

# Level 1 Vertebrate Fauna Risk Assessment for Lot 350 Kalgoorlie West



Version 1. October 2019

Prepared for:

Native Vegetation Solutions  
PO Box 41  
KALGOORLIE, WA 6430

Prepared by:

Terrestrial Ecosystems  
10 Houston Place,  
Mt Claremont,  
Western Australia, 6010  
[www.terrestrialecosystems.com](http://www.terrestrialecosystems.com)

**Record of distribution**

No. of copies	Report File Name	Report Status	Date	Prepared for:	Initials
Electronic	2019-0069-002-st-V1	Draft	25 October 2019	Native Vegetation Solutions	ST
Electronic	2019-0069-002-st-V1	Draft	25 October 2019	Tetris Environmental	ST
Electronic	2019-0069-002-st-V1	Final	29 October 2019	Native Vegetation Solutions	ST
Electronic	2019-0069-002-st-V1	Final	29 October 2019	Tetris Environmental	ST

Suggested citation: Terrestrial Ecosystems (2019) *Level 1 Vertebrate Fauna Risk Assessment for Lot 350 Kalgoorlie West*. Unpublished report for Native Vegetation Solutions, Perth.

**Disclaimer**

This document is prepared in accordance with and subject to an agreement between Terrestrial Ecosystems and the client, Native Vegetation Solutions. It has been prepared and is restricted to those issues that have been raised by the client in its engagement of Terrestrial Ecosystems and prepared using the standard of skill and care ordinarily exercised by environmental scientists in the preparation of such reports.

Persons or agencies that rely on or use this document for purposes or reasons other than those agreed to by Terrestrial Ecosystems and its client without first obtaining prior consent, do so at their own risk and Terrestrial Ecosystems denies all liability in tort, contract or otherwise for any loss, damage or injury of any kind whatsoever (whether in negligence or otherwise) that may be suffered as a consequence.

Front Cover: Typical fauna habitat from the survey area

## TABLE OF CONTENTS

1	Introduction	1
1.1	Background and project location	1
1.2	Project objectives	1
2	Existing Environment	2
2.1	Landform and vegetation	2
2.2	Land use	2
2.2.1	Climate	2
2.2.2	Fauna species at risk	2
3	Existing vertebrate fauna data	3
3.1	Database searches	3
3.2	Contextual data	3
3.3	Fauna habitat assessment	5
3.4	Taxonomy and nomenclature	7
3.5	Survey and reporting staff	7
3.6	Limitations	7
4	Results	9
4.1	Fauna habitat	9
4.2	Vertebrate fauna potentially in the project area	10
4.3	Conservation significant fauna	13
4.3.1	Significant fauna species potentially in the project area	13
4.4	Risk assessment	18
5	Discussion	21
5.1	Adequacy of the fauna surveys	21
5.2	Fauna assemblages	21
5.2.1	Amphibians	21
5.2.2	Reptiles	21
5.2.3	Birds	21
5.2.4	Mammals	22
5.2.5	Fish	22
5.2.6	Malleefowl	22
5.3	Biodiversity value of the project area	22
5.3.1	Ecological functional value at the ecosystem level	22
5.4	Potential impacts of the proposed development on the fauna in the project area	23
5.5	Direct impacts	23
5.5.1	Animal deaths during the clearing process and displacement of fauna	23
5.5.2	Reduction or loss of activity areas and closure of burrows	23
5.6	Indirect impacts	23
5.6.1	Habitat fragmentation	23
5.6.2	Introduced fauna and weeds	24
5.6.3	Road fauna deaths	24
5.6.4	Anthropogenic activity	24
5.7	Native vegetation clearing principles	24
6	Summary and Management	26
7	References	27

**Chart**

1. Mean monthly maximum and minimum temperatures and rainfall for Kalgoorlie

**Plates**

1. Project area habitat
2. Project area habitat
3. Project area habitat
4. Project area habitat
5. Project area habitat
6. Project area habitat
7. Rubbish and disturbance in the project area
8. Historical exploration activity and rehabilitation in the project area

**Tables**

1. Assessment constraints and limitations
2. Birds potentially in the project area
3. Mammals potentially in the vicinity of the project area
4. Reptiles potentially in the vicinity of the project area
5. Amphibians potentially in the vicinity of the project area s
6. Assessment of the potential impact on conservation significant fauna that could occur in the bioregion
7. Fauna impact risk assessment descriptors
8. Level of acceptable risk
9. Risk assessment of the impact of the proposed mining development on the fauna and fauna assemblage
10. Assessment of fauna impact using the native vegetation clearing principles

**Figures**

1. Regional Location
2. Habitat Assessment Points

**Appendixes**

- A. Vertebrate Fauna Recorded in Biological Surveys in the Region
- B. Definitions of Significant Fauna under the Western Australian *Biodiversity Conservation Act 2016*
- C. Commonwealth *EPBC Act 1999* search results
- D. Fauna habitat assessment results

## **EXECUTIVE SUMMARY**

The City of Kalgoorlie-Boulder is undertaking preliminary investigations to support its development application for a parcel of land at Lot 350 on Plan 220598 Yilkari (i.e. project area) in the industrial suburb west of Kalgoorlie. The project is approximately 2.5km south-west of the outskirts of Kalgoorlie and on the southern side of the Great Eastern Highway (Figure 1). The project area is regular in shape, flat in topography, predominantly on fine red loam over a clay base and comprises 213.4ha.

The fauna habitat in the project area is an open eucalypt woodland with a mixed understory of scattered shrubs and chenopods. There were variations in the densities of trees, shrubs and ground cover, but these differences were not sufficient to support a significantly different vertebrate fauna assemblage. Much of the project area was in reasonable condition, however, there is evidence of well used tracks through the area, prior ground disturbance, some rehabilitated landforms and rubbish has been dumped in some areas. The fauna habitat quality varied from degraded to very good.

No Malleefowl mounds were recorded.

The development of the project area will result in the clearing of native vegetation and consequently a loss of, and alteration to existing fauna habitat. The clearing of vegetation will have short term impacts on fauna, but they are not considered to result in significant impacts on fauna habitat and faunal assemblages in the long-term in a bioregional context. The overall impact on fauna species and species of conservation significance will be minimal.

In conclusion, clearing of the project area is unlikely to have a significant impact on the vertebrate fauna, or conservation significant fauna, when considered in a bioregional context.

Implementation of the following two recommendations will improve outcomes for terrestrial vertebrate fauna during the vegetation clearing process:

- A vertebrate fauna management strategy is prepared for the site and ongoing use of the area; and
- where possible, large eucalypt trees are retained in the project area.

# 1 INTRODUCTION

## 1.1 Background and project location

The City of Kalgoorlie-Boulder is undertaking preliminary investigations to support its development application for a parcel of land at Lot 350 on Plan 220598 Yilkari (i.e. project area) in the industrial suburb west of Kalgoorlie.

Terrestrial Ecosystems was commissioned by Native Vegetation Solutions on behalf of Tetris Environmental and the City of Kalgoorlie-Boulder to undertake a Level 1 vertebrate fauna assessment of the project area.

The project is approximately 2.5km south-west of the outskirts of Kalgoorlie and on the southern side of the Great Eastern Highway (Figure 1). The project area is regular in shape, flat in topography, predominantly on fine red loam over a clay base and comprises approximately 213.4ha (Figure 2).

The City of Kalgoorlie-Boulder requested a desktop and an on-site assessment for the presence of conservation significant fauna.

## 1.2 Project objectives

A Level 1 vertebrate fauna risk assessment involves undertaking a desktop review and site visit. The objectives of this fauna risk assessment were to:

- provide an indication of the vertebrate fauna assemblage (reptiles, amphibians, mammals and birds) on and near the project area so that potential impacts on the fauna and fauna assemblage might be adequately assessed;
- identify the presence and/or potential risk of impacts on species of conservation significance that are present or likely to be present in the project area;
- assess the impact and environmental risks associated with the proposed development on the fauna assemblage;
- determine if any additional surveys are required to assess the potential impact on fauna assemblages in the project area, in particular, impacts on species of conservation significance; and
- make recommendations that avoid, mitigate or minimise potential impacts on resident fauna.

To achieve these objectives, Terrestrial Ecosystems:

- searched the Department of Biodiversity, Conservation and Attractions' (DBCAs) NatureMap database for threatened and priority species near the project area;
- searched the Commonwealth Governments database of fauna of national environmental significance to identify species potentially occurring within the area that are protected under the *Environment Protection and Biodiversity Conservation (EPBC) Act 1999* or international migratory bird agreements (JAMBA/CAMBA);
- searched Terrestrial Ecosystems' database (includes Atlas of Living Australia and DBCA records that were available via NatureMap) to identify potential vertebrate fauna within the area;
- reviewed previous fauna surveys and assessments conducted near the project area;
- undertook a search of the project area for Malleefowl and their mounds;
- discussed the likelihood of species listed under the *EPBC Act 1999* and *Biodiversity Conservation Act 2016* being present in the project area; and
- provided management recommendations to avoid, mitigate and minimise potential impacts on the fauna in the project area.

## 2 EXISTING ENVIRONMENT

### 2.1 Landform and vegetation

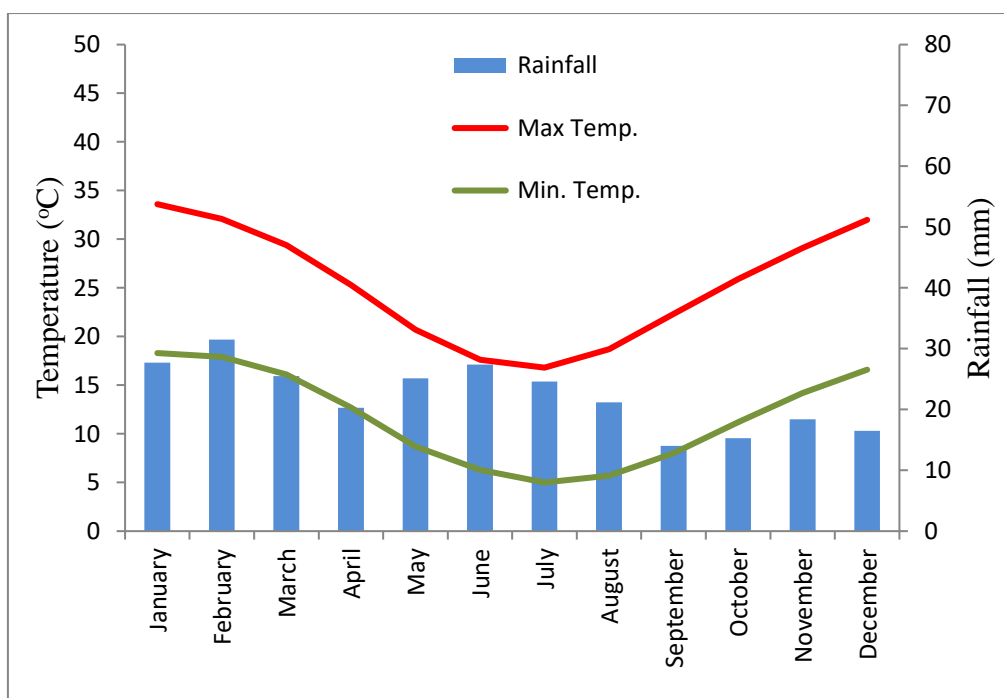
The project area is within the Coolgardie (COO3) Interim Biogeographic Regionalisation of Australia (IBRA) subregion. This subregion is a gently undulating plain on the Yilgarn Craton with calcareous soil being dominant (Cowan 2002). The subregion supports a diverse eucalypt woodland around the salt lakes, on the low ranges and in the broad valleys and mallee and Acacia thickets and shrub heaths on the plains (Cowan 2002). The sub-region is rich in endemic Acacias (Cowan 2002).

### 2.2 Land use

The dominant land uses in the bioregion outside urban development are grazing on natural pasture, crown reserves and mining. Kalgoorlie is the main regional urban and industrial centre in the region. Mining is evident in many areas close to Kalgoorlie, Coolgardie and many of the small towns in the Goldfields, with numerous small abandoned mines and open shafts dotting the landscape. The project area is unallocated crown land on the western edge of the Kalgoorlie-Boulder town site and southern side of the Great Eastern Highway (Figures 1 and 2). Land developments closer to the centre of town are mostly industrial.

#### 2.2.1 Climate

Chart 1 shows the average mean monthly maximum and minimum temperatures and rainfall for Kalgoorlie-Boulder airport, the closest weather station. Temperatures are highest in December–February. Most rain comes in winter or late summer. Winter rain is the result of low pressure cells that move in an easterly direction from the south-west of the state, whereas, summer rain is often from thunderstorms that move in from either the west or the north-west.



**Chart 1. Mean monthly maximum and minimum temperatures and rainfall for Kalgoorlie**  
([http://www.bom.gov.au/climate/averages/tables/cw\\_012038.shtml](http://www.bom.gov.au/climate/averages/tables/cw_012038.shtml); downloaded 6/6/2018)

#### 2.2.2 Fauna species at risk

Cowan (2002) reported the fauna species at risk in the Eastern Goldfields subregion as Malleefowl (*Leipoa ocellata*), Carpet Python (*Morelia spilota imbricata*), Peregrine Falcon (*Falco peregrinus*) Chuditch (*Dasyurus geoffroyi*) and the Freckled Duck (*Stictonetta naevosa*).

### 3 EXISTING VERTEBRATE FAUNA DATA

#### 3.1 Database searches

Several databases were consulted in the preparation of lists of vertebrate fauna that could be in the project area. A search of the Terrestrial Ecosystems database was undertaken to develop a list of birds, reptiles, mammals and amphibians that have been recorded in previous surveys near the project area. A search of the Department of Biodiversity, Conservation and Attractions (DBCA) Threatened and Priority Fauna database via information available in NatureMap was undertaken to identify potential threatened or priority species in the region and a search of the *Environment Protection and Biodiversity Conservation Act (EPBC Act) (1999)* online database of matters national of environmental significance (MNES) was also undertaken for the project area to identify species of conservation interest to the Commonwealth government. The search coordinates for the *EPBC Act 1999* online database were -30.80125°S, 121.4116°E with a 50km radius buffer.

Other more general texts were also used to provide supplementary information including Tyler *et al.* (2000) for frogs; Storr *et al.* (1983, 1990, 1999, 2002) and Thompson and Thompson (2006e) for reptiles; Johnstone and Storr (1998, 2004) for birds, and van Dyck and Strahan (2008) for mammals. In addition, a number of published and unpublished reports of fauna surveys have been used to provide a regional context for the small vertebrate assemblages in the project area.

Collectively, these sources of information were used to create lists of species that are expected to utilise the project area and the broader region. It should be noted that these lists will include species that have been recorded in the general region but are vagrants and they will not generally be found in the project area due to a lack of suitable habitat (e.g. shore birds). Vagrants can be recorded almost anywhere. Many of the bird, mammal, reptile and amphibian species have specific habitat requirements that may be present in the general area but not in the specific survey area. As the ecology of many of these species is often not well understood, it can sometimes be difficult to indicate those species whose specific habitat requirements are not present in the survey area. In addition, most online databases contain historical records for species that are now locally extinct. As a consequence, many species will be included in the lists produced from database searches but will not be present in the actual project area.

The *EPBC Act* online MNES database for terrestrial fauna places a wide buffer around previously known locations of threatened species and includes historical records in its database. Therefore, a search of this database will invariably include species that are either locally extinct or were never present in parts of the search area due to a lack of suitable habitat (e.g. wetland and shore birds).

Terrestrial Ecosystems cannot vouch for the accuracy of the information contained in these records, as it was not possible to check records in NatureMap, Western Australian Museum records, *EPBC Act* MNES database or the work of other environmental consultants reporting on their fauna surveys.

#### 3.2 Contextual data

The frogs, reptiles, mammals and birds in the Eastern Goldfields have been surveyed on many occasions for a variety of purposes and are therefore well known. Fauna surveys and assessments undertaken near the project area that have been reviewed for this assessment include:

- ATA Environmental (2006a) *Fauna assessment proposed clearing around Black Flag*. Unpublished report for Placer Dome Australia Pty Ltd., Perth.
- ATA Environmental (2006b) *Fauna assessment proposed clearing around the Grants Patch Mine Site*. Unpublished report for Placer Dome Australia Pty Ltd., Perth.
- ATA Environmental (2006c) *Fauna Assessment Proposed Clearing at the Janet Ivy Site*. Unpublished report for Placer Dome Australia Pty Ltd. Perth.
- ATA Environmental (2006d) *Fauna assessment proposed clearing around the Moonbeam Mine Site*. Unpublished report for Placer Dome Australia Pty Ltd., Perth.
- ATA Environmental (2006e) *Fauna assessment proposed clearing around the Natal Mine Site*. Unpublished report for Placer Dome Australia Pty Ltd., Perth.
- ATA Environmental (2006f) *Fauna assessment proposed clearing around the Ora Banda Mine Site*. Unpublished report for Placer Dome Australia Pty Ltd, Perth.
- ATA Environmental (2006g) *Fauna assessment proposed clearing around the Rose West Site*. Unpublished report for Placer Dome Australia Pty Ltd., Perth.
- ATA Environmental (2006h) *Malleefowl assessment for clearing application at Janet Ivy Site*. Unpublished report for Placer Dome Australia Pty Ltd. Perth.



- Bamford, M.J., Davies, S.J.J.F. and Ladd, P.G. (1990) *Biological Survey of the Kangaroo Hills and Calooli Timber Reserves, Coolgardie, Western Australia.*
- Chapman, A., Kealley, I., McMillan, D., McMillan, P. and Rolland, G. (1991) *Biological surveys of four Goldfields Reserves, Landnote, 1/91, 1-26*
- Eco Logical (2016) *Biological Assessment - Binduli Expansion Project. Level 1 vertebrate fauna and Short-range Endemic invertebrate survey*, Unpublished report for Norton Gold Fields, Kalgoorlie
- Hart and Associates (2000) *Anaconda Nickel Ltd, Cawse Expansion Project, Fauna Survey*, Unpublished report for Anaconda Nickel Ltd, Perth.
- McKenzie, N.L. and Hall, N.J. (1992) The biological survey of the eastern goldfields of Western Australia. Part 8: Kurnalpi - Kalgoorlie study area, *Records of the Western Australian Museum*, Supplement 41.
- McKenzie, N.L., Rolfe, J.K. and Youngson, W.K. (1992) IV Vertebrate fauna, *Records of the Western Australian Museum*, Supplement, No 41, 37-64.
- Ninox Wildlife Consulting (1999) *Fauna Survey for the White Foil Gold Project*, Unpublished report for Mines and Resources Australia Pty Ltd, Perth.
- Ninox Wildlife Consulting (2002) *A Vertebrate Fauna Assessment of the Proposed White Foil Haul Road Route near Kalgoorlie, Western Australia*, Unpublished report for Mines and Resources Pty Ltd, Perth.
- Risbey (2000) *An assessment of the populations of feral cats and foxes in the Ora Banda region for Cawse Nickel Operations, Western Australia.* Kalgoorlie.
- Shepherdson Environmental Services (2001a) *Fauna of the Black Cat and Panther Leases, M16/34 and M16/365 (P16/1675)*. Unpublished report for Kinver Mining NL.
- Shepherdson Environmental Services (2001b) *Fauna of the proposed Golden Cities to Paddington Haul Road and surrounding area.* Perth.
- Terrestrial Ecosystems (2010) *Level 1 Fauna Risk Assessment for La Mancha Resources White Foil Gold Deposit Project Area.* Perth.
- Terrestrial Ecosystems (2013) *Level 1 Vertebrate Fauna Risk Assessment for the Borefields Road at Coolgardie, V3.* Perth.
- Terrestrial Ecosystems (2016) *Level 1 Vertebrate Fauna Risk Assessment for the Mungari Tailing Storage Facility Cell 3 (TSF3).* Perth.
- Terrestrial Ecosystems (2017) *Level 1 Vertebrate Fauna Risk Assessment for the Jaurdi Hills Mining Area.* Perth.
- Terrestrial Ecosystems (2018) *Level 1 Vertebrate Fauna Risk Assessment for the Anzac Drive West Industrial Estate, V2.* Perth
- Terrestrial Ecosystems (2018a) *Annual Malleefowl Survey - Enterprise, Mulgarrie and north of Federal.* Perth.
- Terrestrial Ecosystems (2018b) *Annual Malleefowl Survey - Enterprise, Carbine and Golden Cities.* Perth.
- Terrestrial Ecosystems (2018c) *Level 1 Fauna Risk Assessment and the results of a Malleefowl search for the Golden Cites project area.* Perth.
- Terrestrial Ecosystems (2018d) *Level 1 Vertebrate Fauna Risk Assessment for Lot 500 Great Eastern Highway, Kalgoorlie.* Perth.
- Thompson, S. (2004) *Mine site rehabilitation index using reptile assemblage as a bio-indicator*, PhD thesis and additional surveys.

In addition, Terrestrial Ecosystems has included in the Thompson (2004) fauna survey data, data collected after Thompson's (2004) PhD was completed. Much of this work has been published or been presented at various workshops and conferences (Thompson 2001, Thompson and Thompson 2002, Thompson 2002, Thompson et al. 2003a, Thompson et al. 2003b, Thompson et al. 2003c, Thompson and Thompson 2003a, Thompson 2003c, a, b, Thompson and Thompson 2003b, Thompson and Thompson 2004a, Thompson 2004, Thompson and Thompson 2004b, Thompson and Thompson 2005a, Thompson and Thompson 2005c, b, Thompson et al. 2005a, b, Thompson and Thompson 2006a, Thompson and Thompson 2006c, b, Thompson and Thompson 2006e, d, Thompson and Thompson 2007a, b, Thompson and Thompson 2008).

Data in the Atlas of Living Australia and Western Australian Museum has also been added to the information contained in Appendix B, and the compilation of the species lists for the project area.

Although the *Binduli Expansion Project* (Eco Logical Australia 2016) report is described as a Level 1 assessment, the surveyors undertook a targeted search of the area for Malleefowl mounds, a systematic (i.e. 24 sites) and opportunistic search for short-range endemic invertebrates and opportunistic searches for vertebrate fauna. The Binduli expansion project is less than 2km west of the project area, it is therefore useful and relevant to this assessment.

Thompson' (2004b) data are the most comprehensive vertebrate fauna survey data for this part of the Goldfields and include all habitat types contained in the project area. The McKenzie *et al.* (1992) data are part of a series of regional surveys undertaken by the Western Australian Museum, the Western Australian Wildlife Centre, National Parks Authority and the Western Australian Herbarium, and this particular this survey focussed on the Kurnalpi – Kalgoorlie area. This survey includes fauna habitats present in the project area. Surveys by Bamford *et al.* (1990) and Chapman *et al.* (1991) are for reserves in this part of the Goldfields and there are two surveys for White Foil the gold mine (Ninox Wildlife Consulting 1999, 2002) which is approximately 15km west of the project area. The other reports listed above are Level 1 assessments and essentially report data from the available government databases and a few of the fauna survey reports for the general area.

### 3.3 Fauna habitat assessment

The fauna habitat assessment was undertaken for the entire project area. This field assessment had two foci:

- assessing fauna habitat types and their condition; and
- assessing the possible presence of and recording evidence of conservation significant fauna so that mitigation and management strategies might be implemented to reduce potential impacts.

The fauna habitat assessor stopped at multiple locations within the project area and recorded a suite of data about the fauna habitat and its condition. This information included a description of the habitat structure, habitat condition, landform, soils and vegetation and time since last fire. The following data were recorded at each location as part of the habitat assessment:

*Observer's name*

*Coordinates* of the location as UTM (WGS 84)

*Fire history* – options

> 5 years

1-5 years

< 1 year

*Landform* – options

Beach

Clay plain

Cliff

Creek line

Dam

Drainage line

Dune crest

Dune slope

Dune swale

Escarpment

Flat

Gorge

Gully

Intertidal / mangrove

Lake / lake edge

Lower slope

Mid slope

Ridge

River

Rocky outcrop / breakaway

Salt lake

Sand dune

Sand plain

Stony plain

Swamp

Undulating

Upper slope

Wetland

Water hole

*Habitat quality* – options

- *High quality fauna habitat* – These areas closely approximate the vegetation mix and quality that would have been in the area prior to any disturbance. The habitat has connectivity with other habitats and is likely to contain the most natural vertebrate fauna assemblage.
- *Very good fauna habitat* - These areas show minimal signs of disturbance (e.g. grazing, clearing, fragmentation, weeds) and generally retain many of the characteristics of the habitat if it had not been disturbed. The habitat has connectivity with other habitats and fauna assemblages in these areas are likely to be minimally affected by disturbance.
- *Good fauna habitat* – These areas showed signs of disturbance (e.g. grazing, clearing, fragmentation, weeds) but generally retain many of the characteristics of the habitat if it had not been disturbed. The habitat has connectivity with other habitats and fauna assemblages in these areas are likely to be affected by disturbance.
- *Disturbed fauna habitat*– These areas showed signs of significant disturbance. Many of the trees, shrubs and undergrowth are cleared. These areas may be in the early succession and regeneration stages. Areas may show signs of significant grazing, containing weeds or have been damaged by vehicle or machinery. Habitats are fragmented or have limited connectivity with other fauna

- habitats. Fauna assemblages in these areas are likely to differ significantly from what might be expected in the area had the disturbance not occurred.
- *Highly degraded fauna habitat* – These areas often have a significant loss of vegetation, an abundance of weeds, and a large number of vehicle tracks or are completely cleared. Limited or no fauna habitat connectivity. Fauna assemblages in these areas are likely to be significantly different to what might have been in the area pre-disturbance.

*Habitat structure - options*

*Upper stratum*

Tall open woodland	Scattered tall trees
Tall woodland	Scattered trees
Open woodland	Scattered low trees
Woodland	Low closed forest
Open forest	Low open forest
Closed forest	Low woodland
Tall closed forest	Low open woodland
Tall open forest	

*Middle stratum*

Shrubland	Open heath
Tall shrubland	Low closed heath
Tall open shrubland	Low open heath
Low shrubland	Tall closed scrub
Scattered low shrubs	Tall open scrub
Low open shrubland	Scattered tall shrubs
Scattered tall shrubs	Open shrubland
Closed heath	Scattered shrubs

*Lower stratum*

Closed hummock grassland	Closed tussock grassland / sedgeland / herbland
Mid-dense hummock grassland	Tussock grass land / sedgeland / herbland
Hummock grassland	Open tussock grassland / sedgeland / herbland
Open hummock grassland	Scattered tussock / grasses / sedges / herbs
Scattered hummock grassland	Very open tussock grassland / herbland

*Soil Type – options*

Sand	Clay loam
Loamy sand	Silty clay loam
Clayey sand	Clay
Sandy loam	Rock
Loam	Peat / organic
Silty loam	Stony
Sandy clay loam	

*Soil Colour –options*

Black	Red
Brown	White
Grey	Yellow
Orange	

*Surface stones - options*

None	Boulders (>250mm)
Pebbles (0-50mm)	Rocks
Cobbles (51-250mm)	

Potential for conservation significant species to be found in the area

- Yes
- No

Impact of clearing on conservation significant species – options

Low	Moderate - high
Low - moderate	High
Moderate	Extreme

Translocation of conservation significant fauna required:

- Yes or No

### **3.4 Taxonomy and nomenclature**

Taxonomy and nomenclature for fauna species used in this report are generally based on the WA Museum species list except for bats, which follow (Churchill 2008) and birds which follow Christidis and Boles (2008). Terrestrial Ecosystems has presumed that the identifications referred to in the appendices or in reports used to provide local and regional comparative data were correct and we have only corrected obvious records where the nomenclature was known to be incorrect.

### **3.5 Survey and reporting staff**

Dr Scott Thompson undertook the site investigation and fauna habitat assessment and searched the site for Malleefowl and their mounds. Dr Scott Thompson prepared the report and Dr Graham Thompson reviewed the report before it was sent to the client. Both senior scientists have appropriate relevant post-graduate qualifications, extensive experience in conducting fauna assessments in the Goldfields, have published research articles on biodiversity, fauna assemblages, conservation significant species, survey strategies for Malleefowl, trapping techniques and temporal variations in trapped fauna assemblages based on Goldfields survey data and are therefore appropriately trained and experienced for the task of preparing this assessment.

### **3.6 Limitations**

Conclusions and management recommendations regarding the vertebrate fauna assemblage have been based on the data available in other fauna surveys nearby and a site visit. It is acknowledged that multiple surveys conducted in different seasons, repeated over several years are necessary to understand the vertebrate fauna in the project area.

Lists of species potentially in and around the project area have been compiled from records in the Western Australian Museum records, Atlas of Living Australia and reports of fauna surveys undertaken nearby. Some records in the Atlas of Living Australia and the Western Australian Museum are very old and those species are no longer present in the area. Terrestrial Ecosystems has not been able to see the primary data and is therefore not able to vouch for the accuracy of these records. All of these sources of data are known to contain errors, and this should be taken into account when reading this assessment.

The *EPBC Act* online MNES database for terrestrial fauna includes historical records and places a wide buffer around previously known locations of threatened species and in its database. A search of this database will invariably include species that are either locally extinct or were never present in parts of the search area.

The EPA's Technical Guidance Terrestrial Fauna Surveys (Environmental Protection Authority 2016b) suggested that fauna surveys may be limited by many variables. Limitations associated with each of these variables are assessed in Table 1.

**Table 1. Assessment constraints and limitations**

Possible limitations	Constraint (yes/no); significant, moderate or negligible	Comment
Competency and experience of the consultants undertaking this assessment	No	The scientists who prepared, revised and reviewed this report are familiar with the task and have a good appreciation of the vertebrate fauna in the Goldfields.
Scope	No	The scope of this assessment has been completed.
Proportion of fauna identified, recorded and/or collected	No	The appended fauna survey data are adequate to understand the vertebrate fauna potentially in the project area.
Sources of information	No	Vertebrate fauna information was available from surveys conducted at other sites nearby, published and unpublished reports and Terrestrial Ecosystems fauna survey database. In addition, the survey effort and survey period for some of these surveys was not optimum, which significantly impacts on the capacity of these data to represent the fauna assemblages in the areas surveyed.
Proportion of the task achieved	No	The site visit and subsequent assessment fulfil the objectives stated.
Timing/weather/season/cycle	Not applicable	
Disturbances which affected results of the survey	Yes, Negligible	The area has been disturbed by a variety of activities. This disturbance has been considered in this assessment.
Intensity of survey effort	Not applicable	
Completeness	No	The entire project area has been assessed.
Resources	No	Adequate resources were available.
Remoteness and/or access problems	No	There were no access or remoteness issues.
Availability of contextual information on the region	No	NatureMap, DBCA's Threatened and Priority species database available via NatureMap, published and unpublished reports of surveys conducted at other sites nearby and Terrestrial Ecosystems' database were available.

Negligible – less than 20%; Moderate – 20-60%; significant – greater than 60%

## 4 RESULTS

### 4.1 Fauna habitat

There is one broad fauna habitat type in the project area. This habitat type is best described as an open eucalypt woodland with a mixed understory of scattered shrubs and chenopods. There were variations in the densities of trees, shrubs and ground cover, but these differences were not sufficient to support a significantly different vertebrate fauna assemblage.

Much of the project area was in good condition, however, there is evidence of well used tracks through the area, ground disturbance and rubbish has been dumped in some areas. Plates 1-8 are images of the area showing a variety of habitats, the internal tracks and some of the rubbish that has been deposited in the area.



**Plate 1. Project area habitat**



**Plate 2. Project area habitat**



**Plate 3. Project area habitat**



**Plate 4. Project area habitat**



**Plate 5. Project area habitat**



**Plate 6. Project area habitat**



**Plate 7. Rubbish and disturbance in the project area**



**Plate 8. Evidence of historical exploration activity and rehabilitation in the project area**

## **4.2 Vertebrate fauna potentially in the project area**

Based on records in Western Australian Museum records, Atlas of Living Australia and other fauna survey reports for sites nearby, vertebrate fauna potentially found in the project area are shown in Tables 2-5.

**Table 2. Birds potentially in the vicinity of the project area**

Family	Species	Common Name
Casuariidae	<i>Dromaius novaehollandiae</i>	Emu
Megapodiidae	<i>Leipoa ocellata</i>	Malleefowl
Columbidae	<i>Phaps chalcoptera</i>	Common Bronzewing
	<i>Phaps elegans</i>	Brush Bronzewing
	<i>Ocyphaps lophotes</i>	Crested Pigeon
Podargidae	<i>Podargus strigoides</i>	Tawny Frogmouth
Caprimulgidae	<i>Eurostodopus argus</i>	Spotted Nightjar
Aegothelidae	<i>Aegotheles cristatus</i>	Australian Owlet-nightjar
Anhingidae	<i>Anhinga melanogaster</i>	Australasian Darter
Ardeidae	<i>Ixobrychus sinensis</i>	Yellow Bittern
	<i>Nycticorax caledonicus</i>	Nankeen Night Heron
Accipitridae	<i>Elanus axillaris</i>	Black-shouldered Kite
	<i>Lophoictinia isura</i>	Square-tailed Kite
Accipitridae	<i>Aquila audax</i>	Wedge-tailed Eagle
Falconidae	<i>Falco cenchroides</i>	Nankeen Kestrel
	<i>Falco berigora</i>	Brown Falcon
	<i>Falco longipennis</i>	Australian Hobby
Charadriidae	<i>Vanellus tricolor</i>	Banded Lapwing
Cacatuidae	<i>Eolophus roseicapillus</i>	Galah
	<i>Nymphicus hollandicus</i>	Cockatiel
Psittacidae	<i>Glossopsitta porphyrocephala</i>	Purple-crowned Lorikeet
	<i>Polytelis anthopeplus</i>	Regent Parrot
	<i>Barnardius zonarius</i>	Australian Ringneck
	<i>Psepholus varius</i>	Mulga Parrot
Cuculidae	<i>Chalcites basalus</i>	Horsfield's Bronze-cuckoo
	<i>Chalcites osculans</i>	Black-eared Cuckoo
	<i>Chalcites lucidus</i>	Shining Bronze-cuckoo
	<i>Cacomantis pallidus</i>	Pallid Cuckoo
Strigidae	<i>Ninox novaeseelandiae</i>	Southern Boobook
Tytonidae	<i>Tyto alba</i>	Barn Owl
Halcyonidae	<i>Todiramphus pyrrhopygius</i>	Red-backed Kingfisher
Meropidae	<i>Merops ornatus</i>	Rainbow Bee-eater
Climacteridae	<i>Climacteris rufa</i>	Rufous Treecreeper
Ptilonorhynchidae	<i>Ptilonorhynchus maculatus</i>	Spotted Bowerbird
Ptilonorhynchidae	<i>Ptilonorhynchus guttatus</i>	Western Bowerbird
Maluridae	<i>Malurus splendens</i>	Splendid Fairy-wren
	<i>Malurus leucopterus</i>	White-winged Fairy-wren
	<i>Malurus pulcherrimus</i>	Blue-breasted Fairy-wren
Acanthizidae	<i>Hylacola cauta</i>	Shy Heathwren
	<i>Calamanthus campestris</i>	Rufous Fieldwren
	<i>Pyrrholaemus brunneus</i>	Redthroat
	<i>Smicrornis brevirostris</i>	Weebill
	<i>Gerygone fusca</i>	Western Gerygone
	<i>Acanthiza robustirostris</i>	Slaty-backed Thornbill
	<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill
	<i>Acanthiza uropygialis</i>	Chestnut-rumped Thornbill
	<i>Acanthiza iredalei</i>	Slender-billed Thornbill
	<i>Acanthiza apicalis</i>	Inland Thornbill
Pardalotidae	<i>Aphelocephala leucopsis</i>	Southern Whiteface
Pardalotidae	<i>Pardalotus punctatus</i>	Spotted Pardalote
	<i>Pardalotus rubricatus</i>	Red-browed Pardalote
	<i>Pardalotus striatus</i>	Striated Pardalote
Meliphagidae	<i>Certhionyx variegatus</i>	Pied Honeyeater
	<i>Lichenostomus virescens</i>	Singing Honeyeater
	<i>Lichenostomus leucotis</i>	White-eared Honeyeater
	<i>Lichenostomus flavicollis</i>	Yellow-throated Honeyeater
	<i>Lichenostomus cratitius</i>	Purple-gaped Honeyeater

Family	Species	Common Name
	<i>Ptilotula keartlandi</i>	Grey-headed Honeyeater
	<i>Lichenostomus ornatus</i>	Yellow-plumed Honeyeater
	<i>Lichenostomus plumulus</i>	Grey-fronted Honeyeater
	<i>Lichenostomus penicillatus</i>	White-plumed Honeyeater
	<i>Purnella albifrons</i>	White-fronted Honeyeater
	<i>Manorina flavigula</i>	Yellow-throated Miner
	<i>Acanthagenys rufogularis</i>	Spiny-cheeked Honeyeater
	<i>Anthochaera carunculata</i>	Red Wattlebird
	<i>Epthianura tricolor</i>	Crimson Chat
	<i>Epthianura aurifrons</i>	Orange Chat
	<i>Epthianura albifrons</i>	White-fronted Chat
	<i>Sugomel niger</i>	Black Honeyeater
	<i>Lichmera indistincta</i>	Brown Honeyeater
	<i>Phylidonyris niger</i>	White-cheeked Honeyeater
	<i>Melithreptus brevirostris</i>	Brown-headed Honeyeater
	<i>Melithreptus chloropsis</i>	Gilbert's Honeyeater
Pomatostomidae	<i>Pomatostomus superciliosus</i>	White-browed Babbler
	<i>Pomatostomus superciliosus</i>	White-browed Babbler
Psophodidae	<i>Cinclosoma castanotum</i>	Chestnut Quail-thrush
Neosittidae	<i>Daphoenositta chrysoptera</i>	Varied Sittella
Campephagidae	<i>Coracina maxima</i>	Ground Cuckoo-shrike
	<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike
	<i>Lalage sueurii</i>	White-winged Triller
Pachycephalidae	<i>Pachycephala inornata</i>	Gilbert's Whistler
	<i>Pachycephala pectoralis</i>	Golden Whistler
	<i>Pachycephala simplex</i>	Grey Whistler
	<i>Pachycephala rufiventris</i>	Rufous Whistler
	<i>Colluricincla harmonica</i>	Grey Shrike-thrush
	<i>Oreoica gutturalis</i>	Crested Bellbird
Artamidae	<i>Artamus personatus</i>	Masked Woodswallow
	<i>Artamus cinereus</i>	Black-faced Woodswallow
	<i>Artamus cyanopterus</i>	Dusky Woodswallow
	<i>Cracticus torquatus</i>	Grey Butcherbird
	<i>Cracticus nigrogularis</i>	Pied Butcherbird
	<i>Cracticus tibicen</i>	Australian Magpie
	<i>Strepera versicolor</i>	Grey Currawong
Rhipiduridae	<i>Rhipidura albiscapa</i>	Grey Fantail
	<i>Rhipidura leucophrys</i>	Willie Wagtail
Corvidae	<i>Corvus coronoides</i>	Australian Raven
	<i>Corvus bennetti</i>	Little Crow
	<i>Corvus orru</i>	Torresian Crow
Monarchidae	<i>Grallina cyanoleuca</i>	Magpie-lark
Petroicidae	<i>Microeca fascians</i>	Jacky Winter
	<i>Petroica goodenovii</i>	Red-capped Robin
	<i>Melanodryas cucullata</i>	Hooded Robin
	<i>Eopsaltria griseogularis</i>	Western Yellow Robin
	<i>Drymodes brunneopygia</i>	Southern Scrub-robin
Megaluridae	<i>Cincloramphus mathewsi</i>	Rufous Songlark
Timaliidae	<i>Zosterops lateralis</i>	White-eye
Hirundinidae	<i>Cheramoeca leucosterna</i>	White-backed Swallow
	<i>Hirundo neoxena</i>	Welcome Swallow
	<i>Petrochelidon ariel</i>	Fairy Martin
	<i>Hirundo nigricans</i>	Tree Martin
Nectariniidae	<i>Dicaeum hirundinaceum</i>	Mistletoebird
Estrildidae	<i>Taeniopygia guttata</i>	Zebra Finch
Motacillidae	<i>Anthus novaeseelandiae</i>	Australasian Pipit



**Table 3. Mammals potentially in the vicinity of the project area**

Family	Species	Common Name
Bovidae	<i>Capra hircus</i>	Goat
	<i>Ovis aries</i>	Sheep
Canidae	<i>Canis familiaris</i>	Dog
	<i>Vulpes vulpes</i>	Red Fox
Felidae	<i>Felis catus</i>	House Cat
Molossidae	<i>Austronomus australis</i>	White-striped Free-tail Bat
	<i>Mormopterus planiceps</i>	Southern Free-tail Bat
Vespertilionidae	<i>Chalinolobus gouldii</i>	Gould's Wattled Bat
	<i>Chalinolobus morio</i>	Chocolate Wattled Bat
	<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat
	<i>Nyctophilus gouldi</i>	Gould's Long-eared Bat
	<i>Nyctophilus major</i>	Greater Long-eared Bat
	<i>Scotorepens balstoni</i>	Inland Broad-nosed Bat
	<i>Vespadelus baverstocki</i>	Inland Forest Bat
	<i>Vespadelus regulus</i>	Southern Forest Bat
Dasyuridae	<i>Antechinomys laniger</i>	Kultarr
	<i>Ningauai ridei</i>	Wongai Ningauai
	<i>Ningauai yvonneae</i>	Mallee Ningauai
	<i>Pseudantechinus woolleyae</i>	Woolley's False Antechinus

Family	Species	Common Name
	<i>Sminthopsis crassicaudata</i>	Fat-tailed Dunnart
	<i>Sminthopsis dolichura</i>	Little Long-tailed Dunnart
	<i>Sminthopsis gilberti</i>	Gilbert's Dunnart
	<i>Sminthopsis ooldea</i>	Ooldea Dunnart
Burramyidae	<i>Cercartetus concinnus</i>	Western Pygmy Possum
Macropodidae	<i>Macropus fuliginosus</i>	Western Grey Kangaroo
	<i>Osphranter robustus</i>	Euro
	<i>Osphranter rufus</i>	Red Kangaroo
Leporidae	<i>Oryctolagus cuniculus</i>	European Rabbit
Tachyglossidae	<i>Tachyglossus aculeatus</i>	Short-beaked Echidna
Muridae	<i>Mus musculus</i>	House Mouse
	<i>Notomys alexis</i>	Spinfex Hopping Mouse
	<i>Notomys mitchellii</i>	Mitchell's Hopping Mouse
	<i>Pseudomys albocinereus</i>	Ash-grey Mouse
	<i>Pseudomys bolami</i>	Bolam's Mouse
	<i>Pseudomys hermannsburgensis</i>	Sandy Inland Mouse

**Table 4. Reptiles potentially in the vicinity of the project area**

Family	Species	Common Name
Agamidae	<i>Ctenophorus cristatus</i>	Crested Dragon
	<i>Ctenophorus fordi</i>	Mallee Dragon
	<i>Ctenophorus isolepis</i>	Military Dragon
	<i>Ctenophorus maculatus</i>	Spotted Dragon
	<i>Ctenophorus nuchalis</i>	Central Netted Dragon
	<i>Ctenophorus reticulatus</i>	Western Netted Dragon
	<i>Ctenophorus salinarum</i>	Saltpan Dragon
	<i>Ctenophorus scutulatus</i>	Lozenge-marked Dragon
	<i>Diporiphora amphiboluroides</i>	Mulga Dragon
	<i>Moloch horridus</i>	Thorny Devil
	<i>Pogona minor</i>	Dwarf Bearded Dragon
	<i>Tympanocryptis cephalus</i>	Pebble Dragon
Boidae	<i>Morelia spilota</i>	Carpet Python
Carphodactylidae	<i>Nephrurus laevisimus</i>	Smooth Knob-tail
	<i>Nephrurus vertebralis</i>	Midline Knob-tail
	<i>Underwoodisaurus milii</i>	Barking Gecko
Diplodactylidae	<i>Amalosa reticulata</i>	Reticulated Velvet Gecko
	<i>Crenadactylus ocellatus</i>	South-west Clawless Gecko
	<i>Diplodactylus conspicillatus</i>	Fat-tailed Diplodactylus
	<i>Diplodactylus granariensis</i>	Wheat-belt Stone Gecko
	<i>Diplodactylus pulcher</i>	Fine-faced Gecko
	<i>Hesperoedura reticulata</i>	Reticulated Velvet Gecko
	<i>Lucasium maini</i>	Main's Ground Gecko
	<i>Oedura marmorata</i>	Marbled Velvet Gecko
	<i>Strophurus assimilis</i>	Goldfields Spiny-tailed Gecko
	<i>Strophurus elderi</i>	Jewelled Gecko
Elapidae	<i>Acanthophis pyrrhus</i>	Desert Death Adder
	<i>Brachyuropis fasciolata</i>	Narrow-banded Burrowing Snake
	<i>Brachyuropis semifasciata</i>	Half-girdled Snake
	<i>Demansia psammophis</i>	Yellow-faced Whipsnake
	<i>Furina ornata</i>	Orange-naped Snake
	<i>Neelaps bimaculatus</i>	Black-naped Burrowing Snake
	<i>Parasuta gouldii</i>	Gould's Snake
	<i>Parasuta monachus</i>	Monk Snake
	<i>Pseudechis australis</i>	Mulga Snake
	<i>Pseudonaja mengdeni</i>	Gwardar
	<i>Pseudonaja modesta</i>	Ringed Brown Snake
	<i>Simoselaps bertholdi</i>	Jan's Banded Snake
	<i>Suta fasciata</i>	Rosen's Snake
	<i>Suta suta</i>	Curl Snake
Gekkonidae	<i>Christinus marmoratus</i>	Marbled Gecko
	<i>Gehyra purpurascens</i>	Purplish Dtella
	<i>Gehyra variegata</i>	Tree Dtella
	<i>Hemidactylus frenatus</i>	Asian House Gecko
	<i>Heteronotia binoei</i>	Bynoe's Prickly Gecko
	<i>Rhynchoedura ornata</i>	Western Beaked Gecko
Pygopodidae	<i>Aprasia repens</i>	Sedgeland's Worm-lizard

Family	Species	Common Name
	<i>Delma australis</i>	Marble-faced Delma
	<i>Delma butleri</i>	Unbanded Delma
	<i>Delma fraseri</i>	Fraser's Delma
	<i>Lialis burtonis</i>	Burton's Snake-lizard
	<i>Pygopus lepidopodus</i>	Common Scaly-foot
	<i>Pygopus nigriceps</i>	Western Hooded Scaly-foot
Scincidae	<i>Cryptoblepharus buchananii</i>	Buchanan's Snake-eyed Skink
	<i>Ctenotus atlas</i>	Southern Mallee Ctenotus
	<i>Ctenotus brooksi</i>	Wedgsnout Ctenotus
	<i>Ctenotus leonhardii</i>	Leonhard's Ctenotus
	<i>Ctenotus schomburgkii</i>	Schomburgk's Ctenotus
	<i>Ctenotus uber</i>	Spotted Ctenotus
	<i>Cyclodomorphus branchialis</i>	Common Slender Bluetongue
	<i>Cyclodomorphus melanops</i>	Spinfex Slender Bluetongue
	<i>Egernia depressa</i>	Southern Pygmy Spiny-tailed Skink
	<i>Egernia formosa</i>	Goldfields Crevice-skink
	<i>Egernia richardi</i>	Bright Crevice-skink
	<i>Eremiascincus richardsonii</i>	Broad-banded Sand Swimmer
	<i>Hemiergus gracilipes</i>	South-western Mulch-skink
	<i>Hemiergus initialis</i>	South-western Earless Skink
	<i>Lampropholis guichenoti</i>	Pale-flecked Garden Skink
	<i>Lerista kingi</i>	King's Slider
	<i>Lerista picturata</i>	Southern Robust Slider
	<i>Lerista timida</i>	Timid Slider
	<i>Liopholis inornata</i>	Desert Skink
	<i>Liopholis striata</i>	Nocturnal Desert Skink
	<i>Menetia greyii</i>	Common Dwarf Skink
	<i>Morethia adelaidensis</i>	Saltbush Morethia Skink
	<i>Morethia butleri</i>	Woodland Morethia Skink
	<i>Morethia obscura</i>	Shrubland Morethia Skink
	<i>Tiliqua occipitalis</i>	Western Blue-tongued Lizard
	<i>Tiliqua rugosa</i>	Bobtail
Typhlopidae	<i>Anilius australis</i>	Austral Blind Snake
	<i>Anilius bicolor</i>	Dark-spined Blind Snake
	<i>Anilius bituberculatus</i>	Prong-snouted Blind Snake
	<i>Anilius hamatus</i>	Pale-headed Blind Snake
	<i>Anilius waitii</i>	Waite's Blind Snake
Varanidae	<i>Varanus caudolineatus</i>	Stripe-tailed Monitor
	<i>Varanus gouldii</i>	Gould's Goanna
	<i>Varanus tristis</i>	Black-headed Monitor

**Table 5. Amphibians potentially in the vicinity of the project area**

Family	Species	Common Name
Hylidae	<i>Litoria moorei</i>	Motorbike Frog
Limnodynastidae	<i>Neobatrachus kunapalari</i>	Kunapalari Frog
	<i>Neobatrachus pelobatoides</i>	Humming Frog
	<i>Neobatrachus sutor</i>	Shoemaker Frog

Family	Species	Common Name
	<i>Neobatrachus wilsmorei</i>	Goldfields Bullfrog
Myobatrachidae	<i>Pseudophryne occidentalis</i>	Orange-crowned Toadlet

Lists of species in Tables 2-5 come from a diverse range of Goldfields habitat types. Species in the project area would therefore be a subset of these lists and would be less than if the area was undisturbed and away from an existing urban area.

### 4.3 Conservation significant fauna

Conservation significant fauna are protected by the Commonwealth *EPBC Act 1999*, and this list includes species covered by international treaties such as the Japan-Australia Migratory Bird Agreement (JAMBA) and China-Australia Migratory Bird Agreement (CAMBA) and the Western Australia (WA) *Biodiversity Conservation Act 2016 (BC Act 2016)*. The *BC Act 2016* provides for the publishing of the *Biodiversity Conservation (Specially Protected Fauna) Notice* that lists species under multiple categories. In addition, DBCA maintains a list of fauna that require monitoring under four priorities based on the current knowledge of their distribution, abundance and threatening processes. The *EPBC Act 1999* and *BC Act 2016* imply legislative requirements for the management of anthropogenic impacts to minimise the effects of disturbances on species and their habitats. Priority species have no statutory protection, other than the DBCA wishes to monitor potential impacts on these species. Environmental consultants and proponents of developments are encouraged to avoid and minimise impacts on these species. Definitions of the significant fauna under the *BC Act* are provided in Appendix B.

#### 4.3.1 Significant fauna species potentially in the project area

The fauna species that have special status in either State or Commonwealth government legislation or are on the DBCA Priority species list and are potentially present in the vicinity of the project area are listed in Table 6. Excluded from Table 6 are migratory species that typically would be found around the edges of salt lakes, clay pans, estuaries and marshes [e.g. *Actitis hypoleucos* (Common Sand Piper), *Calidris acuminata* (Sharp-tailed Sandpiper), *Calidris ferruginea* (Curlew Sandpiper), *Calidris melanotos* (Pectoral Sandpiper), *Thinornis rubricollis* (Hooded Plover), *Tringa nebularia* (Common Greenshank)], as there is no suitable habitat nearby.

Seven species listed under the Commonwealth *EPBC Act 1999* and under the *BC Act 2016* potentially occur in the vicinity of the project area. In addition, another seven listed as Priority species requiring further monitoring, may occur in the vicinity of the project area. Some information on the biology and ecology of these species is provided below along with an assessment of their potential to be in the project area and impacted by the clearing of vegetation.

**Table 6. Assessment of the potential impact on conservation significant fauna that could occur in the bioregion**

Species		Status under WA Biodiversity Conservation Act 2016 Schedule/ Priority	Status under Commonwealth EPBC Act 1999	Comment on potential impact on conservation significant species
<i>Ogyris subterrestris petrina</i>	Arid Bronze Azure Butterfly	Critically Endangered	Critically Endangered	<i>Unlikely</i> to be in the project area, so the potential impact on this species is low.
<i>Pezoporus occidentalis</i>	Night Parrot	Critically Endangered	Endangered	<i>Unlikely</i> to be in the project area, so the potential impact on this species is low.
<i>Leipoa ocellata</i>	Malleefowl	Vulnerable	Vulnerable	<i>Unlikely</i> to be in the project area, so the potential impact on this species is low.
<i>Dasyurus geoffroii</i>	Chuditch	Vulnerable	Vulnerable	<i>Unlikely</i> to be in the project area, so the potential impact on this species is low.
<i>Falco peregrinus</i>	Peregrine Falcon	OS		<i>Potentially</i> be seen in the general area, but the potential impact on this species is low.
<i>Polytelis alexandrae</i>	Princess Parrot	Priority 4	Vulnerable	<i>Unlikely</i> to be in the project area, so the potential impact on this species is low.
<i>Aspidites ramsayi</i>	Woma	Priority 1		<i>Unlikely</i> to be in the project area, so the potential impact on this species is low.
<i>Branchinella apophysata</i> (fairy shrimp)		Priority 1		<i>Unlikely</i> to be in the project area, so the potential impact on this species is low.
<i>Branchinella denticulata</i> (fairy shrimp)		Priority 1		<i>Unlikely</i> to be in the project area, so the potential impact on this species is low.
<i>Branchinella simplex</i> (fairy shrimp)		Priority 1		<i>Unlikely</i> to be in the project area, so the potential impact on this species is low.
<i>Jalmenus aridus</i> (butterfly)		Priority 1		<i>Unlikely</i> to be in the project area, so the potential impact on this species is low.
<i>Platycercus icterotis xanthogenys</i> (Mallee)	Western Rosella	Priority 4		<i>Potentially</i> in the general area, but potential impact on this species is low.
<i>Nyctophilus major tor</i>	Central Long-eared Bat	Priority 4		<i>Potentially</i> in the project area, but the potential for impact on this species is low.
<i>Motacilla cinerea</i>	Grey Wagtail	Migratory	Migratory	<i>Unlikely</i> to be in the general area, but the potential impact on this species is low.
<i>Apus pacificus</i>	Fork-tailed Swift	Migratory	Migratory	<i>May infrequently</i> be seen in the general area, but the potential for impact on this species is low.

OS – Other specially protected fauna; Results of the Commonwealth EPBC Act 1999 protected matters database search are provided in Appendix C.

**Arid Bronze Azure Butterfly** (*Ogyris subterrestris petrina*) – Critically endangered under the *BC Act 2016* and *EPBC Act 1999*

This butterfly is associated with colonies of the ant *Camponotus terebrans* in mallee vegetation on sandy soil, often near flood plains, and typically digs its nest at the base of eucalypts. Larvae hatching from eggs laid near ant nest entrances (often near the bases of various mallee eucalypts) are carried by the ants into their nest. Details of its biology and of any form of herbivory by the larvae are unknown; however, it is likely that the larvae are myrmecophilous (*Camponotus terebrans*). These butterflies fly close to the ground, and have been observed flying over agricultural lands near presumed breeding colonies. It is known from Lake Douglas, about 12kms south-west of Kalgoorlie (Field 1999) and in the Barbalin Nature Reserve (approximately 11km west of Mukinbudin) in the Avon Wheatbelt (Threatened Species Scientific Committee 2014).

It is unlikely that this butterfly is in the project area, therefore it is Terrestrial Ecosystems' assessment that vegetation clearing in the project area is unlikely to have a significant impact on this species.

**Night Parrot** (*Pezoporus occidentalis*) – Critically endangered *BC Act 2016* and Endangered under the *EPBC Act 1999*

The Night Parrot is a small, arid-adapted, nocturnal, ground-feeding parrot (Johnstone and Storr 1998, Threatened Species Scientific Committee 2016). Its length is 22-25cm with a body mass of approximately 104g (Threatened Species Scientific Committee 2016), although it was suggested that they were semi-nomadic, the Night Parrots in south-western Queensland appear to be sedentary (Murphy 2015).

The Night Parrot was probably originally distributed over much of semi-arid and arid Australia (Garnett et al. 2011, Threatened Species Scientific Committee 2016). Recordings in north-west and western Queensland in the early 1990-2000s were in a broad cross section of the habitats available (Garnett et al. 1993, Cupitt and Cupitt 2008, Boles et al. 2016). There have been recent sightings in the Pilbara in 1980, 2005 and 2017, central WA in 1979, north-eastern South Australia in 1979, western Queensland (including Pullen-Pullen-Mt Windsor-Diamantina population) in 1980, 1990, 1993, 2006 and 2013-17 (Davis and Metcalf 2008, Garnett et al. 2011, Charalambous 2016, Pickrell 2016, AG staff 2017, Palaszczuk and Miles 2017, Rykers 2017, AG staff 2018), Pilbara in 2017 (Jones 2017), and the northern Goldfields (Jackett et al. 2017). Garnett et al. (2011) suggested that there were between 50-250 mature individuals in less than 5% of its previous range.

Wilson's (1937) summary of observations provided information on the early records of Night Parrots' preferred habitat and breeding sites. Recent information indicates its preferred habitat appears to be in *Triodia* grasslands, chenopod shrublands, shrubby samphire and floristically diverse habitats dominated by large-seeded species (Threatened Species Scientific Committee 2016, McCarthy 2017, Murphy et al. 2017b). At Pullen Pullen Reserve it nests in large, more or less ring-shaped *Triodia*, and the nest consists of a tunnel (25-30° and 0° to the ground; 20-33cm long) through an apron of dead spinifex leaves that leads to a chamber under a live hummock, with a shallow depression (3-4cm) excavated into the gravelly/sandy soil (Murphy et al. 2017a). In the northern Goldfields the nest was again in a spinifex hummock, it was circular, with an excavated depression (~1.5-2.0cm) in sandy substrate (Hamilton et al. 2017, Jackett et al. 2017). The entrance tunnel was 62cm long, and was downward sloping (27°) with the entrance 28cm above the ground (Hamilton et al. 2017). It has clutches of two to four sub-elliptical, white eggs with a lustrous appearance (Murphy et al. 2017a). Breeding followed significant rains in March for the observations in Pullen-Pullen Reserve and in April in the northern Goldfields (Hamilton et al. 2017, Murphy et al. 2017a), but it is thought that breeding generally occurs between April and October (Murphy et al. 2017a).

Murphy et al. (2017b) placed a GPS tag on Night Parrots and reported that the two birds called at dusk from their diurnal roosts among spinifex hummocks and then flew to more floristically diverse habitats dominated by large-seeded, prolifically seeding species to feed.

There are no recent Night Parrot records near the project area and these are no old large spinifex hummocks in the project area. As the preferred roosting and nesting sites for Night Parrots are not present in the project area, it is Terrestrial Ecosystems' assessment that Night Parrots are not present in the project area.

**Malleefowl** (*Leipoa ocellata*) – Vulnerable under the *BC Act 2016* and *EPBC Act 1999*

Malleefowl are large, ground-dwelling birds that rarely fly unless alarmed or are perching for the night. Historically, Malleefowl have been found in mallee regions of southern Australia from approximately the 26<sup>th</sup> parallel of latitude southwards. Prior to vegetation clearing for agriculture, Malleefowl were abundant in the WA Wheatbelt. Vegetation clearing for agriculture also opened adjacent bushland to predators, and in the south-west of WA, Malleefowl often only persist in isolated remnant patches of native vegetation. Sheep and other herbivores (e.g. goats, kangaroos) grazing in remnant vegetation removes or thins the undergrowth, and they also compete with Malleefowl for herbaceous foods and can cause changes to the structure and floristic diversity of foraging habitats (Benshemesh 2007).

Malleefowl and their eggs are vulnerable to predation by foxes, and newly hatched chicks are vulnerable to foxes, cats and raptors (Priddel and Wheeler 1990, 1997, Benshemesh and Burton 1999, Benshemesh 2007, Lewis and Hines 2014). Their abundance in the Goldfields is low and they are sparsely distributed, favouring those areas that are more densely vegetated. Malleefowl build distinctive nests that comprise a large mound of soil/rock covering a central core of leaf litter. These nest mounds range in diameter but can span more than five metres and may be up to one metre high. Malleefowl are generally monogamous and once breeding commences they pair for life. The presence of nest mounds provides an indication of the presence of Malleefowl in the area.

Malleefowl have been observed in the bioregion, however, there are no recent records of active breeding mounds in the vicinity of the project area, and given its proximity to the Kalgoorlie urban area, open fauna habitat and presence of feral and pest species, the probability of the area supporting Malleefowl is very low. No Malleefowl mounds were observed during the site visit. As a consequence, Terrestrial Ecosystems' assessment is that vegetation clearing in the project area is unlikely to have any significant impact on this species.

**Chuditch** (*Dasyurus geoffroii*) – Vulnerable under the *BC Act 2016* and *EPBC Act 1999*.

The Chuditch is the largest extant carnivorous marsupial in WA. It is usually active from dusk to dawn. Formally known from over 70% of Australia, the Chuditch now has a patchy distribution throughout the Jarrah forest and mixed Karri/Marri/Jarrah forest of south-west WA and other isolated areas. Chuditch are solitary animals for most of their life and den in hollow logs, burrows, culverts, etc. and have also been recorded in tree hollows and rock cavities. Chuditch are opportunistic feeders, and forage primarily on the ground at night. Their diet can include other mammals, birds, lizards, bird and reptile eggs but the majority is a mixture of large invertebrates (e.g. spiders, scorpions and crickets).

How *et al.* (1988) reported Chuditch being found near the Norseman-Lake King Road and near Mount Holland. DBCA records show that one specimen was recorded in 1974 in Kambalda East. There are records south of Southern Cross and Marvel Loch and there have been other reported sightings east of Kambalda and near Norseman. It is therefore possible that this species is in the bioregion, and this could only be verified with an extensive trapping or motion sensitive camera trapping program. As the project area is north-east of the species known distribution and given its proximity to the Kalgoorlie urban area, it is unlikely that the Chuditch would be found in the project area. As a consequence, Terrestrial Ecosystems' assessment is that vegetation clearing in the project area is unlikely to have any significant impact on this species.

**Peregrine Falcon** (*Falco peregrinus*) – Other specially protected fauna under the *BC Act 2016*

The Peregrine Falcon is uncommon, although widespread throughout much of Australia excluding the extremely dry areas and has a wide and patchy distribution. It favours hilly or mountainous country and open woodlands and may be an occasional visitor to the project area. Nesting sites include ledges along cliffs, granite outcrops and quarries, hollow trees near wetlands and old nests of other large bird species. There is no evidence to suggest any change in status in the last 50 years. A Peregrine Falcon was seen at the Randells Timber Reserve (Ninox Wildlife Consulting 1998) and around St Ives mine (Dames and Moore 1999, Ninox Wildlife Consulting 2004) and during the Widgiemooltha biological survey (Dell and How 1984), so they are in the area. It could therefore infrequently be seen in the project area.

It is Terrestrial Ecosystems' assessment that vegetation clearing in the project area is unlikely to have a significant impact on this species as there is abundant areas of similar habitat in the region.

**Princess Parrot** (*Polytelis alexandrae*) - Priority 4 with the DBCA and Vulnerable under the *EPBC Act 1999*

The species is found mostly in the inland arid areas of Australia, and in Western Australia in the Gibson, Little Sandy and Great Victoria Deserts (Johnstone and Storr 1998, Pavey et al. 2014). However, they occasionally occurred in lightly wooded areas adjacent to the sandy deserts (Moriarty 1972).

West Kalgoorlie is a long way south of its known geographic distribution, so it is Terrestrial Ecosystems' assessment it is highly unlikely to be seen in the project area, unless it is an aviary escapee.

**Woma** (southern form: *Aspidites ramsayi*) – Priority 1 with the DBCA

This python was once common in a crescent shaped distribution from Shark Bay through the wheatbelt to Kitchener. It is now only found in one small population east of the wheatbelt, around Shark Bay and east of the project area near Kitchener. It is mostly found in sand plain habitat but is found in eucalypt woodland east of the project area.

Terrestrial Ecosystems' assessment is that the Woma is highly unlikely to be found in the project area due to its proximity to the Kalgoorlie urban area and distance from known populations.

*Branchinella apophysata* – Priority 1 with the DBCA

Geddes (1981) reported the type locality for this species as pools near Mt Margaret near Laverton. Like other Fairy Shrimps in many of WA's temporary lakes, little is known of its distribution or biology.

As it is dependent on water, it is unlikely to be found in the project area and to be affected by vegetation clearing.

*Branchinella denticulata* – Priority 1 with the DBCA

This crustacean is known from Gidgi Lake north of Kalgoorlie. Given the project area does not include a salt lake or samphire flats, it is highly unlikely to occur in the vicinity of this site. It is therefore Terrestrial Ecosystems' assessment that vegetation clearing in the project area is unlikely to have a significant impact on this species.

*Branchinella simplex* – Priority 1 with the DBCA

Geddes (1981) reported the type locality for this Fairy Shrimp's as Lake Kopai, near Kurrawang, about 18km south-west of Kalgoorlie. Little else is reported in the literature about this species. It is presumed that it is a filter feeder like others in this genus.

As it is dependent on water, it is unlikely to be found in the project area and therefore affected by vegetation clearing.

*Jalmenus aridus* - Priority 1 with the DBCA

Caterpillars of this butterfly are green with some red and white lines along the body, and it has a black head and tail. This species is known to feed on the foliage of *Senna* sp. and *Acacia tetragonophylla*. DBCA reported sightings of this species in the vicinity of Lake Douglas, west of Kalgoorlie. *Jalmenus aridus* is known from only a single colony, on a single *Acacia* tree. Subsequent searches have failed to reveal additional colonies.

It is Terrestrial Ecosystems' assessment that vegetation clearing of the project area is unlikely to have a significant impact on this species as it is highly unlikely to be in the project area.

**Western Rosella** (*Platycercus icterotis xanthogenys*) – Priority 4 with the DBCA

The mallee form of the Western Rosella is found mostly in eucalypt and *Casuarina* woodland and shrub lands, especially Wandoo, Flooded Gums and Salmon Gums. This species was sighted by Dames and Moore (1999) around Lake Lefroy, Outback Ecology Services (2009) at Randells and it was reported by Dell and How (1984) in the biological survey of Widgiemooltha. A search of NatureMap indicated that they have been recorded in the vicinity of Kalgoorlie.

It is possible that this species could be infrequently seen in the project area. However, given that the project area represents a very small fraction of similar habitat in adjacent areas, it is Terrestrial Ecosystems' assessment that vegetation clearing in the project area is unlikely to have a significant impact on this species.

**Central Long-eared Bat (*Nyctophilus major tor*)** – Priority 4 with the DBCA

This species is probably the species referred to by Churchill (2008) as the Central Long-eared Bat (*Nyctophilus major tor*). Records in the Atlas of Living Australia indicated this species has been found west of Kalgoorlie and in other areas in the Goldfields and the Wheatbelt. It roosts in tree cavities, foliage and under loose bark.

Given that project area represents a very small fraction of similar habitat in the general area, it is Terrestrial Ecosystems' assessment that vegetation clearing in the project area is unlikely to have a significant impact on this species.

**Grey Wagtail (*Motacilla cinerea*)** - Migratory species under the *EPBC Act 1999* and *BC Act 2016*

The Grey Wagtail is a small yellow breasted bird with a grey back and head. Johnstone and Storr (2004) reported this migratory species as breeding in Palearctic from western Europe and north-west Africa to eastern Asia and wintering in Africa, south-east Asia, Indonesia, the Philippines, New Guinea and Australia. Its preferred habitat in Australia is banks and rocks in fast-running fresh water including rivers, streams and creeks where it feeds on insects. The Atlas of Living Australia records two sightings on the south-coast of Western Australia and none around the project area.

It is highly unlikely to be seen in the project area due to a lack of suitable habitat.

**Fork-tailed Swift (*Apus pacificus*)** - Migratory under the *BC Act 2016* and *EPBC Act 1999*

This species breeds in the northeast and mid-east Asia and winters in Australia and southern New Guinea. It is a visitor to most parts of Western Australia, beginning to arrive in the Kimberley in late September, in the Pilbara in November and in the southwest land division in mid-December, and leaving by late April. The Fork-tailed Swift is an almost exclusively aerial species, foraging and sleeping on the wing. It rarely comes to earth, usually only for breeding. It is more common in the Kimberley, uncommon to moderately common near northwest, west and southeast coasts and rare to scarce elsewhere. It is rarely seen in the Goldfields.

Terrestrial Ecosystems' assessment is that the Fork-tailed Swift may infrequently be seen in the project area. However, the proposed vegetation clearing is unlikely to significantly impact on this species as it will move away to other areas if it is disturbed.

#### **4.4 Risk assessment**

Fauna surveys to support Environmental Impact Assessments (EIA) are part of the environmental risk assessment undertaken to consider what potential impacts a development might have on the biodiversity on a particular area and region. Potential impacts on fauna from the proposed development are identified and briefly described above. Tables 7, 8, and 9 provide a summary of the risk assessment associated with this project.

The assessment contained in Table 9 is supported by more detail discussion in sections above and the management recommendations below. Any risk assessment is a product of the likelihood of an impact occurring and the consequences of that impact. Likelihood and consequences are categorised and described below. These criteria do not fit all circumstances (e.g. adequacy of fauna survey data); however, they are useful in providing the reader with an appreciation of the level of likelihood and consequences of an event. The assessed risk level (likelihood x consequences) is then calculated as the overall risk for the development. This is followed by an assessment of the acceptability of the risk associated with each of the impacts. Disturbances and vegetation clearing have an impact on the fauna at multiple scales – site, local, landscape and regional. Each of these is considered in the risk assessment. This assessment should be considered in the context of the summary in Table 9.

**Table 7. Fauna impact risk assessment descriptors**

Likelihood		
Level	Description	Criteria
A	Rare	The environmental event may occur, or one or more conservation significant species may be present in exceptional circumstances.
B	Unlikely	The environmental event could occur, or one or more conservation significant species could be present at some time.
C	Moderate	The environmental event should occur, or one or more conservation significant species should be present at some time.
D	Likely	The environmental event will probably occur, or one or more conservation significant species will be present in most circumstances.
E	Almost certain	The environmental event is expected to occur, or one or more conservation significant species is expected to be present in most circumstances.
Consequences		
Level	Description	Criteria
1	Insignificant	Insignificant impact on fauna of conservation significance or regional biodiversity, and the loss of individuals will be insignificant in the context of the availability of similar fauna or fauna assemblages in the area.
2	Minor	Impact on fauna localised and no significant impact on species of conservation significance in the project area. Loss of species at the local scale.
3	Moderate	An appreciable loss of fauna in a regional context or a limited impact on species of conservation significance in the project area.
4	Major	Significant impact on conservation significant fauna or their habitat in the project area and/or regional biodiversity and/or a significant loss in the biodiversity at the landscape scale.
5	Catastrophic	Loss of species at the regional scale and/or a significant loss of species categorised as 'vulnerable' or 'endangered' under the <i>EPBC Act (1999)</i> at a regional scale.
Acceptability of Risk		
Level of risk	Management Action Required	
Low	No action required.	
Moderate	Avoid if possible, routine management with internal audit and review of monitoring results annually.	
High	Externally approved management plan to reduce risks, monitor major risks annually with external audit and review of management plan outcomes annually. May a referral to the Commonwealth under the <i>EPBC Act 1999</i> .	
Extreme	Unacceptable, project should be redesigned or not proceed.	

**Table 8. Levels of acceptable risk**

		Likelihood				
		Rare or very low (A)	Unlikely or low (B)	Moderate (C)	Likely (D)	Almost certain (E)
Consequences	Insignificant (1)	Low	Low	Low	Low	Low
	Minor (2)	Low	Low	Low	Moderate	Moderate
	Moderate (3)	Low	Moderate	Moderate	High	High
	Major (4)	Moderate	Moderate	High	High	Extreme
	Catastrophic (5)	Moderate	High	High	Extreme	Extreme



**Table 9. A risk assessment of the impact of ground disturbance activity on fauna**

			Before Management		
Factor	Potential Impact		Inherent Risk		
			Likelihood	Consequence	Significance
Fauna survey data	Inadequate survey data to adequately assess the risks	Unknown loss of fauna, fauna of conservation significance, and fauna assemblages, and an incomplete fauna assessment.	B	2	Low
	Inadequacy of comparative data	Limits on the availability of comparative data reduced the capacity to assess the uniqueness of the fauna assemblages in the project area.	B	2	Low
Clearing vegetation	Loss of fauna habitat – local scale	Loss of some terrestrial fauna in the project area.	E	1	Low
	Loss of fauna habitat – landscape scale	Loss of some fauna in specific habitat types. This is difficult to assess until the scale of mining activity is more fully understood.	B	2	Low
	Loss of fauna habitat – regional scale	Loss of some fauna from the region.	B	1	Low
	Loss of a threatened ecological fauna community	Loss of an undetected threatened ecological fauna community.	A	3	Low
	Habitat fragmentation	Fauna movement restricted resulting in the death of fauna and a loss of biodiversity.	E	1	Low
	Loss of a unique terrestrial fauna ecosystem	Loss of an ecosystem containing fauna with high species richness, high abundance and numerous top of the food chain predators.	A	2	Low
Death or loss of conservation significant fauna	Malleefowl ( <i>Leipoa ocellata</i> )	Death or the reduced viability of the Malleefowl.	A	3	Low
	Peregrine Falcon ( <i>Falco peregrinus</i> )	Death or the reduced viability of the Peregrine Falcon.	A	2	Low
	Fork-tailed Swift ( <i>Apus pacificus</i> )	Death or the reduced viability of Fork-tailed Swift.	A	1	Low
	Princess Parrot ( <i>Polytelis alexandrae</i> )	Death or the reduced viability of the Princess Parrot	A	2	Low
Human impacts	Spread of weeds	Changed vegetation and a resulting loss of fauna habitat.	E	1	Low
	Road kills	Animals being killed as they cross roads by vehicles	D	2	Mod.
	Increase in feral and pest fauna, specifically wild dogs, foxes and cats	Increased predation on the native fauna	D	2	Mod.

## 5 DISCUSSION

### 5.1 Adequacy of the fauna surveys

The EPA's *Technical Guidance Terrestrial Fauna Surveys* (EPA 2016b) and the *Technical Guidance - Sampling methods for terrestrial vertebrate fauna* (EPA 2016a) are the two relevant regulatory documents to assess the adequacy of the available information and reporting for vertebrate fauna surveys and assessments in Western Australia.

Terrestrial Ecosystems has in excess of 120,000 trap-nights of data for small vertebrate fauna for the general area north of Kalgoorlie. These surveys were completed between 2000 and 2006 and were undertaken multiple times in each season and on five occasions in January when the small vertebrate fauna are most active. This is one of the largest, long-term, systematic terrestrial fauna surveys undertaken in Western Australia and has been published or been presented at various workshops and conferences (Thompson 2001, Thompson and Thompson 2002, Thompson 2002, Thompson et al. 2003a, Thompson et al. 2003b, Thompson et al. 2003c, Thompson and Thompson 2003a, Thompson 2003c, a, b, Thompson and Thompson 2003b, Thompson and Thompson 2004a, Thompson 2004, Thompson and Thompson 2004b, Thompson and Thompson 2005a, Thompson and Thompson 2005c, b, Thompson et al. 2005a, b, Thompson and Thompson 2006a, Thompson and Thompson 2006c, b, Thompson and Thompson 2006e, d, Thompson and Thompson 2007a, b, Thompson and Thompson 2008).

In addition, fauna survey data provided by Bamford, et al. (1990), Chapman, et al. (1991), McKenzie, Rolfe and Youngson (McKenzie et al. 1992) and Ninnox (1999, 2002) provide a good indication of the vertebrate fauna assemblage in the project.

The EPA's *Technical Guidance Terrestrial Fauna Surveys* (EPA 2016b) and the *Technical Guidance - Sampling methods for terrestrial vertebrate fauna* (EPA 2016a) indicated that a Level 2 fauna assessment is required for a disturbance area in excess of 75ha in this bioregion. The project area is greater than 75ha, however, given the available information in earlier fauna surveys there is sufficient information on the fauna and fauna assemblages to enable potential impacts to be assessed. It is unlikely that a detailed trapping survey would provide additional information which would change the assessment on fauna and fauna assemblages.

The fauna habitat in the project area is widespread in adjacent areas. It is therefore likely that the terrestrial fauna assemblage found in the project area will also be present in adjacent areas. Given the disturbed nature of the project area, its proximity to the Kalgoorlie urban area, the abundance of similar habitat in adjacent areas and the availability of survey data for similar habitat in adjacent areas, there is no justification for undertaking a more detailed Level 2 vertebrate fauna survey in the project area.

### 5.2 Fauna assemblages

#### 5.2.1 Amphibians

The general area is likely to support four species of frogs, three of which (*Neobatrachus kunapalari*, *Neobatrachus pelobatoides*, *Neobatrachus sutor*) burrow in the ground and only come to the surface after a significant rainfall event to feed and breed. *Pseudophryne occidentalis* finds shelter under rocks and in crevices during the dry periods and enters temporary ponds to breed after major rainfall events. All four species have a wide-spread distribution and are abundant.

#### 5.2.2 Reptiles

Reptile species richness in the project area will be comparable with similar Eucalypt woodlands elsewhere in the bioregion. The list provided in Table 4 represents species likely to be found over a large area of diverse habitat types. Intact, high quality eucalypt woodlands would typically support up to 40 species of reptiles, but many of these would be in low abundance (see Appendix A). The Woma python is found in the bioregion, but it is unlikely to be seen in the project area due to its proximity to the Kalgoorlie urban area, predation by cats, wild dogs and foxes and the extent of prior disturbance.

#### 5.2.3 Birds

Avian species richness in the Goldfields is influenced by rainfall and is generally higher in woodlands compared with chenopod shrublands and more sparsely vegetated areas. The list provided in Table 2 represents species likely to be found over a large area of diverse habitat types. Eucalypt woodlands would typically support up to 50-70 species of birds, but many of these would be in very low numbers (see Appendix A) and are only present after significant rainfall. Birds typically move from an area once vegetation clearing commences, so the impact is relatively low if the area is small. However, eggs and chicks in nests are often lost during the clearing process.

Birds of conservation significance potentially found in the area include the Malleefowl, Peregrine Falcon and Princess Parrot. Predation by feral cats, foxes and wild dogs has significantly reduced the abundance of Malleefowl in the Goldfields and there are a few remaining small populations, mostly in areas of dense shrubland, as the dense vegetation provides the adult birds with some protection from predators. There are no Malleefowl mounds in the project area.

The Princess Parrot is nomadic and moves around the arid interior often in search of water and resources, and has not been recorded this far away from the sandy deserts, so it is unlikely to be recorded in the project area. The Peregrine Falcon will normally have a very large home range in the Goldfields, and clearing a small section of the project area, particularly when similar habitat exists in the adjacent areas, is unlikely to significantly impact on this species.

#### **5.2.4 Mammals**

Appendix A indicates the range of mammals that might be found in the bioregion, and a few of these might be found in the project area. The proximity of the project area to the Kalgoorlie urban area will have affected the structure of the mammal assemblage, possibly by increasing the number of introduced rodent species and reducing native species. Small mammals that retreat to burrows and logs during the day are often lost during the clearing process.

Although, records of Numbats (*Myrmecobius fasciatus*), Burrowing Bettongs (*Bettongia lesueur*) and Bilbies (*Macrotis lagotis*) are shown in the Atlas of Living Australia and Western Australian Museum records (Appendix A), they are no longer present in this area, having been predated on by foxes, cats and wild dogs many years ago. None of the mammals potentially found in the project area are of conservation significance. The loss of small mammals during vegetation clearing is unlikely to be significant in a bioregional context.

#### **5.2.5 Fish**

Two species of fish are potentially in the waterways in the region. The goldfish has been introduced to numerous water holding facilities in the Goldfields and the Spangled Perch is a native fish that moves rapidly from pools of water that it inhabits during dry periods to new areas when heavy rains fall. The lack of permanent freshwater in the project area indicates that neither of these species will be present in the project area.

#### **5.2.6 Malleefowl**

The area was searched for potential habitat that would support Malleefowl. No Malleefowl, and no recently used Malleefowl mounds or foot prints were found in the area. Given the openness and sparseness of the vegetation cover, it is highly unlikely that Malleefowl are in the area and would therefore be impacted by any vegetation clearing.

### **5.3 Biodiversity value of the project area**

An ecological assessment of a site should consider its biodiversity value at the genetic, species and ecosystem levels, and its ecological functional value at the ecosystem level. There are inadequate data to assess the ecological value at the genetic level.

The fauna habitat type represented in the project area is abundant and in similar condition in adjacent areas. Therefore, the fauna assemblage that is present in the project area will also be present and abundant in the adjacent areas. The available fauna survey data (Appendix A) provides a good indication of the vertebrate fauna that are potentially in the project area. From a fauna perspective, some of the vegetation in the project area could be described as in good condition, however, the area also contains some well-established tracks, prior ground disturbance and dumped rubbish. The biodiversity value of the area would generally be rated as low given the disturbance and its proximity to the Kalgoorlie urban area.

#### **5.3.1 Ecological functional value at the ecosystem level**

The reptile and small mammal assemblages in the project area would be a subset of that in a similar area that had not been disturbed and is not near urban and industrial development. It is therefore expected that the area would support a lower species richness and diversity than in similar habitat in a more remote area.

The project area is not of high ecological value due to past disturbance, its abundance in adjacent areas and its proximity to the Kalgoorlie urban area.

#### **5.4 Potential impacts of the proposed development on the fauna in the project area**

Clearing of vegetation will potentially affect vertebrate fauna in the project area in numerous ways, including death/injury of fauna during vegetation clearing and impacts with vehicles and the loss of habitat.

Although there are anticipated short term impacts on the generic vertebrate fauna assemblage, they are not considered to result in significant impacts when considered in a bioregional context in the longer term.

#### **5.5 Direct impacts**

##### **5.5.1 Animal deaths during the clearing process and displacement of fauna**

Clearing vegetation will result in the loss of small fauna that retreat to burrows, such as reptiles and mammals. Nocturnal species are unlikely to be active when most of the land clearing and construction work is taking place which will inevitably result in these individuals being killed or injured in their burrows, retreat sites or as they attempt to escape. Larger terrestrial animals and avian species will most often move to adjacent areas. These species will be required to establish new activity areas and home ranges, and this could result in the temporary displacement of resident species, however, this loss of fauna is unlikely to have a significant impact when considered in a bioregional context.

##### **5.5.2 Reduction or loss of activity areas and closure of burrows**

Clearing vegetation and associated construction activities are likely to destroy reptile and mammal burrows or foraging habitat that are currently in use, or could be used again. Clearing vegetation that forms part of the activity area of individuals has the potential to force these animals into adjacent areas. These areas may offer fewer resources placing individuals under survival pressure. It could also cause individuals to move into the territories of other individuals increasing competition for resources. Forced relocations could increase the possibility of predation.

#### **5.6 Indirect impacts**

In addition to the obvious impact of vegetation clearing there can be an equally significant or greater impact in the adjacent areas because of 'edge effects'. Edge effects can lead to the disruption of ecological processes such as predation and dispersal, animal movements and can change assemblage structure. The consequence is that the impact area will always be much larger than the cleared area. Vehicle tracks also have the propensity to develop weed infestations which can impact on natural fauna habitats. Cleared corridors can also provide improved predator access to areas, enhance the invasion of pest species into areas and may act as inhibitors or disrupt fauna migration and movement patterns.

There are numerous potential threats associated with vegetation clearing and the construction of infrastructure that could have an impact on the vertebrate fauna in the project area. Some of these are discussed below.

##### **5.6.1 Habitat fragmentation**

In addition to vegetation clearing, infrastructure including tracks, has the potential to fragment habitat. Cleared linear tracks of land are 'unnatural' in much of the habitat. These linear structures that partition existing activity areas, isolate sections of established communities and may alter long and medium-term patterns of movement around established home ranges particularly for small mammals and reptiles. A reduction in the population because of this infrastructure would be difficult to detect given our current knowledge of the spatial ecology for most of the small mammals known to be in the area.

As most of the tracks within the project area will be relatively narrow and in sparsely vegetated areas, the potential impact associated with habitat fragmentation is likely to be low.

### 5.6.2 Introduced fauna and weeds

An increase in habitat fragmentation and human activity is often associated with an increase in the abundance of introduced species such as the house mouse (*Mus musculus*), fox (*Vulpes vulpes*), cat (*Felis catus*) and occasionally wild dogs (*Canis lupus*). This increase may be due to a decline in habitat health, increased road kills, poor disposal of waste and easier access to areas via tracks.

House mice, foxes, cats and wild dogs are known to be established in the area. In many situations they have become a 'naturalised' species in the Australian bush. Increases in fox, dog or cat numbers can have a detrimental impact on native fauna because they predate on and compete with native species, severely disrupting the natural balance. The cat is a particularly damaging predator on native fauna and any increase in their numbers could have a detrimental effect of local native fauna (Kinnear 1993, Bamford 1995).

Introduced plant species can successfully and rapidly invade areas of cleared native vegetation or otherwise disturbed by humans. Introduced plant species may replace native species that provide shelter or foraging areas for native fauna. Major changes to the structure of vegetation will alter the fauna habitat and consequently may influence fauna species composition.

### 5.6.3 Road fauna deaths

An increase in road fauna deaths is likely to occur where new roads / tracks are constructed or upgraded, or development is near an existing busy road. Road fauna deaths particularly affect kangaroos, nocturnal birds and ground dwelling large carnivorous predators. Species such as goannas and raptors are attracted to carrion on road verges and therefore, there is an increased propensity for these species to be killed by vehicles. After development the access roads on site will be short with limited speeds zones so the potential for road fauna deaths is low, however, there may be some impact of fauna deaths on the existing Great Eastern Highway. These deaths are likely to be reduced once the site is developed as fauna are less likely to move across the road and into the site.

### 5.6.4 Anthropogenic activity

Unnatural noises, vibrations, artificial light sources, and vehicle and human movement in an area may be sufficient to force individuals or fauna species to move from adjacent areas, or alter their activity periods. This form of disturbance is likely to occur during the vegetation clearing, construction of infrastructure and operations of the industrial sites. However, the overall impact is likely to be confined to a relatively small area and is unlikely to be a significant impact.

## 5.7 Native vegetation clearing principles

The *Environmental Protection Act (1986)* provides criteria to judge the potential impact of a development on clearing native vegetation on flora and fauna. These criteria have been listed below with a response to indicate how clearing of the vegetation in the project area might be judged against these principles as they relate to fauna and fauna assemblages (Table 10). Where possible, native vegetation should not be cleared if any of the following principles are compromised.

**Table 10. Assessment of impact on fauna and fauna assemblages using the native vegetation clearing principles**

<b>Principle</b>	<b>Response</b>
It comprises a high level of biological diversity.	The vegetation to be cleared does not compromise a high level of biological diversity.
It comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.	Clearing the vegetation will not result in the loss of significant habitat for indigenous fauna.
It includes, or is necessary for the continued existence of, rare flora.	N/A
It comprises the whole or a part of, or is necessary for the maintenance of, a threatened ecological community.	The area does not contain a threatened ecological community.
It is significant as a remnant of native vegetation in an area that has been extensively cleared.	The area is not a remnant and the vegetation clearing will not create a remnant.
It is growing in, or in association with, an environment associated with a watercourse or wetland.	The proposed vegetation clearing is not in a water course or wetland.
The clearing of the vegetation is likely to cause appreciable land degradation.	N/A
The clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.	Clearing of vegetation is unlikely to impact on the environmental values of the bioregion.
The clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.	N/A
The clearing of the vegetation is likely to cause, or exacerbate the incidence of flooding.	N/A

## 6 SUMMARY AND MANAGEMENT

Clearing of vegetation and developing an industrial estate in the project area will impact on the terrestrial fauna, however, it is unlikely that any conservation significant species, when considered in a regional context, will be significantly impacted by vegetation clearing or development.

The project area currently does not provide an important ecological linkage or fauna movement corridor. Clearing native vegetation is likely to result in the loss of small vertebrate fauna on-site that are unable to move away during the clearing process. The few larger animals, such as goannas, and most of the birds will move into adjacent areas once clearing commences. Vegetation clearing will result in the loss of numerous small vertebrates in the project area. In addition, others will shift into neighbouring areas. Migrants increase competition for resources, which may result in the subsequent loss of migrants or local individuals. Individuals shifted out of their established activity areas are also vulnerable to predation until they have become established in their new areas.

Impacts on the vertebrate fauna associated with clearing vegetation in the project area in a landscape or bioregional context are likely to be low, as there are vast tracts of similar habitat in adjacent areas.

Implementation of the following two recommendations will improve outcomes for terrestrial vertebrate fauna during the vegetation clearing process:

- A vertebrate fauna management strategy is prepared for the site and ongoing use of the area; and
- where possible, large eucalypt trees are retained in the project area

## 7 REFERENCES

- AG staff. 2017. Night parrot feather discovered in South Australia gives hope to ecologists. Australian Geographic **September**.
- AG staff. 2018. Critically endangered night parrot fledging photographed on Queensland reserve. Australian Geographic **February**.
- ATA Environmental. 2006a. Fauna assessment proposed clearing around Black Flag. Unpublished report for Placer Dome Australia Pty Ltd., Perth.
- ATA Environmental. 2006b. Fauna assessment proposed clearing around the Grants Patch Mine Site. Unpublished report for Placer Dome Australia Pty Ltd., Perth.
- ATA Environmental. 2006c. Fauna assessment proposed clearing around the Janet Ivy Site. Unpublished report for Placer Dome Australia Pty Ltd., Perth.
- ATA Environmental. 2006d. Fauna assessment proposed clearing around the Moonbeam Mine Site. Unpublished report for Placer Dome Australia Pty Ltd., Perth.
- ATA Environmental. 2006e. Fauna assessment proposed clearing around the Natal Mine Site. Unpublished report for Placer Dome Australia Pty Ltd., Perth.
- ATA Environmental. 2006f. Fauna assessment proposed clearing around the Ora Banda Mine Site. Unpublished report for Placer Dome Australia Pty Ltd, Perth.
- ATA Environmental. 2006g. Fauna assessment proposed clearing around the Rose West Site. Unpublished report for Placer Dome Australia Pty Ltd., Perth.
- ATA Environmental. 2006h. Malleefowl assessment for clearing application at Janet Ivy Site. Perth.
- Bamford, M. J. 1995. Predation by feral cats upon lizards. The Western Australian Naturalist **20**:191-196.
- Bamford, M. J., S. J. J. F. Davies, and P. G. Ladd. 1990. Biological Survey of the Kangaroo Hills and Calooli Timber Reserves, Coolgardie, Western Australia.
- Benshemesh, J. 2007. National Recovery Plan for Malleefowl. South Australia.
- Benshemesh, J., and P. Burton. 1999. Fox predation on Malleefowl three years after the spread of RCD in Victoria. Unpublished report for Parks Victoria and Department of Natural Resources and Environment, Mildura.
- Boles, W. E., N. W. Longmore, and M. C. Thompson. 2016. A Recent Specimen of the Night Parrot *Geopsittacus occidentalis*. Emu **94**:37-40.
- Chapman, A., I. Kealley, D. McMillan, P. McMillan, and G. Rolland. 1991. Biological surveys of four Goldfields Reserves: Kurrawang Nature Reserve, Burra Rock Nature Reserve, Cave Hill Nature Reserve and Dordie Rocks Nature Reserve. Landnote **1/91**:1-26.
- Charalambous, S. 2016. First night parrot fledgling spotted in 100 years spotted in western Queensland. Australian Geographic **November**.
- Christidis, L., and W. E. Boles. 2008. Systematics and Taxonomy of Australian Birds. CSIRO Publishing, Collingwood, Victoria.
- Churchill, S. 2008. Australian Bats. Jacana Books, Crows Nest, NSW.
- Cowan, M. 2002. Coolgardie 3 (COO3 - Eastern Goldfields subregion). Pages 156-169 A Biodiversity Audit of Western Australia's 53 Biogeographical Subregions in 2002. Department of Conservation and Land Management, Perth.
- Cupitt, R., and S. Cupitt. 2008. Another recent specimen of the Night Parrot *Pezoporus occidentalis* from Western Queensland. Australian Field Ornithology **25**:69-75.
- Dames and Moore. 1999. Public Environmental Review - Gold Mine Developments on Lake Lefroy. Unpublished report to WMC Resources Ltd (St Ives Gold), Perth.
- Davis, R. A., and B. M. Metcalf. 2008. The Night Parrot (*Pezoporus occidentalis*) in northern Western Australia: a recent sighting from the Pilbara region. Emu **108**:233-236.
- Dell, J., and R. A. How. 1984. Vertebrate fauna. Records of the Australian Museum **Supplement No. 18**:57-89.
- Eco Logical Australia. 2016. Biological Assessment - Binduli Expansion Project. Level 1 vertebrate fauna and Short-range Endemic invertebrate survey. Perth.
- Environmental Protection Authority. 2016a. Technical Guidance - Sampling methods for terrestrial vertebrate fauna. Environmental Protection Authority, Perth.
- Environmental Protection Authority. 2016b. Technical Guidance Terrestrial Fauna Surveys. Perth.
- Field, R. P. 1999. A new species of *Ogyris* Angus (Lepidoptera: Lycaenidae) from southern arid Australia. Memoirs of Museum Victoria **57**:251-251.
- Garnett, S., G. Crowley, R. Duncan, N. Baker, and P. Doherty. 1993. Notes on live Night Parrot sightings in north-western Queensland. Emu **93**:292-296.
- Garnett, S. T., J. K. Szabo, and G. Dutson. 2011. The Action Plan for Australian Birds 2010. CSIRO, Collingwood, Melbourne.
- Geddes, M. C. 1981. Revision of Australian species of Branchinella (Crustacea: Anostraca). Australian Journal of Marine and Freshwater Research **32**:253-295.



- Hamilton, N., A. Burbidge, T. Douglas, and L. Gilbert. 2017. Piecing the puzzle together: the fate of the Night Parrot nest found in Western Australia by Jackett et al. (2017). *Australian Field Ornithology* **34**:151-154.
- Hart Simpson and Associates. 2000. Anaconda Nickel Ltd, Cawse Expansion Project, Fauna Survey. Perth.
- How, R. A., J. Dell, and B. G. Muir. 1988. Vertebrate Fauna. Pages 44-94 in R. A. How, K. R. Newbey, J. Dell, B. G. Muir, and R. J. Hnatiuk, editors. *The Biological Survey of the Eastern Goldfields of Western Australia; Part 4, Lake Johnston - Hyden Study Area*. Records of the Western Australian Museum.
- Jackett, N., B. Greatwich, G. Swann, and A. Boyle. 2017. A nesting record and vocalisations of the Night Parrot *Pezoporus occidentalis* from the East Murchison, Western Australia. *Australian Field Ornithology* **34**:144-150.
- Johnstone, R. E., and G. M. Storr. 1998. *Handbook of Western Australian Birds. Volume I - Non-Passerines (Emu to Dollarbird)*. Western Australian Museum, Perth.
- Johnstone, R. E., and G. M. Storr. 2004. *Handbook of Western Australian Birds, Volume II Passerines (Blue-winged Pitta to Goldfinch)*. Western Australian Museum, Perth.
- Jones, A. 2017. Night parrot sighting in Western Australia shocks birdwatching world. ABC News.
- Kinnear, J. 1993. Masterly marauders: the cat and the fox. *Landscape* **8**:20-28.
- Lewis, M., and M. Hines. 2014. Malleefowl activity at nesting sites increase fox and other feral animal visitation rates. Pages 242-247 *Proceedings of the 5th National Malleefowl Forum 2014*.
- McCarthy, M. 2017. Night parrot feather discovery proves Australia's most elusive bird is alive in South Australia. ABC News.
- McKenzie, N. L., and N. J. Hall. 1992. The biological survey of the eastern goldfields of Western Australia. Part 8 :Kurnalpi - Kalgoorlie study area. *Records of the Western Australian Museum Supplement No. 41*:37-53.
- McKenzie, N. L., J. K. Rolfe, and W. K. Youngson. 1992. IV Vertebrate fauna. Pages 37-64 *The Biological Survey of the Eastern Goldfields of Western Australia. Part 8. Kurnalpi-Kalgoorlie Study Area. Records of the Western Australian Museum, Supplement, No 41*.
- Moriarty, T. K. 1972. Birds of Wanjarri, W.A. (27°25'S, 120°40'E). *Emu* **72**:1-7.
- Murphy, S. 2015. Shining a light: The research unlocking the secrets of the mysterious Night Parrot. *Australian Birdlife* **4**:30-35.
- Murphy, S. A., J. J. Austin, R. K. Murphy, J. Silcock, L. Joseph, S. T. Garnett, N. P. Leseberg, J. E. M. Watson, and A. H. Burbidge. 2017a. Observations on breeding Night Parrots (*Pezoporus occidentalis*) in western Queensland. *Emu* **117**:107-113.
- Murphy, S. A., J. Silcock, R. Murphy, J. Reid, and J. J. Austin. 2017b. Movements and habitat use of the night parrot *Pezoporus occidentalis* in south-western Queensland. *Austral Ecology*.
- Ninox Wildlife Consulting. 1998. A Vertebrate Fauna Survey of Randell Timber Reserve.
- Ninox Wildlife Consulting. 1999. Fauna Survey for the White Foil Gold Project. Perth.
- Ninox Wildlife Consulting. 2002. A Vertebrate Fauna Assessment of the Proposed White Foil Haul Road Route near Kalgoorlie, Western Australia. Perth.
- Ninox Wildlife Consulting. 2004. St Ives Gold Mine, Vertebrate fauna assessment. Perth, unpublished report for Goldfields - St Ives Mining Company Pty Ltd.
- Outback Ecology Services. 2009. Integra Mining Limited Randalls Gold Project, Fauna Survey.
- Palaszczuk, A., and S. Miles. 2017. New night parrot community discovered in central west Queensland.
- Pavey, C. R., C. E. M. Nano, J. R. Cole, P. J. McDonald, P. Nunn, A. Silcocks, and R. H. Clarke. 2014. The breeding and foraging ecology and abundance of the Princess Parrot (*Polytelis alexandrae*) during a population irruption. *Emu*:NULL.
- Pickrell, J. 2016. The night parrot's secret sanctuary. *Australian Geographic* **August**.
- Priddel, D., and R. Wheeler. 1990. Survival of Malleefowl *Leipoa ocellata* chicks in the absence of ground-dwelling predators. *Emu* **90**:81-87.
- Priddel, D., and R. Wheeler. 1997. Efficacy of fox control in reducing the mortality of released captive-reared Malleefowl, *Leipoa ocellata*. *Wildlife Research* **24**:469-482.
- Risbey, D. 2000. An assessment of the populations of feral cats and foxes in the Ora Banda region for Cawse Nickel Operations, Western Australia. Kalgoorlie.
- Rykers, E. 2017. Night parrot call recordings released online for first time. *Australian Geographic* **February**.
- Shepherdson Environmental Services. 2001a. Fauna of the Black Cat and Panther Leases, M16/34 and M16/365 (P16/1675). Unpublished report for Kinver Mining NL.
- Shepherdson Environmental Services. 2001b. Fauna of the proposed Golden Cities to Paddington Haul Road and surrounding area. Perth.
- Storr, G. M., L. A. Smith, and R. E. Johnstone. 1983. *Lizards of Western Australia. II: Dragons and Monitors*. Western Australian Museum, Perth, Western Australia.
- Storr, G. M., L. A. Smith, and R. E. Johnstone. 1990. *Lizards of Western Australia. III: Geckos and Pygopods*. Western Australian Museum, Perth.

- Storr, G. M., L. A. Smith, and R. E. Johnstone. 1999. Lizards of Western Australia. I: Skinks. Western Australian Museum, Perth.
- Storr, G. M., L. A. Smith, and R. E. Johnstone. 2002. Snakes of Western Australia. Western Australian Museum, Perth.
- Terrestrial Ecosystems. 2010. Level 1 Fauna Risk Assessment for La Mancha Resources White Foil Gold Deposit Project Area. Perth.
- Terrestrial Ecosystems. 2013. Level 1 Vertebrate Fauna Risk Assessment for the Borefields Road at Coolgardie, V2. Perth.
- Terrestrial Ecosystems. 2016. Level 1 Vertebrate Fauna Risk Assessment for the Mungari Tailing Storage Facility Cell 3 (TSF3). Perth.
- Terrestrial Ecosystems. 2017. Level 1 Vertebrate Fauna Risk Assessment for the Jaurdi Hills Mining Area. Perth.
- Terrestrial Ecosystems. 2018a. Annual Malleefowl Survey - Enterprise, Mulgarrie and north of Federal. Perth.
- Terrestrial Ecosystems. 2018b. Annual Malleefowl Survey – Enterprise, Carbine and Golden Cities. Perth.
- Terrestrial Ecosystems. 2018c. Level 1 Fauna Risk Assessment and the results of a Malleefowl search for the Golden Cites project area. Perth.
- Terrestrial Ecosystems. 2018d. Level 1 Vertebrate Fauna Risk Assessment for Lot 500 Great Eastern Highway, Kalgoorlie. Perth.
- Thompson, G., and S. Thompson. 2006a. Terrestrial Fauna Survey of Waste Dumps and Undisturbed Areas Around Placer Dome Australia Pty Ltd - Kalgoorlie West Operations and OMG Cawse Nickel Operations during January 2006.
- Thompson, G. G., and S. A. Thompson. 2002. Terrestrial fauna surveys: Why, when and how much? Pages 25-36 *in* Goldfields Environmental Management Group 2002 Workshop on Environmental Management in Arid and Semi-Arid Areas. Goldfields Environmental Management Group, Kalgoorlie.
- Thompson, G. G., and S. A. Thompson. 2004a. Rehabilitation: Being environmentally neutral. Pages 129-134 *in* Workshop on Environmental Management: Proceedings 2004. Goldfields Environmental Management Group, PO Box 2412, Boulder, WA 6432, Kalgoorlie.
- Thompson, G. G., and S. A. Thompson. 2005a. Mammals or reptiles, as surveyed by pit-traps, as bio-indicators of rehabilitation success for mine sites in the goldfields region of Western Australia? *Pacific Conservation Biology* **11**:268-286.
- Thompson, G. G., and S. A. Thompson. 2006b. The impact of land clearing and mining on arid-adapted frogs. Pages 18-35 *in* Goldfields Environmental Management Workshop 2006 Proceedings. Goldfields Environmental Management Group, Kalgoorlie.
- Thompson, G. G., and S. A. Thompson. 2006c. Small vertebrate colonisers of mine site rehabilitated waste dumps in the Goldfields of Western Australia. Pages 309-318 *in* Mine Closure 2006, Proceedings of the First International Seminar on Mine Closure 13-15 September 2006. Australian Centre for Geomechanics, University of Western Australia, Perth.
- Thompson, G. G., and S. A. Thompson. 2007a. Early and late colonizers in mine site rehabilitated waste dumps in the Goldfields of Western Australia. *Pacific Conservation Biology* **13**:235-243.
- Thompson, G. G., and S. A. Thompson. 2007b. Temporal and spatial variability in trappable terrestrial vertebrate fauna assemblages in semi-arid habitats. Page 162 *in* ESA 2007, Program and Abstracts. Ecological Society of Australia, Perth.
- Thompson, G. G., S. A. Thompson, and J. L. Fraser. 2003a. Surface activity of arid-adapted frogs. *Journal of the Royal Society of Western Australia* **86**:115-116.
- Thompson, G. G., S. A. Thompson, P. C. Withers, and E. R. Pianka. 2003b. Diversity and abundance of pit-trapped reptiles in Australian arid and mesic habitats: Biodiversity for environmental impact assessments. *Pacific Conservation Biology* **9**:120-135.
- Thompson, G. G., P. C. Withers, E. R. Pianka, and S. A. Thompson. 2003c. Assessing biodiversity with species accumulation curves; inventories of small reptiles by pit-trapping in Western Australia. *Austral Ecology* **28**:361-383.
- Thompson, S., and G. Thompson. 2003a. Rehabilitation index and monitoring protocol for evaluating the success of rehabilitated mining sites. Perth.
- Thompson, S. A. 2001. Fauna communities as an indicator of rehabilitation success - a preliminary analysis. *in* Goldfields Land Rehabilitation Group Annual general meeting, Kalgoorlie.
- Thompson, S. A. 2002. Rehabilitation index based on reptile community structure for mine site monitoring. Pages 13-24 *in* 2002 Workshop on Environmental Management in Arid and Semi-arid Areas. Goldfields Environmental Management Group, Kalgoorlie.
- Thompson, S. A. 2003a. Geckos show the way. Page 10 *Kalgoorlie Miner*. Kalgoorlie Miner, Kalgoorlie.
- Thompson, S. A. 2003b. Mine rehabilitation and pygmy possums. Page 3 *Kalgoorlie Miner*. Kalgoorlie Miner, Kalgoorlie.

- Thompson, S. A. 2003c. Reproductive observations of a Thorny Devil, *Moloch horridus*, in a natural semi-arid environment. *The Western Australian Naturalist* **24**:73-78.
- Thompson, S. A. 2004. Mine site rehabilitation index using reptile assemblage as a bio-indicator. PhD. Edith Cowan University, Perth.
- Thompson, S. A., and G. G. Thompson. 2003b. The western bearded dragon, *Pogona minor*, (Squamata: Agamidae): An early lizard coloniser of rehabilitated areas. *Journal of the Royal Society of Western Australia* **86**:1-6.
- Thompson, S. A., and G. G. Thompson. 2004b. Adequacy of rehabilitation monitoring practices in the Western Australian mining industry. *Ecological Management and Restoration* **5**:30-33.
- Thompson, S. A., and G. G. Thompson. 2005b. Rehabilitation index for evaluating the success of rehabilitated disturbed areas using reptile assemblages as a bio-indicator. Page 98 in *Fifth World Congress of Herpetology*. Fifth World Congress of Herpetology, Stellenbosch, South Africa, June 2005.
- Thompson, S. A., and G. G. Thompson. 2005c. Temporal variation in reptile assemblages in the Goldfields of Western Australia. *Journal of the Royal Society of Western Australia* **88**:25-36.
- Thompson, S. A., and G. G. Thompson. 2006d. Quantification of rehabilitation success on mine site waste dumps. Pages 731-740 in *Mine Closure 2006*, Proceedings of the First International Seminar on Mine Closure 13-15 September 2006 Australia. Australian Centre for Geomechanics, University of Western Australia, Perth.
- Thompson, S. A., and G. G. Thompson. 2006e. Reptiles of the Western Australian Goldfields. Goldfields Environmental Management Group, Kalgoorlie, WA.
- Thompson, S. A., and G. G. Thompson. 2008. Vertebrate by-catch in invertebrate wet pitfall traps. *Journal of the Royal Society of Western Australia* **91**:237-241.
- Thompson, S. A., G. G. Thompson, and P. C. Withers. 2005a. Capture rates of small vertebrates decrease as the pit-trapping effort increase at Ora Banda. *Journal of the Royal Society of Western Australia* **88**:37-39.
- Thompson, S. A., G. G. Thompson, and P. C. Withers. 2005b. Influence of pit-trap type on the interpretation of fauna diversity. *Wildlife Research* **32**:131-137.
- Threatened Species Scientific Committee. 2014. Conservation Advice *Ogyris subterrestris petrina* Arid bronze azure (a butterfly). Canberra.
- Threatened Species Scientific Committee. 2016. Conservation Advice *Pezoporus occidentalis* Night Parrot. Canberra.
- Tyler, M. J., L. A. Smith, and R. E. Johnstone. 2000. *Frogs of Western Australia*. Western Australian Museum, Perth.
- Van Dyck, S., and R. Strahan. 2008. *The Mammals of Australia*. Reed New Holland, Sydney.
- Wilson, H. 1937. Notes on the Night Parrot, with references to recent occurrences. *Emu* **37**:79-87.

## Figures

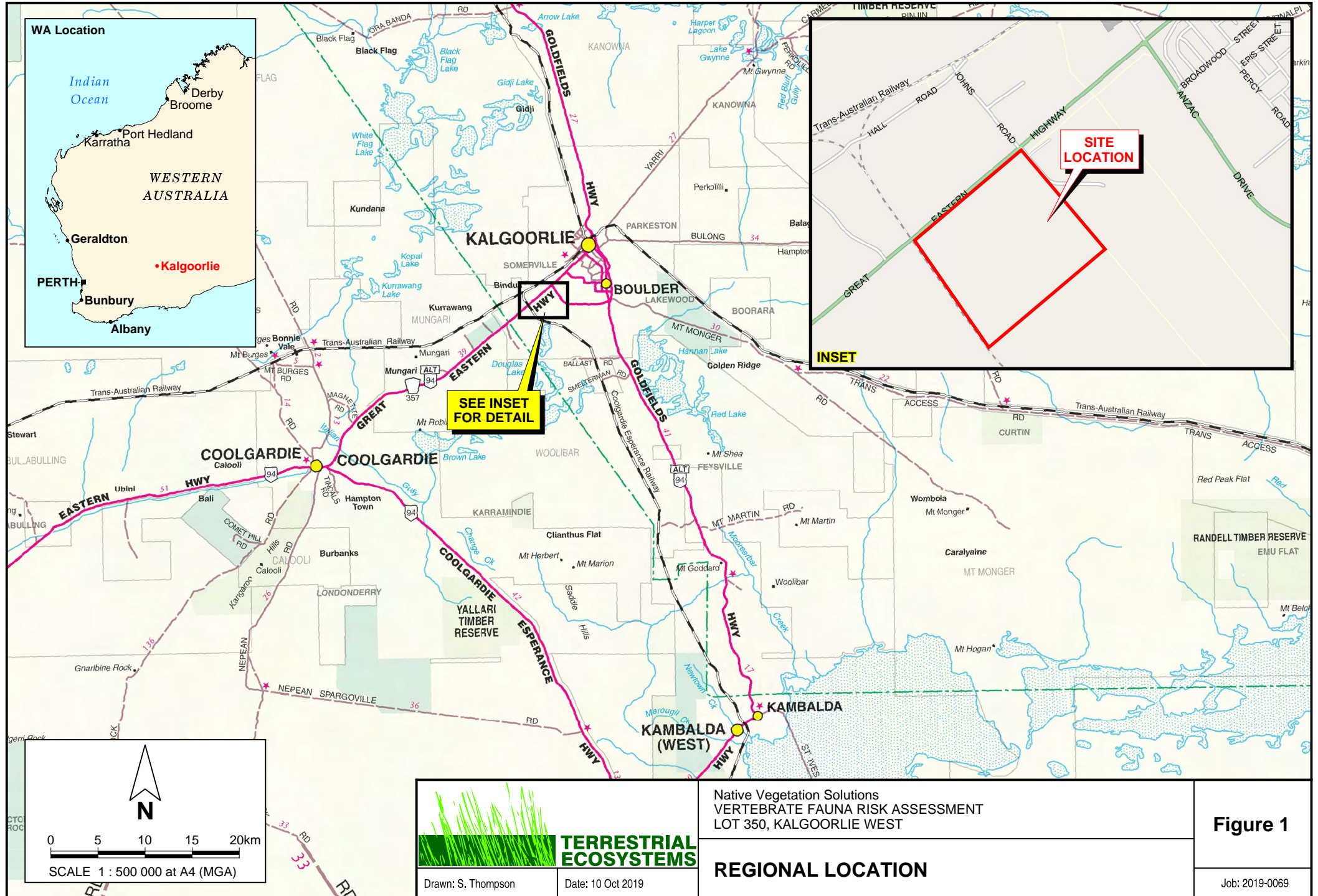
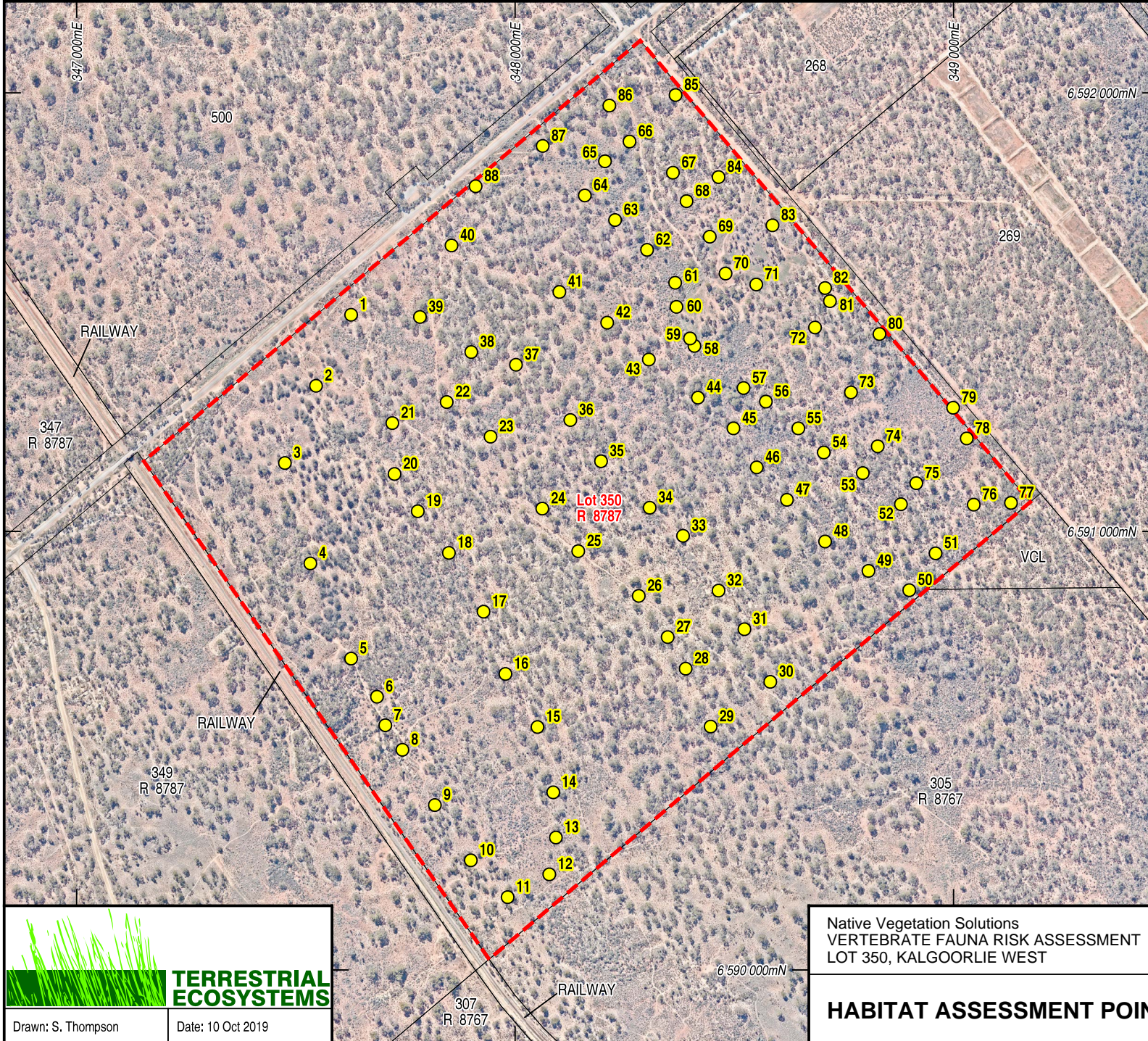

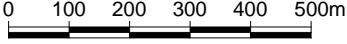


Figure 1





**N**



0 100 200 300 400 500m

SCALE 1 : 12 500 at A4 (MGA)

**Legend**

- - - Site Boundary
- Cadastral Boundary
- Habitat Assessment Location

CADASTRAL SOURCE: Landgate, August 2019.  
 AERIAL PHOTOGRAPH SOURCE: NearMap, flown July 2019.



**TERRESTRIAL ECOSYSTEMS**

Drawn: S. Thompson      Date: 10 Oct 2019

Native Vegetation Solutions  
 VERTEBRATE FAUNA RISK ASSESSMENT  
 LOT 350, KALGOORLIE WEST

HABITAT ASSESSMENT POINTS

Figure 2

Job: 2019-0069

Appendix A  
Vertebrate Fauna Recorded in Biological  
Surveys in the Region













Family	Species	Common Name	Survey		B				C	D	E													F	G		
			A		KK2	KK4	KK1	KK11			Site 1	Site 10	Site 2	Site 5	Site 6	Site 9	Site 12	Site 3	Site 8	Site 7	Site 11	Site 13	White Foil	White Foil			
	<i>Hirundo nigricans</i>	Tree Martin	X	4					X																		
Nectariniidae	<i>Dicaeum hirundinaceum</i>	Mistletoebird							X							1								1			
Estrildidae	<i>Taeniopygia guttata</i>	Zebra Finch							X																		
Motacillidae	<i>Anthus novaeseelandiae</i>	Australasian Pipit		1					X																		
<b>Mammals</b>																											
Bovidae	<i>Capra hircus</i>	Goat	X																						1	1	
	<i>Ovis aries</i>	Sheep																							1	1	
Canidae	<i>Canis familiaris</i>	Dog							X	3																	
	<i>Vulpes vulpes</i>	Red Fox	X				1																	1	1		
Felidae	<i>Felis catus</i>	House Cat	X						X	1																	
Molossidae	<i>Austronomus australis</i>	White-striped Free-tail Bat		17		5	1	X	6																		
	<i>Mormopterus planiceps</i>	Southern Free-tail Bat		8		11		X	18																		
Vespertilionidae	<i>Chalinolobus gouldii</i>	Gould's Wattled Bat						X	15																		
	<i>Chalinolobus morio</i>	Chocolate Wattled Bat		3		1		X	35																		
	<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat		2		1		X	6																		
	<i>Nyctophilus gouldi</i>	Gould's Long-eared Bat		42		10																					
	<i>Nyctophilus major</i>	Greater Long-eared Bat							1																		
	<i>Scotorepens balstoni</i>	Inland Broad-nosed Bat		11		2		X	4																		
	<i>Vespadelus baverstocki</i>	Inland Forest Bat						X	1																		
	<i>Vespadelus regulus</i>	Southern Forest Bat		5		1		X	8																		
Dasyuridae	<i>Antechinomys laniger</i>	Kultarr						X	1																		
	<i>Ningau ridei</i>	Wongai Ningau						X	1						1												
	<i>Ningau yvonneae</i>	Mallee Ningau						X	8																		
	<i>Pseudantechinus woolleyae</i>	Woolley's False Antechinus						X	1																		
	<i>Sminthopsis crassicaudata</i>	Fat-tailed Dunnart		5	1	2	1	X	40																		
	<i>Sminthopsis dolichura</i>	Little Long-tailed Dunnart		3	7	1	4	X	25	1	13	4		1				1	15	1							
	<i>Sminthopsis gilberti</i>	Gilbert's Dunnart						X	1																		
	<i>Sminthopsis ooldea</i>	Ooldea Dunnart						X	1																		
Myrmecobiidae	<i>Myrmecobius fasciatus</i>	Numbat						X	1																		
Burramyidae	<i>Cercartetus concinnus</i>	Southwestern Pygmy Possum		8	2		1	X			1	2	1		1	2	1		4	1	3						
Macropodidae	<i>Macropus fuliginosus</i>	Western Grey Kangaroo	X	2	8		6	X	2																	1	
	<i>Osphranter robustus</i>	Euro					2	X	1																		
	<i>Osphranter rufus</i>	Red Kangaroo		15		1	8																		1		
Leporidae	<i>Oryctolagus cuniculus</i>	European Rabbit	X					X	1															1	1		
Tachyglossidae	<i>Tachyglossus aculeatus</i>	Short-beaked Echidna	X					X	1															1			
Muridae	<i>Mus musculus</i>	House Mouse		13	1		4	X	45				4									9					
	<i>Notomys alexis</i>	Spinifex Hopping Mouse						X																			
	<i>Notomys mitchellii</i>	Mitchell's Hopping Mouse						X	3	42	1	29			2												
	<i>Pseudomys albocinereus</i>	Ash-grey Mouse						X	1																		
	<i>Pseudomys bolami</i>	Bolam's Mouse			9	2		X	32																		
	<i>Pseudomys hermannsburgensis</i>	Sandy Inland Mouse						X	33				1					1	13	2							

- A Ecological (2016) *Biological Assessment - Binduli Expansion Project. Level 1 vertebrate fauna and Short-range Endemic invertebrate survey*, Unpublished report for Norton Gold Fields, Kalgoorlie
- B McKenzie *et al.* (1992) The biological survey of the eastern goldfields of Western Australia. Part 8: Kurnalpi - Kalgoorlie study area, *Records of the Western Australian Museum*, Supplement 41.
- C Atlas of Living Australia
- D Western Australian Museum Records
- E Bamford, M.J., Davies, S.J.J.F. and Ladd, P.G. (1990) *Biological Survey of the Kangaroo Hills and Calooli Timber Reserves, Coolgardie, Western Australia.*
- F Ninox Wildlife Consulting (1999) *Fauna Survey for the White Foil Gold Project*, Unpublished report for Mines and Resources Australia Pty Ltd, Perth.
- G Ninox Wildlife Consulting (2002) *A Vertebrate Fauna Assessment of the Proposed White Foil Haul Road Route near Kalgoorlie, Western Australia*, Unpublished report for Mines and Resources Pty Ltd, Perth









Family	Species	Common Name	Survey																												
			A																	B											
			Golden Arrow Trans	Spinifex	Gimlet South Trans	Palace Rehab	Davyhurst	Gimlet South Undist	Golden Arrow Undist	Palace Undist	Security	Crossroads	Gimlet South Rehab	Golden Arrow Rehab	Palace Trans	Rose Trans	Rose Undist	Salmon Gums	Rose Rehab	Wendy Gully Rehab	Wendy Gully Trans	Wendy Gully Undist	Floodplains	Kurrawang NR #6	Kurrawang NR #4	Kurrawang NR #7	Kurrawang NR #2	Kurrawang NR #1	Kurrawang NR #3	Kurrawang NR #5	
	<i>Sminthopsis crassicaudata</i>	Fat-tailed Dunnart	11	2	14	67		2	15	12	4	26	32	27	57	63	28	5	143	121	100	24	108								
	<i>Sminthopsis dolichura</i>	Little Long-tailed Dunnart	16	63	4	2	47	15	25	36	46	11	2	17	4	5	28	34	2	7	4	32	2								
Burramyidae	<i>Cercartetus concinnus</i>	Southwestern Pygmy Possum	11	23	23	9	37	62	32	20	8	17	27	3	8	11	22	15	20	9	6	16									
Macropodidae	<i>Macropus fuliginosus</i>	Western Grey Kangaroo																													
	<i>Osphranter robustus</i>	Euro																													
Leporidae	<i>Oryctolagus cuniculus</i>	European Rabbit				1		1			1				1																
Tachyglossidae	<i>Tachyglossus aculeatus</i>	Short-beaked Echidna																													
Muridae	<i>Mus musculus</i>	House Mouse	36	26	62	49	19	25	2	24	10	18	128	24	47	33	22	6	56	181	88	13	31								
	<i>Notomys mitchellii</i>	Mitchell's Hopping Mouse					1						1																		1
	<i>Pseudomys albocinereus</i>	Ash-grey Mouse																			1										
	<i>Pseudomys bolami</i>	Bolam's Mouse	39	9	11		49	13	3	13	1	8	20	35	4	19	24	30	25			5	4								
	<i>Pseudomys hermannsburgensis</i>	Sandy Inland Mouse	9	8	3		9	5	3	4		2	5	7			14	9		2	1	5	2						1		

A Thompson, S. (2004b) *Mine site rehabilitation index using reptile assemblage as a bio-indicator*, PhD thesis and additional surveys.

B Chapman, A., Kealley, I., McMillan, D., McMillan, P. and Rolland, G. (1991) *Biological surveys of four Goldfields Reserves*, Landnote, 1/91, 1-26.

Appendix B  
Definitions of Significant Fauna under WA  
*Biodiversity Conservation Act 2016*

## **Appendix B: DEFINITIONS OF SIGNIFICANT FAUNA UNDER THE EPBC ACT AND THE WESTERN AUSTRALIAN BIODIVERSITY CONSERVATION ACT 2016**

Published as Specially Protected under the *Biodiversity Conservation Act 2016*, and listed under Schedules 1 to 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora (which may also be referred to as Declared Rare Flora).

**Threatened fauna** is that subset of ‘Specially Protected Fauna’ declared to be ‘likely to become extinct’ pursuant to section 14(4) of the Biodiversity Conservation Act.

**Threatened flora** is flora that has been declared to be ‘likely to become extinct or is rare, or otherwise in need of special protection’, pursuant to section 23F(2) of the Biodiversity Conservation Act.

The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria as detailed below.

### **CR Critically endangered species**

Threatened species considered to be facing an extremely high risk of extinction in the wild. Published as Specially Protected under the *Biodiversity Conservation Act 2016*, in Schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.

### **EN Endangered species**

Threatened species considered to be facing a very high risk of extinction in the wild. Published as Specially Protected under the *Biodiversity Conservation Act 2016*, in Schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.

### **VU Vulnerable species**

Threatened species considered to be facing a high risk of extinction in the wild. Published as Specially Protected under the *Biodiversity Conservation Act 2016*, in Schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.

### **EX Presumed extinct species**

Species which have been adequately searched for and there is no reasonable doubt that the last individual has died. Published as Specially Protected under the *Biodiversity Conservation Act 2016*, in Schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Presumed Extinct Fauna and Wildlife Conservation (Rare Flora) Notice for Presumed Extinct Flora.

### **IA Migratory birds protected under an international agreement**

Birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and the Bonn Convention, relating to the protection of migratory birds. Published as Specially Protected under the *Biodiversity Conservation Act 2016*, in Schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice.

### **CD Conservation dependent fauna**

Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened. Published as Specially Protected under the *Biodiversity Conservation Act 2016*, in Schedule 6 of the Wildlife Conservation (Specially Protected Fauna) Notice.

### **OS Other specially protected fauna**

Fauna otherwise in need of special protection to ensure their conservation. Published as Specially Protected under the *Biodiversity Conservation Act 2016*, in Schedule 7 of the Wildlife Conservation (Specially Protected Fauna) Notice.

## Priority species

Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened flora or fauna.

Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring.

Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.

### **P1 Priority 1: Poorly-known species**

Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.

### **P2 Priority 2: Poorly-known species**

Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.

### **P3 Priority 3: Poorly-known species**

Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.

### **P4 Priority 4: Rare, Near Threatened and other species in need of monitoring**

(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands.

(b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for Vulnerable, but are not listed as Conservation Dependent.

(c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

Appendix C  
Results of the *EPBC Act* Protected  
Matters Search



# EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about [Environment Assessments](#) and the EPBC Act including significance guidelines, forms and application process details.

Report created: 24/10/19 19:39:32

[Summary](#)

[Details](#)

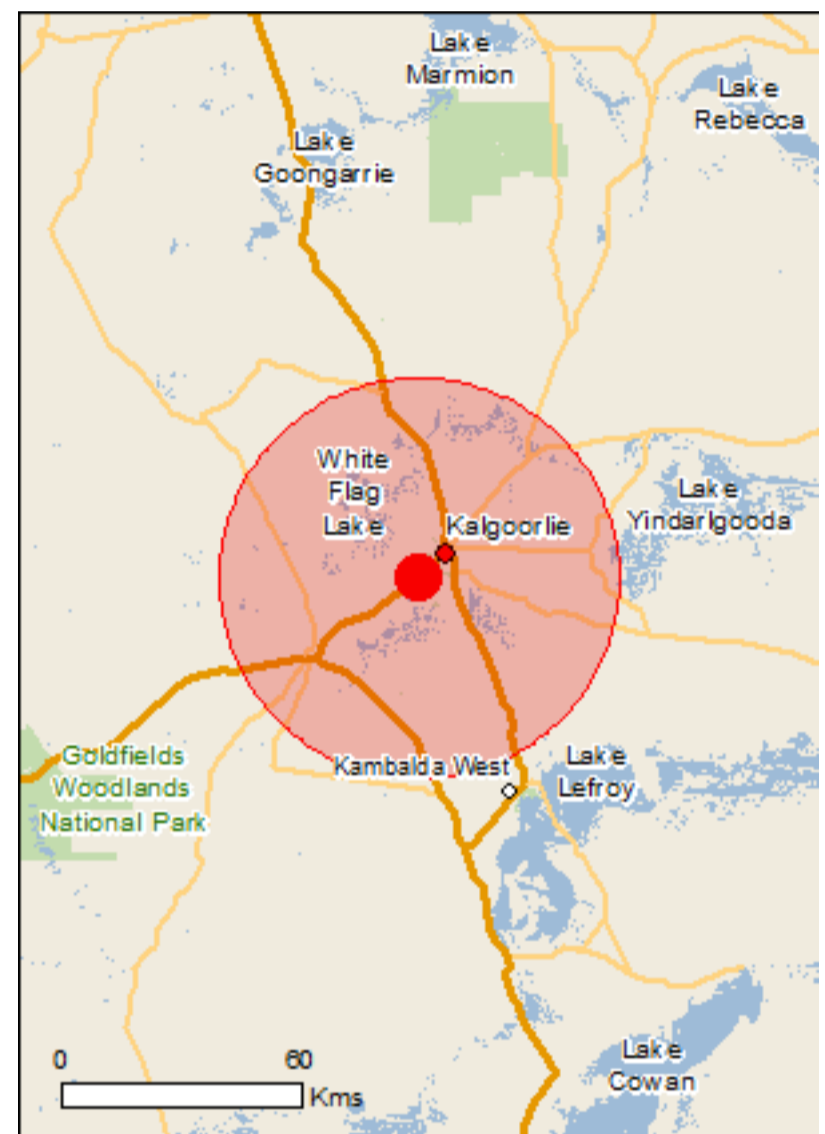
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

[Acknowledgements](#)



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

[Coordinates](#)

Buffer: 50.0Km



# Summary

## Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the [Administrative Guidelines on Significance](#).

<a href="#">World Heritage Properties:</a>	None
<a href="#">National Heritage Places:</a>	1
<a href="#">Wetlands of International Importance:</a>	None
<a href="#">Great Barrier Reef Marine Park:</a>	None
<a href="#">Commonwealth Marine Area:</a>	None
<a href="#">Listed Threatened Ecological Communities:</a>	None
<a href="#">Listed Threatened Species:</a>	8
<a href="#">Listed Migratory Species:</a>	7

## Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at <http://www.environment.gov.au/heritage>

A [permit](#) may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

<a href="#">Commonwealth Land:</a>	4
<a href="#">Commonwealth Heritage Places:</a>	None
<a href="#">Listed Marine Species:</a>	12
<a href="#">Whales and Other Cetaceans:</a>	None
<a href="#">Critical Habitats:</a>	None
<a href="#">Commonwealth Reserves Terrestrial:</a>	None
<a href="#">Australian Marine Parks:</a>	None

## Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

<a href="#">State and Territory Reserves:</a>	8
<a href="#">Regional Forest Agreements:</a>	None
<a href="#">Invasive Species:</a>	16
<a href="#">Nationally Important Wetlands:</a>	None
<a href="#">Key Ecological Features (Marine)</a>	None



# Details

## Matters of National Environmental Significance

National Heritage Properties		<a href="#">[ Resource Information ]</a>
Name	State	Status
<b>Historic</b>		
<a href="#">Goldfields Water Supply Scheme, Western Australia</a>	WA	Listed place

Listed Threatened Species		<a href="#">[ Resource Information ]</a>
Name	Status	Type of Presence

<b>Birds</b>		
--------------	--	--

<a href="#">Calidris ferruginea</a> Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area
---	-----------------------	--

<a href="#">Leipoa ocellata</a> Malleefowl [934]	Vulnerable	Species or species habitat known to occur within area
---	------------	---

<a href="#">Pezoporus occidentalis</a> Night Parrot [59350]	Endangered	Species or species habitat may occur within area
--	------------	--

<b>Insects</b>		
----------------	--	--

<a href="#">Ogyris subterrestris petrina</a> Arid Bronze Azure [77743]	Critically Endangered	Species or species habitat may occur within area
---	-----------------------	--

<b>Mammals</b>		
----------------	--	--

<a href="#">Dasyurus geoffroii</a> Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat may occur within area
---	------------	--

<b>Plants</b>		
---------------	--	--

<a href="#">Gastrolobium graniticum</a> Granite Poison [14872]	Endangered	Species or species habitat likely to occur within area
---	------------	--

<a href="#">Tecticornia flabelliformis</a> Bead Glasswort [82664]	Vulnerable	Species or species habitat likely to occur within area
--	------------	--

<a href="#">Thelymitra stellata</a> Star Sun-orchid [7060]	Endangered	Species or species habitat may occur within area
---	------------	--

Listed Migratory Species		<a href="#">[ Resource Information ]</a>
--------------------------	--	--

\* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
------	------------	------------------

<b>Migratory Marine Birds</b>		
-------------------------------	--	--

<a href="#">Apus pacificus</a> Fork-tailed Swift [678]		Species or species habitat likely to occur within area
---	--	--

<b>Migratory Terrestrial Species</b>		
--------------------------------------	--	--

Name	Threatened	Type of Presence
<a href="#">Motacilla cinerea</a> Grey Wagtail [642]		Species or species habitat may occur within area
<b>Migratory Wetlands Species</b>		
<a href="#">Actitis hypoleucos</a> Common Sandpiper [59309]		Species or species habitat may occur within area
<a href="#">Calidris acuminata</a> Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
<a href="#">Calidris ferruginea</a> Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area
<a href="#">Calidris melanotos</a> Pectoral Sandpiper [858]		Species or species habitat may occur within area
<a href="#">Tringa nebularia</a> Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

## Other Matters Protected by the EPBC Act

### Commonwealth Land [\[ Resource Information \]](#)

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land - Defence - AIRTC KALGOORLIE Defence - KALGOORLIE RIFLE RANGE Defence - KALGOORLIE TRAINING DEPOT

### Listed Marine Species [\[ Resource Information \]](#)

\* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
<b>Birds</b>		
<a href="#">Actitis hypoleucos</a> Common Sandpiper [59309]		Species or species habitat may occur within area
<a href="#">Apus pacificus</a> Fork-tailed Swift [678]		Species or species habitat likely to occur within area
<a href="#">Ardea alba</a> Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
<a href="#">Ardea ibis</a> Cattle Egret [59542]		Species or species habitat may occur within area
<a href="#">Calidris acuminata</a> Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
<a href="#">Calidris ferruginea</a> Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area
<a href="#">Calidris melanotos</a> Pectoral Sandpiper [858]		Species or species

Name	Threatened	Type of Presence
<a href="#">Chrysococcyx osculans</a> Black-eared Cuckoo [705]		habitat may occur within area  Species or species habitat known to occur within area
<a href="#">Merops ornatus</a> Rainbow Bee-eater [670]		Species or species habitat may occur within area
<a href="#">Motacilla cinerea</a> Grey Wagtail [642]		Species or species habitat may occur within area
<a href="#">Thinornis rubricollis</a> Hooded Plover [59510]		Species or species habitat known to occur within area
<a href="#">Tringa nebularia</a> Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

## Extra Information

### State and Territory Reserves [\[ Resource Information \]](#)

Name	State
Bullock Holes Timber Reserve	WA
Kalgoorlie Arboretum	WA
Kambalda	WA
Kangaroo Hills Timber Reserve	WA
Kurrawang	WA
Lakeside Timber Reserve	WA
Scahill Timber Reserve	WA
Yallari Timber Reserve	WA

### Invasive Species [\[ Resource Information \]](#)

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resources Audit, 2001.

Name	Status	Type of Presence
<b>Birds</b>		
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
<b>Mammals</b>		
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Equus asinus Donkey, Ass [4]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Equus caballus Horse [5]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area

## Plants

Carrichtera annua Ward's Weed [9511]		Species or species habitat likely to occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Cylindropuntia spp. Prickly Pears [85131]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area

## Reptiles

Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area
---	--	--

# Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

# Coordinates

-30.80125 121.4116

# Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- [-Office of Environment and Heritage, New South Wales](#)
- [-Department of Environment and Primary Industries, Victoria](#)
- [-Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [-Department of Environment, Water and Natural Resources, South Australia](#)
- [-Department of Land and Resource Management, Northern Territory](#)
- [-Department of Environmental and Heritage Protection, Queensland](#)
- [-Department of Parks and Wildlife, Western Australia](#)
- [-Environment and Planning Directorate, ACT](#)
- [-Birdlife Australia](#)
- [-Australian Bird and Bat Banding Scheme](#)
- [-Australian National Wildlife Collection](#)
- [-Natural history museums of Australia](#)
- [-Museum Victoria](#)
- [-Australian Museum](#)
- [-South Australian Museum](#)
- [-Queensland Museum](#)
- [-Online Zoological Collections of Australian Museums](#)
- [-Queensland Herbarium](#)
- [-National Herbarium of NSW](#)
- [-Royal Botanic Gardens and National Herbarium of Victoria](#)
- [-Tasmanian Herbarium](#)
- [-State Herbarium of South Australia](#)
- [-Northern Territory Herbarium](#)
- [-Western Australian Herbarium](#)
- [-Australian National Herbarium, Canberra](#)
- [-University of New England](#)
- [-Ocean Biogeographic Information System](#)
- [-Australian Government, Department of Defence Forestry Corporation, NSW](#)
- [-Geoscience Australia](#)
- [-CSIRO](#)
- [-Australian Tropical Herbarium, Cairns](#)
- [-eBird Australia](#)
- [-Australian Government – Australian Antarctic Data Centre](#)
- [-Museum and Art Gallery of the Northern Territory](#)
- [-Australian Government National Environmental Science Program](#)
- [-Australian Institute of Marine Science](#)
- [-Reef Life Survey Australia](#)
- [-American Museum of Natural History](#)
- [-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania](#)
- [-Tasmanian Museum and Art Gallery, Hobart, Tasmania](#)
- [-Other groups and individuals](#)

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the [Contact Us](#) page.

Appendix D  
Fauna habitat assessment results

Date: 12-Sep-19

Habitat Assessment #: 1

Observers: Dr Scott Thompson

Zone: 51

Easting: 347626 mE

Northing: 6591494 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods





Date: 12-Sep-19

Habitat Assessment #: 2

Observers: Dr Scott Thompson

Zone: 51

Easting: 347546 mE

Northing: 6591332 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 3

Observers: Dr Scott Thompson

Zone: 51

Easting: 347475 mE

Northing: 6591156 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 4

Observers: Dr Scott Thompson

Zone: 51

Easting: 347533 mE

Northing: 6590927 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 5

Observers: Dr Scott Thompson

Zone: 51

Easting: 347626 mE

Northing: 6590710 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 6

Observers: Dr Scott Thompson

Zone: 51

Easting: 347685 mE

Northing: 6590623 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 7

Observers: Dr Scott Thompson

Zone: 51

Easting: 347704 mE

Northing: 6590558 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Disturbed to good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 8

Observers: Dr Scott Thompson

Zone: 51

Easting: 347743 mE

Northing: 6590502 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Disturbed to good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 9

Observers: Dr Scott Thompson

Zone: 51

Easting: 347817 mE

Northing: 6590376 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods





Date: 12-Sep-19

Habitat Assessment #: 10

Observers: Dr Scott Thompson

Zone: 51

Easting: 347899 mE

Northing: 6590250 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 11

Observers: Dr Scott Thompson

Zone: 51

Easting: 347983 mE

Northing: 6590166 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 12

Observers: Dr Scott Thompson

Zone: 51

Easting: 348078 mE

Northing: 6590218 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 13

Observers: Dr Scott Thompson

Zone: 51

Easting: 348093 mE

Northing: 6590302 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 14

Observers: Dr Scott Thompson

Zone: 51

Easting: 348087 mE

Northing: 6590405 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 15

Observers: Dr Scott Thompson

Zone: 51

Easting: 348051 mE

Northing: 6590554 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 16

Observers: Dr Scott Thompson

Zone: 51

Easting: 347978 mE

Northing: 6590675 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 17

Observers: Dr Scott Thompson

Zone: 51

Easting: 347928 mE

Northing: 6590817 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods





Date: 12-Sep-19

Habitat Assessment #: 18

Observers: Dr Scott Thompson

Zone: 51

Easting: 347849 mE

Northing: 6590951 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 19

Observers: Dr Scott Thompson

Zone: 51

Easting: 347778 mE

Northing: 6591046 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 20

Observers: Dr Scott Thompson

Zone: 51

Easting: 347725 mE

Northing: 6591131 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 21

Observers: Dr Scott Thompson

Zone: 51

Easting: 347720 mE

Northing: 6591247 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 22

Observers: Dr Scott Thompson

Zone: 51

Easting: 347844 mE

Northing: 6591295 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 23

Observers: Dr Scott Thompson

Zone: 51

Easting: 347944 mE

Northing: 6591216 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 24

Observers: Dr Scott Thompson

Zone: 51

Easting: 348062 mE

Northing: 6591052 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 25

Observers: Dr Scott Thompson

Zone: 51

Easting: 348144 mE

Northing: 6590955 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods





Date: 12-Sep-19

Habitat Assessment #: 26

Observers: Dr Scott Thompson

Zone: 51

Easting: 348282 mE

Northing: 6590853 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 27

Observers: Dr Scott Thompson

Zone: 51

Easting: 348348 mE

Northing: 6590759 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand with stones

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 28

Observers: Dr Scott Thompson

Zone: 51

Easting: 348389 mE

Northing: 6590687 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 29

Observers: Dr Scott Thompson

Zone: 51

Easting: 348446 mE

Northing: 6590555 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 30

Observers: Dr Scott Thompson

Zone: 51

Easting: 348582 mE

Northing: 6590657 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 31

Observers: Dr Scott Thompson

Zone: 51

Easting: 348523 mE

Northing: 6590777 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 32

Observers: Dr Scott Thompson

Zone: 51

Easting: 348464 mE

Northing: 6590865 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 33

Observers: Dr Scott Thompson

Zone: 51

Easting: 348383 mE

Northing: 6590990 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods





Date: 12-Sep-19

Habitat Assessment #: 34

Observers: Dr Scott Thompson

Zone: 51

Easting: 348307 mE

Northing: 6591054 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 35

Observers: Dr Scott Thompson

Zone: 51

Easting: 348196 mE

Northing: 6591160 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 36

Observers: Dr Scott Thompson

Zone: 51

Easting: 348126 mE

Northing: 6591254 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 37

Observers: Dr Scott Thompson

Zone: 51

Easting: 348002 mE

Northing: 6591380 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 38

Observers: Dr Scott Thompson

Zone: 51

Easting: 347900 mE

Northing: 6591409 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Disturbed

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 39

Observers: Dr Scott Thompson

Zone: 51

Easting: 347783 mE

Northing: 6591489 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 40

Observers: Dr Scott Thompson

Zone: 51

Easting: 347855 mE

Northing: 6591652 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 41

Observers: Dr Scott Thompson

Zone: 51

Easting: 348101 mE

Northing: 6591546 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods





Date: 12-Sep-19

Habitat Assessment #: 42

Observers: Dr Scott Thompson

Zone: 51

Easting: 348210 mE

Northing: 6591476 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 43

Observers: Dr Scott Thompson

Zone: 51

Easting: 348305 mE

Northing: 6591392 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 44

Observers: Dr Scott Thompson

Zone: 51

Easting: 348417 mE

Northing: 6591305 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 45

Observers: Dr Scott Thompson

Zone: 51

Easting: 348498 mE

Northing: 6591235 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 46

Observers: Dr Scott Thompson

Zone: 51

Easting: 348551 mE

Northing: 6591146 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 47

Observers: Dr Scott Thompson

Zone: 51

Easting: 348620 mE

Northing: 6591072 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 48

Observers: Dr Scott Thompson

Zone: 51

Easting: 348707 mE

Northing: 6590977 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 49

Observers: Dr Scott Thompson

Zone: 51

Easting: 348806 mE

Northing: 6590910 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods





Date: 12-Sep-19

Habitat Assessment #: 50

Observers: Dr Scott Thompson

Zone: 51

Easting: 348899 mE

Northing: 6590866 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 51

Observers: Dr Scott Thompson

Zone: 51

Easting: 348959 mE

Northing: 6590950 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 52

Observers: Dr Scott Thompson

Zone: 51

Easting: 348880 mE

Northing: 6591062 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 53

Observers: Dr Scott Thompson

Zone: 51

Easting: 348793 mE

Northing: 6591133 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 54

Observers: Dr Scott Thompson

Zone: 51

Easting: 348704 mE

Northing: 6591180 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 55

Observers: Dr Scott Thompson

Zone: 51

Easting: 348646 mE

Northing: 6591235 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 56

Observers: Dr Scott Thompson

Zone: 51

Easting: 348572 mE

Northing: 6591296 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 57

Observers: Dr Scott Thompson

Zone: 51

Easting: 348521 mE

Northing: 6591327 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods





Date: 12-Sep-19

Habitat Assessment #: 58

Observers: Dr Scott Thompson

Zone: 51

Easting: 348409 mE

Northing: 6591423 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Rehabilitation

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 59

Observers: Dr Scott Thompson

Zone: 51

Easting: 348399 mE

Northing: 6591440 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Rehabilitation

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 60

Observers: Dr Scott Thompson

Zone: 51

Easting: 348368 mE

Northing: 6591512 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Rehabilitation

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 61

Observers: Dr Scott Thompson

Zone: 51

Easting: 348365 mE

Northing: 6591567 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Rehabilitation

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 62

Observers: Dr Scott Thompson

Zone: 51

Easting: 348301 mE

Northing: 6591642 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 63

Observers: Dr Scott Thompson

Zone: 51

Easting: 348228 mE

Northing: 6591710 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 64

Observers: Dr Scott Thompson

Zone: 51

Easting: 348159 mE

Northing: 6591766 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 65

Observers: Dr Scott Thompson

Zone: 51

Easting: 348205 mE

Northing: 6591844 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods





Date: 12-Sep-19

Habitat Assessment #: 66

Observers: Dr Scott Thompson

Zone: 51

Easting: 348261 mE

Northing: 6591889 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 67

Observers: Dr Scott Thompson

Zone: 51

Easting: 348360 mE

Northing: 6591818 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 68

Observers: Dr Scott Thompson

Zone: 51

Easting: 348391 mE

Northing: 6591753 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 69

Observers: Dr Scott Thompson

Zone: 51

Easting: 348444 mE

Northing: 6591672 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Rehabilitation

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 70

Observers: Dr Scott Thompson

Zone: 51

Easting: 348480 mE

Northing: 6591588 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Disturbed

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 71

Observers: Dr Scott Thompson

Zone: 51

Easting: 348550 mE

Northing: 6591563 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Disturbed

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 72

Observers: Dr Scott Thompson

Zone: 51

Easting: 348684 mE

Northing: 6591465 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 73

Observers: Dr Scott Thompson

Zone: 51

Easting: 348766 mE

Northing: 6591317 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods





Date: 12-Sep-19

Habitat Assessment #: 74

Observers: Dr Scott Thompson

Zone: 51

Easting: 348827 mE

Northing: 6591194 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 75

Observers: Dr Scott Thompson

Zone: 51

Easting: 348915 mE

Northing: 6591110 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 76

Observers: Dr Scott Thompson

Zone: 51

Easting: 349046 mE

Northing: 6591061 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 77

Observers: Dr Scott Thompson

Zone: 51

Easting: 349131 mE

Northing: 6591065 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 78

Observers: Dr Scott Thompson

Zone: 51

Easting: 349030 mE

Northing: 6591212 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 79

Observers: Dr Scott Thompson

Zone: 51

Easting: 348999 mE

Northing: 6591282 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 80

Observers: Dr Scott Thompson

Zone: 51

Easting: 348831 mE

Northing: 6591450 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 81

Observers: Dr Scott Thompson

Zone: 51

Easting: 348718 mE

Northing: 6591525 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Rehabilitation

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods





Date: 12-Sep-19

Habitat Assessment #: 82

Observers: Dr Scott Thompson

Zone: 51

Easting: 348707 mE

Northing: 6591555 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Disturbed

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 83

Observers: Dr Scott Thompson

Zone: 51

Easting: 348587 mE

Northing: 6591698 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Disturbed

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 84

Observers: Dr Scott Thompson

Zone: 51

Easting: 348464 mE

Northing: 6591808 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Degraded to good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 85

Observers: Dr Scott Thompson

Zone: 51

Easting: 348366 mE

Northing: 6591995 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 86

Observers: Dr Scott Thompson

Zone: 51

Easting: 348215 mE

Northing: 6591971 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 87

Observers: Dr Scott Thompson

Zone: 51

Easting: 348063 mE

Northing: 6591879 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods



Date: 12-Sep-19

Habitat Assessment #: 88

Observers: Dr Scott Thompson

Zone: 51

Easting: 347910 mE

Northing: 6591787 mN

Landform: Flat

Fire History: > 5 years

Habitat Quality: Good to very good

Soil Type: Red loam over clay

Surface: Sand

Habitat Structure: Open Eucalypt woodland with a mixed understory of scattered shrubs and chenopods

