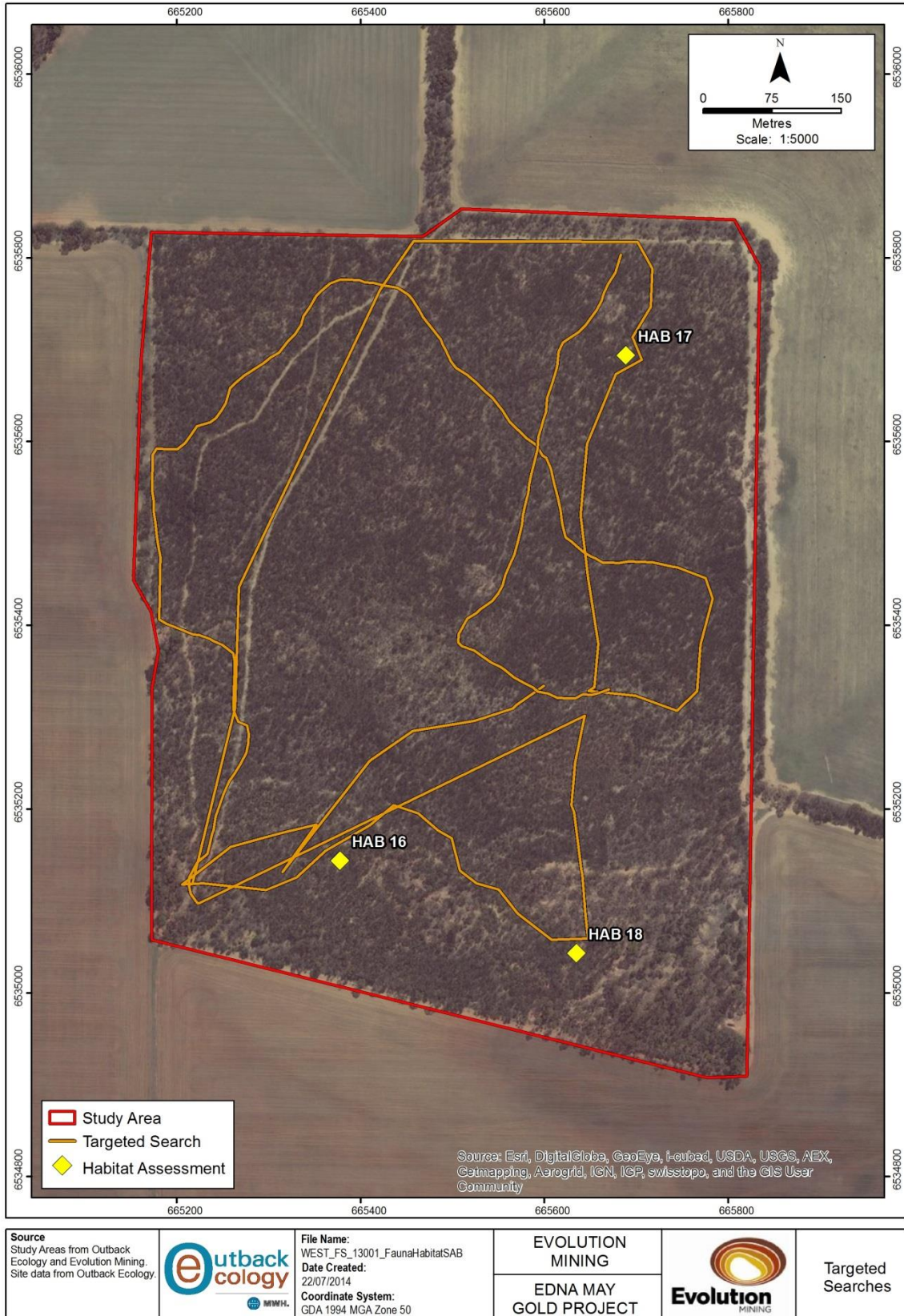


Figure 9: The location of targeted search and habitat assessments in the Della Bosca Study Area

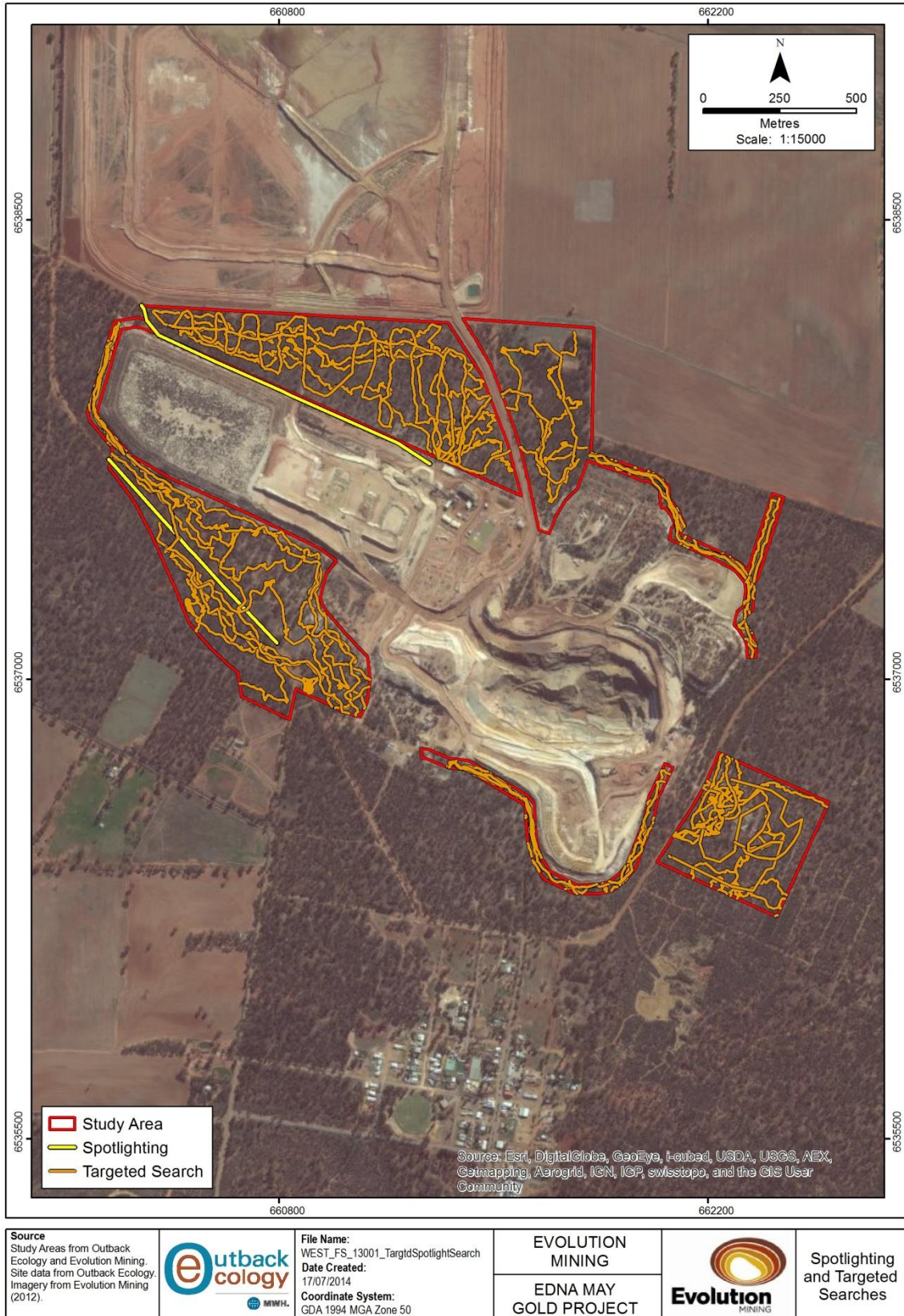


Figure 10: The location of targeted searches and spotlighting within the component of the Study Area surrounding Greenfinch

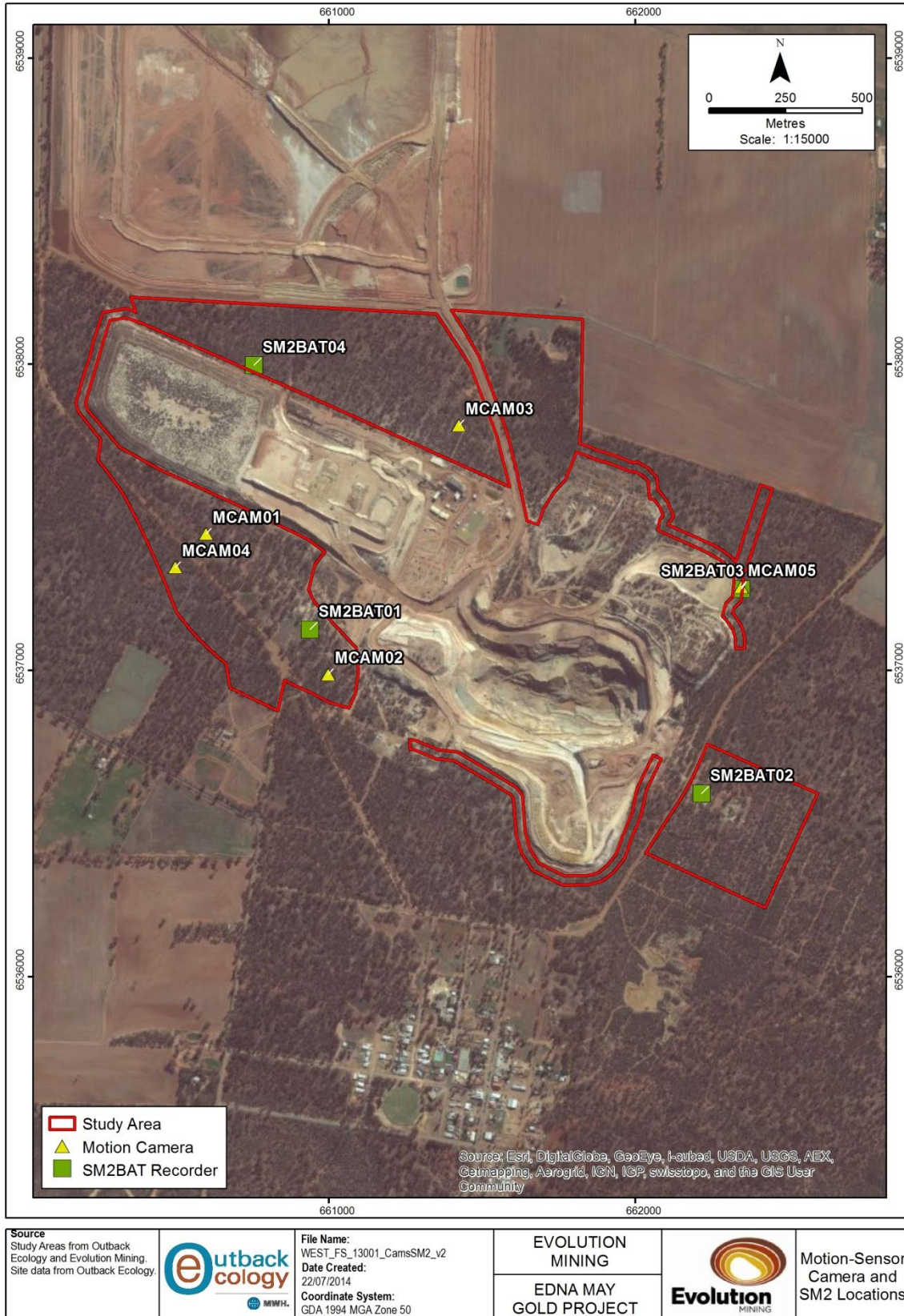


Figure 11: The location of motion sensor camera and SM2 deployments within the component of the Study Area surrounding Greenfinch

Table 5: Motion Sensor Camera, SM2 Bat Detectors Sites in the Study Area

Site Name	Type	Deployment Duration (Days)	Habitat	Co-ordinates (50J UTM)	
				East	North
MCAM01	Motion Camera	4	<i>E. longicornis</i> Woodland	660600	6537446
MCAM02	Motion Camera	4	<i>E. longicornis</i> Woodland	660999	6536987
MCAM03	Motion Camera	4	<i>E. longicornis</i> Woodland	661425	6537800
MCAM04	Motion Camera	4	<i>E. longicornis</i> Woodland	660500	6537337
MCAM05	Motion Camera	2	<i>E. salubris</i> Woodland	662347	6537272
SM2BAT01	SM2BAT Recorder	1	Disturbance	660939	6537134
SM2BAT02	SM2BAT Recorder	1	<i>E. salubris</i> Woodland	662217	6536599
SM2BAT03	SM2BAT Recorder	1	<i>E. salubris</i> Woodland	662347	6537266
SM2BAT04	SM2BAT Recorder	1	<i>E. longicornis</i> Woodland	660756	6537997

4.7. 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 (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, Morcombe 2003, Pizzey and Knight 2007);
- reptiles (Cogger 2000, Wilson and Swan 2008, Wilson and Swan 2010); and
- amphibians (Cogger 2000, Tyler and Doughty 2009).

4.8. 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 Licences to Take Fauna for Scientific Purposes (DEC Regulation 17 Licence) number SF009477 and SF009885.

Table 6: Study Team for the Field Surveys

Study Area	Reg. 17 License Number	Person	Discipline	Qualifications	Position
Greenfinch	SF009477	Rory Swiderski	Zoologist	BSc (Biol and Env Sci) MSc (Env Ass and	Environmental Scientist
Della Bosca	SF009885	Blair Parsons	Zoologist	BSc (Biol/Env Sci) (Hons) PhD (Zool)	Senior Principal Environmental Scientist
		Matt Quinn	Invertebrate Zoologist	BSc (Env. And Marine Sci.)	Environmental Scientist

5. RESULTS AND DISCUSSION

5.1. Fauna Habitats in the subregion and Study Area

Approximately 797,222 ha (12 %) of the subregion comprises remnant native vegetation. Due to extensive clearing within the subregion, the remnant native vegetation forms habitat isolates (refugia) with little to no connecting vegetation corridors. These isolates are therefore extremely important for the conservation of fauna within the subregion.

How and Dell (2000) showed a positive correlation between the size of native remnant vegetation and vertebrate species diversity, emphasising the importance of remnant native vegetation to vertebrate diversity in the subregion. The Study Area lies within a 2,418 ha remnant of native vegetation, which is the 30th largest remnant of native vegetation within the subregion (i.e. 99.87% of the remnants of native vegetation in the subregion are smaller than the remnant vegetation within the Study Area) (Beard 1975). All habitat types in the Study Area are considered to be significant to vertebrate fauna.

Four broad fauna habitat types were identified within the Study Area and two mine shafts were located, which may provide habitat for bats (**Table 7, Figure 12**). Mixed Woodland dominated by Red Morrel (*Eucalyptus longicornis*) was the dominant habitat type comprising 36% of the Study Area. There was no evidence of recent fire activity in the Study Area.

Table 7: Broad Fauna Habitats within the Study Area

Broad habitat type	Size within Study Area (ha)	Proportion of Study Area (%)
Shrubland dominated by <i>Acacia</i> spp. and <i>Melaleuca</i> spp.	58	35
Mixed Woodland dominated by Gimlet (<i>Eucalyptus salubris</i>)	29	17
Mixed Woodland dominated by Red Morrel (<i>Eucalyptus longicornis</i>)	59	36
Mixed <i>Eucalyptus</i> Mallee Woodland	8	5
Total¹	154	93

¹The Study Area includes 12 ha of disturbance (7% of the Study Area), which was not classified as a habitat type; consequently, sizes do not sum to the total area of the Study Area and the proportions do not sum to 100%.

5.1.1. Shrubland dominated by *Acacia* spp. and *Melaleuca* spp.

Approximately 58 ha (35%) of the Study Area consists of a mixed shrubland habitat type (**Table 7, Figure 12 Figure 13**). This habitat generally consists of a mixed *Acacia* shrubland over a grassland a very open low shrubland dominated by *Atriplex* species (**Plate 1**). Fauna of conservation significance known to occupy habitats such as this include the Malleefowl (*Leipoa ocellata*), Western Spiny-tailed Skink (*Egernia stokesii badia*), Bush Stone-curlew (*Burhinus grallarius*), Australian Bustard (*Ardeotis australis*) and Shield-backed Trapdoor Spider (*Idiosoma nigrum*).



Plate 1: Mixed Shrubland Habitat Type

5.1.2. Mixed Woodland dominated by Gimlet (*Eucalyptus salubris*)

Approximately 29 ha (17%) of the Study Area consists of an *Eucalyptus salubris* Woodland habitat type (**Table 7, Figure 12**). This habitat generally consists of a gimlet (*E. salubris*) woodland over a sparse shrubland dominated by *Acacia* spp. over very open low shrubland dominated by *Atriplex* species (**Plate 2**). Fauna of conservation significance known to occupy habitats such as this include the Short-billed Black Cockatoo (*Calyptorhynchus latirostris*), Western Spiny-tailed Skink (*Egernia stokesii badia*), Chuditch (*Dasyurus geoffroii*) and Carpet Python (*Morelia spilota*).



Plate 2: *Eucalyptus salubris* Woodland Habitat Type

5.1.3. Mixed Woodland dominated by *Eucalyptus longicornis*

Approximately 59 ha (36%) of the Study Area consists of a *Eucalyptus longicornis* Woodland habitat type (**Table 7, Figure 12**). This habitat generally consists of *E. longicornis* woodland over a sparse shrubland dominated by *Acacia* spp. over very open low shrubland dominated by *Atriplex* species (**Plate 3**). This habitat type is likely to support the Short-billed Black Cockatoo (*Calyptorhynchus latirostris*), Western Spiny-tailed Skink (*Egernia stokesii badia*), Chuditch (*Dasyurus geoffroi*) and Carpet Python (*Morelia spilota*).



Plate 3: *Eucalyptus longicornis* Woodland Habitat Type

5.1.4. Mixed *Eucalyptus* Mallee Woodland

Approximately 8 ha (5%) of the Study Area consists of a Mixed *Eucalyptus* Mallee Woodland habitat type (**Table 7, Figure 13**). This habitat generally consists of a mixed *Eucalyptus* Mallee Woodland over a sparse shrubland dominated by *Acacia* spp. over an open grassland dominated by *Eragrostis* species (**Plate 4**). This habitat type may support fauna of conservation significance such as the Western Spiny-tailed Skink (*Egernia stokesii badia*), Bush Stone-curlew (*Burhinus grallarius*), Australian Bustard (*Ardeotis australis*) Carpet Python (*Morelia spilota*).



Plate 4: Mixed *Eucalyptus* Mallee Woodland Habitat Type

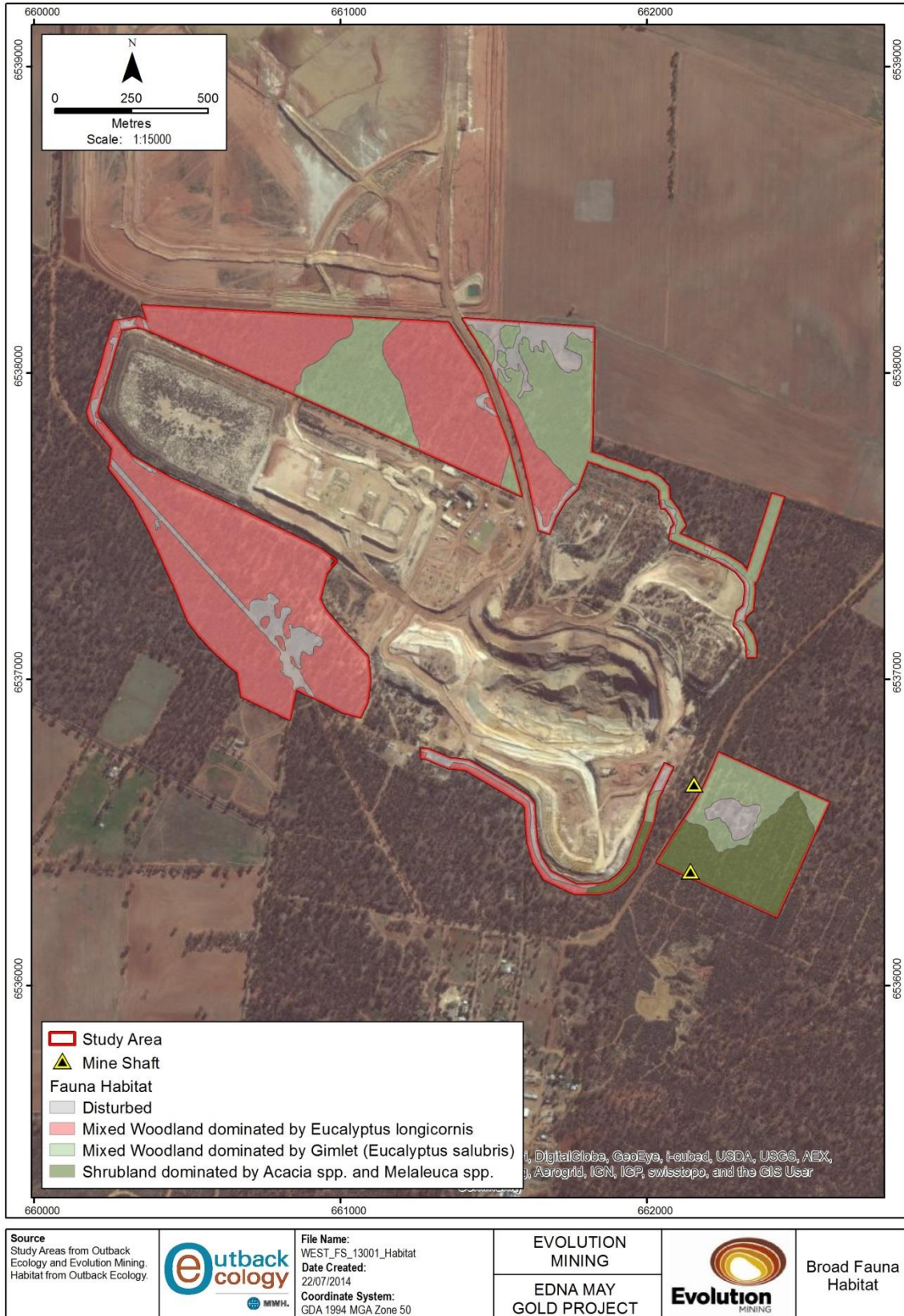


Figure 12: Broad fauna habitats within the component of the Study Area surrounding Greenfinch



Figure 13: Broad fauna habitats within the Della Bosca component of the Study Area

5.2. Fauna Recorded

A total of 37 species (34 native species) were recorded in this assessment comprising, 23 native birds, 8 native mammals, 3 reptiles and 3 introduced species (**Appendix A**). None of these species are of conservation significance and all were identified by the database searches as potentially occurring in the Study Area.

5.3. Fauna of Conservation Significance

The desktop study identified 28 species of conservation significance that potentially occur in the Study Area (see **Section 4**). Of these:

- 17 species are listed as Threatened under the EPBC Act and/or WC Act (**Section 5.3.1**);
- three species are recognized by DEC as Priority fauna (**Section 5.3.2**); and
- ten species (including two species also listed as Threatened under the EPBC Act and/or WC Act) are listed as Migratory under the EPBC Act, 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**).

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 (i.e. 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.

For each species of conservation significance identified by the literature review and database searches as potentially occurring within the Study Area, the reason why a particular rank was assigned is explained. Additional species information is also provided for those species that could Possibly occur or are Likely, Very Likely or Confirmed as occurring within the Study Area. Of the 28 terrestrial vertebrate species of conservation significance that potentially occur within the Study Area, 16 species were considered Unlikely to occur in the Study Area due to a lack of suitable habitat or the Study Area occurring outside of the species known distribution (**Appendix A**). These comprised the;

- Fork-tailed Swift (*Fork-tailed Swift*);
- Eastern Great Egret (*Ardea modesta*);
- Cattle Egret (*Ardea ibis*);
- Major Mitchell's Cockatoo (*Lophochroa leadbeateri*);
- Peregrine Falcon (*Falco peregrinus*);
- Common Sandpiper (*Actitis hypoleucos*);
- Sharp-tailed Sandpiper (*Calidris acuminata*);
- Curlew Sandpiper (*Calidris ferruginea*);
- Red-necked Stint (*Calidris ruficollis*);
- Common Greenshank (*Tringa nebularia*);
- Numbat (*Myrmecobius fasciatus*);
- Black-flanked rock-wallaby (*Petrogale lateralis lateralis*);
- Greater Bilby (*Macrotis lagotis*);
- Greater Stick-nest Rat (*Leporillus conditor*);
- Abrolhos Dwarf Bearded Dragon (*Pogona minor minima*); and
- Woma (*Aspidites ramsayi*).

The remaining 12 fauna species of conservation significance were considered Possible, Likely or Very Likely to occur within the Study Area and are discussed in **Section 5.3.1** to **Section 5.3.3**. These comprised ten native vertebrate fauna species and two invertebrate species of conservation significance. None of the above species were Confirmed during this field survey component of this Assessment.

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 B**. The desktop study identified 7 Threatened species that could potentially occur in the Study Area, none of which were recorded during the field survey (**Table 8**).

Table 8: Threatened fauna potentially occurring in the Study Area

Common name (species name)	Conservation status		Number of		Likelihood of occurrence
	EPBC Act ¹	In WA ²	Literature review	Databases	
Carnaby's Black Cockatoo (<i>Calyptorhynchus latirostris</i>)	EN	S1		1	Likely
Reason for likelihood rank: The Study Area lies within the species distribution of the species and the species has been sighted flying over the Study Area in the past, however breeding is unlikely to occur in the Study Area and surrounds (DSEWPC 2010). This is because the survey did not identify any trees with large hollows that would be considered suitable for breeding within the Study Area. If the species occurs within the Study Area, it is likely to use the Study Area intermittently foraging purposes only. Suitable foraging habitat (Eucalyptus Woodland; 81% of the Study Area) occurs within the Study Area. Extensive targeted searching for the species was conducted within the Study Area, however no evidence of the species was recorded (Outback Ecology 2014).					
Malleefowl (<i>Leipoa ocellata</i>)	VU	S1		4	Possible
Reason for likelihood rank: The Study Area lies within the species distribution of the Malleefowl (DSEWPaC: Department of Sustainability 2013b). Numerous records of this species have been located within a 15km radius of the Study Area, however the majority of these records are over 10 years old (Parsons 2008, Parsons <i>et al.</i> 2009). Mixed Acacia and Melaleuca shrubland in the Study Area may present suitable habitat for foraging and dispersal, however the habitat type was largely degraded and open and considered unsuitable for mound building. Two inactive mounds were recorded within the Shrubland dominated by <i>Acacia</i> spp. and <i>Melaleuca</i> spp. habitat type that occurred within the Della Bosca Study Area, however it is unlikely that the species still occurs in this habitat type due to its degraded nature.					
Chuditch (<i>Dasyurus geoffroi</i>)	VU	S1		1	Possible
Reason for likelihood rank: The Study Area lies within the species distribution of the Chuditch (DSEWPaC: Department of Sustainability 2013b). The Chuditch has previously been recorded within 40 km of the Project, however, no information was available as to when this species was recorded (DEC: Department of Environment and Conservation 2013a). There is potential that this is a historical record and the species no longer inhabits the area surrounding the Study Area. Although suitable habitat (Eucalyptus Woodland; 81% of the Study Area) occurs within the Study Area, the wheat belt population of this species is highly fragmented and has a patchy distribution within the region.					
Red-tailed Phascogale (<i>Phascogale calura</i>)	EN	S1		2	Possible
Reason for likelihood rank: The Study Area is located on the north-eastern boundary of the species distribution ((DSEWPaC: Department of Sustainability 2013b). Generally this species is associated with <i>Allocasuarina</i> woodlands with hollow-containing eucalypts (<i>Eucalyptus wandoo</i>) and <i>Gastrolobium</i> spp. (Kitchener 1981, Maxwell <i>et al.</i> 1996), which do not occur within the Study Area.					
Western Spiny-tailed Skink (<i>Egernia stokesii badia</i>)	EN	S1		1	Very Likely
Reason for likelihood rank: The Study Area lies within the species distribution of the Western Spiny-tailed Skink (DSEWPaC: Department of Sustainability 2013b). Populations persist in woodland patches as small as one hectare and completely surrounded by wheatfields. Suitable habitat for the species occurs throughout the Study Area. Greater numbers of individuals are likely to be found where numerous fallen logs are found, such as sites HAB03, HAB10 and HAB13 (Figure 8, Appendix C).					
Shield-backed Trapdoor Spider (<i>Idiosoma nigrum</i>)	VU	S1		1	Possible
Reason for likelihood rank: The Study Area lies within the western edge of the species distribution (DSEWPaC: Department of Sustainability 2013b). Suitable habitat (Mixed Shrubland; 10% of the Study Area) occurs within the Study Area, however leaf litter accumulation within this habitat type appears to be disturbed by sheet flow water run-off from the surrounding Waste Rock Landform. Without permanent leaf litter accumulations, the species is unlikely to establish burrows within the Study Area. It is possible that the species occurs in areas where leaf litter accumulations are undisturbed, however extensive targeted searches in these areas failed to identify the species within the Study Area. Extensive targeted searching for the species was conducted within the Study Area, however no evidence of the species was recorded (Outback Ecology 2014).					

Common name (species name)	Conservation status		Number of		Likelihood of occurrence
	EPBC Act ¹	In WA ²	Literature review	Databases	
Carpet Python (<i>Morelia spilota imbricata</i>)		S4		1	Likely
Reason for likelihood rank: The Study Area is located on the northern boundary of the species distribution (Wilson and Swan 2008). The close record of this species was occurs near Merredin, approximately 40 km south-west of the Study Area (DEC: Department of Environment and Conservation 2013b). Suitable habitat (Eucalyptus Woodland; 81% of the Study Area) occurs within the Study Area. The species may also utilise the Mixed Shrubland habitat type (10% of the Study Area) within the Study Area for foraging purposes.					

¹Status under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* – EN: Endangered, VU: Vulnerable; ² Status under the Western Australian *Wildlife Conservation Act 1950* – S1: Schedule 1, S4: Schedule 4. See **Appendix B** for full definitions of conservation status

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 B**. The desktop study identified four species of Priority Fauna that potentially occur within the Study Area, none of which were recorded during the survey (**Table 9**).

Table 9: Priority fauna potentially occurring in the Study Area

Common name (species name)	Conservation status		Number of		Likelihood of occurrence
	EPBC Act	In WA ¹	Literature review	Databases	
Bush Stone-curlew (<i>Burhinus grallarius</i>)		P4		1	Likely
Reason for likelihood rank: The Study Area lies within the known distribution of the species and contains suitable habitat of open woodland and dry water courses (Pizzey and Knight 2007). The close record of this species was occurs near Elabbin, approximately 50 km west of the Study Area (DEC: Department of Environment and Conservation 2013b). Suitably habitat for this species occurs throughout the Study Area.					
Brush Bronzewing (<i>Phaps elegans</i>)		P4		1	Likely
Reason for likelihood rank: The Study Area lies within the known distribution of the species and contains suitable habitat of dry woodlands and shrublands (Pizzey and Knight 2007). The close record of this species was occurs near Chiddarcooping Rock, approximately 45 km north of the Study Area (Birdlife Australia 2013). Suitably habitat for this species occurs throughout the Study Area					
Australian Bustard (<i>Ardeotis australis</i>)		P4		3	Possible
Reason for likelihood rank: The Study Area lies within the known distribution of the species, however does not contain suitable habitat of tussock grassland and arid scrub (Pizzey and Knight 2007). This species has been recorded at Bodallin and Meriden. Approximately 17 km south-east and 50 km south-west of the Study Area respectively (Birdlife Australia 2013, DEC: Department of Environment and Conservation 2013b).					
Tree-stem Trapdoor Spider (<i>Aganippe castellum</i>)		P4		1	Possible
The Study Area lies within the species distribution of the Tree-stem Trapdoor Spider (DSEWPaC: Department of Sustainability 2013b). This species is likely to occur throughout the Study Area in habitats which support trees and shrubs with sturdy trunk, and are subject to seasonal inundation by water, such as sites HAB06, HAB09, HAB11 and HAB13 (Figure 8, Appendix C). However, it should be noted that the majority of the Study Area possessed hard, clay soils and that this species prefers sand or loamy type substrates.					

¹Status under the DEC Priority Fauna List – P1, Priority 1 Fauna; P2, Priority 2 Fauna; P3, Priority 3 Fauna; P4, Priority 4 Fauna; P5, Priority 5 Fauna. See **Appendix B** for full definitions of conservation status

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 desktop study identified ten listed Migratory species that have the potential to occur in the Study Area and its surrounds, none of which was recorded during the field survey (**Table 10**).

Table 10: Migratory bird species potentially occurring in the Study Area

Common name (species name)	Conservation status		Number of		Likelihood of occurrence
	EPBC Act ¹	In WA ²	Literature review	Databases	
Rainbow Bee-eater (<i>Merops ornatus</i>)	M	S3	1	4	Very Likely
Reason for likelihood rank: The Study Area lies within the known distribution of the Rainbow Bee-eater and contains suitable habitat of lightly wooded sandy country (Johnstone and Storr 1998, Pizzey and Knight 2007). Suitable habitat for the species occurs throughout the Study Area. The Rainbow Bee-eater was recorded in one survey conducted within 1 km of the Study Area (Section 3, Appendix A) and another individual was sited approximately 300 m outside of the Study Area during this assessment. The species has also been recorded at numerous locations within 40 km of the Study Area (DEC: Department of Environment and Conservation 2013a). The Rainbow Bee-eater is likely to utilise the Study Area for foraging purposes only.					

¹Status under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* – EN: Endangered, VU: Vulnerable, M: Migratory; ²Status under the Western Australian *Wildlife Conservation Act 1950* – S3: Schedule 3 (Migratory birds). See **Appendix B** for full definitions of conservation status.

5.3.4. SRE Invertebrate Fauna

The EPA's guidance statement 20 (2009) states that SRE invertebrate taxa have emerged in recent years as a potentially significant biodiversity issue for environmental impact assessment in WA. Although not specifically listed under either federal (EPBC act) or state (WA Act) legislation, the EPA will aim to ensure that proposal do not potentially threaten the viability of, or lead to the extinction of SRE species. This is consistent with the purpose of the Wildlife Conservation Act 1950, which aims 'to provide for the conservation and protection of wildlife' and also with principles 1 to 3 within Section 4A of the Environmental Protection Act 1986 ('Object and principles') relating to the conservation of biodiversity and ecological integrity, intergenerational equity and the precautionary principle.

The desktop study identified five SRE invertebrate species, *Aname* 'MYG268', *Antichiropus* 'danberrin 3', *Bothriembryon sedgwicki*, *Synsphyronus elegans* and *Atelomastix bamfordi*, that have been identified within a 100 km radius of the Study Area (**Figure 14**). Due to the limited information available regarding the habitat preferences of the above species it is not possible to make an assessment of the likelihood of occurrence of the above species in the Study Area.

It should be noted that the subregion consists largely of lands cleared for pastoral activity and therefore areas of remnant native vegetation will provide habitat isolates for any terrestrial SRE invertebrate fauna which reside within them. Due to their poor powers of dispersal, populations of terrestrial SRE invertebrates in the subregion are likely to be fragmented and genetic exchange

between populations is unlikely. The Study Area contains numerous areas with a large amount of leaf litter accumulation, such as sites HAB01, HAB 04, HAB 06, HAB07, HAB08, HAB10, HAB13, HAB15, HAB 16 and HAB17, which is a micro-habitat known to support SRE invertebrates species (**Figure 8, Appendix C**).

5.4. 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 October 2013 and June 2014 surveys of the Study Area (**Table 11**). 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 11: Discussion of the potential limitations and constraints of this Assessment

Factor	Constraint	Comments
Competency and experience of consultants	No	The surveyors were fauna specialists employed by Outback Ecology, with appropriate qualifications and/or 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. Although the database searches and some studies in the wider region recorded substantially more species, these were performed over larger areas with a wider range of habitat types (including cleared farmland) and sampling techniques/duration.
Information sources (eg historic or recent)	No	The Study Area is located in a relatively well-surveyed region, and the results of past surveys were included as part of the Assessment.
Proportion of task achieved, and further work which might be needed	No	Planned survey works were conducted according to scope. Additional areas were surveyed as instructed by site personnel.
Timing / weather / season / cycle	Partial	This report details the results of a spring survey. The weather was appropriate for a Level 1 survey, although it should be noted that wet conditions experienced from 8 to 10 October may not have been optimal for documenting reptiles or bats (Table 4).
Disturbances	Yes	Historical disturbances were present within the Study Area (e.g. old mine shafts and workings, agriculture, exploration lines) likely to have affected the results of this study.
Intensity	No	The Study Area was sampled for a total of 22 trap nights (motion-sensor cameras and SM2BAT recorders), with a total of 16 person hours spent targeted 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 the Study Area was good and adequate survey coverage was achieved
Availability of contextual information	No	The data available for the Avon Wheatbelt bioregion was adequate for the level of survey work undertaken during this Assessment.

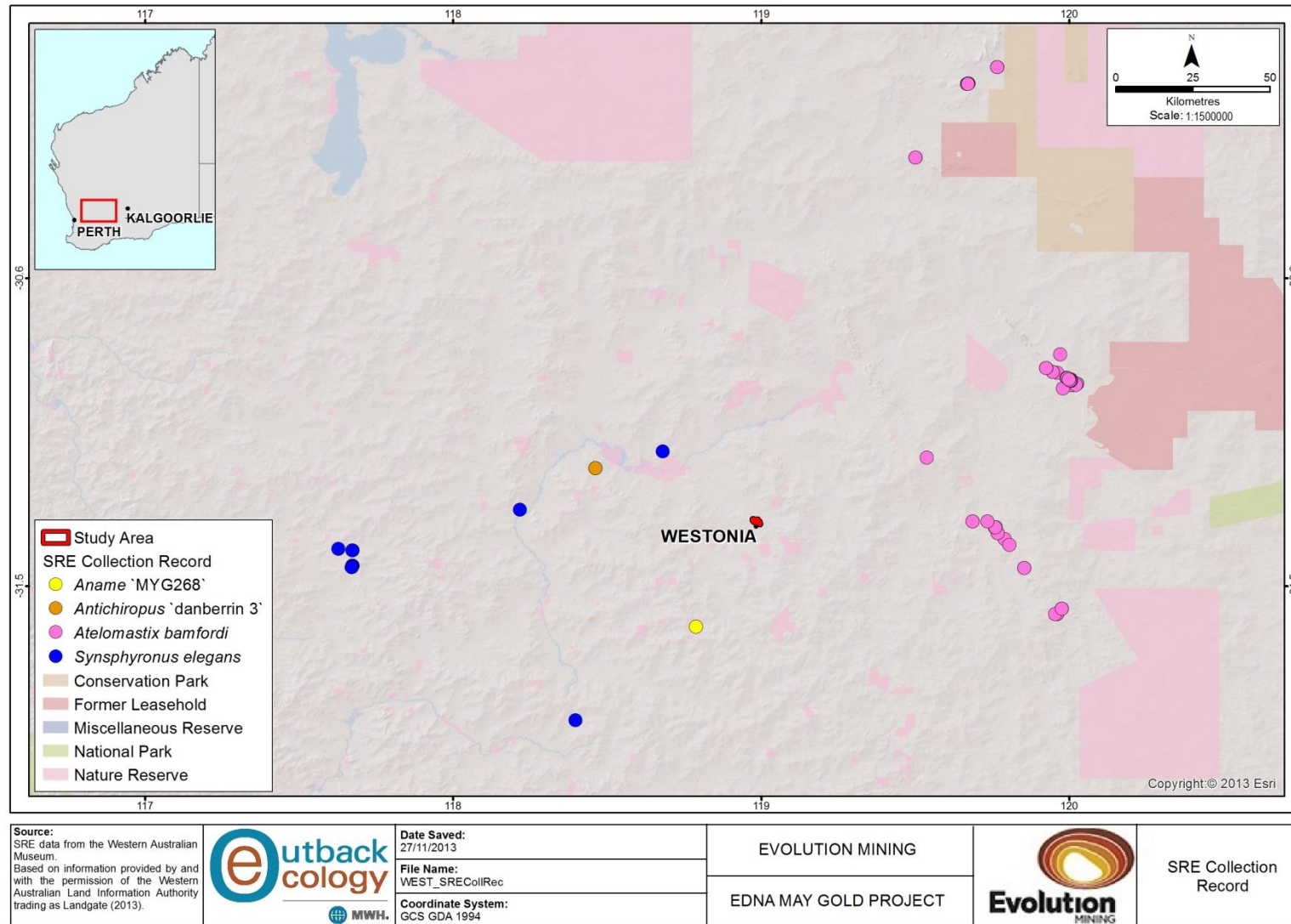


Figure 14: Terrestrial SRE Invertebrate Collection Records in relation to the Study Area

6. THREATENING PROCESSES

Threatening processes relevant to the Avon Wheatbelt bioregion, in which the Project lies, have been identified by the Australian Natural Resources Audit (ANRA) and include feral predators, inappropriate fire regimes, grazing by introduced herbivores, and invasive weeds. Aspects of the Project that constitute threatening processes with potential to impact upon fauna or fauna habitats include the following:

- habitat removal and modification;
- collision with vehicles;
- inappropriate fire regimes;
- noise and vibration;
- artificial light exposure;
- dust emissions;
- introduced flora; and
- introduced fauna.

6.1.1. Habitat Removal and Modification

Clearing vegetation is a necessary aspect of the Project, with the greatest potential to impact upon fauna habitats and fauna assemblages present in the Study Area. Land clearance will result in a reduction in the size of habitats and may reduce the quality of those habitats due to increased edge effects and habitat fragmentation (Davis *et al.* in press, Watson *et al.* 2003). Remnant native vegetation located within the Study Area is important in a regional sense as clearing within the bioregion has been extensive and remnant vegetation is likely to provide refuge for native fauna, including fauna of conservation significance.

Land clearance is likely to result in the direct loss of individual animals. Although more mobile fauna may be able to avoid immediate impact from development of the Project and ongoing operations, the degree of subsequent impact is dependent on the availability of suitable habitat elsewhere in the vicinity and the ability of individual species to disperse to these habitats. Nesting birds and their young may also be directly affected by clearing, although this potential impact can be reduced by considering the timing of clearance activities.

6.1.2. Collision With Vehicles

Vehicle collisions may have an impact on some fauna depending on the amount of traffic present within the Study Area. Collisions typically only involve individual animals and are considerably more likely to occur at night (Rowden *et al.* 2008). Ground-dwelling species that have been recorded from these habitats in the Study Area include the Malleefowl, Chuditch, Bush Stone-curlew and Australian Bustard. Individuals of these species may be at risk when in the vicinity of roads.

6.1.3. Inappropriate Fire Regimes

The development may alter the fire regime of the Study Area through the introduction of unplanned fire resulting from vehicle movements and/or other mining activities. Fire may impact fauna via direct contact, or indirectly by long-term habitat modification brought about by inappropriate fire frequency

and intensity. Species most at risk of direct contact impacts by fire include, but are not limited to, small, sedentary species such as the Western Spiny-tailed Skink, Tree-steam Trapdoor Spider and Shield-backed Trapdoor Spider. The impact of inappropriate fire regimes may be reduced through the implementation of an appropriate fire management plan.

6.1.4. Noise and Vibration

The development and ongoing operation of the Project is likely to generate noise and vibration due to blasting, general operation of heavy machinery and vehicles, diesel generators and the presence of personnel. The effects of noise on wildlife 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 animal species, range from interruptions in feeding and resting behaviour to complete abandonment of a habitat 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.

Vibration may have a negative effect of terrestrial invertebrate fauna that occurs within the Study Area. Raven (2008), suggests that vibrations created by blasting and heavy earthmoving equipment may actually attract spiders and other arachnids, which subsequently places these individuals at risk of direct contact with mining activities. Shallow burrowing mygalomorph spiders, such as the Shield-backed Trapdoor Spider, are most likely to be effected by artificial vibrations. Additionally, scorpions may be affected by vibration as they rely on vibrations for prey detection, navigation and courting (Volschenk 2011). Without further research, it is not possible to predict or quantify the noise and vibration impacts on terrestrial invertebrate species, including those of conservation significance with potential to occur in the Study Area such as the Tree-steam Trapdoor Spider and Shield-backed Trapdoor Spider

6.1.5. Artificial Light Exposure

Exposure of fauna to artificial light may interfere with biological and behavioural activities that are governed by the length of day or photoperiod, including reproduction, dormancy, foraging and migration (Bradshaw and Holzapfel 2007, Le Corre *et al.* 2002, Stone *et al.* 2009). Some examples include reduced foraging activity in nocturnal mice following exposure to artificial light (Bird *et al.* 2004), suspension of normal feeding and reproductive behaviour in nocturnal frogs exposed to artificial light (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). See Longcore and Rich (2004) for a broad review of some of the ecological consequences of light pollution. This artificial light may have detrimental effects on resident bird, mammal and reptile species, and it is likely to have an adverse effect on the natural foraging behaviour of bats. This aspect of the Project is likely to result in highly localised impacts to fauna, however, these impacts will range from negligible to nonexistent effects on fauna at a regional scale.

6.1.6. Dust Emissions

The development and operation of the Project will create dust emissions due to construction, blasting, haulage and general traffic activities. Dust emissions may affect surrounding vegetation. High levels of dust have been associated with a reduction in plant growth and productivity, resulting in degradation of the overall ecosystem and an increased risk of disease in plants (Farmer 1993). Dust has also been linked to changes in soil chemistry and the structure of vegetation communities (Farmer 1993). Changes in vegetation as a result of dust may reduce the suitability of some habitats for fauna within close proximity to the Project; however, effects on fauna and fauna habitat are expected to be negligible to non-existent on a regional scale.

6.1.7. Introduced Flora

Environmental weeds may be brought in by mobile equipment during construction and operation of the Project. Weed invasion is widely recognised as having a negative impact on fauna species, as it can fundamentally alter the composition and structure of native vegetation communities (Cowie and Werner 1993, Gordon 1998). In the extreme, entire ecosystems can be modified (Sodhi and Ehrlich 2010).

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*) can affect the composition of ground vegetation, birds and ant fauna, leading to declines in some species (Binks *et al.* 2005, Smyth *et al.* 2009). There is potential for substantial change to occur to vegetation communities in the Study Area, should invasive flora be introduced and become established. At present, minimal introduced flora occurs within the throughout the Study Area, with scattered weeds being recorded at most habitat assessment sites (**Appendix C**).

6.1.8. Introduced Fauna

Introduced fauna, both herbivorous and predatory, cause fundamental changes to ecosystems and are thought to have contributed to the decline and extinction of many species in Australia (Abbott 2002, Burbidge and McKenzie 1989, Dickman 1996, Ford *et al.* 2001, Short and Smith 1994). Of the 19 key threatening processes listed under the EPBC Act, 11 are concerned with introduced flora and fauna. Predation of native fauna by the Fox and the Feral Cat are key threatening processes of high prominence. Predation by Feral Cats predominantly affects mammals and birds, and has little or negligible impact on reptiles, amphibians and fishes (Dickman 1996). Introduced herbivores have been responsible for widespread degradation of much of semi-arid Australia due to overgrazing (Morton 1990, Newsome 1971).

Three species of introduced fauna were recorded in the area surveyed during the baseline survey: the Domestic Sheep (*Ovis aries*), Fox (*Vulpes vulpes*), Rabbit (*Oryctolagus cuniculus*). The desktop study also identified an additional two introduced mammal species that may occur within the Study Area, comprising the Cat (*Felis catus*) and House Mouse (*Mus musculus*). The Project may provide

additional resources or habitat which attract and support a greater abundance of these species in the Study Area. Introduced predators like the Feral Cat may also be attracted into the Study Area as a result of the scavenging opportunities generated by the presence of road kill along the haul road. This may in turn adversely affect populations of native fauna. Of particular concern would be an increase in the size of the local population of Feral Cat, which is not only a direct predator of the Malleefowl, Chuditch, Bush Stone-curlew and Australian Bustard and other ground-dwelling fauna, but also compete for food resources and habitat requirements with these and other species. This aspect of the Project is likely to result in localised impacts to fauna, although at a regional scale these impacts will range from negligible to non-existent, depending on the efficacy of measures implemented by the Project to limit the introduction or spread of introduced fauna.

7. CONCLUSIONS

A total of 37 species (34 native species) were recorded in this assessment comprising, 23 native birds, 8 native mammals, 3 reptiles and 3 introduced species. None of these species are of conservation significance and all were identified by the database searches as potentially occurring in the Study Area.

The desktop study identified 29 species of conservation significance that potentially occur in the Study Area. Of these, the Western Spiny-tailed Skink (*Egernia stokesii badia*) and the Rainbow Bee-eater (*Merops ornatus*) and snails of the Short-range Endemic genus *Bothriembryon* were considered Very Likely to occur within the Study Area. The Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*), Carpet Python (*Morelia spilota imbricata*), Bush Stone-curlew (*Burhinus grallarius*) and Brush Bronzewing (*Phaps elegans*) were considered Likely to occur and the Malleefowl (*Leipoa ocellata*), Shield-backed Trapdoor Spider (*Idiosoma nigrum*), Tree-stem Trapdoor Spider (*Aganippe castellum*), Chuditch (*Dasyurus geoffroi*), Red-tailed Phascogale (*Phascogale calura*) and Australian Bustard (*Ardeotis australis*) were considered to Possibly occur within the Study Area. The remaining 16 species were considered Unlikely to occur in the Study Area due to a lack of suitable habitat or the Study Area occurring outside of the species known distribution.

Although vertebrate fauna assemblages and vertebrate fauna habitats were adequately documented in terms of a Level 1 Fauna Assessment, further survey effort would almost certainly add to existing species lists for the Study Area. However, expansion of the species list for the Study Area would be unlikely to substantially alter conclusions regarding either the likelihood of occurrence of fauna of conservation significance, or the local and regional importance of vertebrate fauna habitats.

Four broad fauna habitat types were identified within the Study Area comprising, Mixed Shrubland, *Eucalyptus longicornis* Woodland, mixed Mallee Woodland and *Eucalyptus salubris* Woodland. As the Study Area encompasses a large area of remnant native vegetation, which is important in a sub-regional context, all habitat types are considered to be significant to vertebrate fauna. The Study Area lies within a 2,418 ha portion of remnant native vegetation, which is the 30th largest portion of remnant native vegetation within the subregion (i.e. 99.87% of remnant native vegetation that occurs in the subregion occurs in portions smaller than the portion of remnant native vegetation in which the Study Area is located). Approximately 797,222 ha (12 %) of the subregion comprises remnant native vegetation. These isolates are extremely important for the conservation of fauna within the subregion.

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Appendix A**Terrestrial Vertebrate Fauna Recorded Within and Surrounding the Study Area**

This Appendix contains a species list comprising all vertebrate fauna recorded during the field survey, literature review and database searches

Legend**Abbreviations and symbols**

- * Introduced species.
- X Recorded during a field survey, or as part of a database or regional information search.

EPBC Act – 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 Vertebrate Fauna of the Westonia Mine Lease
- B Avian Fauna of the Westonia Commons and Waste Rock Dumps

Database Searches

- C Threatened and Priority Fauna Database – DEC (2013b)
- D BirdData: Custom Atlas Bird List – BirdLife Australia (2013)
- E NatureMap Database – DEC (2013a)
- F Protected Matters Search Tool – DSEWPaC (2013a)

Species Name	Common Name	Conservation Status		This survey	Literature review		Database searches			
		EPBC	WC		A	B	C	D	E	F
Mammals										
BOVIDAE										
<i>Ovis aries</i>	Domestic Sheep*			X						
BURRAMYIDAE										
<i>Cercartetus concinnus</i>	Western Pygmy-possum								X	
CANIDAE										
<i>Vulpes vulpes</i>	Fox*			X					X	
DASYURIDAE										
<i>Dasyurus geoffroii</i>	Chuditch								X	
<i>Dasyurus geoffroii geoffroii</i>	Western Quoll						X			
<i>Phascogale calura</i>	Red-tailed Phascogale	EN	EN				X			X
<i>Phascogale tapoatafa</i>	Brush-tailed Phascogale						X			
<i>Sminthopsis crassicaudata</i>	Fat-tailed Dunnart								X	
<i>Sminthopsis dolichura</i>	Little Long-tailed Dunnart								X	
<i>Sminthopsis granulipes</i>	White-tailed Dunnart								X	
FELIDAE										
<i>Felis catus</i>	Cat*								X	
LEPORIDAE										
<i>Oryctolagus cuniculus</i>	Rabbit*			X	X				X	
MACROPODIDAE										
<i>Macropus fuliginosus</i>	Western Grey Kangaroo			X					X	
<i>Macropus robustus</i>	Common Wallaroo				X					
<i>Petrogale lateralis lateralis</i>	Black-flanked rock-wallaby	VU	VU				X			
MOLOSSIDAE										

Species Name	Common Name	Conservation Status		This survey	Literature review		Database searches			
		EPBC	WC		A	B	C	D	E	F
<i>Mormopterus "sp 4"</i>	South-western Free-tailed Bat			X						
<i>Tadarida australis australis</i>				X					X	
MURIDAE										
<i>Leporillus conditor</i>	Greater Stick-nest Rat	VU	VU				X		X	
<i>Mus musculus</i>	House Mouse*								X	
<i>Notomys mitchellii</i>	Mitchell's Hopping-mouse								X	
MYRMECOBIIDAE										
<i>Myrmecobius fasciatus</i>	Numbat	VU	VU				X		X	
POTOROIDAE										
<i>Bettongia penicillata</i>	Brush-tailed Bettong						X		X	
TACHYGLOSSIDAE										
<i>Tachyglossus aculeatus</i>	Short-beaked Echidna			X	X				X	
THYLACOMYIDAE										
<i>Macrotis lagotis</i>	Greater Bilby	VU	VU				X			
VESPERTILIONIDAE										
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat			X						
<i>Chalinolobus morio</i>	Chocolate Wattled Bat			X						
<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat			X						
<i>Vespadelus regulus</i>	Southern Forest Bat			X						
Birds										
ACANTHIZIDAE										
<i>Acanthiza apicalis</i>	Inland Thornbill				X	X		X	X	
<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill				X	X		X	X	
<i>Acanthiza inornata</i>	Western Thornbill			X		X				

Species Name	Common Name	Conservation Status		This survey	Literature review		Database searches			
		EPBC	WC		A	B	C	D	E	F
<i>Acanthiza iredalei</i>	Slender-billed Thornbill									X
<i>Acanthiza uropygialis</i>	Chestnut-rumped Thornbill			X	X			X	X	
<i>Aphelocephala leucopsis</i>	Southern Whiteface							X	X	
<i>Calamanthus campestris</i>	Rufous Fieldwren							X		
<i>Gerygone fusca</i>	Western Gerygone				X	X		X	X	
<i>Hylacola cauta</i>	Shy Heathwren						X	X		
<i>Pyrrholaemus brunneus</i>	Redthroat							X	X	
<i>Sericornis frontalis</i>	White-browed Scrubwren							X	X	
<i>Smicronis brevirostris</i>	Weebill				X	X		X	X	
ACCIPITRIDAE										
<i>Accipiter cirrocephalus</i>	Collared Sparrowhawk							X		
<i>Accipiter fasciatus</i>	Brown Goshawk							X	X	
<i>Aquila audax</i>	Wedge-tailed Eagle				X	X		X	X	
<i>Circus approximans</i>	Swamp Harrier							X		
<i>Circus assimilis</i>	Spotted Harrier							X	X	
<i>Elanus axillaris</i>	Black-shouldered Kite				X	X		X		
<i>Haliastur sphenurus</i>	Whistling Kite							X	X	
<i>Hieraetus morphnoides</i>	Little Eagle							X		
<i>Lophoictinia isura</i>	Square-tailed Kite							X		
AEGOTHELIDAE										
<i>Aegotheles cristatus</i>	Australian Owlet-nightjar							X	X	
ANATIDAE										
<i>Anas gracilis</i>	Grey Teal							X	X	
<i>Anas platyrhynchos</i>	Mallard*							X		

Species Name	Common Name	Conservation Status		This survey	Literature review		Database searches			
		EPBC	WC		A	B	C	D	E	F
<i>Anas superciliosa</i>	Pacific Black Duck							X	X	
<i>Aythya australis</i>	Hardhead							X		
<i>Biziura lobata</i>	Musk Duck							X		
<i>Chenonetta jubata</i>	Australian Wood Duck			X				X	X	
<i>Cygnus atratus</i>	Black Swan							X		
<i>Malacorhynchus membranaceus</i>	Pink-eared Duck							X	X	
<i>Tadorna tadornoides</i>	Australian Shelduck							X	X	
ANHINGIDAE										
Anhinga novaehollandiae	Australasian Darter							X		
APODIDAE										
<i>Apus pacificus</i>	Fork-tailed Swift	M								X
ARDEIDAE										
<i>Ardea ibis</i>	Cattle Egret	M								X
<i>Ardea modesta</i>	Eastern Great Egret	M								X
<i>Egretta novaehollandiae</i>	White-faced Heron							X		
ARTAMIDAE										
<i>Artamus cinereus</i>	Black-faced Woodswallow				X			X	X	
<i>Artamus cyanopterus</i>	Dusky Woodswallow					X		X	X	
<i>Artamus personatus</i>	Masked Woodswallow					X		X		
<i>Cracticus nigrogularis</i>	Pied Butcherbird			X	X			X	X	
<i>Cracticus tibicen</i>	Australian Magpie			X	X			X	X	
<i>Cracticus torquatus</i>	Grey Butcherbird				X	X		X	X	
<i>Strepera versicolor</i>	Grey Currawong			X		X		X	X	
BURHINIDAE										
<i>Burhinus grallarius</i>	Bush Stone-curlew		P4					X		

Species Name	Common Name	Conservation Status		This survey	Literature review		Database searches			
		EPBC	WC		A	B	C	D	E	F
CACATUIDAE										
<i>Cacatua pastinator</i>	Western Corella							X	X	
<i>Cacatua sanguinea</i>	Little Corella			X					X	
<i>Calyptorhynchus banksii</i>	Red-tailed Black-Cockatoo				X		X	X	X	
<i>Calyptorhynchus latirostris</i>	Short-billed Black-Cockatoo (Carnaby's Black Cockatoo)	EN	EN							X
<i>Eolophus roseicapillus</i>	Galah			X	X	X		X		
<i>Lophochroa leadbeateri</i>	Major Mitchell's Cockatoo		S4				X	X		
<i>Nymphicus hollandicus</i>	Cockatiel				X			X	X	
CAMPEPHAGIDAE										
<i>Coracina maxima</i>	Ground Cuckoo-shrike							X		
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike			X	X			X	X	
<i>Lalage sueurii</i>	White-winged Triller				X			X		
CASUARIIDAE										
<i>Dromaius novaehollandiae</i>	Emu					X		X	X	
CHARADRIIDAE										
<i>Charadrius ruficapillus</i>	Red-capped Plover							X	X	
<i>Elseornis melanops</i>	Black-fronted Dotterel							X		
<i>Thinornis rubricollis</i>	Hooded Plover						X	X		
<i>Vanellus tricolor</i>	Banded Lapwing							X	X	
CLIMACTERIDAE										
<i>Climacteris rufa</i>	Rufous Treecreeper					X		X	X	
COLUMBIDAE										
<i>Columba livia</i>	Rock Dove*							X	X	
<i>Ocyphaps lophotes</i>	Crested Pigeon			X	X			X	X	

Species Name	Common Name	Conservation Status		This survey	Literature review		Database searches			
		EPBC	WC		A	B	C	D	E	F
<i>Phaps chalcoptera</i>	Common Bronzewing			X	X	X		X	X	
<i>Phaps elegans</i>	Brush Bronzewing (Abrolhos pop)		P4					X		
<i>Streptopelia senegalensis</i>	Laughing Turtle-Dove*							X	X	
CORVIDAE										
<i>Corvus bennetti</i>	Little Crow							X	X	
<i>Corvus coronoides</i>	Australian Raven			X	X	X		X	X	
CUCULIDAE										
<i>Cacomantis flabelliformis</i>	Fan-tailed Cuckoo							X	X	
<i>Cacomantis pallidus</i>	Pallid Cuckoo							X	X	
<i>Chalcites basalis</i>	Horsfield's Bronze-Cuckoo							X		
<i>Chalcites osculans</i>	Black-eared Cuckoo							X		
ESTRILDIDAE										
<i>Taeniopygia guttata</i>	Zebra Finch			X				X	X	
EUROSTOPODIDAE										
<i>Eurostopodus argus</i>	Spotted Nightjar							X	X	
FALCONIDAE										
<i>Falco berigora</i>	Brown Falcon					X		X	X	
<i>Falco cenchroides</i>	Nankeen Kestrel					X		X	X	
<i>Falco longipennis</i>	Australian Hobby					X		X	X	
<i>Falco peregrinus</i>	Peregrine Falcon		S4				X	X	X	
HALCYONIDAE										
<i>Dacelo novaeguineae</i>	Laughing Kookaburra					X				
<i>Halcyon pileata</i>	Black-capped Kingfisher								X	
<i>Todiramphus pyrrhopygius</i>	Red-backed Kingfisher							X		

Species Name	Common Name	Conservation Status		This survey	Literature review		Database searches			
		EPBC	WC		A	B	C	D	E	F
<i>Todiramphus sanctus</i>	Sacred Kingfisher				X			X		
HIRUNDINIDAE										
<i>Cheramoeca leucosterna</i>	White-backed Swallow							X		
<i>Hirundo neoxena</i>	Welcome Swallow				X	X		X	X	
<i>Petrochelidon ariel</i>	Fairy Martin							X		
<i>Petrochelidon nigricans</i>	Tree Martin			X	X			X		
LARIDAE										
<i>Chroicocephalus novaehollandiae</i>	Silver Gull							X		
MALURIDAE										
<i>Malurus lamberti</i>	Variegated Fairy-wren			X						
<i>Malurus leucopterus</i>	White-winged Fairy-wren							X	X	
<i>Malurus pulcherrimus</i>	Blue-breasted Fairy-wren				X	X		X	X	
<i>Malurus splendens</i>	Splendid Fairy-wren							X	X	
MEGALURIDAE										
<i>Cincloramphus cruralis</i>	Brown Songlark					X		X	X	
<i>Cincloramphus mathewsi</i>	Rufous Songlark							X	X	
MEGAPODIIDAE										
<i>Leipoa ocellata</i>	Malleefowl	VU	VU				X	X	X	X
MELIPHAGIDAE										
<i>Acanthagenys rufogularis</i>	Spiny-cheeked Honeyeater				X	X		X	X	
<i>Anthochaera carunculata</i>	Red Wattlebird			X	X	X		X	X	
<i>Certhionyx variegatus</i>	Pied Honeyeater							X	X	
<i>Epthianura albifrons</i>	White-fronted Chat							X	X	
<i>Epthianura tricolor</i>	Crimson Chat							X	X	

Species Name	Common Name	Conservation Status		This survey	Literature review		Database searches			
		EPBC	WC		A	B	C	D	E	F
<i>Glyciphila melanops</i>	Tawny-crowned Honeyeater							X		
<i>Lichenostomus cratitius</i>	Purple-gaped Honeyeater								X	
<i>Lichenostomus leucotis</i>	White-eared Honeyeater				X			X	X	
<i>Lichenostomus ornatus</i>	Yellow-plumed Honeyeater							X		
<i>Lichenostomus virescens</i>	Singing Honeyeater			X	X	X		X		
<i>Lichmera indistincta</i>	Brown Honeyeater				X	X		X	X	
<i>Manorina flavigula</i>	Yellow-throated Miner			X	X	X		X	X	
<i>Melithreptus brevirostris</i>	Brown-headed Honeyeater				X			X	X	
<i>Phylidonyris niger</i>	White-cheeked Honeyeater							X		
<i>Phylidonyris novaehollandiae</i>	New Holland Honeyeater					X				
<i>Purnella albifrons</i>	White-fronted Honeyeater							X	X	
<i>Sugomel niger</i>	Black Honeyeater							X		
MEROPIDAE										
<i>Merops ornatus</i>	Rainbow Bee-eater	M			X	X	X	X	X	X
MONARCHIDAE										
<i>Grallina cyanoleuca</i>	Magpie-lark			X	X			X	X	
<i>Myiagra inquieta</i>	Restless Flycatcher							X		
MOTACILLIDAE										
<i>Anthus novaeseelandiae</i>	Australasian Pipit				X			X		
NECTARINIIDAE										
<i>Dicaeum hirundinaceum</i>	Mistletoebird					X				
NEOSITTIDAE										

Species Name	Common Name	Conservation Status		This survey	Literature review		Database searches			
		EPBC	WC		A	B	C	D	E	F
<i>Daphoenositta chrysoptera</i>	Varied Sittella				X			X	X	
OTIDIDAE										
<i>Ardeotis australis</i>	Australian Bustard		P4				X	X	X	
PACHYCEPHALIDAE										
<i>Colluricincla harmonica</i>	Grey Shrike-thrush			X	X	X		X	X	
<i>Oreoica gutturalis</i>	Crested Bellbird				X		X	X	X	
<i>Pachycephala inornata</i>	Gilbert's Whistler							X		
<i>Pachycephala pectoralis</i>	Golden Whistler					X		X	X	
<i>Pachycephala rufiventris</i>	Rufous Whistler				X			X	X	
PARDALOTIDAE										
<i>Pardalotus punctatus</i>	Spotted Pardalote					X			X	
<i>Pardalotus striatus</i>	Striated Pardalote				X	X		X	X	
PELECANIDAE										
<i>Pelecanus conspicillatus</i>	Australian Pelican							X		
PETROICIDAE										
<i>Drymodes brunneopygia</i>	Southern Scrub-robin							X	X	
<i>Eopsaltria griseogularis</i>	Western Yellow Robin							X		
<i>Melanodryas cucullata</i>	Hooded Robin							X		
<i>Microeca fascinans</i>	Jacky Winter				X	X		X	X	
<i>Petroica goodenovii</i>	Red-capped Robin			X	X	X		X	X	
PHALACROCORACIDAE										
<i>Microcarbo melanoleucos</i>	Little Pied Cormorant							X		
PHASIANIDAE										
<i>Coturnix pectoralis</i>	Stubble Quail							X	X	

Species Name	Common Name	Conservation Status		This survey	Literature review		Database searches			
		EPBC	WC		A	B	C	D	E	F
PODARGIDAE										
<i>Podargus strigoides</i>	Tawny Frogmouth							X	X	
PODICIPEDIDAE										
<i>Poliocephalus poliocephalus</i>	Hoary-headed Grebe							X	X	
<i>Tachybaptus novaehollandiae</i>	Australasian Grebe							X	X	
POMATOSTOMIDAE										
<i>Pomatostomus superciliosus</i>	White-browed Babbler						X	X	X	
PSITTACIDAE										
<i>Barnardius zonarius</i>	Australian Ringneck			X	X	X		X	X	
<i>Glossopsitta porphyrocephala</i>	Purple-crowned Lorikeet				X			X	X	
<i>Melopsittacus undulatus</i>	Budgerigar							X	X	
<i>Neophema elegans</i>	Elegant Parrot							X	X	
<i>Platycercus icterotis</i>	Western Rosella							X	X	
<i>Polytelis anthopeplus</i>	Regent Parrot							X	X	
<i>Psephotus varius</i>	Mulga Parrot					X		X		
RALLIDAE										
<i>Fulica atra</i>	Eurasian Coot							X		
RECURVIROSTRIDAE										
<i>Cladorhynchus leucocephalus</i>	Banded Stilt							X	X	
<i>Himantopus himantopus</i>	Black-winged Stilt							X	X	
<i>Recurvirostra novaehollandiae</i>	Red-necked Avocet							X	X	
RHIPIDURIDAE										
<i>Rhipidura albiscapa</i>	Grey Fantail					X		X		

Species Name	Common Name	Conservation Status		This survey	Literature review		Database searches			
		EPBC	WC		A	B	C	D	E	F
<i>Rhipidura leucophrys</i>	Willie Wagtail				X	X		X	X	
<i>Rhipidura rufiventris</i>	Northern Fantail								X	
SCOLOPACIDAE										
<i>Actitis hypoleucos</i>	Common Sandpiper	M					X	X		
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	M					X			
<i>Calidris ferruginea</i>	Curlew Sandpiper	M	VU				X	X		
<i>Calidris ruficollis</i>	Red-necked Stint	M					X	X		
<i>Tringa nebularia</i>	Common Greenshank	M					X	X		
STRIGIDAE										
<i>Ninox novaeseelandiae</i>	Southern Boobook Owl							X	X	
THRESKIORNITHIDAE										
<i>Threskiornis molucca</i>	Australian White Ibis							X		
TIMALIIDAE										
<i>Zosterops lateralis</i>	Silvereye					X		X	X	
TURNICIDAE										
<i>Turnix varius</i>	Painted Button-quail							X		
TYTONIDAE										
<i>Tyto javanica</i>	Eastern Barn Owl							X		
Reptiles										
AGAMIDAE										
<i>Ctenophorus cristatus</i>	Crested Dragon								X	
<i>Ctenophorus maculatus</i>	Spotted Military Dragon								X	
<i>Ctenophorus reticulatus</i>	Western Netted Dragon								X	
<i>Ctenophorus salinarum</i>	Claypan Dragon								X	
<i>Ctenophorus scutulatus</i>	Lozenge-marked Dragon								X	

Species Name	Common Name	Conservation Status		This survey	Literature review		Database searches			
		EPBC	WC		A	B	C	D	E	F
<i>Moloch horridus</i>	Thorny Devil								X	
<i>Pogona minor minima</i>	Abrolhos Dwarf Bearded Dragon		VU						X	
ELAPIDAE										
<i>Brachyuropsis semifasciatus</i>	Southern Shovel-nosed Snake								X	
<i>Parasuta gouldii</i>	Gould's Hooded Snake								X	
<i>Parasuta monachus</i>	Monk Snake								X	
<i>Pseudechis australis</i>	King Brown Snake								X	
<i>Pseudonaja affinis</i>	Dugite			X						
<i>Pseudonaja mengdeni</i>	Mengden's Brown Snake								X	
<i>Pseudonaja modesta</i>	Ringed Brown Snake								X	
<i>Pseudonaja nuchalis</i>	Western Brown Snake								X	
<i>Simoselaps bertholdi</i>	Jan's Banded Snake								X	
<i>Suta fasciata</i>	Rosen's Snake								X	
GEKKONIDAE										
<i>Crenadactylus ocellatus</i>	Clawless Gecko			X					X	
<i>Diplodactylus granariensis</i>	Wheat-belt Stone Gecko				X				X	
<i>Diplodactylus pulcher</i>	Fine-faced Gecko								X	
<i>Gehyra variegata</i>	Tree Dtella								X	
<i>Lucasium maini</i>	Main's Ground Gecko				X				X	
<i>Strophurus assimilis</i>	Goldfields Spiny-tailed Gecko								X	
<i>Strophurus spinigerus</i>	South-western Spiny-tailed Gecko								X	
PYGOPODIDAE										
<i>Delma fraseri</i>	Fraser's Delma								X	

Species Name	Common Name	Conservation Status		This survey	Literature review		Database searches			
		EPBC	WC		A	B	C	D	E	F
<i>Lialis burtonis</i>	Burton's Snake-lizard								X	
<i>Pygopus lepidopodus</i>	Common Scaly-foot								X	
PYTHONIDAE										
<i>Aspidites ramsayi</i>	Woma		S4				X		X	
<i>Morelia spilota imbricata</i>	Carpet Python		S4				X			
SCINCIDAE										
<i>Cryptoblepharus buchananii</i>									X	
<i>Cryptoblepharus plagiocephalus</i>	Callose-palmed Shinning-skink								X	
<i>Ctenotus impar</i>	Odd-striped Ctenotus								X	
<i>Ctenotus schomburgkii</i>	Barred Wedgesnout Ctenotus								X	
<i>Egernia stokesii badia</i>	Western Spiny-tailed Skink	EN	VU							X
<i>Lerista distinguenda</i>	South-western Orange-tailed Slider								X	
<i>Lerista kingi</i>									X	
<i>Lerista macropisthopus</i>	Unpatterned Robust Slider								X	
<i>Lerista muelleri</i>	Wood Mulch-slider								X	
<i>Menetia greyii</i>	Common Dwarf Skink								X	
<i>Morethia butleri</i>	Woodland Morethia Skink								X	
<i>Morethia obscura</i>	Shrubland Morethia Skink								X	
<i>Tiliqua rugosa</i>	Shingle-back			X	X				X	
TYPHLOPIDAE										
<i>Ramphotyphlops waitii</i>	Beaked Blind Snake								X	
VARANIDAE										

Species Name	Common Name	Conservation Status		This survey	Literature review		Database searches			
		EPBC	WC		A	B	C	D	E	F
<i>Varanus gouldii</i>	Gould's Goanna				X				X	
<u>Amphibians</u>										
LIMNODYNASTIDAE										
<i>Limnodynastes dorsalis</i>	Bullfrog								X	
<i>Neobatrachus kunapalari</i>	Kunapalari Frog								X	
<i>Neobatrachus pelobatoides</i>	Humming Frog								X	
MYOBATRACHIDAE										
<i>Crinia pseudinsignifera</i>	False Western Froglet								X	
<i>Pseudophryne guentheri</i>	Gunther's Toadlet								X	

Appendix B

Definitions of Codes and Terms Used to Describe Fauna of 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 Appendix 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.

Definitions of 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 Lists		
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, eg 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, eg 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.

Appendix C**Raw Data from Habitat Assessments**

This Appendix contains the raw data obtained from habitat assessments conducted during this survey.

Location assessed: HAB01

UTM (WGS84 50 J): 660183 6537879

Habitat Type: *E. longicornis* Woodland

Date: 8 October 2013



VEGETATION

Stratum	Height (m)		Cover (%)		Growth form	Dominant species
	Min	Max	Min	Max		
Upper	3	7	10	15	Tree	<i>E. longicornis</i>
Middle	1	5			Shrub	<i>Acacia</i> spp
Lower	0.2	0.5			Tussock Grasses	<i>Atriplex</i> spp

GROUND COVER

Bare soil (%)	Litter (%)	Perennials (%)	Annuals (%)
50	40	5	5

GENERAL

Presence of large trees (20 cm DBH): Yes, occasional

Evidence of recruitment: None

Trees with visible hollows (> 5 cm): None observed

Presence of coarse woody debris: Occasional fallen logs/debris

Weeds: Scattered weeds

SOILS AND GEOLOGY

Soil type and colour: Orange sandy clay

Rock exposure: No exposed bedrock or cemented layers

Coarse surface particles: Common – <30% of site covered by rocks

Coarse surface particle sizes: 2 to 200 mm

Coarse surface particle roundness: Angular

ENVIRONMENT

Slope and aspect: Gently inclined (3-5)

Disturbance: Limited clearing (selective logging)

Erosion: Soil surface stable and undisturbed

Landform: Plain

Feral animals and stock: No

Water impacts: Site is not prone to waterlogging, inundation and flooding

Fire: No burnt tree and shrub remnants, no obvious signs of recent fire

Site degradation: No obvious grazing or trampling impacts on vegetation

ADDITIONAL NOTES

A waste rock landform (WRL) was constructed adjacent to this habitat assessment site. A drainage canal had been constructed between the site and the WRL. Site was located in an area of disturbance within *E. longicornis* Woodland habitat which is why no vegetation data was recorded.

Location assessed: HAB02

UTM (WGS84 50 J): 660683 6538118

Habitat Type: *E. longicornis* Woodland

Date: 8 October 2013



VEGETATION

Stratum	Height (m)		Cover (%)		Growth form	Dominant species
	Min	Max	Min	Max		
Upper	3	8	25	40	Tree	<i>E. longicornis</i>
Middle	1	3			Shrub	<i>Acacia</i> spp
Lower	0.2	0.5			Tussock Grasses	<i>Atriplex</i> spp

GROUND COVER

Bare soil (%)	Litter (%)	Perennials (%)	Annuals (%)
50	25	20	25

GENERAL

Presence of large trees (20 cm DBH): Yes, occasional

Evidence of recruitment: None

Trees with visible hollows (> 5 cm): Yes

Presence of coarse woody debris: Occasional fallen logs/debris

Weeds: Nil

SOILS AND GEOLOGY

Soil type and colour: Orange loamy fine sand

Rock exposure: No exposed bedrock or cemented layers

Coarse surface particles: Common – <30% of site covered by rocks

Coarse surface particle sizes: 6 to 20 mm

Coarse surface particle roundness: Angular

ENVIRONMENT

Slope and aspect: Gently inclined (3-5)

Disturbance: Limited clearing (selective logging)

Erosion: Soil surface stable and undisturbed

Landform: Plain

Feral animals and stock: No

Water impacts: Site is not prone to waterlogging, inundation and flooding

Fire: No burnt tree and shrub remnants, no obvious signs of recent fire

Site degradation: No obvious grazing or trampling impacts on vegetation

ADDITIONAL NOTES

Large amount of leaf/stick litter present at site – may provide suitable habitat for invertebrates.

Location assessed: HAB03

UTM (WGS84 50 J): 660830 6538108

Habitat Type: *E. longicornis* Woodland

Date: 8 October 2013



VEGETATION

Stratum	Height (m)		Cover (%)		Growth form	Dominant species
	Min	Max	Min	Max		
Upper	3	7			Tree	<i>E. longicornis</i>
Middle	1	3			Shrub	<i>Acacia spp</i>
Lower	0.2	0.5			Tussock Grass	<i>Atriplex spp</i>

GROUND COVER

Bare soil (%)	Litter (%)	Perennials (%)	Annuals (%)
50	30	15	5

GENERAL

Presence of large trees (20 cm DBH): Yes, scattered

Evidence of recruitment: No

Trees with visible hollows (> 5 cm): None observed

Presence of coarse woody debris: Fallen logs/debris common

Weeds: Nil

SOILS AND GEOLOGY

Soil type and colour: Hard grey loam with red sands underneath

Rock exposure: >50% of site has exposed bedrock or cemented layers

Coarse surface particles: Common – <30% of site covered by rocks

Coarse surface particle sizes: 6 – 20 mm

Coarse surface particle roundness: Angular

ENVIRONMENT

Slope and aspect: Gently inclined (3-5)

Disturbance: Limited clearing (selective logging)

Erosion: Soil surface stable and undisturbed

Landform: Plain

Feral animals and stock: No

Water impacts: Site is not prone to waterlogging, inundation and flooding

Fire: No burnt tree and shrub remnants, no obvious signs of recent fire

Site degradation: No obvious grazing or trampling impacts on vegetation

ADDITIONAL NOTES

A high amount of leaf debris was present at this site.

Location assessed: HAB04

UTM (WGS84 50 J): 661246 6538091

Habitat Type: *E. longicornis* Woodland

Date: 8 October 2013



VEGETATION

Stratum	Height (m)		Cover (%)		Growth form	Dominant species
	Min	Max	Min	Max		
Upper	5	20	20	40	Tree	<i>E. longicornis</i>
Middle	1	3			Shrub	<i>Melaleuca spp</i>
Lower	0.1	0.4			Tussock Grass	<i>Atriplex spp</i>

GROUND COVER

Bare soil (%)	Litter (%)	Perennials (%)	Annuals (%)
50	40	5	5

GENERAL

Presence of large trees (20 cm DBH): Yes, scattered

Evidence of recruitment: Yes, *E. longicornis* Woodland

Trees with visible hollows (> 5 cm): None observed

Presence of coarse woody debris: Occasional fallen logs/debris

Weeds: Nil

SOILS AND GEOLOGY

Soil type and colour: Red fine sands

Rock exposure: <20 of site has exposed bedrock or cemented layers

Coarse surface particles: Common – <30% of site covered by rocks

Coarse surface particle sizes: 2 to 6 mm

Coarse surface particle roundness: Angular

ENVIRONMENT

Slope and aspect: Level (0-3)

Disturbance: Limited clearing (selective logging)

Erosion: Soil surface stable and undisturbed

Landform: Plain

Feral animals and stock: No

Water impacts: Site is not prone to waterlogging, inundation and flooding

Fire: No burnt tree and shrub remnants, no obvious signs of recent fire

Site degradation: No obvious grazing or trampling impacts on vegetation

ADDITIONAL NOTES

Sparse vegetation was present at site with large trees scattered throughout.

Location assessed: HAB05

UTM (WGS84 50 J): 661368 6537844

Habitat Type: *E. longicornis* Woodland

Date: 8 October 2013



VEGETATION

Stratum	Height (m)		Cover (%)		Growth form	Dominant species
	Min	Max	Min	Max		
Upper	5	25			Tree	<i>E. longicornis</i>
Middle	1	3			Shrub	<i>Melaleuca spp</i>
Lower	0.1	0.4			Tussock Grass	<i>Atriplex spp</i>

GROUND COVER

Bare soil (%)	Litter (%)	Perennials (%)	Annuals (%)
60	20	15	5

GENERAL

Presence of large trees (20 cm DBH): Yes, occasional

Evidence of recruitment: Yes, tussock grasses

Trees with visible hollows (> 5 cm): Yes

Presence of coarse woody debris: Occasional fallen logs/debris

Weeds: Nil

SOILS AND GEOLOGY

Soil type and colour: Red fine sand

Rock exposure: <20 of site has exposed bedrock or cemented layers

Coarse surface particles: Common – <30% of site covered by rocks

Coarse surface particle sizes: 2 – 20 mm

Coarse surface particle roundness: Angular

ENVIRONMENT

Slope and aspect: Gently inclined (3-5)

Disturbance: Limited clearing (selective logging)

Erosion: Soil surface stable and undisturbed

Landform: Plain

Feral animals and stock: No

Water impacts: Site is not prone to waterlogging, inundation and flooding

Fire: No burnt tree and shrub remnants, no obvious signs of recent fire

Site degradation: No obvious grazing or trampling impacts on vegetation

ADDITIONAL NOTES

Sparse woodland with large areas of bare ground.

Location assessed: HAB06

UTM (WGS84 50 J): 661687 6538006

Habitat Type: *E. salubris* Woodland

Date: 9 October 2013



VEGETATION

Stratum	Height (m)		Cover (%)		Growth form	Dominant species
	Min	Max	Min	Max		
Upper	6	10			Tree	<i>E. salubris</i>
Middle						
Lower	0.2	0.5			Tussock Grass	Various perennial spp

GROUND COVER

Bare soil (%)	Litter (%)	Perennials (%)	Annuals (%)
25	50	25	0

GENERAL

Presence of large trees (20 cm DBH): Yes, common

Evidence of recruitment: Yes minor *E. salubris*

Trees with visible hollows (> 5 cm): None observed

Presence of coarse woody debris: Occasional fallen logs/debris

Weeds: Scattered weeds

SOILS AND GEOLOGY

Soil type and colour: Red clay

Rock exposure: No exposed bedrock or cemented layers

Coarse surface particles: Common – <30% of site covered by rocks

Coarse surface particle sizes: 2 to 6 mm

Coarse surface particle roundness: Angular

ENVIRONMENT

Slope and aspect: Gently inclined (3-5)

Disturbance: Limited clearing (selective logging)

Erosion: Soil surface stable and undisturbed

Landform: Plain

Feral animals and stock: No

Water impacts: May be or prone to waterlogging

Fire: No burnt tree and shrub remnants, no obvious signs of recent fire

Site degradation: No obvious grazing or trampling impacts on vegetation

ADDITIONAL NOTES

Heavily disturbed with no middle stratum present.

Location assessed: HAB07

UTM (WGS84 50 J): 661731 6537771

Habitat Type: *E. salubris* Woodland

Date: 9 October 2013 2013



VEGETATION

Stratum	Height (m)		Cover (%)		Growth form	Dominant species
	Min	Max	Min	Max		
Upper	4	6	60	70	Tree	<i>E. salubris</i>
Middle	1	2	20	30	Shrub	<i>Acacia</i> and <i>Maleleuca</i> spp
Lower	0.2	1			Sedge	<i>Chenopod</i> spp

GROUND COVER

Bare soil (%)	Litter (%)	Perennials (%)	Annuals (%)
20	60	10	10

GENERAL

Presence of large trees (20 cm DBH): Yes, occasional

Evidence of recruitment: Yes, minimal *E. salubris*

Trees with visible hollows (> 5 cm): None observed

Presence of coarse woody debris: Occasional fallen logs/debris

Weeds: Scattered weeds

SOILS AND GEOLOGY

Soil type and colour: Orange clay

Rock exposure: No exposed bedrock or cemented layers

Coarse surface particles: Common – <30% of site covered by rocks

Coarse surface particle sizes: None

Coarse surface particle roundness: None

ENVIRONMENT

Slope and aspect: Gently inclined (3-5)

Disturbance: Limited clearing (selective logging)

Erosion: Soil surface stable and undisturbed

Landform: Plain

Feral animals and stock: Evidence of rabbits present

Water impacts: Site is not prone to waterlogging, inundation and flooding

Fire: No burnt tree and shrub remnants, no obvious signs of recent fire

Site degradation: No obvious grazing or trampling impacts on vegetation

Location assessed: HAB08

UTM (WGS84 50 J): 660183 6537879

Habitat Type: *E. salubris* Woodland

Date: 9 October 2013



VEGETATION

Stratum	Height (m)		Cover (%)		Growth form	Dominant species
	Min	Max	Min	Max		
Upper	4	6	50	70	Mallee	<i>E. salubris</i>
Middle	1	2	10	20	Shrub	<i>Acacia</i> spp
Lower	0.1	0.5	5	10	Sedge	

GROUND COVER

Bare soil (%)	Litter (%)	Perennials (%)	Annuals (%)
20	60	10	10

GENERAL

Presence of large trees (20 cm DBH): Yes, occasional

Evidence of recruitment: Yes, minor *E. salubris*

Trees with visible hollows (> 5 cm): Yes

Presence of coarse woody debris: Occasional fallen logs/debris

Weeds: Scattered weeds

SOILS AND GEOLOGY

Soil type and colour: Light orange clay loam

Rock exposure: No exposed bedrock or cemented layers

Coarse surface particles: Common – <30% of site covered by rocks

Coarse surface particle sizes: None

Coarse surface particle roundness: None

ENVIRONMENT

Slope and aspect: Gently inclined (3-5)

Disturbance: Limited clearing (selective logging)

Erosion: Soil surface slightly disturbed (some compacting, signs of increased run-off, some pedestalled tussocks)

Landform: Plain

Feral animals and stock: Evidence of rabbits present

Water impacts: Site is not prone to waterlogging, inundation and flooding

Fire: No burnt tree and shrub remnants, no obvious signs of recent fire

Site degradation: No obvious grazing or trampling impacts on vegetation

ADDITIONAL NOTES

Limited shrubland, high levels of leaf debris present

Location assessed: HAB09

UTM (WGS84 50 J): 661958 6537694

Habitat Type: *E. salubris* Woodland

Date: 9 October 2013



VEGETATION

Stratum	Height (m)		Cover (%)		Growth form	Dominant species
	Min	Max	Min	Max		
Upper	5	20	20	30	Tree	<i>E. salubris</i>
Middle	1	2	50	80	Shrub	<i>Acacia</i> and <i>Malelueca</i> spp
Lower	0.1	0.5	10	20	Sedge	<i>Acacia</i> spp

GROUND COVER

Bare soil (%)	Litter (%)	Perennials (%)	Annuals (%)
50	15	25	10

GENERAL

Presence of large trees (20 cm DBH): Yes, occasional

Evidence of recruitment: Yes, minimal *Acacia* spp

Trees with visible hollows (> 5 cm): Yes

Presence of coarse woody debris: Occasional fallen logs/debris

Weeds: Scattered weeds

SOILS AND GEOLOGY

Soil type and colour: Orange loam clay

Rock exposure: No exposed bedrock or cemented layers

Coarse surface particles: Common – <30% of site covered by rocks

Coarse surface particle sizes: 2 to 6 mm

Coarse surface particle roundness: Angular

ENVIRONMENT

Slope and aspect: Gently inclined (3-5)

Disturbance: Limited clearing (selective logging)

Erosion: Soil surface slightly disturbed (some compacting, signs of increased run-off, some pedestalled tussocks)

Landform: Plain

Feral animals and stock: Evidence of rabbits present

Water impacts: Prone to waterlogging and inundation

Fire: Yes, less than 2 years ago

Site degradation: No obvious grazing or trampling impacts on vegetation

ADDITIONAL NOTES

Reduced leaf debris as a result of fire.

Location assessed: HAB10

UTM (WGS84 50 J): 662293 6536650

Habitat Type: *E. salubris* Woodland

Date: 9 October 2013



VEGETATION

Stratum	Height (m)		Cover (%)		Growth form	Dominant species
	Min	Max	Min	Max		
Upper	4	10	40	60	Tree	<i>E. salubris</i>
Middle	1	3	10	20	Shrub	<i>Acacia</i> and <i>Maleluca</i> spp
Lower		0.5	10	25	Sedge	

GROUND COVER

Bare soil (%)	Litter (%)	Perennials (%)	Annuals (%)
50	40	5	5

GENERAL

Presence of large trees (20 cm DBH): Yes, common

Evidence of recruitment: Yes, minimal *Maleluca* spp

Trees with visible hollows (> 5 cm): None observed

Presence of coarse woody debris: Fallen logs/debris common

Weeds: Scattered weeds

SOILS AND GEOLOGY

Soil type and colour: Orange sandy loam

Rock exposure: No exposed bedrock or cemented layers

Coarse surface particles: Common – <30% of site covered by rocks

Coarse surface particle sizes: 2 to 20 mm

Coarse surface particle roundness: Angular

ENVIRONMENT

Slope and aspect: Gently inclined (3-5)

Disturbance: Limited clearing (selective logging)

Erosion: Soil surface stable and undisturbed

Landform: Plain

Feral animals and stock: Evidence of rabbits present

Water impacts: Site is not prone to waterlogging, inundation and flooding

Fire: No burnt tree and shrub remnants, no obvious signs of recent fire

Site degradation: No obvious grazing or trampling impacts on vegetation

ADDITIONAL NOTES

A lot of historical drill lines/disturbance

Location assessed: HAB11

UTM (WGS84 50 J): 660778 6537320

Habitat Type: *E. salubris* Woodland

Date: 11 October 2013

VEGETATION

Stratum	Height (m)		Cover (%)		Growth form	Dominant species
	Min	Max	Min	Max		
Upper	8	15	40	70	Tree	<i>E. salubris</i>
Middle	1	3	10	30	Shrubs	<i>Acacia</i> and <i>Malelueca</i> spp
Lower	0.2	1			Sedge	<i>Chenopod</i> spp

GROUND COVER

Bare soil (%)	Litter (%)	Perennials (%)	Annuals (%)
35	35	20	10

GENERAL

Presence of large trees (20 cm DBH): Yes, common

Evidence of recruitment: Yes, minimal *chenopod* spp

Trees with visible hollows (> 5 cm): No

Presence of coarse woody debris: Occasional fallen logs/debris

Weeds: Scattered weeds

SOILS AND GEOLOGY

Soil type and colour: Fine orange silt

Rock exposure: No exposed bedrock or cemented layers

Coarse surface particles: Common – <30% of site covered by rocks

Coarse surface particle sizes: 2 to 6 mm

Coarse surface particle roundness: Angular

ENVIRONMENT

Slope and aspect: Gently inclined (3-5)

Disturbance: No effective disturbance, natural

Erosion: Soil surface stable and undisturbed

Landform: Plain

Feral animals and stock: Evidence of rabbits present

Water impacts: Prone to inundation

Fire: No burnt tree and shrub remnants, no obvious signs of recent fire

Site degradation: No obvious grazing or trampling impacts on vegetation

ADDITIONAL NOTES

Good quality Mallee woodland with more woodland bird species present

Location assessed: HAB12

UTM (WGS84 50 J): 662443 6536472

Habitat Type: Mixed Shrubland

Date: 10 October 2013

VEGETATION

Stratum	Height (m)		Cover (%)		Growth form	Dominant species
	Min	Max	Min	Max		
Upper	2.5	4	20	50	Shrubs	<i>Allocasuarina</i> spp
Middle	1	3	50	80	Shrubs	<i>Acacia</i> spp
Lower		1			Tussock Grasses	<i>Atriplex</i> spp

GROUND COVER

Bare soil (%)	Litter (%)	Perennials (%)	Annuals (%)
30	30	30	10

GENERAL

Presence of large trees (20 cm DBH): No

Evidence of recruitment: No

Trees with visible hollows (> 5 cm): Yes

Presence of coarse woody debris: Occasional fallen logs/debris

Weeds: Nil

SOILS AND GEOLOGY

Soil type and colour: Light orange coarse sand

Rock exposure: <20% of site has exposed bedrock or cemented layers

Coarse surface particles: Common – <30% of site covered by rocks

Coarse surface particle sizes: 2 to 6 mm

Coarse surface particle roundness: Angular

ENVIRONMENT

Slope and aspect: Gently inclined (3-5)

Disturbance: No effective disturbance, natural

Erosion: Soil surface stable and undisturbed

Landform: Plain

Feral animals and stock: No

Water impacts: Site is not prone to waterlogging, inundation and flooding

Fire: No burnt tree and shrub remnants, no obvious signs of recent fire

Site degradation: No obvious grazing or trampling impacts on vegetation

ADDITIONAL NOTES

Transitional woodland habitat, shrubs dominant with small areas of sandy substrate which support tussock grasslands

Location assessed: HAB13

UTM (WGS84 50 J): 662293 6536650

Habitat Type: Mixed Shrubland

Date: 10 October 2013



VEGETATION

Stratum	Height (m)		Cover (%)		Growth form	Dominant species
	Min	Max	Min	Max		
Upper	2	4	70	80	Shrub	<i>Allocasuarina</i> spp
Middle		1			Shrub	<i>Malelueca</i> spp
Lower		0.5			Sedge	

GROUND COVER

Bare soil (%)	Litter (%)	Perennials (%)	Annuals (%)
50	40	5	5

GENERAL

Presence of large trees (20 cm DBH): No

Evidence of recruitment: Yes, minimal *Allocasuarina* spp

Trees with visible hollows (> 5 cm): None observed

Presence of coarse woody debris: Fallen logs/debris common

Weeds: Scattered weeds

SOILS AND GEOLOGY

Soil type and colour: Orange sand

Rock exposure: <20% of site has exposed bedrock or cemented layers

Coarse surface particles: 30 – 60% of site covered by rocks

Coarse surface particle sizes: 2 to 60 mm

Coarse surface particle roundness: Angular

ENVIRONMENT

Slope and aspect: Gently inclined (3-5)

Disturbance: Limited clearing (selective logging)

Erosion: Soil surface stable and undisturbed

Landform: Plain

Feral animals and stock: Evidence of rabbits present

Water impacts: Prone to waterlogging and inundation

Fire: No burnt tree and shrub remnants, no obvious signs of recent fire

Site degradation: No obvious grazing or trampling impacts on vegetation

Location assessed: HAB14

UTM (WGS84 50 J): 661527 6536643

Habitat Type: *E. longicornis* Woodland

Date: 10 November 2013



VEGETATION

Stratum	Height (m)		Cover (%)		Growth form	Dominant species
	Min	Max	Min	Max		
Upper	6	20	40	50	Tree	<i>E. longicornis</i>
Middle	1	3			Shrub	<i>Acacia</i> and <i>Malelueca</i> spp
Lower		1	40	50	Sedge	<i>Atriplex</i> spp

GROUND COVER

Bare soil (%)	Litter (%)	Perennials (%)	Annuals (%)
50	30	15	5

GENERAL

Presence of large trees (20 cm DBH): Yes, common

Evidence of recruitment: Yes, occasional *Eucalyptus* spp

Trees with visible hollows (> 5 cm): Yes

Presence of coarse woody debris: Occasional fallen logs/debris

Weeds: Scattered weeds

SOILS AND GEOLOGY

Soil type and colour: Light orange coarse sand

Rock exposure: <20% of site has exposed bedrock or cemented layers

Coarse surface particles: Common – <30% of site covered by rocks

Coarse surface particle sizes: 2 to 200 mm

Coarse surface particle roundness: Angular

ENVIRONMENT

Slope and aspect: Gently inclined (3-5)

Disturbance: Limited clearing (selective logging)

Erosion: Soil surface slightly disturbed (some compacting, signs of increased run-off, some pedestalled tussocks)

Landform: Plain

Feral animals and stock: No

Water impacts: Site is not prone to waterlogging, inundation and flooding

Fire: No burnt tree and shrub remnants, no obvious signs of recent fire

Site degradation: No obvious grazing or trampling impacts on vegetation

ADDITIONAL NOTES

A lot of historical drill lines/disturbance

Location assessed: HAB15

UTM (WGS84 50 J): 660999 6536987

Habitat Type: *E. longicornis* Woodland

Date: 7 October 2013



VEGETATION

Stratum	Height (m)		Cover (%)		Growth form	Dominant species
	Min	Max	Min	Max		
Upper	10	20	20	40	Tree	<i>Eucalyptus</i> spp
Middle	1	4	10	25	Shrub	<i>Malelueca</i> spp
Lower		0.5	5	10	Sedge	<i>Atriplex</i> spp

GROUND COVER

Bare soil (%)	Litter (%)	Perennials (%)	Annuals (%)
40	50	5	5

GENERAL

Presence of large trees (20 cm DBH): Yes, occasional

Evidence of recruitment: Yes, occasional *Malelueca* and *Atriplex* spp

Trees with visible hollows (> 5 cm): None observed

Presence of coarse woody debris: Occasional fallen logs/debris

Weeds: Scattered weeds

SOILS AND GEOLOGY

Soil type and colour: Light orange sandy loam

Rock exposure: <20% of site has exposed bedrock or cemented layers

Coarse surface particles: Common – <30% of site covered by rocks

Coarse surface particle sizes: 2 to 60 mm

Coarse surface particle roundness: Angular

ENVIRONMENT

Slope and aspect: Gently inclined (3-5)

Disturbance: Limited clearing (selective logging)

Erosion: Soil surface stable and undisturbed

Landform: Plain

Feral animals and stock: No

Water impacts: Site is not prone to waterlogging, inundation and flooding

Fire: No burnt tree and shrub remnants, no obvious signs of recent fire

Site degradation: No obvious grazing or trampling impacts on vegetation

ADDITIONAL NOTES

A lot of historical drill lines/disturbance

Location assessed: HAB16

UTM (WGS84 50 J): 660778 6537320

Habitat Type: *E. longicornis* Woodland

Date: 10 October 2013



VEGETATION

Stratum	Height (m)		Cover (%)		Growth form	Dominant species
	Min	Max	Min	Max		
Upper	6	20	30	60	Tree	<i>E. longicornis</i>
Middle	1	3	10	20	Shrubs	<i>Acacia</i> and <i>Maleueca</i> spp
Lower	0.5	0.5	30	60	Sedge	<i>Chenopod</i> spp

GROUND COVER

Bare soil (%)	Litter (%)	Perennials (%)	Annuals (%)
40	40	10	10

GENERAL

Presence of large trees (20 cm DBH): Yes, common

Evidence of recruitment: Yes, moderate *chenopod* spp

Trees with visible hollows (> 5 cm): Yes

Presence of coarse woody debris: Occasional fallen logs/debris

Weeds: Scattered weeds

SOILS AND GEOLOGY

Soil type and colour: Orange clay fine particles

Rock exposure: No exposed bedrock or cemented layers

Coarse surface particles: Common – <30% of site covered by rocks

Coarse surface particle sizes: 2 to 6 mm

Coarse surface particle roundness: Angular

ENVIRONMENT

Slope and aspect: Gently inclined (3-5)

Disturbance: No effective disturbance, natural

Erosion: Soil surface stable and undisturbed

Landform: Plain

Feral animals and stock: Evidence of rabbits present

Water impacts: Site is not prone to waterlogging, inundation and flooding

Fire: No burnt tree and shrub remnants, no obvious signs of recent fire

Site degradation: No obvious grazing or trampling impacts on vegetation

ADDITIONAL NOTES

A lot of historical drill lines/disturbance

Location assessed: HAB17

UTM (WGS84 50 J): 660183 6537879

Habitat Type: *E. longicornis* Woodland

Date: 7 October 2013



VEGETATION

Stratum	Height (m)		Cover (%)		Growth form	Dominant species
	Min	Max	Min	Max		
Upper	5	8	40	60	Tree	<i>E. salubris</i>
Middle	0.5	3	10	25	Shrub	<i>Acacia</i> spp
Lower		0.5			Tussock Grasses	<i>Atriplex</i> spp

GROUND COVER

Bare soil (%)	Litter (%)	Perennials (%)	Annuals (%)
20	60	10	10

GENERAL

Presence of large trees (20 cm DBH): Yes, common

Evidence of recruitment: Yes, occasional *Acacia* spp

Trees with visible hollows (> 5 cm): Yes

Presence of coarse woody debris: Fallen logs/debris common

Weeds: Scattered weeds

SOILS AND GEOLOGY

Soil type and colour: Light red sands

Rock exposure: No exposed bedrock or cemented layers

Coarse surface particles: Common – <30% of site covered by rocks

Coarse surface particle sizes: 2 to 20 mm

Coarse surface particle roundness: Angular

ENVIRONMENT

Slope and aspect: Gently inclined (3-5)

Disturbance: Limited clearing (selective logging)

Erosion: Soil surface stable and undisturbed

Landform: Plain

Feral animals and stock: No

Water impacts: Site is not prone to waterlogging, inundation and flooding

Fire: No burnt tree and shrub remnants, no obvious signs of recent fire

Site degradation: No obvious grazing or trampling impacts on vegetation

ADDITIONAL NOTES

High coarse woody debris suitable for the Western Spiny-tailed Skink, evidence of old mining disturbance.

Location assessed: HAB18

UTM (WGS84 50 J): 660183 6537879

Habitat Type: Mixed Mallee Woodland

Date: 25 June 2014



VEGETATION

Stratum	Height (m)		Cover (%)		Growth form	Dominant species
	Min	Max	Min	Max		
Upper	4	6	20	30	Mallee/Shrub	<i>Eucalyptus</i> spp.
Middle	1.2	1.8	5	15	Shrub	<i>Santalum acuminatum</i>
Lower	0.2	0.4	20	30	Tussock	<i>Eragrostis</i> spp.

GROUND COVER

Bare soil (%)	Litter (%)	Perennials (%)	Annuals (%)
30	30	40	0

GENERAL

Presence of large trees (20 cm DBH): No

Evidence of recruitment: Yes

Trees with visible hollows (> 5 cm): No

Presence of coarse woody debris: Fallen logs/debris common

Weeds: No

SOILS AND GEOLOGY

Soil type and colour: Light brown sandy loam

Rock exposure: No exposed bedrock or cemented layers

Coarse surface particles: Common – <30% of site covered by rocks

Coarse surface particle sizes: None

Coarse surface particle roundness: Angular

ENVIRONMENT

Slope and aspect: Moderately inclined (5-15)

Disturbance: Heavy grazing

Erosion: Soil surface stable and undisturbed

Landform: Plain

Feral animals and stock: Sheep

Water impacts: Site is not prone to waterlogging, inundation and flooding

Fire: No burnt tree and shrub remnants, no obvious signs of recent fire

Site degradation: Evidence of grazing present

ADDITIONAL NOTES

Good Malleefowl habitat, however remnant is unlikely to support species due to size.

Location assessed: HAB19

UTM (WGS84 50 J): 660183 6537879

Habitat Type: Mixed Shrubland

Date: 25 June 2014



VEGETATION

Stratum	Height (m)		Cover (%)		Growth form	Dominant species
	Min	Max	Min	Max		
Upper	2.5	3.5	40	70	Shrub	<i>Acacia</i> spp.
Middle	1.5	1.7	5	10	Shrub	<i>Acacia</i> spp.
Lower	0.5	0.5	20	40	Shrub	Myrtaceous spp.

GROUND COVER

Bare soil (%)	Litter (%)	Perennials (%)	Annuals (%)
40	30	30	0

GENERAL

Presence of large trees (20 cm DBH): No

Evidence of recruitment: Yes, occasional *Acacia* spp

Trees with visible hollows (> 5 cm): No

Presence of coarse woody debris: Occasional fallen logs/debris

Weeds: No

SOILS AND GEOLOGY

Soil type and colour: Light brown sandy loam

Rock exposure: No exposed bedrock or cemented layers

Coarse surface particles: Common – <30% of site covered by rocks

Coarse surface particle sizes: < 2 mm

Coarse surface particle roundness: Angular

ENVIRONMENT

Slope and aspect: Gently inclined (3-5)

Disturbance: No effective disturbance other than grazing by hoofed animals

Erosion: Soil surface stable and undisturbed

Landform: Plain

Feral animals and stock: Sheep

Water impacts: Site is not prone to waterlogging, inundation and flooding

Fire: No burnt tree and shrub remnants, no obvious signs of recent fire

Site degradation: Minor grazing and trampling impacts to vegetation

Location assessed: HAB20

UTM (WGS84 50 J): 660183 6537879

Habitat Type: Mixed Mallee Woodland

Date: 25 June 2014



VEGETATION

Stratum	Height (m)		Cover (%)		Growth form	Dominant species
	Min	Max	Min	Max		
Upper	8	12	15	25	Tree/Mallee	<i>Eucalyptus</i> spp.
Middle	2	3	15	60	Shrub	<i>Melaleuca acuminata</i>
Lower	0.1	0.3	2	5	Tussock	<i>Eragrostis</i> spp.

GROUND COVER

Bare soil (%)	Litter (%)	Perennials (%)	Annuals (%)
50	45	0	5

GENERAL

Presence of large trees (20 cm DBH): Yes, occasional

Evidence of recruitment: No

Trees with visible hollows (> 5 cm): No

Presence of coarse woody debris: Fallen logs/debris common

Weeds: No

SOILS AND GEOLOGY

Soil type and colour: Light brown sandy loam

Rock exposure: No exposed bedrock or cemented layers

Coarse surface particles: Common – <30% of site covered by rocks

Coarse surface particle sizes: < 2 mm

Coarse surface particle roundness: Angular

ENVIRONMENT

Slope and aspect: Gently inclined (3-5)

Disturbance: No effective disturbance other than grazing by hoofed animals

Erosion: Soil surface stable and undisturbed

Landform: Plain

Feral animals and stock: Sheep

Water impacts: Site is not prone to waterlogging, inundation and flooding

Fire: No burnt tree and shrub remnants, no obvious signs of recent fire

Site degradation: Minor grazing and trampling impacts to vegetation