APPENDIX I: TERRESTRIAL FAUNA SURVEY - B2018 PROJECT (PHOENIX ENVIRONMENTAL SCIENCES)

PHOENIX
ENVIRONMENTAL SCIENCES

Terrestrial fauna survey for the St Ives Gold Mine Beyond 2018 Project

Prepared for St Ives Gold Mining Company Pty Ltd

January 2018

Final Report

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Final Report

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EXECUTIVE SUMMARY

In September 2016, Phoenix Environmental Sciences Pty Ltd (Phoenix) was commissioned by Talis Consultants Pty Ltd on behalf of St Ives Gold Mining Company Pty Ltd (SIGM) to undertake a terrestrial fauna assessment for the St Ives Gold Mine Beyond 2018 Project ('B2018 Project') near Kambalda, approximately 50 km south of the City of Kalgoorlie-Boulder. SIGM currently operates open pit and underground gold mining on and adjacent to Lake Lefroy. Environmental approvals have been granted, or are pending, for mining operations to the end of 2018.

The B2018 Project will seek to secure continuation of operations while maintaining maximum operational flexibility after 2018. The detailed B2018 Project site layout is currently unknown but based on current estimates, it is anticipated that the average annual disturbance will be approximately 200 ha on the lake and 300 ha on land over a ten-year period. Due to this large project footprint and associated potential environmental impacts, a referral pursuant to Part IV of the *Environmental Protection Act 1986* to the Environmental Protection Authority (EPA) was submitted.

As part of the environmental impact assessment (EIA) process required under the EP Act, a range of studies are required.

The objective of the fauna survey was to define the fauna values of the B2018 study area, in particular with respect to conservation significant species and short-range endemic invertebrates (SREs) to inform planning and an environmental impact assessment of the B2018 Project. Survey design, methodology and report-writing adhered to relevant principles and guidelines, including:

- EPA *Statement of environmental principals, factors and objectives*
- EPA *Environmental Factor Guideline: Terrestrial fauna*
- EPA *Technical Guidance: Terrestrial fauna surveys*
- EPA *Technical Guidance: Sampling of short-range endemic invertebrate fauna*.

A desktop review of relevant databases, survey reports undertaken within and in the vicinity of the B2018 study area, and published literature preceded the field survey to assess the potential for presence of conservation significant vertebrates and SRE species. Level 1 vertebrate and Level 2 SRE surveys were undertaken from 19–22 October 2016 and comprised on-site habitat assessments, litter/soil sieving and active searches and foraging. A total of 18 sites were surveyed totalling 36 person hours of active searches and foraging, and nine litter sieves. Two bat echolocation call recording devices (SongMeter SM2) were deployed at two sites for overnight recordings between 15–16 November 2016.

The B2018 study area comprised three broad fauna habitats – salt lake playa and riparian zone (56.3% of the 45,013.5 ha study area), woodland on plain (30.2%), and shrubland on dune (4.2%). The remaining 9.3% of the B2018 study area comprised of existing cleared and/or developed areas.

A total of 252 vertebrate fauna species (three frogs, 73 reptiles, 140 birds and 36 mammals – 28 native and eight introduced) were identified in the desktop review as potentially occurring in the B2018 study area. Of these, 26 species were of conservation significance, including 11 listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and/or *Wildlife Conservation Act 1950* (WC Act) as threatened, conservation dependent or specially protected.

The desktop review identified 50 SRE taxa, of which 16 have been recorded in the B2018 study area. Seven of these species were only reported from the B2018 study area, including three mygalomorph spider species (*Aname* 'MYG223', *Aname* 'SIGM121 and *Aname* 'SIGM122'), three scorpions (*Lychas* 'SIGM132', *Urodacus* 'SIGM131', *Urodacus* 'lefroy') and one slater (Philosciidae 'lefroy').

Evidence of three vertebrate fauna species of conservation significance were recorded within the B2018 study area during the field survey:

- Malleefowl (*Leipoa ocellata*) (Vulnerable under the EPBC Act and WC Act)
- Rainbow Bee-eater (*Merops ornatus*) (Migratory under the EPBC Act and WC Act)
- Fork-tailed Swift (*Apus pacificus*) (Migratory under the EPBC Act and WC Act).

Three old inactive Malleefowl mounds were recorded in the survey, but only one of these was within the B2018 study area. Although not recorded directly in the current survey, several previous Malleefowl records exist within and near the B2018 study area, and suitable open woodland habitat is broadly present, indicating the species utilises the B2018 study area. However, its occurrence may be restricted to less developed and disturbed areas, particularly the south-eastern part of the B2018 study area. The Fork-tailed Swift and Rainbow Bee eater were both recorded from direct observation and calls.

Considering presence of suitable habitat and proximity of recent records, a further 16 species of conservation significance, primarily migratory waterbirds and shorebirds, may occur from time to time in the B2018 study area.

A total of 26 specimens in the SRE target groups, which here includes potential salt lake specialists, were collected in the B2018 study area, representing five individually-recognised species and seven unidentified higher taxa from three orders, eight families and at least eleven genera. Of these, the wolf spider *Tetralycosa baudinettei* represents a confirmed SRE, however, this salt lake specialist is known from other lakes in the region. A peacock jumping spider, *Maratus* 'PES340', was for the first time recognised as salt lake specialist. It is currently only known from Lake Lefroy; however, it occurs outside the B2018 study area. The field survey did not report any additional species that are limited to the B2018 study area other than those identified by the desktop review.

Of the SRE species only known from the B2018 study area, those that are habitat specialists of the riparian zone (*Aname* 'SIGM122' and *Lychas* 'SIGM132) should receive most consideration, due to their limited habitat availability. All other species only known from the B2018 study area are likely inhabitants of the expansive woodlands around the lake. In addition, those species currently only known from Lake Lefroy (inside and outside of the B2018 study area) should receive consideration, including two species of spider (*Maratus* 'PES340', Nemesiidae 'SIGM104'), two tiger beetles (*Cicindela salicursoria* and *C. necopinata*) and a slater (*Cubaris* 'lefroy').

All broad fauna habitats occurring within the B2018 study area are also represented in areas adjacent and across the broader Coolgardie bioregion. The dominant habitats of the B2018 study area are the salt lake and its riparian zone (with higher significance for SREs than for vertebrates) and woodland habitats (critical for conservation significant vertebrates such as the Malleefowl). Both occur more broadly in across the Coolgardie bioregion and the B2018 study area is not considered to be of critical to any species due to the mobile nature of most species and the presence of suitable habitat in the broader vicinity.

Previous studies of salt lake terrestrial invertebrates at St Ives have been utilised to support recent approvals for the site, including the Beyond 2010 Project and modifications resulting from the Invincible and Beyond 2016 Projects. Whilst this work has been sufficient to support such approvals, Phoenix is of the view that further work is required in relation to the B2018 Project. It is recommended that additional work should focus on increasing knowledge of significant species known to occur in the B2018 study area, to assist in a better understanding of potential impacts of future development, including:

- Vertebrate fauna:
    - targeted surveys for Malleefowl to be conducted prior to any development in areas of suitable habitat to determine current presence and extent of occurrence of the species in the B2018 study area.
    - where Malleefowl mounds and/or critical habitat are identified, apply clearing exclusion areas to minimise any further removal of nesting mounds and retain areas of suitable habitat within the B2018 study area to allow the species to persist
- SRE fauna:
    - targeted surveys for SREs currently only known from the B2018 study area (all of these are associated with the riparian zone), in particular if currently known populations of these species are affected by future developments (i.e. if significant clearing is proposed within the riparian habitats). These surveys should include other regional lakes to potentially show a wider distribution of these species (and the species currently only known from Lake Lefroy).

1 INTRODUCTION

In September 2016, Phoenix Environmental Sciences Pty Ltd (Phoenix) was commissioned by Talis Consultants Pty Ltd (Talis) on behalf of St Ives Gold Mining Company Pty Ltd (SIGM), which is part of the Gold Fields Australia Pty Ltd (GFA) group of companies, the ultimate parent company of which is Gold Fields Ltd, to undertake a terrestrial fauna assessment for the St Ives Gold Mine Beyond 2018 Project ('B2018 Project') near Kambalda, approximately 50 km south of the City of Kalgoorlie-Boulder and stretching across central parts of Lake Lefroy (Figure 1-1). The survey scope included terrestrial vertebrates and short-range endemic invertebrates (SREs).

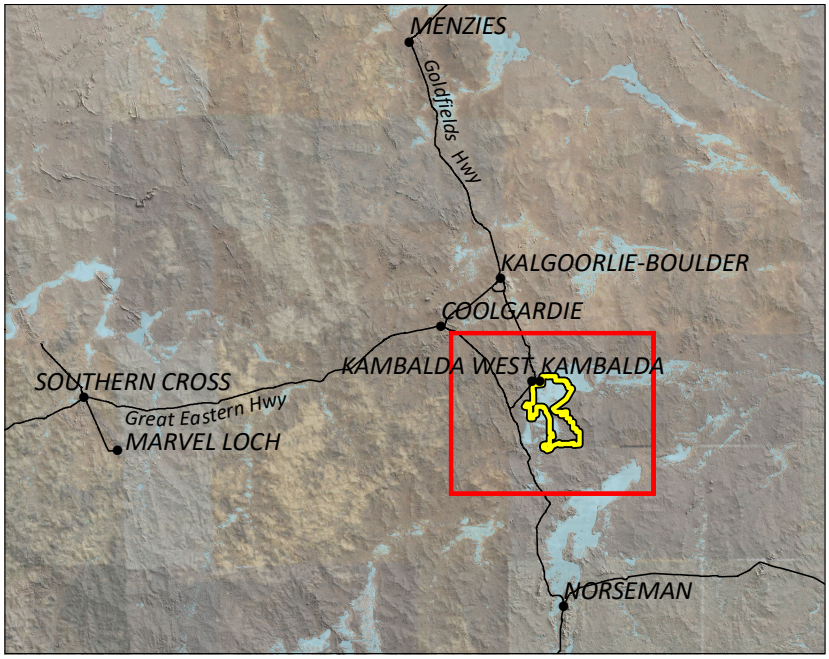
1.1 BACKGROUND

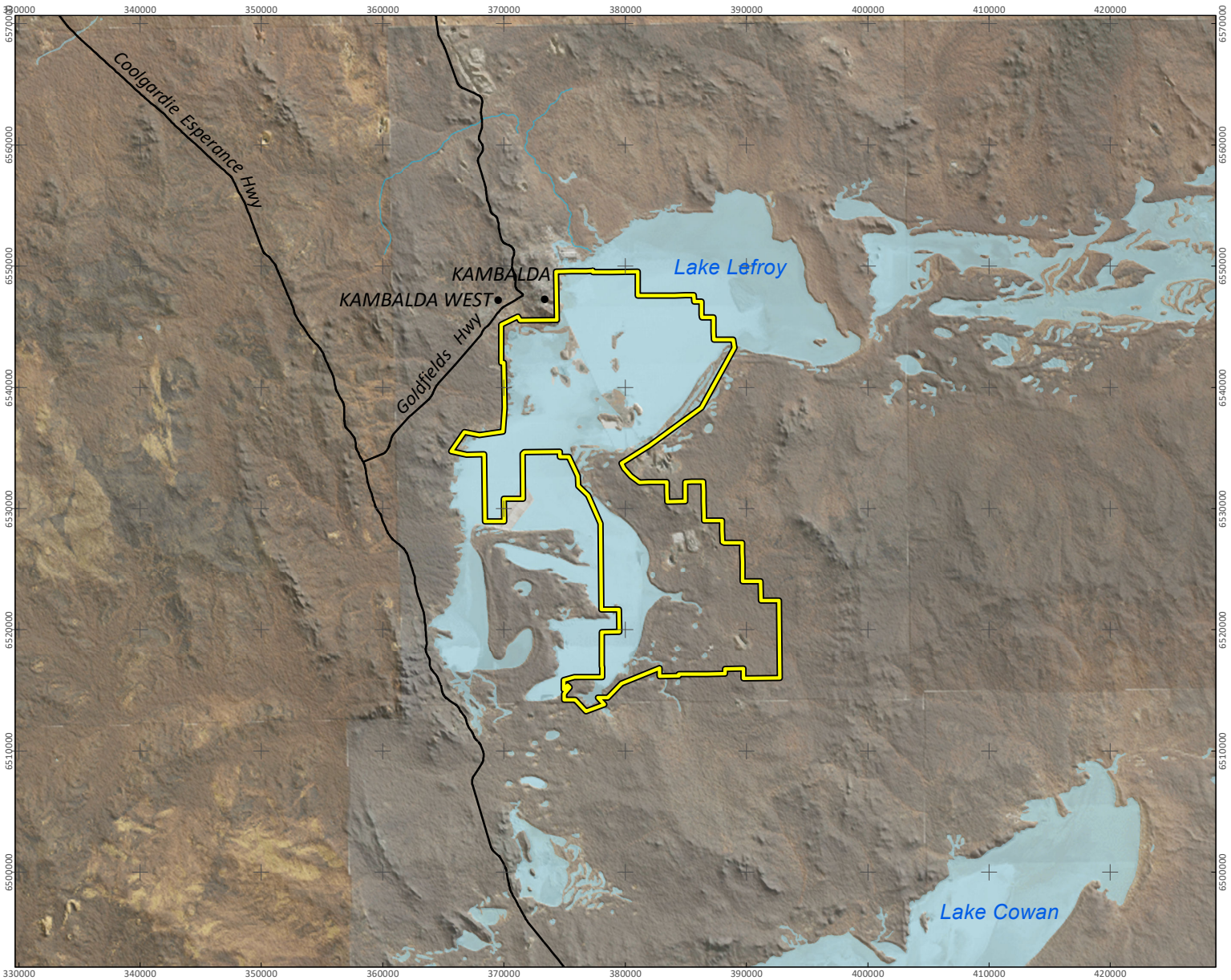
SIGM's St Ives operations at Lake Lefroy are currently approved under Ministerial Statement (MS) 879. Operations at St Ives Gold Mine entail mining beneath the surface of the lake, land-based operations and dewatering discharge to the lake. The lake is a hypersaline ephemeral playa covering approximately 55,400 ha. SIGM recently submitted a Change to Proposal request (including supporting documentation) to the Office of Environmental Protection Authority (EPA) to allow continuation of operations beyond 2016 (the B2016 Project). It is expected that the B2016 proposal will provide sufficient mining capacity to the end of 2018.

To ensure the St Ives operations will continue beyond 2018, the B2018 Project has been initiated. This project will seek to expand outside the existing MS 879 approved footprint, covering a broad area encompassing terrestrial and lake-based operations (the B2018 study area; 45,013.6 ha) (Figure 1-1). Gold Fields has determined that, based on current mining rates, the average annual disturbance will be approximately 200 ha on the lake and 300 ha on land annually over a ten-year period.

Due to the large project footprint and associated potential environmental impacts, a referral pursuant to Part IV of the *Environmental Protection Act 1986* (EP Act) to the Environmental Protection Authority (EPA) was submitted.

A range of studies will be required to be undertaken to support an environmental impact assessment (EIA) process under the EP Act.





St Ives Gold Mine
Beyond 2018 Project

Project No	1128
Date	12/16/2016
Drawn by	KW
Map author	KC

0 2.5 5 10 15 20
Kilometres

1:500,000 (at A4) GDA 1994 MGA Zone 51

B2018 Study area

Figure 1-1

Location of the St Ives Gold Mine Beyond 2018 Project

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1.2 SURVEY OBJECTIVE AND SCOPE OF WORKS

The objective of the survey was to define the terrestrial fauna values of the B2018 study area which will be used to inform an environmental impact assessment (EIA) for the B2018 Project.

The scope of works undertaken to achieve this objective was as follows:

- desktop review of available technical reports and relevant databases to determine the potential vertebrate fauna and SRE species and habitats in the B2018 study area
- field survey for vertebrate fauna and SREs in the B2018 study area:
    - Level 1 vertebrate fauna survey – the survey focused on determining whether the habitats in the B2016 study area are likely to support conservation significant species listed under the *Wildlife Conservation Act 1950* (WC Act) and/or the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).
    - Level 2 SRE survey – several suitable habitats have been identified for SRE taxa in the study B2018 area and it was considered likely that SRE taxa are present.
- data analyses, sample processing and species identifications for samples collected during the field surveys
- preparation of maps showing significant species records and habitats in the B2018 study area
- preparation of a technical report combined for vertebrate and SRE fauna outlining survey methods, results, assessment of significant species and habitats, assessment of potential impacts on fauna from the B2018 Project and recommendations for management and mitigation of impacts.

Survey design, methodology and report-writing adhered to relevant principles and guidelines, including:

- EPA Statement of environmental principals, factors and objectives (EPA 2016b)
- EPA Environmental Factor Guideline: Terrestrial fauna (EPA 2016a)
- EPA Technical Guidance: Terrestrial fauna surveys (EPA 2016d)
- EPA Technical Guidance: Sampling of short-range endemic invertebrate fauna (EPA 2016c).

2 LEGISLATIVE CONTEXT

The protection of flora and fauna in Western Australia (WA) is principally governed by three acts:

- EPBC Act
- WC Act
- EP Act.

2.1 COMMONWEALTH

Under the EPBC Act, actions that have, or are likely to have, a significant impact on a matter of national environmental significance (NES), require approval from the Australian Government Minister for the Environment. The EPBC Act provides for the listing of Threatened native fauna as matters of NES.

Conservation categories applicable to Threatened Fauna species under the EPBC Act are as follows:

- Extinct (EX)[1] – there is no reasonable doubt that the last individual has died
- Extinct in the Wild (EW) – taxa known to survive only in captivity
- Critically Endangered (CR) – taxa facing an extremely high risk of extinction in the wild in the immediate future
- Endangered (EN) – taxa facing a very high risk of extinction in the wild in the near future
- Vulnerable (VU) – taxa facing a high risk of extinction in the wild in the medium-term
- Conservation Dependent[1] – taxa whose survival depends upon ongoing conservation measures; without these measures, a conservation dependent taxon would be classified as Vulnerable or more severely threatened.

The EPBC Act is also the enabling legislation for protection of Migratory species under a number of international agreements:

- Japan-Australia Migratory Bird Agreement (JAMBA)
- China-Australia Migratory Bird Agreement (CAMBA)
- Convention on the Conservation of Migratory Species of Wild Animals (Bonn)
- Agreement between the Government of Australia and the Government of the Republic of Korea on the Protection of Migratory Birds (ROKAMBA).

[1] Species listed as Extinct and Conservation Dependent are not matters of NES and therefore do not trigger the EPBC Act.

2.2 STATE

In WA, the WC Act provides for the listing of Specially Protected Fauna species which are under identifiable threat of extinction. Under current classifications, protected fauna are assigned to one of seven categories under the WC Act (Western Australian Government 2015):

- Schedule 1 – fauna that is rare or is likely to become extinct as Critically Endangered (CR) fauna
- Schedule 2 – fauna that is rare or is likely to become extinct as Endangered (EN) fauna
- Schedule 3 – fauna that is rare or is likely to become extinct as Vulnerable (VU) fauna
- Schedule 4 – fauna presumed to be extinct (EX)
- Schedule 5 – Migratory birds protected under an international agreement (Mig.)
- Schedule 6 – fauna that is of special conservation need as conservation dependent (CD) fauna
- Schedule 7 – other specially protected (SP) fauna.

Assessments for listing are based on the International Union for Conservation of Nature (IUCN) threat categories.

The Department of Parks and Wildlife (DPaW) administers the WC Act and maintains a non-statutory list of Priority Fauna species (updated annually). Priority species are still considered to be of conservation significance – that is they may be rare or threatened – but cannot be considered for listing under the WC Act until there is adequate understanding of their threat levels. Species on the Priority Fauna lists are assigned to one of five Priority (P) categories, P1 (highest) – P4 (lowest), based on level of knowledge/concern.

Any activities that are deemed to have a significant impact on listed fauna species can trigger referral to the EPA for assessment under the EP Act.

3 EXISTING ENVIRONMENT

3.1 INTERIM BIOGEOGRAPHIC REGIONALISATION OF AUSTRALIA

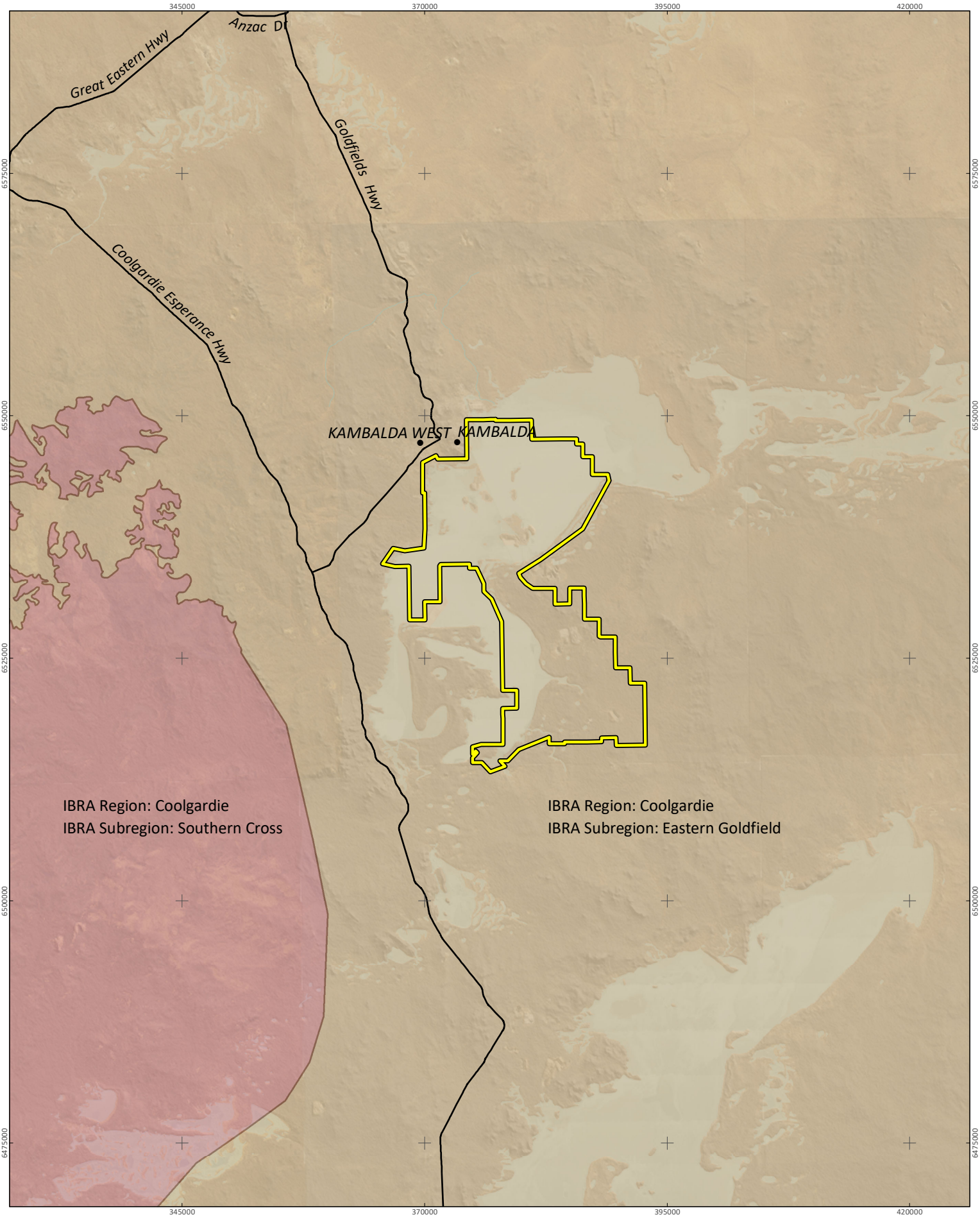
The Interim Biogeographic Regionalisation of Australia (IBRA) defines 'bioregions' as large land areas characterised by broad, landscape-scale natural features and environmental processes that influence the functions of entire ecosystems (Department of the Environment and Energy 2016b; Thackway & Cresswell 1995b). They categorise the large-scale geophysical patterns that occur across the Australian continent that are linked to fauna and flora assemblages and processes at the ecosystem scale. They are a useful means for simplifying and reporting on more complex patterns of biodiversity (Thackway & Cresswell 1995a).

Western Australia contains 26 IBRA bioregions and 53 subregions. The B2018 study area falls within the Coolgardie bioregion. The Coolgardie bioregion covers an area of 129,117 km^2 and is divided into three subregions; Mardabilla (COO1), Southern Cross (COO2) and Eastern Goldfields (COO3) (Thackway & Cresswell 1995a).

The B2018 study area is situated in the Eastern Goldfields subregion (Figure 3-1), which is characterised by (Cowan 2001):

- gently undulating plains interrupted in the west with low hills and ridges of Archaean greenstones and in the east by a horst of Proterozoic basic granulite
- tertiary soils dominated by calcareous earths overlay eroded gneisses and granites
- a series of large playa lakes, including Lake Lefroy, indicate the remnants of an ancient major drainage line in the western half
- vegetation consisting of mallees, *Acacia* thickets and shrub-heaths on sandplains
- dwarf shrublands of samphires persist on salt lakes, surrounded by diverse *Eucalyptus* woodlands, which also occur on ranges and in valleys.

The Eastern Goldfields subregion is regarded for its high floristic species and ecosystem diversity, in particular, *Eucalyptus* spp., *Acacia* spp. and ephemeral flora communities (Cowan 2001).



St Ives Gold Mine
Beyond 2018 Project

Project No	1128
Date	12/16/2016
Drawn by	KW
Map author	KC

0 1.5 3 6 9 12
Kilometres

1:500,000 (at A4) GDA 1994 MGA Zone 51

B2018 Study area

IBRA Subregions

Eastern Goldfield

Southern Cross

Figure 3-1

Location of the St Ives Gold Mine Beyond 2018 Project in relation to IBRA bioregions and subregions

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3.2 LAND SYSTEMS

The Department of Agriculture and Food Western Australia has partially mapped the land systems of the Eastern Goldfields subregion from aerial photography. Land systems are grouped according to landform, soils, vegetation and drainage patterns (Payne *et al.* 1998). The B2018 study area intersects seven land systems (Figure 3-2):

- **Lefroy (LEF):** salt lakes and fringing saline plains, sandy plains and dunes with chenopod low shrublands
- **Lakeside (LAS):** sandplains with occasional sand dunes and prominent claypans, supporting mallee eucalypts and spinifex
- **Graves (GRV):** basalt and greenstone rises and low hills supporting eucalypt woodlands with prominent saltbush and bluebush understoreys
- **Gumland (GML):** extensive pedeplains supporting eucalypt woodlands with halophytic and non-halophytic shrub understoreys
- **Moriarty (MOR):** low greenstone rises and stony plains supporting chenopod shrublands with patchy eucalypt overstoreys
- **Red Hill (RHL):** basalt hills and ridges supporting acacia shrublands and patchy eucalypt woodlands with mainly non-halophytic undershrubs
- **Zed (ZED):** low hills, rises and gently undulating stony plains based on metasedimentary rocks supporting acacia shrublands.

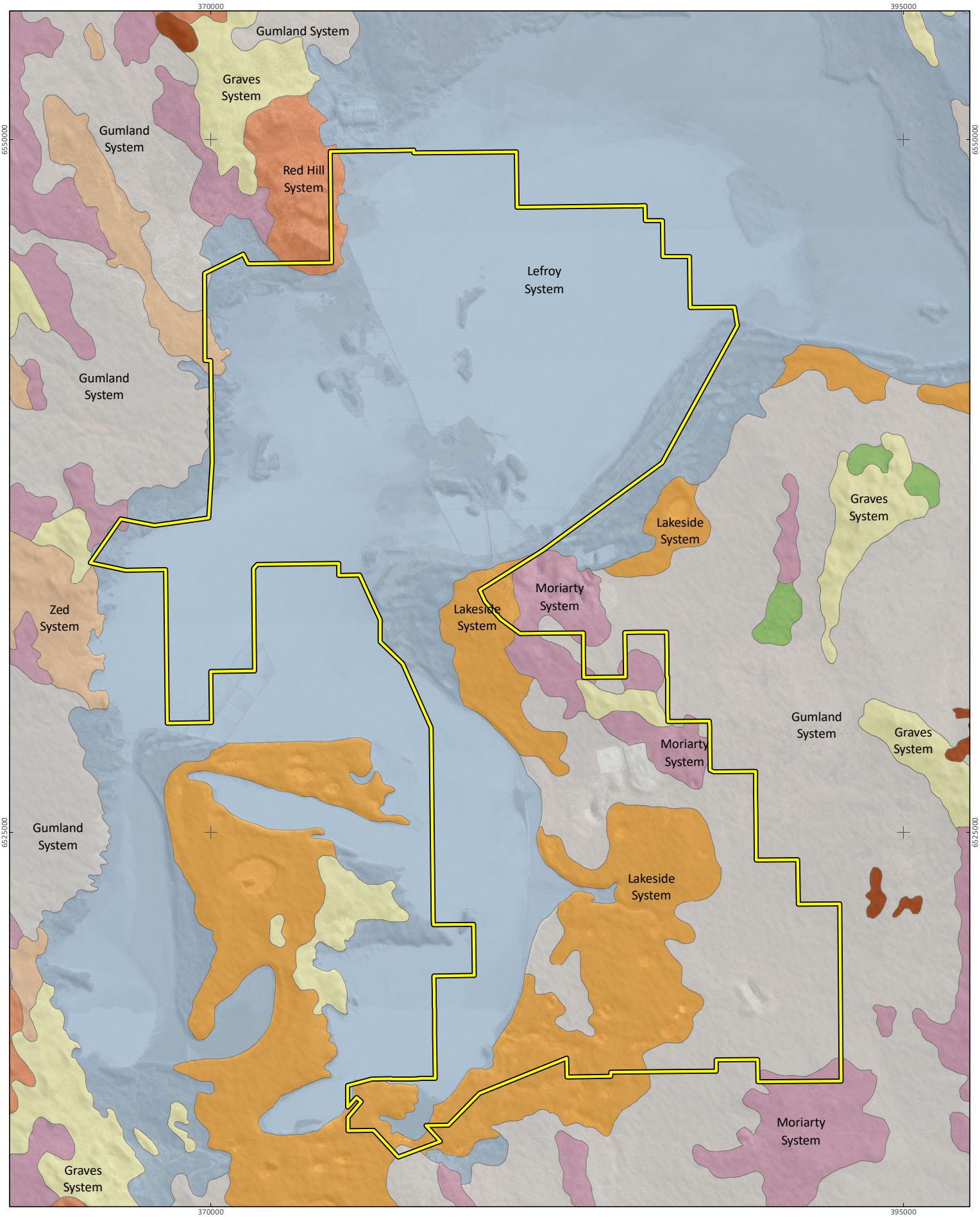
The Lefroy land system covers most the B2018 study area (Table 3-1).

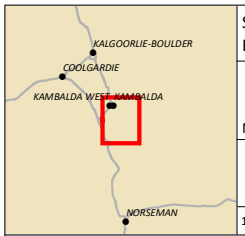
Table 3-1 Extent of each land system present in the B2018 study area

Land system	Study area (ha)	Percentage of study area (%)
Lefroy	2,9217.1	64.9
Gumland	7,243.1	16.1
Lakeside	6,599.8	14.7
Moriarty	1,347.2	3.0
Graves	285.2	0.6
Red Hill	225.4	0.5
Zed	95.7	0.2
Total:	**45,013.5**	**100**

Important fauna habitat contained within the land systems of the B2018 study area includes:

- eucalypt woodlands and acacia shrublands of the Lakeside, Graves, Gumland, Moriarty and Zed land systems provide habitat for conservation significant fauna such as Malleefowl, Peregrine Falcon and the South-west Carpet Python
- salt lakes and saline plains of the Lefroy land system for migratory shorebirds.
- salt lakes of the Lefroy land system as critical habitat for salt lake SRE species
- riparian vegetation along drainage lines of any land systems occurring within the B2018 study area providing refuge habitats with abundant shade, moisture and dense leaf litter.





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Map author	KC

0 0.5 1 2 3 4
Kilometres

1:175,000 (at A4) GDA 1994 MGA Zone 51

B2018 Study area

Land systems

- Graves System
- Gumland System
- Gundockerta System
- Lakeside System
- Lefroy System
- Moriarty System
- Red Hill System
- Sedgman System
- Zed System

Figure 3-2

Land systems of the St Ives Gold Mine Beyond 2018 Project

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3.3 CLIMATE AND WEATHER

The climate of the Coolgardie bioregion is described as arid non-seasonal to semi-arid Mediterranean, with cool winters and hot dry summers. The nearest Bureau of Meteorology (BoM) weather station with comprehensive data collection and historic climate data is located at City of Kalgoorlie-Boulder Airport (Latitude: 30.78°S Longitude: 121.45 °E) approximately 80 km north of the B2018 study area. City of Kalgoorlie-Boulder Airport records the highest maximum mean monthly temperature (33.7°C) in January, the lowest maximum mean annual temperature (16.7°C) in July. Average annual rainfall is 266.3 mm with January, February and June recording the highest monthly averages (26.8, 30.4 and 27.7 mm respectively). Tropical rain-bearing depressions moving southwards from northern Australian waters can cause heavy rainfall events in summer (BoM 2017) (Figure 3-3).

Records from City of Kalgoorlie-Boulder Airport weather station show variable amounts of rainfall in the 12 months preceding the survey (October 2015–September 2016) compared with the long-term average (Figure 3-3). The three months leading up to the field surveys received mixed rainfall, with July receiving slightly below average rainfall while August received well above the average rainfall and September recording well below annual average rainfall. The mean daily maximum and minimum temperatures were variable with annual averages for the 12 months preceding the field survey (Figure 3-3). It should be noted that these conditions are an approximate indication of weather in the region and are not indicative of exact conditions occurring within the B2018 study area.

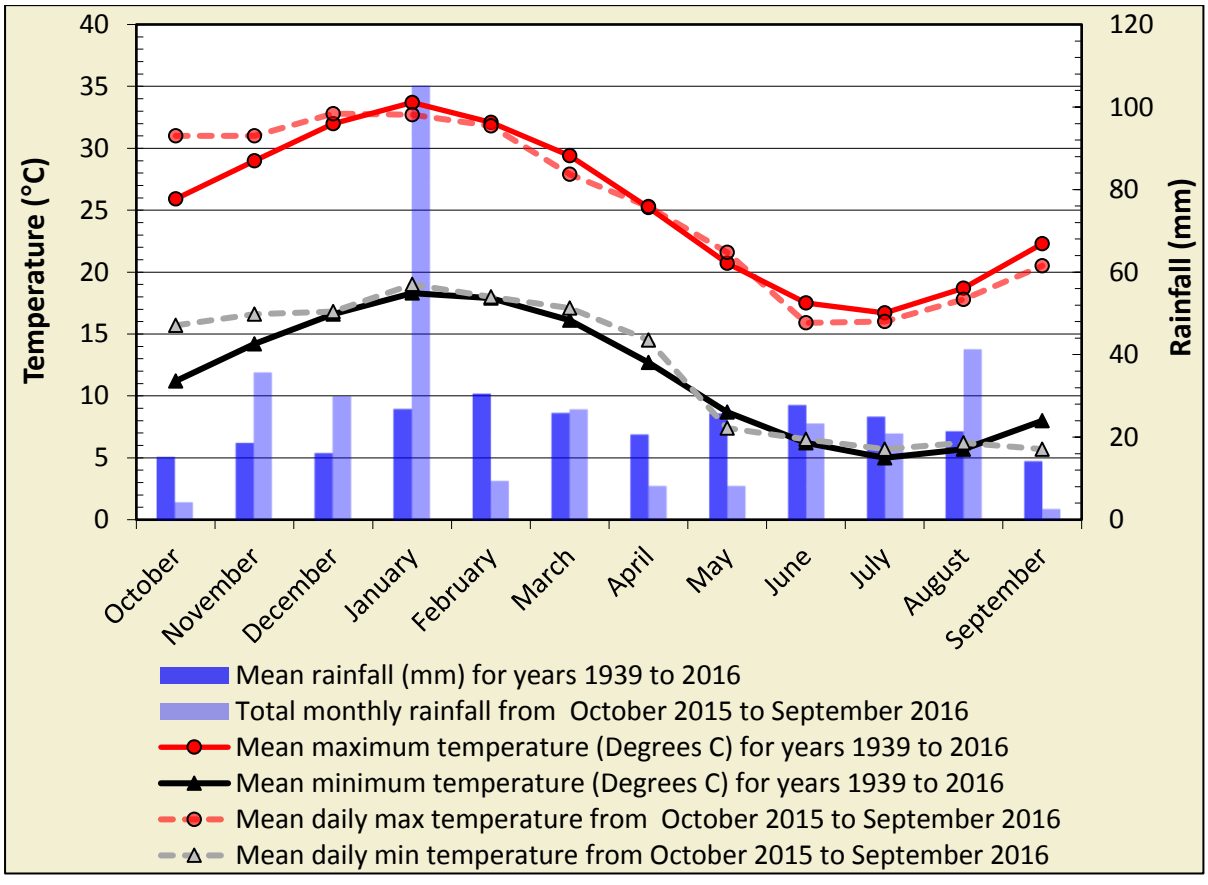


Figure 3-3 **Annual climate and weather data for City of Kalgoorlie Boulder Airport (no. 12038) (BoM 2017) and mean monthly data for the 12 months preceding the field survey**

3.4 LAND USE

The dominant land use within the Eastern Goldfields subregion is Unallocated Crown Land (UCL) or Crown reserve and grazing-native pasture-leasehold and to a lesser extent conservation reserves and mining tenements (Cowan 2001). Mining and mineral exploration tenure covers the entire study area; however, associated activities with these are currently confined to within the northern portion and to the east of Lake Lefroy.

3.5 THREATENING PROCESSES

Several threatening processes affect biodiversity values, including terrestrial fauna, of the Eastern Goldfields subregion (Cowan 2001):

- habitat alteration from grazing pressure
- habitat fragmentation or loss of remnant vegetation
- introduction and spread of feral fauna
- introduction and spread of flora
- wildfire and modified fire regimes
- modification of hydrology
- habitat modification due to mining and mineral exploration activities.

3.6 BIOLOGICAL CONTEXT

A comprehensive biological survey was conducted in the Eastern Goldfields District by the Biological Surveys Committee, a partnership between the Department of Conservation and Land Management (now DPaW), Western Australian Herbarium and Western Australian Museum, between 1978 and 1981. The objective of the surveys was to describe the floral and faunal diversity within the region to identify biodiversity values (Biological Surveys Committee 1984) and provided a benchmark for environmental assessment studies within the Eastern Goldfields subregion. The survey cell encompassing the B2018 study area, the Widgiemooltha-Zanthus Area, was surveyed in 1970 and 1980–81 (Biological Surveys Committee 1984; Biological Surveys Committee *et al.* 1984).

3.6.1 Vertebrate fauna

The Coolgardie bioregion accommodates a rich species assemblage comprising a diverse range of vertebrate fauna (Biological Surveys Committee *et al.* 1984). Terrestrial vertebrate fauna within the bioregion have adapted to survive in harsh semi-arid and arid climatic regions of the bioregion. Several species of conservation significance are known to occur within the bioregion, particularly birds including the Malleefowl, Peregrine Falcon, Carnaby's Black Cockatoo and some migratory shorebirds when water is retained in waterbodies following sufficient rainfall (Biological Surveys Committee *et al.* 1984; Burbidge 2004; Van Dyck & Strahan 2008). A number of conservation significant mammal species known to occur within the Coolgardie bioregion historically have declined in distribution and abundance since European settlement with some now considered regionally extinct, in particular the Chuditch (*Dasyurus geoffroii*), Numbat (*Myrmecobius fasciatus*) and Bilby (*Macrotis lagotis*) (Biological Surveys Committee *et al.* 1984; Burbidge 2004; Van Dyck & Strahan 2008). The Coolgardie bioregion is not known to support any endemic vertebrate species; however, further regional surveys and taxonomic studies may reveal regionally endemic species.

3.6.2 Short-range endemic invertebrates

Short-range endemic (SRE) fauna are defined as animals that display restricted geographic distributions, nominally less than 10,000 km^2, that may also be disjunct and highly localised (Harvey 2002; Ponder & Colgan 2002). Short-range endemism in terrestrial invertebrates is believed to have evolved through two primary processes (Harvey 2002), relictual short-range endemism and dispersal of habitat specialists. Relictual short-range endemics are believed to have had wider distributions, but with a drying climate over the last 60 million years, hospitable habitats only persisted in small pockets where moist conditions remain, such as south-facing rock faces or slopes of mountains or gullies. In contrast, habitat specialist SREs may have settled in isolated habitat types by means of dispersal and evolved in isolation into distinct species. Such habitat islands include rocky or granite outcrops and salt lakes. However, SRE invertebrates have also been reported in more widespread habitats such as spinifex plains or woodlands and here mainly in groups with low dispersal capabilities such as mygalomorph spiders and millipedes.

Short-range endemic fauna need to be considered in EIA as localised, small populations of species are generally at greater risk of changes in conservation status due to environmental change than other, more widely distributed taxa (EPA 2016c).

There can be uncertainty in categorising a specimen as SRE due to several factors including poor regional survey density, lack of taxonomic research and problems of identification, i.e. specimens that may represent SREs cannot be identified to species level based on the life stage at hand. For example, in contrast to mature males, juvenile and female millipedes, mygalomorph spiders and scorpions cannot be identified at the species level. Molecular techniques such as 'barcoding' (Hebert *et al.* 2003a; Hebert *et al.* 2003b) are routinely employed to overcome taxonomic or identification problems.

The WA Museum has introduced a three tier-rating (confirmed, potential and not SRE) for SREs (Western Australian Museum 2013), which is applied in this report. Any SRE categorisation of a taxon is based on the information available at the time. As new information emerges from additional surveys, the SRE status of a taxon may change.

Although the different categories of 'SRE-likelihood' may help to set conservation priorities, SRE taxa of all categories should be assessed on their merit, in order to determine appropriate conservation measures that adhere to the Precautionary Principle within EIA. That is, "where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason to postpone measures to prevent environmental degradation" (EPA 2016b).

4 METHODS

4.1 DESKTOP REVIEW

4.1.1 Database searches and literature review

Database searches and literature reviews of relevant publications were undertaken to compile a list of potential conservation significant species that may occur within the B2018 study area based on the proximity of previous records.

The following database searches were undertaken within a 40 km buffer around the B2016 study area:

- EPBC Act Protected Matters Search Tool (Department of the Environment 2016)
- DPaW Threatened Flora, Fauna and Ecological Communities database searches (DPaW 2016b)
- DPaW/WA Museum NatureMap database (DPaW 2016a)
- Birdlife Australia Birdata database (Birdlife Australia 2016).

The SRE invertebrate fauna database search area was based on a rectangular search grid determined by the proposed maximum range of short-range endemism, 10,000 km^2, equivalent to approximately 100 km x 100 km (Harvey 2002). It included:

- WA Museum Arachnology and Myriapodology, Crustacea and Mollusca databases
- Phoenix invertebrate database.

A literature search was conducted for accessible reports of vertebrate and SRE invertebrate fauna surveys conducted within the vicinity of the B2018 study area to build on the potential species lists developed from the database searches. Reports for many of these surveys may not give detailed distribution data; however, distribution information for many of the vertebrates and invertebrates collected is available through the WA Museum database, which was accessed for this desktop review. Several terrestrial fauna surveys have been conducted near the B2018 study area (Table 4-1).

A number of peer-reviewed scientific publications allowed an interpretation of the distribution and life history data of invertebrates at Lake Lefroy. These mainly included papers on salt lake specialists, such as tiger beetles (Golding 2016; McCairns *et al.* 1997; Pearson & Vogler 2001; Sumlin 1987, 1997), ants (Heterick & Shattuck 2011) and wolf spiders (Framenau *et al.* 2006; Framenau & Hudson 2017; Hudson 1997, 2000; Hudson & Adams 1996; McKay 1976).

Table 4-1 Terrestrial fauna survey reports incorporated in the desktop review

Report	Survey type	Project
Hudson (1995)	Terrestrial invertebrate fauna survey	Lake Lefroy
Curtin Unversity of Technology (1999)	Baseline ecological study	Lake Lefroy
Outback Ecology (2004)	Assessment of biota	Lake Lefroy
Outback Ecology (2005),	Re-assessment of biota	Lake Lefroy
ATA Environmental (2006)	Level 2 terrestrial vertebrate fauna survye	St Ives Gold Mine
Outback Ecology (2006),	Aquatic biota and fringing flora	Lake Lefroy
Western Wildlife (2006)	Level 2 terrestrial vertebrate fauna survey	St Ives Gold Mine
Keith Lindbeck and Associates (2007)	Level 2 terrestrial vertebrate fauna survey	Tailings Storage Facility (No. 4
Outback Ecology (2007)	Aquatic biota and fringing flora	Lake Lefroy
Keith Lindbeck and Associates (2008)	Level 1 terrestrial vertebrate fauna survey	AAA Project
Outback Ecology (2009)	Aquatic biota and fringing flora	Lake Lefroy
Bamford (2010)	Level 2 terrestrial fauna survey	St Ives Gold Mine
Dalcon (2010)	Environmental survey	Lake Lefroy
Harewood (2010b)	Level 1 terrestrial fauna survey	Diana Mine Area
Harewood (2010c)	Level 1 terrestrial vertebrate fauna survey	Pistol Club Mine Area
Harewood (2010a)	Level 1 terrestrial fauna survey	Bellerophon Mine Area
Harewood (2010d)	Level 1 terrestrial fauna survey	West Idough Mine Area
Botanica Consulting (2011)	Desktop review, terrestrial fauna	Athena area power line
Harewood (2011c)	Pre-clearence fauna survey	Tailings Storace Facility 4
Harewood (2011b)	Level 1 terrestrial fauna survey	Work shop Project Area
Harewood (2011a)	Level 1 terrestrial fauna survey	Thunderer Mine Area
Dalcon (2013a, b)	Terrestrial invertebrate fauna monitoring 2011 and 2012	Beyond 2010
Dalcon (2013c)	September/October 2010	Beyond 2010
Harewood (2013)	Level 1 terrestrial fauna survey	Neptune Mine Area and Invincible Road
Phoenix (2013a)	Invertebrates from Lake Lefroy	Identification of invertebrates for Dalcon (2013a, b, c)
Phoenix (2013b)	Desktop review, terrestrial invertebrate monitoring program	St Ives Gold Mine
Phoenix (2014)	Terrestrial invertebrate fauna monitoring	Beyond 2010
Phoenix (2015)	Terrestrial invertebrate fauna monitoring	Beyond 2010
Terratree (2015)	Level 1 flora and vegetation and fauna survey	Pistol Club Survey Area
Terratree (2016)	Desktop review, ecological constraints	Delta Island South and Incredible South Projects

4.1.2 Habitat assessment

Initial characterisation of terrestrial fauna habitats in the B2018 study area was undertaken using various remote geographical tools, including aerial photography (incl. Google™ Earth), land system maps and topographic maps. Results of the flora and vegetation survey undertaken by Phoenix from 28 September to 6 October 2016 (Phoenix 2016) were used to further delineate fauna habitats prior to the field survey. Desktop habitat characterisation was verified and broad fauna habitats were defined and mapped within the B2018 study area during the field survey.

The potential for the habitats of the B2018 study area to support conservation significant vertebrate fauna and SRE invertebrates was then assessed based on species-specific habitat preferences and nearest records. The SRE habitat assessment considered key habitat types known to facilitate short-range endemism, such as salt lakes and their riparian zone and woodlands on plain, specifically those along drainage lines.

4.2 FIELD SURVEY

The field survey was undertaken over four consecutive days from 19–22 October 2016. SM2 SongMeter bat echolocation recording devices were deployed for one overnight recording period from 15–16 November 2016.

4.2.1 Site selection

A total of 18 systematic sites were surveyed (Figure 4-1; Appendix 1). Site selection for the field survey was based on the habitats identified during the desktop review and data collected during the flora and vegetation field survey which were then refined after ground-truthing during the field survey. At the broadest scale, site selection considered aspect, topography and land systems. At the finer scale, consideration was given to proximity to water bodies (ephemeral drainage lines and creeks), vegetation structure and condition, including recent fire history and soil type.

Sites were primarily chosen to:

- represent the best examples of habitats with the potential to support conservation significant vertebrates or SRE invertebrates
- represent the best examples of the broader habitat associations of the B2018 study area
- best inform the assessment process (e.g. potential impact/non-impact areas based on resource location and interim project layout available at the time).

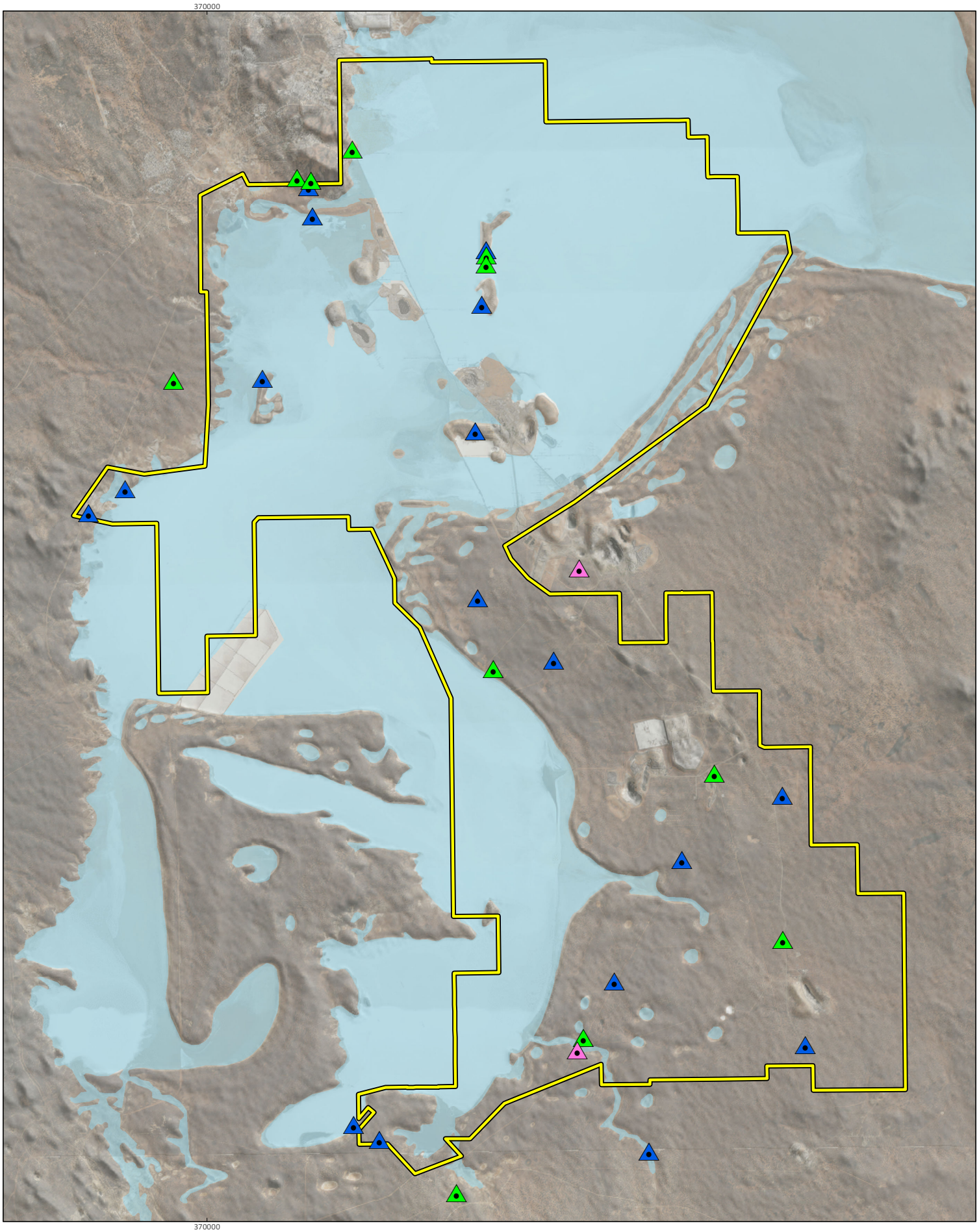
Detailed habitat descriptions were compiled at each of the survey sites (Appendix 1).

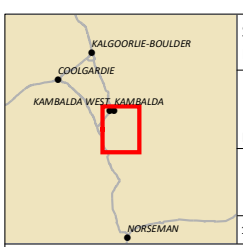
In addition, fauna were recorded at six opportunistic sites and previously mapped Malleefowl mounds were revisited to check for activity of birds (Figure 4-1; Appendix 1).

Table 4-2 Survey effort of the field survey

Site	Type	Easting (GDA94, zone 51J)	Northing (GDA94, zone 51J)	In B2018 study area	Habitat	Vertebrates		SRE Invertebrates	
						SongMeter (nights)	Active searches (hrs)	Foraging (hrs)	Litter/soil sifts (qty)
Site 01	systematic	421483	6548802	yes	Woodland on plain	-	1	1	-
Site 02	systematic	378739	6537485	yes	Woodland on plain	-	1	1	-
Site 03	systematic	378960	6541602	yes	Woodland on plain	-	1	1	-
Site 04	systematic	379092	6543379	yes	Woodland on plain (riparian)	-	1	1	-
Site 05	systematic	366142	6534815	yes	Woodland on plain	-	1	1	-
Site 06	systematic	383269	6519536	yes	Woodland on plain	-	1	1	3
Site 07	systematic	378826	6532040	yes	Woodland on plain	-	1	1	-
Site 08	systematic	373316	6545425	yes	Woodland on plain	-	1	1	-
Site 09	systematic	381297	6530004	yes	Woodland on plain	-	1	1	-
Site 10	systematic	388747	6525587	yes	Woodland on plain	-	1	1	3
Site 11	systematic	389490	6517467	yes	Woodland on plain	-	1	1	3
Site 12	systematic	375616	6514379	yes	Woodland on plain	-	1	1	-
Site 13	systematic	385475	6523497	no	Woodland on plain (riparian)	-	1	1	-
Site 14	systematic	384405	6513998	no	Salt lake playa and riparian zone	-	1	1	-
Site 15	systematic	374785	6514869	yes	Salt lake playa and riparian zone	-	1	1	-
Site 16	systematic	367340	6535583	yes	Shrubland on dune	-	1	1	-
Site 17	systematic	371817	6539189	yes	Salt lake playa and riparian zone	-	1	1	-
Site 18	systematic	373434	6544487	yes	Salt lake playa and riparian zone	-	1	1	-
Opp 01	opportunistic	388763	6520909	yes	Woodland on plain	-	-	-	-
Opp 02	opportunistic	378129	6512646	no	Woodland on plain	-	-	-	-
Opp 03	opportunistic	379100	6543206	yes	Salt lake playa and riparian zone		-		
Opp 04	opportunistic	382267	6517715	yes	Woodland on plain	-	-	-	-
Opp 05	opportunistic	368917	6539116	no	Shrubland on dune	-	-	-	-

Site	Type	Easting (GDA94, zone 51J)	Northing (GDA94, zone 51J)	In B2018 study area	Habitat	Vertebrates		SRE Invertebrates	
						SongMeter (nights)	Active searches (hrs)	Foraging (hrs)	Litter/soil sifts (qty)
Opp 06	opportunistic	374733	6546659	yes	Woodland on plain	-	-	-	-
Opp 07	opportunistic	379334	6529737	yes	Shrubland on dune	-	-	-	-
Opp 08	opportunistic	379089	6542906	yes	Salt lake playa and riparian zone	-	-	-	-
Opp 09	opportunistic	372939	6545729	no	Woodland on plain (with small rocky hills)	-	-	-	-
Opp 10	opportunistic	373392	6545658	no	Woodland on plain (with small rocky hills)	-	-	-	-
Opp 11	opportunistic	386531	6526324	yes	Woodland on plain	-	-	-	-
SM 01	SongMeter	382066	6517294	yes	Woodland on plain (riparian)	1	-	-	-
SM 02	SongMeter	382135	6532995	Yes	Woodland on plain	1	-	-	-
Total:						**2**	**18 hrs**	**18 hrs**	**9**





St Ives Gold Mine
Beyond 2018 Project

Project No	1128
Date	12/16/2016
Drawn by	KW
Map author	KC

0 0.5 1 2 3 4
Kilometres

1:160,000 (at A4) GDA 1994 MGA Zone 51

- B2018 Study area
- Systematic sites
- Opportunistic sites
- SongMeter locations

Figure 4-1

Terrestrial fauna survey site locations

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4.2.2 Vertebrate fauna

Survey methods for vertebrate fauna comprised:

- active searches (4.2.2.1)
- opportunistic records (4.2.2.2)
- bat echolocation call recordings (4.2.2.3).

4.2.2.1 Active searches

Active searches primarily targeted diurnal reptiles, birds and mammals from direct sightings and secondary evidence of species occurrence. Active surveys comprised searches of any observable microhabitats likely to support target taxa.

Active search techniques included raking leaf and bark litter, overturning logs and rocks, searching beneath the bark of trees, investigating dead trees and fallen logs, burrows, rock piles and identifying any secondary evidence including tracks, diggings, scats, fur or sloughs (shed skins), predation or feeding evidence, and fauna constructed structures such as pebble mounds. A minimum of one-person hour was spent active searching at each site and totaled 18 hours over the survey period (Table 4-2).

4.2.2.2 Opportunistic records

All opportunistic observations of vertebrate species were recorded during the survey. Opportunistic or non-systematic sampling involved recording all sightings of vertebrate fauna species while working and travelling within the B2018 study area. A total of six opportunistic records were taken, two of which were located outside the B2018 study area (Table 4-2).

4.2.2.3 Bat echolocation call recordings

Two SongMeter (SM2BAT) recording devices were used to record bat echolocation calls at two sites, one within and one outside the B2018 study area for a single night (Figure 4-1; Table 4-2). Recording devices were deployed horizontally at height or aimed at a 45° angle from the ground, and were set to record overnight. Areas of habitat likely to support bat species were targeted; a drainage line and associated riparian vegetation in the south and a freshwater dam located in the north of the B2018 study area (Figure 4-1).

4.2.3 Short-range endemic invertebrates

The collecting methods consisted of two proven, industry-recognised sampling techniques to target SRE taxa consistent with EPA (2016c): active searches (foraging) and the sieving of combined leaf litter and soil samples (see Table 4-2 for total survey effort). At sites with no suitable litter, combined litter/soil sieving was not conducted.

Dry pitfall trapping is generally used to collect live scorpions by installing a small plastic cup in front of a scorpion burrow. No scorpion burrows were detected during the field survey and therefore this method was not utilised.

Specimens collected were transported life the laboratory and subsequently fixed in absolute ethanol (EtOH) to preserve tissue for future molecular analyses.

4.2.3.1 Foraging

Foraging incorporated the systematic inspection of logs, larger plant debris, the underside of bark of larger trees and the underside of rocks. Methodical searches were conducted amongst the leaf litter of shade-bearing tall shrubs and trees, including raking of litter, and spinifex bases were inspected thoroughly. Rocks and rock crevices were inspected, particularly for pseudoscorpions.

A standardised approach was undertaken, whereby each site was sampled for a minimum of one person hour (Table 4-2 for foraging effort). Trapdoor spider burrows identified during the searches were excavated if they were considered inhabited. Excavation involved removing soil from around the burrow to carefully expose the burrow chamber and remove the spider.

4.2.3.2 Litter/soil sieving

At least three combined litter/soil sifts were undertaken at each site where sufficient leaf litter was present (Table 4-2). The collection of leaf litter samples was standardised volumetrically by the diameter and height (310 mm x 50 mm = 1.55 L) of the sieves which were completely filled with compressed litter and the upper layers of underlying soil. Samples were sieved through three stages of decreasing mesh size over a round tray and invertebrates were picked from the sieves and tray with forceps. These samples particularly targeted small spiders (Araneomorphae), pseudoscorpions, buthid scorpions, millipedes, centipedes (in particular Geophilomorpha and Cryptopidae), smaller species of molluscs (e.g. Pupillidae) and slaters.

In situ collecting and sieving is preferred over transporting litter samples to the laboratory. Small invertebrates are best detected when moving and transport to the laboratory can kill a large proportion of the catch. In addition, if litter sieves in the field contain groups of interest, more extensive searches can be conducted, providing greater flexibility in the sampling protocol.

4.2.1 Morphological species identification

The nomenclature follows several taxon-specific references (Table 4-3); however, many invertebrate species are currently unnamed requiring morphospecies designation as listed in this report. These are indicated with apostrophes (i.e. *Aname* 'MYG001') and adopted from the nomenclatural systems developed by the WA Museum or other respective taxonomic authorities (Table 4-3). Interim 'SIGM' and 'PES' morphocodes are used for some of the species identified in previous and the current survey at Lake Lefroy (Phoenix 2013a, 2014, 2015) pending a code-designation by the WA Museum. Reference collections for these morphospecies generally reside with WA Museum as expected by the EPA (2004). Other morphocodes may be used as indicated in the report, i.e. following Hudson (Hudson 1995) and Curtin (Curtin University of Technology 1999).

Table 4-3 Nomenclatural references, morphospecies designations and reference collections

Taxonomic group	Taxonomic reference for described species and higher taxa	Morphospecies designation and reference collection (invertebrates only)
Mammals	Menkhorst and Knight (2011)	
Birds	Simpson and Day (2010); Christidis and Boles (2008)	
Reptiles	Wilson and Swan (2013)	
Amphibians	Tyler and Doughty (2009)	
Araneae	World Spider Catalog (2017)	"MYG" and "ARA"-numbering system for Mygalomorphae developed by V.W. Framenau (WAM, Phoenix) and continued by WAM, reference collection at WAM
Coleoptera (Carabidae – Cicindelinae)	McCairns (1997); Anichtchenko (2007–2017)	Golding (2016)
Scorpiones	Rein (2011); Koch, (1977), Volschenk *et al.* (2000) Volschenk *et al.* (2012)	Morphospecies designation developed by E.S. Volschenk (Phoenix, WAM), reference collection at WAM
Eupulmonata[a]	Stanisic *et al.* (2010), Whisson & Kirkendale (2014)	Morphospecies designations developed by C. Whisson and S. Slack-Smith (WAM); reference collection at WAM
Isopoda	Schotte *et al.* (2008)	Morphospecies designations developed by S. Judd, reference material at WAM

[a] – For practical purposes, Eupulmonata is here considered an order following Department of Environment and Energy (2016a); however, it is acknowledged that Bouchet *et al.* (2005) consider it a rank-free clade.

4.3 SURVEY PERSONNEL

The personnel involved in the survey are presented (Table 4-4).

Table 4-4 Project team

Name	Qualifications	Role/s
Dr Volker Framenau	BSc. (Chem. Eng.); MSc. (Cons. Biol.); PhD. (Zool.)	Project manager, field survey, taxonomy (SRE invertebrates), reporting
Mrs Karen Crews	BSc. (Env. Biol.) (Hons)	Report review
Mr Ryan Ellis	Dip. (Cons. Land Mgmt.)	Reporting
Mr Tim Sachse	BSc. (Biological Science)	Field survey, bat echolocation analysis
Mrs Kathryn Wyatt	BIS. (GIS) Grad. Cert. (GIS)	GIS

5 RESULTS

5.1 DESKTOP REVIEW

5.1.1 Vertebrate fauna

A total of 252 terrestrial vertebrate fauna species were identified in the desktop review as potentially occurring in the B2018 study area (Appendix 2). This comprised of three frogs, 73 reptiles (72 native and one introduced), 140 birds (137 native and three introduced) and 36 mammals (28 native and eight introduced). Three of the species identified in the desktop review were only identified to genus level, one frog (*Neobatrachus* sp.) and two mammals (*Ningaui* sp. and *Pseudomys* sp.).

A total of 26 species of conservation significance were identified in the desktop review including 11 listed under the EPBC Act and/or WC Act as Threatened, Conservation Dependent or Specially Protected (Table 5-1). A further 11 species are listed as 'Migratory' under the EPBC Act and WC Act and five species are listed as Priority species (Table 5-1). One species, the Curlew Sandpiper, is listed as Threatened and Migratory under the EPBC Act (CR) and WC Act (VU) (Table 5-1).

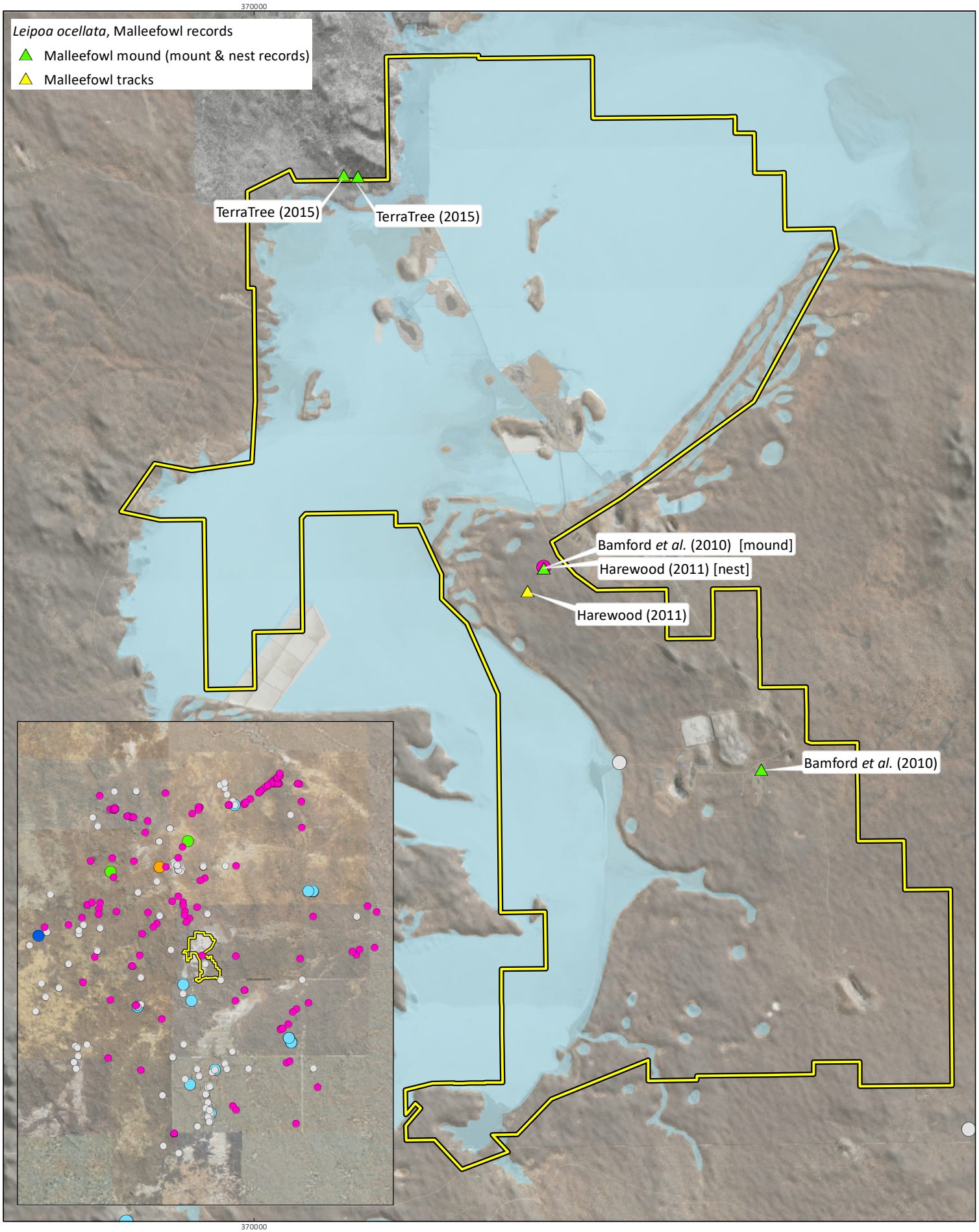
Three conservation significant species have previously been recorded in the B2018 study area, Malleefowl, Rainbow Bee-eater and Hooded Plover, the latter with an unspecified record in a recent desktop review (Terratree 2016) (Figure 5-1). Malleefowl has previously been recorded three times within the B2018 study area from secondary evidence (tracks and an inactive mound), with two further inactive mounds just north of it (Figure 5-1) (Bamford 2010; Harewood 2011c; Terratree 2015). Rainbow Bee-eaters have been recorded multiple times within the B2018 study area (Figure 5-1) (Bamford 2010; Harewood 2010a, b, c, d; Keith Lindbeck and Associates 2007; Terratree 2015).

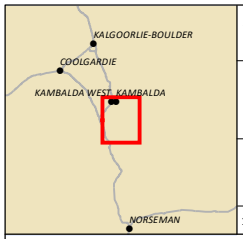
ATA Environmental (2006) recorded the species *Nyctophilus major tor* (then known as *Nyctophilys timorensis*) (Parnaby 2009). The report lacks sufficient detail to determine the precise location of the record in relation to the B2018 study area, although records are likely to be from within 5 km of the B2018 study area.

Table 5-1 Conservation significant vertebrates identified through the desktop review

Scientific name	Common name	Conservation status[1]			Inside B2018 study area	Outside B2018 study area
		EPBC Act	WC Act	DPaW		
Reptiles						
Egernia stokesii badia	Western Spiny-tailed Skink	EN	EN			●
Birds						
Leipoa ocellata	Malleefowl	VU	VU		●	●
Oxyura australis	Blue-billed Duck			P4		●
Apus pacificus	Fork-tailed Swift	Mig	Mig			●
Ardea modesta	Eastern Great Egret	Mig	Mig			●
Ardea ibis	Cattle Egret	Mig	Mig			●
Plegadis falcinellus	Glossy Ibis	Mig	Mig			●
Falco hypoleucos	Grey Falcon		VU			●
Falco peregrinus	Peregrine Falcon		SP			●
Thinornis rubricollis	Hooded Plover			P4	●	●
Tringa nebularia	Common Greenshank	Mig	Mig			●
Tringa glareola	Wood Sandpiper	Mig	Mig			●
Calidris ruficollis	Red-necked Stint	Mig	Mig			●
Calidris acuminata	Sharp-tailed Sandpiper	Mig	Mig			●
Calidris ferruginea	Curlew Sandpiper	CR/ Mig	VU/ Mig			●
Calyptorhynchus latirostris	Carnaby's Black-cockatoo	EN	EN			●
Platycercus icterotis xanthogenys	Western Rosella (inland ssp.)			P4		●
Pezoporus occidentalis	Night Parrot	EN	CR			●
Merops ornatus	Rainbow Bee-eater	Mig	Mig		●	●
Amytornis textilis textilis	Thick-billed Grasswren			P4		●
Motacilla cinerea	Grey Wagtail	Mig	Mig			●
Mammals						
Dasyurus geoffroii	Western Quoll	VU	VU			●
Phascogale calura	Red-tailed Phascogale	EN	CD			●
Myrmecobius fasciatus	Numbat	VU	EN			●
Macrotis lagotis	Greater Bilby	VU	VU			●
Nyctophilus major tor	South-western Long-eared Bat			P4	●[?]	●[?]

1 — CR – Critically Endangered; EN – Endangered; VU – Vulnerable; SP – Specially Protected; CD – Conservation Dependant; Mig — Migratory; P1–P4 —Priority 1–4.





St Ives Gold Mine
Beyond 2018 Project

Project No	1128
Date	07-Dec-16
Drawn by	KW
Map author	KC

0 0.5 1 2 3 4
Kilometres

1:160,000 (at A4) GDA 1994 MGA Zone 51

DPaW fauna records in the study area
- *Leipoa ocellata*, Malleefowl
- *Merops ornatus*, Rainbow bee-eater

DPaW fauna records outside of the study area
- *Apus pacificus*, Fork-tailed Swift
- *Ardea ibis*, Cattle egret
- *Calidris ferruginea*, Curlew sandpiper
- *Falco peregrinus*, Peregrine falcon

Figure 5-1

Conservation significant vertebrate fauna identified in the desktop review

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5.1.2 Short-range endemic invertebrates

The desktop review identified 50 SRE taxa, of which 16 have been recorded in the B2018 study area. Ten of the species in the desktop review area are unidentifiable based on morphology, i.e. female or juvenile spiders or snails ("sp. indet.") and may represent other species listed in the same genus.

Only one of the species from the B2018 study area, the playa specialist wolf spider *Tetralycosa baudinettei*, is considered a confirmed SRE based on the total area of all salt lakes the species is known from in its range, which reaches beyond the desktop review study area (Framenau & Hudson 2017). Distribution patterns of all other species from the B2018 study area are poorly known and these are therefore considered potential SREs.

Seven species are currently only known from B2018 study area (Table 5-2):

- *Aname* 'MYG223', *Aname* 'SIGM121 and *Aname* 'SIGM122' (trapdoor spiders)
- *Lychas* 'SIGM132', *Urodacus* 'SIGM131', *Urodacus* 'lefroy' (scorpions)
- Philosciidae 'lefroy' (slater).

Two conservation significant terrestrial invertebrate species were returned in the desktop review. The Arid Bronze Azure Butterfly (*Ogyris subterrestris petrina*) (EPBC, WA Act – CR) has been recorded from around Kalgoorlie until the early 1990s (Field 1999), but is currently only known from Barbalin Nature Reserve in the northern Avon Wheatbelt (Gamblin *et al.* 2009).

The Inland Hairstreak (*Jalmenus aridus*) (DPaW – P1), originally described from Lake Douglas, ca. 12 km SW of Kalgoorlie (Graham & Moulds 1988). The larvae feed on the leaves and flowers of *Senna nemophila* and *Acacia tetragonophylla*. The caterpillars are attended by the ant species *Froggatella kirbii*. It is currently not known from the B2018 study area.

Five species returned by the desktop review as SREs are considered salt lake specialists:

- *Tetralycosa baudinettei* (wolf spider)
- *Cicindela* (*Rivacindela*) *salicursoria*, *Cicindela* (*Rivacindela*) *necopinata* and *Cicindela* (*Rivacindela*) 'yindarla' (tiger beetles)
- *Apterogryllus* sp. A (cricket).

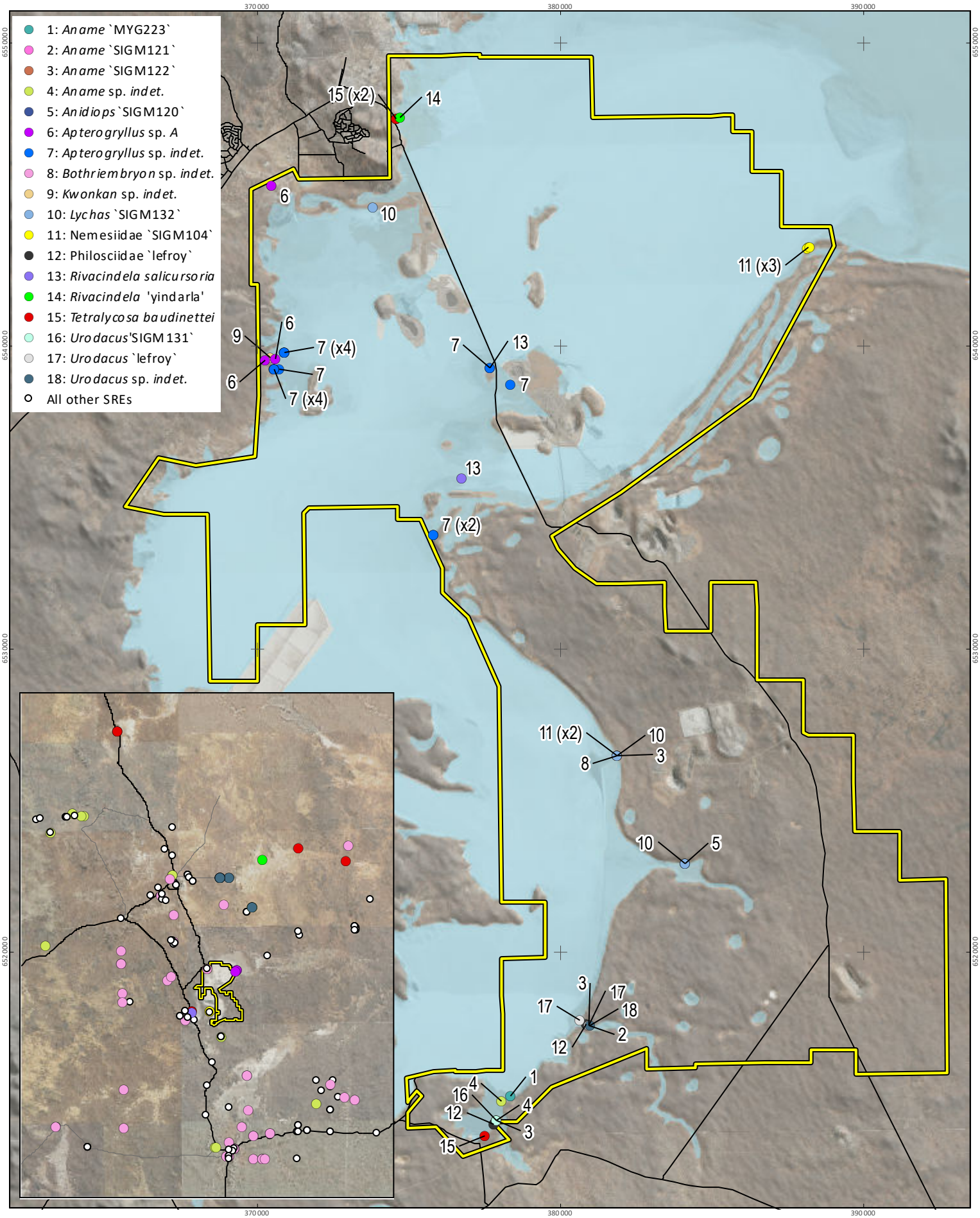
Table 5-2 Short-range endemic invertebrates identified through the desktop review

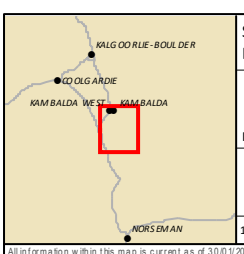
Family	Genus and species	Locality	SRE category	Source	Inside B2018 study area	Outside B2018 study area
Order Araneae (spiders)						
Infraorder Araneomorphae (modern spiders)						
Lycosidae	*Tetralycosa baudinettei*	Lake Lefroy, Lake Goongarrie, Lake Roe, Lake Yindarlgooda	Confirmed	Hudson (1995) , Phoenix (2014) Framenau and Hudson (2017)	x	x
Infraorder Mygalomorphae (trapdoor spiders)						
Actinopodidae	*Missulena* sp. indet.	S and E of Kalgoorlie, Boulder Race Course	Potential	WA Museum		x
	Missulena 'kalgoorlie'	20 km E Kalgoorlie	Potential	Phoenix invertebrate database		x
Barychelidae	*Synothele houstoni*	3.7 km SSW McDermid Rock	Potential	WA Museum		x
	Synothele pectinata	Woodline	Potential	WA Museum		x
	Synothele 'MYG264'	Aldiss, 100 km ESE Kalgoorlie	Potential	WA Museum		x
	Barychelidae sp. indet.	S of Kambalda	Potential	WA Museum		x
Ctenizidae	*Conothele* 'kalgoorlie'	E of Kalgoorlie	Potential	WA Museum		x
	Conothele sp. indet.	NNW Norseman; N of Eyre Highway; Rowles Lagoon NR	Potential	WA Museum		x
Dipluridae	*Cethegus* sp. indet.	Binaronca Nature Reserve; S of Kambalda, ESE Kalgoorlie	Potential	WA Museum		x
Idiopidae	*Aganippe* 'MYG191'	S of Kambalda	Potential	WA Museum		x
	Aganippe 'MYG244'	Rowles Lagoon NR	Potential	WA Museum		x
	Aganippe sp. indet.	Throughout desktop area	Potential	WA Museum		x
	Aganippe 'kalgoorlie'	E of Kalgoorlie	Potential	WA Museum		x
Nemesiidae	Aname 'MYG181'	Aldiss, 100 km ESE of Kalgoorlie	Potential	WA Museum		x
	Aname 'MYG213'	S of Kalgoorlie	Potential	WA Museum		x
	Aname 'MYG223'	Lake Lefroy ('Location K')	Potential	WA Museum, Dalcon (2013c)	x	
	Aname 'SIGM121'	Lake Lefroy ('Junction Recovery')	Potential	WA Museum, Phoenix (2013a)	x	

Family	Genus and species	Locality	SRE category	Source	Inside B2018 study area	Outside B2018 study area
	Aname 'SIGM122'	Lake Lefroy ('Junction Recovery', 'Argo', 'Location K'	Potential	WA Museum, Phoenix (2013a)	x	
	Aname sp. indet.	Throughout desktop area	Potential	WA Museum, Dalcon (2013a)	x	x
	Kwonkan 'MYG263'	Aldiss, 100 km ESE of Kalgoorlie	Potential	WA Museum		x
	Kwonkan sp. indet.	Lake Lefroy	Potential	WA Museum, Phoenix (2014)	x	x
	Proshermacha 'PRO025'	50 km ESE Kalgoorlie	Potential	WA Museum		x
	Nemesiidae 'SIGM104'	Lake Lefroy ('Argo', 'North-east Dune', Location 170')	Potential	WA Museum; SIGM 2012	x	x
Order Pseudoscorpiones (pseudoscorpions)						
Garypidae	*Synsphyronus* ` 7/2 Goldfields`	Burra Rock	Potential	WA Museum		x
	Synsphyronus sp. indet.	S and SE of Lake Lefroy	Potential	WA Museum		x
Order Scorpiones (scorpions)						
Buthidae	*Lychas* 'SIGM132'	Lake Lefroy ('Argo', 'Junction Reference')	Potential	Phoenix (2014)	x	
Urodacidae	*Urodacus* 'SIGM131'	Lake Lefroy ('Location K')	Potential	Dalcon (2013a)	x	
	Urodacus 'lefroy'	Lake Lefroy ('Junction South')	Potential	Phoenix (2014)	x	
	Urodacus sp. indet.	Widgiemooltha, S of Kalgoorlie, Lake Lefroy	Potential	WA Museum, SIGM 2009, 2010	x	x
Order Polydesmida (keeled millipedes)						
Paradoxosomatidae	*Antichiropus anconus*	Buldania Rock; Woodline	Confirmed	WA Museum, Car & Harvey (2014)		x
	Antichiropus cincinnus	McDermid Rock	Confirmed	WA Museum, Car & Harvey (2014)		x
	Antichiropus exclamatus	Norseman	Confirmed	WA Museum, Car & Harvey (2014)		x
	Antichiropus incomptus	Bedourie Hill, S of Kambalda, Woodline	Confirmed	WA Museum, Car & Harvey (2014)		x

Family	Genus and species	Locality	SRE category	Source	Inside B2018 study area	Outside B2018 study area
	Antichiropus paracalothamnus	McDermid Rock, Disappointment Rock	Confirmed	WA Museum, Car & Harvey (2014)		x
	Antichiropus 'broad arrows'	E of Kalgoorlie	Confirmed	WA Museum; Phoenix database		x
Order Coleoptera (beetles)						
Carabidae	*Cicindela* (*Rivacindela*) *necopinata*	Lake Lefroy	Potential	WA Museum; Sumlin (1997); Phoenix (2014)		x
	Cicindela (*Rivacindela*) *salicursoria*	Lake Lefroy	Potential	Sumlin (1987); Hudson (1995); Phoenix (2014)	x	x
	Cicindela (*Rivacindela*) 'yindarla'	Lake Lefroy, Lake Yindarlgooda	Potential	Hudson (1995) (as *Cicindela* sp. nov.), Golding (2016)	x	x
Order Orthoptera (grasshoppers and crickets)						
Gryllidae	*Apterogryllus* sp. A	Lake Lefroy, Lake Cowan	Potential	Hudson (1995); Curtin (1999); Phoenix (2014)	x	x
Order Lepidoptera (butterflies)						
Lycaenidae	*Jalmenus aridus*	Lake Douglas, 12 km SW Kalgoorlie	Potential (DPaW – P1)	Graham and Moulds (1988)		x
	Ogyris subterrestris petrina	Around Kalgoorlie	Confirmed EPBC, WC Act – CR	ALA (2016)		x
Isopoda (slaters)						
Armadilidae	*Cubaris* 'lefroy'	Lake Lefroy ('Location 170')	Potential	Phoenix (2014)		x
Philoscidae	Philoscidae 'lefroy'	Lake Lefroy '(Location K', 'Junction South')	Potential	Phoenix (2014)	x	
Order Eupulmonata (land snails)						
Bothriembryontidae	*Bothriembryon balteolus*	Woodline, Norseman	Potential	WA Museum		x
	Bothriembryon cf. *sedgwicki*	Widgiemooltha	Potential	WA Museum		x
	Bothriembryon sp. indet.	Throughout desktop area	Potential	WA Museum; Phoenix database	x	x

Family	Genus and species	Locality	SRE category	Source	Inside B2018 study area	Outside B2018 study area
Camaenidae	*Sinumelon* cf. *jimberlanensis*	Coolgardie, Mt Edward, Widgiemooltha	Potential	WA Museum		x
	Sinumelon kalgum	Kambalda	Potential	WA Museum		x
	Sinumelon sp. indet.	Widgiemooltha	Potential	WA Museum		x





St Ives Gold Mine
Beyond 2018 Project

Project No	1128
Date	30/01/2017
Drawn by	KW
Map author	KC

0 1 2 4 6
Kilometres

1:160,000 (at A4) GDA 1994 MGA Zone 51

B2018 Study area

Figure 5-2

Short-range endemic invertebrates identified in the desktop review

PHOENIX ENVIRONMENTAL SCIENCES

5.2 FIELD SURVEY

5.2.1 Fauna habitats

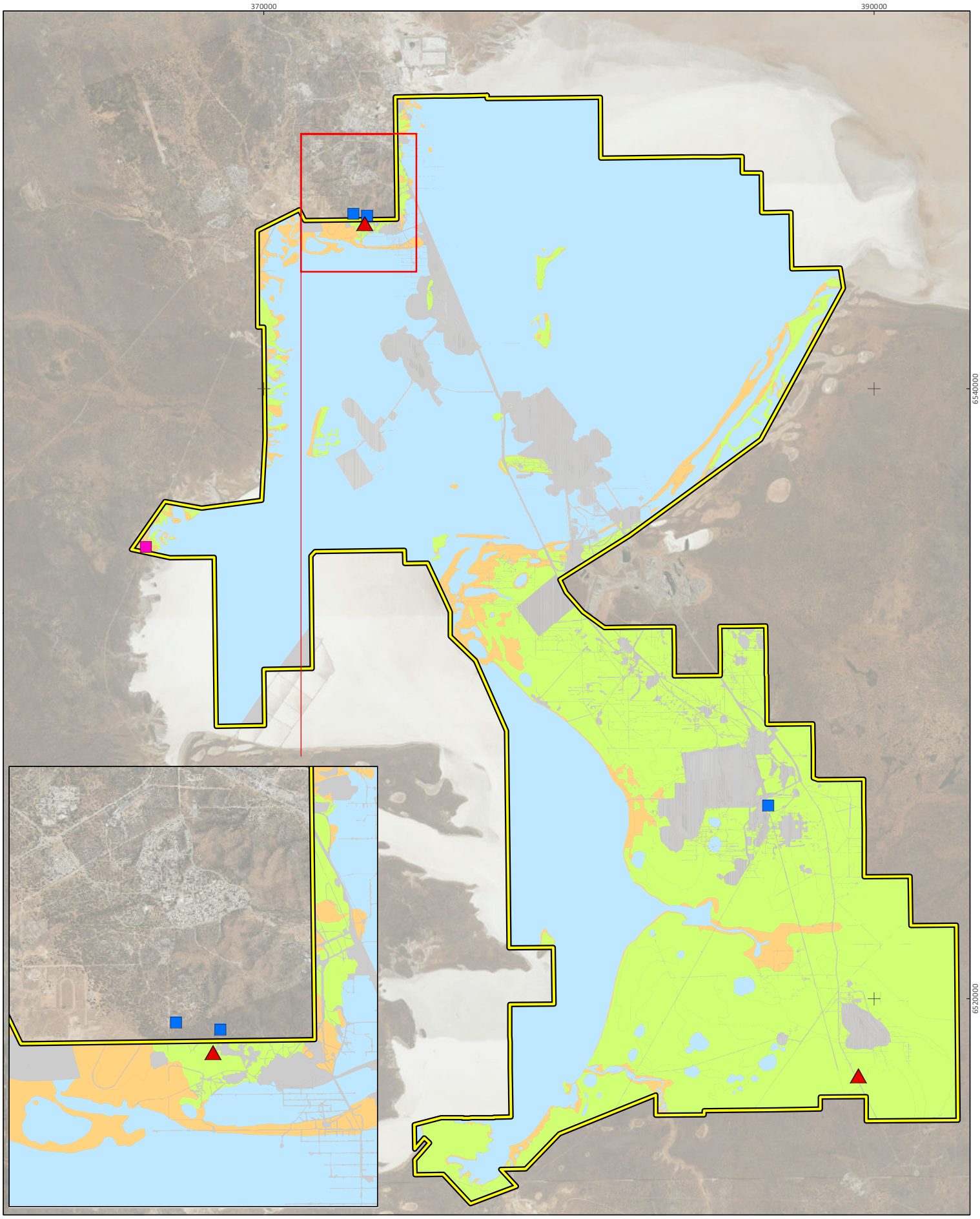
The B2018 study area contains three broad fauna habitats, in addition to developed areas (Table 5-3; Figure 5-3):

- **Salt lake playa and riparian zone**. Salt lake habitat and associated fringing riparian zone habitat encompassed more than half of the B2018 study area (Table 5-3; Figure 5-3). With the exception of small scattered islands and fringing riparian vegetation, salt lake playa was devoid of vegetation and consisted of large areas of dry salt lake with scattered areas where pooled water was present. Water presence and position on the salt lake playa is largely dependent on rainfall and wind patterns. The associated fringing riparian zone varied greatly in width and was generally dominated by samphire vegetation. Salt lakes provide potential habitat for a range of waterbird and shorebird species which forage on the lakes surface when the water level is low and may roost in fringing vegetation where suitable cover is present. Suitable habitat is also provided for specialist salt lake endemic specie invertebrate species, some of which are endemic to particular salt lakes, including Lake Disappointment and Lake Lefroy.
- **Woodland on plain.** Approximately 30% of the B2018 study area is comprised of woodland on plain and includes riparian vegetation on sandy to clay-loam substrates along drainage lines (i.e. not around the lake) and open woodland with scattered small rocky hills (Table 5-3; Figure 5-3). Woodlands were often dominated by *Eucalyptus* species up to 15 m, over *Acacia* species to 3 m, over mixed small to medium shrubs to 2 m and hummock and tussock grasses to 0.8 m. Understory in woodland on plain habitat was patchy with scattered areas of sparse vegetation and exposed sandy-loam and clay-loam or stony substrates. This habitat provides suitable foraging and nesting habitat for conservation significant species including Malleefowl, Peregrine Falcon, Western Rosella, Rainbow Bee-eater, Greater Long-eared Bat and possibly Red-tailed Phascogale. Migratory waterbirds and shorebirds may occasionally occur in the riparian vegetation, particularly following suitable rainfall events. This habitat also provides suitable habitat for a range of SRE invertebrate species, particularly areas where leaf litter is more abundant or suitable burrowing substrates are present. Where small rocky hills are present these provide suitable structures for some conservation significant species. For example, Malleefowl are likely to occur along the foot slopes of rocky hills while others (e.g. Peregrine Falcon) are more likely to occur at higher altitude which offer the species a better vantage point of the surrounding area when foraging.
- **Shrubland on dune.** A very small proportion of the B2018 study area comprised of shrubland on sand dune habitat (Table 5-3; Figure 5-3). Vegetation associated with this habitat type consists of patches of mixed small to medium shrubs to 2 m with scattered larger shrubs to 3 m, often dominated by *Acacia* species. Shrubland on dune habitat present within the B2018 study area provides suitable nesting habitat for the Rainbow Bee-eater.

Less than a tenth of the B2018 study area consisted of disturbed and/or developed areas (Table 5-3; Figure 5-3) which do not provide suitable habitat for most terrestrial fauna species. Some conservation significant species may occur occasionally in these areas as transients from adjacent fauna habitats (e.g. Malleefowl and migratory bird species) or to nest where suitable structures are present (e.g. Peregrine Falcon).

Table 5-3 Fauna habitats of the B2018 study area

Habitat	Area (ha)	Percentage
Salt lake playa and associated riparian zone	25,338.2	56.3%
Shrubland on dune	1,887.3	4.2%
Woodland on plain (incl. woodlands along drainage lines and those with scattered small rocky hills)	13,613.7	30.2%
Disturbed/developed	4,174.4	9.3%
Total:	**45,013.5**	**100.0%**



St Ives Gold Mine
Beyond 2018 Project

Project No	1128
Date	21-Sep-18
Drawn by	AL
Map author	KC

0 1.25 2.5 5
Kilometres

1:160,000 (at A4) GDA 1994 MGA Zone 51

Study area

Apus pacificus, Fork-tailed Swift
Leipoa ocellata, Malleefowl
Merops ornatus, Rainbow Bee-eater

Fauna habitats

- Disturbed/developed
- No access
- Salt lake playa and associated riparian zone
- Shrubland on dune
- Woodland

Figure 5-3

Fauna habitats and conservation significant vertebrates recorded during the field survey

PHOENIX ENVIRONMENTAL SCIENCES

5.2.2 Vertebrate fauna

A total of 33 vertebrate species were recorded during the field survey representing approximately 13% of the species identified from the desktop review (Table 5-4; Table 5-5). Four of the recorded species were not identified in the desktop review: one reptile (Western Bluetongue, *Tiliqua occipitalis*), two birds (Purple-gaped Honeyeater, *Lichenostomus cratitius* and Tawny-crowned Honeyeater, *Glyciphila melanops*) and one mammal (Cattle, *Bos taurus*).

Evidence of three conservation significant species were recorded within the B2018 study area during the field survey (Figure 5-3; Table 5-6):

- Malleefowl (*Leipoa ocellata*) (VU - EPBC Act, WA Act)
- Rainbow Bee-eater (*Merops ornatus*) (Mig – EPBC Act, WC Act)
- Fork-tailed Swift (*Apus pacificus*) (Mig – EPBC Act, WC Act).

Table 5-4 Vertebrate species recorded during the field survey

Scientific name	Common name	Conservation status[1]			Introduced
		EPBC Act	WC Act	DPaW	
Reptiles					
Ctenophorus cristatus	Bicycle Dragon				
Ctenophorus salinarum	Salt Pan Dragon				
Hesperoedura reticulata	Reticulated Velvet Gecko				
Christinus marmoratus	Marbled Gecko				
Heteronotia binoei	Bynoe's Gecko				
Tiliqua rugosa	Shingleback				
Tiliqua occipitalis	Western Bluetongue				
Varanus gouldii	Sand Monitor				
Morelia spilota imbricata	South-western Carpet Python				
Birds					
Dromaius novaehollandiae	Emu				
Leipoa ocellata[2]	Malleefowl	VU	VU		
Tadorna tadornoides	Australian Shelduck				
Apus pacificus	Fork-tailed Swift	Mig.	Mig.		
Falco berigora	Brown Falcon				
Psephotus varius	Mulga Parrot				
Melopsittacus undulatus	Budgerigar				
Merops ornatus	Rainbow Bee-eater		Mig.		
Smicrornis brevirostris	Weebill				
Lichenostomus cratitius	Purple-gaped Honeyeater				
Lichenostomus leucotis	White-eared Honeyeater				

Scientific name	Common name	Conservation status[1]			Introduced
		EPBC Act	WC Act	DPaW	
Anthochaera carunculata	Red Wattlebird				
Glyciphila melanops	Tawny-crowned Honeyeater				
Cracticus tibicen	Australian Magpie				
Strepera versicolor	Grey Currawong				
Rhipidura leucophrys	Willie Wagtail				
Corvus coronoides	Australian Raven				
Grallina cyanoleuca	Magpie-lark				
Taeniopygia guttata	Zebra Finch				
Mammals					
Chalinolobus gouldii	Gould's Wattled Bat				
Austronomus australis	White-striped Freetail-bat				
Oryctolagus cuniculus	Rabbit				●
Capra hircus	Goat				●
Bos taurus	Cattle				●

1 —VU – Vulnerable; Mig — Migratory.
2 – Only disused mounds were found.

Table 5-5 Vertebrate taxa recorded during the survey and the total number of species potentially occurring in the B2018 study area

Taxa	No. of species recorded during this survey in the B2018 study area	Total no. of species potentially occurring in study area (based on desktop review)
Amphibians	-	3
Reptiles	9	73
Birds	19	140
Mammals	5	36
Total	**33**	**252**

Table 5-6 Conservation significant vertebrate fauna recorded during the field survey

Species	Common name	Record type	Qty	Inside B2018 study area	Easting (GDA94, zone 51J)	Northing (GDA94, zone 51J)
Apus pacificus	Fork-tailed Swift	direct observation	1	Yes	366142	6534815
Merops ornatus	Rainbow Bee-eater	direct observation	1	Yes	373316	6545425
Merops ornatus	Rainbow Bee-eater	direct observation; call	3	Yes	389490	6517467
Leipoa ocellata	Malleefowl	old inactive mound		Yes	386535	6526329
Leipoa ocellata	Malleefowl	old inactive mound		No	372938	6545728
Leipoa ocellata	Malleefowl	old inactive mound		No	373392	6545661

5.2.2.1 Conservation significant species recorded or potentially occurring in the B2018 study area

In addition to the evidence of three conservation significant fauna (Malleefowl, Rainbow Bee-eater and Fork-tailed Swift), potential habitat was identified in the B2018 study area for a further 16 species (Figure 5-3; Table 5-6). Potential habitat was identified for a further 16 of the 27 conservation significant species identified in the desktop review (Table 5-1). Potential occurrence of conservation significant species in the B2018 study area was assessed based on presence of suitable habitat, proximity of previous records and current distributions. It was noted that lack of records for many conservation significant species is likely due to the limited survey effort within the broader region. Species from the desktop review that were considered unlikely to occur in the B2018 study area due to the lack of suitable habitat or because that are regionally extinct are not discussed further.

5.2.2.1.1 **Malleefowl (*Leipoa ocellata*)**

Status: Vulnerable (EPBC Act), Vulnerable (WC Act)

Distribution and ecology: The Malleefowl is found across the southern half of the Australian continent and is the only Megapodiidae in the South-west Region. In WA, the majority of the population is found south of a line from Shark Bay to the Nullarbor Plain. In the extreme south-west of WA, the species displays a patchy distribution. Recent work (Parsons *et al.* 2008) highlighted the substantial contraction of the Malleefowl distributional range in WA.

The Malleefowl is a mound builder. Pairs are territorial. The eggs (on average 16) are laid in a chamber over which the male builds a mound from soil and leaf litter material. The combination of solar heat and fermenting plant material provides the heat required for egg incubation.

Malleefowl are typically found in mallee woodlands but also in *Eucalyptus* woodlands and shrublands. The decline of the species is due to several factors: land clearing, habitat fragmentation, predation from introduced predators, altered fire regime, competition for food with stock, road kill and the bio-accumulation of chemicals used in agriculture (Garnett et al. 2011). A National Recovery Plan was launched in 2007 in response to the dramatic decrease experienced by Malleefowl throughout Australia (Benshemesh 2007). In WA, a Strategic Action Plan was enacted for the 2005–2010 period (Western Australian Malleefowl Network 2006).

Records and likely distribution in B2018 study area: The Malleefowl was recorded once from secondary evidence during the field survey. One inactive mound was recorded within 10 m of an

access track in the south-east of the B2018 study area (Figure 5-3; Table 5-6). Condition of the mound and vegetation growth occurring on the mound indicates the mound has remained unused for some time (Figure 5-4). The mound recorded during the field survey was previously recorded and identified as inactive in a previous survey within the B2018 study area (Figure 5-4) (Bamford 2010). The species has previously been recorded three times from inactive mounds in the B2018 study area (two mounds from three records) (Bamford 2010; Harewood 2011c) and once from tracks (Harewood 2011c). Of the two mounds previously recorded, one located centrally within the B2018 study area (Figure 5-1) (Bamford 2010; Harewood 2011c) has since been removed during clearing for tailings pond. Two additional inactive mounds belonging to the species have previously been recorded from approximately 100–200 m north of the northern boundary of the B2018 study area (Terratree 2015). Both mounds were examined during the field survey and both showed no sign of recent use.

Given the location of previous Malleefowl records within and in the broader vicinity of the B2018 study area, and the presence of suitable habitat for the species throughout large areas of the B2018 study area, it is considered likely to occur in areas of open to dense shrubland and woodland (Figure 5-3). Additional mounds may be located with additional targeted searches or clearance surveys for the species.

Figure 5-4 Inactive Malleefowl mound recorded opportunistically (Opp 11) in the B2018 study area during the field survey

5.2.2.1.2 **Blue-billed Duck (*Oxyura australis*)**

Status: Priority 4 (DPaW)

Distribution and ecology: The Blue-billed Duck is a small Anatidae species endemic to Australia where it is mostly found across the southern half of the country. In WA, the species is confined to the south west where it is rare to locally common (Johnstone & Storr 1998). They are found in terrestrial wetlands (fresh or saline) with extensive bordering vegetation (Garnett & Crowley 2000b). The population estimate for WA is about 5,000 individuals.

Blue-billed Ducks feed on aquatic invertebrates, seeds and plants. They nest from August to March. Habitat degradation (drainage, salinization), bycatch in gill net, climate change, and introduced species are the main causes that lead to the decline of the species over the past decades (del Hoyo *et al.* 2014).

Records and likely distribution in the B2018 study area: The Blue-billed duck was not recorded during the survey; however, potential habitat was identified and the species may occur, particularly after suitable rainfall events when salt lakes may become flooded. The species has previously been recorded approximately 90 km south and 116 km north-west of the B2018 study area (DPaW 2016a).

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

Status: Migratory (EPBC Act), Migratory (WC Act)

Distribution and ecology: The Fork-tailed Swift is a widespread migratory species that overwinters in Australia. It can be found across most of WA and is uncommon to moderately common in the north-west. They are mostly found over inland plains and along foothills, coastal areas and over settlements. They occur in a wide range of dry or open habitats, including riparian woodlands, tea-tree swamps, low scrub, heathland, saltmarsh, grassland and spinifex sandplains, open farmland and inland and coastal sand-dunes. Fork-tailed Swifts are often found in areas that experience updraughts around cliffs and normally forage several hundred metres above ground level (Department of the Environment 2015).

Records and likely distribution in the B2018 study area: The Fork-tailed Swift was recorded once during the field survey from a single individual flying overhead in riparian woodland habitat (Figure 5-3; Table 5-6). The species is likely to occur occasionally in the B2018 study area. The species can occur within a wide range of habitats, including those found in the B2018 study area and is likely to forage, though it is unlikely it will land or nest within the B2018 study area. The Fork-tailed Swift has previously been recorded approximately 105 km west of the B2018 study area at Victoria Rock (Birdlife Australia 2016).

5.2.2.1.4 **Eastern Great Egret (*Ardea modesta*)**

Status: Migratory (EPBC Act); Migratory (WC Act)

Distribution and ecology: The Eastern Great Egret can be found along inland rivers, lakes and shallow freshwater or saltwater wetlands and inundated samphire flats. This species is highly mobile and can be found throughout most of the western fringes of WA in coastal areas and towards the semi-arid interior (Johnstone & Storr 1998).

Records and likely distribution in B2018 study area: The Eastern Great Egret was not recorded but has the potential to occur in the B2018 study area. The nearest record of the Eastern Great Egret is located approximately 220 km south of the B2018 study area (DPaW 2016a). Permanent creek and drainage lines are not present within the B2018 study area; however, the species may occur after rains when water is present in drainage lines and lakes are holding water.

5.2.2.1.5 Cattle Egret (*Ardea ibis*)

Status: Migratory (EPBC Act); Migratory (WC Act)

Distribution and ecology: The Cattle Egret is a widespread, medium-size waterbird. In Australia, they are more common in eastern states than on the west coast. The species is uncommon in south-western WA and breeds in small numbers near Kununurra. The origin of the species in Australia is not certain. It may have been introduced but a natural colonisation from individuals reaching the northern coast through Indonesian islands is more probable (McKilligan 2005).

In Australia, Cattle Egrets have benefited from human settlements (irrigation, grazing). They can feed on a wide range of prey (vertebrates and invertebrates) that they find in swamps and open grasslands, inland as well as on the coast. The species is partially migratory with movement between New-Zealand and Australia.

Records and likely distribution in the B2018 study area: No records of the Cattle Egret were collected during the survey; however, the desktop review revealed a record of the species near Kalgoorlie, approximately 54 km north-northeast of the B2018 study area (Birdlife Australia 2016; DPaW 2016a). The Cattle Egret may occasionally occur in the B2018 study area following suitable rainfall events when water is present in lakes.

5.2.2.1.6 Glossy Ibis (*Plegadis falcinellus*)

Status: Migratory (EPBC Act); Migratory (WC Act)

Distribution and ecology: The preferred habitat of the Glossy Ibis is well-watered flatlands such as shallows, flats and pools of freshwater lakes, swamps and rivers, flooded samphire and sewage ponds. The most notable habitat for this bird in WA is the north-east and south-west Kimberley and the Swan Coastal Plain (Johnstone & Storr 1998).

Records and likely distribution in the B2018 study area: The Glossy Ibis was not recorded during the survey; however, the species has previously been recorded near Kalgoorlie, approximately 54 km north-northeast of the B2018 study area (Birdlife Australia 2016; DPaW 2016a) and may occur occasionally following suitable rainfall events and subsequent flooding of lakes.

5.2.2.1.7 Grey Falcon (*Falco hypoleucos*)

Status: Vulnerable (WC Act)

Distribution and ecology: The Grey Falcon is a widespread but rare species inhabiting much of the semi-arid interior of Australia. Its distribution is centred along inland drainage systems. It has a large foraging range extending from timbered plains, such as *Acacia* shrublands, into open grasslands. Prey includes mainly birds (Sutton 2010), but also invertebrates and mammals. The species often utilizes old nests of other species, particularly other raptors, in the tallest trees along watercourses and sometimes in telecommunication towers (Sutton 2010).

There are no confirmed threats to the Grey Falcon but it is thought that clearing of the semi-arid zone for marginal farming has reduced habitat availability and overgrazing of arid zone rangelands may affect prey abundance (Garnett *et al.* 2011).

Records and likely distribution in the B2018 study area: The Grey Falcon was not recorded; however, the species is likely to occur occasionally due to its large foraging range which may include all habitats of the B2018 study area. The species is unlikely to nest in the B2018 study area due to the lack of suitable nesting trees or tall infrastructure such as telecommunications towers; however, may do so in the vicinity where suitable nesting structures are present. The nearest record of the species is located approximately 47 km south of the B2018 study area (DPaW 2016a).

5.2.2.1.8 **Peregrine Falcon (*Falco peregrinus*)**

Status: Specially Protected (WC Act)

Distribution and ecology: The Peregrine Falcon is a widespread bird of prey with a large foraging range found across Australia. In WA, it can be rare or scarce to moderately common. The Peregrine Falcon's preferred habitat includes cliffs and wooded watercourses. Nesting occurs mainly on cliff ledges, granite outcrops, quarries and in trees with old raven or Wedge-tailed Eagle nests (Johnstone & Storr 1998).

Birds constitute a very large proportion of their diet, if not the exclusive part (Johnstone & Storr 1998; Ratcliffe 1980). Historically, the widespread use of DDT caused worldwide global decline of the Peregrine Falcon. The main current threat to the species in Australia is habitat loss, particularly woodland trees for nesting (Department of the Environment 2015).

Records and likely distribution in the B2018 study area: The Peregrine Falcon was not recorded but is likely to occasionally forage in the B2018 study area. The species is unlikely to nest in the B2018 study area due to the lack of suitable nesting trees or tall infrastructure such as telecommunications towers; however, may do so in the vicinity where suitable nesting structures are present. It has previously been recorded approximately 9.5 km west of the B2018 study area (Birdlife Australia 2016; DPaW 2016a).

5.2.2.1.9 **Hooded Plover (*Thinornis rubricollis*)**

Status: Priority 4 (DEC)

Distribution and ecology: The Hooded Plover population extends from coastal New South Wales to the west coast of WA. The species is absent between Eyre and the South Australian border but is present in Tasmania. Most of the Western Australian population is found on the coast from Jurien to the east of Esperance, and a part of the population nests inland (Elson & Singor 2008).

Nesting pairs of Hooded Plovers can be found on the shore of inland salt lakes, inlets and coastal sandy beaches. They lay two to three eggs on open sandy shores and beaches. Eggs and flightless young are highly vulnerable to predation (Red Foxes, feral cats, dogs), human disturbance and vehicles (Burbidge & Mather 2002). Predation by foxes seems to have decreased since the beginning of the Western Shield Program.

Records and likely distribution in the B2018 study area: The Hooded Plover was not recorded during the field survey; however, suitable habitat was identified in the B2018 study area and the species is considered likely to occur. The Hooded Plover has previously been recorded approximately 70 km north of the B2018 study area (DPaW 2016a).

5.2.2.1.10 **Common Greenshank (*Tringa nebularia*)**

Status: Migratory (EPBC Act); Migratory (WC Act)

Distribution and ecology: The species is present in summer across all Australian states, mostly along the coast but sometimes inland. The overall population appears stable (Delany & Scott 2006). The species is not gregarious. Small groups can sometimes be seen when roosting at high tide (Geering *et al.* 2007). They prefer coastal open mudflats.

Records and likely distribution in the B2018 study area: The Common Greenshank was not recorded during the survey; however, it has previously been recorded approximately 64 km north-northwest of the B2018 study area (DPaW 2016a) and may occur in the B2018 study area occasionally following suitable rainfall events when water is present in lakes.

5.2.2.1.11 **Wood Sandpiper (*Tringa glareola*)**

Status: Migratory (EPBC Act); Migratory (WC Act)

Distribution and ecology: This graceful, active wader prefers shallows of wooded lakes or swamps with trees. It also inhabits freshwater swamps, lakes, flooded pastures and occasionally, mangroves. It occurs solitary or in large flocks of mixed waders and is an uncommon migrant (Morcombe 2004).

Records and likely distribution in the B2018 study area: The Wood Sandpiper was not recorded during the survey and the nearest record of the species is located approximately 47 km north-northwest of the B2018 study area (DPaW 2016a). The Wood Sandpiper may occur in salt lake habitat and adjacent shorelines after rain, when water is present.

5.2.2.1.12 **Red-necked Stint (*Calidris ruficollis*)**

Status: Migratory (EPBC Act), Migratory (WC Act)

Distribution and ecology: Red-necked Stints are found in great numbers along the East Asian – Australasian Flyway (325.000 individuals overall, 270.000 in Australia (Geering *et al.* 2007)). Numbers are increasing in Australia but decreasing in other countries (e.g. Japan, (Amano *et al.* 2010)) which may suggest a shift of the wintering range according to Delany and Scott (2006).

They can congregate in large flocks and are very active when foraging. They are found across a wide range of open mudflat-like habitats in salt as well as in fresh water systems.

Records and likely distribution in the B2018 study area: The Red-necked Stint was not recorded during the survey; however, suitable potential habitat was recorded for the species and may possibly occur occasionally in salt lake habitat when water is present within salt lakes following suitable rainfall events. The species has previously been recorded approximately 68 km north of the B2018 study area (DPaW 2016a).

5.2.2.1.13 **Sharp-tailed Sandpiper (*Calidris acuminata*)**

Status: Migratory (EPBC Act), Migratory (WC Act)

Distribution and ecology: The Sharp-tailed Sandpiper is one of the most common Australian shorebirds. They breed in Arctic north-east Siberia and a large majority of the world population (155,000 individuals) winters in Australia (91% cited in Bamford *et al.* 2008). The distribution of the species in Australia depends on water quantity conditions; some large wetlands may be available inland after important rainfall, but only occasionally. The distribution on the coast is more regular, the conditions being more consistent. The species is semi-gregarious and occurs in scattered flocks, mainly on non-tidal flats, often inland.

Records and likely distribution in the B2018 study area: The Sharp-tailed Sandpiper was not recorded during the survey; however, it has previously been recorded approximately 34 km north of the B2018 study area (DPaW 2016a) and may occur in salt lake habitat when water is present following suitable rainfall events.

5.2.2.1.14 **Curlew Sandpiper (*Calidris ferruginea*)**

Status: Critically Endangered/Migratory (EPBC Act); Vulnerable/Migratory (WC Act)

Distribution and ecology: The Curlew Sandpiper has a widespread distribution across coastal Australia. It forages on intertidal mudflats and more rarely on inland freshwater wetlands (Geering *et al.* 2007; Johnstone & Storr 1998).

Records and likely distribution in the B2018 study area: No records of the Curlew Sandpiper were recorded during the survey; however, the species has previously been recorded approximately 68 km north of the B2018 study area (DPaW 2016a) and may occasionally occur in salt lake habitat, particularly following rainfall when water may be present.

5.2.2.1.15 Western Rosella (inland subsp.) (*Platycercus icterotis xanthogenys*)

Status: Priority 4 (DPaW)

Distribution and ecology: Two subspecies are recognised: *P. i. xanthogenys* in the Wheatbelt and *P. i. icterotis* in the extreme coastal south-west. The species as a whole is endemic to the WA south-west (Garnett & Crowley 2000a). Only *P. i. xanthogenys* is of conservation concern.

Both subspecies live in eucalypt woodland along watercourses. *P. i. xanthogenys* mainly feed on casuarina seeds. They nest in tree hollows where they lay an average of 5.6 eggs (Garnett & Crowley 2000a).

Habitat clearance for agriculture has been responsible for the decline of the species in the Wheatbelt. Resources as well as nesting habitats for the species are affected (Garnett & Crowley 2000a).

Records and likely distribution in the B2018 study area: The Western Rosella was not recorded during the field survey and the nearest record of the species is approximately 45 km southwest of the B2018 study area (DPaW 2016a). The species may occur in woodland habitat of the B2018 study area where it is likely to forage and may also nest where suitable hollows are present.

5.2.2.1.16 Night Parrot (*Pezoporus occidentalis*)

Status: Endangered (EPBC Act), Critically Endangered (WC Act)

Distribution and ecology: The Night Parrot is considered the rarest bird in Australia. The species was thought to be extinct until a single road-killed specimen was collected in Queensland in October 1990 (Boles *et al.* 1994). Since then, additional specimens have been recorded in Queensland (McDougall *et al.* 2009) and further sightings were confirmed in the Pilbara, Goldfields and East Murchison regions of WA (DBCA 2017; Hamilton *et al.* 2017a; Hamilton *et al.* 2017b; Jackett *et al.* 2017). A recent feather of the species was also reported recently from near Lake Eyre in South Australia (Young *et al.* 2017).

Little is known about the biology of this cryptic species. Most sightings or recordings occur at night, near water and it is assumed that birds come to drink prior to feeding at night. The nest is located in tunnelled dense vegetation and can contain three to six eggs (Garnett *et al.* 2011; Hamilton *et al.* 2017a).

Recent survey guidelines (DPaW 2017) which post-date the current survey define the broad habitat requirements of the species in Western as including areas of old-growth spinifex (*Triodia*) for roosting and nesting, together with foraging habitats that are likely to include various native grasses and herbs, and may or may not contain shrubs or low trees. Roosting and nesting sites are in clumps of dense vegetation, primarily patches of old and large spinifex (often >50 years unburnt), especially ring-forming hummocks. These may be in expanses or isolated patches, and may be associated with other vegetation types, such as dense chenopod shrubs (DPaW 2017; Hamilton *et al.* 2017b). These habitats are often naturally fragmented and therefore well-protected from fire. Collapsed spinifex hummocks (<40–50 cm high) are not likely to provide adequate shelter (DPaW 2017).

Foraging habitat preferences of Night Parrots are not well understood. Favoured sites are likely to vary across the range of the species, and by season. Based on observations in Queensland, areas rich in herbs including forbs, grasses and grass-like plants, are believed to be important in WA. *Triodia*, *Sclerolaena* and other succulent chenopods are likely to be important (DPaW 2017). Foraging habitat is likely to be more important if it is adjacent to or within about 10 km of patches of *Triodia* deemed

suitable as roosting habitat (DPaW 2017). Where *Triodia* is absent, samphire near salt lakes appear to provide sufficient foraging habitat for the species (Young *et al.* 2017).

Alteration of fire regime, predation by introduced species and over grazing by cattle are the main threats to the species, resulting in poor habitat quality and direct mortality of individuals (DBCA 2017). Murphy *et al* (2017) observed that in Queensland persistence of the species correlated with the absence of foxes and the low prevalence of cats. Murphy *et al* (2017) also analysed archival aerial imagery and determined that fire was "not a feature of their study area, resulting in the long-term, stable availability of patchy *Triodia* habitats separated by natural no-fuel areas." Murphy *et al* (2017) determined that their study area had a long history of moderate grazing concentrated on alluvial habitats and concluded that Night Parrots and cattle had coexisted on Brighton Downs for at least 11 years.

The map of historical records in WA indicates the species can potentially occur across a wide range of common habitat (Davis & Metcalf 2008).

Records and likely distribution in the B2018 study area: The Night Parrot was not recorded during the field survey. There is a record of the species approximately 286 km southeast of the B2018 study area; however, the record lacks information to determine its accuracy and validity (DPaW 2016a). Likelihood of occurrence within the B2018 study area was assessed as possible due to the presence of open woodland with mature spinifex (*Triodia* spp.) and chenopod vegetation on some of the salt lake shoreline where suitable vegetation cover was present.

A subsequent targeted survey at eight sites in July and August 2017 did not record any evidence of the birds, nor identify any high quality habitat for breeding (Phoenix 2018).

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

Status: Migratory (EPBC Act), Migratory (WC Act)

Distribution and ecology: The Rainbow Bee-eater is a migratory bird that moves between Australia and Asia and is commonly seen singly or in pairs. It can be found across Australia, with complex seasonal movements depending on location and rainfall, preferring the more watered areas of the country. In WA, the Rainbow Bee-eater can be found in lightly wooded, preferably sandy country, near water (Department of the Environment 2015).

Occurring as a resident, breeding visitor, postnuptial nomad, passage migrant or winter visitor, and being highly mobile, they can be scarce to locally common. They are often associated with creek lines supporting sandy banks in which burrows can be created (Johnstone & Storr 1998). Its diet consists primarily of bees (especially hive bees) and flies, but it is known to predate on other invertebrates.

The species nests in sandy banks and breeding occurs from August to November; however, breeding can occur at other times of year if environmental conditions are suitable. Four to six eggs are laid in an open chamber at the end of a burrow (Johnstone & Storr 1998).

Records and likely distribution in the B2018 study area: The Rainbow Bee-eater was recorded twice during the field survey from direct observation and calls (Figure 5-3; Table 5-6). The species is likely to occur frequently throughout the B2018 study area in most habitats to forage and may occasionally nest in habitats providing suitable sandy substrates for burrows. The species has previously been recorded multiple times within the B2018 study area (Figure 5-1) (Bamford 2010; Harewood 2010a, b, c, d; Keith Lindbeck and Associates 2007; Terratree 2015) and multiple times in the close vicinity of the B2018 study area (DPaW 2016a).

5.2.2.1.18 **Red-tailed Phascogale (*Phascogale calura*)**

Status: Endangered (EPBC Act), Conservation Dependent (WC Act)

Distribution and ecology: The Red-tailed Phascogale is a small dasyurid now restricted to the forests of south-western WA. The species was formerly widespread across a large part of WA, Northern Territory and small portions of South Australia. Red-tailed Phascogales seem to favour dense and tall vegetation with tree hollows that can potentially be used as nest or diurnal shelters. They are carnivorous and feed on any kind of prey, from birds to invertebrates. All males die after the mating season and therefore live less than one year.

The species has mostly suffered from predation by introduced predators, mainly the Red Fox and Feral Cat. Changes of fire regimes since European settlements may also have affected the species' habitat and reduced the availability of shelters (Van Dyck & Strahan 2008).

Records and likely distribution in the B2018 study area: The Red-tailed Phascogale was not recorded during the survey and the B2018 study area is outside the species current known distribution (Van Dyck & Strahan 2008); however, there is an unconfirmed record of the species from 2005 located approximately 21 km south-east of the B2018 study area, with additional records further south from the 1980s suggesting the species may possibly still occur within the B2018 study area (DPaW 2016a). It is possible the 2005 record is a misidentification and the species is in fact regionally extinct within the vicinity of the B2018 study area.

5.2.2.1.19 **South-western Long-eared Bat (*Nyctophilus major tor*)**

Status: Priority 4 (DPaW)

Distribution and ecology: The Greater Long-eared Bat is a small insectivorous bat belonging to the family Vespertilionidae. It occurs in woodlands, mallee and thicket habitat with a prominent shrub stratum in southern WA and south-eastern South Australia (Woinarski *et al.* 2014). It roosts in tree crevices, foliage or under loose bark (Woinarski *et al.* 2014). Little is known of the species ecology or population size across its distribution and specific threats to the species have not been identified.

Records and likely distribution in the B2018 study area: The Greater Long-eared Bat was not recorded during the survey from bat echolocation recordings; however, the species is considered likely to occur, predominantly in open eucalypt woodland habitat to forage and in open woodland habitat where suitable hollows are present to roost. ATA Environmental (2006) recorded the species *Nyctophilus major tor* (then known as *Nyctophilus timorensis*, see Parnaby 2009); however, the report lacks sufficient detail to determine if the record is from the current B2018 study area. Any records are likely to be from within 5 km of the B2018 study area. Excluding the ATA Environmental (2006) records, the nearest record of the species is located approximately 140 km southwest of the B2018 study area (DPaW 2016a)

5.2.3 Short-range endemic invertebrates

A total of 26 specimens in the SRE target groups, which here includes potential salt lake specialists, were collected in the B2018 study area, representing five individually-recognised species and seven unidentified higher taxa from three orders, eight families and at least eleven genera (Table 5-7; Appendix 4).

One species, *Tetralycosa baudinettei*, represents a confirmed SRE, whereas the immature *Tetralycosa* sp. indet. are considered potential SREs, as they may represent *T. baudinettei* or the widespread *T. alteripa* (Framenau & Hudson 2017).

Maratus 'PES0340' was only found on the salt lake playa and was here recognised for the first time as a salt lake specialist and therefore potential SRE, after the species was previously collected during riparian invertebrate monitoring surveys (Phoenix 2013a, 2014, 2015).

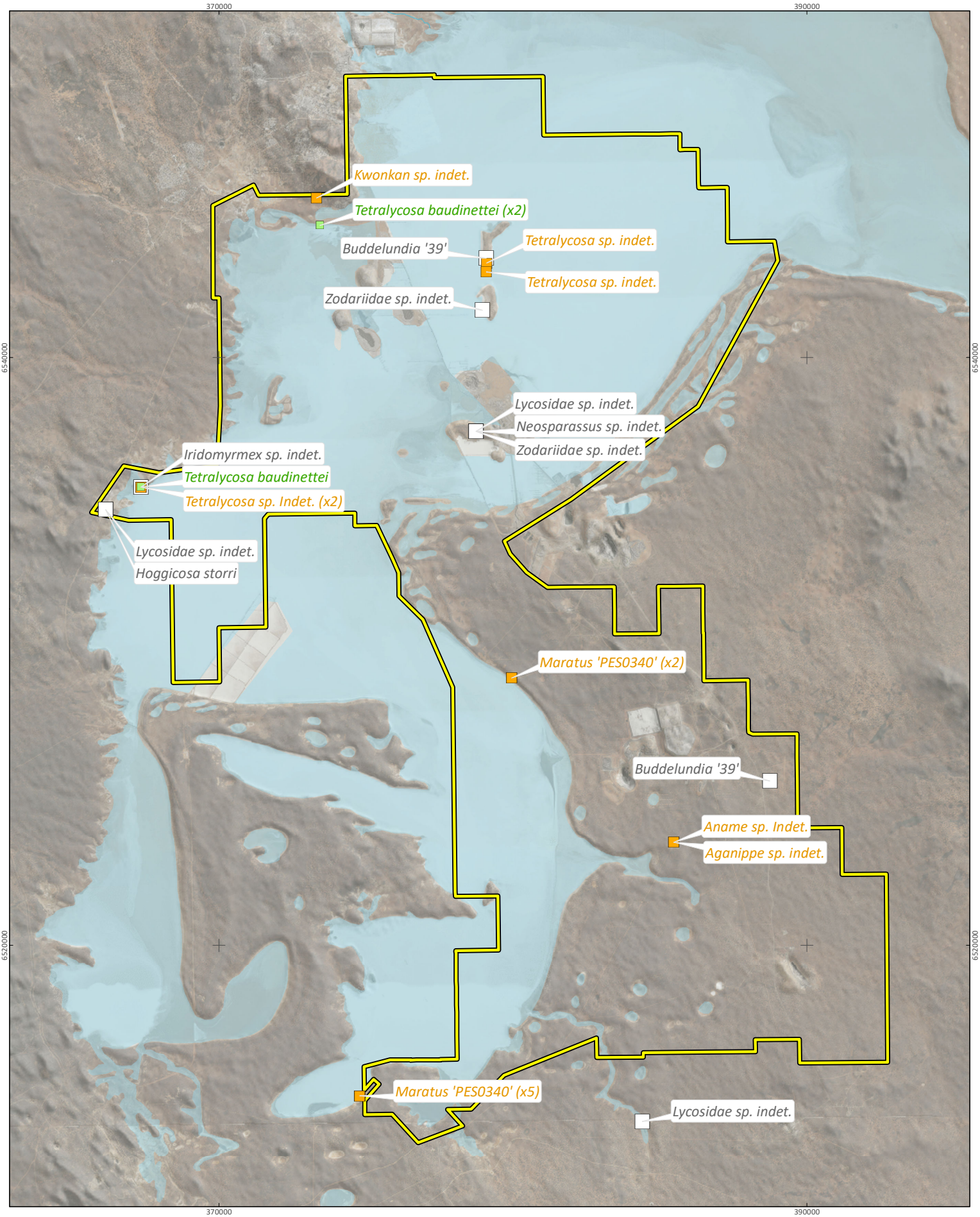
Three trapdoor spiders in the families Idiopidae and Nemesiidae were collected during the field survey. All were juvenile and could not be identified at the species level ('sp. indet.'). All three are here considered potential SREs.

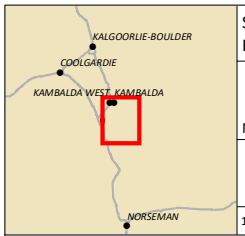
Species-level identifications, either morphological or molecular, were not possible for all specimens, so unidentified SRE taxa recorded from inside the B2018 study area (Table 5-7) may not represent the same taxa of 'sp. indet.' as those from outside (Table 5-1). Detailed assessments of taxonomy and distributions for all SREs collected in the B2018 study area are given in section 5.2.3.

Two habitats recorded SRE invertebrates, the salt lake playa and associated riparian zone, and woodland on plain.

Table 5-7 Invertebrates in the short-range endemic invertebrate target taxa collected during the field survey

Family	Genus and species	SRE status	Sites	No. of specimens	Habitat
Order Araneae (spiders)					
Infraorder Araneomorphae (modern spiders)					
Lycosidae	*Tetralycosa baudinettei*	Confirmed	15, 17,	3	Salt lake playa and riparian zone
	Tetralycosa sp. indet.	Potential	15, Opp 03, Opp 09	4	Salt lake playa and riparian zone
	Hoggicosa storri	Widespread	4	1	Woodland on plain (riparian)
	Lycosidae sp. indet.	Widespread	1, 4, 13	3	Woodland on plain (riparian)
Salticidae	*Maratus* 'PES0340'	Potential	14, 18	7	Salt lake playa and riparian zone
Sparassidae	*Neosparassus* sp. indet.	Widespread	1	1	Woodland on plain
Zodariidae	Zodariidae sp. indet.	Widespread	1, 2	2	Woodland on plain
Infraorder Mygalomorphae (trapdoor spiders)					
Idiopidae	*Aganippe* sp. indet.	Potential	12	1	Woodland on plain
Nemesiidae	*Aname* sp. indet.	Potential	12	1	Woodland on plain
	Kwonkan sp. indet.	Potential	07	1	Woodland on plain
Order Isopoda (slaters)					
Armadillidae	*Buddelundia* '39'	Widespread	3, 9	1	Woodland on plain
Order Hymenoptera (bees, wasps, ants)					
Formicidae	*Iridomyrmex brennani*	Widespread	15	1	Salt lake playa and riparian zone





St Ives Gold Mine
Beyond 2018 Project

Project No	1128
Date	12/16/2016
Drawn by	KW
Map author	KC

0 0.5 1 2 3 4
Kilometres

1:165,000 (at A4) GDA 1994 MGA Zone 51

- B2018 Study area
- Widespread SRE
- Confirmed SRE
- Potential SRE

Figure 5-5

Short range endemic invertebrates collected during the field survey

PHOENIX ENVIRONMENTAL SCIENCES

5.2.3.1 Araneae – Araneomorphae (modern spiders)

The Araneae (spiders) are characterised by a number of unique characters, including abdominal appendages modified as spinnerets, silk glands and associated spigots, cheliceral venom glands and male pedipalp tarsi modified as secondary genitalia for sperm transfer (Coddington & Levi 1991). Spiders are one of the largest and most diverse orders of arachnids with more than 46,000 described species worldwide (World Spider Catalog 2017), and approximately 3,700 species named from Australia (Framenau 2016).

In contrast to the Mygalomorphae (trapdoor spiders, see section 5.2.3.2), Araneomorphae are rarely targeted in SRE surveys. Araneomorphae often disperse very well, for example by wind-drift on gossamer threads ('ballooning') (e.g. Bell *et al.* 2005), and many species are widely distributed across the Australian landscape (Harvey 2002).

The wolf spider *T. baudinettei* was the only SRE araneomorph spider species identified from the B2018 study area in the desktop review (Table 5-2). A number of modern spiders previously reported from Lake Lefroy, for example members of the families Desidae (or Amaurobiidae) (Curtin University of Technology 1999; Hudson 1995), are unlikely SREs and not further discussed here.

The field survey reported *T. baudinettei*, and in addition an apparent salt lake specialist in the jumping spider genus *Maratus* (the Peacock Spiders), which is here considered a potential SRE.

5.2.3.1.1 **Lycosidae**

Wolf spiders (family Lycosidae) belong to one of the most diverse and abundant ground living spiders in Australia. They are characterised by a peculiar eye pattern with a row of four small eyes at the front of the carapace and four larger eyes forming a square on its top. Additional features of the family include the lack of a retrolateral tibial apophysis in the male pedipalp and mobile brood care; female carry their eggsacs fixed to the spinnerets and subsequently the young spiderlings on their abdomen (Framenau & Vink 2001).

The Australian wolf spider fauna has received recent taxonomic attention with the revision of many genera and species (Framenau 2002, 2006a, b, c; Framenau & Baehr 2007; Framenau & Leung 2013; Framenau & Vink 2001); however, the taxonomy of the Australian fauna is still only moderately well known (Framenau 2009). Currently 167 species in 30 genera are described (Framenau 2016).

The Australian Lycosidae are generally not targeted during SRE surveys; however, some habitat specialists are clearly range-restricted. For example, *Artoria albopedipalpis* is only known from riparian gravel banks in the Victorian Alps (Framenau 2002).

Genus *Tetralycosa*

The wolf spider genus *Tetralycosa* can be identified by morphological characters of the male genitalia, such as a hook-shaped tegular apophysis (Framenau & Hudson 2017). It includes exclusively halotolerant species which are found on beaches along the southern Australian coast, inland mound springs of the Great Artesian Basin, and salt pans and salt lakes in the arid zone (Framenau & Hudson 2017). A distinct lineage of *Tetralycosa* exclusively inhabits the surface of inland salt lakes, where they construct burrows in which they stay during the day and when the lake is inundated. The burrows can be recognised by a mound of mud pellets with a semi-circle of pellets deposited around them (Framenau & Hudson 2017). A number of *Tetralycosa* species are only known from single lakes, such as *T. williamsi* (Lake Moore) and *T. rebecca* (Lake Rebecca) and therefore represent SREs, whilst others are widespread throughout WA and South Australia (such as *T. alteripa*).

Tetralycosa baudinettei

Tetralycosa baudinettei (Figure 5-6) was first recorded from Lake Lefroy and Lake Zot as '*Lycosa* sp. nov. aff. *alteripa*' (Hudson 1995). On Lake Lefroy, it is currently the most commonly collected wolf spider species and has been found throughout and outside the B2018 study area; during this survey, it was collected at sites 15 and 17. Some unidentified juveniles (*Tetralycosa* sp. indet.) may also belong to this species and are therefore listed as potential SREs here. *Tetralycosa baudinettei* is found on other lakes of the region, such as Lake Goongarrie, Lake Roe and Lake Yindarlgooda (Framenau & Hudson 2017). It is considered a confirmed SRE as the total surface of the lakes it is found on is smaller than the nominal range of short-range endemism (Phoenix 2014). Two other widespread species of salt lake dwelling lycosids are found on Lake Lefroy, *T. alteripa* and *Lycosa salifodina* and it is currently unclear, how these species separate ecologically (Framenau & Hudson 2017; Hudson 1995).

Figure 5-6 *Tetralycosa baudinettei* male (left) and female (right)

5.2.3.1.2 Salticidae

Jumping Spiders (family Salticidae) are amongst the most easily identified spider families based on their large anterior median eyes and optical orientation. Males are often colourful reflecting a mating behaviour that is based on visual cues. Genus identification within Australia is possible applying the key of Davies and Żabka (1989), although subsequent studies have added to the knowledge of the local fauna (e.g. Gardzinska & Żabka 2010; Otto & Hill 2012; Richardson & Gunter 2012; Żabka & Waldock 2012). Jumping spiders are the largest spider family based on the number of described species, both world-wide and in Australia (Framenau 2016; World Spider Catalog 2017). They are currently not routinely targeted in SRE surveys although many are known from small ranges.

Genus *Maratus*

The genus *Maratus* includes the peacock spiders, aptly named due the magnificent abdominal colouration of males and the ability of many species to unfold abdominal flaps from underneath the abdomen to enhance courtship display (Hill & Otto 2011; Otto & Hill 2011a, b, 2012; Waldock 1995, 2008; Żabka 1987). Despite their often very small size, they belong to some of the most spectacularly coloured jumping spiders worldwide. The genus *Maratus* currently includes 56 described Australian species, some of which only known from small ranges (Framenau 2016).

***Maratus* 'PES0340'**

Maratus 'PES0340' was collected at two sites, 14 and 18, from the thick salt crust near the eastern shoreline of Lake Lefroy up to about 100 m onto the lake. Nearby searches in the riparian zone of the lake did not reveal any further specimens. Supported by the light colouration of the specimens, in particular the female (Figure 5-7), that provides camouflage against the surface of the lake and reflects the heat of the sun, the species should be considered a salt lake specialist.

Following the establishment of this species as a salt lake specialist during the field survey, the material of previous collections at Lake Lefroy (Phoenix 2013a, 2014, 2015) was re-examined providing additional records of *Maratus* 'PES0340' on and around the lake. The species is known from eight sites, two of which, the current site 14 and the previous 'Location 170' (Phoenix 2013a, 2014, 2015), are located outside the B2018 study area.

Based on our current knowledge, i.e. distribution patterns in the genus *Maratus* (with many range-restricted species) and the apparent habitat specialisation of the species occurring predominantly on the salt crust of Lake Lefroy, *Maratus* 'PES0430' is considered a potential SRE.

Figure 5-7 Female (left) and male (right) of *Maratus* 'PES0340'

5.2.3.2 Araneae – Mygalomorphae (trapdoor spiders)

Trapdoor spiders represent one of the focal groups in surveys of SRE taxa (Harvey 2002). A number of mygalomorph spiders, e.g. *Idiosoma nigrum* (VU), *Kwonkan eboracum* (CR) and *Moggridgea tingle* (EN) are listed as Threatened on the *Wildlife Conservation (Specially Protected Fauna) Notice 2015* (DPaW 2015). The Western Australian mygalomorph fauna is vast and many families and genera remain taxonomically poorly known (e.g. Barychelidae: *Idiommata*; Idiopidae: *Aganippe*; Nemesiidae: *Aname*, *Chenistonia*, *Kwonkan*).

Three species of *Aname* (*Aname* 'MYG223', 'SIGM121' & 'SIGM122'), unidentified species of *Kwonkan* (*Kwonkan* sp. indet.) and a nemesiid species of unknown genus (Nemesiidae 'SIGM104') were identified from the desktop review as SREs previously recorded in the B2018 study area (Table 5-2). The field survey resulted in three records of juvenile mygalomorph spiders, *Aganippe* sp. indet (family Idiopidae) and *Aname* sp. indet. and *Kwonkan* sp. indet. (both Nemesiidae) from the B2018 study area (Table 5-7). All of these are considered potential SREs. *Aname* 'MYG223', *Aname* 'SIGM121'and *Aname* 'SIGM122' are currently only known from the B2018 study area.

5.2.3.2.1 **Idiopidae**

The mygalomorph spider family Idiopidae includes a number of genera in WA, including *Anidiops*, *Gaius* (currently listed as junior synonym of *Anidiops*), *Euoplos*, *Blakistonia*, *Cataxia*, *Eucyrtops*, *Idiosoma* and *Misgolas* (Main 1985b; Raven & Wishart 2006; Wishart 2011). They comprise the 'typical' trap door spiders, i.e. those species that usually close the burrow with a hinged door. Spiders of this family are abundant, in particular in relatively stable habitats in temperate to tropical regions (Main 1985b). The taxonomy of the Idiopidae is poorly resolved and is currently under revision at the Queensland Museum (M. Rix, email to V.W. Framenau, October 2016).

Genus *Aganippe*

The genus *Aganippe* differs from all other genera in the family Idiopidae by the presence of abdominal sigillae and the presence of two processes on the male pedipalp tibia (Main 1985b). It is common throughout southern Australia. Fifteen species are described from Australia, of which four occur in WA, and many new species await description (Main 1985b). A current revision of idiopid genera conducted at the Queensland Museum recognises *Aganippe* as junior synonym of *Idiosoma*; however, associated taxonomic changes have not been published (M. Rix, email to V.W. Framenau, October 2016).

***Aganippe* sp. indet.**

A juvenile specimen of *Aganippe* (Figure 5-8) was collected from a burrow with a trapdoor at site 12. The specimen cannot be identified at the species level. Based on our current knowledge of the distribution patterns in the genus *Aganippe*, the specimen is considered to represent a potential SRE.

Figure 5-8 *Aganippe* sp. indet. collected during the field survey (site 12)

5.2.3.2.2 Nemesiidae

Members of the mygalomorph spider family Nemesiidae include those trapdoor spiders with two rows of teeth on the superior tarsal claws and comparatively long spinnerets. The family currently includes 98 described species in 14 genera in Australia, but the fauna is clearly much more diverse with an estimated 250+ species (Framenau *et al.* 2014). In WA the family is represented by several genera, including *Aname*, *Chenistonia*, *Yilgarnia*, *Stanwellia*, *Teyl*, *Swolnpes* and *Kwonkan* (Main & Framenau 2009). They usually dig burrows in the soil, and do not cover their burrow entrances with lids.

Nemesiidae 'SIGM104'

Previous surveys recovered a nemesiid trapdoor spider that cannot be placed in a currently known genus. It has similarities with species in the genus *Teyl*; however, lacks the typical male genital morphology of that genus (Main 1985a). Nemesiidae 'SIGM104' has been found at three locations in the riparian zone at Lake Lefroy, 'Argo' and 'North-east Dune' inside the B2018 study area and 'Location 170' outside (Phoenix 2014, 2015) (Figure 5-2). It is possibly a riparian specialist and is here considered a potential SRE based on our knowledge of distribution patterns of species within the trapdoor spider family Nemesiidae, that includes widespread and range-restricted species.

Genus *Aname*

The genus *Aname* currently includes 37 named species in Australia and is well represented by four named and numerous unnamed species from many different regions in WA. *Aname* currently represents a highly diverse array of species of very small to large spiders. Males generally have a spur and spine on the first tibia of males opposing an often incrassate metatarsus. Members of the genus *Aname* are believed to be most common in sclerophyll forest, but are also known from rainforests and deserts (Raven 1981). *Aname* regularly belongs to the most diverse mygalomorph genera in biological spider surveys and with 12 species, the Pilbara survey (Durrant *et al.* 2010) resulted in a similar number as found during the Carnarvon Basin survey (13 species) (Main *et al.* 2000). Many *Aname* species appear to have restricted distributions as shown by two studies from northern Australia, including the Pilbara (Harvey *et al.* 2012; Raven 1985). Therefore, unidentifiable specimens are considered potential SREs.

***Aname* 'MYG223', 'SIGM121' & 'SIGM122'**

Previous surveys in the riparian zone of Lake Lefroy recovered three species of *Aname*, all restricted to the south-eastern parts of Lake Lefroy. *Aname* 'MYG223' is currently only known from 'Location K'; *Aname* 'SIGM121' from 'Junction Recovery' and *Aname* 'SIGM122' from 'Argo', 'Junction Recovery' and 'Location K' (Figure 5-2). All are currently only known from the B2018 study area. Although all species were collected during riparian surveys, it is unknown if these species represent riparian specialists. This is most likely from Aname 'SIGM122' which is the only of the three species that was collected at more than one site. Based on known distribution patterns in the genus *Aname*, all species are here considered potential SREs.

***Aname* sp. indet.**

A juvenile specimen of *Aganippe* (Figure 5-9) was collected at site 12. The specimen cannot be identified at the species level. It may represent one of the species listed above. Based on our current knowledge of the distribution patterns in the genus *Aname*, the specimen is considered to represent a potential SRE.

Figure 5-9 *Aname* sp. indet. collected during the field survey

Genus *Kwonkan*

The genus *Kwonkan*, as currently defined, differs from *Aname* in the presence of tarsal spines and details of the male genitalia. It is restricted to WA and South Australia and currently includes six named species (Framenau *et al.* 2014; Main 1977; Main 1983). All of these are currently known from their type specimens only. *Kwonkan eboracum* from the York region is listed as Critically Endangered at State level (DPaW 2015).

***Kwonkan* sp. indet.**

A juvenile specimen of *Kwonkan* was collected from site 7. The specimen cannot be identified at the species level. Based on our current knowledge of the distribution patterns in the genus *Kwonkan*, the specimen is considered to represent a potential SRE.

5.2.3.3 Scorpiones (scorpions)

Scorpions are characterised by the presence of chelate pedipalps, pectines and an elongate metasoma furnished with a sting. Scorpions are important components of arid ecosystems because their levels of diversity and abundance contribute significantly to the biomass of animal assemblages and they are important predators and prey for other species (Volschenk *et al.* 2010).

The desktop review recovered three SRE scorpions from the B2018 study area, *Lychas* 'SIGM1032' (family Buthidae), *Urodacus* 'SIGM132' and *U.* 'lefroy' (Table 5-2). All of these are currently only known from the B2018 study area. The field survey did not collect any SRE scorpions (Table 5-7).

5.2.3.3.1 **Buthidae**

The family Buthidae is the most diverse and wide spread of all scorpion families (Fet & Lowe 2000). In Australia. Buthidae are represented by the genera *Australobuthus*, *Isometrus*, *Isometroides*, *Lychas*, and *Hemilychas*. In WA, only the genera *Isometrus*, *Isometroides* and *Lychas* have been recorded. The taxonomy of the constituent species of these three genera is very problematic and each genus contains numerous undescribed species, most notably in the genus *Lychas* (E.S. Volschenk unpublished data).

Genus *Lychas*

The genus *Lychas* is widespread across the Australian mainland. Numerous undescribed species are known in Australia (Volschenk *et al.* 2010). The situation is further complicated with the genus being also represented in Africa, India and eastern Asia (Fet & Lowe 2000). All of the Australian species are endemic and are currently under revision by E.S. Volschenk. Most species of *Lychas* appear to have wide distributions; however, a small number of undescribed species are known to be SREs.

***Lychas* 'SIGM132'**

Lychas 'SIGM132' was collected in the riparian zone at three sites, 'Beta Hunt', 'Argo' and 'Junction Reference', during previous surveys at Lake Lefroy (Phoenix 2013a) (Figure 5-2). It may represent a riparian specialist as it was collected at several sites. As it is currently only known from the B2018 study area, it is here considered a potential SRE.

5.2.3.3.2 Urodacidae

The family Urodacidae is endemic to Australia where it is represented by the genera *Urodacus* and *Aops* (Fet 2000; Prendini 2000; Prendini & Wheeler 2005; Volschenk *et al.* 2000).

Genus *Urodacus*

Urodacus was considered a member of the family Scorpionidae for many years, but in a revision of the superfamily Scorpionoidea, Prendini (2000) placed the genus in its own family. Unlike the species designations for Buthidae, Koch's (1977) species of *Urodacus* have been mostly supported by subsequent authors (Harvey & Volschenk 2002; Volschenk & Prendini 2008; Volschenk *et al.* 2000). The biggest issue confronting *Urodacus* taxonomy is the number of undescribed species being uncovered through current revisionary work (E. S. Volschenk unpublished data). Currently 23 species of *Urodacus* are described; however, this may represent as little as 20% of the real diversity of this genus in Australia. *Urodacus* appears to be most diverse in WA and few species are recorded east of the Great Dividing Range in eastern Australia. *Urodacus* contains both widespread and SRE species.

***Urodacus* 'SIGM131' & 'lefroy'**

Two species of *Urodacus* have been recorded in previous surveys in the riparian zone at two sites, *Urodacus* 'SIGM131' ('Location K') and *U.* 'lefroy' ('Junction Recovery') (Phoenix 2013a, 2014) (Figure 5-2). As typical arid-zone, burrowing scorpions, both species are unlikely to be riparian specialists. Both are currently only known from the B2018 study area. Taking the currently known distribution patterns in the genus *Urodacus* into account, both species are here considered potential SREs.

5.2.3.4 Coleoptera (beetles)

The beetles, order Coleoptera, are the most species rich group of insects in Australia and world-wide (Lawrence & Britton 1991). They are generally not considered in SRE surveys although flightless ground beetles (family Carabidae) have been considered SREs in the Pilbara (Guthrie *et al.* 2010).

5.2.3.4.1 Carabidae

The ground beetles (Carabidae) are one of the largest animal families world-wide including some 40,000 described species. They are active, cursorial and primarily carnivorous and occur in a wide variety of habitats (Lawrence & Britton 1991). Tiger beetles are sometimes considered a separate family (Pearson & Vogler 2001), but are here considered a subfamily within the Carabidae.

Genus *Cicindela* (subgenus *Ravicindela*)

Rivacindela is endemic to Australia, where they many species occupy the dry salt lakes and salt flats of the arid region (Pearson & Vogler 2001). They are extreme fast runners; however, many are known only from single lake beds (Pons *et al.* 2006). To date, 30 species of *Rivacindela* have been formally described but because of the inaccessibility of their habitat many species still await discovery (Anichtchenko 2007–2017; Golding 2016; Sumlin 1997). Species formation in *Rivacindela* appears to be a direct result of the fragmentation of their habitat near edges of the disappearing ancient river systems that is today represented by ancient palaeodrainage channels (Pons *et al.* 2006). Whilst adult beetles are fast and mobile, the larvae of tiger beetles live immobile in burrows underground and this stationary habit may contribute to their highly fragmented distribution patterns. Based on their currently known distribution patterns, members of *Rivacindela* should be considered potential SREs if a wider distribution cannot be ascertained.

***Cicindela* (*Rivacindela*) *salicursoria* and *Cicindela* (*Rivacindela*) 'yindarla'**

Two species of *Rivacindela* tiger beetles have been collected in the B2018 study area. *Cicindela* (*Rivacindela*) *salicursoria* (Figure 5-10, left) has initially been described from the western edge of Lake Lefroy north of Widgiemooltha (Sumlin 1987), but has subsequently been found near the causeway (Hudson 1995) (Figure 5-2). In contrast, *Cicindela* (*Rivacindela*) 'yindarla' (Figure 5-10, right) has only been collected at the northern limit of the B2018 study area (Hudson 1995) and subsequently at Lake Yindarlgooda (Golding 2016) (Figure 5-2)

Figure 5-10 ***Rivacindela salicursoria* (left) and *Rivacindela* 'yindarla' (right) from Lake Lefroy (photos: P. Hudson)**

5.2.3.5 Orthoptera (grasshoppers and crickets)

Similar to beetles, crickets are generally not considered a target group in SRE surveys as most can fly and therefore disperse very well (Otte & Alexander 1983).

5.2.3.5.1 Gryllidae

The Gryllidae represent the 'typical' crickets. The family has been comprehensively reviewed by Otte and Alexander (1983), who believed that about 75% of the Australian fauna is now taxonomically treated.

Genus *Apterogryllus*

The Australian endemic genus *Apterogryllus* includes 20 species in Australia (Baehr 1989; Otte & Alexander 1983). They are wingless which limits their dispersal capabilities. The distribution and the real number of species in Australia is poorly known, as the species live either in deep earth-cracks, burrows or on the rainforest floor and do rarely come to light (Baehr 1989).

***Apterogryllus* sp. A**

The genus *Apterogryllus* was first reported as *Apterogryllus* 'A' from Lake Lefroy by Curtin (1999), after Hudson (1995) only referred to these as 'salt lake crickets'. Subsequently, Phoenix (Phoenix 2014) collected juvenile crickets that could not be identified at the species level (*Apterogryllus* sp. indet.) It is likely, that both represent the same species, as both have been collected at very close sites, and therefore all *Apterogryllus* are here considered to represent *Apterogryllus* sp. A. They are common on Lake Lefroy and the desktop review reported them both from inside and outside the B2018 study area (Figure 5-2). Hudson (1995) considered the crickets widespread and Curtin (1999) also reported them from Lake Cowan. However, the distribution of these crickets has not been tested rigorously and it is possible that these wingless crickets have restricted distributions. They are here considered potential SREs.

5.2.3.6 Isopoda (slaters)

Almost 200 described species of Oniscidea, a suborder of the Isopoda containing the supralittoral, terrestrial and secondarily aquatic slaters (or woodlice), have been recorded from Australia (Green *et al.* 2010). The WA fauna is comparatively poorly known with many undescribed species (Judd & Horwitz 2003). Slaters are an ideal biological model for faunistic and biogeographical studies, due to their reduced dispersal ability and narrow habitat preferences (Taiti & Argano 2009). Consequently, they belong to one of the target groups of SRE surveys. The isopod fauna of south-west WA is fairly well known based on a taxonomic study by Judd (2004).

A single SRE slater, Philosciidae 'lefroy', was recovered from the B2018 study area by the desktop review (Table 5-2). The species is currently only known from this record. The field survey only reported the common armadillid *Buddelundia* '39'.

5.2.3.6.1 Philosciidae

In contrast to the Armadillidae, members of the family Philosciidae cannot conglobate (roll into a ball). Five of ten genera described from Australia are endemic to the country (*Abebaioscia*, *Ashtonia*, *Eurygastor*, *Huntonia* and *Metriogaster*) and *Laevophiloscia* and *Plymophiloscia* are mainly Australian (Department of the Environment 2011). The Philosciidae in WA are very poorly known. Since they are very rarely collected and the taxonomy is poorly known with numerous putative species, all undescribed philosciids should be considered potential SRE species. Specimens are fragile and easily damaged and they are best investigated by molecular methods.

Philosciidae 'lefroy'

Two specimens of Philosciidae 'lefroy' have been collected in the south of the B2018 study area, at 'Location K' and 'Junction South' (Figure 5-2). These are currently the only known location of this species.

5.2.3.7 Eupulmonata (land snails)

Molluscs are one of the most diverse groups of invertebrates and the Australian fauna is characterised by a high degree of endemism (Beesley *et al.* 1998). Lands snails (Eupulmonata) belong to the target groups for SRE surveys due to their limited dispersal capabilities, in combination with often strict dependencies on particular soils (EPA 2009; Harvey 2002). These characteristics have also resulted in a significant global decline of non-marine molluscs (Lydeard *et al.* 2004).

Only the record of an unidentified *Bothriembryon* snail was recorded in the B2018 study area in the desktop review (Table 5-2). No snails were collected in the B2018 study area during the field survey (Table 5-7).

5.2.3.7.1 **Bothriembryontidae**

The family Bothriembryontidae was only recently establish to include the Australian endemic genus *Bothriembryon* (Breure & Romero 2012).

Genus *Bothriembryon*

The genus *Bothriembryon* is endemic to Australia and most diverse in WA's south-western region, extending northwards and eastwards with decreasing density and diversity. Many species are currently undescribed and there are many isolated records of taxa with unresolved taxonomic status (Breure & Whisson 2012; Whisson & Breure 2016). The genus is considered to include a significant number of range-restricted species (Whisson & Breure 2016).

***Bothriembryon* sp. indet.**

A single specimen of and unidentified Bothriembryon land snails was collected at the riparian zone at 'Argo' during a previous survey (Figure 5-2). Whilst unidentified specimens of the genus should be considered potential SREs, *Bothriembryon* is prevalent throughout the desktop review area and therefore it is unlikely that the specimens from 'Argo' represents a species that is limited to the B2018 study area. It is not considered to represent a riparian specialist.

5.3 SURVEY LIMITATIONS

The EPA Technical Guide: Terrestrial fauna surveys (EPA 2016d) identified potential limitations that may be encountered during terrestrial fauna surveys. With respect to this guidance statement, no major limitations were identified for the survey (Table 5-8).

Table 5-8 Survey limitations from EPA Technical Guidance: Terrestrial fauna surveys (EPA 2016d)

Limitations	Limitation for this survey?	Comments
Competency/experience of survey personnel, including taxonomy	No	The field team and report authors have extensive experience in terrestrial vertebrate and SRE invertebrate fauna surveys within the region and across WA.
Scope and completeness - were all target groups sampled, were all planned survey methods implemented successfully, was the study area fully surveyed	No	All target groups and habitats within the B2018 study area were surveyed adequately.
Intensity - in retrospect, was the intensity adequate	No	The survey intensity was appropriate for the areas that were surveyed.
Proportion of fauna identified, recorded and/or collected.	No	All of the fauna was identified to species level in the field with the exception of invertebrate fauna collected and analyses of bat echolocation call recordings. Consultation with external experts was undertaken to identify invertebrate specimens collected during the survey. Bat echolocation call recordings were analysed by experience staff on return to Perth.
Availability of adequate contextual information	No	There have been numerous fauna surveys incorporating all or parts of the B2018 study area and its vicinity. There is a paucity of comparative data in across the region.
Timing, weather, season, cycle	No	Weather preceding and during the survey was comparable to the annual averages for previous years.
Disturbances which affected the results of the survey	No	No disturbances occurring during the period of the field survey are considered to have impacted the results.
Remoteness and/or access problems	No	The whole of the B2018 study area was accessible by vehicle or on foot.

6 DISCUSSION

In assessing development proposals, the EPA's broad objective for terrestrial fauna is its protection so that biological diversity and ecological integrity are maintained (EPA 2016b). Accordingly, the aim of this assessment was to determine the conservation significant vertebrate fauna species and habitats present or likely to be present to enable an impact assessment to be completed and management actions to be identified.

The EPA's objective for SRE species in particular is to ensure that proposals do not potentially threaten the viability of, or lead to the extinction of any SRE species (EPA 2016c). This objective focuses on the impacts of the B2018 Project on the persistence of species rather than, as in vertebrates, impacts on populations of conservation significant (i.e. EPBC Act and WC Act listed) species which are often widespread. Therefore, the aim of this assessment for SREs was to:

- determine whether any SRE taxa may be restricted solely to the B2018 study area and therefore be at risk of extinction from the B2018 Project
- determine whether adequate habitat exists outside the proposed project area for SRE species recorded within the proposed project area.

6.1 VERTEBRATE FAUNA

Nineteen of the 26 conservation significant vertebrate species identified in the desktop review have the potential to occur in the B2018 study area based on the results of the field survey, desktop study (i.e. historic or recent records of species or suitable habitat near the B2018 study area) and known habitat preferences (Table 6-1). Three of these species were recorded during the field survey from direct observation and secondary evidence (Malleefowl, Rainbow Bee-eater, Fork-tailed Swift), although all Malleefowl mounds were disused at the time of the survey (Figure 5-3; Table 6-1). Seven of the 19 species occurring or potentially occurring within the B2018 study area are listed under the EPBC Act and/or WC Act as Threatened, Conservation Dependent or Specially Protected and a further ten as 'Migratory' under the EPBC Act and WC Act (Table 6-1). A further four species are listed as state DPaW Priority species (Table 6-1). Seven of the 26 species identified in the desktop review are considered unlikely to occur due to the lack of suitable habitat within the B2018 study area or the B2018 study area occurring outside of current known distribution for the species, particularly critical weight range mammals that have suffered significant declines since European settlement (Table 6-1).

All broad fauna habitats identified within the B2018 study area may support species of conservation significance. Woodland habitat within the B2018 study area provides suitable habitat for the highest number of conservation significant vertebrate species known to occur or considered to possibly occur as residents within the B2018 study area (Table 6-1). Woodland habitat is likely to provide suitable foraging and possibly nesting or roosting habitat for several conservation significant species, particularly Malleefowl, Peregrine Falcon, Grey Falcon, Western Rosella and possibly Red-tailed Phascogale (Table 6-1). Salt lake habitat of the B2018 study area may be of some value to vertebrate fauna, particularly infrequent visitors such as migratory waterbirds and shorebirds which are only likely to occur following suitable rainfall events when water is present in the Lake Lefroy system. The lack records of migratory shorebirds and waterbirds on Lake Lefroy reflects the lack of a freshwater phase during the filling cycle of the lake. The lake of this phase limits the aquatic invertebrate productivity of the lake and therefore attracts fewer shore and waterbirds (SIGM 2010).

Of the 19 conservation significant species that may occur in the B2018 study area, ten are consisted to be infrequent visitors reliant on the occurrence of suitable rainfall events and the presence of water in Lake Lefroy (Table 6-1). The Grey Falcon and Peregrine Falcon may occasionally occur within the

B2018 study area due to their large foraging ranges, even if they have not been seen to nest within. Nesting within the B2018 study area cannot be excluded where suitable tall trees or infrastructure are present to provide necessary high vantage points.

The records of disused Malleefowl mounds within and in close vicinity to the B2018 study area (Figure 5-1; Figure 5-3) in combination with the broad coverage of open woodland habitat indicate the species still utilises the B2018 study area; however, its occurrence may be restricted to less developed and disturbed areas such as the south-eastern portion. The removal of one Malleefowl mound where a tailings pond now occurs and other future project expansions may result in the species progressively moving to less disturbed areas of and beyond in the B2018 study area.

Many of the conservation significant critical weight range mammals and the single reptile are considered unlikely to occur in the B2018 study area, although they may have historically occurred there. This applies in particular to the Western Spiny-tailed Skink, Western Quoll, Numbat and Greater Bilby (Table 6-1). Due to a lack of recent records despite a higher survey activity, these are now considered locally and regionally extinct (Burbidge 2004).

The presence of a recent record of the Red-tailed Phascogale suggests the species may occur within the B2018 study area; however, the record is unconfirmed and falls well outside of the species current known distribution. Should the species occur, it is likely to occur within open woodland habitat, particularly in areas where suitable small hollows are present that may act as refuge sites. However, the unconfirmed record may be a result of a misidentification and the species may in fact be regionally extinct in the vicinity of the B2018 study area based on current known distribution of the species (Burbidge 2004; Van Dyck & Strahan 2008).

All habitats represented within the B2018 study area are also represented in areas adjacent to the B2018 study area and across the broader Coolgardie bioregion. The dominant habitats of the B2018 study area, salt lake and woodland habitats, occur more broadly in across the Coolgardie bioregion and the B2018 study area is not considered to be of critical to any species considered as potentially occurring within the B2018 study area due to the mobile nature of most species and the present of suitable habitat in the broader vicinity of the B2018 study area.

Table 6-1 Summary of conservation significant vertebrate fauna species with likelihood of occurrence for the B2018 study area

Scientific name	Common name	Conservation status			Likelihood of occurrence	Fauna habitat					Summary of records and occurrence	Nearest record to the B2018 study area (Birdlife Australia 2016; DPaW 2016a, b)
		EPBC Act	WC Act	DPaW		Salt lake playa and riparian zone	Shrubland on dune	Open woodland on plain	Open woodland on rocky hill	Riparian woodland		
Reptiles												
Egernia stokesii badia	Western Spiny-tailed Skink	EN	EN		Unlikely						Study area outside of species current known distribution. Single record located to the east of Kalgoorlie is likely to be in error.	~60 km north (no date specified)
Birds												
Leipoa ocellata	Malleefowl	VU	VU		Recorded		•	•	•	•	Recorded once within the B2018 study area from secondary evidence, one old inactive mound. Previously recorded within and in close proximity to the B2018 study area (Bamford 2010; Harewood 2011c; Terratree 2015). Suitable habitat likely to support the species recorded throughout the B2018 study area.	within study area & ~100–200 m north
Oxyura australis	Blue-billed Duck			P4	Possible	•					May occasionally occur in salt lake habitat following suitable rainfall events and flooding, particularly in areas with well vegetated banks.	~90 km south

Scientific name	Common name	Conservation status			Likelihood of occurrence	Fauna habitat					Summary of records and occurrence	Nearest record to the B2018 study area (Birdlife Australia 2016; DPaW 2016a, b)
		EPBC Act	WC Act	DPaW		Salt lake playa and riparian zone	Shrubland on dune	Open woodland on plain	Open woodland on rocky hill	Riparian woodland		
Apus pacificus	Fork-tailed Swift	Mig	Mig		Recorded	•	•	•	•	•	Recorded flying overhead in riparian woodland habitat. Likely to occasionally occur to forage; however, unlikely to land within the B2018 study area.	within study area & ~90 km west
Ardea modesta	Eastern Great Egret	Mig	Mig		Possible	•					May occasionally occur in salt lake habitat and drainage areas following suitable rainfall events and flooding of lakes.	~220 km south
Ardea ibis	Cattle Egret	Mig	Mig		Possible	•					May occasionally occur in salt lake habitat and drainage areas following suitable rainfall events and flooding of lakes.	~54 km north-northeast
Plegadis falcinellus	Glossy Ibis	Mig	Mig		Possible	•					May occasionally occur in salt lake habitat and drainage areas following suitable rainfall events and flooding of lakes.	~54 km north-northeast
Falco hypoleucos	Grey Falcon		VU		Likely		•	•	•	•	Likely to occasionally occur within the B2018 study area to forage, unlikely to nest within study area though may utilise suitable nesting structures in the vicinity.	~47 km south

Scientific name	Common name	Conservation status			Likelihood of occurrence	Fauna habitat					Summary of records and occurrence	Nearest record to the B2018 study area (Birdlife Australia 2016; DPaW 2016a, b)
		EPBC Act	WC Act	DPaW		Salt lake playa and riparian zone	Shrubland on dune	Open woodland on plain	Open woodland on rocky hill	Riparian woodland		
Falco peregrinus	Peregrine Falcon		SP		Likely		•	•	•	•	Likely to occasionally occur within the B2018 study area to forage, unlikely to nest within study area though may utilise suitable nesting structures in the vicinity.	9.5 km west
Thinornis rubricollis	Hooded Plover			P4	Likely	•					Likely to occur on salt lakes and may occasionally nest on suitable shorelines surrounding salt lakes.	70 km north
Tringa nebularia	Common Greenshank	Mig	Mig		Possible	•					May possibly occur in salt lake habitat and adjacent shorelines following suitable rainfall events when water is present.	64 km north-northwest
Tringa glareola	Wood Sandpiper	Mig	Mig		Possible	•					May possibly occur in salt lake habitat and adjacent shorelines following suitable rainfall events when water is present.	47 north-northwest
Calidris ruficollis	Red-necked Stint	Mig	Mig		Possible	•					May possibly occur in salt lake habitat and adjacent shorelines following suitable rainfall events when water is present.	68 km north
Calidris acuminata	Sharp-tailed Sandpiper	Mig	Mig		Possible	•					May possibly occur in salt lake habitat and adjacent shorelines following suitable rainfall events when water is present.	34 km north

Scientific name	Common name	Conservation status			Likelihood of occurrence	Fauna habitat					Summary of records and occurrence	Nearest record to the B2018 study area (Birdlife Australia 2016; DPaW 2016a, b)
		EPBC Act	WC Act	DPaW		Salt lake playa and riparian zone	Shrubland on dune	Open woodland on plain	Open woodland on rocky hill	Riparian woodland		
Calidris ferruginea	Curlew Sandpiper	CR/ Mig	VU/ Mig		Possible	•					May possibly occur in salt lake habitat and adjacent shorelines following suitable rainfall events when water is present.	68 km north
Calyptorhynchus latirostris	Carnaby's Black-cockatoo	EN	EN		Unlikely						Study area outside of species current modelled distribution {DSEWPaC, 2012 #10635}. Previously recorded approximately 78 km south of the B2018 study area on 1975.	78 km south (1975)
Platycercus icterotis xanthogenys	Western Rosella (inland ssp.)			P4	Possible			•	•	•	May occur in woodland habitat of the B2018 study area, nesting may also occur in woodland habitat where suitable hollows are present.	45 km southwest
Pezoporus occidentalis	Night Parrot	EN	CR		Possible	•		•			Potential roosting / nesting habitat identified in open woodland with mature spinifex (*Triodia* spp.) and chenopod vegetation on salt lake shoreline. Refer to Phoenix (2018) for more detailed assessment of Night Parrot.	286 km west-southwest (no date specified)

Scientific name	Common name	Conservation status			Likelihood of occurrence	Fauna habitat					Summary of records and occurrence	Nearest record to the B2018 study area (Birdlife Australia 2016; DPaW 2016a, b)
		EPBC Act	WC Act	DPaW		Salt lake playa and riparian zone	Shrubland on dune	Open woodland on plain	Open woodland on rocky hill	Riparian woodland		
Merops ornatus	Rainbow Bee-eater		Mig		Recorded		•	•	•	•	Recorded twice within the B2018 study area from direct observation and call. Likely to frequently occur throughout the study are in all habitats to forage and may nest where suitable sandy substrate permitting burrow construction are present.	within & approx. 160 m southeast
Amytornis textilis textilis	Thick-billed Grasswren			P4	Unlikely						Study area outside of species current known distribution in the Shark Bay area. Record near study area from 1908 may be in error.	approx. 55 km north-northeast (1908)
Motacilla cinerea	Grey Wagtail	Mig	Mig		Unlikely						Study area well outside of species known distribution in north WA.	over 1500 km north
Mammas												
Dasyurus geoffroii	Western Quoll	VU	VU		Unlikely						Study area outside of species current known distribution, species considered regionally extinct in association with the B2018 study area (Burbidge 2004; Van Dyck & Strahan 2008).	approx. 1 km west (1974)

Scientific name	Common name	Conservation status			Likelihood of occurrence	Fauna habitat					Summary of records and occurrence	Nearest record to the B2018 study area (Birdlife Australia 2016; DPaW 2016a, b)
		EPBC Act	WC Act	DPaW		Salt lake playa and riparian zone	Shrubland on dune	Open woodland on plain	Open woodland on rocky hill	Riparian woodland		
Phascogale calura	Red-tailed Phascogale	EN	CD		Possible			•		•	Study area outside of species current known distribution and species considered regionally extinct in association with the B2018 study area (Burbidge 2004; Van Dyck & Strahan 2008); however, records of the species indicate it may possibly occur within the B2018 study area. An unconfirmed record exists ~21 km southeast of the B2018 study area and others further south from the 1980s suggesting the species may occur.	21 km southeast (2005)
Myrmecobius fasciatus	Numbat	VU	EN		Unlikely						Study area outside of species current known distribution, species considered regionally extinct in association with the B2018 study area (Burbidge 2004; Van Dyck & Strahan 2008). Unconfirmed record from 2001 approximately 52 km north-northwest of the B2018 study area.	52 km north-northwest (2001)

Scientific name	Common name	Conservation status			Likelihood of occurrence	Fauna habitat					Summary of records and occurrence	Nearest record to the B2018 study area (Birdlife Australia 2016; DPaW 2016a, b)
		EPBC Act	WC Act	DPaW		Salt lake playa and riparian zone	Shrubland on dune	Open woodland on plain	Open woodland on rocky hill	Riparian woodland		
Macrotis lagotis	Greater Bilby	VU	VU		Unlikely						Study area outside of species current known distribution, species considered regionally extinct in association with the B2018 study area (Burbidge 2004; Van Dyck & Strahan 2008). Unconfirmed record from unknown data approximately 52 km north-northwest of the B2018 study area.	52 km north-northwest (no date specified)
Nyctophilus major tor	South-western Long-eared Bat			P4	Likely			•	•	•	Species likely to frequently occur within the B2018 study area to forage and may roost in woodland habitat where suitable hollows are present.	within study area or within 10 km of

6.2 SHORT-RANGE ENDEMIC INVERTEBRATES

Those SREs that are potentially restricted to the B2018 study area require the highest consideration within this assessment, as developments in this area may affect their populations most. Currently, seven invertebrate species are only known from the B2018 study area, three species of mygalomorph spiders, three scorpions and one slater respectively (Table 6-2). All species were collected as part of the B2010 PER and associated monitoring of the riparian zone, suggesting that some of these are riparian habitat specialists. This is more likely for those species that were found in higher frequency in the riparian zone, i.e. at more than two sites, whereas single records indicate only occasional use of the riparian zone (Table 6-2).

Consequently, we consider *Aname* 'SIGM122' and *Lychas* 'SIGM132' potential riparian specialists. Whilst *Aname* 'SIGM122' was only found along the south-eastern margin of Lake Lefroy, *Lychas* 'SIGM132' was also found at Beta Hunt south of Kambalda. These two areas, the lake shore in the south-east and near Kambalda, appear to have highest value in the B2018 study area with respect to SREs.

Table 6-2 Short-range endemics currently only known from the B2018 study area

Family	Genus and species	Locality	SRE category	Original source	Habitat
Order Araneae (spiders)					
Infraorder Mygalomorphae (trapdoor spiders)					
Nemesiidae	*Aname* 'MYG223'	Location K	Potential	WA Museum, Dalcon (2013c)	Likely woodland species
	Aname 'SIGM121'	Junction Recovery	Potential	Phoenix (2013a)	Likely woodland species
	Aname 'SIGM122'	Argo, Junction Recovery, Location K	Potential	Phoenix (2013a)	Potentially riparian around lake
Order Scorpiones (scorpions)					
Buthidae	*Lychas* 'SIGM132'	Argo, Beta Hunt, Junction Reference	Potential	Phoenix (2014)	Potentially riparian around lake
Urodacidae	*Urodacus* 'SIGM131'	Location K	Potential	Dalcon (2013a)	Likely woodland species
	Urodacus 'lefroy'	Junction Recovery	Potential	Phoenix (2014)	Likely woodland species
Isopoda (slaters)					
Philosciidae	Philosciidae 'lefroy'	Location K, Junction South	Potential	Phoenix (2014)	Possibly riparian around lake

All other species are considered occasional visitors to the riparian zone and are likely to occur in the expansive woodlands around the lake. These are unlikely affected by a proposed development. The status of Philosciidae 'lefroy', that was found at two sites, remains ambiguous when applying this criterion.

We here consider a second level of endemism of species, i.e. those species that have so far only been found on Lake Lefroy, i.e. both inside and outside the B2018 study area (Table 6-3). This includes two species of spiders, two tiger beetles and a slater. Three of these are playa specialists, a jumping spider and the two beetles, and one a likely riparian species, Nemesiidae 'SIGM104', the most commonly collected mygalomorph spider in the riparian zone. The single slater is considered an occasional visitor to the riparian zone from the surrounding woodland.

Whilst tiger beetles in the genus *Cicindela* (*Rivacindela*) are well-known salt lake inhabitants (Golding 2016; Pons *et al.* 2006), jumping spiders have rarely been reported from salt lakes and therefore this species was not recognised as salt lake dweller during previous surveys. However, a different species of *Maratus* lives on salt lakes in South Australia (P. Hudson, email to. to V.W. Framenau, 25 October 2016) and Hickman (1944) described a species in a different genus, *Saitis lacustris*, from (p. 19) "on the salt-crust surface of Lake Eyre two and a half miles from shore". Whilst these spiders appear to hunt on the salt crust of the lake, they also frequent the riparian zone as they were collected in pitfall traps there (Phoenix 2013a, 2014, 2015). It is likely that gravid females seek the riparian vegetation, as the salt lake playa lacks the appropriate structures for them to fix their eggsacs (Framenau *et al.* 2014).

Whilst tiger beetles are very mobile and are extremely fast runners, they are often unable to fly restricting their dispersal capabilities (Pearson & Vogler 2001). In addition, the larvae of tiger beetles are burrowing, i.e. their habitat requirements are likely similar to salt lake dwelling wolf spiders and crickets.

Table 6-3 Short-range endemics currently only known from Lake Lefroy (excl. those only known from the B2018 study area)

Family	Genus and species	Locality	SRE category[1]	Original source	Habitat
Order Araneae (spiders)					
Infraorder Araneomorphae (modern spiders)					
Salticidae	*Maratus* 'PES0340'	Sites 14, 18, Beta Hunt, Argo, Location 170	Potential	This study, WA Museum, Dalcon (2013c)	Salt lake playa specialist, but likely to obligatory use riparian zone for laying eggs
Infraorder Mygalomorphae (trapdoor spiders)					
Nemesiidae	Nemesiidae 'SIGM104'	Argo, Location 170, North-East Dune	Potential	WA Museum, Dalcon (2013c)	Potentially riparian around lake
Order Coleoptera (beetles)					
Carabidae	*Cicindela salicursoria*	North of Widgiemooltha, near causeway	Potential	Hudson (1995)	Salt lake playa specialist with burrowing larvae
	Cicindela necopinata	North of Widgiemooltha	Potential	Sumlin (1997)	Salt lake playa specialist with burrowing larvae
Isopoda (slaters)					
Philosciidae	*Cubaris* 'lefroy'	Location 170	Potential	Phoenix (2014)	Likely woodland species

6.2.1 Habitats of short-range endemic species

Based on the faunal composition of the SREs identified from the B2018 study area and the taxa only known from Lake Lefroy (including potential Lake Lefroy endemics), the habitat type 'salt lake and associated riparian zone' is the most important for potentially range-restricted species, whereas the woodland habitats surrounding the lake represent regionally widespread habitat types which facilitate the broader distribution of species.

When considering the 'salt lake and its riparian zone' as habitat, it must be considered that some of its inhabiting specialists may utilise only the playa, some only the riparian zone, and other may be dependent on the presence of both. For example, the three tiger beetles are specialists of the salt lake playa with their burrowing larvae and foraging adults only found there, and the two mygalomorph spiders and a scorpion appear to be riparian specialists based on the frequency of their occurrence in the B2010 riparian monitoring program. In contrast, the jumping spider *Maratus* 'PES340' (Table 6-3) appears to primarily forage on the playa of the salt lake, but based on our knowledge of the reproductive behaviour of these spiders, they are likely to utilise structures in the riparian zone such as debris and vegetation to lay their eggs. These spiders require both the playa and the riparian zone supported by the fact that some of these spiders were collected in pitfall traps in previous surveys.

However, the salt lake playa is not uniform and different habitat qualities favour different salt lake inhabitants. The single most important habitat characteristic of the salt lake playa appears to be the thickness of the salt crust, which can vary from barely visible to some 50 mm or more in particular along the eastern shoreline, where salt accumulation appears to occur through water being pushed by the prevailing winds. Locally increased salt crust thickness may also be observed at the dewatering points of hypersaline water (Curtin University of Technology 1999). Whilst non-burrowing species, such as the jumping spider *Maratus* 'PES340', are not affected by a thicker salt crust (they appear to be most common at these places), those salt lake specialists that spend a large part of their life in burrows, may not be able to live there as they cannot penetrate the salt crust to construct their burrow. This includes the wolf spiders and crickets, but also the tiger beetles, as their larvae have a burrowing life style (Pearson & Vogler 2001).

Similarly, the riparian zone of a salt lake is generally not uniform around a lake. Differences in the slope of the lake shore determine the width of the riparian zone and its vegetation. Little is known about the precise habitat preferences of the potential riparian habitat specialists and such fine-scale differences could not be evaluated here based on the limited number of records of invertebrates around the lake.

An impact assessment on terrestrial invertebrates evaluated as part of the B2010 PER and its associated riparian monitoring program concentrated on the effects of increased flooding of the riparian zone. It has been argued that this impact is negligible (Phoenix 2013b, 2014), mainly because coping with varying water levels is one of the main characters of true riparian fauna (Framenau *et al.* 2002; Manderbach & Framenau 2001). Species from the arid woodland matrix that only utilise the riparian zone opportunistically will not be affected. In contrast, the B2018 Project includes additional impacts, such as the excavation of pits and the construction of infrastructure leading to a direct loss of habitat. In this case, riparian specialists are particularly susceptible to these impacts as their habitat within the B2018 study area is relatively small being limited to a habitat strip around Lake Lefroy. In addition to direct habitat loss, fragmentation of the continuous riparian zone into smaller stretches without the ability for dispersal for the specialised fauna may compromise those smaller populations that remain in the less affected parts outside future developments (Ewers & Didham 2006; Hobbs 1993).

The likelihood of SREs to occur in a particular habitat of the B2018 study area is discussed below. The three different levels of endemism previously considered in this report, i.e. known only from B2018, known only from Lake Lefroy and regional endemic are reviewed.

6.2.1.1 Salt lake playa and riparian zone

The salt lake playa and its riparian zone (excluding woodlands) has the highest likelihood to harbour SREs:

- **B2018 endemics (i.e. currently known only from B2018 study area)**: Unlikely; all three potential habitat specialists (Table 6-2) that were only found in the B2018 study area were found at more than one site suggesting these to occur outside the B2018 study area. However, they may represent Lake Lefroy endemics (see next point).
- **Lake Lefroy endemics (i.e. currently known only Lake Lefroy)**:
    - *Aname* `SIGM122`: Confirmed in B2018 study area – This mygalomorph spider is currently only known from the riparian zone of the B2018 study area, but from a number of sites. It is likely to occur elsewhere around the lake. A small, light species and likely riparian specialist.
    - *Lychas* `SIGM132`: Confirmed in B2018 study area – This small scorpion is currently only known from the B2018 study area, but from a number of sites and is likely to occur elsewhere around the lake. It is considered a riparian specialist.
    - Philosciidae 'lefroy': Confirmed in B2018 study area – This slater is currently only known from two sites in the B2018 study area, but is likely to occur elsewhere around the lake. It may or may not be a riparian specialist.
    - Nemesiidae `SIGM104`: Confirmed in B2018 study area – This small trapdoor spider was collected in the B2018 study area, but also at other sites around the lake. It is considered a riparian specialist.
    - *Maratus* `PES340`: Confirmed in B2018 study area – This jumping spider forages far onto the lake playa but was also found in pitfall traps in the riparian zone indicating a use of this area. Jumping spiders require solid substrate (i.e. rocks and logs) to fix their egg sacs to, which are not found on the salt lake playa. It likely requires both the playa and riparian zone. The spider was found inside and outside the B2018 study area, but has not been found outside Lake Lefroy. It is therefore considered a potential Lake Lefroy endemic.
    - *Cicindela salicursoria* and *C. necopinata*: confirmed for or highly likely to occur in the B2018 study area – both tiger beetles have so far only been found at Lake Lefroy; *C. salicursoria* within and outside the B2018 study area and *C. necopinata* only outside the B2018 study area, but is likely to occur inside. These tiger beetles construct burrows on the salt lake playa and forage on the playa, but may occasionally visit the riparian zone.
- **Regional SREs**:
    - *Tetralycosa baudinettei*: Confirmed in B2018 study area – this wolf spider is a burrowing specialist on salt lakes and does not utilise the riparian zone. It was found on Lake Lefroy inside and outside the B2018 study area, but also occurs at other lakes in the vicinity. Its overall distribution range is within that of SREs. Similar to the tiger beetles, it is currently unknown how much of Lake Lefroy is available habitat for the species, as it will not be able to burrow where the salt crust is too thick.

6.2.1.2 Shrubland on sand dune

No targeted surveys for SREs have been conducted in this habitat, as it is not considered an SRE habitat. Unlike woodlands, shrubland habitat does not provide thick layers of litter that may harbour SREs.

- **B2018 endemics**: Unlikely
- **Lake Lefroy endemics**: None (habitat not part of Lake Lefroy)
- **Regional SREs**: Unlikely.

6.2.1.3 Open woodland

Some targeted surveys have been conducted in open woodland on plain and some potential SREs, in particular mygalomorph spiders, where collected at sites 07 and 12 (Phoenix 2017). The desktop review identified some species in the B2018 study area that are likely woodland specialists (based on morphology and habitat preferences of related species). However, none of these are likely to be restricted to the B2018 study area, as this habitat is common throughout the region and not an island or relictual habitat. Woodlands are known to support SREs mainly where there is a thick layer of litter in high density vegetation. Based on the distribution patterns of some of the SRE groups (i.e. spiders, scorpions, millipedes), it is likely that some SREs exist in this habitat at a regional scale.

- **B2018 endemics**: Unlikely
- **Lake Lefroy endemics**: None (habitat not part of Lake Lefroy)
- **Regional SREs**:
    - *Aname* `MYG223' and *Aname* `SIGM121`: These two large trapdoor spider species similar to the widespread *Aname mainae* are likely woodland species. Whilst *Aname* includes some SRE species, it is unlikely that the two species currently known only from the B2018 study area only occur there.
    - *Urodacus* `SIGM131` and *Urodacus* `lefroy`: *Urodacus* include very large and mobile scorpions typical for open woodlands and forests. Whilst it is possible that these are SREs, they are unlikely restricted to the B2018 study area, from where they are currently only known
    - *Cubaris* `lefroy`: Based on habitat preferences of similar species, Cubaris `lefroy` may represent an SRE. It was only found at a single site outside the B2018 study area.

6.3 RECOMMENDATIONS

6.3.1 Vertebrate fauna

Given the number and location of previous Malleefowl records in and near the B2018 study area, and the presence of suitable open woodland habitat for the species across a large portion of the B2018 study area, it is likely the species occurs. Due to the higher conservation status of the species, it is recommended:

- targeted surveys for Malleefowl be conducted prior to any development within areas of suitable habitat across the B2018 study area to determine current presence and extent of occurrence of the species within the B2018 study area.

- where Malleefowl mounds and/or critical habitat are identified, apply clearing exclusion areas to minimise any further removal of nesting mounds and retain areas of suitable habitat within the B2018 study area to allow the species to persist.

6.3.2 Short-range endemic invertebrates

Future work on the SREs of Lake Lefroy should focus on filling knowledge gaps with respect to the distribution of salt lake playa and riparian specialists to assist in better understanding of future developments of the lake. It is recommended:

- to conduct targeted surveys for SREs currently only known from the B2018 study area (all of these are associated with the riparian zone), in particular if currently known populations of these species are affected by future developments (i.e. if significant clearing is proposed within the riparian habitats). These surveys should include other regional lakes to potentially show a wider distribution of these species (and the other potential Lake Lefroy endemics).

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Appendix 1 Terrestrial fauna survey site descriptions

Site:	**Site 01 (Systematic Fauna Site) (-31.290658, 121.725967)**
Habitat type:	Woodland on plain
Topography:	plain
Slope:	negligible
Soil:	sandy loam
Soil colour:	red-orange
Rock type:	none
Fire age:	>5 years
Disturbance:	vehicle tracks
Habitat description:	*Eucalyptus* spp. (to 10 m) over sporadic shrubs (to 1 m) over *Triodia* spp. (to 0.7 m) dominated grassland on sandy loam substrate.

Site:	**Site 02 (Systematic Fauna Site) (-31.253542, 121.728791)**
Habitat type:	Woodland on plain
Topography:	hill top
Slope:	gentle
Soil:	sand
Soil colour:	red-brown
Rock type:	gypsum
Fire age:	>5 years
Disturbance:	litter
Habitat description:	Snake wood (to 4 m) over mixed shrubs (to 2 m) on sandy red sand mixed with gypsum.

Site:	**Site 03 (Systematic Fauna Site) (-31.237525, 121.730391)**
Habitat type:	Woodland on plain
Topography:	hill top
Slope:	negligible
Soil:	sandy clay, clay
Soil colour:	red-orange
Rock type:	gypsum
Fire age:	>5 years
Disturbance:	litter
Habitat description:	*Eucalyptus* spp. (to 14 m) over mixed shrubs (to 3 m) over *Triodia* spp. (to 0.7 m).

Site:	**Site 04 (Systematic Fauna Site) (-31.313356, 121.593294)**
Habitat type:	Woodland on plain (riparian)
Topography:	plain
Slope:	negligible
Soil:	sandy clay
Soil colour:	red-brown
Rock type:	quartz
Fire age:	>5 years
Disturbance:	current mining operations, vehicle tracks
Habitat description:	*Eucalyptus* spp. (to 10 m) over mixed shrubs (to 2 m) and sporadic grasses (to 0.5 m).

Site:	**Site 05 (Systematic Fauna Site) (-31.453034, 121.771453)**
Habitat type:	Woodland on plain
Topography:	plain
Slope:	negligible
Soil:	sandy loam
Soil colour:	red-orange
Rock type:	none
Fire age:	>5 years
Disturbance:	vehicle tracks
Habitat description:	*Eucalyptus* spp. (to 13 m) over mixed shrubs (to 2 m) and *Triodia* spp. (to 70 cm).

Site:	**Site 06 (Systematic Fauna Site) (-31.339785, 121.726226)**
Habitat type:	Woodland on plain
Topography:	plain
Slope:	negligible
Soil:	sandy clay
Soil colour:	red-orange
Rock type:	none
Fire age:	>5 years
Disturbance:	historic clearing, vehicle tracks
Habitat description:	*Eucalyptus* spp. (to 10 m) over mixed shrubs (to 2 m) and *Triodia* spp. (to 0.7 m).

Site: **Site 07 (Systematic Fauna Site) (-31.218455, 121.670006)**

Habitat type: Woodland on plain
Topography: undulating plain
Slope: gentle down towards lake
Soil: pebbly, sandy loam
Soil colour: red-brown
Rock type: granite
Fire age: >5 years
Disturbance: evidence of feral animals, litter, vehicle tracks
Habitat description: Salmon Gum (*Eucalyptus salmonophloia*) and other *Eucalyptus* spp. (to 14 m) over mixed shrubs (to 3 m).

Site: **Site 08 (Systematic Fauna Site) (-31.358404, 121.751947)**

Habitat type: Woodland on plain
Topography: plain
Slope: negligible
Soil: sandy loam
Soil colour: red-orange
Rock type: none
Fire age: >5 years
Disturbance: historic clearing, vehicle tracks
Habitat description: *Eucalyptus* spp. (to 12 m) over mixed shrubs (to 3 m) over *Triodia* spp. (to 0.7 m).

Site: **Site 09 (Systematic Fauna Site) (-31.398983, 121.829771)**

Habitat type: Woodland on plain
Topography: plain
Slope: negligible
Soil: clay loam
Soil colour: red-orange
Rock type: none
Fire age: >5 years
Disturbance: litter, vehicle tracks
Habitat description: *Eucalyptus* spp. (to 15 m) over mixed shrubs (to 2 m).

Site: **Site 10 (Systematic Fauna Site) (-31.472306, 121.836679)**

Habitat type: Woodland on plain
Topography: plain
Slope: negligible
Soil: clay loam
Soil colour: red-orange
Rock type: none
Fire age: >5 years
Disturbance: historic clearing, litter, vehicle tracks
Habitat description: *Eucalyptus* spp. (to 10 m) over other tree species (to 8 m) over mixed shrubs (to 3 m).

Site: **Site 11 (Systematic Fauna Site) (-31.498754, 121.690275)**

Habitat type: Woodland on plain
Topography: plain
Slope: negligible
Soil: sand
Soil colour: red-orange
Rock type: none
Fire age: >5 years
Disturbance: vehicle tracks
Habitat description: *Eucalyptus* spp. (to 10 m) over mixed shrub land (to 3 m) over mixed hummock and tussock grasses (to 0.8 m).

Site: **Site 12 (Systematic Fauna Site) (-31.417524, 121.795122)**

Habitat type: Woodland on plain
Topography: plain
Slope: negligible
Soil: sandy clay
Soil colour: red-orange
Rock type: none
Fire age: >5 years
Disturbance: litter, vehicle tracks
Habitat description: *Eucalyptus* spp. (to 15 m) over mixed shrubs (to 3 m) and *Triodia* spp. (to 0.8 m).

Site:	**Site 13 (Systematic Fauna Site) (-31.503101, 121.782756)**
Habitat type:	woodland on plain (riparian)
Topography:	plain
Slope:	negligible
Soil:	clay loam
Soil colour:	red-orange
Rock type:	granite/rocks
Fire age:	>5 years
Disturbance:	vehicle tracks, cattle
Habitat description:	Small waterbody on drainage depression surrounded by small shrubs (to 0.8 m) on one side and open *Eucalyptus* woodland (to 15 m) above mixed shrubland (to 4 m) on the opposite side.

Site:	**Site 14 (Systematic Fauna Site) (-31.494239, 121.681582)**
Habitat type:	salt lake playa and riparian zone
Topography:	plain
Slope:	negligible
Soil:	sand
Soil colour:	yellow
Rock type:	none
Fire age:	>5 years
Disturbance:	historic clearing, historic operations, vehicle tracks
Habitat description:	Salt lake playa near riparian zone of Lake Lefroy consisting of fringing salt tolerant shrubs (to 0.8 m).

Site:	**Site 15 (Systematic Fauna Site) (-31.306569, 121.605979)**
Habitat type:	salt lake playa and riparian zone
Topography:	plain
Slope:	negligible
Soil:	sandy clay
Soil colour:	red-brown
Rock type:	none
Fire age:	>5 years
Disturbance:	vehicle tracks
Habitat description:	Salt lake playa without vegetation.

Site:	**Site 16 (Systematic Fauna Site) (-31.274542, 121.653479)**
Habitat type:	shrubland on dune
Topography:	plain
Slope:	negligible
Soil:	sand
Soil colour:	red-orange
Rock type:	none
Fire age:	>5 years
Disturbance:	evidence of feral animals
Habitat description:	Open shrubland with scattered shrubs (to 3.5 m) over sparse understory/ground cover.

Site:	**Site 17 (Systematic Fauna Site) (-31.226935, 121.671133)**
Habitat type:	salt lake playa and riparian zone
Topography:	plain
Slope:	negligible
Soil:	sandy clay
Soil colour:	red-brown
Rock type:	none
Fire age:	>5 years
Disturbance:	litter, vehicle tracks
Habitat description:	Salt lake playa with no vegetation.

Site:	**Site 18 (Systematic Fauna Site) (-31.366545, 121.737704)**
Habitat type:	salt lake playa and riparian zone
Topography:	plain
Slope:	gentle
Soil:	sand
Soil colour:	red-orange
Rock type:	none
Fire age:	>5 years
Disturbance:	vehicle tracks
Habitat description:	Salt lake edge with herbaceous heath of riparian vegetation (to 1 m) with sparsely scattered *Eucalyptus* spp. (to 30 m) further from edge of salt lake.

Appendix 2 Vertebrate species records from desktop review and this survey

Scientific Name	Common name	Conservation status				DPaW Threatened Fauna Database	EPBC Protected Matters Database	Birdata Database	NatureMap	Western Wildlife (2006)	ATA Environmental (2006)	Keith Lindbeck and Associates (2007)	Keith Lindbeck and Associates (2008)	Harewood (2010c)	Bamford (2010)	Harewood (2010a)	Harewood (2010d)	Harewood (2010b)	Harewood (2011b)	Harewood (2011c)	Harewood (2011a)	This survey
		EPBC Threatened species	WC Act	DPaW	Introduced																	
Amphibians																						
Neobatrachus kunapalari	Kunapalari Frog								●						●							
Neobatrachus sp.											●											
Pseudophryne occidentalis	Western Toadlet								●	●	●				●							
Reptiles																						
Ctenophorus cristatus	Bicycle Dragon								●	●	●	●			●	●	●	●			●	●
Ctenophorus fordi	Mallee Sand Dragon								●	●	●				●	●	●	●			●	
Ctenophorus isolepis	Military Dragon											●										
Ctenophorus ornatus	Ornate Crevice Dragon								●			●										
Ctenophorus reticulatus	Western Netted Dragon								●													
Ctenophorus salinarum	Salt Pan Dragon								●	●	●	●			●	●	●	●			●	●
Ctenophorus scutulatus	Lozenge-marked Dragon								●	●	●	●			●	●						
Moloch horridus	Thorny Devil								●		●				●							
Pogona minor minor	Western Bearded Dragon								●	●	●	●			●							
Tympanocryptis cephalus	Pebble Dragon								●		●											
Crenadactylus ocellatus	Clawless Gecko								●	●	●											

Scientific Name	Common name	Conservation status				DPaW Threatened Fauna Database	EPBC Protected Matters Database	Birdata Database	NatureMap	Western Wildlife (2006)	ATA Environmental (2006)	Keith Lindbeck and Associates (2007)	Keith Lindbeck and Associates (2008)	Harewood (2010c)	Bamford (2010)	Harewood (2010a)	Harewood (2010d)	Harewood (2010b)	Harewood (2011b)	Harewood (2011c)	Harewood (2011a)	This survey
		EPBC Threatened species	WC Act	DPaW	Introduced																	
Diplodactylus granariensis granariensis	Western Stone Gecko								●	●	●											
Diplodactylus pulcher	No Common Name								●	●	●	●										
Hesperoedura reticulata	Reticulated Velvet Gecko									●	●	●										●
Lucasium maini	Main's Ground Gecko								●	●	●	●										
Strophurus assimilis	Goldfields Spiny-tailed Gecko								●	●	●	●			●							
Strophurus elderi	Jewelled Gecko								●	●	●				●							
Nephrurus laevissimus	Pale Knob-tailed Gecko								●	●	●				●							
Underwoodisaurus milii	Southern Barking Gecko								●	●	●	●			●							
Christinus marmoratus	Marbled Gecko								●	●		●										●
Gehyra purpurascens	Purplish Dtella								●			●			●							
Gehyra variegata	Variegated Tree Dtella								●	●	●				●							
Hemidactylus frenatus	Asian House Gecko				●		●															
Heteronotia binoei	Bynoe's Gecko								●	●	●	●			●	●	●	●				●
Delma australis	Marble-faced Delma								●	●	●				●							
Delma butleri	Unbanded Delma								●	●	●											
Delma fraseri	Fraser's Delma								●	●	●											
Lialis burtonis	Burton's Legless Lizard								●	●	●				●							
Pygopus lepidopodus	Common Scaly-foot								●	●	●											

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		EPBC Threatened species	WC Act	DPaW	Introduced																	
Cryptoblepharus buchananii	Buchanan's Snake-eyed Skink								●			●										
Cryptoblepharus plagiocephalus	Peron's Snake-eyed Skink								●	●	●											
Ctenotus atlas	Southern Mallee Ctenotus								●	●	●	●			●							
Ctenotus leonhardii	Leonhard's Ctenotus								●						●							
Ctenotus severus	No Common Name											●										
Ctenotus schomburgkii	Barred Widesnout Ctenotus								●	●	●				●	●	●	●				
Ctenotus uber uber	No Common Name									●	●											
Cyclodomorphus melanops	Spinifex Slender Blue-tongue								●	●	●	●										
Egernia depressa	Southern Pygmy Spiny-tailed Skink								●		●											
Egernia formosa	No Common Name								●	●	●											
Egernia stokesii badia	Western Spiny-tailed Skink	EN	EN			●																
Eremiascincus richardsonii	Broad-banded Sand Swimmer								●	●	●											
Hemiergis initialis	Southwestern Earless Skink								●	●	●											
Hemiergis peronii	No Common Name								●													
Lerista distinguenda	South-western Orange-tailed Slider								●	●	●				●							

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		EPBC Threatened species	WC Act	DPaW	Introduced																	
Lerista kingi	King's Lerista								●	●	●											
Lerista picturata	Southern Robust Slider									●	●											
Lerista taeniata	No Common Name								●													
Lerista timida	Timid Slider								●	●	●											
Liopholis inornata	Desert Skink								●	●	●	●			●							
Liopholis multiscutata	Bull Skink								●													
Menetia greyii	Common Dwarf Skink								●	●	●	●			●							
Morethia adelaidensis	Saltbush Morethia								●	●	●											
Morethia butleri	Woodland Morethia								●	●	●											
Morethia obscura	Red-throated Skink								●	●	●				●							
Tiliqua rugosa	Shingleback									●	●	●				●	●	●			●	●
Tiliqua occipitalis	Western Bluetongue																					●
Varanus gouldii	Sand Monitor								●	●	●	●			●							●
Varanus tristis	Black-headed Monitor								●		●											
Anilios australis	No Common Name									●	●				●							
Anilios bicolor	Bicolor Blind Snake														●							
Morelia spilota imbricata	South-western Carpet Python								●	●												●
Brachyurophis fasciolatus fasciolatus	No Common Name								●													

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		EPBC Threatened species	WC Act	DPaW	Introduced																	
Brachyurophis semifasciatus	Southern Shovel-nosed Snake								●	●	●				●							
Demansia psammophis psammophis	Yellow-faced Whipsnake								●	●	●											
Furina ornata	Moon Snake								●													
Parasuta gouldii	Gould's Hooded Snke								●	●	●											
Parasuta monachus	Monk Snake								●	●	●											
Parasuta nigriceps	Black-backed Snake								●													
Pseudechis australis	Mulga Snake								●	●	●	●										
Pseudonaja affinis	Dugite								●													
Pseudonaja mengdeni	Western Brown Snake								●						●							
Pseudonaja modesta	Ringed Brown Snake								●	●	●											
Simoselaps bertholdi	Jan's Banded Snake								●	●	●											
Suta fasciata	Rosen's Snake								●													
Birds																						
Dromaius novaehollandiae	Emu							●	●	●	●	●			●	●	●	●				●
Leipoa ocellata	Malleefowl	VU	VU			●	●		●						●					●		●
Coturnix pectoralis	Stubble Quail							●														
Coturnix ypsilophora	Brown Quail							●														
Biziura lobata	Musk Duck							●														

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		EPBC Threatened species	WC Act	DPaW	Introduced																	
Cygnus atratus	Black Swan							●	●							●	●	●				
Tadorna tadornoides	Australian Shelduck							●	●													●
Chenonetta jubata	Australian Wood Duck							●	●													
Anas rhynchotis	Australasian Shoveler							●	●													
Anas gracilis	Grey Teal							●	●													
Anas superciliosa	Pacific Black Duck							●	●			●										
Aythya australis	Hardhead							●														
Oxyura australis	Blue-billed Duck			P4		●																
Tachybaptus novaehollandiae	Australasian Grebe							●	●													
Poliocephalus poliocephalus	Hoary-headed Grebe							●	●													
Columba livia	Rock Dove				●		●															
Streptopelia senegalensis	Laughing Dove				●		●															
Streptopelia chinensis	Spotted Dove				●		●															
Phaps chalcoptera	Common Bronzewing							●	●	●	●	●			●	●	●	●	●			
Ocyphaps lophotes	Crested Pigeon							●	●	●	●			●	●	●	●	●	●		●	
Podargus strigoides	Tawny Frogmouth								●	●						●	●	●				
Eurostopodus argus	Spotted Nightjar								●													
Aegotheles cristatus	Australian Owlet-nightjar							●	●						●							

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		EPBC Threatened species	WC Act	DPaW	Introduced																	
Apus pacificus	Fork-tailed Swift	Mig	Mig			●	●															●
Microcarbo melanoleucos	Little Pied Cormorant							●	●													
Phalacrocorax carbo	Great Cormorant							●														
Phalacrocorax sulcirostris	Little Black Cormorant							●														
Ardea modesta	Eastern Great Egret	Mig	Mig				●															
Ardea ibis	Cattle Egret	Mig	Mig			●	●															
Egretta novaehollandiae	White-faced Heron							●	●													
Plegadis falcinellus	Glossy Ibis	Mig	Mig			●																
Lophoictinia isura	Square-tailed Kite							●	●	●											●	
Hamirostra melanosternon	Black-breasted Buzzard									●												
Haliastur sphenurus	Whistling Kite							●		●												
Accipiter fasciatus	Brown Goshawk							●	●	●	●	●							●			
Accipiter cirrocephalus	Collared Sparrowhawk								●													
Circus assimilis	Spotted Harrier							●	●													
Aquila audax	Wedge-tailed Eagle							●	●	●	●	●			●	●	●	●				
Hieraaetus morphnoides	Little Eagle								●													
Falco cenchroides	Nankeen Kestrel							●	●	●											●	

Scientific Name	Common name	Conservation status				DPaW Threatened Fauna Database	EPBC Protected Matters Database	Birdata Database	NatureMap	Western Wildlife (2006)	ATA Environmental (2006)	Keith Lindbeck and Associates (2007)	Keith Lindbeck and Associates (2008)	Harewood (2010c)	Bamford (2010)	Harewood (2010a)	Harewood (2010d)	Harewood (2010b)	Harewood (2011b)	Harewood (2011c)	Harewood (2011a)	This survey
		EPBC Threatened species	WC Act	DPaW	Introduced																	
Falco berigora	Brown Falcon							●	●	●				●	●	●	●	●				●
Falco longipennis	Australian Hobby							●	●													
Falco hypoleucos	Grey Falcon		Mig			●																
Falco peregrinus	Peregrine Falcon		SP			●			●													
Tribonyx ventralis	Black-tailed Native-hen							●														
Fulica atra	Eurasian Coot							●	c													
Himantopus himantopus	Black-winged Stilt							●	●													
Charadrius ruficapillus	Red-capped Plover							●														
Thinornis rubricollis	Hooded Plover			P4		●	●															
Erythrogonys cinctus	Red-kneed Dotterel							●														
Tringa nebularia	Common Greenshank	Mig	Mig			●	●															
Tringa glareola	Wood Sandpiper	Mig	Mig			●																
Calidris ruficollis	Red-necked Stint	Mig	Mig			●																
Calidris acuminata	Sharp-tailed Sandpiper	Mig	Mig			●		●														
Calidris ferruginea	Curlew Sandpiper	CR/ Mig	VU / Mig			●	●															

Scientific Name	Common name	Conservation status				DPaW Threatened Fauna Database	EPBC Protected Matters Database	Birdata Database	NatureMap	Western Wildlife (2006)	ATA Environmental (2006)	Keith Lindbeck and Associates (2007)	Keith Lindbeck and Associates (2008)	Harewood (2010c)	Bamford (2010)	Harewood (2010a)	Harewood (2010d)	Harewood (2010b)	Harewood (2011b)	Harewood (2011c)	Harewood (2011a)	This survey
		EPBC Threatened species	WC Act	DPaW	Introduced																	
Calyptorhynchus latirostris	Carnaby's Black-cockatoo	EN	EN			●																●
Eolophus roseicapillus	Galah							●		●												
Glossopsitta porphyrocephala	Purple-crowned Lorikeet							●	●	●	●			●	●	●	●	●			●	
Polytelis anthopeplus	Regent Parrot							●		●	●	●			●	●	●	●				
Platycercus icterotis xanthogenys	Western Rosella (inland ssp.)			P4		●																
Barnardius zonarius	Australian Ringneck								●	●	●	●		●	●	●	●	●	●		●	
Psephotus varius	Mulga Parrot							●	●						●	●	●	●				●
Melopsittacus undulatus	Budgerigar							●	●						●							●
Neophema splendida	Scarlet-chested Parrot														●							
Pezoporus occidentalis	Night Parrot	EN	CR				●															
Chalcites basalis	Horsfield's Bronze-cuckoo							●	●						●	●	●	●				
Chalcites osculans	Black-eared Cuckoo							●														
Cacomantis pallidus	Pallid Cuckoo							●	●													
Ninox novaeseelandiae	Southern Boobook							●	●	●												
Todiramphus pyrrhopygius	Red-backed Kingfisher							●	●	●	●											
Merops ornatus	Rainbow Bee-eater	Mig	Mig			●	●	●	●	●	●	●		●	●	●	●	●				●
Climacteris rufa	Rufous Treecreeper							●	●	●	●	●			●	●	●	●			●	

Scientific Name	Common name	Conservation status				DPaW Threatened Fauna Database	EPBC Protected Matters Database	Birdata Database	NatureMap	Western Wildlife (2006)	ATA Environmental (2006)	Keith Lindbeck and Associates (2007)	Keith Lindbeck and Associates (2008)	Harewood (2010c)	Bamford (2010)	Harewood (2010a)	Harewood (2010d)	Harewood (2010b)	Harewood (2011b)	Harewood (2011c)	Harewood (2011a)	This survey
		EPBC Threatened species	WC Act	DPaW	Introduced																	
Malurus splendens	Splendid Fairy-wren							●	●													
Malurus leucopterus	White-winged Fairy-wren							●	●	●	●				●	●	●	●				
Malurus lamberti	Variegated Fairy-wren															●	●	●				
Malurus pulcherrimus	Blue-breasted Fairy-wren							●	●	●	●			●								
Amytornis textilis textilis	Thick-billed Grasswren			P4		●																
Sericornis frontalis	White-browed Scrubwren							●														
Hylacola cauta	Shy Heathwren								●		●					●	●	●				
Calamanthus campestris	Rufous Fieldwren									●												
Pyrrholaemus brunneus	Redthroat							●	●	●	●			●	●	●	●	●	●		●	
Smicrornis brevirostris	Weebill							●	●	●	●	●	●	●	●	●	●	●	●		●	●
Gerygone fusca	Western Gerygone							●				●				●	●	●	●			
Acanthiza robustirostris	Slaty-backed Thornbill								●							●						
Acanthiza chrysorrhoa	Yellow-rumped Thornbill							●	●	●						●	●	●				
Acanthiza uropygialis	Chestnut-rumped Thornbill							●	●	●	●	●			●	●	●	●	●			
Acanthiza apicalis	Inland Thornbill							●	●	●	●	●			●	●	●	●	●		●	
Pardalotus punctatus	Spotted Pardalote							●	●				●									
Pardalotus striatus	Striated Pardalote							●	●	●	●	●		●	●	●	●	●	●		●	
Certhionyx variegatus	Pied Honeyeater															●	●	●				

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		EPBC Threatened species	WC Act	DPaW	Introduced																	
Lichenostomus virescens	Singing Honeyeater							●		●	●	●			●	●	●	●	●		●	
Lichenostomus leucotis	White-eared Honeyeater							●	●	●	●					●	●	●				●
Lichenostomus cratitius	Purple-gaped Honeyeater																					●
Lichenostomus ornatus	Yellow-plumed Honeyeater							●		●	●	●	●		●	●	●	●	●		●	
Purnella albifrons	White-fronted Honeyeater							●	●	●		●			●	●	●	●			●	
Manorina flavigula	Yellow-throated Miner							●	●	●	●	●	●	●	●	●	●	●	●		●	
Acanthagenys rufogularis	Spiny-cheeked Honeyeater							●	●	●	●	●			●	●	●	●	●		●	
Anthochaera lunulata	Western Wattlebird															●						
Anthochaera carunculata	Red Wattlebird							●	●	●	●	●		●	●		●	●			●	●
Epthianura albifrons	White-fronted Chat							●	●													
Glyciphila melanops	Tawny-crowned Honeyeater																					●
Lichmera indistincta	Brown Honeyeater							●	●	●	●				●	●	●	●	●		●	
Melithreptus brevirostris	Brown-headed Honeyeater							●	●	●		●			●	●	●	●	●		●	
Pomatostomus superciliosus	White-browed Babbler							●	●	●	●	●				●	●	●				
Cinclosoma castanotum	Chestnut Quail-thrush							●	●	●	●					●	●	●				
Daphoenositta chrysoptera	Varied Sittella							●	●	●					●							

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		EPBC Threatened species	WC Act	DPaW	Introduced																	
Coracina maxima	Ground Cuckoo-shrike								●													
Coracina novaehollandiae	Black-faced Cuckoo-shrike							●	●	●		●		●	●	●	●	●			●	
Lalage sueurii	White-winged Triller							●		●						●	●	●				
Pachycephala inornata	Gilbert's Whistler							●	●													
Pachycephala pectoralis	Golden Whistler							●	●													
Pachycephala rufiventris	Rufous Whistler							●	●				●									
Colluricincla harmonica	Grey Shrike-thrush							●	●	●	●	●	●		●	●	●	●			●	
Oreoica gutturalis pallescens	Crested Bellbird							●						●			●	●			●	
Oreoica gutturalis gutturalis	Crested Bellbird (southern)								●	●	●				●	●						
Artamus personatus	Masked Woodswallow								●						●							
Artamus cinereus	Black-faced Woodswallow							●	●	●		●										
Artamus cyanopterus	Dusky Woodswallow							●	●	●	●				●	●	●	●			●	
Cracticus torquatus	Grey Butcherbird							●	●	●	●	●		●	●		●	●				
Cracticus nigrogularis	Pied Butcherbird							●	●	●		●	●			●						
Cracticus tibicen	Australian Magpie							●	●	●	●	●			●	●	●	●			●	●
Strepera versicolor	Grey Currawong							●	●	●	●	●	●		●	●	●	●	●			●
Rhipidura albiscapa	Grey Fantail							●	●							●	●	●				
Rhipidura leucophrys	Willie Wagtail							●	●	●	●				●	●			●		●	●

Scientific Name	Common name	Conservation status				DPaW Threatened Fauna Database	EPBC Protected Matters Database	Birdata Database	NatureMap	Western Wildlife (2006)	ATA Environmental (2006)	Keith Lindbeck and Associates (2007)	Keith Lindbeck and Associates (2008)	Harewood (2010c)	Bamford (2010)	Harewood (2010a)	Harewood (2010d)	Harewood (2010b)	Harewood (2011b)	Harewood (2011c)	Harewood (2011a)	This survey
		EPBC Threatened species	WC Act	DPaW	Introduced																	
Corvus coronoides	Australian Raven							●	●	●	●	●	●	●	●	●	●	●	●		●	●
Corvus bennetti	Little Crow							●														
Myiagra inquieta	Restless Flycatcher									●												
Grallina cyanoleuca	Magpie-lark							●	●	●												●
Microeca fascinans	Jacky Winter							●	●	●						●	●	●			●	
Petroica goodenovii	Red-capped Robin							●	●	●		●			●							
Melanodryas cucullata	Hooded Robin							●														
Eopsaltria griseogularis	Western Yellow Robin								●													
Drymodes brunneopygia	Southern Scrub-robin							●			●											
Cincloramphus mathewsi	Rufous Songlark							●		●												
Zosterops lateralis	Silvereye							●	●	●					●							
Cheramoeca leucosterna	White-backed Swallow							●	●	●					●	●	●	●	●		●	
Hirundo neoxena	Welcome Swallow							●	●	●						●	●	●			●	
Petrochelidon nigricans	Tree Martin							●	●	●		●		●	●	●					●	
Dicaeum hirundinaceum	Mistletoebird							●	●	●					●							
Taeniopygia guttata	Zebra Finch							●	●													●
Anthus novaeseelandiae	Australasian Pipit							●							●							
Motacilla cinerea	Grey Wagtail	Mig	Mig				●															
Mammals																						

Scientific Name	Common name	Conservation status				DPaW Threatened Fauna Database	EPBC Protected Matters Database	Birdata Database	NatureMap	Western Wildlife (2006)	ATA Environmental (2006)	Keith Lindbeck and Associates (2007)	Keith Lindbeck and Associates (2008)	Harewood (2010c)	Bamford (2010)	Harewood (2010a)	Harewood (2010d)	Harewood (2010b)	Harewood (2011b)	Harewood (2011c)	Harewood (2011a)	This survey
		EPBC Threatened species	WC Act	DPaW	Introduced																	
Tachyglossus aculeatus	Short-beaked Echidna									●	●	●	●		●	●	●	●	●		●	
Dasyurus geoffroii	Western Quoll	VU	VU			●			●													
Ningaui ridei	Wongai Ningaui									●												
Ningaui yvonneae	Southern Ningaui								●	●		●			●							
Ningaui sp.											●											
Phascogale calura	Red-tailed Phascogale	EN	CD			●			●													
Sminthopsis crassicaudata	Fat-tailed Dunnart									●	●											
Sminthopsis dolichura	Little long-tailed Dunnart									●	●	●										
Sminthopsis gilberti	Gilbert's Dunnart										●											
Sminthopsis ooldea	Ooldea Dunnart								●													
Myrmecobius fasciatus	Numbat	VU	EN			●																
Macrotis lagotis	Greater Bilby	VU	VU			●																
Macropus fuliginosus	Western Grey Kangaroo								●	●		●	●	●	●	●	●	●	●		●	
Macropus rufus	Red Kangaroo									●												
Cercartetus concinnus	Western Pygmy-possum								●	●	●	●			●							
Chalinolobus gouldii	Gould's Wattled Bat								●	●	●											●
Chalinolobus morio	Chocolate Wattled Bat										●											
Nyctophilus geoffroyi	Lesser Long-eared Bat										●											

Scientific Name	Common name	Conservation status				DPaW Threatened Fauna Database	EPBC Protected Matters Database	Birdata Database	NatureMap	Western Wildlife (2006)	ATA Environmental (2006)	Keith Lindbeck and Associates (2007)	Keith Lindbeck and Associates (2008)	Harewood (2010c)	Bamford (2010)	Harewood (2010a)	Harewood (2010d)	Harewood (2010b)	Harewood (2011b)	Harewood (2011c)	Harewood (2011a)	This survey
		EPBC Threatened species	WC Act	DPaW	Introduced																	
Nyctophilus major tor	South-western Long-eared Bat			P4							●											
Scotorepens balstoni	Inland Broad-nosed Bat										●											
Vespadelus regulus	Southern Forest Bat										●											
Mormopterus planiceps	Southern Freetail-bat										●											
Austronomus australis	White-striped Freetail-bat									●	●											●
Mus musculus	House Mouse				●		●		●	●	●	●			●							
Notomys alexis	Spinifex Hopping-mouse										●											
Notomys mitchellii	Mitchell's Hopping-mouse								●	●	●				●						●	
Pseudomys bolami	Bolam's Mouse								●	●					●							
Pseudomys sp.											●											
Oryctolagus cuniculus	Rabbit				●		●		●	●		●	●	●	●	●	●	●	●		●	●
Canis lupus	Dog / Dingo						●			●					●							
Vulpes vulpes	Red Fox				●		●						●									
Felis catus	Cat				●		●		●		●	●			●							
Equus asinus	Donkey				●		●															
Equus caballus	Horse				●		●															
Camelus dromedarius	Camel				●		●									●	●	●				
Capra hircus	Goat				●		●															●

Scientific Name	Common name	Conservation status				DPaW Threatened Fauna Database	EPBC Protected Matters Database	Birdata Database	NatureMap	Western Wildlife (2006)	ATA Environmental (2006)	Keith Lindbeck and Associates (2007)	Keith Lindbeck and Associates (2008)	Harewood (2010c)	Bamford (2010)	Harewood (2010a)	Harewood (2010d)	Harewood (2010b)	Harewood (2011b)	Harewood (2011c)	Harewood (2011a)	This survey
		EPBC Threatened species	WC Act	DPaW	Introduced																	
Bos taurus	Cattle				•																	•

Appendix 3 Short-range endemic invertebrates identified in the desktop review

Source (registration)[1]	Order	Family	Genus and species	Location	Latitude (GDA94)[2]	Longitude (GDA94)[2]
PES 19816	Araneae	Actinopodidae	*Missulena* `kalgoorlie`	20 km E of Kalgoorlie	-30.744722	121.566944
WAM	Araneae	Actinopodidae	*Missulena* sp. indet.	Boulder Race Course	-30.7833	121.483
WAM	Araneae	Actinopodidae	*Missulena* sp. indet.	Kalgoorlie	-30.7505	121.464
WAM	Araneae	Actinopodidae	*Missulena* sp. indet.	Kalgoorlie; 20 km S. of	-30.9333	121.467
WAM	Araneae	Barychelidae	Barychelidae sp. indet.	S. of Kambalda @	-31.5675	121.745
WAM	Araneae	Barychelidae	*Synothele* `MYG264`	Aldiss; ca. 100 km ESE. of Kalgoorlie	-31.0069	122.557
WAM	Araneae	Barychelidae	*Synothele houstoni*	3.7 km SSW. of McDermid Rock	-32.0166	120.733
WAM	Araneae	Barychelidae	*Synothele pectinata*	Woodline; site WLR9	-31.8833	122.45
WAM	Araneae	Barychelidae	*Synothele* sp. indet.	Woodline; site WLR2	-31.95	122.4
WAM	Araneae	Barychelidae	*Synothele* sp. indet.	Woodline; site WLR5	-31.8333	122.4
WAM T139800	Araneae	Ctenizidae	*Conothele* `kalgoorlie`	14 km E of Kalgoorlie	-30.7322	121.556
WAM	Araneae	Ctenizidae	*Conothele* `kalgoorlie`	15 km E of Kalgoorlie	-30.7325	121.556
WAM T139801	Araneae	Ctenizidae	*Conothele* `kalgoorlie`	16 km E of Kalgoorlie	-30.7325	121.555
WAM T134175	Araneae	Ctenizidae	*Conothele* sp. indet.	28 km NNW. of Norseman; Coolgardie-Esperance Highway	-31.9728	121.649
WAM T134176	Araneae	Ctenizidae	*Conothele* sp. indet.	on track 3.6 km N. of Eyre Highway	-32.0308	122.204
WAM T114994	Araneae	Ctenizidae	*Conothele* sp. indet.	Rowles Lagoon Nature Reserve	-30.4253	120.834

Source (registration)[1]	Order	Family	Genus and species	Location	Latitude (GDA94)[2]	Longitude (GDA94)[2]
WAM T134177	Araneae	Dipluridae	*Cethegus* sp. indet.	18.8 km W. of Fraser Range rest stop; Eyre Highway	-32.0644	122.397
WAM T101087	Araneae	Dipluridae	*Cethegus* sp. indet.	Binaronca Nature Reserve @	-31.7044	121.69
WAM T109001	Araneae	Dipluridae	*Cethegus* sp. indet.	ca. 50 km ESE. of Kalgoorlie	-30.9278	121.907
WAM T109006	Araneae	Dipluridae	*Cethegus* sp. indet.	ca. 50 km ESE. of Kalgoorlie	-30.9278	121.907
WAM T109010	Araneae	Dipluridae	*Cethegus* sp. indet.	ca. 50 km ESE. of Kalgoorlie	-30.9278	121.907
WAM T26791	Araneae	Dipluridae	*Cethegus* sp. indet.	Kurrawang Reserve	-30.8333	121.333
WAM T95770	Araneae	Dipluridae	*Cethegus* sp. indet.	S. of Kambalda @	-31.5675	121.745
PES 19807	Araneae	Idiopidae	*Aganippe* `kalgoorlie`	16 km E of Kalgoorlie	-30.7325	121.555278
WAM T139804	Araneae	Idiopidae	*Aganippe* `kalgoorlie`	20 km E of Kalgoorlie	-30.7447	121.567
WAM T99987	Araneae	Idiopidae	*Aganippe* `MYG191`	S. of Kambalda	-31.5675	121.745
WAM T118992	Araneae	Idiopidae	*Aganippe* `MYG244`	Rowles Lagoon Nature Reserve	-30.4264	120.842
WAM T134186	Araneae	Idiopidae	*Aganippe* sp. indet.	18.8 km W. of Fraser Range rest stop; Eyre Highway	-32.0644	122.397
WAM T134179	Araneae	Idiopidae	*Aganippe* sp. indet.	42 km NNE. of Norseman; Eyre Highway	-32.0633	122.201
WAM T118325	Araneae	Idiopidae	*Aganippe* sp. indet.	78 km SE of Kalgoorlie	-31.0497	122.225
WAM T118326	Araneae	Idiopidae	*Aganippe* sp. indet.	78 km SE of Kalgoorlie	-31.0294	122.211
WAM T134187	Araneae	Idiopidae	*Aganippe* sp. indet.	8 km E. of Fraser Range rest stop; Eyre Highway	-32.0706	122.679
WAM T134178	Araneae	Idiopidae	*Aganippe* sp. indet.	9.7 km SSW. of Higginsville; Coolgardie-Esperance Highway	-31.8228	121.659

Source (registration)[1]	Order	Family	Genus and species	Location	Latitude (GDA94)[2]	Longitude (GDA94)[2]
WAM T32552	Araneae	Idiopidae	*Aganippe* sp. indet.	Boulder	-30.7833	121.483
WAM T115757	Araneae	Idiopidae	*Aganippe* sp. indet.	Cape Le Grand National Park; Lucky Bay; 63 km SE. of Kalgoorlie	-31.151	122.031
WAM T30016	Araneae	Idiopidae	*Aganippe* sp. indet.	East Kalgoorlie	-30.75	121.467
WAM T26866	Araneae	Idiopidae	*Aganippe* sp. indet.	Gidgi; ca. 17 km N. of Kalgoorlie off Menzies Road	-30.6	121.417
WAM T42336	Araneae	Idiopidae	*Aganippe* sp. indet.	Kalgoorlie	-30.7333	121.467
WAM T32168	Araneae	Idiopidae	*Aganippe* sp. indet.	Kalgoorlie; Belmont Ave	-30.7333	121.467
WAM T44172	Araneae	Idiopidae	*Aganippe* sp. indet.	Kalgoorlie; Goldfields Prison	-30.75	121.45
WAM T44175	Araneae	Idiopidae	*Aganippe* sp. indet.	Kalgoorlie; Kamington	-30.7333	121.467
WAM T134184	Araneae	Idiopidae	*Aganippe* sp. indet.	on track 3.6 km N. of Eyre Highway	-32.0308	122.204
WAM T134185	Araneae	Idiopidae	*Aganippe* sp. indet.	on track 3.6 km N. of Eyre Highway	-32.0308	122.204
WAM T21149	Araneae	Idiopidae	*Aganippe* sp. indet.	Paddington Gold Mine; About 30 km N. of Kalgoorlie	-30.4833	121.467
WAM T26826	Araneae	Idiopidae	*Aganippe* sp. indet.	West Kalgoorlie; MRSA Workshop Yard	-30.7505	121.464
WAM T28476	Araneae	Idiopidae	*Aganippe* sp. indet.	Widgiemooltha	-31.4833	121.583
WAM T16330	Araneae	Idiopidae	*Aganippe* sp. indet.	Woodline; site WLB2	-31.85	122.35
WAM T16340	Araneae	Idiopidae	*Aganippe* sp. indet.	Woodline; site WLR2	-31.95	122.4
PES 11822	Araneae	Idiopidae	*Anidiops* `SIGM120`	Lake Lefroy	-31.4222	121.7808018
SAM NN21890	Araneae	Lycosidae	*Tetralycosa baudinettei*	Lake Goongarrie	-29.9833	121.15

Source (registration)[1]	Order	Family	Genus and species	Location	Latitude (GDA94)[2]	Longitude (GDA94)[2]
SAM NN21891	Araneae	Lycosidae	*Tetralycosa baudinettei*	Lake Goongarrie	-29.9833	121.15
SAM NN21855	Araneae	Lycosidae	*Tetralycosa baudinettei*	Lake Lefroy	-31.4333	121.5666667
SAM NN21896	Araneae	Lycosidae	*Tetralycosa baudinettei*	Lake Lefroy	-31.4333	121.566667
SAM NN21897	Araneae	Lycosidae	*Tetralycosa baudinettei*	Lake Lefroy	-31.2	121.6833333
SAM NN21898	Araneae	Lycosidae	*Tetralycosa baudinettei*	Lake Lefroy	-31.2	121.6833333
WAM T141307	Araneae	Lycosidae	*Tetralycosa baudinettei*	Lake Lefroy	-31.5026	121.7102472
SAM NN21903	Araneae	Lycosidae	*Tetralycosa baudinettei*	Lake Roe	-30.6666	122.5
SAM NN21912	Araneae	Lycosidae	*Tetralycosa baudinettei*	Lake Yindarlgooda	-30.6	122.2166667
WAM T126765	Araneae	Nemesiidae	*Aname* `MYG181`	Aldiss; ca. 100 km ESE. of Kalgoorlie	-31.0069	122.557
WAM T126766	Araneae	Nemesiidae	*Aname* `MYG181`	Aldiss; ca. 100 km ESE. of Kalgoorlie	-31.0124	122.558
WAM T126767	Araneae	Nemesiidae	*Aname* `MYG181`	Aldiss; ca. 100 km ESE. of Kalgoorlie	-31.0226	122.56
WAM T108997	Araneae	Nemesiidae	*Aname* `MYG213`	ca. 50 km ESE. of Kalgoorlie	-30.8994	121.938
WAM T110283	Araneae	Nemesiidae	*Aname* `MYG223`	6 km SE. of Kambalda; Lake Lefroy; St Ives Gold Mine; K	-31.4911	121.719
PES 11821	Araneae	Nemesiidae	*Aname* `SIGM121`	Lake Lefroy, Junction Recovery	-31.47015	121.7468466
PES 11819	Araneae	Nemesiidae	*Aname* `SIGM122`	Lake Lefroy, Argo	-31.39003	121.7576716
PES 11820	Araneae	Nemesiidae	*Aname* `SIGM122`	Lake Lefroy, Junction Recovery	-31.47015	121.7468466
PES 11818	Araneae	Nemesiidae	*Aname* `SIGM122`	Lake Lefroy, Location K	-31.49804	121.7141406
WAM T108996	Araneae	Nemesiidae	*Aname* sp. indet.	ca. 50 km ESE. of Kalgoorlie	-30.8994	121.938

Source (registration)[1]	Order	Family	Genus and species	Location	Latitude (GDA94)[2]	Longitude (GDA94)[2]
WAM T108998	Araneae	Nemesiidae	*Aname* sp. indet.	ca. 50 km ESE. of Kalgoorlie	-30.8994	121.938
WAM T108999	Araneae	Nemesiidae	*Aname* sp. indet.	ca. 50 km ESE. of Kalgoorlie	-30.8994	121.938
WAM T109000	Araneae	Nemesiidae	*Aname* sp. indet.	ca. 50 km ESE. of Kalgoorlie	-30.8994	121.938
WAM T109008	Araneae	Nemesiidae	*Aname* sp. indet.	ca. 50 km ESE. of Kalgoorlie	-30.8994	121.938
WAM T118609	Araneae	Nemesiidae	*Aname* sp. indet.	Credo Station	-30.5001	120.74
WAM T29859	Araneae	Nemesiidae	*Aname* sp. indet.	Dedari	-31.0833	120.7
WAM T27289	Araneae	Nemesiidae	*Aname* sp. indet.	Goldminer Caravan Park; Kalgoorlie	-30.7333	121.467
WAM T27290	Araneae	Nemesiidae	*Aname* sp. indet.	Goldminer Caravan Park; Kalgoorlie	-30.7333	121.467
WAM T27232	Araneae	Nemesiidae	*Aname* sp. indet.	Kambalda	-31.2166	121.667
WAM T130433	Araneae	Nemesiidae	*Aname* sp. indet.	Lake Cowan; ca. 10 km NW. Norseman	-32.1366	121.7
WAM T130487	Araneae	Nemesiidae	*Aname* sp. indet.	Lake Cowan; ca. 10 km NW. Norseman	-32.1366	121.705
PES 11823	Araneae	Nemesiidae	*Aname* sp. indet.	Lake Lefroy	-31.49804	121.7141406
WAM T135346	Araneae	Nemesiidae	*Aname* sp. indet.	Lake Lefroy; Location K	-31.4925	121.716
WAM T115542	Araneae	Nemesiidae	*Aname* sp. indet.	Rowles Lagoon Nature Reserve	-30.4195	120.941
WAM T118626	Araneae	Nemesiidae	*Aname* sp. indet.	Rowles Lagoon Nature Reserve	-30.4028	120.87
WAM T118630	Araneae	Nemesiidae	*Aname* sp. indet.	Rowles Lagoon Nature Reserve	-30.4195	120.924
WAM T95772	Araneae	Nemesiidae	*Aname* sp. indet.	S. of Kambalda @	-31.5675	121.745
WAM T17127	Araneae	Nemesiidae	*Aname* sp. indet.	Woodline; site WLR1	-31.9166	122.317
WAM T124886	Araneae	Nemesiidae	*Kwonkan* `MYG263`	Aldiss; ca. 100 km ESE. of Kalgoorlie	-31.018	122.56

Source (registration)[1]	Order	Family	Genus and species	Location	Latitude (GDA94)[2]	Longitude (GDA94)[2]
WAM T126747	Araneae	Nemesiidae	*Kwonkan* `MYG263`	Aldiss; ca. 100 km ESE. of Kalgoorlie	-31.0069	122.557
WAM T126749	Araneae	Nemesiidae	*Kwonkan* `MYG263`	Aldiss; ca. 100 km ESE. of Kalgoorlie	-31.0265	122.555
WAM T135339	Araneae	Nemesiidae	*Kwonkan* sp. indet.	Lake Lefroy	-31.4392	121.676
WAM T135340	Araneae	Nemesiidae	*Kwonkan* sp. indet.	Lake Lefroy	-31.2704	121.639
PES 11278	Araneae	Nemesiidae	Nemesiidae `SIGM104`	Lake Lefroy, Argo	-31.38994	121.757322
PES 11294	Araneae	Nemesiidae	Nemesiidae `SIGM104`	Lake Lefroy, Argo	-31.39003	121.757671
WAM T136259	Araneae	Nemesiidae	Nemesiidae `SIGM104`	Lake Lefroy, Location 170	-31.4385	121.674
PES 15251	Araneae	Nemesiidae	Nemesiidae `SIGM104`	Lake Lefroy, NED	-31.23926	121.825680
PES 15252	Araneae	Nemesiidae	Nemesiidae `SIGM104`	Lake Lefroy, NED	-31.23974	121.825097
WAM T136258	Araneae	Nemesiidae	Nemesiidae `SIGM104`	Lake Lefroy, NED	-31.2393	121.826
WAM T109003	Araneae	Nemesiidae	*Proshermacha* `PRO025`	ca. 50 km ESE. of Kalgoorlie	-30.8994	121.938
WAM T109004	Araneae	Nemesiidae	*Proshermacha* `PRO025`	ca. 50 km ESE. of Kalgoorlie	-30.8994	121.938
Hudson (1995)	Coleoptera	Carabidae	*Rivacindela* 'yindarla' (as *Cicindela* sp. nov.)	Lake Lefroy, site C	-31.19936	121.685068
Golding (2016)	Coleoptera	Carabidae	*Rivacindela* 'yindarla' (as *Cicindela* sp. nov.)	Lake Yindarlgooda (no exact locality)	-30.660	122.000
WAM	Coleoptera	Carabidae	*Rivacindela necopinata*	Lake Lefroy, 6 km N of Widgiemooltha	-31.443	121.568958
Hudson (1995)	Coleoptera	Carabidae	*Rivacindela salicursoria*	Lake Lefroy, site D	-31.27438	121.714854
Hudson (1995)	Coleoptera	Carabidae	*Rivacindela salicursoria*	Lake Lefroy, site F	-31.307003	121.704642
WAM	Coleoptera	Carabidae	*Rivacindela salicursoria*	Lake Lefroy, 4 km N of Widgiemooltha	-31.44319	121.566136

Source (registration)[1]	Order	Family	Genus and species	Location	Latitude (GDA94)[2]	Longitude (GDA94)[2]
WAM T120314	Geophilo-morpha	Geophilidae	Geophilidae sp. indet.	Disappointment Rock	-32.1305	120.928
PES 15590	Isopoda	Armadillidae	*Cubaris* `lefroy`	Lake Lefroy	-31.441225	121.6809694
PES 15588	Isopoda	Philosciidae	Philosciidae `lefroy`	Lake Lefroy	-31.49941	121.7131
PES 15589	Isopoda	Philosciidae	Philosciidae `lefroy`	Lake Lefroy	-31.46974	121.7457306
Curtin (1999)	Orthoptera	Gryllidae	*Apterogryllus* sp. A	NE Ref Site - Beach	-31.227444	121.839437
Curtin (1999)	Orthoptera	Gryllidae	*Apterogryllus* sp. A	NE Ref Site - Lake	-31.22666	121.839447
Curtin (1999)	Orthoptera	Gryllidae	*Apterogryllus* sp. A	NE Ref Site - Pool	-31.229012	121.835292
Curtin (1999)	Orthoptera	Gryllidae	*Apterogryllus* sp. A	Redoubtable Dewatering	-31.219432	121.640223
Curtin (1999)	Orthoptera	Gryllidae	*Apterogryllus* sp. A	SW Ref Site - Beach	-31.271198	121.637054
Curtin (1999)	Orthoptera	Gryllidae	*Apterogryllus* sp. A	SW Ref Site -Lake	-31.270784	121.6405584
PES 14512	Orthoptera	Gryllidae	*Apterogryllus* sp. A	Lake Lefroy	-31.323675	121.6948028
PES 14515	Orthoptera	Gryllidae	*Apterogryllus* sp. A	Lake Lefroy	-31.323675	121.6948028
PES 14516	Orthoptera	Gryllidae	*Apterogryllus* sp. A	Lake Lefroy	-31.269153	121.643692
PES 14517	Orthoptera	Gryllidae	*Apterogryllus* sp. A	Lake Lefroy	-31.269153	121.643692
PES 14867	Orthoptera	Gryllidae	*Apterogryllus* sp. A	Lake Lefroy	-31.269153	121.643692
PES 14891	Orthoptera	Gryllidae	*Apterogryllus* sp. A	Lake Lefroy	-31.269153	121.643692
PES 14892	Orthoptera	Gryllidae	*Apterogryllus* sp. A	Lake Lefroy	-31.27392	121.641997
PES 14894	Orthoptera	Gryllidae	*Apterogryllus* sp. A	Lake Lefroy	-31.273733	121.640231

Source (registration)[1]	Order	Family	Genus and species	Location	Latitude (GDA94)[2]	Longitude (GDA94)[2]
PES 15153	Orthoptera	Gryllidae	*Apterogryllus* sp. A	Lake Lefroy	-31.273733	121.640231
PES 15154	Orthoptera	Gryllidae	*Apterogryllus* sp. A	Lake Lefroy	-31.273733	121.640231
PES 16160	Orthoptera	Gryllidae	*Apterogryllus* sp. A	Lake Lefroy	-31.273733	121.640231
Hudson (1995)	Orthoptera	Gryllidae	*Apterogryllus* sp. A	Lake Lefroy, site D	-31.27438	121.714854
Hudson (1995)	Orthoptera	Gryllidae	*Apterogryllus* sp. A	Lake Lefroy, site E	-31.279221	121.722244
PES 19802	Polydesmida	Paradoxosomatidae	*Antichiropus* `broad arrows`	23 km E of Kalgoorlie	-30.7675	121.59
WAM T139886	Polydesmida	Paradoxosomatidae	*Antichiropus* `broad arrows`	23 km E of Kalgoorlie	-30.7675	121.59
WAM T139886	Polydesmida	Paradoxosomatidae	*Antichiropus* `broad arrows`	23 km E of Kalgoorlie	-30.7675	121.59
WAM T119062	Polydesmida	Paradoxosomatidae	*Antichiropus anconus*	Buldania Rocks; ca. 27 km NE. of Norseman	-32.0794	122.038
WAM T119063	Polydesmida	Paradoxosomatidae	*Antichiropus anconus*	Buldania Rocks; ca. 27 km NE. of Norseman	-32.0794	122.038
WAM T119064	Polydesmida	Paradoxosomatidae	*Antichiropus anconus*	Buldania Rocks; ca. 27 km NE. of Norseman	-32.0794	122.038
WAM T126106	Polydesmida	Paradoxosomatidae	*Antichiropus anconus*	Buldania Rocks; Eyre Highway	-32.0787	122.034
WAM T71828	Polydesmida	Paradoxosomatidae	*Antichiropus anconus*	Woodline	-31.8	122.417
WAM T72055	Polydesmida	Paradoxosomatidae	*Antichiropus cincinnus*	McDermid Rock; site MRR 4	-32.0278	120.746
WAM T54243	Polydesmida	Paradoxosomatidae	*Antichiropus exclamatus*	Norseman	-32.1631	121.797
WAM T119065	Polydesmida	Paradoxosomatidae	*Antichiropus incomptus*	Bedourie Hill; ca. 47 km NE. of Norseman	-32.0556	122.259
WAM T119066	Polydesmida	Paradoxosomatidae	*Antichiropus incomptus*	Bedourie Hill; ca. 47 km NE. of Norseman	-32.0556	122.259

Source (registration)[1]	Order	Family	Genus and species	Location	Latitude (GDA94)[2]	Longitude (GDA94)[2]
WAM T119067	Polydesmida	Paradoxosomatidae	*Antichiropus incomptus*	Bedourie Hill; ca. 47 km NE. of Norseman	-32.0556	122.259
WAM T119068	Polydesmida	Paradoxosomatidae	*Antichiropus incomptus*	Bedourie Hill; ca. 47 km NE. of Norseman	-32.0556	122.259
WAM T112935	Polydesmida	Paradoxosomatidae	*Antichiropus incomptus*	S. of Kambalda	-31.5675	121.745
WAM T112936	Polydesmida	Paradoxosomatidae	*Antichiropus incomptus*	S. of Kambalda	-31.5675	121.745
WAM T124577	Polydesmida	Paradoxosomatidae	*Antichiropus incomptus*	S. of Kambalda	-31.5675	121.745
WAM T99989	Polydesmida	Paradoxosomatidae	*Antichiropus incomptus*	S. of Kambalda	-31.5675	121.745
WAM T71829	Polydesmida	Paradoxosomatidae	*Antichiropus incomptus*	Woodline	-31.95	122.4
WAM T115128	Polydesmida	Paradoxosomatidae	*Antichiropus paracalothamnus*	Disappointment Rock	-32.1305	120.928
WAM T115141	Polydesmida	Paradoxosomatidae	*Antichiropus paracalothamnus*	Disappointment Rock	-32.1305	120.928
WAM T115143	Polydesmida	Paradoxosomatidae	*Antichiropus paracalothamnus*	Disappointment Rock	-32.1305	120.928
WAM T115144	Polydesmida	Paradoxosomatidae	*Antichiropus paracalothamnus*	Disappointment Rock	-32.1305	120.928
WAM T115026	Polydesmida	Paradoxosomatidae	*Antichiropus paracalothamnus*	McDermid Rock; Hyden-Norseman Road	-32.0201	120.74
WAM T115036	Polydesmida	Paradoxosomatidae	*Antichiropus paracalothamnus*	McDermid Rock; Hyden-Norseman Road	-32.0201	120.74
WAM T115130	Polydesmida	Paradoxosomatidae	*Antichiropus paracalothamnus*	McDermid Rock; Hyden-Norseman Road	-32.0201	120.74

Source (registration)[1]	Order	Family	Genus and species	Location	Latitude (GDA94)[2]	Longitude (GDA94)[2]
WAM T124574	Polydesmida	Paradoxosomatidae	*Antichiropus paracalothamnus*	McDermid Rock; Hyden-Norseman Road	-32.0201	120.74
WAM T73776	Polydesmida	Paradoxosomatidae	*Antichiropus* sp. indet.	Woodline; site WLR 1	-31.8	122.317
WAM T64877	Pseudo-scorpiones	Garypidae	*Synsphyronus* `sp. nov. 7/2 Goldfields`	Burra Rock	-31.3833	121.2
WAM T65491	Pseudo-scorpiones	Garypidae	*Synsphyronus* `sp. nov. 8/3 McDermid Rock`	McDermid Rock	-32.0219	120.738
WAM S1581	Eupulmonata	Bothriembryontidae	*Bothriembryon balteolus*	Norseman	-31.9333	121.7833
WAM S1582	Eupulmonata	Bothriembryontidae	*Bothriembryon balteolus*	Norseman	-32.2	121.7833
WAM S1561	Eupulmonata	Bothriembryontidae	*Bothriembryon balteolus*	Woodline	-31.9	122.55
WAM S84126	Eupulmonata	Bothriembryontidae	*Bothriembryon* cf. sedgwicki	Buldania	-32.0793	122.0378
WAM S66449	Eupulmonata	Bothriembryontidae	*Bothriembryon* cf. sedgwicki	Jimberlana Hill	-32.1471	121.815
WAM S3617	Eupulmonata	Bothriembryontidae	*Bothriembryon* cf. sedgwicki	Norseman	-32.0638	122.2044
WAM S84123	Eupulmonata	Bothriembryontidae	*Bothriembryon* cf. sedgwicki	Norseman	-32.0772	122.0428
WAM S42914	Eupulmonata	Bothriembryontidae	*Bothriembryon* cf. sedgwicki	Widgiemooltha	-31.4608	121.5005
WAM S84008	Eupulmonata	Bothriembryontidae	*Bothriembryon* cf. sedgwicki	Widgiemooltha	-31.4354	121.5297
WAM S3624	Eupulmonata	Bothriembryontidae	*Bothriembryon* sp. indet.	Beacon Hill	-32.1833	121.7833
WAM S3625	Eupulmonata	Bothriembryontidae	*Bothriembryon* sp. indet.	Beacon Hill	-32.1833	121.7833
WAM S88409	Eupulmonata	Bothriembryontidae	*Bothriembryon* sp. indet.	Binduli	-30.8332	121.3914
WAM S9342	Eupulmonata	Bothriembryontidae	*Bothriembryon* sp. indet.	Buldania	-32.0666	122.0333

Source (registration)[1]	Order	Family	Genus and species	Location	Latitude (GDA94)[2]	Longitude (GDA94)[2]
WAM S9343	Eupulmonata	Bothriembryontidae	*Bothriembryon* sp. indet.	Buldania	-32.0666	122.0333
WAM S3615	Eupulmonata	Bothriembryontidae	*Bothriembryon* sp. indet.	Clinker Hill	-30.8833	121.7667
WAM S3611	Eupulmonata	Bothriembryontidae	*Bothriembryon* sp. indet.	Coolgardie	-31.8333	121.15
WAM S3612	Eupulmonata	Bothriembryontidae	*Bothriembryon* sp. indet.	Coolgardie	-31.3333	121.15
WAM S3613	Eupulmonata	Bothriembryontidae	*Bothriembryon* sp. indet.	Coolgardie	-31.1833	121.15
WAM S3614	Eupulmonata	Bothriembryontidae	*Bothriembryon* sp. indet.	Coolgardie	-32.0333	121.15
WAM S3616	Eupulmonata	Bothriembryontidae	*Bothriembryon* sp. indet.	Coolgardie	-31.1166	121.15
WAM S41349	Eupulmonata	Bothriembryontidae	*Bothriembryon* sp. indet.	Coolgardie	-31.275	121.4278
WAM S41352	Eupulmonata	Bothriembryontidae	*Bothriembryon* sp. indet.	Coolgardie	-31.2571	121.4517
WAM S61464	Eupulmonata	Bothriembryontidae	*Bothriembryon* sp. indet.	Coolgardie	-31.0769	121.4647
WAM S7864	Eupulmonata	Bothriembryontidae	*Bothriembryon* sp. indet.	Coolgardie	-31.3833	121.15
WAM S7865	Eupulmonata	Bothriembryontidae	*Bothriembryon* sp. indet.	Coolgardie	-31.1833	121.15
WAM S66709	Eupulmonata	Bothriembryontidae	*Bothriembryon* sp. indet.	Jimberlana Hill	-32.1471	121.815
WAM S66710	Eupulmonata	Bothriembryontidae	*Bothriembryon* sp. indet.	Jimberlana Hill	-32.1471	121.815
WAM S66711	Eupulmonata	Bothriembryontidae	*Bothriembryon* sp. indet.	Jimberlana Hill	-32.1471	121.815
WAM S66716	Eupulmonata	Bothriembryontidae	*Bothriembryon* sp. indet.	Jimberlana Hill	-32.1471	121.815
WAM S8065	Eupulmonata	Bothriembryontidae	*Bothriembryon* sp. indet.	Jimberlana Hill	-32.15	121.8167
WAM S30779	Eupulmonata	Bothriembryontidae	*Bothriembryon* sp. indet.	Kalgoorlie	-30.75	121.45
WAM S9340	Eupulmonata	Bothriembryontidae	*Bothriembryon* sp. indet.	Kalgoorlie	-30.9333	121.4667

Source (registration)[1]	Order	Family	Genus and species	Location	Latitude (GDA94)[2]	Longitude (GDA94)[2]
WAM S3621	Eupulmonata	Bothriembryontidae	*Bothriembryon* sp. indet.	Kambalda	-31.2166	121.6667
WAM S3618	Eupulmonata	Bothriembryontidae	*Bothriembryon* sp. indet.	Lake Cowan	-31.7666	121.9
WAM S8137	Eupulmonata	Bothriembryontidae	*Bothriembryon* sp. indet.	Lake Cowan	-31.7666	121.9
PES 17751	Eupulmonata	Bothriembryontidae	*Bothriembryon* sp. indet.	Lake Lefroy	-31.38994	121.7573222
WAM S9368	Eupulmonata	Bothriembryontidae	*Bothriembryon* sp. indet.	McDermid Rock	-32.0166	120.7333
WAM S7950	Eupulmonata	Bothriembryontidae	*Bothriembryon* sp. indet.	Mount Charles	-30.5833	122.5167
WAM S1750	Eupulmonata	Bothriembryontidae	*Bothriembryon* sp. indet.	Norseman	-32.2	121.9333
WAM S30885	Eupulmonata	Bothriembryontidae	*Bothriembryon* sp. indet.	Norseman	-32.1833	121.7667
WAM S30989	Eupulmonata	Bothriembryontidae	*Bothriembryon* sp. indet.	Norseman	-32.0833	121.9333
WAM S30990	Eupulmonata	Bothriembryontidae	*Bothriembryon* sp. indet.	Norseman	-32.2	121.9833
WAM S3619	Eupulmonata	Bothriembryontidae	*Bothriembryon* sp. indet.	Norseman	-32.2	121.9833
WAM S8044	Eupulmonata	Bothriembryontidae	*Bothriembryon* sp. indet.	Norseman	-32.0833	121.9333
WAM S8054	Eupulmonata	Bothriembryontidae	*Bothriembryon* sp. indet.	Norseman	-32.1166	121.7833
WAM S8060	Eupulmonata	Bothriembryontidae	*Bothriembryon* sp. indet.	Norseman	-31.95	121.9
WAM S8083	Eupulmonata	Bothriembryontidae	*Bothriembryon* sp. indet.	Norseman	-32.0333	121.8667
WAM S8135	Eupulmonata	Bothriembryontidae	*Bothriembryon* sp. indet.	Norseman	-32.2	122
WAM S3620	Eupulmonata	Bothriembryontidae	*Bothriembryon* sp. indet.	Widgiemooltha	-31.4833	121.5333
WAM S9390	Eupulmonata	Bothriembryontidae	*Bothriembryon* sp. indet.	Widgiemooltha	-31.4833	121.5333
WAM S9373	Eupulmonata	Bothriembryontidae	*Bothriembryon* sp. indet.	Woodline	-31.8833	122.4833

Source (registration)[1]	Order	Family	Genus and species	Location	Latitude (GDA94)[2]	Longitude (GDA94)[2]
WAM S9374	Eupulmonata	Bothriembryontidae	*Bothriembryon* sp. indet.	Woodline	-31.8166	122.4
WAM S9375	Eupulmonata	Bothriembryontidae	*Bothriembryon* sp. indet.	Woodline	-31.9	122.55
WAM S6392	Eupulmonata	Camaenidae	*Sinumelon* cf. *jimberlanensis*	Beacon Hill	-32.1833	121.7833
WAM S61458	Eupulmonata	Camaenidae	*Sinumelon* cf. *jimberlanensis*	Coolgardie	-31.0704	121.4621
WAM S61459	Eupulmonata	Camaenidae	*Sinumelon* cf. *jimberlanensis*	Coolgardie	-31.0882	121.4658
WAM S61460	Eupulmonata	Camaenidae	*Sinumelon* cf. *jimberlanensis*	Coolgardie	-31.0816	121.4749
WAM S61463	Eupulmonata	Camaenidae	*Sinumelon* cf. *jimberlanensis*	Coolgardie	-31.07	121.4549
WAM S66450	Eupulmonata	Camaenidae	*Sinumelon* cf. *jimberlanensis*	Jimberlana Hill	-32.1471	121.815
WAM S8764	Eupulmonata	Camaenidae	*Sinumelon* cf. *jimberlanensis*	Jimberlana Hill	-32.1594	121.8108
WAM S84119	Eupulmonata	Camaenidae	*Sinumelon* cf. *jimberlanensis*	Mt Edward	-31.4702	121.5439
WAM S6394	Eupulmonata	Camaenidae	*Sinumelon* cf. *jimberlanensis*	Norseman	-32.2	122.2
WAM S6395	Eupulmonata	Camaenidae	*Sinumelon* cf. *jimberlanensis*	Norseman	-32.15	121.7833
WAM S42915	Eupulmonata	Camaenidae	*Sinumelon* cf. *jimberlanensis*	Widgiemooltha	-31.4608	121.5005
WAM S6454	Eupulmonata	Camaenidae	*Sinumelon* cf. *jimberlanensis*	Beacon Hill	-32.1833	121.7833
WAM S6448	Eupulmonata	Camaenidae	*Sinumelon* cf. *jimberlanensis*	Coolgardie	-30.95	121.15
WAM S33137	Eupulmonata	Camaenidae	*Sinumelon* cf. *jimberlanensis*	Credo Station	-30.4329	120.6599
WAM S33139	Eupulmonata	Camaenidae	*Sinumelon* cf. *jimberlanensis*	Credo Station	-30.425	120.8342
WAM S33141	Eupulmonata	Camaenidae	*Sinumelon* cf. *jimberlanensis*	Credo Station	-30.4263	120.8423
WAM S33147	Eupulmonata	Camaenidae	*Sinumelon* cf. *jimberlanensis*	Credo Station	-30.4298	120.6803

Source (registration)[1]	Order	Family	Genus and species	Location	Latitude (GDA94)[2]	Longitude (GDA94)[2]
WAM S33162	Eupulmonata	Camaenidae	*Sinumelon* cf. *jimberlanensis*	Credo Station	-30.4192	120.8905
WAM S6412	Eupulmonata	Camaenidae	*Sinumelon* cf. *jimberlanensis*	Kambalda	-31.2166	121.6667
WAM S6441	Eupulmonata	Camaenidae	*Sinumelon* cf. *jimberlanensis*	Karonie	-30.8666	122.65
WAM S1367	Eupulmonata	Camaenidae	*Sinumelon* cf. *jimberlanensis*	Lake Gidgie	-30.6333	121.4667
WAM S14760	Eupulmonata	Camaenidae	*Sinumelon* cf. *jimberlanensis*	Norseman	-32.2	121.7833
WAM S88407	Eupulmonata	Camaenidae	*Sinumelon* sp. indet.	Binduli	-30.8577	121.3988
WAM S88408	Eupulmonata	Camaenidae	*Sinumelon* sp. indet.	Binduli	-30.7959	121.3798
WAM S88410	Eupulmonata	Camaenidae	*Sinumelon* sp. indet.	Binduli	-30.8599	121.4243
WAM S88411	Eupulmonata	Camaenidae	*Sinumelon* sp. indet.	Binduli	-30.8273	121.4043
WAM S33165	Eupulmonata	Camaenidae	*Sinumelon* sp. indet.	Credo Station	-30.5007	120.7406
WAM S84009	Eupulmonata	Camaenidae	*Sinumelon* sp. indet.	Widgiemooltha	-31.4354	121.5297
PES 10616	Scorpiones	Buthidae	*Lychas* `SIGM132`	Lake Lefroy	-31.22606	121.6753778
PES 10617	Scorpiones	Buthidae	*Lychas* `SIGM132`	Lake Lefroy	-31.3900352	121.7576716
PES 17931	Scorpiones	Buthidae	*Lychas* `SIGM132`	Lake Lefroy	-31.4222933	121.7808018
PES 10618	Scorpiones	Urodacidae	*Urodacus* "SIGM131`	Lake Lefroy	-31.4980451	121.7141406
PES 15000	Scorpiones	Urodacidae	*Urodacus* `lefroy`	Lake Lefroy	-31.4701056	121.7465806
PES 15001	Scorpiones	Urodacidae	*Urodacus* `lefroy`	Lake Lefroy	-31.4688278	121.7436028
WAM T1340	Scorpiones	Urodacidae	*Urodacus* sp. indet.	Bulong	-30.75	121.8
WAM T3298	Scorpiones	Urodacidae	*Urodacus* sp. indet.	Bulong; Hampton Hill station	-30.75	121.8

Source (registration)[1]	Order	Family	Genus and species	Location	Latitude (GDA94)[2]	Longitude (GDA94)[2]
WAM T109012	Scorpiones	Urodacidae	*Urodacus* sp. indet.	ca. 50 km ESE. of Kalgoorlie	-30.8994	121.938
WAM T1000	Scorpiones	Urodacidae	*Urodacus* sp. indet.	Hampton Hill Station; Bulong	-30.75	121.75
WAM T1001	Scorpiones	Urodacidae	*Urodacus* sp. indet.	Hampton Hill Station; Bulong	-30.75	121.75
WAM T1002	Scorpiones	Urodacidae	*Urodacus* sp. indet.	Hampton Hill Station; Bulong	-30.75	121.75
WAM T1003	Scorpiones	Urodacidae	*Urodacus* sp. indet.	Hampton Hill Station; Bulong	-30.75	121.75
WAM T1004	Scorpiones	Urodacidae	*Urodacus* sp. indet.	Hampton Hill Station; Bulong	-30.75	121.75
WAM T586	Scorpiones	Urodacidae	*Urodacus* sp. indet.	Hampton Hill Station; Bulong	-30.75	121.75
WAM T992	Scorpiones	Urodacidae	*Urodacus* sp. indet.	Hampton Hill Station; Bulong	-30.75	121.75
WAM T993	Scorpiones	Urodacidae	*Urodacus* sp. indet.	Hampton Hill Station; Bulong	-30.75	121.75
WAM T994	Scorpiones	Urodacidae	*Urodacus* sp. indet.	Hampton Hill Station; Bulong	-30.75	121.75
WAM T995	Scorpiones	Urodacidae	*Urodacus* sp. indet.	Hampton Hill Station; Bulong	-30.75	121.75
WAM T996	Scorpiones	Urodacidae	*Urodacus* sp. indet.	Hampton Hill Station; Bulong	-30.75	121.75
WAM T997	Scorpiones	Urodacidae	*Urodacus* sp. indet.	Hampton Hill Station; Bulong	-30.75	121.75
WAM T998	Scorpiones	Urodacidae	*Urodacus* sp. indet.	Hampton Hill Station; Bulong	-30.75	121.75
WAM T999	Scorpiones	Urodacidae	*Urodacus* sp. indet.	Hampton Hill Station; Bulong	-30.75	121.75
WAM T99729	Scorpiones	Urodacidae	*Urodacus* sp. indet.	Lake Lefroy Junction; Recovery; 6 km SE. of Kambalda; site 5	-31.4702	121.747

1 – WAM – Western Australian Museum; SAM – South Australian Museum (from Framenau & Hudson 2017); PES – Phoenix Environmental Sciences.

2 – UTM coordinates not available through WA Museum database searches.

Appendix 4 Short-range invertebrate target taxa recorded during survey

Phoenix database	Order	Family	Genus and species	SRE	Number	Site	Northing (Zone 51)	Easting (Zone 51)
28965	Araneae	Idiopidae	*Aganippe* sp. indet.	Potential	1	12	6523497	385475
28971	Araneae	Lycosidae	*Hoggicosa storri*		1	04	6534815	366142
28969	Araneae	Lycosidae	Lycosidae sp. indet.		1	01	6537485	378739
28957	Araneae	Lycosidae	Lycosidae sp. indet.		1	13	6513998	384405
28967	Araneae	Lycosidae	Lycosidae sp. indet.		1	04	6534815	366142
29394	Araneae	Lycosidae	*Tetralycosa baudinettei*	Confirmed	1	17	6544487	373434
29392	Araneae	Lycosidae	*Tetralycosa baudinettei*	Confirmed	1	15	6535583	367340
29393	Araneae	Lycosidae	*Tetralycosa baudinettei*	Confirmed	1	17	6544487	373434
29391	Araneae	Lycosidae	*Tetralycosa* sp. indet.	Potential	1	Opp03	6543206	379100
29400	Araneae	Lycosidae	*Tetralycosa* sp. indet.	Potential	1	15	6535583	367340
29401	Araneae	Lycosidae	*Tetralycosa* sp. indet.	Potential	1	15	6535583	367340
28959	Araneae	Lycosidae	*Tetralycosa* sp. indet.	Potential	1	Opp08	6542906	379089
28963	Araneae	Nemesiidae	*Aname* sp. Indet.	Potential	1	12	6523497	385475
28958	Araneae	Nemesiidae	*Kwonkan* sp. indet.	Potential	1	07	6545425	373316
29399	Araneae	Salticidae	*Maratus* 'PES0340'	Potential	1	14	6514869	374785
29403	Araneae	Salticidae	*Maratus* 'PES0340'	Potential	1	14	6514869	374785
29397	Araneae	Salticidae	*Maratus* 'PES0340'	Potential	1	14	6514869	374785
29402	Araneae	Salticidae	*Maratus* 'PES0340'	Potential	1	14	6514869	374785

29396	Araneae	Salticidae	*Maratus* 'PES0340'	Potential	1	14	6514869	374785
29398	Araneae	Salticidae	*Maratus* 'PES0340'	Potential	1	18	6529086	379952
29395	Araneae	Salticidae	*Maratus* 'PES0340'	Potential	1	18	6529086	379952
28962	Araneae	Sparassidae	*Neosparassus* sp. indet.		1	01	6537485	378739
28970	Araneae	Zodariidae	Zodariidae sp. indet.		1	01	6537485	378739
28968	Araneae	Zodariidae	Zodariidae sp. indet.		1	02	6541602	378960
28954	Hymenoptera	Formicidae	*Iridomyrmex* sp. indet.		1	15	6535583	367340
28961	Isopoda	Armadillidae	*Buddelundia* '39'		1	03	6543379	379092
28960	Isopoda	Armadillidae	*Buddelundia* '39'		1	09	6525587	388747