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RAVENSTHORPE NICKEL PROJECT: SIGNIFICANT FAUNA MONITORING PROGRAM 2021

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Revision Schedule

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Executive Summary

First Quantum Minerals Ltd (FQM) commissioned Stantec Australia Pty Ltd to conduct a survey of significant fauna species in the vicinity of the Ravensthorpe Nickel Operations. The Survey was designed to meet regulatory requirements predominantly relating to the following species (conservation codes under the EPBC, BC Act and DBCA provided respectively):

- Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) (EN, EN);
- Malleefowl (*Leipoa ocellata*)(VU, VU);
- Chuditch (*Dasyurus geoffroii*)(VU, VU);
- Heath Mouse (*Pseudomys shortridgei*)(EN, VU);
- Western Mouse (*Pseudomys occidentalis*) (P4);
- Western Brush Wallaby (*Notamacropus irma*) (P4); and
- Western Whipbird (*Psophodes nigrogularis oberon*) (P4).

The specific objectives of this survey were to:

- Conduct a fauna survey at the locations that were established during the 2019 baseline survey, to monitor significant fauna and feral predators;
- Utilise a 'mark recapture' technique with PIT tags or ear notching during the field survey to provide quantitative data on demographics and distribution of the following species when trapped; Chuditch, Heath Mouse and Western Mouse; and
- Record the survey results in the population dataset to compare changes of significant fauna species over time, in relation to Project developments and environmental variables.

The Survey Area for this monitoring program comprised the areas surveyed by the Stantec (2019a) fauna survey and surrounds. This Survey Area encompassed:

- areas of historical mining;
- areas of mining as part of the Shoemaker Levy expansion; and
- areas of suitable habitat identified in the surrounding area.

During the Survey 14 targeted sites were monitored, comprising six impact sites and eight control sites. Four sites (three impact; one control) were not monitored during the Survey due to timing constraints and access issues associated with the ongoing construction of the Shoemaker Levy. The impact sites occur near historical, current, and proposed mining areas, and as mine expansion continues, these sites will allow any future impacts to be detected. Construction of the Shoemaker Levy began in late June 2020 and 201.2 ha of vegetation has been cleared as of December 2020.

Chuditch monitoring sites were monitored at seven locations within appropriate Chuditch habitat. Three of these sites were close to current or proposed mining activity and are referred to as 'impact' sites. The remaining four monitoring sites were located outside any current or proposed disturbance and represent 'control' sites. Ten large cage traps were deployed at each site for four consecutive nights, equating to a total of 280 trap nights for the Survey.

Western Mouse and Heath Mouse monitoring sites were established at seven locations within appropriate habitat. Three of these were established near current or proposed mining activity and are referred to as 'impact' sites. The remaining four monitoring sites were located outside any proposed or historical mining disturbance and represent 'control' sites. Twenty small Elliot traps were deployed at each Mouse monitoring site for four consecutive nights, equating to a total of 560 trap nights for the Survey.

Additional survey techniques were conducted to compliment trapping and confirm presence and distribution of species across the Survey Area. Five motion-sensor cameras were deployed at each

Chuditch monitoring site and one motion-sensor camera was deployed at each Mouse monitoring site. In total, motion-sensor cameras were deployed at 56 locations for four consecutive nights each, equating to a total of 168 recording nights for the Survey. In total, eight Malleefowl mound assessments were undertaken at known active and inactive mounds and were compared with previous assessments to determine Malleefowl presence and activity.

Four Chuditch were captured on five occasions during the Survey, which equates to a trapping success rate of 1.79% and was the highest trapping success rate to date. All four Chuditch captured during the Survey were in good condition and comprised two mature males, one juvenile female, and one individual of unknown sex that escaped from the cage during processing. The Chuditch captured during the Survey had not been PIT tagged during previous surveys, however the individual that escaped during processing was unable to be scanned. In addition to the four Chuditch captured during the Survey, a fifth Chuditch was observed deceased on South Coast Highway nearby to clearing for Shoemaker-Levy The individual was an untagged mature male which had been struck and killed by vehicle. Chuditch presence was also recorded via motion cameras on seven occasions at two Chuditch trapping sites and at one Heath/Western Mouse trapping site. No Chuditch were captured between 2013 and 2015 but have been caught each year since then.

No Western Mouse or Heath Mouse individuals were captured or confirmed via motion-sensor cameras during the Survey. The Heath Mouse has been recorded in the Survey Area only once following the 2003 fire in 2010. The Western Mouse has been recorded in the Survey Area once during the 2017 monitoring survey and on six occasions in the surrounds between 1998 to 2017. Of these, three records occurred post 2003. This indicates that recent events such as fire are potentially limiting Heath Mouse and Western Mouse populations/habitat suitability.

Three Malleefowl mounds were assessed as 'active' during the Survey, a decrease from the four active mounds recorded in 2020 and five active mounds recorded in 2019. One mound, classified as inactive between 2017 and 2020, had been cleared for construction of the Shoemaker Levy. The Carnaby's Black Cockatoo was not recorded during the Survey.

The Western Brush Wallaby was recorded on 19 occasions during the Survey, compared with 20 occasions in 2020 and 12 locations in 2019. Of the 19 records from the Survey, three were carcasses located on South Coast Highway.

Western Whipbirds were recorded from 48 locations during the Survey. Male and female whipbird duet calling was recorded on 12 occasions. In comparison, Western Whipbirds were recorded on 34 occasions in 2020 and on eight occasions in 2019 within the Survey Area. A single Peregrine Falcon was opportunistically recorded on the Dingo proof fence on the northern boundary of the Survey Area. The Peregrine Falcon was last recorded within the Survey Area in 2018.

The Survey utilised survey sites established during the 2019 baseline survey, to conduct annual monitoring of significant fauna and feral predators occurring within the Survey Area. Annual monitoring will accurately capture potential impacts from mining activity while controlling for environmental factors, through the utilisation of appropriate impact and control sites. Continued annual monitoring at impact and control sites will clarify whether any populations are influenced by current and future mining operations undertaken for the Project.

Due to the short period of time between the commencement of clearing (June 2020) and this Survey, it is too early to draw any substantial conclusions on whether mining might be impact on significant species within the Survey Area. However, to date, detections of significant fauna during the Survey are comparable to those detected over the past two years that Stantec have been conducting the surveys. In particular, Chuditch, Malleefowl, Western Brush Wallaby and Western Whipbirds have been regularly recorded in all years, confirming ongoing presence within the Survey Area.

1.0 Introduction

1.1 Project Background

The First Quantum Minerals Ltd (FQM) Ravensthorpe Nickel Operation (RNO) Project (the Project) is an open-pit Nickel mine and primary processing plant located in the Esperance region of Western Australia, 550 km south east of Perth. The Project commenced development in 2004 and began active mining in 2008 under the ownership of BHP Billiton, before being entirely acquired by FQM in 2010. In 2017, the mine was placed in to 'care and maintenance' due to persistently low nickel prices. FQM restarted mining operations at RNO in early 2020. Clearing of native vegetation for the construction of the new Shoemaker-Levy Mine, located to the north-west of the existing mine area, began in late June 2020 (Figure 2-2).

Stantec Australia Pty Ltd (Stantec), was engaged to conduct the significant species fauna monitoring program for 2021 (the Survey). The Survey was designed to meet the following requirements of the Environmental Protection Authority (EPA), while aligning with existing and anticipated fauna monitoring conditions for the Project:

- Ministerial Statement 633 (MS 633) EPA (2003)
  - Condition 7-1: Monitor the Heath Rat (*Pseudomys shortridgei*) (EN, VU) and the Western Mouse (*Pseudomys occidentalis)* (P4);
- Environmental Scoping Document (ESD) (EPA 2017a)
  - Work Item 32a: to monitor the health and population sizes of threatened species within the development envelope and in areas of indirect impact, in particular, the following species (which are all Matters of National Environmental Significance [MNES]):
    - Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) (EN, EN);
    - Heath Mouse (*Pseudomys shortridgei*) (EN, VU); and
    - Chuditch (*Dasyurus geoffroii*) (VU, VU).
- Potential monitoring requirements of known active or inactive mounds of the Malleefowl (*Leipoa ocellata*) (Vulnerable) in the vicinity of the Project; and
- Opportunistic recording of other significant species including the;
  - Western Whipbird (*Psophodes nigrogularis oberon*) (P4); and
  - Western Brush Wallaby (*Notamacropus irma*) (P4).

MS 633 (EPA 2003) and the ESD for the Project (EPA 2017a) used conservation schedules under The Wildlife Conservation (Specially Protected Fauna) Notice 2018. These schedules have been updated under regulations 170, 171 and 172 of the Biodiversity Conservation Regulations 2018 to be the lists of Threatened, Extinct and Specially Protected species (Appendix A). This report uses the current listings recognised under the Biodiversity Conservation Act 2016 rather than the previous listings used in MS633 and the ESD. The Survey Area for the Project comprised areas previously surveyed during the Stantec (2019a) fauna survey and surrounds (Figure 1-1). The Survey Area encompassed:

- historic mining and existing impacts;
- current and future disturbance associated with the Shoemaker Levy expansion; and
- suitable surrounding habitat identified as control areas.

A baseline fauna survey was initially undertaken in 2013 and annual monitoring surveys were conducted by Terrestrial Ecosystems from 2014 to 2017 (Terrestrial Ecosystems 2013, 2014, 2015, 2016a, 2017a). Following these surveys, Stantec conducted a Level 1 targeted significant fauna survey to infill

survey gaps and to better inform an environmental impact assessment for the Project. Subsequently, a new baseline monitoring program was designed and conducted (Stantec 2019a, b) which took into account the proposed impacts of the Project and would be better able to monitor potential impacts to significant fauna over time. The Survey is a continuation of the Stantec (2019a), Stantec (2019b), and Stantec (2020) surveys.

1.1.1 Historic Survey Effort

The Project has been extensively surveyed (BHPBIO 2006, Biota 2000, 2005, Coffey Environments 2009, 2010, Stantec 2019a, Terrestrial Ecosystems 2013, 2014, 2015, 2016a, b, 2017a, b, 2018). A comprehensive summary of the baseline survey and annual monitoring surveys conducted for the Project is provided in Stantec (2019a). Records of significant species confirmed for the Project are summarised in Figure 1-1 and Table 1-1.

During the literature review by Stantec (2019a), a number of inconsistencies were identified between the annual monitoring surveys (Terrestrial Ecosystems 2013, 2014, 2015, 2016a, 2017a). These inconsistencies comprised the location and number of sites monitored, the survey methods used, and intensity of surveying undertaken between years. These inconsistencies resulted in the inability to compare records of significant fauna accurately and rigorously over time. The lack of consistent linking between significant species and habitats of importance in many previous surveys was of particular concern (Biota 2005, Coffey Environments 2009, 2010, Terrestrial Ecosystems 2013, 2014, 2015, 2016a, b, 2017a, b, 2018). Additionally, monitoring sites were changed by Terrestrial Ecosystems (2017a) to better represent the dominant habitats present near the Project and not in areas that will be cleared for the Project. The Terrestrial Ecosystems (2017a) monitoring survey concentrated trap sites near existing clearing and infrastructure for the Project, resulting in a reduced spatial coverage and a biased survey design that would allow for a standardised comparison between impacted and reference sites.

Due to these issues, the Survey was redesigned by Stantec (2019b) to better meet regulatory conditions and assess the proposed impacts from the expansion of the Project (incorporating previous sites and methodology where possible). Consequently, the results from the Stantec (2019b) and Stantec (2020) surveys will not be directly comparable to those of previous surveys. However, the survey data collected from previous monitoring still provides contextual data on the occurrence of species.

1.2 Survey Scope and Objectives

The overarching objective of the Survey was to meet the requirements of condition 7-1 of MS633 and item 32a of the ESD for the project (EPA 2017a). The specific objectives of the program were to:

- conduct a fauna survey at the locations that were established during the Stantec (2019a) baseline survey, to monitor significant fauna and feral predators;
- utilize a 'mark recapture' technique with pit tags or ear notching to provide quantitative data on demographics and distribution of the following species: Chuditch, Heath Mouse and Western Mouse;
- assess the activity of known Malleefowl mounds previously assessed by Stantec (2019a); and
- record the survey results in the population dataset to compare changes of significant fauna species over time, in relation to project developments and environmental variables.

Table 1-1: Significant species records from previous monitoring surveys of the RNO.

Reference	Survey Details	Survey Effort and Methods	Significant Species
Terrestrial Ecosystems (2013)	**Location**: Ravensthorpe Nickel Operations **Survey type**: Annual monitoring baseline survey; trapping, camera trapping, Western Whipbird assessment **Survey dates**: Trapping 14/10 - 19/10/2013	**Trapping**: • 500 box traps – 2,500 trap nights • 100 cage traps – 500 trap nights **Western Whipbird**: • 11 sites **Motion camera**: • Eight deployed at breakaway – 16 trap nights	• Western Whipbird (*Psophodes nigrogularis oberon* [P4]) ○ Ten locations - Monitoring sites • Western Brush Wallaby (*Notamacropus irma* [P4]) - Opportunistic
Terrestrial Ecosystems (2014)	**Location**: Ravensthorpe Nickel Operations **Survey type**: Annual monitoring; trapping, camera trapping, Western Whipbird assessment **Survey dates**: Trapping: 12/09 - 18/09/2014	**Trapping**: • 500 box traps – 2,500 trap nights • 100 cage traps – 500 trap nights **Western Whipbird**: • 10 sites **Motion camera**: • 50 deployed - 1,550 trap nights	• Western Brush Wallaby (*Notamacropus irma* [P4]) ○ Six sites - Motion camera • Western Whipbird (*Psophodes nigrogularis oberon* [P4]) ○ Eight locations - Monitoring sites ○ Five occasions - Opportunistic • Malleefowl (*Leipoa ocellata* [VU, VU]) ○ One location - Opportunistic ○ Two sites - Motion camera • Carnaby**'s Cockatoo (***Calyptorhynchus latirostris* [EN, EN]) ○ One site - Motion camera
Terrestrial Ecosystems (2015)	**Location**: Ravensthorpe Nickel Operations **Survey type**: Annual monitoring; trapping, camera trapping, Western Whipbird assessment **Survey dates**: Trapping: 13/10 - 19/10/2015	**Trapping** • 500 box traps – 2,500 trap nights • 100 cage traps – 500 trap nights **Western Whipbird**: • 10 sites **Motion camera**: • 50 deployed – 1,550 trap nights	• Chuditch (*Dasyurus geoffroii* [VU, VU]) ○ Four sites - Motion camera • Western Brush Wallaby (*Notamacropus irma* [P4]) ○ Six sites - Motion camera • Western Whipbird (*Psophodes nigrogularis oberon* [P4]) ○ One site - Motion camera ○ Eight occasions - Monitoring site ○ One location - Opportunistic • Carn**aby's Cockatoo (***Calyptorhynchus latirostris* [EN, EN])

Reference	Survey Details	Survey Effort and Methods	Significant Species
Terrestrial Ecosystems (2016a)	Location: Ravensthorpe Nickel Operations Survey type: Annual monitoring; trapping, camera trapping, Western Whipbird assessment. Feral animal trapping Survey dates: 15/11 - 21/11/2016	Trapping • 500 box traps – 2,500 trap nights • 100 cage traps and 119 feral trapping cage traps – 1,095 trap nights Western Whipbird: • 10 sites Motion camera: • 50 deployed – 1,550 trap nights	• Chuditch (*Dasyurus geoffroii* [VU, VU]) ○ Seven captures - Trapping ○ Five sites - Motion camera • Malleefowl (*Leipoa ocellata* [VU, VU]) ○ One location - Opportunistic ○ Five sites - Motion camera • Western Brush Wallaby (*Notamacropus irma* [P4]) ○ Six sites - Motion camera • Western Whipbird (*Psophodes nigrogularis oberon* [P4]) ○ Eight locations - Monitoring site ○ 10 occasions - Opportunistic • **Carnaby's Cockatoo (***Calyptorhynchus latirostris* [EN, EN])
Terrestrial Ecosystems (2017a)	Location: Ravensthorpe Nickel Operations Survey type: Annual monitoring; trapping, camera trapping, Western Whipbird assessment Survey dates: Trapping 02/11 - 07/11/2017	Trapping • 450 box traps – 2,250 trap nights • 150 cage traps – 750 trap nights Western Whipbird: • 12 sites Motion camera: • 90 deployed – 3,600 trap nights	• Chuditch (*Dasyurus geoffroii* [VU, VU]) ○ 16 captures - Trapping ○ 24 locations - Motion camera • Western Whipbird (*Psophodes nigrogularis oberon* [P4]) ○ 10 locations - Monitoring site ○ 18 occasions - Opportunistic • Malleefowl (*Leipoa ocellata* [VU, VU]) ○ One location - Motion camera • Western Brush Wallaby (*Notamacropus irma* [P4]) ○ 77 locations - Motion camera • Western Mouse (Pseudomys occidentalis [P4]) ○ One individual - Trapping • **Carnaby's Cockatoo (***Calyptorhynchus latirostris* [EN, EN])

Reference	Survey Details	Survey Effort and Methods	Significant Species
Stantec (2019b)	**Location**: Ravensthorpe Nickel Operations **Survey type**: Annual monitoring; trapping, camera trapping, Western Whipbird assessment, Malleefowl mound assessment **Survey dates**: 04/02/2019 – 15/02/2019	**Trapping** • 180 box traps – 720 trap nights • 60 cage traps – 240 trap nights **Motion camera**: 38 deployed – 507 trap nights	• Chuditch (*Dasyurus geoffroii* [VU, VU]) ○ Five captures - Trapping ○ Five locations - Motion camera • Western Whipbird (*Psophodes nigrogularis oberon* [P4]) ○ Eight occasions - Opportunistic • Malleefowl (*Leipoa ocellata* [VU, VU]) ○ Two locations - Motion camera ○ Two occasions - Opportunistic • Western Brush Wallaby (*Notamacropus irma* [P4]) ○ Five occasions - Opportunistic ○ Seven locations - Motion camera
(Stantec 2020)	**Location**: Ravensthorpe Nickel Operations **Survey type**: Annual monitoring; trapping, camera trapping, Western Whipbird assessment, Malleefowl mound assessment **Survey dates**: 03/02/2020 – 13/02/2020	**Trapping** • 200 box traps – 800 trap nights • 80 cage traps – 320 trap nights **Motion camera**: 56 deployed – 248 trap nights	• Chuditch (*Dasyurus geoffroii* [VU, VU]) ○ Two captures - Trapping ○ Nine locations - Motion camera • Western Whipbird (*Psophodes nigrogularis oberon* [P4]) ○ 34 occasions - Opportunistic • Malleefowl (*Leipoa ocellata* [VU, VU]) ○ Seven occasions - Opportunistic • Western Brush Wallaby (*Notamacropus irma* [P4]) ○ 16 occasions - Opportunistic ○ Four locations - Motion camera • **Carnaby's Cockatoo (Calyptorhynchus latirostris [EN, EN])** ○ Three occasions - Opportunistic

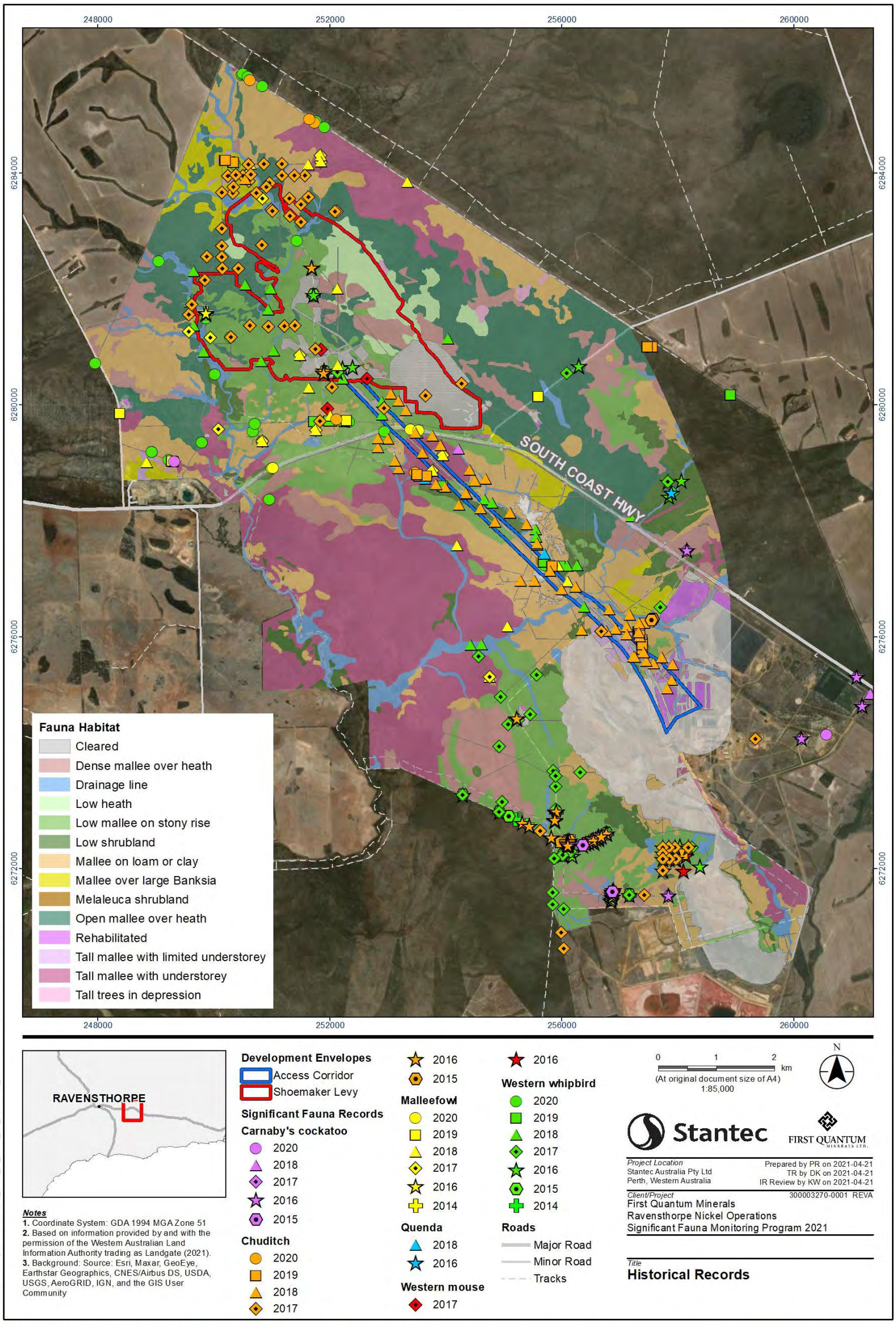

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Figure 1-1: Previous significant fauna survey records for the Project

2.0 Methods

The existing environment of the Project has been documented previously by Stantec (2019b). This includes a summary of the biogeographic region, climate, land systems and land use, as well as conservation reserves and environmentally sensitive areas. This Survey continues the annual monitoring methodology utilised by Stantec (2019b) and Stantec (2020), and to monitor significant species in the Survey Area.

2.1 Field Survey

2.1.1 Timing

The field survey conducted over 15 days from the 23rd of February to the 9th of March 2021. The survey timing was appropriate for the species being targeted during the Survey. Trapping was conducted outside the season when Chuditch females will have pouch or den young (mid-August to mid-November). The timing coincided with dispersal of juvenile Chuditch (September-May) (Soderquist and Serena 2000) and preceding heavy rainfall, avoiding the restriction of nocturnal foraging by Chuditch (DEC 2012a). The Survey was also conducted when Carnaby's Black Cockatoo's are known to forage along the south coast (January to July) (DotEE 2017).

2.1.2 Survey Team and Licensing

The field survey was conducted by experienced zoologists Kyle Wood (Survey Lead) and Scott Pansini (Project Zoologist). Kyle has more than three years' experience as a zoologist and has previously conducted targeted surveys for threatened species in Western Australia, including the Western Whipbird. Scott Pansini has three years' experience as a zoologist, with considerable experience conducting targeted surveys for Malleefowl and small mammals. Both Kyle and Scott conducted the Stantec (2020) RNO monitoring program and are familiar with the survey methods including trapping, PIT tagging, motion camera use and avifauna identification.

The Survey was conducted in accordance with the conditions set out in Fauna Taking (Biological Assessment) License Number BA27000372. Authorization to take or Disturb Threatened Species was approved through Authorization Number TFA 2020-0008-2.

2.1.3 Climate and Weather

In the six months preceding the Survey (August 2020 to January 2021), Ravensthorpe weather station (010633), located approximately 30 km east of the Survey Area, recorded 182.9 mm of rainfall, which was 20.8 mm lower than the long-term annual average rainfall of 203.7 mm for the same period (BoM 2021) (Figure 2-1). Rainfall in February was above the long-term average by 12.2 mm, with 28.4 mm of rainfall recorded at Ravensthorpe weather station on the 7th of February (BoM 2021).

Local weather conditions during the Survey were variable, with maximum daily temperatures ranging from 23.0 ºC to 36.5 ºC, of which three days were over 30.0 ºC. Minimum daily temperatures ranged from 14.5 ºC to 18.5 ºC. A total of 22.2 mm of rainfall was recorded at Ravensthorpe weather station during the Survey, with 8.2 mm recorded on the 4th of March. Relative humidity (recorded only at 0900) ranged between 38 and 98% during the Survey (Table 2-1) (BoM 2021).

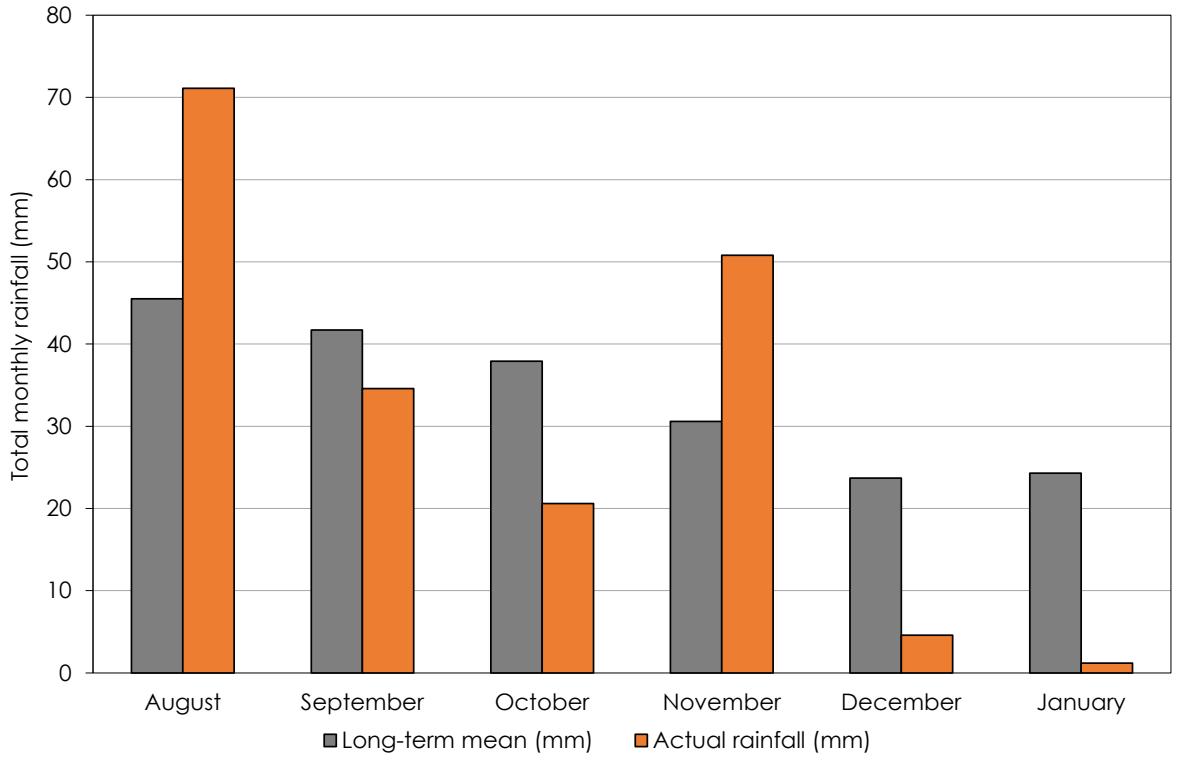

Figure 2-1: Long-term average and pre-survey rainfall recorded at Ravensthorpe (BoM 2021).

Table 2-1: Daily weather observations recorded at Ravensthorpe during the Survey (BoM 2021).

Date	Temperature (°C)		Rainfall (mm)	Humidity (%)
	Minimum	Maximum		
23-02-21	15.0	36.5	0	38
24-02-21	15.0	29.2	0	78
25-02-21	14.5	33.0	0	61
26-02-21	15.0	24.4	0	76
27-02-21	15.3	23.0	0	94
28-02-21	14.9	24.0	1.4	90
01-03-21	15.0	24.0	0	76
02-03-21	15.5	27.0	4.2	85
03-03-21	18.0	30.3	0	81
04-03-21	18.0	24.0	8.2	91
05-03-21	18.5	28	5.2	75
06-03-21	18	24	0.4	98
07-03-21	17	22.5	2	97
08-03-21	16.5	25.2	0.8	81
09-03-21	15	29.3	0	72
Average	16.1	27.0	1.5	79.5

2.1.4 Survey Site Locations

A total of 18 targeted monitoring sites, comprising eight Chuditch sites and ten Heath/Western Mouse monitoring sites, were established within the Survey Area by Stantec (2019b) and Stantec (2020) (Table 2-2). Initially, 15 targeted trapping sites were established by Stantec (2019b), with an additional three targeted monitoring sites being added to the program during the Stantec (2020) Survey. Monitoring sites were installed in areas of high-quality habitat for the targeted species, across both control and impact areas, whilst also taking into consideration records from previous surveys conducted in the Survey Area (BHPBIO 2006, Biota 2000, 2005, Coffey Environments 2009, 2010, Stantec 2019a, b, Terrestrial Ecosystems 2013, 2014, 2015, 2016a, b, 2017a, b, 2018). Nine sites within the Survey Area were close to current or proposed mining disturbance and are referred to as 'impact' sites. The other nine sites were in areas that are unlikely to be directly or indirectly impacted by current or proposed mining activities, and therefore represent 'control' sites (Table 2-2). This survey design allows for the comparison of significant fauna trends between control and impact areas, as well as over time, particularly in relation to before and after clearing in impact areas.

Of the 18 targeted monitoring sites, 14 were monitored during the Survey, comprising 7 Chuditch cage trapping sites (4 Control; 3 Impact) and 7 Heath/Western Mouse Elliot trapping sites (4 Control, 3 Impact) (Table 2-2). Four sites were not monitored during the Survey due to timing constraints and access issues associated with the ongoing construction of the Shoemaker Levy (Section 3.3).

Table 2-2: Targeted monitoring site locations and survey effort for the Survey.

Site	Target	Type	Trap Nights			Location (UTM)	
			Elliot	Cage	Camera	Easting	Northing
B	Chuditch	Control	-	40	20	256135	6272396
N	Chuditch	Control	-	40	20	257466	6280948
Q	Chuditch	Control	-	40	20	248949	6282487
R	Chuditch	Control	-	40	20	250381	6285755
D	Chuditch	Impact	-	40	20	257344	6276023
E	Chuditch	Impact	-	40	20	253675	6278713
J*	Chuditch	Impact	-	-	-	250343	6284181
L	Chuditch	Impact	-	40	20	252254	6279715
C	Mouse	Control	80	-	4	253352	6273692
G	Mouse	Control	80	-	4	249049	6279114
M	Mouse	Control	80	-	4	258864	6280074
O	Mouse	Control	80	-	4	247945	6280759
P*	Mouse	Control	-	-	-	254645	6282991
A	Mouse	Impact	80	-	4	258195	6272253
F*	Mouse	Impact	-	-	-	254375	6279642
H	Mouse	Impact	80	-	4	251828	6279722
I	Mouse	Impact	80	-	4	255703	6277452
K*	Mouse	Impact	-	-	-	250335	6284193
Total			560	280	168		

*Grey shading indicates sites not monitored during the 2021 Survey.

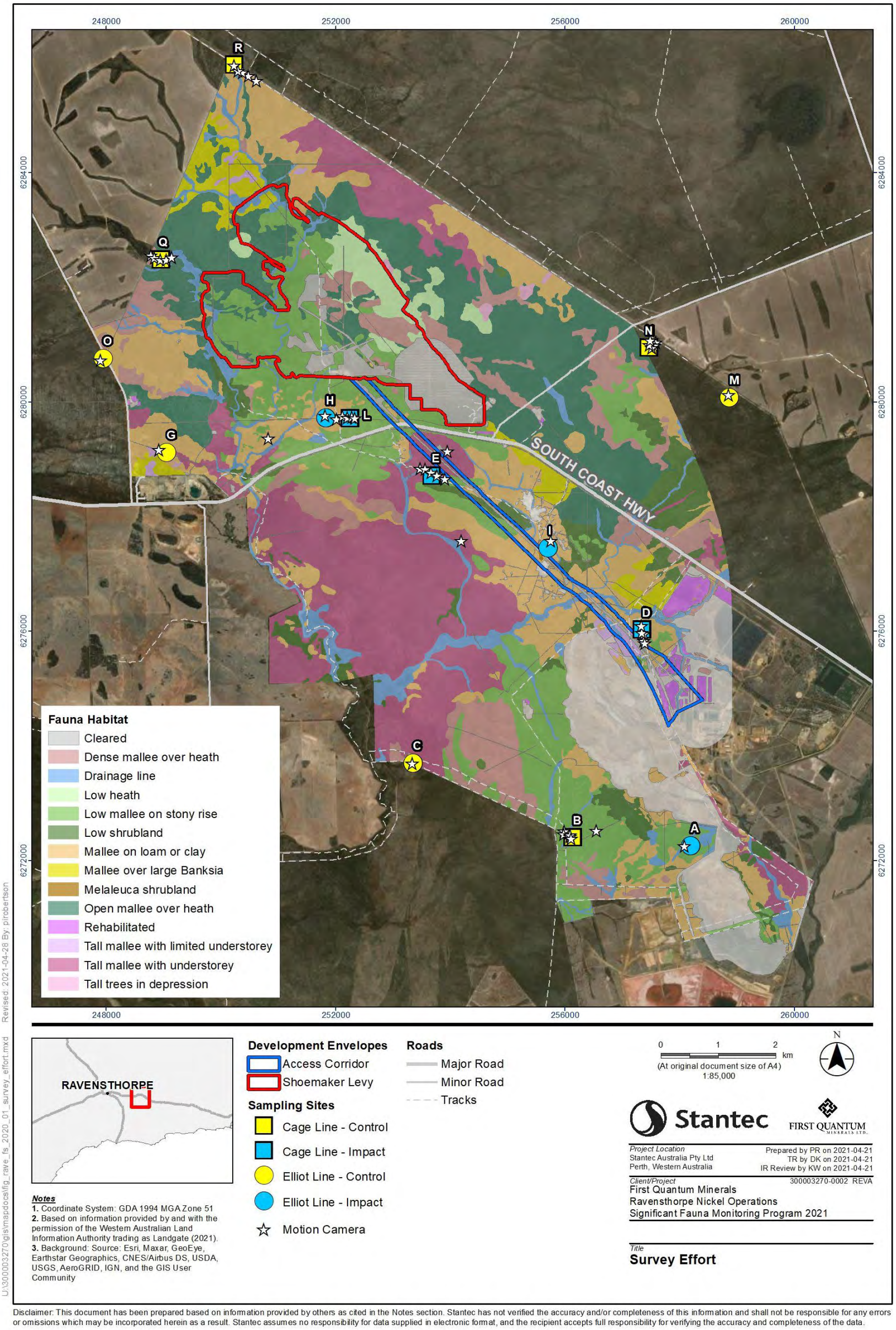

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Figure 2-2: The Survey Area showing monitoring site locations for the Survey.

2.1.5 Habitat Assessment

Formal habitat assessments had previously been conducted by Stantec (2019a) to characterise the quality and complexity of fauna habitats present for species of significance throughout the Survey Area. These habitats were reassessed by Stantec (2019b) and Stantec (2020) to determine if any changes in habitat quality or complexity had occurred.

The following parameters were reassessed at each monitoring site:

- landscape, soil features and structural composition;
- vegetation cover, condition and species composition;
- the presence or absence of habitat structures;
- the presence or absence of water; and
- types of disturbance and levels of disturbance.

This allows for the assessment of future changes in the quality and complexity of habitats and the interpretation of temporal changes in the distribution and abundance of significant species present. For example, changes may occur as a result of mining disturbance such as clearing, or as a result of environmental factors such as fire.

In addition to the formal habitat assessments conducted during the Survey, long-term photo point monitoring sites were installed at each habitat assessment site (Appendix D). When used alongside the formal habitat assessment data, photo point monitoring can be used to compare physical changes in the environment over time.

2.1.6 Trapping

Trapping methods targeting the Chuditch, Heath Mouse and Western Mouse broadly followed the following:

- EPBC Survey Guidelines for Australia's Threatened Mammals (DSEWPaC 2011);
- EPA Technical Guidance: Terrestrial Fauna Surveys (EPA 2016c);
- EPA Technical Guidance: Sampling Methods for Terrestrial Vertebrate Fauna (EPA 2016b);
- EPA Environmental Factor Guideline – Terrestrial Fauna (EPA 2016a);
- Conservation Advice for the Heath Mouse (TSSC 2016); and
- DBCA's Standard Operating Procedures (SOPs).

Traps were set in habitats considered to be the most prospective for the species based on literature and previous surveys of the Survey Area (BHPBIO 2006, Biota 2000, 2005, Coffey Environments 2009, 2010, DBCA 2013, DEC 2012a, Morris *et al.* 1993, Rayner *et al.* 2012, Stantec 2019a, b, Terrestrial Ecosystems 2013, 2014, 2015, 2016a, b, 2017a, b, 2018, TSSC 2016).

2.1.6.1 Chuditch Trapping

At each Chuditch monitoring site (Table 2-2), 10 large cage traps (20 x 20 x 56 cm) were positioned approximately 50 m apart in a transect line. Traps were baited with 'Chuditch bait' (a mixture of kangaroo mince, rolled oats, sardines, fish oil and chicken oil)(Wayne *et al.* 2008). Traps were re-baited at least once or when required over the duration of the trapping period. Each site was trapped for four consecutive nights (Table 2-2), equating to a total of 280 trapping nights for the Survey.

2.1.6.2 Heath Mouse and Western Mouse Trapping

At each Mouse monitoring site (Table 2-2), 20 small Elliot traps were placed approximately 10 m apart in two transects lines separated by 25 m. Traps were baited with a universal bait mixture of rolled oats and peanut butter and were re-baited at least once or when required over the duration of the trapping period. Each site was trapped for four consecutive nights (Table 2-2), equating to a total of 560 trap nights for the Survey.

2.1.6.3 Marking and Measurements

To identify re-captured individuals, newly caught Chuditch were marked at the time of capture using PIT tags. These were placed beneath the skin of the animal, between the shoulders. Heath and Western Mouse individuals were marked using ear-notching. An ear notch tissue sample was taken and preserved in 100% ethanol from each captured individual to provide material for DNA analysis. These were submitted to DBCA for use in ongoing research.

The following parameters were measured and recorded for each captured individual:

- sex – male or female;
- general condition – markings, fur condition, damage and behaviour;
- weight – in grams (g);
- tail diameter – in millimetres (mm);
- pes size – length of left hind foot from the heel to the base of the digits, in mm;
- ear notching – locations of notch recorded for Heath and Western Mouse only;
- photograph of rear foot-pads – recorded for Heath and Western Mouse only; and
- photograph of head profile – recorded for Heath and Western Mouse only.

2.1.7 Malleefowl Mound Assessment

During the Survey, Malleefowl mounds that were previously identified as 'active' or 'inactive' in Stantec (2019b) were reassessed for mound activity. In addition, one Malleefowl mound identified as 'extinct' in Stantec (2020) was also reassessed for mound activity.

Malleefowl mound activity was assessed by noting if:

- cross sticks placed on mound in the Stantec (2020) survey were present or absent;
- mound contained incubating material, or a recently made dome or crater;
- recent Malleefowl tracks or signs (e.g. eggshells etc.) were present;
- mound surface was recently scraped;
- surface crust or moss was present or absent; and
- fauna tracks or diggings from other species were present.

2.1.8 Motion Camera

Reconyx HC600 and Reconyx Hyperfire 2 motion cameras were baited with non-reward bait tubes containing Chuditch bait at Chuditch monitoring sites and universal bait at Mouse monitoring sites. One motion camera was deployed at each Mouse monitoring site, and five were deployed at each Chuditch monitoring site. Less motion camera survey effort was invested at the Mouse monitoring sites due to the difficulty in differentiating Mouse species from motion camera photographs.

In total, motion cameras were deployed at 45 locations across 14 targeted trapping sites and three Malleefowl mounds (**Appendix H**). Motion Cameras were deployed for four consecutive nights at targeted trapping sites, equating to a total of 168 recording nights for the Survey. Motion cameras at Malleefowl mounds were deployed for a total of 14 recording nights.

In comparison, Stantec (2019b) deployed motion cameras at 38 locations, comprising 15 targeted trapping sites for between 10 and 18 consecutive nights, equating to a total of 507 recording nights. Stantec (2020) deployed motion cameras at 56 locations, comprising 18 targeted trapping sites for between 2 and 7 consecutive nights, equating to a total of 253 recording nights.

2.1.9 Carnaby's Black Cockatoo Assessment and Evidence

Potential foraging, breeding and roosting habitat for Carnaby's Black Cockatoo was previously assessed in Stantec (2019a), with reassessment conducted by Stantec (2019b) and Stantec (2020). Habitats within the Survey Area were given a quality score based on the draft foraging scoring tool within the revised draft guidelines (DotEE 2017). This scoring tool considers the key attributes of foraging habitat for Black

Cockatoo species, taking into account connectivity and proximity, as well as the threats that can reduce the functionality of that habitat for Black Cockatoos (DotEE 2017) (Table 2-3).

Where encountered, evidence of Carnaby's Black Cockatoo in the Survey Area was recorded. Evidence included feathers, feeding signs or debris (e.g. chewed banksia flowers, pinecones and marri nuts), potential breeding or roosting habitat and sighting records.

Table 2-3: **Foraging habitat scoring tool for Carnaby's cockatoo** (DotEE 2017).

Starting Score	**Foraging habitat for Carnaby's cockatoo**
10 (Very high quality)	Foraging habitat that is being managed for Black Cockatoos such as habitat that is the focus of successful rehabilitation, and/or has some level of protection from clearing, and/or is quality habitat described below with attributes contributing to meet a score of ≥10.
7 (High quality)	Native shrubland, kwongan heathland and woodland dominated by proteaceous plant species such as Banksia spp. (including Dryandra spp.), Hakea spp. and Grevillea spp., as well as native eucalypt woodland and forest that contains foraging species, including along roadsides. Does not include orchards, canola, or areas under a Regional Forestry Agreement.
5 (Quality)	Pine plantation or introduced eucalypts.
1 (Low quality)	Individual foraging plants or small stand of foraging plants.
Additions	Context adjustor - attributes improving functionality of foraging habitat
+3	Is within the SCP (important foraging area).
+3	Contains trees with suitable nest hollows.
+2	Primarily comprises marri.
+2	Contains trees with potential to be used for breeding (dbh ≥ 500 mm or ≥ 300 mm dbh for salmon gum and wandoo).
+1	Is known to be a roosting site.
Subtractions	Context adjustor - attributes reducing functionality of foraging habitat
-2	No clear evidence of feeding debris.
-2	No other foraging habitat within 6 km.
-1	Is > 12 km from a known breeding location.
-1	Is > 12 km from a known roosting site.
-1	Is > 2 km from a watering point.

2.1.10 Opportunistic Observations

During the establishment and monitoring of survey sites and while traversing the Survey Area, any evidence of species of significance and feral predators, such as remains, feathers, scats, tracks and/or direct observations of individuals, was recorded. These comprised the Chuditch, Western Mouse, Heath Mouse, Western Brush Wallaby, Carnaby's Black Cockatoo, Malleefowl, Western Whipbird, any other species of significance, and feral predators such as feral cats and foxes.

2.1.11 Data Analysis

Due to the changes in survey design required for the Survey (e.g., site locations), data cannot be directly compared to monitoring events prior to 2019. The Survey data compared the results from Stantec (2019b) and (Stantec 2020)and are presented to facilitate statistical analysis during future monitoring surveys. Where capture rates were too low to meet the assumptions of statistical testing, Chuditch capture rate was standardized to allow for comparison by calculating success rate per 100 traps.

3.0 Results and Discussion

3.1 Habitats and Disturbance

The Survey Area comprises of 12 broad fauna habitats, as well as cleared and rehabilitated areas (Figure 3-1; Appendix C). To ensure adequate representation of habitats at control sites, some sites (control sites M, N and O) were located outside of the area previously mapped by Stantec (2019a). Habitat mapping was not extended to include these sites as vegetation mapping, which informed the habitat mapping in Stantec (2019a) was not available. Habitats differed primarily in the composition of their vegetation structure and substrates, variation in time since last fire, density of Mallee, presence of heath on sandy substrate and abundance of stony substrate. Eleven habitats were considered important to species of conservation significance; this includes all habitats aside from Melaleuca shrubland, as well as cleared and rehabilitated areas. A summary of the habitats present in the Survey Area is presented in Table 3-1 below.

Although habitat assessments from Stantec (2019a) are considered 'baseline', many of these monitoring sites have existing impacts either from historic exploration, mining prior to care and maintenance or natural causes. Specifically, many sites in the vicinity of the proposed expansion displayed evidence of historic exploration, although many of the tracks were overgrown. There was no evidence of recent fire at any of the monitoring sites, however a large-scale fire burnt the majority of the Survey Area during 2003 (Figure 3-2). Although vegetation cover and complexity had substantially regenerated across the Survey Area since the fire (Stantec 2019a), some species, such as the Heath and Western Mouse, are only likely to utilise habitats 10 to 30 years post fire (Section 3.2.2).

Clearing of native vegetation for the Shoemaker-Levy, located to the north-west of the existing mine area, began in late June 2020. Additional disturbance at the impact sites was generally associated with the construction of the Shoemaker Levy (Appendix B). Site F had been half cleared due to changes of the development envelope after the site was installed by Stantec (2019b). As of December 2020, a total of 202.1 ha across eight fauna habitats has been cleared for the Shoemaker Levy (Table 3-1).

Table 3-1: Impacts to fauna habitats recorded within the Survey Area (SA) and Shoemaker Levy (SML) Development Envelope (DE).

Broad Landform	Habitat	Trapping Sites	SA (Pre SML clearance)		SML DE^ (Pre SML clearance)		SML DE^ (Post clearance) *		Change*	Change in SA extent*	Change in SML DE extent*
			(ha)	(%)	(ha)	(%)	(ha)	(%)	(ha)	(%)	(%)
Disturbed Area	Cleared	-	1040.4	10.9	52.2	4.5	253.5	22.0	201.21	19.34	385.14
	Rehabilitated	-	85.4	0.9	24.4	2.1	23.3	2.0	-1.09	-1.28	-4.47
Plains comprising grey sandy soils	Dense mallee over heath	-	784.5	8.2	98.7	8.5	83.4	7.2	-15.25	-1.94	-15.45
	Low heath	-	217.5	2.3	138.6	12.0	117.7	10.2	-20.96	-9.64	-15.12
	Open mallee over heath	-	1501.5	15.7	216.5	18.7	169.1	14.6	-47.42	-3.16	-21.90
Undulating low hills and rises comprising clay or loam soils	Low mallee on stony rise	B, E, F	1547.0	16.2	450.5	39.0	336.4	29.1	-114.03	-7.37	-25.31
	Low shrubland	-	404.0	4.2	12.5	1.1	11.5	1.0	-1.04	-0.26	-8.29
	Mallee over large Banksia	J, K, M	227.5	2.4	9.4	0.8	9.4	0.8	0	0	0
	Tall mallee with limited understorey	A	52.4	0.5	14.2	1.2	14.2	1.2	0	0	0
	Tall mallee with understorey	D	1627.4	17.1	21.1	1.8	21.1	1.8	0	0	0
	Mallee on loam or clay	C, G, H, I, L, O P, R	1546.5	16.2	61.0	5.3	60.6	5.2	-0.43	-0.03	-0.70
Water courses	Drainage line	Q	486.4	5.1	54.3	4.7	53.3	4.6	-1.01	-0.21	-1.85
	Melaleuca shrubland	-	0.9	0	0.9	0.1	0.9	0.1	0	0	0
	Tall trees in depression	N	15.3	0.2	0.2	0	0.2	0	0	0	0
Total			9536.7	100.0	1154.6	100.0	1154.6	100.0	-201.2	-2.11	-17.43

*clearing as of December 2020. Additional areas may have been cleared between December 2020 and the Survey period.

^ Only includes areas of the Development Envelope currently approved by the EPA.

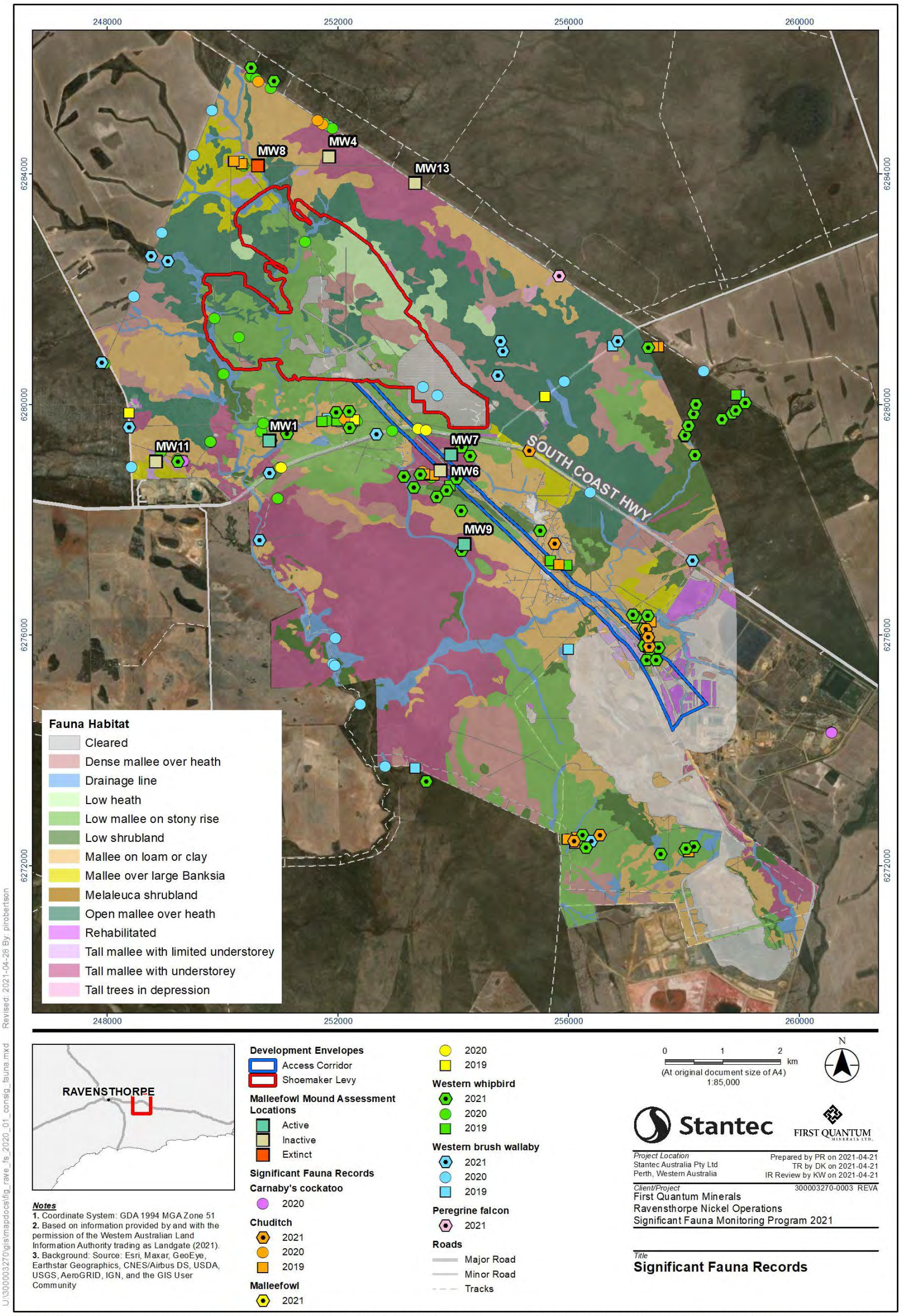

Figure 3-1: Species of significance recorded during the Survey.

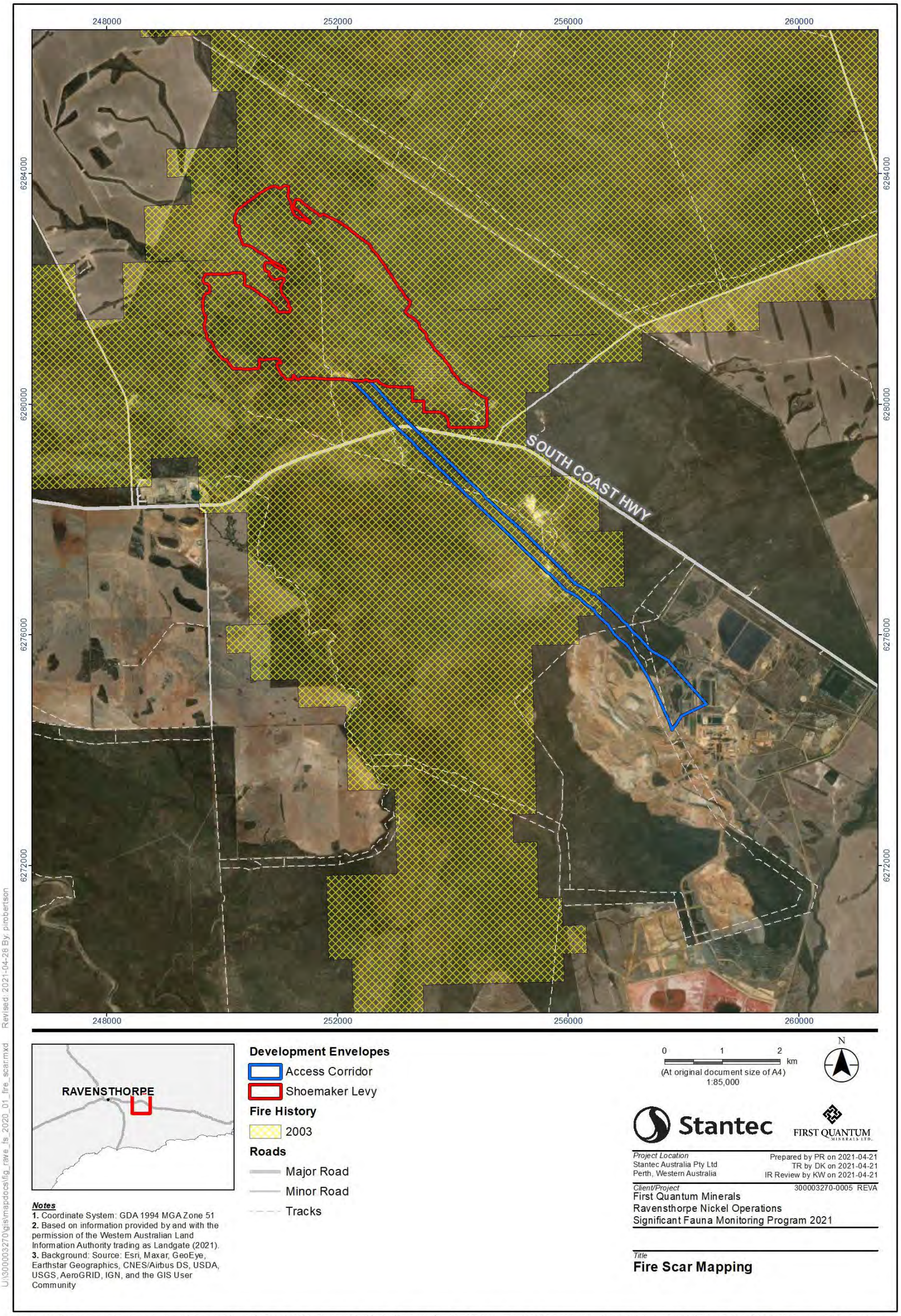

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Figure 3-2: Broad-scale fire scar mapping of the Survey Area.

3.2 Capture data and other fauna observations

3.2.1 Chuditch

Four Chuditch were captured on five occasions during the Survey, which equates to a trapping success rate of 1.79% and is the highest trapping success rate to date (Figure 3-3; Table 3-2) (Stantec 2019b, 2020, Terrestrial Ecosystems 2013, 2014, 2015, 2016a, 2017a). All four Chuditch captured during the Survey were in good condition and comprised two mature males, one juvenile female, and one individual of unknown sex that escaped from the cage during processing. The Chuditch captured during the Survey had not been PIT tagged during previous surveys, however the individual that escaped during processing was unable to be scanned (Appendix E). Three individual Chuditch were captured at Site D (Impact) (Figure 3-1; Figure 2-2), which is consistent with where Chuditch were captured by Stantec (2019b) and (Stantec 2020). The fourth Chuditch was captured at Site E (Impact), which is where a Chuditch was captured by Stantec (2019b) (Figure 3-1;Figure 2-2). Three individuals were PIT tagged for future monitoring programs with ear notch samples provided to DBCA for ongoing research into the genetic diversity of Chuditch (Appendix E).

The absence of recaptures during the Survey may be due to the short lifespan of Chuditch in the wild, with the average lifespan for established adults being only two years (Soderquist 1988). Despite the absence of recaptures during the Survey, the continued capture of both mature and juvenile Chuditch at Site D indicates a breeding population is persisting in the area (Stantec 2019b, 2020). Site D intersects Mallee on loam or clay and Low mallee on stony rise habitats, while Site E occurs within Tall mallee with understory habitat. All three habitats were identified as significant habitats for Chuditch by Stantec (2019a).

In addition to the four Chuditch captured during the Survey, a fifth Chuditch was observed deceased on South Coast Highway nearby to clearing for Shoemaker-Levy (Figure 3-1; Appendix E). The individual was a mature male which had been struck and killed by vehicle overnight on the 1st of March. The Chuditch had not been PIT tagged during previous surveys (Stantec 2019b, 2020). Deliberate and accidental death of Chuditch is listed as a threatening process to the species in the National Recovery Plan for Chuditch (DEC 2012a). Chuditch are known to use roads for dispersal and foraging, which increases their risk of mortality through vehicle collisions. Serena *et al.* (1991), Orell and Morris (1994), and DEC (2012a) all identified vehicle collisions as a significant source of mortality of Chuditch. In addition, mortality of Chuditch from vehicle collisions is known to increase when vegetation clearing occurs for, or adjacent to roads (Morris 2003). Vegetation clearing and other disturbances (dust, noise, light, blasting, vehicle movements etc.) associated with mining construction for the Shoemaker Levy and conveyor corridor were occurring nearby to where the Chuditch was killed on South Coast Highway (Figure 3-1).

Chuditch presence was recorded via motion cameras on seven occasions at two (B, D) Chuditch trapping sites monitored during the Survey, and at one (I) Heath/Western Mouse trapping sites. Only presence / absence data is presented for motion camera records as it is difficult to determine whether a bait is being visited by several individuals or the same individual on multiple occasions. In comparison, Chuditch were recorded via motion camera at seven of the eight Chuditch trapping sites and at one Heath/Western Mouse trapping site by Stantec (2020). Site I (Impact) occur within Mallee on Loam or Clay habitat.

The Chuditch has been recorded in, and is known to occupy, a wide range of habitats within the Survey Area (Figure 1-1) (Stantec 2019a, b, 2020, Terrestrial Ecosystems 2013, 2014, 2015, 2016a, 2017a). Stantec (2019a) identified the following four habitats as being optimal for Chuditch based on the species' habitat preferences and density of previous records:

- Mallee on loam or clay;
- Low mallee on stony rise;
- Tall mallee with understorey; and
- Tall mallee with limited understorey.

Clearing for the Shoemaker Levy and conveyor corridor begun in late June 2020 with 202.1 ha cleared as of December 2020 (Table 3-1). A combined total 114.45 ha of Low mallee on stony rise and Mallee on loam or clay has been cleared for the Shoemaker Levy.

Habitat loss and fragmentation has contributed significantly to the decline of Chuditch populations across its range (DEC 2012a). Chuditch require large areas of intact habitat (>20,000 ha) to survive and are rarely found in habitats that are severely fragmented by clearing (DEC 2012a, Rayner *et al.* 2012). They also require adequate den resources (e.g. hollow logs or rock crevices), protective vegetation cover, and suitable prey resources, which are generally removed when land is cleared or degraded (DEC 2012a, Rayner *et al.* 2012). The 2012 Recovery Plan identifies the following clearing activities as 'particularly deleterious' to Chuditch:

- the affected land includes or adjoins riparian habitat (Serena and Soderquist 1989);
- it creates new gaps in otherwise homogeneous habitat;
- it leads to progressive fragmentation of habitat; or
- it necessitates the construction of roads (especially sealed roads) through, or adjacent to, uncleared habitat (Serena *et al.* 1991).

All four of the 'particularly deleterious' clearing activities are occurring within the Survey Area for the construction of the Shoemaker Levy and associated conveyor corridor. The Project (including the Shoemaker Levy) occurs within the Bandalup Corridor, an area of native vegetation that links the vegetation of the Fitzgerald River National Park to vegetated areas to the north east leading to the eastern Goldfields. The corridor is of important conservation value as habitat and a corridor for the dispersal of fauna through the otherwise highly cleared agricultural zone (EPA 2017b). The EPA recognizes that clearing for the mine pits and waste rock dumps of the Shoemaker Levy will reduce the effective width of the corridor in the Survey Area. Despite creating new gaps within otherwise homogeneous habitats, the progressive fragmentation of habitat, and the loss of riparian habitats, the EPA considers the Shoemaker Levy will not significantly reduce the ecological function of the Bandalup Corridor (EPA 2017b).

In addition to the impact of direct habitat loss, there is also an increased risk of mortality from vehicle strikes and competition and predation from feral cats and foxes in fragmented landscapes (DEC 2012a, McGregor *et al.* 2015, Serena *et al.* 1991). Recent research by Moseby *et al.* (2021) found feral cats were responsible for killing 21% of adult Chuditch at Ikara-Flinders Ranges National Park in South Australia. Feral cat predation is also known to be greater in open habitats (e.g cleared areas) compared with areas of complex vegetation cover which provide protection to small prey species (McGregor *et al.* 2015). The ongoing clearance and fragmentation of habitat for the construction of the Shoemaker Levy is expected to increase the likelihood of mortality of Chuditch by feral cats, foxes, and vehicle strikes within the Survey Area. This may be mitigated by the ongoing feral predator control program being conducted for the Project; however, the successful suppression of feral predator numbers is dependent on the frequency and control methodology used. The current annual control program is unlikely to effectively reduce feral predators within the Survey Area, with bi-annual or quarterly control programs needed to maintain reduced feral predator numbers in the Survey Area (APMS 2020) (Section 3.2.8).

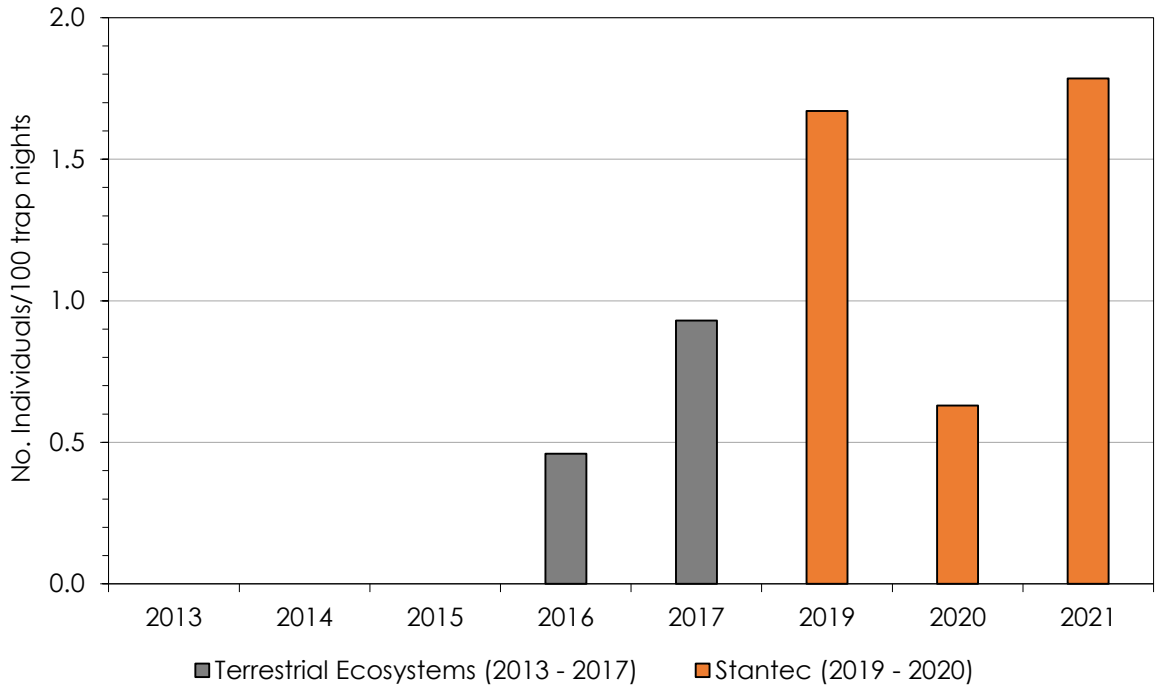

Figure 3-3: Standardized capture rate of Chuditch for each survey conducted for the Project.

Table 3-2: Summary statistics for Chuditch captures at the RNO.

Survey	Trap nights	Number of captures	
		Total	/100 trap nights
Terrestrial Ecosystems (2013)	250	0	0.00
Terrestrial Ecosystems (2014)	500	0	0.00
Terrestrial Ecosystems (2015)	500	0	0.00
Terrestrial Ecosystems (2016a)	876	4	0.46
Terrestrial Ecosystems (2017a)	750	7	0.93
Stantec (2019b)	240	4	1.67
Stantec (2020)	320	2	0.63
Stantec (2021)	280	5	1.79

3.2.2 Heath Mouse and Western Mouse

No Western Mice or Heath Mice were captured during the Survey, or previously by Stantec (2019b) and Stantec (2020). The lack of captures may be attributed to several factors such as: lower than average rainfall preceding the Survey; the presence of feral predators (Section 3.2.7) (DBCA 2013, Morris *et al.* 1993); and/or limited suitable habitat due to the 2003 fire (DBCA 2013, Morris *et al.* 1993).

The Heath Mouse has been recorded in the Survey Area only once following the 2003 fire in 2010 (Coffey Environments 2010). The Western Mouse has been recorded in the Survey Area once during the 2017 monitoring survey (Terrestrial Ecosystems 2017a) and on six occasions in the surrounds between 1998 to 2017. Of these, three records occurred post 2003 (Biota 2005, Coffey Environments 2010, Terrestrial Ecosystems 2016a).

The Western Mouse and Heath Mouse require long unburnt (30-50 years) or dense habitat to persist (DBCA 2013, TSSC 2016). The Heath Mouse tends to occupy unburnt areas for at least 10 years, with the largest numbers recorded in vegetation unburnt for 30 years. While the species has been known to inhabit vegetation less than 10 years unburnt, it requires dense vegetation for protection from feral predators that otherwise utilise more open habitats and runways through the understory to hunt (TSSC 2016). This indicates that recent events such as fire and subsequent predation are potentially limiting populations.

There has only been 16 years of vegetation regrowth post-fire in the Survey Area. This is not considered long enough to provide suitable habitat and protection from predation for the Western Mouse and only six years beyond the minimal post fire recovery (10 years) period for the Heath Mouse. The large-scale nature of the fire has also potentially reduced the species distribution in the immediate surrounds, which may increase recovery time for populations within the Survey Area.

Previous studies have shown Heath Mouse abundance is strongly correlated with rainfall, with the species responding in a 'boom and bust' dynamic in response to increased primary productivity (Senior 2014, TSSC 2016). Abundance generally peaks in response to high rainfall events, and declines during normal drought conditions (Senior 2014). Average annual rainfall at Ravensthorpe weather station has been below the long term average since 2018 (BoM 2021). In the six months preceding the Survey (August 2020 to January 2021), Ravensthorpe weather station recorded 182.9 mm of rainfall, which was 20.8 mm lower than the long-term annual average rainfall (BoM 2021). Based on the below average rainfall, it is likely that any Heath Mouse or Western Mouse populations in the Survey Area would have been at low densities during the Survey.

House Mice were captured on 35 occasions from five of the seven Elliot trapping sites during the Survey. In addition, rodents, all likely to be house mice (based on size, tail length, head/ear shape), were recorded from motion cameras at 12 sites (A, B, C, D, E, I, L, M, N, O, Q, R) of the 14 trapping sites monitored during the Survey. Due to the resolution of the motion cameras, the images were generally not detailed enough to allow for accurate species identification.

3.2.3 Malleefowl

Eight Malleefowl mounds were reassessed during the Survey (Table 3-3; Table 3-4). These comprised:

- three active mounds (MW1, MW7, MW9);
- four inactive mounds (MW4, MW6, MW11, MW13); and
- one extinct mound (MW8).

Five active mounds were recorded by Stantec (2019a) and Stantec (2019b), followed by four active mounds recorded by Stantec (2020). The three active mounds recorded during the Survey was least number of active mounds within the Survey Area since annual mound monitoring began in 2017 (Terrestrial Ecosystems 2017a) (Table 3-3).

In comparison to Stantec (2020):

- MW4 was re-classified as inactive due to the presence of cross sticks placed in the previous year;

- MW3 was classified as inactive between 2017 and 2020 (Stantec 2019a, b, 2020, Terrestrial Ecosystems 2017a), however, has now been cleared during construction of the Shoemaker Levy. A total of six inactive mounds have been cleared for the Project (Table 3-3).

MW7 (active), which is located ~100 m northeast of the clearing for the Shoemaker Levy conveyor corridor, did not appear to have been adversely impacted by the clearing. The mound has been classified as active since first being monitored by Terrestrial Ecosystems (2017a). A pair of Malleefowl were actively tending to the mound during the Survey despite the ongoing construction nearby (Plate 3-1).

No Malleefowl were opportunistically observed during the Survey, however Malleefowl were confirmed to occur based on motion cameras placed at the three active mounds. Stantec (2020) observed Malleefowl on seven occasions on South Coast Highway, however these records were adjacent to where clearing has occurred for where the Shoemaker Levy conveyor corridor crosses South Coast Highway. Given the increase in personnel and machinery operating in area, it is likely the Malleefowl would be avoiding the area. The nearest known mound to these records is MW7, 600 m south-east, which is still actively being tended to by Malleefowl (Plate 3-1).

The Survey has shown that Malleefowl are still present in the Survey Area, including in areas close to Shoemaker Levy (Figure 3-1). Together with sightings and mound assessments from past surveys (Biota 2000, Coffey Environments 2010, Stantec 2019a, Terrestrial Ecosystems 2014, 2016a, 2017a, b), this demonstrates that the species inhabits the area over the long-term. While the three active mounds recorded during the Survey was the least mound activity recorded since annual mound monitoring began in 2017, early observations indicate Malleefowl will still actively use their mound despite nearby vegetation clearing.

Clearing of mallee habitats has been a major factor for the decline of Malleefowl across southern Australia. The 2007 recovery plan recognizes habitat loss from mining as an ongoing threat to Malleefowl in Western Australia (Benshemesh 2007). Clearing of vegetation causes fragmentation of habitats, disturbance to suitable substrates, and may exacerbate other threats such as fire and introduced predators (Section 3.2.7) (Saunders *et al.* 1995). The recovery plan recommends clearing for mining should be avoided in areas that support remnant vegetation and relatively high densities of Malleefowl unless 'clear long term gains for Malleefowl can be demonstrated' (Benshemesh 2007). Clearing for the Shoemaker Levy and conveyor corridor began in late June 2020 with 201.2 ha of vegetation cleared as of December 2020.

Plate 3-1: Malleefowl actively tending to MW7 during the Survey.

Table 3-3: Malleefowl mounds recorded within the Survey Area and their status.

Mound	Easting	Northing	(Chapman 2000)	(Coffey Environments 2010, Terrestrial Ecosystems 2013, 2014, 2015, 2016a, 2017a)	(Terrestrial Ecosystems 2017b)	(Stantec 2019a)	(Stantec 2019b)	(Stantec 2020)	Stantec (2021) (Current survey)
Halley's pit M1	258558	6272887	Inactive	Cleared					
Halley's pit M2	257404	6274812	Inactive	Cleared					
Halley's pit M3	256905	6274744	Inactive	Cleared					
Halley's pit M4	256877	6274754	Inactive	Cleared					
Halley's pit M5	256765	6274762	Inactive	Cleared					
MW1	250836	6279368	Not Assessed	Not Assessed	Recently Active	Active	Active	Active	Active
MW2	251756	6279561	Not Assessed	Not Assessed	Inactive	Extinct			
MW3	251488	6280854	Not Assessed	Not Assessed	Recently Active	Inactive	Inactive	Inactive	Cleared
MW4	251847	6284308	Not Assessed	Not Assessed	Active	Inactive	Active	Active	Inactive
MW5	251845	6284302	Not Assessed	Not Assessed	Inactive	Extinct			
MW6	253772	6278858	Not Assessed	Not Assessed	Recently Active	Active	Active	Inactive	Inactive
MW7	253953	6279136	Not Assessed	Not Assessed	Active	Active	Active	Active	Active
MW8	250628	6284152	Not Assessed	Not Assessed	Extinct				
MW9	254196	6277583	Not Assessed	Not Assessed	Not Assessed	Active	Active	Active	Active
MW10	256104	6276950	Not Assessed	Not Assessed	Not Assessed	Extinct			
MW11	248844	6279008	Not Assessed	Not Assessed	Not Assessed	Inactive	Inactive	Inactive	Inactive
MW12	251632	6284149	Not Assessed	Not Assessed	Not Assessed	Extinct			
MW13	253342	6283846	Not Assessed	Not Assessed	Not Assessed	Extinct	Not Assessed	Inactive	Inactive

Table 3-4: Malleefowl mounds assessed during the Survey.

Mound	Status, Habitat and Notes	Reference Photograph
MW1	Active Mallee on loam or clay. Mound with peak present. Crossed sticks removed. Actively being used by Malleefowl.	
MW4	Inactive Tall mallee with understory. Cross sticks still present from Stantec (2020). No evidence of recent scraping or any other Malleefowl activity. MW4 was assessed as active between 2017 and 2020 (Stantec 2019a, b, 2020, Terrestrial Ecosystems 2017a).	
MW6	Inactive Tall mallee with understory. Cross sticks were displaced but still present in the mound. No evidence of recent scraping was observed. Mound last classified as active by Stantec (2019b).	

Mound	Status, Habitat and Notes	Reference Photograph
MW7	Active Tall mallee with understory. Mound with crater. Freshly scraped with no cross sticks present. Motion-sensor camera data confirmed the mound was actively being used by a breeding pair.	
MW8	Extinct Drainage line. Low, flat mound with no crater. No evidence of recent scraping or other Malleefowl visitation. Some crusting on the mound surface was present. Cross sticks still present.	
MW9	Active Tall mallee with understory. Mound with crater. Cross sticks removed and with Malleefowl activity present in the form of scat and fresh scrapings.	

Mound	Status, Habitat and Notes	Reference Photograph
MW11	Inactive Mallee over large banksia, however, in a transition to Tall mallee with limited understory. Low, flat mound. Cross sticks present with no evidence of recent scraping. Some crusting of the mound surface.	
MW13	Inactive Tall mallee with understory. Near of edge of the barrier fence track. Mound with crater. Cross sticks still present and no recent scraping or other Malleefowl activity observed.	

3.2.4 Carnaby's Black Cockatoo

The Carnaby's Black Cockatoo was not recorded during the Survey; however, the species has previously been confirmed to occur within and surrounding the Survey Area through direct and indirect evidence during previous surveys (Biota 2000, Coffey Environments 2009, 2010), Stantec (2019a), (Stantec 2020, Terrestrial Ecosystems 2014, 2015, 2016a, b, 2017a, b, 2018).

The Survey Area occurs within the non-breeding range, however it is within close proximity to the known breeding range for the species (DotEE 2017). Tall trees that may be used for roosting within the Survey Area were generally restricted to drainage line areas or areas of planted pine trees such as those near the entrance to the FQM mine.

3.2.5 Western Whipbird

The Western Whipbird has been recorded in all monitoring surveys since 2013 (Stantec 2019a, Terrestrial Ecosystems 2013, 2014, 2015, 2016a, 2017a). During the Survey, Western Whipbirds were recorded from 48 locations, of which 47 were via their distinctive calls (Figure 3-1; Appendix F). Male and female whipbird duet calling was recorded on 12 occasions. A single bird was recorded on motion camera at Site E (Impact).

In comparison, Western Whipbirds were recorded by Stantec (2020) on 34 occasions and by Stantec (2019b) on eight occasions within the Survey Area. The increase in Western Whipbird records cannot be conclusively attributed to an increase in Western Whipbirds in the Survey Area over the past three years but may be a combination of environmental conditions during the Survey (low winds, increased calling post rainfall, the experience of field staff in detecting calls, or increase habitat suitability (dense vegetation, feeding plants) for the species as fire-age increases across the Survey Area). The Western Whipbirds recorded during the Survey were generally associated with, or nearby to drainage lines and long unburnt vegetation (Figure 3-1).

Western Whipbirds inhabit mallee vegetation with a dense, tall shrub layer, usually dominated by species from genera such as *Hakea*, *Lambertia*, *Dryandra or Banksia (TSSC 2009).* Western Whipbirds generally occur in long unburnt habitats, usually with a fire age longer than 15 years (TSSC 2009). The density of the vegetation structure (long-unburnt, drainage lines) is generally regarded as more important than the floristic composition (TSSC 2009).

The ability of the species to disperse following the disturbance or destruction (fire, land clearing) of habitat is unknown (TSSC 2009). The Survey Area was previously burnt in 2003 (Figure 3-2), indicating the vegetation may be approaching a suitable fire age for Western Whipbirds. However, the records from the Survey were generally still in association with smaller patches of long unburnt vegetation and dense vegetation in drainage lines. These drainage lines and long unburnt areas may represent crucial habitat for the species within the Survey Area. Of the 53.3 ha of drainage line habitat that occurs within the Shoemaker Levy Development, 1.01 ha of drainage line habitat has been cleared as of December 2020 (Table 3-1).

3.2.6 Western Brush Wallaby

The Western Brush Wallaby has been recorded in all monitoring surveys since 2013 (Stantec 2019a, Terrestrial Ecosystems 2013, 2014, 2015, 2016a, 2017a). The Western Brush Wallaby was recorded on 19 occasions during the Survey. The species was opportunistically recorded on 13 occasions, of which three were carcasses located on South Coast Highway (Figure 3-1). The carcasses were observed on the 26th and 27th of February, two of which were nearby to clearing for the Shoemaker Levy (Figure 3-1).

An additional 10 individuals were observed when they were disturbed from vegetation whilst driving/walking within the Survey Area. The remaining six records were from motion cameras, comprising two control trapping sites (O, Q), as well as at two Malleefowl mounds (MW7, MW9).

In comparison, Western Brush Wallabies were recorded on at total of 20 locations by Stantec (2020) and 12 locations by Stantec (2019b). These records confirm the ongoing presence of the Western Brush Wallaby in the Survey Area.

The Western Brush Wallaby inhabits open woodland and forest, mallee and heath and preferentially utilizes open seasonally wet flats and scrubby thickets (DEC 2012b). Stantec (2019a) identified the following habitats as optimal for the Western Brush Wallaby within the Survey Area:

- Dense mallee over heath
- Open mallee over heath; and
- Low heath.

A total of 83.62 ha of these habitats have been cleared out of the 453.8 ha that occurs within the Shoemaker Levy Development Envelope (Table 3-1).

Plate 3-2: Western Brush Wallabies recorded foraging during the Survey.

3.2.7 Peregrine Falcon

A single Peregrine Falcon was opportunistically recorded on the Dingo proof fence on the northern boundary of the Survey Area (Figure 3-1). The species was last recorded within the Survey Area in 2018 over Mallee on Loam or clay habitat (Stantec 2019a). The majority of the Survey Area does not contain suitably tall trees for breeding, however the species may occasionally use drainage areas for foraging (Stantec 2019a).

3.2.8 Feral Predators

Foxes were recorded on motion camera within the Survey Area at two locations (Sites N and L) (Plate 3-3; Figure 3-4). No feral cats were recorded during the Survey, however FQM staff reportedly observed a feral cat near the construction of the Shoemaker Levy. In comparison, Stantec (2020) recorded one fox and three feral cats, while Stantec (2019b) also recorded one fox and six feral cats within the Survey Area.

Clearing of vegetation is known to increase the presence of feral predators such as foxes and feral cats (Saunders *et al.* 1995). In addition, feral cat predation is known to be greater in open habitats (e.g

cleared areas) compared with areas of complex vegetation cover which provide protection to small prey species (McGregor *et al.* 2015).

Foxes and feral cats are known to predate on the significant species recorded within the Survey Area (Benshemesh 2007, DEC 2012a, b, Morris *et al.* 1993, Saunders *et al.* 2014, TSSC 2009, 2016). The records from this Survey, along with records from previous surveys (Biota 2000, Coffey Environments 2010, Stantec 2019a, b, 2020, Terrestrial Ecosystems 2014, 2015, 2016a), indicate feral predators continue to inhabit the Survey Area and are potentially threatening native fauna.

To combat this, FQM have engaged Animal Pest Management Services (APMS) to conduct feral animal control for the RNO project (APMS 2020). APMS conducted annual control work of foxes, feral cats, and rabbits for the Project in July 2018, February 2019, March 2020; with an additional control program scheduled to be completed in April 2021 (APMS 2020). APMS (2020) used multiple controls (trapping, shooting, and 1080 poison baiting) to reduce feral predator numbers in the Survey Area. A total of 28 foxes were trapped or shot in 2020, compared with 17 foxes in 2019 and 14 foxes in 2018 (APMS 2020). Three feral cats were trapped or shot in 2020, compared with six feral cats in 2019 (APMS 2020).

APMS (2020) acknowledge the annual control program is likely to be ineffective at supressing feral predators, as 'new' foxes will migrate into the Survey Area once adult foxes are removed. Therefore APMS (2020) recommended conducting control programs for foxes and feral cats at least bi-annually; preferably quarterly, to effectively suppress feral predators for the Project.

If control programs continue to be conducted annually, the clearing of native vegetation will likely result in an increase of feral predators utilising the Survey Area and potentially predating upon significant species within the Survey Area.

Plate 3-3: Red Fox recorded on motion camera during the Survey.

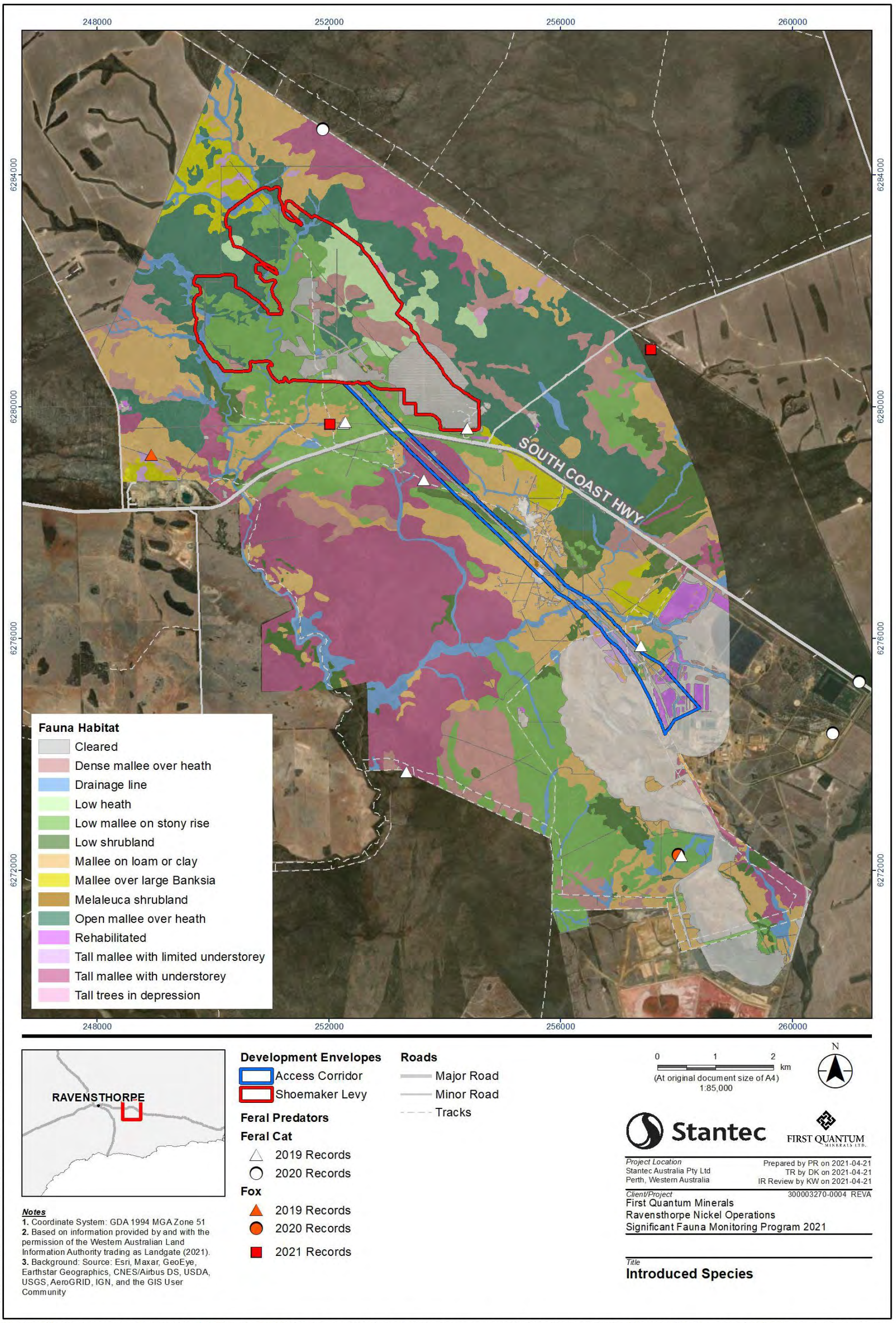

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Figure 3-4: Feral predator locations from within the Survey Area.

3.3 Limitations and Constraints

There are several possible limitations and constraints that can affect the adequacy of fauna surveys (EPA 2016c). Such limitations and constraints with respect to this Survey are discussed below in Table 3-5.

Table 3-5: Limitations and constraints of the Survey

Factor	Limitation/Constraint	Comments
Competency and experience of consultants	No	Field personnel were qualified zoologists with extensive experience conducting fauna surveys, including various targeted surveys for significant fauna throughout Western Australia. Both field personnel conducted the Stantec (2020) field survey and were familiar with target species and survey methodologies in the Survey Area.
Completeness	Moderate	Four sites (J [Chuditch, Impact], K, F [Mouse, Impact], P [Mouse, Control) were not monitored due to timing constraints and access issues associated with the ongoing construction of the Shoemaker Levy. As accommodation was unavailable at RNO, field staff were required to mobilise from Hopetoun each morning, which limited the number of trapping sites which could be cleared within three hours of sunrise as required by Biological Assessment License Number BA27000372.
Disturbance (i.e. to control sites)	Minor	Disturbance has not unduly affected the control sites, however one mouse trapping impact site (F) had been partially cleared due to changes in the development envelope of the Shoemaker Levy after the site was installed by Stantec (2019b). Monitoring site F was not monitored during the Survey.
Survey timing/weather	No	Timing of the survey was consistent with previous surveys. Rainfall was below the long-term average in the six months preceding the Survey. The Survey was conducted outside of when female Chuditch have pouch or den young and before heavy rainfall restricted nocturnal foraging.
Availability of previous data (specific and/or contextual)	No	Capture data from baseline fauna assessments and previous monitoring surveys were readily available ((BHPBIO 2006, Coffey Environments 2010, Stantec 2019b, 2020, Terrestrial Ecosystems 2013, 2014, 2015, 2016a, 2017a). General environmental information regarding the Survey Area and the Esperance Plains bioregion is readily available from previous surveys conducted by Stantec (2019a) and Stantec (2019b). Current fire history mapping does not accurately represent the small mosaics of long-burnt vegetation located within the Survey Area. Relevant scientific research publications were reviewed prior to the Survey.
Remoteness/access problems	Minor	Two sites (J [Chuditch, Impact], K [Mouse, Impact]) could not be accessed during the Survey due to timing constraints and access issues associated with the ongoing construction of the Shoemaker Levy. While most exploration tracks were aged (made pre-2000), vehicle access was still available for the remaining the sites.

4.0 Conclusions

During the Survey 14 targeted sites were monitored, comprising six impact sites and eight control sites. Four sites (three impact; one control) were not monitored during the Survey due to timing constraints and access issues associated with the ongoing construction of the Shoemaker Levy. Five species were targeted to meet existing regulatory conditions during the Survey, comprising Chuditch [Vu, Vu], Malleefowl [Vu, Vu], Heath Mouse [En, Vu], Western Mouse [P4], and Carnaby's Cockatoo [En, En]. An additional two species of significance; the Western Whipbird (*Psophodes nigrogularis oberon*) [P4] and the Western Brush Wallaby [P4] were also opportunistically recorded during the Survey.

Four Chuditch were captured on five occasions during the Survey, which equates to a trapping success rate of 1.79% and was the highest trapping success rate to date. All four Chuditch captured during the Survey were in good condition and comprised two mature males, one juvenile female, and one individual of unknown sex that escaped from the cage during processing. In addition, a fifth Chuditch was observed deceased on South Coast Highway nearby to clearing for Shoemaker-Levy. The individual was an untagged mature male. Chuditch presence was also recorded via motion cameras on seven occasions at two Chuditch trapping sites and at one Heath/Western Mouse trapping site. No Chuditch were captured between 2013 and 2015 but have been caught each year since then.

No Western Mouse or Heath Mouse individuals were captured or confirmed via motion-sensor cameras during the Survey. The Heath Mouse has been recorded in the Survey Area only once following the 2003 fire in 2010. The Western Mouse has been recorded in the Survey Area once during the 2017 monitoring survey and on six occasions in the surrounds between 1998 to 2017. Of these, three records occurred post 2003. This indicates that recent events such as fire are potentially limiting Heath Mouse and Western Mouse populations/habitat suitability.

Eight Malleefowl mound assessments were undertaken during the Survey, of which three were assessed as 'active', a decrease from the four active mounds recorded in 2020 and five active mounds recorded in 2019. One mound, classified as inactive between 2017 and 2020, had been cleared for construction of the Shoemaker Levy.

Western Whipbirds were recorded from 48 locations during the Survey. Male and female whipbird duet calling was recorded on 12 occasions. In comparison, Western Whipbirds were recorded on 34 occasions in 2020 and on eight occasions in 2019 within the Survey Area.

The Western Brush Wallaby was recorded on 19 occasions during the Survey, compared with 20 occasions in 2020 and 12 locations in 2019. Of the 19 records from the Survey, three were carcasses located on South Coast Highway.

The Carnaby's Black Cockatoo was not recorded during the Survey; however, the species has been recorded within the Survey Area previously. A single Peregrine Falcon was opportunistically recorded on the Dingo proof fence on the northern boundary of the Survey Area. The Peregrine Falcon was last recorded within the Survey Area in 2018.

Evidence of feral animals was also present within the Survey Area, with foxes recorded via motion camera at two systematic trapping sites. No feral cats were recorded within the Survey Area, however FQM staff reportedly observed a feral cat near the construction of the Shoemaker Levy during the Survey.

Due to the short period of time since the comment of clearing (June 2020) and this Survey, it is too early to draw any substantial conclusions on whether mining is having an impact on significant species within the Survey Area. However, to date, detections of significant fauna during the Survey are comparable to those detected over the past two years that Stantec have been conducting the surveys. In particular, Chuditch, Malleefowl, Western Brush Wallaby and Western Whipbirds have been regularly recorded in all years, confirming ongoing presence within the Survey Area. Future monitoring at both impact and control sites will inform whether the targeted species continue to persist in the Survey Area and what impact current and future mining operations will have on the species.

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Appendices

We design with community in mind

Appendix A Codes Used to Describe Significant Species

Fauna may be afforded legislative protection by being listed under the EPBC Act and/or the BC Act, or by being listed on the DBCA Priority Species List. This Appendix presents a summary of the different rankings and listings used to describe conservation status. Some categories, such as 'extinct', 'extinct in the wild' and 'conservation dependent' (EPBC Act) are not presented here, as the table includes only the information needed to fully understand the codes presented in the preceding report. Refer to the relevant legislation for a full description of all codes in use, as well as their associated criteria.

Categories used under the EPBC Act

Status	Code	Description
Critically Endangered	CR	Taxa that is considered to be facing an extremely high risk of extinction in the wild in the immediate future
Endangered	EN	Taxa that is considered to be facing a very high risk of extinction in the wild in the near future
Vulnerable	VU	Taxa that is considered to be facing a high risk of extinction in the wild in the medium-term future
Migratory	MI	Species that migrate to, over and within Australia and its external territories

Conservation Codes used under the BC Act

Status	Code	Schedule (WC Act)	Description
Critically Endangered	CR	S1	Taxa that is rare or likely to become extinct, as critically endangered taxa
Endangered	EN	S2	Taxa that is rare or likely to become extinct, as endangered taxa
Vulnerable	VU	S3	Taxa that is rare or likely to become extinct, as vulnerable taxa
Presumed Extinct	EX	S4	Taxa that is presumed to be extinct
Migratory	IA	S5	Birds that are subject to international agreements relating to the protection of migratory birds
Conservation Dependent	CD	S6	Taxa that are of special conservation need being species dependent on ongoing conservation intervention
Special Protection	OS	S7	Taxa that is in need of special protection

Appendix B Monitoring Site Disturbance history

Site	Type	Category	History and records of disturbance		
			2019	2020	2021
B	Chuditch	Control	Established • Disturbance limited to access tracks.	Monitored • No additional disturbance recorded.	Monitored No additional disturbance recorded.
N	Chuditch	Control	Established • Disturbance limited to access tracks and minor clearing.	Monitored • Decline in vegetation cover, including mortality of *Banksia lemanniana* and *Cyperaceae sp.*	Monitored No additional disturbance recorded.
Q	Chuditch	Control	-	Established • No disturbance recorded.	Monitored Minor noise associated with construction of Shoemaker Levy
R	Chuditch	Control	-	Established • Located on the edge of the barrier fence. • Firebreak nearby.	Monitored No additional disturbance recorded.
D	Chuditch	Impact	Established • Disturbance limited to access tracks. • Feral cat present.	Monitored • No additional disturbance recorded.	Monitored No additional disturbance recorded.
E	Chuditch	Impact	Established • Disturbance limited to access tracks. • Feral cat present.	Monitored • No additional disturbance recorded.	Monitored Nearby to clearing for Shoemaker Levy conveyor corridor
J	Chuditch	Impact	Established • Disturbance limited to access tracks.	Monitored • No additional disturbance recorded.	Not Monitored
L	Chuditch	Impact	Established • Disturbance limited to access tracks and minor clearing. • Feral cat present.	Monitored • No additional disturbance recorded	Monitored Traffic and noise associated with Shoemaker Levy construction
C	Mouse	Control	Established • Disturbance limited to access tracks.	Monitored • No additional disturbance recorded.	Monitored No additional disturbance recorded.

Site	Type	Category	History and records of disturbance		
			2019	2020	2021
G	Mouse	Control	Established • Disturbance limited to access tracks. • Red fox present.	Monitored • No additional disturbance recorded.	Monitored No additional disturbance recorded.
M	Mouse	Control	Established • Disturbance limited to access tracks.	Monitored • No additional disturbance recorded.	Monitored No additional disturbance recorded.
O	Mouse	Control	Established • Disturbance limited to access tracks.	Monitored • No additional disturbance recorded.	Monitored No additional disturbance recorded.
P	Mouse	Control	-	Established • Located on the edge of the barrier fence. • Firebreak nearby.	Not Monitored
A	Mouse	Impact	Established • Disturbance limited to access tracks. • Feral cat present.	Monitored • No additional disturbance recorded. • Fox scat present.	Monitored No additional disturbance recorded.
F	Mouse	Impact	Established • Disturbance limited to access tracks. • Feral cat present.	Monitored • No additional disturbance recorded.	Not Monitored Site half cleared for construction of the Shoemaker Levy
H	Mouse	Impact	Established • Disturbance limited to access tracks.	Monitored • No additional disturbance recorded.	Monitored Traffic and noise associated with Shoemaker Levy construction
I	Mouse	Impact	Established • Previous clearing for mining in the area.	Monitored • No additional disturbance recorded.	Monitored Nearby to clearing for Shoemaker Levy conveyor corridor.
K	Mouse	Impact	Established • Disturbance limited to access tracks.	Monitored • No additional disturbance recorded.	Not Monitored

Appendix C Habitat Assessments

Name	Habitat Type	Landform
A	Tall mallee with limited understory	Hill
Condition	Condition	Excellent
	Disturbance Type	Tracks
	Fire Age	> 15
% Ground Cover	Rock	0
	Soil	0
	Leaf Litter	90
	Vegetation	10
Rocks	Type	N/A
	Size (mm)	N/A
	Abundance (%)	0
	Exposed Bedrock (%)	0
Soil	Type	Clay loam
	Colour	Grey
Habitat Features	Slope	Gently inclined (3-5)
	Water	No - Never
	Termite Presence	Rare
	Woody Debris	Very Common
	Peeling Bark	Common
	Rock Crevices	None
	Burrowing Suitability	Moderate
	Tree Hollows (<10 cm)	None
	Tree Hollows (>10 cm)	None

Site Photograph

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	4	30–70	Mallee
Middle	Shrub	2	70–100	*Banksia*, *Isopogon*, parrot bush
Lower	Shrub, Sedge	0.3	10–30	Sedge, juveniles of mid storey

Name	Habitat Type	Landform	Site Photograph
B	Low mallee on stony rise	Rocky Outcrop	
Condition	Condition	Very Good	
	Disturbance Type	Tracks	
	Fire Age	5 to 15	
% Ground Cover	Rock	10	
	Soil	40	
	Leaf Litter	20	
	Vegetation	30	
Rocks	Type	Ferricrete	
	Size (mm)	60–200	
	Abundance (%)	20–50	
	Exposed Bedrock (%)	2–10	
Soil	Type	Clay loam	
	Colour	Grey	
Habitat Features	Slope	Moderately inclined (5-15)	
	Water	No - Never	
	Termite Presence	Rare	
	Woody Debris	Common	
	Peeling Bark	Rare	
	Rock Crevices	Moderate	
	Burrowing Suitability	Low	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Tree	3	< 10	Mallee, *Acacia*
Middle	Shrub	2	30–70	*Acacia, Melaleuca*
Lower	Shrub	0.4	30–70	*Melaleuca*

Name	Habitat Type	Landform	Site Photograph
C	Mallee on loam or clay	Gentle slope	
Condition	Condition	Excellent	
	Disturbance Type	Tracks	
	Fire Age	5 to 15	
% Ground Cover	Rock	5	
	Soil	30	
	Leaf Litter	30	
	Vegetation	35	
Rocks	Type	Ironstone	
	Size (mm)	6–20	
	Abundance (%)	50–90	
	Exposed Bedrock (%)	0	
Soil	Type	Clay loam	
	Colour	Orange	
Habitat Features	Slope	Gently inclined (3-5)	
	Water	No - Never	
	Termite Presence	None	
	Woody Debris	Common	
	Peeling Bark	Moderate	
	Rock Crevices	None	
	Burrowing Suitability	Moderate	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	4	5–15 (isolated clumps)	Mallee
Middle	Shrub	2.5	30–70	Mallee
Lower	Sedge, Shrub	1	30–70	Sedge, *Grevillea sp.*, Mallee, *Melaleuca sp.*, *Hakea sp.*

Name	Habitat Type	Landform	Site Photograph
D	Tall mallee with understory	Hill	
Condition	Condition	Very Good	
	Disturbance Type	Tracks	
	Fire Age	5 to 15	
% Ground Cover	Rock	25	
	Soil	25	
	Leaf Litter	85	
	Vegetation	10	
Rocks	Type	Ferricrete	
	Size (mm)	20–60	
	Abundance (%)	2–10	
	Exposed Bedrock (%)	2–10	
Soil	Type	Sandy loam	
	Colour	Brown	
Habitat Features	Slope	Moderately inclined (5-15)	
	Water	No - Never	
	Termite Presence	Rare	
	Woody Debris	Common	
	Peeling Bark	Common	
	Rock Crevices	Rare	
	Burrowing Suitability	Moderate	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Tree	6	30–70	Mallee
Middle	Shrub	2	30–70	*Banksia*, *Melaleuca*, *Acacia*
Lower	Sedge, Shrub	0.5	10–30	Sedges, *Melaleuca*, *Grevillia*

Name	Habitat Type	Landform	Site Photograph
E	Low mallee on stony rise	Plain	
Condition	Condition	Very Good	
	Disturbance Type	Tracks	
	Fire Age	5 to 15	
% Ground Cover	Rock	30	
	Soil	30	
	Leaf Litter	25	
	Vegetation	15	
Rocks	Type	Quartzite	
	Size (mm)	20–60	
	Abundance (%)	50–90	
	Exposed Bedrock (%)	0	
Soil	Type	Clay loam	
	Colour	Grey	
Habitat Features	Slope	Gently inclined (3-5)	
	Water	No - Never	
	Termite Presence	Rare	
	Woody Debris	Moderate	
	Peeling Bark	Moderate	
	Rock Crevices	None	
	Burrowing Suitability	Moderate	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Tree	5	0–5 (isolated clumps)	Unknown burnt
Middle	Mallee	3	30–70	Mallee vines
Lower	Shrub, Sedge	1	30–70	*A. Glaucoptera, Grevillia, Melaleuca*.

Name	Habitat Type	Landform	Site Photograph
F	Low mallee on stony rise	Plain	
Condition	Condition	Very Good	
	Disturbance Type	Tracks	
	Fire Age	5 to 15	
% Ground Cover	Rock	20	
	Soil	10	
	Leaf Litter	60	
	Vegetation	10	
Rocks	Type	Quartzite, Ironstone	
	Size (mm)	6–20	
	Abundance (%)	50–90	
	Exposed Bedrock (%)	0	
Soil	Type	Clay loam	
	Colour	Grey	
Habitat Features	Slope	Gently inclined (3-5)	
	Water	No - Never	
	Termite Presence	Rare	
	Woody Debris	Common	
	Peeling Bark	Moderate	
	Rock Crevices	None	
	Burrowing Suitability	Moderate	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	5	10–30	Mallee
Middle	Mallee	2.5	30–70	*Banksia*, *Mallee*, *Isopogon*
Lower	Shrub	0.5	30–70	*Melaleuca*, Sedges, *Isopogon*

Name	Habitat Type	Landform	Site Photograph
G	Mallee on loam or clay	Undulating slope	
Condition	Condition	Very Good	
	Disturbance Type	Tracks	
	Fire Age	>20	
% Ground Cover	Rock	5	
	Soil	5	
	Leaf Litter	50	
	Vegetation	40	
Rocks	Type	Quartzite	
	Size (mm)	6–20	
	Abundance (%)	10–20	
	Exposed Bedrock (%)	0	
Soil	Type	Clay loam	
	Colour	White/brown	
Habitat Features	Slope	Gently inclined (3-5)	
	Water	No - Never	
	Termite Presence	Rare	
	Woody Debris	Very Common	
	Peeling Bark	Common	
	Rock Crevices	None	
	Burrowing Suitability	Moderate	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Tree	7	10–30	Mallee
Middle	Shrub	3	30–70	Mallee
Lower	Shrub	1	30–70	*Melaleuca*

Name	Habitat Type	Landform	Site Photograph
H	Mallee on clay or loam	Plain	
Condition	Condition	Excellent	
	Disturbance Type	Tracks	
	Fire Age	5 to 15	
% Ground Cover	Rock	20	
	Soil	45	
	Leaf Litter	20	
	Vegetation	40	
Rocks	Type	Quartzite, Ironstone	
	Size (mm)	6–20,20–60	
	Abundance (%)	50–90	
	Exposed Bedrock (%)	0	
Soil	Type	Clay loam	
	Colour	Brown	
Habitat Features	Slope	Level (0-3)	
	Water	No - Never	
	Termite Presence	Some/mound	
	Woody Debris	Very Common	
	Peeling Bark	Moderate	
	Rock Crevices	None	
	Burrowing Suitability	Moderate	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	4	0–5 (isolated clumps)	Unknown dead
Middle	Mallee	2	30–70	Mallee
Lower	Shrub, Sedge	0.5	30–70	*Acacia glaucoptera*, sedge, *Acacia sp.*, *Grevillea sp.*, *Melaleuca sp.*

Name	Habitat Type	Landform	Site Photograph
I	Mallee on loam or clay	Stony Hill	
Condition	Condition	Good	
	Disturbance Type	Clearing	
	Fire Age	5 to 15	
% Ground Cover	Rock	40	
	Soil	40	
	Leaf Litter	10	
	Vegetation	10	
Rocks	Type	Quartzite	
	Size (mm)	20–60	
	Abundance (%)	50–90	
	Exposed Bedrock (%)	<2	
Soil	Type	Clay loam	
	Colour	Grey	
Habitat Features	Slope	Gently inclined (3-5)	
	Water	No - Never	
	Termite Presence	Rare	
	Woody Debris	Moderate	
	Peeling Bark	Moderate	
	Rock Crevices	None	
	Burrowing Suitability	Moderate	
	Tree Hollows (<10 cm)	Rare	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Tree	6	10–30	Mallee
Middle	Shrub	2	30–70	Mallee, *Banksia*, *Melaleuca*
Lower	Heath shrub	0.5	30–70	Sedges, *Melaleuca*

Name	Habitat Type	Landform	Site Photograph
J	Mallee over large banksia	Plain	
Condition	Condition	Excellent	
	Disturbance Type	Tracks	
	Fire Age	> 15	
% Ground Cover	Rock	0	
	Soil	30	
	Leaf Litter	50	
	Vegetation	20	
Rocks	Type	N/A	
	Size (mm)	N/A	
	Abundance (%)	0	
	Exposed Bedrock (%)	0	
Soil	Type	Loamy sand	
	Colour	White	
Habitat Features	Slope	Level (0-3)	
	Water	No - Never	
	Termite Presence	None	
	Woody Debris	Common	
	Peeling Bark	Moderate	
	Rock Crevices	None	
	Burrowing Suitability	High	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Tree, Mallee	6	30–70	*Banksia*, Mallee
Middle	Shrub, Mallee	2	70–100	Mallee, *Isopogon*, *Banksia*, *Melaleuca*
Lower	Shrub	0.5	30–70	*Melaleuca*, Sedges

Name	Habitat Type	Landform	Site Photograph
K	Mallee over large banksia	Plain	
Condition	Condition	Excellent	
	Disturbance Type	Tracks	
	Fire Age	> 15	
% Ground Cover	Rock	0	
	Soil	30	
	Leaf Litter	50	
	Vegetation	20	
Rocks	Type	N/A	
	Size (mm)	N/A	
	Abundance (%)	0	
	Exposed Bedrock (%)	0	
Soil	Type	Loamy sand	
	Colour	White	
Habitat Features	Slope	Level (0-3)	
	Water	No - Never	
	Termite Presence	None	
	Woody Debris	Common	
	Peeling Bark	Moderate	
	Rock Crevices	None	
	Burrowing Suitability	High	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Tree, Mallee	6	30–70	*Banksia*, Mallee
Middle	Shrub, Mallee	2	70–100	Mallee, *Isopogon*, *Banksia*, *Melaleuca*
Lower	Shrub	0.5	30–70	*Melaleuca*, Sedges

Name	Habitat Type	Landform	Site Photograph
L	Mallee over heath	Undulating plain	
Condition	Condition	Excellent	
	Disturbance Type	Clearing, fire, tracks	
	Fire Age	5 - 15	
% Ground Cover	Rock	10	
	Soil	60	
	Leaf Litter	10	
	Vegetation	20	
Rocks	Type	Quartzite	
	Size (mm)	2-6, 6-20	
	Abundance (%)	10-20	
	Exposed Bedrock (%)	0	
Soil	Type	Clay loam	
	Colour	Brown	
Habitat Features	Slope	Gently inclined (3-5)	
	Water	No - never	
	Termite Presence	Rare	
	Woody Debris	Rare	
	Peeling Bark	Rare	
	Rock Crevices	None	
	Burrowing Suitability	High	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	2	10-30	*Eucalyptus spp.*
Middle	Shrub	0.8	10-30	*Melaleuca sp., Acacia bifaria, Grevillea sp.*
Lower	Sedge	0.05	<10	*?Poaceae sp.*

Name	Habitat Type	Landform
M	Mallee over large banksia	Plain
Condition	Condition	Very Good
	Disturbance Type	Tracks
	Fire Age	> 15
% Ground Cover	Rock	0
	Soil	50
	Leaf Litter	40
	Vegetation	10
Rocks	Type	N/A
	Size (mm)	N/A
	Abundance (%)	0
	Exposed Bedrock (%)	0
Soil	Type	Clayey sand
	Colour	White
Habitat Features	Slope	Level (0-3)
	Water	No - Never
	Termite Presence	Rare
	Woody Debris	Common
	Peeling Bark	Moderate
	Rock Crevices	None
	Burrowing Suitability	Moderate
	Tree Hollows (<10 cm)	None
	Tree Hollows (>10 cm)	None

Site Photograph

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Tree, Mallee	3	10–30	Mallee, *Banksia*
Middle	Shrub, Mallee	2	10–30	Mallee, *Melaleuca*, *Banksia*, *Isopogon*
Lower	Shrub	1	70–100	*Melaleuca*, *Hakea*, *Isopogon*

Name	Habitat Type	Landform	Site Photograph
N	Tall trees in depression	Depression	
Condition	Condition	Poor	
	Disturbance Type	Tracks, Clearing	
	Fire Age	> 15	
% Ground Cover	Rock	0	
	Soil	10	
	Leaf Litter	60	
	Vegetation	30	
Rocks	Type	N/A	
	Size (mm)	N/A	
	Abundance (%)	0	
	Exposed Bedrock (%)	0	
Soil	Type	Sand	
	Colour	Grey	
Habitat Features	Slope	Level (0-3)	
	Water	No - Prone to Ponding	
	Termite Presence	None	
	Woody Debris	Common	
	Peeling Bark	Common	
	Rock Crevices	None	
	Burrowing Suitability	High	
	Tree Hollows (<10 cm)	Moderate	
	Tree Hollows (>10 cm)	Rare	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Tree	10	30–70	*Eucalyptus sp.*
Middle	Shrub	2	30–70	*Melaleuca*
Lower	Sedge	0.3	30–70	Sedges

Name	Habitat Type	Landform
O	Mallee on loam or clay	Plain
Condition	Condition	Very Good
	Disturbance Type	Tracks
	Fire Age	5 to 15
% Ground Cover	Rock	5
	Soil	60
	Leaf Litter	20
	Vegetation	15
Rocks	Type	Laterite
	Size (mm)	6–20,2–6
	Abundance (%)	50–90
	Exposed Bedrock (%)	0
Soil	Type	Clay loam
	Colour	Brown
Habitat Features	Slope	Level (0-3)
	Water	No - Never
	Termite Presence	Rare
	Woody Debris	Common
	Peeling Bark	Moderate
	Rock Crevices	None
	Burrowing Suitability	Moderate
	Tree Hollows (<10 cm)	None
	Tree Hollows (>10 cm)	None

Site Photograph

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	4	0–5 (isolated clumps)	Dead Mallee
Middle	Mallee	2.5	30–70	Mallee, *Eucalyptus* red
Lower	Shrub, Sedge	0.5	30–70,10–30	*Melaleuca*, Sedges, other shrubs

Name	Habitat Type	Landform	Site Photograph
P	Mallee with understory	Plain	
Condition	Condition	Excellent	
	Disturbance Type	None	
	Fire Age	>15	
% Ground Cover	Rock	0	
	Soil	5	
	Leaf Litter	15	
	Vegetation	80	
Rocks	Type	N/A	
	Size (mm)	N/A	
	Abundance (%)	0	
	Exposed Bedrock (%)	0	
Soil	Type	Sand	
	Colour	Grey	
Habitat Features	Slope	Gently inclined (3 – 5)	
	Water	No - never	
	Termite Presence	None	
	Woody Debris	Common	
	Peeling Bark	Very common	
	Rock Crevices	None	
	Burrowing Suitability	High	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	4	30 - 70	*Eucalyptus tetraptera, Eucalyptus pleurocarpa, Banksia leihmannii,*
Middle	Shrub, mallee, heath shrub	1.5	30 - 70	*Hakea sp., melaleuca sp., Eucalyptus tetrapthera, Banksia leihmannii,*
Lower	Shrub	0.5	10 - 30	*Grevillea sp. poaceae sp. sedge sp.*

Name	Habitat Type	Landform	Site Photograph
Q	Minor drainage line	Minor drainage line	
Condition	Condition	Excellent	
	Disturbance Type	None	
	Fire Age	5 - 15	
% Ground Cover	Rock	0	
	Soil	20	
	Leaf Litter	20	
	Vegetation	60	
Rocks	Type	N/A	
	Size (mm)	N/A	
	Abundance (%)	0	
	Exposed Bedrock (%)	0	
Soil	Type	Sand	
	Colour	Grey	
Habitat Features	Slope	Gently inclined (3 – 5)	
	Water	Yes – semi permanent	
	Termite Presence	Rare	
	Woody Debris	Common	
	Peeling Bark	Common	
	Rock Crevices	None	
	Burrowing Suitability	Moderate	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	6	30 - 70	*Eucalyptus sp.*
Middle	Shrub	2	10 - 30	*Callistemon sp. kunzea sp. hakea sp. myrtaceae sp.*
Lower	Sedge, rush	0.5	10 - 30	Rushes and sedges, *lepidosperma sp.*

Name	Habitat Type	Landform	Site Photograph
R	Mallee over heath	Plain	
Condition	Condition	Excellent	
	Disturbance Type	None	
	Fire Age	>15	
% Ground Cover	Rock	0	
	Soil	2	
	Leaf Litter	8	
	Vegetation	90	
Rocks	Type	N/A	
	Size (mm)	N/A	
	Abundance (%)	0	
	Exposed Bedrock (%)	0	
Soil	Type	Sand	
	Colour	Grey	
Habitat Features	Slope	Gently inclined (3 – 5)	
	Water	No - never	
	Termite Presence	None	
	Woody Debris	Moderate	
	Peeling Bark	Moderate	
	Rock Crevices	None	
	Burrowing Suitability	Low	
	Tree Hollows (<10 cm)	None	
		None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	6	30 - 70	*Eucalyptus sp., hakea sp.*
Middle	Tree, mallee, vine, tussock grass	2	30 - 70	*Exocarpus sp., Melaleuca sp., ?Acacia sp.*
Lower	Rush	0.5	10 - 30	*Poaceae sp.*

Appendix D Photo Point Monitoring

Site A (51H 258095 mE 6272248 mS)	
2020	
PM1 to PM2	PM1 to PM3
2021	

Site B (51H 256144 mE 6272399 mS)	
2020	
PM1 to PM2	PM1 to PM3
2021	

Site C (51H 253338 mE 6273680 mS)

2020

PM1 to PM2	PM1 to PM3

2021

Site D (51H 257343 mE 6276005 mS)	
2020	
PM1 to PM2	PM1 to PM3
2021	

Site E (51H 253992 mE 6278578 mS)	
2020	
PM1 to PM2	PM1 to PM3
2021	

Site F (51H 254375 mE 6279639 mS)	
2020	
PM1 to PM2	PM1 to PM3
2021	
Not Monitored	Not Monitored

Site G (51H 248886 mE 6279167 mS)	
2020	
PM1 to PM2	PM1 to PM3
2021	

Site H (51H 251995 mE 6279723 mS)	
2020	
PM1 to PM2	PM1 to PM3
2021	

Site I (51H 255835 mE 6277225 mS)	
2020	
PM1 to PM2	PM1 to PM3
2021	

Site J/K (51H 250631 mE 6284153 mS)	
2020	
PM1 to PM2	PM1 to PM3
2021	
Not Monitored	Not Monitored

Site L (51H 252242 mE 6279733 mS)

2020

PM1 to PM2	PM1 to PM3

2021

Site M (51H 258865 mE 6280119 mS)	
2020	
PM1 to PM2	PM1 to PM3
2021	

Site N (51H 257582 mE 6281073 mS)	
2020	
PM1 to PM2	PM1 to PM3
2021	

Site O (51H 247921 mE 6280770 mS)	
2020	
PM1 to PM2	PM1 to PM3
2021	

Site P (51H 254695 mE 6282922 mS)	
2020	
PM1 to PM2	PM1 to PM3
2021	
Not Monitored	Not Monitored

Site Q (51H 248780 mE 6282558 mS)

2020

PM1 to PM2	PM1 to PM3

2021

Site R (51H 250232 mE 6285885 mS)

2020

PM1 to PM2	PM1 to PM3

2021

Appendix E Chuditch Capture Data

Site	Trap	Date	Easting	Northing	Recapture	PIT ID	Condition	Weight (g)	Sex	PES (mm)	Tail Base (mm)
-	-	01-03-21	255313.0	6279190.0	No	No, Carcass	Good	900	Male	64	-
D	10	05-03-21	257428.5	6276228.3	No	943094322007456	Good	1030	Male	56	16
D	03	06-03-21	257384.1	6275905.4	No	Unknown, escaped	Good	Unknown	Unknown	Unknown	Unknown
D	06	06-03-21	257338.1	6276079.3	No	943094322007593	Good	745	Female	56	14
E	08	07-03-21	253565.0	6278781.7	No	943094322007967	Good	1230	Male	64	32
D	01	08-03-21	257403.7	6275799.7	Yes	943094322007593	Good	745	Male	56	14

		Carcass
Site	-	
Trap	-	
Date	01-03-21	
Easting	255313	
Northing	6279190	
Recapture	No	
PIT ID	No, Carcass	
Condition	Good	
Weight (g)	900	
Sex	Male	
PES (mm)	64	
Tail Base (mm)	-	
Notes	Mature male struck and killed by unknown vehicle on South Coast Highway. Not previously PIT tagged. Ear notch sample donated to DBCA for research.	

		Left Side	Right Side
Site	D		
Trap	10		
Date	05-03-21		
Easting	257428.5		
Northing	6276228.3		
Recapture	No		
PIT ID	943094322007456		
Condition	Good		
Weight (g)	1030		
Sex	Male		
PES (mm)	56		
Tail Base (mm)	16		
Notes	Healthy mature male not previously PIT tagged. Placid. PIT tagged and ear notch sample donated to DBCA for research. Released at location of capture.		

		Left Side	Right Side
Site	D	NA	NA
Trap	3		
Date	06-03-21		
Easting	257384.1		
Northing	6275905.4		
Recapture	No		
PIT ID	Unknown, escaped		
Condition	Good		
Weight (g)	Unknown		
Sex	Unknown		
PES (mm)	Unknown		
Tail Base (mm)	Unknown		
Notes	Escaped from cage during processing. Unknown if the individual had been PIT tagged during previous monitoring programs. Appeared in good condition. Escaped at location of capture.		

		Left Side	Right Side
Site	D		
Trap	6		
Date	06-03-21		
Easting	257338.1		
Northing	6276079.3		
Recapture	No		
PIT ID	943094322007593		
Condition	Good		
Weight (g)	745		
Sex	Female		
PES (mm)	56		
Tail Base (mm)	14		
Notes	Healthy juvenile female not previously PIT tagged. Placid. PIT tagged and ear notch sample donated to DBCA for research. Released at location of capture.		

		Left Side	Right Side
Site	E		
Trap	8		
Date	07-03-21		
Easting	253565		
Northing	6278781.7		
Recapture	No		
PIT ID	943094322007967		
Condition	Good		
Weight (g)	1230		
Sex	Male		
PES (mm)	64		
Tail Base (mm)	32		
Notes	Healthy mature male not previously PIT tagged. Placid. PIT tagged and ear notch sample donated to DBCA for research. Released at location of capture.		

		Left Side	Right Side
Site	D		
Trap	1		
Date	08-03-21		
Easting	257403.7		
Northing	6275799.7		
Recapture	Yes		
PIT ID	943094322007593		
Condition	Good		
Weight (g)	745		
Sex	Female		
PES (mm)	56		
Tail Base (mm)	14		
Notes	Recapture from two days previously at D6. Still healthy and released.		

Appendix F Fauna of Significance Records

Date	Species name	Common name	Record type	Individuals
23-Feb	*Notamacropus irma*	Western Brush Wallaby	observed	1
24-Feb	*Notamacropus irma*	Western Brush Wallaby	observed	1
	Psophodes nigrogularis oberon	Western Whipbird	heard	1
25-Feb	*Notamacropus irma*	Western Brush Wallaby	observed	2
	Psophodes nigrogularis oberon	Western Whipbird	observed	1
26-Feb	*Notamacropus irma*	Western Brush Wallaby	motion camera	1
27-Feb	*Falco peregrinus*	Peregrine Falcon	observed	1
	Notamacropus irma	Western Brush Wallaby	carcass	3
			observed	1
	Psophodes nigrogularis oberon	Western Whipbird	heard	13
28-Feb	*Notamacropus irma*	Western Brush Wallaby	motion camera	1
			observed	2
	Psophodes nigrogularis oberon	Western Whipbird	heard	6
01-Mar	*Dasyurus geoffroii*	Chuditch	carcass	1
			motion camera	1
	Leipoa ocellata	Malleefowl	motion camera	2
	Notamacropus irma	Western Brush Wallaby	motion camera	1
	Psophodes nigrogularis oberon	Western Whipbird	heard	5
02-Mar	*Dasyurus geoffroii*	Chuditch	motion camera	1
	Leipoa ocellata	Malleefowl	motion camera	2
	Notamacropus irma	Western Brush Wallaby	motion camera	2
	Psophodes nigrogularis oberon	Western Whipbird	heard	1
03-Mar	*Leipoa ocellata*	Malleefowl	motion camera	2
	Notamacropus irma	Western Brush Wallaby	motion camera	1
	Psophodes nigrogularis oberon	Western Whipbird	heard	2
04-Mar	*Notamacropus irma*	Western Brush Wallaby	observed	1
	Psophodes nigrogularis oberon	Western Whipbird	heard	4
05-Mar	*Dasyurus geoffroii*	Chuditch	caught	1
			motion camera	3
	Psophodes nigrogularis oberon	Western Whipbird	heard	6
06-Mar	*Dasyurus geoffroii*	Chuditch	caught	2
			motion camera	1
	Leipoa ocellata	Malleefowl	motion camera	2
	Notamacropus irma	Western Brush Wallaby	observed	2
	Psophodes nigrogularis oberon	Western Whipbird	heard	3
07-Mar	*Dasyurus geoffroii*	Chuditch	motion camera	1
			caught	1
	Leipoa ocellata	Malleefowl	motion camera	2
	Psophodes nigrogularis oberon	Western Whipbird	heard	11
			motion camera	1
08-Mar	*Dasyurus geoffroii*	Chuditch	caught	1
	Psophodes nigrogularis oberon	Western Whipbird	heard	4
09-Mar	*Psophodes nigrogularis oberon*	Western Whipbird	heard	2

Appendix G Non-target Species Captured During the Survey

Date	Scientific Name	Common Name	Trap Number	Count
01/3/2021	*Tiliqua rugosa*	Bobtail	B10	1
02/3/2021	*Mus musculus*	*House Mouse	C02	1
02/3/2021	*Mus musculus*	*House Mouse	C08	2
02/3/2021	*Mus musculus*	*House Mouse	C14	1
02/3/2021	*Mus musculus*	*House Mouse	O09	1
03/3/2021	*Mus musculus*	*House Mouse	C17	1
03/3/2021	*Tiliqua rugosa*	Bobtail	B01	1
03/3/2021	*Tiliqua rugosa*	Bobtail	B05	1
03/3/2021	*Tiliqua rugosa*	Bobtail	B07	1
03/3/2021	*Tiliqua rugosa*	Bobtail	B08	1
03/3/2021	*Tiliqua rugosa*	Bobtail	B10	1
03/3/2021	*Tiliqua rugosa*	Bobtail	G15	1
04/3/2021	*Mus musculus*	*House Mouse	C14	1
04/3/2021	*Mus musculus*	*House Mouse	C17	1
04/3/2021	*Tiliqua rugosa*	Bobtail	B2	1
04/3/2021	*Tiliqua rugosa*	Bobtail	B4	1
06/3/2021	*Tiliqua rugosa*	Bobtail	A08	1
06/3/2021	*Tiliqua rugosa*	Bobtail	A16	1
06/3/2021	*Tiliqua rugosa*	Bobtail	A18	1
06/3/2021	*Tiliqua rugosa*	Bobtail	D02	1
06/3/2021	*Tiliqua rugosa*	Bobtail	D04	1
06/3/2021	*Varanus rosenbergi*	Heath Monitor	L03	1
06/3/2021	*Varanus rosenbergi*	Heath Monitor	L08	1
07/3/2021	*Mus musculus*	*House Mouse	A20	2
07/3/2021	*Mus musculus*	*House Mouse	H03	2
07/3/2021	*Mus musculus*	*House Mouse	H04	2
07/3/2021	*Mus musculus*	*House Mouse	H15	2
07/3/2021	*Mus musculus*	*House Mouse	I04	2
07/3/2021	*Tiliqua rugosa*	Bobtail	L07	1
08/3/2021	*Mus musculus*	*House Mouse	H01	1
08/3/2021	*Mus musculus*	*House Mouse	H04	2
08/3/2021	*Mus musculus*	*House Mouse	H14	1
08/3/2021	*Mus musculus*	*House Mouse	H15	1
08/3/2021	*Mus musculus*	*House Mouse	H18	2
08/3/2021	*Mus musculus*	*House Mouse	H19	1
09/3/2021	*Mus musculus*	*House Mouse	A18	2
09/3/2021	*Mus musculus*	*House Mouse	H03	1
09/3/2021	*Mus musculus*	*House Mouse	H06	2
09/3/2021	*Mus musculus*	*House Mouse	H18	1

Date	Scientific Name	Common Name	Trap Number	Count
09/3/2021	*Mus musculus*	*House Mouse	H20	2
09/3/2021	*Tiliqua rugosa*	Bobtail	A17	1
09/3/2021	*Tiliqua rugosa*	Bobtail	L02	1
09/3/2021	*Tiliqua rugosa*	Bobtail	L07	1
09/3/2021	*Tiliqua rugosa*	Bobtail	L08	1
09/3/2021	*Varanus rosenbergi*	Heath Monitor	L01	1
24/2/2021	*Varanus rosenbergi*	Heath Monitor	Q1	1
25/2/2021	*Tiliqua rugosa*	Bobtail	Q04	1
25/2/2021	*Tiliqua rugosa*	Bobtail	Q09	1
26/2/2021	*Tiliqua rugosa*	Bobtail	M05	1
26/2/2021	*Tiliqua rugosa*	Bobtail	M13	1
26/2/2021	*Tiliqua rugosa*	Bobtail	Q01	1
26/2/2021	*Varanus rosenbergi*	Heath Monitor	N02	1
26/2/2021	*Varanus rosenbergi*	Heath Monitor	N08	1
28/2/2021	*Varanus rosenbergi*	Heath Monitor	N02	1
28/2/2021	*Varanus rosenbergi*	Heath Monitor	N06	1
28/2/2021	*Varanus rosenbergi*	Heath Monitor	N08	1

Appendix H Motion Camera Locations

Site	Motion Camera	Deployment Date	Trap Nights	Easting	Northing
A	REC67	05/3/2021	4	258093.3	6272245.9
B	REC57	28/2/2021	4	256548.7	6272518.4
B	REC83	28/2/2021	4	255992.7	6272508.2
B	REC91	28/2/2021	4	256091.3	6272417.8
B	REC92	28/2/2021	4	255983.7	6272456.2
B	REC93	28/2/2021	4	256111.3	6272382.8
C	REC89	28/2/2021	4	253341.4	6273695.3
D	REC57	04/3/2021	4	257397.4	6275793.2
D	REC89	04/3/2021	4	257382.4	6275837.7
D	REC91	04/3/2021	4	257337.4	6276090.5
D	REC92	04/3/2021	4	257380.0	6275951.3
D	REC93	04/3/2021	4	257345.9	6275974.5
E	REC59	03/3/2021	4	253669.2	6278772.4
E	REC66	03/3/2021	4	253564.1	6278831.5
E	REC75	03/3/2021	4	253474.9	6278839.0
E	REC87	03/3/2021	4	253771.6	6278721.8
E	REC88	03/3/2021	4	253914.0	6278658.5
G	REC87	27/2/2021	4	248921.4	6279164.8
H	REC07	05/3/2021	4	251823.9	6279764.1
I	REC90	03/3/2021	4	255757.3	6277577.8
L	REC20	05/3/2021	4	252209.2	6279727.8
L	REC56	05/3/2021	4	252016.7	6279699.7
L	REC74	05/3/2021	4	252120.6	6279751.3
L	REC83	05/3/2021	4	252289.9	6279734.7
L	REC84	05/3/2021	4	252340.3	6279722.3
M	REC74	24/2/2021	4	258861.3	6280121.9
N	REC57	24/2/2021	4	257472.4	6280995.3
N	REC83	24/2/2021	4	257562.6	6280992.1
N	REC89	24/2/2021	4	257592.3	6281040.8
N	REC92	24/2/2021	4	257491.9	6281073.9
N	REC93	24/2/2021	4	257519.3	6280950.2
O	REC88	27/2/2021	4	247901.9	6280726.7
Q	REC56	23/2/2021	4	249049.4	6282480.1
Q	REC59	23/2/2021	4	248836.3	6282517.6
Q	REC66	23/2/2021	4	249143.7	6282524.8
Q	REC75	23/2/2021	4	248942.4	6282485.4
Q	REC90	23/2/2021	4	248784.3	6282562.9
R	REC77	23/2/2021	4	250301.2	6285779.2
R	REC87	23/2/2021	4	250228.3	6285873.5
R	REC88	23/2/2021	4	250483.6	6285696.3
R	REC91	23/2/2021	4	250381.5	6285753.8
R	REC94	23/2/2021	4	250615.5	6285610.4
MW1	REC84	26/2/2021	5	250828.6	6279365.1
MW7	REC94	02/3/2021	5	253957.1	6279138.2
MW9	REC75	01/3/2021	2	254194.6	6277579.5

CREATING COMMUNITIES

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12 March 2021

First Quantum Minerals
Ravensthorpe Nickel Operations, WA 6346

Attention: Phillip Knapton
Superintendent, Environmental

Regarding: Shoemaker-Levy Stage 2 - Targeted Malleefowl Survey

Dear Phillip,

In line with our proposal, this memo details the results of the Targeted Malleefowl Survey (the Survey) conducted by Kyle Wood (Intermediate Zoologist – Survey Lead) and Scott Pansini (Intermediate Zoologist) for Stage 2 of the Shoemaker-Levy Project.

The Survey Area comprised three individual areas totalling 66.67 ha (Table 1). Transect searches were conducted by field staff in each Survey Area to look for evidence of Malleefowl (including feathers, mounds, tracks, or individuals). Transects were spaced 20-30 m apart, which allowed for 10-15 m of visibility either side of the transect, consistent with the methods of *National Malleefowl Monitoring Manual: Standards, Protocols and Monitoring Procedures Edition 2016* (National Malleefowl Recovery Team 2016) (Figure 1; Figure 2; Figure 3). The survey effort was based on the density of vegetation within fauna habitats previously mapped by Stantec (2019a). In addition to the targeted Malleefowl searches, any other significant species observed during the field survey were also recorded.

The Survey found no evidence (including feathers, mounds, tracks, or individuals) of Malleefowl within any of the Survey Areas. Please note that that the detection of Malleefowl tracks may have been hindered by heavy rainfall that occurred prior to, and during the field survey. Whilst no evidence of Malleefowl were detected during the Survey, Malleefowl are known to occur in the surrounding area (Stantec 2018, 2019a, b, 2020) and have been recorded 120 m to the south of the Southern Malleefowl Survey Area by Stantec (2020). In addition, three active Malleefowl mounds were known to occur in the surrounding area during the 2021 annual fauna monitoring program, 500 m south (MW7), 2 km south (MW9), and 2.5 km west (MW1) of the Southern Malleefowl Survey Area. Malleefowl are known to range over several kilometres from their mounds during the year, and therefore may still utilise the Survey Areas for foraging and dispersal (Benshemesh 2007).

Table 1: Targeted Malleefowl survey areas and survey effort

Survey Area	Size (ha)	Survey Date	Survey Effort	Malleefowl Evidence
Northern Survey Area	13.78	25/02/2021	3h 10m	None found
Eastern Survey Area	38.71	05-06/03/2021	7h 39m	None found
Southern Survey Area	14.18	03/03/2021	3h 38m	None found

In addition to the Malleefowl Survey, the Western Brush Wallaby (P4) was opportunistically recorded within the Eastern Malleefowl Survey Area on three occasions (Figure 2).

Yours sincerely,

Kyle Wood
Intermediate Zoologist
Stantec Australia Pty Ltd

Melissa Jensen
Senior Zoologist
Stantec Australia Pty Ltd

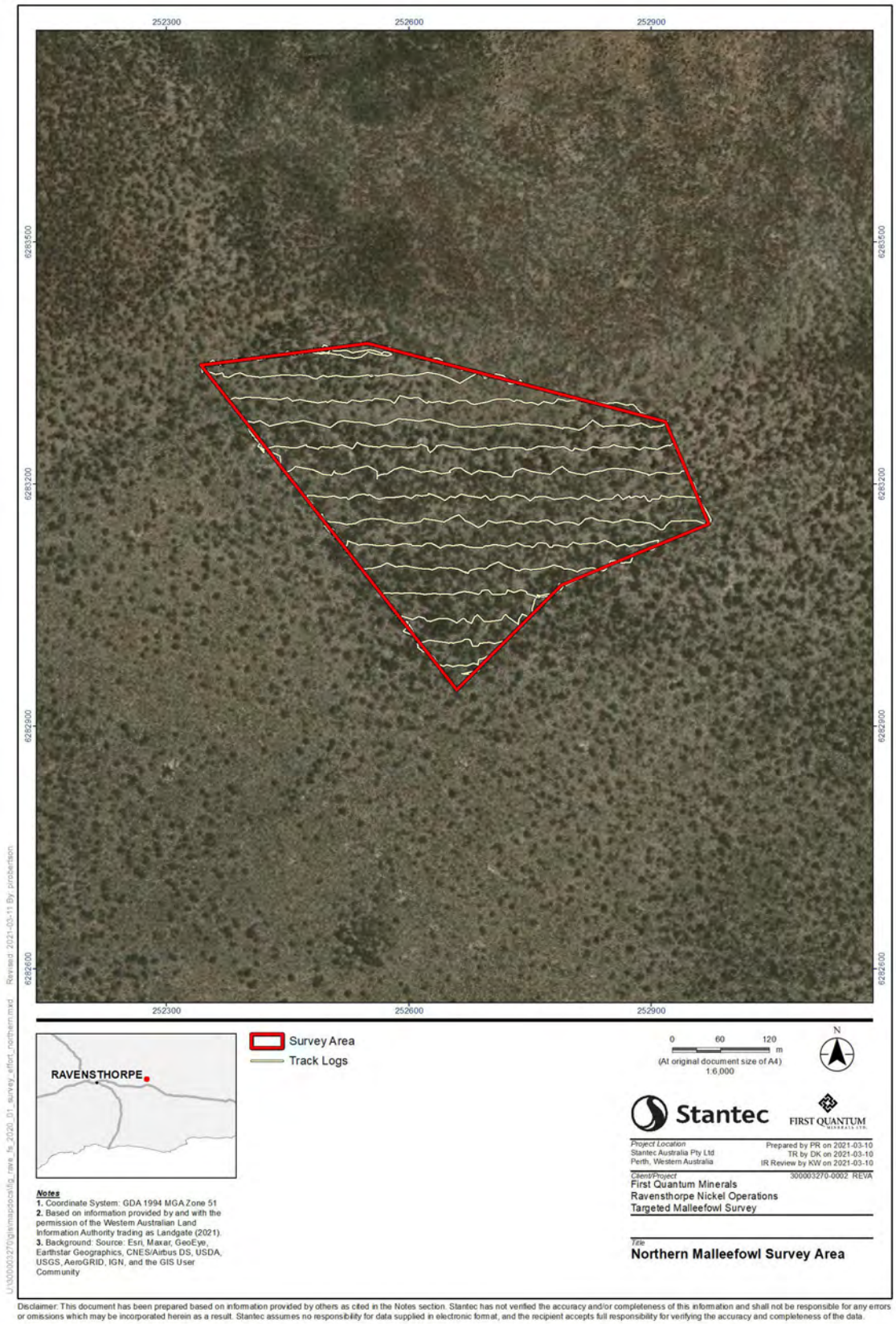

Figure 1: Northern Malleefowl Survey Area and Survey Effort

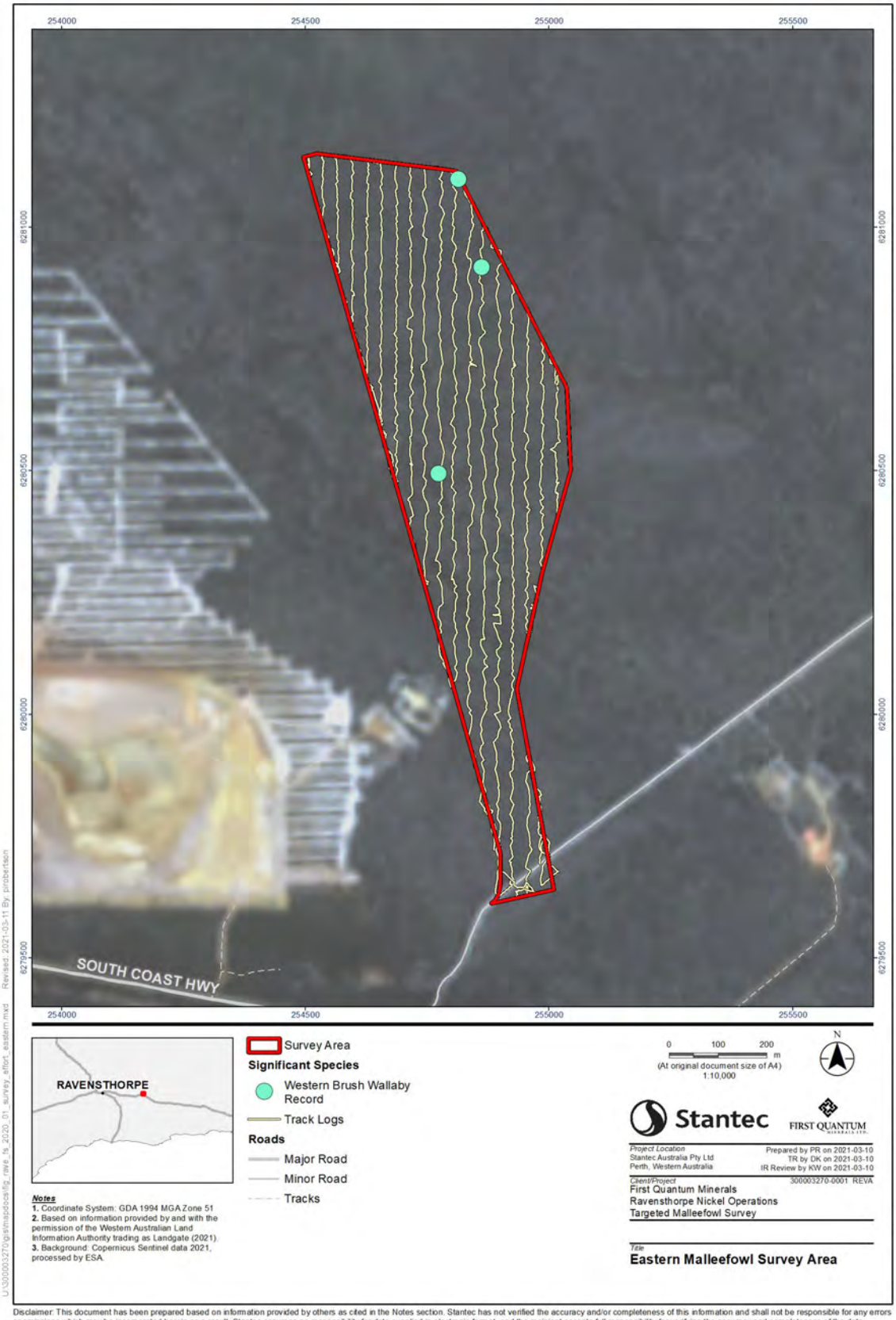

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Figure 2: Eastern Malleefowl Survey Area and Survey Effort

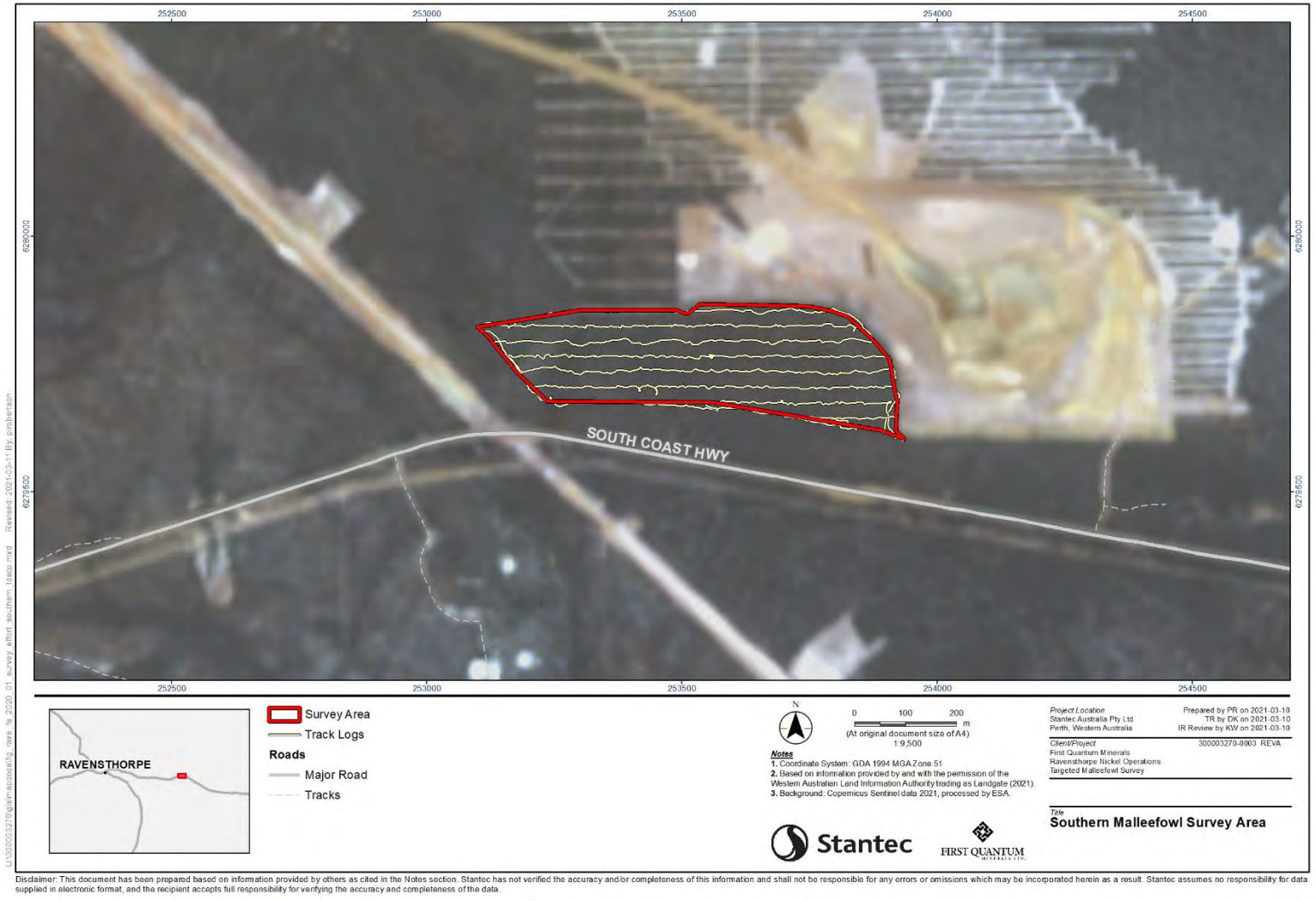

Figure 3: Southern Malleefowl Survey Area and Survey Effort

References

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QUALITY STATEMENT

PROJECT MANAGER	PROJECT TECHNICAL LEAD
Tracy Schwinkowski	Paul Bolton

PREPARED BY		
Kyle Wood	.....	13 May 2020
CHECKED BY		
Stephanie Williams	.....	13 May 2020
REVIEWED BY		
Paul Bolton	.....	13 May 2020
APPROVED FOR ISSUE BY		
Paul Bolton	.....	13 May 2020

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REVISION SCHEDULE

Rev No.	Date	Description	Signature or Typed Name (documentation on file)			
			Prepared by	Checked by	Reviewed by	Approved by
1.0	13/5/20	Draft for comment	KW	SW	PB	PB

Executive Summary

First Quantum Minerals Ltd (FQM) commissioned Stantec Australia Pty Ltd (Stantec) to conduct a survey of significant species (the Survey), in the vicinity of the Ravensthorpe Nickel Operations (the Project). The Survey was designed to meet regulatory requirements predominantly relating to the following species (conservation codes under the EPBC, BC Act and DBCA provided respectively):

- Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*)(En, En);
- Heath Mouse (*Pseudomys shortridgei*)(En, Vu);
- Chuditch (*Dasyurus geoffroii*)(Vu, Vu);
- Malleefowl (*Leipoa ocellata*)(Vu, Vu);
- Western Whipbird (*Psophodes nigrogularis oberon*) (P4); and
- Western Brush Wallaby (*Notamacropus irma*) (P4).

The specific objectives of this survey were to:

- Conduct a fauna survey at the locations that were established during the 2019 baseline survey, to monitor significant fauna and feral predators;
- Utilise a 'mark recapture' technique with PIT tags or ear notching during the field survey to provide quantitative data on demographics and distribution of the following species when trapped; Chuditch, Heath Mouse and Western Mouse; and
- Record the survey results in the population dataset to compare changes of significant fauna species over time, in relation to Project developments and environmental variables.

The Survey Area for this monitoring program comprised the 'Study Area' surveyed during the 2018 fauna survey and surrounds. This Survey Area encompassed:

- areas of historical mining;
- areas of proposed mining as part of the proposed Shoemaker Levy expansion; and
- areas of suitable habitat identified in the surrounding area.

During the Survey 18 targeted sites were monitored, comprising nine impact sites and nine control sites. All 15 sites previously established in 2019 were monitored during the Survey with three sites added to the program to provide additional control site sampling effort.

The nine impact sites occur near historical and proposed mining, and as mine expansions occur and activity continues these sites may potentially be impacted. The establishment of 'impact' sites prior to mining activity will provide a baseline comparison, allowing any future impacts to be detected.

Chuditch monitoring sites were established at eight locations within appropriate Chuditch habitat. Four of these sites were close to current or proposed mining activity and are referred to as 'impact' sites. The remaining four monitoring sites were located outside any current or proposed disturbance and represent 'control' sites. Ten large cage traps were deployed at each site for four consecutive nights, equating to a total of 320 trap nights for the Survey.

Western Mouse and Heath Mouse monitoring sites were established at ten locations within appropriate habitat. Five of these were established near current or proposed mining activity and are referred to as 'impact' sites. The remaining five monitoring sites were located outside any proposed or historical mining disturbance and represent 'control' sites. Twenty small Elliot traps were deployed at each Mouse monitoring site for four consecutive nights, equating to a total of 800 trap nights for the Survey.

Additional survey techniques were conducted to compliment trapping and confirm presence and distribution of species across the Survey Area. Five motion-sensor cameras were deployed at each Chuditch monitoring site and one motion-sensor camera was deployed at each Mouse monitoring site. Two motion-sensor camera sites, comprising a total of five motion-sensor cameras, were also installed in areas of high-quality habitat to aid in determining potential future trapping sites. In total, motion-sensor cameras were deployed at 56 locations for between 2 and 7 consecutive nights, equating to a total of 253 recording nights for the Survey. In total nine Malleefowl mound assessments were undertaken at known

active and inactive mounds and were compared with previous assessments to determine Malleefowl presence and activity. Evidence of Carnaby's Black Cockatoo foraging in the area was also recorded.

Two Chuditch were captured from one Chuditch trapping site D (Impact) during the Survey, a decline from the four Chuditch captured in the 2019 monitoring program (Stantec 2019b). Both captures were young females that had not been PIT tagged in previous surveys. Chuditch presence was also confirmed via motion-sensor cameras at seven of the eight Chuditch monitoring sites, one Mouse monitoring site, and at one motion-sensor camera site during the Survey, indicating the species is persisting across a range of habitats within the Survey Area. No Western Mouse or Heath Mouse individuals were captured or confirmed via motion-sensor cameras during the Survey. Heath Mice have not been recorded in any of the previous monitoring programs within the Survey Area (Stantec 2019b, Terrestrial Ecosystems 2013, 2014, 2015, 2016a, 2017a), while the Western Mouse has only been recorded once, in 2017 (Terrestrial Ecosystems 2017a).

Four Malleefowl mounds were assessed as 'active' during the Survey, a decrease from the five active mounds recorded by Stantec (2019b). Individual Malleefowl were directly observed within the Survey Area on seven occasions and likely comprised two breeding pairs. Motion-sensor cameras placed at two active mounds near the sightings confirmed breeding pairs were actively tending to the mounds.

Carnaby's Black Cockatoo were observed on three occasions, despite not being recorded in the 2019 monitoring program (Stantec 2019b). Foraging evidence from Carnaby's Black Cockatoo was also confirmed at one location within the Survey Area. The presence of foraging increased the habitat foraging score of Mallee on loam or clay habitat from 'low quality' to 'medium quality'.

The Western Brush Wallaby was observed directly on 16 occasions during the Survey, as well as at four locations via motion-sensor cameras. In 2019, the Western Brush Wallaby was observed on four occasions and via motion-sensor camera at seven locations. The Western Whipbird was recorded on 34 occasions during the Survey, an increase from the eight individuals recorded by Stantec (2019b). The Western Whipbirds recorded during the survey were mainly located in vegetation in, and adjacent to drainage lines.

This Survey utilised survey sites established during the 2019 baseline survey, to conduct annual monitoring of significant fauna and feral predators occurring within the Survey Area. Annual monitoring will accurately capture potential impacts from mining activity while controlling for environmental factors, through the utilisation of appropriate impact and control sites. Continued annual monitoring at impact and control sites will clarify whether any populations are influenced by future mining operations undertaken for the Project.

First Quantum Minerals

RAVENSTHORPE NICKEL PROJECT: SIGNIFICANT SPECIES FAUNA MONITORING PROGRAM 2020

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1. Introduction

1.1 Project Background

The First Quantum Mineral Ltd (FQM) Ravensthorpe Nickel Operation (RNO) Project (the Project) is located in the Goldfields-Esperance region of Western Australia, approximately 455km southeast of Perth. The Project commenced development in 2004 and began actively mining in 2008, however was placed under 'care and maintenance' in October 2017. There are currently plans to restart mining operations in 2020. Stantec Australia Pty Ltd (Stantec), were engaged to continue the significant species fauna monitoring program for 2020 (the Survey), with consideration of:

- existing and anticipated fauna monitoring conditions associated with the Project and its expansion; and
- areas that were previously monitored in association with historic disturbance.

The Survey was designed to meet the following Environmental Protection Authority (EPA) requirements, while aligning with existing and anticipated fauna monitoring conditions:

- Ministerial Statement 633 (EPA 2003) (MS633) Condition 7-1 to monitor the Heath Rat (*Pseudomys shortridgei*)(En, Vu) and the Western Mouse (*Pseudomys occidentalis*) (P4);
- Environmental Scoping Document (ESD) for the Project (EPA 2017), required Work Item 32a: to monitor the health and population sizes of threatened species within the development envelope and in areas of indirect impact, in particular, the following species (which are all Matters of National Environmental Significance [MNES]):
    - Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*)(En, En);
    - Heath Mouse (*Pseudomys shortridgei*)(En, Vu); and
    - Chuditch (*Dasyurus geoffroii*)(Vu, Vu).
- Potential monitoring requirements of known active or inactive mounds of the Malleefowl (*Leipoa ocellata*)(Vu, Vu) in the vicinity of the Project; and
- opportunistic recording of other significant species including the;
    - Western Whipbird (*Psophodes nigrogularis oberon*) (P4); and
    - Western Brush Wallaby (*Notamacropus irma*) (P4).

MS 633 (EPA 2003) and the ESD for the Project (EPA 2017) used conservation schedules under The Wildlife Conservation (Specially Protected Fauna) Notice 2018. These schedules have been transitioned under regulations 170, 171 and 172 of the Biodiversity Conservation Regulations 2018 to be the lists of Threatened, Extinct and Specially Protected species under Part 2 of the Biodiversity Conservation Act 2016 (**Appendix A**). This report uses the current listings recognised under the Biodiversity Conservation Act 2016 rather than the previous listings used in MS633 and the ESD.

The Survey Area for this monitoring program comprised the 'Study Area' surveyed during the Stantec 2019 fauna survey and surrounds (Figure 1-1Error! Reference source not found.). This Survey Area encompassed:

- historic mining – existing impacts;
- proposed mining as part of the proposed Shoemaker Levy expansion – proposed impacts; and
- suitable surrounding habitat identified– control areas.

Previously, a baseline fauna survey was undertaken in 2013 and annual monitoring surveys were undertaken from 2014 to 2017 (Terrestrial Ecosystems 2013, 2014, 2015, 2016a, 2017a). After these surveys, a Level 1 targeted significant fauna survey was undertaken to 2018 to infill survey gaps and to better inform an environmental impact assessment for the Project. Subsequently, a new baseline monitoring program was designed and conducted (Stantec 2019a, b) which took into account the proposed impacts of the Project and would be better able to monitor potential impacts to significant fauna over time. The 2020 survey intensity matched the 2019 baseline survey, but with an additional three control trapping sites established.

1.1.1 Historic Survey Effort

The Project and surrounds have been extensively surveyed (BHPBIO 2006, Biota 2000, 2005, Coffey Environments 2009, 2010, Stantec 2019a, Terrestrial Ecosystems 2013, 2014, 2015, 2016a, b, 2017a, b, 2018). A comprehensive summary of the baseline survey and annual monitoring surveys conducted for the Project is provided in Stantec (2019a), (Stantec 2019b). Records of significant species confirmed within the RNO and surrounding areas are summarised in Figure 1-1Error! Reference source not found. and Table 1-1

During the literature review by Stantec (2019a), a number of inconsistencies were identified between the annual monitoring surveys (Terrestrial Ecosystems 2013, 2014, 2015, 2016a, 2017a). These inconsistencies typically comprised the location and number of sites monitored, and the survey methods and intensity undertaken. This resulted in the inability to confidently compare records of significant species from previous surveys due to differences in presenting record locations. The lack of consistent linking between significant species and habitats of importance in many previous surveys was of particular concern (Biota 2005, Coffey Environments 2009, 2010, Terrestrial Ecosystems 2013, 2014, 2015, 2016a, b, 2017a, b, 2018). Additionally, monitoring sites were altered by Terrestrial Ecosystems (2017a) to better represent the dominant habitats present near the Project and to not be in areas that will become cleared for the proposed Shoemaker Levy mine. The Terrestrial Ecosystems (2017a) monitoring survey concentrated trap sites near the existing mine resulting in a reduced spatial coverage and a survey design that would not be able to assess potential impacts of the expansion on fauna over time.

Due to these issues the Survey was redesigned by Stantec in 2019 to better meet regulatory conditions and assess the proposed impacts from the expansion of the Project (incorporating previous sites and methodology where possible). Consequently, the results from Stantec's 2019 and 2020 Surveys will not be directly comparable to those of previous surveys. However, the survey data collected from previous monitoring still provides contextual data on the occurrence of species.

1.2 Survey Scope and Objectives

The overarching objective of the Survey was to meet the requirements of condition 7-1 of MS633 and required work item 32a of the Environmental Scoping Document for the project (EPA 2017). In addition to these requirements, the activity of known Malleefowl mounds within the vicinity of the Project were re-assessed. The specific objectives of the program were to:

- conduct a fauna survey at the locations that were established during the 2019 baseline survey, to monitor significant fauna and feral predators;
- utilise a 'mark recapture' technique with pit tags or ear notching during the field survey to provide quantitative data on demographics and distribution of the following species when trapped; chuditch, heath mouse and western mouse; and
- record the survey results in the population dataset to compare changes of significant fauna species over time, in relation to project developments and environmental variables.

In summary, this survey used a targeted survey effort to record the Chuditch (*Dasyurus geoffroii)*, Western Mouse (*Pseudomys occidentalis*), Heath Mouse (*Pseudomys shortridgei*), Malleefowl (*Leipoa ocellata*), and Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*), while recording opportunistic sightings of the Western Brush Wallaby (*Notamacropus irma*) and Western Whipbird (*Psophodes nigrogularis oberon)*.

Table 1-1: Significant species records from previous monitoring surveys of the RNO.

Reference	Survey Details	Survey Effort and Methods	Significant Species
Terrestrial Ecosystems (2013)	**Location:** RNO **Survey type:** Annual monitoring baseline survey; trapping, camera trapping, Western Whipbird assessment **Survey dates:** Trapping 14/10 - 19/10/2013	**Trapping:** • 500 box traps – 2,500 trap nights • 100 cage traps – 500 trap nights **Western Whipbird:** • 11 sites **Motion-sensor camera:** • Eight deployed at breakaway – 16 trap nights	• Western Whipbird (*Psophodes nigrogularis oberon* [P4]) ○ Ten locations - Monitoring sites • Western Brush Wallaby (*Notamacropus irma* [P4]) - Opportunistic
Terrestrial Ecosystems (2014)	**Location:** RNO **Survey type:** Annual monitoring; trapping, camera trapping, Western Whipbird assessment **Survey dates:** Trapping: 12/09 - 18/09/2014	**Trapping:** • 500 box traps – 2,500 trap nights • 100 cage traps – 500 trap nights **Western Whipbird:** • 10 sites **Motion-sensor camera:** • 50 deployed - 1,550 trap nights	• Western Brush Wallaby (*Notamacropus irma* [P4]) ○ 6 sites - Motion-sensor camera • Western Whipbird (*Psophodes nigrogularis oberon* [P4]) ○ Eight locations - Monitoring sites ○ Five occasions - Opportunistic • Malleefowl (*Leipoa ocellata* [VU, VU]) ○ One location - Opportunistic ○ Two sites - Motion-sensor camera • Carnaby's Cockatoo (*Calyptorhynchus latirostris* [EN, EN]) ○ One site - Motion-sensor camera

Reference	Survey Details	Survey Effort and Methods	Significant Species
Terrestrial Ecosystems (2015)	**Location**: RNO **Survey type**: Annual monitoring; trapping, camera trapping, Western Whipbird assessment **Survey dates**: Trapping: 13/10 - 19/10/2015	**Trapping** • 500 box traps – 2,500 trap nights • 100 cage traps – 500 trap nights **Western Whipbird:** • 10 sites **Motion-sensor camera:** • 50 deployed – 1,550 trap nights	• Chuditch (*Dasyurus geoffroii* [VU, VU]) ○ 4 sites - Motion-sensor camera • Western Brush Wallaby (*Notamacropus irma* [P4]) ○ 6 sites - Motion-sensor camera • Western Whipbird (*Psophodes nigrogularis oberon* [P4]) ○ One site - Motion-sensor camera ○ Eight occasions - Monitoring site ○ One location - Opportunistic • Carnaby's Cockatoo (*Calyptorhynchus latirostris* [EN, EN])

Reference	Survey Details	Survey Effort and Methods	Significant Species
Terrestrial Ecosystems (2016a)	**Location**: RNO **Survey type**: Annual monitoring; trapping, camera trapping, Western Whipbird assessment. Feral animal trapping **Survey dates**: 15/11 - 21/11/2016	**Trapping** • 500 box traps – 2,500 trap nights • 100 cage traps and 119 feral trapping cage traps – 1,095 trap nights **Western Whipbird:** • 10 sites **Motion-sensor camera:** • 50 deployed – 1,550 trap nights	• Chuditch (*Dasyurus geoffroii* [VU, VU]) ○ Seven captures - Trapping ○ Five sites - Motion-sensor camera • Malleefowl (*Leipoa ocellata* [VU, VU]) ○ One location - Opportunistic ○ Five sites - Motion-sensor camera • Western Brush Wallaby (*Notamacropus irma* [P4]) ○ 6 sites - Motion-sensor camera • Western Whipbird (*Psophodes nigrogularis oberon* [P4]) ○ Eight locations - Monitoring site ○ 10 occasions - Opportunistic • Carnaby's Cockatoo (*Calyptorhynchus latirostris* [EN, EN])

Reference	Survey Details	Survey Effort and Methods	Significant Species
Terrestrial Ecosystems (2017a)	**Location**: RNO **Survey type**: Annual monitoring; trapping, camera trapping, Western Whipbird assessment **Survey dates**: Trapping 02/11 - 07/11/2017	**Trapping** • 450 box traps – 2,250 trap nights • 150 cage traps – 750 trap nights **Western Whipbird:** • 12 sites **Motion-sensor camera:** • 90 deployed – 3,600 trap nights	• Chuditch (*Dasyurus geoffroii* [VU, VU]) ○ 16 captures - Trapping ○ 24 locations - Motion-sensor camera • Western Whipbird (*Psophodes nigrogularis oberon* [P4]) ○ 10 locations - Monitoring site ○ 18 occasions - Opportunistic • Malleefowl (*Leipoa ocellata* [VU, VU]) ○ One location - Motion-sensor camera • Western Brush Wallaby (*Notamacropus irma* [P4]) ○ 77 locations - Motion-sensor camera • Western Mouse (Pseudomys occidentalis [P4]) ○ One individual - Trapping • Carnaby's Cockatoo (*Calyptorhynchus latirostris* [EN, EN])

Reference	Survey Details	Survey Effort and Methods	Significant Species
Stantec (2019b)	**Location**: RNO **Survey type**: Annual monitoring; trapping, camera trapping, Western Whipbird assessment, Malleefowl mound assessment **Survey dates**: 04/02/2019 – 15/02/2019	**Trapping** • 180 box traps – 720 trap nights • 60 cage traps – 240 trap nights **Motion-sensor camera**: 38 deployed – 507 trap nights	• Chuditch (***Dasyurus geoffroii*** [VU, VU]) ○ 5 captures - Trapping ○ 5 locations - Motion-sensor camera • Western Whipbird (***Psophodes nigrogularis oberon*** [P4]) ○ 8 occasions - Opportunistic • Malleefowl (***Leipoa ocellata*** [VU, VU]) ○ 2 location - Motion-sensor camera ○ 2 occasions - Opportunistic • Western Brush Wallaby (***Notamacropus irma*** [P4]) ○ 4 locations - Motion-sensor camera

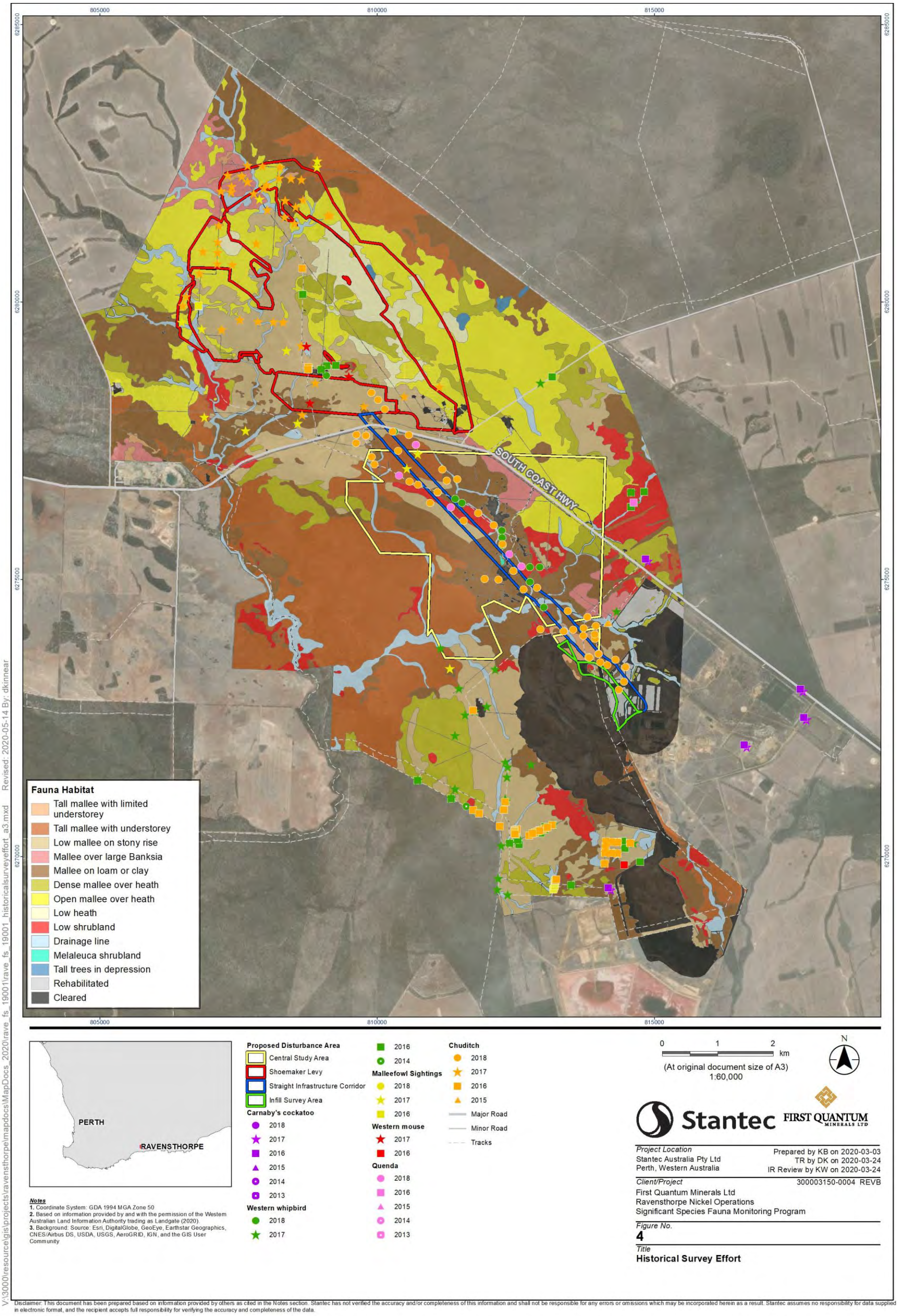


Figure 1-1: Historic survey results for the Project

2. Methods

The existing environment of the Project has been documented previously by Stantec (2019b). This includes a summary of the biogeographic region, climate, land systems and land use, as well as reserves and environmentally sensitive areas. This Survey continues the annual monitoring methodology utilised by Stantec (2019b) to monitor significant species in the Survey Area.

Conservation status and rankings used under the Environment Protection and Biodiversity Conservation (EPBC) Act, *Biodiversity Conservation Act 2016* (BC Act), as well as the Department of Biodiversity, Conservation and Attractions (DBCA) Priority list, are defined in Appendix A. The BC Act replaces both the *Wildlife Conservation Act 1950* (WC Act) and the Sandalwood Act and came into effect on 1 January 2019.

2.1 Field Survey

2.1.1 Timing

The field survey was conducted from the 3rd to the 13th of February 2020. Chuditch cage trapping was conducted from the 3rd to the 12th of February, while Heath Mouse and Western Mouse small Elliot trapping was conducted from the 4th to the 13th of February. Motion-sensor cameras were deployed between the 3rd and 13th of February, recording between four and seven nights at each targeted trapping site.

Survey timing was appropriate for the species being targeted during the Survey. The Survey was conducted outside the season when Chuditch females will have pouch or den young (mid-August to mid-November). The timing coincides with dispersal of juvenile Chuditch (September-May) (Soderquist and Serena 2000) and preceding heavy rainfall, avoiding the restriction of nocturnal foraging by Chuditch (DEC 2012a). The Survey was also conducted when Carnaby's Black Cockatoo's are known to forage along the south coast (January to July) (DotEE 2017).

2.1.2 Climate and Weather

In the six months preceding the field survey (August 2019 to January 2020), the Ravensthorpe weather station 010633, located approximately 30 km east of the Survey Area, recorded 131.4mm of rainfall. This was 73 mm lower than the long-term annual average rainfall of 204.4 mm for the same period (BoM 2020) (Figure 2-1). Local weather conditions during the Survey were variable, with maximum temperatures ranging from 19.0º C to 40.8º C, of which six days were over 30.0º C (Table 2-1). Minimum temperature data for Ravensthorpe (station 010633) was unavailable for most of Survey but ranged from 12.0 º C to 19.5º C between the 3rd and 6th of February (Table 2-1). Rainfall was recorded on two days during the Survey, with 6.2mm and 6.8mm falling on the 7th and 12th of February respectively (Table 2-1). Relative humidity (recorded only at 0900) ranged between 18 and 95%. Weather conditions during the survey were unseasonal and largely influenced by ex-tropical cyclone Damian that passed over the Survey Area on 12 February.

Table 2-1: Daily weather observations recorded at Ravensthorpe during the Survey (BoM 2020)

Date	Temperature (°C)		Rainfall (mm)	Humidity (%)
	Min	Max		
03/02/2020	15.1	28.2	0	56
04/02/2020	12.0	32.5	0	90
05/02/2020	15.5	32.0	0	46
06/02/2020	19.5	32.6	0	18
07/02/2020	N/A	36.8	6.2	47
08/02/2020	N/A	40.8	0	62
09/02/2020	N/A	23.0	0	58
10/02/2020	N/A	23.5	0	58
11/02/2020	N/A	19.0	0	75
12/02/2020	N/A	23.5	6.8	95
13/02/2020	N/A	31.6	0	74
Average	15.5	29.4	1.2	61.7

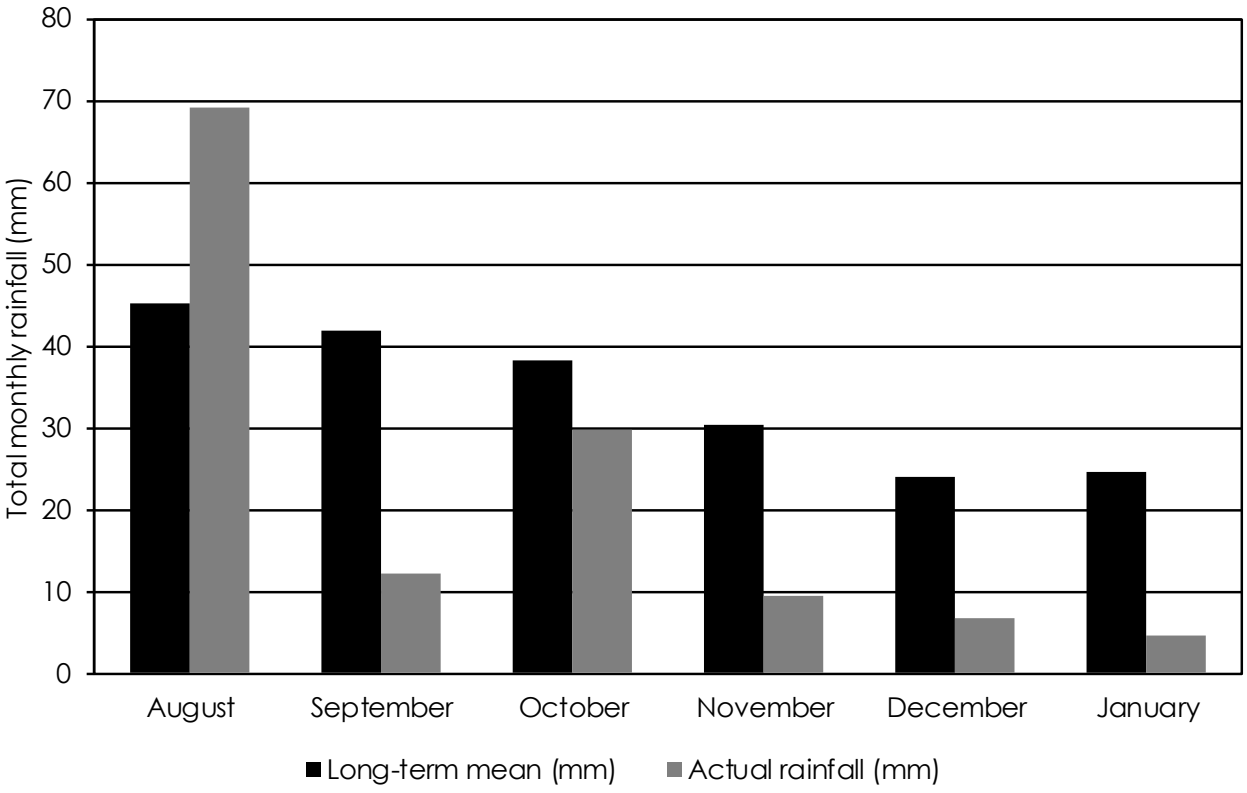


Figure 2-1: Long-term average and pre-Survey rainfall received at Ravensthorpe weather station 10633.

2.1.3 Survey Site Locations

In addition to the 15 sties previously established in 2019, three targeted monitoring sites were added to the program during the Survey, comprising of two Chuditch (Q, R) and one Heath/ Western Mouse site (P). New monitoring sites were installed in areas of high quality habitat for their targeted species, whilst also taking into consideration records from previous surveys conducted in the Survey Area (BHPBIO 2006, Biota 2000, 2005, Coffey Environments 2009, 2010, Stantec 2019a, b, Terrestrial Ecosystems 2013, 2014, 2015,

2016a, b, 2017a, b, 2018). The three new sites installed during the field survey were installed in long-unburnt areas within FQM tenements and represent additional control sites (Error! Reference source not found.).

Additionally, two motion-sensor camera sites (MC1, MC2) were installed in areas of long unburnt vegetation to help inform potential future trapping sites. In total, this Survey included 18 targeted monitoring sites and two motion-sensor camera sites. Nine sites within the Survey Area were close to current or proposed mining disturbance and are referred to as 'impact' sites (Table 2-2). The other nine sites were in areas that are unlikely to be directly or indirectly impacted by current or proposed mining activities, and therefore represent 'control' sites. The Malleefowl mound assessment component of the Survey is summarized in Section 2.1.7

Table 2-2: Targeted monitoring site locations and survey effort for the Survey

Site	Monitoring Site	Category	Trap nights			Location (51H)	
			Elliot	Cage	Camera	Easting	Northing
B	Chuditch	Control	-	40	20	256135	6272396
N	Chuditch	Control	-	40	20	257466	6280948
Q	Chuditch	Control	-	40	25	248949	6282487
R	Chuditch	Control	-	40	25	250381	6285755
D	Chuditch	Impact	-	40	20	257344	6276023
E	Chuditch	Impact	-	40	20	253675	6278713
J	Chuditch	Impact	-	40	20	250343	6284181
L	Chuditch	Impact	-	40	35	252254	6279715
C	Mouse	Control	80	-	4	253352	6273692
G	Mouse	Control	80	-	4	249049	6279114
M	Mouse	Control	80	-	4	258864	6280074
O	Mouse	Control	80	-	6	247945	6280759
P	Mouse	Control	80	-	5	254645	6282991
A	Mouse	Impact	80	-	4	258195	6272253
F	Mouse	Impact	80	-	6	254375	6279642
H	Mouse	Impact	80	-	7	251828	6279722
I	Mouse	Impact	80	-	4	255703	6277452
K	Mouse	Impact	80	-	6	250335	6284193
MC1	-	-	-	-	4	250031	6280505
MC2	-	-	-	-	9	251736	6284870
Total			800	320	248		

2.1.4 Survey Team and Licensing

The field survey was conducted by experienced zoologists Jeff Turpin, Mike Brown, Scott Pansini, and Kyle Wood. Jeff Turpin and Mike Brown are senior zoologists with more than 10 years' experience conducting Level 1, Level 2 and fauna monitoring surveys across Western Australia. Jeff and Mike were technical leads during the field survey and supported by Scott and Kyle. Scott Pansini has three years' experience as a zoologist, with considerable experience conducting targeted surveys for Malleefowl. Kyle has two years' experience as a zoologist and has previously conducted targeted surveys for threatened species in Western Australia, including the Western Whipbird. All four zoologists are experienced in survey methods including tracking, motion-sensor camera recording and avifauna identification.

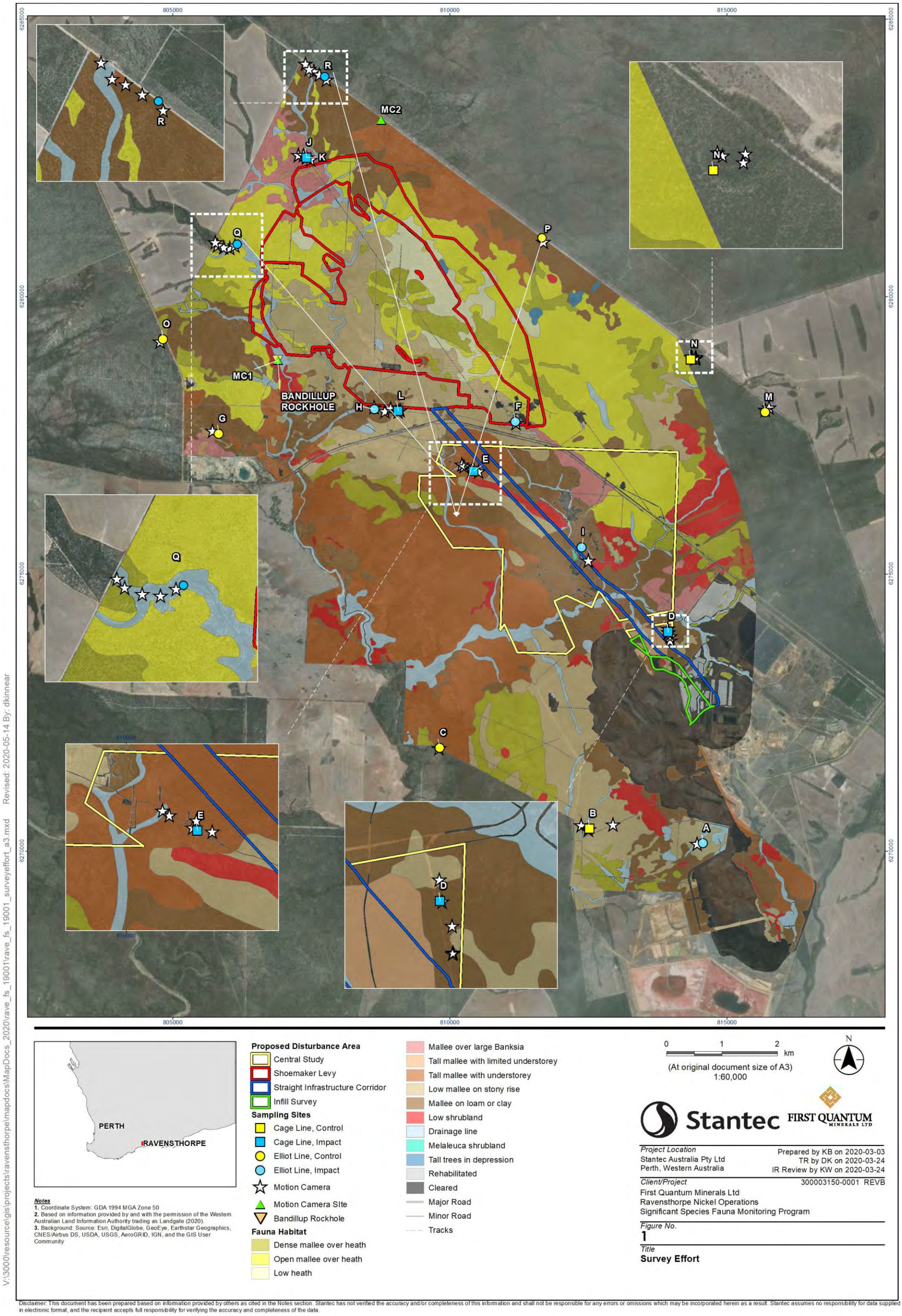


Figure 2-2: The Survey Area showing monitoring site locations for the Survey

2.1.5 Habitat Assessment

Formal habitat assessments had previously been conducted by Stantec (2019a) to characterise the quality and complexity of fauna habitats present for species of significance throughout the Survey Area. These habitats were reassessed by Stantec (2019b) to determine if any changes in habitat quality or complexity had occurred. Habitat Assessments conducted by Stantec (2019a) and Stantec (2019b) were reassessed during the Survey, while additional habitat assessments were undertaken at the three new targeted monitoring sites (P, Q, and R).

The following parameters were reassessed at each monitoring site:

- landscape, soil features and structural composition;
- vegetation cover, condition and species composition;
- the presence or absence of habitat structures;
- the presence or absence of water; and
- types of disturbance and levels of disturbance.

This allows for the assessment of future changes in the quality and complexity of habitats and the interpretation of temporal changes in the distribution and abundance of significant species present. For example, changes may occur as a result of mining disturbance such as clearing, or as a result of environmental factors such as fire.

In addition to the formal habitat assessments conducted during the Survey, long-term photo point monitoring sites were installed at each habitat assessment site. When used alongside the formal habitat assessment data, photo point monitoring can be used to compare physical changes in the environment over time.

Photo point monitoring sites consisted of a fixed camera post (labelled PM1) (1.5m fencing post), with two 'sighter' posts (labelled PM2 and PM3) (1.5m fencing posts) installed 5m away at right angles. Photos were taken from the fixed camera post towards each sighter post, capturing a wider representation of the vegetation at each habitat assessment site (Appendix D).

2.1.6 Trapping

Trapping methods targeting the Chuditch, Heath Mouse and Western Mouse broadly followed the following:

- EPBC Survey Guidelines for Australia's Threatened Mammals (DSEWPaC 2011);
- EPA Technical Guidance: Terrestrial Fauna Surveys (EPA 2016c);
- EPA Technical Guidance: Sampling Methods for Terrestrial Vertebrate Fauna (EPA 2016b);
- EPA Environmental Factor Guideline – Terrestrial Fauna (EPA 2016a); and
- Conservation Advice for the Heath Mouse (Threatened Species Scientific Committee 2016).

Traps were set in habitats considered to be the most prospective for the species based on literature and previous surveys of the Survey Area (Stantec 2019a, b).

2.1.6.1 Chuditch Trapping

At each Chuditch monitoring site (B, D, E, J, L, N, Q, and R) (Table 2-2), 10 large cage traps (20 x 20 x 56cm) were positioned approximately 50 metres apart in a transect line. Traps were baited with a 'Chuditch bait' (a mixture of kangaroo mince, rolled oats, sardines, fish oil and chicken oil) (Wayne *et al.* 2008). Traps were re-baited at least once or when required over the duration of the trapping period. The substitution of 'universal bait' for 'Chuditch bait' also greatly reduced the likelihood of Western Brush Wallaby capture which would have made the traps unavailable for capturing Chuditch. Each site was trapped for four consecutive nights (Table 2-2), equating to a total of 320 trapping nights for the Survey.

2.1.6.2 Heath Mouse and Western Mouse Trapping

At each Mouse monitoring site (A, C, F, G, H, I, K, M, O, and P) (Table 2-2) 20 small Elliot traps were placed approximately 10 metres apart in two line transects separated by 25 metres. Traps were baited with a

species-specific mixture (rolled oats and peanut butter) (Wayne *et al.* 2008), and re-baited at least once or when required over the duration of the trapping period. Each site was trapped with 20 Elliot traps deployed for four consecutive nights (Table 2-2), equating to a total of 800 trap nights for the Survey.

2.1.6.3 Marking and Measurements

To identify re-captured individuals, new Chuditch were marked at the time of capture using PIT tags. These were placed beneath the skin of the animal, between the shoulders. Heath and Western Mouse individuals were marked using ear-notching. An ear notch tissue sample was taken and preserved in 100% ethanol from each captured individual to provide material for DNA analysis. These were submitted to the Western Australian Museum for use in ongoing research.

The following parameters were measured and recorded for each captured individual:

- sex – male or female;
- general condition – markings, fur condition, damage and behaviour;
- weight – in grams (g);
- tail diameter – in millimetres (mm);
- pes size – length of left hind foot from the heel to the base of the digits, in mm;
- ear notching – locations of notch recorded for Heath and Western Mouse only;
- photograph of rear foot-pads – recorded for Heath and Western Mouse only; and
- photograph of head profile – recorded for Heath and Western Mouse only.

2.1.7 Malleefowl Mound Assessment

During the Survey, Seven Malleefowl mounds that were previously identified as 'active' or 'inactive' in Stantec (2019b) were reassessed for mound activity. In addition, two Malleefowl mounds identified as 'extinct' in Stantec (2019a) were also reassessed for mound activity. Malleefowl mound activity was assessed by noting if:

- cross sticks placed on mound in the stantec 2019 survey were present or absent;
- mound contained incubating material, or a recently made dome or crater;
- recent malleefowl tracks or signs (e.g. eggshells etc.) were present;
- mound surface was recently scraped;
- surface crust or moss was present or absent; and
- fauna tracks or diggings from other species were present.

2.1.8 Motion-sensor camera

Reconyx HC600 and Reconyx Hyperfire 2 motion-sensor cameras were baited with non-reward bait tubes containing Chuditch bait at Chuditch monitoring sites and universal bait at Mouse monitoring sites. One motion-sensor camera was deployed at each Mouse monitoring site, and five were deployed at each Chuditch monitoring site. Less motion camera survey effort was invested at the Mouse monitoring sites dur to the difficulty in differentiating Mouse species from motion-sensor camera photographs.

In total, motion-sensor cameras were deployed at 56 locations (Appendix I), comprising 18 targeted trapping sites, two motion-sensor camera sites (MC1 and MC2), and two Malleefowl mounds (MW1 and MW7) for between 2 and 7 consecutive nights (Table 2-2), equating to a total of 253 recording nights for the Survey.

In comparison, Stantec (2019b) deployed motion-sensor cameras at 38 locations, comprising 15 targeted trapping sites for between 10 and 18 consecutive nights, equating to a total of 507 recording nights.

2.1.9 **Carnaby's Black Cockatoo Assessment and Evidence**

Potential foraging, breeding and roosting habitat for Carnaby's Black Cockatoo was previously assessed in Stantec (2019a), with reassessment conducted by Stantec (2019b) (DotEE 2017). The new monitoring sites

installed during the Survey (P, Q and R) were given a foraging assessment score based on the habitat assigned to the area in Stantec (2019a). Habitats within the Survey Area were given a quality score based on the draft foraging scoring tool within the revised draft guidelines (DotEE 2017).

The scoring tool considers the key attributes of foraging habitat for Black Cockatoo species, taking into account connectivity and proximity, as well as the threats that can reduce the functionality of that habitat for black cockatoos (DotEE 2017) (Table 2-3).

Where encountered, evidence of Carnaby's Black Cockatoo in the Survey Area was recorded. Evidence included feathers, feeding signs or debris (e.g. chewed banksia flowers, pinecones and marri nuts), potential breeding or roosting habitat and sighting records.

Table 2-3: Foraging habitat scoring tool for Carnaby's cockatoo (DotEE 2017).

Starting Score	Foraging habitat for Carnaby's cockatoo
10 (Very high quality)	Foraging habitat that is being managed for black cockatoos such as habitat that is the focus of successful rehabilitation, and/or has some level of protection from clearing, and/or is quality habitat described below with attributes contributing to meet a score of ≥10.
7 (High quality)	Native shrubland, kwongan heathland and woodland dominated by proteaceous plant species such as *Banksia* spp. (including *Dryandra* spp.), *Hakea* spp. and *Grevillea* spp., as well as native eucalypt woodland and forest that contains foraging species, including along roadsides. Does not include orchards, canola, or areas under a Regional Forestry Agreement.
5 (Quality)	Pine plantation or introduced eucalypts.
1 (Low quality)	Individual foraging plants or small stand of foraging plants.
Additions	Context adjustor - attributes improving functionality of foraging habitat
+3	Is within the SCP (important foraging area).
+3	Contains trees with suitable nest hollows.
+2	Primarily comprises marri.
+2	Contains trees with potential to be used for breeding (dbh ≥ 500 mm or ≥ 300 mm dbh for salmon gum and wandoo).
+1	Is known to be a roosting site.
Subtractions	Context adjustor - attributes reducing functionality of foraging habitat
-2	No clear evidence of feeding debris.
-2	No other foraging habitat within 6 km.
-1	Is > 12 km from a known breeding location.
-1	Is > 12 km from a known roosting site.
-1	Is > 2 km from a watering point.
1	Disease present (e.g. *Phytophthora cinnamomi* or marri canker).

2.1.10 Opportunistic Observations

During the establishment and monitoring of survey sites and while traversing the Survey Area, any evidence of species of significance, such as remains, feathers, scats, tracks and/or direct observations of individuals,

was recorded. These comprised the Chuditch, Western Mouse, Heath Mouse, Western Brush Wallaby, Carnaby's Black Cockatoo, Malleefowl, and Western Whipbird.

2.1.11 Data analysis

Due to the changes in survey design required for the Survey (e.g. site locations), data cannot be directly compared to monitoring events prior to 2019. The Survey data compared the results from Stantec (2019b) and presented to facilitate statistical analysis during future monitoring surveys to understand changes over time. Where capture rates were too low to meet the assumptions of statistical testing, Chuditch capture rate was standardized to allow for comparison by calculating success rate per 100 traps.

3. Results and Discussion

3.1 Habitats and Disturbance

Habitat assessments undertaken during the Survey reassessed the current level of habitat disturbance at each monitoring site i.e. prior to the Shoemaker Levy expansion (Appendix C). New monitoring sites (P, Q and R) were also assessed to determine 'baseline' habitat information to inform future monitoring programs. Future comparisons against these habitat assessments will be used to determine potential impacts of the expansion (Appendix B). This will provide context to changes in species recorded at trapping sites, particularly species of significance, over time. This will be achieved by comparing changes at impact sites with control sites.

In addition to the formal habitat assessments conducted during the Survey, long-term photo point monitoring sites were installed at each habitat assessment site. When used alongside the formal habitat assessment data, photo point monitoring can be used to compare physical changes in the environment over time.

The Survey Area comprises of 12 broad fauna habitats, as well as cleared and rehabilitated areas (Figure 3-1) To ensure adequate representation of habitats at control sites, some sites (control sites M, N and O) were located to outside of the area previously mapped by Stantec (2019a) (Figure 3-1) due to previous access constraints (Stantec 2019b). Habitat mapping was not extended to include these sites as vegetation mapping, which informed the habitat mapping in Stantec (2019a) was not available. Habitats differed primarily in the composition of their vegetation structure and substrates, variation in time since last fire, density of Mallee, presence of heath on sandy substrate and abundance of stony substrate. Eleven habitats were considered important to species of conservation significance or distinct fauna assemblages; this includes all habitats aside from Melaleuca shrubland, as well as cleared and rehabilitated areas. A summary of the habitats present in the Survey Area is presented in Table 3-1.

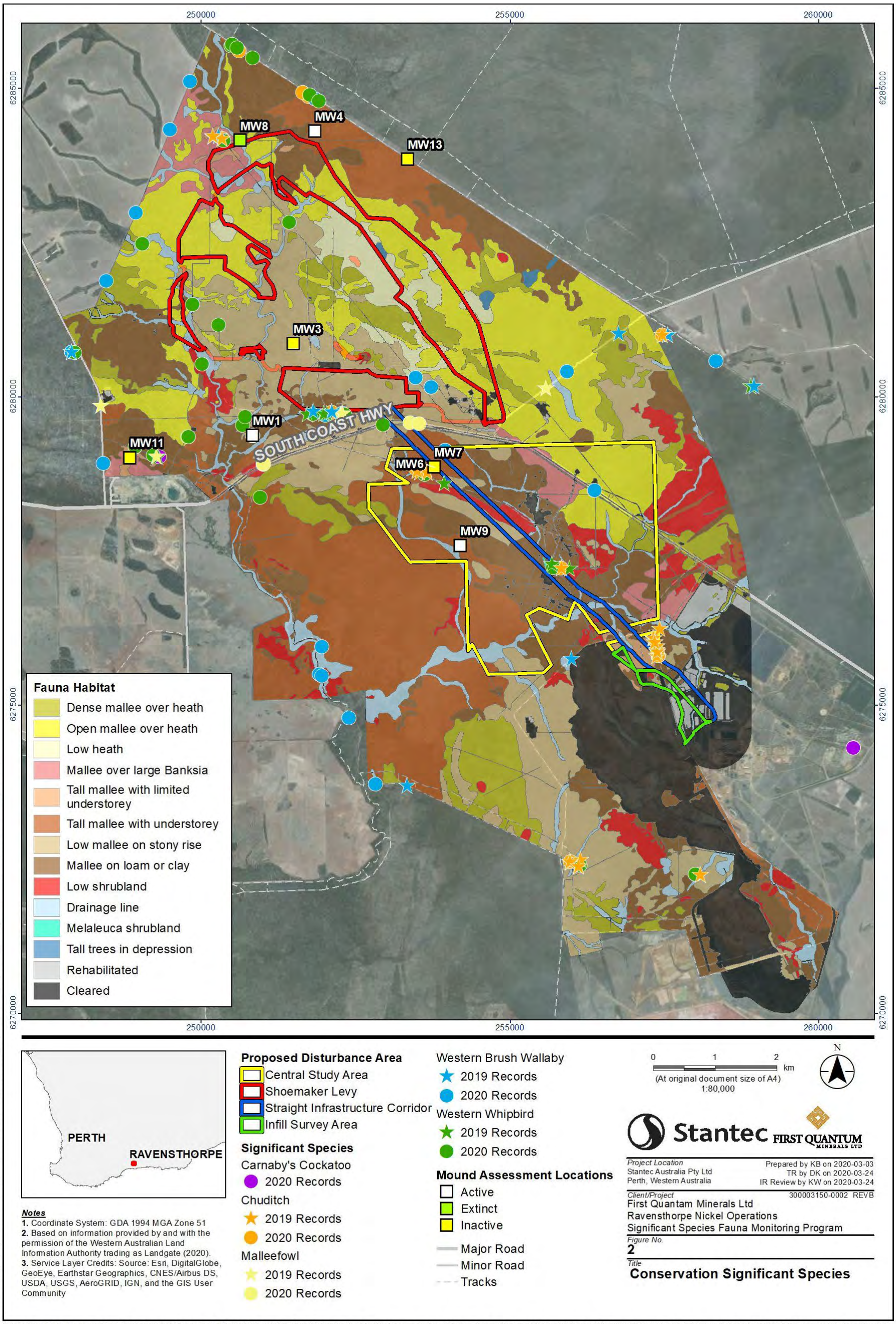
Although habitat assessments from the Survey are considered 'baseline', many of these monitoring sites have existing impacts either from historic exploration, mining prior to care and maintenance or natural causes. Specifically, many sites in the vicinity of the proposed expansion displayed evidence of historic exploration, although many of the tracks were overgrown. There was no evidence of recent fire at any of the monitoring sites, however a large-scale fire burnt the majority of the Survey Area during 2003 (Figure 3-2). Although vegetation cover and complexity had substantially regenerated across the Survey Area since the fire (Stantec 2019a), some species, such as the Heath and Western Mouse, are only likely to utilise habitats 10 to 30 years post fire (Section 3.2.2).

No additional disturbance of vegetation had occurred at 14 of the 15 monitoring sites installed by Stantec (2019b), although at Monitoring Site N (Table 2-2), vegetation cover had declined, including mortality of *Banksia lemanniana* and sedge spp. Monitoring Site N occurs in tall trees in depression habitat, which is prone to ponding during winter (Appendix C). The decline in sedge cover may indicate water deficiency due to the below average rainfall at Ravensthorpe in the five months preceding the Survey (Section 2.1.1).

The new monitoring sites (P, Q and R) were all installed in patches of long-unburnt vegetation (unburnt in 2003) along the northern and western boundaries of the Survey Area. Sites P and R were located along the barrier fence line, with track disturbance occurring at both sites (Appendix B). No disturbance was noted at monitoring site Q.

Table 3-1: Fauna habitats recorded within the Survey Area (Percentages of each habitat expressed as a proportion of the Total Area Mapped)

Broad Landform	Habitat	Sites	Total Area Mapped (pre-disturbance)	
			Ha	%
Plains comprising grey sandy soils	Dense mallee over heath		784.51	8.23
	Open mallee over heath		1501.53	15.74
	Low heath		217.53	2.28
Undulating low hills and rises comprising clay or loam soils	Mallee over large Banksia	J, K, M	227.51	2.39
	Tall mallee with limited understory	A	52.42	0.55
	Tall mallee with understory	D	1627.42	17.06
	Low mallee on stony rise	B, E, F	1546.98	16.22
	Mallee on loam or clay	C, G, H, I, L, O P, R	1546.55	16.22
	Low shrubland		404.01	4.24
Water courses	Drainage line	Q	486.37	5.10
	Melaleuca shrubland		0.85	0.01
	Tall trees in depression	N	15.26	0.16
Disturbed Area	Rehabilitated		85.38	0.90
	Cleared		1040.39	10.91
Total			9536.73	100



Disclaimer: This document has been prepared based on information provided by others as cited in the Notes section. Stantec has not verified the accuracy and/or completeness of this information and shall not be responsible for any errors or omissions which may be incorporated herein as a result. Stantec assumes no responsibility for data supplied in electronic format, and the recipient accepts full responsibility for verifying the accuracy and completeness of the data.

Figure 3-1: Fauna habitats and significant species recorded during the Survey.

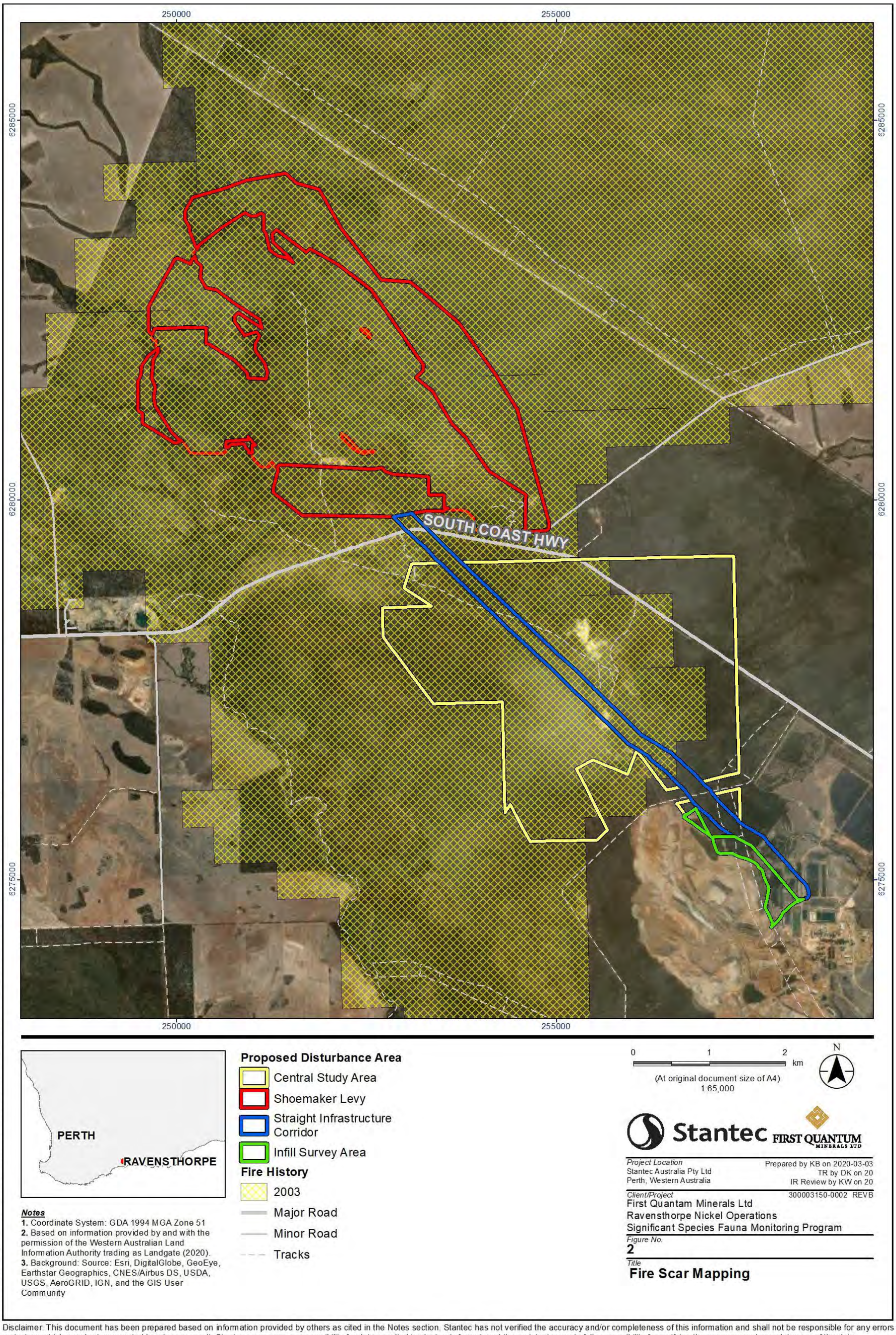


Figure 3-2: Fire scar mapping of the Survey Area.

3.2 Capture Data and Other Fauna Observations

3.2.1 Chuditch

Two Chuditch were captured during the Survey (Figure 3-1), compared with four Chuditch captured by Stantec (2019b). The two Chuditch caught during the Survey equates to a trap success of 0.63%, a decline from 1.67% in 2019 (Table 3-2; Figure 3-3). Both Chuditch were captured at Site D (Impact), which is where two Chuditch were also captured by Stantec (2019b). Both individuals captured during this Survey were young females that had not been captured in previous surveys. The Chuditch were in good condition and had developed pouches. Each individual was PIT tagged for future monitoring programs (PIT no. 943094322007524, PIT no. 943094322007148) (Appendix E).

The absence of recaptures during the Survey may be due to the short lifespan of Chuditch in the wild, with the average lifespan for established adults being only two years. As both individuals caught at Site D in 2019 were recaptures (PIT no. 0007ACA0A5, and PIT no. 0007ACA0A5), it is likely they had reached the average age of mortality for wild Chuditch prior to the current Survey (DEC 2012a, Stantec 2019b). The continued capture of Chuditch at Site D indicates a breeding population is persisting in the area (Stantec 2019b). Site D occurs in Tall mallee with understory, indicating this habitat is important for Chuditch occurring in the Survey Area (Figure 2-2Error! Reference source not found.).

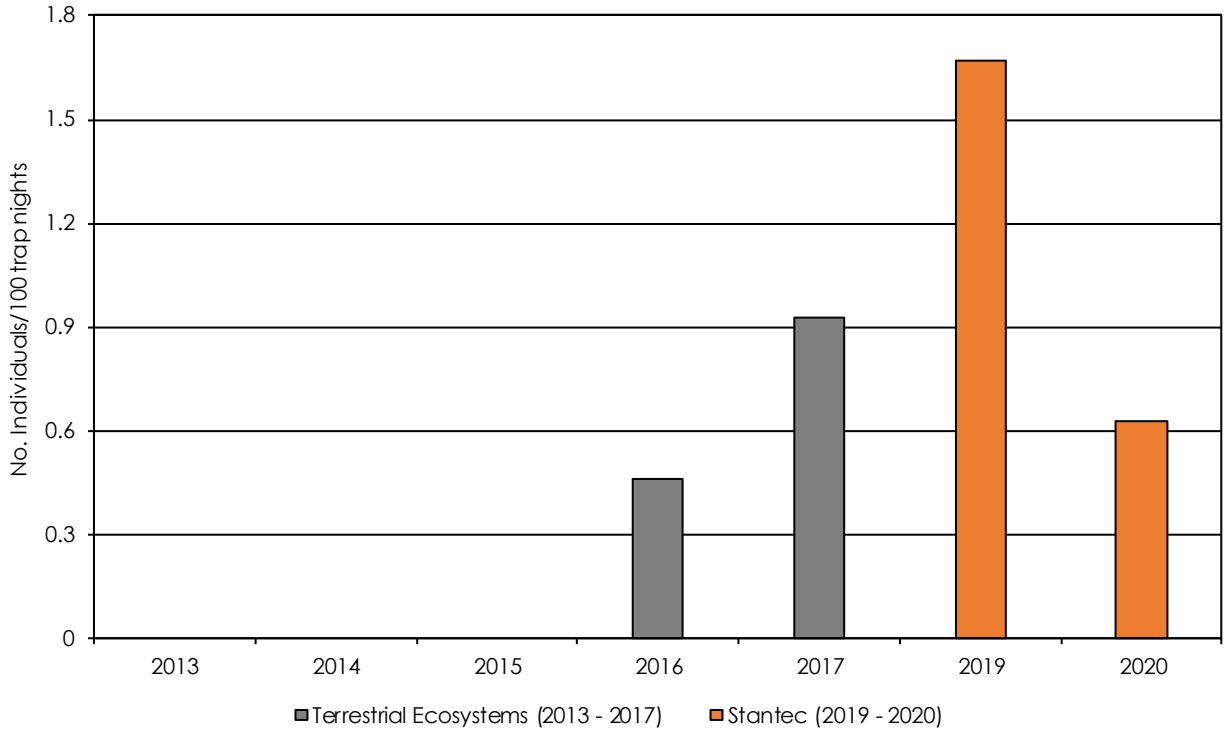


Figure 3-3: Standardised capture rate of Chuditch for each survey conducted at the RNO.

Table 3-2: Summary statistics for Chuditch captures at the RNO from previous and current surveys.

Company	Year	Trap nights	Number of individuals*	
			Total	/100 trap nights
Terrestrial Ecosystems	2013	250	0	0.00
Terrestrial Ecosystems	2014	500	0	0.00
Terrestrial Ecosystems	2015	500	0	0.00
Terrestrial Ecosystems	2016	876	4	0.46
Terrestrial Ecosystems	2017	750	7	0.93
Stantec	2019	240	4	1.67
Stantec	2020	320	2	0.63

* Due to information available, the number of captures over the sites was averaged for each survey to provide comparable data

Chuditch presence was recorded via motion-sensor cameras at seven of the eight Chuditch targeted monitoring sites, one targeted Mouse monitoring site, and at one Motion-sensor camera site during the Survey (**Table 3-3**, **Appendix F**). Only presence / absence data is presented for motion camera records as it is difficult to determine whether a bait is being visited by several individuals or the same individual on multiple occasions. The only Chuditch targeted monitoring site that did not record Chuditch was Site Q (Control), which was in a drainage line (Error! Reference source not found.).

During the Survey, Chuditch were recorded in Low mallee on stony rise, Mallee on loam or clay, Tall mallee with understorey, and Mallee over large Banksia, indicating the species is utilising a variety of habitats across the Survey Area. It is difficult to list specific habitats that should be preserved, however some key aspects that are required for Chuditch to survive in the area include; adequate den resources (e.g. hollow logs or rock crevices), adequate prey resources, and connected habitats (>20,000 ha) (DEC 2012a).

Table 3-3: Chuditch records (trapping and motion-sensor camera) during the Survey.

Site	Monitoring Site	Category	Chuditch Recorded		Location (51H)	
			Cage	Camera	Easting	Northing
B	Chuditch	Control	-	X	256135	6272396
N	Chuditch	Control	-	X	257466	6280948
Q	Chuditch	Control	-	-	248949	6282487
R	Chuditch	Control	-	X	250381	6285755
D	Chuditch	Impact	X	X	257344	6276023
E	Chuditch	Impact	-	X	253675	6278713
J	Chuditch	Impact	-	X	250343	6284181
L	Chuditch	Impact	-	X	252254	6279715
C	Mouse	Control	-	-	253352	6273692
G	Mouse	Control	-	-	249049	62791145
M	Mouse	Control	-	-	258864	6280074
O	Mouse	Control	-	-	247945	6280759
P	Mouse	Control	-	-	254645	6282991
A	Mouse	Impact	-	-	258195	6272253
F	Mouse	Impact	-	-	254375	6279642
H	Mouse	Impact	-	-	251828	6279722
I	Mouse	Impact	-	X	255703	6277452
K	Mouse	Impact	-	-	250335	6284193
MC1	NA	NA	-	-	250031	6280505
MC2	NA	NA	-	X	251736	6284870

3.2.2 Heath Mouse and Western Mouse

No Western Mouse or Heath Mouse were captured during the Survey, or previously by Stantec (2019b) (Figure 3-1). Rodents were recorded on eleven motion-sensor cameras at four sites (B, C, N, MC1) during the Survey, however, the images were not detailed enough to allow for accurate species identification.

The absence of captures may be attributed to several factors, including; below-average rainfall for Ravensthorpe in the five months preceding the Survey (Figure 2-1) (Threatened Species Scientific Committee 2016), the continued presence of feral predators, including feral cats and foxes (Section 3.2.7) (DBCA 2013, Morris *et al.* 1993); and/or limited habitat suitability due to the 2003 fire that occurred in the Survey Area (DBCA 2013, Morris *et al.* 1993). In addition, juvenile Western mice become independent and disperse in early summer (September-November) (Morris *et al.* 1993), which may account for decreased detectability due to missing the dispersal event.

Previous studies have shown Heath Mouse abundance is strongly correlated with rainfall, with the species responding in a 'boom and bust' dynamic in response to increased primary productivity (Senior 2014, Threatened Species Scientific Committee 2016). Abundance generally peaks in response to high rainfall events, and declines during normal drought conditions (Senior 2014). Rainfall has been low at Ravensthorpe Weather Station since 2018, and has been below the long term-average for five months preceding the Survey (BoM 2020). It is likely that Heath Mouse and Western Mouse densities were low during the Survey.

The Western Mouse and Heath Mouse require long unburnt (30-50 years) or dense habitat to persist (DBCA 2013, Threatened Species Scientific Committee 2016). The Heath Mouse tends to occupy unburnt areas for at least 10 years, with the largest numbers recorded in vegetation unburnt for 30 years. While the species has been known to inhabit vegetation less than 10 years unburnt, it requires dense vegetation for protection from feral predators that otherwise utilise more open habitats and runways through the understory to hunt (Threatened Species Scientific Committee 2016). The Heath Mouse has been recorded in the Survey Area only once following the 2003 fire (Coffey Environments 2010). This indicates that recent events such as fire and subsequent predation are potentially limiting populations.

The Western Mouse has been recorded in the Survey Area once during the 2017 monitoring survey (Terrestrial Ecosystems 2017a) and on six occasions in the surrounds between 1998 to 2017. Of these, three records occurred post 2003 (Biota 2005, Coffey Environments 2010, Terrestrial Ecosystems 2016a). There has only been 16 years of vegetation regrowth post-fire in the Survey Area. This is not considered long enough to provide suitable habitat and protection from predation for the Western Mouse and only six years beyond the minimal post fire recovery (10 years) period for the Heath Mouse. The large-scale nature of the fire has also potentially reduced the species distribution in the immediate surrounds, which may increase recovery time for populations within the Survey Area. This may explain the failure to record the species during the Survey.

3.2.3 Malleefowl

Nine Malleefowl mounds were reassessed during the Survey (Table 3-4, Figure 3-1). These comprised:

- four active mounds (MW1, MW4, MW7, and MW9);
- four inactive mounds (MW3, MW6, MW11, and MW13); and
- one extinct mound (MW8).

In comparison to Stantec (2019b):

- MW6 was re-classified as inactive due to the presence of cross sticks placed by Stantec (2019b). MW6 was previously assessed as active in Stantec (2019b).
- MW11, was reclassified as 'inactive' due to semi-recent reforming of the mound crater. MW11 had previously been classified as 'extinct' in 2019 (Stantec 2019a).

All four active mounds were located between 100m and 650m from the proposed expansion (Error! Reference source not found.), where they have potential to be impacted by future mining activity. Of the four active mounds recorded during the Survey, three occurred in Tall mallee with understory, while one was in Mallee on loam or clay.

Malleefowl were observed on seven occasions during the survey. These observations were likely composed of two pairs of breeding individuals (Appendix G). One pair was observed on the 6th and the 12th of February foraging along a 100m stretch on the northern side of South Coast Highway. Stantec conducted

targeted surveys north of South Coast Highway near where the Malleefowl were observed and found no evidence of Malleefowl mounds in the area. The nearest known mound was MW7 (Error! Reference source not found.Table 3-4), approximately 600m south-east on the south side of South Coast Highway. A motion-sensor camera from MW7 confirmed a breeding pair of Malleefowl were actively using the mound. A second pair was observed on 4th and 9th of February also foraging on the northern side of South Coast Highway, approximately 2.5km west of the first pair. The nearest known mound was MW1(Table 3-4), approximately 500m north of the highway. Motion-sensor camera data from MW1 also confirmed a pair of breeding Malleefowl were using the mound.

The Malleefowl that were observed during the Survey were all occurring on the edge of Low mallee on stony rise. The Malleefowl were actively foraging in the ditch of South Coast Highway, indicating the roadside may be providing a source of food for the breeding pairs. Malleefowl are generalist feeders, and feed on a diet of seeds, flowers, fruits, herbs, invertebrates, tubers and fungi (Benshemesh 2007). Malleefowl are also known to feed on fallen seed and grain on the edges of cleared habitats (such as highways), which may explain why the two pairs were observed foraging on the roadside.

While home ranges can span several kilometres, breeding pairs tend to be sedentary, and nest in the same general area between years (Benshemesh 2007). Home-ranges do not appear to be defended; however, males will remain close-by its mound during breeding season. While it is possible for the pairs observed on South Coast Highway to be the same pairs from MW1 and MW7, this was unable to be conclusively verified during the Survey. Despite this, records from this survey, as well as previous surveys (Biota 2000, Coffey Environments 2010, Stantec 2019a, b, Terrestrial Ecosystems 2014, 2016a, 2017a, b) indicate the species inhabits the area over the long-term, and utilises habitat for foraging and breeding nearby to the Shoemaker Levy (Figure 3-1Error! Reference source not found.).

Table 3-4: Malleefowl mound assessment during the Survey.

Mound	Location (51H)		Assessment		Habitat and Notes	Reference Photograph
	Easting	Northing	(Stantec 2019b)	2020		
MW1	250836	6279368	Active	Active	Mallee on loam or clay. Mound with peak present. Crossed sticks removed. Motion-sensor camera data confirmed the mound was actively being used by a breeding pair.	
MW3	251488	6280854	Inactive	Inactive	Low mallee on stony rise. Mound with crater. Cross sticks were still present with no evidence of recent scaping or incubating material. Likely unused due to the presence of a termite mound, varanid diggings, and some areas of crusting	

Mound	Location (51H)		Assessment		Habitat and Notes	Reference Photograph
	Easting	Northing	(Stantec 2019b)	2020		
MW4	251847	6284308	Active	Active	Tall mallee with understory. Mound with recently dug crater. Cross sticks were displaced. An abundance of eggshells present.	
MW6	253772	6278858	Active	Inactive	Tall mallee with understory. Classified as active in Stantec (2019b), however, cross sticks were present, and no evidence of recent scraping was observed.	

Mound	Location (51H)		Assessment		Habitat and Notes	Reference Photograph
	Easting	Northing	(Stantec 2019b)	2020		
MW7	253953	6279136	Active	Active	Tall mallee with understory. Mound with crater. Cross sticks were displaced, and some incubating material was present. Motion-sensor camera data confirmed the mound was actively being used by a breeding pair	
MW8	250628	6284152	Not Assessed	Extinct	Drainage line. Low, flat mound with no crater. No evidence of recent scraping or other Malleefowl visitation. Some crusting on the mound surface was present. Cross sticks were placed.	

Mound	Location (51H)		Assessment		Habitat and Notes	Reference Photograph
	Easting	Northing	(Stantec 2019b)	2020		
MW9	254196	6277583	Active	Active	Tall mallee with understory. Mound with crater filled with incubating litter. Cross sticks gone, with Malleefowl activity present in the form of scat and fresh scrapings. Eggshells present.	
MW11	248844	6279008	Inactive	Inactive	Mallee over large banksia, however, in a transition to Tall mallee with limited understory. Low, flat mound. Cross sticks present with no evidence of recent scraping. Some crusting of the mound surface.	

Mound	Location (51H)		Assessment		Habitat and Notes	Reference Photograph
	Easting	Northing	(Stantec 2019b)	2020		
MW13	253342	6283846	Not Assessed	inactive	Tall mallee with understory. Near of edge of the barrier fence track. Classified as extinct in Stantec (2019a), however, the mound was no longer eroded and had a distinct crater. No recent scraping was present, but the mound has been reformed since the site was last assessed. Cross sticks placed in 2020.	

3.2.4 Carnaby's Black Cockatoo

The Carnaby's Black Cockatoo was recorded on three occasions during the Survey. In comparison, no Carnaby's Black Cockatoo were recorded by Stantec (2019b) within the Survey Area. On the 4th of February, at least two individuals were heard calling from trees near the FQM accommodation area, while on the 12th of February at least two individuals were heard calling from the pine plantation near the FQM mine site turnoff (Figure 3-1; Appendix G). Carnaby's Black Cockatoo forage on a range of food items, but feed predominately on seeds of native and introduced plant species. The most commonly foraged native species include *Banksia*, *Hakea*, *Grevillea*, *Eucalyptus*, *Corymbia* and *Allocasuarina* (Valentine and Stock 2008). Introduced forestry pines have also become a major food resource for Carnaby's Black-Cockatoo, which is likely why the species was heard calling from the plantation.

Evidence of Carnaby's Black Cockatoo foraging was also present at site G within Mallee on loam or clay habitat, with gnawing of *Banksia lemanniana* cones present (Appendix G). Foraging evidence was restricted to a long unburnt mature *Banksia lemanniana* plant at Site G and was not widespread in the area. Previous foraging assessments conducted by Stantec (2019b) produced '*low* quality' scores (DotEE 2017) for all monitoring sites, including site G; indicating the area was unlikely to be a significant foraging area for the species (DotEE 2017). However, the addition of foraging evidence to Mallee on loam or clay habitat increases the foraging score for this habitat from 3 (*low* quality) to 5 (*valued* quality) (Table 3-5). Impacts on foraging habitat that is *valued*, with a score of 4 to 6, may require referral, depending upon how much habitat is being impacted, the location and what measures are proposed to avoid and/or mitigate that impact (DotEE 2017).

The Survey Area occurs within the non-breeding range, however it is within close proximity to the known breeding range for the species (DotEE 2017). Given the proximity of the predicted breeding range and known breeding locations, the species may breed near the Survey Area. Carnaby's Black Cockatoos nest and breed in the hollows of trees such as Eucalypts, Marri, Karri and Jarrah (DotEE 2017, DSEWPaC 2012). Tall trees within the Survey Area were generally restricted to drainage line areas.

Carnaby's Black Cockatoos may roost in any tall trees, particularly those near a permanent water source or within a riparian zone (DotEE 2017, DSEWPaC 2012). A small area of permanent water was present along Bandillup Creek, known as Bandillup Rockhole (Figure 2-2). The rock hole was being utilised by a range of species including; wedge-tail eagles, emus, kangaroos, dugites, a brush-tail possum, and a barn owl. The tall trees and permanent water may provide roosting habitat for Carnaby's Black Cockatoos, however, no evidence (e.g. feathers, droppings, direct observations) of cockatoo roosting was observed during the Survey.

Table 3-5: Updated Carnaby's Black Cockatoo foraging habitat assessment scores from Stantec (2019a), (Stantec 2019b).

Scoring tool	Criteria	Habitat Type (site) and Scores											
Starting Score		Mallee over large *Banksia*	Drainage line	Tall mallee with limited understory	Tall mallee with understory	Low mallee on stony rise	Mallee on loam or clay	Low shrubland	Melaleuca shrubland	Dense mallee over heath	Open mallee over heath	Low heath	Tall trees in depression
10 (Very high quality)	Foraging habitat that is being managed for black cockatoos such as habitat that is the focus of successful rehabilitation, and/or has some level of protection from clearing, and/or is quality habitat described below with attributes contributing to meet a sore of ≥10.												
7 (High quality)	Native shrubland, kwongan heathland and woodland dominated by proteaceous plant species such as *Banksia* spp. (including *Dryandra* spp.), *Hakea* spp. and *Grevillea* spp., as well as native eucalypt woodland and forest that contains foraging species, including along roadsides. Does not include orchards, canola, or areas under a Regional Forestry Agreement.	7	7		7	7	7			7	7	7	7
5 (Quality)	Pine plantation or introduced eucalypts.												
1 (Low quality)	Individual foraging plants or small stand of foraging plants.			1				1	1				
Additions	Context adjustor - attributes improving functionality of foraging habitat												
+3	Is within the Swan Coastal Plain (important foraging area).												
+3	Contains trees with suitable nest hollows.												
+2	Primarily comprises marri.												
+2	Contains trees with potential to be used for breeding (diameter breast height (dbh) ≥ 500 mm or ≥ 300 mm dbh for salmon gum and wandoo).												
+1	Is known to be a roosting site.												
Subtractions	Context adjustor - attributes reducing functionality of foraging habitat												
-2	No clear evidence of feeding debris.	-2	-2	-2	-2	-2		-2	-2	-2	-2	-2	-2
-2	No other foraging habitat within 6 km.												
-1	Is > 12 km from a known breeding location.	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
-1	Is > 12 km from a known roosting site.	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
-1	Is > 2 km from a watering point.												
-1	Disease present (e.g. *Phytophthora cinnamomi* or marri canker).												
Total		3	3	0	3	3	5	0	0	3	3	3	3

3.2.5 Western Whipbird

Western Whipbirds were recorded via their distinctive call on 34 occasions during the Survey (Error! Reference source not found.)(Appendix G), confirming their presence in the Survey Area. In comparison, eight Western Whipbirds were recorded by Stantec (2019b) in the Survey Area (Table 2-1). The increase in Western Whipbird records cannot be conclusively attributed to an increase in Western Whipbirds in the Survey Area, but is likely a combination of increased survey effort (four zoologists vs two zoologists) and environmental conditions during the Survey. Of the 34 Western Whipbirds recorded during the Survey, 19 were during or on the day after rainfall (Table 2-1). The Western Whipbirds recorded during the Survey were generally located within, or nearby to drainage lines and long unburnt vegetation (Table 3-6). Of the 34 Western Whipbirds recorded, eight were heard calling from outside the Survey Area and were all associated with long unburnt vegetation.

Western Whipbirds inhabit open mallee vegetation with a dense, tall shrub layer, usually dominated by species from genera such as *Hakea*, *Lambertia*, *Dryandra or Banksia* (Threatened Species Scientific Committee 2009). Western Whipbirds generally occur in long unburnt habitats, usually with a fire age longer than 15 years (Threatened Species Scientific Committee 2009).

The Western Whipbird has been recorded in all monitoring surveys aside from 2010, including being heard at 14 locations and sighted at one location in 2019 (Stantec 2019a, Terrestrial Ecosystems 2013, 2014, 2015, 2016a, 2017a). These records confirm the species presence in the Survey Area. The ability of the species to disperse following the disturbance or destruction (fire, land clearing) of habitat is unknown (Threatened Species Scientific Committee 2009). The Survey Area was previously burnt in 2003 (Figure 3-2), indicating the vegetation may be approaching a suitable fire age for Western Whipbirds. However, most records from the Survey indicate association with smaller patches of long unburnt vegetation. These long unburnt areas may represent crucial habitat for the species within the Survey Area.

Table 3-6: Number of Western Whipbirds recorded within fauna habitats identified by Stantec (2019a)

Fauna Habitat (Stantec 2019a)	No. of Individuals recorded	
	(Stantec 2019b)	2020
Open Mallee over heath	0	2
Drainage line	0	12
Mallee on loam or clay	6	5
Low Mallee on stony rise	1	4
Tall Mallee with understorey	0	2
Tall mallee with limited understory	0	0
Mallee over large Banksia	1	1
Dense mallee over heath	0	0
Low Shrubland	0	0
Low Heath	0	0
Melaleuca shrubland	0	0
Tall trees in depression	0	0
Outside of mapped fauna habitats	0	8

3.2.6 Western Brush Wallaby

Sixteen Western Brush Wallabies were opportunistically recorded during the Survey, of which two were carcasses located on South Coast Highway (Appendix G). The fourteen other individuals were observed when they were disturbed from vegetation whilst driving within the Survey Area. In comparison, four Western Brush Wallabies were opportunistically recorded by Stantec (2019b) within the Survey Area.

The Western Brush Wallaby inhabits open woodland and forest, Mallee and heath and preferentially utilises open seasonally wet flats and scrubby thickets (DEC 2012b). More than half of the individuals observed during the Survey were associated with open Mallee over heath and drainage lines, indicating these habitats are most utilised by the species (Table 3-7).

Western Brush Wallabies were also recorded on motion-sensor cameras at four locations within the Survey Area, comprising of one impact (L) and one control (O) trapping site, as well as at two Malleefowl mounds (MW1, MW7)(Error! Reference source not found.) (Appendix F). Due to the difficulty in identifying separate individuals from motion-sensor camera footage, it was not feasible to estimate population demographics from these photographs. The individuals captured on motion-sensor cameras combined with direct observations confirms the presence of the Western Brush Wallaby within the Survey Area.

Table 3-7: Number of Western Brush Wallabies opportunistically recorded within the Survey Area

Fauna Habitat (Stantec 2019a)	No. of individuals recorded	
	Stantec (2019b)	2020
Open mallee over heath	0	5
Drainage line	0	4
Mallee on loam or clay	3	1
Low mallee on stony rise	0	1
Tall mallee with understorey	1	1
Tall mallee with limited understory	0	0
Mallee over large banksia	1	1
Dense mallee over heath	1	1
Low Shrubland	0	0
Low Heath	0	0
Melaleuca shrubland	0	0
Tall trees in depression	0	0
Outside of mapped fauna habitats	3	2

3.2.7 Feral Predators

Feral predators recorded during the Survey included; feral cats (*Felis catus*) and the fox (*Vulpes vulpes*) (Figure 3-4)(Appendix H). Three feral cats were recorded during the Survey, representing an ongoing threat to native fauna within the Survey Area. One feral cat was directly observed crossing the road to the FQM accommodation carpark on the 9th of February (Figure 3-4). A second feral cat was observed as roadkill on South Coast highway on the 8th of February, approximately 250m east of the FQM mine site turnoff (Figure 3-4). A third feral cat was recorded on motion-sensor camera at Site MC2 on the 11th of February, indicating feral cats were actively utilising the Survey Area. Fox presence within the Survey Area was recorded based on scat at Site A on the 4th of February (Figure 3-4).

In 2019, Feral cats were recorded at control site C and impact sites F, A, E, L and D, while a single Red Fox was recorded at control Site G (Stantec 2019b). The reduction in feral animal records between 2019 and 2020 cannot be definitively attributed to a decline in feral animals but may due to a reduction in motion-sensor camera trapping nights (507 in 2019 vs 248 in 2020).

Foxes and/or feral cats are known to predate on each of the significant species present within the Survey Area (Benshemesh 2007, DEC 2012a, b, Morris *et al.* 1993, Saunders *et al.* 2014, Threatened Species Scientific Committee 2009, Threatened Species Scientific Committee 2016). The records from this Survey, along with records from previous surveys (Biota 2000, Coffey Environments 2010, Stantec 2019a, b, Terrestrial Ecosystems 2014, 2015, 2016a), indicate feral predators are an ongoing threat to native fauna in the Survey Area.

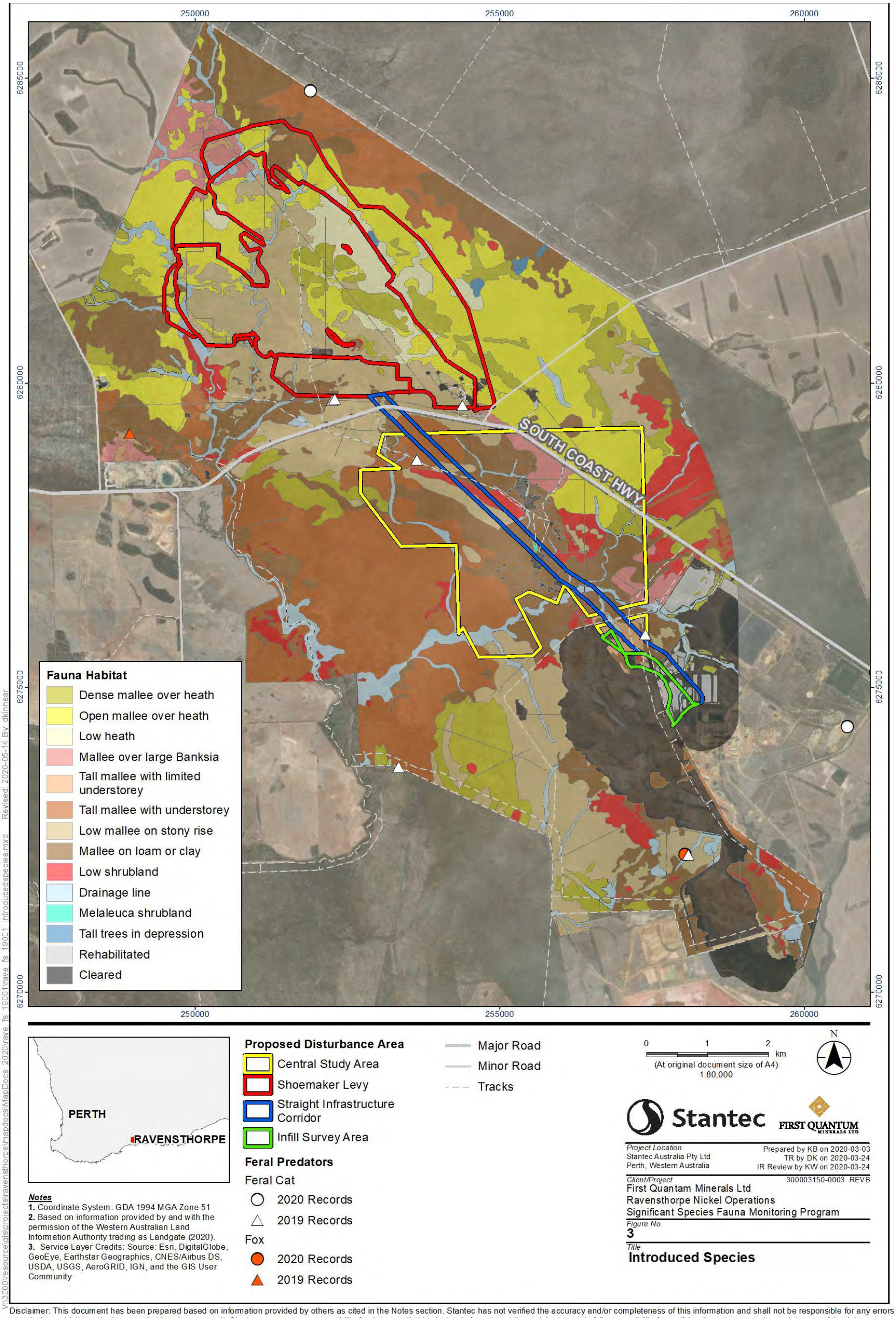


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Figure 3-4: Feral predator records from within the Survey Area

3.3 Limitations and Constraints

There are a number of possible limitations and constraints that can affect the adequacy of fauna surveys (EPA 2016b). All fauna surveys are limited to some degree by time and seasonal factors. Such limitations and constraints with respect to this Survey are discussed below (Table 3-8)

Table 3-8: Limitations and constraints of this Survey

Factor	Limitation/Constraint	Comments
Competency and experience of consultants	No	Field personnel were qualified Stantec zoologists with extensive experience conducting fauna surveys, including various targeted surveys for significant fauna throughout Western Australia.
Completeness	No	The survey was completed to an adequate standard. Survey effort was sufficient to achieve survey objectives. All sites monitored by Stantec (2019b) were monitored during the Survey.
Disturbance (i.e. to control sites)	No	Disturbance has not unduly affected impact or control sites. The level of disturbance at newly established impact sites is appropriate to acquire a baseline assessment of activity prior to mining activity. The three new control sites established during this Survey will provide additional context with respect to environmental variables.
Survey timing/weather	Slight	Timing of the survey was adequate. The maximum temperatures recorded on the 7th and 8th of February may have limited the movement of species targeted during the Survey (Table 2-1). Rainfall was below the long-term average in the five months preceding the Survey. The Survey was conducted outside of when female Chuditch have pouch or den young and before heavy rainfall restricted nocturnal foraging. The Survey was conducted outside of when the Western Mouse juveniles disperse, potentially reducing efficacy of the trapping.
Availability of previous data (specific and/or contextual)	No	Capture data from baseline fauna assessments and previous monitoring surveys were readily available ((BHPBIO 2006, Coffey Environments 2010, Terrestrial Ecosystems 2013, 2014, 2015, 2016a, 2017a). General environmental information regarding the Survey Area and the Esperance Plains bioregion is readily available from previous surveys conducted by Stantec (2019a), (Stantec 2019b). Current fire history mapping does not accurately represent the small mosaics of long-burnt vegetation located within the Survey Area.
Remoteness/access problems	Slight	While most exploration tracks were aged (made pre-2000), vehicle access was still available for the majority of the sites.

4. Conclusions

During the Survey, 18 targeted monitoring sites were surveyed, comprising nine impact sites and nine control sites. Impact sites were still exhibiting baseline conditions and will continue to be monitored to identify future changes as mining activity restarts and expansion plans are developed. Five species were targeted to meet existing regulatory conditions during the Survey, comprising Chuditch [Vu, Vu], Malleefowl [Vu, Vu], Heath Mouse [En, Vu], Western Mouse [P4], and Carnaby's Cockatoo [En, En]. An additional two species of significance; the Western Whipbird (*Psophodes nigrogularis oberon*) [P4] and the Western Brush Wallaby [P4] were also opportunistically recorded during the Survey.

Two Chuditch were captured at one site (D) during the Survey, equating to a trapping success of 0.63%. This result represents a decline in trapping success during this survey compared to Stantec (2019b) (1.67%), when four Chuditch were captured. Both individuals caught during the Survey were young females and had not been captured previously. Chuditch presence was also recorded via motion-sensor cameras at seven of the eight Chuditch monitoring sites, one Mouse monitoring site, and at one motion-sensor camera site during the Survey. These results indicate Chuditch are utilising a range of habitats within the Survey Area. Further monitoring will be required to understand the potential impact of the proposed expansion on the species and their preferred habitats.

The Western Mouse and Heath Mouse were not detected during the Survey. This result is consistent with Stantec (2019b), which did not record the Western Mouse or Heath Mouse in 2019. The absence of this species from the Survey Area could be the result of reduced habitat suitability due to a large-scale fire in 2003, reduced rainfall in the months preceding the survey and/or presence of feral predators. The species require dense long-unburnt (30-50 years) vegetation to persist (present in the southern portion of the Survey Area).

Nine Malleefowl mounds were reassessed during the Survey, of which four were classified as active, four were classified as 'inactive', and one mound was classified as 'extinct'. In comparison, Stantec (2019b) assessed seven Malleefowl mounds, of which five were active and two were inactive. The classification of one mound (MW6) was changed from active in 2019 to inactive in 2020 and one mound (MW11) was changed from 'extinct' to 'active'. All four active mounds were located between 100m and 650m from the proposed expansion, where they are potentially at risk of being impacted by future mining activity. Malleefowl were opportunistically recorded on seven occasions during the survey. Motion-sensor cameras were used during the Survey to confirm breeding pairs were actively tending to MW1 and MW7.

Carnaby's Black Cockatoos were opportunistically recorded on three occasions during the Survey, compared with no records made by Stantec (2019b). All three observations occurred in disturbed areas near the FQM accommodation area. In addition, foraging evidence of *Banksia lemanniana* cones was present at Site G within Mallee on loam or clay habitat. Previous foraging assessment scores (Stantec 2019a, b) produced 'low quality' scores (0-3) for all habitats within the Survey Area. The addition of foraging evidence at Site G increases the foraging assessment score of Mallee on loam or clay habitat from 3 (low quality) up to 5 (medium quality). Mallee on loam or clay habitat occurs within and surrounding the proposed Shoemaker Levy disturbance area.

Both the Western Brush Wallaby and Western Whipbird were opportunistically recorded within the Survey Area. The Western Brush Wallaby was recorded on 16 occasions during the Survey, compared with four occasions by Stantec (2019b). Five Western Brush Wallabies were observed in open Mallee over heath habitat, indicating this habitat is most utilised by the species. Western Whipbirds were recorded on 34 occasions during the Survey, compared with eight occasions by Stantec (2019b).

Evidence of feral animals was also present within the Survey Area, comprising of both feral cats and foxes. Feral cats and foxes are known to predate on the threatened species occurring within the Survey Area, including the Heath Mouse and Western Mouse. The absence of Heath Mouse and Western Mouse captures within the Survey Area may indicate post-fire predation by feral cats and foxes is occurring.

Future monitoring at both impact and control sites will inform whether the targeted species continue to persist in the Survey Area and what impact future mining operations will have on the species.

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Appendices

Appendix A Codes and terms used to describe significant species

Fauna may be afforded legislative protection by being listed under the EPBC Act and/or the BC Act, or by being listed on the DBCA Priority Species List. This Appendix presents a summary of the different rankings and listings used to describe conservation status. Some categories, such as 'extinct', 'extinct in the wild' and 'conservation dependent' (EPBC Act) are not presented here, as the table includes only the information needed to fully understand the codes presented in the preceding report. Refer to the relevant legislation for a full description of all codes in use, as well as their associated criteria.

Categories used under the EPBC Act		
Status	Code	Description
Critically Endangered	CR	Taxa that is considered to be facing an extremely high risk of extinction in the wild in the immediate future
Endangered	EN	Taxa that is considered to be facing a very high risk of extinction in the wild in the near future
Vulnerable	VU	Taxa that is considered to be facing a high risk of extinction in the wild in the medium-term future
Migratory	MI	Species that migrate to, over and within Australia and its external territories

Conservation Codes used under the BC Act			
Status	Code	Schedule (Status from the superseded WC Act)	Description
Critically Endangered	CR	S1	Taxa that is rare or likely to become extinct, as critically endangered taxa
Endangered	EN	S2	Taxa that is rare or likely to become extinct, as endangered taxa
Vulnerable	VU	S3	Taxa that is rare or likely to become extinct, as vulnerable taxa
Presumed Extinct	EX	S4	Taxa that is presumed to be extinct
Migratory	IA	S5	Birds that are subject to international agreements relating to the protection of migratory birds
Conservation Dependent	CD	S6	Taxa that are of special conservation need being species dependent on ongoing conservation intervention
Special Protection	OS	S7	Taxa that is in need of special protection

Appendix B Monitoring site disturbance history

Site	Monitoring Site	Category	History and records of disturbance	
			2019	2020
B	Chuditch	Control	Established • Disturbance limited to access tracks.	Monitored • No additional disturbance recorded.
N	Chuditch	Control	Established • Disturbance limited to access tracks and minor clearing.	Monitored • Decline in vegetation cover, including mortality of *Banksia lemanniana* and *Cyperaceae sp.*
Q	Chuditch	Control	-	Established • No disturbance recorded.
R	Chuditch	Control	-	Established • Located on the edge of the barrier fence. • Firebreak nearby.
D	Chuditch	Impact	Established • Disturbance limited to access tracks. • Feral cat present.	Monitored • No additional disturbance recorded.
E	Chuditch	Impact	Established • Disturbance limited to access tracks. • Feral cat present.	Monitored • No additional disturbance recorded.
J	Chuditch	Impact	Established • Disturbance limited to access tracks.	Monitored • No additional disturbance recorded.
L	Chuditch	Impact	Established • Disturbance limited to access tracks and minor clearing. • Feral cat present.	Monitored • No additional disturbance recorded
C	Mouse	Control	Established • Disturbance limited to access tracks.	Monitored • No additional disturbance recorded.

Site	Monitoring Site	Category	History and records of disturbance	
			2019	2020
G	Mouse	Control	Established • Disturbance limited to access tracks. • Red fox present.	Monitored • No additional disturbance recorded.
M	Mouse	Control	Established • Disturbance limited to access tracks.	Monitored • No additional disturbance recorded.
O	Mouse	Control	Established • Disturbance limited to access tracks.	Monitored • No additional disturbance recorded.
P	Mouse	Control	-	Established • Located on the edge of the barrier fence. • Firebreak nearby.
A	Mouse	Impact	Established • Disturbance limited to access tracks. • Feral cat present.	Monitored • No additional disturbance recorded. • Fox scat present.
F	Mouse	Impact	Established • Disturbance limited to access tracks. • Feral cat present.	Monitored • No additional disturbance recorded.
H	Mouse	Impact	Established • Disturbance limited to access tracks.	Monitored • No additional disturbance recorded.
I	Mouse	Impact	Established • Previous clearing for mining in the area.	Monitored • No additional disturbance recorded.
K	Mouse	Impact	Established • Disturbance limited to access tracks.	Monitored • No additional disturbance recorded.

Appendix C Habitat assessments

Name	Habitat Type	Landform	Site Photograph
A	Tall mallee with limited understory	Hill	
Condition	Condition	Excellent	
	Disturbance Type	Tracks	
	Fire Age	> 15	
% Ground Cover	Rock	0	
	Soil	0	
	Leaf Litter	90	
	Vegetation	10	
Rocks	Type	N/A	
	Size (mm)	N/A	
	Abundance (%)	0	
	Exposed Bedrock (%)	0	
Soil	Type	Clay loam	
	Colour	Grey	
Habitat Features	Slope	Gently inclined (3-5)	
	Water	No - Never	
	Termite Presence	Rare	
	Woody Debris	Very Common	
	Peeling Bark	Common	
	Rock Crevices	None	
	Burrowing Suitability	Moderate	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation				
Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	4	30–70	Mallee
Middle	Shrub	2	70–100	*Banksia*, *Isopogon*, parrot bush
Lower	Shrub, Sedge	0.3	10–30	Sedge, juveniles of mid storey

Name	Habitat Type	Landform	Site Photograph
B	Low mallee on stony rise	Rocky Outcrop	
Condition	Condition	Very Good	
	Disturbance Type	Tracks	
	Fire Age	5 to 15	
% Ground Cover	Rock	10	
	Soil	40	
	Leaf Litter	20	
	Vegetation	30	
Rocks	Type	Ferricrete	
	Size (mm)	60–200	
	Abundance (%)	20–50	
	Exposed Bedrock (%)	2–10	
Soil	Type	Clay loam	
	Colour	Grey	
Habitat Features	Slope	Moderately inclined (5-15)	
	Water	No - Never	
	Termite Presence	Rare	
	Woody Debris	Common	
	Peeling Bark	Rare	
	Rock Crevices	Moderate	
	Burrowing Suitability	Low	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Tree	3	< 10	Mallee, *Acacia*
Middle	Shrub	2	30–70	*Acacia, Melaleuca*
Lower	Shrub	0.4	30–70	*Melaleuca*

Name	Habitat Type	Landform
C	Mallee on loam or clay	Gentle slope
Condition	Condition	Excellent
	Disturbance Type	Tracks
	Fire Age	5 to 15
% Ground Cover	Rock	5
	Soil	30
	Leaf Litter	30
	Vegetation	35
Rocks	Type	Ironstone
	Size (mm)	6–20
	Abundance (%)	50–90
	Exposed Bedrock (%)	0
Soil	Type	Clay loam
	Colour	Orange
Habitat Features	Slope	Gently inclined (3-5)
	Water	No - Never
	Termite Presence	None
	Woody Debris	Common
	Peeling Bark	Moderate
	Rock Crevices	None
	Burrowing Suitability	Moderate
	Tree Hollows (<10 cm)	None
	Tree Hollows (>10 cm)	None

Site Photograph

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	4	5–15 (isolated clumps)	Mallee
Middle	Shrub	2.5	30–70	Mallee
Lower	Sedge, Shrub	1	30–70	Sedge, *Grevillea sp.*, Mallee, *Melaleuca sp.*, *Hakea sp.*

Name	Habitat Type	Landform	Site Photograph
D	Tall mallee with understory	Hill	
Condition	Condition	Very Good	
	Disturbance Type	Tracks	
	Fire Age	5 to 15	
% Ground Cover	Rock	25	
	Soil	25	
	Leaf Litter	85	
	Vegetation	10	
Rocks	Type	Ferricrete	
	Size (mm)	20–60	
	Abundance (%)	2–10	
	Exposed Bedrock (%)	2–10	
Soil	Type	Sandy loam	
	Colour	Brown	
Habitat Features	Slope	Moderately inclined (5-15)	
	Water	No - Never	
	Termite Presence	Rare	
	Woody Debris	Common	
	Peeling Bark	Common	
	Rock Crevices	Rare	
	Burrowing Suitability	Moderate	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Tree	6	30–70	Mallee
Middle	Shrub	2	30–70	*Banksia*, *Melaleuca*, *Acacia*
Lower	Sedge, Shrub	0.5	10–30	Sedges, *Melaleuca*, *Grevillia*

Name	Habitat Type	Landform	Site Photograph
E	Low mallee on stony rise	Plain	
Condition	Condition	Very Good	
	Disturbance Type	Tracks	
	Fire Age	5 to 15	
% Ground Cover	Rock	30	
	Soil	30	
	Leaf Litter	25	
	Vegetation	15	
Rocks	Type	Quartzite	
	Size (mm)	20–60	
	Abundance (%)	50–90	
	Exposed Bedrock (%)	0	
Soil	Type	Clay loam	
	Colour	Grey	
Habitat Features	Slope	Gently inclined (3-5)	
	Water	No - Never	
	Termite Presence	Rare	
	Woody Debris	Moderate	
	Peeling Bark	Moderate	
	Rock Crevices	None	
	Burrowing Suitability	Moderate	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Tree	5	0–5 (isolated clumps)	Unknown burnt
Middle	Mallee	3	30–70	Mallee vines
Lower	Shrub, Sedge	1	30–70	*A. Glaucoptera, Grevillia, Melaleuca.*

Name	Habitat Type	Landform	Site Photograph
F	Low mallee on stony rise	Plain	
Condition	Condition	Very Good	
	Disturbance Type	Tracks	
	Fire Age	5 to 15	
% Ground Cover	Rock	20	
	Soil	10	
	Leaf Litter	60	
	Vegetation	10	
Rocks	Type	Quartzite, Ironstone	
	Size (mm)	6–20	
	Abundance (%)	50–90	
	Exposed Bedrock (%)	0	
Soil	Type	Clay loam	
	Colour	Grey	
Habitat Features	Slope	Gently inclined (3-5)	
	Water	No - Never	
	Termite Presence	Rare	
	Woody Debris	Common	
	Peeling Bark	Moderate	
	Rock Crevices	None	
	Burrowing Suitability	Moderate	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	5	10–30	Mallee
Middle	Mallee	2.5	30–70	*Banksia*, *Mallee*, *Isopogon*
Lower	Shrub	0.5	30–70	*Melaleuca*, Sedges, *Isopogon*

Name	Habitat Type	Landform	Site Photograph
G	Mallee on loam or clay	Undulating slope	
Condition	Condition	Very Good	
	Disturbance Type	Tracks	
	Fire Age	>20	
% Ground Cover	Rock	5	
	Soil	5	
	Leaf Litter	50	
	Vegetation	40	
Rocks	Type	Quartzite	
	Size (mm)	6–20	
	Abundance (%)	10–20	
	Exposed Bedrock (%)	0	
Soil	Type	Clay loam	
	Colour	White/brown	
Habitat Features	Slope	Gently inclined (3-5)	
	Water	No - Never	
	Termite Presence	Rare	
	Woody Debris	Very Common	
	Peeling Bark	Common	
	Rock Crevices	None	
	Burrowing Suitability	Moderate	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Tree	7	10–30	Mallee
Middle	Shrub	3	30–70	Mallee
Lower	Shrub	1	30–70	*Melaleuca*

Name	Habitat Type	Landform	Site Photograph
H	Mallee on clay or loam	Plain	
Condition	Condition	Excellent	
	Disturbance Type	Tracks	
	Fire Age	5 to 15	
% Ground Cover	Rock	20	
	Soil	45	
	Leaf Litter	20	
	Vegetation	40	
Rocks	Type	Quartzite, Ironstone	
	Size (mm)	6–20,20–60	
	Abundance (%)	50–90	
	Exposed Bedrock (%)	0	
Soil	Type	Clay loam	
	Colour	Brown	
Habitat Features	Slope	Level (0-3)	
	Water	No - Never	
	Termite Presence	Some/mound	
	Woody Debris	Very Common	
	Peeling Bark	Moderate	
	Rock Crevices	None	
	Burrowing Suitability	Moderate	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	4	0–5 (isolated clumps)	Unknown dead
Middle	Mallee	2	30–70	Mallee
Lower	Shrub, Sedge	0.5	30–70	*Acacia glaucoptera*, sedge, *Acacia sp.*, *Grevillea sp.*, *Melaleuca sp.*

Name	Habitat Type	Landform	Site Photograph
I	Mallee on loam or clay	Stony Hill	
Condition	Condition	Good	
	Disturbance Type	Clearing	
	Fire Age	5 to 15	
% Ground Cover	Rock	40	
	Soil	40	
	Leaf Litter	10	
	Vegetation	10	
Rocks	Type	Quartzite	
	Size (mm)	20–60	
	Abundance (%)	50–90	
	Exposed Bedrock (%)	<2	
Soil	Type	Clay loam	
	Colour	Grey	
Habitat Features	Slope	Gently inclined (3-5)	
	Water	No - Never	
	Termite Presence	Rare	
	Woody Debris	Moderate	
	Peeling Bark	Moderate	
	Rock Crevices	None	
	Burrowing Suitability	Moderate	
	Tree Hollows (<10 cm)	Rare	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Tree	6	10–30	Mallee
Middle	Shrub	2	30–70	Mallee, *Banksia*, *Melaleuca*
Lower	Heath shrub	0.5	30–70	Sedges, *Melaleuca*

Name	Habitat Type	Landform	Site Photograph
J	Mallee over large banksia	Plain	
Condition	Condition	Excellent	
	Disturbance Type	Tracks	
	Fire Age	> 15	
% Ground Cover	Rock	0	
	Soil	30	
	Leaf Litter	50	
	Vegetation	20	
Rocks	Type	N/A	
	Size (mm)	N/A	
	Abundance (%)	0	
	Exposed Bedrock (%)	0	
Soil	Type	Loamy sand	
	Colour	White	
Habitat Features	Slope	Level (0-3)	
	Water	No - Never	
	Termite Presence	None	
	Woody Debris	Common	
	Peeling Bark	Moderate	
	Rock Crevices	None	
	Burrowing Suitability	High	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Tree, Mallee	6	30–70	*Banksia*, Mallee
Middle	Shrub, Mallee	2	70–100	Mallee, *Isopogon*, *Banksia*, *Melaleuca*
Lower	Shrub	0.5	30–70	*Melaleuca*, Sedges

Name	Habitat Type	Landform	Site Photograph
K	Mallee over large banksia	Plain	
Condition	Condition	Excellent	
	Disturbance Type	Tracks	
	Fire Age	> 15	
% Ground Cover	Rock	0	
	Soil	30	
	Leaf Litter	50	
	Vegetation	20	
Rocks	Type	N/A	
	Size (mm)	N/A	
	Abundance (%)	0	
	Exposed Bedrock (%)	0	
Soil	Type	Loamy sand	
	Colour	White	
Habitat Features	Slope	Level (0-3)	
	Water	No - Never	
	Termite Presence	None	
	Woody Debris	Common	
	Peeling Bark	Moderate	
	Rock Crevices	None	
	Burrowing Suitability	High	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Tree, Mallee	6	30–70	*Banksia*, Mallee
Middle	Shrub, Mallee	2	70–100	Mallee, *Isopogon*, *Banksia*, *Melaleuca*
Lower	Shrub	0.5	30–70	*Melaleuca*, Sedges

Name	Habitat Type	Landform	Site Photograph
L	Mallee over heath	Undulating plain	
Condition	Condition	Excellent	
	Disturbance Type	Clearing, fire, tracks	
	Fire Age	5 - 15	
% Ground Cover	Rock	10	
	Soil	60	
	Leaf Litter	10	
	Vegetation	20	
Rocks	Type	Quartzite	
	Size (mm)	2-6, 6-20	
	Abundance (%)	10-20	
	Exposed Bedrock (%)	0	
Soil	Type	Clay loam	
	Colour	Brown	
Habitat Features	Slope	Gently inclined (3-5)	
	Water	No - never	
	Termite Presence	Rare	
	Woody Debris	Rare	
	Peeling Bark	Rare	
	Rock Crevices	None	
	Burrowing Suitability	High	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	2	10-30	*Eucalyptus spp.*
Middle	Shrub	0.8	10-30	*Melaleuca sp., Acacia bifaria, Grevillea sp.*
Lower	Sedge	0.05	<10	*?Poaceae sp.*

Name	Habitat Type	Landform	Site Photograph
M	Mallee over large banksia	Plain	
Condition	Condition	Very Good	
	Disturbance Type	Tracks	
	Fire Age	> 15	
% Ground Cover	Rock	0	
	Soil	50	
	Leaf Litter	40	
	Vegetation	10	
Rocks	Type	N/A	
	Size (mm)	N/A	
	Abundance (%)	0	
	Exposed Bedrock (%)	0	
Soil	Type	Clayey sand	
	Colour	White	
Habitat Features	Slope	Level (0-3)	
	Water	No - Never	
	Termite Presence	Rare	
	Woody Debris	Common	
	Peeling Bark	Moderate	
	Rock Crevices	None	
	Burrowing Suitability	Moderate	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Tree, Mallee	3	10–30	Mallee, *Banksia*
Middle	Shrub, Mallee	2	10–30	Mallee, *Melaleuca*, *Banksia*, *Isopogon*
Lower	Shrub	1	70–100	*Melaleuca*, *Hakea*, *Isopogon*

Name	Habitat Type	Landform	Site Photograph
N	Tall trees in depression	Depression	
Condition	Condition	Poor	
	Disturbance Type	Tracks, Clearing	
	Fire Age	> 15	
% Ground Cover	Rock	0	
	Soil	10	
	Leaf Litter	60	
	Vegetation	30	
Rocks	Type	N/A	
	Size (mm)	N/A	
	Abundance (%)	0	
	Exposed Bedrock (%)	0	
Soil	Type	Sand	
	Colour	Grey	
Habitat Features	Slope	Level (0-3)	
	Water	No - Prone to Ponding	
	Termite Presence	None	
	Woody Debris	Common	
	Peeling Bark	Common	
	Rock Crevices	None	
	Burrowing Suitability	High	
	Tree Hollows (<10 cm)	Moderate	
	Tree Hollows (>10 cm)	Rare	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Tree	10	30–70	*Eucalyptus sp.*
Middle	Shrub	2	30–70	*Melaleuca*
Lower	Sedge	0.3	30–70	Sedges

Name	Habitat Type	Landform	Site Photograph
O	Mallee on loam or clay	Plain	
Condition	Condition	Very Good	
	Disturbance Type	Tracks	
	Fire Age	5 to 15	
% Ground Cover	Rock	5	
	Soil	60	
	Leaf Litter	20	
	Vegetation	15	
Rocks	Type	Laterite	
	Size (mm)	6–20,2–6	
	Abundance (%)	50–90	
	Exposed Bedrock (%)	0	
Soil	Type	Clay loam	
	Colour	Brown	
Habitat Features	Slope	Level (0-3)	
	Water	No - Never	
	Termite Presence	Rare	
	Woody Debris	Common	
	Peeling Bark	Moderate	
	Rock Crevices	None	
	Burrowing Suitability	Moderate	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	4	0–5 (isolated clumps)	Dead Mallee
Middle	Mallee	2.5	30–70	Mallee, *Eucalyptus* red
Lower	Shrub, Sedge	0.5	30–70,10–30	*Melaleuca*, Sedges, other shrubs

Name	Habitat Type	Landform	Site Photograph
P	Mallee with understorey	Plain	
Condition	Condition	Excellent	
	Disturbance Type	None	
	Fire Age	>15	
% Ground Cover	Rock	0	
	Soil	5	
	Leaf Litter	15	
	Vegetation	80	
Rocks	Type	N/A	
	Size (mm)	N/A	
	Abundance (%)	0	
	Exposed Bedrock (%)	0	
Soil	Type	Sand	
	Colour	Grey	
Habitat Features	Slope	Gently inclined (3 – 5)	
	Water	No - never	
	Termite Presence	None	
	Woody Debris	Common	
	Peeling Bark	Very common	
	Rock Crevices	None	
	Burrowing Suitability	High	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	4	30 - 70	*Eucalyptus tetraptera, Eucalyptus pleurocarpa, Banksia leihmannii, Eucalyptus sp.*
Middle	Shrub, mallee, heath shrub	1.5	30 - 70	*Hakea sp., melaleuca sp., Eucalyptus tetrapthera, Banksia leihmannii,*
Lower	Shrub	0.5	10 - 30	*Grevillea sp. poaceae sp. sedge sp.*

Name	Habitat Type	Landform	Site Photograph
Q	Minor drainage line	Minor drainage line	
Condition	Condition	Excellent	
	Disturbance Type	None	
	Fire Age	5 - 15	
% Ground Cover	Rock	0	
	Soil	20	
	Leaf Litter	20	
	Vegetation	60	
Rocks	Type	N/A	
	Size (mm)	N/A	
	Abundance (%)	0	
	Exposed Bedrock (%)	0	
Soil	Type	Sand	
	Colour	Grey	
Habitat Features	Slope	Gently inclined (3 – 5)	
	Water	Yes – semi permanent	
	Termite Presence	Rare	
	Woody Debris	Common	
	Peeling Bark	Common	
	Rock Crevices	None	
	Burrowing Suitability	Moderate	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	6	30 - 70	*Eucalyptus sp.*
Middle	Shrub	2	10 - 30	*Callistemon sp. kunzea sp. hakea sp. myrtaceae sp.*
Lower	Sedge, rush	0.5	10 - 30	Rushes and sedges, *lepidosperma sp.*

Name	Habitat Type	Landform	Site Photograph
R	Mallee over heath	Plain	
Condition	Condition	Excellent	
	Disturbance Type	None	
	Fire Age	>15	
% Ground Cover	Rock	0	
	Soil	2	
	Leaf Litter	8	
	Vegetation	90	
Rocks	Type	N/A	
	Size (mm)	N/A	
	Abundance (%)	0	
	Exposed Bedrock (%)	0	
Soil	Type	Sand	
	Colour	Grey	
Habitat Features	Slope	Gently inclined (3 – 5)	
	Water	No - never	
	Termite Presence	None	
	Woody Debris	Moderate	
	Peeling Bark	Moderate	
	Rock Crevices	None	
	Burrowing Suitability	Low	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	6	30 - 70	*Eucalyptus sp., hakea sp.*
Middle	Tree, mallee, vine, tussock grass	2	30 - 70	*Exocarpus sp., Melaleuca sp., ?Acacia sp.*
Lower	Rush	0.5	10 - 30	*Poaceae sp.*

Appendix D Photo point monitoring

Site A (51H 258095 mE 6272248 mS)	
2020	
PM1 to PM2	PM1 to PM3

Site B (51H 256144 mE 6272399 mS)	
2020	
PM1 to PM2	PM1 to PM3

Site C (51H 253338 mE 6273680 mS)	
2020	
PM1 to PM2	PM1 to PM3

Site D (51H 257343 mE 6276005 mS)	
2020	
PM1 to PM2	PM1 to PM3

Site E (51H 253992 mE 6278578 mS)	
2020	
PM1 to PM2	PM1 to PM3

Site F (51H 254375 mE 6279639 mS)	
2020	
PM1 to PM2	PM1 to PM3

Site G (51H 248886 mE 6279167 mS)	
2020	
PM1 to PM2	PM1 to PM3

Site H (51H 251995 mE 6279723 mS)	
2020	
PM1 to PM2	PM1 to PM3

Site I (51H 255835 mE 6277225 mS)	
2020	
PM1 to PM2	PM1 to PM3

Site J (51H 250631 mE 6284153 mS)	
2020	
PM1 to PM2	PM1 to PM3

Site L (51H 252242 mE 6279733 mS)	
2020	
PM1 to PM2	PM1 to PM3

Site M (51H 258865 mE 6280119 mS)	
2020	
PM1 to PM2	PM1 to PM3

Site N (51H 257582 mE 6281073 mS)	
2020	
PM1 to PM2	PM1 to PM3

Site O (51H 247921 mE 6280770 mS)	
2020	
PM1 to PM2	PM1 to PM3

Site P (51H 254695 mE 6282922 mS)	
2020	
PM1 to PM2	PM1 to PM3

Site Q (51H 248780 mE 6282558 mS)	
2020	
PM1 to PM2	PM1 to PM3

Site R (51H 250232 mE 6285885 mS)	
2020	
PM1 to PM2	PM1 to PM3

Appendix E Raw capture data

Date	Site	Trap No.	Coordinates (51H)		PIT ID	Recapture	Condition	Weight (g)	Sex	Pes (mm)	Tail base (mm)
			Eastings	Northings							
04/02/2020	D	7	257303	6276145	943094322007148	no	Good	210	Female	44.9	18
05/02/2020	D	6	257313	6276095	943094322007524	no	Good	247	Female	41.1	15.1

Capture Images			
PIT ID: 943094322007148		PIT ID: 943094322007524	
Right side	Left side	Right side	Left side

Appendix F Motion-sensor camera records

Date	Site	Type	Trap No.	Species Name	Common Name
03-02-20	B	Control	REC21	*Dasyurus geoffroii*	Chuditch
05-02-20	D	Impact	REC54	*Dasyurus geoffroii*	Chuditch
05-02-20	D	Impact	REC59	*Dasyurus geoffroii*	Chuditch
06-02-20	E	Impact	REC62	*Dasyurus geoffroii*	Chuditch
07-02-20	N	Control	REC70	*Dasyurus geoffroii*	Chuditch
08-02-20	L	Impact	REC46	*Dasyurus geoffroii*	Chuditch
08-02-20	I	Impact	REC82	*Dasyurus geoffroii*	Chuditch
09-02-20	R	Control	REC39	*Dasyurus geoffroii*	Chuditch
11-02-20	J	Impact	REC54	*Dasyurus geoffroii*	Chuditch
11-02-20	MC2	Control	REC62	*Dasyurus geoffroii*	Chuditch
11-02-20	MC2	Control	REC74	*Dasyurus geoffroii*	Chuditch
12-02-20	J	Impact	REC59	*Dasyurus geoffroii*	Chuditch
06-02-20	L	Impact	REC58	*Notamacropus irma*	Western Brush Wallaby
10-02-20	O	Control	REC33	*Notamacropus irma*	Western Brush Wallaby
10-02-20	O	Control	REC33	*Notamacropus irma*	Western Brush Wallaby
11-02-20	O	Control	REC33	*Notamacropus irma*	Western Brush Wallaby
11-02-20	L	Impact	REC63	*Notamacropus irma*	Western Brush Wallaby
10-02-20	MW7	-	REC73	*Notamacropus irma*	Western Brush Wallaby
10-02-20	MW7	-	REC73	*Notamacropus irma*	Western Brush Wallaby
12-02-20	MW7	-	REC73	*Notamacropus irma*	Western Brush Wallaby

Date	Site	Type	Trap No.	Species Name	Common Name
10-02-20	MW1	-	REC82	*Notamacropus irma*	Western Brush Wallaby
11-02-20	MW1	-	REC82	*Notamacropus irma*	Western Brush Wallaby
10-02-20	MW7	-	REC73	*Leipoa ocellata*	Malleefowl
11-02-20	MW7	-	REC73	*Leipoa ocellata*	Malleefowl
11-02-20	MW7	-	REC73	*Leipoa ocellata*	Malleefowl
12-02-20	MW7	-	REC73	*Leipoa ocellata*	Malleefowl
10-02-20	MW1	-	REC82	*Leipoa ocellata*	Malleefowl
10-02-20	MW1	-	REC82	*Leipoa ocellata*	Malleefowl
11-02-20	MW1	-	REC82	*Leipoa ocellata*	Malleefowl
12-02-20	MW1	-	REC82	*Leipoa ocellata*	Malleefowl

Appendix G Non-systematic fauna of significance records

Date	Coordinates (51H)		Scientific Name	Common Name	Record Type	Number
	Eastings	Northings				
10-02-20	249318.979	6279023.755	*Calyptorhynchus latirostris*	Carnaby's Black Cockatoo	Foraging Evidence	-
04-02-20	260568.517	6274311.894	*Calyptorhynchus latirostris*	Carnaby's Black Cockatoo	Heard	>1
12-02-20	260571.328	6274307.771	*Calyptorhynchus latirostris*	Carnaby's Black Cockatoo	Heard	>1
09-02-20	251001.708	6278907.987	*Leipoa ocellata*	Malleefowl	Observed	1
04-02-20	251014.049	6278910.952	*Leipoa ocellata*	Malleefowl	Observed	2
06-02-20	253389.763	6279579.149	*Leipoa ocellata*	Malleefowl	Observed	2
12-02-20	253533.025	6279560.128	*Leipoa ocellata*	Malleefowl	Observed	2
04-02-20	248415.180	6278917.644	*Notamacropus irma*	Western Brush Wallaby	Observed	1
11-02-20	248457.076	6281878.240	*Notamacropus irma*	Western Brush Wallaby	Observed	1
05-02-20	248943.554	6282987.964	*Notamacropus irma*	Western Brush Wallaby	Observed	1
11-02-20	249496.610	6284331.814	*Notamacropus irma*	Western Brush Wallaby	Observed	1
10-02-20	249816.608	6285112.270	*Notamacropus irma*	Western Brush Wallaby	Carcass	1
05-02-20	251912.790	6275502.948	*Notamacropus irma*	Western Brush Wallaby	Observed	1
12-02-20	251953.465	6275471.503	*Notamacropus irma*	Western Brush Wallaby	Observed	1
12-02-20	251957.515	6275944.175	*Notamacropus irma*	Western Brush Wallaby	Observed	1
08-02-20	251853.685	6284832.668	*Notamacropus irma*	Western Brush Wallaby	Observed	1
06-02-20	252393.702	6274793.553	*Notamacropus irma*	Western Brush Wallaby	Observed	1

Date	Coordinates (51H)		Scientific Name	Common Name	Record Type	Number
	Eastings	Northings				
11-02-20	252821.706	6273718.146	*Notamacropus irma*	Western Brush Wallaby	Observed	1
08-02-20	253478.640	6280308.863	*Notamacropus irma*	Western Brush Wallaby	Observed	1
12-02-20	253728.970	6280157.355	*Notamacropus irma*	Western Brush Wallaby	Observed	1
12-02-20	255933.146	6280404.440	*Notamacropus irma*	Western Brush Wallaby	Observed	1
09-02-20	256377.746	6278478.803	*Notamacropus irma*	Western Brush Wallaby	Carcass	1
07-02-20	258346.674	6280579.813	*Notamacropus irma*	Western Brush Wallaby	Observed	1
11-02-20	247947.982	6280717.158	*Psophodes nigrogularis oberon*	Western Whipbird	Heard	1
12-02-20	248928.491	6279187.158	*Psophodes nigrogularis oberon*	Western Whipbird	Observed	1
12-02-20	248930.442	6279186.973	*Psophodes nigrogularis oberon*	Western Whipbird	Observed	1
12-02-20	249048.657	6282479.037	*Psophodes nigrogularis oberon*	Western Whipbird	Heard	1
12-02-20	249221.048	6279052.824	*Psophodes nigrogularis oberon*	Western Whipbird	Heard	1
12-02-20	249789.281	6279351.879	*Psophodes nigrogularis oberon*	Western Whipbird	Heard	1
06-02-20	249790.501	6279353.827	*Psophodes nigrogularis oberon*	Western Whipbird	Heard	1
12-02-20	249856.061	6281498.982	*Psophodes nigrogularis oberon*	Western Whipbird	Heard	1
12-02-20	250015.391	6280529.573	*Psophodes nigrogularis oberon*	Western Whipbird	Heard	1
08-02-20	250283.419	6281167.497	*Psophodes nigrogularis oberon*	Western Whipbird	Heard	1
12-02-20	250360.629	6284152.030	*Psophodes nigrogularis oberon*	Western Whipbird	Heard	1
12-02-20	250485.384	6285695.384	*Psophodes nigrogularis oberon*	Western Whipbird	Heard	1
06-02-20	250497.716	6285712.482	*Psophodes nigrogularis oberon*	Western Whipbird	Heard	1

Date	Coordinates (51H)		Scientific Name	Common Name	Record Type	Number
	Eastings	Northings				
11-02-20	250498.974	6285716.133	*Psophodes nigrogularis oberon*	Western Whipbird	Heard	1
12-02-20	250499.244	6285715.609	*Psophodes nigrogularis oberon*	Western Whipbird	Heard	1
06-02-20	250669.245	6279539.561	*Psophodes nigrogularis oberon*	Western Whipbird	Heard	1
11-02-20	250708.289	6279673.478	*Psophodes nigrogularis oberon*	Western Whipbird	Heard	1
10-02-20	250581.503	6285661.893	*Psophodes nigrogularis oberon*	Western Whipbird	Heard	1
07-02-20	250831.023	6279372.835	*Psophodes nigrogularis oberon*	Western Whipbird	Heard	1
07-02-20	250959.159	6278369.813	*Psophodes nigrogularis oberon*	Western Whipbird	Heard	1
09-02-20	250831.415	6285500.248	*Psophodes nigrogularis oberon*	Western Whipbird	Heard	1
06-02-20	251428.072	6282831.593	*Psophodes nigrogularis oberon*	Western Whipbird	Heard	1
08-02-20	251809.777	6279719.817	*Psophodes nigrogularis oberon*	Western Whipbird	Heard	1
12-02-20	251759.769	6284893.437	*Psophodes nigrogularis oberon*	Western Whipbird	Heard	1
08-02-20	251903.774	6284795.869	*Psophodes nigrogularis oberon*	Western Whipbird	Heard	1
04-02-20	252330.624	6279710.951	*Psophodes nigrogularis oberon*	Western Whipbird	Heard	1
12-02-20	252945.905	6279545.076	*Psophodes nigrogularis oberon*	Western Whipbird	Heard	1
11-02-20	253622.778	6278738.650	*Psophodes nigrogularis oberon*	Western Whipbird	Heard	1
07-02-20	255702.817	6277231.476	*Psophodes nigrogularis oberon*	Western Whipbird	Heard	2
09-02-20	256143.544	6272400.093	*Psophodes nigrogularis oberon*	Western Whipbird	Heard	1
11-02-20	258010.893	6272255.486	*Psophodes nigrogularis oberon*	Western Whipbird	Heard	1
08-02-20	258011.564	6272254.823	*Psophodes nigrogularis oberon*	Western Whipbird	Heard	1

Appendix H Non-target species recorded during the Survey

Date	Site	Trap no.	Species Name	Common Name
05-02-20	A	E1	*Tiliqua rugosa*	Bobtail
07-02-20	A	E11	*Tiliqua rugosa*	Bobtail
08-02-20	A	E12	*Hemiergis initialis*	Southwestern earless skink
06-02-20	A	E14	*Tiliqua rugosa*	Bobtail
08-02-20	A	E2	*Hemiergis peronii*	Four-toed earless skink
07-02-20	A	E20	*Tiliqua rugosa*	Bobtail
04-02-20	A	REC85	*Tiliqua rugosa*	Bobtail
06-02-20	A	REC85	*Drymodes brunneopygia*	Southern Scrub-robin
07-02-20	A	REC85	*Drymodes brunneopygia*	Southern Scrub-robin
07-02-20	A	REC85	*Strepera versicolor*	Grey Currawong
08-02-20	A	REC85	*Strepera versicolor*	Grey Currawong
08-02-20	A	REC85	*Drymodes brunneopygia*	Southern Scrub-robin
07-02-20	B	1	*Tiliqua rugosa*	Bobtail
06-02-20	B	4	*Tiliqua rugosa*	Bobtail
07-02-20	B	7	*Tiliqua rugosa*	Bobtail
07-02-20	B	8	*Tiliqua rugosa*	Bobtail
06-02-20	B	8	*Tiliqua rugosa*	Bobtail
07-02-20	B	9	*Tiliqua rugosa*	Bobtail
06-02-20	B	9	*Pseudonaja affinis*	Dugite
04-02-20	B	REC39	*Tiliqua rugosa*	Bobtail
06-02-20	B	REC56	*Tiliqua rugosa*	Bobtail

Date	Site	Trap no.	Species Name	Common Name
04-02-20	B	REC77	*Tiliqua rugosa*	Bobtail
04-02-20	B	REC81	*Tachyglossus aculeatus*	Short-beaked Echidna
06-02-20	B	REC81	*Drymodes brunneopygia*	Southern Scrub-robin
08-02-20	C	E8	*Tiliqua rugosa*	Bobtail
04-02-20	C	REC48	*Tachyglossus aculeatus*	Short-beaked Echidna
07-02-20	D	2	*Tiliqua rugosa*	Bobtail
06-02-20	D	4	*Tiliqua rugosa*	Bobtail
06-02-20	D	4	*Tiliqua rugosa*	Bobtail
07-02-20	D	9	*Tiliqua rugosa*	Bobtail
07-02-20	D	10	*Varanus rosenbergi*	Heath Monitor
04-02-20	D	REC57	*Tiliqua rugosa*	Bobtail
04-02-20	D	REC59	*Tiliqua rugosa*	Bobtail
07-02-20	D	REC64	*Strepera versicolor*	Grey Currawong
04-02-20	D	REC72	*Drymodes brunneopygia*	Southern Scrub-robin
04-02-20	D	REC72	*Tiliqua rugosa*	Bobtail
05-02-20	D	REC72	*Drymodes brunneopygia*	Southern Scrub-robin
06-02-20	D	REC72	*Tachyglossus aculeatus*	Short-beaked Echidna
06-02-20	E	3	*Tiliqua rugosa*	Bobtail
07-02-20	E	8	*Varanus rosenbergi*	Heath Monitor
10-02-20	F	E13	*Mus musculus*	House Mouse
10-02-20	F	REC22	*Drymodes brunneopygia*	Southern Scrub-robin
13-02-20	G	E17	*Mus musculus*	House Mouse
10-02-20	G	E19	*Varanus rosenbergi*	Heath Monitor

Date	Site	Trap no.	Species Name	Common Name
11-02-20	G	REC47	*Macropus fuliginosus*	Western Grey Kangaroo
08-02-20	H	E10	*Tiliqua rugosa*	Bobtail
08-02-20	I	E18	*Tiliqua rugosa*	Bobtail
09-02-20	J	7	*Tiliqua rugosa*	Bobtail
11-02-20	J	8	*Tiliqua rugosa*	Bobtail
11-02-20	J	REC59	*Strepera versicolor*	Grey Currawong
08-02-20	J	REC72	*Strepera versicolor*	Grey Currawong
09-02-20	K	E18	*Tiliqua rugosa*	Bobtail
07-02-20	L	2	*Tiliqua rugosa*	Bobtail
07-02-20	L	9	*Varanus rosenbergi*	Heath Monitor
08-02-20	L	9	*Tiliqua rugosa*	Bobtail
11-02-20	L	REC51	*Strepera versicolor*	Grey Currawong
06-02-20	M	E1	*Tiliqua rugosa*	Bobtail
09-02-20	M	E12	*Mus musculus*	House Mouse
08-02-20	M	E17	*Mus musculus*	House Mouse
09-02-20	M	E9	*Tiliqua rugosa*	Bobtail
05-02-20	M	REC80	*Corvus coronoides*	Australian Raven
06-02-20	M	REC80	*Corvus coronoides*	Australian Raven
07-02-20	M	REC80	*Macropus fuliginosus*	Western Grey Kangaroo
09-02-20	N	3	*Varanus rosenbergi*	Heath Monitor
08-02-20	N	4	*Varanus rosenbergi*	Heath Monitor
08-02-20	N	5	*Tiliqua rugosa*	Bobtail
08-02-20	N	6	*Varanus rosenbergi*	Heath Monitor

Date	Site	Trap no.	Species Name	Common Name
08-02-20	N	7	*Varanus rosenbergi*	Heath Monitor
07-02-20	N	7	*Varanus rosenbergi*	Heath Monitor
08-02-20	N	8	*Varanus rosenbergi*	Heath Monitor
06-02-20	N	9	*Varanus rosenbergi*	Heath Monitor
08-02-20	N	9	*Varanus rosenbergi*	Heath Monitor
07-02-20	N	9	*Varanus rosenbergi*	Heath Monitor
09-02-20	N	E8	*Tiliqua rugosa*	Bobtail
08-02-20	N	REC55	*Varanus rosenbergi*	Heath Monitor
07-02-20	N	REC71	*Varanus rosenbergi*	Heath Monitor
08-02-20	N	REC71	*Varanus rosenbergi*	Heath Monitor
10-02-20	O	E10	*Tiliqua rugosa*	Bobtail
09-02-20	P	REC53	*Varanus rosenbergi*	Heath Monitor
11-02-20	Q	4	*Varanus rosenbergi*	Heath Monitor
11-02-20	Q	9	*Tiliqua rugosa*	Bobtail
06-02-20	Q	REC61	*Macropus fuliginosus*	Western Grey Kangaroo
12-02-20	R	REC39	*Drymodes brunneopygia*	Southern Scrub-robin
10-02-20	R	REC68	*Varanus rosenbergi*	Heath Monitor
10-02-20	R	REC78	*Varanus rosenbergi*	Heath Monitor
10-02-20	MC1	REC50	*Strepera versicolor*	Grey Currawong
11-02-20	MC1	REC50	*Trichosurus vulpecula*	Common Brushtail Possum
11-02-20	MC1	REC50	*Macropus fuliginosus*	Western Grey Kangaroo
11-02-20	MC1	REC81	*Macropus fuliginosus*	Western Grey Kangaroo
-	Opportunistic	Heard	*Drymodes brunneopygia*	Southern Scrub-robin

Date	Site	Trap no.	Species Name	Common Name
-	Opportunistic	Heard	*Lichmera indistincta*	Brown Honeyeater
-	Opportunistic	Heard	*Pardalotus punctatus*	Spotted Pardalote
-	Opportunistic	Heard	*Phylidonyris novaehollandiae*	New Holland Honeyeater
-	Opportunistic	Heard	*Sericornis frontalis*	White-browed Scrubwren
-	Opportunistic	Heard	*Corvus coronoides*	Australian Raven
-	Opportunistic	Heard	*Lichenostomus cratitius*	Purple-gaped Honeyeater
-	Opportunistic	Heard	*Lichenostomus leucotis*	White-eared Honeyeater
-	Opportunistic	Heard	*Calamanthus cauta*	Shy Heathwren
-	Opportunistic	Heard	*Malurus pulcherrimus*	Blue-breasted Fairy-wren
-	Opportunistic	Heard	*Zosterops lateralis*	Silvereye
-	Opportunistic	Observed	*Pomatostomus superciliosus*	White-browed Babbler
-	Opportunistic	Observed	*Aquila audax*	Wedge-tailed Eagle
-	Opportunistic	Observed	*Macropus fuliginosus*	Western Grey Kangaroo
-	Opportunistic	Observed	*Ctenophorus maculatus griseus*	Spotted Dragon
-	Opportunistic	Scat	*Vulpes vulpes*	Red Fox
-	Opportunistic	Observed	*Petrochelidon nigricans*	Tree Martin
-	Opportunistic	Heard	*Smicrornis brevirostris*	Weebill
-	Opportunistic	Observed	*Phaps chalcoptera*	Common Bronzewing
-	Opportunistic	Scat	*Dromaius novaehollandiae*	Emu
-	Opportunistic	Heard	*Anthochaera lunulata*	Western Little Wattlebird
-	Opportunistic	Observed	*Accipiter cirrocephalus*	Collared Sparrowhawk
-	Opportunistic	Observed	*Rhipidura leucophrys*	Willie Wagtail
-	Opportunistic	Heard	*Stipiturus malachurus*	Southern Emu-wren

Date	Site	Trap no.	Species Name	Common Name
-	Opportunistic	Heard	*Strepera versicolor*	Grey Currawong
-	Opportunistic	Heard	*Cracticus torquatus*	Grey Butcherbird
-	Opportunistic	Observed	*Manorina flavigula*	Yellow-throated Miner
-	Opportunistic	Observed	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike
-	Opportunistic	Observed	*Platycercus spurius*	Red-capped Parrot
-	Opportunistic	Observed	*Ocyphaps lophotes*	Crested Pigeon
-	Opportunistic	Observed	*Falco berigora*	Brown Falcon
-	Opportunistic	Observed	*Platycercus zonarius*	Australian Ringneck
-	Opportunistic	Observed	*Melithreptus brevirostris*	Brown-headed Honeyeater
-	Opportunistic	Observed	*Neophema elegans*	Elegant Parrot
-	Opportunistic	Heard	*Pachycephala occidentalis*	Western Golden Whistler
-	Opportunistic	Observed	*Eopsaltria australis griseogularis*	Western Yellow Robin
-	Opportunistic	Observed	*Dicaeum hirundinaceum*	Mistletoebird
-	Opportunistic	Observed	*Tyto alba*	Barn Owl
-	Opportunistic	Heard	*Colluricincla harmonica*	Grey Shrike-thrush
-	Opportunistic	Observed	*Pogona minor*	Dwarf Bearded Dragon
-	Opportunistic	Carcass	*Felis catus*	Cat
-	Opportunistic	Observed	*Rhipidura albiscapa*	Grey Fantail
-	Opportunistic	Heard	*Oreoica gutturalis*	Crested Bellbird
-	Opportunistic	Observed	*Phaps elegans*	Brush Bronzewing
-	Opportunistic	Observed	*Anas gracilis*	Grey Teal
-	Opportunistic	Observed	*Anthochaera carunculata*	Red wattlebird
-	Opportunistic	Observed	*Anthus australis*	Australian Pipit

Date	Site	Trap no.	Species Name	Common Name
-	Opportunistic	Observed	*Coturnix ypsilophora*	Brown Quail
-	Opportunistic	Observed	*Cracticus nigrogularis*	Pied Butcherbird
-	Opportunistic	Observed	*Falco cenchroides*	Australian kestrel
-	Opportunistic	Observed	*Gavicalis virescens*	Singing honeyeater
-	Opportunistic	Observed	*Glyciphila melanops*	Tawny-crowned honeyeater
-	Opportunistic	Observed	*Hirundo neoxena*	Welcome swallow
-	Opportunistic	Observed	*Hirundo neoxena*	Fairy martin
-	Opportunistic	Observed	*Pardalotus striatus*	Striated Pardalote
-	Opportunistic	Observed	*Parvipsitta porphyrocephala*	Purple-crowned lorikeet
-	Opportunistic	Observed	*Sugomel niger*	Black honeyeater
09-02-20	Opportunistic	Observed	*Felis catus*	Cat
10-02-20	MC2	REC62	*Drymodes brunneopygia*	Southern Scrub-robin
11-02-20	MC2	REC62	*Drymodes brunneopygia*	Southern Scrub-robin
11-02-20	MC2	REC74	*Drymodes brunneopygia*	Southern Scrub-robin
11-02-20	MC2	REC77	*Felis catus*	Cat
09-02-20	MW7	REC73	*Varanus rosenbergi*	Heath Monitor
11-02-20	MW1	REC82	*Macropus fuliginosus*	Western Grey Kangaroo
12-02-20	MW1	REC82	*Macropus fuliginosus*	Western Grey Kangaroo

Appendix I Motion-sensor camera locations

Camera Name	Location (51H)		Recording Nights
	Easting	Northing	
REC21	255983.31	6272458.42	4
REC22	254395.76	6279624.71	6
REC33	247900.36	6280726.45	6
REC35	250415.94	6284161.99	6
REC36	257591.51	6281043.42	4
REC39	250616.86	6285608.50	5
REC39	255993.24	6272505.65	4
REC46	252117.38	6279754.16	7
REC47	253667.02	6278770.16	4
REC47	248923.20	6279164.27	4
REC48	253337.86	6273696.07	4
REC49	257516.77	6280953.64	4
REC50	253557.38	6278828.97	4
REC50	250035.63	6280501.78	2
REC51	252209.48	6279728.78	7
REC53	254693.62	6282920.05	5
REC54	257406.22	6275796.93	4
REC54	250284.97	6284225.88	5
REC55	257565.03	6280990.01	4
REC56	256547.57	6272520.48	4
REC57	257383.10	6275954.73	4
REC57	250201.88	6284228.84	5
REC58	252013.34	6279701.87	7
REC59	257391.30	6275871.18	4
REC59	250342.76	6284186.95	5
REC60	250382.66	6285751.79	5
REC61	249051.12	6282482.01	5
REC62	253472.54	6278837.73	4
REC62	251734.75	6284867.74	3

Camera Name	Location (51H)		Recording Nights
	Easting	Northing	
REC63	252287.34	6279736.38	7
REC64	257360.77	6276035.48	4
REC65	249143.40	6282526.79	5
REC66	248942.38	6282485.07	5
REC68	250227.11	6285872.17	5
REC70	257472.60	6280997.86	4
REC71	257491.06	6281075.00	4
REC72	257336.06	6276087.69	4
REC72	250168.13	6284145.56	5
REC73	253766.18	6278718.76	4
REC73	253956.28	6279135.28	2
REC74	253907.00	6278661.28	4
REC74	251643.60	6284932.90	3
REC75	252334.04	6279724.73	7
REC76	248833.76	6282516.89	5
REC77	251894.57	6284793.04	3
REC77	256111.64	6272381.23	4
REC78	250300.15	6285779.25	5
REC79	251820.81	6279766.06	7
REC80	258862.39	6280119.61	4
REC81	256090.96	6272416.37	4
REC81	250026.62	6280532.48	2
REC82	255835.10	6277224.67	4
REC82	250835.97	6279369.55	3
REC84	250486.01	6285696.11	5
REC85	258095.18	6272245.02	4
REC86	248784.52	6282568.45	5
TOTAL			253

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REPORT

RAVENSTHORPE NICKEL PROJECT: SIGNIFICANT SPECIES FAUNA MONITORING PROGRAM 2019

PREPARED FOR FIRST QUANTUM MINERALS LTD

June 2019

Stantec

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FIRST QUANTUM MINERALS

Ravensthorpe Nickel Project: Significant Species Fauna Monitoring Program 2019

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Executive Summary

First Quantum Minerals Ltd (FQM) commissioned Stantec Australia Pty Ltd (Stantec) to conduct a survey of species of conservation significance (the Survey), in the vicinity of the Ravensthorpe Nickel Operations (the Project). The Survey was designed to meet regulatory requirements predominantly relating to the following species:

- Carnaby's black cockatoo (*Calyptorhynchus latirostris*) (S2, En);
- Heath Mouse (*Pseudomys shortridgei*) (S3, En);
- Chuditch (*Dasyurus geoffroii*) (S3, Vu);
- Malleefowl (Leipoa ocellata) (S3, Vu);
- Western Whipbird (*Psophodes nigrogularis oberon*) (P4); and
- Western Brush Wallaby (*Notamacropus irma*) (P4).

The specific objectives of this survey were to:

- Establish a survey methodology suitable for repeatable ongoing monitoring including;
    - Survey methods that are suitable for the detection of all conservation significant species likely to require monitoring for the project; and
    - Site locations that account for current and future impacts as well as adequate controls.
- Utilise a 'mark recapture' technique with Passive Integrated Transponder (PIT) tags (Chuditch) and ear notches (Heath Mouse and Western Mouse) to provide quantitative data on the demographics and distribution of targeted species when trapped; and
- Establish a baseline population dataset which can be used to monitor changes in populations over time, in relation to Project developments and environmental variables.

Although previous significant species monitoring programs have been undertaken for FQM, these have not considered the proposed expansion of the Project which is currently under 'care and maintenance'. Consequently, the Survey Area for this monitoring program comprised the 'Study Area' surveyed during the 2018 fauna survey and surrounds. This Survey Area encompassed:

- areas of historical mining;
- areas of proposed mining as part of the proposed Shoemaker Levy expansion; and
- areas of suitable habitat identified in the surrounding area.

During this survey 15 monitoring sites were surveyed, comprising nine impact sites and six control sites. The nine impact sites occur near historical and proposed mining, and as mine expansions occur and activity continues these sites will potentially be impacted. The establishment of 'impact' sites prior to mining activity will provide a baseline comparison, allowing any future impacts to be detected.

Chuditch monitoring sites were established at six locations within appropriate Chuditch habitat. Four of these sites were close to current or proposed mining activity and are referred to as 'impact' sites. The remaining two monitoring sites were located outside any current or proposed disturbance and represent 'control' sites. Ten large cage traps were deployed at each site for four consecutive nights, equating to a total of 240 trap nights for the Survey.

Western Mouse and Heath Mouse monitoring sites were established at nine locations within appropriate habitat. Five of these were established near current or proposed mining activity and are referred to as 'impact' sites. The remaining four monitoring sites were located outside any proposed or historical mining disturbance and represent 'control' sites. Twenty small Elliot traps were deployed at each Mouse monitoring site for four consecutive nights, equating to a total of 720 trap nights for the Survey.

Additional survey techniques were conducted to compliment trapping and confirm presence and distribution of species across the Survey Area. Five motion-sensor cameras were deployed at each Chuditch monitoring site and one motion-sensor camera was deployed at each Mouse monitoring site. This totalled 38 motion-sensor camera locations, where were deployed for between ten and 18 nights resulting in a total of 507 trap nights for the Survey. Malleefowl mound assessments were undertaken at known mounds (excluding extinct mounds) and compared with previous assessments to determine Malleefowl

presence and activity. Foraging scores of suitable Carnaby's Black Cockatoo habitat were recorded and searches for any evidence of foraging in the area conducted.

Chuditch were captured at three locations (one control site and two impacts sites) during the Survey, comprising two females and two males. The two female Chuditch had been captured during previous surveys, as evident from PIT tags. Chuditch were also confirmed present via motion-sensor cameras at four additional locations, comprising one control and three impact sites. The recapture of two individuals combined with detection of the species via motion-sensor camera is evidence that a population is persisting in the area. Five Malleefowl mounds were assessed as 'active' and the species was recorded at five locations, comprising two direct sightings, two records on motion-sensor camera, and one feather. No Western Mouse or Heath Mouse individuals were captured or confirmed via motion-sensor cameras during the Survey. Carnaby's Black Cockatoo was not observed during the Survey, and habitat foraging scores remained 'low quality', with no signs of foraging in the Survey Area. The Western Whipbird and Western Brush Wallaby were observed directly and via motion-sensor camera at 13 locations, comprising five control and eight impact sites.

This Survey established new survey sites that will accurately capture potential impacts from mining activity while controlling for environmental factors, through the utilisation of appropriate impact and control sites. Future monitoring at impact and control sites will clarify whether any populations are influenced by mining operations undertaken for the Project.

1. Introduction

1.1 Project Background

The First Quantum Mineral Ltd (FQM) Ravensthorpe Nickel Operation (RNO) Project (the Project) is located in the Goldfields-Esperance region of Western Australia, approximately 455km southeast of Perth. The Project commenced development in 2004 and began actively mining in 2008, however has been under 'care and maintenance' since October 2017. There are currently plans to restart the operation of the Project, which include the proposed Shoemaker Levy expansion. Stantec Australia Pty Ltd (Stantec), were engaged to undertake the significant species fauna monitoring program for 2019 (the Survey), taking into consideration:

- existing and anticipated fauna monitoring conditions associated with the Project and its expansion; and
- areas that were previously monitored in association with historic disturbance.

The Survey was designed to meet the following Environmental Protection Authority (EPA) requirements, while aligning with existing and anticipated fauna monitoring conditions:

- Ministerial Statement 633 (EPA 2003) (MS633) Condition 7-1 to monitor the Heath Rat *(Pseudomys shortridgei)* (En, S3) and the Western Mouse (*Pseudomys occidentalis*) (P4);
- Environmental Scoping Document (ESD) for the Project (EPA 2017), required Work Item 32a: to monitor the health and population sizes of threatened species within the development envelope and in areas of indirect impact, in particular, the following species (which are all Matters of National Environmental Significance [MNES]):
    - Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) (Schedule [S] 2, Endangered [En]);
    - Heath Mouse (*Pseudomys shortridgei*) (S3, En); and
    - Chuditch (*Dasyurus geoffroii*) (S3, Vulnerable [Vu]).
- Potential monitoring requirements of known active or inactive mounds of the Malleefowl (*Leipoa ocellata*) (S3, Vu) in the vicinity of the Project; and
- Opportunistic recording of other species of conservation significance including the;
    - Western Whipbird (*Psophodes nigrogularis oberon*) (Priority [P] 4); and
    - Western Brush Wallaby (*Notamacropus irma*) (P4).

The Survey Area for this monitoring program comprised the 'Study Area' surveyed during the 2018 fauna survey and surrounds. This Survey Area encompassed:

- historic mining – existing impacts;
- proposed mining as part of the proposed Shoemaker Levy expansion – proposed impacts; and
- suitable surrounding habitat identified– control areas.

This survey follows the 2013 baseline survey and 2014 to 2017 annual monitoring surveys (Terrestrial Ecosystems 2013, 2014, 2015, 2016a, 2017a), and occurred prior to large scale development of the Shoemaker Levy.

1.1.1 Historic Survey Effort

The Project and surrounds has been extensively surveyed (BHPBIO 2006, Biota 2000, 2005, Coffey Environments 2009, 2010, Stantec 2019, Terrestrial Ecosystems 2013, 2014, 2015, 2016a, b, 2017a, b, 2018). A comprehensive summary of the baseline survey and annual monitoring surveys conducted for the Project is provided in Stantec (2019). Records of species of conservation significance confirmed within the RNO and surrounding areas are summarised in Figure 1-1 and Table 1-1.

During the literature review by Stantec (2019), a number of inconsistencies were identified between the annual monitoring surveys (Terrestrial Ecosystems 2013, 2014, 2015, 2016a, 2017a). These inconsistencies

typically comprised the location and number of sites monitored, and the survey methods and intensity undertaken. This resulted in the inability to confidently compare records of species of conservation significance from previous surveys due to differences in presenting record locations. The lack of consistent linking between species of conservation significance and habitats of importance in many previous surveys was of particular concern(Biota 2005, Coffey Environments 2009, 2010, Terrestrial Ecosystems 2013, 2014, 2015, 2016a, b, 2017a, b, 2018). The monitoring sites were altered in Terrestrial Ecosystems (2017a) to better represent the dominant habitats present near the project and to not be in areas that will become cleared for the proposed Shoemaker Levy mine. The Terrestrial Ecosystems (2017a) monitoring survey concentrated trap sites near the existing mine resulting in a reduced spatial coverage that may not have captured local populations of species of conservation significance. The potential effects associated with the proposed Shoemaker Levy and Straight Infrastructure Corridor may not be captured by this methodology.

Due to these inconsistencies the Survey was redesigned to better meet regulatory conditions and assess the proposed impacts from the expansion of the Project (incorporating previous sites and methodology where possible). Due to this, the results from this Survey will not be directly comparable to those of previous surveys. However, the survey data collected from previous monitoring still provides contextual data on the occurrence of species.

1.2 Survey Scope and Objectives

The overarching objective of the Survey was to meet the requirements of condition 7-1 of MS633 and required work item 32a of the environmental Scoping Document for the project (EPA 2017). In addition to the requirements of these documents, the activity of known Malleefowl mounds within the vicinity of the Project were re-assessed. The specific objectives were to:

- establish a survey methodology and plan suitable for repeatable ongoing monitoring including;
    - survey methods that are suitable for the detection of all conservation significant species likely to require monitoring for the Project; and
    - site locations that account for current and future impacts as well as adequate control sites.
- utilise a 'mark recapture' technique with Passive Implant Transponder (PIT) tags (Chuditch) and ear notches (Heath Mouse and Western Mouse) to provide quantitative data on the demographics and distribution of targeted species when trapped; and
- establish a baseline population dataset which can be used to monitor changes in populations over time, in relation to Project development and environmental variables.

In summary, this survey used a targeted survey effort to record the Chuditch (*Dasyurus geoffroii)*, Western Mouse (*Pseudomys occidentalis*), Heath Mouse (*Pseudomys shortridgei*), Malleefowl (*Leipoa ocellata*), and Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*), while recording opportunistic sightings of the Western Brush Wallaby (*Notamacropus irma*) and Western Whipbird (*Psophodes nigrogularis oberon)*.

Table 1-1: Species of conservation significance records from previous monitoring surveys of the RNO.

Reference	Study Details	Survey Effort and Methods	Species of Conservation Significance
Terrestrial Ecosystems, 2013	**Location:** RNO **Study type:** Annual monitoring baseline survey; trapping, camera trapping, western whipbird assessment **Survey dates:** Trapping 14/10-19/10/2013	**Trapping:** • 500 box traps – 2,500 trap nights • 100 cage traps – 500 trap nights **Western whipbird:** • 11 sites **Motion camera:** • Eight deployed at breakaway – 16 trap nights	• Western whipbird (*Psophodes nigrogularis oberon* [P4]) ○ Ten locations - Monitoring sites • Western brush wallaby (*Notamacropus irma* [P4]) ○ Small mob - Opportunistic
Terrestrial Ecosystems, 2014	**Location:** RNO **Study type:** Annual monitoring; trapping, camera trapping, western whipbird assessment **Survey dates:** Trapping: 12/09-18/09/2014	**Trapping:** • 500 box traps – 2,500 trap nights • 100 cage traps – 500 trap nights **Western whipbird:** • 10 sites **Motion camera:** • 50 deployed - 1,550 trap nights	• Western brush wallaby (*Notamacropus irma* [P4]) ○ 6 sites - Motion camera • Western whipbird (*Psophodes nigrogularis oberon* [P4]) ○ Eight locations - Monitoring sites ○ Five occasions - Opportunistic • Malleefowl (*Leipoa ocellata* [S3 VU]) ○ One location - Opportunistic ○ Two sites - Motion camera • Carnaby's cockatoo (*Calyptorhynchus latirostris* [S2 EN]) ○ One site - Motion camera
Terrestrial Ecosystems, 2015	**Location:** RNO **Study type:** Annual monitoring; trapping, camera trapping, western whipbird assessment **Survey dates:** Trapping: 13/10-19/10/2015	**Trapping** • 500 box traps – 2,500 trap nights • 100 cage traps – 500 trap nights **Western whipbird:**	• Chuditch (*Dasyurus geoffroii* [S3 VU]) ○ 4 sites - Motion camera • Western brush wallaby (*Notamacropus irma* [P4])

Reference	Study Details	Survey Effort and Methods	Species of Conservation Significance
		• 10 sites Motion camera: • 50 deployed – 1,550 trap nights	○ 6 sites - Motion camera • Western whipbird (*Psophodes nigrogularis oberon* [P4]) ○ One site - Motion camera ○ Eight occasions - Monitoring site ○ One location - Opportunistic • Carnaby's cockatoo (*Calyptorhynchus latirostris* [S2 EN])
Terrestrial Ecosystems, 2016	Location: RNO Study type: Annual monitoring; trapping, camera trapping, western whipbird assessment. Feral animal trapping Survey dates: 15/11-21/11/2016	Trapping • 500 box traps – 2,500 trap nights • 100 cage traps and 119 feral trapping cage traps – 1,095 trap nights Western whipbird: • 10 sites Motion camera: • 50 deployed – 1,550 trap nights	• Chuditch (*Dasyurus geoffroii* [S3 VU]) ○ Seven captures - Trapping ○ Five sites - Motion camera • Malleefowl (*Leipoa ocellata* [S3 VU]) ○ One location - Opportunistic ○ Five sites - Motion camera • Western brush wallaby (*Notamacropus irma* [P4]) ○ 6 sites - Motion camera • Western whipbird (*Psophodes nigrogularis oberon* [P4]) ○ Eight locations - Monitoring site ○ 10 occasions - Opportunistic • Carnaby's cockatoo (*Calyptorhynchus latirostris* [S2 EN])

Reference	Study Details	Survey Effort and Methods	Species of Conservation Significance
Terrestrial Ecosystems, 2017	**Location:** RNO **Study type:** Annual monitoring; trapping, camera trapping, western whipbird assessment **Survey dates:** Trapping 02/11-07/11/2017	**Trapping** • 450 box traps – 2,250 trap nights • 150 cage traps – 750 trap nights **Western whipbird:** • 12 sites **Motion camera:** • 90 deployed – 3,600 trap nights	• Chuditch (*Dasyurus geoffroii* [S3 VU]) ○ 16 captures - Trapping ○ 24 locations - Motion camera • Western whipbird (*Psophodes nigrogularis oberon* [P4]) ○ 10 locations - Monitoring site ○ 18 occasions - Opportunistic • Malleefowl (*Leipoa ocellata* [S3 VU]) ○ One location - Motion camera • Western brush wallaby (*Notamacropus irma* [P4]) ○ 77 locations - Motion camera • Western mouse (Pseudomys occidentalis [P4]) ○ One individual - Trapping • Carnaby's cockatoo (*Calyptorhynchus latirostris* [S2 EN])

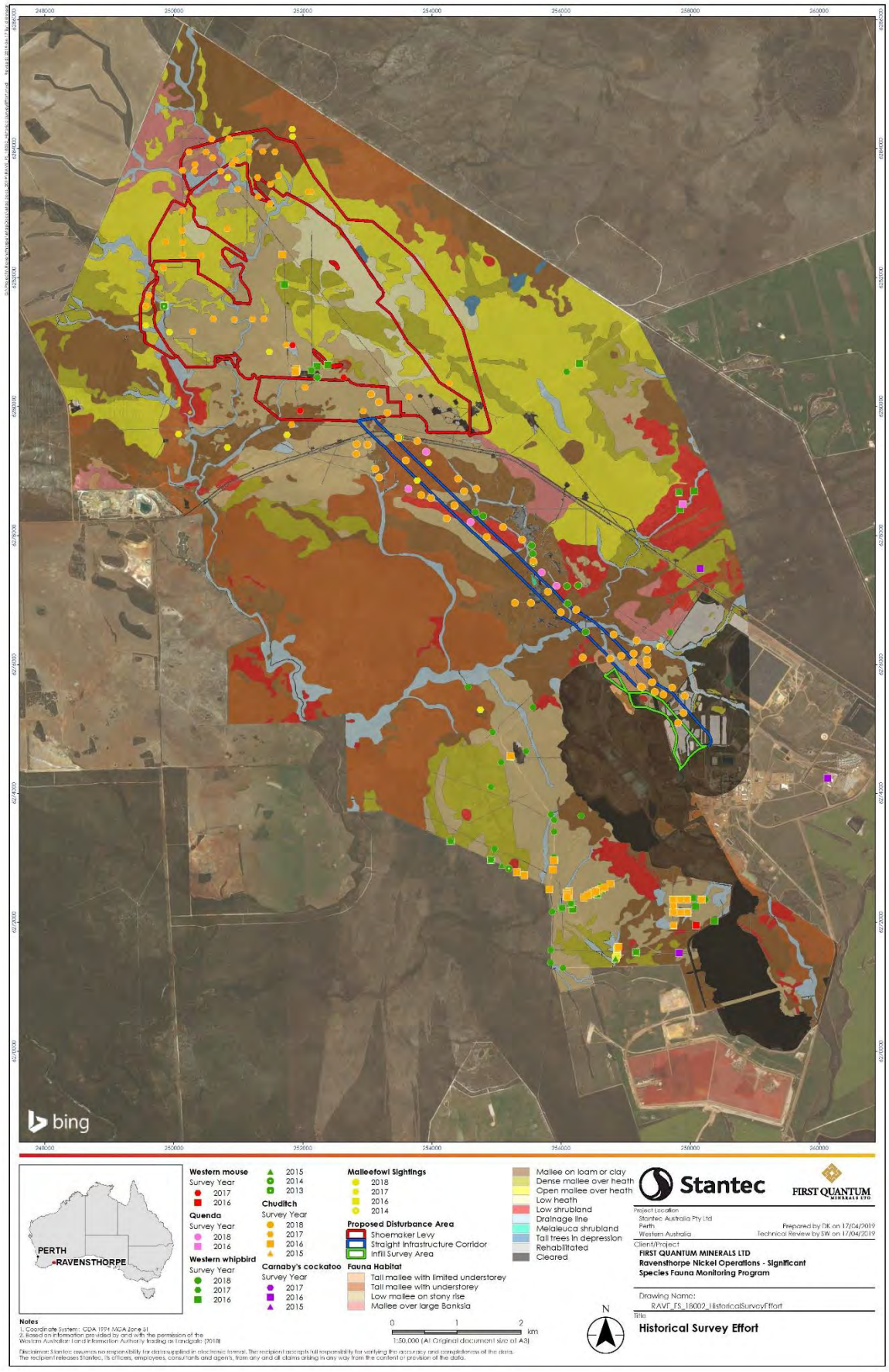

Figure 1-1: Historic survey results within the Survey Area

2. Methods

The existing environment of the Survey Area has been documented previously by Stantec (2019). This includes a summary of the biogeographic region, climate, land systems and land use, as well as reserves and environmentally sensitive areas.

Conservation significance and rankings used under the Environment Protection and Biodiversity Conservation (EPBC) Act, ***Biodiversity Conservation Act 2016*** (BC Act), as well as the Department of Biodiversity, Conservation and Attractions (DBCA) Priority list, are defined in **Appendix A**. The BC Act replaces both the ***Wildlife Conservation Act 1950*** (WC Act) and the Sandalwood Act and came into effect on 1 January 2019.

2.1 Field Survey

2.1.1 Timing

The field survey was conducted from 4th to 15th February 2019. Chuditch cage trapping and Western Mouse and Heath Mouse small Elliot trapping occurred from the 5th -14th February. Motion cameras were deployed from the 8th to 26th of February, recording between ten and eighteen nights at each site.

Survey timing was appropriate for the species being targeted during the survey. The survey was conducted outside the season when Chuditch females will have pouch or den young (mid-August to mid-November). The timing coincides with dispersal of juvenile Chuditch (September-May) (Soderquist and Serena 2000) and preceding heavy rainfall, avoiding the restriction of nocturnal foraging by Chuditch (DEC 2012a). The survey was also conducted when Carnaby's Black Cockatoo's are known to forage along the south coast (January to July) (DoEE 2017).

2.1.2 Climate & Weather

During the six months preceding the field survey (August 2018 to January 2019), Ravensthorpe station (weather station 010633, located approximately 30 km east of the Survey Area), recorded 166.5 mm of rainfall. This was lower than the long-term annual average rainfall of 204.4 mm for the same period (BoM 2019) (**Figure 2-1**). Local weather conditions were typical for the time of year. Minimum temperatures ranged from 12.6° C to 16.0° C, with an average of 14.0° C (**Table 2-1**). Maximum temperatures ranged from 20.9° C to 35.0° C, with an average of 27.8° C (**Table 2-1**). Relative humidity (recorded only at 0900) ranged between 42 to 99% (**Table 2-1**) (BoM 2019).

Table 2-1: Daily weather observations recorded at Ravensthorpe during the Survey

Date	Temperature (°C)		Rainfall (mm)	Humidity (%)
	Min	Max		
4/2/2019	13	24	0	42
5/2/2019	12.5	29.5	0	83
6/2/2019	14	31	0	59
7/2/2019	16	24.2	0	48
8/2/2019	14.6	24.1	0	99
9/2/2019	13.3	26.3	0	86
10/2/2019	12.6	31	0	94
11/2/2019	16	28.5	0	75
12/2/2019	13	20.9	0	64
13/02/2019	-	31	0	77
14/02/2019	14.5	35	0	90
Average	13.95	27.77	0	74
All weather data taken from Ravensthorpe (station 010633). Source: (BoM 2019)				

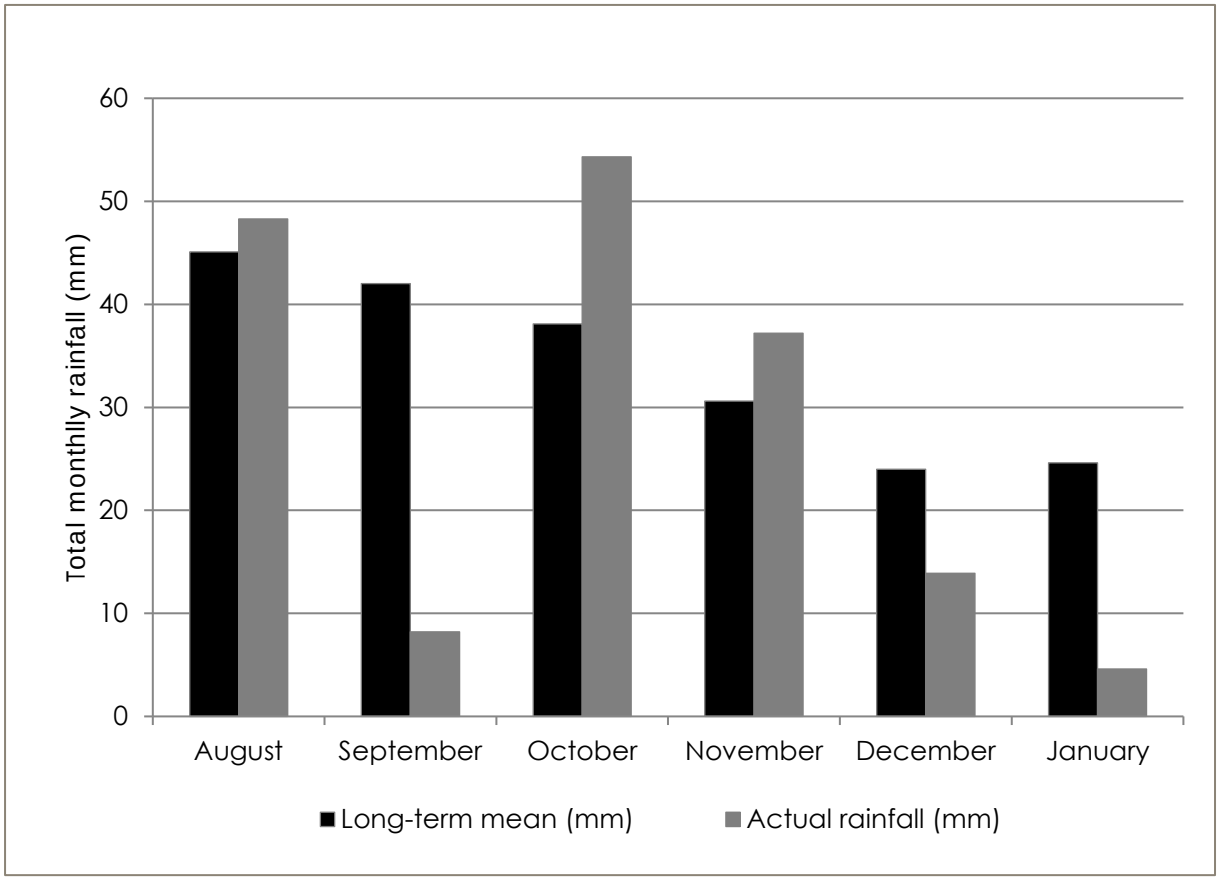

Figure 2-1: Long-term average and pre-Survey rainfall received at Ravensthorpe station (BoM 2019)

2.1.3 Survey Site Locations

Records of Chuditch, Western Mouse and Heath Mouse from previous surveys were considered prior to the 2019 field survey to identify sites suitable for a long-term monitoring programme (BHPBIO 2006, Biota 2000, 2005, Coffey Environments 2009, 2010, Stantec 2019, Terrestrial Ecosystems 2013, 2014, 2015, 2016a, b, 2017a, b, 2018). This Survey comprised fifteen monitoring sites (Table 2-2; Figure 2-2). Nine sites within the Survey Area were close to current or proposed mining disturbance and are referred to as 'impact' sites (Table 2-2). The remaining six sites were established in areas that are unlikely to be directly or indirectly impacted by current or proposed mining activities, and therefore represent 'control' sites. The Malleefowl mound assessment component of the Survey is summarized in Section 2.1.7.

Table 2-2: Monitoring site locations and survey effort for the Survey

Site	Monitoring Site	Category	Trap nights			Location (51H)	
			Elliot	Cage	Camera	Easting	Northing
B	Chuditch	Control	-	40	55	256135	6272396
N	Chuditch	Control	-	40	65	257466	6280948
D	Chuditch	Impact	-	40	50	257344	6276023
E	Chuditch	Impact	-	40	90	253675	6278713
J	Chuditch	Impact	-	40	52	250343	6284181
L	Chuditch	Impact	-	40	65	252254	6279715
C	Mouse	Control	80	-	14	253352	6273692
G	Mouse	Control	80	-	17	249049	6279114
M	Mouse	Control	80	-	13	258864	6280074
O	Mouse	Control	80	-	14	247945	6280759
A	Mouse	Impact	80	-	14	258195	6272253
F	Mouse	Impact	80	-	14	254375	6279642
H	Mouse	Impact	80	-	17	251828	6279722
I	Mouse	Impact	80	-	14	255703	6277452
K	Mouse	Impact	80	-	13	250335	6284193

2.1.4 Survey Team and Licensing

The field survey was conducted by experienced Stantec zoologists Paul Bolton and Samantha Lostrom. Paul has over eleven years' experience with vertebrate and invertebrate zoological surveys and was the technical lead for the field survey. Samantha has five years' experience in zoology and has completed a variety of targeted fauna survey work throughout Western Australia. Both are experienced in survey methods including tracking, motion camera recording and avifauna identification.

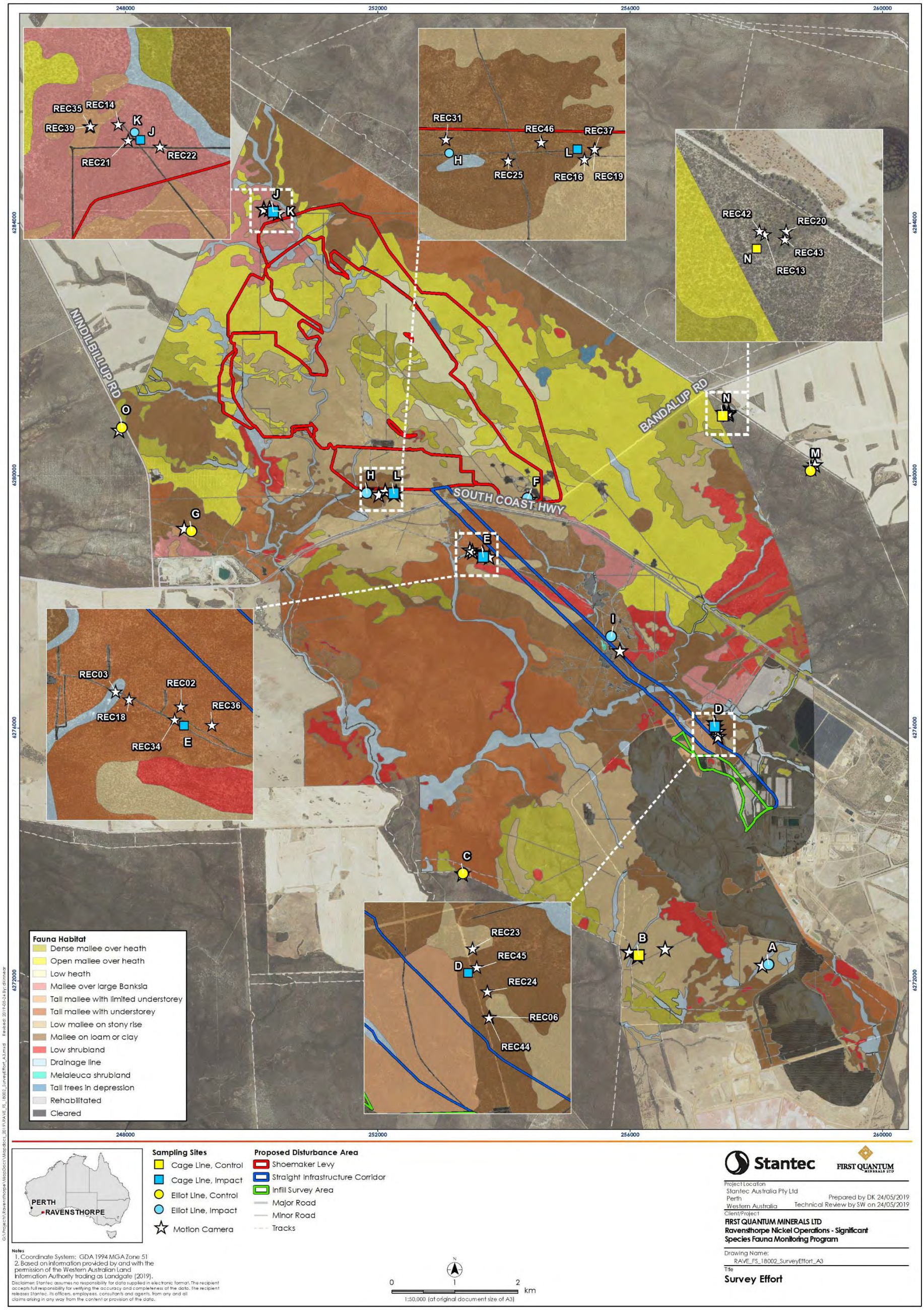

Figure 2-2: The Study Area showing monitoring site locations for the Survey

General Field and Analysis Techniques

The Survey was designed and conducted in accordance with methods outlined in guidelines prescribed by relevant regulatory bodies, including:

- EPA Factor Guideline: Environmental Factor Guideline: Terrestrial Fauna (EPA 2016a);
- EPA Technical Guide: Sampling Methods for Terrestrial Vertebrate Fauna (EPA 2016b);
- EPA Technical Guide: Technical Guidance – Terrestrial Fauna Surveys (EPA 2016c);
- Department of Environment Regulation (DER): A guide to the assessment of applications to clear native vegetation (DER 2014);
- Department of the Environment (DoE): Matters of National Environmental Significance - Significant Impact Guidelines 1.1 EPBC Act (DoE 2013);
- Department of the Environment and Energy (DoEE): Revised Draft Referral Guidelines for Three Threatened Black Cockatoo Species (DoEE 2017);
- EPBC Act referral guidelines for three threatened black cockatoo species: Carnaby's cockatoo (endangered) *Calyptorhynchus latirostris*, Baudin's cockatoo (vulnerable) *Calyptorhynchus baudinii*, Forest red-tailed black cockatoo (vulnerable) *Calyptorhynchus banksii naso* (DSEWPaC 2012);
- National Recovery Plan for Malleefowl (Benshemesh 2007);
- Approved species recovery plans, threatened species survey guidelines and conservation advice; and
- Other FQM standards or requirements.

2.1.5 Habitat Assessment

Formal habitat assessments were previously conducted by Stantec (2019) to characterise the quality and complexity of fauna habitats present for species of conservation significance throughout the Survey Area . The habitats were re-assessed during the Survey, with any changes recorded., Additional habitat assessments were completed at select control sites (M, N, and O) where no assessments or mapping had previously been completed, to ensure adequate representation of habitats at control sites.

During this survey, baseline habitat assessments were undertaken at each of the monitoring sites. The following parameters were assessed:

- landscape, soil features and structural composition;
- vegetation cover, condition and species composition;
- the presence or absence of habitat structures;
- the presence or absence of water; and
- types of disturbance and levels of disturbance.

This allows for the assessment of future changes in the quality and complexity of habitats and the interpretation of temporal changes in the distribution and abundance of conservation significant species present. For example, changes may occur as a result of mining disturbance such as clearing, or as a result of environmental factors such as fire.

2.1.6 Trapping

Trapping methods targeting the Chuditch, Heath Mouse and Western Mouse broadly followed the following:

- EPBC Survey Guidelines for Australia's Threatened Mammals (DSEWPaC 2011);
- EPA Technical Guidance: Terrestrial Fauna Surveys (EPA 2016c);
- EPA Technical Guidance: Sampling Methods for Terrestrial Vertebrate Fauna (EPA 2016b);

- EPA Environmental Factor Guideline – Terrestrial Fauna (EPA 2016a); and
- Conservation Advice for the Heath Mouse (Threatened Species Scientific Committee 2016).

Traps were set in habitats considered to be the most prospective for the species based on literature and previous surveys of the Survey Area (Stantec 2019).

2.1.6.1 Chuditch Trapping

At each Chuditch monitoring site (B, D, E, J, L and N) (Table 2-2), 10 large cage traps (20 x 20 x 56cm) were positioned approximately 50 metres apart in a transect line. Traps were baited with a 'Chuditch bait' (a mixture of meat meal, rolled oats, sardines, fish oil and chicken oil) (Wayne *et al.* 2008). Traps were re-baited at least once or when required over the duration of the trapping period. The substitution of 'universal bait' for 'Chuditch bait' also greatly reduced the likelihood of Western Brush Wallaby capture and resulting trap destruction. Each site was trapped for four consecutive nights (Table 2-2), equating to a total of 240 traps nights for the Survey.

2.1.6.2 Heath Mouse and Western Mouse Trapping

At each Mouse monitoring site (A, C, F, G, H, I, K, M, and O) (Table 2-2), 20 small Elliot traps were placed approximately 10 metres apart in line transects separated by 25 metres. Traps were baited with a species-specific mixture (rolled oats and peanut butter), and re-baited at least once or when required over the duration of the trapping period. Each site was trapped with 20 Elliot traps deployed for four consecutive nights (Table 2-2), equating to a total of 720 trap nights for the Survey.

2.1.6.3 Marking and Measurements

To identify re-captured individuals, new Chuditch were marked at the time of capture using PIT tags. These were placed beneath the skin of the animal, between the shoulders. Heath and Western Mouse individuals were marked using ear-notching. An ear notch tissue sample was taken and preserved in 100% ethanol from each captured individual to provide material for DNA analysis. These were submitted to the Western Australian Museum for use in ongoing research.

The following parameters were measured and recorded for each captured individual:

- sex – male or female;
- general condition – markings, fur condition, damage and behaviour;
- weight – in grams (g);
- tail diameter – in millimetres (mm);
- pes size – length of left hind foot from the heel to the base of the digits, in mm;
- ear notching – locations of notch recorded for Heath and Western Mouse only;
- photograph of rear foot-pads – recorded for Heath and Western Mouse only; and
- photograph of head profile – recorded for Heath and Western Mouse only.

2.1.7 Malleefowl Mound Assessment

Habitat assessments were completed at Malleefowl mounds known to occur within the Survey Area or immediate surrounds that were previously identified as 'active' or 'inactive' in Stantec (2019). Malleefowl mound activity was assessed by noting if:

- Cross sticks placed on mound in the Stantec 2018 survey were present or absent;
- Mound contained incubating material, or a recently made dome or crater;
- Recent Malleefowl tracks or signs (e.g. eggshells etc.) were present;
- Mound surface was recently scraped;
- Surface crust or moss was present or absent; and
- Fauna tracks or diggings from other species were present.

2.1.8 Motion-sensor Camera

Reconyx HC600 motion-sensor cameras were baited with non-reward bait tubes containing Chuditch bait at Chuditch monitoring sites and universal bait at Mouse monitoring sites. One motion camera was deployed at each Mouse monitoring site, and five were deployed at each Chuditch monitoring site. The difference in survey effort was due to the difficulty in identifying Mouse species from motion cameras.

In total, motion-sensor cameras were deployed at 38 locations (Appendix G) across all 15 sites for between 10 and 18 consecutive nights (Table 2-2), equating to a total of 507 recording nights for the Survey.

2.1.9 **Carnaby's Black Cockatoo Assessment and Evidence**

Potential foraging, breeding and roosting habitat for Carnaby's Black Cockatoo was previously assessed in Stantec (2019). The habitats within the Survey Area were given a quality score based on the draft foraging scoring tool within the revised draft guidelines (DoEE 2017, Stantec 2019).

During this survey, changes in foraging score assessments and habitat utilisation by Carnaby's Black Cockatoo were recorded at each monitoring site. Where encountered, evidence of Carnaby's Black Cockatoo in the Survey Area was recorded. Evidence included feathers, feeding signs or debris (e.g. chewed banksia flowers, pine cones and marri nuts), potential breeding or roosting habitat and sighting records.

2.1.10 Opportunistic Observations

During the establishment and monitoring of survey sites and while traversing the Survey Area, any evidence of species of conservation significance, such as remains, feathers, scats, tracks and/or direct observations of individuals, was recorded. These comprised the Chuditch, Western Mouse, Heath Mouse, Western Brush Wallaby, Carnaby's Black Cockatoo, Malleefowl, and Western Whipbird.

2.1.11 Data analysis

Due to the changes in survey design required for the Survey (e.g. site locations), data cannot be directly compared to previous monitoring events. As such, the Survey data will be discussed in the context of previous monitoring and presented to facilitate statistical analysis during future monitoring surveys to understand changes over time.

Chuditch capture rate was standardized, during this survey and previous surveys, to allow for comparison by calculating success rate per 100 traps.

3. Results and Discussion

3.1 Habitats and Disturbance

Habitat assessments undertaken during the Survey assessed the current level of habitat disturbance at each monitoring site i.e. prior to the Shoemaker Levy expansion (Appendix B). Future comparisons against these habitat assessments will be used to determine potential impacts of the expansion. This will provide context to changes in species recorded at trapping sites, particularly species of conservation significance, over time. This will be achieved by comparing changes at impact sites with control sites.

The Survey Area comprises of 12 broad fauna habitats, as well as cleared and rehabilitated areas (Figure 3-1). To ensure adequate representation of habitats at control sites, some sites (control sites M, N and O) were located to outside of the area previously mapped by Stantec (2019) (Figure 3-1) due to access constraints (see Section 3.3). Habitat mapping was not extended to include these sites as vegetation mapping, which informed the habitat mapping in Stantec (2019), was not available. Habitats differed primarily in the composition of their vegetation structure and substrates, in particular variation in time since last fire, density of Mallee, presence of heath on sandy substrate and abundance of stony substrate. Eleven habitats were considered important to species of conservation significance or distinct fauna assemblages; this includes all habitats aside from Melaleuca shrubland, as well as cleared and rehabilitated areas. A summary of the habitats present in the Survey Area is presented in Table 3-1.

Although habitat assessments from the Survey are considered 'baseline', many of these monitoring sites have existing impacts either from historic exploration, mining prior to care and maintenance or natural causes. Specifically, many sites in the vicinity of the proposed expansion displayed evidence of historic exploration, although many of the tracks were overgrown. There was no evidence of recent fire at any of the monitoring sites, however a large-scale fire burnt the majority of the Survey Area during 2003 (Figure 3-2). Although vegetation cover and complexity had substantially regenerated across the Survey Area since the fire (Stantec 2019), some species, such as the Heath and Western Mouse, are only likely to utilise habitats 10 to 30 years post fire (Section 3.2.2).

Table 3-1: Fauna habitats recorded within the Survey Area (Percentages of each habitat expressed as a proportion of the Total Area Mapped)

Broad Landform	Habitat	Sites	Total Area Mapped (pre-disturbance)	
			Ha	%
Plains comprising grey sandy soils	Dense mallee over heath		784.51	8.23
	Open mallee over heath		1501.53	15.74
	Low heath		217.53	2.28
Undulating low hills and rises comprising clay or loam soils	Mallee over large Banksia	J, K, M	227.51	2.39
	Tall mallee with limited understory	A	52.42	0.55
	Tall mallee with understory	D	1627.42	17.06
	Low mallee on stony rise	B, E, F	1546.98	16.22
	Mallee on loam or clay	C, G, H, I, L, O	1546.55	16.22
	Low shrubland		404.01	4.24
Water courses	Drainage line		486.37	5.10
	Melaleuca shrubland		0.85	0.01
	Tall trees in depression	N	15.26	0.16
Disturbed Area	Rehabilitated		85.38	0.90
	Cleared		1040.39	10.91
Total			9536.73	100

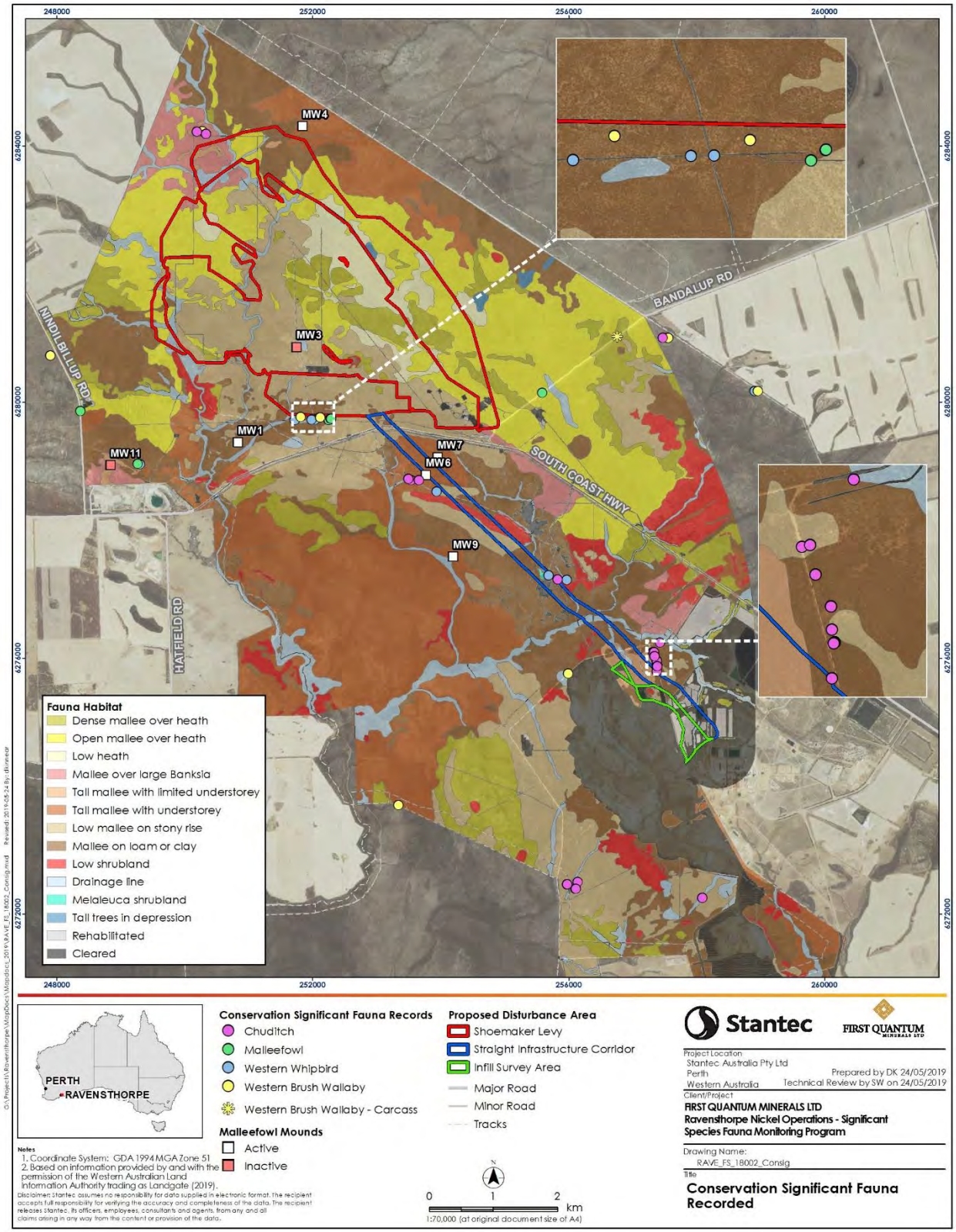

Figure 3-1: Species of conservation significance recorded during the Survey.

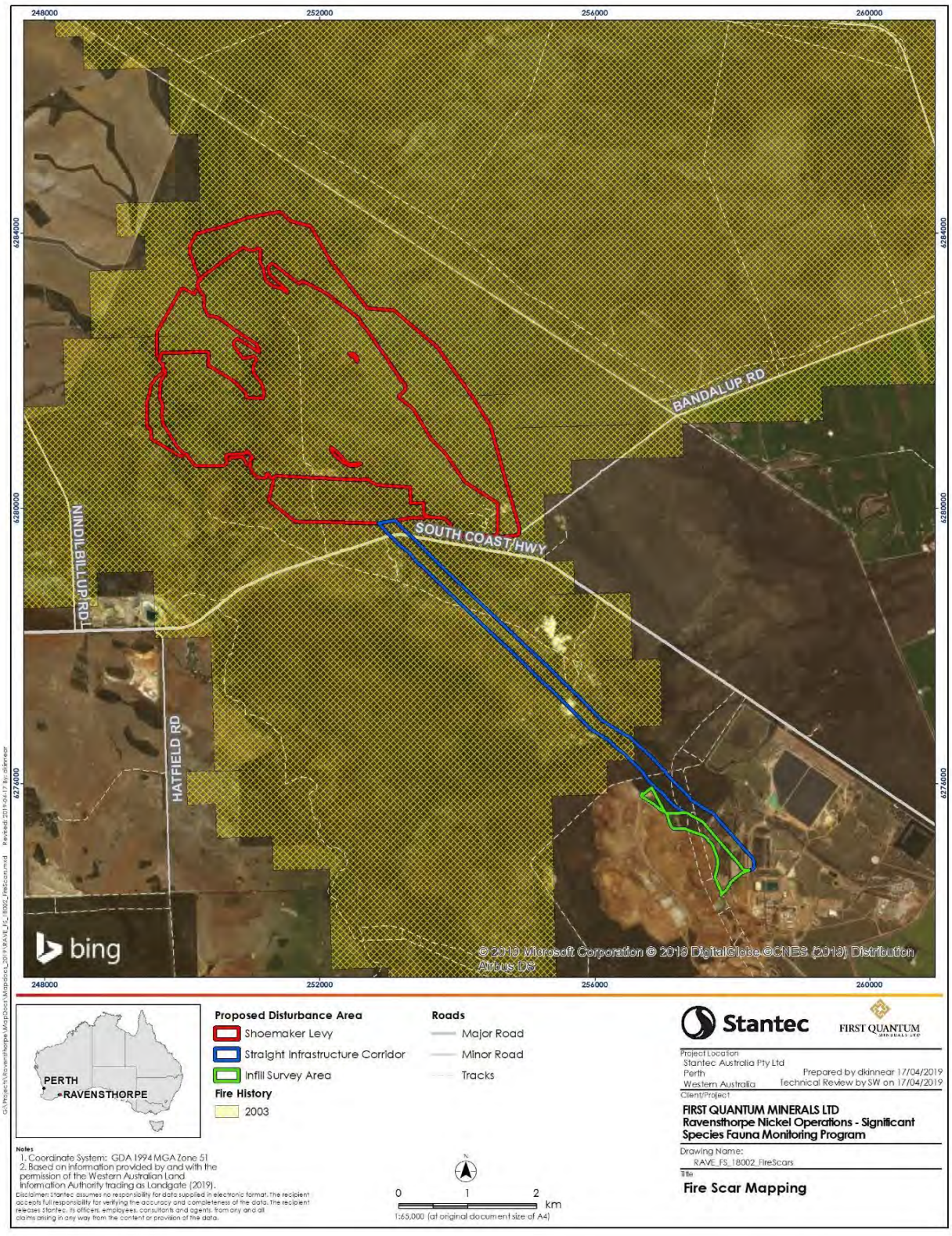

Figure 3-2: Fire scar mapping of the Survey Area

3.2 Capture Data and Other Fauna Observations

3.2.1 Chuditch

Four Chuditch were captured during the Survey, equating to a trap success of 1.66% for the Survey; the highest of any monitoring conducted to date and a 79.6% increase from 2017 to 2019 trap success (Table 3-2). This increase cannot be confidently attributed to an increase in Chuditch population numbers within the area and is more likely a result of the use of 'Chuditch bait' in place of 'universal bait' (which was used during the previous surveys) combined with new trap locations. Chuditch were captured at three of the six Chuditch monitoring sites, including two impact sites (sites D and E) and one control site (site B) (Table 3-3, Figure 3-1). The most individuals were captured at impact site D, where two individuals were recorded from four captures. One Chuditch capture event occurred at control Site B and impact Site E. Individuals from site B and E were new captures, i.e. have not been recorded during previous monitoring surveys. The two individuals (PIT no. 0007ACA0A5, and PIT no. 0007ACA0A5) captured at Site D were recaptured individuals which have been recorded during previous surveys (Appendix C). The recaptured individuals were both female, and the two new individuals were male. Wild Chuditch often die before they reach their fourth year (DEC 2012a), and there is no evidence that mortality differs between the sexes. However, Northern Quoll (a close relative) males rarely live past their first year, while females live for two to three years. This is represented in captures, with females being recaptured more often than males, and could explain the trapping results of the Survey. All individuals (except one) were in good condition and did not exhibit any obvious weight loss, skin lesions or loss of fur. One male (PIT no. 943094000000000) at site E was in moderately good condition.

Table 3-2: Summary statistics for Chuditch captures at the RNO from previous and current surveys

Company	Year	Trap nights	Number of individuals*	
			Total	/100 trap nights
Terrestrial Ecosystems	2013	250	0	0.00
Terrestrial Ecosystems	2014	500	0	0.00
Terrestrial Ecosystems	2015	500	0	0.00
Terrestrial Ecosystems	2016	876	4	0.46
Terrestrial Ecosystems	2017	750	7	0.93
Stantec	2018	240	4	1.67

* Due to information available, the number of captures over the sites was averaged for each survey to provide comparable data

Table 3-3: Chuditch captures at monitoring sites during the Survey

Site	Category	Habitat Type	Trap nights	Number of individuals	
				Total	/100 trap nights
B	Control	Low mallee on stony rise	40	1	2.50
D	Impact	Tall mallee with understory	40	2	5.00
E	Impact	Low mallee on stony rise	40	1	2.50
J	Impact	Mallee over large banksia	40	0	0.00
L	Impact	Mallee on clay or loam	40	0	0.00
N	Control	Tall trees in depression	40	0	0.00

Chuditch presence was recorded via motion-sensor cameras at five of the six Chuditch monitoring sites and at two of the Mouse monitoring sites during the Survey (Figure 3-1,Appendix D). Across capture and motion camera records, Chuditch were recorded at all Chuditch sites aside from impact site L, and at Mouse impact sites I and A (Table 3-4). Spot patterns of individuals recorded

on the same night at each site were compared to estimate the number of individuals present. Due to the number of camera records of Chuditch across this Survey and the difficulty in identifying individuals (number of potential angles and varying photograph clarity), it was not feasible to estimate the total number of individuals present.

Table 3-4: Chuditch records during the Survey

Site	Monitoring Site	Category	Chuditch Recorded		Location (51H)	
			Cage	Camera	Easting	Northing
B	Chuditch	Control	X	X	256135	6272396
N	Chuditch	Control	-	X	257466	6280948
D	Chuditch	Impact	X	X	257344	6276023
E	Chuditch	Impact	X	X	253675	6278713
J	Chuditch	Impact	-	X	250343	6284181
L	Chuditch	Impact	-	-	252254	6279715
C	Mouse	Control	-	-	253352	6273692
G	Mouse	Control	-	-	249049	62791145
M	Mouse	Control	-	-	258864	6280074
O	Mouse	Control	-	-	247945	6280759
A	Mouse	Impact	-	X	258195	6272253
F	Mouse	Impact	-	-	254375	6279642
H	Mouse	Impact	-	-	251828	6279722
I	Mouse	Impact	-	X	255703	6277452
K	Mouse	Impact	-	-	250335	6284193

The species is recorded in and known to occupy a wide range of habitats and utilise trees to obtain prey or seek refuge from predators (DEC 2012a). Based on previous records the species may occupy all habitats in the Survey Area aside from dense Mallee over heath and low heath. The majority of Chuditch were recorded in Mallee on loam or clay, low Mallee on stony rise, tall Mallee with understory, and tall Mallee with limited understory.

During this survey, Chuditch were recorded in: tall Mallee with understory, low Mallee with understory, Mallee on loam or clay, large Banksia, and tall trees in depression habitats (Figure 3-1; Table 3-3), demonstrating the variety of habitats the Chuditch utilises in the Survey Area. Overall, 41 Chuditch records were associated with tall Mallee with understory and low Mallee on stony rise, suggesting these habitats are important for Chuditch in the Survey Area. It is difficult to list specific habitats that should be preserved, however some key aspects that are required for Chuditch to survive in the area include; adequate den resources (e.g. hollow logs or rock crevices), adequate prey resources, and connected habitats (>20,000 ha) (DEC 2012a).

3.2.2 Western Mouse and Heath Mouse

No Western Mouse or Heath Mouse were captured during the Survey. The lack of captures may be attributed to several factors such as: lower than average rainfall in the two months preceding the Survey (Figure 2-1) (Threatened Species Scientific Committee 2016); the presence of feral predators (Section 3.2.7) (DBCA 2013, Morris *et al.* 1993); and/or limited suitable habitat due to the 2003 fire (DBCA 2013, Morris *et al.* 1993). In addition, juvenile Western mice become independent and disperse in early summer (September-November) (Morris *et al.* 1993), which may account for decreased detectability due to missing the dispersal event. The Heath Mouse responds to rainfall in a 'boom and bust' dynamic, being most abundant in the months after high rainfall in response to increased primary production (Threatened Species Scientific Committee 2016).

The Western Mouse and Heath Mouse require long unburnt (30-50 years) or dense habitat to persist (DBCA 2013, Threatened Species Scientific Committee 2016). The Heath Mouse tends to occupy unburnt areas for at least 10 years, with the largest numbers recorded in vegetation unburnt for 30 years. While the species has been known to inhabit vegetation less than 10 years unburnt, it requires dense vegetation for protection from feral predators that otherwise utilise more open habitats and runways through the understory to hunt (Threatened Species Scientific Committee 2016). The Heath Mouse has been recorded in the Survey Area only once following the 2003 fire (Coffey Environments

2010). This indicates that recent events such as fire and subsequent predation are potentially limiting populations.

The Western Mouse has been recorded in the Survey Area once during the 2017 monitoring survey (Terrestrial Ecosystems 2017a) and on six occasions in the surrounds between 1998 to 2017. Of these, three records occurred post 2003 (Biota 2005, Coffey Environments 2010, Terrestrial Ecosystems 2016a). There has only been 16 years of vegetation regrowth post-fire in the Survey Area. This is not considered long enough to provide suitable habitat and protection from predation for the Western Mouse and only six years beyond the minimal post fire recovery (10 years) period for the Heath Mouse. The large-scale nature of the fire has also potentially reduced the species distribution in the immediate surrounds, which may increase recovery time for populations within the Survey Area. This may explain the failure to record the species during the Survey.

Seven rodent individuals where recorded on two motion-sensor cameras (control Site B and impact Site H), however, the images were not detailed enough to allow for accurate species identification. The presence of rodents was recorded on six occasions at Site B, which was on a rocky outcrop supporting tall Mallee with understory habitat. The site was unburnt during the 2003 fire (Stantec 2019) and could potentially offer suitable habitat for the Western Mouse (DBCA 2013).

3.2.3 Malleefowl

Seven Malleefowl mounds were reassessed during the Survey, of which five were active (M1, M4, M6, M7 and M9) and two were inactive (MW3 and MW7; Table 3-5; Figure 3-1). All five active mounds were located near the proposed expansion, (within 13–842 m of the boundary; Figure 3-1), where they are potentially at risk of being impacted by future mining activity. Two individuals were also observed during the Survey; one near MW11 and one on the Bandalup road east of site F (Figure 3-1)(Appendix E). Malleefowl were also recorded on two motion-sensor cameras (Appendix D; Figure 3-1) at site L. In addition, a Malleefowl feather was recorded near site G (closest mound MW11)(Figure 3-1). Of the five Malleefowl records (excluding mounds), three were recorded in mallee on loam or clay habitat, and the remaining two were in open mallee over heath.

Malleefowl tend to inhabit arid or semi-arid shrublands or woodlands dominated by long-unburnt Mallee and may also occur in areas dominated by *Acacia sp.*, Wandoo, Marri or Mallet (Benshemesh 2007). Substrates tend to be sandy loams and loamy sands with an abundance of leaf litter for mound construction, and may contain gravel or lateritic fragments (Benshemesh 2007, Parsons 2008). Habitat requirements for the Malleefowl are poorly understood; however, they are known to prefer old growth vegetation (long unburnt) and require sandy substrate and an abundance of leaf litter to construct incubator nests (Benshemesh 2007). Malleefowl populations are at risk from habitat loss and fragmentation; however, the scale at which these impacts become significant has not yet studied. Some studies suggest that if the Mallee/shrubland cover within 5 km of the surrounding area remains above 30% and patches of 500 ha or greater are maintained this will increase the probability of the species occurring(Parsons *et al.* 2009).

The Survey recorded four active mounds in tall Mallee with understory habitat, and one in Mallee on loam or clay. Additionally, two Malleefowl were recorded in Mallee on loam or clay with another two in open Mallee over heath, and one record in Mallee over large Banksia (Figure 3-1). The records suggest that tall Mallee with understory and Mallee on loam or clay are important habitats for Malleefowl breeding and foraging within the Survey Area.

The Malleefowl is a sedentary bird that tend to nest in the same general area year after year (Benshemesh 2007). Malleefowl individuals are known to disperse many kilometres between nesting seasons (Benshemesh 2007) and have a home range of 1.7 to 4.6km^2 (Benshemesh 2007, Gindalbie Metals 2009). Males and females take several months (autumn to spring) of intermittent work to construct their incubator nests; however, information on habitat utilisation during this time and construction of new nests is limited. Due to this it is not possible to link the observations of Malleefowl individuals close to mounds to infer breeding/mound activity or to infer the potential for Malleefowl to relocate to undisturbed areas once mining activities have commenced. Records from the Survey show that Malleefowl are present in the Survey Area, particularly close to Shoemaker Levy (Figure 3-1). Together with sightings and mound assessments from past surveys (Biota 2000, Coffey Environments 2010, Stantec 2019, Terrestrial Ecosystems 2014, 2016a, 2017a, b), this demonstrates that the species inhabits the area over the long-term.

Table 3-5: Malleefowl mound assessment during the Survey.

Mound	Location (51H)		Assessment	Habitat and Notes	Reference Photograph
	Easting	Northing			
MW1	250836	6279368	Active	Mallee on loam or clay Cross sticks removed, fresh digging, surface freshly scraped. Deep crater.	
MW3	251753	6280858	Inactive	Low Mallee on stony rise Varanid diggings, no recent scraping, one cross stick remaining.	

Mound	Location (51H)		Assessment	Habitat and Notes	Reference Photograph
	Easting	Northing			
MW4	251847	6284308	Active	Tall Mallee with understory Recently scraped, crater present, cross sticks removed.	
MW6	253772	6278858	Active	Tall Mallee with understory Recently scaped, crater present, cross sticks removed.	

Mound	Location (51H)		Assessment	Habitat and Notes	Reference Photograph
	Easting	Northing			
MW7	253953	6279136	Active	Tall Mallee with understory Crater filled with litter, no eggshells, potentially incubating, freshly scraped	
MW9	254196	6277583	Active	Tall Mallee with understory Crater filled, potentially incubating, cross sticks removed, recently scraped, feathers, droppings. Cross sticks placed	

Mound	Location (51H)		Assessment	Habitat and Notes	Reference Photograph
	Easting	Northing			
MW11	248844	6279008	Inactive	Mallee over large banksia, however, in a transition to tall Mallee with limited understory No cross sticks present, walls eroded and uneven, macropod scat present.	

3.2.4 **Carnaby's Black Cockatoo**

The Carnaby's Black Cockatoo was not recorded during the survey, however the species has previously been confirmed to occur within and in the surrounds of the Survey Area during 2000, 2005, 2009, 2010 and between 2014 – 2018 (Biota 2000, Coffey Environments 2009, 2010), Stantec (2019), (Terrestrial Ecosystems 2014, 2015, 2016a, b, 2017a, b, 2018). The Survey Area occurs within the non-breeding range, however it is within close proximity to the known breeding range for the species (DoEE 2017).

Given the proximity of the predicted breeding range and known breeding locations, the species may breed near the Survey Area. Carnaby's Black Cockatoos nest and breed in the hollows of trees such as Eucalypts, Marri, Karri and Jarrah (DoEE 2017, DSEWPaC 2012). The Survey Area is dominated by Mallee and Banksia, with Eucalyptus trees present only within the Tall trees in depression habitat which was surveyed at site N. The trees within this habitat, were not suitable for breeding as they did not have hollows, they had a diameter at breast height of less than 500 mm, and were unlikely to form hollows (DoEE 2017, DSEWPaC 2012). Given that the Survey Area lies outside the predicted breeding range of the species (DoEE 2017) and given the lack of suitable breeding habitat, Carnaby's Black Cockatoo is unlikely to use habitats within the Study Areas for breeding.

Carnaby's Black Cockatoos may roost in any tall trees, particularly those near a permanent water source or within a riparian zone (DoEE 2017, DSEWPaC 2012). Groups of relatively tall trees were present within tall trees in depression habitat which were assessed at control site N during the survey. Although this habitat may become seasonally inundated, the habitat would not provide a permanent water source. While this habitat may contain marginally suitable roosting suitability, no evidence of roosting (e.g. feathers, droppings, direct observations) was recorded during the Survey. In addition, there are no known roosting sites within the nearby vicinity (DBCA 2018).

No evidence of foraging was recorded at the monitoring sites during the survey and it appears that the habitats in the Survey Area and local surrounds, including habitats assessed at control sites M, N and O, do not provide important foraging resources. However, the species may occasionally forage in heath and Mallee over large *Banksia* habitats from time to time. The three monitoring sites located outside the Study Area (control sites M, N and O) were assessed for foraging habitat score to the same standard as habitats within the previously assessed area in October 2018 by Stantec (2019). The foraging score assessment of habitats at all monitoring sites produced 'low quality' scores (0-3) for all habitats; the same as the assessments of the associated habitat types in Stantec (2019) (Table 3-6). Low quality foraging scores indicate that the area is unlikely to be a significant foraging habitat for the species (DoEE 2017).

The attributes reducing the functionality of the foraging habitat within the Survey Area (including sites M, N and O) comprise of; no clear evidence of feeding debris in the area, the area is >12km from a known breeding location and the area is >12km from a known roosting site. In contrast, medium to high quality foraging habitats contain; trees with suitable nest hollows, trees with the potential to be used for breeding, foraging tree species, and may be a known roosting site (DoEE 2017).

Table 3-6: Carnaby's Black Cockatoo foraging habitat assessment from Stantec (2019)

Scoring tool	Criteria	Habitat Type (site) and Scores											
Starting Score		Mallee over large *Banksia* (J, K, M)	Drainage line	Tall mallee with limited understory (A)	Tall mallee with understory (D)	Low mallee on stony rise (B, E, F)	Mallee on loam or clay (C, G, H, I, L, O)	Low shrubland	Melaleuca shrubland	Dense mallee over heath	Open mallee over heath	Low heath	Tall trees in depression (N)
10 (Very high quality)	Foraging habitat that is being managed for black cockatoos such as habitat that is the focus of successful rehabilitation, and/or has some level of protection from clearing, and/or is quality habitat described below with attributes contributing to meet a sore of ≥10.												
7 (High quality)	Native shrubland, kwongan heathland and woodland dominated by proteaceous plant species such as *Banksia* spp. (including *Dryandra* spp.), *Hakea* spp. and *Grevillea* spp., as well as native eucalypt woodland and forest that contains foraging species, including along roadsides. Does not include orchards, canola, or areas under a Regional Forestry Agreement.	7	7		7	7	7			7	7	7	7
5 (Quality)	Pine plantation or introduced eucalypts.												
1 (Low quality)	Individual foraging plants or small stand of foraging plants.			1				1	1				
Additions	Context adjustor - attributes improving functionality of foraging habitat												
+3	Is within the Swan Coastal Plain (important foraging area).												
+3	Contains trees with suitable nest hollows.												
+2	Primarily comprises marri.												
+2	Contains trees with potential to be used for breeding (diameter breast height (dbh) ≥ 500 mm or ≥ 300 mm dbh for salmon gum and wandoo).												
+1	Is known to be a roosting site.												
Subtractions	Context adjustor - attributes reducing functionality of foraging habitat												
-2	No clear evidence of feeding debris.	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
-2	No other foraging habitat within 6 km.												
-1	Is > 12 km from a known breeding location.	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
-1	Is > 12 km from a known roosting site.	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
-1	Is > 2 km from a watering point.												
-1	Disease present (e.g. *Phytophthora cinnamomi* or marri canker).												
Total		3	3	0	3	3	3	0	0	3	3	3	3

3.2.5 Western Whipbird

Western Whipbirds were recorded via their distinctive call on eight occasions during the Survey (Figure 3-1)(Appendix E), confirming their presence in the Survey Area. Three individuals were recorded near impact site H, within Mallee on loam or clay habitat (Figure 3-1). Two individuals were recorded near impact site I in stony heath habitat (Figure 3-1). The remaining three individuals were sighted at control sites G and M in Mallee on loam or clay and Mallee over large banksia, and impact site E, in low Mallee on stony rise habitat (Figure 3-1). Overall, individuals were recorded near three impact sites and two control sites.

Hakea and *Daviesia* species may serve as nesting sites for the Western Whipbird (Threatened Species Scientific Committee 2009) and are common in heath dominated habitats, present at impact sites H and site E.

The Western Whipbird has been recorded in all monitoring surveys aside from 2010, including being heard at 14 locations and sighted at one location in 2018 (Stantec 2019, Terrestrial Ecosystems 2013, 2014, 2015, 2016a, 2017a). The records confirm the species presence in the Survey Area.

3.2.6 Western Brush Wallaby

Four Western Brush Wallaby individuals were sighted during the Survey; two together at the edge of the existing mine footprint and two together near control site M (Figure 3-1). These individuals were flushed from the vegetation while driving within the Survey Area. One western Brush Wallaby carcass was found along a road within the Survey Area and showed signs of predation (Figure 3-1).

Western Brush Wallaby presence was recorded on motion-sensor cameras at seven of the fifteen monitoring sites (Figure 3-1; Appendix D). Of these, three were impact sites (sites H, J, L) and four were control sites (sites B, C, N, O). A large proportion of the individuals were sited on motion-sensor cameras deployed around impact Site L. Due to the difficulty in identifying separate individuals from motion camera footage, it was not feasible to estimate population demographics. The individuals captured on motion-sensor cameras combined with direct observations confirms the presence of the Western Brush Wallaby within and around the Survey Area.

The Western Brush Wallaby inhabits open woodland and forest, Mallee and heath and preferentially utilises open seasonally wet flats and scrubby thickets (DEC 2012b). The species was recorded within seven broad habitat types in the Survey Area, with 11 records in Mallee on loam or clay habitats, suggesting this habitat is most utilised by the species (Figure 3-1).

3.2.7 Feral Predators

Feral predators recorded during the Survey included; feral cats (*Felis catus*) and the Red Fox (*Vulpes vulpes*) (Figure 3-3; Appendix F). Feral cats were recorded at control site C and impact sites F, A, E, L and D. Motion-sensor cameras at site A, F and L recorded feral cats on five, three and two nights respectively, suggesting the cats visit these areas frequently. A single Red Fox was recorded at control Site G. This, together with historic records of feral predators (Biota 2000, Coffey Environments 2010, Stantec 2019, Terrestrial Ecosystems 2014, 2015, 2016a) indicates an ongoing threat to native fauna in the Survey Area.

Predation by or competition from feral predators such as the fox and cat, have a negative effect on Chuditch, Malleefowl, and Western Brush Wallaby populations (Benshemesh 2007, DEC 2012a, b) and is likely to be exacerbated by clearing of habitats that provide protection for the species. One study on the effects of feral predators on the Western Mouse suggest that predators are not limiting the population where it inhabits dense vegetation; however, it may restrict populations in more sparse vegetation (Morris *et al.* 1993). It is likely that predation of the Heath Mouse by feral predators occurs across its range, potentially restricting populations (Threatened Species Scientific Committee 2016). Furthermore, when a fox control program has been implemented it can lead to the species being recorded in locations previously not recorded in (Morris *et al.* 1993).

A recent fauna control program (2017-2019) was conducted by Animal Pest Management for the Project, resulting in the reduction of fox and cat populations in the area (Butcher 2019). The number of foxes caught and shot during the program increased in 2019(5 vs 6, 9 vs 11 respectively), suggesting a higher level of activity likely due to juvenile and sub-adult individuals immigrating into the area (Butcher 2019). The program appears to be a successful start at controlling foxes with average weight of caught individuals decreasing by 1.5 kilograms, and an increased number of breeding females removed from the population in 2019 (4 vs 11), in turn reducing future recruitment

(Butcher 2019). No cats were shot during 2019 however the number of cats trapped increased by one between 2018 and 2019 (Butcher 2019). Cat activity appeared to be relatively similar to previous years highlighting the need to target the breeding and migration of cats in the area. As the fauna control program continues it is likely that Chuditch, Malleefowl, Western and Heath Mouse populations could increase, which would be evident by increased trapping records.

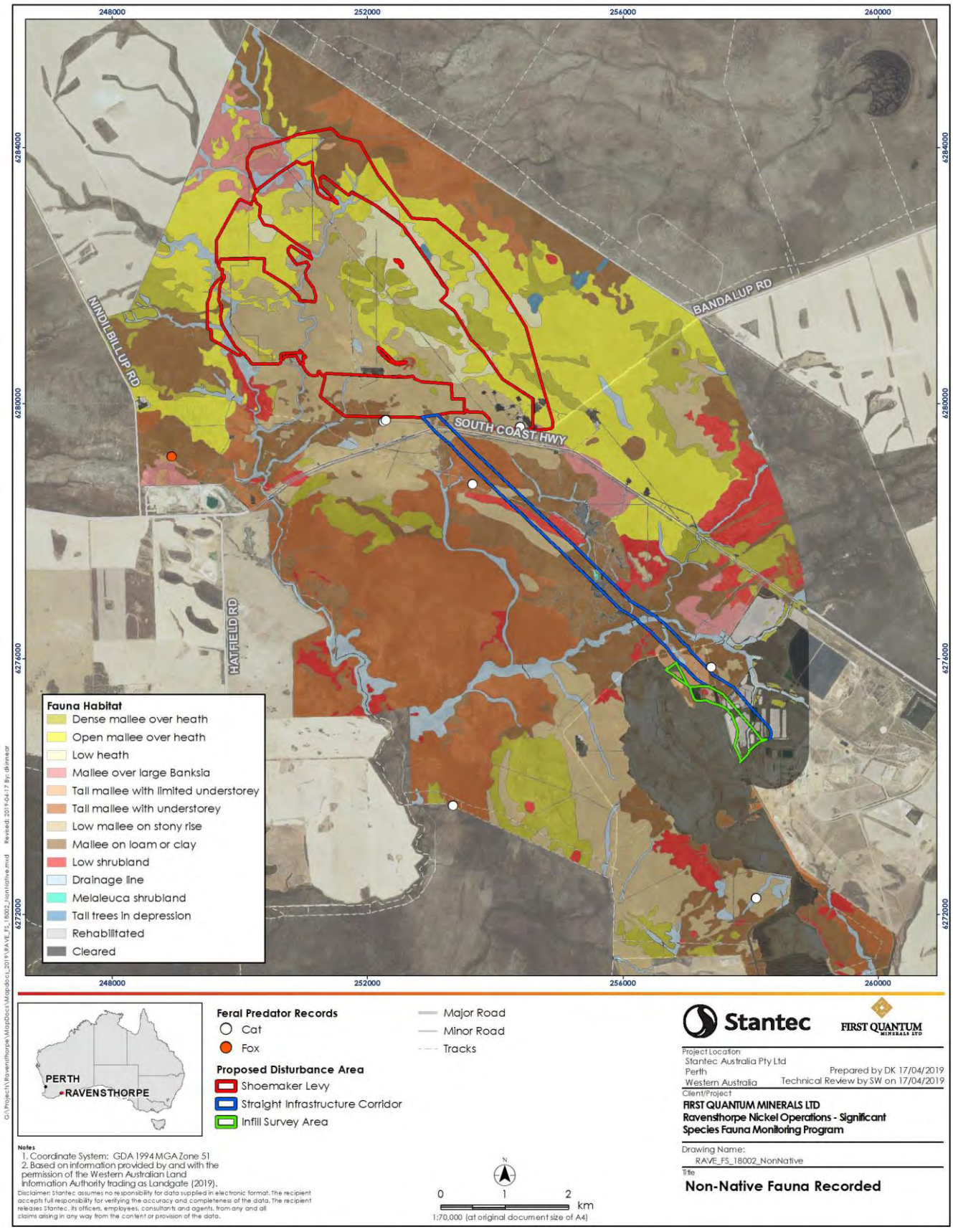

Figure 3-3: Feral predator records during the Survey

3.3 Limitations and Constraints

There are a number of possible limitations and constraints that can affect the adequacy of fauna surveys (EPA 2016b). All fauna surveys are limited to some degree by time and seasonal factors. Such limitations and constraints with respect to this Survey are discussed below (Table 3-7).

Table 3-7: Limitations and constraints of this Survey

Factor	Limitation/Constraint	Comments
Competency and experience of consultants	No	Field personnel were qualified Stantec zoologists with extensive experience conducting fauna surveys, including various targeted surveys for conservation significant fauna throughout Western Australia.
Completeness	Slight	The survey was completed to an adequate standard. Survey effort was sufficient to achieve survey objectives. One planned mouse monitoring site was not established due to inaccessibility.
Disturbance (i.e. to control sites)	No	Disturbance has not unduly affected impact or control sites. The level of disturbance at newly established impact sites is appropriate to acquire a baseline assessment of activity prior to mining activity. Control sites established during this Survey will remain effective in the future.
Survey timing/weather	No	Timing of the survey was adequate. Overall, conditions were appropriate for the activity of the conservation significant fauna targeted in this Survey. The Survey was conducted outside of when female Chuditch have pouch or den young and before heavy rainfall restricted nocturnal foraging. The Survey was conducted outside of when the Western Mouse juveniles disperse, potentially reducing efficacy of the trapping.
Availability of previous data (specific and/or contextual)	No	Capture data from baseline fauna assessments and previous monitoring surveys were readily available ((BHPBIO 2006, Coffey Environments 2010, Terrestrial Ecosystems 2013, 2014, 2015, 2016a, 2017a). General environmental information regarding the Survey Area and the Esperance Plains bioregion is readily available from previous surveys conducted by Stantec (2019).
Remoteness/access problems	Slight	While most exploration tracks were aged (made pre-2000), vehicle access was available for majority of the sites. However, some tracks were overgrown or non-existent due to age, resulting in some planned monitoring locations being inaccessible. Alternative sites were located where possible. One proposed monitoring site could not be established due to a lack of access.

4. Conclusion

During the Survey 15 monitoring sites were surveyed, comprising nine impact sites and six control sites. The nine impact sites are not currently impacted, however may be in the future as mining activity restarts and expansion plans are developed. Therefore, the Survey data may be considered baseline to assess changes in the future.

The species targeted as part of the Survey have been stipulated under existing regulatory conditions, work items or anticipated environmental conditions, and include: Chuditch (*Dasyurus geoffroii*)[S3, Vu], Malleefowl (*Leipoa ocellata*)[S3, Vu], Heath Mouse (*Pseudomys shortridgei*)[S3, En], Western Mouse (*Pseudomys occidentalis*)[P4], and Carnaby's Cockatoo (*Calyptorhynchus latirostris*)[S2, En]. In addition, opportunistic observations of any species of conservation significance identified in Stantec (2019) were also recorded, including the Western Whipbird (*Psophodes nigrogularis oberon*) [P4] and the Western Brush Wallaby [P4].

Four Chuditch were trapped at three of the six monitoring sites during the Survey. Between 2017 and 2019 the capture rate increased 79.6% from 0.93 to 1.67. This increase cannot be confidently attributed to an increase in Chuditch population in the area and is more likely a result of the use of 'Chuditch bait' during the Survey in place of 'universal bait' which was used during the previous surveys. The species was also recorded on motion-sensor cameras at seven monitoring sites (five impact sites and two control sites). Through the combination of trapping data and motion camera records, Chuditch were found to be present at all Chuditch monitoring sites (excluding impact Site L), and at two of the mouse monitoring sites; impact Site I and Site A. This indicates the species exists in proximity to the proposed expansion. Chuditch utilise a variety of habitats present across the Survey Area. Further monitoring will be needed to understand the potential impact of mining and proposed expansion on the population and their preferred habitats.

The Western Mouse and Heath Mouse were not detected during the Survey. This could be the result of reduced habitat suitability due to a large-scale fire in 2003, reduced rainfall in the months preceding the survey and/or presence of feral predators. The species require dense long-unburnt (30-50 years) vegetation to persist (present in the southern portion of the Survey Area). Although several rodents were recorded on motion-sensor cameras, (mostly at control Site B, although also impact Site H), identification to species level was not possible.

Five of the seven Malleefowl mounds known to occur in the Survey Area were assessed as 'active' mounds. All five active mounds are near the proposed expansion and may be impacted by mining activity. Records suggest that tall Mallee with understory and Mallee on loam or clay are important habitats for Malleefowl breeding and foraging within the Survey Area. Opportunistic observations of Malleefowl during the Survey demonstrate that the species is active in the Survey Area and inhabit the area long-term.

No evidence (sightings or foraging activity) of Carnaby's Black Cockatoo were recorded during the survey, despite the survey being conducted during a time the species is known to utilise nearby habitat. The foraging score assessment of all monitoring sites produced 'low quality' scores (0-3); the same quality level produced when these habitats types were assessed in October 2018 by Stantec (2019).

Western Brush Wallaby (*Notamacropus irma*) and Western Whipbird (*Psophodes nigrogularis oberon)* were confirmed via opportunistic records during the Survey. Western Brush Wallaby were recorded across seven broad habitat types, with 11 records in Mallee on loam or clay habitats, suggesting this habitat is most utilised by the species. Western Whipbird may utilise *Hakea* and *Daviesia* species as nesting sites and are common in heath dominated habitats (present at sites H and site E).

Motion-sensor cameras detected the presence of cats and foxes within the Survey Area. This suggests that feral predators frequently hunt in the Survey Area and may account for the lack of Western Mouse or Heath Mouse records during the Survey and/or be hindering their recovery after the 2003 fire. A feral fauna control program has recently commenced within the Survey Area and further monitoring will help to determine whether this control program is having a positive effect on the recovery of the conservation significant species being monitored as part of this program.

5. References

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Appendices

Appendix A Codes and Terms Used to Describe Species of Conservation Significance

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

Categories used under the EPBC Act		
Status	Code	Description
Critically Endangered	CR	Taxa that is considered to be facing an extremely high risk of extinction in the wild in the immediate future
Endangered	EN	Taxa that is considered to be facing a very high risk of extinction in the wild in the near future
Vulnerable	VU	Taxa that is considered to be facing a high risk of extinction in the wild in the medium-term future
Migratory	MI	Species that migrate to, over and within Australia and its external territories

Conservation Codes used under the WC Act			
Status	Code	Schedule	Description
Critically Endangered	CR	S1	Taxa that is rare or likely to become extinct, as critically endangered taxa
Endangered	EN	S2	Taxa that is rare or likely to become extinct, as endangered taxa
Vulnerable	VU	S3	Taxa that is rare or likely to become extinct, as vulnerable taxa
Presumed Extinct	EX	S4	Taxa that is presumed to be extinct
Migratory	IA	S5	Birds that are subject to international agreements relating to the protection of migratory birds
Conservation Dependent	CD	S6	Taxa that are of special conservation need being species dependent on ongoing conservation intervention
Special Protection	OS	S7	Taxa that is in need of special protection

Appendix B Habitat Assessments

Name	Habitat Type	Landform	Site Photograph
A	Tall mallee with limited understory	Hill	
Condition	Condition	Excellent	
	Disturbance Type	Tracks	
	Fire Age	> 15	
% Ground Cover	Rock	0	
	Soil	0	
	Leaf Litter	90	
	Vegetation	10	
Rocks	Type	N/A	
	Size (mm)	N/A	
	Abundance (%)	0	
	Exposed Bedrock (%)	0	
Soil	Type	Clay loam	
	Colour	Grey	
Habitat Features	Slope	Gently inclined (3-5)	
	Water	No - Never	
	Termite Presence	Rare	
	Woody Debris	Very Common	
	Peeling Bark	Common	
	Rock Crevices	None	
	Burrowing Suitability	Moderate	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation				
Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	4	30–70	Mallee
Middle	Shrub	2	70–100	Banksia, Isopogon, parrot bush
Lower	Shrub, Sedge	0.3	10–30	Sedge, juveniles of mid storey

Name	Habitat Type	Landform	Site Photograph
B	Low mallee on stony rise	Rocky Outcrop	
Condition	Condition	Very Good	
	Disturbance Type	Tracks	
	Fire Age	5 to 15	
% Ground Cover	Rock	10	
	Soil	60	
	Leaf Litter	20	
	Vegetation	10	
Rocks	Type	Ferricrete	
	Size (mm)	60–200	
	Abundance (%)	20–50	
	Exposed Bedrock (%)	2–10	
Soil	Type	Clay loam	
	Colour	Grey	
Habitat Features	Slope	Moderately inclined (5-15)	
	Water	No - Never	
	Termite Presence	Rare	
	Woody Debris	Common	
	Peeling Bark	Rare	
	Rock Crevices	Moderate	
	Burrowing Suitability	Low	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Tree	3	< 10	Mallee, Acacia
Middle	Shrub	2	30–70	Acacia, melaleuca
Lower	Shrub	0.4	30–70	Melaleuca

Name	Habitat Type	Landform	Site Photograph
C	Mallee on loam or clay	Slope	
Condition	Condition	Excellent	
	Disturbance Type	Tracks	
	Fire Age	5 to 15	
% Ground Cover	Rock	5	
	Soil	45	
	Leaf Litter	30	
	Vegetation	20	
Rocks	Type	Ironstone	
	Size (mm)	6–20	
	Abundance (%)	50–90	
	Exposed Bedrock (%)	0	
Soil	Type	Clay loam	
	Colour	Orange	
Habitat Features	Slope	Gently inclined (3-5)	
	Water	No - Never	
	Termite Presence	None	
	Woody Debris	Common	
	Peeling Bark	Moderate	
	Rock Crevices	None	
	Burrowing Suitability	Moderate	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	4	0–5 (isolated clumps)	Mallee
Middle	Shrub	2.5	30–70	Mallee
Lower	Sedge, Shrub	1	30–70	Sedge, Grevillea sp., Mallee, Melaleuca sp., Hakea sp.

Name	Habitat Type	Landform	Site Photograph
D	Tall Mallee with understory	Hill	
Condition	Condition	Very Good	
	Disturbance Type	Tracks	
	Fire Age	5 to 15	
% Ground Cover	Rock	25	
	Soil	25	
	Leaf Litter	85	
	Vegetation	10	
Rocks	Type	Ferricrete	
	Size (mm)	20–60	
	Abundance (%)	2–10	
	Exposed Bedrock (%)	2–10	
Soil	Type	Sandy loam	
	Colour	Brown	
Habitat Features	Slope	Moderately inclined (5-15)	
	Water	No - Never	
	Termite Presence	Rare	
	Woody Debris	Common	
	Peeling Bark	Common	
	Rock Crevices	Rare	
	Burrowing Suitability	Moderate	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Tree	6	30–70	Mallee
Middle	Shrub	2	30–70	Banksia, Melaleuca, Acacia
Lower	Sedge, Shrub	0.5	10–30	Sedges, Melaleuca, Grevillia

Name	Habitat Type	Landform	Site Photograph
E	Low Mallee on stony rise	Plain	
Condition	Condition	Very Good	
	Disturbance Type	Tracks	
	Fire Age	5 to 15	
% Ground Cover	Rock	30	
	Soil	30	
	Leaf Litter	25	
	Vegetation	15	
Rocks	Type	Quartzite	
	Size (mm)	20–60	
	Abundance (%)	50–90	
	Exposed Bedrock (%)	0	
Soil	Type	Clay loam	
	Colour	Grey	
Habitat Features	Slope	Gently inclined (3-5)	
	Water	No - Never	
	Termite Presence	Rare	
	Woody Debris	Moderate	
	Peeling Bark	Moderate	
	Rock Crevices	None	
	Burrowing Suitability	Moderate	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Tree	5	0–5 (isolated clumps)	Unknown burnt
Middle	Mallee	3	30–70	Mallee vines
Lower	Shrub, Sedge	1	30–70	A. Glaucoptera, Grevillia, Melaleuca.

Name	Habitat Type	Landform	Site Photograph
F	Low mallee on stony rise	Plain	
Condition	Condition	Very Good	
	Disturbance Type	Tracks	
	Fire Age	5 to 15	
% Ground Cover	Rock	20	
	Soil	10	
	Leaf Litter	60	
	Vegetation	10	
Rocks	Type	Quartzite, Ironstone	
	Size (mm)	6–20	
	Abundance (%)	50–90	
	Exposed Bedrock (%)	0	
Soil	Type	Clay loam	
	Colour	Grey	
Habitat Features	Slope	Gently inclined (3-5)	
	Water	No - Never	
	Termite Presence	Rare	
	Woody Debris	Common	
	Peeling Bark	Moderate	
	Rock Crevices	None	
	Burrowing Suitability	Moderate	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	5	10–30	Mallee
Middle	Mallee	2.5	30–70	Banksia, Mallee, Isopogon
Lower	Shrub	0.5	30–70	Melaleuca, Sedges, Isopogon

Name	Habitat Type	Landform	Site Photograph
G	Mallee on loam or clay	Plain	
Condition	Condition	Very Good	
	Disturbance Type	Tracks	
	Fire Age	5 to 15	
% Ground Cover	Rock	5	
	Soil	5	
	Leaf Litter	80	
	Vegetation	10	
Rocks	Type	Quartzite	
	Size (mm)	6–20	
	Abundance (%)	10–20	
	Exposed Bedrock (%)	0	
Soil	Type	Clay loam	
	Colour	White	
Habitat Features	Slope	Gently inclined (3-5)	
	Water	No - Never	
	Termite Presence	Rare	
	Woody Debris	Very Common	
	Peeling Bark	Common	
	Rock Crevices	None	
	Burrowing Suitability	Moderate	
	Tree Hollows (<10 cm)	Rare	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Tree	4	10–30	Mallee
Middle	Shrub	2.5	30–70	Mallee
Lower	Shrub	1	30–70	Melaleuca

Name	Habitat Type	Landform	Site Photograph
H	Mallee on clay or loam	Plain	
Condition	Condition	Excellent	
	Disturbance Type	Tracks	
	Fire Age	5 to 15	
% Ground Cover	Rock	20	
	Soil	45	
	Leaf Litter	20	
	Vegetation	15	
Rocks	Type	Quartzite, Ironstone	
	Size (mm)	6–20,20–60	
	Abundance (%)	50–90	
	Exposed Bedrock (%)	0	
Soil	Type	Clay loam	
	Colour	Brown	
Habitat Features	Slope	Level (0-3)	
	Water	No - Never	
	Termite Presence	None	
	Woody Debris	Very Common	
	Peeling Bark	Moderate	
	Rock Crevices	None	
	Burrowing Suitability	Moderate	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	4	0–5 (isolated clumps)	Unknown dead
Middle	Mallee	2	30–70	Mallee
Lower	Shrub, Sedge	0.5	30–70	Acacia glaucoptera, sedge, Acacia sp., Grevillea sp., Melaleuca sp.

Name	Habitat Type	Landform
I	Mallee on loam or clay	Stony Hill
Condition	Condition	Good
	Disturbance Type	Clearing
	Fire Age	5 to 15
% Ground Cover	Rock	40
	Soil	40
	Leaf Litter	10
	Vegetation	10
Rocks	Type	Quartzite
	Size (mm)	20–60
	Abundance (%)	50–90
	Exposed Bedrock (%)	<2
Soil	Type	Clay loam
	Colour	Grey
Habitat Features	Slope	Gently inclined (3-5)
	Water	No - Never
	Termite Presence	Rare
	Woody Debris	Moderate
	Peeling Bark	Moderate
	Rock Crevices	None
	Burrowing Suitability	Moderate
	Tree Hollows (<10 cm)	Rare
	Tree Hollows (>10 cm)	None

Site Photograph

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Tree	6	10–30	Mallee
Middle	Shrub	2	30–70	Mallee, banksia, melaleuca
Lower	Heath shrub	0.5	30–70	Sedges, Melaleuca

Name	Habitat Type	Landform	Site Photograph
J	Mallee over large banksia	Plain	
Condition	Condition	Excellent	
	Disturbance Type	Tracks	
	Fire Age	> 15	
% Ground Cover	Rock	0	
	Soil	30	
	Leaf Litter	50	
	Vegetation	20	
Rocks	Type	N/A	
	Size (mm)	N/A	
	Abundance (%)	0	
	Exposed Bedrock (%)	0	
Soil	Type	Loamy sand	
	Colour	White	
Habitat Features	Slope	Level (0-3)	
	Water	No - Never	
	Termite Presence	None	
	Woody Debris	Common	
	Peeling Bark	Moderate	
	Rock Crevices	None	
	Burrowing Suitability	High	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Tree, Mallee	6	30–70	Banksia, Mallee
Middle	Shrub, Mallee	2	70–100	Mallee, Isopogon, Banksia, Melaleuca
Lower	Shrub	0.5	30–70	Melaleuca, Sedges

Name	Habitat Type	Landform	Site Photograph
K	Mallee over large banksia	Plain	
Condition	Condition	Excellent	
	Disturbance Type	Tracks	
	Fire Age	> 15	
% Ground Cover	Rock	0	
	Soil	30	
	Leaf Litter	50	
	Vegetation	20	
Rocks	Type	N/A	
	Size (mm)	N/A	
	Abundance (%)	0	
	Exposed Bedrock (%)	0	
Soil	Type	Loamy sand	
	Colour	White	
Habitat Features	Slope	Level (0-3)	
	Water	No - Never	
	Termite Presence	None	
	Woody Debris	Common	
	Peeling Bark	Moderate	
	Rock Crevices	None	
	Burrowing Suitability	High	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Tree, Mallee	6	30–70	Banksia, Mallee
Middle	Shrub, Mallee	2	70–100	Mallee, Isopogon, Banksia, Melaleuca
Lower	Shrub	0.5	30–70	Melaleuca, Sedges

Name	Habitat Type	Landform	Site Photograph
L	Mallee on clay or loam	Plain	
Condition	Condition	Excellent	
	Disturbance Type	Tracks	
	Fire Age	5 to 15	
% Ground Cover	Rock	20	
	Soil	45	
	Leaf Litter	20	
	Vegetation	15	
Rocks	Type	Quartzite, Ironstone	
	Size (mm)	6–20,20–60	
	Abundance (%)	50–90	
	Exposed Bedrock (%)	0	
Soil	Type	Clay loam	
	Colour	Brown	
Habitat Features	Slope	Level (0-3)	
	Water	No - Never	
	Termite Presence	None	
	Woody Debris	Very Common	
	Peeling Bark	Moderate	
	Rock Crevices	None	
	Burrowing Suitability	Moderate	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	4	0–5 (isolated clumps)	Unknown dead
Middle	Mallee	2	30–70	Mallee
Lower	Shrub, Sedge	0.5	30–70	Acacia glaucoptera, Sedge, Acacia sp., Grevillea sp., Melaleuca sp.

Name	Habitat Type	Landform	Site Photograph
M	Mallee over large banksia	Plain	
Condition	Condition	Very Good	
	Disturbance Type	Tracks	
	Fire Age	> 15	
% Ground Cover	Rock	0	
	Soil	50	
	Leaf Litter	40	
	Vegetation	10	
Rocks	Type	N/A	
	Size (mm)	N/A	
	Abundance (%)	0	
	Exposed Bedrock (%)	0	
Soil	Type	Clayey sand	
	Colour	White	
Habitat Features	Slope	Level (0-3)	
	Water	No - Never	
	Termite Presence	Rare	
	Woody Debris	Common	
	Peeling Bark	Moderate	
	Rock Crevices	None	
	Burrowing Suitability	Moderate	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Tree, Mallee	3	10–30	Mallee, banksia
Middle	Shrub, Mallee	2	10–30	Mallee, Melaleuca, Banksia, Isopogon
Lower	Shrub	1	70–100	Melaleuca, Hakea, Isopogon

Name	Habitat Type	Landform	Site Photograph
N	Tall trees in depression	Depression	
Condition	Condition	Good	
	Disturbance Type	Tracks, Clearing	
	Fire Age	> 15	
% Ground Cover	Rock	0	
	Soil	10	
	Leaf Litter	60	
	Vegetation	30	
Rocks	Type	N/A	
	Size (mm)	N/A	
	Abundance (%)	0	
	Exposed Bedrock (%)	0	
Soil	Type	Sand	
	Colour	Grey	
Habitat Features	Slope	Level (0-3)	
	Water	No - Prone to Ponding	
	Termite Presence	None	
	Woody Debris	Common	
	Peeling Bark	Common	
	Rock Crevices	None	
	Burrowing Suitability	High	
	Tree Hollows (<10 cm)	Moderate	
	Tree Hollows (>10 cm)	Rare	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Tree	10	30–70	Eucalyptus sp.
Middle	Shrub	2	30–70	Melaleuca
Lower	Sedge	0.3	30–70	Sedges

Name	Habitat Type	Landform	Site Photograph
O	Mallee on loam or clay	Plain	
Condition	Condition	Very Good	
	Disturbance Type	Tracks	
	Fire Age	5 to 15	
% Ground Cover	Rock	5	
	Soil	60	
	Leaf Litter	20	
	Vegetation	15	
Rocks	Type	Laterite	
	Size (mm)	6–20,2–6	
	Abundance (%)	50–90	
	Exposed Bedrock (%)	0	
Soil	Type	Clay loam	
	Colour	Brown	
Habitat Features	Slope	Level (0-3)	
	Water	No - Never	
	Termite Presence	Rare	
	Woody Debris	Common	
	Peeling Bark	Moderate	
	Rock Crevices	None	
	Burrowing Suitability	Moderate	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	4	0–5 (isolated clumps)	Dead Mallee
Middle	Mallee	2.5	30–70	Mallee, Eucalyptus red
Lower	Shrub, Sedge	0.5	30–70,10–30	Melaleuca, Sedges, other shrub

Appendix C Raw Capture Data

Date	Site	Trap No.	Coordinates (51H)		PIT ID	Condition	Weight (g)	Sex	Pes (mm)	Tail base (mm)	Recapture				
			Eastings	Northings							Date	Site	Trap	Coordinates	
														Eastings	Northings
6/2/2019	D	6	257338.06	6276079.29	943094322007149	Good	730	Male	48.4	16.5	7/2/2019	D	10	257428.53	6276228.3
											8/2/2019	D	3	257384.15	6275905.43
9/2/2019	B	9	256148.48	6272486.37	0007ACA0A5 (previous survey)	Good	1220	Female	51.1	22	-	-	-	-	-
9/2/2019	D	1	257403.72	6275799.71	0007AC4487 (previous survey)	Good	790	Female	46.4	21.1	-	-	-	-	-
10/2/2019	E	8	253564.96	6278781.71	943094000000000	Moderate	850	Male	50.6	17	-	-	-	-	-

Appendix D Motion-Sensor Camera Records

Date	Site	Type	Trap No.	Species Name	Common Name
18/2/19	A	Impact	REC32	*Dasyurus geoffroii*	Chuditch
22/2/19	A	Impact	REC32	*Dasyurus geoffroii*	Chuditch
13/2/19	B	Control	REC33	*Dasyurus geoffroii*	Chuditch
13/2/19	B	Control	REC38	*Dasyurus geoffroii*	Chuditch
17/2/19	B	Control	REC17	*Dasyurus geoffroii*	Chuditch
18/2/19	B	Control	REC17	*Dasyurus geoffroii*	Chuditch
18/2/19	B	Control	REC38	*Dasyurus geoffroii*	Chuditch
19/2/19	B	Control	REC33	*Notamacropus irma*	Western Brush Wallaby
20/2/19	B	Control	REC41	*Dasyurus geoffroii*	Chuditch
21/2/19	B	Control	REC17	*Dasyurus geoffroii*	Chuditch
22/2/19	B	Control	REC33	*Dasyurus geoffroii*	Chuditch
13/2/19	C	Control	REC29	*Notamacropus irma*	Western Brush Wallaby
13/2/19	D	Impact	REC06	*Dasyurus geoffroii*	Chuditch
13/2/19	D	Impact	REC24	*Dasyurus geoffroii*	Chuditch
13/2/19	D	Impact	REC45	*Dasyurus geoffroii*	Chuditch
14/2/19	D	Impact	REC06	*Dasyurus geoffroii*	Chuditch
14/2/19	D	Impact	REC23	*Dasyurus geoffroii*	Chuditch
14/2/19	D	Impact	REC24	*Dasyurus geoffroii*	Chuditch
14/2/19	D	Impact	REC44	*Dasyurus geoffroii*	Chuditch
14/2/19	D	Impact	REC45	*Dasyurus geoffroii*	Chuditch
15/2/19	D	Impact	REC06	*Dasyurus geoffroii*	Chuditch
15/2/19	D	Impact	REC23	*Dasyurus geoffroii*	Chuditch
15/2/19	D	Impact	REC24	*Dasyurus geoffroii*	Chuditch
15/2/19	D	Impact	REC44	*Dasyurus geoffroii*	Chuditch
16/2/19	D	Impact	REC24	*Dasyurus geoffroii*	Chuditch
16/2/19	D	Impact	REC45	*Dasyurus geoffroii*	Chuditch
17/2/19	D	Impact	REC06	*Dasyurus geoffroii*	Chuditch
17/2/19	D	Impact	REC24	*Dasyurus geoffroii*	Chuditch
18/2/19	D	Impact	REC06	*Dasyurus geoffroii*	Chuditch
18/2/19	D	Impact	REC24	*Dasyurus geoffroii*	Chuditch
18/2/19	D	Impact	REC45	*Dasyurus geoffroii*	Chuditch
19/2/19	D	Impact	REC24	*Dasyurus geoffroii*	Chuditch
20/2/19	D	Impact	REC06	*Dasyurus geoffroii*	Chuditch
22/2/19	D	Impact	REC06	*Dasyurus geoffroii*	Chuditch
22/2/19	D	Impact	REC24	*Dasyurus geoffroii*	Chuditch
22/2/19	D	Impact	REC44	*Dasyurus geoffroii*	Chuditch
23/2/19	D	Impact	REC44	*Dasyurus geoffroii*	Chuditch
13/2/19	E	Impact	REC02	*Dasyurus geoffroii*	Chuditch
15/2/19	E	Impact	REC02	*Dasyurus geoffroii*	Chuditch
17/2/19	E	Impact	REC18	*Dasyurus geoffroii*	Chuditch
18/2/19	E	Impact	REC18	*Dasyurus geoffroii*	Chuditch
9/2/19	H	Impact	REC31	*Notamacropus irma*	Western Brush Wallaby
13/2/19	H	Impact	REC46	*Notamacropus irma*	Western Brush Wallaby
22/2/19	H	Impact	REC46	*Notamacropus irma*	Western Brush Wallaby

Date	Site	Type	Trap No.	Species Name	Common Name
14/2/19	I	Impact	REC27	*Dasyurus geoffroii*	Chuditch
15/2/19	J	Impact	REC39	*Dasyurus geoffroii*	Chuditch
18/2/19	J	Impact	REC21	*Dasyurus geoffroii*	Chuditch
18/2/19	J	Impact	REC35	*Dasyurus geoffroii*	Chuditch
19/2/19	J	Impact	REC14	*Notamacropus irma*	Western Brush Wallaby
19/2/19	J	Impact	REC21	*Dasyurus geoffroii*	Chuditch
24/2/19	J	Impact	REC21	*Dasyurus geoffroii*	Chuditch
14/2/19	L	Impact	REC16	*Notamacropus irma*	Western Brush Wallaby
14/2/19	L	Impact	REC19	*Notamacropus irma*	Western Brush Wallaby
15/2/19	L	Impact	REC37	*Notamacropus irma*	Western Brush Wallaby
16/2/19	L	Impact	REC19	*Notamacropus irma*	Western Brush Wallaby
17/2/19	L	Impact	REC16	*Leipoa ocellata*	Malleefowl
19/2/19	L	Impact	REC16	*Notamacropus irma*	Western Brush Wallaby
19/2/19	L	Impact	REC37	*Leipoa ocellata*	Malleefowl
22/2/19	L	Impact	REC19	*Notamacropus irma*	Western Brush Wallaby
24/2/19	L	Impact	REC37	*Leipoa ocellata*	Malleefowl
14/2/19	N	Control	REC42	*Dasyurus geoffroii*	Chuditch
15/2/19	N	Control	REC20	*Notamacropus irma*	Western Brush Wallaby
21/2/19	N	Control	REC20	*Dasyurus geoffroii*	Chuditch
14/2/19	O	Control	REC28	*Notamacropus irma*	Western Brush Wallaby
18/2/19	O	Control	REC28	*Notamacropus irma*	Western Brush Wallaby

Appendix E Non-systematic Fauna of Conservation Significance Records

Date	Coordinates (51H)		Species	Record Type	Number
	Eastings	Northings			
12/02/2019	-33.591369	120.288518	*Leipoa ocellata*	Observational	1
11/02/2019	-33.590444	120.366321	*Leipoa ocellata*	Observational	1
07/02/2019	-33.599045	120.298295	*Psophodes nigrogularis oberon*	Observational	1
09/02/2019	-33.603979	120.348145	*Psophodes nigrogularis oberon*	Observational	1
08/02/2019	-33.59343	120.324575	*Psophodes nigrogularis oberon*	Observational	1
07/02/2019	-33.593417	120.327966	*Psophodes nigrogularis oberon*	Observational	1
09/02/2019	-33.616904	120.369636	*Psophodes nigrogularis oberon*	Observational	1
11/02/2019	-33.590974	120.402101	*Psophodes nigrogularis oberon*	Observational	1
10/02/2019	-33.616171	120.366591	*Psophodes nigrogularis oberon*	Observational	1
08/02/2019	-33.593407	120.327408	*Psophodes nigrogularis oberon*	Observational	1
08/02/2019	-33.598958	120.297964	*Leipoa ocellata*	Feather	1
10/02/2019	-33.582776	120.379216	*Notamacropus irma*	Carcass	1
10/02/2019	-33.590964	120.402668	*Notamacropus irma*	Observational	2
06/02/2019	-33.630084	120.369529	*Notamacropus irma*	Observational	2

Appendix F Non-Target Species Recorded During the Survey

Date	Site	Trap no.	Species Name	Common Name
9/2/19	A	E14	*Tiliqua rugosa*	Shingleback/Bobtail
9/2/19	A	E19	*Tiliqua rugosa*	Shingleback/Bobtail
9/2/19	A	E3	*Tiliqua rugosa*	Shingleback/Bobtail
12/2/19	A	REC32	*Drymodes brunneopygia*	Southern Scrub-robin
12/2/19	A	REC32	*Felis catus*	Cat
13/2/19	A	REC32	*Drymodes brunneopygia*	Southern Scrub-robin
14/2/19	A	REC32	*Felis catus*	Cat
14/2/19	A	REC32	*Drymodes brunneopygia*	Southern Scrub-robin
15/2/19	A	REC32	*Drymodes brunneopygia*	Southern Scrub-robin
17/2/19	A	REC32	*Felis catus*	Cat
17/2/19	A	REC32	*Drymodes brunneopygia*	Southern Scrub-robin
18/2/19	A	REC32	*Drymodes brunneopygia*	Southern Scrub-robin
19/2/19	A	REC32	*Drymodes brunneopygia*	Southern Scrub-robin
20/2/19	A	REC32	*Felis catus*	Cat
9/2/19	B	E6	*Tiliqua rugosa*	Shingleback/Bobtail
9/2/19	B	E6	*Varanus rosenbergi*	Heath Monitor
9/2/19	B	E6	*Rattus fuscipes*	Bush Rat
13/2/19	B	REC33	*Varanus rosenbergi*	Heath Monitor
14/2/19	B	REC33	*Varanus rosenbergi*	Heath Monitor
15/2/19	B	REC26	*Drymodes brunneopygia*	Southern Scrub-robin
15/2/19	B	REC33	*Tachyglossus aculeatus*	Short-beaked Echidna
15/2/19	B	REC38	*Varanus rosenbergi*	Heath Monitor
16/2/19	B	REC26	*Drymodes brunneopygia*	Southern Scrub-robin
16/2/19	B	REC38	*Varanus rosenbergi*	Heath Monitor
17/2/19	B	REC26	*Drymodes brunneopygia*	Southern Scrub-robin
17/2/19	B	REC38	*Varanus rosenbergi*	Heath Monitor
18/2/19	B	REC38	*Dromaius novaehollandiae*	Emu
19/2/19	B	REC17	*Macropus fuliginosus*	Western Grey Kangaroo
19/2/19	B	REC38	*Macropus fuliginosus*	Western Grey Kangaroo
21/2/19	B	REC33	*Pseudonaja affinis*	Dugite
12/2/19	C	REC29	*Strepera versicolor*	Grey Currawong
13/2/19	C	REC29	*Felis catus*	Cat
9/2/19	D	E9	*Tiliqua rugosa*	Shingleback/Bobtail
9/2/19	D	E4	*Tiliqua rugosa*	Shingleback/Bobtail
14/2/19	D	REC24	*Drymodes brunneopygia*	Southern Scrub-robin
14/2/19	D	REC45	*Macropus fuliginosus*	Western Grey Kangaroo
15/2/19	D	REC24	*Drymodes brunneopygia*	Southern Scrub-robin

Date	Site	Trap no.	Species Name	Common Name
15/2/19	D	REC44	*Felis catus*	Cat
15/2/19	D	REC45	*Macropus fuliginosus*	Western Grey Kangaroo
15/2/19	D	REC45	*Drymodes brunneopygia*	Southern Scrub-robin
16/2/19	D	REC24	*Drymodes brunneopygia*	Southern Scrub-robin
16/2/19	D	REC45	*Macropus fuliginosus*	Western Grey Kangaroo
16/2/19	D	REC45	*Drymodes brunneopygia*	Southern Scrub-robin
17/2/19	D	REC23	*Macropus fuliginosus*	Western Grey Kangaroo
17/2/19	D	REC24	*Corvus cronoides*	Australia Raven
17/2/19	D	REC24	*Drymodes brunneopygia*	Southern Scrub-robin
17/2/19	D	REC45	*Corvus cronoides*	Australia Raven
17/2/19	D	REC45	*Macropus fuliginosus*	Western Grey Kangaroo
17/2/19	D	REC45	*Tiliqua rugosa rugosa*	Shingleback/Bobtail
17/2/19	D	REC45	*Strepera versicolor*	Grey Currawong
18/2/19	D	REC23	*Strepera versicolor*	Grey Currawong
18/2/19	D	REC24	*Drymodes brunneopygia*	Southern Scrub-robin
18/2/19	D	REC45	*Macropus fuliginosus*	Western Grey Kangaroo
18/2/19	D	REC45	*Drymodes brunneopygia*	Southern Scrub-robin
18/2/19	D	REC45	*Strepera versicolor*	Grey Currawong
19/2/19	D	REC23	*Drymodes brunneopygia*	Southern Scrub-robin
19/2/19	D	REC23	*Strepera versicolor*	Grey Currawong
19/2/19	D	REC24	*Tiliqua rugosa rugosa*	Shingleback/Bobtail
19/2/19	D	REC24	*Drymodes brunneopygia*	Southern Scrub-robin
19/2/19	D	REC45	*Corvus cronoides*	Australia Raven
19/2/19	D	REC45	*Drymodes brunneopygia*	Southern Scrub-robin
19/2/19	D	REC45	*Strepera versicolor*	Grey Currawong
20/2/19	D	REC06	*Trichosurus vulpecula*	Common Brushtail Possum
20/2/19	D	REC24	*Drymodes brunneopygia*	Southern Scrub-robin
20/2/19	D	REC45	*Tiliqua rugosa rugosa*	Shingleback/Bobtail
20/2/19	D	REC45	*Strepera versicolor*	Grey Currawong
21/2/19	D	REC06	*Strepera versicolor*	Grey Currawong
21/2/19	D	REC24	*Tiliqua rugosa rugosa*	Shingleback/Bobtail
21/2/19	D	REC24	*Drymodes brunneopygia*	Southern Scrub-robin
21/2/19	D	REC45	*Strepera versicolor*	Grey Currawong
22/2/19	D	REC06	*Strepera versicolor*	Grey Currawong
22/2/19	D	REC24	*Drymodes brunneopygia*	Southern Scrub-robin
22/2/19	D	REC44	*Strepera versicolor*	Grey Currawong
22/2/19	D	REC45	*Corvus cronoides*	Australia Raven
22/2/19	D	REC45	*Tachyglossus aculeatus*	Short-beaked Echidna
22/2/19	D	REC45	*Macropus fuliginosus*	Western Grey Kangaroo
22/2/19	D	REC45	*Strepera versicolor*	Grey Currawong

Date	Site	Trap no.	Species Name	Common Name
23/2/19	D	REC06	*Strepera versicolor*	Grey Currawong
23/2/19	D	REC24	*Tiliqua rugosa rugosa*	Shingleback/Bobtail
23/2/19	D	REC24	*Drymodes brunneopygia*	Southern Scrub-robin
23/2/19	D	REC44	*Strepera versicolor*	Grey Currawong
11/2/19	E	REC36	*Tiliqua occipitalis*	Western Blue-tongue
12/2/19	E	REC18	*Macropus fuliginosus*	Western Grey Kangaroo
14/2/19	E	REC34	*Felis catus*	Cat
17/2/19	E	REC02	*Strepera versicolor*	Grey Currawong
17/2/19	E	REC18	*Macropus fuliginosus*	Western Grey Kangaroo
18/2/19	E	REC18	*Macropus fuliginosus*	Western Grey Kangaroo
20/2/19	E	REC36	*Tiliqua rugosa rugosa*	Shingleback/Bobtail
21/2/19	E	REC36	*Varanus rosenbergi*	Heath Monitor
23/2/19	E	REC02	*Varanus rosenbergi*	Heath Monitor
23/2/19	E	REC18	*Drymodes brunneopygia*	Southern Scrub-robin
24/2/19	E	REC18	*Drymodes brunneopygia*	Southern Scrub-robin
10/2/19	F	E06	*Tiliqua rugosa*	Shingleback/Bobtail
11/2/19	F	REC05	*Drymodes brunneopygia*	Southern Scrub-robin
12/2/19	F	REC05	*Felis catus*	Cat
14/2/19	F	REC05	*Felis catus*	Cat
14/2/19	F	REC05	*Drymodes brunneopygia*	Southern Scrub-robin
15/2/19	F	REC05	*Tiliqua rugosa rugosa*	Shingleback/Bobtail
17/2/19	F	REC05	*Felis catus*	Cat
20/2/19	F	REC05	*Drymodes brunneopygia*	Southern Scrub-robin
21/2/19	F	REC05	*Varanus rosenbergi*	Heath Monitor
22/2/19	F	REC05	*Varanus rosenbergi*	Heath Monitor
10/2/19	G	E02	*Tiliqua rugosa*	Shingleback/Bobtail
19/2/19	G	REC30	*Vulpes vulpes*	Red Fox
9/2/19	H	REC31	*Drymodes brunneopygia*	Southern Scrub-robin
9/2/19	H	REC31	*Strepera versicolor*	Grey Currawong
10/2/19	H	REC31	*Drymodes brunneopygia*	Southern Scrub-robin
11/2/19	H	REC31	*Drymodes brunneopygia*	Southern Scrub-robin
11/2/19	H	REC31	*Felis catus*	Cat
12/2/19	H	REC31	*Strepera versicolor*	Grey Currawong
13/2/19	H	REC31	*Drymodes brunneopygia*	Southern Scrub-robin
14/2/19	H	REC31	*Drymodes brunneopygia*	Southern Scrub-robin
15/2/19	H	REC31	*Drymodes brunneopygia*	Southern Scrub-robin
16/2/19	H	REC31	*Drymodes brunneopygia*	Southern Scrub-robin
17/2/19	H	REC31	*Drymodes brunneopygia*	Southern Scrub-robin
18/2/19	H	REC31	*Drymodes brunneopygia*	Southern Scrub-robin
19/2/19	H	REC31	*Drymodes brunneopygia*	Southern Scrub-robin

Date	Site	Trap no.	Species Name	Common Name
20/2/19	H	REC31	*Drymodes brunneopygia*	Southern Scrub-robin
21/2/19	H	REC31	*Drymodes brunneopygia*	Southern Scrub-robin
22/2/19	H	REC31	*Drymodes brunneopygia*	Southern Scrub-robin
23/2/19	H	REC31	*Drymodes brunneopygia*	Southern Scrub-robin
25/2/19	H	REC31	*Drymodes brunneopygia*	Southern Scrub-robin
11/2/19	I	E06	*Varanus rosenbergi*	Heath Monitor
12/2/19	I	6	*Varanus rosenbergi*	Heath Monitor
12/2/19	I	E07	*Varanus rosenbergi*	Heath Monitor
11/2/19	J	9	*Tiliqua rugosa*	Shingleback/Bobtail
11/2/19	J	10	*Tiliqua rugosa*	Shingleback/Bobtail
12/2/19	J	10	*Varanus rosenbergi*	Heath Monitor
15/2/19	J	REC21	*Varanus rosenbergi*	Heath Monitor
16/2/19	J	REC21	*Drymodes brunneopygia*	Southern Scrub-robin
16/2/19	J	REC21	*Strepera versicolor*	Grey Currawong
16/2/19	J	REC35	*Strepera versicolor*	Grey Currawong
17/2/19	J	REC21	*Strepera versicolor*	Grey Currawong
17/2/19	J	REC39	*Strepera versicolor*	Grey Currawong
18/2/19	J	REC21	*Drymodes brunneopygia*	Southern Scrub-robin
19/2/19	J	REC14	*Tiliqua rugosa rugosa*	Shingleback/Bobtail
19/2/19	J	REC21	*Drymodes brunneopygia*	Southern Scrub-robin
19/2/19	J	REC21	*Varanus rosenbergi*	Heath Monitor
20/2/19	J	REC14	*Drymodes brunneopygia*	Southern Scrub-robin
20/2/19	J	REC21	*Drymodes brunneopygia*	Southern Scrub-robin
21/2/19	J	REC14	*Tiliqua rugosa rugosa*	Shingleback/Bobtail
21/2/19	J	REC39	*Macropus fuliginosus*	Western Grey Kangaroo
22/2/19	J	REC14	*Drymodes brunneopygia*	Southern Scrub-robin
22/2/19	J	REC39	*Strepera versicolor*	Grey Currawong
24/2/19	J	REC14	*Drymodes brunneopygia*	Southern Scrub-robin
24/2/19	J	REC35	*Tiliqua rugosa rugosa*	Shingleback/Bobtail
25/2/19	J	REC14	*Drymodes brunneopygia*	Southern Scrub-robin
26/2/19	J	REC14	*Drymodes brunneopygia*	Southern Scrub-robin
26/2/19	J	REC21	*Strepera versicolor*	Grey Currawong
22/2/19	K	REC22	*Varanus rosenbergi*	Heath Monitor
13/2/19	L	REC37	*Felis catus*	Cat
22/2/19	L	REC16	*Felis catus*	Cat
22/2/19	L	REC37	*Felis catus*	Cat
14/02/19	M	13	*Varanus rosenbergi*	Heath Monitor
14/2/19	M	REC10	*Macropus fuliginosus*	Western Grey Kangaroo
15/2/19	M	REC07	*Tiliqua rugosa rugosa*	Shingleback/Bobtail
15/2/19	M	REC10	*Notechis scutatus*	Tiger Snake

Date	Site	Trap no.	Species Name	Common Name
15/2/19	M	REC10	*Varanus rosenbergi*	Heath Monitor
16/2/19	M	REC07	*Tiliqua rugosa rugosa*	Shingleback/Bobtail
23/2/19	M	REC07	*Macropus fuliginosus*	Western Grey Kangaroo
13/2/19	N	REC20	*Macropus fuliginosus*	Western Grey Kangaroo
13/2/19	N	REC42	*Varanus rosenbergi*	Heath Monitor
14/2/19	N	REC13	*Macropus fuliginosus*	Western Grey Kangaroo
15/2/19	N	REC13	*Macropus fuliginosus*	Western Grey Kangaroo
15/2/19	N	REC13	*Varanus rosenbergi*	Heath Monitor
15/2/19	N	REC20	*Varanus rosenbergi*	Heath Monitor
16/2/19	N	REC13	*Varanus rosenbergi*	Heath Monitor
16/2/19	N	REC42	*Varanus rosenbergi*	Heath Monitor
17/2/19	N	REC13	*Macropus fuliginosus*	Western Grey Kangaroo
17/2/19	N	REC42	*Macropus fuliginosus*	Western Grey Kangaroo
18/2/19	N	REC13	*Varanus rosenbergi*	Heath Monitor
18/2/19	N	REC20	*Macropus fuliginosus*	Western Grey Kangaroo
18/2/19	N	REC42	*Varanus rosenbergi*	Heath Monitor
19/2/19	N	REC13	*Macropus fuliginosus*	Western Grey Kangaroo
20/2/19	N	REC42	*Macropus fuliginosus*	Western Grey Kangaroo
21/2/19	N	REC20	*Varanus rosenbergi*	Heath Monitor
21/2/19	N	REC42	*Macropus fuliginosus*	Western Grey Kangaroo
21/2/19	N	REC42	*Varanus rosenbergi*	Heath Monitor
21/2/19	N	REC43	*Macropus fuliginosus*	Western Grey Kangaroo
23/2/19	N	REC20	*Varanus rosenbergi*	Heath Monitor
25/2/19	N	REC20	*Varanus rosenbergi*	Heath Monitor
25/2/19	N	REC43	*Macropus fuliginosus*	Western Grey Kangaroo
11/2/19	O	E02	*Tiliqua rugosa*	Shingleback/Bobtail
12/2/19	O	E02	*Tiliqua rugosa*	Shingleback/Bobtail
16/2/19	O	REC28	*Strepera versicolor*	Grey Currawong

Appendix G Motion-sensor Camera Locations

Camera Name	Location (51H)		Recording Nights
	Easting	Northing	
REC02	253666.6	6278772.88	18
REC03	253472.05	6278837.26	18
REC05	254395.53	6279628.42	14
REC06	257392.42	6275868.45	10
REC07	258861.49	6280121.74	13
REC10	257593.7	6281046.3	13
REC13	257476.79	6280996.51	13
REC14	250286.28	6284226.21	13
REC16	252207.54	6279729.26	13
REC17	255983	6272458	11
REC18	253557.74	6278831.47	18
REC19	252288.79	6279737.13	13
REC20	257563.99	6280997.72	13
REC21	250339.62	6284186.64	13
REC22	250413.03	6284162.13	13
REC23	257336.96	6276089.69	10
REC24	257381.28	6275952.63	10
REC25	252012.47	6279704.03	13
REC26	256550.2	6272522.01	11
REC27	255836.02	6277227.19	14
REC28	247901.42	6280726.25	14
REC29	253342.38	6273692.71	14
REC30	248918.56	6279163.88	17
REC31	251822.89	6279765.17	17
REC32	258095.97	6272246.63	14
REC33	256093.61	6272417.83	11
REC34	253767.3	6278721.41	18
REC35	250197.62	6284222.47	13
REC36	253909.07	6278665.67	18
REC37	252337.61	6279724.4	13
REC38	255993.15	6272506.84	11
REC39	250166.91	6284145.64	13
REC41	256115.63	6272384.09	11
REC42	257493.65	6281075.63	13
REC43	257519.11	6280953.96	13
REC44	257410.43	6275798.77	10
REC45	257358.47	6276036.19	10
REC46	252120.14	6279754.09	13
TOTAL			507

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RAVENSTHORPE NICKEL OPERATION: LEVEL 1 TARGETED FAUNA SURVEY

PREPARED FOR FIRST QUANTUM MINERALS LTD

30 January 2019

Stantec

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Executive Summary

First Quantum Minerals Australia (FQM) is proposing to expand the Ravensthorpe Nickel Operation (RNO) as approved under Ministerial Statement 633 (MS 633), currently under care and maintenance. As a result of planned development to the north, Stantec Australia Pty Ltd (Stantec) was required to conduct a Level 1 Targeted Fauna Survey within four Study Areas across 1,962.8 ha comprising:

- Proposed Change Area;
- Central Study Area;
- Straight Infrastructure Corridor; and
- Infill Survey Area.

The objectives of the Level 1 fauna survey and desktop assessment were to define the environmental values of the Study Areas and to assess their conservation significance in relation to the proposed RNO expansion. These were addressed by undertaking a desktop assessment and a field survey and consolidating all previous fauna surveys within and adjacent to RNO.

The field survey took place between the 25th September and 5th October 2018, and comprised habitat mapping and targeted searches for species of conservation significance. This included conducting malleefowl search transects, malleefowl mound assessments, 53 fauna habitat assessments and the deployment of 27 motion cameras.

Based on the desktop assessment, a total of 275 species of vertebrate fauna have the potential to occur in the Study Areas. Of these, 34 species are listed as being of conservation significance, comprising nine mammals, 24 birds and one reptile. The following nine conservation significant vertebrate fauna species were confirmed within the Study Areas or the immediate surrounds:

- Chuditch (*Dasyurus geoffroii* [Vu, S3]);
- Malleefowl (*Leipoa ocellata* [Vu, S3]);
- Heath mouse (*Pseudomys shortridgei* [En, S3]);
- Carnaby's cockatoo (*Calyptorhynchus latirostris* [En, S2]);
- Western mouse (*Pseudomys occidentalis* [P4]);
- Western brush wallaby (*Notamacropus irma* [P4]);
- Western whipbird (*Psophodes nigrogularis oberon* [P4]);
- Quenda (*Isoodon fusciventer* [P4]); and
- Peregrine Falcon (*Falco peregrinus* [S7]).

All of these confirmed species have been recorded from within the Study Areas with the exception of the Peregrine Falcon, which was recorded in the immediate surrounds. Of the remaining conservation significant fauna, no species were considered very likely or likely to occur, however three were considered possible to occur. The remaining conservation significant fauna from the desktop study were considered unlikely to occur in the Study Areas or immediate surrounds.

Twelve broad fauna habitats, as well as cleared and rehabilitated areas, were identified during the Level 1 Fauna Survey. These comprised mallee over large *Banksia*, drainage lines, tall mallee with limited understorey, tall mallee with understorey, low mallee on stony rise, mallee on loam or clay, low shrubland, *Melaleuca* shrubland, dense mallee over heath, open mallee over heath, low heath and tall trees in depressions. Of these, all habitats aside from cleared/ rehabilitated, *Melaleuca* shrubland were considered to have a high or confirmed potential for fauna of conservation significance.

Records of malleefowl indicate that most individuals occur in low mallee on stony rise or in or near drainage line habitats, indicating these may be utilised for foraging. Targeted malleefowl assessments during the current Level 1 Fauna Survey detected three mounds in addition to the ten known mounds recorded previously. Of the total thirteen mounds:

- four were considered active and demonstrate breeding malleefowl;

- three were considered inactive; and
- six were considered extinct.

With respect to active or inactive mounds in the Study Areas, three active mounds occurred in the Central Study Area. All other mounds recorded during the Level 1 fauna survey, one of which was active, occurred in the immediate surrounds. With respect to habitats, all mounds aside from three occurred in tall mallee shrubland or mallee on loam or clay habitats. Additionally, tall mallee habitat with limited understorey was also considered to have potential to serve as suitable mound building habitat, however no mounds were recorded from this habitat during the survey.

Targeted Carnaby's cockatoo assessments did not detect any evidence of feeding, roosting or breeding within the Study Areas, and no trees with large hollows or of suitable diameter at breast height were recorded. One habitat type represents preferential foraging habitat owing to the presence of large foraging vegetation, which was distinctive in the Study Areas: mallee over large *Banksia*. Furthermore, tall trees in depression was considered marginally suitable for roosting. However, owing to the reduced breeding suitability, distance from suitable resources and lack of foraging evidence in the area, all fauna habitats were assigned a low-quality score according to the DoEE draft referral guidelines (2017).

First Quantum Minerals Ltd

Ravensthorpe Nickel Operation: Level 1 Targeted Fauna Survey

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APPENDICES

Appendix A Codes and Terms Used to Describe Species of Conservation Significance
Appendix B Vertebrate Fauna Identified from the Desktop Assessment
Appendix C Fauna habitat assessments
Appendix D Conservation Significant Fauna Records Within the Study Areas and Immediate Surrounds (Stantec 2018)

1. Introduction

1.1 Project Background

First Quantum Minerals Australia (FQM) commissioned Stantec Australia Pty Ltd (Stantec) to undertake a fauna survey of the Ravensthorpe Nickel Operation (RNO), located ~455km southeast of Perth (Figure 1-1). RNO operates under Ministerial Statement 633 and is currently in care and maintenance. The northern areas of RNO have not yet been fully developed. Due to the proposed development, a Level 1 Targeted Fauna Survey was required to inform environmental approvals. Stantec completed the additional fauna survey work in the following four areas, collectively comprising 1,962.80ha and referred to as the Study Areas (Figure 1-1, Figure 1-2):

- Proposed Change Area (639.18ha);
- Central Study Area (1,134.64ha);
- Straight Infrastructure Corridor (153.58ha); and
- Infill Survey Area (35.40ha).

1.2 Report Scope and Objectives

The objectives of the Level 1 Fauna Survey were to define the environmental values of the Study Areas and to assess the importance of these areas for conservation significant fauna in relation to the proposed expansion of the RNO. Specific tasks undertaken to address the objectives included:

- completion of a Desktop Assessment to summarise all previous fauna survey work, including the consolidation of existing habitat mapping and conservation significant fauna records;
- completion of a Level 1 Targeted Fauna Survey to assess the Study Areas, including the following assessment techniques:
    - Targeted transect searches within the Proposed Change Area to identify direct and indirect evidence of conservation significant fauna presence including direct observations, scats, tracks, burrows, nests, calls, etc;
    - Habitat assessments and mapping to determine the extent, condition and value of habitat for conservation listed species; and
    - Targeted malleefowl assessment, comprising transect searches in suitable habitat and mound assessments (including ground-truthing of mounds previously detected).
- discussion and comparison of data and findings within a local and regional context; and
- presentation of revised likelihood of occurrences of conservation significant fauna.

All survey work was aligned with relevant regulatory guidance including:

- Environmental Protection Authority (EPA) Factor Guideline, Environmental Factor Guideline: Terrestrial Fauna (EPA 2016a);
- EPA Factor Guideline, Sampling Methods for Terrestrial Vertebrate Fauna (EPA 2016b);
- EPA Technical Guide, Technical Guidance – Terrestrial Fauna Surveys (EPA 2016c);
- A Guide to the Assessment of Applications to Clear Native Vegetation (Department of Environmental Regulation (DER 2014);
- Matters of National Environmental Significance - Significant Impact Guidelines 1.1 Environmental Protection and Biodiversity Conservation Act (EPBC Act; Department of the Environment (DoE 2013));
- EPBC Act Referral Guidelines for three Threatened Black Cockatoo Species: Carnaby's Cockatoo (Endangered) *Calyptorhynchus latirostris*, Baudin's Cockatoo (Vulnerable) *Calyptorhynchus baudinii*, Forest Red-Tailed Black Cockatoo (Vulnerable) *Calyptorhynchus banksii naso* (Department of Sustainability, Environment, Water, Populations and Communities (DSEWPaC 2012);

- Revised Draft Referral Guideline for three Threatened Black Cockatoo Species: Carnaby's Cockatoo (Endangered) *Calyptorhynchus latirostris,* Baudin's Cockatoo (Vulnerable) *Calyptorhynchus baudinii,* Forest Red-tailed Black Cockatoo (Vulnerable) *Calyptorhynchus banksii naso* (Department of Energy and the Environment (DoEE 2017);
- National Recovery Plan for Malleefowl (Benshemesh 2007);
- Chuditch (*Dasyurus geoffroii*) Recovery Plan: Wildlife Management Program No. 54 (Department of Environment and Conservation (DEC 2012a); and
- Conservation Advice *Pseudomys shortridgei* Heath Mouse (Threatened Species Scientific Committee 2016).

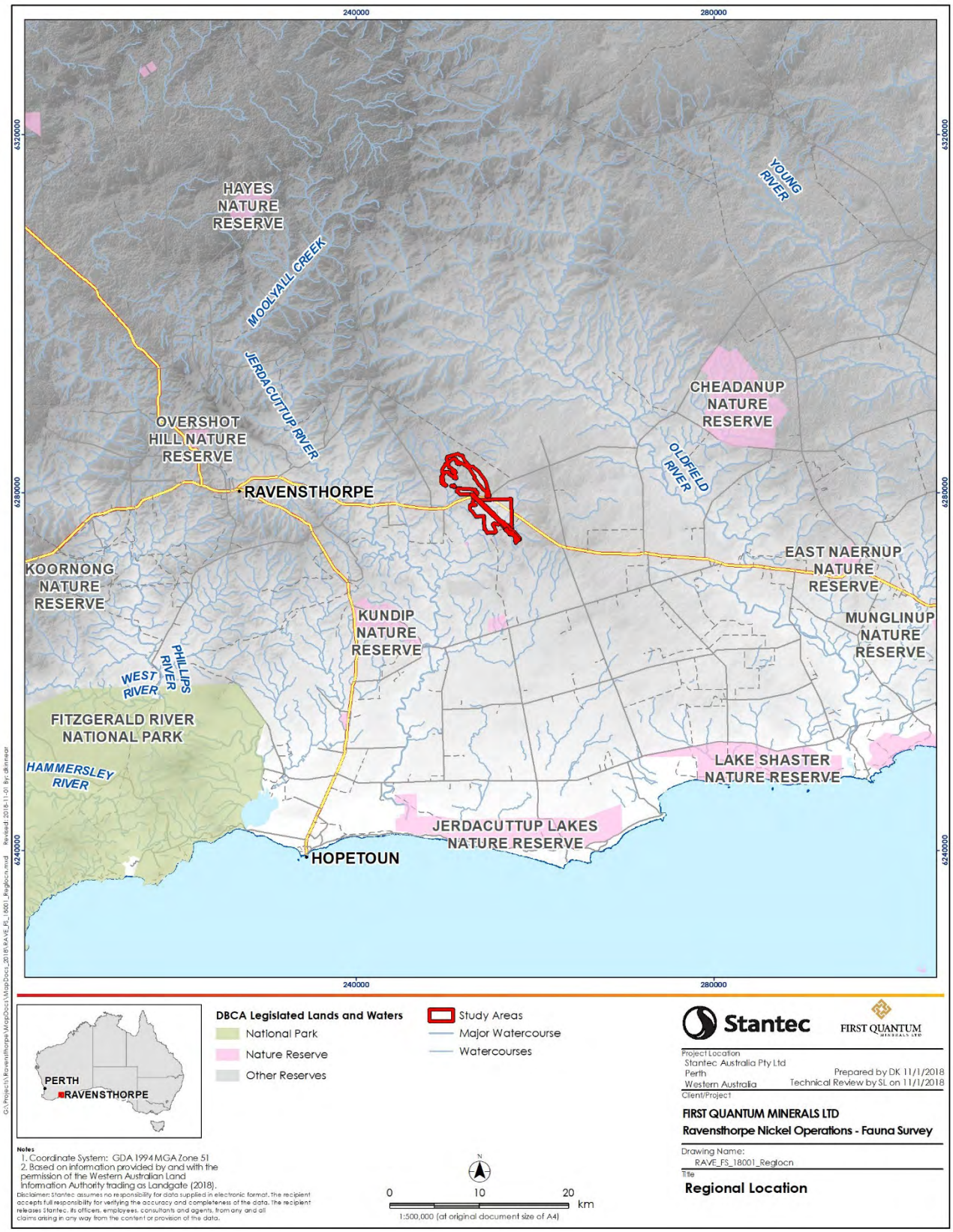


Figure 1-1: Regional location of the Study Areas, on the south coast of Western Australia

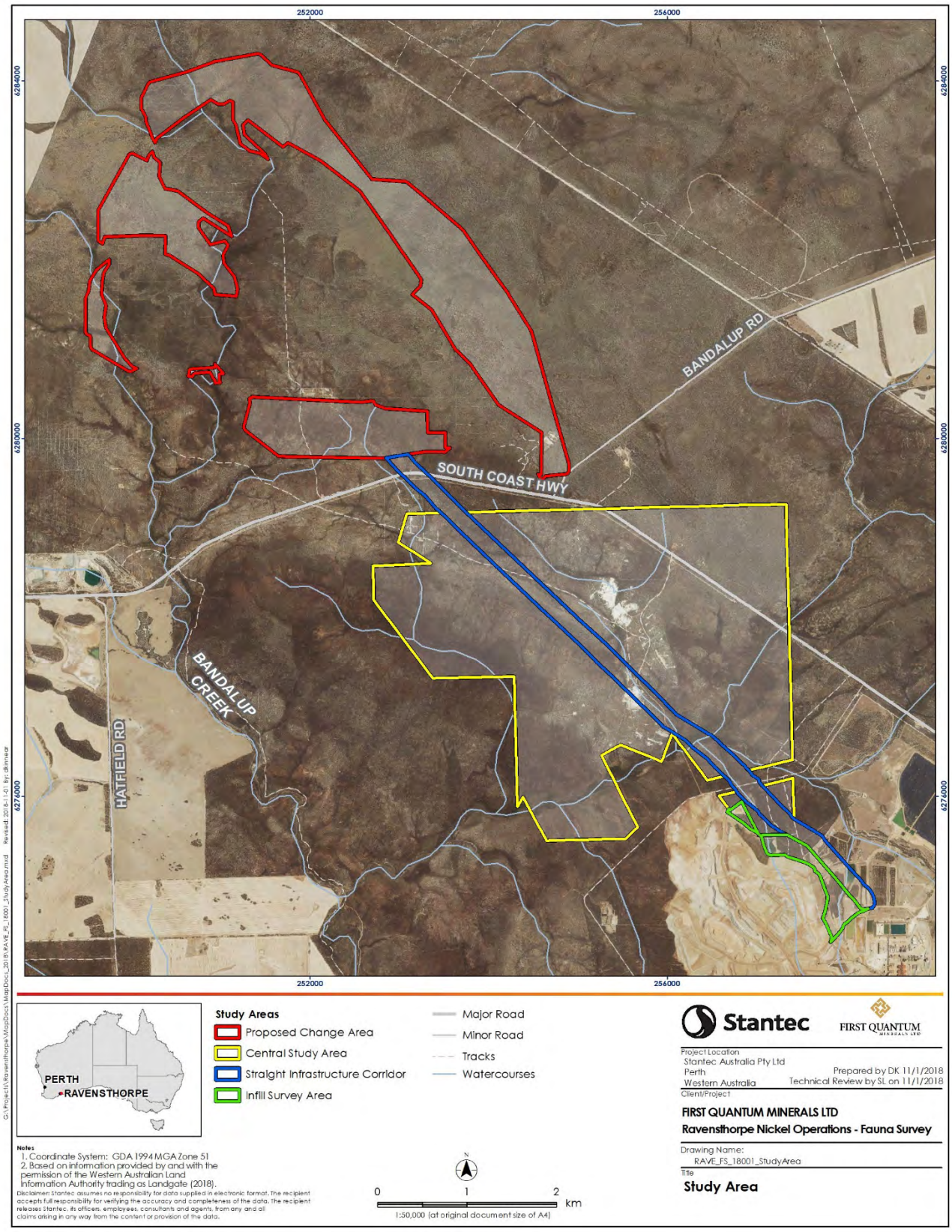


Figure 1-2: Locations of the Proposed Change Area, Central Study Area, Straight Infrastructure Corridor and Infill Survey Area

2. Existing Environment

2.1 Biophysical Environment

2.1.1 Biogeographic Location

The Interim Biogeographic Regionalisation for Australia (IBRA) is a bioregional framework that divides Australia into 89 biogeographic regions and 419 subregions on the basis of climate, geology, landforms, vegetation and fauna (Thackway and Cresswell 1995). It was developed through collaboration between state and territory conservation agencies with coordination by the Commonwealth Department of the Environment, Water, Heritage and the Arts (now the Commonwealth Department of the Environment and Energy, DoEE).

The Study Area is located within the Esperance Plains bioregion; largely within the Fitzgerald subregion with a small portion of the Straight Infrastructure Corridor and Infill Survey Area extending into the Recherche subregion (Figure 2-1). The Esperance plains bioregion is characterised by diverse, cryptic and endemic vegetation on sandplains, particularly myrtaceous and proteaceous scrubs and mallee-heaths (Comer *et al.* 2001). The Fitzgerald subregion contains reduced relief on coastal sandplain areas with sections of granite and quartzite ranges (Comer *et al.* 2001).

Figure 2-1: IBRA location of the Study Areas within the Esperance Plains region of Western Australia

2.1.2 Land Systems

An assessment of land systems provides an indication of the occurrence and distribution of fauna habitats and vegetation within and surrounding the Study Areas. Land Systems in the Rangelands and Arid Interior of Western Australia have been mapped by the Department of Primary Industries and Regional Development (formerly the Department of Agriculture and Food) and provide a comprehensive description of biophysical resources within the area (Tille 2006). Most of the Study Areas overlap the Oldfield and Ravensthorpe System (Table 2-1, Figure 2-2).

Table 2-1: Land systems and their extent within the Study Areas

Land System	Description	Total Area of Land System in WA (ha)	Extent within Study Area	
			Hectare (ha)	Percentage (%)
Oldfield System	Dissected headwater plains and rises on Proterozoic and Archaean granite and gneiss, in the eastern Ravensthorpe Zone, with grey sandy duplex (shallow and deep) and deep sandy gravel. Mallee with scrub-heath in gravelly areas.	181,792.93	1309.18	67
Ravensthorpe System	Undulating low hills on Archean greenstone of metasediments and ultramafics in the Ravensthorpe Zone, with alkaline red shallow loamy duplex, shallow gravel and self muching cracking clay, non-cracking clay and stony soil. Salmon gum, York	58,335.73	627.34	32
Munglinup System	Gently undulating plain and rises on Tertiary marine sediments wrapping around occasional highs of Proterozoic gneiss	213,770.62	26.28	1
Total	-	-	1962.80	100

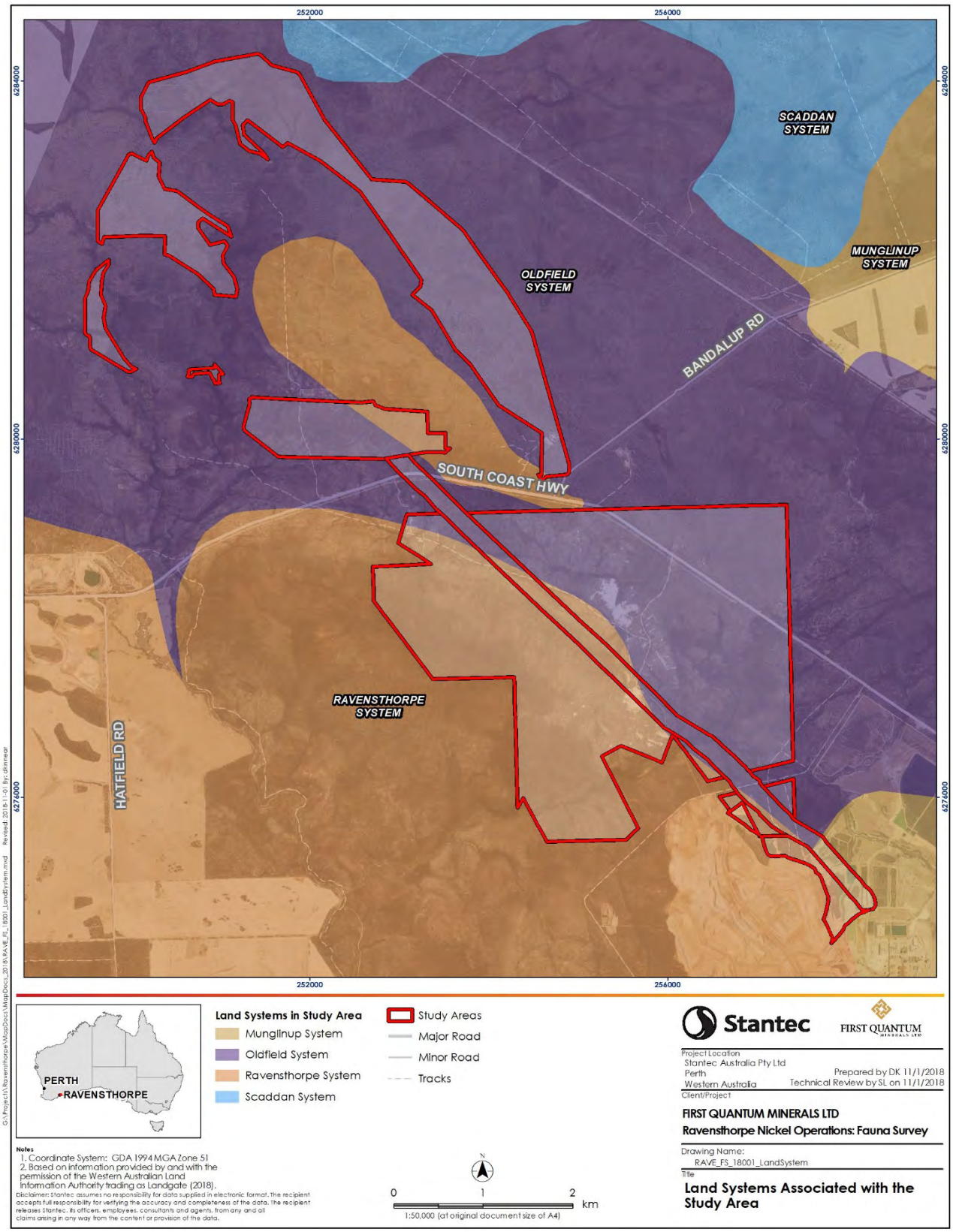


Figure 2-2: Land systems associated with the Study Area (Tille 2006)

2.2 Physical Environment

2.2.1 Climate

The Fitzgerald subregion has a temperate Mediterranean climate, characterised by low amounts of winter rainfall relative to the length of the dry season, annually ranging between 600 and 800mm, (Beard 1990, Comer *et al.* 2001). This results in mallee dominating rather than woodland (Beard 1990). Temperatures are typically cool during winter and warm to hot during summer (Lillicrap 2004).

The nearest operating Bureau of Meteorology (BOM) weather station for the Study Areas with relevant long-term and recent climatic data is Ravensthorpe weather station (station number 010633), located approximately 25km west of the Study Areas (BoM 2018). The long-term (1901 to 2018) annual rainfall recorded is 430.7 millimetres (mm) per annum. While the majority of rainfall occurs during the cooler months of May to September (maximum average during July, 47.2mm), rainfall tends to occur throughout the year (Figure 2-3). The hottest three months occur between December and February, however daily maximum temperatures rarely exceeding 30°C (Figure 2-3). The coolest three months occur between July and September, with minimum temperatures regularly falling below 10°C (Figure 2-3).

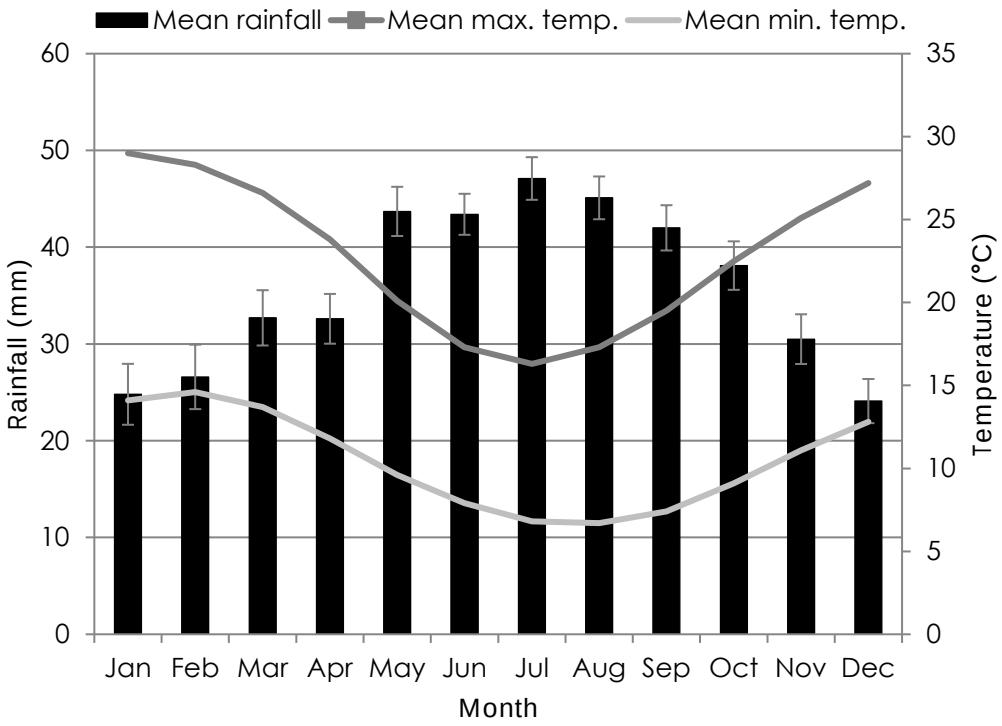


Figure 2-3: Long-term mean rainfall and mean maximum temperatures (1901 – 2018) recorded at Ravensthorpe weather station (010633) (BoM 2018).

2.2.2 Landforms, Geology and Soils

Substrate within the Esperance plains largely comprises duplex soils, sand of varying depth on plains and shallow sand on mountain ranges (Comer *et al.* 2001). Areas in the eastern area of the Esperance Plains are dominated by sandy soils over clay, which transitions to sandy soils over laterite in the west (Beard 1990). The region is dominated by flat plains, with small areas of hills, ranges and granite outcrops, largely resulting in a mosaic vegetation pattern (Beard 1990).

2.2.3 Land Use

The majority of the area serves as pasture and agriculture, with some portions serving as conservation, reserves, roads and forestry plantation areas (Comer *et al.* 2001). By 2004, just over half of the Fitzgerald subregion (730,000ha) had been cleared for agriculture (Lillicrap 2004). The subregion is also used for mining, with existing mines, exploration or mining tenements coinciding with major landscape components such as the Ravensthorpe Range (Comer *et al.* 2001).

2.2.4 Reserves and Environmentally Sensitive Areas

The Study Areas do not coincide with any reserves or environmentally sensitive areas, however numerous occur in the surrounding area. The closest ESA occurs ~4.6km west of the Central Study Area, extending to the northwest. Reserves within 35km of the Study Areas include Kundip Nature Reserve, Cheadanup Nature Reserve, Overshot Hill Nature Reserve, Cocanarup Timber Reserve, Lake Shaster Nature Reserve, Jerdacuttup Lakes Nature Reserve, Fitzgerald River National Park and an unnamed nature reserve ~9km south of the Study Areas (the closest reserve).

Of these, the Fitzgerald River National Park holds particular significance. Spanning an area of ~29,7244ha, the national park comprises a variety of landforms including coastal areas, quartzite ranges and granite exposures (DoEE 2018c). It was included in the National Heritage List during 2016 due to the diversity and endemism of its vegetation, which includes 75 species endemic to the national park and ~250 rare or restricted species (DoEE 2018c). Furthermore, a relatively high number of vertebrate fauna species occur within the national park, including a variety of conservation significant species such as the Dibbler (*Paratechinus apicalis*), Heath Mouse (*Pseudomys shortridgei*), Ground Parrot (*Pezoporus wallicus flaviventris*), Tammar Wallaby (*Notamacropus eugenii derbianus*), Quenda (*Isoodon fusciventer*), Western Whipbird (*Psophodes nigrogularis*), Carnaby's Cockatoo (*Calyptorhynchus latirostris*) and Western bristlebird (*Dasyornis longirostris*) (DoEE 2018c). Main threats to the condition of the park include feral animals (foxes, cats, rabbits and bees), dieback and weed infestation; the latter two currently have minimal effect on the national park however have a high potential to spread (DoEE 2018c).

3. Survey Methodology

3.1 Desktop Assessment

A Desktop Assessment, comprising database searches and a literature review, was undertaken prior to the field survey to gather contextual information on the Study Areas. The purpose of the desktop assessment was to identify terrestrial fauna potentially occurring in the Study Areas, particularly species of conservation significance.

Conservation significance and rankings used under the EPBC Act, *Biodiversity Conservation Act 2016* (BC Act), as well as the Department of Biodiversity, Conservation and Attractions (DBCA) Priority list, are defined in **Appendix A**. The BC Act replaces both the *Wildlife Conservation Act 1950* (WC Act) and the Sandalwood Act and came into effect on 1 January 2019.

3.1.1 Database Searches

Database searches were completed to generate a list of vertebrate fauna previously recorded within and nearby the Study Areas, with an emphasis on species of conservation significance. Three databases were searched using central coordinates (**Table 3-1**). Appropriate search buffers were selected for each database, according to their technical capabilities, as well as the ecological features of the Study Areas.

Table 3-1: Database searches conducted for the desktop assessment

Authority	Database	Reference	Buffer (km)	Location (51H)	
				Easting	Northing
DoEE	Protected Matters Search Tool (PMST)	DoEE (2018a)	30km	253402	6278991
DBCA	NatureMap	DBCA (2018a)			
DBCA	Threatened and Priority Fauna	DBCA (2018b)			
Birdlife	Atlas Bird List	Birdlife Australia (2018)			

3.1.2 Literature Review

A literature review of vertebrate fauna and habitats within and adjacent to the Study Areas was also completed as part of the Desktop Assessment. This review investigated the occurrence of conservation significant species and informed habitat mapping. Owing to the extensive baseline, impact assessment and annual monitoring surveys conducted at RNO previously, the literature review focussed on data specific to RNO tenements (**Figure 3-1**), in addition to the Central Study Area and immediate surrounds.

Twelve trapping surveys were included in the literature review (Table 3-2). Adequacy of previous surveys was assessed according to the following potential limitations outlined EPA guidelines (EPA 2016c):

- competency/experience of the consultant carrying out the survey;
- scope (what faunal groups were sampled and were some sampling methods not able to be employed because of constraints such as weather conditions, e.g. pitfall trapping in waterlogged soils or inability to use pitfall traps because of rocky terrain or impenetrable subsoil);
- proportion of fauna identified, recorded and/or collected;
- sources of information e.g. previously available information (whether historic or recent) as distinct from new data;
- the proportion of the task achieved and further work which might be needed;
- timing/weather/season/cycle;
- disturbances (e.g. fire, flood, accidental human intervention etc.) which affected results of survey;
- intensity (in retrospect, was the intensity adequate);
- completeness (e.g. was relevant area fully surveyed);
- resources (e.g. degree of expertise available in animal identification to taxon level);
- remoteness and/or access problems; and
- availability of contextual (e.g. biogeographic) information on the region.

Where applicable, limitations are listed in Table 3-2. In all cases the survey area was large and access was limited to existing exploration tracks. However this did not substantially affect survey adequacy. Furthermore, a large scale fire burnt the majority of the Study Areas during 2003 (Figure 4-1). Fires were also noted in late January 2002, 2001 and 2004 (small) (Terrestrial Ecosystems 2013, Woodman Environmental Consulting 2017), however fire scar mapping for these years was unavailable. Three targeted species, the heath mouse, western mouse and western whipbird, prefer dense vegetation or long unburnt areas. In particular, the heath mouse occupies areas unburnt for at least 10 years with the largest numbers recorded in vegetation unburnt for 30 years, and the western mouse optimally inhabits areas 30 years unburnt (Threatened Species Scientific Committee 2016, van Dyck and Strahan 2008). Consequently, the Study Areas may contain suitable habitats for these species in the future, but potentially not at the time of the surveys. Survey specific details of this are outlined in Table 3-2.

Table 3-2: Summary of findings of previous fauna surveys conducted within RNO

Reference	Study Details	Survey Effort and Methods	Adequacy	Fauna Habitats	Fauna Assemblages	Species of Conservation Significance*

Biota (2000)	**Location**: RNO, Proposed Change Area, Hale Bopp and five permanent grid locations (Rare Species Monitoring Program)
	
	Study type: Trapping, avifauna surveys, bat echolocation recording, small vertebrate ground raking and vehicle transects
	
	Survey dates: 9/10 – 23/10/2000
		Intensive trapping grids:
		• Seven grids for five to seven nights (1,194 trap nights), comprising:
		  ○ Two rows of six pitfall traps – 534 trap nights
		  ○ Elliotts adjacent to each pit and a central line of eight Elliotts (with exception of one site) – 600 trap nights
		  ○ Two cage traps – 60 trap nights
		
		Rare Species Monitoring Program:
		• Five sites of 20 Elliotts for five nights – 500 trap nights
			N/A	• Mallee
				• Mallee heath
				• Thickets
				• Low forest
				• Woodland
					• 121 taxa
					• 58 families
					• 100 genera
						• Malleefowl (*Leipoa ocellata* [S3 VU])
						  ○ Two individuals
						  - Vehicle transect and opportunistic
						• Carnaby's cockatoo (*Calyptorhynchus latirostris* [S2 EN]) (note ID based on distribution rather than positive ID)
						  ○ Flocks of 15 – 30 individuals
						  - Opportunistic
						• Western whipbird (*Psophodes nigrogularis oberon* [P4])
						  ○ Twelve records from nine locations
						  - Opportunistic and avifauna surveys
						• Heath mouse (*Pseudomys shortridgei* [S3 EN])
						  ○ One individual
						  - Pit trap
						• Western mouse (*Pseudomys occidentalis* [P4])
						  ○ One individual
						  - Trapping
						• Western brush wallaby (*Notamacropus irma* [S2 EN])
						  ○ Five individuals
						  - Opportunistic
						• Quenda (*Isoodon fusciventer* [P4])
						  ○ Two records
						  - Diggings

Biota (2005)	**Location**: RNO, including Bandalup Corridor
	
	Study type: Rare species and short range endemic (SRE) trapping survey and vehicle transects
	
	Survey dates: 22/08 – 28/08/2005
		Rare species trapping:
		• Five lines of 20 Elliotts (one for four nights and four for three nights) – 320 trap nights
		• One line of 50 cage traps for two nights – 100 trap nights
		
		Bandalup Corridor trapping:
		• Eight trapping grids with 12 pitfall traps, eight Eliotts and two cage traps for three to five nights – 638 trap nights
			• Targeted SREs; timed for cooler months, less optimal for reptiles.
			• Rainfall and wet conditions: pit traps not used, may reduce trapping success, accessibility in some areas reduced (vehicle transect not conducted) and trapping effort shortened to three nights at four sites and four nights at one site.
			• Two trapping lines occurred in an area burnt during 2003, and vegetation was only in the early stages of succession. An additional trapping line was established in unburnt vegetation.
			• Occurrence of conservation significant vertebrate species and value to fauna was not consistently linked with habitats of importance within the Study Area.
				N/A	• 123 taxa
					• 54 families
					• 101 genera
						• Western mouse (*Pseudomys occidentalis* [P4])
						  ○ Four captures
						  - Elliott traps
						• Western whipbird (*Psophodes nigrogularis oberon* [P4])
						  ○ Three locations
						  - Opportunistic
						• Western brush wallaby (*Notamacropus irma* [S2 EN])
						  ○ Two records
						  - Vehicle transects
						• Carnaby's cockatoo (*Calyptorhynchus latirostris* [S2 EN])
						• Quenda (*Isoodon fusciventer* [P4])
						• SRE invertebrates. No confirmed SRE or conservation listed invertebrates. Specimens collected from groups with potential for shor-range endemism included:
						  o Millipede: *Antechiropus* sp
						  o Snails: Bothriembryon dux, B. melos, and two unidentified species
						  o Mygalomorph spiders: 16 spp.

Coffey Environments (2009)	**Location**: RNO; Proposed Change Area
	
	Study type: Trapping, spotlighting, bat echolocation recordings, Malleefowl grid searches, avifauna dawn – midday searches
	
	Survey dates: Trapping from 12/10 – 19/10/2008, avifauna from 14/10 – 19/10/2008
		Trapping sites:
		• Twenty sites with four trap lines (8,960 trap nights), each line comprising:
		  ○ Three 20L buckets – 1,680 trap nights
		  ○ Three PVC pipe pit traps – 1,680 trap nights
		  ○ Six funnel traps – 3,360 trap nights
			• A second survey was not conducted to identify temporal variations in fauna assemblages. However the October timing of the survey was conducted at the optimal time of year for detecting reptiles, birds and mammals.
			• Bat recorders were not deployed due to potential rainfall.
			• The 2003 fire affected six of the 20 trapping sites; these occurred in
				• Heath on a sand or sand over a lateritic substrate
				• Mallee regrowth on a sandy clay substrate
				• Long unburnt mallee on a sand or lateritic rock substrate
				• Creek lines on a sandy clay substrate
					• 94 taxa
					• 41 families
					• 80 genera
						• Quenda (*Isoodon fusciventer* [P4])
						  ○ One individual
						  - Trapping
						• Western brush wallaby (*Notamacropus irma* [P4])
						  ○ Spotlighting
						• Chuditch (*Dasyurus geoffroii* [S3 VU])
						  ○ Killed on access road outside of Study Area
						• Western whipbird (*Psophodes nigrogularis oberon* [P4])

Reference	Study Details	Survey Effort and Methods	Adequacy	Fauna Habitats	Fauna Assemblages	Species of Conservation Significance*
		○ Three Elliott traps – 1,680 trap nights ○ One cage trap – 560 trap nights	creek lines and mallee regrowth on sand and rock, including with a heath understorey. However all habitats were also represented at unburnt sites. • No habitat mapping provided. • Occurrence of conservation significant species and value to fauna was not consistently linked with habitats of importance within the Study Area.			○ Three locations - Avifauna survey • Carnaby's cockatoo (*Calyptorhynchus latirostris* [S2 EN]) ○ Frequently observed feeding - Opportunistic observation adjacent to mining village outside Study Area
Coffey Environments (2010)	Location: RNO; Proposed Change Area and existing mine Study type: Trapping survey Survey dates: 08/01 – 18/01/2010	Non-cage trapping lines: • Thirty sites with four trap lines (12,516 trap nights), each line comprising: ○ Three 20L buckets – 2,478 trap nights ○ Three PVC pipe pit traps (2,478 trap nights) ○ Six funnel traps – 5,040 trap nights ○ Three Elliotts – 2,520 trap nights Cage trapping: • Four sites of 15 cage traps – 420 trap nights	• Species accumulation curves indicate all habitats aside from mallee woodland required further sampling to identify the species occurring in other habitats. • Contained burnt and unburnt sites (two burnt mallee on laterite sites listed in plates). • No habitat mapping provided. • Occurrence of conservation significant species and value to fauna was not consistently linked with habitats of importance within the Study Area.	• Mallee Heath on sand • Mallee on laterite • Mallee Woodland • Creek lines • Rocky outcrop	• 127 taxa • 57 families • 106 genera	• Malleefowl (*Leipoa ocellata* [S3 VU]) ○ One individual - Opportunistic • Western brush wallaby (*Notamacropus irma* [P4]) ○ Eight individuals ○ Opportunistic observation • Carnaby's cockatoo (*Calyptorhynchus latirostris* [S2 EN]) ○ Two individuals - Opportunistic • Chuditch (*Dasyurus geoffroii* [S3 VU]) ○ 10 records - Cage traps • Heath mouse (*Pseudomys shortridgei* [S3 EN]) ○ One individual - Pipe pit trap • Western mouse (*Pseudomys occidentalis* [P4]) ○ Two individuals - Pipe pit trap
Terrestrial Ecosystems (2013)	Location: RNO Study type: Annual monitoring baseline survey; trapping, camera trapping, western whipbird assessment Survey dates: Trapping: 14/10 – 19/10/2013	Trapping: • 500 box traps – 2,500 trap nights • 100 cage traps – 500 trap nights Western whipbird: • 11 sites Motion camera: • Eight deployed at breakaway – 16 trap nights	• Rainfall occurred over 4 days during the survey, and may have limited trapping success. • Bait theft by ravens occurred at one site, which may have limited trapping success. • While habitat of trapping sites was outlined, occurrence of conservation significant species and value to fauna was not linked with habitats of importance within the Study Area. • No habitat mapping provided. • Three trapping areas were affected by the 2003 fire, while fire history of two trapping areas was not specified. • Relatively low number of fauna taxa recorded compared to future annual monitoring surveys.	• Drainage line • Mallee heath on duplex soils • Dense mallee heath • Thickets on sandy calcrete • Mallee heath on komatities • Thickets on sandy silcrete	• 14 taxa • 11 families • 14 genera	• Western whipbird (*Psophodes nigrogularis oberon* [P4]) ○ Ten locations - Monitoring sites • Western brush wallaby (*Notamacropus irma* [P4]) ○ Small mob - Opportunistic
Terrestrial Ecosystems (2014)	Location: RNO Study type: Annual monitoring; trapping, camera trapping, western whipbird assessment Survey dates: Trapping: 12/09 – 18/09/14	Trapping: • 500 box traps – 2,500 trap nights • 100 cage traps – 500 trap nights Western whipbird: • 10 sites Motion camera: • 50 deployed - 1,550 trap nights	• Occurrence of conservation significant species and value to fauna was not linked with habitats of importance within the Study Area. • No habitat mapping provided. • Burn history as above, however one new trapping area was implemented with an unspecified fire history. • Shifting of one site was necessary to avoid future development (replaced	N/A	• 66 taxa • 37 families • 56 genera	• Western brush wallaby (*Notamacropus irma* [P4]) ○ 6 sites - Motion camera • Western whipbird (*Psophodes nigrogularis oberon* [P4]) ○ Eight locations - Monitoring sites ○ Five occasions - Opportunistic

Reference	Study Details	Survey Effort and Methods	Adequacy	Fauna Habitats	Fauna Assemblages	Species of Conservation Significance*
			by site mentioned above). Data from this site would not be comparable to 2013. • Some bait theft by ravens at one site, however considered unlikely to affect trapping success.			• Malleefowl (*Leipoa ocellata* [S3 VU]) ○ One locations - Opportunistic ○ Two sites - Motion camera • Carnaby's cockatoo (*Calyptorhynchus latirostris* [S2 EN]) ○ One site - Motion camera
Terrestrial Ecosystems (2015)	Location: RNO Study type: Annual monitoring; trapping, camera trapping, western whipbird assessment Survey dates: Trapping: 13/10 – 19/10/15	Trapping • 500 box traps – 2,500 trap nights • 100 cage traps – 500 trap nights Western whipbird: • 10 sites Motion camera: • 50 deployed – 1,550 trap nights	• Occurrence of conservation significant species and value to fauna was not linked with habitats of importance within the Study Area. • No habitat mapping provided. • Fire history as above.	N/A	• 60 taxa • 35 families • 52 genera	• Chuditch(*Dasyurus geoffroii* [S3 VU]) ○ 4 sites - Motion camera • Western brush wallaby (*Notamacropus irma* [P4]) ○ 6 sites - Motion camera • Western whipbird (Psophodes nigrogularis oberon [P4]) ○ One site - Motion camera ○ Eight occasions - Monitoring site ○ One location - Opportunistic • Carnaby's cockatoo (*Calyptorhynchus latirostris* [S2 EN])
Terrestrial Ecosystems (2016a)	Location: RNO Study type: Annual monitoring; trapping, camera trapping, western whipbird assessment. Feral animal trapping Survey dates: Trapping: 15/11 – 21/11/15	Trapping • 500 box traps – 2,500 trap nights • 100 cage traps and 119 feral trapping cage traps – 1,095 trap nights Western whipbird: • 10 sites Motion camera: • 50 deployed – 1,550 trap nights	• Occurrence of conservation significant species and value to fauna was not linked with habitats of importance within the Study Area. • No habitat mapping provided. • Fire history as above.	N/A	• 68 taxa • 38 families • 58 genera	• Chuditch(*Dasyurus geoffroii* [S3 VU]) ○ Seven captures - Trapping ○ Five sites - Motion camera • Malleefowl (*Leipoa ocellata* [S3 VU]) ○ One location - Opportunistic ○ Five sites - Motion camera • Western brush wallaby (*Notamacropus irma* [P4]) ○ 6 sites - Motion camera • Western whipbird (*Psophodes nigrogularis oberon* [P4]) ○ Eight locations - Monitoring site ○ 10 occasions - Opportunistic • Carnaby's cockatoo (*Calyptorhynchus latirostris* [S2 EN])
Terrestrial Ecosystems (2016b)	Location: RNO including corridor and Hale-Bopp pit Study type: Trapping, camera trapping, western whipbird assessment. Feral animal trapping Survey dates: Trapping: 20/09/16 – 25/09/16, 16/11/16 – 21/11/16	Trapping • 1,000 box traps • 119 feral trapping cage traps Western whipbird: • 18 sites Motion camera: 50 deployed – 13/09 – 18/11/16	• While habitats were specified, occurrence of conservation significant species and value to fauna was not consistently linked with habitats within the Study Area. • No habitat mapping provided. • Fire history (e.g. 2003) not addressed. While survey occurred 13 years post fire, large scale fires may have lasting impacts to species requiring long-unburnt habitats.	• Mallee shrubland • Low heaths on granite substrate • Mallee heaths • Drainage and creek lines with relatively dense shrubs up to 2m high • Open mallee with shrubs • Closed mallee with understorey thickets	• 29 taxa • 23 families • 27 genera	• Western whipbird (*Psophodes nigrogularis oberon* [P4]) ○ 10 locations - Monitoring site ○ 10 occasions - Opportunistic • Western brush wallaby (*Notamacropus irma* [P4]) ○ 47 locations - Motion camera ○ Two locations - Opportunistic

Reference	Study Details	Survey Effort and Methods	Adequacy	Fauna Habitats	Fauna Assemblages	Species of Conservation Significance*
			• Ravens and currawongs removed bait and pins from traps, resulting in these being ineffective on some nights. • Data collected by other consultancies was considered to contain errors, but this was also considered to have negligible impact on the survey.			• Quenda (*Isoodon fusciventer* [P4]) ○ One individual - Motion camera • Chuditch(*Dasyurus geoffroii* [S3 VU]) ○ 16 captures - Trapping ○ 9 locations - Motion camera • Carnaby's cockatoo (*Calyptorhynchus latirostris* [S2 EN]) ○ Between one and 18 individuals observed in seven locations - Opportunistic
Terrestrial Ecosystems (2017a)	Location: RNO Study type: Annual monitoring; trapping, camera trapping, western whipbird assessment Survey dates: Trapping: 02/11 – 07/11/17	Trapping • 450 box traps – 2,250 trap nights • 150 cage traps – 750 trap nights Western whipbird: • 12 sites Motion camera: 90 deployed – 3,600 trap nights	• Trap lines only concentrated near the existing mine. Potential effects associated with the Proposed Change Area and Northern section of the Central Study Area may not be captured. As previous records of some targeted species (e.g. heath mouse) indicate a sparse local distribution, the reduced spatial coverage may not capture local populations. • Occurrence of conservation significant species and value to fauna was not linked with habitats of importance within the Study Area. • No habitat mapping provided. • Ravens and currawongs removed bait and pins from traps, resulting in these being ineffective on some nights. • Data collected by other consultancies was considered to contain errors, but this was also considered to have negligible impact on the survey.	• Mallee shrubland with dense understory of shrubland, grasses and herbs • Open mallee shrubland over low heath, grasses and herbs • Closed mallee shrubland with almost no understory	• 66 taxa • 36 families • 58 genera	• Chuditch(*Dasyurus geoffroii* [S3 VU]) ○ 16 captures - Trapping ○ 24 locations - Motion camera • Western whipbird (*Psophodes nigrogularis oberon* [P4]) ○ 10 locations - Monitoring site ○ 18 occasions - Opportunistic • Malleefowl (*Leipoa ocellata* [S3 VU]) ○ One location - Motion camera • Western brush wallaby (*Notamacropus irma* [P4]) ○ 77 locations - Motion camera • Western mouse (*Pseudomys occidentalis* [P4]) ○ One individual - Trapping • Carnaby's cockatoo (*Calyptorhynchus latirostris* [S2 EN])
Terrestrial Ecosystems (2017b)	Location: RNO; Hale Bopp and Northwest pit corridor and Proposed Change Area (including extension to area) Study type: Black cockatoo foraging habitat assessment, malleefowl assessment, western whipbird assessment, camera trapping and trapping Survey dates: Trapping: 20/09 – 25/09/2016, 21/09 – 26/09/2016, 22/02 – 01/03/2017	Box trapping: • 300 in infrastructure corridor • 200 in Hale Bopp north • 540 in Shoemaker Levy expansion • Total of 3,780 trap nights Cage trapping: • 180 in Shoemaker Levy mine site and expansion area – 1,260 trap nights Motion camera • 150 deployed – 6,650 trap nights	• While habitats were specified, occurrence of conservation significant species and value to fauna was not consistently linked with habitats within the Study Area. • Ravens and currawongs removed bait and pins from traps, resulting in these being ineffective on some nights. • Species names of previous reports could not always be verified, but this was also considered to have negligible impact on the survey.	• Mallee shrubland with dense understorey of shrubland, grasses and herbs • Open mallee shrubland over low heath, grasses and herbs • Low heath and shrubs over grasses and herbs (very few trees) • Closed mallee shrubland with almost no understorey • Damp areas or drainage and creek lines with relatively dense shrubs to 2m high • Tall trees and sparse shrubland	• 39 taxa • 28 families • 36 genera	• Malleefowl (*Leipoa ocellata* [S3 VU]) ○ Eight mounds recorded (five active or recently active) - Targeted searches ○ One individual observed - Opportunistic ○ Eleven locations - Motion camera • Carnaby's cockatoo (*Calyptorhynchus latirostris* [S2 EN]) ○ Between one and 15+ individuals observed in seven locations - Opportunistic • Western brush wallaby (*Notamacropus irma* [P4]) ○ Numerous locations (50+) - Motion camera ○ One individual - Opportunistic • Quenda (*Isoodon fusciventer* [P4]) ○ One individual - Motion camera

Reference	Study Details	Survey Effort and Methods	Adequacy	Fauna Habitats	Fauna Assemblages	Species of Conservation Significance*

						• Chuditch (*Dasyurus geoffroii* [S3 VU])
						  ○ 46 locations
						  - Motion camera
						  ○ Five records
						  - Cage trapping
						• Western mouse (*Pseudomys occidentalis* [P4])
						  ○ Five records
						  - Box trapping
						• Western whipbird (*Psophodes nigrogularis oberon* [P4])
						  ○ Detected at 19 locations
						  - 11 at monitoring sites

Terrestrial Ecosystems (2018)	Location: RNO, corridor
	Study type: Trapping, motion camera
	Survey Dates: Trapping between 27/01 – 5/03/2018
		Trapping
		• 450 box traps – 2,250 trap nights
		• 150 cage traps – 750 trap nights
		Motion camera:
		• 90 deployed – 12/02 – 03/03/2018
			• While habitats were specified, occurrence of conservation significant species and value to fauna was not consistently linked with habitats within the Study Area.
			• No habitat mapping provided.
			• Species names of previous reports could not always be verified, but this was also considered to have negligible impact on the survey.
			• Ravens and currawongs removed bait and pins from traps, resulting in these being ineffective on some nights.
				N/A	• 59 taxa
					• 40 families
					• 51 genera
						• Chuditch(*Dasyurus geoffroii* [S3 VU])
						  ○ 4 individuals
						  - Trapping
						  ○ 46 locations
						  - Motion camera
						• Quenda (*Isoodon fusciventer* [P4])
						  ○ Five locations
						  - Motion camera
						• Western brush wallaby (*Notamacropus irma* [P4])
						  ○ 80 locations
						  - Motion camera
						• Western whipbird (*Psophodes nigrogularis oberon* [P4])
						  ○ 15 locations
						  - Opportunistic
						• Carnaby's cockatoo (*Calyptorhynchus latirostris* [S2 EN])
						  ○ Flock of 30 feeding
						  - Opportunistic
						• Malleefowl (*Leipoa ocellata* [S3 VU])
						  ○ Two birds
						  - Opportunistic
						  ○ Four locations
						  - Motion camera

*'Individuals' represent separate individuals of the same species, 'captures' represent capture events

*Motion camera 'locations' represent separate camera traps, 'sites' represent areas containing multiple motion cameras

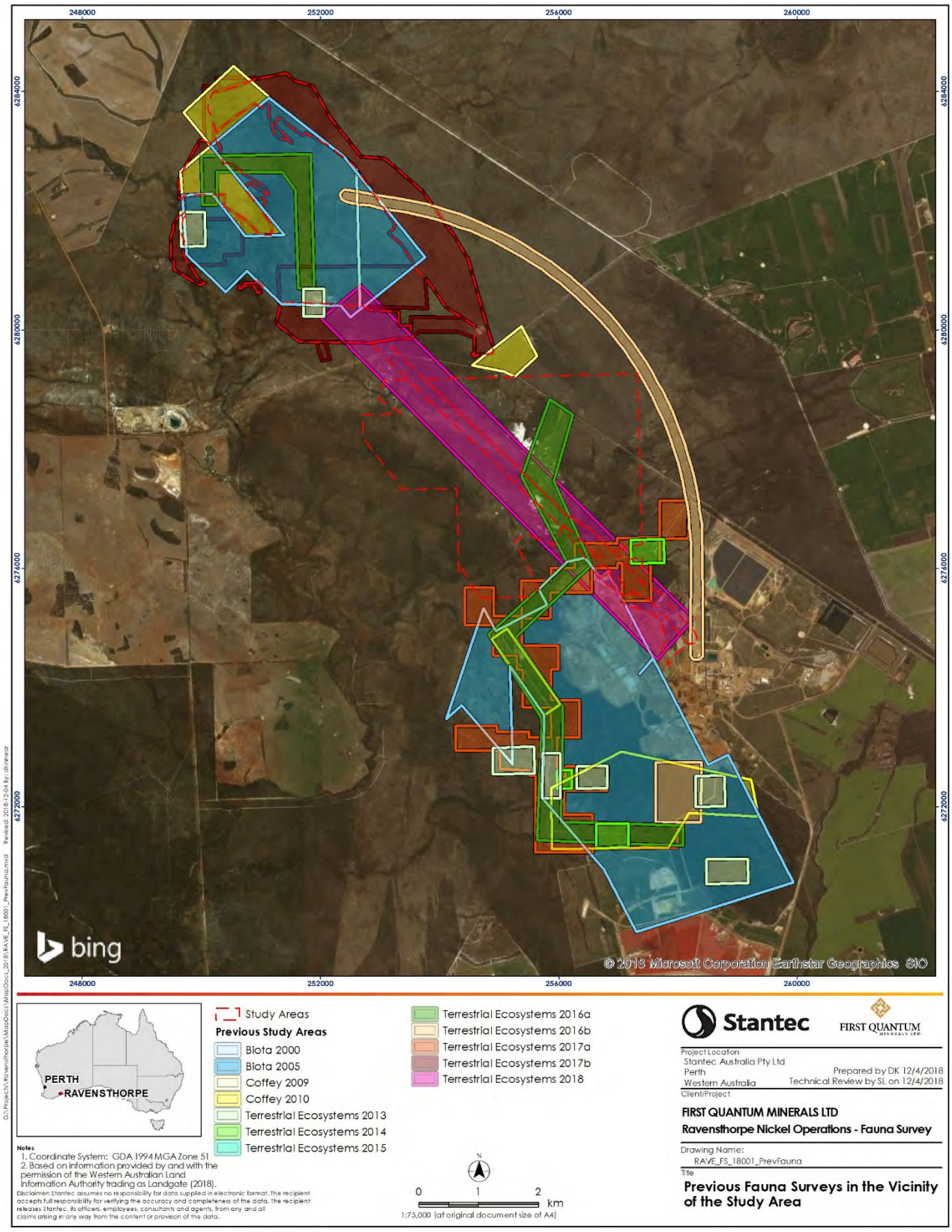


Figure 3-1: Previous fauna surveys in the vicinity of the Study Area

3.2 Likelihood of Occurrence of Conservation Significant Fauna

Conservation significant fauna were assessed on their likelihood to occur within the Study Areas (Section 4.5), based on the proximity and duration since the most recent records and the presence of suitable habitat. The likelihood rankings were assigned using the following criteria:

Confirmed – the presence of the species in the Study Areas has been recorded unambiguously during the last ten years (i.e. during recent surveys of the Study Areas or from reliable records obtained via database searches).

Very Likely – the Study Areas lie within the known distribution of the species, is likely to contain suitable habitat(s), and has been recorded nearby within the last 20 years.

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

- the Study Areas are likely to contain only a small area of suitable habitat, or habitat that is only marginally suitable; or
- the species is generally rare and patchily distributed in suitable habitat.

Possible – there is limited likelihood of occurrence, because:

- the Study Areas are outside the known distribution of the species, but are likely to contain suitable and sufficient habitat (the species may be common, rare, or patchily distributed); or
- the Study Areas lie within the known distribution of the species, but the species is very rare and/or patchily distributed; or
- the Study Areas lie on the edge of, or within, the known distribution and are likely to contain suitable habitat, but the species has not been recorded in the area for over 20 years.

Unlikely – the Study Areas lie outside the known distribution of the species, are unlikely to contain suitable habitat, and the species has not been recorded in the area for over 20 years.

3.3 Level 1 Targeted Fauna Survey

3.3.1 Survey Timing

The fauna survey was conducted from the 25th of September to the 5th of October 2018, during optimal timing for mammal and bird surveys in the South West Province (where the Study Areas are located), as recommended by (EPA 2016b). This includes all species of conservation significance targeted during the current survey. The survey also overlapped with the optimal survey timing recommended for reptiles (EPA 2016b).

Rainfall occurred during the survey from the 30/09 – 04/10. Mean monthly rainfall compared to the long-term average at Ravensthorpe station (station number 010633) (BoM 2018) in the six months preceding the fauna survey is represented in Figure 2-3. Rainfall during the current survey tended to be lower than the long-term average in all months aside from August. While long-term rainfall ranged from 32.6mm to 47.1mm, 2018 rainfall ranged from 8.0mm to 28.4mm, aside from a high amount of rainfall relative to other months in August, totalling 48.3mm. Particularly low 2018 rainfall was recorded in May (8.0mm) and September (8.2mm).

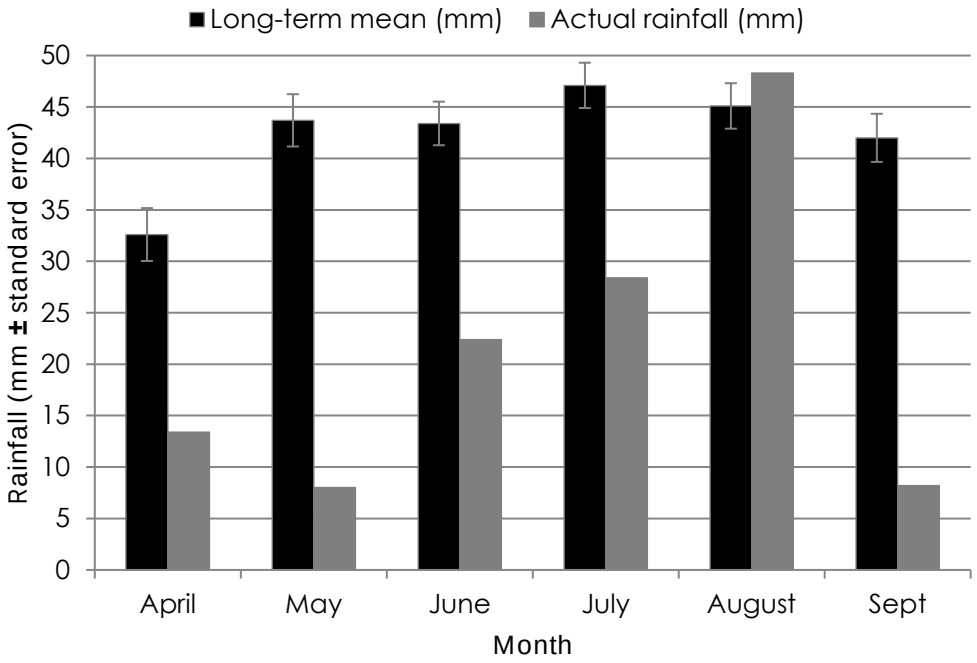


Figure 3-2: Long-term mean monthly rainfall (1901 to 2018) and rainfall 6 months preceding the current Survey at Ravensthorpe weather station (010633) .

3.3.2 Survey Team and Licencing

The field survey was conducted by experienced Stantec zoologists Paul Bolton and Samantha Lostrom. Paul has over eleven years' experience with vertebrate and invertebrate zoological surveys, and was the technical lead for the field survey. Samantha has 5 years experience in zoology, has completed a variety of targeted fauna survey work throughout Western Australia and is experienced in survey methods including tracking, motion camera recording and avifauna identification.

3.3.3 Field Survey

The fauna and habitat assessment techniques summarised in subsequent sections were undertaken across the Study Areas defined in Figure 1-2, with the focus of each outlined in Table 3-3.

Table 3-3: Fauna assessment techniques applied within the Study Areas

Assessment Techniques	Proposed Change Area	Central Study Area, Straight Infrastructure Corridor and Infill Survey Area	Immediate Surrounds
Habitat assessment and mapping	✓	✓	✓
Transect searches for evidence of conservation significant fauna	✓		
Malleefowl transects	✓		✓
Black cockatoo assessments	✓		
Motion camera deployments	✓		

3.3.3.1 Habitat Assessments

A total of 53 fauna habitat assessments were undertaken within the Study Areas and immediate surrounds (Figure 3-3). At each assessment location, the following key habitat parameters were recorded:

- description of broad vegetation community;

- hollow bearing trees and dead trees (average size and abundance);
- presence of fauna refuges such as burrows;
- substrate (description of composition, presence of algal crust and percentage cover of leaf litter); and
- wetland habitats and water courses including drainage lines, sumplands, floodplains, etc.

3.3.3.2 Targeted searches

Targeted searches included methods appropriate for the detection of conservation significant fauna with potential to occur, but with a focus on detection of fauna considered to be a matter of national environmental significance (MNES; i.e. those listed under the EPBC Act). Key species targeted during the survey included the following:

- Chuditch (*Dasyurus geoffroii* [Vu, S3]);
- Malleefowl (*Leipoa ocellata* [Vu, S3]);
- Heath mouse (*Pseudomys shortridgei* [En, S3]);
- Carnaby's cockatoo (*Calyptorhynchus latirostris* [En, S2]);
- Western mouse (*Pseudomys occidentalis* [P4]);
- Western brush wallaby (*Notamacropus irma* [P4]);
- Western whipbird (*Psophodes nigrogularis oberon* [P4]);
- Quenda (*Isoodon fusciventer* [P4]); and
- Peregrine falcon (*Falco peregrinus* [S7]).

Note that while the heath and western mouse may be detected by motion camera, these species are likely to only be confidently identified via trapping, as images usually do not provide sufficient detail to identify rodents to species level. However, numerous trapping surveys have previously been conducted at RNO, including surveys that have detected the western mouse (Biota 2000, 2005, Coffey Environments 2010, Terrestrial Ecosystems 2016b, 2017a, b) and heath mouse (Biota 2000, Coffey Environments 2010). Consequently, trapping was not required and the Level 1 Targeted Fauna Survey focused on assessing habitat suitability for conservation significant fauna within Study Areas.

Targeted searches were conducted on foot with a focus on habitat suitable to support MNES species (Figure 3-3). Evidence of conservation significant species, including visual records, mounds, burrows, tracks, scat, carcasses and bones were recorded using the Fulcrum™ in-field data collection application. GPS track logs (GDA94) were recorded to demonstrate targeted survey effort.

3.3.3.3 Targeted Malleefowl Assessment

Targeted Malleefowl searches were carried out within suitable habitat using transects. This incorporated all areas of the Proposed Change Area, which was the only Study Area requiring additional Malleefowl survey effort. In addition, transect searches were also conducted in the immediate surrounds of the Study Areas, focusing on suitable habitat. The following features were recorded, with reference to information from the National Manual for the Malleefowl Monitoring System (Natural Heritage Trust 2007) and Malleefowl (*Leipoa ocellata*) Management and Monitoring Procedure (Gindalbie Metals 2009):

- Malleefowl mound location and an assessment of mound activity; and
- Malleefowl individuals, tracks and signs.

The activity of the mounds was assessed through signs described below, classifying mounds into three categories.

Active:

- Mound contained incubating leaf litter or a recently made dome or crater;
- Recent malleefowl tracks or signs (e.g. eggshells etc.); and
- Recently scraped mound surface.

Inactive:

- Mound tall with crater present however;
- Surface not recently scraped;
    - Presence of other fauna tracks or diggings on mound; and
    - Surface crust or moss present.

Extinct:

- Mound eroded and low, without a distinct crater; and
- Mound surface old and long un-scraped;
    - Established vegetation (e.g. shrubs) on mound surface; and
    - Fauna tracks and diggings present.

In addition to recording mounds detected in the Level 1 Targeted Fauna Survey, mounds recorded during previous surveys were ground-truthed and activity assessed. Habitat assessments (Section 3.3.3.1) were conducted at mounds to indicate the suitability of habitats within the Study Areas for malleefowl breeding.

3.3.3.4 Targeted Black Cockatoo Assessment

The Study Areas are located on the south coast of WA, which potentially provides breeding, roosting and foraging habitat for species of black cockatoo in areas with jarrah, marri, karri, and heath and scrub (particularly areas supporting *Banksia* spp.) (DoEE 2017).

The Study Areas lie within the predicted non-breeding range and just outside the predicted breeding range (extending to Hopetoun and Ravensthorpe) of Carnaby's cockatoo (DoEE 2017). However, the Study Areas occur outside the predicted range of the Red-tailed Black Cockatoo and Baudin's Cockatoo (DoEE 2017). As such, habitats suitable for Carnaby's cockatoo were the focus of the field survey (Table 3-4). Habitat assessments are the primary method used to identify any habitat used for foraging, breeding or roosting by the species (DoEE 2017, DSEWPaC 2012). Objectives were aligned with both guidelines as follows:

- identify and map significant habitat and trees (breeding, night roosting and foraging) based on those in Table 3-4, and assess the likelihood of their use as habitat;
- assign a quality score to potential foraging habitat from 1-10 using the scoring tool in Table 3-5;
- record evidence or signs of black cockatoo species in the area, including chewed hollows, droppings, feathers, feeding signs or debris (e.g. chewed banksia flowers, pine cones and marri nuts), and sighting records. Bite patterns will be used to determine species (where possible) using available guides i.e.; Fleming (2011);
- the vegetation present in the surrounding area, i.e. at least 12 km from the impact area, including proximity to any breeding habitat, roosting sites or watering points;
- breeding habitat, such as an estimate of the number of trees with a diameter at breast height (1.3 metres from the ground) of 500 mm, or 300 mm if salmon gum or wandoo, as well as the number and size of hollows if present;
- numbers of any known nesting trees; and
- presence of disease, such as *Phytophthora cinnamomi* or marri canker (*Quambalaria coyrecup*).

Table 3-4: Habitat features of Carnaby's cockatoo (DoEE 2017)

Habitat	Features
Breeding	Generally in woodland or forest, but also breeds in partially cleared woodland or forest, including isolated trees. Nest in hollows in live or dead trees (any tree species may provide suitable hollows), particularly salmon gum (*E. salmonophloia*), wandoo, tuart, jarrah, flooded gum (*E. rudis*), york gum (*E. loxophleba* subsp. *loxophleba*), powderbark (*E. accedens*), karri and marri.
Night roosting	Generally in or near riparian environments or natural and artificial permanent water sources. Any tall trees may provide suitable roosting, but particularly flat-topped yate (*E. occidentalis*), salmon gum, wandoo, marri, karri, blackbutt, tuart, introduced eucalypts and introduced pines.
Foraging and common food items	Native shrubland, kwongan heathland and woodland on seeds, flowers and nectar of native proteaceous plant species (*Banksia* spp., *Hakea* spp., *Dryandra* spp., and *Grevillea* spp.), as well as *Callistemon* spp. and marri. Also seeds of introduced species including *Pinus* spp., *Erodium* spp., wild radish, canola, almonds and pecan nuts; insects and insect larvae; occasionally flesh and juice of apples and persimmons.

Table 3-5: Foraging habitat scoring tool for Carnaby's cockatoo (DoEE 2017)

Starting Score	Foraging habitat for Carnaby's cockatoo
10 (Very high quality)	Foraging habitat that is being managed for black cockatoos such as habitat that is the focus of successful rehabilitation, and/or has some level of protection from clearing, and/or is quality habitat described below with attributes contributing to meet a score of ≥10.
7 (High quality)	Native shrubland, kwongan heathland and woodland dominated by proteaceous plant species such as *Banksia* spp. (including *Dryandra* spp.), *Hakea* spp. and *Grevillea* spp., as well as native eucalypt woodland and forest that contains foraging species, including along roadsides. Does not include orchards, canola, or areas under a Regional Forestry Agreement.
5 (Quality)	Pine plantation or introduced eucalypts.
1 (Low quality)	Individual foraging plants or small stand of foraging plants.
Additions	Context adjustor - attributes improving functionality of foraging habitat
+3	Is within the SCP (important foraging area).
+3	Contains trees with suitable nest hollows.
+2	Primarily comprises marri.
+2	Contains trees with potential to be used for breeding (dbh ≥ 500 mm or ≥ 300 mm dbh for salmon gum and wandoo).
+1	Is known to be a roosting site.
Subtractions	Context adjustor - attributes reducing functionality of foraging habitat
-2	No clear evidence of feeding debris.
-2	No other foraging habitat within 6 km.
-1	Is > 12 km from a known breeding location.
-1	Is > 12 km from a known roosting site.
-1	Is > 2 km from a watering point.
1	Disease present (e.g. *Phytophthora cinnamomi* or marri canker).

3.3.3.5 Motion Sensor Camera

A total of 27 Reconyx HC600 motion sensor cameras were deployed to record fauna species unlikely to be sighted opportunistically during the Level 1 Targeted Fauna Survey, including conservation significant species such as the chuditch. Cameras were placed in habitats likely to support fauna of conservation significance and in areas displaying fauna activity (e.g. burrows, foraging evidence, etc.). Cameras were deployed to ensure adequate coverage of habitats and to achieve appropriate geographical coverage of the Study Areas (Table 3-6, Figure 3-3).

Table 3-6: Motion camera locations within the Study Areas

Camera Name	Location (51H)		Habitat type	Recording nights
	Easting	Northing		
REC02	252781	6279990	Low mallee on stony rise	16
REC03	249545	6281217	Drainage line	16
REC05	252676	6282758	Low heath	10
REC07	251036	6284042	Open mallee over heath	14
REC13	250431	6283770	Mallee over large *Banksia*	14
REC16	252250	6283101	Low heath	11
REC17	250927	6281801	Drainage line	15
REC18	253747	6281105	Dense mallee over heath	18
REC19	250951	6280735	Drainage line	15
REC20	253738	6281290	Dense mallee over heath	17
REC21	252967	6282787	Open mallee over heath	11
REC25	252383	6280189	Low mallee on stony rise	16
REC26	254365	6280870	Open mallee over heath	18
REC27	253095	6280107	Low mallee on stony rise	16
REC28	249952	6282764	Open mallee over heath	15
REC30	250538	6283900	Tall mallee with limited understorey	14
REC32	252129	6279962	Mallee on loam or clay	16
REC33	254587	6280389	Dense mallee over heath	18
REC36	249627	6281375	Open mallee over heath	16
REC38	252898	6282378	Tall trees in depression	17
REC39	249588	6281778	Drainage line	16
REC41	254167	6281277	Open mallee over heath	18
REC42	253649	6281792	Low heath	17
REC43	249739	6282417	Open mallee over heath	15
REC44	250404	6282648	Low heath	15
REC45	251474	6283805	Mallee on loam or clay	11
REC46	251642	6280296	Drainage line	16
TOTAL				411

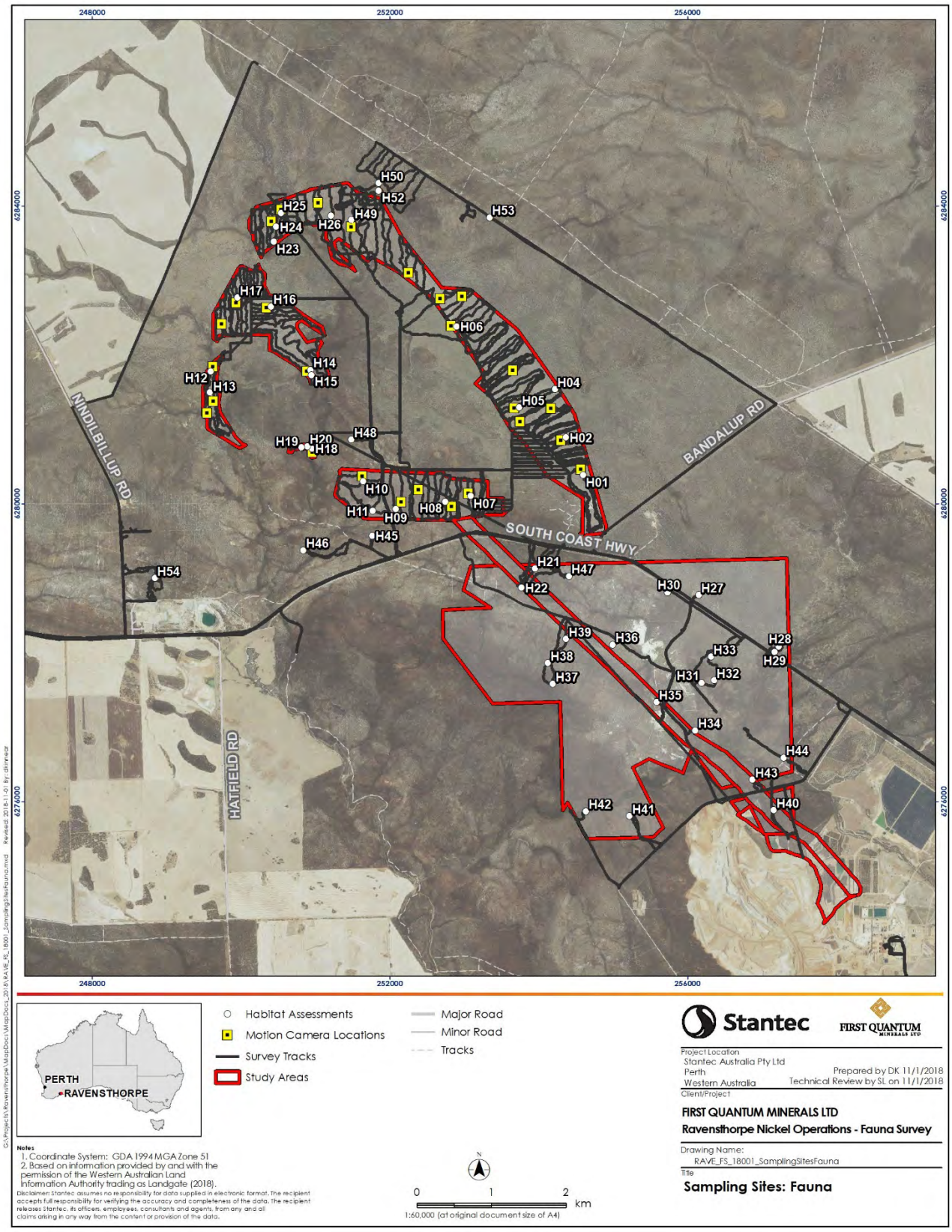


Figure 3-3: Fauna survey effort

4. Results and Discussion

4.1 Survey Limitations and Constraints

A range of factors were assessed to determine potential limitations and constraints related to the Level 1 Targeted Fauna Survey, in accordance with the EPA Guidelines for Terrestrial Fauna (Table 4-1) (EPA 2016c).

Table 4-1: Summary of limitations and constrains related to the Level 1 Targeted Fauna Survey.

Factor	Limitation / Constraint	Comments
Competency and experience of consultants	No	Field personnel are qualified Stantec zoologists with extensive experience conducting fauna surveys, including various targeted surveys for conservation significant fauna throughout Western Australia.
Scope	No	The scope was well-defined. Fauna and their habitats were surveyed using standardised and well-established techniques involving targeted searches and motion camera trapping. Relevant databases and previous studies surrounding the Study Area were reviewed.
Proportion of species identified	No	A total of 45 species were recorded during the survey, including four species of conservation significance, which is comparable to other surveys region given the survey did not include trapping. It should be noted that the reviewed surveys were of Level 2 trapping surveys, and consequently had a higher representation of mammal and reptile species due to different techniques employed. Trapping was not undertaken as the scope of works comprised identifying fauna habitats and relating this to habitat requirements for species of conservation significance. While motion cameras were deployed, images of rodents are usually not detailed enough to allow for species identification. As such, species such as the heath mouse and western mouse were not identified during the current survey.
Information sources (e.g. historic or recent)	Slight	Stantec had access to previous surveys conducted for FQM, which included baseline, targeted and monitoring surveys over 18 years at RNO. Stantec conducted a detailed analysis of survey reports, which included the Study Areas and immediate surrounds. However spatial data was unavailable, fauna records were not easily accessible, and records were not consistent between the previous survey reports. While there were inconsistencies in the number of records, the presence or absence of conservation significant species during survey events is likely to be correct. As such, the data did not limit the assessment of likelihood of conservation significant species for the Study Areas. Historical vegetation type and fauna habitat mapping was available to Stantec, and was utilised during the field survey. Habitat mapping effort focused on the Proposed Change Area, Straight Infrastructure Corridor, and Infill Survey Area, and was extrapolated in areas of the Immediate Surrounds based on the most recent Vegetation Mapping made available to Stantec by (Eco Logical in prep).
Completeness and Intensity	Slight	Adequate survey coverage was achieved to describe and delineate the habitats within the Study Areas. Additionally, survey coverage specifically focused on obtaining adequate coverage of fauna habitats with potential to support fauna of conservation significance and extensive searches have been conducted by survey teams in the area. Survey methods comprised: • 53 habitat assessments; • Targeted transects within the Proposed Change Area and Immediate Surrounds; and • 27 motion camera deployments.

Factor	Limitation / Constraint	Comments
		As noted below, malleefowl mound assessments in the Immediate Surrounds were limited due to inaccessibility of tracks following rain.
Timing / weather / season / cycle	Slight	The timing of the fauna survey was adequate. While rain occurred, survey work was only limited during the last two days, when access tracks became inaccessible. This only impacted the transect survey effort in the Immediate Surrounds, as Study Areas were surveyed beforehand. Overall, conditions were appropriate for the activity of the conservation significant fauna considered to have potential to occur in the Study Areas, with four conservation significant species detected. While Carnaby's cockatoo is known to forage in the South Coast from January – July, which occurs outside of the September October timing of the current survey, the species may occur outside of these months if breeding nearby (DoEE 2017). Results from the DBCA database search included two nearby breeding areas and the species was observed in the immediate surrounds, indicating timing was sufficient.
Disturbances	Slight	The Study Areas showed very little recent disturbance. Disturbance was limited to historic exploration and historic fires. Exploration mainly comprising drill tracks which tended to be inaccessible owing to vegetation regrowth. Fauna habitats were classified as being in excellent or pristine condition. The most recent and largest of fire disturbance was a large scale fire that burnt the majority of the Study Areas during 2003 (Figure 4-1). Note that a fire was reported in late January 2002 (Woodman Environmental Consulting 2017), during 2001 and a small fire in 2004 (Terrestrial Ecosystems 2013), however fire scar mapping was unavailable. While vegetation cover and complexity had substantially regenerated during the current survey, some targeted species of conservation significance are sensitive to fire, or require long un-burnt or dense habitat (the western whipbird, western mouse and heath mouse). As vegetation has regenerated, the western whipbird may have returned to burnt areas, and was recorded in the Study Areas. However the western and heath mouse are optimally found in habitats that have been unburnt for >30 years (Threatened Species Scientific Committee 2016, van Dyck and Strahan 2008). As such, fire may reduce the probability of the species being recorded within the Study Areas.
Resources	No	Resources were adequate to complete the survey and the survey participants were physically fit and capable of achieving adequate coverage of the Study Areas. The personnel were zoologists experienced at identifying secondary fauna signs, mapping habitat types and in deploying scientific survey equipment, such as motion cameras. DBCA database searches and data from previous survey reports were all used to prepare for the survey.
Remoteness / access problems	No	While most tracks were aged, vehicle access was available for majority of the Study Areas and was not a constraint of the survey. Adequate survey coverage was achieved on foot as evidenced by the targeted search tracks. Note coverage of the immediate surrounds was limited when rainfall made the unsealed access tracks inaccessible on the last two days of the survey. However this did not impact coverage of the Study Areas, which were surveyed beforehand.

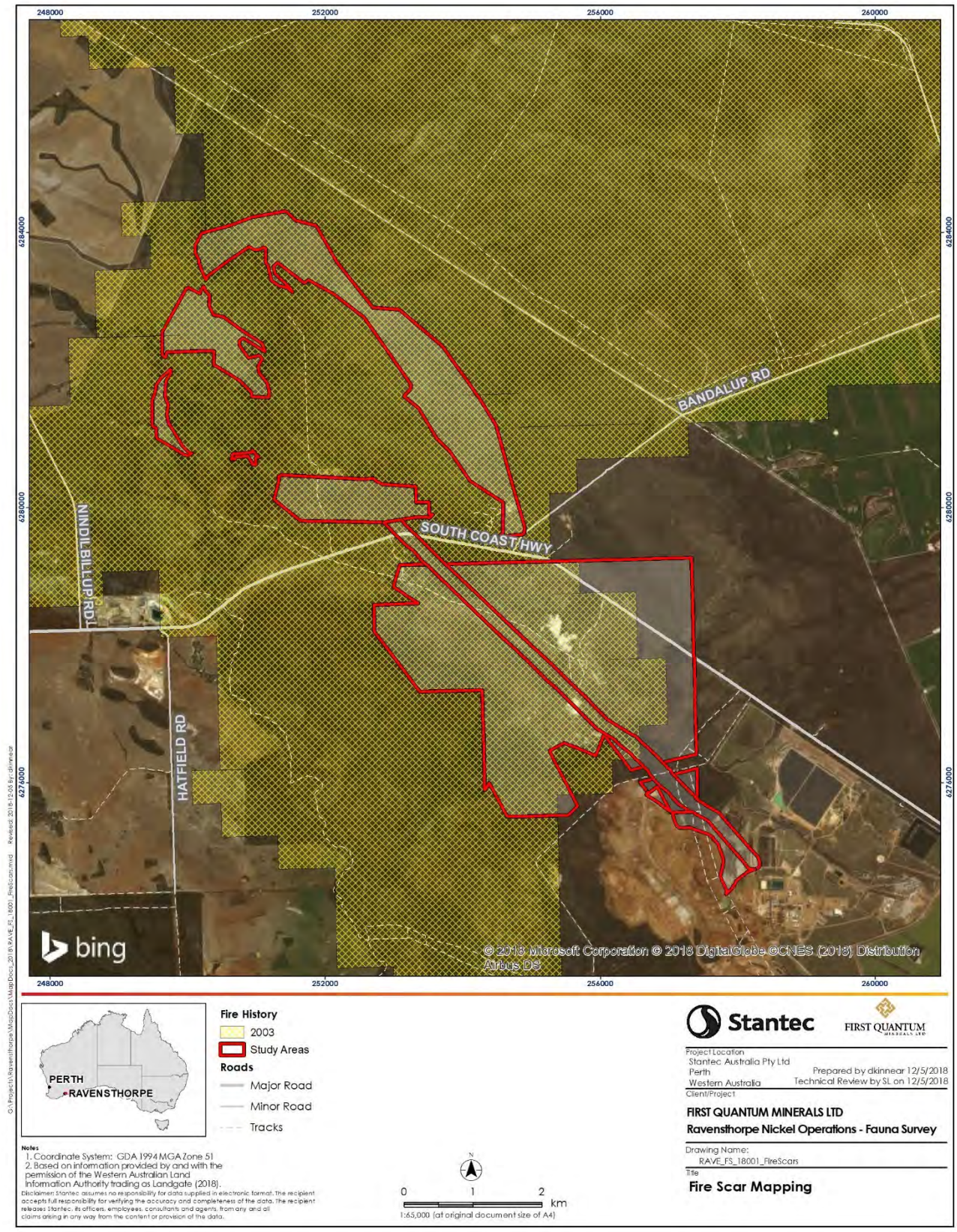


Figure 4-1: Fire scar mapping

4.2 Desktop Assessment

The desktop study identified a total of 275 species of vertebrate fauna, which have been recorded and/or have the potential to occur within the Study Areas (**Appendix B**). This comprised 25 native mammal, seven introduced mammal, 177 native bird, three introduced bird, 51 native reptile, and 12 amphibian species. Of the 275 species of vertebrate fauna identified during the desktop assessment, 34 species are listed as being of conservation significance, comprising nine mammals, 24 birds and one reptile (**Table 4-2**).

Many of these species are unlikely to occur in the Study Areas because, as leading practice, these records have been collected from a large area encompassing a wide range of habitats, many of which do not occur within the Study Areas. Furthermore, some small, common, ground-dwelling reptile and mammal species tend to be patchily distributed even where appropriate habitats are present, and many species of bird can occur as regular migrants, occasional visitors or vagrants.

Table 4-2: Vertebrate fauna of conservation significance identified during the desktop assessment

Species Name	Common Name	EPBC	WA
Mammals			
Pseudomys shortridgei	Heath Mouse	En	S3
Myrmecobius fasciatus	Numbat	En	S2
Parantechinus apicalis	Dibbler	En	S2
Dasyurus geoffroii	Chuditch	Vu	S3
Phascogale calura	Red-tailed Phascogale	Vu	S6
Notamacropus eugenii derbianus	Tammar Wallaby		P4
Notamacropus irma	Western Brush Wallaby		P4
Psophodes nigrogularis oberon	Western Whipbird (southern WA ssp.)		P4
Isoodon fusciventer	Quenda		P4
Pseudomys occidentalis	Western Mouse		P4
Birds			
Calidris ferruginea	Curlew Sandpiper	Cr; Mi	S3; S5
Numenius madagascariensis	Eastern Curlew	Cr; Mi	S3; S5
Pezoporus occidentalis	Night Parrot	En	S1
Psophodes nigrogularis nigrogularis	Western Whipbird (western heath)	En	S2
Botaurus poiciloptilus	Australasian Bittern	En	S2
Dasyornis longirostris	Western Bristlebird	En	S3
Calidris canutus	Red Knot	En; Mi	S5
Leipoa ocellata	Malleefowl	Vu	S3
Thalassarche chlororhynchos	Yellow-nosed Albatross	Vu; Mi	S3; S5
Pandion haliaetus	Osprey	Mi	S5
Arenaria interpres	Ruddy Turnstone	Mi	S5
Calidris acuminata	Sharp-tailed Sandpiper	Mi	S5
Calidris alba	Sanderling	Mi	S5
Calidris melanotos	Pectoral Sandpiper	Mi	S5
Calidris ruficollis	Red-necked Stint	Mi	S5
Tringa hypoleucos	Common Sandpiper	Mi	S5
Tringa nebularia	Common Greenshank	Mi	S5

Sterna bergii	Crested Tern	Mi	S5
Apus pacificus	Fork-tailed Swift	Mi	S5
Motacilla cinerea	Grey Wagtail	Mi	S5
Falco peregrinus	Peregrine Falcon		S7
Thinornis cucullatus	Hooded Plover		P4
Reptiles			
Lerista viduata			P1

4.3 Fauna Habitat

Twelve broad fauna habitats, as well as cleared and rehabilitated areas, were identified and delineated throughout the Study Areas during the Level 1 Targeted Fauna Survey (Table 4-3, Table 4-4, Figure 4-2, Appendix A). Habitat mapping was based on interpretations of Woodman Environmental Consulting (2017) and Eco Logical (in prep) vegetation type mapping in the area. Habitat assessments and ground-truthing were used to determine associations between broad habitat and vegetation types, largely within the Study Areas. These 12 habitats occurred within three broad landforms across the Study Areas (Table 4-3).

Habitats differed primarily in the composition of their vegetation structure and substrates, in particular variation in time since last fire, density of mallee, presence of heath on sandy substrate and abundance of stony substrate. The habitat types in the Study Areas were assessed based on their extents and levels of significance according to the following criteria:

- Distribution: those habitats widespread and common within the surrounding regions were categorised as widespread; otherwise they were categorised as being of limited extent. Three habitats were considered to have a limited extent; tall mallee with limited understorey, tall trees in depression and , melaleuca shrubland. These were considered limited extent as they occupied relatively small, isolated areas. Of these, tall trees in depression and mallee with limited understorey was recorded in the Proposed Change Area and also in the immediate surrounds. Melaleuca shrubland was only recorded in the Straight Infrastructure Corridor.
- Significance: those habitats considered important to species of conservation significance or distinct fauna assemblages are deemed significant; otherwise they were categorised as being of limited significance. Eleven habitats were considered significant; this includes all habitats aside from Melaleuca shrubland, as well as cleared and rehabilitated areas.

All habitats aside from *Melaleuca* shrubland were associated with records of conservation significant species in the area (Figure 4-3).

Table 4-3: Fauna habitats within the Study Areas (Percentages of each habitat expressed as a proportion of the Total Area Mapped)

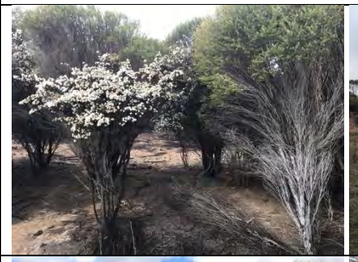
Broad Landform	Habitat	Proposed Change Area		Central Study Area		Infill Survey Area		Straight Infrastructure Corridor		*Study Areas		Immediate Surrounds		#Total Area Mapped	
		Ha	%	Ha	%	Ha	%	Ha	%	Ha	%	Ha	%	Ha	%
Plains comprising grey sandy soils	Dense mallee over heath	42.64	5.44	34.32	4.37	0	0	0	0	76.96	9.81	707.55	90.19	784.51	8.23
	Open mallee over heath	278.21	18.53	179.68	11.97	0	0	0	0	457.89	30.49	1043.64	69.51	1501.53	15.74
	Low heath	65.91	30.30	0	0	0	0	0	0	65.91	30.30	151.62	69.70	217.53	2.28
Undulating low hills and rises comprising clay or loam soils	Mallee over large Banksia	22.82	10.03	63.70	28.00	0	0	0	0	86.52	38.03	140.99	61.97	227.51	2.39
	Tall mallee with limited understorey	7.89	15.05	11.10	21.18	1.78	3.40	13.13	25.04	33.90	64.67	18.52	35.33	52.42	0.55
	Tall mallee with understorey	4.43	0.27	225.34	13.85	0	0	21.50	1.32	251.27	15.44	1376.15	84.56	1627.42	17.06
	Low mallee on stony rise	116.31	7.52	86.65	5.60	2.21	0.14	21.98	1.42	227.15	14.68	1319.83	85.32	1546.98	16.22
	Mallee on loam or clay	65.75	4.25	361.46	23.37	2.49	0.16	51.78	3.35	481.49	31.13	1065.06	68.87	1546.55	16.22
	Low shrubland	0	0	65.11	16.11	0.84	0.21	10.19	2.52	76.13	18.84	327.88	81.16	404.01	4.24
Water courses	Drainage line	26.60	5.47	64.49	13.26	1.66	0.34	11.37	2.34	104.12	21.41	382.25	78.59	486.37	5.10
	Melaleuca shrubland	0	0	0	0	0	0	0.85	100	0.85	100	0	0	0.85	0.01
	Tall trees in depression	2.97	19.48	0	0	0	0	0	0	2.97	19.48	12.29	80.52	15.26	0.16
Disturbed Area	Rehabilitated	0.15	0.18	0	0	10.72	12.55	6.77	7.93	17.64	20.66	67.74	79.34	85.38	0.90
	Cleared	5.49	0.53	42.95	4.13	15.69	1.51	16.01	1.54	80.14	7.70	960.25	92.30	1040.39	10.91
Total (relative to total area mapped)		639.18	6.70	1134.79	11.90	35.40	0.37	153.58	1.61	1962.95	20.58	7573.79	79.42	9536.73	100

*Sum of Proposed Change Area, Central Study Area, Infill Survey Area and Straight Infrastructure Corridor

#Sum of the Study Areas and Immediate Surrounds

Table 4-4: Fauna habitats recorded within the Study Areas

Habitat type	Dominant Vegetation Types*	Condition in Study Areas	Description / Value to Fauna	Reference Photographs
Mallee over large *Banksia* • Widespread • Significant	VT6	Excellent – Pristine	Areas characterised by long-unburnt vegetation, producing a relatively tall upper storey of mallee and banksia. Mid storey varied from low to high cover, dominated by mallee, melaleuca and banksia species, over a medium to dense lower cover of melaleuca, shrubs and sedges. Woody debris and peeling bark were common, with moderate leaf litter cover. The large, long unburnt *Banksia* present in these areas would potentially provide feeding habitat for Carnaby's cockatoo (En S2), however no evidence of feeding was recorded. Being long unburnt, the vegetation was well established and increased shelter would be provided to fauna. This is particularly important to species sensitive to fire, including the western mouse (P4). While the heath mouse (En S3) may inhabit areas with a dense lower shrub storey, the species tends to inhabit heath and as such this habitat may not be preferable.	
Drainage line • Widespread • Significant	VT12, VT6, VT11, VT17, VT16	Excellent – Pristine	Drainage lines were characterised by dense vegetation, varying from relatively major (left) to minor (right) channels. Areas comprised a relatively tall, medium to dense upper storey of mallee over a medium to dense middle storey of shrubs. These included mallee, *Melaleuca*, *Acacia* (particularly *Acacia glaucoptera*), vines and hakea species. Lower storey comprised a low to medium cover of shrubs and sedges. Woody debris and peeling bark were common or abundant, and leaf litter cover was moderate to high. Drainage lines would provide a water source once flooded. Dense vegetation would provide suitable cover and shelter for a variety of reptile, mammal and bird species. This includes the western mouse (P4,) western whipbird (P4) and heath mouse (En S3), however the latter tends to inhabit heath, which was absent in these areas. Some vegetation potentially supporting western whipbird nests (e.g. *Hakea*) was present.	
Tall mallee with limited understorey • Limited extent • Significant	VT8	Excellent – Pristine	This habitat was characterised by an abundance of tall mallee (~6m) forming a high cover canopy over sparse melaleuca with minimal understorey. Vegetation provided very high leaf litter cover and abundant woody debris over loamy soils. These habitats were long-unburnt. This habitat may provide potential breeding habitat for malleefowl (Vu S3) as the species is thought to favour areas with a dense canopy cover, reduced sedges, loamy substrates with gravel and an abundance of leaf litter (Parsons 2008). While these areas tended to lack malleefowl food shrubs (e.g. *Acacia*), they were typically relatively small and surrounded by habitats containing potential foraging habitat, and as such may remain suitable for mound construction. However, no malleefowl mounds were recorded.	
Tall mallee with understorey • Widespread • Significant	VT8	Excellent – Pristine	This habitat ranged from a shrub understorey with relatively tall mallee (left) to younger dense mallee (right). Upper storey cover ranged from moderate to dense mallee over shrubs including mallee, acacia, melaleuca, vines, dodenaea and banksia. Lower shrubs included acacia and sedges. Most areas comprised loamy substrates, however included clay in some areas. Ground cover was almost entirely gravel fragments between 6 – 20mm in diameter in the southwest of the Central Study Area. Woody debris and peeling bark were common, and leaf litter cover tended to range from low to moderate. This habitat would provide, cover, burrowing suitability and additional shelter from woody debris and peeling bark for mammals and reptiles (including the quenda [P4] and western mouse [P4]). The tall mallee and loamy substrate may provide suitable mound construction habitat for malleefowl (Vu S3), and several mounds were recorded in this habitat.	
Mallee on loam or clay • Widespread • Significant	VT14, VT9, VT18	Excellent – Pristine	This habitat displayed the largest degree of variation, however tended to comprise mallee (3-4m) over species including acacia (usually *Acacia glaucoptera*), mallee, *Grevillea*, *Melaleuca* and sedges. Vines were present in some areas, and the upper shrub layer varied from a moderate to high cover. While no areas contained a large amount of exposed bedrock or high cover of large coarse fragments, the cover of coarse fragments varied. Substrates included clay or loam. These habitats tended to comprise moderate levels of peeling bark, leaf litter and woody debris. This habitat would provide high suitability for a variety of species owing to the diverse vegetation and moderate to high cover. This includes the western mouse (P4), western whipbird (P4) and heath mouse (Vu S3). Some vegetation potentially supporting western whipbird nests (e.g. *Hakea*) was present. The lack of exposed bedrock and large coarse fragments and presence of loam and mallee would provide potential breeding habitat for malleefowl, and mounds were recorded within the habitat.	

Habitat type	Dominant Vegetation Types*	Condition in Study Areas	Description / Value to Fauna	Reference Photographs
Low mallee on stony rise • Widespread • Significant	VT6, VT3, VT14, VT7	Excellent – Pristine	Characterised by a mallee which tended to occur in stony substrates on rises and slopes, with minimal or no upper cover and a dense mid-storey. The shrub lower storey comprised ***Melaleuca*** and ***Acacia***, commonly ***Acacia glaucoptera***, over mixed shrubs and sedges. Most ground cover comprised coarse rocks and fragments, ranging from 20 – 200mm. Habitat in the southern section of the Proposed Change Area comprised a moderate cover of exposed bedrock. Woody debris was abundant, with a moderate amount of leaf litter and peeling bark. The dense mallee would provide cover for fauna, such as the western whipbird (P4), and contained some ***Hakea*** which is listed as potential nesting habitat. The substrate had limited burrowing suitability in some areas owing to the abundance of relatively large rocks. However areas of exposed rock would provide shelter for reptiles and small mammals.	
Low shrubland • Widespread • Significant	VT4, VT10	Excellent – Pristine	Low shrubland habitat typically lacked an upper storey and was characterised by a dense low cover of shrubs (~1m tall) on hills. This was mainly dominated by acacia (left), or melaleuca in one area near the eastern Study Area boundary (right). This habitat tended to have rare or low leaf litter cover, peeling bark and woody debris. Areas with ***Melaleuca*** tended to comprise a sandy substrate with no coarse fragments, while acacia substrates contained clay and were largely covered by coarse fragments from 20 – 200mm in diameter. Low shrublands would provide cover for mammals and reptiles, such as the quenda (P4), however would have limited suitability for birds owing to the height of vegetation. This is aside from the western whipbird (P4), which requires dense low vegetation and was recorded in the habitat. Coarse fragments would reduce burrowing and foraging suitability in acacia dominated areas, while ***Melaleuca*** areas would have high suitability owing to the sandy substrate.	
Melaleuca shrubland • Limited extent • Limited significance	C	Degraded	***Melaleuca*** shrubland comprised a dense upper-storey of ***Melaleuca*** with no mid or lower storey surrounding a cleared depression (right). Substrates comprised compact clayey sand, with an abundance of woody debris and little of no peeling bark and leaf litter. The habitat was degraded; areas were cleared (including vehicle tracks) and hydrology was altered. This habitat was degraded however it has some potential to water birds including migrator species when inundated. The vegetation would provided limited shelter for terrestrial fauna owing to the large cleared areas and the lack of dense lower cover. Burrowing suitability was poor, potentially limiting burrowing and foraging. When flooded, the depression would serve as a water source.	
Dense mallee over heath • Widespread • Significant	VT5	Excellent – Pristine	Characterised by a dense mallee upper-storey ~3m high over mallee, banksia and some hakea shrubs over mixed heath and sedges. Substrates were sandy with minimal coarse fragment cover and an abundance of leaf litter, woody debris and peeling bark. This habitat would provide substantial shelter for fauna owing to the lower cover, woody debris and peeling bark. The loose sandy substrate would provide high burrowing and foraging suitability. Due to this, these areas would potentially support the heath mouse (En, S3), western mouse (P4), western brush wallaby (P4), quenda (P4) and western whipbird (P4).	

Habitat type	Dominant Vegetation Types*	Condition in Study Areas	Description / Value to Fauna	Reference Photographs
Open mallee over heath • Widespread • Significant	VT1, VT15	Excellent – Pristine	Characterised by a relatively open mallee upper storey over a high lower cover of ***Banksia***, ***Hakea***, ***Isopogon***, ***Eucalyptus tetraptera*** heath and sedges, and in some areas ***Melaleuca***. While the upper storey tended to be open, some areas contained denser thickets of mallee. This habitat occurred on sandy substrates with minimal or no coarse fragments with a moderate level of leaf litter, woody debris and peeling bark. The high burrowing and foraging suitability of the sandy substrate and shelter provided by the heath understorey would serve as habitat for a variety of mammal and reptile species. These include the heath mouse (En, S3), western mouse (P4), quenda (P4) and the western brush wallaby (P4). Vegetation potentially supporting nesting habitat for the western whipbird (P4) was present, and this habitat was interspersed with dense mallee thickets (see right), which would be suitable for the species.	
Low heath • Widespread • Significant	VT2	Excellent – Pristine	This habitat comprised a sparse upper storey of mallee over a high lower cover of ***Hakea***, ***Banksia***, ***Isopogon***, heath and sedges. Substrates were sandy with little or no coarse fragments, and leaf litter, woody debris and peeling bark were rare and largely restricted to areas with upper storey. The high burrowing and foraging suitability of the sandy substrate and the dense heath understorey would provide habitat for a variety of mammal and reptile species, including the heath mouse (En, S3), western mouse (P4) the western brush wallaby (P4), and quenda (P4). However the area tended to lack an upper storey, and would have reduced suitability for some bird species. Vegetation potentially supporting western whipbird (P4) nests was present, and this habitat was interspersed with dense mallee thickets (see two above), which would be suitable for the species.	
Tall trees in depression • Limited extent • Significant	VT13	Pristine	An isolated, small area of habitat in a natural depression characterised by an open cover of tall trees over a low cover of melaleuca and hakea. Lower storey was dominated by high sedge cover. Substrate was sandy and lacked coarse fragments, and peeling bark and leaf litter were low. There was an abundance of woody debris, including large dead trees. No tree hollows were recorded. The tall trees may provide marginally suitable roosting habitat for Carnaby's cockatoo (En S2), however no trees exceeded 50mm in diameter and no evidence of roosting was recorded. Fallen trees may serve as shelter for reptiles and mammals such as the chuditch (En S3), and some fallen trees contained shallow hollows. Some ***Hakea*** was present, which may be suitable for western whipbird nesting (P4), however denser and likely more suitable vegetation was located in surrounding heath.	
Rehabilitated	R	Completely degraded	Areas that have been historically cleared or landforms that have been constructed as a result of mining. Unlikely to be suitable for supporting fauna until more developed.	NA
Cleared	C	Completely degraded	Cleared areas lacked vegetation and provided minimal shelter and value for fauna.	NA

* Vegetation types (VT) mapped in Eco Logical (in prep)

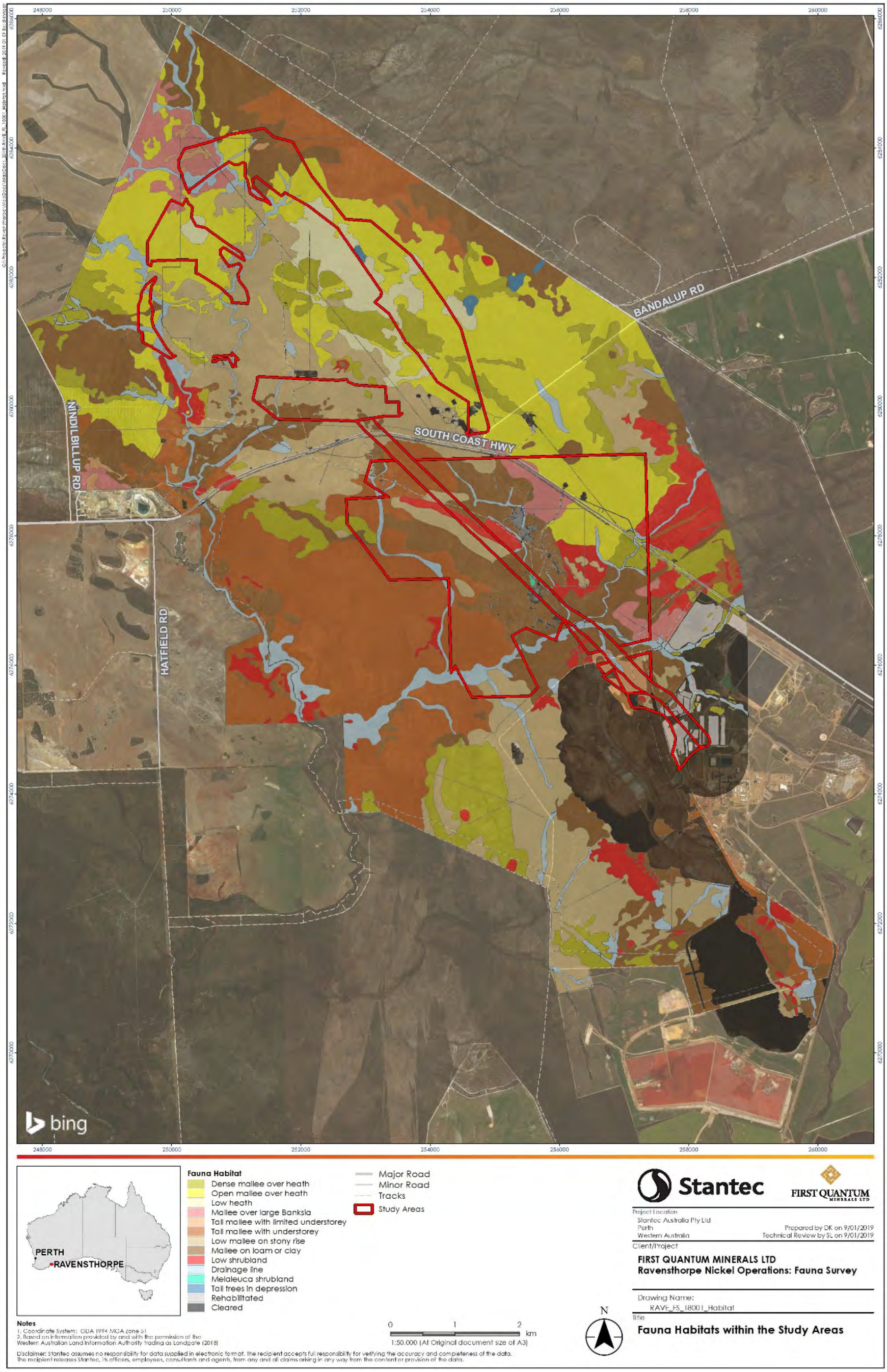


Figure 4-2: Fauna habitats within the Study Areas

4.4 Fauna Assemblages

A total of 45 species of vertebrate fauna were recorded during the Level 1 Targeted Fauna Survey, of which seven were mammals, 32 were birds and six were reptiles (Table 4-5). Four species of conservation significance were recorded; the chuditch (VU, S3), western brush wallaby (P4), malleefowl (VU, S3), and the western whipbird (P4) (Section 4.5). Two introduced species, the fox (*Vulpes Vulpes*) and the cat (*Felis catus*) were also recorded.

Table 4-5: Vertebrate fauna species recorded from the Study Areas during the field survey

Species name	Common name	EPBC	WA
Mammals			
Dasyurus geoffroii	Chuditch	Vu	S3
Notamacropus irma	Western brush wallaby		P4
Tachyglossus aculeatus	Echidna		
Macropus fuliginosus	Western grey kangaroo		
Tarsipes rostratus	Honey possum		
Felis catus	*Cat		
Vulpes vulpes	*Fox		
Birds			
Leipoa ocellata	Malleefowl	Vu	S3
Psophodes nigrogularis oberon	Western whipbird		P4
Falco cenchroides	Australian kestrel		
Coracina novaehollandiae	Black-faced cuckoo-shrike		
Lichenostomus leucotis	White-eared honeyeater		
Anthochaera carunculata	Red wattlebird		
Gavicalis virescens	Singing honeyeater		
Corvus coronoides	Australian raven		
Strepera versicolor	Grey currawong		
Platycercus zonarius	Australian ringneck		
Dromaius novaehollandiae	Emu		
Phaps chalcoptera	Common bronzewing		
Milvus migrans	Black kite		
Anthochaera lunulata	Western little wattlebird		
Eurostopodus argus	Spotted nightjar		
Phylidonyris novaehollandiae	New holland honeyeater		
Parvipsitta porphyrocephala	Purple-crowned lorikeet		
Pomatostomus superciliosus	White-browed babbler		

Species name	Common name	EPBC	WA
Glyciphila melanops	Tawny-crowned honeyeater		
Colluricincla harmonica rufiventris	Western grey shrike-thrush		
Rhipidura leucophrys	Willie wagtail		
Oreoica gutturalis	Crested bellbird		
Lichmera indistincta	Brown honeyeater		
Zosterops lateralis chloronotus	Silvereye		
Hirundo neoxena	Welcome swallow		
Hirundo neoxena	Fairy martin		
Podargus strigoides	Tawny frogmouth		
Cracticus tibicen	Australian magpie		
Aquila audax	Wedge-tailed eagle		
Sugomel niger	Black honeyeater		
Manorina flavigula	Yellow-throated miner		
Lichenostomus cratitius	Purple-gaped honeyeater		
Reptiles			
Tiliqua rugosa	Blue tongue		
Ctenophorus maculatus griseus			
Ctenophorus chapmani	Southern heath dragon		
Varanus rosenbergi	Heath monitor		
Pseudonaja affinis	Dugite		
Notechis scutatus	Tiger snake		

4.5 Fauna of Conservation Significance

Of the 275 species of vertebrate fauna identified from the Desktop Assessment, 34 species are listed as being of conservation significance, comprising nine mammals, 24 birds and one reptile. Of these, nine species have been confirmed either during the Level 1 Fauna Survey or previous surveys within the Study Areas or Immediate Surrounds (Table 4-7, Figure 4-3 – Figure 4-6). One Priority listed species of invertebrate, Eula's planthopper (*Budginmaya eulae*; P1) was identified from the database searches, having been previously recorded in the Immediate Surrounds (Table 4-7).

Additionally, based on previous surveys and database searches, a further 23 species of conservation significance potentially occur within the Study Areas (Table 4-8). Of these, three species are considered to possibly occur due to the occurrence of suitable habitat and/or nearby records including *Apus pacificus* (Fork-tailed Swift), *Dasyornis longirostris* (Western Bristlebird) and *Lerista viduata*. The remaining species are considered unlikely to occur (Table 4-8).

Of the 34 conservation significant species:

- 15 are listed as threatened under the EPBC Act and/or the WC Act;
- seven are recognised as being of conservation concern under the WC Act (Priority fauna);
- one is recognised under the WC Act to require special protection; and

- 15 are listed under the EPBC Act and/or WC Act as Migratory, in alignment with applicable international agreements.

Habitat mapping delineated in the Level 1 Targeted Fauna Survey was used to indicate areas potentially preferred by species confirmed within the Study Areas or immediate surrounds. Where records occurred outside of the Study Areas surveyed, habitat mapping was extrapolated based on vegetation types identified and delineated by Woodman Environmental Consulting (2017) and Eco Logical Australia (in prep).

Habitat associations for conservation significate fauna have varying degrees of confidence, based on broader scientific knowledge, the number of records from the RNO area and potential for confounding factors such as fire. These associations are summarised in Table 4-6 and detailed within Table 4-7.

Table 4-6: Summary of Conservation Significant fauna (confirmed or likely to occur) and associated habitat within the Study Areas and local surrounds

Conservation significant fauna	Conservation status		Plains comprising grey sandy soils			Undulating low hills and rises comprising clay or loam soils						Water courses			Disturbed areas	
	EPBC Act	WA	Dense mallee over heath	Open mallee over heath	Low heath	Mallee over large Banksia	Tall mallee with limited understorey	Tall mallee with understorey	Low mallee on stony rise	Mallee on loam or clay	Low shrubland	Drainage line	Melaleuca shrubland	Tall trees in depression	Rehabilitated	Cleared
Chuditch (Dasyurus geoffroii)	Vu	S3					✓	✓	✓	✓						
Heath mouse (Pseudomys shortridgei)	Vu	S3				✓			✓	✓						
Western mouse (Pseudomys occidentalis)		P4	✓						✓	✓	✓					
Western brush wallaby (Notamacropus irma)		P4	✓	✓	✓											
Quenda (Isoodon fusciventer)		P4						✓		✓	✓					
Malleefowl *(Leipoa ocellata) – Breeding habiatat*	Vu	S3					✓	✓		✓						
Malleefowl *(Leipoa ocellata) – Foraging habitat*		P4							✓			✓				
Western whipbird *(southern WA ssp.) (Psophodes nigrogularis oberon)*	En	S2	✓	✓					✓	✓		✓				
Carnaby's Cockatoo *(Calyptorhynchus latirostris)*		S7				✓								✓		
Peregrine Falcon *(Falco peregrinus)*	Vu	S3										✓				
Eula's planthopper (*Budginmaya eulae*)		P1								✓						

Table 4-7: Fauna of conservation significance confirmed within the Study Areas or immediate surrounds

Common name (scientific name)	Conservation status		Presence of species				Habitat preferences	Likelihood of occurrence, reason for likelihood and habitat associations
	EPBC Act	WA	Central Study Area and Infill Survey Area	Straight Infrastructure Corridor Area	Proposed Change Area	Immediate Surrounds		
Mammals								
Chuditch (*Dasyurus geoffroii*)	Vu	S3	✓	✓	✓	✓	Inhabit a range of areas including forest, mallee shrublands, woodlands and desert (DEC 2012a). The species requires hollow logs or burrows to serve as shelter, and feeds on reptiles, mammals and larger invertebrates (DEC 2012a).	**Confirmed** The species has been confirmed within the Study Areas and immediate surrounds during 2009, 2010 and 2015 – 2018 (Coffey Environments 2009, 2010, DEC 2012a, Terrestrial Ecosystems 2015, 2016a, b, 2017a, b, 2018) (**Figure 4-3**). This includes one record from the current survey within tall mallee with limited understorey habitat in the northern area of the Proposed Change Area (**Figure 4-3**, **Appendix D**). Overall, these records demonstrate the species is a long-term inhabitant of Study Areas and surrounds. Most habitats identified in the area may support chuditch. While hollow logs were not common in the Study Areas, most habitats comprised substrates with medium to high burrowing suitability, mallee shrubs and prey or evidence of prey (e.g. varanids, reptile and mammal diggings etc.). In accordance, the species has been recorded throughout the Study Areas and immediate surrounds in a variety of habitats. This includes within tall mallee shrubland with limited understorey, despite comprising a relatively small area. However, there were relatively few or no records associated with sandy heath habitats, indicating these may be less preferable. **Optimal habitats within Study Areas**: The species is recorded in and known to occupy a wide range of habitats. Based on previous records the species may occupy all habitats aside from tall trees in depression, dense mallee over heath and low heath, with records most common to the following habitats: • Mallee on loam or clay; • Low mallee on stony rise; • Tall mallee with understorey; and • Tall mallee with limited understorey.
Heath mouse (*Pseudomys shortridgei*)	Vu	S3	✓			✓	Tend to occupy habitats with a diverse and complex heath understorey, such as open woodlands and forests, however may also occur in mixed scrub and mallee (Threatened Species Scientific Committee 2016). Western populations inhabit areas unburnt for at least ten years, with relatively high population densities recorded in habitat unburnt for 30 years (Threatened Species Scientific Committee 2016). The species was correlated with a dense, 40 years unburnt diverse lower storey of proteaceous and myrtaceous vegetation over yellow-brown soils with laterite at Lake Magenta Nature Reserve (14 out of 15 captures) (Quinlan 2001).	**Confirmed** All records within the Study Areas and immediate surrounds occurred within or near the southern portion of the Central Study Area and Infill Survey Area. The species was only confirmed once within the Central Study Area during 2000 and in the immediate surrounds in seven locations (**Figure 4-3**). Two of these records were from 2010, while the remaining records were between 1999 and 2000. This lack of recent records despite extensive trapping effort may indicate the population has declined within the area. Furthermore, the species has been recorded once recently in the surrounding area (during 2016 ~15km south west of the Study Area (DBCA 2018b), which together with RNO records indicates the species is sparsely distributed in the area. Habitat mapping indicates most species records occur within mallee on loam or clay, mallee over large *Banksia* and low mallee on stony rise (transitioning into dense mallee over heath). Two of these locations occur near drainage lines, which may result in increased lower storey cover. Remaining records occur in areas which have since been cleared, however were mapped as low mallee on stony rise (two locations), mallee on loam or clay and tall mallee with understorey (one location each) based on habitat associations with vegetation mapping completed by Woodman Environmental Consulting (2017). It should be noted that the species is sparsely distributed (Threatened Species Scientific Committee 2016) and as such they potentially occupy other suitable habitats such as areas of heath dominated habitats with a dense lower storey, which occur in the Proposed Change Area (**Table 4-4**). **Optimal habitats within Study Areas**: Potentially favour long unburned areas of the following habitats with a particularly dense lower cover (note most of the Study Area aside from the Infill Survey Area and eastern edge of the Central Study Area were burnt in 2003, see **Figure 4-1**). The

Common name (scientific name)	Conservation status		Presence of species				Habitat preferences	Likelihood of occurrence, reason for likelihood and habitat associations
	EPBC Act	WA	Central Study Area and Infill Survey Area	Straight Infrastructure Corridor Area	Proposed Change Area	Immediate Surrounds		
								species has been recorded in the following habitats in the Study Areas and immediate surrounds: • Mallee on loam or clay; • Low mallee on stony rise; and • Mallee over large *Banksia*. **Likelihood of occurrence within the Proposed Change Area: Likely** The species has been recorded near and the Proposed Change Area and the Proposed Change Area contains suitable habitat. However there is a paucity of records, particularly following the 2003 fire. Furthermore, the 2003 fire affected all habitats within the Proposed Change Area, creating habitat that is 15 years unburnt. While the species occupies habitat at least ten years unburnt, high species densities occur in habitat 30 years unburnt (Threatened Species Scientific Committee 2016). Due to this, the species is considered **Likely** to occur.
Western mouse (*Pseudomys occidentalis*)		P4			✓	✓	Occupy a wide range of habitats, however tend to be recorded in long unburnt (>30 years) vegetation with a storey of low dense vegetation, including *Eucalytpus*, *Isopogon*, *Acacia*, *Casuarina* and *Melaleuca* species, particularly Quandong and sedges (van Dyck and Strahan 2008). Most habitats occur on sandy clay loams or sandy loams with a high gravel component, and are often near granite outcrops (Morris *et al.* 1993).	**Confirmed** The western mouse has been confirmed once in the southern region of the Proposed Change Area during 2017 (Terrestrial Ecosystems 2017a) (**Figure 4-3**). All other records occur in the immediate surrounds, with two records in close proximity to the southern portion of Proposed Change Area during 2017 (<50m and ~500m north) (Terrestrial Ecosystems 2017a) (**Figure 4-3**). Records occur south of the Central Study Area in 13 broad locations ranging from 1998 – 2017 (**Figure 4-3**), indicating the species is a long-term inhabitant in the area. There is only one record within 30 km of the Study Areas but outside the immediate surrounds (~24km west of the project (2002) (DBCA 2018b)), which together with the relatively low capture rates in the immediate surrounds despite extensive trapping indicates the species is sparsely distributed. Habitat mapping demonstrates that most records occur within low mallee on stony rise habitats. Four of these records occurred in low shrubland (from two broad locations), three from mallee on loam or clay (including a 2017 record), with one record from drainage line and one from dense mallee over heath. However, it is worth noting that four of the record locations were from low mallee on stony rise habitat near a transition into dense mallee over heath, and one occurred near a transition into drainage line habitat. As the species may be sparsely distributed and not easily recorded, it should be noted that they may occupy other habitats with a suitable dense lower storey and fire history. **Optimal habitats within Study Areas:** Potentially favour long unburned areas of the following habitats (note most of the Study Area aside from the Infill Survey Area and eastern edge of the Central Study Area were burnt in 2003, see **Figure 4-1**). The species has been recorded from within the Study Areas and immediate surrounds from the following habitats: • Low mallee on stony rise; • Low shrubland; • Mallee on loam or clay; and • Dense mallee over heath.
Western brush wallaby (*Notamacropus irma*)		P4	✓	✓	✓	✓	Inhabits open woodland and forest, mallee and heath (DEC 2012b). The species also preferentially utilise open seasonally wet flats and scrub thickets (DEC 2012b).	**Confirmed** The western brush wallaby was confirmed on numerous occasions throughout the Study Areas during the current survey. Records comprised scat ranging from very old to recent (437 locations), opportunistic observations (13 locations), motion camera photos (13 locations) and one carcass of a young individual with a wound that indicated predation (**Appendix D**, **Figure 4-5**). The species has also been recorded in numerous other surveys, including all other surveys conducted at RNO from 2000 – 2018 (Biota 2000, 2005, Coffey Environments 2009, 2010, Terrestrial Ecosystems 2013, 2014, 2015, 2016a, b, 2017a, b, 2018) (**Figure 4-5**).

Common name (scientific name)	Conservation status		Presence of species				Habitat preferences	Likelihood of occurrence, reason for likelihood and habitat associations
	EPBC Act	WA	Central Study Area and Infill Survey Area	Straight Infrastructure Corridor Area	Proposed Change Area	Immediate Surrounds		
								While evidence of the species was recorded in all habitats during the current survey, the vast majority of scat records and all opportunistic observations were recorded in dense and open mallee over heath and low heath habitats. This indicates that the species favours sandy areas dominated by heath. **Optimal habitats within Study Areas:** • Dense mallee over heath; • Open mallee over heath; and • Low heath.
Quenda (*Isoodon fusciventer*)		P4	✓	✓		✓	Range of habitats including woodland, forest, shrub and heath, with a tendency to favour sandy soils with a dense heath lower storey (van Dyck and Strahan 2008).	**Confirmed** The quenda has been recorded once in the Straight Infrastructure Corridor and three times in the Central Study Area during 2018 (Terrestrial Ecosystems 2018). The species has also been recorded in the area during 2000, 2009 and 2016 – 2018 (Biota 2000, Coffey Environments 2009, Terrestrial Ecosystems 2016a, 2017a, 2018) (**Figure 4-3**). While recorded across multiple years, there are relatively few records for the species, including in the surrounding region (the closest most recent record occurs ~18km west of the Study Areas during 2000 (DBCA 2018b). This indicates the species may be sparsely distributed in the area. The Quenda has been recorded in tall mallee with understorey, low shrubland and mallee shrubland or near drainage lines in the Study Areas or immediate surrounds. However, based on known habitat preferences (heath lower storey over sandy substrates) and given that the species is sparsely distributed; the Quenda also has potential to occur in dense and open mallee over heath and low heath habitats. **Optimal habitats within Study Areas:** • Low shrubland; • Mallee on loam or clay; and • Tall mallee with understorey. **Likelihood of occurrence within the Proposed Change Area: Likely** The species has been recorded recently nearby, and the Proposed Change Area contains suitable habitat. However the species records are sparsely distributed, and as such the species is considered **Likely** to occur.
Birds								
Malleefowl (*Leipoa ocellata*)	Vu	S3	✓		✓	✓	Knowledge of specific habitat preferences are limited, however the species tends to inhabit arid or semi-arid shrublands or woodlands dominated by long unburnt mallee, and may also occur in areas dominated by *Acacia sp.*, wandoo, marri or mallet (Benshemesh 2007). Substrates tend to be sandy loams and loamy sands with an abundance of leaf litter for mound construction, and may contain gravel or lateritic fragments (Benshemesh 2007, Parsons 2008). A 2008 study indicates the species may be associated with	**Confirmed** Thirteen mounds are known to occur within the Study Areas or immediate surrounds. The activity of 12 of these mounds were assessed during the Level 1 Targeted Fauna Survey (mound MW8 was not assessed as it was classified as extinct during 2017 (Terrestrial Ecosystems 2017b))(**Table 4-9**,**Figure 4-4**). Four of these mounds were classified as active, indicating the species breeds within the area. Malleefowl individuals have been detected within the area on numerous occasions, including during 2000, 2010, 2014 and 2016 – 2018 (Biota 2000, Coffey Environments 2010, Terrestrial Ecosystems 2014, 2016a, 2017a, b, 2018) (Table 4-9), indicating they inhabit the area long-term. See **Section 4.6** for additional information on breeding and foraging habitat and record details. **Optimal habitats within Study Areas:** Due to the relatively limited understanding of specific malleefowl breeding habitat preferences in the RNO area, mound locations within the area were used to indicate optimal habitat within the Study Areas and immediate surrounds. In addition to those habitats where mounds were recorded, one habitat (of limited extent) tall mallee with limited understorey, was not found to have mallefowl mounds but is included below as

Common name (scientific name)	Conservation status		Presence of species				Habitat preferences	Likelihood of occurrence, reason for likelihood and habitat associations
	EPBC Act	WA	Central Study Area and Infill Survey Area	Straight Infrastructure Corridor Area	Proposed Change Area	Immediate Surrounds		
							areas of tall vegetation providing canopy cover, shrubs that provide food such as ***Acacia*** and ***Gastrolobium*** species and reduced sedge cover (Parsons 2008). The species diet is variable, including the seeds, flowers and fruits of shrubs (especially legumes), herbs, invertebrates, tubers and fungi (Benshemesh 2007).	it has characteristics which align with preferred habitat as described by Parsons (2008). • Tall mallee with understorey; • Mallee on loam or clay; and • Tall mallee with limited understorey. Malleefowl were mainly opportunistically sighted in the following habitats, indicating that the following habitats may be utilised for foraging: • Low mallee on stony rise; and • Within or near drainage lines.
Western whipbird (southern WA ssp.) (*Psophodes nigrogularis oberon*)		P4	✓	✓	✓	✓	Inhabits mallee and heath shrubland that tends to have 10 – 30% cover but may be interspersed with dense thickets, with a dense lower storey (Threatened Species Scientific Committee 2009). Nests tend to be recorded in ***Banksia caleyi***, however have also been observed in ***Daviesia*** and ***Hakea*** species (Threatened Species Scientific Committee 2009).	**Confirmed** The western whipbird has been recorded in all surveys undertaken at RNO aside from during 2010, including being heard (14 locations) and sighted (one location) during the current survey (Biota 2000, 2005, Coffey Environments 2009, Terrestrial Ecosystems 2013, 2014, 2015, 2016a, b, 2017a, b, 2018) (**Figure 4-3**). The western whipbird has a distinctive call and records are widespread throughout the Study Areas and immediate surrounds. Most records within the Study Areas occurred in low mallee on stony rise and in or near drainage lines, followed by mallee on loam or clay. The species was recorded from between seven and nine locations within each of the following habtitas: dense mallee over heath, low shrubland, and open mallee over heath. Relatively few records occurred in tall mallee with understorey. While flora species most commonly associated with nesting (***Banksia caleyi***) was not recorded in the Study Area or immediate surrounds (Woodman Environmental Consulting 2017), ***Hakea*** and ***Daviesia*** may also serve as nesting sites. These flora species occurred in heath, low mallee on stony rise, mallee over loam or clay, low shrubland, drainage lines, and tall trees in depression habitat. ***Hakea*** and ***Daviesia*** species tended to be particularly common in heath dominated habitats. **Optimal habitats within Study Areas:** • Low mallee on stony rise; • Drainage line; • Dense mallee over heath; • Open mallee over heath; and • Mallee on loam or clay.
Carnaby's Cockatoo (*Calyptorhynchus latirostris*)	En	S2	*	*	*	✓	The species feeds on native shrubland vegetation, particularly flowers, seeds and nectar of proteaceous plants (e.g. Banksia, Hakea, Dryandra and Grevillea species), marri and Callistemon spp. (DoEE 2017, DSEWPaC 2012). Carnaby's cockatoo may roost in any tall trees, particularly in riparian areas, and may breed in any trees with suitable hollows (DoEE 2017, DSEWPaC 2012). See section 4.7 for an assessment of foraging,	**Confirmed** The species has been detected in the Study Areas and immediate surrounds during 2000, 2005, 2009, 2010 and between 2014 – 2018 (Biota 2000, Coffey Environments 2009, 2010, Terrestrial Ecosystems 2014, 2015, 2016a, b, 2017a, b, 2018) and two individuals were observed ~3km east of the southern section of the Straight Infrastructure Corridor during the current survey (**Figure 4-6**). Records ranged from one to 30 individuals, and a flock of 30 individuals were observed feeding in Halley's rehabilitation area during 2018 (Terrestrial Ecosystems 2018). Please note, various opportunistic sightings during previous surveys were not associated with coordinates, and as such, could not be included in **Figure 4-6**. See **Section 4.7** for further details concerning breeding, roosting and foraging assessments. **Optimal habitats within Study Areas:** • Mallee over large Banksia; and • Tall trees in depression.

Common name (scientific name)	Conservation status		Presence of species				Habitat preferences	Likelihood of occurrence, reason for likelihood and habitat associations
	EPBC Act	WA	Central Study Area and Infill Survey Area	Straight Infrastructure Corridor Area	Proposed Change Area	Immediate Surrounds		
							breeding and roosting habitat.	**Likelihood of occurrence within the Proposed Change Area: Very Likely** The species has been recorded recently nearby, and the Proposed Change Area contains suitable foraging habitat. However no evidence of foraging was recorded during the current survey. Furthermore it does not contain suitable breeding trees and only contains marginally suitable roosting trees in a small area of habitat (tall trees in depression). As such, the species is considered **Very Likely** to occur but less likely to depend upon habitats within the Proposed Change Area – see **Section 4.7**.
Peregrine Falcon (***Falco peregrinus***)		S7				✓	The species occurs along coastal cliffs, rivers and ranges as well as wooded watercourses and lakes, nesting on cliffs, granite outcrops, large tree hollows, nests of other raptors and quarries (Johnstone and Storr 1998, Pizzey and Knight 2007).	**Confirmed** The species was confirmed most recently during 2018 and during 1999 and 2000 ~3km south of the Central Study Area (**Figure 4-3**) (DBCA 2018b), however as the 1999 and 2000 records are in identical locations one may be a replicate. While the species was recorded over mallee on loam or clay habitat, the species is more likely to utilise drainage lines for foraging and only fly over surrounding habitats. As the Study Areas do not contain large tree hollows, cliffs or outcropping suitable for nesting, the species is unlikely to rely on the Study Areas for breeding. **Optimal habitats within Study Areas (foraging only):** • Drainage line. **Likelihood of occurrence within the Proposed Change Area: Likely** The species was only recorded recently nearby in one location (likely to be on one occasion), and is considered uncommon (Pizzey and Knight 2007). While drainage lines may provide suitable foraging habitat, the Proposed Change Area does not contain suitable breeding habitat. As such, the species is considered **Likely** to occur within the Proposed Change Area, however is unlikely to rely upon the habitats for breeding.
Invertebrates								
Eula's planthopper (***Budginmaya eulae***)		P1				✓	Only known from a single location on Bandalup Hill on the Ravensthorpe Range (Flectcher and Moir 2009). ***Budginmaya eulae*** was collected from a single ant's nest of the species ***Camponotus terebrans***. ***Budginmaya eulae*** shows adaptations for a subterranean life and is the first record of an Australian planthopper cohabitating with ants. ***Budginmaya eulae*** was collected from mallee heath habitat that included a number of rare plant species such as ***Kuinzea similis*** and ***Eucalyptus purpurata*** (Flectcher and Moir 2009).	**Confirmed** The species was recorded once ~2km south of the Infill Survey Area during 2007 (**Figure 4-3**) (DBCA 2018c). The single location of this species occurs in association with the Kunzea Exclusion Zone. It is likely that additional specimens occur in the area in association with ***Kunzea similis***, however further information is not currently available. A population of ***Kunzea similis mediterranea*** was delineated by Woodman Environmental Consulting (2017) in an area approximately 1.7km south of the southern boundary Study Area, and approximately 8.3km southeast of the Proposed Change Area at its closest point. **Optimal habitats within Study Areas:** • In association with ***Kunzea similis*** which has been found to occur in association with Vegetation Type 3 on low mallee on stony rise. **Likelihood of occurrence within the Proposed Change Area: Possible** The species was only recorded once ~8.8km south of the Proposed Change Area (DBCA 2018c). Vegetation type 3 occurs within small areas of the Proposed Change Area, however largely occurs within the immediate surrounds. The distribution of ***Kunzea similis*** delineated by Woodman Environmental Consulting (2017) only occurs south of the Study Area. As such, the species is considered **Possible** to occur within the Proposed Change Area.

* The species has been confirmed from within the Study Areas during previous surveys, however as coordinates were unavailable, the specific Study Area or habitat associations cannot be determined.

Table 4-8: Fauna of conservation significance potentially occurring within the Study Areas

Common name (scientific name)	Conservation status		Habitat	Likelihood of Occurrence and Reason for Likelihood
	EPBC Act	WA		
Mammals				
Dibbler (*Parantechinus apicalis*)	En	S2	Largely restricted in distribution to national parks, protected or fenced areas and islands (Threatened Species Scientific Committee 2015, van Dyck and Strahan 2008). May also occur along western coastal areas (Threatened Species Scientific Committee 2015)	**Unlikely** The species is largely restricted to a population within the Fitzgerald River National Park and translocated populations into national parks, reserves or fenced areas, such as the proposed Peninup reserve and Stirling Range National Park (Threatened Species Scientific Committee 2015, van Dyck and Strahan 2008). There are no recent records of the species nearby (DBCA 2018b), with the closest recent record occurring ~42km southwest during 2015 (DBCA 2018a).
Red-tailed phascogale (*Phascogale calura*)	Vu	S6	Preferably inhabits forests and woodlands with dense, tall vegetation, particularly areas with Wandoo and Rock Sheoak (van Dyck and Strahan 2008). The species nests in trees with hollows (van Dyck and Strahan 2008).	**Unlikely** The Study Areas do not contain suitable habitat and the species has not been recorded recently nearby (DBCA 2018a, b, van Dyck and Strahan 2008). As such, the species is considered unlikely to occur.
Numbat (*Myrmecobius fasciatus*)	En	S2	Inhabit areas with Eucalypts, which form woody debris that provides hollow logs for shelter and termites for foraging (Threatened Species Scientific Committee 2018b). Currently inhabits Jarrah forest and Wandoo woodland (Threatened Species Scientific Committee 2018b).	**Unlikely** The Study Area does not contain optimal habitat and occurs outside the known species distribution (Threatened Species Scientific Committee 2018b). The species is largely restricted to two natural populations at Dryandra and Perup, and translocated populations outside the Study Area (Threatened Species Scientific Committee 2018b). Furthermore, the closest nearby records of the species occur ~37km west of the Study Areas, during 2013 and 2008 (DBCA 2018a). As such the species is considered unlikely to occur.
Tammar wallaby		P4	Inhabits areas with dense low vegetation coupled with	**Unlikely**

(*Notamacropus eugenii derbianus*)			open grasses for foraging (van Dyck and Strahan 2008).	While the Study Area contains suitable shelter, it does not contain suitable foraging habitat (van Dyck and Strahan 2008). Furthermore, the species is known to inhabit nine mainland sites which occur outside the Study Areas, the closest of which are Hopetoun and Fitzgerald River National Park (van Dyck and Strahan 2008). The species has been recorded during 2016 ~25km southwest, and on two other occasions during 2016 ~40km southwest of the Study Areas (DBCA 2018a, b). As such, the species is considered unlikely to occur.
Birds				
Fork-tailed Swift (*Apus pacificus*)	Mi	S5	Aerial species, which forage high above the tree canopy and rarely lower (Johnstone and Storr 1998). Occurs over a range of habitats including islands, open country, coasts, semi-deserts, urban, forests (Pizzey and Knight 2007).	Possible While the Study Areas occur within the species range and the species occurs in a variety of habitat types (Pizzey and Knight 2007), it has not been recorded recently nearby and as such is only considered to possibly occur. If the species were to occur, it would likely overfly the Study Areas without being dependent upon any particular habitat. Likelihood of occurrence within the Proposed Change Area: Possible Assessment unchanged from above.
Western Bristlebird (*Dasyornis longirostris*)	En	S3	Inhabits low dense and closed heath, and may occupy more open areas if interspersed with dense habitat (Threatened Species Scientific Committee 2018a).	Possible While the Study Areas contain suitable habitat, the species is only known to occur in the Two People's Bay Nature Reserve, between Betty's Beach and Waychinicup National Park (near Albany) and at Fitzgerald River National Park (Threatened Species Scientific Committee 2018a). Based on the indicative distribution for the species (DoEE 2018b), the Study Areas occur just outside the range of where the species 'may' or is 'likely' to occur. Given the close proximity of the indicative range, it is considered 'Possible' that the species could occur. Likelihood of occurrence within the Proposed Change Area: Assessment unchanged from above.
Night Parrot (*Pezoporus occidentalis*)	En	S1	Known to inhabit treeless or sparsely wooded long unburnt spinifex hummock plains often interspersed	Unlikely The Study Areas occur south of the species predicted range and the Study Areas do not contain suitable habitat (Pyke and Ehrlich 2014, Wildlife 2017). Additionally, the species has not been recorded recently nearby.

			with chenopods (Pyke and Ehrlich 2014).	
Grey Wagtail (*Motacilla cinereal*)	Mi	S5	Occupies a wide range of habitats, may be associated with water such as sandy or rocky streams, airfields, ploughed fields and sewerage ponds (Pizzey and Knight 2007).	Unlikely The species has not been recorded recently nearby and mainly visits northern areas of Australia (Pizzey and Knight 2007).
Three sea-bird species: Yellow-nosed Albatross (*Thalassarche chlororhynchos*); Osprey (*Pandion haliaetus*); and Crested tern (*Sterna bergii*).	Vu, Mi	S3, S5	Occupy coastal areas and open water, including estuaries, bays, cliffs, islands, swamps, tidal rivers etc. (Pizzey and Knight 2007).	Unlikely These species are associated with coastal habitats not present within the Study Areas and these species have not been recorded recently nearby (Pizzey and Knight 2007).
Twelve wetland bird species from the following families: Scolopacidae; Laridae; Apodidae; Falconidae; and Cacatuidae	En, Cr, Mi	S3, S5, S2, P4	Associated with aquatic habitats, usually with shallow areas, including tidal mudflats, wetlands, marshes, ponds, estuaries and lake margins (Pizzey and Knight 2007).	Unlikely The Study Areas and immediate surrounds do not contain suitable habitat (Pizzey and Knight 2007). Although the species have been recorded in the area, they are unlikely to use the habitats available. While the melaleuca shrubland area does contain a shallow pond, this habitat was minimal and degraded. Overall, the species are likely to preferentially rely on coastal areas and lakes in the surrounding region.
Reptiles				
Ravensthorpe Range slider (*Lerista viduata*)		P1	Inhabits eucalypt woodlands where leaf litter at the bases of trees and shrubs on loam or loamy clay provides shelter (Wilson and Swan 2013).	Possible The Study Areas contain suitable habitat, however the species is only known to occur within the Ravensthorpe range to the west of the area (Wilson and Swan 2013). Furthermore, the species has not been detected despite extensive trapping in the Study Areas since 2000, including annual trapping from 2013 – 2017 (Table 3-2). However, as there are recent

				records nearby (2016 and 2004 record, ~15km southwest of the Study Areas within the Ravensthorpe range (DBCA 2018b)), the species is considered to possibly occur. Likelihood of occurrence within the Proposed Change Area: Possible Assessment unchanged from above.

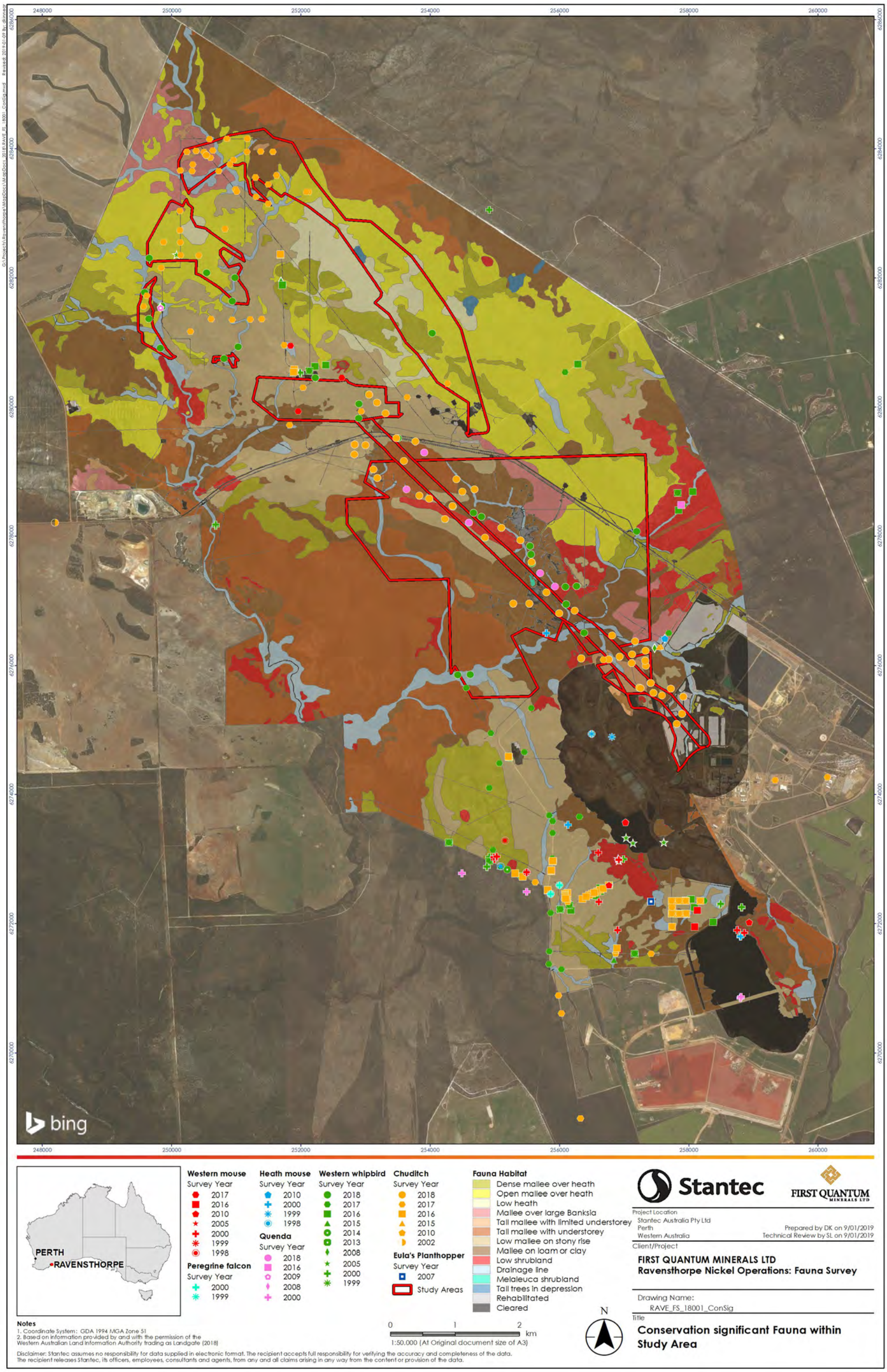


Figure 4-3: Conservation significant fauna within the Study Area

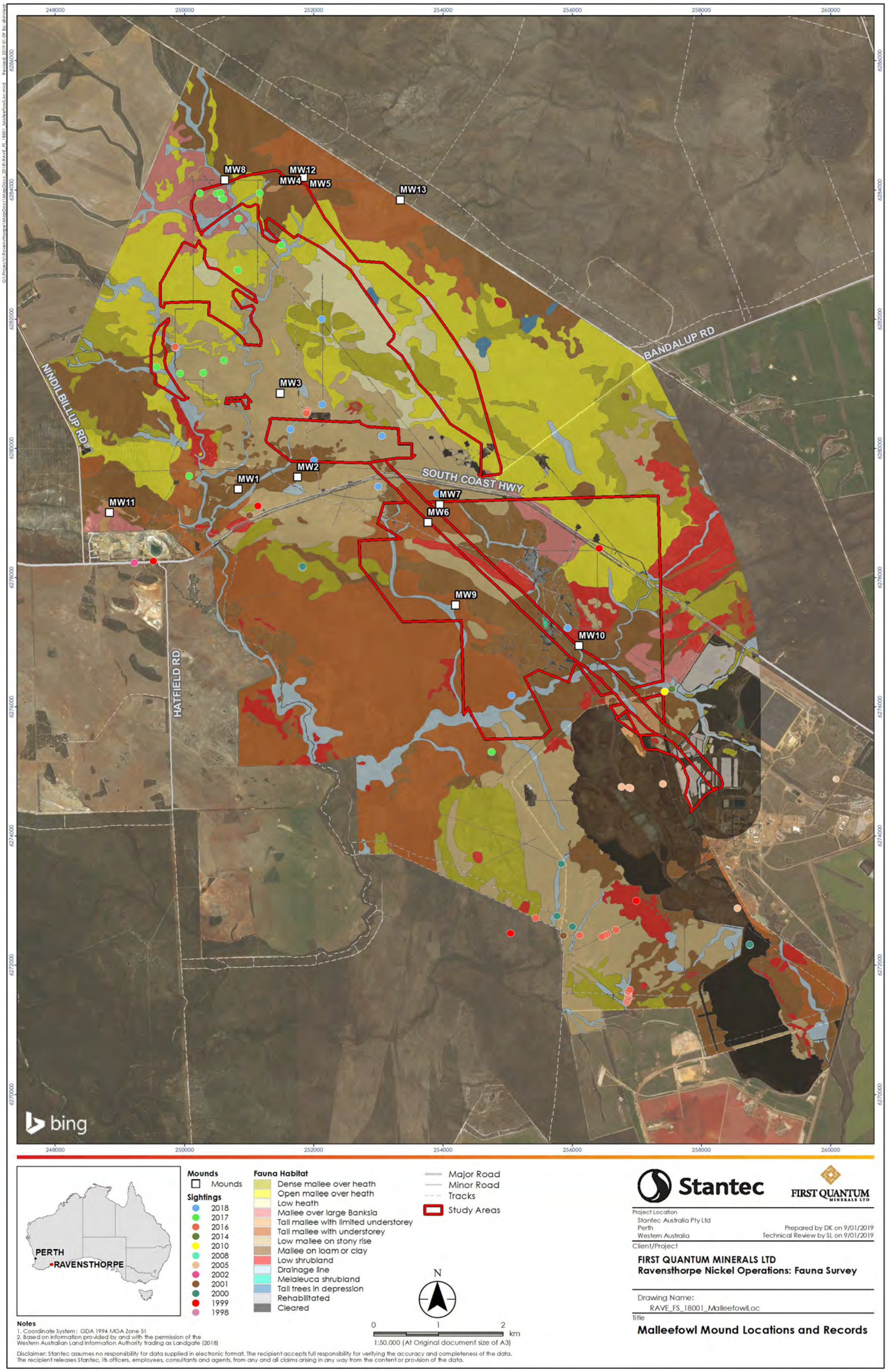


Figure 4-4: Malleefowl mound locations and records

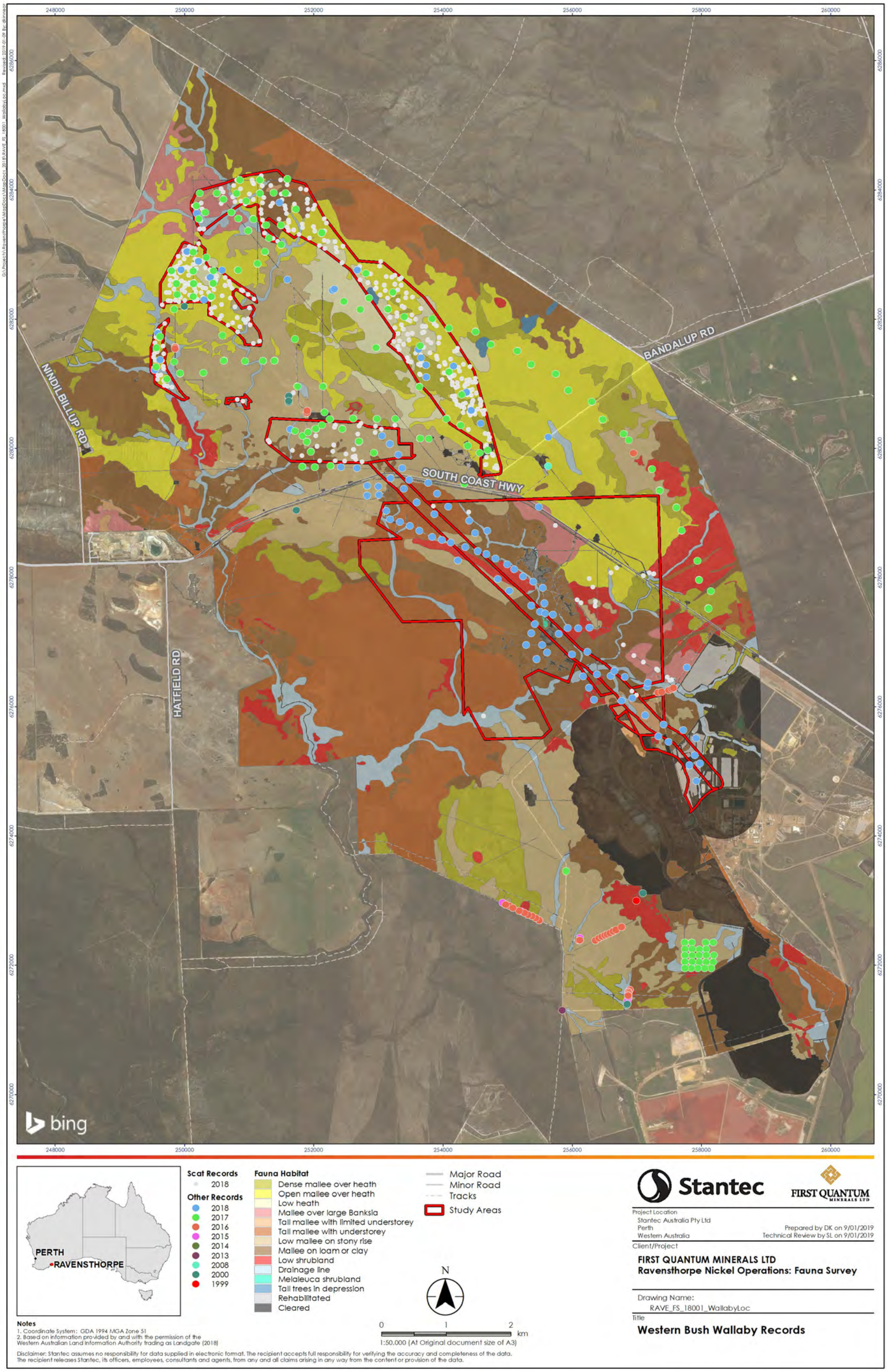


Figure 4-5: Western Brush Wallaby records

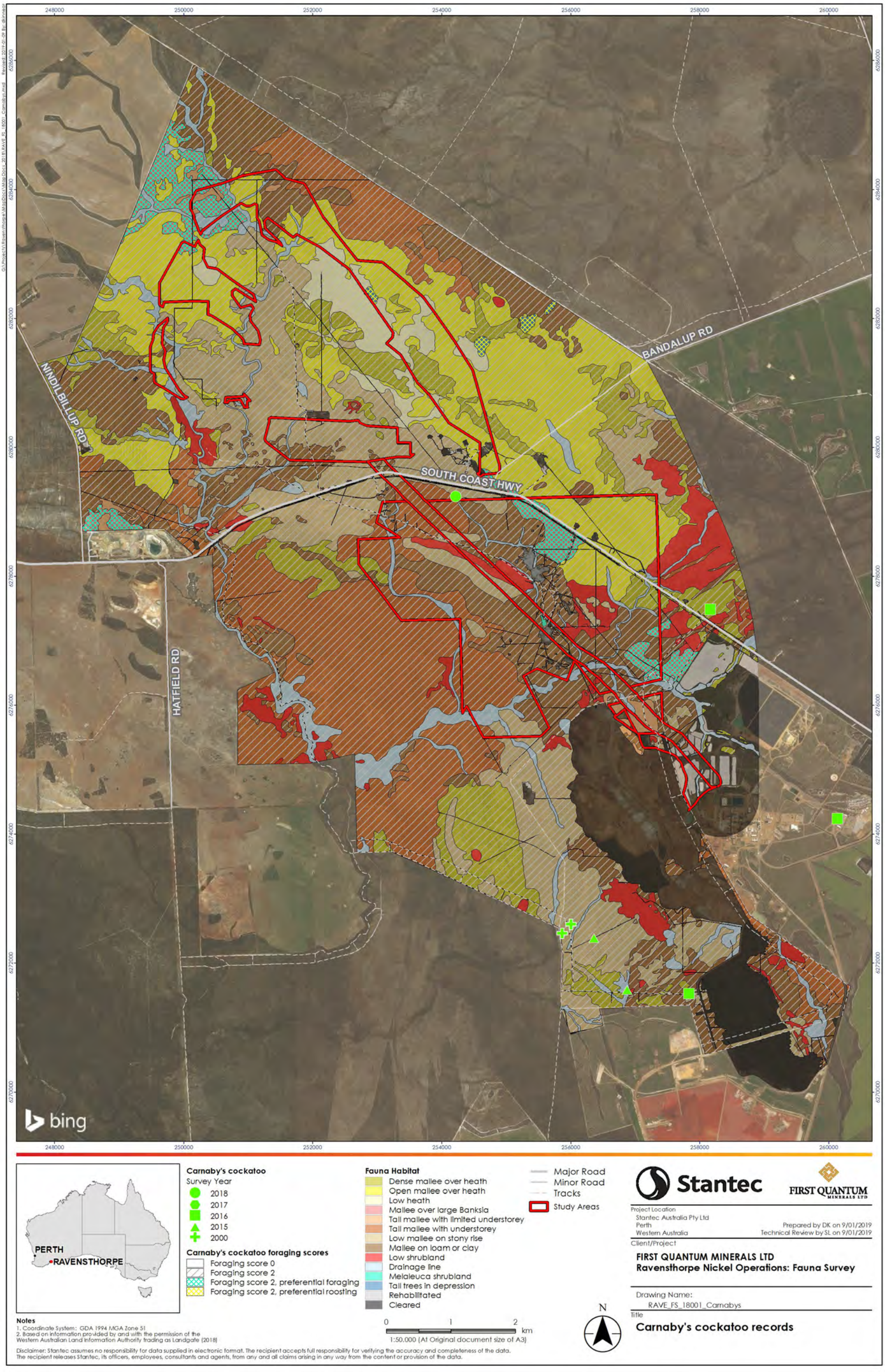


Figure 4-6: Carnaby's cockatoo foraging habitat scores, preferential habitat and records

4.6 Malleefowl Targeted Survey

Malleefowl individuals were observed during the Level 1 Targeted Fauna Survey on three occasions, including one direct observation and from one motion camera site (Figure 4-4). A recent malleefowl carcass was also recorded during the 2018 Eco Logical botanical survey (Figure 4-4) (Eco Logical Australia in prep).

Thirteen mounds are known to occur within the Study Areas or immediate surrounds. Three were discovered during the Level 1 Targeted Fauna Survey (MW11 – 13), the remaining 10 had been previously detected (one by Eco Logical, 9 by Terrestrial Ecosystems (Eco Logical Australia in prep, Terrestrial Ecosystems 2017b, 2018)). The activity of 12 of these mounds were assessed during the Level 1 Targeted Fauna Survey (Mound MW8 was not assessed as it was classified as extinct during 2017 (Terrestrial Ecosystems 2017b))(Table 4-9,Figure 4-4).

4.6.1 Sighting Records and Potential Foraging Habitat

Malleefowl diet is variable, including the seeds, flowers and fruits of shrubs (especially legumes), herbs, invertebrates, tubers and fungi (Benshemesh 2007). Sightings (separate from mounds) were recorded as indicating foraging habitat. Malleefowl have been recorded during seven of the 12 surveys in the literature review, including during two 2017 and one 2018 survey (Biota 2000, Coffey Environments 2010, Terrestrial Ecosystems 2014, 2016a, 2017a, b, 2018). This demonstrates that the species inhabits the area long-term. When considering all malleefowl records in the Study Areas spanning 1999 to 2018, most tended to occur in low mallee on stony rise or in or near drainage line habitats (Figure 4-4). Sighting records also occurred in dense mallee over heath, tall mallee with understorey, tall mallee with limited understorey, open mallee over heath (four record locations) mallee on loam or clay, melaleuca over large *Banksia* and low shrubland (2 - 3 record locations). Overall, records indicate the following habitats tend to be occupied and preferentially used for foraging:

- Low mallee on stony rise; and
- Within or near the border of drainage lines.

4.6.2 Mounds and Breeding Activity

Of the 13 malleefowl mounds known to occur within the Study Areas or immediate surrounds, four were considered active and demonstrate breeding, three were considered inactive and six were considered extinct (Table 4-9). With respect to each of the Study Areas, one mound MW12 occurred within the Proposed Change Area and was classified as extinct (MW12)(Figure 4-4). Four mounds occurred within the Central Study Area; three of these mounds (MW6, MW7 and MW9) were considered active, and one mound was inactive (MW10). All other mounds occurred in the immediate surrounds of the Study Areas. Of these, all were considered extinct with the exception of MW1 (currently active), and MW4 (currently inactive, active during 2017) (Terrestrial Ecosystems 2017b).

Habitat assessments completed at each mound during the Level 1 Targeted Fauna Survey were used to indicate potential habitat preferences for malleefowl mound construction. Mounds tended to be associated with the following features:

- low proportion of lower vegetation cover, with two mounds occurring in areas with <10% cover and all others occurring in areas with between 10-30% cover;
- habitats with a mid and/or upper storey;
- loam or clay substrates (no mounds occurred in areas dominated by sand);
- presence of relatively small coarse fragments, or a low cover of large coarse fragments. Most mound locations lacked fragments or comprised fragments <20mm in diameter;
- tall mallee with understorey (six mounds) and mallee on loam or clay (four mounds) habitats. One mound occurred in low mallee on stony rise, drainage line and mallee over large B*anksia* habitats, however the latter was on the edge of a transition into tall mallee with no understorey. No mounds occurred in tall trees in depression, tall mallee with no understorey or the three heath dominated habitats; and
- the abundance of small coarse fragments varied from 0 to >90%, indicating there is no preference for small coarse fragment cover.

Tall mallee with reduced understorey (which is of limited extent) had several characteristics considered preferable for mound construction. These included long unburnt, tall mallee forming a canopy, a loam based substrate, abundant leaf litter and reduced sedge cover (Benshemesh 2007, Parsons 2008). No mounds were found in this habitat during the Level 1 Fauna Survey (or previous surveys); however, this habitat has potential to be used for mound construction in the future.

Table 4-9: Malleefowl mounds within the Study Areas and immediate surrounds

Mound name	Location (51H)		Status	Habitat and notes	Reference photograph
	Easting	Northing			
MW1	250832	6279369	**Active** Recently cleared surface with crater. Malleefowl feather observed in crater. Classified as **recently active** in February 2017 (Terrestrial Ecosystems 2017b).	Classified under **mallee on loam or clay**. Low lower storey cover, 2-10% abundance of calcrete coarse fragments (<20mm) over clay loam. Habitat corresponds with habitat assessment H46 (see **Appendix A**).	
MW2	251756	6279561	**Extinct** Woody debris and leaf litter present on surface of eroded, low mound with no crater. Classified as **not used** in February 2017 (Terrestrial Ecosystems 2017b).	Classified under **mallee on loam or clay**. Low lower storey cover, 20-50% abundance of coarse fragments (<20mm) over clay loam. Habitat corresponds with H45 (see **Appendix A**).	

Mound name	Location (51H)		Status	Habitat and notes	Reference photograph
	Easting	Northing			
MW3	251486	6280853	**Inactive** Mound surface not recently cleared. Burnt woody debris and fauna diggings present on surface. Crater present. Classified as **recently active** in February 2017 (Terrestrial Ecosystems 2017b).	Classified under **low mallee on stony rise.** Medium lower storey cover, >90% abundance of coarse fragments (<20mm) over clayey sand. Habitat corresponds with H48 (see **Appendix A**).	
MW4	251845	6284302	**Inactive** Surface not recently cleared and fauna diggings in centre of mound. Crater present. Classified as **active** in February 2017 (Terrestrial Ecosystems 2017b).	Classified under **tall mallee with understorey.** Low lower storey cover, <2% abundance of coarse fragments (<200mm) over medium clay. Habitat corresponds with H50 (see **Appendix A**).	
MW5	251845	6284197	**Extinct** Mound surface long undisturbed; large woody debris and established shrubs in mound centre. Eroded with no crater. Classified as **not used** in February 2017 (Terrestrial Ecosystems 2017b).	Classified under **tall mallee with understorey.** Low lower storey cover, no coarse fragments present, substrate of loamy sand. Habitat corresponds with H52 (see **Appendix A**).	

Mound name	Location (51H)		Status	Habitat and notes	Reference photograph
	Easting	Northing			
MW6	253771	6278858	Active Surface recently cleared with minimal debris. Crater present. Recorded as active in March 2018, with recently hatched egg shells observed (Terrestrial Ecosystems 2018). Classified as recently active in February 2017 (Terrestrial Ecosystems 2017b).	Classified under tall mallee with understorey. Particularly low lower storey cover, 2-10% coarse fragment cover (<60mm) over silty loam. Habitat corresponds with H22 (see Appendix A).	
MW7	253954	6279132	Active Surface recently cleared and crater containing leaf litter present. Recorded as recently active during March, 2018 (Terrestrial Ecosystems 2018). Classified as active in February 2017 (Terrestrial Ecosystems 2017b).	Classified under tall mallee with understorey. Particularly low lower storey cover, 2-10% cover of coarse fragments (<60mm) over silty loam. Habitat corresponds with H21 (see Appendix A).	
MW8	250627	6284155	Extinct Classified by Terrestrial Ecosystems (Terrestrial Ecosystems 2017b).	Classified under Drainage line. Habitat corresponds with H50 and H52 (see Appendix A).	-

Mound name	Location (51H)		Status	Habitat and notes	Reference photograph
	Easting	Northing			
MW9	254194	6277578	Active Mound contained crater with leaf litter. Surface recently cleared with minimal debris indicating recently attended to.	Classified under **tall mallee with understorey**. Low lower storey cover with >90% cover of coarse fragments (<10mm) on sandy loam. Habitat corresponds with H37 (see **Appendix A**).	
MW10	256104	6276950	Extinct Surface was eroded and not recently cleared. Only contained slight evidence of an old crater. Recorded as dormant, or inactive for at least ten years, during March 2018 (Terrestrial Ecosystems 2018).	Classified under **mallee on loam or clay**. Low lower storey cover with no coarse fragments over sandy loam substrate. Habitat corresponds with H34 (see **Appendix A**).	
MW11	248843	6279011	Inactive Fauna tracks on surface of mound, woody debris in centre and surface undisturbed. Crater present.	Classified under **mallee over large *Banksia***. Note was in a transition to **tall mallee with limited understorey**. Low lower storey cover with 20-50% abundance of coarse fragments (<20mm) over sandy loam. Habitat corresponds with H54 (see **Appendix A**).	

Mound name	Location (51H)		Status	Habitat and notes	Reference photograph
	Easting	Northing			
MW12	251632	6284149	Extinct Old and largely eroded to form a low mound with no recent clearing or crater.	Classified under **mallee on loam or clay**. Low lower storey cover with no coarse fragments over loamy sand. Habitat corresponds with H50 and H52 (see **Appendix A**).	
MW13	253341	6283848	Extinct Surface was not recently cleared. Mound was eroded and lacked crater.	Classified under **tall mallee with understorey**. Medium lower storey cover with 20-50% abundance of coarse fragments (<60mm) on medium clay. Habitat corresponds with H53 (see **Appendix A**).	

4.7 Carnaby's Cockatoo Targeted Survey

The Study Areas lie outside the known range of the forest red-tailed black cockatoo and Baudin's cockatoo, and within the predicted non-breeding range of Carnaby's Cockatoo (DoEE 2017).

Two Carnaby's cockatoos were directly observed ~2.9km east of the southern area of the Straight Infrastructure Corridor during the Level 1 Targeted Fauna Survey; however, the species was not observed within the Study Areas (Figure 4-3). The species has previously been recorded within the Study Areas or immediate surrounds, including up to 30 individuals recorded in 2000, 2005, 2009, 2010 and 2014 to 2018 (Biota 2000, Coffey Environments 2009, 2010, Terrestrial Ecosystems 2014, 2015, 2016a, b, 2017a, b, 2018). These records include two individuals from within the Proposed Change Area (Coffey Environments 2010), and indicate that the species is a long-term inhabitant of the area. It should be noted that the coordinates for these historical observations were not recorded and consequently could not be presented in Figure 4-6.

4.7.1 Potential Breeding Habitat

The Study Areas lie just outside the predicted breeding range of Carnaby's cockatoo, which extends to Hopetoun and Ravensthorpe (DoEE 2017). This was supported by database searches, which identified two confirmed breeding areas for the species ~35km northwest and ~25km west of the Study Areas (DBCA 2018b). Furthermore, numerous nests and hollows were recorded ~37km west of the Study Areas during 2016, four of which contained eggs (DBCA 2018b).

Given the proximity of the predicted breeding range and known breeding locations, the species may breed near the Study Areas. However, the Study Areas did not contain any trees considered suitable for breeding (i.e. with hollows or of a diameter that may form hollows). Furthermore, no trees associated with breeding were recorded in the Study Areas; salmon gum, wandoo, tuart, jarrah, flooded gum, York gum, powderbark, karri and marri (DoEE 2017). The vast majority of habitats, aside from tall trees in depression, were dominated by thin mallee and acacia shrubs which are not considered suitable for breeding. Additionally, the tall trees in depression were not of a sufficient size to develop nesting hollows suitable for black cockatoos and comprised *Eucalyptus occidentalis*, which are not listed as a preferable breeding tree (DoEE 2017). As such, Carnaby's cockatoo is unlikely to use habitats within the Study Areas for breeding.

4.7.2 Potential Roosting Habitat

Carnaby's cockatoo may roost in any tall trees, particularly those near a permanent water source or within a riparian zone (DoEE 2017). Groups of relatively tall trees were present within tall trees in depression, which is also likely to become seasonally inundated and provide a non-permanent water source. Furthermore, this habitat contained *Eucalyptus occidentalis*, which is recognised as a potential roosting tree species (DoEE 2017). While this habitat may contain marginally suitable roosting suitability, no evidence of roosting (e.g. feathers, droppings, direct observations and dawn/dusk sightings) has been recorded at RNO to date (Biota 2000, 2005, Coffey Environments 2009, 2010, Terrestrial Ecosystems 2013, 2014, 2015, 2016a, b, 2017a, b, 2018). In addition, there are no known roosting sites within the nearby vicinity (DBCA 2018b).

4.7.3 Potential Foraging Habitat

Carnaby's cockatoo are known to feed on a variety of plant species, which were recorded within the Study Areas and immediate surrounds during the Level 1 Targeted Fauna Survey. This includes Proteaceous species such as *Banksia* and *Hakea*, which were common in the Study Areas. While potential foraging vegetation was present in all habitats, it was particularly common within sandy heath habitat (low heath, open mallee over heath and dense mallee over heath) and mallee over large *Banksia* habitat. Sandy heath habitats (foraging score 2) were dominated by low *Banksia* and *Hakea* species, and less unlikely to provide preferential foraging habitat due to the proximity of the feeding species to the ground (generally lower than 50 cm). In contrast mallee over large *Banksia* habitat (foraging score 2, potential foraging) contained relatively tall, long unburnt *Banksia* trees (approx. 3-5m tall) which were largely absent from other habitats in the Study Areas.

Carnaby's cockatoos were recorded foraging in the area, comprising records adjacent to the mining village in 2009 (Coffey Environments 2009), along the northern access road near the original mine (18 individuals)(Terrestrial Ecosystems 2016b) and in Halley's rehabilitation area (30 individuals)(Terrestrial Ecosystems 2018). The behaviour of the species was not specified during four surveys (Biota 2005, Terrestrial Ecosystems 2015, 2016a, 2017a) and the species was recorded via motion camera during one survey (Terrestrial Ecosystems 2014). As such foraging behaviour associated with these records could not be determined. All other species records are specified as fly overs. As such, the species has not been confirmed foraging within the Study Areas. However the location of foraging at Halley's rehabilitation was

not specified. Halley's pit occurs near the southern portion of the Study Areas, with nearby rehabilitation extending into the Infill Survey Area and Straight Infrastructure Corridor. As such whether this record occurs within the Study Areas remains unlear. More generally, it appears that the habitats in the Study Areas do not provide important foraging resources, although the species may occasionally forage in heath and mallee over large *Banksia* habitats from time to time.

This conclusion is supported by an assessment of the importance of each habitat using the DoEE (2017) draft foraging scoring tool, which categorised all habitats as low quality (Table 4-10, Figure 4-6). Tall mallee habitat with limited understorey, low shrubland and *Melaleuca* shrubland habitat were assigned a low-quality starting score (1) as they did not support suitable foraging species, and a low-quality finishing score (0). All other habitats contained suitable foraging vegetation (largely proteaceous species) and were assigned a high-quality starting score (7), however owing to the lack of breeding trees, foraging evidence and distance from resources, they were assigned a final low-quality score (2). It should be noted that while the tool classified all habitats as low quality, scores are heavily influenced by breeding trees which were absent from the Study Areas.

Table 4-10: Carnaby's cockatoo foraging habitat assessment based on the Level 1 Fauna Survey

Scoring tool	Criteria	Habitat Type and Scores											
Starting Score		Mallee over large *Banksia*	Drainage line	Tall mallee with limited understorey	Tall mallee with understorey	Low mallee on stony rise	Mallee on loam or clay	Low shrubland	Melaleuca shrubland	Dense mallee over heath	Open mallee over heath	Low heath	Tall trees in depression
10 (Very high quality)	Foraging habitat that is being managed for black cockatoos such as habitat that is the focus of successful rehabilitation, and/or has some level of protection from clearing, and/or is quality habitat described below with attributes contributing to meet a sore of ≥10.												
7 (High quality)	Native shrubland, kwongan heathland and woodland dominated by proteaceous plant species such as *Banksia* spp. (including *Dryandra* spp.), *Hakea* spp. and *Grevillea* spp., as well as native eucalypt woodland and forest that contains foraging species, including along roadsides. Does not include orchards, canola, or areas under a RFA.	7	7		7	7	7			7	7	7	7
5 (Quality)	Pine plantation or introduced eucalypts.												
1 (Low quality)	Individual foraging plants or small stand of foraging plants.			1				1	1				
Additions	Context adjustor - attributes improving functionality of foraging habitat												
+3	Is within the Swan Coastal Plain (important foraging area).												
+3	Contains trees with suitable nest hollows.												
+2	Primarily comprises marri.												
+2	Contains trees with potential to be used for breeding (dbh ≥ 500 mm or ≥ 300 mm dbh for salmon gum and wandoo).												
+1	Is known to be a roosting site.												
Subtractions	Context adjustor - attributes reducing functionality of foraging habitat												
-2	No clear evidence of feeding debris.	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
-2	No other foraging habitat within 6 km.												
-1	Is > 12 km from a known breeding location.	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
-1	Is > 12 km from a known roosting site.	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
-1	Is > 2 km from a watering point.	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
-1	Disease present (e.g. *Phytophthora cinnamomi* or marri canker).												
Total		2	2	0	2	2	2	0	0	2	2	2	2

5. Summary

Based on the desktop assessment, a total of 275 species of vertebrate fauna have the potential to occur in the Study Areas. Of these, 34 species are listed as being of conservation significance, comprising nine mammals, 24 birds and one reptile. The following nine conservation significant vertebrate fauna species were confirmed within the Study Areas or the immediate surrounds:

- Chuditch (*Dasyurus geoffroii* [Vu, S3]);
- Malleefowl (*Leipoa ocellata* [Vu, S3]);
- Heath mouse (*Pseudomys shortridgei* [En, S3]);
- Carnaby's cockatoo (*Calyptorhynchus latirostris* [En, S2]);
- Western mouse (*Pseudomys occidentalis* [P4]);
- Western brush wallaby (*Notamacropus Irma* [P4]);
- Western whipbird (*Psophodes nigrogularis oberon* [P4]);
- Quenda (*Isoodon fusciventer* [P4]); and
- Peregrine Falcon (*Falco peregrinus* [S7]).

All of these confirmed species have been recorded from within the Study Areas with the exception of the Peregrin Falcon which was recorded in the immediate surrounds. No conservation significant fauna were considered very likely or likely to occur, however three were considered 'posible to occur. The remaining conservation significant fauna from the desktop study were considered unlikely to occur in the Study Areas or immediate surrounds.

Twelve broad fauna habitats, as well as cleared areas, were identified during the Level 1 Fauna Survey. These comprised mallee over large *Banksia*, drainage lines, tall mallee with limited understorey, tall mallee with understorey, low mallee on stony rise, mallee on loam or clay, low shrubland, *Melaleuca* shrubland, dense mallee over heath, open mallee over heath, low heath, and tall trees in depressions. Of these, all habitats aside from cleared/ rehabilitated, *Melaleuca* shrubland were considered to have a high or confirmed potential for fauna of conservation significance.

Records of malleefowl indicate that most individuals occur in low mallee on stony rise or in or near drainage line habitats, indicating these may be utilised for foraging. Targeted malleefowl assessments during the current Level 1 Fauna Survey detected three mounds in addition to the ten known mounds recorded previously. Of the total thirteen mounds:

- four were considered active and demonstrate breeding malleefowl;
- three were considered inactive; and
- six were considered extinct.

With respect to active or inactive mounds in the Study Areas, three active mounds occurred in the Central Study Area. All other mounds recorded during the Level 1 fauna survey, one of which was active, occurred in the immediate surrounds. With respect to habitats, all mounds aside from three occurred in tall mallee shrubland or mallee on loam or clay habitats. Additionally, tall mallee habitat with limited understorey was also considered to have potential to serve as suitable mound building habitat, however no mounds were recorded from this habitat during the survey.

Targeted Carnaby's cockatoo assessments did not detect any evidence of feeding, roosting or breeding within the Study Areas, and no trees with large hollows or of suitable diameter at breast height were recorded. One habitat type represents preferential foraging habitat owing to the presence of large foraging vegetation, which was distinctive in the Study Areas: mallee over large *Banksia*. Furthermore, tall trees in depression was considered marginally suitable for roosting. However, owing to the reduced breeding suitability, distance from suitable resources and lack of foraging evidence in the area, all fauna habitats were assigned a low-quality score according to the DoEE draft referral guidelines (2017).

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Appendices

Appendix A Codes and Terms Used to Describe Species of Conservation Significance

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

Categories used under the EPBC Act		
Status	Code	Description
Critically Endangered	CR	Taxa that is considered to be facing an extremely high risk of extinction in the wild in the immediate future
Endangered	EN	Taxa that is considered to be facing a very high risk of extinction in the wild in the near future
Vulnerable	VU	Taxa that is considered to be facing a high risk of extinction in the wild in the medium-term future
Migratory	MI	Species that migrate to, over and within Australia and its external territories

Conservation Codes used under the WC Act			
Status	Code	Schedule	Description
Critically Endangered	CR	S1	Taxa that is rare or likely to become extinct, as critically endangered taxa
Endangered	EN	S2	Taxa that is rare or likely to become extinct, as endangered taxa
Vulnerable	VU	S3	Taxa that is rare or likely to become extinct, as vulnerable taxa
Presumed Extinct	EX	S4	Taxa that is presumed to be extinct
Migratory	IA	S5	Birds that are subject to international agreements relating to the protection of migratory birds
Conservation Dependent	CD	S6	Taxa that are of special conservation need being species dependent on ongoing conservation intervention
Special Protection	OS	S7	Taxa that is in need of special protection

Appendix B Vertebrate Fauna Identified from the Desktop Assessment

Legend:

A Current Survey

Database searches:

B NatureMap Database (DBCA 2018a)

C Protected Matters Search Tool (DoEE 2018a)

D Threatened and Priority Fauna Search (DBCA 2018b)

E Birdata: Custom Atlas Bird List (Birdlife Australia 2018)

Literature Review:

F RNO Expansion Fauna Survey (Biota 2000)

G BHP Billiton RNO Fauna Trapping Program (Biota 2005)

H Terrestrial Vertebrate Fauna Risk Assessment for the Proposed Change Area Ore Body, RNO (Coffey Environments 2009)

I Fauna Monitoring: RNO (Coffey Environments 2010)

J Conservation Significant Vertebrate Fauna Monitoring for RNO (Terrestrial Ecosystems 2013)

K Conservation Significant Vertebrate Fauna Monitoring for RNO (Terrestrial Ecosystems 2014)

L Conservation Significant Vertebrate Fauna Monitoring for RNO (Terrestrial Ecosystems 2015)

M Conservation Significant Vertebrate Fauna Monitoring and Feral Cat Trapping Program for RNO (Terrestrial Ecosystems 2016a)

N Potential Impact of Vegetation Clearing and Development of an Infrastructure Corridor and the Hale-Bopp North-west Pit on Vertebrate Fauna at the RNO (Terrestrial Ecosystems 2016b)

O Conservation Significant Vertebrate Fauna Monitoring for RNO (Terrestrial Ecosystems 2017a)

P Vertebrate fauna surveys for the Hale Bopp North West pit, an Infrastructure Corridor and Extension to the Proposed Change Area Mining Area at the RNO (Terrestrial Ecosystems 2017b)

Q Vertebrate Fauna Survey for a Proposed Infrastructure Corridor at the Ravensthorpe Nickel Operations (Terrestrial Ecosystems 2018)

Family	Scientific Name	Common Name	EPBC	WA	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Tachyglossidae	*Tachyglossus aculeatus*	Short-beaked Echidna			x	x				x	x	x	x	x	x	x	x	x	x	x	x
Dasyuridae	*Dasyurus geoffroii*	Chuditch	Vu	S3	x	x		x				x	x			x	x	x	x	x	x
	Parantechinus apicalis	Dibbler	En	S2		x	x	x													
	Phascogale calura	Red-tailed Phascogale	Vu	S6		x	x	x													
	Sminthopsis griseoventer									x	x	x		x							
	Sminthopsis crassicaudata	Fat-tailed Dunnart				x															
	Sminthopsis fuliginosus	Grey-bellied Dunnart											x								
	Sminthopsis granulipes	White-tailed Dunnart				x					x	x	x								
Myrmecobiidae	*Myrmecobius fasciatus*	Numbat	En	S2		x		x													
Peramelidae	*Isoodon fusciventer*	Quenda		P4		x		x		x		x						x		x	x
Burramyidae	*Cercartetus concinnus*	Western Pygmy-possum				x				x	x	x	x								
Tarsipedidae	*Tarsipes rostratus*	Honey Possum			x	x				x	x	x	x		x			x	x	x	
Phalangeridae	*Trichosurus vulpecula*	Common Brushtail Possum				x				x							x				x
Macropodidae	*Macropus fuliginosus*	Western Grey Kangaroo			x	x				x	x		x		x	x	x	x	x	x	x
	Notamacropus eugenii derbianus	Tammar Wallaby		P4		x		x													
	Notamacropus irma	Western Brush Wallaby		P4	x	x		x		x	x	x	x	x	x	x	x	x	x	x	x
Muridae	*Mus musculus*	*House Mouse				x	x			x	x	x	x	x	x			x	x	x	x
	Notomys mitchellii	Mitchell's Hopping-mouse				x					x		x	x	x					x	
	Pseudomys albocinereus	Ash-grey Mouse				x				x	x	x	x	x	x			x		x	
	Pseudomys occidentalis	Western Mouse		P4		x		x		x	x		x					x	x	x	
	Pseudomys shortridgei	Heath Mouse	En	S3		x	x	x		x			x								
	Rattus fuscipes	Western Bush Rat				x				x	x	x	x	x	x	x	x	x	x	x	x
Leporidae	*Oryctolagus cuniculus*	*Rabbit					x			x	x		x		x	x	x	x	x	x	x
Molossidae	*Austronomus australis*	White-striped Freetail-bat								x	x		x								
Vespertilionidae	*Chalinolobus gouldii*	Gould's Wattled Bat				x				x	x		x								
	Chalinolobus morio	Chocolate Wattled Bat				x															
	Nyctophilus geoffroyi	Lesser Long-eared Bat				x															
Canidae	*Canis lupus*	*Dog				x															
	Vulpes vulpes	*Red Fox			x	x	x			x	x		x		x	x	x	x	x	x	x
Felidae	*Felis catus*	*Cat			x	x	x			x	x		x	x	x	x	x	x	x	x	x
Suidae	*Sus scrofa*	*Pig					x														
Bovidae	*Capra hircus*	*Goat					x														
Dromaiidae	*Dromaius novaehollandiae*	Emu			x	x			x	x	x	x	x		x	x	x	x	x	x	x
Anatidae	*Anas castanea*	Chestnut Teal				x			x	x			x								
	Anas gracilis	Grey Teal				x			x												
	Anas rhynchotis	Australasian Shoveler				x															
	Anas superciliosa	Pacific Black Duck				x			x	x			x								
	Aythya australis	Hardhead				x			x												
	Chenonetta jubata	Australian Wood Duck				x			x												

Family	Scientific Name	Common Name	EPBC	WA	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
	Cygnus atratus	Black Swan				x															
	Malacorhynchus membranaceus	Pink-eared Duck				x			x												
	Tadorna tadornoides	Australian Shelduck				x			x												
Megapodiidae	*Leipoa ocellata*	Malleefowl	Vu	S3	x	x	x	x	x	x			x		x		x		x	x	x
Phasianidae	*Coturnix pectoralis*	Stubble Quail				x			x												
	Coturnix ypsilophora	Brown Quail									x										
Diomedeidae	*Thalassarche chlororhynchos*	Yellow-nosed Albatross	Vu; Mi	S3; S5				x													
Podicipedidae	*Podiceps cristatus*	Great Crested Grebe				x			x												
	Poliocephalus poliocephalus	Hoary-headed Grebe				x			x												x
	Tachybaptus novaehollandiae	Australasian Grebe				x			x												
Threskiornithidae	*Platalea flavipes*	Yellow-billed Spoonbill				x															
Ardeidae	*Ardea ibis*	Cattle Egret					x														
	Ardea modesta	Eastern Great Egret					x														
	Ardea novaehollandiae	White-faced Heron				x			x	x	x		x								
	Botaurus poiciloptilus	Australasian Bittern	En	S2			x	x													
Phalacrocoracidae	*Phalacrocorax melanoleucos*	Little Pied Cormorant				x			x						x						
	Phalacrocorax sulcirostris	Little Black Cormorant				x			x												
Pandionidae	*Pandion haliaetus*	Osprey	Mi	S5			x														
Accipitridae	*Accipiter cirrocephalus*	Collared Sparrowhawk				x			x	x			x								
	Accipiter cirrocephalus cirrocephalus										x										
	Accipiter fasciatus	Brown Goshawk				x			x								x		x	x	x
	Aquila audax	Wedge-tailed Eagle			x	x			x	x	x	x	x		x	x	x	x	x		x
	Circus approximans	Swamp Harrier				x															
	Circus assimilis	Spotted Harrier				x			x												
	Elanus caeruleus	Black-shouldered Kite							x												
	Elanus caeruleus axillaris	Australian Black-shouldered Kite				x				x			x			x					
	Haliaeetus leucogaster	White-bellied Sea-Eagle					x														
	Haliastur sphenurus	Whistling Kite								x			x								
	Hamirostra isura	Square-tailed Kite				x			x	x	x		x						x		
	Hieraaetus morphnoides	Little Eagle				x			x				x								
	Milvus migrans	Black Kite			x																
Rallidae	*Fulica atra*	Eurasian Coot				x			x												
	Porzana tabuensis	Spotless Crake				x			x												
	Tribonyx ventralis	Black-tailed Native-hen				x															
Turnicidae	*Turnix varia*	Painted Button-quail				x			x	x			x		x	x	x	x	x	x	x
Recurvirostridae	*Himantopus himantopus*					x															
	Himantopus himantopus	Black-winged Stilt							x												
Charadriidae	*Charadrius melanops*	Black-fronted Dotterel				x			x												x
	Charadrius ruficapillus	Red-capped Plover				x			x												

Family	Scientific Name	Common Name	EPBC	WA	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
	Thinornis cucullatus	Hooded Plover		P4		x	x		x												
	Vanellus tricolor	Banded Lapwing				x			x												
Scolopacidae	*Arenaria interpres*	Ruddy Turnstone	Mi	S5				x													
	Calidris acuminata	Sharp-tailed Sandpiper	Mi	S5			x	x													
	Calidris alba	Sanderling	Mi	S5				x													
	Calidris canutus	Red Knot	En; Mi	S5			x														
	Calidris ferruginea	Curlew Sandpiper	Cr; Mi	S3; S5			x	x													
	Calidris melanotos	Pectoral Sandpiper	Mi	S5			x														
	Calidris ruficollis	Red-necked Stint	Mi	S5				x													
	Numenius madagascariensis	Eastern Curlew	Cr; Mi	S3; S5			x														
	Tringa hypoleucos	Common Sandpiper	Mi	S5			x														
	Tringa nebularia	Common Greenshank	Mi	S5		x	x	x	x												
Laridae	*Sterna bergii*	Crested Tern	Mi	S5				x													
Columbidae	*Columba livia*	*Domestic Pigeon					x														
	Ocyphaps lophotes	Crested Pigeon				x			x	x	x	x	x		x	x	x		x		
	Phaps chalcoptera	Common Bronzewing			x	x			x	x	x	x	x		x	x	x	x	x	x	x
	Phaps elegans	Brush Bronzewing				x			x	x	x	x	x		x	x	x	x	x	x	x
	Streptopelia senegalensis	*Laughing Turtle-Dove				x	x		x												
Cuculidae	*Cacomantis flabelliformis*	Fan-tailed Cuckoo				x			x	x	x	x	x		x	x	x		x		x
	Cacomantis flabelliformis flabelliformis					x															
	Cacomantis pallidus	Pallid Cuckoo				x			x												
	Chrysococcyx basalis	Horsfield's Bronze Cuckoo				x			x	x	x	x	x		x	x	x		x		
	Chrysococcyx lucidus	Shining Bronze Cuckoo				x			x		x		x						x		
	Chrysococcyx lucidus plagosus									x											
	Chrysococcyx osculans	Black-eared Cuckoo					x		x												
Tytonidae	*Tyto alba*	Barn Owl				x			x	x			x								
Strigidae	*Ninox boobook*	Boobook Owl							x		x									x	x
Podargidae	*Podargus strigoides*	Tawny Frogmouth			x	x			x	x			x								
Caprimulgidae	*Eurostopodus argus*	Spotted Nightjar			x	x			x		x										x
Aegothelidae	*Aegotheles cristatus*	Australian Owlet-nightjar				x			x	x	x		x								
Apodidae	*Apus pacificus*	Fork-tailed Swift	Mi	S5			x														
Alcedinidae	*Dacelo novaeguineae*	Laughing Kookaburra				x			x												
	Todiramphus sanctus	Sacred Kingfisher				x			x												
Meropidae	*Merops ornatus*	Rainbow Bee-eater				x	x		x	x	x	x	x								
Falconidae	*Falco berigora*	Brown Falcon				x			x	x		x	x		x	x	x		x		x
	Falco berigora berigora										x										
	Falco cenchroides	Australian Kestrel			x	x			x	x		x	x		x	x	x		x		x
	Falco cenchroides cenchroides										x										
	Falco longipennis	Australian Hobby				x															x

Family	Scientific Name	Common Name	EPBC	WA	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
	Falco longipennis longipennis	Australian Hobby							x												
	Falco peregrinus	Peregrine Falcon		S7		x		x	x		x										x
Cacatuidae	*Cacatua roseicapilla*	Galah				x			x	x	x	x	x		x	x	x		x		
	Calyptorhynchus latirostris	Carnaby's Cockatoo	En	S2		x	x	x	x	x	x	x	x		x	x	x	x	x	x	x
Psittacidae	*Neophema elegans*	Elegant Parrot				x			x												
	Parvipsitta porphyrocephala	Purple-crowned Lorikeet			x				x	x		x	x		x	x	x		x		x
	Pezoporus occidentalis	Night Parrot	En	S1			x														
	Platycercus spurius	Red-capped Parrot				x			x	x	x	x	x		x		x				
	Platycercus zonarius	Australian Ringneck			x	x			x	x	x	x	x		x		x		x		
	Polytelis anthopeplus	Regent Parrot				x			x												
	Trichoglossus moluccanus	Rainbow Lorikeet				x															
Maluridae	*Malurus pulcherrimus*	Blue-breasted Fairy-wren				x			x	x	x	x	x			x	x		x		
	Malurus splendens	Splendid Fairy-wren				x			x								x		x		
	Stipiturus malachurus	Southern Emu-wren				x			x		x		x		x		x				
	Stipiturus malachurus westernensis					x				x											
Meliphagidae	*Acanthagenys rufogularis*	Spiny-cheeked Honeyeater				x			x												
	Acanthorhynchus superciliosus	Western Spinebill				x			x	x	x	x	x			x					
	Anthochaera carunculata	Red Wattlebird			x	x			x	x	x	x	x		x	x	x		x	x	x
	Anthochaera lunulata	Western Little Wattlebird			x	x			x	x	x	x	x		x	x	x		x		x
	Epthianura albifrons	White-fronted Chat				x			x												
	Gavicalis virescens	Singing Honeyeater			x				x												
	Glyciphila melanops	Tawny-crowned Honeyeater			x	x			x	x	x	x	x		x	x	x		x	x	x
	Lichenostomus cratitius	Purple-gaped Honeyeater			x	x			x	x	x	x	x		x	x	x		x		x
	Lichenostomus leucotis	White-eared Honeyeater			x	x			x	x	x	x	x		x		x				x
	Lichmera indistincta	Brown Honeyeater			x	x			x	x		x	x		x	x	x		x		x
	Lichmera indistincta indistincta										x										
	Manorina flavigula	Yellow-throated Miner			x	x			x	x	x	x	x		x	x	x	x	x	x	
	Melithreptus brevirostris	Brown-headed Honeyeater				x			x			x	x		x	x	x				
	Melithreptus brevirostris leucogenys					x				x	x										
	Melithreptus chloropsis	Western White-naped Honeyeater				x			x	x	x										
	Phylidonyris nigra	White-cheeked Honeyeater				x			x	x	x	x	x		x	x	x				
	Phylidonyris novaehollandiae	New Holland Honeyeater			x	x			x	x	x	x	x		x	x	x		x	x	x
	Ptilotula ornatus	Yellow-plumed Honeyeater							x												
	Purnella albifrons	White-fronted Honeyeater				x			x												
	Sugomel niger	Black Honeyeater			x				x												
Dasyornithidae	*Dasyornis longirostris*	Western Bristlebird	En	S3		x	x	x													
Pardalotidae	*Pardalotus punctatus*	Spotted Pardalote				x			x		x	x	x		x	x	x		x		x
	Pardalotus punctatus punctatus					x															
	Pardalotus punctatus xanthopyge	Yellow-rumped Pardalote				x				x											

Family	Scientific Name	Common Name	EPBC	WA	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
	Pardalotus striatus	Striated Pardalote				x			x	x	x					x	x		x		x
	Pardalotus striatus westraliensis					x															
Acanthizidae	*Acanthiza apicalis*	Inland Thornbill				x			x	x	x	x	x		x	x	x		x		
	Acanthiza chrysorrhoa	Yellow-rumped Thornbill				x			x	x	x		x			x					
	Calamanthus campestris	Rufous Fieldwren				x						x	x		x						
	Calamanthus cauta	Shy Heathwren				x			x	x	x		x		x	x	x		x		x
	Gerygone fusca fusca										x										
	Sericornis frontalis	White-browed Scrubwren				x			x		x	x	x		x	x	x		x		x
	Sericornis frontalis maculatus					x				x											
	Smicrornis brevirostris	Weebill				x			x	x	x	x	x		x	x	x		x		x
Pomatostomidae	*Pomatostomus superciliosus*	White-browed Babbler			x	x			x	x	x	x	x		x	x	x	x	x	x	x
Psophodidae	*Psophodes nigrogularis nigrogularis*	Western Whipbird (western heath)	En	S2		x		x					x								
	Psophodes nigrogularis oberon	Western Whipbird (southern WA ssp.)		P4	x	x		x	x	x	x	x		x	x	x	x	x	x	x	x
Artamidae	*Artamus cinereus*	Black-faced Woodswallow															x		x		
	Artamus cyanopterus	Dusky Woodswallow				x			x	x	x		x								
Cracticidae	*Cracticus nigrogularis*	Pied Butcherbird				x			x												
	Cracticus tibicen	Australian Magpie			x	x			x		x	x	x		x	x	x	x	x	x	x
	Cracticus tibicen dorsalis	White-backed Magpie								x											
	Cracticus torquatus	Grey Butcherbird				x			x	x		x	x		x	x	x		x		x
	Cracticus torquatus torquatus										x										
	Strepera versicolor	Grey Currawong			x	x			x	x		x	x	x	x	x	x	x	x	x	x
	Strepera versicolor plumbea										x										
Campephagidae	*Coracina maxima*	Ground Cuckoo-shrike				x			x												
	Coracina novaehollandiae	Black-faced Cuckoo-shrike			x	x			x	x	x	x	x		x	x	x		x		x
	Lalage tricolor	White-winged Triller							x										x		
Neosittidae	*Daphoenositta chrysoptera*	Varied Sittella				x					x		x								
	Daphoenositta chrysoptera pileata	Varied Sittella (Black-capped Sittella)								x											
Oreoicidae	*Oreoica gutturalis*	Crested Bellbird			x	x			x	x	x	x	x		x	x	x		x	x	x
Pachycephalidae	*Colluricincla harmonica*	Grey Shrike-thrush				x			x	x	x	x	x		x	x	x		x		
	Colluricincla harmonica rufiventris				x	x															
	Pachycephala occidentalis	Western Golden Whistler																			x
	Pachycephala pectoralis	Golden Whistler							x	x	x	x	x		x	x	x		x		
	Pachycephala rufiventris	Rufous Whistler				x			x												
Rhipiduridae	*Rhipidura albiscapa*	Grey Fantail				x			x	x	x	x	x		x						
	Rhipidura leucophrys	Willie Wagtail			x	x			x	x		x	x		x	x	x		x	x	x
	Rhipidura leucophrys leucophrys										x										
Monarchidae	*Grallina cyanoleuca*	Magpie-lark				x			x	x	x		x		x	x	x		x		
	Myiagra inquieta	Restless Flycatcher				x			x	x	x		x								
Corvidae	*Corvus coronoides*	Australian Raven			x	x			x	x		x	x	x	x	x	x	x	x	x	x

Family	Scientific Name	Common Name	EPBC	WA	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
	Corvus coronoides perplexus					x					x										
Petroicidae	*Drymodes brunneopygia*	Southern Scrub-robin				x			x	x	x	x	x		x	x	x	x	x	x	x
	Eopsaltria australis griseogularis	Western Yellow Robin							x		x								x		
	Petroica boodang	Scarlet Robin									x										
	Petroica goodenovii	Red-capped Robin				x			x												
Hirundinidae	*Cheramoeca leucosternus*	White-backed Swallow				x															
	Hirundo neoxena	Welcome Swallow			x	x			x	x	x	x	x		x	x	x		x		x
	Petrochelidon ariel	Fairy Martin				x			x												
	Petrochelidon nigricans	Tree Martin				x			x	x	x		x				x		x		x
Locustellidae	*Megalurus mathewsi*	Rufous Songlark							x												
Zosteropidae	*Zosterops lateralis*	Silvereye				x			x	x		x	x		x	x	x		x		x
	Zosterops lateralis chloronotus				x																
Sturnidae	*Sturnus vulgaris*	*Common Starling					x														
Estrildidae	*Stagonopleura oculata*	Red-eared Firetail				x			x							x					x
Motacillidae	*Anthus australis*	Australian Pipit				x			x	x			x		x	x					x
	Anthus australis australis										x										
	Motacilla cinerea	Grey Wagtail	Mi	S5			x														
Carphodactylidae	*Underwoodisaurus milii*	Southern Barking Gecko				x				x	x		x								
Diplodactylidae	*Crenadactylus ocellatus*	Clawless Gecko				x				x	x	x	x								
	Diplodactylus calcicolus	South Coast Gecko				x															
	Diplodactylus granariensis					x				x		x	x								
	Diplodactylus granariensis granariensis										x										
	Strophurus spinigerus					x						x	x								
	Strophurus spinigerus inornatus					x					x										
Gekkonidae	*Christinus marmoratus*	Marbled Gecko				x				x	x	x	x								
Pygopodidae	*Aprasia repens*					x				x	x	x	x								
	Aprasia striolata					x															
	Delma australis					x				x	x	x	x								
	Delma fraseri					x				x	x	x	x								
	Delma hebesa	Heath Delma				x													x		x
	Pygopus lepidopodus	Common Scaly Foot				x				x	x	x	x								
Agamidae	*Amphibolurus norrisi*					x				x	x	x	x								
	Ctenophorus adelaidensis	Western Heath Dragon										x	x								
	Ctenophorus chapmani	Eastern Heath Dragon			x	x				x	x										
	Ctenophorus isolepis	Military Dragon											x								
	Ctenophorus maculatus	Spotted Military Dragon				x									x						
	Ctenophorus maculatus griseus				x	x				x	x	x									
	Ctenophorus ornatus	Ornate Crevice Dragon				x															
	Pogona minor					x						x									

Family	Scientific Name	Common Name	EPBC	WA	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
	Pogona minor minor	Western Bearded Dragon								x	x		x								
Scincidae	*Acritoscincus trilineatus*					x				x	x	x	x								
	Cryptoblepharus pulcher					x						x	x								
	Ctenotus gemmula					x				x	x	x	x								
	Ctenotus impar					x				x	x	x	x								
	Ctenotus labillardieri					x				x	x										
	Egernia kingii	King's Skink				x															
	Egernia richardi									x	x										
	Hemiergis initialis					x				x		x	x								
	Hemiergis initialis initialis					x					x										
	Hemiergis peronii					x				x		x	x								
	Hemiergis peronii peronii					x					x										
	Lerista distinguenda					x				x	x	x	x								
	Lerista viduata			P1		x		x													
	Liopholis multiscutata										x	x	x								
	Menetia greyii					x				x	x	x	x								
	Morethia obscura					x				x	x	x	x								
	Tiliqua occipitalis	Western Bluetongue				x				x	x	x	x		x	x	x		x	x	
	Tiliqua rugosa				x					x		x	x	x	x	x	x	x	x	x	x
	Tiliqua rugosa rugosa					x					x										
Varanidae	*Varanus rosenbergi*	Heath Monitor			x	x				x	x	x	x	x	x	x	x	x	x	x	x
Typhlopidae	*Anilios australis*									x	x	x	x								
Elapidae	*Echiopsis curta*	Bardick				x				x	x	x	x								
	Elapognathus coronatus	Crowned Snake				x				x	x	x	x								
	Notechis scutatus	Tiger Snake			x	x				x	x	x	x				x				
	Parasuta gouldii					x				x	x	x	x								
	Pseudonaja affinis	Dugite			x							x	x				x			x	
	Pseudonaja affinis affinis					x				x	x										
	Rhinoplocephalus bicolor	Square-nosed Snake				x															
Hylidae	*Litoria adelaidensis*	Slender Tree Frog				x															
	Litoria cyclorhyncha	Spotted-thighed Frog				x				x	x	x	x	x			x				
Limnodynastidae	*Heleioporus albopunctatus*	Western Spotted Frog				x					x	x	x								
	Heleioporus eyrei	Moaning Frog				x															
	Heleioporus psammophilus	Sand Frog									x		x								
	Limnodynastes dorsalis	Western Banjo Frog				x					x	x	x								
	Neobatrachus albipes	White-footed Trilling Frog				x				x	x	x	x								
	Neobatrachus kunapalari	Kunapalari Frog				x															
Myobatrachidae	*Crinia pseudinsignifera*	Bleating Froglet				x															
	Myobatrachus gouldii	Turtle Frog				x						x	x								

Family	Scientific Name	Common Name	EPBC	WA	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
	Pseudophryne guentheri	Crawling Toadlet				x					x										
	Pseudophryne occidentalis	Western Toadlet				x															

Appendix C Fauna habitat assessments

Name	Habitat Type	Landform	Site Photograph
H01	Dense mallee over heath	Slope	
Condition	Condition	Pristine	
	Disturbance Type	N/A	
	Fire Age	5 to 15	
% Ground Cover	Rock	2	
	Soil	30	
	Leaf Litter	58	
	Vegetation	10	
Rocks	Type	Bauxite	
	Size (mm)	6-20	
	Abundance (%)	2-10	
	Exposed Bedrock (%)	0	
Soil	Type	Sand	
	Colour	Grey	
Habitat Features	Slope	Gently inclined (3-5)	
	Water	No - Never	
	Termite Presence	None	
	Woody Debris	Very Common	
	Peeling Bark	Very common	
	Rock Crevices	None	
	Burrowing Suitability	High	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation				
Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	3	70-100	Mallee
Middle	Shrub	1.5	30-70	Mallee, *Banksia*, *Isopogon*, *Eucalyptus tetraptera*
Lower	Heath, Sedge	0.3	30-70	Sedges, herbs, mixed low heath, tussock grass

Name	Habitat Type	Landform	Site Photograph
H02	Open mallee over heath	Plain	
Condition	Condition	Excellent	
	Disturbance Type	Tracks	
	Fire Age	5 to 15	
% Ground Cover	Rock	0	
	Soil	75	
	Leaf Litter	10	
	Vegetation	15	
Rocks	Type	N/A	
	Size (mm)	N/A	
	Abundance (%)	0	
	Exposed Bedrock (%)	0	
Soil	Type	Sand	
	Colour	Grey	
Habitat Features	Slope	Level (0-3)	
	Water	No - Never	
	Termite Presence	Rare	
	Woody Debris	Common	
	Peeling Bark	Common	
	Rock Crevices	None	
	Burrowing Suitability	High	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	3	10-30	Mallee
Middle	Shrub	1	< 10	Hakea, *Banksia*, *Isopogon*, *Eucalyptus tetraptera*
Lower	Heath shrub	0.5	30-70	Mixed low heath, shrubs

Name	Habitat Type	Landform	Site Photograph
H04	Low heath	Plain	
Condition	Condition	Pristine	
	Disturbance Type	N/A	
	Fire Age	Unknown (no evidence)	
% Ground Cover	Rock	0	
	Soil	65	
	Leaf Litter	10	
	Vegetation	25	
Rocks	Type	N/A	
	Size (mm)	N/A	
	Abundance (%)	0	
	Exposed Bedrock (%)	0	
Soil	Type	Sand	
	Colour	Grey	
Habitat Features	Slope	Level (0-3)	
	Water	No - Never	
	Termite Presence	None	
	Woody Debris	Rare	
	Peeling Bark	Rare	
	Rock Crevices	None	
	Burrowing Suitability	High	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	3	0-5 (isolated clumps)	Mallee
Middle	Shrub	1.5	10-30	Hakea, *Banksia*, *Isopogon*
Lower	Heath shrub	0.5	30-70	*Banksia*, mixed heath, drosera

Name	Habitat Type	Landform	Site Photograph
H05	Dense mallee over heath	Plain	
Condition	Condition	Pristine	
	Disturbance Type	N/A	
	Fire Age	5 to 15	
% Ground Cover	Rock	0	
	Soil	20	
	Leaf Litter	70	
	Vegetation	10	
Rocks	Type	Bauxite	
	Size (mm)	N/A	
	Abundance (%)	<2	
	Exposed Bedrock (%)	0	
Soil	Type	Sand	
	Colour	Grey	
Habitat Features	Slope	Level (0-3)	
	Water	No - Never	
	Termite Presence	None	
	Woody Debris	Very Common	
	Peeling Bark	Very common	
	Rock Crevices	None	
	Burrowing Suitability	High	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Tree	3.5	70-100	Mallee a
Middle	Shrub	1	10-30	*Banksia*, mallee
Lower	Heath shrub	0.5	10-30	Mixed heath

Name	Habitat Type	Landform	Site Photograph
H06	Tall trees in depression	Depression	
Condition	Condition	Pristine	
	Disturbance Type	N/A	
	Fire Age	5 to 15	
% Ground Cover	Rock	0	
	Soil	40	
	Leaf Litter	20	
	Vegetation	40	
Rocks	Type	N/A	
	Size (mm)	N/A	
	Abundance (%)	0	
	Exposed Bedrock (%)	0	
Soil	Type	Sand	
	Colour	Grey	
Habitat Features	Slope	Level (0-3)	
	Water	No - Prone to Flooding	
	Termite Presence	None	
	Woody Debris	Very Common	
	Peeling Bark	Rare	
	Rock Crevices	None	
	Burrowing Suitability	High	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation				
Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Tree	7	< 10	Tree
Middle	Shrub	1.5	10-30	*Melaleuca*, Hakea
Lower	Sedge	0.3	30-70	Sedge

Name	Habitat Type	Landform	Site Photograph
H07	Low mallee on stony rise	Hill	
Condition	Condition	Excellent	
	Disturbance Type	Tracks	
	Fire Age	5 to 15	
% Ground Cover	Rock	65	
	Soil	5	
	Leaf Litter	25	
	Vegetation	5	
Rocks	Type	Bauxite	
	Size (mm)	20-60,6-20	
	Abundance (%)	50-90	
	Exposed Bedrock (%)	20-50	
Soil	Type	Clay loam	
	Colour	Brown	
Habitat Features	Slope	Gently inclined (3-5)	
	Water	No - Never	
	Termite Presence	None	
	Woody Debris	Very Common	
	Peeling Bark	Moderate	
	Rock Crevices	None	
	Burrowing Suitability	None	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	3	< 10	Mallee
Middle	Mallee, Shrub	2	70-100	Mallee, *Banksia*, *Acacia*
Lower	Shrub	0.5	10-30	Mixed low shrubs

Name	Habitat Type	Landform	Site Photograph
H08	Low mallee on stony rise	Hill	
Condition	Condition	Pristine	
	Disturbance Type	N/A	
	Fire Age	5 to 15	
% Ground Cover	Rock	50	
	Soil	10	
	Leaf Litter	30	
	Vegetation	10	
Rocks	Type	Bauxite	
	Size (mm)	20-60,60-200	
	Abundance (%)	50-90	
	Exposed Bedrock (%)	20-50	
Soil	Type	Clay loam	
	Colour	Brown	
Habitat Features	Slope	Gently inclined (3-5)	
	Water	No - Never	
	Termite Presence	None	
	Woody Debris	Very Common	
	Peeling Bark	Moderate	
	Rock Crevices	None	
	Burrowing Suitability	None	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	3	0-5 (isolated clumps)	Mallee
Middle	Mallee	1.5	70-100	Mallee
Lower	Shrub	0.5	10-30	*Melaleuca*, *Acacia* (including *Acacia glaucoptera*)

Name	Habitat Type	Landform	Site Photograph
H09	Mallee on loam or clay	Plain	
Condition	Condition	Pristine	
	Disturbance Type	N/A	
	Fire Age	5 to 15	
% Ground Cover	Rock	10	
	Soil	50	
	Leaf Litter	25	
	Vegetation	15	
Rocks	Type	Bauxite, Quartzite	
	Size (mm)	20-60,6-20	
	Abundance (%)	20-50	
	Exposed Bedrock (%)	0	
Soil	Type	Clay loam	
	Colour	Brown	
Habitat Features	Slope	Level (0-3)	
	Water	No - Never	
	Termite Presence	None	
	Woody Debris	Common	
	Peeling Bark	Moderate	
	Rock Crevices	None	
	Burrowing Suitability	Low	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	2	10-30,30-70	Mallee
Middle	Mallee,Shrub	1.5	30-70	Mallee, *Melaleuca*, *Acacia* (including *Acacia glaucoptera*)
Lower	Shrub	0.5	30-70	*Acacia*, tussock grass

Name	Habitat Type	Landform	Site Photograph
H10	Drainage line	Minor Drainage Line	
Condition	Condition	Pristine	
	Disturbance Type	N/A	
	Fire Age	5 to 15	
% Ground Cover	Rock	2	
	Soil	13	
	Leaf Litter	80	
	Vegetation	5	
Rocks	Type	Bauxite,Quartzite	
	Size (mm)	6-20	
	Abundance (%)	<2	
	Exposed Bedrock (%)	0	
Soil	Type	Clay loam	
	Colour	Grey	
Habitat Features	Slope	Level (0-3)	
	Water	No - Prone to Flooding	
	Termite Presence	None	
	Woody Debris	Very Common	
	Peeling Bark	Very common	
	Rock Crevices	None	
	Burrowing Suitability	Low	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	6	30-70	Mallee
Middle	Mallee, Shrub	1.5	70-100	Mallee, *Melaleuca*, *Acacia* (including *Acacia glaucoptera*)
Lower	Shrub	0.5	30-70	Mixed low shrubs

Name	Habitat Type	Landform	Site Photograph
H11	Mallee on loam or clay	Plain	
Condition	Condition	Pristine	
	Disturbance Type	N/A	
	Fire Age	5 to 15	
% Ground Cover	Rock	10	
	Soil	25	
	Leaf Litter	45	
	Vegetation	20	
Rocks	Type	Bauxite, Quartzite	
	Size (mm)	20-60	
	Abundance (%)	10-20	
	Exposed Bedrock (%)	0	
Soil	Type	Clay loam	
	Colour	Brown	
Habitat Features	Slope	Level (0-3)	
	Water	No - Never	
	Termite Presence	None	
	Woody Debris	Common	
	Peeling Bark	Rare	
	Rock Crevices	None	
	Burrowing Suitability	None	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	3	10-30	Mallee
Middle	Mallee	1.5	30-70	Mallee
Lower	Shrub	0.5	10-30	*Acacia* (including *Acacia glaucoptera*), low mallee

Name	Habitat Type	Landform	Site Photograph
H12	Drainage line	Minor Drainage Line	
Condition	Condition	Pristine	
	Disturbance Type	N/A	
	Fire Age	> 15	
% Ground Cover	Rock	0	
	Soil	20	
	Leaf Litter	70	
	Vegetation	10	
Rocks	Type	N/A	
	Size (mm)	N/A	
	Abundance (%)	0	
	Exposed Bedrock (%)	0	
Soil	Type	Sand	
	Colour	Grey	
Habitat Features	Slope	Level (0-3)	
	Water	No - Prone to Flooding	
	Termite Presence	None	
	Woody Debris	Very Common	
	Peeling Bark	Common	
	Rock Crevices	None	
	Burrowing Suitability	High	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	6	30-70	Mallee
Middle	Mallee, Shrub	1	10-30	*Melaleuca*, mallee
Lower	Sedge, Shrub	0.5	30-70	Sedge, *Grevillea*

Name	Habitat Type	Landform	Site Photograph
H13	Open mallee over heath	Plain	
Condition	Condition	Pristine	
	Disturbance Type	N/A	
	Fire Age	> 15	
% Ground Cover	Rock	0	
	Soil	65	
	Leaf Litter	25	
	Vegetation	10	
Rocks	Type	Bauxite	
	Size (mm)	2-6	
	Abundance (%)	10-20	
	Exposed Bedrock (%)	0	
Soil	Type	Sandy loam	
	Colour	Yellow	
Habitat Features	Slope	Level (0-3)	
	Water	No - Never	
	Termite Presence	None	
	Woody Debris	Common	
	Peeling Bark	Moderate	
	Rock Crevices	None	
	Burrowing Suitability	High	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	4	30-70	Mallee
Middle	Mallee, Shrub	2	30-70	*Banksia*, mallee, Hakea native pine
Lower	Shrub	0.5	30-70	Mixed shrub

Name	Habitat Type	Landform	Site Photograph
H14	Drainage line	Minor Drainage Line	
Condition	Condition	Pristine	
	Disturbance Type	N/A	
	Fire Age	5 to 15	
% Ground Cover	Rock	5	
	Soil	40	
	Leaf Litter	35	
	Vegetation	20	
Rocks	Type	Bauxite	
	Size (mm)	20-60,6-20	
	Abundance (%)	10-20	
	Exposed Bedrock (%)	0	
Soil	Type	Clayey sand	
	Colour	Brown	
Habitat Features	Slope	Level (0-3)	
	Water	No - Prone to Flooding	
	Termite Presence	None	
	Woody Debris	Very Common	
	Peeling Bark	Common	
	Rock Crevices	None	
	Burrowing Suitability	Moderate	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	6	30-70	Mallee
Middle	Mallee,Shrub	1.5	30-70	Hakea, *Acacia glaucoptera*, *Melaleuca*, mallee
Lower	Sedge,Shrub	0.5	30-70	*Acacia glaucoptera*, sedge, mixed shrub

Name	Habitat Type	Landform	Site Photograph
H15	Low mallee on stony rise	Hill	
Condition	Condition	Pristine	
	Disturbance Type	N/A	
	Fire Age	5 to 15	
% Ground Cover	Rock	60	
	Soil	15	
	Leaf Litter	15	
	Vegetation	10	
Rocks	Type	Bauxite	
	Size (mm)	20-60,60-200	
	Abundance (%)	50-90	
	Exposed Bedrock (%)	2-10	
Soil	Type	Clay loam	
	Colour	Brown	
Habitat Features	Slope	Gently inclined (3-5)	
	Water	No - Never	
	Termite Presence	None	
	Woody Debris	Common	
	Peeling Bark	Common	
	Rock Crevices	None	
	Burrowing Suitability	None	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	3	30-70	Mallee
Middle	Mallee,Shrub	1	30-70	*Banksia*, *Melaleuca*, mallee, *Acacia*
Lower	Sedge,Shrub	0.3	10-30	Sedge

Name	Habitat Type	Landform	Site Photograph
H16	Low heath	Plain	
Condition	Condition	Pristine	
	Disturbance Type	N/A	
	Fire Age	5 to 15	
% Ground Cover	Rock	0	
	Soil	50	
	Leaf Litter	20	
	Vegetation	30	
Rocks	Type	N/A	
	Size (mm)	N/A	
	Abundance (%)	0	
	Exposed Bedrock (%)	0	
Soil	Type	Sand	
	Colour	White	
Habitat Features	Slope	Level (0-3)	
	Water	No - Never	
	Termite Presence	None	
	Woody Debris	Moderate	
	Peeling Bark	Rare	
	Rock Crevices	None	
	Burrowing Suitability	High	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	3	0-5 (isolated clumps)	Mallee b
Middle	Heath shrub, Shrub	1.5	10-30	Hakea, *Banksia Melaleuca*, *Isopogon*
Lower	Heath shrub	0.5	30-70	*Banksia*, Casuarinaceae, mixed heath

Name	Habitat Type	Landform	Site Photograph
H17	Open mallee over heath	Plain	
Condition	Condition	Pristine	
	Disturbance Type	N/A	
	Fire Age	5 to 15	
% Ground Cover	Rock	0	
	Soil	40	
	Leaf Litter	20	
	Vegetation	40	
Rocks	Type	N/A	
	Size (mm)	N/A	
	Abundance (%)	0	
	Exposed Bedrock (%)	0	
Soil	Type	Sand	
	Colour	White	
Habitat Features	Slope	Level (0-3)	
	Water	No - Never	
	Termite Presence	None	
	Woody Debris	Moderate	
	Peeling Bark	Moderate	
	Rock Crevices	None	
	Burrowing Suitability	High	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation				
Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	3	10-30	Mallee
Middle	Heath shrub, Mallee, Shrub	1	10-30	Hakea, *Banksia*, mallee Casuarinaceae, *Eucalyptus tetraptera*
Lower	Heath shrub	0.5	30-70	Casuarinaceae, *Melaleuca*, *Banksia*, mixed heath

Name	Habitat Type	Landform	Site Photograph
H18	Drainage line	Minor Drainage Line	
Condition	Condition	Pristine	
	Disturbance Type	N/A	
	Fire Age	5 to 15	
% Ground Cover	Rock	5	
	Soil	45	
	Leaf Litter	40	
	Vegetation	10	
Rocks	Type	Bauxite	
	Size (mm)	20-60,6-20	
	Abundance (%)	2-10	
	Exposed Bedrock (%)	0	
Soil	Type	Clayey sand	
	Colour	Brown	
Habitat Features	Slope	Level (0-3)	
	Water	No - Prone to Flooding	
	Termite Presence	None	
	Woody Debris	Very Common	
	Peeling Bark	Common	
	Rock Crevices	None	
	Burrowing Suitability	Moderate	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	7	30-70	Mallee
Middle	Mallee,Shrub	1.5	30-70	*Acacia glaucoptera*, mallee, *Melaleuca*, Hakea
Lower	Sedge,Shrub	0.5	30-70	Mixed shrubs and sedges

Name	Habitat Type	Landform	Site Photograph
H19	Low mallee on stony rise	Hill	
Condition	Condition	Pristine	
	Disturbance Type	N/A	
	Fire Age	5 to 15	
% Ground Cover	Rock	65	
	Soil	5	
	Leaf Litter	15	
	Vegetation	15	
Rocks	Type	Bauxite	
	Size (mm)	20-60,6-20	
	Abundance (%)	50-90	
	Exposed Bedrock (%)	0	
Soil	Type	Clayey sand	
	Colour	Brown	
Habitat Features	Slope	Gently inclined (3-5)	
	Water	No - Never	
	Termite Presence	None	
	Woody Debris	Very Common	
	Peeling Bark	Moderate	
	Rock Crevices	None	
	Burrowing Suitability	None	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	3	30-70	Mallee
Middle	Mallee,Shrub	1	30-70	Mallee, *Melaleuca*, *Acacia*
Lower	Sedge,Shrub	0.5	30-70	Mixed shrub and sedges

Name	Habitat Type	Landform	Site Photograph
H20	Low mallee on stony rise	Hill	
Condition	Condition	Pristine	
	Disturbance Type	N/A	
	Fire Age	5 to 15	
% Ground Cover	Rock	70	
	Soil	5	
	Leaf Litter	20	
	Vegetation	5	
Rocks	Type	Bauxite	
	Size (mm)	20-60,6-20	
	Abundance (%)	50-90	
	Exposed Bedrock (%)	0	
Soil	Type	Clayey sand	
	Colour	Brown	
Habitat Features	Slope	Gently inclined (3-5)	
	Water	No - Never	
	Termite Presence	None	
	Woody Debris	Very Common	
	Peeling Bark	Moderate	
	Rock Crevices	None	
	Burrowing Suitability	None	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	2.5	30-70	Mallee
Middle	Mallee,Shrub	1	10-30	Mallee, *Grevillea*, *Acacia glaucoptera*
Lower	Shrub	0.5	10-30	Mixed shrub

Name	Habitat Type	Landform	Site Photograph
H21	Tall mallee with understorey	Plain	
Condition	Condition	Pristine	
	Disturbance Type	N/A	
	Fire Age	5 to 15	
% Ground Cover	Rock	5	
	Soil	45	
	Leaf Litter	40	
	Vegetation	10	
Rocks	Type	Bauxite	
	Size (mm)	20-60	
	Abundance (%)	2-10	
	Exposed Bedrock (%)	0	
Soil	Type	Silty loam	
	Colour	Brown	
Habitat Features	Slope	Level (0-3)	
	Water	No - Never	
	Termite Presence	None	
	Woody Debris	Very Common	
	Peeling Bark	Rare	
	Rock Crevices	None	
	Burrowing Suitability	High	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	5	30-70	Mallee a
Middle	Mallee, Shrub	1	30-70	*Acacia*, *Dodonaea*, vines
Lower	Shrub	0.3	< 10	*Acacia*, mixed shrubs

Name	Habitat Type	Landform	Site Photograph
H22	Tall mallee with understorey d	Plain	
Condition	Condition	Pristine	
	Disturbance Type	N/A	
	Fire Age	5 to 15	
% Ground Cover	Rock	5	
	Soil	65	
	Leaf Litter	20	
	Vegetation	10	
Rocks	Type	Bauxite	
	Size (mm)	20-60	
	Abundance (%)	2-10	
	Exposed Bedrock (%)	0	
Soil	Type	Silty loam	
	Colour	Brown	
Habitat Features	Slope	Level (0-3)	
	Water	No - Never	
	Termite Presence	None	
	Woody Debris	Very Common	
	Peeling Bark	Rare	
	Rock Crevices	None	
	Burrowing Suitability	High	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	4	30-70	Mallee
Middle	Mallee,Shrub	1.5	30-70	*Dodonaea*, *Acacia Melaleuca*, vines
Lower	Shrub	0.5	< 10	Young *Dodonaea*, *Acacia Melaleuca* and mixed shrubs

Name	Habitat Type	Landform	Site Photograph
H23	Drainage line	Slope	
Condition	Condition	Excellent	
	Disturbance Type	Tracks	
	Fire Age	> 15	
% Ground Cover	Rock	35	
	Soil	5	
	Leaf Litter	50	
	Vegetation	10	
Rocks	Type	Bauxite	
	Size (mm)	20-60	
	Abundance (%)	50-90	
	Exposed Bedrock (%)	0	
Soil	Type	Loamy sand	
	Colour	Brown	
Habitat Features	Slope	Gently inclined (3-5)	
	Water	No - Never	
	Termite Presence	None	
	Woody Debris	Very Common	
	Peeling Bark	Moderate	
	Rock Crevices	None	
	Burrowing Suitability	Low	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee,Tree	6	10-30	*Banksia*, mallee
Middle	Mallee,Shrub	2	70-100	Mallee, *Melaleuca* (dominant), *Banksia*
Lower	Shrub	0.5	10-30	Mixed shrubs

Name	Habitat Type	Landform	Site Photograph
H24	Mallee over large *Banksia*	Plain	
Condition	Condition	Pristine	
	Disturbance Type	N/A	
	Fire Age	> 15	
% Ground Cover	Rock	5	
	Soil	40	
	Leaf Litter	50	
	Vegetation	5	
Rocks	Type	Bauxite	
	Size (mm)	20-60	
	Abundance (%)	2-10	
	Exposed Bedrock (%)	0	
Soil	Type	Sand	
	Colour	Grey	
Habitat Features	Slope	Level (0-3)	
	Water	No - Never	
	Termite Presence	None	
	Woody Debris	Common	
	Peeling Bark	Common	
	Rock Crevices	None	
	Burrowing Suitability	Moderate	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee,Tree	6	30-70	***Banksia*** mallee a
Middle	Mallee,Shrub	1.5	10-30	Mallee a ***Melaleuca*** (dom)
Lower	Shrub	0.3	30-70	***Melaleuca*** spp

Name	Habitat Type	Landform	Site Photograph
H25	Tall mallee with limited understorey	Plain	
Condition	Condition	Pristine	
	Disturbance Type	Tracks	
	Fire Age	> 15	
% Ground Cover	Rock	30	
	Soil	5	
	Leaf Litter	60	
	Vegetation	5	
Rocks	Type	Bauxite	
	Size (mm)	20-60	
	Abundance (%)	20-50	
	Exposed Bedrock (%)	0	
Soil	Type	Sandy loam	
	Colour	Brown	
Habitat Features	Slope	Level (0-3)	
	Water	No - Never	
	Termite Presence	None	
	Woody Debris	Very Common	
	Peeling Bark	Common	
	Rock Crevices	None	
	Burrowing Suitability	Moderate	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	6	70-100	Mallee
Middle	Shrub	2	10-30	*Melaleuca*
Lower	N/A	0	0-5 (isolated clumps)	None

Name	Habitat Type	Landform	Site Photograph
H26	Open mallee over heath	Plain	
Condition	Condition	Pristine	
	Disturbance Type	Tracks	
	Fire Age	5 to 15	
% Ground Cover	Rock	0	
	Soil	60	
	Leaf Litter	20	
	Vegetation	20	
Rocks	Type	N/A	
	Size (mm)	N/A	
	Abundance (%)	0	
	Exposed Bedrock (%)	0	
Soil	Type	Sand	
	Colour	Grey	
Habitat Features	Slope	Level (0-3)	
	Water	No - Never	
	Termite Presence	None	
	Woody Debris	Moderate	
	Peeling Bark	Rare	
	Rock Crevices	None	
	Burrowing Suitability	High	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	3	30-70	Mallee
Middle	Mallee,Shrub	1	10-30	Mallee, *Banksia*, *Eucalyptus tetraptera*
Lower	Heath shrub	0.3	30-70	Unknown

Name	Habitat Type	Landform	Site Photograph
H27	Open mallee over heath	Plain	
Condition	Condition	Excellent	
	Disturbance Type	Tracks	
	Fire Age	5 to 15	
% Ground Cover	Rock	0	
	Soil	40	
	Leaf Litter	40	
	Vegetation	20	
Rocks	Type	N/A	
	Size (mm)	N/A	
	Abundance (%)	0	
	Exposed Bedrock (%)	0	
Soil	Type	Sand	
	Colour	White	
Habitat Features	Slope	Level (0-3)	
	Water	No - Never	
	Termite Presence	None	
	Woody Debris	Moderate	
	Peeling Bark	Moderate	
	Rock Crevices	None	
	Burrowing Suitability	High	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	3.5	10-30	Mallee, *Eucalyptus tetraptera*
Middle	Shrub	1	10-30	Mallee, Hakea, *Banksia*, *Isopogon*
Lower	Heath shrub	0.5	30-70	Mixed heath

Name	Habitat Type	Landform	Site Photograph
H28	Low shrubland	Hill	
Condition	Condition	Excellent	
	Disturbance Type	Tracks	
	Fire Age	5 to 15	
% Ground Cover	Rock	0	
	Soil	60	
	Leaf Litter	20	
	Vegetation	20	
Rocks	Type	N/A	
	Size (mm)	N/A	
	Abundance (%)	0	
	Exposed Bedrock (%)	<2	
Soil	Type	Sand	
	Colour	Grey	
Habitat Features	Slope	Gently inclined (3-5)	
	Water	No - Never	
	Termite Presence	None	
	Woody Debris	None	
	Peeling Bark	Rare	
	Rock Crevices	None	
	Burrowing Suitability	High	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	N/A	0	0-5 (isolated clumps)	0
Middle	Shrub	1	70-100	*Melaleuca*
Lower	Sedge,Shrub	0.2	10-30	*Melaleuca* and sedge

Name	Habitat Type	Landform	Site Photograph
H29	Dense mallee over heath (*Acacia* thicket variation)	Hill	
Condition	Condition	Excellent	
	Disturbance Type	Tracks	
	Fire Age	5 to 15	
% Ground Cover	Rock	2	
	Soil	3	
	Leaf Litter	85	
	Vegetation	10	
Rocks	Type	Granite	
	Size (mm)	20-60,60-200	
	Abundance (%)	2-10	
	Exposed Bedrock (%)	<2	
Soil	Type	Clayey sand	
	Colour	Brown	
Habitat Features	Slope	Gently inclined (3-5)	
	Water	No - Never	
	Termite Presence	None	
	Woody Debris	Rare	
	Peeling Bark	Rare	
	Rock Crevices	None	
	Burrowing Suitability	Moderate	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	6	< 10	Mallee
Middle	Shrub	2.5	70-100	*Acacia*
Lower	Sedge, Shrub	0.3	10-30	Sedge, *Melaleuca*

Name	Habitat Type	Landform	Site Photograph
H30	Mallee over large *Banksia*	Slope	
Condition	Condition	Excellent	
	Disturbance Type	Tracks	
	Fire Age	> 15	
% Ground Cover	Rock	10	
	Soil	30	
	Leaf Litter	40	
	Vegetation	20	
Rocks	Type	Granite	
	Size (mm)	20-60	
	Abundance (%)	20-50	
	Exposed Bedrock (%)	0	
Soil	Type	Clayey sand	
	Colour	Brown	
Habitat Features	Slope	Gently inclined (3-5)	
	Water	No - Never	
	Termite Presence	None	
	Woody Debris	Common	
	Peeling Bark	Common	
	Rock Crevices	None	
	Burrowing Suitability	Moderate	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	5	30-70	Mallee, *Banksia*
Middle	Shrub	1.5	30-70	*Melaleuca*, Hakea, *Banksia*, mallee, native pine
Lower	Sedge, Shrub	0.5	30-70	*Melaleuca*, sedge

Name	Habitat Type	Landform	Site Photograph
H31	Low shrubland	Hill	
Condition	Condition	Pristine	
	Disturbance Type	N/A	
	Fire Age	5 to 15	
% Ground Cover	Rock	40	
	Soil	10	
	Leaf Litter	40	
	Vegetation	10	
Rocks	Type	Basalt	
	Size (mm)	20-60,6-20	
	Abundance (%)	>90	
	Exposed Bedrock (%)	0	
Soil	Type	Medium clay	
	Colour	Brown	
Habitat Features	Slope	Gently inclined (3-5)	
	Water	No - Never	
	Termite Presence	None	
	Woody Debris	Moderate	
	Peeling Bark	Rare	
	Rock Crevices	None	
	Burrowing Suitability	Low	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	3	0-5 (isolated clumps)	Mallee
Middle	Shrub	1	70-100	*Acacia, Grevillea*
Lower	Sedge, Shrub	0.2	< 10	Sedge

Name	Habitat Type	Landform	Site Photograph
H32	Low mallee on stony rise	Hill	
Condition	Condition	Excellent	
	Disturbance Type	Mining	
	Fire Age	5 to 15	
% Ground Cover	Rock	5	
	Soil	40	
	Leaf Litter	40	
	Vegetation	15	
Rocks	Type	Calcrete	
	Size (mm)	60-200	
	Abundance (%)	50-90	
	Exposed Bedrock (%)	0	
Soil	Type	Sandy loam	
	Colour	Grey	
Habitat Features	Slope	Gently inclined (3-5)	
	Water	No - Never	
	Termite Presence	None	
	Woody Debris	Common	
	Peeling Bark	Moderate	
	Rock Crevices	None	
	Burrowing Suitability	High	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	4	0-5 (isolated clumps)	Mallee
Middle	Mallee, Shrub	2	30-70	Mallee, *Melaleuca*
Lower	Sedge, Shrub	0.3	10-30	*Melaleuca*, sedge, mixed shrubs

Name	Habitat Type	Landform	Site Photograph
H33	Open mallee over heath	Mallee heath stones	
Condition	Condition	Excellent	
	Disturbance Type	Tracks	
	Fire Age	5 to 15	
% Ground Cover	Rock	5	
	Soil	65	
	Leaf Litter	15	
	Vegetation	15	
Rocks	Type	Bauxite	
	Size (mm)	6-20	
	Abundance (%)	10-20	
	Exposed Bedrock (%)	0	
Soil	Type	Sand	
	Colour	Yellow	
Habitat Features	Slope	Gently inclined (3-5)	
	Water	No - Never	
	Termite Presence	Rare	
	Woody Debris	Moderate	
	Peeling Bark	Moderate	
	Rock Crevices	None	
	Burrowing Suitability	High	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	3	10-30	Mallee
Middle	Mallee,Shrub	1	10-30	Mallee, *Banksia*, *Eucalyptus tetraptera*
Lower	Heath shrub,Sedge,Shrub	0.3	30-70	Mixed heath and sedges

Name	Habitat Type	Landform	Site Photograph
H34	Mallee on loam or clay	Plain	
Condition	Condition	Pristine	
	Disturbance Type	Tracks	
	Fire Age	5 to 15	
% Ground Cover	Rock	0	
	Soil	30	
	Leaf Litter	60	
	Vegetation	10	
Rocks	Type	N/A	
	Size (mm)	N/A	
	Abundance (%)	0	
	Exposed Bedrock (%)	0	
Soil	Type	Sandy loam	
	Colour	Brown	
Habitat Features	Slope	Level (0-3)	
	Water	No - Never	
	Termite Presence	None	
	Woody Debris	Common	
	Peeling Bark	Common	
	Rock Crevices	None	
	Burrowing Suitability	High	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	4	30-70	Mallee
Middle	Mallee, Shrub	1	30-70	*Acacia glaucoptera*, *Grevillea*, mallee, vines
Lower	Sedge, Shrub	0.3	10-30	Mixed shrubs and sedge

Name	Habitat Type	Landform	Site Photograph
H35	*Melaleuca* shrubland	Wetland	
Condition	Condition	Degraded	
	Disturbance Type	Changed hydrology, Clearing, Tracks	
	Fire Age	5 to 15	
% Ground Cover	Rock	0	
	Soil	20	
	Leaf Litter	65	
	Vegetation	15	
Rocks	Type	N/A	
	Size (mm)	N/A	
	Abundance (%)	0	
	Exposed Bedrock (%)	0	
Soil	Type	Clayey sand	
	Colour	Brown	
Habitat Features	Slope	Gently inclined (3-5)	
	Water	No - Prone to Ponding	
	Termite Presence	None	
	Woody Debris	Very Common	
	Peeling Bark	Rare	
	Rock Crevices	None	
	Burrowing Suitability	Low	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Shrub	3	70-100	*Melaleuca*
Middle	Shrub	0	0-5 (isolated clumps)	N/A
Lower	N/A	0	0-5 (isolated clumps)	N/A

Name	Habitat Type	Landform	Site Photograph
H36	Low shrubland	Hill	
Condition	Condition	Pristine	
	Disturbance Type	N/A	
	Fire Age	5 to 15	
% Ground Cover	Rock	70	
	Soil	10	
	Leaf Litter	10	
	Vegetation	10	
Rocks	Type	Unknown chert?	
	Size (mm)	20-60,60-200	
	Abundance (%)	>90	
	Exposed Bedrock (%)	10-20	
Soil	Type	Clayey sand	
	Colour	Grey	
Habitat Features	Slope	Gently inclined (3-5)	
	Water	No - Never	
	Termite Presence	None	
	Woody Debris	Rare	
	Peeling Bark	None	
	Rock Crevices	None	
	Burrowing Suitability	None	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	N/A	0	0-5 (isolated clumps)	Na
Middle	Shrub	1	10-30	*Melaleuca*, Hakea
Lower	Shrub	0.5	30-70	*Acacia*

Name	Habitat Type	Landform	Site Photograph
H37	Tall mallee with understorey	Plain	
Condition	Condition	Pristine	
	Disturbance Type	N/A	
	Fire Age	> 15	
% Ground Cover	Rock	75	
	Soil	5	
	Leaf Litter	15	
	Vegetation	5	
Rocks	Type	Bauxite	
	Size (mm)	6-20	
	Abundance (%)	>90	
	Exposed Bedrock (%)	2-10	
Soil	Type	Sandy loam	
	Colour	Brown	
Habitat Features	Slope	Level (0-3)	
	Water	No - Never	
	Termite Presence	None	
	Woody Debris	Common	
	Peeling Bark	Common	
	Rock Crevices	None	
	Burrowing Suitability	Moderate	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	4	30-70	Mallee
Middle	Shrub	1.5	30-70	*Melaleuca*, *Banksia*
Lower	Sedge, Shrub	0.5	10-30	Sedge, *Acacia*, mixed shrubs

Name	Habitat Type	Landform	Site Photograph
H38	Mallee over loam or clay	Slope	
Condition	Condition	Pristine	
	Disturbance Type	N/A	
	Fire Age	5 to 15	
% Ground Cover	Rock	30	
	Soil	45	
	Leaf Litter	15	
	Vegetation	10	
Rocks	Type	Bauxite	
	Size (mm)	6-20	
	Abundance (%)	50-90	
	Exposed Bedrock (%)	0	
Soil	Type	Sandy loam	
	Colour	Orange	
Habitat Features	Slope	Gently inclined (3-5)	
	Water	No - Never	
	Termite Presence	None	
	Woody Debris	Common	
	Peeling Bark	Moderate	
	Rock Crevices	None	
	Burrowing Suitability	Moderate	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	3	10-30	Mallee
Middle	Mallee, Shrub	1.5	30-70	Mallee, *Banksia*
Lower	Sedge, Shrub	0.5	30-70	*Melaleuca* and sedges

Name	Habitat Type	Landform	Site Photograph
H39	Low mallee on stony rise	Slope	
Condition	Condition	Pristine	
	Disturbance Type	N/A	
	Fire Age	5 to 15	
% Ground Cover	Rock	70	
	Soil	5	
	Leaf Litter	15	
	Vegetation	10	
Rocks	Type	Calcrete	
	Size (mm)	20-60	
	Abundance (%)	>90	
	Exposed Bedrock (%)	0	
Soil	Type	Sand	
	Colour	Grey	
Habitat Features	Slope	Gently inclined (3-5)	
	Water	No - Never	
	Termite Presence	None	
	Woody Debris	Common	
	Peeling Bark	Moderate	
	Rock Crevices	None	
	Burrowing Suitability	Moderate	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee, Shrub	3	30-70	*Banksia*, mallee
Middle	Mallee, Shrub	2	30-70	*Banksia*, mallee
Lower	Sedge, Shrub	0.3	10-30	Sedge, mixed shrubs

Name	Habitat Type	Landform	Site Photograph
H40	Tall mallee with limited understorey	Plain	
Condition	Condition	Excellent	
	Disturbance Type	Tracks	
	Fire Age	> 15	
% Ground Cover	Rock	0	
	Soil	0	
	Leaf Litter	95	
	Vegetation	5	
Rocks	Type	N/A	
	Size (mm)	N/A	
	Abundance (%)	0	
	Exposed Bedrock (%)	0	
Soil	Type	Loamy sand	
	Colour	Brown	
Habitat Features	Slope	Level (0-3)	
	Water	No - Never	
	Termite Presence	Rare	
	Woody Debris	Very Common	
	Peeling Bark	Moderate	
	Rock Crevices	None	
	Burrowing Suitability	Moderate	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	6	70-100	Mallee
Middle	Shrub	1.5	< 10	*Melaleuca, Acacia glaucoptera*
Lower	Shrub	0.3	0-5 (isolated clumps)	*Melaleuca, Acacia*

Name	Habitat Type	Landform	Site Photograph
H41	Mallee on loam or clay	Plain	
Condition	Condition	Pristine	
	Disturbance Type	N/A	
	Fire Age	5 to 15	
% Ground Cover	Rock	5	
	Soil	60	
	Leaf Litter	20	
	Vegetation	15	
Rocks	Type	Bauxite	
	Size (mm)	6-20	
	Abundance (%)	20-50	
	Exposed Bedrock (%)	0	
Soil	Type	Loamy sand	
	Colour	Brown	
Habitat Features	Slope	Level (0-3)	
	Water	No - Never	
	Termite Presence	None	
	Woody Debris	Moderate	
	Peeling Bark	Moderate	
	Rock Crevices	None	
	Burrowing Suitability	High	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	2	30-70	Mallee
Middle	Mallee, Shrub	1	30-70	Mallee, *Melaleuca*, vine
Lower	Sedge, Shrub	0.5	10-30	*Melaleuca*, sedge

Name	Habitat Type	Landform	Site Photograph
H42	Drainage Line	Drainage Line	
Condition	Condition	Pristine	
	Disturbance Type	N/A	
	Fire Age	> 15	
% Ground Cover	Rock	0	
	Soil	40	
	Leaf Litter	40	
	Vegetation	20	
Rocks	Type	N/A	
	Size (mm)	N/A	
	Abundance (%)	0	
	Exposed Bedrock (%)	0	
Soil	Type	Loamy sand	
	Colour	Brown	
Habitat Features	Slope	Gently inclined (3-5)	
	Water	Yes - Semi-permanent	
	Termite Presence	None	
	Woody Debris	Common	
	Peeling Bark	Common	
	Rock Crevices	None	
	Burrowing Suitability	High	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	7	30-70	Mallee
Middle	Mallee,Shrub	1.5	70-100	*Acacia*, mallee, vine
Lower	Sedge	0.5	< 10	Sedge

Name	Habitat Type	Landform	Site Photograph
H43	Mallee on loam or clay	Plain	
Condition	Condition	Pristine	
	Disturbance Type	N/A	
	Fire Age	5 to 15	
% Ground Cover	Rock	45	
	Soil	15	
	Leaf Litter	25	
	Vegetation	15	
Rocks	Type	Bauxite	
	Size (mm)	6-20	
	Abundance (%)	50-90	
	Exposed Bedrock (%)	0	
Soil	Type	Clayey sand	
	Colour	Brown	
Habitat Features	Slope	Level (0-3)	
	Water	No - Never	
	Termite Presence	None	
	Woody Debris	Moderate	
	Peeling Bark	Moderate	
	Rock Crevices	None	
	Burrowing Suitability	Low	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	3	30-70	Mallee
Middle	Mallee, Shrub	1.5	10-30	Mallee, *Acacia glaucoptera*, *Melaleuca*, vines
Lower	Sedge, Shrub	0.5	30-70	*Melaleuca*

Name	Habitat Type	Landform	Site Photograph
H44	Mallee over large Banksia	Plain	
Condition	Condition	Excellent	
	Disturbance Type	Tracks	
	Fire Age	> 15	
% Ground Cover	Rock	0	
	Soil	65	
	Leaf Litter	15	
	Vegetation	20	
Rocks	Type	N/A	
	Size (mm)	N/A	
	Abundance (%)	0	
	Exposed Bedrock (%)	0	
Soil	Type	Sand	
	Colour	Yellow	
Habitat Features	Slope	Level (0-3)	
	Water	No - Never	
	Termite Presence	None	
	Woody Debris	Moderate	
	Peeling Bark	Moderate	
	Rock Crevices	None	
	Burrowing Suitability	High	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	3	30-70	Mallee, *Banksia*
Middle	Mallee, Shrub	1.5	10-30	Mallee, *Banksia*, *Melaleuca*
Lower	Sedge, Shrub	0.5	30-70	*Melaleuca*, sedge, mixed shubs

Name	Habitat Type	Landform	Site Photograph
H45	Mallee on loam or clay	Plain	
Condition	Condition	Excellent	
	Disturbance Type	Tracks	
	Fire Age	5 to 15	
% Ground Cover	Rock	5	
	Soil	45	
	Leaf Litter	35	
	Vegetation	15	
Rocks	Type	Bauxite,Quartzite	
	Size (mm)	20-60,6-20	
	Abundance (%)	20-50	
	Exposed Bedrock (%)	0	
Soil	Type	Clay loam	
	Colour	Brown	
Habitat Features	Slope	Level (0-3)	
	Water	No - Never	
	Termite Presence	None	
	Woody Debris	Common	
	Peeling Bark	Moderate	
	Rock Crevices	None	
	Burrowing Suitability	Moderate	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	2	30-70	Mallee
Middle	Mallee, Shrub	1.5	70-100	Mallee, *Acacia glaucoptera*, *Grevillea*, vine, *Melaleuca*
Lower	Sedge, Shrub	0.5	10-30	Sedge, *Melaleuca*, *Acacia glaucoptera*

Name	Habitat Type	Landform	Site Photograph
H46	Mallee on loam or clay	Plain	
Condition	Condition	Excellent	
	Disturbance Type	Clearing, Tracks	
	Fire Age	5 to 15	
% Ground Cover	Rock	5	
	Soil	65	
	Leaf Litter	15	
	Vegetation	15	
Rocks	Type	Calcrete	
	Size (mm)	20-60,6-20	
	Abundance (%)	2-10	
	Exposed Bedrock (%)	<2	
Soil	Type	Clay loam	
	Colour	Brown	
Habitat Features	Slope	Level (0-3)	
	Water	No - Never	
	Termite Presence	Rare	
	Woody Debris	Common	
	Peeling Bark	Moderate	
	Rock Crevices	None	
	Burrowing Suitability	High	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	4	30-70	Mallee
Middle	Mallee, Shrub	1	30-70	Mallee, *Acacia*, *Melaleuca*, vine *Dodonaea*
Lower	Shrub	0.5	10-30	Mixed shrub

Name	Habitat Type	Landform	Site Photograph
H47	Mallee on loam or clay	Slope	
Condition	Condition	Pristine	
	Disturbance Type	N/A	
	Fire Age	5 to 15	
% Ground Cover	Rock	20	
	Soil	50	
	Leaf Litter	10	
	Vegetation	20	
Rocks	Type	Quartzite	
	Size (mm)	20-60	
	Abundance (%)	>90	
	Exposed Bedrock (%)	0	
Soil	Type	Sandy loam	
	Colour	Brown	
Habitat Features	Slope	Gently inclined (3-5)	
	Water	No - Never	
	Termite Presence	None	
	Woody Debris	Common	
	Peeling Bark	Moderate	
	Rock Crevices	None	
	Burrowing Suitability	Moderate	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	2	30-70	Mallee
Middle	Mallee, Shrub	1	30-70	Mallee, *Grevillea*, *Melaleuca*, *Acacia glaucoptera*
Lower	Sedge, Shrub	0.5	30-70	Sedge, *Melaleuca*

Name	Habitat Type	Landform	Site Photograph
H48	Low mallee on stony rise	Slope	
Condition	Condition	Excellent	
	Disturbance Type	Tracks	
	Fire Age	5 to 15	
% Ground Cover	Rock	40	
	Soil	30	
	Leaf Litter	20	
	Vegetation	10	
Rocks	Type	Chert, Ironstone, Quartzite	
	Size (mm)	20-60,6-20	
	Abundance (%)	>90	
	Exposed Bedrock (%)	0	
Soil	Type	Clayey sand	
	Colour	Orange	
Habitat Features	Slope	Gently inclined (3-5)	
	Water	No - Never	
	Termite Presence	None	
	Woody Debris	Moderate	
	Peeling Bark	Moderate	
	Rock Crevices	None	
	Burrowing Suitability	Moderate	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	3	30-70	Mallee
Middle	Mallee, Shrub	1	10-30	Mallee, *Melaleuca*
Lower	Sedge, Shrub	0.5	30-70	*Grevillea*, *Melaleuca*, sedge, *Acacia*

Name	Habitat Type	Landform	Site Photograph
H49	Mallee on loam or clay	Plain	
Condition	Condition	Pristine	
	Disturbance Type	N/A	
	Fire Age	5 to 15	
% Ground Cover	Rock	0	
	Soil	70	
	Leaf Litter	20	
	Vegetation	10	
Rocks	Type	Bauxite	
	Size (mm)	6-20	
	Abundance (%)	<2	
	Exposed Bedrock (%)	0	
Soil	Type	Loamy sand	
	Colour	Brown	
Habitat Features	Slope	Level (0-3)	
	Water	No - Never	
	Termite Presence	None	
	Woody Debris	Very Common	
	Peeling Bark	Moderate	
	Rock Crevices	None	
	Burrowing Suitability	Moderate	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	2	30-70	Mallee
Middle	Mallee, Shrub	2	10-30	Mallee, *Melaleuca*, *Grevillea*
Lower	Sedge, Shrub	0.5	10-30	Sedge, *Melaleuca*, *Acacia glaucoptera*

Name	Habitat Type	Landform	Site Photograph
H50	Tall mallee with understorey	Plain	
Condition	Condition	Excellent	
	Disturbance Type	Tracks	
	Fire Age	5 to 15	
% Ground Cover	Rock	0	
	Soil	45	
	Leaf Litter	40	
	Vegetation	15	
Rocks	Type	Conglomerate, Sandstone	
	Size (mm)	20-60,60-200	
	Abundance (%)	<2	
	Exposed Bedrock (%)	0	
Soil	Type	Medium clay	
	Colour	Brown	
Habitat Features	Slope	Level (0-3)	
	Water	No - Never	
	Termite Presence	None	
	Woody Debris	Common	
	Peeling Bark	Common	
	Rock Crevices	None	
	Burrowing Suitability	Low	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	3	30-70	Mallee
Middle	Mallee, Shrub	1	10-30	*Melaleuca*, mallee
Lower	Sedge, Shrub	0.3	10-30	Sedge, *Melaleuca*

Name	Habitat Type	Landform	Site Photograph
H52	Tall mallee with understorey	Plain	
Condition	Condition	Pristine	
	Disturbance Type	N/A	
	Fire Age	5 to 15	
% Ground Cover	Rock	0	
	Soil	45	
	Leaf Litter	30	
	Vegetation	25	
Rocks	Type	N/A	
	Size (mm)	N/A	
	Abundance (%)	0	
	Exposed Bedrock (%)	0	
Soil	Type	Loamy sand	
	Colour	Dark	
Habitat Features	Slope	Level (0-3)	
	Water	No - Never	
	Termite Presence	None	
	Woody Debris	Common	
	Peeling Bark	Rare	
	Rock Crevices	None	
	Burrowing Suitability	Moderate	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	4	30-70	Mallee
Middle	Mallee, Shrub	1	30-70	*Melaleuca*, *Acacia* (including *Acacia glaucoptera*) *Dodonaea*, vine
Lower	Sedge, Shrub	0.3	10-30	Sedge, *Melaleuca*, *Dodonaea*

Name	Habitat Type	Landform	Site Photograph
H53	Tall mallee with understorey	Plain	
Condition	Condition	Excellent	
	Disturbance Type	Tracks	
	Fire Age	5 to 15	
% Ground Cover	Rock	5	
	Soil	50	
	Leaf Litter	35	
	Vegetation	10	
Rocks	Type	Quartzite	
	Size (mm)	20-60	
	Abundance (%)	20-50	
	Exposed Bedrock (%)	0	
Soil	Type	Medium clay	
	Colour	Brown	
Habitat Features	Slope	Level (0-3)	
	Water	No - Never	
	Termite Presence	None	
	Woody Debris	Moderate	
	Peeling Bark	Moderate	
	Rock Crevices	None	
	Burrowing Suitability	Moderate	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	3	30-70	Mallee
Middle	Mallee, Shrub	1.5	30-70	Mallee, *Melaleuca*, *Acacia*
Lower	Sedge, Shrub	0.3	30-70	*Melaleuca*, sedge, *Grevillea*

Name	Habitat Type	Landform	Site Photograph
H54	Mallee over large *Banksia*	Plain	
Condition	Condition	Pristine	
	Disturbance Type	N/A	
	Fire Age	> 15	
% Ground Cover	Rock	5	
	Soil	40	
	Leaf Litter	45	
	Vegetation	10	
Rocks	Type	Quartzite	
	Size (mm)	6-20	
	Abundance (%)	20-50	
	Exposed Bedrock (%)	0	
Soil	Type	Sandy loam	
	Colour	Brown	
Habitat Features	Slope	Level (0-3)	
	Water	No - Never	
	Termite Presence	None	
	Woody Debris	Very Common	
	Peeling Bark	Common	
	Rock Crevices	None	
	Burrowing Suitability	Moderate	
	Tree Hollows (<10 cm)	None	
	Tree Hollows (>10 cm)	None	

Vegetation

Stratum	Form/s	Height (m)	Cover (%)	Species
Upper	Mallee	5	30-70	Mallee, sparse *Banksia*
Middle	Mallee, Shrub	1.5	30-70	*Melaleuca*, mallee
Lower	Sedge, Shrub	0.5	10-30	*Melaleuca*, sedge

Appendix D Conservation Significant Fauna Records Within the Study Areas and Immediate Surrounds (Stantec 2018)

Species name	Common name	Site	Method	Location (51H)	
				Easting	Northing
Calyptorhynchus latirostris	Carnaby's Cockatoo		Observation	261329	6275012
Dasyurus geoffroii	Chuditch	REC30	Camera Trap	250538	6283900
Leipoa ocellata	Malleefowl	REC46	Camera Trap	251642	6280296
Leipoa ocellata	Malleefowl		Observation	254755	6275301
Leipoa ocellata	Malleefowl		Carcass	255064.2	6276178
Leipoa ocellata	Malleefowl		Observation	252009.1	6279815
Leipoa ocellata	Malleefowl		Observation	252136.1	6280680
Leipoa ocellata	Malleefowl		Observation	252130	6282002
Leipoa ocellata	Malleefowl	MW1	Mound	250832	6279369
Leipoa ocellata	Malleefowl	MW10	Mound	256104	6276950
Leipoa ocellata	Malleefowl	MW11	Mound	248843	6279011
Leipoa ocellata	Malleefowl	MW12	Mound	251632	6284149
Leipoa ocellata	Malleefowl	MW13	Mound	253341	6283848
Leipoa ocellata	Malleefowl	MW2	Mound	251756	6279561
Leipoa ocellata	Malleefowl	MW3	Mound	251486	6280853
Leipoa ocellata	Malleefowl	MW4	Mound	251845	6284302
Leipoa ocellata	Malleefowl	MW5	Mound	251845	6284197
Leipoa ocellata	Malleefowl	MW6	Mound	253771	6278858
Leipoa ocellata	Malleefowl	MW7	Mound	253954	6279132
Leipoa ocellata	Malleefowl	MW8	Mound	250627	6284155
Leipoa ocellata	Malleefowl	MW9	Mound	254194	6277578
Psophodes nigrogularis oberon	Western Whipbird		Heard	254036.2	6281142
Psophodes nigrogularis oberon	Western Whipbird		Heard	252898.5	6279827
Psophodes nigrogularis oberon	Western Whipbird		Heard	249587.2	6281777
Psophodes nigrogularis oberon	Western Whipbird		Heard	249826.2	6280918
Psophodes nigrogularis oberon	Western Whipbird		Heard	250544.5	6282077
Psophodes nigrogularis oberon	Western Whipbird		Heard	249655.5	6282308
Psophodes nigrogularis oberon	Western Whipbird		Heard	249651.4	6281367
Psophodes nigrogularis oberon	Western Whipbird		Heard	250983.5	6282000
Psophodes nigrogularis oberon	Western Whipbird		Heard	254622.2	6275860
Psophodes nigrogularis oberon	Western Whipbird		Heard	252902.8	6280049
Psophodes nigrogularis oberon	Western Whipbird		Heard	251030.7	6280938

Species name	Common name	Site	Method	Location (51H)	
				Easting	Northing
Psophodes nigrogularis oberon	Western Whipbird		Observation	250814.8	6280754
Psophodes nigrogularis oberon	Western Whipbird		Heard	250938.6	6281640
Psophodes nigrogularis oberon	Western Whipbird		Heard	257196.4	6278076
Psophodes nigrogularis oberon	Western Whipbird		Heard	254429.6	6275859
Notamacropus irma	Western Brush Wallaby	REC03	Camera Trap	249545	6281217
Notamacropus irma	Western Brush Wallaby	REC03	Camera Trap	249545	6281217
Notamacropus irma	Western Brush Wallaby	REC03	Camera Trap	249545	6281217
Notamacropus irma	Western Brush Wallaby	REC03	Camera Trap	249545	6281217
Notamacropus irma	Western Brush Wallaby	REC05	Camera Trap	252676	6282758
Notamacropus irma	Western Brush Wallaby	REC18	Camera Trap	253747	6281105
Notamacropus irma	Western Brush Wallaby	REC18	Camera Trap	253747	6281105
Notamacropus irma	Western Brush Wallaby	REC18	Camera Trap	253747	6281105
Notamacropus irma	Western Brush Wallaby	REC18	Camera Trap	253747	6281105
Notamacropus irma	Western Brush Wallaby	REC20	Camera Trap	253738	6281290
Notamacropus irma	Western Brush Wallaby	REC20	Camera Trap	253738	6281290
Notamacropus irma	Western Brush Wallaby	REC20	Camera Trap	253738	6281290
Notamacropus irma	Western Brush Wallaby	REC20	Camera Trap	253738	6281290
Notamacropus irma	Western Brush Wallaby	REC20	Camera Trap	253738	6281290
Notamacropus irma	Western Brush Wallaby	REC20	Camera Trap	253738	6281290
Notamacropus irma	Western Brush Wallaby	REC20	Camera Trap	253738	6281290
Notamacropus irma	Western Brush Wallaby	REC20	Camera Trap	253738	6281290
Notamacropus irma	Western Brush Wallaby	REC26	Camera Trap	254365	6280870
Notamacropus irma	Western Brush Wallaby	REC26	Camera Trap	254365	6280870
Notamacropus irma	Western Brush Wallaby	REC33	Camera Trap	254587	6280389
Notamacropus irma	Western Brush Wallaby	REC39	Camera Trap	249588	6281778
Notamacropus irma	Western Brush Wallaby	REC39	Camera Trap	249588	6281778
Notamacropus irma	Western Brush Wallaby	REC39	Camera Trap	249588	6281778
Notamacropus irma	Western Brush Wallaby	REC39	Camera Trap	249588	6281778
Notamacropus irma	Western Brush Wallaby	REC41	Camera Trap	254167	6281277
Notamacropus irma	Western Brush Wallaby	REC41	Camera Trap	254167	6281277
Notamacropus irma	Western Brush Wallaby	REC41	Camera Trap	254167	6281277
Notamacropus irma	Western Brush Wallaby	REC44	Camera Trap	250404	6282648
Notamacropus irma	Western Brush Wallaby	REC45	Camera Trap	251474	6283805
Notamacropus irma	Western Brush Wallaby	REC46	Camera Trap	251642	6280296
Notamacropus irma	Western Brush Wallaby	REC46	Camera Trap	251642	6280296
Notamacropus irma	Western Brush Wallaby	REC28	Camera Trap	249952	6282764
Notamacropus irma	Western Brush Wallaby	REC28	Camera Trap	249952	6282764

Species name	Common name	Site	Method	Location (51H)	
				Easting	Northing
Notamacropus irma	Western Brush Wallaby	REC28	Camera Trap	249952	6282764
Notamacropus irma	Western Brush Wallaby	REC28	Camera Trap	249952	6282764
Notamacropus irma	Western Brush Wallaby	REC36	Camera Trap	249627	6281375
Notamacropus irma	Western Brush Wallaby		Observation	250586.9	6282759
Notamacropus irma	Western Brush Wallaby		Observation	253662.8	6281405
Notamacropus irma	Western Brush Wallaby		Observation	251597.7	6282614
Notamacropus irma	Western Brush Wallaby		Observation	250220	6282899
Notamacropus irma	Western Brush Wallaby		Observation	257775.6	6276611
Notamacropus irma	Western Brush Wallaby		Observation	252293.5	6282452
Notamacropus irma	Western Brush Wallaby		Observation	250041.7	6283050
Notamacropus irma	Western Brush Wallaby		Observation	250305.6	6282301
Notamacropus irma	Western Brush Wallaby		Observation	255488.6	6279097
Notamacropus irma	Western Brush Wallaby		Observation	250196	6283637
Notamacropus irma	Western Brush Wallaby		Observation	252321.2	6282472
Notamacropus irma	Western Brush Wallaby		Observation	255631.8	6280176
Notamacropus irma	Western Brush Wallaby		Observation	253621	6281533
Notamacropus irma	Western Brush Wallaby		Carcass	254439.3	6280591
Notamacropus irma	Western Brush Wallaby		Scat	254395.4	6280290
Notamacropus irma	Western Brush Wallaby		Scat	254674.9	6280050
Notamacropus irma	Western Brush Wallaby		Scat	254660.5	6279746
Notamacropus irma	Western Brush Wallaby		Scat	254657.6	6280020
Notamacropus irma	Western Brush Wallaby		Scat	254842.6	6279693
Notamacropus irma	Western Brush Wallaby		Scat	254674.6	6279866
Notamacropus irma	Western Brush Wallaby		Scat	254775.5	6279892
Notamacropus irma	Western Brush Wallaby		Scat	254801.8	6279703
Notamacropus irma	Western Brush Wallaby		Scat	254671.3	6279752
Notamacropus irma	Western Brush Wallaby		Scat	254725.9	6280167
Notamacropus irma	Western Brush Wallaby		Scat	254824.3	6279733
Notamacropus irma	Western Brush Wallaby		Scat	254423.9	6280516
Notamacropus irma	Western Brush Wallaby		Scat	254703.9	6280221
Notamacropus irma	Western Brush Wallaby		Scat	254764.2	6279910
Notamacropus irma	Western Brush Wallaby		Scat	254496.8	6280529
Notamacropus irma	Western Brush Wallaby		Scat	254713.8	6280126
Notamacropus irma	Western Brush Wallaby		Scat	254449.8	6280548
Notamacropus irma	Western Brush Wallaby		Scat	254631.9	6280528
Notamacropus irma	Western Brush Wallaby		Scat	254653.2	6280230
Notamacropus irma	Western Brush Wallaby		Scat	254544.4	6280612

Species name	Common name	Site	Method	Location (51H)	
				Easting	Northing
Notamacropus irma	Western Brush Wallaby		Scat	254642.8	6280591
Notamacropus irma	Western Brush Wallaby		Scat	251315	6280093
Notamacropus irma	Western Brush Wallaby		Scat	254331.1	6280627
Notamacropus irma	Western Brush Wallaby		Scat	251673.9	6279969
Notamacropus irma	Western Brush Wallaby		Scat	251817.3	6279891
Notamacropus irma	Western Brush Wallaby		Scat	249697.8	6281930
Notamacropus irma	Western Brush Wallaby		Scat	249583	6281789
Notamacropus irma	Western Brush Wallaby		Scat	249560.6	6281725
Notamacropus irma	Western Brush Wallaby		Scat	249545.4	6281636
Notamacropus irma	Western Brush Wallaby		Scat	254607.7	6280580
Notamacropus irma	Western Brush Wallaby		Scat	254415.5	6280641
Notamacropus irma	Western Brush Wallaby		Scat	254496.4	6280574
Notamacropus irma	Western Brush Wallaby		Scat	254585.7	6280666
Notamacropus irma	Western Brush Wallaby		Scat	254465.4	6280577
Notamacropus irma	Western Brush Wallaby		Scat	254466.7	6280743
Notamacropus irma	Western Brush Wallaby		Scat	254574	6280763
Notamacropus irma	Western Brush Wallaby		Scat	254423.7	6280565
Notamacropus irma	Western Brush Wallaby		Scat	254218.1	6280682
Notamacropus irma	Western Brush Wallaby		Scat	254202.2	6280735
Notamacropus irma	Western Brush Wallaby		Scat	254283.6	6280647
Notamacropus irma	Western Brush Wallaby		Scat	254439.6	6280825
Notamacropus irma	Western Brush Wallaby		Scat	254399.8	6280559
Notamacropus irma	Western Brush Wallaby		Scat	254456.8	6280909
Notamacropus irma	Western Brush Wallaby		Scat	254365.7	6280879
Notamacropus irma	Western Brush Wallaby		Scat	254447.3	6280671
Notamacropus irma	Western Brush Wallaby		Scat	254315.2	6280555
Notamacropus irma	Western Brush Wallaby		Scat	254338.4	6280963
Notamacropus irma	Western Brush Wallaby		Scat	254584.5	6280690
Notamacropus irma	Western Brush Wallaby		Scat	254511.2	6281021
Notamacropus irma	Western Brush Wallaby		Scat	254293.6	6281076
Notamacropus irma	Western Brush Wallaby		Scat	254456.5	6280716
Notamacropus irma	Western Brush Wallaby		Scat	254595.4	6280728
Notamacropus irma	Western Brush Wallaby		Scat	254146.3	6281023
Notamacropus irma	Western Brush Wallaby		Scat	254116.3	6281087
Notamacropus irma	Western Brush Wallaby		Scat	254347	6280701
Notamacropus irma	Western Brush Wallaby		Scat	254163	6281125
Notamacropus irma	Western Brush Wallaby		Scat	254312.7	6280687

Species name	Common name	Site	Method	Location (51H)	
				Easting	Northing
Notamacropus irma	Western Brush Wallaby		Scat	254175	6281134
Notamacropus irma	Western Brush Wallaby		Scat	254249.3	6280669
Notamacropus irma	Western Brush Wallaby		Scat	254421.1	6281266
Notamacropus irma	Western Brush Wallaby		Scat	254182.5	6280759
Notamacropus irma	Western Brush Wallaby		Scat	254316.2	6281302
Notamacropus irma	Western Brush Wallaby		Scat	254281.4	6280827
Notamacropus irma	Western Brush Wallaby		Scat	254019.9	6281167
Notamacropus irma	Western Brush Wallaby		Scat	254420.3	6280847
Notamacropus irma	Western Brush Wallaby		Scat	254378.3	6280831
Notamacropus irma	Western Brush Wallaby		Scat	253647.2	6281138
Notamacropus irma	Western Brush Wallaby		Scat	254516.4	6280854
Notamacropus irma	Western Brush Wallaby		Scat	254032.8	6281300
Notamacropus irma	Western Brush Wallaby		Scat	254351.9	6280840
Notamacropus irma	Western Brush Wallaby		Scat	254410.1	6280893
Notamacropus irma	Western Brush Wallaby		Scat	254228.8	6281551
Notamacropus irma	Western Brush Wallaby		Scat	254266.7	6280830
Notamacropus irma	Western Brush Wallaby		Scat	253903.9	6281428
Notamacropus irma	Western Brush Wallaby		Scat	254184.4	6280813
Notamacropus irma	Western Brush Wallaby		Scat	253674.8	6281335
Notamacropus irma	Western Brush Wallaby		Scat	254146.6	6280809
Notamacropus irma	Western Brush Wallaby		Scat	253621	6281303
Notamacropus irma	Western Brush Wallaby		Scat	254201.3	6280939
Notamacropus irma	Western Brush Wallaby		Scat	253507.8	6281337
Notamacropus irma	Western Brush Wallaby		Scat	253989.2	6281065
Notamacropus irma	Western Brush Wallaby		Scat	254234.2	6280958
Notamacropus irma	Western Brush Wallaby		Scat	253762.8	6281679
Notamacropus irma	Western Brush Wallaby		Scat	254099	6281114
Notamacropus irma	Western Brush Wallaby		Scat	254348.5	6280987
Notamacropus irma	Western Brush Wallaby		Scat	253645.2	6281591
Notamacropus irma	Western Brush Wallaby		Scat	250286.2	6282335
Notamacropus irma	Western Brush Wallaby		Scat	250575.6	6282227
Notamacropus irma	Western Brush Wallaby		Scat	250785	6283816
Notamacropus irma	Western Brush Wallaby		Scat	250711.6	6282326
Notamacropus irma	Western Brush Wallaby		Scat	250136.1	6283757
Notamacropus irma	Western Brush Wallaby		Scat	250940.6	6283779
Notamacropus irma	Western Brush Wallaby		Scat	250584.2	6282363
Notamacropus irma	Western Brush Wallaby		Scat	251008.1	6283935

Species name	Common name	Site	Method	Location (51H)	
				Easting	Northing
Notamacropus irma	Western Brush Wallaby		Scat	250377	6282416
Notamacropus irma	Western Brush Wallaby		Scat	250258.1	6282414
Notamacropus irma	Western Brush Wallaby		Scat	250178.9	6282422
Notamacropus irma	Western Brush Wallaby		Scat	250148.5	6282579
Notamacropus irma	Western Brush Wallaby		Scat	250489.7	6282595
Notamacropus irma	Western Brush Wallaby		Scat	250690.5	6282582
Notamacropus irma	Western Brush Wallaby		Scat	250500.9	6282668
Notamacropus irma	Western Brush Wallaby		Scat	250468.2	6282187
Notamacropus irma	Western Brush Wallaby		Scat	250132.4	6282737
Notamacropus irma	Western Brush Wallaby		Scat	250324.4	6282793
Notamacropus irma	Western Brush Wallaby		Scat	250233.7	6283396
Notamacropus irma	Western Brush Wallaby		Scat	250398.8	6282766
Notamacropus irma	Western Brush Wallaby		Scat	250291.6	6282902
Notamacropus irma	Western Brush Wallaby		Scat	250121.6	6283105
Notamacropus irma	Western Brush Wallaby		Scat	250139.2	6282848
Notamacropus irma	Western Brush Wallaby		Scat	250088.9	6282789
Notamacropus irma	Western Brush Wallaby		Scat	250078.6	6283023
Notamacropus irma	Western Brush Wallaby		Scat	250076.3	6283124
Notamacropus irma	Western Brush Wallaby		Scat	249935.7	6282875
Notamacropus irma	Western Brush Wallaby		Scat	250577.2	6282055
Notamacropus irma	Western Brush Wallaby		Scat	249933.7	6282718
Notamacropus irma	Western Brush Wallaby		Scat	249953.3	6282590
Notamacropus irma	Western Brush Wallaby		Scat	250302.6	6283394
Notamacropus irma	Western Brush Wallaby		Scat	249967	6282455
Notamacropus irma	Western Brush Wallaby		Scat	249942.7	6282345
Notamacropus irma	Western Brush Wallaby		Scat	249886.9	6282566
Notamacropus irma	Western Brush Wallaby		Scat	249878.3	6282644
Notamacropus irma	Western Brush Wallaby		Scat	249895.1	6282822
Notamacropus irma	Western Brush Wallaby		Scat	249904.8	6282971
Notamacropus irma	Western Brush Wallaby		Scat	249722.8	6282411
Notamacropus irma	Western Brush Wallaby		Scat	249745.9	6282285
Notamacropus irma	Western Brush Wallaby		Scat	250750.1	6281942
Notamacropus irma	Western Brush Wallaby		Scat	249656.8	6282222
Notamacropus irma	Western Brush Wallaby		Scat	250147.4	6282348
Notamacropus irma	Western Brush Wallaby		Scat	253852.8	6279110
Notamacropus irma	Western Brush Wallaby		Scat	250273.8	6283705
Notamacropus irma	Western Brush Wallaby		Scat	250857.7	6281881

Species name	Common name	Site	Method	Location (51H)	
				Easting	Northing
Notamacropus irma	Western Brush Wallaby		Scat	250749.1	6283892
Notamacropus irma	Western Brush Wallaby		Scat	250948	6281945
Notamacropus irma	Western Brush Wallaby		Scat	250763.4	6284069
Notamacropus irma	Western Brush Wallaby		Scat	250916.7	6281990
Notamacropus irma	Western Brush Wallaby		Scat	250807.7	6284156
Notamacropus irma	Western Brush Wallaby		Scat	250817.3	6282024
Notamacropus irma	Western Brush Wallaby		Scat	250868	6284019
Notamacropus irma	Western Brush Wallaby		Scat	250783	6282192
Notamacropus irma	Western Brush Wallaby		Scat	250874.5	6283824
Notamacropus irma	Western Brush Wallaby		Scat	253709	6281801
Notamacropus irma	Western Brush Wallaby		Scat	254391	6280997
Notamacropus irma	Western Brush Wallaby		Scat	252166.8	6283222
Notamacropus irma	Western Brush Wallaby		Scat	257536.5	6276419
Notamacropus irma	Western Brush Wallaby		Scat	251693.5	6283381
Notamacropus irma	Western Brush Wallaby		Scat	252168.4	6283361
Notamacropus irma	Western Brush Wallaby		Scat	251823.4	6283470
Notamacropus irma	Western Brush Wallaby		Scat	252166.8	6283549
Notamacropus irma	Western Brush Wallaby		Scat	252200.7	6283486
Notamacropus irma	Western Brush Wallaby		Scat	252456.1	6283130
Notamacropus irma	Western Brush Wallaby		Scat	252441.2	6282870
Notamacropus irma	Western Brush Wallaby		Scat	253147.3	6282328
Notamacropus irma	Western Brush Wallaby		Scat	253230.7	6282378
Notamacropus irma	Western Brush Wallaby		Scat	253303.7	6282452
Notamacropus irma	Western Brush Wallaby		Scat	253355.2	6282526
Notamacropus irma	Western Brush Wallaby		Scat	251830.1	6283414
Notamacropus irma	Western Brush Wallaby		Scat	253124.3	6282659
Notamacropus irma	Western Brush Wallaby		Scat	252966.6	6282561
Notamacropus irma	Western Brush Wallaby		Scat	252841.4	6282566
Notamacropus irma	Western Brush Wallaby		Scat	252713.8	6282816
Notamacropus irma	Western Brush Wallaby		Scat	252662.6	6282772
Notamacropus irma	Western Brush Wallaby		Scat	251776.6	6283313
Notamacropus irma	Western Brush Wallaby		Scat	251702.5	6283780
Notamacropus irma	Western Brush Wallaby		Scat	251801.9	6284016
Notamacropus irma	Western Brush Wallaby		Scat	251557.7	6283756
Notamacropus irma	Western Brush Wallaby		Scat	257260.1	6278058
Notamacropus irma	Western Brush Wallaby		Scat	251884	6284001
Notamacropus irma	Western Brush Wallaby		Scat	257513	6276412

Species name	Common name	Site	Method	Location (51H)	
				Easting	Northing
Notamacropus irma	Western Brush Wallaby		Scat	251907.9	6283858
Notamacropus irma	Western Brush Wallaby		Scat	251900.5	6283795
Notamacropus irma	Western Brush Wallaby		Scat	251916.6	6283699
Notamacropus irma	Western Brush Wallaby		Scat	251907.2	6283596
Notamacropus irma	Western Brush Wallaby		Scat	251936.5	6283256
Notamacropus irma	Western Brush Wallaby		Scat	253899.9	6281898
Notamacropus irma	Western Brush Wallaby		Scat	254501.2	6281082
Notamacropus irma	Western Brush Wallaby		Scat	254460.2	6281022
Notamacropus irma	Western Brush Wallaby		Scat	253457.2	6281764
Notamacropus irma	Western Brush Wallaby		Scat	254407.6	6281061
Notamacropus irma	Western Brush Wallaby		Scat	253328.4	6281666
Notamacropus irma	Western Brush Wallaby		Scat	254371	6281052
Notamacropus irma	Western Brush Wallaby		Scat	253385.6	6281845
Notamacropus irma	Western Brush Wallaby		Scat	253578.3	6281995
Notamacropus irma	Western Brush Wallaby		Scat	254220.1	6281017
Notamacropus irma	Western Brush Wallaby		Scat	253293.3	6282045
Notamacropus irma	Western Brush Wallaby		Scat	254148.3	6280984
Notamacropus irma	Western Brush Wallaby		Scat	253403.5	6282181
Notamacropus irma	Western Brush Wallaby		Scat	253435.3	6282410
Notamacropus irma	Western Brush Wallaby		Scat	253309.7	6282290
Notamacropus irma	Western Brush Wallaby		Scat	253159	6282188
Notamacropus irma	Western Brush Wallaby		Scat	254257.7	6281193
Notamacropus irma	Western Brush Wallaby		Scat	252607.9	6279870
Notamacropus irma	Western Brush Wallaby		Scat	253640.4	6281151
Notamacropus irma	Western Brush Wallaby		Scat	254244.1	6281249
Notamacropus irma	Western Brush Wallaby		Scat	252502.3	6279916
Notamacropus irma	Western Brush Wallaby		Scat	249590.6	6281820
Notamacropus irma	Western Brush Wallaby		Scat	254070	6281162
Notamacropus irma	Western Brush Wallaby		Scat	249585	6281730
Notamacropus irma	Western Brush Wallaby		Scat	253942.9	6281273
Notamacropus irma	Western Brush Wallaby		Scat	249547.8	6281576
Notamacropus irma	Western Brush Wallaby		Scat	254022.3	6281329
Notamacropus irma	Western Brush Wallaby		Scat	249578.9	6281497
Notamacropus irma	Western Brush Wallaby		Scat	254118.5	6281383
Notamacropus irma	Western Brush Wallaby		Scat	249553.4	6281362
Notamacropus irma	Western Brush Wallaby		Scat	254219.4	6281518
Notamacropus irma	Western Brush Wallaby		Scat	249636	6281132

Species name	Common name	Site	Method	Location (51H)	
				Easting	Northing
Notamacropus irma	Western Brush Wallaby		Scat	253914.6	6281383
Notamacropus irma	Western Brush Wallaby		Scat	254180	6281505
Notamacropus irma	Western Brush Wallaby		Scat	249806.9	6280946
Notamacropus irma	Western Brush Wallaby		Scat	253462.9	6281345
Notamacropus irma	Western Brush Wallaby		Scat	253740.8	6281278
Notamacropus irma	Western Brush Wallaby		Scat	249679.9	6281230
Notamacropus irma	Western Brush Wallaby		Scat	253660.6	6281442
Notamacropus irma	Western Brush Wallaby		Scat	253654.2	6281284
Notamacropus irma	Western Brush Wallaby		Scat	253799.6	6281478
Notamacropus irma	Western Brush Wallaby		Scat	253930.9	6281634
Notamacropus irma	Western Brush Wallaby		Scat	253943.8	6281714
Notamacropus irma	Western Brush Wallaby		Scat	253814.1	6281635
Notamacropus irma	Western Brush Wallaby		Scat	253703.9	6281564
Notamacropus irma	Western Brush Wallaby		Scat	253576.2	6281474
Notamacropus irma	Western Brush Wallaby		Scat	253321.8	6281530
Notamacropus irma	Western Brush Wallaby		Scat	253450.7	6281401
Notamacropus irma	Western Brush Wallaby		Scat	253392.8	6281611
Notamacropus irma	Western Brush Wallaby		Scat	253474.9	6281677
Notamacropus irma	Western Brush Wallaby		Scat	253681.9	6281789
Notamacropus irma	Western Brush Wallaby		Scat	253735.1	6281887
Notamacropus irma	Western Brush Wallaby		Scat	250545.8	6282001
Notamacropus irma	Western Brush Wallaby		Scat	253867.6	6281925
Notamacropus irma	Western Brush Wallaby		Scat	253858.1	6281991
Notamacropus irma	Western Brush Wallaby		Scat	253681.6	6281885
Notamacropus irma	Western Brush Wallaby		Scat	253528	6281779
Notamacropus irma	Western Brush Wallaby		Scat	253301.4	6281580
Notamacropus irma	Western Brush Wallaby		Scat	253242.8	6281657
Notamacropus irma	Western Brush Wallaby		Scat	253306.3	6281775
Notamacropus irma	Western Brush Wallaby		Scat	249526.1	6281414
Notamacropus irma	Western Brush Wallaby		Scat	249659	6281355
Notamacropus irma	Western Brush Wallaby		Scat	251019.1	6281913
Notamacropus irma	Western Brush Wallaby		Scat	251188.2	6284216
Notamacropus irma	Western Brush Wallaby		Scat	256076.8	6277657
Notamacropus irma	Western Brush Wallaby		Scat	252177.4	6283094
Notamacropus irma	Western Brush Wallaby		Scat	249680.9	6281462
Notamacropus irma	Western Brush Wallaby		Scat	250157.2	6282299
Notamacropus irma	Western Brush Wallaby		Scat	250984.9	6282000

Species name	Common name	Site	Method	Location (51H)	
				Easting	Northing
Notamacropus irma	Western Brush Wallaby		Scat	250257.3	6283523
Notamacropus irma	Western Brush Wallaby		Scat	251203.5	6284067
Notamacropus irma	Western Brush Wallaby		Scat	257193.8	6278076
Notamacropus irma	Western Brush Wallaby		Scat	256993.1	6276182
Notamacropus irma	Western Brush Wallaby		Scat	251466.6	6283549
Notamacropus irma	Western Brush Wallaby		Scat	252223.2	6283208
Notamacropus irma	Western Brush Wallaby		Scat	249668.9	6281584
Notamacropus irma	Western Brush Wallaby		Scat	251008.8	6282173
Notamacropus irma	Western Brush Wallaby		Scat	251229.3	6283882
Notamacropus irma	Western Brush Wallaby		Scat	252333.3	6283201
Notamacropus irma	Western Brush Wallaby		Scat	249536.3	6281465
Notamacropus irma	Western Brush Wallaby		Scat	251078.6	6282311
Notamacropus irma	Western Brush Wallaby		Scat	251212.1	6283799
Notamacropus irma	Western Brush Wallaby		Scat	252350.4	6283110
Notamacropus irma	Western Brush Wallaby		Scat	250984.9	6282385
Notamacropus irma	Western Brush Wallaby		Scat	251184.8	6283694
Notamacropus irma	Western Brush Wallaby		Scat	252359.2	6283036
Notamacropus irma	Western Brush Wallaby		Scat	250905	6282438
Notamacropus irma	Western Brush Wallaby		Scat	251191.4	6283635
Notamacropus irma	Western Brush Wallaby		Scat	253029.8	6282376
Notamacropus irma	Western Brush Wallaby		Scat	250879.9	6282456
Notamacropus irma	Western Brush Wallaby		Scat	251208.1	6283531
Notamacropus irma	Western Brush Wallaby		Scat	253112.4	6282442
Notamacropus irma	Western Brush Wallaby		Scat	250735.8	6282481
Notamacropus irma	Western Brush Wallaby		Scat	251219.3	6283439
Notamacropus irma	Western Brush Wallaby		Scat	253256.7	6282543
Notamacropus irma	Western Brush Wallaby		Scat	250457.5	6282460
Notamacropus irma	Western Brush Wallaby		Scat	251238.9	6283334
Notamacropus irma	Western Brush Wallaby		Scat	253327.5	6282619
Notamacropus irma	Western Brush Wallaby		Scat	250330.2	6282479
Notamacropus irma	Western Brush Wallaby		Scat	251374.3	6283250
Notamacropus irma	Western Brush Wallaby		Scat	253359.6	6282640
Notamacropus irma	Western Brush Wallaby		Scat	249523.1	6281245
Notamacropus irma	Western Brush Wallaby		Scat	250283.8	6282491
Notamacropus irma	Western Brush Wallaby		Scat	251444	6283205
Notamacropus irma	Western Brush Wallaby		Scat	253259.5	6282679
Notamacropus irma	Western Brush Wallaby		Scat	250159.6	6282477

Species name	Common name	Site	Method	Location (51H)	
				Easting	Northing
Notamacropus irma	Western Brush Wallaby		Scat	250200.1	6282305
Notamacropus irma	Western Brush Wallaby		Scat	250261.7	6283797
Notamacropus irma	Western Brush Wallaby		Scat	251334.7	6283752
Notamacropus irma	Western Brush Wallaby		Scat	257262	6278059
Notamacropus irma	Western Brush Wallaby		Scat	256925.7	6276241
Notamacropus irma	Western Brush Wallaby		Scat	251512.2	6283845
Notamacropus irma	Western Brush Wallaby		Scat	253212.4	6282646
Notamacropus irma	Western Brush Wallaby		Scat	250235.9	6282527
Notamacropus irma	Western Brush Wallaby		Scat	251368.6	6283796
Notamacropus irma	Western Brush Wallaby		Scat	253094.7	6282527
Notamacropus irma	Western Brush Wallaby		Scat	250422.8	6282521
Notamacropus irma	Western Brush Wallaby		Scat	251338.8	6284068
Notamacropus irma	Western Brush Wallaby		Scat	252966.7	6282485
Notamacropus irma	Western Brush Wallaby		Scat	250630.7	6282523
Notamacropus irma	Western Brush Wallaby		Scat	251489.5	6284158
Notamacropus irma	Western Brush Wallaby		Scat	252950.1	6282471
Notamacropus irma	Western Brush Wallaby		Scat	250707.1	6282529
Notamacropus irma	Western Brush Wallaby		Scat	251591.6	6284081
Notamacropus irma	Western Brush Wallaby		Scat	252719.9	6282607
Notamacropus irma	Western Brush Wallaby		Scat	250631	6282643
Notamacropus irma	Western Brush Wallaby		Scat	251621.6	6283932
Notamacropus irma	Western Brush Wallaby		Scat	252882	6282698
Notamacropus irma	Western Brush Wallaby		Scat	250473	6282619
Notamacropus irma	Western Brush Wallaby		Scat	251564.3	6283705
Notamacropus irma	Western Brush Wallaby		Scat	253022.7	6282818
Notamacropus irma	Western Brush Wallaby		Scat	250355.6	6282634
Notamacropus irma	Western Brush Wallaby		Scat	251581	6283632
Notamacropus irma	Western Brush Wallaby		Scat	253038.2	6282890
Notamacropus irma	Western Brush Wallaby		Scat	250236.2	6282867
Notamacropus irma	Western Brush Wallaby		Scat	251613	6283530
Notamacropus irma	Western Brush Wallaby		Scat	252689.6	6282770
Notamacropus irma	Western Brush Wallaby		Scat	249540.3	6281222
Notamacropus irma	Western Brush Wallaby		Scat	250213.4	6282920
Notamacropus irma	Western Brush Wallaby		Scat	251617.1	6283498
Notamacropus irma	Western Brush Wallaby		Scat	252702.9	6282756
Notamacropus irma	Western Brush Wallaby		Scat	250220.4	6283170
Notamacropus irma	Western Brush Wallaby		Scat	250400.3	6282300

Species name	Common name	Site	Method	Location (51H)	
				Easting	Northing
Notamacropus irma	Western Brush Wallaby		Scat	250570.2	6283788
Notamacropus irma	Western Brush Wallaby		Scat	251593	6283422
Notamacropus irma	Western Brush Wallaby		Scat	256598.3	6278074
Notamacropus irma	Western Brush Wallaby		Scat	257470.3	6276461
Notamacropus irma	Western Brush Wallaby		Scat	251499.7	6283938
Notamacropus irma	Western Brush Wallaby		Scat	250167.1	6283097
Notamacropus irma	Western Brush Wallaby		Scat	251612.3	6283374
Notamacropus irma	Western Brush Wallaby		Scat	250164.8	6283027
Notamacropus irma	Western Brush Wallaby		Scat	250163.5	6282933
Notamacropus irma	Western Brush Wallaby		Scat	250183.8	6282862
Notamacropus irma	Western Brush Wallaby		Scat	250183.9	6282778
Notamacropus irma	Western Brush Wallaby		Scat	250104.5	6282758
Notamacropus irma	Western Brush Wallaby		Scat	250036.4	6282807
Notamacropus irma	Western Brush Wallaby		Scat	250050.2	6282999
Notamacropus irma	Western Brush Wallaby		Scat	249589.1	6281128
Notamacropus irma	Western Brush Wallaby		Scat	250031.5	6283076
Notamacropus irma	Western Brush Wallaby		Scat	249990.7	6283058
Notamacropus irma	Western Brush Wallaby		Scat	250411.1	6282158
Notamacropus irma	Western Brush Wallaby		Scat	250571.9	6284021
Notamacropus irma	Western Brush Wallaby		Scat	255739.8	6278807
Notamacropus irma	Western Brush Wallaby		Scat	257305.8	6276589
Notamacropus irma	Western Brush Wallaby		Scat	251905.6	6283853
Notamacropus irma	Western Brush Wallaby		Scat	249995.5	6283004
Notamacropus irma	Western Brush Wallaby		Scat	249996.8	6282933
Notamacropus irma	Western Brush Wallaby		Scat	249993	6282797
Notamacropus irma	Western Brush Wallaby		Scat	249975.8	6282770
Notamacropus irma	Western Brush Wallaby		Scat	250007.2	6282562
Notamacropus irma	Western Brush Wallaby		Scat	250004.6	6282504
Notamacropus irma	Western Brush Wallaby		Scat	250005	6282424
Notamacropus irma	Western Brush Wallaby		Scat	250005.7	6282294
Notamacropus irma	Western Brush Wallaby		Scat	249583	6281066
Notamacropus irma	Western Brush Wallaby		Scat	249917.3	6282271
Notamacropus irma	Western Brush Wallaby		Scat	249860.4	6282291
Notamacropus irma	Western Brush Wallaby		Scat	250419.5	6282090
Notamacropus irma	Western Brush Wallaby		Scat	250601.7	6283968
Notamacropus irma	Western Brush Wallaby		Scat	256136.5	6277611
Notamacropus irma	Western Brush Wallaby		Scat	257100.3	6276694

Species name	Common name	Site	Method	Location (51H)	
				Easting	Northing
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Notamacropus irma	Western Brush Wallaby		Scat	249837.8	6282462
Notamacropus irma	Western Brush Wallaby		Scat	249851.5	6282582
Notamacropus irma	Western Brush Wallaby		Scat	249839.2	6282691
Notamacropus irma	Western Brush Wallaby		Scat	249837.6	6282717
Notamacropus irma	Western Brush Wallaby		Scat	249853.1	6282801
Notamacropus irma	Western Brush Wallaby		Scat	249790.9	6282761
Notamacropus irma	Western Brush Wallaby		Scat	249778.5	6282696
Notamacropus irma	Western Brush Wallaby		Scat	249785	6282602
Notamacropus irma	Western Brush Wallaby		Scat	249689.1	6280970
Notamacropus irma	Western Brush Wallaby		Scat	249779.3	6282526
Notamacropus irma	Western Brush Wallaby		Scat	249765.5	6282412
Notamacropus irma	Western Brush Wallaby		Scat	250677	6281908
Notamacropus irma	Western Brush Wallaby		Scat	251068.8	6283853
Notamacropus irma	Western Brush Wallaby		Scat	256355.1	6277562
Notamacropus irma	Western Brush Wallaby		Scat	256792.2	6276959
Notamacropus irma	Western Brush Wallaby		Scat	251994.8	6283703
Notamacropus irma	Western Brush Wallaby		Scat	249787.8	6282280
Notamacropus irma	Western Brush Wallaby		Scat	250084.7	6282375
Notamacropus irma	Western Brush Wallaby		Scat	250069.5	6282540
Notamacropus irma	Western Brush Wallaby		Scat	250069.2	6282678
Notamacropus irma	Western Brush Wallaby		Scat	250074.1	6282761
Notamacropus irma	Western Brush Wallaby		Scat	250904.4	6280733
Notamacropus irma	Western Brush Wallaby		Scat	250821.5	6280759
Notamacropus irma	Western Brush Wallaby		Scat	250136.5	6282364
Notamacropus irma	Western Brush Wallaby		Scat	249738.6	6280961
Notamacropus irma	Western Brush Wallaby		Scat	250193.2	6283751
Notamacropus irma	Western Brush Wallaby		Scat	250825.5	6281800
Notamacropus irma	Western Brush Wallaby		Scat	251072.5	6284095
Notamacropus irma	Western Brush Wallaby		Scat	257101	6278031
Notamacropus irma	Western Brush Wallaby		Scat	256357.9	6277628
Notamacropus irma	Western Brush Wallaby		Scat	254626.9	6275860
Notamacropus irma	Western Brush Wallaby		Scat	256955	6276792
Notamacropus irma	Western Brush Wallaby		Scat	251688.4	6280860
Notamacropus irma	Western Brush Wallaby		Scat	251997.9	6283427
Notamacropus irma	Western Brush Wallaby		Scat	249682.9	6281049
Notamacropus irma	Western Brush Wallaby		Scat	251070.3	6281626

Species name	Common name	Site	Method	Location (51H)	
				Easting	Northing
Notamacropus irma	Western Brush Wallaby		Scat	251058.8	6284123
Notamacropus irma	Western Brush Wallaby		Scat	256317.9	6277854
Notamacropus irma	Western Brush Wallaby		Scat	257324.6	6276567
Notamacropus irma	Western Brush Wallaby		Scat	252016.6	6283363
Notamacropus irma	Western Brush Wallaby		Scat	249677.3	6281269
Notamacropus irma	Western Brush Wallaby		Scat	251164.3	6281664
Notamacropus irma	Western Brush Wallaby		Scat	251045.6	6284154
Notamacropus irma	Western Brush Wallaby		Scat	256265.4	6277983
Notamacropus irma	Western Brush Wallaby		Scat	254398.7	6279018
Notamacropus irma	Western Brush Wallaby		Scat	252089.7	6283141
Notamacropus irma	Western Brush Wallaby		Scat	253360.2	6281909
Notamacropus irma	Western Brush Wallaby		Scat	253660.4	6282166
Notamacropus irma	Western Brush Wallaby		Scat	253498.1	6281972
Notamacropus irma	Western Brush Wallaby		Scat	253521.3	6282064
Notamacropus irma	Western Brush Wallaby		Scat	253453.8	6281993
Notamacropus irma	Western Brush Wallaby		Scat	253255.6	6281865
Notamacropus irma	Western Brush Wallaby		Scat	253179.6	6282029
Notamacropus irma	Western Brush Wallaby		Scat	253289.2	6282098
Notamacropus irma	Western Brush Wallaby		Scat	253368.8	6282202
Notamacropus irma	Western Brush Wallaby		Scat	253529.9	6282341
Notamacropus irma	Western Brush Wallaby		Scat	253422.3	6282334
Notamacropus irma	Western Brush Wallaby		Scat	253257	6280357
Notamacropus irma	Western Brush Wallaby		Scat	253051	6280294
Notamacropus irma	Western Brush Wallaby		Scat	252959.4	6280343
Notamacropus irma	Western Brush Wallaby		Scat	252953.2	6280245
Notamacropus irma	Western Brush Wallaby		Scat	252748.4	6279792
Notamacropus irma	Western Brush Wallaby		Scat	252732.7	6280390
Notamacropus irma	Western Brush Wallaby		Scat	252703.7	6280344
Notamacropus irma	Western Brush Wallaby		Scat	252684.1	6280218
Notamacropus irma	Western Brush Wallaby		Scat	252617.7	6279985
Notamacropus irma	Western Brush Wallaby		Scat	252643.7	6279882
Notamacropus irma	Western Brush Wallaby		Scat	252655.2	6279826
Notamacropus irma	Western Brush Wallaby		Scat	252481.3	6279801
Notamacropus irma	Western Brush Wallaby		Scat	252440.9	6280288
Notamacropus irma	Western Brush Wallaby		Scat	252450.4	6280327
Notamacropus irma	Western Brush Wallaby		Scat	252339.5	6280363
Notamacropus irma	Western Brush Wallaby		Scat	252322.2	6280327

Species name	Common name	Site	Method	Location (51H)	
				Easting	Northing
Notamacropus irma	Western Brush Wallaby		Scat	252310.4	6280054
Notamacropus irma	Western Brush Wallaby		Scat	252297.6	6279957
Notamacropus irma	Western Brush Wallaby		Scat	252334	6279806
Notamacropus irma	Western Brush Wallaby		Scat	252095.3	6279808
Notamacropus irma	Western Brush Wallaby		Scat	252054.1	6280030
Notamacropus irma	Western Brush Wallaby		Scat	252034.3	6280192
Notamacropus irma	Western Brush Wallaby		Scat	252002.3	6280312
Notamacropus irma	Western Brush Wallaby		Scat	250077.3	6282563
Notamacropus irma	Western Brush Wallaby		Scat	256690.3	6278153
Notamacropus irma	Western Brush Wallaby		Scat	251298.9	6280125

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Vertebrate fauna survey for a proposed infrastructure corridor at the Ravensthorpe Nickel Operations - 2018

Version 1. April 2018

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DISCLAIMER

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Front Cover: Short-beaked Echidna (*Tachyglossus aculeatus*)

EXECUTIVE SUMMARY

FQM Australia Nickel Pty Ltd (FQM) is the owner of Ravensthorpe Nickel Operations which is located 35km east of Ravensthorpe, and 550km southeast of Perth. The nickel mining operation is currently in care and maintenance. FQM is seeking environmental approval under Part IV of the *Environmental Protection Act 1986* (EP Act) and the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) to expand approved mining operations at Shoemaker-Levy and develop the associated corridor.

Terrestrial Ecosystems were commissioned by FQM to conduct a targeted terrestrial fauna survey of conservation significant fauna species which may utilise the project area.

One hundred camera traps were deployed for 44 days and 150 large cage traps and 450 aluminium box traps were deployed for five nights of trapping. Monitoring for Western Whipbird occurred while setting up the camera traps and conducting the trapping survey.

Seven species of conservation significance were recorded, along with multiple non-native introduced species.

Four Chuditch were captured during the survey and the species was recorded at 46 camera trap locations throughout the proposed infrastructure corridor.

The Southern Brown Bandicoot was recorded at five camera trap locations in the middle of the survey area, while Western Brush Wallabies were recorded at 80 camera trap locations throughout the survey area.

Western Whipbirds were heard calling frequently and were recorded from 13 individual sites across the proposed infrastructure corridor; they were not recorded in the rehabilitation area. Western Whipbirds appeared to be relatively abundant. A single observation was made of a flock of 30 Carnaby's Black Cockatoos feeding in Halleys rehabilitation area. A Peregrine Falcon was recorded for the first time since Terrestrial Ecosystems stated surveying the area in 2009.

The status of two known Malleefowl mounds in close proximity to one another were assessed during the survey. The southern mound was found to be active, with egg shells scattered across the mound and fresh scratchings around the crater. The northern mound appeared to be inactive at the time of the survey, however, this mound was recently active in the 2017 breeding season. Two birds were observed in the vicinity of the mounds and Malleefowl were recorded from four camera trap locations near the mounds.

A high number of foxes and cats were recorded on the camera traps across the entire proposed infrastructure corridor.

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B. Trapping sites and camera trap locations
C. Trapping results

1 INTRODUCTION

1.1 Background

FQM Australia Nickel Pty Ltd (FQM) own and manage the Ravensthorpe Nickel Operations (RNO) which is located 35km east of Ravensthorpe and 550km southeast of Perth (Figures 1 and 2). The nickel mining operation is currently in care and maintenance. FQM is seeking environmental approval under Part IV of the *Environmental Protection Act 1986* (EP Act) and the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) to expand approved mining operations at Shoemaker-Levy and develop the associated corridor from the existing processing facilities to the SML deposit.

1.2 Assessment objectives

The purpose of this targeted fauna survey was to assess the potential for conservation significant species to utilise the proposed infrastructure corridor area. The survey specifically targeted the threatened and conservation significant Malleefowl (*Leipoa ocellata*), Heath Rat (*Pseudomys shortridgei*), Western Mouse (*Pseudomys occidentalis*), Western Whipbird (*Psophodes nigrogularis oberon*), Chuditch (*Dasyurus geoffroii*), Western Brush Wallaby (*Notamacropus irma*) and Southern Brown Bandicoot (*Isoodon fusciventer*).

1.3 Previous vertebrate fauna monitoring surveys and fauna survey reports

There have been numerous fauna assessments and surveys undertaken on the RNO tenements. These include:

- Biota Environmental Sciences (2000) *Ravensthorpe Nickel Project – Fauna Survey 2000*. Unpublished report for Ravensthorpe Nickel Operations.
- Biota Environmental Sciences (2005) *BHP Billiton Ravensthorpe Nickel Operations Fauna Trapping Program 2005*. Unpublished report for BHP Billiton, Perth.
- Cancilla, D. and Johnson, B. (2013) The status and ecology of the *Pseudomys shortridgei* (Heath Mouse) in southern western Australia. Unpublished report for Murdoch University.
- Chapman A. (2000) *Fauna Management Plan Year One 1999-2000*. Unpublished report for Comet Resources, Ravensthorpe.
- Coffey Environments (2009) *Terrestrial Vertebrate Fauna Risk Assessment for the Shoemaker-Levy Ore Body, Ravensthorpe Nickel Operations*, Unpublished report for BHP Billiton Ravensthorpe Nickel, Ravensthorpe.
- Coffey Environments (2010) *Fauna Monitoring, Ravensthorpe Nickel Operations, January 2010*. Unpublished report for Ravensthorpe Nickel Operations, Ravensthorpe.
- Craig G.F. and Chapman A. (1998) *Ravensthorpe Nickel Project. Comet Resources NL. Vegetation, Flora and Fauna Survey*. Unpublished report for Ravensthorpe Nickel Project.
- Terrestrial Ecosystems (2013) *Conservation Significant Vertebrate Fauna Monitoring for Ravensthorpe Nickel Operations, Ravensthorpe*. Unpublished report for FQM Australia Nickel, Ravensthorpe.
- Terrestrial Ecosystems (2014) *Conservation Significant Vertebrate Fauna Monitoring for Ravensthorpe Nickel Operations - 2014, Ravensthorpe*. Unpublished report for FQM Australia Nickel, Ravensthorpe.
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- Terrestrial Ecosystems (2015) *Potential Impact of Vegetation Clearing and the Development of a Conveyor Belt on Fauna at the Ravensthorpe Nickel Operations*. Unpublished report FQM Australia Nickel, Ravensthorpe.
- Terrestrial Ecosystems (2017) *Conservation Significant Vertebrate Fauna Monitoring and Feral Cat Trapping Program for Ravensthorpe Nickel Operations – 2016*. Unpublished report for FQM Australia Nickel, Perth.
- Terrestrial Ecosystems (2017) *Vertebrate fauna surveys for the Hale Bopp North West pit, an infrastructure corridor and extension to the proposed Shoemaker-Levy mining area on vertebrate fauna at the Ravensthorpe Nickel Operation*. Unpublished report for FQM Australia Nickel, Perth.
- Terrestrial Ecosystems (2017) *Conservation Significant Vertebrate Fauna Monitoring for Ravensthorpe Nickel Operations – 2017*. Unpublished report for FQM Australia Nickel, Perth.

In addition, there are three fauna survey reports for other mining operations that are nearby:

- Animal Plant Mineral (2016) *Ravensthorpe Gold Copper Project Biological Survey*. Unpublished report for ACH Minerals Pty Ltd;
- Biota Environmental Sciences (2004) *Fauna and Fauna Assemblages of Kundip and Trilogy Study Sites*. Unpublished report for Tectonic Resources NL, Perth; and
- Biota Environmental Sciences (2005) *Kundip Phase II Fauna Survey - Summary of findings*. Letter to Tectonic Resources NL, Perth.

The data and summary information for the regional fauna surveys by Animal Plant Mineral (2016), and Biota Environmental Sciences (2004, 2005b) are discussed in more detail in Terrestrial Ecosystems (2015b, 2017).

1.4 Summary of historical fauna survey data

A summary table combining conservation significant fauna records from the historical reports is presented in Appendix A.

The Craig and Chapman's (1998) fauna survey report is unavailable, so it has not been possible to extract the relevant data on conservation significant fauna from this report. A brief report by Cancilla and Johnson (2013) indicated that 720 trap-nights were used in an attempt to catch the Heath Rat at Bandalup Hill; but no Heath Rats were caught in this survey. No other details of trapping sites were provided.

Chapman (2000) reported on surveys undertaken between 8-23 November 1999 and 4-17 April 2000 as the first year of a long term monitoring program for three conservation significant mammals and two conservation significant bird species that were known to be present at the RNO. This survey followed on from the earlier survey work undertaken by Craig and Chapman (1998). Nine sites were established; sites E1-E5 had 20 aluminium box traps and sites CMS1-CMS4 had one cage trap, 20 aluminium box traps and 12 pit traps. In addition, 12 cage traps were deployed in other locations. The total trapping effort was 480 pit trap-nights, 1,000 aluminium box trap nights and 200 cage trap nights (Table 1). The trap type(s) that captured the conservation significant fauna was not mentioned in the report.

Table 1. Trapping effort for multiple fauna surveys on the RNO tenements

	Trap nights				
Survey	Pit traps	Box traps	Cage traps	Funnel traps	Camera traps
Chapman (2000)	480	1,000	200		
Biota Environmental Sciences (2000)	534	600	60		
Biota Environmental Sciences (2005a)	408	672	168		
Coffey Environments (2009)	3,360	1,680	560	3,360	
Coffey Environments (2010)	4,956	2,520	420	5,040	
Terrestrial Ecosystems (2013)		2,500	500		
Cancilla and Johnson (2013)		720			
Terrestrial Ecosystems (2014)		2,500	500		1,550
Terrestrial Ecosystems (2015a)		2,500	500		1,550
Terrestrial Ecosystems (2017a)		2,500	1,095		1,550
Terrestrial Ecosystems (2017c)		3,780	1,260		6,650
Terrestrial Ecosystems (2017b)		2,250	750		3,600

Biota Environmental Sciences (2000) undertook a survey for Sinclair Knight Merz as part of the preparation of an environmental impact assessment (EIA). Trapping was undertaken between 13-18 October 2000, with 20 aluminium box traps, 12 pit traps and two cage traps deployed at six sites (RNO01-06) mostly for five nights, and a seventh site (RNO07) had 12 pit-traps deployed for five nights. The total trapping effort was 600 aluminium box trap-nights, 534 pit-trap nights and 60 cage trap-nights (Table 1).

Biota Environmental Sciences (2005a) indicated that it undertook a fauna survey in December 2001 that has not been reported. Lines of 20 aluminium box traps were set at sites RNOE1, RNOE2, RNOE3, RNOE4 and RNOE5, and these were the same sites used by Chapman (2000). In addition, pit traps, cage traps and aluminium box traps were deployed at sites RNOCTS01, RNOCTS02, RNOCTS03, RNOCTS04, RNOCMS01, RNOCMS02, RNOCMS03, RNOCMS04 and cage traps were deployed along a cage trapping line.

Biota Environmental Sciences (2005a) undertook a survey between 23-26 August 2005 for RNO. Six sites (RNOE1-E5, Elliott lines) had 20 aluminium box traps set for three nights, one site had 50 cage traps set for two nights and there were eight sites with 12 pit-fall traps, eight aluminium box traps and two cage traps. The total trapping effort was 672 aluminium box trap-nights, 408 pit trap-nights and 168 cage trap-nights (Table 1). There is no record of the trap type(s) that caught the conservation significant fauna.

Coffey Environments (2009) undertook a vertebrate fauna survey of the Halley's pit surrounds and Shoemaker–Levy area between 12-19 October 2008. In part, this survey was to meet the Ministerial conditions for on-going monitoring of conservation significant fauna and to provide analogue sites for when fauna monitoring was undertaken in the rehabilitated areas. Pit-traps, aluminium box traps and cage traps were deployed (Table 1). Conservation significant fauna recorded during this survey included Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*), Western Whipbird, Western Brush Wallaby, Southern Brown Bandicoot and Rainbow Bee-eater (*Merops ornatus*) (Appendix A). Coffey Environments (2009) reported a dead Chuditch on the southern access road into the RNO, but coordinates were not provided.

Coffey Environments (2010) undertook a second vertebrate fauna monitoring survey to comply with Ministerial conditions. Survey sites included those used in 2009 plus 14 additional sites (N1-N10 and C1-C4) and the field survey was completed between 8-18 January 2010. These additional sites were used to provide a comparison with the existing 20 Shoemaker-Levy and Halley's pit sites (Table 1). Pit-traps, aluminium box traps and cage traps were deployed at sites N1-N10, and cage traps where deployed at sites C1-C4. Chuditch were caught in cage traps, and the Western Mouse and Heath Rat were caught in pipe pit-traps. A Malleefowl was also recorded during the survey. Conservation significant fauna recorded during this survey are shown in Appendix A. The identification of the Heath Rat was not confirmed with a photo or tissue sample.

Terrestrial Ecosystems (2013) established six trapping sites in 2013 as part of a long-term monitoring program for conservation significant fauna. Sites A, C, D and E each had 100 aluminium box traps and 20 wire cage traps, and sites B and F had 50 aluminium box traps and 10 wire cage traps (Table 1). Site A was split into east and west trapping grids each with 50 aluminium box traps and 10 wire cage traps. The location of all trapping sites was marked with a star picket. In addition, eleven sites were established and marked with a star picket to monitor the presence of the mallee subspecies of the Western Whipbird. Conservation significant fauna recorded during the survey are shown in Appendix A.

Terrestrial Ecosystems (2014) established a new trapping site G to replace site B (Terrestrial Ecosystems 2013) which had been removed due to mining activity. Western Whipbird monitoring site 7 was also removed due to mining activity but this site was not replaced. In addition, 50 camera traps were deployed as follows: site A east – 3 camera traps, site A west – 3 camera traps, site D – 9 camera traps, site E – 10 camera traps, site F – 5 camera traps, site G – 10 camera traps (Coffey Environments 'gully' site) and Coffey Environments' (2010) Chuditch trapping site on the 'hill' – 10 camera traps (Table 1). Conservation significant fauna recorded during the survey are shown in Appendix A.

Terrestrial Ecosystems (2015a) undertook its third annual conservation significant fauna monitoring survey in October 2015. Camera traps were deployed between 14-17 September 2015 and closed on 14-15 October 2015. Traps were laid out and opened on 13-14 October 2015 and all traps were cleared daily and closed on 18-19 October 2015 for five nights of trapping at each site (Table 1). Trapping and Western Whipbird monitoring sites were the same as in 2014. Conservation significant fauna recorded during the survey are shown in Appendix A.

Terrestrial Ecosystems (2017a) undertook its fourth annual conservation significant fauna monitoring survey between September and November 2016. Camera traps were deployed between 13-18 September 2016 and retrieved between 15-18 November 2016. Traps were laid out and opened on 15-16 November 2015 and all traps were cleared daily and closed on 20-21 November 2016 for five nights of trapping. Fauna trapping, and Whipbird monitoring sites were the same as in 2014 and 2015, but 119 baited large wire cage traps were deployed to target feral cats (Table 1). Conservation significant fauna recorded during this survey are shown in Appendix A. This survey report also includes camera trap records for the infrastructure corridor and Hale Bopp North West pit area, as these areas were surveyed concurrently.

Terrestrial Ecosystems (2017c) undertook vertebrate fauna surveys for the Hale Bopp North West pit, an infrastructure corridor and extension to the proposed Shoemaker-Levy mining area. Four site visits were made between September 2016 and March 2017. Camera traps were deployed between 13 and 18 September 2016 and retrieved between 15

and 18 November 2016 in the Hale Bopp North West pit and in the infrastructure corridor. Camera traps were deployed in the Shoemaker-Levy mining area on or about 4 January 2017 and retrieved on or about 24 February 2017. Traps were laid out and opened in the infrastructure corridor and the Hale Bopp North West pit on 20-21 September 2017 and all traps were cleared daily and closed on 25-26 November 2016 for five nights of trapping. Traps were laid out and opened in the Shoemaker-Levy mining area and proposed expansion area on 22 February and closed on 1 March 2017 for seven nights of trapping (Table 1). The Hale Bopp North West development footprint was also searched for Malleefowl and their mounds. A survey was also undertaken for Western Whipbirds in the infrastructure corridor and in the proposed Hale Bopp North West development footprint. Conservation significant fauna recorded during this survey are shown in Appendix A.

Terrestrial Ecosystems (2017b) undertook its fifth annual conservation significant fauna monitoring survey between September and November 2017. Camera traps were deployed between 17-21 September 2017 and retrieved between 1-4 November 2017. Traps were laid out and opened on 2 November 2017 and all traps were cleared daily and closed on 7 November 2017 for five nights of trapping. Permanent long-term monitoring sites were established for Heath Rat, Western Mouse, Southern Brown Bandicoot, Chuditch and Western Whipbird in 2013. These same sites were used in 2014, 2015 and 2016. Some of these sites were no longer useful for monitoring purposes, as they will be cleared for the proposed Shoemaker-Levy mine and associated infrastructure, so some new sites were created in 2017. The new sites were established based on the dominant fauna habitats near the RNO project. A total of 450 aluminium box traps, 150 large wire cage traps and 90 camera traps were deployed across three habitat types (Table 1). Western Whipbird monitoring was undertaken at 12 monitoring sites. Conservation significant fauna recorded during this survey are shown in Appendix A.

2 METHODS

2.1 Trapping for Conservation Significant Fauna

2.1.1 Camera traps

One hundred camera traps (Reconyx HC600) were deployed across the proposed infrastructure corridor. Cameras were spaced more than 200m apart so that observations could be considered independent. All camera traps were set up between 12-16 January 2018 and retrieved between 1-3 March 2018. Locations of all camera traps are shown in Figure 3. Details of all camera locations are outlined in Appendix B.

Non-reward bait lures (Plate 1) containing a bolus of universal bait (peanut butter, sardines and rolled oats) and topped up with mullie oil were used as a lure for fauna. All bait pods were partially buried into the ground and secured with a metal stake. Cameras were mounted on a star picket (Plate 2) 2-4m from the bait pod and directed to capture images of fauna moving through the area or attracted to the lure.

Plate 1. Non-reward bait pod containing a lure secured in the ground

Plate 2. Camera trap attached to a star picket

2.1.2 Aluminium box and large wire cage traps

One hundred and fifty large wire cage traps (Plate 3) and 450 aluminium box traps were deployed across the proposed infrastructure corridor. The large cage traps were spaced approximately 120m apart following the main access tracks and old drill lines. The aluminium box traps were deployed in 14 transects of 25 or 50 traps at approximately 10m intervals, resulting in 10 transects of 25 traps and four transects of 50 traps. Traps were opened on 27-28 January 2018, checked daily and closed between 4-5 March 2018. Locations are shown in Figure 4 and coordinates are listed in Appendix B.

Aluminium box traps were baited with universal bait (i.e. a mixture of peanut butter, sardines and rolled oats), while the wire cage traps were baited with an open tin of sardines. Baits were replenished when taken and after three days of setting the traps.

Target species for the large cage traps included:

- Chuditch;
- Southern Brown Bandicoots; and
- Feral cats.

Target species for the aluminium box traps were;

- Heath Mouse;
- Western Mouse;
- Ash-grey Mouse; and

- Mitchell's Hopping Mouse.

Plate 3. Cage trap site

2.2 Avian survey

Birds seen or heard while undertaking other tasks were recorded and used to create an avian species list for the project area during the deployment of camera traps, trapping program and collection of cameras (i.e. 12-16 January; and 27 February-5 March 2018). Specific records were taken of the locations where Western Whipbirds were heard calling.

2.3 Survey personnel

Five Terrestrial Ecosystems staff were involved in the field survey. This report was prepared by Dr Margot Oorebeek and reviewed by Dr Graham Thompson and Dr Scott Thompson. The qualifications and experience of Terrestrial Ecosystems staff involved in this survey are shown in Table 2.

Table 2. Qualifications and experience of Terrestrial Ecosystems survey and review team

Name	Qualifications	Experienced
Dr Graham Thompson	PhD (Zoology)	> 20 years
Dr Scott Thompson	BSc, MSc, PhD (Env Sci/Man)	> 15 years
Dr Margot Oorebeek	MSc, PhD (Zoology)	> 10 years
Ray Turnbull	B Nat Res, G.Dip Ornithology	> 10 years
Dr Justine Barker	BSc (Hons), PhD	<5 years
Jodie Millar	BSc	< 2 years

2.4 Weather

Table 3 shows the daily minimum and maximum temperatures and rainfall for the survey trapping period as recorded at the Ravensthorpe Nickel Operations weather station.

Table 3. Daily weather data record in the RNO project area

Date	Min. Temp. ºC	Max. Temp. ºC	Rainfall (mm)
26-2-2018	15.9	25.7	1.8
27-2-2018	9.8	20.3	
28-2-2018	7.8	22.4	
1-3-2018	10.2	31.2	
2-3-2018	15.4	21.7	
3-3-2018	10.4	20.5	
4-3-2018	9.9	23.8	
5-3-2018	12.3	28.1	
6-3-2018	14.3	32.1	
7-3-2018	15.2	35.0	

2.5 Limitations

The weather was suitable for trapping and was generally mild to warm.

Australian Ravens and Grey Currawongs disturbed some of the aluminium box traps by taking the bait and removing the trap pins. Disturbed traps were rebaited, however, some traps would have been ineffective on some nights.

The EPA's (2016) Guidance for *Technical Guidance Terrestrial Fauna Surveys* suggested that fauna surveys may be limited by many variables. Limitations associated with each of these variables are assessed in Table 4.

Table 4. Fauna assessment limitations and constraints

Possible limitations	**Constraint (yes/no); significant, moderate or negligible**	**Comment**
Competency and experience of the consultant carrying out this assessment	No	The zoologists that undertook the field survey and prepared this monitoring report are familiar with the vertebrate fauna of this bioregion and around RNO, have completed the previous 5 years of surveys and are experienced in these types of surveys.
Scope	No	All aspects of the scope of works have been addressed.
Proportion of fauna identified, recorded and/or collected	No	Not applicable.
Accuracy of previous survey work	Yes, negligible	Terrestrial Ecosystems has reported fauna survey data recorded by various authors but is not able to vouch for the accuracy of this information. It is acknowledged that the taxonomy of Western Australian vertebrates is continually being revised and the nomenclature of some previous captures may have changed since publication by the authors.
Sources of information	Yes, negligible	Vertebrate fauna information was available from on-line databases and unpublished and published reports of surveys conducted on-site over a period of time. Many of these surveys employed a low level of trapping effort which significantly impacts on the capacity of these data to represent the fauna assemblages in the areas surveyed.
Timing/weather/ season/ cycle	No	Weather was suitable for a survey.
Disturbances which affected results of the survey	No	Ravens and Currawongs reduced the effectiveness of the aluminium box trapping, but this would not have significantly impacted the results. This level of disturbance has been considered in this assessment.
Intensity of survey effort	No	The survey effort is consistent with previous years.
Resources	No	Adequate resources were available.

Possible limitations	Constraint (yes/no); significant, moderate or negligible	Comment
Remoteness and/or access problems	Yes, negligible	Access was not a significant limitation or constraint.
Availability of contextual information on the region	No	There is a reasonable quantity of historical fauna survey data available for this project area.

Negligible = less than 20%.

3 RESULTS

3.1 Aluminium box and cage trap captures

Appendix C contains the complete list of vertebrate fauna caught and the location for each capture. Table 5 provides a summary of the number of individuals caught in the trapping program for each species across the proposed infrastructure corridor.

Table 5. Number of individuals caught for each species

Taxa	Species	Common Name	Number caught
Mammals	*Tachyglossus aculeatus*	Short-beaked Echidna	1
	Dasyurus geoffroii	Chuditch	4
	Mus musculus	House Mouse	429
	Rattus fuscipes	Bush Rat	4
Reptiles	*Tiliqua rugosa*	Bobtail	30
	Varanus rosenbergi	Heath Goanna	11

3.2 Camera traps

Vertebrate fauna have been recorded for each camera trap on a 'presence only' basis (Table 6). Where possible we have provided an indicative number or minimum number of individuals present (i.e. based on colour patterns or number of individuals in one image), however, this is not an accurate count.

Table 6. Fauna present as recorded on cameras

	Camera location	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Corvus coronoides	Australian Raven	2+	1			1+			1+			2				2+
Dromaius novaehollandiae	Emu	7+	12+	6+	2+	2	6+	2	5	8+	1	2+	2+	8+		3+
Drymodes brunneopygia	Southern Scrub-Robin	1														
Pachycephalus occidentalis	Western Whistler		1													
Pardalotus punctatus	Spotted Pardalote	1														
Phaps elegans	Brush Bronzewing	1											1+			1
Pomatostomus superciliosus	White-browed Babbler									1						
Rhipidura leucophrys	Willie Wagtail															1
Strepera versicolor	Grey Currawong	1+	1	1	1+					1						1+
Dasyurus geoffroii	Chuditch	1+	1	1+	1		4+			1+			1			1+
Felis catus	Feral Cat	1	1+	1	1+	1	1		1	1+	1	1		1+		1+
Macropus fuliginosus	Western Grey Kangaroo	2	2+	2+	2+	2+	2+	1+	3+	3+		2+	1	4+		8+
Mus sp.	Mouse/Rat sp.						1				3+				1	
Notamacropus irma	Western Brush Wallaby			1+	1+			1+			2+			1+		1
Oryctolagus cuniculus	Rabbit					1+	1		1+							1
Tachyglossus aculeatus	Echidna								1							1+
Vulpes	Red Fox	1+	1+				1+	1	1+	1		1+	1+	1+		1+
Tiliqua rugosa	Bobtail			1			1									
Varanus rosenbergi	Heath Goanna										1					
	Camera location	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Corvus coronoides	Australian Raven				2+		1	1+	2+	1	2	1			2+	
Gymnorhina tibicen	Australian Magpie															
Dromaius novaehollandiae	Emu	7+	8+	8+	2+	1	5+	9+	7+	2	5+	2+	3+	1	1+	
Drymodes brunneopygia	Southern Scrub-Robin														1	
Gliciphila melanops	Tawny-crowned Honeyeater													1+		
Hylacola cauta	Shy Heathwren													1		
Leipoa ocellata	Malleefowl										1+					
Phaps chalcoptera	Common Bronzewing															1
Phaps elegans	Brush Bronzewing									1					1	
Strepera versicolor	Grey Currawong		1				1+		1	1		1			1+	1+
Turnix varius	Painted Button-quail				2											
Dasyurus geoffroii	Chuditch	1	1	1		1		1+	2+						1	1+
Felis catus	Feral Cat	2+		1+	1+		1+	1+	2+		3+	2+	2+	1+	1	
Isoodon fusciventer	Southern Brown Bandicoot									1	1					
Macropus fuliginosus	Western Grey Kangaroo	2+	3+	2+	2	1+	1	2+	4+	2+	2+	1+	1+	3+		1+
Mus sp.	Mouse/Rat sp.						1				1			2+		

Notamacropus irma	Western Brush Wallaby	2+			2+	1+	2+	1+	2+	2+	2+	1+	1+	2+	2+	1
Oryctolagus cuniculus	Rabbit											1				
Tachyglossus aculeatus	Echidna					1		1+	1+					1		
Vulpes	Red Fox	1+		1+	1+	1	2	1+			1+	2+	1+		2+	1
Tiliqua rugosa	Bobtail				2									1+		
	Camera location	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
Corvus coronoides	Australian Raven			1+	2+										1	
Gymnorhina tibicen	Australian Magpie									1						
Dromaius novaehollandiae	Emu	8+	1	2+	6+	6+	3+	2+	5+	5+	3	4+	5+	5+	2+	6+
Drymodes brunneopygia	Southern Scrub-Robin									1						
Gliciphila melanops	Tawny-crowned Honeyeater									1+	1+					
Phaps chalcoptera	Common Bronzewing				1											
Phaps elegans	Brush Bronzewing														2+	
Pomatostomus superciliosus	White-browed Babbler				3											
Rhipidura leucophrys	Willie Wagtail	1			1											
Strepera versicolor	Grey Currawong							1+								1+
Turnix varius	Painted Button-quail										3+					
Dasyurus geoffroii	Chuditch				2			6+		1					1+	
Felis catus	Feral Cat	1+	1+	1+	1	2+	1+	1	2	1+	2	1+	1	1	1	2
Macropus fuliginosus	Western Grey Kangaroo	3+		1+	2+	2+	2+	3+	3+	1	3+	2+	2	1	3+	2+
Mus sp.	Mouse/Rat sp.										1+					
Notamacropus irma	Western Brush Wallaby	2+	2+	2+	2+	2+	2+	1+	1+	2+	2+	2+	1+	2+	2+	1+
Tachyglossus aculeatus	Echidna				1+										1	
Trichosurus vulpecula	Common Brushtail Possum							1								
Vulpes vulpes	Red Fox	1+		1+		1+	1+	1+	1	1+	1	1+		1+	1+	1+
Tiliqua rugosa	Bobtail				1					1+	1				1+	
Varanus rosenbergi	Heath Goanna	1			2+				1	1	1		1			
	Camera location	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Corvus coronoides	Australian Raven		1						1+		1		2	2+	1	
Gymnorhina tibicen	Australian Magpie												2			
Dromaius novaehollandiae	Emu	4+	3+	5+		1	2+	2+	7+	9+	3+	4+	2+	4+	2+	1+
Gliciphila melanops	Tawny-crowned Honeyeater						1									
Leipoa ocellata	Malleefowl									1+						
Phaps chalcoptera	Common Bronzewing		1+													
Phaps elegans	Brush Bronzewing		1+					2+								
Rhipidura leucophrys	Willie Wagtail								1							
Strepera versicolor	Grey Currawong		1				1	1+						1+	1	
Turnix varius	Painted Button-quail							4+					1			
Dasyurus geoffroii	Chuditch	2+	2+				1	1		1+	1+	1		1	2+	
Felis catus	Feral Cat	1+	3+	1	1		1	1	2+	2+	1+	1+	1	2+	1+	1+

Isoodon fusciventer	Southern Brown Bandicoot			1												
Macropus fuliginosus	Western Grey Kangaroo	2+	2+	3+	2+	2+	2+	2+	1	1+		1+	1+		4+	1
Mus sp.	Mouse/Rat sp.			1						1						
Notamacropus irma	Western Brush Wallaby	2+	2+	1+	1	1	2+	2+	1	2+	2+	1	1+	1+		2+
Oryctolagus cuniculus	Rabbit										1	1			1+	
Tachyglossus aculeatus	Echidna		1+				1+	1		1					1	
Trichosurus vulpecula	Common Brushtail Possum		1+					1							1	
Vulpes vulpes	Red Fox	1+	1+				1+		2+	1+			1+	1+	1+	
Tiliqua rugosa	Bobtail							1+								
Varanus rosenbergi	Heath Goanna		1													
	Camera location	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
Corvus coronoides	Australian Raven	1	1+	1	1+	2+			1		2+				1	2+
Dromaius novaehollandiae	Emu	8+	6+	3+	5+	16+	6+	11+	2+	5+	4+	2+	8+		1+	12+
Drymodes brunneopygia	Southern Scrub-Robin				1				1							
Gliciphila melanops	Tawny-crowned Honeyeater														1	
Leipoa ocellata	Malleefowl														1	
Malurus sp.	Fairywren sp.														1	
Ninox boobook	Southern Boobook		1													
Phaps chalcoptera	Common Bronzewing										1					
Phaps elegans	Brush Bronzewing	1									1			1		
Rhipidura leucophrys	Willie Wagtail													1		
Strepera versicolor	Grey Currawong				1	2+			1+		1					1
Dasyurus geoffroii	Chuditch					1+			2+						2+	1
Felis catus	Feral Cat	1+		1	1+	1		1+		1+		1+	3+			1
Macropus fuliginosus	Western Grey Kangaroo	2+	4+	2+	4+	2+	1+	3+	1+	1+		2+	2+	2+	1+	2+
Mus sp.	Mouse/Rat sp.														1	
Notamacropus irma	Western Brush Wallaby	2+		2+	1	2+	2+	1+	2+	2+	2				2+	1+
Oryctolagus cuniculus	Rabbit		1+		1									2+		
Tachyglossus aculeatus	Echidna								1		1				1+	
Vulpes vulpes	Red Fox	1	1+		1+	1+	1	1	1	1	1	1+	1+	1		1+
Tiliqua rugosa	Bobtail										2					
Varanus rosenbergi	Heath Goanna							1			1					
	Camera location	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
Accipiter fasciatus	Brown Goshawk	1														
Corvus coronoides	Australian Raven							1+	1+	2+	1	1			1	
Gymnorhina tibicen	Australian Magpie								1	1						
Dromaius novaehollandiae	Emu	5+	6+	8+	12+	8+		2+	2+	2+		5+	6+	4+	5+	5+
Eurostopodus argus	Spotted Nightjar								1							
Gliciphila melanops	Tawny-crowned Honeyeater										1+					
Oreoica gutturalis	Crested Bellbird								1							

Phaps elegans	Brush Bronzewing								1							
Rhipidura leucophrys	Willie Wagtail							1								
Strepera versicolor	Grey Currawong	1			1				1+		1	2+		1		1
Turnix varius	Painted Button-quail	1														
Dasyurus geoffroii	Chuditch	1		1	2+				1	1+	1+	2			1+	1+
Felis catus	Feral Cat	1+	1+	2	1+	1+		2	2+	3+	1	1		1		
Isoodon fusciventer	Southern Brown Bandicoot															1
Macropus fuliginosus	Western Grey Kangaroo	2+	3+	1+	2+	2	2+	3+	1			3+	2+	2+	2+	2+
Mus sp.	Mouse/Rat sp.													1		
Notamacropus irma	Western Brush Wallaby	1+		1	2+	1+	1+		2	1	2+	2+	2+	2+	1+	
Oryctolagus cuniculus	Rabbit							2+								
Tachyglossus aculeatus	Echidna							1		1	1	1				
Vulpes vulpes	Red Fox	1	1+	1+	1+	1+		1+	2+	1+	1			1	1	
Tiliqua rugosa	Bobtail												1			

	Camera location	91	92	93	94	95	96	97	98	99	100
Accipiter fasciatus	Brown Goshawk										
Corvus coronoides	Australian Raven	1			1			1	1		
Gymnorhina tibicen	Australian Magpie									2	
Dromaius novaehollandiae	Emu	11+	6+				2+		5+	6+	
Drymodes brunneopygia	Southern Scrub-Robin							1+			
Hylacola cauta	Shy Heathwren						1				
Leipoa ocellata	Malleefowl					1					
Phaps elegans	Brush Bronzewing									1	
Phylidonyris novaehollandiae	New Holland Honeyeater								1		
Rhipidura leucophrys	Willie Wagtail	1									
Stagonopleura oculata	Red-eared Firetail	2									
Turnix varius	Painted Button-quail				2						
Dasyurus geoffroii	Chuditch			1		3+		1+	1+		
Felis catus	Feral Cat	1+		1+		1+	2+	2+	1	2+	
Isoodon fusciventer	Southern Brown Bandicoot					1+					
Macropus fuliginosus	Western Grey Kangaroo	6+	3+	1+	1		3+	1	4+	1+	
Mus sp.	Mouse/Rat sp.	2					1			1	
Notamacropus irma	Western Brush Wallaby		2+	1+	1+	2+	1+	2+	1	1+	1+
Oryctolagus cuniculus	Rabbit	1+							1		
Tachyglossus aculeatus	Echidna	1		1	1				1		
Vulpes vulpes	Red Fox	1					1+		1+	1+	1
Tiliqua rugosa	Bobtail					1			1		

3.3 Chuditch

Chuditch were recorded by 46 of 100 camera traps across most of the survey area, except for Shoemaker-Levy and Halleys rehabilitation areas (Table 6). Four new Chuditch were captured during the trapping program. All of the Chuditch were trapped on the southern side of the proposed infrastructure corridor, just north of Halleys rehabilitation areas.

3.4 Southern Brown Bandicoot

Southern Brown Bandicoots were recorded by five camera traps all on the southern side of the South Coast Highway (Table 6). No Southern Brown Bandicoots were captured during the trapping program.

3.5 Western Brush Wallaby

Western Brush Wallabies were recorded by 80 of 100 camera traps across most of the survey area, except for Halleys rehabilitation areas (Table 6).

3.6 Avian survey results

Forty-seven species of birds were recorded during the fauna monitoring program (Table 7). This is the first record of a Peregrine Falcon near RNO tenements since Terrestrial Ecosystems has been undertaking monitoring surveys for RNO.

Table 7. Birds recorded during the fauna monitoring program

Family	Species	Common Name
Casuariidae	*Dromaius novaehollandiae*	Emu
Megapodiidae	*Leipoa ocellata*	Malleefowl
Podicipedidae	*Poliocephalus poliocephalus*	Hoary-headed Grebe
Accipitridae	*Aquila audax*	Wedge-tailed Eagle
	Accipiter fasciatus	Brown Goshawk
Turnicidae	*Turnix varius*	Painted Button-quail
Charadriidae	*Elseyornis melanops*	Black-fronted Dotterel
Columbidae	*Phaps chalcoptera*	Common Bronzewing
	Phaps elegans	Brush Bronzewing
Cuculidae	*Cacomantis flabelliformis*	Fan-tailed Cuckoo
Strigidae	*Ninox boobook*	Southern Boobook
Caprimulgidae	*Eurostopodus argus*	Spotted Nightjar
Falconidae	*Falco cenchroides*	Nankeen Kestrel
	Falco longipennis	Australian Hobby
	Falco berigora	Brown Falcon
	Falco peregrinus	Peregrine Falcon
Cacatuidae	*Calypthorhynchus latirostris*	Carnaby's Black Cockatoo
Psittaculidae	*Parvipsitta porphyrocephala*	Purple-crowned Lorikeet
Maluridae	*Malurus* sp.	Fairy-wren sp.
Meliphagidae	*Glyciphila melanops*	Tawny-crowned Honeyeater
	Lichmera indistincta	Brown Honeyeater
	Phylidonyris novaehollandiae	New Holland Honeyeater
	Nesoptilotis leucotis	White-eared Honeyeater
	Anthochaera lunulata	Western Wattlebird
	Anthochaera carunculata	Red Wattlebird
	Lichenostomus cratitius	Purple-gaped Honeyeater
Pardalotidae	*Pardalotus punctatus*	Spotted Pardalote
	Pardalotus striatus	Striated Pardalote
Acanthizidae	*Hylacola cauta*	Shy Heathwren
	Sericornis frontalis	White-browed Scrubwren
	Smicrornis brevirostris	Weebill
Pomatostomidae	*Pomatostomus superciliosus*	White-browed Babbler

Family	Species	Common Name
Psophodidae	*Psophodes nigrogularis*	Western Whipbird
Artamidae	*Gymnorhina tibicen*	Australian Magpie
	Cracticus torquatus	Grey Butcherbird
	Strepera versicolor	Grey Currawong
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike
Oreoicidae	*Oreoica gutturalis*	Crested Bellbird
Pachycephalidae	*Pachycephala occidentalis*	Western Whistler
Rhipiduridae	*Rhipidura leucophyrs*	Willie Wagtail
Corvidae	*Corvus coronoides*	Australian Raven
Petroicidae	*Drymodes brunneopygia*	Southern Scrub Robin
Hirundinidae	*Hirundo neoxena*	Welcome Swallow
	Petrochelidon nigricans	Tree Martin
Zosteropidae	*Zosterops lateralis*	Silvereye
Estrilididae	*Stagonopleura oculata*	Red-eared Firetail
Motacillidae	*Anthus australis*	Australian Pipit

3.7 Western Whipbirds

No targeted Western Whipbird surveys were undertaken in the proposed infrastructure corridor; however, incidental observations were recorded while setting up the camera traps and conducting the trapping survey. A detailed account of all incidental observations is shown in Table 8 and locations are shown in Figure 5.

Table 8. Western Whipbird incidental observations

Date	Time	Location	Comment
12-01-2018	1026	256094E, 6277219N	A whipbird was heard calling near camera 26 whilst setting up.
12-01-2018	1134	256104E, 6276950N	A whipbird was heard calling whilst inspecting an old Malleefowl mound.
13-01-2018	0648	256384E, 6276509N	A whipbird was heard calling near camera 66 whilst setting up.
14-01-2018	0824	255106E, 6278134N	A whipbird was heard calling near camera 39 whilst setting up.
14-01-2018	0933	254674E, 6278366N	A whipbird was heard calling near camera 42 whilst setting up.
27-02-2018	0700	252226E, 6280454N	A whipbird was heard calling near Shoemaker-Levy laydown.
27-02-2018	1151	255549E, 6277847N	A whipbird was heard calling near Cage 63 whilst opening trap lines.
28-02-2018	0939	256270E, 6277230N	A whipbird was heard calling near Cage 85 whilst opening trap lines.
01-03-2018	1034	255576E, 6277584N	A whipbird was heard calling just to the northwest of Cage 65 whilst checking traps.
01-03-2018	1128	254798E, 6278304N	A whipbird was heard calling near Cage 57 whilst checking traps.
02-03-2018	0636	252226E, 6280454N	Two whipbirds were heard calling just to the south of the Shoemaker-Levy laydown.
02-03-2018	0801	253507E, 6279516N	A whipbird was heard calling near Cage 25 whilst checking traps.
03-03-2018	0642	252226E, 6280454N	A whipbird was heard calling near Shoemaker-Levy laydown.
04-03-2018	0717	254355E, 6278463N	A whipbird was heard calling to the north of Cage 49 whilst checking traps.
04-03-2018	0750	255563E, 6277720N	A whipbird was heard calling to the east of Cage 64 whilst checking traps.

3.8 Malleefowl

Malleefowl were recorded by four camera traps on the southern side of the South Coast Highway (Table 6). Two Malleefowl were also observed on the Telstra Track (253570E, 6279501N) while checking the traps on 5 March 2018. All sightings were centred around two active mounds that were discovered in a 2017 aerial photogrammetry survey (Terrestrial Ecosystems 2017c). The status of these mounds was checked again on 4 March 2018. The northern mound (253953E, 6279131N) was estimated to be recently active (active in February 2017; Plate 4), while the southern mound (253770E, 6278858N) was found to be active, with shells of recently hatched eggs observed across the mound and fresh scratch marks around the crater (recently active in February 2017; Plate 5). A dormant mound was discovered while setting up the camera traps (256104E, 6276950N; Plate 6). This mound has been inactive for the past ten years, judging by the size of the vegetation growing on the edge of the mound. Figure 5 shows the locations of the three mounds.

Plate 4. Northern Malleefowl mound

Plate 5. Southern Malleefowl mound

Plate 6. Dormant Malleefowl mound

3.9 Carnaby's Black Cockatoo

On 3 March 2018 a flock of 30 Carnaby's Black Cockatoo was observed foraging on vegetation in Halleys rehabilitation area while checking traps.

4 DISCUSSION

4.1 General

4.1.1 Trapping effort

The total trapping effort of the proposed infrastructure corridor of 2,250 aluminium box trap-nights and 750 cage trap-nights is similar to the previous monitoring surveys implemented by Terrestrial Ecosystems (Table 1). This trapping effort significantly exceeds the trapping effort of Chapman (2000) and Biota Environmental Sciences (2000, 2005a) to support the Public Environmental Review and is comparable with Coffey Environments (2009, 2010) 1,680 aluminium box trap-nights and 560 cage trap nights in 2009 and 2,520 aluminium box trap-nights and 420 cage trap-nights in 2010. The efficacy of the aluminium box traps might have been slightly reduced by the high number of House Mice recorded during this survey. Due to their high density, House Mice would have had a higher probability of entering the trap first, therefore rendering the trap inaccessible to other animals. However, the large number of traps deployed meant that over 80% of the aluminium box traps remained available for other rodents. It appears as if the trapping effort was adequate and it is not the reason for the lack of captures of conservation significant fauna.

4.1.2 Trap type

It is not known which trap type the Western Mice and Heath Rats were caught in during the Chapman (2000) and Biota Environmental Sciences (2000, 2005a) surveys, however, Coffey Environments (2010) caught both species in pipe pit-traps in 2010 where no bait was used. Rodents are often targeted using aluminium box traps (Quinlan et al. 2004), however, based on a single survey by Coffey Environments (2010), the non-use of pit-traps may have been a factor in not catching Western Mice and Heath Rats.

4.2 Vertebrate Fauna

4.2.1 Chuditch

The Chuditch or Western Quoll is restricted to the south-west of Western Australia, mostly in the Jarrah forest, but they are also in the Fitzgerald River National Park and the Ravensthorpe Range (Orell and Morris 1994, Woinarski et al. 2014). The Chuditch is listed as Vulnerable under both the *EPBC Act 1999* and the *Wildlife Conservation Act 1950*, meaning it is a threatened species considered to be facing a high risk of extinction in the wild.

The Chuditch is a medium-sized arboreal-terrestrial dasyurid that is carnivorous/insectivorous and nocturnal (Serena and Soderquist 2008). In the Jarrah forest male Chuditch have a home range of up to 15km^2 and for females 3-4km^2 (Serena and Soderquist 2008). The core activity area of females, as defined by denning sites, do not overlap but they do for males (Serena and Soderquist 1989). Serena and Soderquist (1989) reported core activity areas along the Murray River, WA being 55-120ha for females and about 438ha for males. For most of the time, individuals live a solitary life.

The Department of Biodiversity, Conservation and Attractions (2012) estimated there were less than 10,000 Chuditch in 2007, with 75% of these occurring in the eucalypt forest and woodlands, and mallee heath and shrub lands of the south-west and south coast. Major threats are listed as habitat alteration due to vegetation clearing, frequent fires and predation by foxes (Morris et al. 2008).

In 2010 Coffey Environments (2010) trapped 10 Chuditch on the RNO tenements. Subsequent fauna monitoring surveys in 2013 and 2014 by Terrestrial Ecosystems (2013, 2014) failed to record any Chuditch. Since 2015 they have been recorded from an increasing number of locations across the tenements (Terrestrial Ecosystems 2015a, 2017a, d, b). In this survey they were captured on four occasions and recorded at 46 camera trap locations across the proposed infrastructure corridor, except for Shoemaker-Levy and Halleys rehabilitation areas. However, previous surveys have found them to be present in the Shoemaker-Levy mining and proposed mine expansion areas (Terrestrial Ecosystems 2017c). Chuditch numbers fluctuate and they are predated on by foxes, however, it is likely that there has been an increase in the local population as they are now being recorded at new locations.

4.2.2 Southern Brown Bandicoot

The Western Australian Southern Brown Bandicoot or Quenda occurs from the Moore River mouth in the north, south to east of Esperance and inland to Hyden. It is listed on the Department of Biodiversity, Conservation and Attractions Priority Species list as Priority 4: Rare, Near Threatened and other species in need of monitoring.

Southern Brown Bandicoot inhabit dense shrublands, often associated with low lying, swampy areas, and the understorey of adjacent forests. They prefer a thick ground cover layer where they can establish runways that are difficult to detect beneath the interlocking vegetation which provides them protection from predators. They are active late in the afternoon, during the night and often early in the morning when they forage for plant material, fungi and invertebrates. Bandicoots use their powerful front claws to dig into the soil to look for fungi and invertebrates and as a result they leave distinctive conical-shaped hollows. During the day the Southern Brown Bandicoot shelters in a nest build under dense bushes or the skirts of grass trees (Paull 2008).

The major threats to the Southern Brown Bandicoot are habitat clearing for land development, altered fire regimes and predation by introduced species (Burbidge and Woinarski 2016a). The body size of an adult Southern Brown Bandicoot ranges from 400-1600 grams and, as such, it falls into the critical weight range of mammals particularly susceptible to predation by foxes and cats (Johnson and Isacc 2009).

During the survey Southern Brown Bandicoot were recorded at five camera trap locations. The cameras that recorded the Southern Brown Bandicoot were situated in the middle of the proposed infrastructure corridor. Previous surveys have reported the Southern Brown Bandicoot in low numbers across the RNO mining tenements (Biota Environmental Sciences 2000, Chapman 2000, Coffey Environments 2009, Terrestrial Ecosystems 2017d).

4.2.3 Western Brush Wallaby

The Western Brush Wallaby is a medium sized wallaby that is found in a variety of habitats from open forest or woodland, around seasonally wet flats to dry open shrub land and scrubby thickets (Christensen 2000). Woinarski et al. (2014) reported its geographic distribution extending from Kalbarri to Cape Arid in WA. It is listed on the Department of Biodiversity, Conservation and Attractions Priority Species list as Priority 4: Rare, Near Threatened and other species in need of monitoring.

Woinarski and Burbidge (2016b) indicated there are no current major threats to this species. Vegetation clearing for agriculture has reduced the population and its geographical range in the past and currently foxes are known to predate on Western Brush Wallabies, particularly joeys.

Western Brush Wallabies were recorded at 80 camera traps across the proposed infrastructure corridor, except for Halleys rehabilitation areas. At many of these sites they were recorded on multiple occasions and multiple individuals. Previous surveys on the RNO tenements have recorded similarly high numbers of Western Brush Wallabies (Terrestrial Ecosystems 2014, 2015a, 2017a, b) and this suggests that the species is widespread across the area.

4.2.4 Western Whipbirds

The Western Mallee subspecies of the Western Whipbird (*Psophodes nigrogularis oberon*) has a scattered distribution throughout the southern wheatbelt and central south coast region, with the majority in the Fitzgerald River National Park and the Stirling Ranges National Park. It is listed on the Department of Biodiversity, Conservation and Attractions Priority Species list as Priority 4: Rare, Near Threatened and other species in need of monitoring.

The Western Whipbird is a sedentary, ground-dwelling species that occurs in open mallee eucalypt woodland with a dense, tall shrub layer up to 1.5m tall, dominated by such species as *Hakea*, *Lambertia*, or *Banksia* (McNee 1986). This species prefers to run rather than fly when disturbed, rendering visual observation difficult. However, the birds are vocal throughout the year (Smith 1991) and song can be used to locate the animals in the field.

Fire and predation by feral predators are considered to be the main threats to the Western Whipbird in Western Australia (Department of Parks and Wildlife 2014). A large wildfire at Mt Manypeaks in 2004 resulted in a significant population decline of the Western Whipbird (Comer et al. 2005) and McNee (1986) found that the Western Whipbird only occurred in areas that had remained unburned for at least 14 years. The ground-dwelling habit of the Western Whipbird, along with its preference to run rather than fly when disturbed makes this species

highly susceptible to predation by foxes and cats. While foxes prefer the more open vegetation areas, cats can more easily catch prey in denser habitat due to their stalk and ambush hunting techniques.

Western Whipbirds were recorded at 13 locations while setting up camera traps or checking traps. The observations were made across the proposed infrastructure corridor, except for Halleys rehabilitation areas. Previous surveys from 2000 to 2017 (Biota Environmental Sciences 2000, Chapman 2000, Biota Environmental Sciences 2005a, Coffey Environments 2009, 2010, Terrestrial Ecosystems 2013, 2014, 2015a, 2017a, d) have recorded the Western Whipbird at numerous locations and the species appears to be relatively abundant across the RNO tenements.

4.2.5 Malleefowl

Since 1981 the Malleefowl has suffered a range contraction of 28-30% within Western Australia (Benshemesh 2007, Parsons et al. 2008). The species is now primarily found in the Goldfields and the Wheatbelt and is associated with landscapes that have lower rainfall, greater amounts of mallee and shrubland that occur as large remnants, and lighter soil surface textures (Parsons et al. 2008). The Malleefowl is listed as Vulnerable under both the *EPBC Act 1999* and the *Wildlife Conservation Act 1950*, meaning it is a threatened species considered to be facing a high risk of extinction in the wild.

A sandy or gravelly substrate and abundance of leaf litter are requirements for the construction of the birds' incubator mounds (Firth 1959, 1962). Malleefowl mounds are typically 60-90 cm high and 3.7m wide, however, there is considerable variability in the size, which is often influenced by how often the mound has been used (Jones and Goth 2008). Malleefowl frequently use existing mounds (Priddel and Wheeler 2003) by raking more material from the surrounding area each year on to the existing mound, with the consequence that some of the older mounds are higher than 100cm and wider than 5m. Clutch size and thus the duration of the breeding period varies from year to year and breeding may not occur at all in years when rainfall is low. In mid-west WA, breeding activity is influenced by winter rainfall (Firth 1959) and in the occasional years when winter rainfall is very low, breeding activity can be non-existent or very low. Insufficient rain prevents organic matter in the centre of the mound from decomposing at a rate sufficient to generate enough heat to incubate the eggs (Firth 1956). Therefore, mound usage is variable from year to year.

Major threats to Malleefowl are vegetation clearing for agriculture, population fragmentation, predation by foxes, wild dogs, feral cats, grazing by goats and introduction of weeds (Birdlife International 2016).

Malleefowl were recorded at four camera trap locations on the southern side of the South Coast Highway. Additionally, two birds were observed in the same general area while checking traps. All these sightings occurred in the vicinity of two (recently) active Malleefowl mounds that were recorded in the 2017 survey (Terrestrial Ecosystems 2017c). A status check revealed the southern mound to be active, while the northern mound was currently inactive. Breeding activity appears to have switched between 2017 and 2018, with the southern mound being inactive in February 2017, but showing signs of breeding activity in 2018 with egg shells found in the centre of the mound. The northern mound was active in 2017 but was found to be inactive in 2018. Due to the close proximity of the two mounds it is possible that both mounds belong to the same breeding pair and they have switched mounds between breeding seasons.

4.2.6 Carnaby's Black Cockatoo

The Carnaby's Black Cockatoo is listed as Endangered under both the *EPBC Act* and the *Wildlife Conservation Act 1950*, meaning it is a threatened species considered to be facing a very high risk of extinction in the wild. Both species are endemic to the south-west of WA.

The distribution of the Carnaby's Black Cockatoo extends from the lower Murchison River in the north to Israelite Bay in the south-east and extends inland to Merredin and Norseman. The majority of the species display a seasonal migratory pattern that is linked to breeding (Saunders 1980). Breeding occurs in the inland regions from late July to December, after which the birds move the higher rainfall coastal regions of their range. However, a few populations remain resident in their breeding range year-round and these include the populations occupying the Jarrah forests around Mundaring (Johnstone et al. 2011). They prefer to nest in large hollows of mature Salmon Gum (*Eucalyptus salmonophloia*) and Wandoo (Saunders 1982), but nests have also been found in Marri. The diet of the Carnaby's Black Cockatoo consists of the seeds of a mix of native species, such as eucalypts, banksias and hakeas, but also includes introduced species such as Pine (*Pinus radiata*) and Canola (*Brassica* spp.) (Finn et al. 2009, Jackson 2009, Groom 2011).

The major threatening processes facing the Carnaby's Black Cockatoo are habitat loss due to clearing for residential development, nest hollow shortage, nest hollow competition with feral honey bees, vehicle strikes and illegal shooting by orchardists and landholders(Department of Environment and Conservation 2013).

A flock of 30 Carnaby's Black Cockatoo was observed feeding in Halleys rehabilitation areas. Most of the proposed infrastructure corridor provides limited food sources for the Carnaby's Black Cockatoo and there are no large trees in the area to provide either roosting or breeding habitat.

4.2.7 Peregrine Falcon

The Peregrine Falcon was recorded for the first time since Terrestrial Ecosystems has been undertaking fauna surveys around the RNO tenements in 2013. This falcon is widely distributed in Western Australia and is also seen on some of the continental islands but is absent from the sandy desert areas (Johnstone and Storr 1998). It is mostly seen around cliffs, wooded water courses, lakes and ranges, but it can be seen almost anywhere in the wooded areas. It feeds almost entirely on birds.

It is listed as a Schedule 7 species under the *Wildlife Conservation Act 1950*. This raptor typically has a large home range, and vegetation clearing is part of its home range will have little impacts other that require it to shift its foraging to another area.

4.2.8 Introduced fauna

Both the fox and feral cats have been recorded in high numbers throughout the proposed infrastructure corridor. The fox was recorded at 70 camera trap locations, while the cat was recorded at 79 camera trap locations. While some of these records represent the same individual moving through the area, these numbers indicate a very high abundance of both species throughout the survey area.

The high abundance of House Mice captured during this survey (429 individuals) compared to previous years (0-60 individuals) (Terrestrial Ecosystems 2014, 2015a, 2017a, d, b) indicates a boom in the local population. This is most likely due to the favourable conditions created by high rainfall in 2017. A high abundance of House Mice can in turn lead to an increase in feral predators, as both foxes and feral cats will predate on House Mice. With an abundance of prey available, predators will have a successful breeding season and recruitment into the next season will be high. This in turn will increase the predation pressure on the local small to medium sized vertebrates, especially once the boom in House Mouse numbers subsides.

Foxes and cats are a potential threat to several conservation significant species that occur on the RNO tenements. Burbidge (2004), in his book on threatened animals in Western Australia, indicated that the fox was a known predator of Chuditch, Heath Rat and Malleefowl, and the cat is a known threat to the Heath Rat. The national recovery plan for Malleefowl (Benshemesh 2007) reported the fox, and to a lesser extent cats, as a major cause of mortality of Malleefowl. Similarly, cats and foxes are known predators of Southern Brown Bandicoot and Western Whipbird (Coates and Wright 2003, Department of Parks and Wildlife 2014). The high density of feral predators found within the survey area might explain the low numbers of conservation significant species captured.

5 CONCLUSIONS

Recent survey records indicate that the conservation significant Chuditch, Southern Brown Bandicoot, Western Brush Wallaby, Western Whipbird, Malleefowl, Carnaby's Black Cockatoo and the Peregrine Falcon are in the proposed infrastructure corridor.

Chuditch have been frequently recorded on camera traps throughout the proposed infrastructure corridor and appear to be relatively common in the area. While the Southern Brown Bandicoot was only recorded on five camera traps and occurs in very low numbers.

There are two active Malleefowl mounds within the proposed infrastructure corridor and a pair of birds has been observed in the vicinity of those mounds. A recent visit showed that the southern mound was active at the time of the survey, with egg shells present in the centre of the mound and fresh scratch marks around the crater. The northern mound was considered to be inactive at the time of the survey, but this mound had been active the previous year. It is possible that the birds have switched mounds between breeding seasons.

Western Whipbird were present throughout the proposed infrastructure corridor, except for Halleys rehabilitation areas. They appear to be relatively abundant in the dense vegetation. Carnaby's Black Cockatoo were observed feeding in Halleys rehabilitation area. While the proposed infrastructure corridor provides some food sources for the cockatoos, there are no large trees available for either roosting or breeding. A Peregrine Falcon was seen for the first time in Terrestrial Ecosystems surveys in the vicinity of RNO project area.

The proposed infrastructure corridor was found to support a very high abundance of foxes and cats. These feral predators will pose a major threat to the population levels of all small and medium sized vertebrates in the survey area. An intensive control program should be implemented through winter and spring 2018 to reduce the fox and cat numbers before they breed again in spring 2018. The progress and outcomes of this program should be monitored.

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Figures

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TERRESTRIAL ECOSYSTEMS

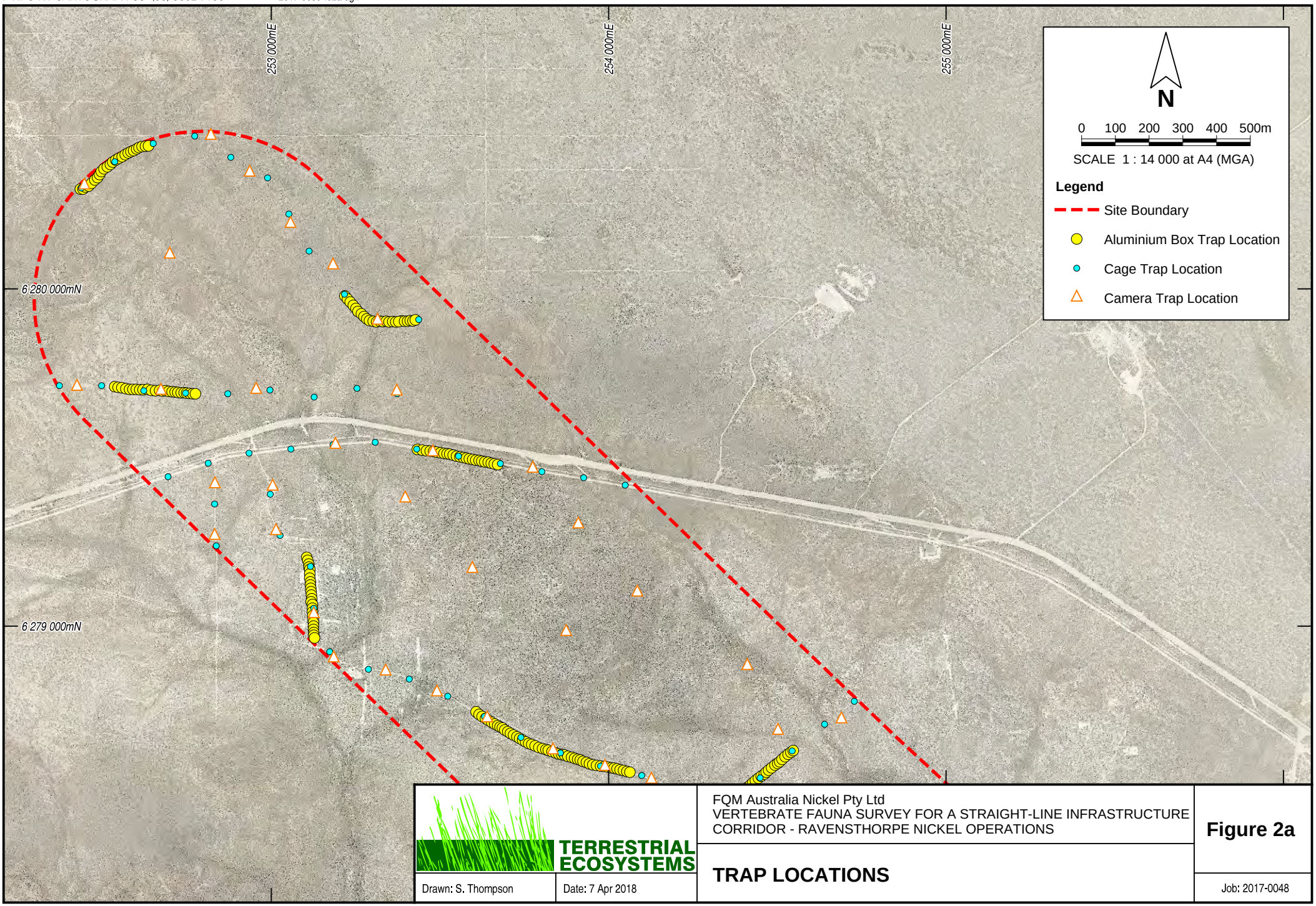
FQM Australia Nickel Pty Ltd
VERTEBRATE FAUNA SURVEY FOR A STRAIGHT-LINE INFRASTRUCTURE CORRIDOR - RAVENSTHORPE NICKEL OPERATIONS

Figure 1

REGIONAL LOCATION

Drawn: S. Thompson | Date: 7 Apr 2018 | Job: 2017-0048

PINPOINT CARTOGRAPHICS (08) 9562 7136 2017-0089-f02a.dgn



TERRESTRIAL ECOSYSTEMS

Drawn: S. Thompson | Date: 7 Apr 2018

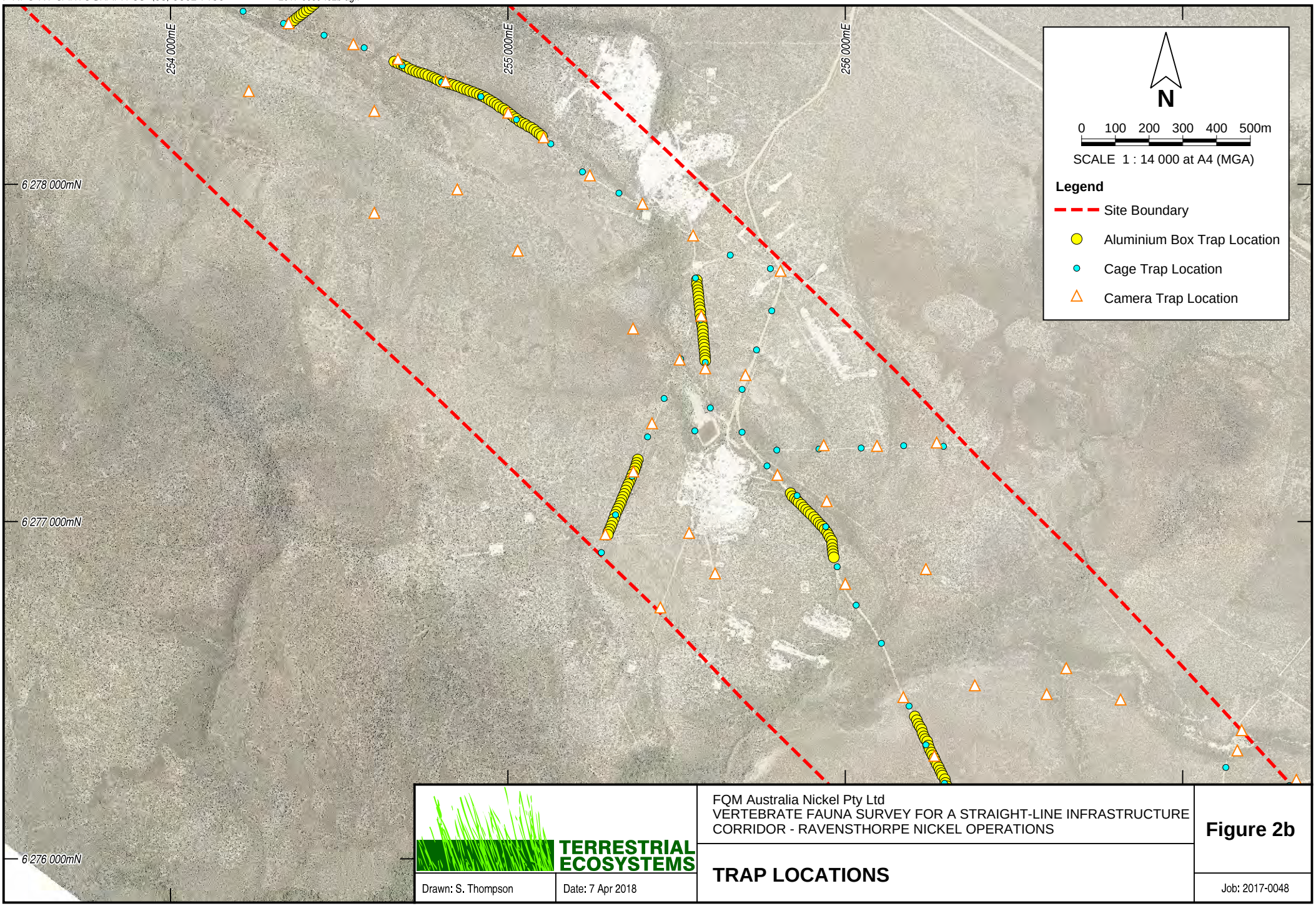
FQM Australia Nickel Pty Ltd
VERTEBRATE FAUNA SURVEY FOR A STRAIGHT-LINE INFRASTRUCTURE CORRIDOR - RAVENSTHORPE NICKEL OPERATIONS

TRAP LOCATIONS

Figure 2a

Job: 2017-0048

PINPOINT CARTOGRAPHICS (08) 9562 7136 2017-0089-f02b.dgn



TERRESTRIAL ECOSYSTEMS

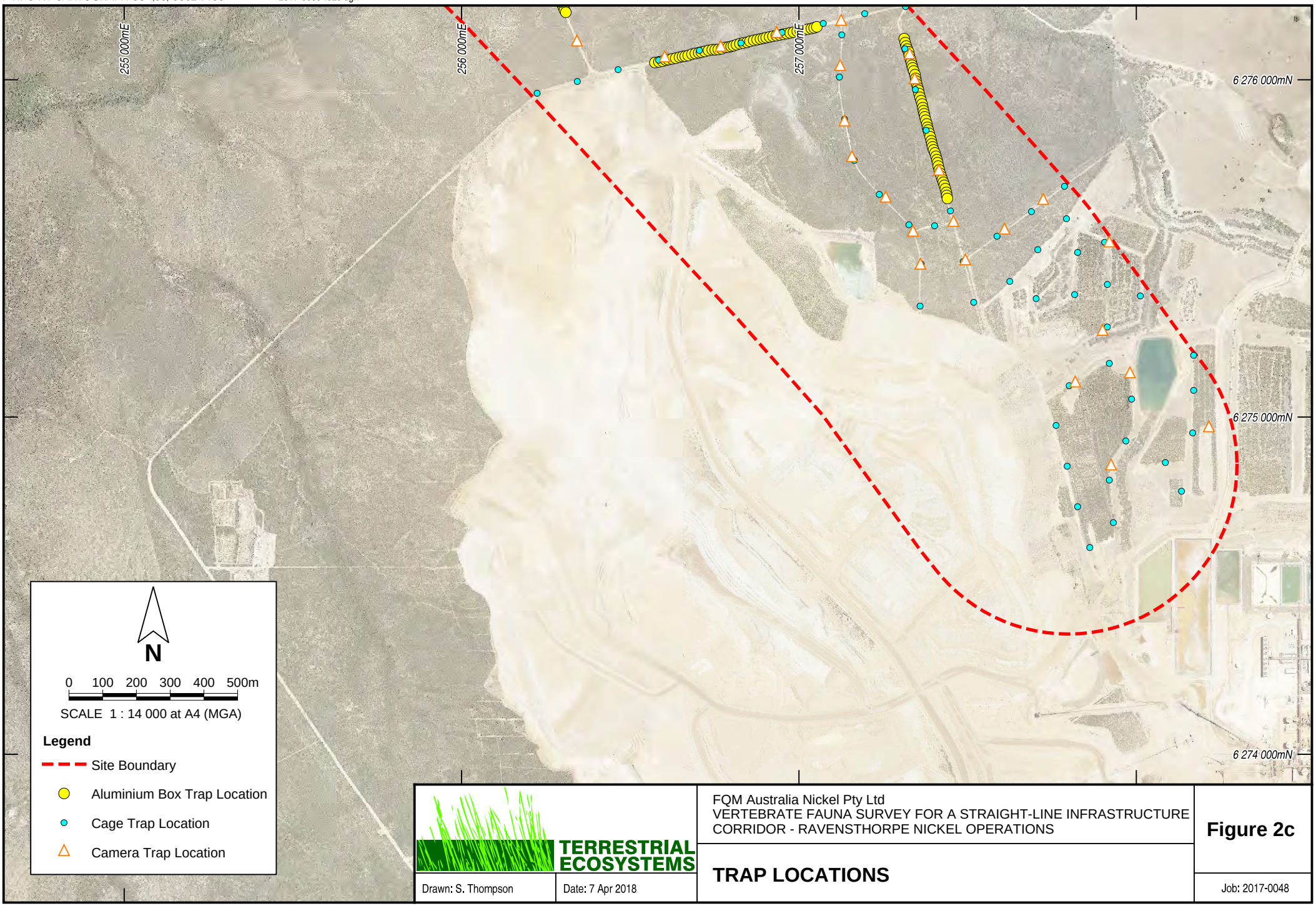
FQM Australia Nickel Pty Ltd
VERTEBRATE FAUNA SURVEY FOR A STRAIGHT-LINE INFRASTRUCTURE CORRIDOR - RAVENSTHORPE NICKEL OPERATIONS

Figure 2b

TRAP LOCATIONS

Drawn: S. Thompson | Date: 7 Apr 2018 | Job: 2017-0048

PINPOINT CARTOGRAPHICS (08) 9562 7136 2017-0089-f02c.dgn



TERRESTRIAL ECOSYSTEMS

FQM Australia Nickel Pty Ltd
VERTEBRATE FAUNA SURVEY FOR A STRAIGHT-LINE INFRASTRUCTURE CORRIDOR - RAVENSTHORPE NICKEL OPERATIONS

Figure 2c

TRAP LOCATIONS

Drawn: S. Thompson | Date: 7 Apr 2018 | Job: 2017-0048

Appendix A
Summary of historical fauna survey data for conservation significant species

Appendix A. Summary of historical fauna survey data for conservation significant species

Species	Year	Latitude	Longitude	Bibliographic Reference
Leipoa ocellata	1999	-33.6592	120.3584	(Chapman 2000)
Leipoa ocellata	1999	-33.6551	120.3795	(Chapman 2000)
Notamacropus irma	1999	-33.6551	120.3795	(Chapman 2000)
Notamacropus irma	1999	-33.6551	120.3795	(Chapman 2000)
Pseudomys occidentalis	1999	-33.6566	120.3633	(Chapman 2000)
Pseudomys occidentalis	1999	-33.6566	120.3633	(Chapman 2000)
Pseudomys shortridgei	1999	-33.6375	120.3747	(Chapman 2000)
Isoodon fusciventer	2000	-33.6749	120.3984	(Biota Environmental Sciences 2000)
Notamacropus irma	2000	-33.5707	120.3067	(Biota Environmental Sciences 2000)
Pseudomys occidentalis	2000	-33.6547	120.3580	(Biota Environmental Sciences 2000)
Pseudomys shortridgei	2000	-33.6663	120.3987	(Biota Environmental Sciences 2000)
Psophodes nigrogularis oberon	2000	-33.6618	120.3954	(Biota Environmental Sciences 2000)
Psophodes nigrogularis oberon	2000	-33.6663	120.3987	(Biota Environmental Sciences 2000)
Isoodon fusciventer	2000	-33.6593	120.3632	(Chapman 2000)
Isoodon fusciventer	2000	-33.6593	120.3632	(Chapman 2000)
Leipoa ocellata	2000	-33.6570	120.3662	(Chapman 2000)
Leipoa ocellata	2000	-33.6497	120.3671	(Chapman 2000)
Notamacropus irma	2000	-33.6694	120.3776	(Chapman 2000)
Notamacropus irma	2000	-33.6541	120.3806	(Chapman 2000)
Pseudomys occidentalis	2000	-33.6654	120.3981	(Chapman 2000)
Pseudomys occidentalis	2000	-33.6654	120.3981	(Chapman 2000)
Pseudomys occidentalis	2000	-33.6650	120.3782	(Chapman 2000)
Pseudomys occidentalis	2000	-33.6654	120.3981	(Chapman 2000)
Pseudomys occidentalis	2000	-33.6654	120.3981	(Chapman 2000)
Pseudomys occidentalis	2000	-33.6650	120.3782	(Chapman 2000)
Pseudomys occidentalis	2000	-33.6650	120.3782	(Chapman 2000)
Pseudomys occidentalis	2000	-33.6654	120.3981	(Chapman 2000)
Pseudomys occidentalis	2000	-33.6650	120.3782	(Chapman 2000)
Pseudomys occidentalis	2000	-33.6566	120.3633	(Chapman 2000)
Pseudomys occidentalis	2000	-33.6566	120.3633	(Chapman 2000)
Pseudomys occidentalis	2000	-33.6566	120.3633	(Chapman 2000)
Pseudomys occidentalis	2000	-33.6541	120.3753	(Chapman 2000)
Pseudomys occidentalis	2000	-33.6566	120.3633	(Chapman 2000)
Pseudomys occidentalis	2000	-33.6566	120.3633	(Chapman 2000)
Pseudomys shortridgei	2000	-33.6233	120.3676	(Chapman 2000)
Pseudomys shortridgei	2000	-33.6233	120.3676	(Chapman 2000)
Pseudomys shortridgei	2000	-33.6233	120.3676	(Chapman 2000)
Pseudomys shortridgei	2000	-33.6233	120.3676	(Chapman 2000)
Psophodes nigrogularis oberon	2000	-33.6541	120.3753	(Chapman 2000)
Psophodes nigrogularis oberon	2000	-33.6551	120.3795	(Chapman 2000)
Psophodes nigrogularis oberon	2000	-33.6375	120.3747	(Chapman 2000)
Psophodes nigrogularis oberon	2000	-33.6375	120.3747	(Chapman 2000)
Psophodes nigrogularis oberon	2000	-33.6566	120.3633	(Chapman 2000)
Psophodes nigrogularis oberon	2000	-33.6375	120.3747	(Chapman 2000)
Psophodes nigrogularis oberon	2000	-33.6541	120.3753	(Chapman 2000)
Psophodes nigrogularis oberon	2000	-33.6593	120.3632	(Chapman 2000)
Psophodes nigrogularis oberon	2000	-33.6566	120.3633	(Chapman 2000)
Psophodes nigrogularis oberon	2000	-33.6375	120.3747	(Chapman 2000)
Psophodes nigrogularis oberon	2000	-33.6566	120.3633	(Chapman 2000)
Psophodes nigrogularis oberon	2000	-33.6593	120.3632	(Chapman 2000)
Psophodes nigrogularis oberon	2000	-33.6375	120.3747	(Chapman 2000)
Psophodes nigrogularis oberon	2000	-33.6551	120.3795	(Chapman 2000)
Psophodes nigrogularis oberon	2000	-33.6551	120.3795	(Chapman 2000)
Leipoa ocellata	2005	-33.6392	120.3775	Chapman, A. (2005) unpublished data

Species	Year	Latitude	Longitude	Bibliographic Reference
Leipoa ocellata	2005	-33.6394	120.3790	Chapman, A. (2005) unpublished data
Leipoa ocellata	2005	-33.6393	120.3787	Chapman, A. (2005) unpublished data
Leipoa ocellata	2005	-33.6565	120.3963	Chapman, A. (2005) unpublished data
Leipoa ocellata	2005	-33.6389	120.3844	Chapman, A. (2005) unpublished data
Psophodes nigrogularis oberon	2005	-33.6529	120.3863	Chapman, A. (2005) unpublished data
Psophodes nigrogularis oberon	2005	-33.6521	120.3800	Chapman, A. (2005) unpublished data
Isoodon fusciventer	2008	-33.5765	120.3047	(Coffey Environments 2009)
Leipoa ocellata	2008	-33.5557	120.3135	(Coffey Environments 2009)
Notamacropus irma	2008	-33.5942	120.3666	(Coffey Environments 2009)
Psophodes nigrogularis oberon	2008	-33.6245	120.3873	(Coffey Environments 2009)
Psophodes nigrogularis oberon	2008	-33.5733	120.3249	(Coffey Environments 2009)
Psophodes nigrogularis oberon	2008	-33.6258	120.3856	(Coffey Environments 2009)
Dasyurus geoffroii	2010	-33.6608	120.3700	(Coffey Environments 2010)
Dasyurus geoffroii	2010	-33.6608	120.3700	(Coffey Environments 2010)
Dasyurus geoffroii	2010	-33.6608	120.3700	(Coffey Environments 2010)
Dasyurus geoffroii	2010	-33.6608	120.3700	(Coffey Environments 2010)
Dasyurus geoffroii	2010	-33.6608	120.3700	(Coffey Environments 2010)
Dasyurus geoffroii	2010	-33.6608	120.3700	(Coffey Environments 2010)
Dasyurus geoffroii	2010	-33.6608	120.3700	(Coffey Environments 2010)
Dasyurus geoffroii	2010	-33.6608	120.3700	(Coffey Environments 2010)
Dasyurus geoffroii	2010	-33.6608	120.3700	(Coffey Environments 2010)
Dasyurus geoffroii	2010	-33.6608	120.3700	(Coffey Environments 2010)
Dasyurus geoffroii	2010	-33.6608	120.3700	(Coffey Environments 2010)
Dasyurus geoffroii	2010	-33.6608	120.3700	(Coffey Environments 2010)
Dasyurus geoffroii	2010	-33.6682	120.3778	(Coffey Environments 2010)
Dasyurus geoffroii	2010	-33.6682	120.3778	(Coffey Environments 2010)
Dasyurus geoffroii	2010	-33.6608	120.3700	(Coffey Environments 2010)
Dasyurus geoffroii	2010	-33.6608	120.3700	(Coffey Environments 2010)
Dasyurus geoffroii	2010	-33.6608	120.3700	(Coffey Environments 2010)
Dasyurus geoffroii	2010	-33.6608	120.3700	(Coffey Environments 2010)
Dasyurus geoffroii	2010	-33.6608	120.3700	(Coffey Environments 2010)
Dasyurus geoffroii	2010	-33.6608	120.3700	(Coffey Environments 2010)
Pseudomys occidentalis	2010	-33.6587	120.3770	(Coffey Environments 2010)
Pseudomys occidentalis	2010	-33.6587	120.3770	(Coffey Environments 2010)
Pseudomys occidentalis	2010	-33.6644	120.4002	(Coffey Environments 2010)
Pseudomys occidentalis	2010	-33.6644	120.4002	(Coffey Environments 2010)
Pseudomys shortridgei	2010	-33.6245	120.3873	(Coffey Environments 2010)
Pseudomys shortridgei	2010	-33.6245	120.3873	(Coffey Environments 2010)
Leipoa ocellata	2014	-33.5762	120.3050	(Terrestrial Ecosystems 2014)
Leipoa ocellata	2014	-33.6257	120.3863	(Terrestrial Ecosystems 2014)
Notamacropus irma	2014	-33.6605	120.3725	(Terrestrial Ecosystems 2014)
Notamacropus irma	2014	-33.6604	120.3699	(Terrestrial Ecosystems 2014)
Notamacropus irma	2014	-33.6604	120.3697	(Terrestrial Ecosystems 2014)
Notamacropus irma	2014	-33.6575	120.3632	(Terrestrial Ecosystems 2014)
Notamacropus irma	2014	-33.5765	120.3050	(Terrestrial Ecosystems 2014)
Notamacropus irma	2014	-33.6552	120.3577	(Terrestrial Ecosystems 2014)
Notamacropus irma	2014	-33.6259	120.3858	(Terrestrial Ecosystems 2014)
Notamacropus irma	2014	-33.5765	120.3050	(Terrestrial Ecosystems 2014)
Notamacropus irma	2014	-33.6675	120.3780	(Terrestrial Ecosystems 2014)
Notamacropus irma	2014	-33.6685	120.3778	(Terrestrial Ecosystems 2014)
Notamacropus irma	2014	-33.6677	120.3778	(Terrestrial Ecosystems 2014)
Notamacropus irma	2014	-33.6678	120.3778	(Terrestrial Ecosystems 2014)
Notamacropus irma	2014	-33.6687	120.3777	(Terrestrial Ecosystems 2014)
Notamacropus irma	2014	-33.6680	120.3778	(Terrestrial Ecosystems 2014)
Notamacropus irma	2014	-33.6683	120.3777	(Terrestrial Ecosystems 2014)
Notamacropus irma	2014	-33.6690	120.3776	(Terrestrial Ecosystems 2014)
Notamacropus irma	2014	-33.6692	120.3775	(Terrestrial Ecosystems 2014)

Species	Year	Latitude	Longitude	Bibliographic Reference
Notamacropus irma	2014	-33.6593	120.3755	(Terrestrial Ecosystems 2014)
Notamacropus irma	2014	-33.6595	120.3750	(Terrestrial Ecosystems 2014)
Notamacropus irma	2014	-33.6600	120.3736	(Terrestrial Ecosystems 2014)
Notamacropus irma	2014	-33.6602	120.3731	(Terrestrial Ecosystems 2014)
Notamacropus irma	2014	-33.5762	120.3050	(Terrestrial Ecosystems 2014)
Notamacropus irma	2014	-33.6572	120.3626	(Terrestrial Ecosystems 2014)
Notamacropus irma	2014	-33.6569	120.3620	(Terrestrial Ecosystems 2014)
Notamacropus irma	2014	-33.6567	120.3614	(Terrestrial Ecosystems 2014)
Notamacropus irma	2014	-33.6564	120.3608	(Terrestrial Ecosystems 2014)
Notamacropus irma	2014	-33.6561	120.3599	(Terrestrial Ecosystems 2014)
Notamacropus irma	2014	-33.6557	120.3589	(Terrestrial Ecosystems 2014)
Notamacropus irma	2014	-33.6554	120.3583	(Terrestrial Ecosystems 2014)
Notamacropus irma	2014	-33.6602	120.3696	(Terrestrial Ecosystems 2014)
Notamacropus irma	2014	-33.6549	120.3572	(Terrestrial Ecosystems 2014)
Notamacropus irma	2014	-33.5859	120.3267	(Terrestrial Ecosystems 2014)
Notamacropus irma	2014	-33.5856	120.3267	(Terrestrial Ecosystems 2014)
Notamacropus irma	2014	-33.5763	120.3050	(Terrestrial Ecosystems 2014)
Notamacropus irma	2014	-33.6262	120.3840	(Terrestrial Ecosystems 2014)
Dasyurus geoffroii	2015	-33.6602	120.3731	(Terrestrial Ecosystems 2015)
Dasyurus geoffroii	2015	-33.6595	120.3750	(Terrestrial Ecosystems 2015)
Dasyurus geoffroii	2015	-33.6605	120.3725	(Terrestrial Ecosystems 2015)
Dasyurus geoffroii	2015	-33.6678	120.3778	(Terrestrial Ecosystems 2015)
Dasyurus geoffroii	2015	-33.6256	120.3866	(Terrestrial Ecosystems 2015)
Dasyurus geoffroii	2015	-33.6591	120.3760	(Terrestrial Ecosystems 2015)
Dasyurus geoffroii	2015	-33.6257	120.3863	(Terrestrial Ecosystems 2015)
Dasyurus geoffroii	2015	-33.6604	120.3697	(Terrestrial Ecosystems 2015)
Dasyurus geoffroii	2015	-33.6600	120.3736	(Terrestrial Ecosystems 2015)
Dasyurus geoffroii	2015	-33.6597	120.3699	(Terrestrial Ecosystems 2015)
Dasyurus geoffroii	2015	-33.6604	120.3699	(Terrestrial Ecosystems 2015)
Dasyurus geoffroii	2015	-33.6602	120.3696	(Terrestrial Ecosystems 2015)
Dasyurus geoffroii	2015	-33.6600	120.3696	(Terrestrial Ecosystems 2015)
Dasyurus geoffroii	2015	-33.6597	120.3696	(Terrestrial Ecosystems 2015)
Dasyurus geoffroii	2015	-33.6596	120.3700	(Terrestrial Ecosystems 2015)
Notamacropus irma	2015	-33.6602	120.3731	(Terrestrial Ecosystems 2015)
Notamacropus irma	2015	-33.5763	120.3050	(Terrestrial Ecosystems 2015)
Notamacropus irma	2015	-33.6605	120.3725	(Terrestrial Ecosystems 2015)
Notamacropus irma	2015	-33.6593	120.3755	(Terrestrial Ecosystems 2015)
Notamacropus irma	2015	-33.6256	120.3866	(Terrestrial Ecosystems 2015)
Notamacropus irma	2015	-33.6259	120.3858	(Terrestrial Ecosystems 2015)
Notamacropus irma	2015	-33.5762	120.3050	(Terrestrial Ecosystems 2015)
Notamacropus irma	2015	-33.6262	120.3840	(Terrestrial Ecosystems 2015)
Notamacropus irma	2015	-33.6604	120.3699	(Terrestrial Ecosystems 2015)
Notamacropus irma	2015	-33.6601	120.3699	(Terrestrial Ecosystems 2015)
Notamacropus irma	2015	-33.5856	120.3267	(Terrestrial Ecosystems 2015)
Notamacropus irma	2015	-33.6604	120.3697	(Terrestrial Ecosystems 2015)
Notamacropus irma	2015	-33.6690	120.3776	(Terrestrial Ecosystems 2015)
Notamacropus irma	2015	-33.6685	120.3778	(Terrestrial Ecosystems 2015)
Notamacropus irma	2015	-33.6683	120.3777	(Terrestrial Ecosystems 2015)
Notamacropus irma	2015	-33.6557	120.3589	(Terrestrial Ecosystems 2015)
Notamacropus irma	2015	-33.6562	120.3603	(Terrestrial Ecosystems 2015)
Notamacropus irma	2015	-33.6564	120.3608	(Terrestrial Ecosystems 2015)
Notamacropus irma	2015	-33.6567	120.3614	(Terrestrial Ecosystems 2015)
Notamacropus irma	2015	-33.6554	120.3583	(Terrestrial Ecosystems 2015)
Notamacropus irma	2015	-33.6552	120.3577	(Terrestrial Ecosystems 2015)
Notamacropus irma	2015	-33.6549	120.3572	(Terrestrial Ecosystems 2015)
Notamacropus irma	2015	-33.6569	120.3620	(Terrestrial Ecosystems 2015)
Notamacropus irma	2015	-33.6675	120.3780	(Terrestrial Ecosystems 2015)

Species	Year	Latitude	Longitude	Bibliographic Reference
Notamacropus irma	2015	-33.6677	120.3778	(Terrestrial Ecosystems 2015)
Notamacropus irma	2015	-33.6678	120.3778	(Terrestrial Ecosystems 2015)
Notamacropus irma	2015	-33.6680	120.3778	(Terrestrial Ecosystems 2015)
Notamacropus irma	2015	-33.6682	120.3777	(Terrestrial Ecosystems 2015)
Notamacropus irma	2015	-33.6572	120.3626	(Terrestrial Ecosystems 2015)
Notamacropus irma	2015	-33.6575	120.3632	(Terrestrial Ecosystems 2015)
Notamacropus irma	2015	-33.6600	120.3736	(Terrestrial Ecosystems 2015)
Notamacropus irma	2015	-33.6587	120.3769	(Terrestrial Ecosystems 2015)
Psophodes nigrogularis oberon	2015	-33.6230	120.3526	(Terrestrial Ecosystems 2015)
Psophodes nigrogularis oberon	2015	-33.6587	120.3769	(Terrestrial Ecosystems 2015)
Psophodes nigrogularis oberon	2015	-33.6591	120.3760	(Terrestrial Ecosystems 2015)
Dasyurus geoffroii	2016	-33.5696	120.3249	(Terrestrial Ecosystems 2017a)
Dasyurus geoffroii	2016	-33.6552	120.3676	(Terrestrial Ecosystems 2017a)
Dasyurus geoffroii	2016	-33.6595	120.3750	(Terrestrial Ecosystems 2017a)
Dasyurus geoffroii	2016	-33.6598	120.3741	(Terrestrial Ecosystems 2017a)
Dasyurus geoffroii	2016	-33.6611	120.3874	(Terrestrial Ecosystems 2017a)
Dasyurus geoffroii	2016	-33.6605	120.3725	(Terrestrial Ecosystems 2017a)
Dasyurus geoffroii	2016	-33.6604	120.3699	(Terrestrial Ecosystems 2017a)
Dasyurus geoffroii	2016	-33.6675	120.3780	(Terrestrial Ecosystems 2017a)
Dasyurus geoffroii	2016	-33.6601	120.3699	(Terrestrial Ecosystems 2017a)
Dasyurus geoffroii	2016	-33.6600	120.3736	(Terrestrial Ecosystems 2017a)
Dasyurus geoffroii	2016	-33.6599	120.3700	(Terrestrial Ecosystems 2017a)
Dasyurus geoffroii	2016	-33.6593	120.3755	(Terrestrial Ecosystems 2017a)
Dasyurus geoffroii	2016	-33.5859	120.3267	(Terrestrial Ecosystems 2017a)
Dasyurus geoffroii	2016	-33.6567	120.3614	(Terrestrial Ecosystems 2017a)
Dasyurus geoffroii	2016	-33.6647	120.3873	(Terrestrial Ecosystems 2017a)
Dasyurus geoffroii	2016	-33.6612	120.3921	(Terrestrial Ecosystems 2017a)
Dasyurus geoffroii	2016	-33.6597	120.3745	(Terrestrial Ecosystems 2017a)
Dasyurus geoffroii	2016	-33.6611	120.3897	(Terrestrial Ecosystems 2017a)
Dasyurus geoffroii	2016	-33.6572	120.3626	(Terrestrial Ecosystems 2017a)
Dasyurus geoffroii	2016	-33.6611	120.3885	(Terrestrial Ecosystems 2017a)
Dasyurus geoffroii	2016	-33.6629	120.3873	(Terrestrial Ecosystems 2017a)
Dasyurus geoffroii	2016	-33.6602	120.3731	(Terrestrial Ecosystems 2017a)
Dasyurus geoffroii	2016	-33.6597	120.3699	(Terrestrial Ecosystems 2017a)
Dasyurus geoffroii	2016	-33.6596	120.3700	(Terrestrial Ecosystems 2017a)
Dasyurus geoffroii	2016	-33.6629	120.3885	(Terrestrial Ecosystems 2017a)
Dasyurus geoffroii	2016	-33.6630	120.3897	(Terrestrial Ecosystems 2017a)
Dasyurus geoffroii	2016	-33.6597	120.3696	(Terrestrial Ecosystems 2017a)
Dasyurus geoffroii	2016	-33.6599	120.3696	(Terrestrial Ecosystems 2017a)
Dasyurus geoffroii	2016	-33.6600	120.3696	(Terrestrial Ecosystems 2017a)
Dasyurus geoffroii	2016	-33.6602	120.3696	(Terrestrial Ecosystems 2017a)
Dasyurus geoffroii	2016	-33.6620	120.3874	(Terrestrial Ecosystems 2017a)
Dasyurus geoffroii	2016	-33.5856	120.3267	(Terrestrial Ecosystems 2017a)
Dasyurus geoffroii	2016	-33.6587	120.3769	(Terrestrial Ecosystems 2017a)
Dasyurus geoffroii	2016	-33.5860	120.3266	(Terrestrial Ecosystems 2017a)
Dasyurus geoffroii	2016	-33.6604	120.3697	(Terrestrial Ecosystems 2017a)
Dasyurus geoffroii	2016	-33.6591	120.3760	(Terrestrial Ecosystems 2017a)
Dasyurus geoffroii	2016	-33.6592	120.3667	(Terrestrial Ecosystems 2017a)
Dasyurus geoffroii	2016	-33.6565	120.3674	(Terrestrial Ecosystems 2017a)
Dasyurus geoffroii	2016	-33.6405	120.3608	(Terrestrial Ecosystems 2017a)
Dasyurus geoffroii	2016	-33.6565	120.3674	(Terrestrial Ecosystems 2017a)
Dasyurus geoffroii	2016	-33.6405	120.3608	(Terrestrial Ecosystems 2017a)
Isoodon fusciventer	2016	-33.6059	120.3906	(Terrestrial Ecosystems 2017a)
Leipoa ocellata	2016	-33.6572	120.3626	(Terrestrial Ecosystems 2017a)
Leipoa ocellata	2016	-33.6591	120.3760	(Terrestrial Ecosystems 2017a)
Leipoa ocellata	2016	-33.5763	120.3050	(Terrestrial Ecosystems 2017a)
Leipoa ocellata	2016	-33.6597	120.3745	(Terrestrial Ecosystems 2017a)

Species	Year	Latitude	Longitude	Bibliographic Reference
Leipoa ocellata	2016	-33.6598	120.3741	(Terrestrial Ecosystems 2017a)
Leipoa ocellata	2016	-33.6600	120.3736	(Terrestrial Ecosystems 2017a)
Leipoa ocellata	2016	-33.5762	120.3050	(Terrestrial Ecosystems 2017a)
Leipoa ocellata	2016	-33.6597	120.3699	(Terrestrial Ecosystems 2017a)
Leipoa ocellata	2016	-33.5856	120.3267	(Terrestrial Ecosystems 2017a)
Leipoa ocellata	2016	-33.6692	120.3775	(Terrestrial Ecosystems 2017a)
Leipoa ocellata	2016	-33.6690	120.3776	(Terrestrial Ecosystems 2017a)
Leipoa ocellata	2016	-33.6687	120.3777	(Terrestrial Ecosystems 2017a)
Leipoa ocellata	2016	-33.6685	120.3778	(Terrestrial Ecosystems 2017a)
Leipoa ocellata	2016	-33.6682	120.3777	(Terrestrial Ecosystems 2017a)
Leipoa ocellata	2016	-33.6680	120.3778	(Terrestrial Ecosystems 2017a)
Leipoa ocellata	2016	-33.6678	120.3778	(Terrestrial Ecosystems 2017a)
Leipoa ocellata	2016	-33.6677	120.3778	(Terrestrial Ecosystems 2017a)
Leipoa ocellata	2016	-33.5859	120.3267	(Terrestrial Ecosystems 2017a)
Leipoa ocellata	2016	-33.6675	120.3780	(Terrestrial Ecosystems 2017a)
Leipoa ocellata	2016	-33.5860	120.3266	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6146	120.3927	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6122	120.3932	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6079	120.3911	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.5717	120.3360	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.5729	120.3433	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.5747	120.3507	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.5770	120.3576	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.5800	120.3642	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.5837	120.3703	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6554	120.3583	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.5879	120.3759	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.5927	120.3809	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.5980	120.3851	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6037	120.3886	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6004	120.3878	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.5950	120.3839	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.5900	120.3794	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.5854	120.3742	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.5814	120.3683	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.5780	120.3620	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6552	120.3577	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.5752	120.3551	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.5733	120.3479	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.5718	120.3406	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.5705	120.3333	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6647	120.3873	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6647	120.3884	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6647	120.3895	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6648	120.3906	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6648	120.3917	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6638	120.3873	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6638	120.3885	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6639	120.3897	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6639	120.3908	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6639	120.3920	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6629	120.3873	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6629	120.3885	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6630	120.3897	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6630	120.3909	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6630	120.3922	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6620	120.3874	(Terrestrial Ecosystems 2017a)

Species	Year	Latitude	Longitude	Bibliographic Reference
Notamacropus irma	2016	-33.5860	120.3266	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6621	120.3886	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6621	120.3898	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6621	120.3909	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6611	120.3874	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6611	120.3885	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6612	120.3909	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6612	120.3921	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6675	120.3780	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.5859	120.3267	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6677	120.3778	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6678	120.3778	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6680	120.3778	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6682	120.3777	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6683	120.3777	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6604	120.3697	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.5856	120.3267	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6604	120.3699	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6262	120.3840	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.5762	120.3050	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6261	120.3846	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6259	120.3858	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6257	120.3863	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6256	120.3866	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6605	120.3725	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6602	120.3731	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6600	120.3736	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6598	120.3741	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6597	120.3745	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6595	120.3750	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.5763	120.3050	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6593	120.3755	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6591	120.3760	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6587	120.3769	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6575	120.3632	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6572	120.3626	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6569	120.3620	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6567	120.3614	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6564	120.3608	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6561	120.3599	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6106	120.3913	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.6557	120.3589	(Terrestrial Ecosystems 2017a)
Notamacropus irma	2016	-33.5765	120.3050	(Terrestrial Ecosystems 2017a)
Pseudomys occidentalis	2016	-33.6648	120.3911	(Terrestrial Ecosystems 2017a)
Psophodes nigrogularis oberon	2016	-33.5859	120.3267	(Terrestrial Ecosystems 2017a)
Psophodes nigrogularis oberon	2016	-33.6522	120.3505	(Terrestrial Ecosystems 2017a)
Psophodes nigrogularis oberon	2016	-33.5738	120.3251	(Terrestrial Ecosystems 2017a)
Psophodes nigrogularis oberon	2016	-33.6587	120.3770	(Terrestrial Ecosystems 2017a)
Psophodes nigrogularis oberon	2016	-33.6612	120.3921	(Terrestrial Ecosystems 2017a)
Psophodes nigrogularis oberon	2016	-33.6066	120.3902	(Terrestrial Ecosystems 2017a)
Psophodes nigrogularis oberon	2016	-33.6590	120.3754	(Terrestrial Ecosystems 2017a)
Psophodes nigrogularis oberon	2016	-33.6619	120.3687	(Terrestrial Ecosystems 2017a)
Psophodes nigrogularis oberon	2016	-33.6549	120.3571	(Terrestrial Ecosystems 2017a)
Psophodes nigrogularis oberon	2016	-33.6551	120.3677	(Terrestrial Ecosystems 2017a)
Psophodes nigrogularis oberon	2016	-33.5852	120.3320	(Terrestrial Ecosystems 2017a)
Psophodes nigrogularis oberon	2016	-33.6595	120.3756	(Terrestrial Ecosystems 2017a)
Psophodes nigrogularis oberon	2016	-33.6601	120.3747	(Terrestrial Ecosystems 2017a)

Species	Year	Latitude	Longitude	Bibliographic Reference
Psophodes nigrogularis oberon	2016	-33.6610	120.3906	(Terrestrial Ecosystems 2017a)
Psophodes nigrogularis oberon	2016	-33.6621	120.3705	(Terrestrial Ecosystems 2017a)
Psophodes nigrogularis oberon	2016	-33.5853	120.3302	(Terrestrial Ecosystems 2017a)
Psophodes nigrogularis oberon	2016	-33.6041	120.3926	(Terrestrial Ecosystems 2017a)
Psophodes nigrogularis oberon	2016	-33.6621	120.3911	(Terrestrial Ecosystems 2017a)
Psophodes nigrogularis oberon	2016	-33.6622	120.3966	(Terrestrial Ecosystems 2017a)
Psophodes nigrogularis oberon	2016	-33.5859	120.3740	(Terrestrial Ecosystems 2017a)
Dasyurus geoffroii	2017	-33.5624	120.3231	(Terrestrial Ecosystems 2017b)
Dasyurus geoffroii	2017	-33.5658	120.3083	(Terrestrial Ecosystems 2017b)
Dasyurus geoffroii	2017	-33.5674	120.3055	(Terrestrial Ecosystems 2017b)
Dasyurus geoffroii	2017	-33.5800	120.3096	(Terrestrial Ecosystems 2017b)
Dasyurus geoffroii	2017	-33.5694	120.3113	(Terrestrial Ecosystems 2017b)
Dasyurus geoffroii	2017	-33.5785	120.3196	(Terrestrial Ecosystems 2017b)
Dasyurus geoffroii	2017	-33.5822	120.3252	(Terrestrial Ecosystems 2017b)
Dasyurus geoffroii	2017	-33.5609	120.3299	(Terrestrial Ecosystems 2017b)
Dasyurus geoffroii	2017	-33.5785	120.3215	(Terrestrial Ecosystems 2017b)
Dasyurus geoffroii	2017	-33.5882	120.3281	(Terrestrial Ecosystems 2017b)
Dasyurus geoffroii	2017	-33.5552	120.3241	(Terrestrial Ecosystems 2017b)
Dasyurus geoffroii	2017	-33.5675	120.3083	(Terrestrial Ecosystems 2017b)
Dasyurus geoffroii	2017	-33.5710	120.3050	(Terrestrial Ecosystems 2017b)
Dasyurus geoffroii	2017	-33.5603	120.3177	(Terrestrial Ecosystems 2017b)
Dasyurus geoffroii	2017	-33.5631	120.3084	(Terrestrial Ecosystems 2017b)
Dasyurus geoffroii	2017	-33.5783	120.3131	(Terrestrial Ecosystems 2017b)
Dasyurus geoffroii	2017	-33.5533	120.3199	(Terrestrial Ecosystems 2017b)
Dasyurus geoffroii	2017	-33.5614	120.3211	(Terrestrial Ecosystems 2017b)
Dasyurus geoffroii	2017	-33.5917	120.3377	(Terrestrial Ecosystems 2017b)
Dasyurus geoffroii	2017	-33.5882	120.3522	(Terrestrial Ecosystems 2017b)
Dasyurus geoffroii	2017	-33.5763	120.3019	(Terrestrial Ecosystems 2017b)
Dasyurus geoffroii	2017	-33.5899	120.3454	(Terrestrial Ecosystems 2017b)
Dasyurus geoffroii	2017	-33.5576	120.3106	(Terrestrial Ecosystems 2017b)
Dasyurus geoffroii	2017	-33.5558	120.3137	(Terrestrial Ecosystems 2017b)
Dasyurus geoffroii	2017	-33.5551	120.3221	(Terrestrial Ecosystems 2017b)
Dasyurus geoffroii	2017	-33.5562	120.3175	(Terrestrial Ecosystems 2017b)
Dasyurus geoffroii	2017	-33.5597	120.3232	(Terrestrial Ecosystems 2017b)
Dasyurus geoffroii	2017	-33.5785	120.3166	(Terrestrial Ecosystems 2017b)
Dasyurus geoffroii	2017	-33.5550	120.3126	(Terrestrial Ecosystems 2017b)
Dasyurus geoffroii	2017	-33.5577	120.3150	(Terrestrial Ecosystems 2017b)
Dasyurus geoffroii	2017	-33.5693	120.3083	(Terrestrial Ecosystems 2017b)
Dasyurus geoffroii	2017	-33.5532	120.3165	(Terrestrial Ecosystems 2017b)
Dasyurus geoffroii	2017	-33.5551	120.3198	(Terrestrial Ecosystems 2017b)
Dasyurus geoffroii	2017	-33.5748	120.3025	(Terrestrial Ecosystems 2017b)
Dasyurus geoffroii	2017	-33.5587	120.3211	(Terrestrial Ecosystems 2017b)
Dasyurus geoffroii	2017	-33.5934	120.3257	(Terrestrial Ecosystems 2017b)
Dasyurus geoffroii	2017	-33.5549	120.3098	(Terrestrial Ecosystems 2017b)
Dasyurus geoffroii	2017	-33.5658	120.3158	(Terrestrial Ecosystems 2017b)
Dasyurus geoffroii	2017	-33.5575	120.3086	(Terrestrial Ecosystems 2017b)
Dasyurus geoffroii	2017	-33.5532	120.3136	(Terrestrial Ecosystems 2017b)
Dasyurus geoffroii	2017	-33.5585	120.3246	(Terrestrial Ecosystems 2017b)
Dasyurus geoffroii	2017	-33.5567	120.3107	(Terrestrial Ecosystems 2017b)
Dasyurus geoffroii	2017	-33.5609	120.3295	(Terrestrial Ecosystems 2017b)
Dasyurus geoffroii	2017	-33.5568	120.3169	(Terrestrial Ecosystems 2017b)
Leipoa ocellata	2017	-33.5992	120.3484	(Terrestrial Ecosystems 2017b)
Leipoa ocellata	2017	-33.6016	120.3464	(Terrestrial Ecosystems 2017b)
Leipoa ocellata	2017	-33.5531	120.3271	(Terrestrial Ecosystems 2017b)
Leipoa ocellata	2017	-33.5521	120.3271	(Terrestrial Ecosystems 2017b)
Leipoa ocellata	2017	-33.5831	120.3223	(Terrestrial Ecosystems 2017b)
Leipoa ocellata	2017	-33.5948	120.3249	(Terrestrial Ecosystems 2017b)

Species	Year	Latitude	Longitude	Bibliographic Reference
Leipoa ocellata	2017	-33.5963	120.3149	(Terrestrial Ecosystems 2017b)
Leipoa ocellata	2017	-33.5558	120.3137	(Terrestrial Ecosystems 2017b)
Leipoa ocellata	2017	-33.5800	120.3096	(Terrestrial Ecosystems 2017b)
Leipoa ocellata	2017	-33.5783	120.3131	(Terrestrial Ecosystems 2017b)
Leipoa ocellata	2017	-33.5800	120.3057	(Terrestrial Ecosystems 2017b)
Leipoa ocellata	2017	-33.5624	120.3231	(Terrestrial Ecosystems 2017b)
Leipoa ocellata	2017	-33.5658	120.3158	(Terrestrial Ecosystems 2017b)
Leipoa ocellata	2017	-33.5586	120.3161	(Terrestrial Ecosystems 2017b)
Leipoa ocellata	2017	-33.5790	120.3018	(Terrestrial Ecosystems 2017b)
Leipoa ocellata	2017	-33.5549	120.3098	(Terrestrial Ecosystems 2017b)
Leipoa ocellata	2017	-33.5551	120.3198	(Terrestrial Ecosystems 2017b)
Leipoa ocellata	2017	-33.5550	120.3126	(Terrestrial Ecosystems 2017b)
Leipoa ocellata	2017	-33.5943	120.3068	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5839	120.3526	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5800	120.3057	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5575	120.3257	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5701	120.3375	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5882	120.3522	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5934	120.3257	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5790	120.3018	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5899	120.3454	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5886	120.3268	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5882	120.3281	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5675	120.3083	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5532	120.3165	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5869	120.3344	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5872	120.3499	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5763	120.3019	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5785	120.3196	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5756	120.3250	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5609	120.3299	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5693	120.3083	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5911	120.3533	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5871	120.3414	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5917	120.3377	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5551	120.3198	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5870	120.3383	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5770	120.3458	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5576	120.3106	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5921	120.3553	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5827	120.3455	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5675	120.3116	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5690	120.3056	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5533	120.3244	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5624	120.3231	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5869	120.3305	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5771	120.3385	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5567	120.3092	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5658	120.3158	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5807	120.3035	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5748	120.3025	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5658	120.3083	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5533	120.3199	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5550	120.3126	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5667	120.3371	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5552	120.3241	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5935	120.3278	(Terrestrial Ecosystems 2017b)

Species	Year	Latitude	Longitude	Bibliographic Reference
Notamacropus irma	2017	-33.5859	120.3296	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5551	120.3159	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5549	120.3098	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5597	120.3232	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5783	120.3131	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5883	120.3325	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5656	120.3047	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5674	120.3055	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5877	120.3291	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5800	120.3096	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5807	120.3505	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5694	120.3415	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5918	120.3566	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5899	120.3266	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5551	120.3221	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5562	120.3175	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5650	120.3191	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5694	120.3113	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5558	120.3137	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5823	120.3295	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5587	120.3186	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5901	120.3353	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5633	120.3204	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5596	120.3207	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5710	120.3050	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5639	120.3106	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5603	120.3177	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5614	120.3211	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5913	120.3272	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5631	120.3084	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5785	120.3166	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5822	120.3252	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5658	120.3117	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5785	120.3215	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5884	120.3246	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5964	120.3526	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5586	120.3161	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5577	120.3150	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5585	120.3095	(Terrestrial Ecosystems 2017b)
Notamacropus irma	2017	-33.5934	120.3304	(Terrestrial Ecosystems 2017b)
Pseudomys occidentalis	2017	-33.5915	120.3272	(Terrestrial Ecosystems 2017b)
Pseudomys occidentalis	2017	-33.5870	120.3346	(Terrestrial Ecosystems 2017b)
Pseudomys occidentalis	2017	-33.5823	120.3262	(Terrestrial Ecosystems 2017b)
Pseudomys occidentalis	2017	-33.5823	120.3262	(Terrestrial Ecosystems 2017b)

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Appendix B
Trapping sites and camera trap locations

Appendix B. Trapping sites and camera trap locations

Datum	WGS84	
Site	Easting	Northing
CM-1	257337	6276229
CM-2	257125	6276172
CM-3	256934	6276136
CM-4	256768	6276095
CM-5	256602	6276064
CM-6	257122	6276038
CM-7	257135	6275874
CM-8	257157	6275768
CM-9	257257	6275648
CM-10	257338	6275547
CM-11	257360	6275449
CM-12	257458	6275576
CM-13	257493	6275462
CM-14	257609	6275553
CM-15	257724	6275641
CM-16	257415	6275728
CM-17	257343	6275999
CM-18	257328	6276073
CM-19	257162	6276316
CM-20	257175	6276376
CM-21	256172	6276474
CM-22	256000	6276810
CM-23	255799	6277133
CM-24	255704	6277429
CM-25	255936	6277221
CM-26	256094	6277219
CM-27	256271	6277229
CM-28	255452	6276740
CM-29	255537	6276961
CM-30	255289	6276957
CM-31	255372	6277143
CM-32	255427	6277286
CM-33	255509	6277475
CM-34	255573	6277605
CM-35	255585	6277449
CM-36	255549	6277843
CM-37	255399	6277937
CM-38	255243	6278021
CM-39	255106	6278134
CM-40	255001	6278207
CM-41	254815	6278300
CM-42	254674	6278366
CM-43	254542	6278410
CM-44	254350	6278472
CM-45	254127	6278545
CM-46	253989	6278583
CM-47	253835	6278632
CM-48	253640	6278727
CM-49	253491	6278804
CM-50	253339	6278866
CM-51	253185	6278905
CM-52	253126	6279036
CM-53	253014	6279282
CM-54	253004	6279414
CM-55	252832	6279268
CM-56	252833	6279421
CM-57	253190	6279538
CM-58	253479	6279516
CM-59	253775	6279467
CM-60	252424	6279710
CM-61	252673	6279698
CM-62	252955	6279701
CM-63	253372	6279696
CM-64	255614	6276841
CM-65	256239	6276854
CM-66	256384	6276509
CM-67	256597	6276483

Datum	WGS84	
Site	Easting	Northing
CM-68	256816	6276467
CM-69	256655	6276560
CM-70	256264	6276300
CM-71	255808	6277738
CM-72	252821	6280454
CM-73	252936	6280345
CM-74	253057	6280193
CM-75	253183	6280070
CM-76	253315	6279906
CM-77	255945	6277055
CM-78	257900	6275253
CM-79	257920	6275515
CM-80	257981	6275127
CM-81	257925	6274854
CM-82	258215	6274967
CM-83	257819	6275100
CM-84	256342	6276111
CM-85	254502	6278690
CM-86	254232	6278271
CM-87	255371	6277567
CM-88	255029	6277798
CM-89	254850	6277980
CM-90	254604	6278212
CM-91	254604	6277910
CM-92	253874	6278983
CM-93	253596	6279170
CM-94	253397	6279379
CM-95	253910	6279302
CM-96	254085	6279100
CM-97	254690	6278724
CM-98	254411	6278882
CM-99	252446	6280307
CM-100	252699	6280102
C1	252437	6280299
C2	252536	6280377
C3	252650	6280431
C4	252773	6280453
C5	252880	6280390
C6	252989	6280329
C7	253052	6280222
C8	253112	6280112
C9	253217	6279984
C10	253312	6279905
C11	253437	6279909
C12	253373	6279689
C13	253254	6279705
C14	253127	6279679
C15	252996	6279700
C16	252871	6279689
C17	252746	6279691
C18	252622	6279698
C19	252497	6279713
C20	252372	6279713
C21	254049	6279418
C22	253926	6279440
C23	253802	6279458
C24	253679	6279482
C25	253555	6279504
C26	253431	6279525
C27	253308	6279545
C28	253183	6279538
C29	253058	6279525
C30	252934	6279513
C31	252813	6279483
C32	252694	6279443
C33	252832	6279362
C34	252837	6279238

Datum	WGS84	
Site	Easting	Northing
C35	252997	6279391
C36	253026	6279269
C37	253116	6279177
C38	253126	6279053
C39	253173	6278924
C40	253288	6278872
C41	253409	6278843
C42	253523	6278792
C43	253632	6278732
C44	253740	6278670
C45	253857	6278624
C46	253976	6278585
C47	254098	6278557
C48	254215	6278513
C49	254335	6278477
C50	254449	6278550
C51	254544	6278630
C52	254640	6278709
C53	254728	6278777
C54	254455	6278442
C55	254574	6278405
C56	254687	6278352
C57	254803	6278303
C58	254920	6278260
C59	255025	6278192
C60	255127	6278120
C61	255329	6277974
C62	255221	6278037
C63	255548	6277846
C64	255556	6277722
C65	255571	6277598
C66	255585	6277472
C67	255600	6277337
C68	255554	6277269
C69	255512	6277482
C70	255463	6277365
C71	255414	6277251
C72	255368	6277134
C73	255319	6277020
C74	255277	6276908
C75	255659	6277790
C76	255778	6277750
C77	255782	6277625
C78	255737	6277509
C79	255694	6277392
C80	255694	6277265
C81	255797	6277212
C82	255922	6277215
C83	256047	6277218
C84	256173	6277225
C85	256291	6277223
C86	255768	6277165
C87	255857	6277077
C88	255942	6276985
C89	255976	6276866
C90	256032	6276752
C91	256107	6276639
C92	256189	6276453
C93	256239	6276338
C94	256294	6276224
C95	256343	6276109
C96	256224	6275960
C97	256343	6275995
C98	256464	6276030
C99	256584	6276058
C100	256705	6276087
C101	256828	6276109

Datum	WGS84	
Site	Easting	Northing
C102	256950	6276140
C103	257072	6276167
C104	257195	6276196
C105	257316	6276217
C106	257128	6276271
C107	257314	6276092
C108	257345	6275971
C109	257377	6275850
C110	257414	6275731
C111	257449	6275611
C112	257487	6275461
C113	257518	6275340
C114	257587	6275536
C115	257689	6275609
C116	257787	6275684
C117	257402	6275567
C118	257359	6275329
C119	257362	6275454
C120	257326	6275570
C121	257238	6275660
C122	257164	6275761
C123	257135	6275883
C124	257120	6276008
C125	257127	6276133
C126	257625	6275402
C127	257708	6275496
C128	257793	6275588
C129	257906	6275518
C130	257914	6275393
C131	257914	6275267
C132	258012	6275359
C133	257826	6275488
C134	257817	6275363
C135	257703	6275351
C136	257920	6275159
C137	257986	6275053
C138	257969	6274929
C139	257920	6274813
C140	257932	6274687
C141	257862	6274613
C142	257826	6274734
C143	257795	6274854
C144	257762	6274975
C145	257801	6275093
C146	258170	6275183
C147	258170	6275079
C148	258167	6274953
C149	258086	6274865
C150	258134	6274780
E1.01	252434	6280296
E1.02	252442	6280296
E1.03	252449	6280302
E1.04	252459	6280305
E1.05	252467	6280313
E1.06	252477	6280323
E1.07	252485	6280330
E1.08	252491	6280339
E1.09	252496	6280348
E1.10	252504	6280356
E1.11	252514	6280362
E1.12	252523	6280369
E1.13	252530	6280376
E1.14	252539	6280382
E1.15	252548	6280387
E1.16	252558	6280392
E1.17	252567	6280398
E1.18	252576	6280403
E1.19	252584	6280407

Datum	WGS84	
Site	Easting	Northing
E1.20	252592	6280410
E1.21	252601	6280415
E1.22	252608	6280419
E1.23	252617	6280422
E1.24	252627	6280423
E1.25	252636	6280424
E2.01	253218	6279979
E2.02	253226	6279970
E2.03	253234	6279961
E2.04	253243	6279951
E2.05	253251	6279942
E2.06	253257	6279933
E2.07	253267	6279926
E2.08	253275	6279918
E2.09	253283	6279911
E2.10	253291	6279906
E2.11	253302	6279904
E2.12	253312	6279902
E2.13	253322	6279904
E2.14	253331	6279903
E2.15	253341	6279904
E2.16	253349	6279902
E2.17	253360	6279903
E2.18	253369	6279902
E2.19	253386	6279905
E2.20	253378	6279903
E2.21	253395	6279904
E2.22	253404	6279904
E2.23	253412	6279906
E2.24	253420	6279905
E2.25	253427	6279908
E3.01	252536	6279710
E3.02	252546	6279708
E3.03	252557	6279707
E3.04	252569	6279704
E3.05	252580	6279702
E3.06	252590	6279702
E3.07	252600	6279702
E3.08	252610	6279701
E3.09	252620	6279701
E3.10	252633	6279702
E3.11	252644	6279699
E3.12	252657	6279698
E3.13	252669	6279699
E3.14	252678	6279697
E3.15	252686	6279698
E3.16	252696	6279696
E3.17	252706	6279695
E3.18	252715	6279694
E3.19	252723	6279693
E3.20	252733	6279692
E3.21	252742	6279692
E3.22	252749	6279691
E3.23	252758	6279690
E3.24	252767	6279689
E3.25	252775	6279689
E4.01	253433	6279524
E4.02	253447	6279522
E4.03	253460	6279520
E4.04	253471	6279519
E4.05	253481	6279518
E4.06	253490	6279516
E4.07	253502	6279514
E4.08	253512	6279512
E4.09	253521	6279511
E4.10	253529	6279510
E4.11	253539	6279507
E4.12	253549	6279504

Datum	WGS84	
Site	Easting	Northing
E4.13	253559	6279502
E4.14	253569	6279500
E4.15	253578	6279498
E4.16	253587	6279496
E4.17	253597	6279494
E4.18	253606	6279492
E4.19	253616	6279491
E4.20	253624	6279489
E4.21	253633	6279487
E4.22	253643	6279486
E4.23	253652	6279483
E4.24	253661	6279481
E4.25	253671	6279479
E5.01	253105	6279204
E5.02	253108	6279195
E5.03	253111	6279184
E5.04	253112	6279175
E5.05	253114	6279168
E5.06	253114	6279155
E5.07	253114	6279142
E5.08	253116	6279131
E5.09	253116	6279122
E5.10	253117	6279112
E5.11	253118	6279102
E5.12	253119	6279092
E5.13	253120	6279081
E5.14	253118	6279072
E5.15	253122	6279064
E5.16	253122	6279053
E5.17	253122	6279042
E5.18	253123	6279031
E5.19	253124	6279020
E5.20	253125	6279011
E5.21	253125	6279000
E5.22	253125	6278990
E5.23	253126	6278981
E5.24	253126	6278973
E5.25	253128	6278965
E6.01	253607	6278746
E6.02	253616	6278738
E6.03	253625	6278732
E6.04	253635	6278726
E6.05	253643	6278721
E6.06	253653	6278715
E6.07	253662	6278710
E6.08	253671	6278705
E6.09	253678	6278701
E6.10	253685	6278698
E6.11	253692	6278692
E6.12	253701	6278687
E6.13	253709	6278682
E6.14	253718	6278677
E6.15	253728	6278672
E6.16	253736	6278667
E6.17	253745	6278662
E6.18	253754	6278657
E6.19	253763	6278652
E6.20	253772	6278649
E6.21	253782	6278645
E6.22	253793	6278640
E6.23	253804	6278637
E6.24	253814	6278634
E6.25	253821	6278632
E6.26	253832	6278628
E6.27	253843	6278624
E6.28	253852	6278621
E6.29	253861	6278619
E6.30	253869	6278618

Datum	WGS84	
Site	Easting	Northing
E6.31	253879	6278614
E6.32	253890	6278611
E6.33	253899	6278608
E6.34	253908	6278605
E6.35	253916	6278603
E6.36	253924	6278599
E6.37	253934	6278596
E6.38	253943	6278592
E6.39	253953	6278589
E6.40	253964	6278587
E6.41	253976	6278585
E6.42	253988	6278584
E6.43	253998	6278582
E6.44	254008	6278580
E6.45	254016	6278579
E6.46	254025	6278577
E6.47	254034	6278574
E6.48	254044	6278572
E6.49	254054	6278569
E6.50	254063	6278567
E7.01	254359	6278480
E7.02	254367	6278487
E7.03	254375	6278494
E7.04	254382	6278499
E7.05	254388	6278504
E7.06	254396	6278510
E7.07	254404	6278516
E7.08	254412	6278522
E7.09	254420	6278529
E7.10	254427	6278535
E7.11	254435	6278542
E7.12	254444	6278549
E7.13	254452	6278555
E7.14	254461	6278561
E7.15	254467	6278567
E7.16	254474	6278573
E7.17	254483	6278580
E7.18	254493	6278588
E7.19	254501	6278593
E7.20	254507	6278598
E7.21	254514	6278605
E7.22	254523	6278613
E7.23	254532	6278620
E7.24	254540	6278626
E7.25	254547	6278631
E8.01	254663	6278364
E8.02	254674	6278359
E8.03	254684	6278355
E8.04	254692	6278351
E8.05	254699	6278348
E8.06	254709	6278342
E8.07	254719	6278338
E8.08	254728	6278334
E8.09	254737	6278331
E8.10	254746	6278329
E8.11	254755	6278326
E8.12	254764	6278322
E8.13	254776	6278318
E8.14	254784	6278314
E8.15	254791	6278310
E8.16	254801	6278305
E8.17	254812	6278302
E8.18	254823	6278299
E8.19	254832	6278297
E8.20	254840	6278294
E8.21	254850	6278291
E8.22	254860	6278287
E8.23	254869	6278283

Datum	WGS84	
Site	Easting	Northing
E8.24	254879	6278280
E8.25	254888	6278276
E8.26	254898	6278273
E8.27	254908	6278269
E8.28	254917	6278265
E8.29	254926	6278261
E8.30	254934	6278257
E8.31	254944	6278251
E8.32	254952	6278246
E8.33	254961	6278241
E8.34	254969	6278235
E8.35	254976	6278229
E8.36	254986	6278224
E8.37	254993	6278219
E8.38	255002	6278212
E8.39	255010	6278206
E8.40	255018	6278199
E8.41	255026	6278194
E8.42	255034	6278187
E8.43	255043	6278182
E8.44	255052	6278178
E8.45	255060	6278172
E8.46	255069	6278168
E8.47	255078	6278162
E8.48	255086	6278155
E8.49	255094	6278149
E8.50	255101	6278143
E9.01	255560	6277716
E9.02	255560	6277704
E9.03	255562	6277695
E9.04	255563	6277686
E9.05	255564	6277677
E9.06	255565	6277667
E9.07	255566	6277656
E9.08	255567	6277645
E9.09	255568	6277635
E9.10	255570	6277626
E9.11	255570	6277614
E9.12	255572	6277602
E9.13	255574	6277593
E9.14	255575	6277584
E9.15	255577	6277576
E9.16	255578	6277566
E9.17	255578	6277555
E9.18	255579	6277544
E9.19	255580	6277534
E9.20	255581	6277525
E9.21	255582	6277515
E9.22	255583	6277504
E9.23	255584	6277494
E9.24	255584	6277485
E9.25	255585	6277477
E10.01	255385	6277184
E10.02	255382	6277174
E10.03	255380	6277166
E10.04	255377	6277158
E10.05	255374	6277149
E10.06	255369	6277140
E10.07	255365	6277129
E10.08	255361	6277119
E10.09	255357	6277111
E10.10	255353	6277102
E10.11	255349	6277092
E10.12	255345	6277082
E10.13	255341	6277073
E10.14	255337	6277064
E10.15	255334	6277055
E10.16	255330	6277046

Datum	WGS84	
Site	Easting	Northing
E10.17	255326	6277038
E10.18	255322	6277029
E10.19	255318	6277020
E10.20	255314	6277008
E10.21	255310	6276997
E10.22	255306	6276987
E10.23	255302	6276977
E10.24	255298	6276969
E10.25	255296	6276961
E11.01	255838	6277084
E11.02	255843	6277075
E11.03	255851	6277068
E11.04	255857	6277062
E11.05	255862	6277057
E11.06	255870	6277050
E11.07	255877	6277042
E11.08	255884	6277035
E11.09	255891	6277028
E11.10	255898	6277022
E11.11	255907	6277013
E11.12	255914	6277005
E11.13	255921	6276997
E11.14	255927	6276990
E11.15	255933	6276985
E11.16	255939	6276977
E11.17	255946	6276968
E11.18	255950	6276960
E11.19	255955	6276951
E11.20	255960	6276943
E11.21	255961	6276932
E11.22	255962	6276921
E11.23	255963	6276912
E11.24	255964	6276903
E11.25	255966	6276894
E12.01	256206	6276422
E12.02	256212	6276411
E12.03	256216	6276400
E12.04	256221	6276392
E12.05	256226	6276384
E12.06	256229	6276373
E12.07	256233	6276363
E12.08	256237	6276355
E12.09	256243	6276348
E12.10	256246	6276336
E12.11	256250	6276325
E12.12	256255	6276315
E12.13	256259	6276307
E12.14	256264	6276298
E12.15	256267	6276290
E12.16	256272	6276280
E12.17	256277	6276271
E12.18	256281	6276262
E12.19	256285	6276254
E12.20	256288	6276247
E12.21	256295	6276236
E12.22	256297	6276225
E12.23	256302	6276215
E12.24	256305	6276207
E12.25	256309	6276200
E13.01	256573	6276051
E13.02	256585	6276053
E13.03	256596	6276055
E13.04	256606	6276058
E13.05	256613	6276060
E13.06	256624	6276062
E13.07	256635	6276064
E13.08	256646	6276067
E13.09	256655	6276069

Datum	WGS84	
Site	Easting	Northing
E13.10	256663	6276070
E13.11	256672	6276072
E13.12	256683	6276076
E13.13	256693	6276078
E13.14	256703	6276080
E13.15	256711	6276082
E13.16	256721	6276084
E13.17	256732	6276087
E13.18	256743	6276089
E13.19	256752	6276089
E13.20	256761	6276090
E13.21	256771	6276092
E13.22	256781	6276096
E13.23	256791	6276097
E13.24	256799	6276099
E13.25	256806	6276101
E13.26	256815	6276104
E13.27	256825	6276107
E13.28	256835	6276109
E13.29	256846	6276111
E13.30	256855	6276114
E13.31	256866	6276117
E13.32	256876	6276119
E13.33	256886	6276121
E13.34	256895	6276123
E13.35	256903	6276125
E13.36	256913	6276127
E13.37	256923	6276129
E13.38	256933	6276131
E13.39	256943	6276133
E13.40	256953	6276135

Datum	WGS84	
Site	Easting	Northing
E13.41	256964	6276137
E13.42	256974	6276139
E13.43	256984	6276141
E13.44	256995	6276144
E13.45	257004	6276146
E13.46	257016	6276148
E13.47	257027	6276150
E13.48	257037	6276152
E13.49	257045	6276154
E13.50	257053	6276157
E14.01	257312	6276122
E14.02	257315	6276110
E14.03	257318	6276100
E14.04	257321	6276091
E14.05	257325	6276083
E14.06	257327	6276072
E14.07	257330	6276062
E14.08	257333	6276052
E14.09	257335	6276043
E14.10	257337	6276035
E14.11	257340	6276026
E14.12	257344	6276015
E14.13	257346	6276004
E14.14	257347	6275996
E14.15	257349	6275987
E14.16	257352	6275977
E14.17	257354	6275969
E14.18	257356	6275959
E14.19	257359	6275948
E14.20	257362	6275938
E14.21	257365	6275928

Datum	WGS84	
Site	Easting	Northing
E14.22	257367	6275917
E14.23	257369	6275908
E14.24	257371	6275899
E14.25	257373	6275890
E14.26	257376	6275880
E14.27	257379	6275869
E14.28	257381	6275859
E14.29	257383	6275851
E14.30	257386	6275841
E14.31	257389	6275831
E14.32	257392	6275819
E14.33	257394	6275810
E14.34	257396	6275801
E14.35	257399	6275792
E14.36	257403	6275783
E14.37	257406	6275773
E14.38	257409	6275763
E14.39	257411	6275754
E14.40	257413	6275744
E14.41	257416	6275733
E14.42	257419	6275722
E14.43	257422	6275713
E14.44	257425	6275704
E14.45	257428	6275696
E14.46	257431	6275687
E14.47	257434	6275677
E14.48	257437	6275666
E14.49	257438	6275657
E14.50	257440	6275648

Appendix C
Trapping results

Appendix C. Trapping results

Date	Common name	Scientific name	Trap no.	Trap type
28/02/2018	House Mouse	*Mus musculus*	1.01	Aluminium box trap
28/02/2018	House Mouse	*Mus musculus*	1.02	Aluminium box trap
28/02/2018	House Mouse	*Mus musculus*	1.09	Aluminium box trap
28/02/2018	House Mouse	*Mus musculus*	1.10	Aluminium box trap
28/02/2018	House Mouse	*Mus musculus*	1.10	Aluminium box trap
28/02/2018	Bush Rat	*Rattus fuscipes*	1.18	Aluminium box trap
28/02/2018	House Mouse	*Mus musculus*	1.25	Aluminium box trap
28/02/2018	House Mouse	*Mus musculus*	2.02	Aluminium box trap
28/02/2018	House Mouse	*Mus musculus*	2.02	Aluminium box trap
28/02/2018	House Mouse	*Mus musculus*	2.06	Aluminium box trap
28/02/2018	House Mouse	*Mus musculus*	2.06	Aluminium box trap
28/02/2018	House Mouse	*Mus musculus*	2.25	Aluminium box trap
28/02/2018	House Mouse	*Mus musculus*	3.01	Aluminium box trap
28/02/2018	House Mouse	*Mus musculus*	3.02	Aluminium box trap
28/02/2018	House Mouse	*Mus musculus*	3.23	Aluminium box trap
28/02/2018	House Mouse	*Mus musculus*	9.04	Aluminium box trap
28/02/2018	House Mouse	*Mus musculus*	9.14	Aluminium box trap
28/02/2018	House Mouse	*Mus musculus*	10.01	Aluminium box trap
28/02/2018	House Mouse	*Mus musculus*	10.02	Aluminium box trap
28/02/2018	House Mouse	*Mus musculus*	10.05	Aluminium box trap
28/02/2018	House Mouse	*Mus musculus*	10.05	Aluminium box trap
28/02/2018	House Mouse	*Mus musculus*	10.05	Aluminium box trap
28/02/2018	House Mouse	*Mus musculus*	10.11	Aluminium box trap
28/02/2018	House Mouse	*Mus musculus*	10.11	Aluminium box trap
28/02/2018	House Mouse	*Mus musculus*	10.17	Aluminium box trap
28/02/2018	House Mouse	*Mus musculus*	10.17	Aluminium box trap
28/02/2018	House Mouse	*Mus musculus*	11.19	Aluminium box trap
28/02/2018	House Mouse	*Mus musculus*	11.21	Aluminium box trap
28/02/2018	House Mouse	*Mus musculus*	11.21	Aluminium box trap
28/02/2018	House Mouse	*Mus musculus*	11.23	Aluminium box trap
28/02/2018	House Mouse	*Mus musculus*	13.01	Aluminium box trap
28/02/2018	House Mouse	*Mus musculus*	13.38	Aluminium box trap
28/02/2018	House Mouse	*Mus musculus*	13.41	Aluminium box trap
28/02/2018	House Mouse	*Mus musculus*	13.43	Aluminium box trap
28/02/2018	House Mouse	*Mus musculus*	13.43	Aluminium box trap
28/02/2018	House Mouse	*Mus musculus*	13.44	Aluminium box trap
28/02/2018	House Mouse	*Mus musculus*	14.05	Aluminium box trap
28/02/2018	House Mouse	*Mus musculus*	14.09	Aluminium box trap
28/02/2018	House Mouse	*Mus musculus*	14.40	Aluminium box trap
28/02/2018	House Mouse	*Mus musculus*	14.40	Aluminium box trap
28/02/2018	Bobtail	*Tiliqua rugosa*	95	Cage trap
28/02/2018	Chuditch	*Dasyurus hallucatus*	121	Cage trap
1/03/2018	House Mouse	*Mus musculus*	1.02	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	1.12	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	1.12	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	1.25	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	1.25	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	2.02	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	2.06	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	2.06	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	2.07	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	2.18	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	2.21	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	2.23	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	2.23	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	2.25	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	3.01	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	3.02	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	3.23	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	3.23	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	4.04	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	4.04	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	4.07	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	4.09	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	4.13	Aluminium box trap

Date	Common name	Scientific name	Trap no.	Trap type
1/03/2018	House Mouse	*Mus musculus*	4.13	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	4.13	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	6.10	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	6.17	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	6.30	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	6.31	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	7.08	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	7.08	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	7.10	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	7.14	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	7.15	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	7.17	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	7.25	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	8.10	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	8.12	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	8.12	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	8.49	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	9.01	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	9.01	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	9.02	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	9.02	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	9.04	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	9.04	Aluminium box trap
1/03/2018	Shingleback	*Tiliqua rugosa*	9.06	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	9.07	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	9.14	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	9.14	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	9.23	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	9.23	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	10.01	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	10.19	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	10.22	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	10.22	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	10.23	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	11.07	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	11.07	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	11.21	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	12.03	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	12.03	Aluminium box trap
1/03/2018	Bobtail	*Tiliqua rugosa*	12.05	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	12.17	Aluminium box trap
1/03/2018	Bobtail	*Tiliqua rugosa*	12.23	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	13.19	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	13.19	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	13.29	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	13.41	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	13.43	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	13.49	Aluminium box trap
1/03/2018	House Mouse	*Mus musculus*	14.17	Aluminium box trap
1/03/2018	Heath Goanna	*Varanus rosenbergi*	17	Cage trap
1/03/2018	Chuditch	*Dasyurus hallucatus*	114	Cage trap
1/03/2018	Bobtail	*Tiliqua rugosa*	117	Cage trap
1/03/2018	Chuditch	*Dasyurus hallucatus*	121	Cage trap
1/03/2018	Bobtail	*Tiliqua rugosa*	123	Cage trap
1/03/2018	Bobtail	*Tiliqua rugosa*	125	Cage trap
2/03/2018	House Mouse	*Mus musculus*	1.02	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	1.02	Aluminium box trap
2/03/2018	Heath Goanna	*Varanus rosenbergi*	1.08	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	1.09	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	1.09	Aluminium box trap
2/03/2018	Heath Goanna	*Varanus rosenbergi*	1.11	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	1.12	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	1.25	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	1.25	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	2.02	Aluminium box trap
2/03/2018	Heath Goanna	*Varanus rosenbergi*	2.20	Aluminium box trap
2/03/2018	Heath Goanna	*Varanus rosenbergi*	2.21	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	2.25	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	2.70	Aluminium box trap

Date	Common name	Scientific name	Trap no.	Trap type
2/03/2018	House Mouse	*Mus musculus*	3.02	Aluminium box trap
2/03/2018	Bobtail	*Tiliqua rugosa*	3.12	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	3.23	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	4.04	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	4.04	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	4.04	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	4.07	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	4.09	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	4.10	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	4.16	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	4.22	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	4.22	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	4.25	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	6.03	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	6.03	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	6.04	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	6.04	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	6.08	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	6.14	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	6.14	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	6.16	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	6.30	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	6.31	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	6.32	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	7.01	Aluminium box trap
2/03/2018	Heath Goanna	*Varanus rosenbergi*	8.04	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	8.08	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	8.08	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	8.10	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	8.22	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	8.22	Aluminium box trap
2/03/2018	Heath Goanna	*Varanus rosenbergi*	8.25	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	8.35	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	8.39	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	8.39	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	8.44	Aluminium box trap
2/03/2018	Bush Rat	*Rattus fuscipes*	8.47	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	9.01	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	9.02	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	9.02	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	9.04	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	9.07	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	9.14	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	9.14	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	9.15	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	9.23	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	10.01	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	10.08	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	10.17	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	10.17	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	10.18	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	10.22	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	11.01	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	11.01	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	11.13	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	11.21	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	11.25	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	12.03	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	12.03	Aluminium box trap
2/03/2018	Bobtail	*Tiliqua rugosa*	12.24	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	13.13	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	13.13	Aluminium box trap
2/03/2018	Bobtail	*Tiliqua rugosa*	13.15	Aluminium box trap
2/03/2018	Bobtail	*Tiliqua rugosa*	13.15	Aluminium box trap
2/03/2018	Bobtail	*Tiliqua rugosa*	13.22	Aluminium box trap
2/03/2018	Bobtail	*Tiliqua rugosa*	13.30	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	13.37	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	13.42	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	13.43	Aluminium box trap

Date	Common name	Scientific name	Trap no.	Trap type
2/03/2018	House Mouse	*Mus musculus*	13.43	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	14.15	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	14.30	Aluminium box trap
2/03/2018	Bobtail	*Tiliqua rugosa*	14.40	Aluminium box trap
2/03/2018	House Mouse	*Mus musculus*	14.50	Aluminium box trap
2/03/2018	Bobtail	*Tiliqua rugosa*	28	Cage trap
2/03/2018	Bobtail	*Tiliqua rugosa*	54	Cage trap
2/03/2018	Bobtail	*Tiliqua rugosa*	72	Cage trap
2/03/2018	Bobtail	*Tiliqua rugosa*	77	Cage trap
2/03/2018	Bobtail	*Tiliqua rugosa*	95	Cage trap
2/03/2018	Bobtail	*Tiliqua rugosa*	109	Cage trap
2/03/2018	Bobtail	*Tiliqua rugosa*	122	Cage trap
2/03/2018	Bobtail	*Tiliqua rugosa*	123	Cage trap
2/03/2018	Bobtail	*Tiliqua rugosa*	124	Cage trap
2/03/2018	Bobtail	*Tiliqua rugosa*	133	Cage trap
2/03/2018	Heath Goanna	*Varanus rosenbergi*	142	Cage trap
3/03/2018	House Mouse	*Mus musculus*	1.02	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	1.02	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	1.09	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	1.09	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	1.12	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	1.12	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	1.12	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	1.12	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	1.25	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	1.25	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	2.02	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	2.07	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	2.07	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	2.21	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	2.25	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	2.25	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	3.02	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	3.23	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	3.23	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	4.04	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	4.07	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	4.07	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	4.22	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	4.22	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	6.05	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	6.28	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	6.29	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	6.30	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	7.01	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	7.15	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	7.16	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	8.10	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	8.35	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	8.35	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	8.39	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	8.39	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	8.47	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	8.49	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	9.01	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	9.14	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	9.14	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	9.14	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	10.01	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	10.08	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	10.17	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	10.17	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	10.18	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	10.18	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	10.22	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	10.22	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	11.13	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	11.13	Aluminium box trap
3/03/2018	Bush Rat	*Rattus fuscipes*	11.15	Aluminium box trap

Date	Common name	Scientific name	Trap no.	Trap type
3/03/2018	House Mouse	*Mus musculus*	11.21	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	12.01	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	12.01	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	12.03	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	12.03	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	12.13	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	12.13	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	12.15	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	12.15	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	12.17	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	12.17	Aluminium box trap
3/03/2018	Bobtail	*Tiliqua rugosa*	12.21	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	13.28	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	13.28	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	13.30	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	13.30	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	14.18	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	14.18	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	14.21	Aluminium box trap
3/03/2018	House Mouse	*Mus musculus*	14.21	Aluminium box trap
3/03/2018	Bush Rat	*Rattus fuscipes*	15.02	Aluminium box trap
3/03/2018	Short-beaked Echidna	*Tachyglossus aculeatus*	56	Cage trap
3/03/2018	Bobtail	*Tiliqua rugosa*	96	Cage trap
3/03/2018	Chuditch	*Dasyurus hallucatus*	110	Cage trap
4/03/2018	House Mouse	*Mus musculus*	1.02	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	1.02	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	1.09	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	1.09	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	1.25	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	2.02	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	2.02	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	2.07	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	2.21	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	2.25	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	2.25	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	3.02	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	3.23	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	3.23	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	4.04	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	4.06	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	4.24	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	4.25	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	5.02	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	5.04	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	5.12	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	5.12	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	6.01	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	6.02	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	6.02	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	6.15	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	6.15	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	6.17	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	6.17	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	6.18	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	6.18	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	6.19	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	6.19	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	6.22	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	6.23	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	6.23	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	6.24	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	6.32	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	6.50	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	6.50	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	7.06	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	7.06	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	7.08	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	7.10	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	7.15	Aluminium box trap

Date	Common name	Scientific name	Trap no.	Trap type
4/03/2018	House Mouse	*Mus musculus*	7.16	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	7.17	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	7.17	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	7.20	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	7.20	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	7.24	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	7.24	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	8.09	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	8.09	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	8.10	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	8.10	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	8.24	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	8.24	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	8.26	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	8.26	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	8.27	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	8.35	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	8.36	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	8.36	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	8.39	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	8.41	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	8.47	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	8.47	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	8.49	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	8.50	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	8.50	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	9.14	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	10.02	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	10.02	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	10.05	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	10.05	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	10.11	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	10.11	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	10.15	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	10.15	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	10.17	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	10.17	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	10.18	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	10.18	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	10.18	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	10.20	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	10.20	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	10.21	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	10.21	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	10.21	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	10.22	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	10.22	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	10.23	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	11.01	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	11.01	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	11.13	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	11.17	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	11.21	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	11.23	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	11.23	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	11.24	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	11.25	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	11.26	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	11.26	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	12.03	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	12.03	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	12.09	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	12.09	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	13.01	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	13.03	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	13.03	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	13.22	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	13.22	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	13.25	Aluminium box trap

Date	Common name	Scientific name	Trap no.	Trap type
4/03/2018	House Mouse	*Mus musculus*	13.35	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	13.36	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	13.38	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	13.40	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	14.23	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	14.23	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	14.24	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	14.39	Aluminium box trap
4/03/2018	House Mouse	*Mus musculus*	14.40	Aluminium box trap
4/03/2018	Bobtail	*Tiliqua rugosa*	15	Cage trap
4/03/2018	Heath Goanna	*Varanus rosenbergi*	20	Cage trap
4/03/2018	Heath Goanna	*Varanus rosenbergi*	104	Cage trap
5/03/2018	House Mouse	*Mus musculus*	4.05	Aluminium box trap
5/03/2018	House Mouse	*Mus musculus*	4.05	Aluminium box trap
5/03/2018	House Mouse	*Mus musculus*	4.18	Aluminium box trap
5/03/2018	House Mouse	*Mus musculus*	4.18	Aluminium box trap
5/03/2018	House Mouse	*Mus musculus*	4.18	Aluminium box trap
5/03/2018	House Mouse	*Mus musculus*	4.21	Aluminium box trap
5/03/2018	House Mouse	*Mus musculus*	4.21	Aluminium box trap
5/03/2018	House Mouse	*Mus musculus*	5.01	Aluminium box trap
5/03/2018	House Mouse	*Mus musculus*	5.03	Aluminium box trap
5/03/2018	House Mouse	*Mus musculus*	5.03	Aluminium box trap
5/03/2018	House Mouse	*Mus musculus*	6.03	Aluminium box trap
5/03/2018	House Mouse	*Mus musculus*	6.03	Aluminium box trap
5/03/2018	House Mouse	*Mus musculus*	6.07	Aluminium box trap
5/03/2018	House Mouse	*Mus musculus*	6.07	Aluminium box trap
5/03/2018	House Mouse	*Mus musculus*	6.09	Aluminium box trap
5/03/2018	House Mouse	*Mus musculus*	6.09	Aluminium box trap
5/03/2018	House Mouse	*Mus musculus*	6.12	Aluminium box trap
5/03/2018	House Mouse	*Mus musculus*	6.12	Aluminium box trap
5/03/2018	House Mouse	*Mus musculus*	6.14	Aluminium box trap
5/03/2018	House Mouse	*Mus musculus*	6.14	Aluminium box trap
5/03/2018	House Mouse	*Mus musculus*	6.15	Aluminium box trap
5/03/2018	House Mouse	*Mus musculus*	6.35	Aluminium box trap
5/03/2018	House Mouse	*Mus musculus*	6.35	Aluminium box trap
5/03/2018	House Mouse	*Mus musculus*	6.42	Aluminium box trap
5/03/2018	House Mouse	*Mus musculus*	6.48	Aluminium box trap
5/03/2018	House Mouse	*Mus musculus*	6.50	Aluminium box trap
5/03/2018	House Mouse	*Mus musculus*	6.50	Aluminium box trap
5/03/2018	House Mouse	*Mus musculus*	7.10	Aluminium box trap
5/03/2018	House Mouse	*Mus musculus*	7.12	Aluminium box trap
5/03/2018	House Mouse	*Mus musculus*	7.15	Aluminium box trap
5/03/2018	House Mouse	*Mus musculus*	7.16	Aluminium box trap
5/03/2018	House Mouse	*Mus musculus*	7.18	Aluminium box trap
5/03/2018	House Mouse	*Mus musculus*	7.18	Aluminium box trap
5/03/2018	House Mouse	*Mus musculus*	7.18	Aluminium box trap
5/03/2018	House Mouse	*Mus musculus*	7.20	Aluminium box trap
5/03/2018	House Mouse	*Mus musculus*	7.20	Aluminium box trap
5/03/2018	House Mouse	*Mus musculus*	7.24	Aluminium box trap
5/03/2018	House Mouse	*Mus musculus*	8.07	Aluminium box trap
5/03/2018	House Mouse	*Mus musculus*	8.07	Aluminium box trap
5/03/2018	House Mouse	*Mus musculus*	8.10	Aluminium box trap
5/03/2018	House Mouse	*Mus musculus*	8.18	Aluminium box trap
5/03/2018	House Mouse	*Mus musculus*	8.24	Aluminium box trap
5/03/2018	House Mouse	*Mus musculus*	8.24	Aluminium box trap
5/03/2018	House Mouse	*Mus musculus*	8.26	Aluminium box trap
5/03/2018	House Mouse	*Mus musculus*	8.35	Aluminium box trap
5/03/2018	House Mouse	*Mus musculus*	8.39	Aluminium box trap
5/03/2018	House Mouse	*Mus musculus*	8.41	Aluminium box trap
5/03/2018	House Mouse	*Mus musculus*	8.41	Aluminium box trap
5/03/2018	House Mouse	*Mus musculus*	8.47	Aluminium box trap
5/03/2018	House Mouse	*Mus musculus*	8.49	Aluminium box trap
5/03/2018	House Mouse	*Mus musculus*	8.49	Aluminium box trap
5/03/2018	House Mouse	*Mus musculus*	8.50	Aluminium box trap
5/03/2018	House Mouse	*Mus musculus*	8.50	Aluminium box trap
5/03/2018	Bobtail	*Tiliqua rugosa*	24	Cage trap
5/03/2018	Bobtail	*Tiliqua rugosa*	48	Cage trap
5/03/2018	Heath Goanna	*Varanus rosenbergi*	82	Cage trap
5/03/2018	Bobtail	*Tiliqua rugosa*	84	Cage trap

Conservation Significant Vertebrate Fauna Monitoring for Ravensthorpe Nickel Operations - 2017

Version 2. January 2018

Prepare for:

FQM Australia Nickel
Locked Bag 100,
Ravensthorpe, WA, 6346

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Front Cover: Common Scaly-foot (*Pygopus lepidopodus*), which is relativel common in the project area.

EXECUTIVE SUMMARY

In accordance with Ministerial Condition 7-1 of Statement 633, Ravensthorpe Nickel Operations (RNO) requested a vertebrate fauna monitoring survey be undertaken again in 2017. Threatened terrestrial vertebrate fauna targeted in this monitoring survey included the Heath Rat (*Pseudomys shortridgei*), Western Mouse (*Pseudomys occidentalis*), Western Brush Wallaby (*Macropus irma*), Western Whipbird (*Psophodes nigrogularis oberon*), Chuditch (*Dasyurus geoffroii*), Malleefowl (*Leipoa ocellata*) and Southern Brown Bandicoot (*Isoodon obesulus fusciventer*).

Four hundred and fifty aluminium box traps, 150 large wire cage traps and 90 camera traps were set at multiple locations in three fauna habitats. Twelve Western Whipbird monitoring sites were surveyed.

No Heath Rats, Western Mice or Southern Brown Bandicoots were recorded in the monitoring survey. Chuditch were recorded by 24 of 90 camera traps in all three habitat types and were captured on 16 occasions. Malleefowl were recorded at one camera trap site only. Western Whipbirds were recorded at 10 of the 12 monitoring sites. This survey confirmed the presence of an established population of Western Brush Wallabies.

Cats were recorded by 52 of 90 camera traps and foxes by 27 of 90 camera traps. No cats were caught in cage traps during this survey.

The declining number of small mammals since the early surveys undertaken by Chapman (2000), Biota Environmental Sciences (2000, 2005a) and Coffey Environments (2009a, 2010) when very low numbers of Heath Rat, Western Mouse or Southern Brown Bandicoot were caught is most likely due to the on-going predation by cats and foxes in the project area. It is therefore recommended that RNO continue with the cat and fox reduction program that was first implemented in 2017.

Western Grey Kangaroos are also very common in the project area are doing considerable damage to the fencing, and rabbits are common in some areas, and along with the kangaroos are likely to start impacted on mine rehabilitation and native vegetation, so population reduction programs should be considered for both species.

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1 INTRODUCTION

1.1 Background

In accordance with Ministerial Condition 7-1 of Statement 633; Ravensthorpe Nickel Operations (RNO) requested a vertebrate fauna monitoring survey be undertaken in 2017.

The approved fauna management plan requires:

- the establishment of permanent monitoring sites on and around rehabilitated areas, and for these sites to be included in the annual monitoring;
- maintain the fauna monitoring sites of the RNO and adjacent areas of the Bandalup Corridor;
- comparable trapping intensity to be applied in the monitoring program; and
- monitoring the population of rare fauna.

The rehabilitation program has commenced and is progressing, but it is too early to undertake monitoring of the vertebrate fauna in these areas. Threatened terrestrial vertebrate fauna that require monitoring include the Heath Rat (*Pseudomys shortridgei*), Western Mouse (*Pseudomys occidentalis*), Western Brush Wallaby (*Macropus irma*), Western Whipbird (*Psophodes nigrogularis oberon*), Chuditch (*Dasyurus geoffroii*), Southern Brown Bandicoot (*Isoodon obesulus fusciventer*) and Malleefowl (*Leipoa ocellata*).

Malleefowl mounds were present in the RNO tenements prior to the establishment of the mine, but these mounds were in the mining area and have been removed. Prior to this survey, Malleefowl had been recorded once in 2010 by Coffey Environments (2010) and on three occasions during 2014 (Terrestrial Ecosystems 2014). Malleefowl were not recorded in the 2015 survey (Terrestrial Ecosystems 2015a) but were recorded at multiple locations during the 2016-17 surveys (Terrestrial Ecosystems 2017a, c).

Some of the previously used permanent trapping sites that were established in 2013 and adjusted in 2014 to accommodate an expansion in mining activity, and camera trapping sites that were established in 2014, and then used in 2015 and 2016 will be cleared for the proposed Shoemaker-Levy mine and associated infrastructure. New trapping sites were therefore required. The location of the new trapping sites took into consideration fauna habitats in the proposed Shoemaker-Levy project area (Figures 1 and 2).

1.2 Previous vertebrate fauna monitoring surveys and fauna survey reports

There have been numerous fauna assessments and surveys undertaken on the RNO tenements. These include:

- Biota Environmental Sciences (2000) *Ravensthorpe Nickel Project – Fauna Survey 2000*. Unpublished report for Ravensthorpe Nickel Operations.
- Biota Environmental Sciences (2005) *BHP Billiton Ravensthorpe Nickel Operations Fauna Trapping Program 2005*. Unpublished report for BHP Billiton, Perth.
- Cancilla, D. and Johnson, B. (2013) The status and ecology of the *Pseudomys shortridgei* (Heath Mouse) in southern western Australia. Unpublished report for Murdoch University.
- Chapman A. (2000) *Fauna Management Plan Year One 1999-2000*. Unpublished report for Comet Resources, Ravensthorpe.
- Coffey Environments (2009) *Terrestrial Vertebrate Fauna Risk Assessment for the Shoemaker-Levy Ore Body, Ravensthorpe Nickel Operations*, Unpublished report for BHP Billiton Ravensthorpe Nickel, Ravensthorpe.
- Coffey Environments (2010) *Fauna Monitoring, Ravensthorpe Nickel Operations, January 2010*. Unpublished report for Ravensthorpe Nickel Operations, Ravensthorpe.
- Craig G.F. and Chapman A. (1998) *Ravensthorpe Nickel Project. Comet Resources NL. Vegetation, Flora and Fauna Survey*. Unpublished report for Ravensthorpe Nickel Project.
- Terrestrial Ecosystems (2013) *Conservation Significant Vertebrate Fauna Monitoring for Ravensthorpe Nickel Operations, Ravensthorpe*. Unpublished report for FQM Australia Nickel, Ravensthorpe.
- Terrestrial Ecosystems (2014) *Conservation Significant Vertebrate Fauna Monitoring for Ravensthorpe Nickel Operations - 2014, Ravensthorpe*. Unpublished report for FQM Australia Nickel, Ravensthorpe.
- Terrestrial Ecosystems (2015) *Conservation Significant Vertebrate Fauna Monitoring for Ravensthorpe Nickel Operations – 2015*. Unpublished report for FQM Australia Nickel, Ravensthorpe.

- Terrestrial Ecosystems (2015) *Potential Impact of Vegetation Clearing and the Development of a Conveyor Belt on Fauna at the Ravensthorpe Nickel Operations*. Unpublished report FQM Australia Nickel, Ravensthorpe.
- Terrestrial Ecosystems (2017) *Conservation Significant Vertebrate Fauna Monitoring and Feral Cat Trapping Program for Ravensthorpe Nickel Operations – 2016*. Unpublished report for FQM Australia Nickel, Perth.
- Terrestrial Ecosystems (2017) *Vertebrate fauna surveys for the Hale Bopp North West pit, an infrastructure corridor and extension to the proposed Shoemaker-Levy mining area on vertebrate fauna at the Ravensthorpe Nickel Operation*. Unpublished report for FQM Australia Nickel, Perth.

In addition, there are three fauna survey reports for other mining operations that are nearby:

- Animal Plant Mineral (2016) *Ravensthorpe Gold Copper Project Biological Survey*. Unpublished report for ACH Minerals Pty Ltd;
- Biota Environmental Sciences (2004) *Fauna and Fauna Assemblages of Kundip and Trilogy Study Sites*. Unpublished report for Tectonic Resources NL, Perth; and
- Biota Environmental Sciences (2005) *Kundip Phase II Fauna Survey - Summary of findings*. Letter to Tectonic Resources NL, Perth.

The data and summary information for the regional fauna surveys by Animal Plant Mineral (2016), and Biota Environmental Sciences (2004, 2005b) are discussed in more detail in Terrestrial Ecosystems (2015b, 2017c).

1.3 Summary of historical fauna survey data

A summary table combining conservation significant fauna records from the historical reports is presented in Appendix A.

The Craig and Chapman's (1998) fauna survey report is unavailable, so it has not been possible to extract the relevant data on conservation significant fauna from this report. A brief report by Cancilla and Johnson (2013) indicated that 720 trap-nights were used in an attempt to catch the Heath Rat at Bandalup Hill; but no Heath Rats were caught in this survey. No other details of trapping sites were provided.

Chapman (2000) reported on surveys undertaken between 8-23 November 1999 and 4-17 April 2000 as the first year of a long term monitoring program for three conservation significant mammals and two conservation significant bird species that were known to be present at the RNO. This survey followed on from the earlier survey work undertaken by Craig and Chapman (1998). Nine sites were established; sites E1-E5 had 20 aluminium box traps and sites CMS1-CMS4 had one cage trap, 20 aluminium box traps and 12 pit traps. In addition, 12 cage traps were deployed in other locations. The total trapping effort was 480 pit trap-nights, 1,000 aluminium box trap nights and 200 cage trap nights (Table 1). The trap type(s) that captured the conservation significant fauna was not mentioned in the report.

Table 1. Trapping effort for multiple fauna surveys on the RNO tenements

	Trap nights				
Survey	Pit traps	Box traps	Cage traps	Funnel traps	Camera traps
Chapman (2000)	480	1,000	200		
Biota Environmental Sciences (2000)	534	600	60		
Biota Environmental Sciences (2005a)	408	672	168		
Coffey Environments (2009b)	3,360	1,680	560	3,360	
Coffey Environments (2010)	4,956	2,520	420	5,040	
Terrestrial Ecosystems (2013)		2,500	500		
Cancilla and Johnson (2013)		720			
Terrestrial Ecosystems (2014)		2,500	500		1,550
Terrestrial Ecosystems (2015a)		2,500	500		1,550
Terrestrial Ecosystems (2017a)		2,500	1,095		1,550
Terrestrial Ecosystems (2017c)		3,780	1,260		6,650
This survey		2,250	750		3,600

Biota Environmental Sciences (2000) undertook a survey for Sinclair Knight Merz as part of the preparation of an environmental impact assessment (EIA). Trapping was undertaken between 13-18 October 2000, with 20 aluminium box traps, 12 pit traps and two cage traps deployed at six sites (RNO01-06) mostly for five nights, and a seventh site (RNO07) had 12 pit-traps deployed for five nights. The total trapping effort was 600 aluminium box trap-nights, 534 pit-trap nights and 60 cage trap-nights (Table 1).

Biota Environmental Sciences (2005a) indicated that it undertook a fauna survey in December 2001 that has not been reported. Lines of 20 aluminium box traps were set at sites RNOE1, RNOE2, RNOE3, RNOE4 and RNOE5, and these were the same sites used by Chapman (2000). In addition, pit traps, cage traps and aluminium box traps were deployed at sites RNOCTS01, RNOCTS02, RNOCTS03, RNOCTS04, RNOCMS01, RNOCMS02, RNOCMS03, RNOCMS04 and cage traps were deployed along a cage trapping line.

Biota Environmental Sciences (2005a) undertook a survey between 23-26 August 2005 for RNO. Six sites (RNOE1-E5, Elliott lines) had 20 aluminium box traps set for three nights, one site had 50 cage traps set for two nights and there were eight sites with 12 pit-fall traps, eight aluminium box traps and two cage traps. The total trapping effort was 672 aluminium box trap-nights, 408 pit trap-nights and 168 cage trap-nights (Table 1). There is no record of the trap type(s) that caught the conservation significant fauna.

Coffey Environments (2009b) undertook a vertebrate fauna survey of the Halley's pit surrounds and Shoemaker–Levy area between 12-19 October 2008. In part, this survey was to meet the Ministerial conditions for on-going monitoring of conservation significant fauna and to provide analogue sites for when fauna monitoring was undertaken in the rehabilitated areas. Pit-traps, aluminium box traps and cage traps were deployed (Table 1). Conservation significant fauna recorded during this survey included Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*), Western Whipbird, Western Brush Wallaby (*Macropus irma*), Southern Brown Bandicoot and Rainbow Bee-eater (*Merops ornatus*) (Appendix A). Coffey Environments (2009b) reported a dead Chuditch on the southern access road into the RNO, but coordinates were not provided.

Coffey Environments (2010) undertook a second vertebrate fauna monitoring survey to comply with Ministerial conditions. Survey sites included those used in 2009 plus 14 additional sites (N1-N10 and C1-C4) and the field survey was completed between 8-18 January 2010. These additional sites were used to provide a comparison with the existing 20 Shoemaker-Levy and Halley's pit sites (Table 1). Pit-traps, aluminium box traps and cage traps were deployed at sites N1-N10, and cage traps where deployed at sites C1-C4. Chuditch were caught in cage traps, and the Western Mouse and Heath Rat were caught in pipe pit-traps. A Malleefowl was also recorded during the survey. Conservation significant fauna recorded during this survey are shown in Appendix A. The identification of the Heath Rat was not confirmed with a photo or tissue sample.

Terrestrial Ecosystems (2013) established six trapping sites in 2013 as part of a long-term monitoring program for conservation significant fauna. Sites A, C, D and E each had 100 aluminium box traps and 20 wire cage traps, and sites B and F had 50 aluminium box traps and 10 wire cage traps (Table 1). Site A was split into east and west trapping grids each with 50 aluminium box traps and 10 wire cage traps. The location of all trapping sites was marked with a star picket. In addition, eleven sites were established and marked with a star picket to monitor the presence of the mallee subspecies of the Western Whipbird. Conservation significant fauna recorded during the survey are shown in Appendix A.

Terrestrial Ecosystems (2014) established a new trapping site G to replace site B (Terrestrial Ecosystems 2013) which had been removed due to mining activity. Western Whipbird monitoring site 7 was also removed due to mining activity but this site was not replaced. In addition, 50 camera traps were deployed as follows: site A east – 3 camera traps, site A west – 3 camera traps, site D – 9 camera traps, site E – 10 camera traps, site F – 5 camera traps, site G – 10 camera traps (Coffey Environments 'gully' site) and Coffey Environments' (2010) Chuditch trapping site on the 'hill' – 10 camera traps (Table 1). Conservation significant fauna recorded during the survey are shown in Appendix A.

Terrestrial Ecosystems (2015a) undertook its third annual conservation significant fauna monitoring survey in October 2015. Camera traps were deployed between 14-17 September 2015 and closed on 14-15 October 2015. Traps were laid out and opened on 13-14 October 2015 and all traps were cleared daily and closed on 18-19 October 2015 for five nights of trapping at each site. Trapping and Western Whipbird monitoring sites were the same as in 2014. Conservation significant fauna recorded during the survey are shown in Appendix A.

Terrestrial Ecosystems (2017a) undertook its fourth annual conservation significant fauna monitoring survey between September and November 2016. Camera traps were deployed between 13-18 September 2016 and retrieved between 15-18 November 2016. Traps were laid out and opened on 15-16 November 2015 and all traps were cleared daily and closed on 20-21 November 2016 for five nights of trapping. Fauna trapping, and Whipbird monitoring sites were the same as in 2014 and 2015, but 119 baited large wire cage traps were deployed to target feral cats (Table 1). Conservation significant fauna recorded during this survey are shown in Appendix A. This survey report also includes camera trap records for the infrastructure corridor and Hale Bopp North West pit area, as these areas were surveyed concurrently.

Terrestrial Ecosystems (2017c) undertook vertebrate fauna surveys for the Hale Bopp North West pit, an infrastructure corridor and extension to the proposed Shoemaker-Levy mining area. Four site visits were made between September 2016 and March 2017. Camera traps were deployed between 13 and 18 September 2016 and retrieved between 15 and 18 November 2016 in the Hale Bopp North West pit and in the infrastructure corridor. Camera traps were deployed in the Shoemaker-Levy mining area on or about 4 January 2017 and retrieved on or about 24 February 2017. Traps were laid out and opened in the infrastructure corridor and the Hale Bopp North West pit on 20-21 September 2017 and all traps were cleared daily and closed on 25-26 November 2016 for five nights of trapping. Traps were laid out and opened in the Shoemaker-Levy mining area and proposed expansion area on 22 February and closed on 1 March 2017 for seven nights of trapping. The Hale Bopp North West development footprint was also searched for Malleefowl and their mounds. A survey was also undertaken for Western Whipbirds in the infrastructure corridor and in the proposed Hale Bopp North West development footprint. Conservation significant fauna recorded during this survey are shown in Appendix A.

1.4 Project objectives and scope of works

Permanent long-term monitoring sites were established for Heath Rat, Western Mouse, Southern Brown Bandicoot, Chuditch and Western Whipbird in 2013. One trapping and one Whipbird site were deleted in 2013 for mine expansion and a replacement site was established during the 2014 survey. These same sites were used in 2014, 2015 and 2016. Some of these sites are no longer useful for monitoring purposes, as they will be cleared for the proposed Shoemaker-Levy mine and associated infrastructure, so some new sites were added in 2017. The new sites were established based on the dominant fauna habitats near the RNO project, and where possible previous trapping sites were used. Sites were also chosen to minimise potential impacts by the public. Where possible, the existing Western Whipbird sites were utilised. The location of camera trapping and cage trapping sites were altered to better survey and monitor the target fauna in the area.

This revised methodology will partially satisfy the vertebrate fauna monitoring recommendations detailed in the Public Environmental Review which will be submitted to the Environmental Protection Authority for assessment.

To monitor conservation significant fauna and feral predator fauna in 2017, three strategies were adopted:

- deployment of 90 camera traps for approximately 40 days;
- Western Whipbird aural surveys; and
- deployment of 150 baited large wire cage traps and 450 baited aluminium box traps.

Where feasible and practical:

- trapping sites used between 2013 and 2016 in the annual monitoring program were used again, so that data from these monitoring periods years is usable; and
- an integrated program is used to maximise the use of Terrestrial Ecosystems staff time at RNO and reduce costs to FQM Australia.

2 METHODS

Terrestrial Ecosystems' (2013) report outlined the rationale for the trapping program and Whipbird observations, this remains unchanged, although trapping sites have been altered in 2017. This report also recommended the use of camera traps to record the presence of Malleefowl, Chuditch, Western Brush Wallaby, cats and foxes in the project area. This recommendation was implemented in 2014, 2015 and 2016. In 2016, large baited wire cage traps were specifically deployed to target feral cats. This style of cage trap was also used in 2017 to target Chuditch and Southern Brown Bandicoot as well as feral cats.

2.1 Survey sites

The vertebrate fauna monitoring sites were established in the following three main fauna habitat types which are relatively abundant on the RNO tenements:

- Habitat type 1 - Mallee shrubland with dense understory of shrubland, grasses and herbs;
- Habitat type 2 - Open mallee shrubland over low heath, grasses and herbs; and
- Habitat type 4 - Closed mallee shrubland with almost no understory.

One hundred and fifty large wire cage traps and 450 aluminium box traps were deployed. The box traps were deployed in transect with 25 traps at approximately 10m intervals with 225 located in habitat type 1, 150 in habitat type 2 and 75 in habitat type 4. The large cage traps were spaced at least 200m apart along the main access tracks with 75 in habitat type 1, 50 in habitat type 2 and 25 in habitat type 4 (Figure 2; Appendix B).

Target species for the large cage traps included:

- Chuditch;
- Southern Brown Bandicoots; and
- Feral cats.

Target species for the aluminium box traps were;

- Heath Mouse;
- Western Mouse;
- Ash-grey Mouse;
- Grey-bellied Dunnart; and
- Mitchell's Hopping Mouse.

Aluminium box traps were baited with universal bait (i.e. a mixture of peanut butter, sardines and rolled oats). Wire cage traps were baited with an open tin of sardines. Baits were replenished when taken.

Traps were laid out and opened on 2 November 2017. All traps were cleared daily and closed on 7 November 2016 for five nights of trapping.

Plate 1. Cage trap site

2.2 Cameras

Ninety camera traps (Reconyx HC600) were deployed as part of the monitoring program with 45 cameras located in habitat type 1, 30 cameras in habitat type 2 and 15 in habitat type 4. Cameras were spaced more than 200m apart so that observations could be considered independent. Locations of all camera traps are shown in Figure 2. Details of all camera locations are outlined in Appendix B.

Non-reward bait pods (Plate 2) containing a bolus of universal bait (peanut butter, sardines and rolled oats) and topped up with mullie oil were used as a lure for fauna. All bait pods were partially buried into the ground and secured with a metal stake. Cameras were mounted on a star picket (Plate 3) 2-4m from the bait pod and directed to capture images of fauna moving through the area or attracted to the lure.

Cameras were deployed between 17-21 September 2017 and retrieved between 1-4 November 2017.

Plate 2. Non-reward bait pod containing a lure secured in the ground

Plate 3. Camera trap attached to a star picket

2.3 Western Whipbird observations

Six of the Western Whipbird monitoring sites use in 2014, 2015 and 2016 were revisited as part of the monitoring program (i.e. WW 1-5, 11). Sites WW-6, WW-8, WW-9 and WW-10 were not surveyed due to the potential for future disturbance as part of mine expansion operations. Site WW-7 was removed during clearing operations. Sites WW-12 to WW18 were established as part of the investigation into the mine expansion and were not surveyed. Six new survey sites were established (i.e. WW19-24). Three of these monitoring sites are along Mason Bay Road and three near Bandalup Track, north of the highway (Figure 2; Appendix B).

Surveys for Western Whipbirds were conducted within a two-hour period following sunrise using the following protocol:

- initially listening for a period of 10 minutes;
- if no whipbirds were heard, then the call was played; and
- a further 10-minute listening period was undertaken after the call was played back.

As soon as a Western Whipbird was heard the survey was ended. The call playback was not initiated if a Western Whipbird was heard in the initial 10 minutes of listening.

Incidental observations of Western Whipbirds calling were also recorded while conducting other work.

2.4 Avian survey

Birds seen or heard while undertaking other tasks were recorded and used to create an avian species list for the project area during the deployment of camera traps, and trapping and collection of cameras (i.e. 17-21 September; and 1-7 November 2017).

2.5 Survey personnel

Four Terrestrial Ecosystems staff were involved in the field survey. This report was prepared by Ray Turnbull and reviewed by Dr Graham Thompson and Dr Scott Thompson. The qualifications and experience of Terrestrial Ecosystems staff involved in this survey are shown in Table 2.

Table 2. Qualifications and experience of Terrestrial Ecosystems survey and review team

Name	Qualifications	Experienced
Dr Graham Thompson	PhD (Zoology)	> 20 years
Dr Scott Thompson	BSc, MSc, PhD (Env Sci/Man)	> 15 years
Ray Turnbull	B Nat Res, G.Dip Ornithology	> 10 years
Erika Eto	B Sc (Hons)	< 2 years
Sasha Ayton	B Sc (Hons)	< 2 years

2.6 Weather

Table 3 shows the daily minimum and maximum temperatures and rainfall for the survey trapping period as recorded at the Ravensthorpe weather station.

Table 3. Daily weather data record in the RNO project area

Date	Min. Temp. ºC	Max. Temp. ºC	Rainfall (mm)
1/11/2017	7.75	20.77	0
2/11/2017	9.96	14.73	0.8
3/11/2017	10.02	18.02	0
4/11/2017	8.70	22.33	0
5/11/2017	7.53	21.73	0
6/11/2017	7.63	24.08	0
7/11/2017	10.27	29.91	0

2.7 Limitations

The weather was suitable for trapping and was generally mild to warm.

Australia Ravens and Currawongs disturbed some of the aluminium box traps by taking the bait and removing the trap pins. Where possible, traps were rebaited late in the day, however, some traps would have been ineffective on some nights.

The EPA's (2016) Guidance for *Technical Guidance Terrestrial Fauna Surveys* suggested that fauna surveys may be limited by many variables. Limitations associated with each of these variables are assessed in Table 4.

Table 4. Fauna assessment limitations and constraints

Possible limitations	Constraint (yes/no); significant, moderate or negligible	Comment
Competency and experience of the consultant carrying out this assessment	No	The zoologists that undertook the field survey and prepared this monitoring report are familiar with the vertebrate fauna of this bioregion and around RNO, have completed the previous 4 years of surveys and are experienced in these types of surveys.
Scope	No	All aspects of the scope of works have been addressed.
Proportion of fauna identified, recorded and/or collected	No	Not applicable.
Accuracy of previous survey work	Yes, negligible	Terrestrial Ecosystems has reported fauna survey data recorded by various authors but is not able to vouch for the accuracy of this information. It is acknowledged that the taxonomy of Western Australian vertebrates is continually being revised and the nomenclature of some previous captures may have changed since publication by the authors.
Sources of information	Yes, negligible	Vertebrate fauna information was available from on-line databases and unpublished and published reports of surveys conducted on-site over a period of time. Many of these surveys employed a low level of trapping effort which significantly impacts on the capacity of these data to represent the fauna assemblages in the areas surveyed.
Timing/weather/ season/ cycle	No	Weather was suitable for a survey.
Disturbances which affected results of the survey	No	Ravens and Currawongs reduced the effectiveness of the aluminium box trapping, but this would not have significantly impacted the results. This level of disturbance has been considered in this assessment.
Intensity of survey effort	No	The survey effort is consistent with previous years.
Resources	No	Adequate resources were available.
Remoteness and/or access problems	Yes, negligible	Access was not a significant limitation or constraint.
Availability of contextual information on the region	No	There is a reasonable quantity of historical fauna survey data available for this project area.

Negligible = less than 20%.

3 RESULTS

3.1 Aluminium box and cage trap captures

Appendix C contains the complete list of vertebrate fauna caught and the location for each capture. Table 5 provides a summary of the number of individuals caught in the trapping program for each species across all sites.

Table 5. Number of individuals caught for each species

Taxa	Species	Common Name	Number caught
Birds	*Cracticus torquatus*	Grey Butcherbird	1
Mammals	*Dasyurus geoffroii*	Chuditch	16
	Tarsipes rostratus	Honey Possum	1
	Mus musculus	House Mouse	4
	Rattus fuscipes	Bush Rat	14
Reptiles	*Tiliqua occipitalis*	Western Bluetongue	4
	Tiliqua rugosa	Bobtail	94
	Varanus rosenbergi	Heath Monitor	7

3.2 Camera traps

Vertebrate fauna have been recorded for each camera trap and the data grouped by habitat on a 'presence only' basis (Tables 6-8). Where possible we have provided an indicative number or minimum number of individuals present (i.e. based on colour patterns or number of individuals in one image), however, this is not an accurate count. The number of animals recorded by habitat is shown in Table 9.

Table 6. Fauna present as recorded on cameras in habitat type 1

	Camera No.	1	2	3	4	5	6	18	19	20	21	22	23	24	25	26
Anthochaera carunculata	Red Wattlebird										1					
Corvus coronoides	Australian Raven	x	x	x	x	x	X	x	x	x	x58	x	x	x	x	x
Gymnorhina tibicen	Australian Magpie								x		1		x		x	
Dromaius novaehollandiae	Emu	x	x	x	x	x	x	x	x	x	8+	14+	x	x	x	x
Phaps elegans	Brush Bronzewing										1					1
Strepera versicolor	Grey Currawong	1														
Felis catus	Feral Cat	1	1		1	1	1	1	x	x		1		1	1+	2+
Macropus fuliginosus	Western Grey Kangaroo	x	x	x	x	x	x	x	x	x	2+	x	x	x	x	
Macropus irma	Western Brush Wallaby		2+				3+	2+	x		1	1	2	1	2	x
Oryctolagus cuniculus	Rabbit				1		1+									
Vulpes vulpes	Red Fox	1+	1+	1		1+	1+	1	x	x	1	1				
Tiliqua rugosa	Bobtail			1												
	Camera No.	27	28	29	30	34	35	36	37	38	39	40	41	42	47	49
Corvus coronoides	Australian Raven	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Dromaius novaehollandiae	Emu	11+	11+	9+	x	13+	10+	x	13+	x	x	x	x	x	x	x
Phaps chalcoptera	Common Bronzewing						1	1			1	x			x	
Phaps elegans	Brush Bronzewing		1			1						x			x	
Strepera versicolor	Grey Currawong	1	1		1										x	x
Dasyurus geoffroii	Chuditch					1	1	1					1		x	x
Felis catus	Feral Cat	1	3	2	1	1	1		1	1	1	x			x	x
Macropus fuliginosus	Western Grey Kangaroo	2+	2+	2+	x	x	x	x	x	x	x	x	x	x	x	x
Macropus irma	Western Brush Wallaby	3+	1+	1	1	1	3+	x	1	3+	x	x	2+	x	x	x
Tachyglossus aculeatus	Echidna					3		2								
Vulpes vulpes	Red Fox					1									x	
	Camera No.	50	51	52	53	55	58	60	61*	62	63	64	65	66	74	75
Corvus coronoides	Australian Raven	x	x	x	x	x	x	x		x			x		x	x
Dromaius novaehollandiae	Emu	x	x	x	x	x	x	x		x	x	x	x	x	x	x
Phaps chalcoptera	Common Bronzewing															2
Strepera versicolor	Grey Currawong			x			x						1			
Dasyurus geoffroii	Chuditch					x	x			1						
Felis catus	Feral Cat		x	x		x	x				x		1		x	1
Macropus fuliginosus	Western Grey Kangaroo	x	x	x	x	x	x	x		x	x	x	x	x	x	x
Mus sp.	Mouse/Rat sp.															
Macropus irma	Western Brush Wallaby	x	x	x	x	x	x	1+		1+	x	1+	4+	2+	x	x
Tachyglossus aculeatus	Echidna		x	x		x		1					1			
Vulpes vulpes	Red Fox		x	x	x			1			x					
Tiliqua rugosa	Bobtail		2										1			

*Camera malfunctioned

Table 7. Fauna present as recorded on cameras in habitat type 2

	Camera No.	7	8	9	12	13	14	15	16	17	31	32	33	43	44	45
Aquila audax	Wedge-tailed Eagle							2								
Corvus coronoides	Australian Raven	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Gymnorhina tibicen	Australian Magpie						1	1								
Dromaius novaehollandiae	Emu	x	x	x	x	x	x	x	x	x	9+	x	x	x	x	x
Phaps elegans	Brush Bronzewing			1			1			1						
Strepera versicolor	Grey Currawong								1	1					x	x
Turnix varius	Painted Button-quail															x
Dasyurus geoffroii	Chuditch				1			1			1		1+	x		x
Felis catus	Feral Cat	1				x	1	1	1	1	1					x
Macropus fuliginosus	Western Grey Kangaroo	x	x	x	x	x	x	x	x	x	1+	x	x	x	x	x
Macropus irma	Western Brush Wallaby	1+		1+	1	x	1	1+	1	1	2	1		x	x	x
Vulpes vulpes	Red Fox	1			1	x		1								
Tiliqua rugosa	Bobtail															x
Varanus rosenbergi	Heath Monitor															x
	Camera No.	46	48	54	56	57	59	67	68	76	77	86	87	88	89	90
Accipiter fasciatus	Brown Goshawk														x	
Anthochaera carunculata	Red Wattlebird						x									
Corvus coronoides	Australian Raven	x	x	x	x	x	x				x	x	x			x
Gymnorhina tibicen	Australian Magpie		1													
Dromaius novaehollandiae	Emu	x	x	x	x	x	x		x	x	x	x	x	x	x	x
Phaps chalcoptera	Common Bronzewing	x								2						
Phaps elegans	Brush Bronzewing		3+													
Strepera versicolor	Grey Currawong	x	1+		x		x			2						x
Dasyurus geoffroii	Chuditch			2			x					x	x			x
Felis catus	Feral Cat		1	2+	x		x			1+			x	x		
Macropus fuliginosus	Western Grey Kangaroo	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Macropus irma	Western Brush Wallaby			x	x	x	x	x	x	x	1+	x		x		x
Tachyglossus aculeatus	Echidna			x				x						x		x
Vulpes vulpes	Red Fox		1	x												
Tiliqua rugosa	Bobtail	x						1						x		

Table 8. Fauna present as recorded on cameras in habitat type 4

	Camera No.	10	11	69	70	71	72	73	78	79	80	81	82	83	84	85
Aquila audax	Wedge-tailed Eagle														x	
Corvus coronoides	Australian Raven		x	x		x	x	x			x	x	x	x	x	
Dromaius novaehollandiae	Emu	x	x	2		x	x	x	x	x	x	x	x	x	x	x
Leipoa ocellata	Malleefowl										1					
Oreoica gutturalis	Crested Bellbird									1						
Phaps chalcoptera	Common Bronzewing										1					
Phaps elegans	Brush Bronzewing							1								x
Strepera versicolor	Grey Currawong	1	1+		1		1								x	
Turnix varius	Painted Button-quail		1													
Dasyurus geoffroii	Chuditch					1+	1+	1+							x	
Felis catus	Feral Cat	1		2						1	1		1			
Macropus fuliginosus	Western Grey Kangaroo	x	x	x	x			x	x	x	x	x	x	x	x	x
Macropus irma	Western Brush Wallaby	1+	1+	2	3+	3+	3+	2+	1+	3+	3+	1	1+	x		x
Tachyglossus aculeatus	Echidna		1		1			1				1		x		
Vulpes vulpes	Red Fox	1								1				x	x	
Tiliqua rugosa	Bobtail		1													x

Table 9. Conservation significant fauna and pest species recorded by camera traps by habitat type

		Habitat Type			
		1	2	4	Total
Leipoa ocellata	Malleefowl	-	-	1	1
Dasyurus geoffroii	Chuditch	9	11	4	24
Macropus irma	Western Brush Wallaby	39	24	14	77
Felis catus	Feral Cat	32	15	5	52
Vulpes vulpes	Red Fox	17	6	4	27
Oryctolagus cuniculus	Rabbit	2	-	-	2

Table 10. Species recorded by camera traps in 2014, 2015, 2016 and 2017

Species	Year	2014	2015	2016	2017
Leipoa ocellata	Malleefowl	X		X	X
Dasycercus geoffroii	Chuditch		X	X	X
Felis catus	Feral Cat	X	X	X	X
Macropus fuliginosus	Western Grey Kangaroo	X	X	X	X
Macropus irma	Western Brush Wallaby	X	X	X	X
Mus/Rattus sp.	Unidentified Mouse/Rat	X	X	X	X
Oryctolagus cuniculus	Rabbit	X	X	X	X
Tachyglossus aculeatus	Echidna	X	X	X	X
Vulpes vulpes	Red Fox	X	X	X	X

3.3 Western Whipbirds

Surveys for Western Whipbirds were conducted between 17-21 September 2017 using the protocol described earlier and the results are shown in Table 11. A detailed account of any incidental observations is also provided (Table 11). Western Whipbirds were recorded at 10 of the 12 monitoring sites and as incidental observations.

Table 11. Western Whipbird observations

Site	Findings
WW-1	Surveyed on 17-09-2017 (0646-0706). A probable bird was heard calling well to the north. Surveyed again on 18-09-2017 (0634-0635). A whipbird was heard calling at 0635 50m to the south during the initial listening period.
WW-2	Surveyed on 17-09-2017 (0636-0640). A whipbird was heard calling at 0640 100m north west of the site during the initial listening period.
WW-3	Surveyed on 17-09-2017 (0616). A whipbird was heard calling 100m to the south west upon arrival at the site.
WW-4	Surveyed on 137-09-2017 (0608-0610). A whipbird was heard calling at 0610 about 100m to the north east during the initial listening period.
WW-5	Surveyed on 17-09-2017 (0717-0731). A whipbird was heard calling at 0731 about 300m to the north east during the second listening period after the call was played.
WW-11	Surveyed on 17-09-2017 (0608). A whipbird was heard calling 50m to the west upon arrival at the site.
WW-19	Surveyed on 18-09-2017 (0720-0734). A whipbird was heard calling at 0734 about 50m to the south during the second listening period after the call was played.
WW-20	Surveyed on 18-09-2017 (0545-0605). No whipbirds recorded. Surveyed again on 19-09-2017 (0806-0826). No whipbirds recorded. Surveyed again on 20-09-2017 (0700-0702). A whipbird was heard calling at 0702 about 100m north west during the initial listening period.

Site	Findings
WW-21	Surveyed on 19-09-2017 (0650-0710). No whipbirds recorded. Surveyed again on 20-09-2017 (0644-0647). A whipbird was heard calling at 0647 about 50m to the west during the initial listening period.
WW-22	Surveyed on 19-09-2017 (0553-0613). No whipbirds recorded. Surveyed again on 20-09-2017 (0620-0640). No whipbirds recorded. Surveyed again on 21-09-2017 (0619-0639). No whipbirds recorded.
WW-23	Surveyed on 19-09-2017 (0620-0640). No whipbirds recorded. Surveyed again on 20-09-2017 (0556-0616). No whipbirds recorded. Surveyed again on 21-09-2017 (0555-0615). No whipbirds recorded.
WW-24	Surveyed on 17-09-2017 (0608). A whipbird was heard calling 50m to the west upon arrival at the site.

Incidental Western Whipbird observations

17-09-2017

- At 1153 a whipbird was heard calling 100m west of camera site 39 whilst installing camera traps. (UTM 255841E, 6271375N)

18-09-2017

- At 0808 a whipbird was heard calling near the junction of Mason Bay Road and the weather station track. (UTM 255847E, 6271577N)
- At 0824 a whipbird was heard calling 25m west of camera site 35 whilst installing camera traps. (UTM 255866E, 6272171N)
- At 0929 a whipbird was heard calling 100m north east of camera site 31 whilst installing camera traps. (UTM 255892E, 6273013N)
- At 0952 a whipbird was heard calling 100m north west of camera site 29 whilst installing camera traps. (UTM 255897E, 6273408N)
- At 1031 a whipbird was heard calling 50m east of camera site 28 whilst installing camera traps. (UTM 255898E, 6273593N)
- At 1110 a whipbird was heard calling 25m north of camera site 25 whilst installing camera traps. (UTM 255539E, 6274104N)

19-09-2017

- At 1210 a whipbird was heard calling 50m south of WW-3 whilst installing camera traps. (UTM 254918E, 6272971N)

20-09-2017

- At 0744 a whipbird was heard calling 25m south of camera site 64 whilst installing camera traps. (UTM 254973E, 6273142N)
- At 0928 a whipbird was heard calling 50m west of camera site 73 whilst installing camera traps. (UTM 256315E, 6273657N)

21-09-2017

- At 0914 a whipbird was heard calling 100m north of camera site 5 whilst installing camera traps. (UTM 257697E, 6276502N)

02-11-2017

- At 1236 a whipbird was heard calling at the intersection of Masons Bay Road and the north-west track. (UTM 255075E, 62744867N)

03-11-2017

- At 0820 a whipbird was heard calling near Cage 95. (UTM 255569E, 6275339N)
- At 0854 a whipbird was heard calling at the junction of Mason Bay Road and the old laydown track. (UTM 255245E, 6274563N)
- At 1042 a whipbird was heard calling near Camera Site 53. (UTM 256033E, 6271294N)
- At 1119 a whipbird was heard calling near Camera Site 82. (UTM 254563E, 6275655N)
- At 1140 a whipbird was heard calling near Camera Site 78. (UTM 254943E, 6274954N)

05-11-2017

- At 0758 a whipbird was heard calling west of Trap 287. (UTM 255159E, 6274657N)

3.4 Malleefowl

Malleefowl were recorded at one camera trap site only in habitat type 4 (Table 8).

3.5 Chuditch

Chuditch were recorded by 24 camera traps and in all habitat types (Tables 6-8). Chuditch were captured 16 times during the trapping program of which nine were recaptures.

3.6 Western Brush Wallaby

Western Brush Wallabies were recorded by 77 of 90 camera traps in all habitat types (Tables 6-8).

3.7 Avian survey results

Fifty-three species of birds were recorded during the fauna monitoring program (Table 12).

Table 12. Birds recorded during the fauna monitoring program

Family	Species	Common Name
Casuariidae	*Dromaius novaehollandiae*	Emu
Megapodidae	*Leipoa ocellata*	Malleefowl
Columbidae	*Phaps elegans*	Brush Bronzewing
	Phaps chalcoptera	Common Bronzewing
	Ocyphaps lophotes	Crested Pigeon
Accipitridae	*Aquila audax*	Wedge-tailed Eagle
	Lophoictinia isura	Square-tailed Kite
	Accipiter fasciatus	Brown Goshawk
Falconidae	*Falco cenchroides*	Nankeen Kestrel
	Falco berigora	Brown Falcon
Turnicidae	*Turnix varius*	Painted Button-quail
Cacatuidae	*Calyptorhynchus latirostris*	Carnaby's Black-Cockatoo
	Eolophus roseicapillus	Galah
Psittacidae	*Glossopsitta porphyrocephala*	Purple-crowned Lorikeet
	Barnardius zonarius	Australian Ringneck
Cuculidae	*Chalcites basalis*	Horsfield's Bronze-Cuckoo
	Chalcites lucidus	Shining Bronze-cuckoo
	Cacomantis flabelliformis	Fan-tailed Cuckoo
Maluridae	*Malurus splendens*	Splendid Fairywren
	Malurus pulcherrimus	Blue-breasted Fairywren
Acanthizidae	*Hylacola cauta*	Shy Heathwren
	Smicrornis brevirostris	Weebill
	Sericornis frontalis	White-browed Scrubwren
	Acanthiza apicalis	Inland Thornbill
Pardalotidae	*Pardalotus punctatus*	Spotted Pardalote
	Pardalotus striatus	Striated Pardalote
Meliphagidae	*Lichenostomus cratitius*	Purple-gaped Honeyeater
	Manorina flavigula	Yellow-throated Miner
	Anthochaera lunulata	Western Wattlebird
	Anthochaera carunculata	Red Wattlebird
	Glyciphila melanops	Tawny-crowned Honeyeater
	Lichmera indistincta	Brown Honeyeater
	Phylidonyris novaehollandiae	New Holland Honeyeater
Pomatostomidae	*Pomatostomus superciliosus*	White-browed Babbler
Eupetidae	*Psophodes nigrogularis*	Western Whipbird
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike

Family	Species	Common Name
	Lalage sueurii	White-winged Triller
Pachycephalidae	*Pachycephala pectoralis*	Golden Whistler
	Colluricincla harmonica	Grey Shrike-thrush
	Oreoica gutturalis	Crested Bellbird
Artamidae	*Artamus cinereus*	Black-faced Woodswallow
	Cracticus torquatus	Grey Butcherbird
	Gymnorhina tibicen	Australian Magpie
	Strepera versicolor	Grey Currawong
Rhipiduridae	*Rhipidura leucophrys*	Willie Wagtail
Corvidae	*Corvus coronoides*	Australian Raven
Monarchidae	*Grallina cyanoleuca*	Magpie-lark
Petroicidae	*Drymodes brunneopygia*	Southern Scrub-robin
	Eopsaltria griseogularis	Western Yellow Robin
Timaliidae	*Zosterops lateralis*	Silvereye
Hirundinidae	*Hirundo neoxena*	Welcome Swallow
	Petrochelidon nigricans	Tree Martin

4 DISCUSSION

4.1 General

4.1.1 Trapping effort

The total trapping effort in 2017 of 2,250 aluminium box trap-nights and 750 cage trap-nights is similar to the previous monitoring surveys implemented by Terrestrial Ecosystems (Table 1). This trapping effort significantly exceeds the trapping effort of Chapman (2000) and Biota Environmental Sciences (2000, 2005a) and is comparable with Coffey Environments (2009b, 2010) 1,680 aluminium box trap-nights and 560 cage trap nights in 2009 and 2,520 aluminium box trap-nights and 420 cage trap-nights in 2010. It appears as if the trapping effort was adequate and it is not the reason for the lack of captures of conservation significant fauna.

4.1.2 Trap locations

Trapping locations for the monitoring surveys from 2013-2016 were selected based on where Western Mice, Heath Rats, Chuditch and Southern Brown Bandicoots had been previously caught, but they were altered in 2017 to better represent the habitat matrix present in the project area and to not be in areas that will be cleared for the proposed Shoemaker-Levy mine.

4.1.3 Bait

The universal bait used to trap the Western Mouse and Heath Rat is widely used and there is no evidence to indicate that it was unsuitable (Cockburn 1978, Quinlan et al. 2004). Wayne et al. (2008) concluded that chicken frames were superior to the universal bait for Chuditch, and Terrestrial Ecosystems routinely uses white bread and peanut butter to trap Southern Brown Bandicoots. Paull et al. (2011) compared three bait types for attracting small mammals to cameras: peanut butter with rolled oats, black truffle oil and live mealworms in bran. Overall, they concluded that peanut butter and rolled oats was a significantly superior bait type for *Antechinus*, *Isoodon*, *Perameles* and *Rattus*, relative to a control bait. Chuditch were attracted to bait pods containing sardines, rolled oats, peanut butter and mullie oil. So, it does not appear as if the bait used was an issue.

4.1.4 Trap type

It is not known in what trap type the Western Mice and Heath Rats were caught in during the Chapman (2000) and Biota Environmental Sciences (2000, 2005a) surveys, however, Coffey Environments (2010) caught both species in pipe pit-traps in 2010 where no bait was used. Rodents are often targeted using aluminium box traps (Quinlan et al. 2004), however, based on a single survey by Coffey Environments (2010), the non-use of pit-traps may have been a factor in not catching Western Mice and Heath Rats.

4.1.5 Seasonal population fluctuations and fire

Dickman et al. (1999) reported all species of rodents monitored over a period of 7-9 years fluctuated dramatically, from being absent or in low numbers during droughts and erupting after rainfall. If Heath Rats and Western Mice are in low numbers in years when resources are plentiful or after a major wide spread fire, then it might be expected that they would be almost undetectable in years when resources were limited. Rainfall prior to the 2017 survey had been sufficient for an abundance of native plants to flower, so if this is an indication of the available resources, then resources should not have been a limiting factor.

Much of the project area was significantly impacted by a severe fire in 2003, but this did not affect all areas. This fire might account for a reduction in Malleefowl, Heath Rat and Western Mice in areas that were burnt and adjacent areas. The regeneration of habitat in fire affected areas appears suitable to support all three species, but if source populations are not present, then their numbers will not increase until animals move in from adjacent areas.

Southern Brown Bandicoot numbers can be influenced by predation and a loss of suitable habitat. Coates and Wright (2003), for example, indicated that Southern Brown Bandicoots are susceptible to predation by foxes and cats, both of which are present in the project area.

4.1.6 Predators

The presence of introduced predators, in particular the cat and fox, were surveyed using camera traps and cage traps. No cats or foxes were captured; however, cats were recorded by 50 camera traps and foxes by 26 camera traps in all habitat types. Exploration activity that clears numerous tracks through the relatively dense undergrowth enables both of these species to have much better access to a greater range of habitats. This access can result in a high level of predation which in turn leads to increased predator numbers.

Western Mice, Heath Rat and the Southern Brown Bandicoots were recorded in very low number in early surveys (see Biota Environmental Sciences 2000, Chapman 2000, Coffey Environments 2009a, 2010), but are now rarely or not recorded. This suggests that the continued presence of feral cats and foxes is having an ongoing impact on these species. Feral cats and in particular foxes is also likely to be impacting on Malleefowl (Department of the Environment and Energy 2018a).

4.2 Vertebrate Fauna

4.2.1 Western Whipbirds

Western Whipbirds were recorded at 10 of the 12 monitoring sites (Table 11). Western Whipbirds were heard calling at similar locations to previous surveys by Chapman (2000), Coffey Environments (2009b), Biota Environmental Sciences (2000, 2005a) and Terrestrial Ecosystems (2013, 2014, 2015a, 2017a). Chapman (2000) reported Western Whipbirds at 10 sites and Biota Environmental Sciences (2000, 2005a) reported Western Whipbirds at 10 and 3 sites in 2000 and 2005 respectively, and Chapman, working for Coffey Environments (2009b), again recorded Western Whipbirds at three sites in 2009. Western Whipbirds therefore appear to be relatively abundant in areas adjacent to the mining operations.

4.2.2 Mammals

Details of the number of mammals caught during this and previous surveys are outlined in Table 13.

No Western Mice, Heath Rats or Southern Brown Bandicoots were caught or observed in the 2017 monitoring survey. Mitchell's Hopping Mice and Ash Grey Mice were caught in 2014 but were not caught between 2015-2017 (during the monitoring surveys), and the number of Bush Rats caught has increased from a low of one capture in 2015 to 14 captures this survey. Cooper et al. (2003) reported the Heath Rat in Western Australia to have a preference for long-unburnt areas (30-70 years) which contrasts with the same species in Victoria that has a preference for post-fire regrowth (Cockburn et al. 1981). Heath Rats are either rare across its range or difficult to trap. For example, Cooper et al. (2003) cited survey work in the Fitzgerald Biosphere Reserve between 1993 and 2001, with 77 captures from 11 sites from 4,460 aluminium box trap-nights and 1,494 pit trap-nights. Ash-Grey Mice have been recorded by Terrestrial Ecosystems (2017c) during surveys for the mine expansion but not during the monitoring programs.

It is interesting to note that Chapman (2000) recorded 17 Western Mice and six Heath Rats, Biota Environmental Science (2000) caught two Western Mice and one Heath Rat in 2000, and four Western Mice in 2005, Coffey Environments (2009b, 2010) caught no Western Mice or Heath Rats in 2009 and two Western Mice and one Heath Rat in 2010. Terrestrial Ecosystems (2013, 2014, 2015a, 2017a) caught no conservation significant mammals during the four monitoring surveys in 2013, 2014, 2015 and 2016, apart from seven captures of Chuditch in 2016 and 16 in this year's survey, and had multiple images on camera traps. Only two Southern Brown Bandicoots have been caught, one in 2000 and the other in 2009, and they were not subsequently recorded in Terrestrial Ecosystems monitoring surveys. One however, was recorded on a camera trap in the proposed infrastructure corridor during November 2016 (Terrestrial Ecosystems 2017a).

In 2015, images of Chuditch were recorded by cameras at sites D20, D40, D70, D80, D90, F21, F25, seven of the cameras on the hill and one of the cameras at site G and in 2016 at sites Site A (east), D, E, G and 10 sites on the

hill. In 2016, seven Chuditch were also caught in baited wire cage traps set to catch cats at trapping sites 25 (near site A - east), 82, 95, 96 and 98 (Mason Bay Road). Of these, four were new individuals, and the others were recaptures. In this survey, Chuditch were captured on 16 occasions. Nine of these captures were of previously caught individuals, whereas, seven captures were of new animals. They were also recorded at 24 camera trap sites in all habitat types. These data indicate an increase in the number of Chuditch in the project area as they are now being recorded at sites where they have not been previously recorded.

Table 13. Comparison of the number of mammals caught in previous monitoring surveys

Species	Common Name	2013	2014	2015	2016	2017
Dasyurus geoffroii	Chuditch	-	-	-	7	16
Felis catus	Cat	1	3	2	3	-
Mus musculus	House Mouse	5	5	-	-	4
Notomys mitchellii	Mitchell's Hopping Mouse	2	1	-	-	-
Pseudomys albocinereus	Ash Grey Mouse	1	1	-	-	-
Rattus fuscipes	Bush Rat	16	6	1	4	14
Sminthopsis griseoventer	Grey-bellied Dunnart	1	-	-	-	-
Tachyglossus aculeatus	Echidna	1	-	-	-	-
Tarsipes rostratus	Honey Possum	-	-	-	-	1

One cat was caught in 2013, three cats were caught in 2014, two cats were caught in 2015 and three cats were caught in 2016 with the addition of 119 traps to specifically target cats. An additional 21 cats and 11 foxes were euthanased in 2017 (Terrestrial Ecosystems 2017b). No cats were caught as part of this survey, although they were recorded by 52 of the 90 camera traps, suggesting they are still widespread. Foxes were recorded by 27 of the 90 camera traps.

4.2.3 Malleefowl

Malleefowl were reported by Chapman (2000) and Biota Environmental Sciences (2000) and a single bird was seen in 2010 by Coffey Environments (2010). The Coffey Environments (2009b) and Terrestrial Ecosystems (2013) surveys covered large areas and habitat that was suitable for Malleefowl but they were not seen. The known Malleefowl mounds in the area were destroyed with the development of Halley's pit, waste dumps and tailings storage facilities. These data, although not systematically recorded, would suggest a decline in the number of Malleefowl in the project area that probably coincides with the widespread 2003 fire.

Malleefowl were recorded at two camera locations and on Masons Bay Road during the 2014 survey, they were not recorded during the 2015 survey but were recorded at sites A (east and west), D, E, G and on the hill in 2016. During this survey, Malleefowl were recorded once by camera trap 80 and once crossing Mason Bay Road.

4.2.4 Western Brush Wallaby

Western Brush Wallabies were recorded at 77 of the 90 camera traps across all habitat types. At many of these sites they were seen on multiple occasions. Some of these occasions would have been the same individual returning to the area or being recorded on multiple cameras deployed in an area. It does, however, suggest that they are widespread across the area.

4.2.5 Chuditch

Chuditch were first recorded on site by Coffey Environments (2010). In 2015 they were recorded on camera traps at multiple locations (Terrestrial Ecosystems 2015a) and in 2016, they were recorded at multiple camera trap locations and also captured on seven occasions (Terrestrial Ecosystems 2017a). In this survey they were captured on 16 occasions (9 recaptures) and recorded at 24 camera trap locations. Chuditch numbers fluctuate and they are predated on by foxes, however, it is likely that there has been an increase in the local population as they are now being recorded at new locations.

4.2.6 Cats and foxes

Cats and foxes were recorded by multiple camera traps across all habitat types suggesting that they are widespread and reasonably abundant.

Burbidge(2004), in his book on threatened animals in Western Australia, indicated that the fox was a known predator of Chuditch, Heath Rat and Malleefowl, and the cat is a known threat to the Heath Rat. The national recovery plan for Malleefowl (Benshemesh 2007) reported the fox, and to a lesser extent cats and raptors as a major cause of mortality of Malleefowl. Similarly, the national recovery plan for Chuditch lists predation by, and competition from, feral dogs, foxes and feral cats among other factors contributing to its decline.

The cat and fox reduction program that was commenced in 2017 should see a significant long-term increase in the Malleefowl and Chuditch, and perhaps Southern Brown Bandicoots, Ash Grey Mice, Heath Rat and Western Mouse if residual populations still exist in the area.

A significant decline in fox numbers could result in an increase in the number of cats (i.e. mesopredator release), which is highly undesirable. Therefore, the management program to reduce fox numbers is being undertaken in conjunction with a trapping program to reduce the cat population.

The feral cat and fox reduction program involved the wide scale distribution of buried 1080 baits with a follow up distribution at 2, 4 and 6-week intervals in autumn of 2017. Camera traps were used to monitor bait uptake at selected sites. During Stage 1 in 2017 21 cats and 11 foxes were shot or caught and euthanased (Terrestrial Ecosystems 2017b). Significantly more foxes would have died from the 1080 baits.

Stage 2 will involve the deployment of canid pest ejectors (CPE) along established tracks for a period of two years to reduce the number of foxes. Again, bait uptake should be monitored using camera traps. Canid pest ejectors are an effective tool for delivering 1080 (Marks and Bloomfield 1999, Marks et al. 2003). This program should be implemented in autumn and winter 2018 when food for cats and foxes is at its lowest level, thus increasing the bait uptake rate.

Burying 1080 meat baits reduces the bait uptake by non-targeted species such as ravens, currawongs and goannas.

Given the abundance of cats and foxes currently recorded in the RNO tenements, it is highly likely that similar densities exist in the adjacent area, and an influx of individuals from these areas will occur after the initial removal of some foxes and cats on the RNO tenements. To reduce this influx, a cat and fox shooting program was implemented in the paddocks around the RNO mine site in 2017 to complement the trapping programs, and this program should continue.

5 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusion

A baseline monitoring program for the Heath Rat, Western Mouse, Southern Brown Bandicoot and Western Whipbirds was established in 2013 and 50 camera traps were deployed during the 2014 survey to establish baseline data that can now be used to monitor changes in the population of Western Brush Wallabies, Malleefowl, Chuditch, cats and foxes. The 2014, 2015, 2016 and 2017 survey results provide an indication of the number of mammals near the RNO project area. In 2017, the monitoring locations were adjusted to better reflect the habitat matrix on site and to avoid future mine expansion operations.

Cage trap captures, and camera trap recordings indicate that Chuditch are present at numerous locations. The use of large cage traps and different baits (e.g. partially opened tins of sardines) have contributed to the increased number Chuditch captured. The increase in records of Chuditch from both camera traps and cage trap captures suggest that the local population is increasing.

Western Whipbirds are present in numerous locations that have not been recently burnt, with calls heard at a similar number of sites to that reported by Chapman (2000) and Terrestrial Ecosystems (2013, 2014, 2015a, 2017a).

The decline in records of Malleefowl from 2016 to this survey is disappointing. Foxes, and to a lesser extent cats, can predate on Malleefowl, and their abundance is likely to place continual pressure on the survival of the Malleefowl around the mine.

Heath Rats, Southern Brown Bandicoots and Western Mice have not been caught in the 2013, 2014, 2015 and 2016 monitoring surveys, but were caught in some of the earlier surveys (Biota Environmental Sciences 2000, Chapman 2000, Biota Environmental Sciences 2005a, Coffey Environments 2009b). The number of House Mice (5 - 2013, 5 - 2014, 0 - 2015, 0 – 2016, 4-2017), Ash Grey Mice (1 - 2013, 1 - 2014, 0 - 2015, 0 – 2016, 0-2017), Bush Rats (16 - 2013, 6 - 2014, 1 - 2015, 6 – 2016, 14-2017) and Grey Bellied Dunnarts (1 - 2013, 0 - 2014, 0 - 2015, 0 – 2016, 0-2017) caught in the monitoring surveys has generally decreased since 2013, except for Bush Rats which showed an increase during this survey. The number of small mammals caught in 2,250 baited aluminium box-trap nights during this survey is lower than might have been expected.

Cats and foxes were recorded by multiple camera traps across all habitat types. The abundance of feral cats and foxes in the areas monitored would clearly continue to suppress the abundance of small reptiles, mammals and amphibians in the surveyed areas, and would significantly contribute to the decline in Southern Brown Bandicoots, Heath Rats and Western Mice, and would restrict the growth in the number of Malleefowl and Chuditch.

5.2 Recommendation

The low abundance of small mammals caught and reduction in the observations of Malleefowl during the survey is likely to be due to predation by cats and foxes in the project area. Loss of vegetation due to the major fire across some of the RNO tenements in 2003 could also have had an impact in the small mammal population, but the surveys by Coffey Environments (2009b, 2010)indicated that small mammals were present in areas that had been burnt approximately eight years earlier, suggesting that this is not a major factor.

Recommendation 1. The cat and fox reduction program first implemented in 2017 is continued in 2018.

Western Grey Kangaroos are also very common in the project area are doing considerable damage to the fencing, and rabbits are common in some areas, and along with the kangaroos are likely to start impacted on mine rehabilitation and native vegetation.

Recommendation 2. Rabbits and Western Grey Kangaroos are culled concurrently with the cat and fox reduction program.

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Appendix A
Summary of historical fauna survey data for conservation significant species

Appendix A. Summary of historical fauna survey data for conservation significant species

Species	Common Name	Nº of records	Easting	Northing	Site	Reference
Psophodes n. oberon	Western Whipbird	8	254881	6272874	E1	Chapman (2000)
Psophodes n. oberon	Western Whipbird	3	254916	6273037	E2	Chapman (2000)
Psophodes n. oberon	Western Whipbird	1	256141	6273526	E3	Chapman (2000)
Psophodes n. oberon	Western Whipbird	2	256922	6272980	E4	Chapman (2000)
Psophodes n. oberon	Western Whipbird	5	256813	6274885	E5	Chapman (2000)
Psophodes n. oberon	Western Whipbird	4	258863	6271850	CMS1	Chapman (2000)
Psophodes n. oberon	Western Whipbird	6	256612	6272327	CMS2	Chapman (2000)
Psophodes n. oberon	Western Whipbird	13	254881	6272874	CMS3	Chapman (2000)
Psophodes n. oberon	Western Whipbird	1	254662	6274642	CMS4	Chapman (2000)
Psophodes n. oberon	Western Whipbird	1	256065	6272214	-	Chapman (2000)
Leipoa ocellata	Malleefowl	1	255832	6273571	-	Chapman (2000)
Leipoa ocellata	Malleefowl	1	255769	6272758	-	Chapman (2000)
Leipoa ocellata	Malleefowl	1	253853	6273499	-	Chapman (2000)
Leipoa ocellata	Malleefowl	1	254881	6272874	-	Chapman (2000)
Pseudomys occidentalis	Western Mouse	5	258863	6271850	CMS1	Chapman (2000)
Pseudomys occidentalis	Western Mouse	4	256612	6272327	CMS2	Chapman (2000)
Pseudomys occidentalis	Western Mouse	7	254916	6273037	E2	Chapman (2000)
Pseudomys occidentalis	Western Mouse	1	256922	6272980	E4	Chapman (2000)
Pseudomys shortridgei	Heath Rat	4	256141	6273526	E3	Chapman (2000)
Pseudomys shortridgei	Heath Rat	1	256813	6274885	E5	Chapman (2000)
Pseudomys shortridgei	Heath Rat	1	254881	6272874	E1	Chapman (2000)
Isoodon obesulus	Southern Brown Bandicoot	1	254881	6272874	E1	Chapman (2000)
Leipoa ocellata	Malleefowl	1	258752	6272315	Site 5	BES (2000)
Leipoa ocellata	Malleefowl	1	251832	6278164	-	BES (2000)
Psophodes n. oberon	Western Whipbird	-	251997	6280520	Site 4	BES (2000)
Psophodes n. oberon	Western Whipbird	-	258494	6272294	Site 5	BES (2000)
Psophodes n. oberon	Western Whipbird	-	258808	6270857	Site 6	BES (2000)
Psophodes n. oberon	Western Whipbird	-	258805	6271802	Site 7	BES (2000)
Psophodes n. oberon	Western Whipbird	-	254881	6272874	E1	BES (2000)
Psophodes n. oberon	Western Whipbird	-	254916	6273037	E2	BES (2000)
Psophodes n. oberon	Western Whipbird	-	256922	6272980	E4	BES (2000)
Psophodes n. oberon	Western Whipbird	-	256813	6274885	E5	BES (2000)
Psophodes n. oberon	Western Whipbird	-	250688	6278164	-	BES (2000)
Psophodes n. oberon	Western Whipbird	-	258822	6272248	-	BES (2000)
Pseudomys occidentalis	Western Mouse	1	254986	6273022	-	BES (2000)
Pseudomys occidentalis	Western Mouse	1	255037	6273031	-	BES (2000)
Pseudomys shortridgei	Heath Rat	1	251997	6280520	Site 4	BES (2000)
Isoodon obesulus	Southern Brown Bandicoot	1	249835	6281541	CK5	CE (2009b)
Psophodes n. oberon	Western Whipbird	-	257482	6276271	CK3	CE (2009b)
Psophodes n. oberon	Western Whipbird	-	251701	6281945	ML1	CE (2009b)
Psophodes n. oberon	Western Whipbird	-	257631	6276419	ML2	CE (2009b)
Dasyurus geoffroii	Chuditch	9	256130	6272352	Cage 1	CE (2010)
Dasyurus geoffroii	Chuditch	1	256872	6271544	Cage 2	CE (2010)
Pseudomys occidentalis	Western Mouse	1	256777	6272598	N1	CE (2010)
Pseudomys occidentalis	Western Mouse	1	258940	6272024	N8	CE (2010)
Pseudomys shortridgei	Heath Rat	1	257631	6276419	ML2	CE (2010)
Leipoa ocellata	Malleefowl	1	257482	6276271	-	CE (2010)
Psophodes n. oberon	Western Whipbird	-	256774	6272601	WW1	TE (2013)
Psophodes n. oberon	Western Whipbird	-	256017	6272225	WW2	TE (2013)
Psophodes n. oberon	Western Whipbird	-	254917	6272970	WW3	TE (2013)
Psophodes n. oberon	Western Whipbird	-	255905	6272974	WW4	TE (2013)
Psophodes n. oberon	Western Whipbird	-	257167	6271537	WW5	TE (2013)
Psophodes n. oberon	Western Whipbird	-	258380	6272026	WW6	TE (2013)
Psophodes n. oberon	Western Whipbird	-	251905	6280559	WW8	TE (2013)
Psophodes n. oberon	Western Whipbird	-	251718	6281891	WW9	TE (2013)
Psophodes n. oberon	Western Whipbird	-	249851	6281558	WW10	TE (2013)
Psophodes n. oberon	Western Whipbird	-	254294	6273261	WW11	TE (2013)
Macropus irma	Western Brush Wallabies	-	255850	6271307	-	TE (2013)
Psophodes n. oberon	Western Whipbird	-	256780	6272585	RNOCMS2	BES (2005a)
Psophodes n. oberon	Western Whipbird	-	256922	6272980	RNOE4	BES (2005a)
Psophodes n. oberon	Western Whipbird	-	257142	6273254	-	BES (2005a)
Pseudomys occidentalis	Western Mouse	4	256922	6272980	RNOE4	BES (2005a)
Psophodes n. oberon	Western Whipbird	-	256774	6272601	WW1	TE (2014)
Psophodes n. oberon	Western Whipbird	-	256017	6272225	WW2	TE (2014)
Psophodes n. oberon	Western Whipbird	-	254917	6272970	WW3	TE (2014)
Psophodes n. oberon	Western Whipbird	-	255905	6272974	WW4	TE (2014)
Psophodes n. oberon	Western Whipbird	-	257167	6271537	WW5	TE (2014)
Psophodes n. oberon	Western Whipbird	-	251905	6280559	WW8	TE (2014)
Psophodes n. oberon	Western Whipbird	-	251718	6281891	WW9	TE (2014)
Psophodes n. oberon	Western Whipbird	-	249851	6281558	WW10	TE (2014)
Psophodes n. oberon	Western Whipbird	-	254294	6273261	WW11	TE (2014)

Species	Common Name	Nº of records	Easting	Northing	Site	Reference
Psophodes n. oberon	Western Whipbird	-	255195	6272841	E48	TE (2014)
Psophodes n. oberon	Western Whipbird	-	255408	6272731	E86	TE (2014)
Leipoa ocellata	Malleefowl	-	255856	6272767	-	TE (2014)
Leipoa ocellata	Malleefowl	-	249858	6281576	A5	TE (2014)
Leipoa ocellata	Malleefowl	-	257545	6276278	F25	TE (2014)
Macropus irma	Western Brush Wallaby	-	249857	6281952	A1	TE (2014)
Macropus irma	Western Brush Wallaby	-	258609	6272195	A3	TE (2014)
Macropus irma	Western Brush Wallaby	-	256546	6272486	A5	TE (2014)
Macropus irma	Western Brush Wallaby	-	255208	6272836	A57	TE (2014)
Macropus irma	Western Brush Wallaby	-	257082	6271543	A60	TE (2014)
Macropus irma	Western Brush Wallaby	-	256757	6271549	Creek	TE (2014)
Macropus irma	Western Brush Wallaby	-	256093	6272411	D30	TE (2014)
Macropus irma	Western Brush Wallaby	-	256592	6272506	D40	TE (2014)
Macropus irma	Western Brush Wallaby	-	256462	6272443	D70	TE (2014)
Macropus irma	Western Brush Wallaby	-	256412	6272419	D80	TE (2014)
Macropus irma	Western Brush Wallaby	-	256363	6272395	D90	TE (2014)
Macropus irma	Western Brush Wallaby	-	254923	6272967	E1	TE (2014)
Macropus irma	Western Brush Wallaby	-	254973	6272945	E10	TE (2014)
Macropus irma	Western Brush Wallaby	-	255492	6272704	E100	TE (2014)
Macropus irma	Western Brush Wallaby	-	255030	6272917	E20	TE (2014)
Macropus irma	Western Brush Wallaby	-	255087	6272891	E30	TE (2014)
Macropus irma	Western Brush Wallaby	-	255178	6272847	E45	TE (2014)
Macropus irma	Western Brush Wallaby	-	255267	6272808	E60	TE (2014)
Macropus irma	Western Brush Wallaby	-	255322	6272785	E70	TE (2014)
Macropus irma	Western Brush Wallaby	-	255376	6272758	E80	TE (2014)
Macropus irma	Western Brush Wallaby	-	255433	6272732	E90	TE (2014)
Macropus irma	Western Brush Wallaby	-	257504	6276257	F26	TE (2014)
Macropus irma	Western Brush Wallaby	-	257328	6276217	F48	TE (2014)
Macropus irma	Western Brush Wallaby	-	256124	6272481	Hill	TE (2014)
Macropus irma	Western Brush Wallaby	-	249857	6281562	A3	TE (2015a)
Macropus irma	Western Brush Wallaby	-	249858	6281576	A5	TE (2015a)
Macropus irma	Western Brush Wallaby	-	251895	6280583	A57	TE (2015a)
Macropus irma	Western Brush Wallaby	-	251896	6280559	A60	TE (2015a)
Macropus irma	Western Brush Wallaby	-	249856	6281776	D30	TE (2015a)
Macropus irma	Western Brush Wallaby	-	251890	6280477	D70	TE (2015a)
Macropus irma	Western Brush Wallaby	-	251891	6280399	D80	TE (2015a)
Macropus irma	Western Brush Wallaby	-	251890	6280322	D90	TE (2015a)
Macropus irma	Western Brush Wallaby	-	254923	6272966	E1	TE (2015a)
Macropus irma	Western Brush Wallaby	-	254973	6272944	E10	TE (2015a)
Macropus irma	Western Brush Wallaby	-	255490	6272702	E100	TE (2015a)
Macropus irma	Western Brush Wallaby	-	255030	6272916	E20	TE (2015a)
Macropus irma	Western Brush Wallaby	-	255085	6272890	E30	TE (2015a)
Macropus irma	Western Brush Wallaby	-	255211	6272831	E51	TE (2015a)
Macropus irma	Western Brush Wallaby	-	255322	6272783	E70	TE (2015a)
Macropus irma	Western Brush Wallaby	-	255376	6272758	E80	TE (2015a)
Macropus irma	Western Brush Wallaby	-	255432	6272732	E90	TE (2015a)
Macropus irma	Western Brush Wallaby	-	257565	6276293	F21	TE (2015a)
Macropus irma	Western Brush Wallaby	-	257503	6276257	F26	TE (2015a)
Macropus irma	Western Brush Wallaby	-	257326	6276217	F48	TE (2015a)
Macropus irma	Western Brush Wallaby	-	256115	6272386	G CM1	TE (2015a)
Macropus irma	Western Brush Wallaby	-	256087	6272433	G CM2	TE (2015a)
Macropus irma	Western Brush Wallaby	-	256502	6272465	G CM3	TE (2015a)
Macropus irma	Western Brush Wallaby	-	256121	6272465	G CM4	TE (2015a)
Macropus irma	Western Brush Wallaby	-	256544	6272486	G CM5	TE (2015a)
Macropus irma	Western Brush Wallaby	-	255375	6272759	G CM6	TE (2015a)
Macropus irma	Western Brush Wallaby	-	254973	6272944	G CM7	TE (2015a)
Macropus irma	Western Brush Wallaby	-	257328	6276216	G CM8	TE (2015a)
Macropus irma	Western Brush Wallaby	-	257502	6276257	G CM9	TE (2015a)
Macropus irma	Western Brush Wallaby	-	257545	6276279	G CM10	TE (2015a)
Psophodes n. oberon	Western Whipbird	-	256767	6272594	D1	TE (2015a)
Psophodes n. oberon	Western Whipbird	-	256680	6272550	D20	TE (2015a)
Psophodes n. oberon	Western Whipbird	-	256774	6272601	WW1	TE (2015a)
Psophodes n. oberon	Western Whipbird	-	256017	6272225	WW2	TE (2015a)
Psophodes n. oberon	Western Whipbird	-	254917	6272970	WW3	TE (2015a)
Psophodes n. oberon	Western Whipbird	-	255905	6272974	WW4	TE (2015a)
Psophodes n. oberon	Western Whipbird	-	257167	6271537	WW5	TE (2015a)
Psophodes n. oberon	Western Whipbird	-	251905	6280559	WW8	TE (2015a)
Psophodes n. oberon	Western Whipbird	-	251718	6281891	WW9	TE (2015a)
Psophodes n. oberon	Western Whipbird	-	249851	6281558	WW10	TE (2015a)
Psophodes n. oberon	Western Whipbird	-	254294	6273261	WW11	TE (2015a)
Dasyurus geoffroii	Chuditch	-	256680	6272550	D20	TE (2015a)
Dasyurus geoffroii	Chuditch	-	256546	6272486	D50	TE (2015a)

Species	Common Name	Nº of records	Easting	Northing	Site	Reference
Dasyurus geoffroii	Chuditch	-	256460	6272440	D70	TE (2015a)
Dasyurus geoffroii	Chuditch	-	256412	6272418	D80	TE (2015a)
Dasyurus geoffroii	Chuditch	-	256361	6272392	D90	TE (2015a)
Dasyurus geoffroii	Chuditch	-	257565	6276293	F21	TE (2015a)
Dasyurus geoffroii	Chuditch	-	257545	6276278	F25	TE (2015a)
Dasyurus geoffroii	Chuditch	-	257545	6276279	H27	TE (2015a)
Dasyurus geoffroii	Chuditch	-	256872	6271591	H48	TE (2015a)
Dasyurus geoffroii	Chuditch	-	256865	6271552	H46	TE (2015a)
Dasyurus geoffroii	Chuditch	-	256868	6271532	H45	TE (2015a)
Dasyurus geoffroii	Chuditch	-	256588	6272507	H20	TE (2015a)
Dasyurus geoffroii	Chuditch	-	255490	6272702	H16	TE (2015a)
Dasyurus geoffroii	Chuditch	-	256636	6272529	H19	TE (2015a)
Dasyurus geoffroii	Chuditch	-	256087	6272433	G38	TE (2015a)
Dasyurus geoffroii	Chuditch	-	251690	6282353	Cat25	TE (2017a)
Dasyurus geoffroii	Chuditch	-	255897	6272961	Cat95	TE (2017a)
Dasyurus geoffroii	Chuditch	-	255221	6274575	Cat82	TE (2017a)
Dasyurus geoffroii	Chuditch	-	255874	6272823	Cat96	TE (2017a)
Dasyurus geoffroii	Chuditch	-	255821	6272517	Cat98	TE (2017a)
Dasyurus geoffroii	Chuditch	-	255221	6274575	Cat82	TE (2017a)
Dasyurus geoffroii	Chuditch	-	255874	6272823	Cat96	TE (2017a)
Dasyurus geoffroii	Chuditch	-	256413	6272418	Site A	TE (2017a)
Dasyurus geoffroii	Chuditch	-	257567	6276297	Site A	TE (2017a)
Dasyurus geoffroii	Chuditch	-	256504	6272465	Site A	TE (2017a)
Dasyurus geoffroii	Chuditch	-	256091	6272453	Site E	TE (2017a)
Dasyurus geoffroii	Chuditch	-	256889	6271625	Site E	TE (2017a)
Dasyurus geoffroii	Chuditch	-	256089	6272435	Site E	TE (2017a)
Dasyurus geoffroii	Chuditch	-	257391	6276233	Site E	TE (2017a)
Dasyurus geoffroii	Chuditch	-	254924	6272968	Site E	TE (2017a)
Dasyurus geoffroii	Chuditch	-	251893	6280544	Site E	TE (2017a)
Dasyurus geoffroii	Chuditch	-	256849	6271439	Site E	TE (2017a)
Dasyurus geoffroii	Chuditch	-	256546	6272486	Site E	TE (2017a)
Dasyurus geoffroii	Chuditch	-	256867	6271552	Site E	TE (2017a)
Dasyurus geoffroii	Chuditch	-	256122	6272427	Site E	TE (2017a)
Dasyurus geoffroii	Chuditch	-	256364	6272393	Site D	TE (2017a)
Dasyurus geoffroii	Chuditch	-	256095	6272474	Hill	TE (2017a)
Dasyurus geoffroii	Chuditch	-	256126	6272481	Site G	TE (2017a)
Dasyurus geoffroii	Chuditch	-	256870	6271569	Site G	TE (2017a)
Dasyurus geoffroii	Chuditch	-	256121	6272466	Site G	TE (2017a)
Dasyurus geoffroii	Chuditch	-	256589	6272507	Site G	TE (2017a)
Dasyurus geoffroii	Chuditch	-	256128	6272448	Site G	TE (2017a)
Dasyurus geoffroii	Chuditch	-	249860	6281564	Site G	TE (2017a)
Dasyurus geoffroii	Chuditch	-	256101	6272397	Site G	TE (2017a)
Dasyurus geoffroii	Chuditch	-	255088	6272891	Site G	TE (2017a)
Dasyurus geoffroii	Chuditch	-	255267	6272810	Site G	TE (2017a)
Dasyurus geoffroii	Chuditch	-	249857	6281578	Site G	TE (2017a)
Dasyurus geoffroii	Chuditch	-	257966	6272157	Hale Bopp	TE (2017a)
Dasyurus geoffroii	Chuditch	-	258184	6272359	Hale Bopp	TE (2017a)
Dasyurus geoffroii	Chuditch	-	257746	6272255	Hale Bopp	TE (2017a)
Dasyurus geoffroii	Chuditch	-	258075	6272255	Hale Bopp	TE (2017a)
Dasyurus geoffroii	Chuditch	-	255939	6280901	Hale Bopp	TE (2017a)
Dasyurus geoffroii	Chuditch	-	258154	6271956	Hale Bopp	TE (2017a)
Dasyurus geoffroii	Chuditch	-	257852	6272357	Hale Bopp	TE (2017a)
Dasyurus geoffroii	Chuditch	-	257963	6272054	Hale Bopp	TE (2017a)
Dasyurus geoffroii	Chuditch	-	257891	6278485	Hale Bopp	TE (2017a)
Leipoa ocellata	Malleefowl	-	255326	6272781	Site A	TE (2017a)
Leipoa ocellata	Malleefowl	-	251898	6280559	Site A	TE (2017a)
Leipoa ocellata	Malleefowl	-	257567	6276297	Site A	TE (2017a)
Leipoa ocellata	Malleefowl	-	256504	6272465	Site A	TE (2017a)
Leipoa ocellata	Malleefowl	-	256889	6271625	Site E	TE (2017a)
Leipoa ocellata	Malleefowl	-	256089	6272435	Site E	TE (2017a)
Leipoa ocellata	Malleefowl	-	257391	6276233	Site E	TE (2017a)
Leipoa ocellata	Malleefowl	-	256546	6272486	Site E	TE (2017a)
Leipoa ocellata	Malleefowl	-	256364	6272393	Site D	TE (2017a)
Leipoa ocellata	Malleefowl	-	256095	6272474	Hill	TE (2017a)
Leipoa ocellata	Malleefowl	-	256872	6271591	Hill	TE (2017a)
Leipoa ocellata	Malleefowl	-	254973	6272945	Hill	TE (2017a)
Leipoa ocellata	Malleefowl	-	257329	6276218	Hill	TE (2017a)
Leipoa ocellata	Malleefowl	-	256638	6272531	Hill	TE (2017a)
Leipoa ocellata	Malleefowl	-	256860	6271461	Hill	TE (2017a)
Leipoa ocellata	Malleefowl	-	251896	6280585	Hill	TE (2017a)
Leipoa ocellata	Malleefowl	-	256682	6272552	Hill	TE (2017a)
Leipoa ocellata	Malleefowl	-	257545	6276281	Hill	TE (2017a)

Species	Common Name	Nº of records	Easting	Northing	Site	Reference
Leipoa ocellata	Malleefowl	-	255088	6272891	Site G	TE (2017a)
Macropus irma	Western Brush Wallaby	-	249858	6281544	Site A	TE (2017a)
Macropus irma	Western Brush Wallaby	-	255326	6272781	Site A	TE (2017a)
Macropus irma	Western Brush Wallaby	-	251898	6280559	Site A	TE (2017a)
Macropus irma	Western Brush Wallaby	-	256413	6272418	Site A	TE (2017a)
Macropus irma	Western Brush Wallaby	-	257567	6276297	Site A	TE (2017a)
Macropus irma	Western Brush Wallaby	-	256504	6272465	Site A	TE (2017a)
Macropus irma	Western Brush Wallaby	-	256091	6272453	Site E	TE (2017a)
Macropus irma	Western Brush Wallaby	-	256889	6271625	Site E	TE (2017a)
Macropus irma	Western Brush Wallaby	-	256089	6272435	Site E	TE (2017a)
Macropus irma	Western Brush Wallaby	-	257391	6276233	Site E	TE (2017a)
Macropus irma	Western Brush Wallaby	-	254924	6272968	Site E	TE (2017a)
Macropus irma	Western Brush Wallaby	-	251893	6280544	Site E	TE (2017a)
Macropus irma	Western Brush Wallaby	-	256849	6271439	Site E	TE (2017a)
Macropus irma	Western Brush Wallaby	-	256546	6272486	Site E	TE (2017a)
Macropus irma	Western Brush Wallaby	-	256867	6271552	Site E	TE (2017a)
Macropus irma	Western Brush Wallaby	-	256122	6272427	Site E	TE (2017a)
Macropus irma	Western Brush Wallaby	-	256869	6271532	Site D	TE (2017a)
Macropus irma	Western Brush Wallaby	-	256870	6271488	Site D	TE (2017a)
Macropus irma	Western Brush Wallaby	-	256364	6272393	Site D	TE (2017a)
Macropus irma	Western Brush Wallaby	-	256117	6272388	Site D	TE (2017a)
Macropus irma	Western Brush Wallaby	-	257502	6276257	Site D	TE (2017a)
Macropus irma	Western Brush Wallaby	-	256093	6272412	Site D	TE (2017a)
Macropus irma	Western Brush Wallaby	-	256877	6271602	Site D	TE (2017a)
Macropus irma	Western Brush Wallaby	-	255492	6272704	Site D	TE (2017a)
Macropus irma	Western Brush Wallaby	-	255377	6272759	Site F	TE (2017a)
Macropus irma	Western Brush Wallaby	-	255431	6272733	Site F	TE (2017a)
Macropus irma	Western Brush Wallaby	-	256879	6271511	Site F	TE (2017a)
Macropus irma	Western Brush Wallaby	-	256769	6272595	Site F	TE (2017a)
Macropus irma	Western Brush Wallaby	-	255178	6272850	Site F	TE (2017a)
Macropus irma	Western Brush Wallaby	-	256095	6272474	Hill	TE (2017a)
Macropus irma	Western Brush Wallaby	-	254973	6272945	Hill	TE (2017a)
Macropus irma	Western Brush Wallaby	-	255029	6272915	Hill	TE (2017a)
Macropus irma	Western Brush Wallaby	-	256638	6272531	Hill	TE (2017a)
Macropus irma	Western Brush Wallaby	-	251896	6280585	Hill	TE (2017a)
Macropus irma	Western Brush Wallaby	-	257545	6276281	Hill	TE (2017a)
Macropus irma	Western Brush Wallaby	-	256589	6272507	Site G	TE (2017a)
Macropus irma	Western Brush Wallaby	-	249857	6281578	Site G	TE (2017a)
Macropus irma	Western Brush Wallaby	-	257859	6272254	Hale Bopp	TE (2017a)
Macropus irma	Western Brush Wallaby	-	258051	6271957	Hale Bopp	TE (2017a)
Macropus irma	Western Brush Wallaby	-	257845	6271956	Hale Bopp	TE (2017a)
Macropus irma	Western Brush Wallaby	-	258073	6272054	Hale Bopp	TE (2017a)
Macropus irma	Western Brush Wallaby	-	257966	6272157	Hale Bopp	TE (2017a)
Macropus irma	Western Brush Wallaby	-	258184	6272359	Hale Bopp	TE (2017a)
Macropus irma	Western Brush Wallaby	-	257747	6272058	Hale Bopp	TE (2017a)
Macropus irma	Western Brush Wallaby	-	257946	6271957	Hale Bopp	TE (2017a)
Macropus irma	Western Brush Wallaby	-	258068	6272358	Hale Bopp	TE (2017a)
Macropus irma	Western Brush Wallaby	-	257746	6272255	Hale Bopp	TE (2017a)
Macropus irma	Western Brush Wallaby	-	257857	6272056	Hale Bopp	TE (2017a)
Macropus irma	Western Brush Wallaby	-	255154	6281512	Hale Bopp	TE (2017a)
Macropus irma	Western Brush Wallaby	-	258075	6272255	Hale Bopp	TE (2017a)
Macropus irma	Western Brush Wallaby	-	255747	6281156	Hale Bopp	TE (2017a)
Macropus irma	Western Brush Wallaby	-	255939	6280901	Hale Bopp	TE (2017a)
Macropus irma	Western Brush Wallaby	-	257857	6272156	Hale Bopp	TE (2017a)
Macropus irma	Western Brush Wallaby	-	258154	6271956	Hale Bopp	TE (2017a)
Macropus irma	Western Brush Wallaby	-	257852	6272357	Hale Bopp	TE (2017a)
Macropus irma	Western Brush Wallaby	-	257745	6271958	Hale Bopp	TE (2017a)
Macropus irma	Western Brush Wallaby	-	257744	6272358	Hale Bopp	TE (2017a)
Macropus irma	Western Brush Wallaby	-	253402	6282037	Hale Bopp	TE (2017a)
Macropus irma	Western Brush Wallaby	-	257891	6278485	Hale Bopp	TE (2017a)
Macropus irma	Western Brush Wallaby	-	254508	6281805	Hale Bopp	TE (2017a)
Macropus irma	Western Brush Wallaby	-	252469	6282278	Corridor	TE (2017a)
Macropus irma	Western Brush Wallaby	-	257955	6272359	Corridor	TE (2017a)
Macropus irma	Western Brush Wallaby	-	256799	6280225	Corridor	TE (2017a)
Macropus irma	Western Brush Wallaby	-	258192	6272157	Corridor	TE (2017a)
Macropus irma	Western Brush Wallaby	-	257696	6278730	Corridor	TE (2017a)
Macropus irma	Western Brush Wallaby	-	253836	6282005	Corridor	TE (2017a)
Macropus irma	Western Brush Wallaby	-	257239	6279680	Corridor	TE (2017a)
Macropus irma	Western Brush Wallaby	-	257354	6279348	Corridor	TE (2017a)
Macropus irma	Western Brush Wallaby	-	256304	6280725	Corridor	TE (2017a)
Macropus irma	Western Brush Wallaby	-	257617	6279085	Corridor	TE (2017a)
Macropus irma	Western Brush Wallaby	-	257942	6278267	Corridor	TE (2017a)

Species	Common Name	Nº of records	Easting	Northing	Site	Reference
Macropus irma	Western Brush Wallaby	-	253150	6282156	Corridor	TE (2017a)
Macropus irma	Western Brush Wallaby	-	255366	6281300	Corridor	TE (2017a)
Macropus irma	Western Brush Wallaby	-	258184	6272054	Corridor	TE (2017a)
Macropus irma	Western Brush Wallaby	-	257971	6272253	Corridor	TE (2017a)
Macropus irma	Western Brush Wallaby	-	254093	6281858	Corridor	TE (2017a)
Macropus irma	Western Brush Wallaby	-	257745	6272157	Corridor	TE (2017a)
Macropus irma	Western Brush Wallaby	-	258148	6277792	Corridor	TE (2017a)
Macropus irma	Western Brush Wallaby	-	252723	6282150	Corridor	TE (2017a)
Macropus irma	Western Brush Wallaby	-	257967	6277963	Corridor	TE (2017a)
Macropus irma	Western Brush Wallaby	-	256476	6280447	Corridor	TE (2017a)
Macropus irma	Western Brush Wallaby	-	258111	6277522	Corridor	TE (2017a)
Macropus irma	Western Brush Wallaby	-	258077	6272157	Corridor	TE (2017a)
Macropus irma	Western Brush Wallaby	-	256953	6279933	Corridor	TE (2017a)
Psophodes n. oberon	Western Whipbird	-	251719	6281890	WW-9	TE (2017a)
Psophodes n. oberon	Western Whipbird	-	251905	6280559	WW-8	TE (2017a)
Psophodes n. oberon	Western Whipbird	-	252221	6280631	-	TE (2017a)
Psophodes n. oberon	Western Whipbird	-	252388	6280649	-	TE (2017a)
Psophodes n. oberon	Western Whipbird	-	254294	6273261	-	TE (2017a)
Psophodes n. oberon	Western Whipbird	-	254918	6272970	WW-3	TE (2017a)
Psophodes n. oberon	Western Whipbird	-	255905	6272974	WW-4	TE (2017a)
Psophodes n. oberon	Western Whipbird	-	256017	6272225	WW-2	TE (2017a)
Psophodes n. oberon	Western Whipbird	-	256184	6272210	-	TE (2017a)
Psophodes n. oberon	Western Whipbird	-	256291	6280668	-	TE (2017a)
Psophodes n. oberon	Western Whipbird	-	256564	6272438	-	TE (2017a)
Psophodes n. oberon	Western Whipbird	-	256630	6272560	-	TE (2017a)
Psophodes n. oberon	Western Whipbird	-	256642	6272506	-	TE (2017a)
Psophodes n. oberon	Western Whipbird	-	256773	6272601	WW-1	TE (2017a)
Psophodes n. oberon	Western Whipbird	-	257168	6271538	-	TE (2017a)
Psophodes n. oberon	Western Whipbird	-	257848	6278408	-	TE (2017a)
Psophodes n. oberon	Western Whipbird	-	258042	6272380	-	TE (2017a)
Psophodes n. oberon	Western Whipbird	-	258068	6278692	WW-5	TE (2017a)
Psophodes n. oberon	Western Whipbird	-	258092	6272257	-	TE (2017a)
Psophodes n. oberon	Western Whipbird	-	258183	6272358	-	TE (2017a)
Psophodes n. oberon	Western Whipbird	-	258380	6272027	WW-6	TE (2017a)
Dasyurus geoffroii	Chuditch	-	252092	6283331	Shoemaker	TE (2017)
Dasyurus geoffroii	Chuditch	-	251627	6283593	Shoemaker	TE (2017)
Dasyurus geoffroii	Chuditch	-	250594	6284150	Shoemaker	TE (2017)
Dasyurus geoffroii	Chuditch	-	250910	6283758	Shoemaker	TE (2017)
Dasyurus geoffroii	Chuditch	-	250333	6283756	Shoemaker	TE (2017)
Pseudomys occidentalis	Western Mouse	-	252636	6280454	Shoemaker	TE (2017)
Pseudomys occidentalis	Western Mouse	-	251844	6280954	Shoemaker	TE (2017)
Pseudomys occidentalis	Western Mouse	-	251844	6280954	Shoemaker	TE (2017)
Pseudomys occidentalis	Western Mouse	-	251963	6279935	Shoemaker	TE (2017)

* Biota Environmental Sciences uses AMG datum and all other surveys are using WGS84.
BES - Biota Environmental Sciences
CE – Coffey Environments

Appendix B
Trapping sites, Western Whipbird listening locations and camera trap locations

Appendix B. Trapping sites, Western Whipbird listening locations and camera trap locations

Datum WGS84			Datum WGS84			Datum WGS84		
Site	Easting	Northing	Site	Easting	Northing	Site	Easting	Northing
CM-1	258100	6277104	CM-72	256197	6273658	C53	254754	6275300
CM-2	258028	6276999	CM-73	256315	6273657	C54	254700	6275408
CM-3	257915	6276833	CM-74	255418	6273958	C55	254661	6275477
CM-4	257808	6276670	CM-75	255498	6274553	C56	254600	6275586
CM-5	257697	6276502	CM-76	255700	6274552	C57	254563	6275655
CM-6	257580	6276331	CM-77	255896	6274554	C58	255079	6274767
CM-7	257397	6276235	CM-78	254943	6274954	C59	255120	6274720
CM-8	257200	6276194	CM-79	254853	6275125	C60	255198	6274601
CM-9	257004	6276146	CM-80	254755	6275301	C61	255242	6274536
CM-10	256806	6276101	CM-81	254661	6275477	C62	255498	6274552
CM-11	256608	6276058	CM-82	254563	6275655	C63	255699	6274552
CM-12	256393	6276024	CM-83	257122	6276090	C64	255823	6274554
CM-13	256201	6275945	CM-84	257126	6275890	C65	255896	6274554
CM-14	256050	6275809	CM-85	257195	6275702	C66	255319	6274429
CM-15	255907	6275665	CM-86	257337	6275551	C67	255353	6274364
CM-16	255752	6275529	CM-87	257486	6275459	C68	255417	6274263
CM-17	255632	6275421	CM-88	257419	6275721	C69	255465	6274214
CM-18	255471	6275266	CM-89	257367	6275868	C70	255539	6274104
CM-19	255302	6275105	CM-90	257325	6276049	C71	255582	6274034
CM-20	255158	6274960	C1	258100	6277103	C72	255647	6273936
CM-21	255080	6274767	C2	258070	6277062	C73	255705	6273861
CM-22	255199	6274602	C3	258028	6276998	C74	255768	6273769
CM-23	255310	6274433	C4	257914	6276832	C75	255830	6273674
CM-24	255417	6274263	C5	257869	6276761	C76	255910	6273729
CM-25	255539	6274104	C6	257808	6276670	C77	255969	6273752
CM-26	255648	6273936	C7	257758	6276598	C78	256130	6273767
CM-27	255769	6273769	C8	257697	6276502	C79	256265	6273752
CM-28	255898	6273593	C9	257643	6276426	C80	256246	6273659
CM-29	255897	6273408	C10	257580	6276330	C81	256332	6273656
CM-30	255900	6273209	C11	257396	6276234	C82	255897	6273592
CM-31	255892	6273013	C12	257324	6276226	C83	255903	6273516
CM-32	255870	6272808	C13	257200	6276194	C84	255896	6273407
CM-33	255825	6272592	C14	257104	6276180	C85	255897	6273334
CM-34	255828	6272390	C15	257121	6276090	C86	255900	6273209
CM-35	255866	6272171	C16	257121	6276005	C87	255891	6273122
CM-36	255858	6271967	C17	257126	6275889	C88	255892	6273013
CM-37	255849	6271774	C18	257149	6275800	C89	255891	6272940
CM-38	255848	6271577	C19	257194	6275702	C90	255870	6272807
CM-39	255841	6271375	C20	257337	6275550	C91	255851	6272730
CM-40	256040	6271575	C21	257449	6275594	C92	255824	6272592
CM-41	256242	6271567	C22	257419	6275721	C93	255729	6272598
CM-42	256443	6271560	C23	257367	6275867	C94	255628	6272639
CM-43	256639	6271548	C24	257325	6276048	C95	255544	6272682
CM-44	256842	6271547	C25	257004	6276146	C96	255446	6272719
CM-45	257045	6271540	C26	256911	6276128	C97	255359	6272766
CM-46	257246	6271532	C27	256805	6276101	C98	255269	6272807
CM-47	257450	6271525	C28	256705	6276085	C99	255165	6272856
CM-48	257658	6271523	C29	256608	6276058	C100	255081	6272895
CM-49	257834	6271527	C30	256500	6276044	C101	254980	6272934
CM-50	256630	6271305	C31	256392	6276024	C102	254900	6272973
CM-51	256424	6271308	C32	256299	6275991	C103	254793	6273026
CM-52	256227	6271305	C33	256200	6275944	C104	254716	6273061
CM-53	256033	6271294	C34	256135	6275888	C105	254623	6273100
CM-54	256008	6272346	C35	256050	6275808	C106	254538	6273146
CM-55	256153	6272292	C36	255994	6275763	C107	254444	6273184
CM-56	256370	6272399	C37	255907	6275665	C108	254354	6273230
CM-57	256586	6272506	C38	255849	6275610	C109	254628	6273327
CM-58	256778	6272597	C39	255751	6275529	C110	254700	6273287
CM-59	255629	6272639	C40	255698	6275484	C111	254786	6273246
CM-60	255447	6272719	C41	255632	6275420	C112	254870	6273204
CM-61	255270	6272808	C42	255563	6275351	C113	254980	6273135
CM-62	255081	6272895	C43	255470	6275265	C114	255053	6273108
CM-63	254901	6272974	C44	255403	6275197	C115	255126	6273081
CM-64	254973	6273142	C45	255302	6275105	C116	255198	6273041
CM-65	255167	6273062	C46	255241	6275043	C117	255295	6273000
CM-66	255365	6272977	C47	255158	6274960	C118	255393	6272959
CM-67	255552	6272883	C48	255084	6274888	C119	255477	6272932
CM-68	255778	6272765	C49	254943	6274953	C120	255828	6272390
CM-69	255970	6273752	C50	254884	6275055	C121	255840	6272350
CM-70	256131	6273768	C51	254853	6275124	C122	255866	6272171
CM-71	256295	6273751	C52	254798	6275220	C123	255880	6272086

Datum	WGS84	
Site	Easting	Northing
C124	255858	6271967
C125	255863	6271896
C126	255849	6271773
C127	255850	6271689
C128	255847	6271577
C129	255843	6271483
C130	255841	6271375
C131	255947	6271582
C132	256040	6271575
C133	256116	6271570
C134	256241	6271567
C135	256339	6271567
C136	256443	6271560
C137	256535	6271557
C138	256639	6271547
C139	256757	6271550
C140	256843	6271547
C141	256951	6271546
C142	257053	6271543
C143	257142	6271534
C144	257245	6271531
C145	257333	6271531
C146	257450	6271524
C147	257566	6271521
C148	257658	6271523
C149	257748	6271523
C150	257834	6271526
E1	256559	6276059
E2	256568	6276060
E3	256577	6276063
E4	256586	6276065
E5	256595	6276067
E6	256602	6276068
E7	256609	6276069
E8	256616	6276071
E9	256623	6276072
E10	256631	6276074
E11	256639	6276076
E12	256646	6276078
E13	256656	6276080
E14	256666	6276082
E15	256675	6276084
E16	256684	6276087
E17	256694	6276089
E18	256704	6276091
E19	256715	6276093
E20	256724	6276095
E21	256732	6276096
E22	256740	6276098
E23	256749	6276100
E24	256758	6276101
E25	256767	6276103
E26	257119	6276071
E27	257120	6276060
E28	257119	6276048
E29	257118	6276037
E30	257117	6276027
E31	257115	6276019
E32	257114	6276012
E33	257113	6276004
E34	257113	6275997
E35	257113	6275990
E36	257112	6275983
E37	257113	6275975
E38	257115	6275967
E39	257116	6275958
E40	257119	6275950
E41	257120	6275941
E42	257121	6275931
E43	257122	6275920
E44	257124	6275909
E45	257126	6275900

Datum	WGS84	
Site	Easting	Northing
E46	257128	6275890
E47	257130	6275880
E48	257132	6275871
E49	257134	6275861
E50	257135	6275851
E51	254840	6275142
E52	254834	6275153
E53	254828	6275164
E54	254821	6275176
E55	254814	6275189
E56	254809	6275200
E57	254803	6275209
E58	254798	6275218
E59	254793	6275227
E60	254788	6275237
E61	254783	6275249
E62	254777	6275260
E63	254772	6275270
E64	254767	6275279
E65	254762	6275288
E66	254756	6275296
E67	254750	6275305
E68	254745	6275315
E69	254740	6275326
E70	254734	6275336
E71	254730	6275345
E72	254727	6275353
E73	254723	6275363
E74	254718	6275372
E75	254716	6275384
E76	255628	6275415
E77	255639	6275425
E78	255649	6275434
E79	255658	6275443
E80	255664	6275451
E81	255677	6275462
E82	255688	6275473
E83	255699	6275483
E84	255707	6275490
E85	255715	6275499
E86	255725	6275508
E87	255735	6275517
E88	255744	6275526
E89	255753	6275533
E90	255761	6275543
E91	255772	6275553
E92	255782	6275564
E93	255793	6275573
E94	255801	6275580
E95	255809	6275590
E96	255819	6275600
E97	255830	6275609
E98	255841	6275619
E99	255850	6275627
E100	255860	6275634
E101	257811	6271519
E102	257803	6271520
E103	257794	6271520
E104	257785	6271520
E105	257775	6271519
E106	257766	6271520
E107	257756	6271520
E108	257745	6271521
E109	257734	6271520
E110	257724	6271521
E111	257716	6271521
E112	257706	6271521
E113	257695	6271521
E114	257683	6271521
E115	257671	6271520
E116	257661	6271521
E117	257649	6271521

Datum	WGS84	
Site	Easting	Northing
E118	257636	6271523
E119	257624	6271522
E120	257614	6271521
E121	257604	6271522
E122	257593	6271522
E123	257581	6271522
E124	257568	6271522
E125	257553	6271521
E126	257267	6271531
E127	257259	6271531
E128	257250	6271531
E129	257240	6271531
E130	257230	6271532
E131	257220	6271531
E132	257210	6271531
E133	257199	6271532
E134	257188	6271533
E135	257178	6271534
E136	257168	6271533
E137	257156	6271533
E138	257144	6271534
E139	257131	6271535
E140	257120	6271536
E141	257110	6271535
E142	257099	6271535
E143	257087	6271535
E144	257074	6271537
E145	257061	6271538
E146	257052	6271539
E147	257041	6271539
E148	257030	6271539
E149	257019	6271539
E150	257008	6271538
E151	255848	6272731
E152	255849	6272741
E153	255850	6272751
E154	255851	6272762
E155	255852	6272774
E156	255855	6272786
E157	255858	6272797
E158	255863	6272808
E159	255866	6272818
E160	255870	6272827
E161	255875	6272838
E162	255879	6272847
E163	255883	6272857
E164	255885	6272869
E165	255886	6272882
E166	255887	6272893
E167	255887	6272902
E168	255888	6272913
E169	255889	6272926
E170	255889	6272941
E171	255889	6272954
E172	255889	6272965
E173	255890	6272976
E174	255891	6272986
E175	255893	6273000
E176	255783	6272570
E177	255775	6272573
E178	255767	6272578
E179	255758	6272582
E180	255750	6272587
E181	255741	6272590
E182	255732	6272594
E183	255723	6272598
E184	255712	6272603
E185	255703	6272608
E186	255694	6272611
E187	255684	6272615
E188	255673	6272620
E189	255663	6272625

Datum	WGS84	
Site	Easting	Northing
E190	255654	6272630
E191	255643	6272635
E192	255632	6272641
E193	255620	6272646
E194	255610	6272652
E195	255599	6272656
E196	255589	6272660
E197	255580	6272664
E198	255569	6272668
E199	255558	6272673
E200	255548	6272679
E201	256372	6276034
E202	256369	6276042
E203	256365	6276050
E204	256362	6276057
E205	256357	6276066
E206	256353	6276075
E207	256350	6276081
E208	256347	6276088
E209	256343	6276095
E210	256340	6276105
E211	256336	6276113
E212	256332	6276122
E213	256328	6276131
E214	256325	6276140
E215	256320	6276148
E216	256317	6276158
E217	256312	6276167
E218	256310	6276175
E219	256307	6276181
E220	256303	6276189
E221	256300	6276196
E222	256297	6276203
E223	256294	6276208
E224	256291	6276215
E225	256288	6276222
E226	257905	6276810
E227	257896	6276801
E228	257890	6276792
E229	257884	6276785
E230	257878	6276777
E231	257872	6276769
E232	257867	6276760
E233	257860	6276750
E234	257853	6276739
E235	257845	6276728
E236	257839	6276719
E237	257833	6276709
E238	257826	6276699
E239	257818	6276688
E240	257811	6276677
E241	257805	6276668
E242	257799	6276658
E243	257793	6276649
E244	257788	6276641
E245	257781	6276632
E246	257775	6276624
E247	257768	6276615
E248	257761	6276605
E249	257753	6276594
E250	257745	6276584
E251	255342	6275143
E252	255335	6275134
E253	255327	6275126
E254	255318	6275119
E255	255308	6275110
E256	255299	6275101
E257	255289	6275091
E258	255279	6275082
E259	255269	6275071
E260	255259	6275062
E261	255252	6275054

Datum	WGS84	
Site	Easting	Northing
E262	255243	6275046
E263	255231	6275034
E264	255220	6275024
E265	255210	6275016
E266	255203	6275008
E267	255194	6275000
E268	255186	6274992
E269	255177	6274983
E270	255168	6274975
E271	255157	6274965
E272	255150	6274958
E273	255141	6274949
E274	255131	6274939
E275	255119	6274928
E276	255098	6274744
E277	255105	6274736
E278	255111	6274726
E279	255117	6274718
E280	255123	6274709
E281	255129	6274700
E282	255136	6274691
E283	255141	6274683
E284	255147	6274675
E285	255152	6274667
E286	255158	6274658
E287	255164	6274650
E288	255170	6274641
E289	255176	6274633
E290	255182	6274623
E291	255189	6274613
E292	255196	6274602
E293	255202	6274593
E294	255208	6274584
E295	255214	6274575
E296	255220	6274566
E297	255226	6274557
E298	255231	6274549
E299	255237	6274542
E300	255240	6274535
E301	255579	6274041
E302	255574	6274048
E303	255568	6274057
E304	255561	6274066
E305	255556	6274074
E306	255551	6274082
E307	255545	6274090
E308	255539	6274099
E309	255532	6274110
E310	255525	6274119
E311	255519	6274128
E312	255513	6274137
E313	255507	6274146
E314	255500	6274156
E315	255493	6274165
E316	255487	6274174
E317	255482	6274182
E318	255476	6274191
E319	255470	6274200
E320	255464	6274209
E321	255459	6274218
E322	255452	6274226
E323	255447	6274234
E324	255442	6274242
E325	255437	6274254
E326	255827	6273685
E327	255820	6273694
E328	255814	6273702
E329	255809	6273710
E330	255803	6273718
E331	255798	6273727
E332	255792	6273735
E333	255786	6273743

Datum	WGS84	
Site	Easting	Northing
E334	255779	6273753
E335	255771	6273763
E336	255765	6273774
E337	255759	6273782
E338	255753	6273791
E339	255746	6273802
E340	255738	6273810
E341	255732	6273820
E342	255726	6273828
E343	255720	6273839
E344	255713	6273848
E345	255705	6273857
E346	255701	6273867
E347	255694	6273877
E348	255686	6273887
E349	255677	6273898
E350	255668	6273910
E351	255901	6273474
E352	255900	6273464
E353	255900	6273453
E354	255899	6273443
E355	255899	6273432
E356	255899	6273421
E357	255898	6273409
E358	255898	6273399
E359	255897	6273389
E360	255897	6273379
E361	255898	6273368
E362	255898	6273357
E363	255898	6273345
E364	255897	6273332
E365	255896	6273319
E366	255896	6273306
E367	255896	6273293
E368	255895	6273280
E369	255895	6273267
E370	255895	6273255
E371	255895	6273242
E372	255896	6273229
E373	255896	6273216
E374	255895	6273204
E375	255896	6273194
E376	255862	6272150
E377	255862	6272141
E378	255861	6272133
E379	255861	6272125
E380	255861	6272116
E381	255860	6272106
E382	255860	6272097
E383	255859	6272088
E384	255859	6272080
E385	255859	6272071
E386	255858	6272060
E387	255858	6272052
E388	255857	6272043
E389	255857	6272033
E390	255857	6272021
E391	255856	6272007
E392	255857	6271994
E393	255856	6271982
E394	255856	6271972
E395	255856	6271961
E396	255855	6271948
E397	255855	6271936
E398	255855	6271924
E399	255854	6271913
E400	255853	6271903
E401	256129	6271571
E402	256139	6271569
E403	256149	6271568
E404	256160	6271568
E405	256171	6271568

Datum	WGS84	
Site	Easting	Northing
E406	256184	6271567
E407	256195	6271566
E408	256206	6271566
E409	256216	6271566
E410	256226	6271566
E411	256240	6271566
E412	256252	6271565
E413	256262	6271565
E414	256272	6271565
E415	256282	6271566
E416	256293	6271565
E417	256304	6271564
E418	256314	6271564
E419	256323	6271564
E420	256331	6271564
E421	256343	6271563
E422	256353	6271563
E423	256362	6271562
E424	256370	6271561
E425	256376	6271558

Datum	WGS84	
Site	Easting	Northing
E426	255381	6272756
E427	255375	6272760
E428	255368	6272763
E429	255362	6272766
E430	255355	6272769
E431	255349	6272771
E432	255343	6272774
E433	255337	6272777
E434	255330	6272780
E435	255324	6272783
E436	255317	6272786
E437	255311	6272789
E438	255304	6272792
E439	255297	6272795
E440	255291	6272798
E441	255284	6272801
E442	255277	6272804
E443	255269	6272807
E444	255262	6272810
E445	255255	6272813

Datum	WGS84	
Site	Easting	Northing
E446	255249	6272816
E447	255243	6272819
E448	255236	6272821
E449	255228	6272825
E450	255221	6272828
WW-1	256774	6272602
WW-2	256018	6272225
WW-3	254918	6272971
WW-4	255905	6272975
WW-5	257168	6271538
WW-11	254294	6273261
WW-19	255849	6273677
WW-20	255071	6274878
WW-21	258110	6277125
WW-22	255464	6279470
WW-23	255405	6280003
WW-24	256090	6280541

Appendix C
Trapping results

Appendix C. Trapping results

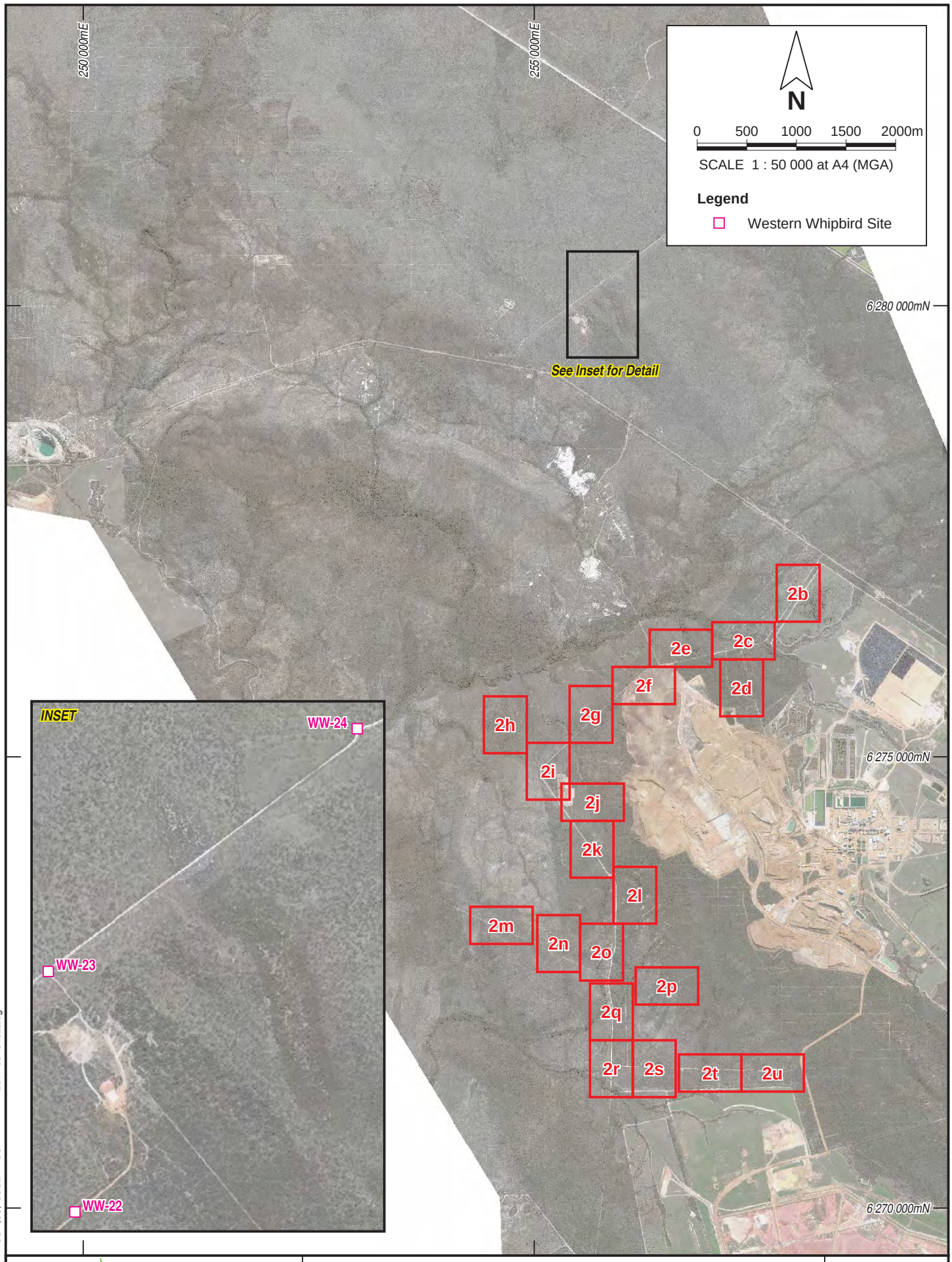
Date	Trap No.	Species
3/11/2017	C30	*Dasyurus geoffroii*
3/11/2017	C16	*Dasyurus geoffroii*
3/11/2017	C21	*Dasyurus geoffroii*
3/11/2017	C120	*Dasyurus geoffroii*
3/11/2017	E025	*Mus musculus*
3/11/2017	T188	*Rattus fuscipes*
3/11/2017	E350	*Tarsipes rostratus*
4/11/2017	C18	*Dasyurus geoffroii*
4/11/2017	C117	*Dasyurus geoffroii*
4/11/2017	C21	*Dasyurus geoffroii*
4/11/2017	E157	*Dasyurus geoffroii*
4/11/2017	C138	*Dasyurus geoffroii*
4/11/2017	E193	*Mus musculus*
4/11/2017	E251	*Rattus fuscipes*
4/11/2017	C86	*Tiliqua rugosa*
4/11/2017	E138	*Tiliqua rugosa*
5/11/2017	C90	*Dasyurus geoffroii*
5/11/2017	C122	*Dasyurus geoffroii*
5/11/2017	C28	*Dasyurus geoffroii*
5/11/2017	E194	*Rattus fuscipes*
5/11/2017	E070	*Tiliqua rugosa*
5/11/2017	E260	*Tiliqua rugosa*
5/11/2017	C43	*Tiliqua rugosa*
5/11/2017	C35	*Tiliqua rugosa*
5/11/2017	C058	*Tiliqua rugosa*
5/11/2017	C117	*Tiliqua rugosa*
5/11/2017	C36	*Tiliqua rugosa*
5/11/2017	E438	*Tiliqua rugosa*
5/11/2017	E290	*Tiliqua rugosa*
5/11/2017	E199	*Tiliqua rugosa*
5/11/2017	C33	*Tiliqua rugosa*
5/11/2017	C9	*Tiliqua rugosa*
5/11/2017	C10	*Tiliqua rugosa*
5/11/2017	C8	*Tiliqua rugosa*
5/11/2017	E138	*Tiliqua rugosa*
5/11/2017	E140	*Tiliqua rugosa*
5/11/2017	E133	*Tiliqua rugosa*
5/11/2017	E218	*Tiliqua rugosa*
5/11/2017	E210	*Tiliqua rugosa*
5/11/2017	E039	*Tiliqua rugosa*
5/11/2017	C21	*Tiliqua rugosa*
5/11/2017	C62	*Tiliqua rugosa*
5/11/2017	C67	*Tiliqua rugosa*
5/11/2017	C83	*Tiliqua rugosa*
5/11/2017	E351	*Tiliqua rugosa*
5/11/2017	C127	*Tiliqua rugosa*
5/11/2017	C127	*Tiliqua rugosa*
5/11/2017	C139	*Tiliqua rugosa*
5/11/2017	C140	*Tiliqua rugosa*
5/11/2017	C141	*Tiliqua rugosa*
5/11/2017	C144	*Tiliqua rugosa*
5/11/2017	C147	*Tiliqua rugosa*
5/11/2017	C149	*Tiliqua rugosa*
5/11/2017	C138	*Tiliqua rugosa*
5/11/2017	C138	*Tiliqua rugosa*
5/11/2017	C140	*Tiliqua rugosa*
5/11/2017	E250	*Varanus rosenbergi*

Date	Trap No.	Species
6/11/2017	C68	*Cracticus torquatus*
6/11/2017	C96	*Dasyurus geoffroii*
6/11/2017	E046	*Dasyurus geoffroii*
6/11/2017	E286	*Mus musculus*
6/11/2017	E258	*Rattus fuscipes*
6/11/2017	E192	*Rattus fuscipes*
6/11/2017	E321	*Rattus fuscipes*
6/11/2017	E349	*Rattus fuscipes*
6/11/2017	E425	*Tiliqua occipitalis*
6/11/2017	E150	*Tiliqua occipitalis*
6/11/2017	C28	*Tiliqua rugosa*
6/11/2017	E003	*Tiliqua rugosa*
6/11/2017	E014	*Tiliqua rugosa*
6/11/2017	E074	*Tiliqua rugosa*
6/11/2017	E288	*Tiliqua rugosa*
6/11/2017	C31	*Tiliqua rugosa*
6/11/2017	C2	*Tiliqua rugosa*
6/11/2017	C14	*Tiliqua rugosa*
6/11/2017	E238	*Tiliqua rugosa*
6/11/2017	C10	*Tiliqua rugosa*
6/11/2017	C13	*Tiliqua rugosa*
6/11/2017	C21	*Tiliqua rugosa*
6/11/2017	E024	*Tiliqua rugosa*
6/11/2017	E039	*Tiliqua rugosa*
6/11/2017	C20	*Tiliqua rugosa*
6/11/2017	C62	*Tiliqua rugosa*
6/11/2017	C81	*Tiliqua rugosa*
6/11/2017	E168	*Tiliqua rugosa*
6/11/2017	C125	*Tiliqua rugosa*
6/11/2017	C126	*Tiliqua rugosa*
6/11/2017	C138	*Tiliqua rugosa*
6/11/2017	E158	*Tiliqua rugosa*
6/11/2017	C144	*Tiliqua rugosa*
6/11/2017	E149	*Tiliqua rugosa*
6/11/2017	C101	*Tiliqua rugosa*
6/11/2017	C101	*Tiliqua rugosa*
6/11/2017	C32	*Tiliqua rugosa*
6/11/2017	C30	*Tiliqua rugosa*
6/11/2017	E120	*Tiliqua rugosa*
6/11/2017	C26	*Tiliqua rugosa*
6/11/2017	C25	*Tiliqua rugosa*
6/11/2017	C11	*Tiliqua rugosa*
6/11/2017	E036	*Varanus rosenbergi*
6/11/2017	C120	*Varanus rosenbergi*
7/11/2017	C18	*Dasyurus geoffroii*
7/11/2017	C81	*Dasyurus geoffroii*
7/11/2017	E137	*Mus musculus*
7/11/2017	E273	*Rattus fuscipes*
7/11/2017	E190	*Rattus fuscipes*
7/11/2017	E279	*Rattus fuscipes*
7/11/2017	E323	*Rattus fuscipes*
7/11/2017	E326	*Rattus fuscipes*
7/11/2017	E385	*Rattus fuscipes*
7/11/2017	E407	*Rattus fuscipes*
7/11/2017	C57	*Tiliqua occipitalis*
7/11/2017	C118	*Tiliqua occipitalis*
7/11/2017	C14	*Tiliqua occipitalis*

Date	Trap No.	Species
7/11/2017	C146	*Tiliqua occipitalis*
7/11/2017	C100	*Tiliqua rugosa*
7/11/2017	C93	*Tiliqua rugosa*
7/11/2017	E440	*Tiliqua rugosa*
7/11/2017	E107	*Tiliqua rugosa*
7/11/2017	C53	*Tiliqua rugosa*
7/11/2017	E251	*Tiliqua rugosa*
7/11/2017	C27	*Tiliqua rugosa*
7/11/2017	E029	*Tiliqua rugosa*
7/11/2017	C12	*Tiliqua rugosa*
7/11/2017	E258	*Tiliqua rugosa*
7/11/2017	E58	*Tiliqua rugosa*
7/11/2017	C79	*Tiliqua rugosa*
7/11/2017	C78	*Tiliqua rugosa*
7/11/2017	C90	*Tiliqua rugosa*

Date	Trap No.	Species
7/11/2017	E376	*Tiliqua rugosa*
7/11/2017	E384	*Tiliqua rugosa*
7/11/2017	C126	*Tiliqua rugosa*
7/11/2017	C138	*Tiliqua rugosa*
7/11/2017	C140	*Tiliqua rugosa*
7/11/2017	E150	*Tiliqua rugosa*
7/11/2017	E125	*Tiliqua rugosa*
7/11/2017	E117	*Tiliqua rugosa*
7/11/2017	E116	*Tiliqua rugosa*
7/11/2017	E106	*Tiliqua rugosa*
7/11/2017	E274	*Varanus rosenbergi*
7/11/2017	C96	*Varanus rosenbergi*
7/11/2017	C122	*Varanus rosenbergi*
7/11/2017	E147	*Varanus rosenbergi*

WA Location
Indian Ocean
Derby
Broome
Port Hedland
Karratha
WESTERN AUSTRALIA
Geraldton
Kalgoorlie
PERTH
Bunbury
Hopetoun
Albany
SITE LOCATION
Shire of Ravensthorpe
RAVENSTHORPE
HOPETOUN
MUNGLINUP
NEWDEGATE
Lake Ronnerup
Pallarup Rocks
MUNCASTER
Myuna Rock
TILBROOK RD
BEATTY RD
HATTER RD
NORTH RD
MILSTEED RD
PHILLIPS RD
HAYES RD
NINDILBILLUP RD
Coujinup Hill
Coujinup Creek
Munkinwoaert Rock
Ninidilbillup Creek
MUNGLINUP
Lake Chidnup
MOOLYALL RD
Moolyall Creek
Moolyall Rocks
WOODENUP
Woodenup Creek
JERDACUTTUP RIVER
Getenmellup
Ravensthorpe Range
Mt Benson
Mt McMahon
Mt Cattlin
Overshot Hill
Carlingup
Carlingup Creek
Bandalup Creek
Boaiup
Claytup
Mt Desmond
Bandalup Hill
Hawks Nest
Mt Short
Mt Ishort
RAVENSTHORPE RANGE
KING RD
COX RD
FLOATER RD
DAM RD
BELLI RD
AERODROME
JENKINS RD
WEST RIVER
LONG CREEK
FITZGERALD RIVER
BRIDGER RD
MALLEE RD
KOORNONG
THOMAS RD
GORDON RD
Jackilup Creek
Long Creek
Parton Ck
Heals Ck
Twertatup Creek
COCANARUP RD
MANYUTUP Ck
Manyutup Creek
Quagitup
DESMOND RD
Desmond
ELVERTON RD
MAYDON RD
HATFIELD RD
HOPETOUN RD
Kundip
HORNER RD
JERDACUTTUP RIVER
STEERE RIVER
RAVENSTHORPE RD
LAURINA RD
FORREST RD
JONES RD
BUEGGE RD
Frosts Camp
Kuliba
Cowerdup
No Tree Hill
Parwoonup
Mainnerup
Wooganup
ONGERUP
OLD RD
HAMERSLEY RD
Kybulup Creek
MOIR RD
Carramungup
PHILLIPS RD
West River
Annie Peak
Eyre Range
Fortification Hill
HOPETOUN
FITZGERALD RIVER NATIONAL PARK
Mt Drummond
East Mt Barren
Whalebone Beach
Edwards Pt
Harmersley Inlet
Woogarup Range
Mylies Beach
Barrens Beach
Four Mile Beach
Cave Pt
West Beach
Mary Ann Pt
Seal Island
Mary Ann Haven
Two Mile Beach
Table Hill
Culham Inlet
DOTTEREL SWAMP
DANIELS RD
LAKES RD
TAMARINE RD
JERDACUTTUP LAKES
JERDACUTTUP LAKES NATURE RESERVE
OCEAN
Twelve Mile Beach
Mason Bay
Lime Hill
West Hill
Emu Hill
Swan Hill
East Hill
Starvation Boat Harbour
North Powell Pt
Powell Pt
Dorrinup
Darkanuttup
Parriup
Lake Shaster
Oldfield Estuary
Munglinup Beach
Mound Spring
Nangarup
Cowerup
SPRINGDALE
EAST MUNGLINUP
WASHPOOL RD
BEDFORD HARBOUR
EAST RD
JERDACUTTUP MIDDLE
MIDDLE RD
BURABUP BAY
Burabup Creek
Yallosup
Colliup Ck
Jerdacuttup
Moolanup
Cheadanup
Mayruup
Dallinup
Rockhole
Bandalup Hill
Ghamma Ck
COULJINUP RD
WEST POINT
CHEADANUP NATURE RESERVE
RAWLINSON RD
CLAYHOLE RD
Boanaernup
JONEGATUP
COWELL RD
COXALL RD
DOYLE RD
FUSS RD
FENCE RD
BEDFORD HARBOUR
COLDFIELD
SOUTH COAST HWY
COAST HWY
N
0 5 10 15 20km
SCALE 1 : 500 000 at A4 (MGA)
TERRESTRIAL ECOSYSTEMS
Drawn: G. Thompson
Date: 23 Jan 2018
FQM Australia Nickel Pty Ltd
CONSERVATION SIGNIFICANT VERTEBRATE FAUNA MONITORING 2017
FOR RAVENSTHORPE NICKEL OPERATIONS
REGIONAL LOCATION
Figure 1
Job: 2017-0048



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TERRESTRIAL ECOSYSTEMS

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FOR RAVENSTHORPE NICKEL OPERATIONS

Figure 2a

TRAPPING SITES

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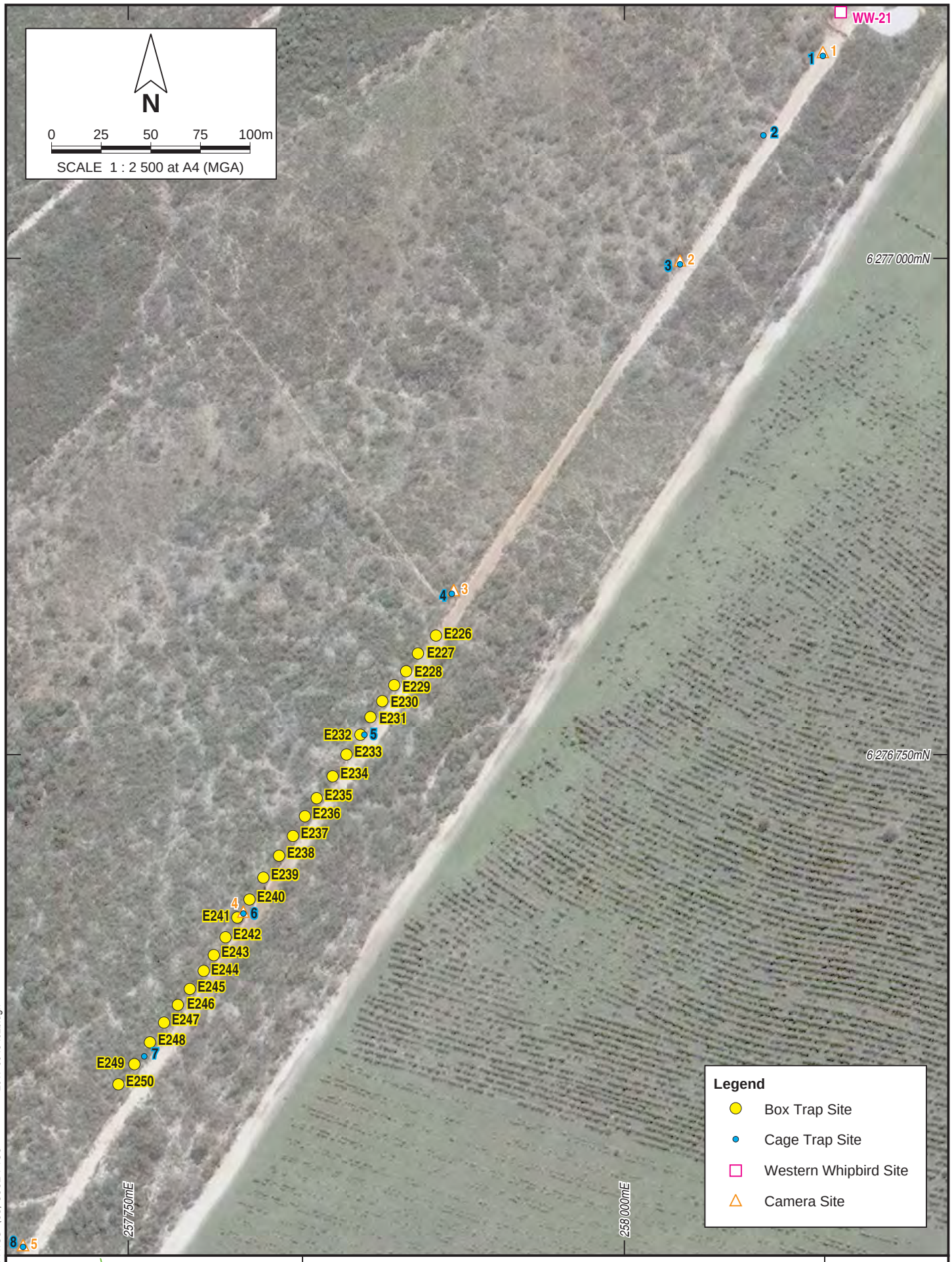

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TERRESTRIAL ECOSYSTEMS

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CONSERVATION SIGNIFICANT VERTEBRATE FAUNA MONITORING 2017
FOR RAVENSTHORPE NICKEL OPERATIONS

TRAPPING SITES

Figure 2b

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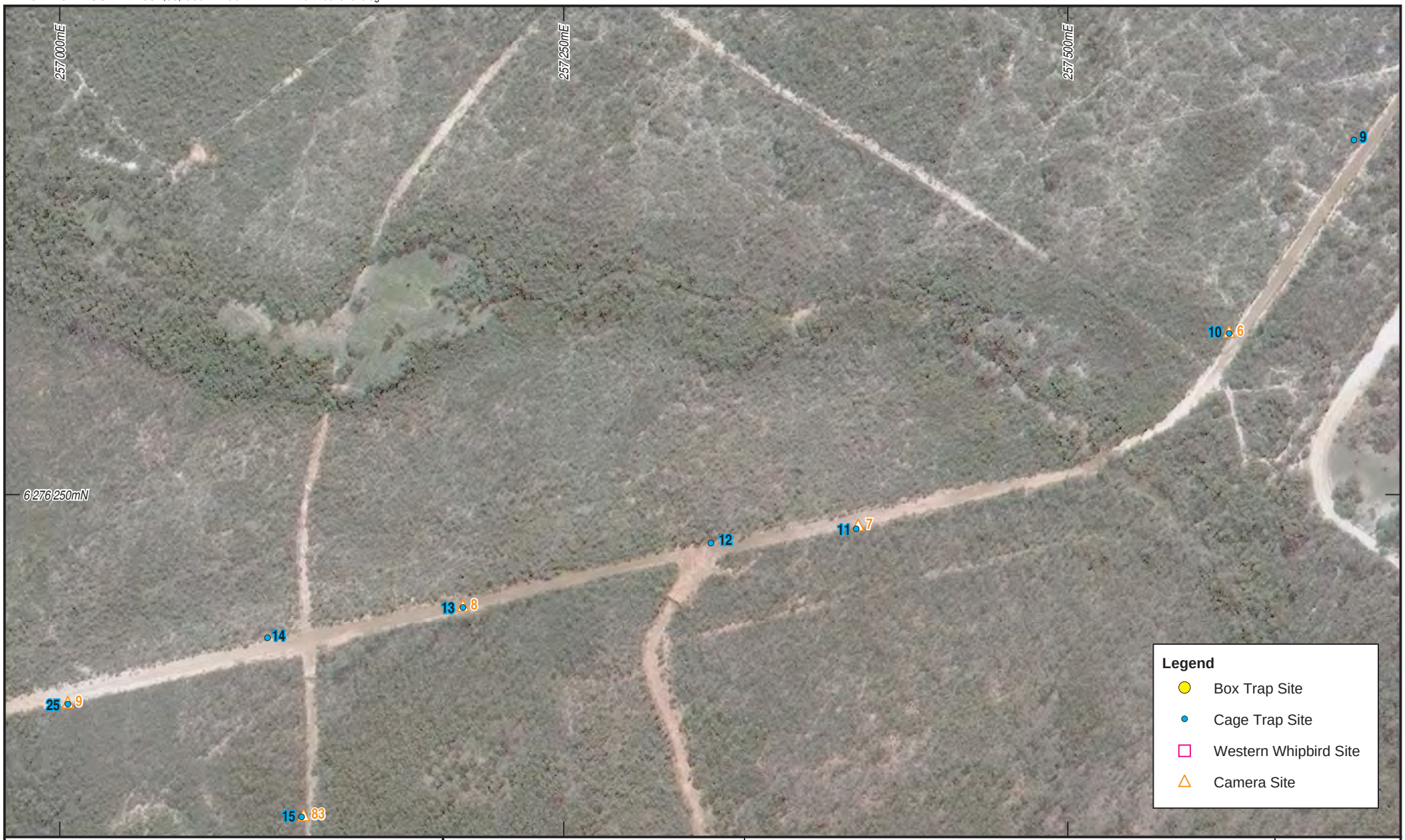

N

0 25 50 75 100m

SCALE 1 : 2 500 at A4 (MGA)

TERRESTRIAL ECOSYSTEMS

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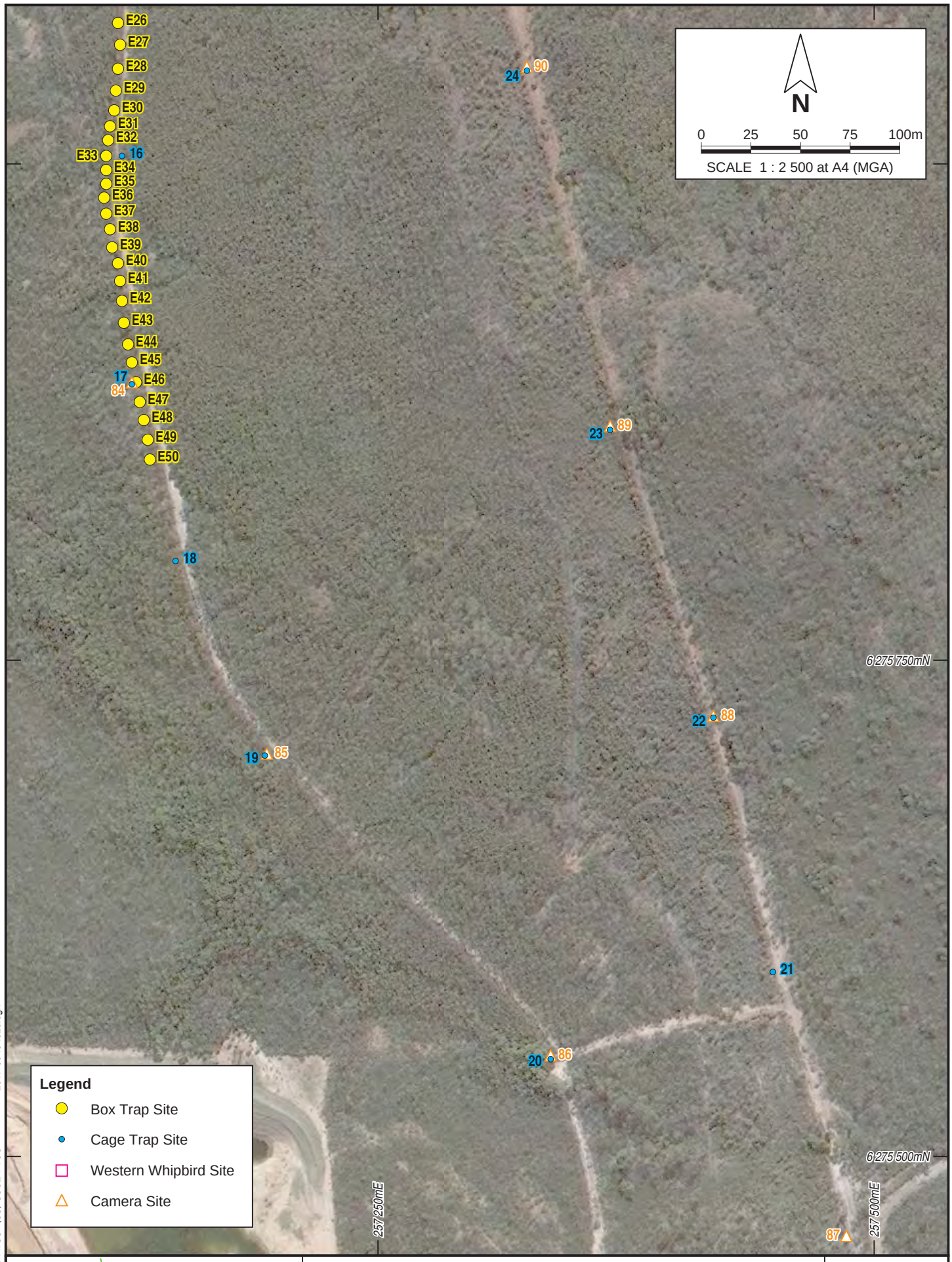
CONSERVATION SIGNIFICANT VERTEBRATE FAUNA MONITORING 2017
FOR RAVENSTHORPE NICKEL OPERATIONS

TRAPPING SITES

Figure 2c

Job: 2017-0048



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TERRESTRIAL ECOSYSTEMS

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CONSERVATION SIGNIFICANT VERTEBRATE FAUNA MONITORING 2017
FOR RAVENSTHORPE NICKEL OPERATIONS

Figure 2d

TRAPPING SITES

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N

0 25 50 75 100m

SCALE 1 : 2 500 at A4 (MGA)

TERRESTRIAL ECOSYSTEMS

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Date: 23 Jan 2018

FQM Australia Nickel Pty Ltd
CONSERVATION SIGNIFICANT VERTEBRATE FAUNA MONITORING 2017
FOR RAVENSTHORPE NICKEL OPERATIONS

TRAPPING SITES

Figure 2e

Job: 2017-0048

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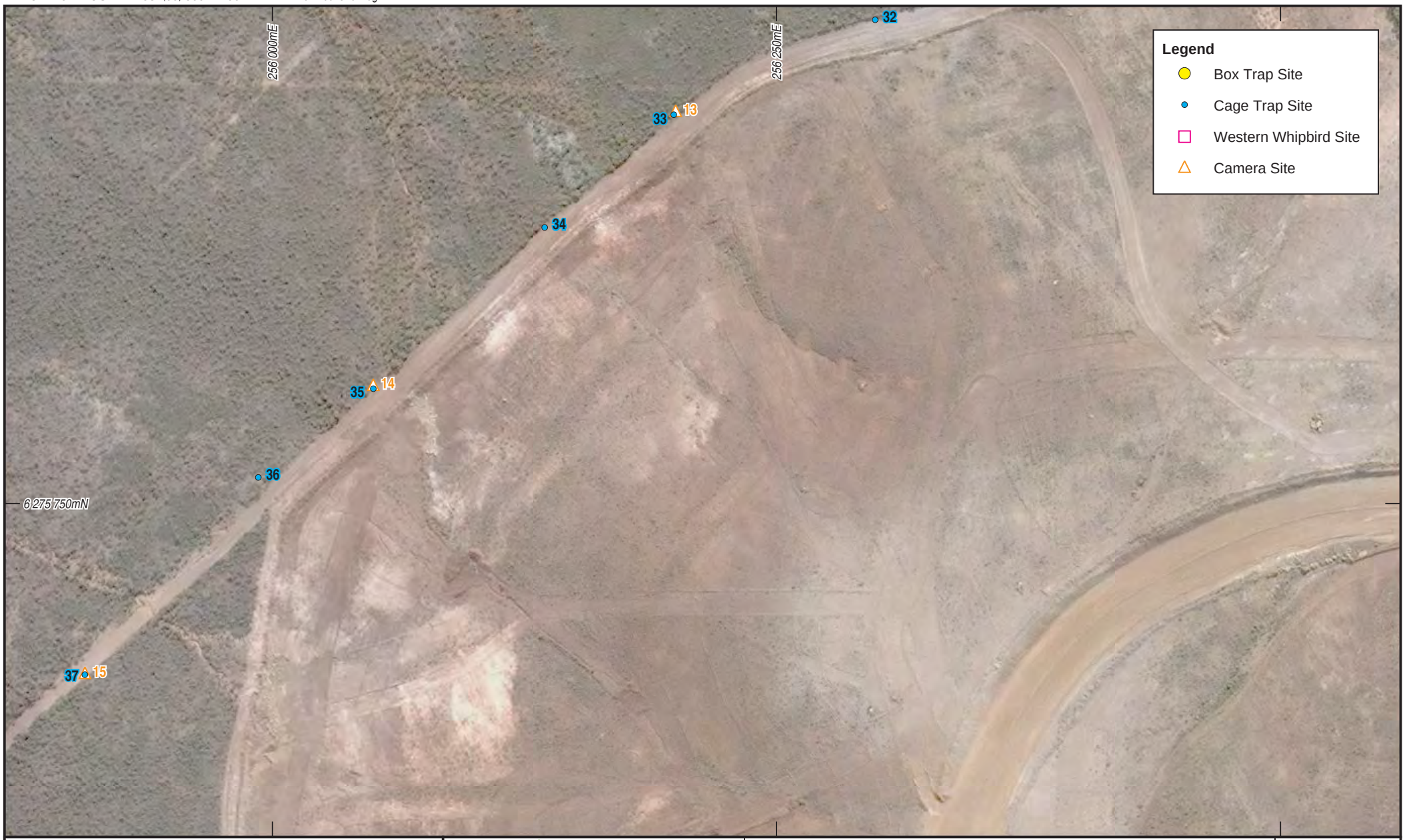

N

0 25 50 75 100m

SCALE 1 : 2 500 at A4 (MGA)

TERRESTRIAL ECOSYSTEMS

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CONSERVATION SIGNIFICANT VERTEBRATE FAUNA MONITORING 2017
FOR RAVENSTHORPE NICKEL OPERATIONS

TRAPPING SITES

Figure 2f

Job: 2017-0048

2017-0048-f02g.dgn

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TERRESTRIAL ECOSYSTEMS

FQM Australia Nickel Pty Ltd
CONSERVATION SIGNIFICANT VERTEBRATE FAUNA MONITORING 2017
FOR RAVENSTHORPE NICKEL OPERATIONS

TRAPPING SITES

Figure 2g

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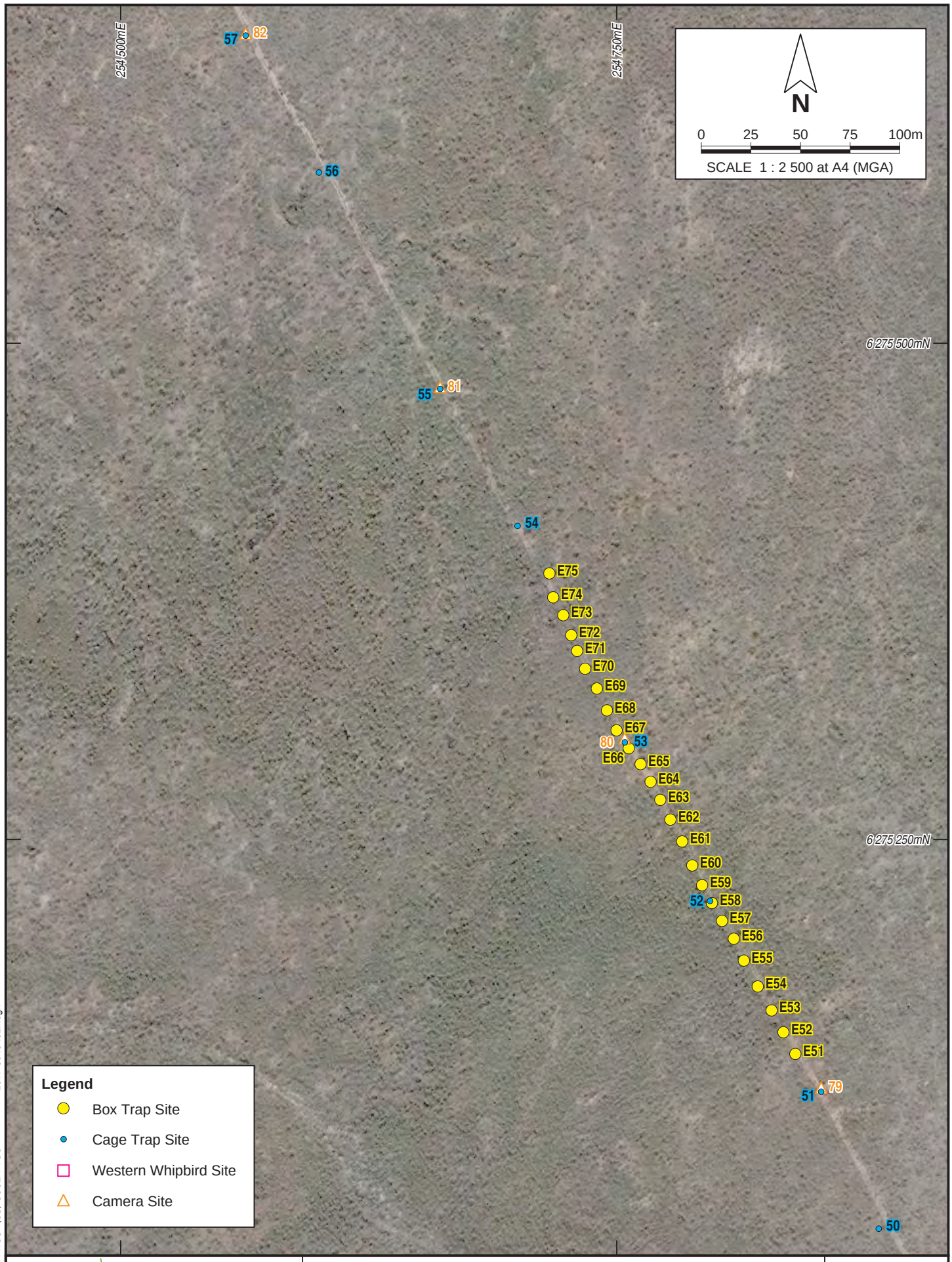

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TERRESTRIAL ECOSYSTEMS

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CONSERVATION SIGNIFICANT VERTEBRATE FAUNA MONITORING 2017
FOR RAVENSTHORPE NICKEL OPERATIONS

Figure 2h

TRAPPING SITES

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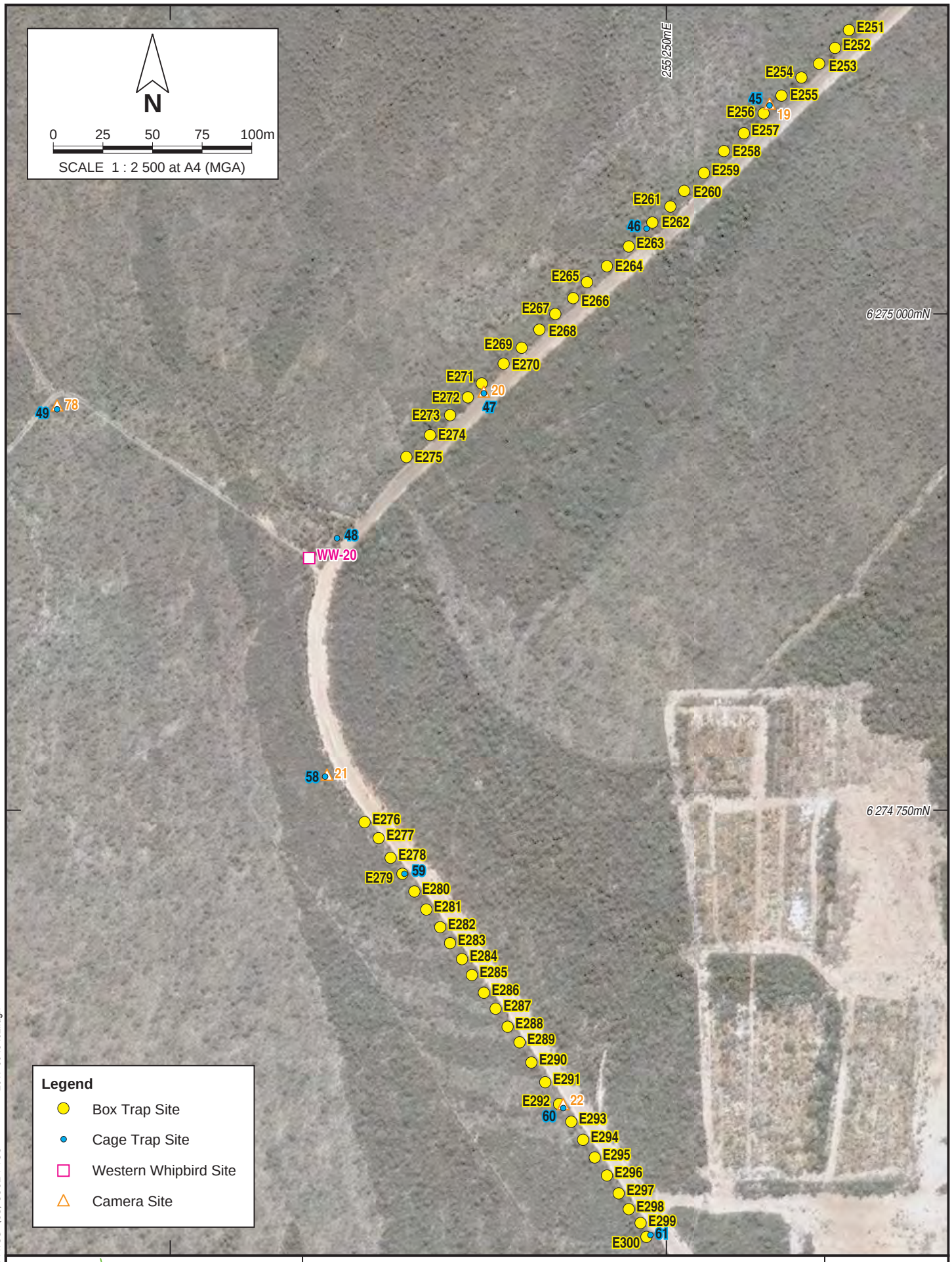

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TERRESTRIAL ECOSYSTEMS

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CONSERVATION SIGNIFICANT VERTEBRATE FAUNA MONITORING 2017
FOR RAVENSTHORPE NICKEL OPERATIONS

Figure 2i

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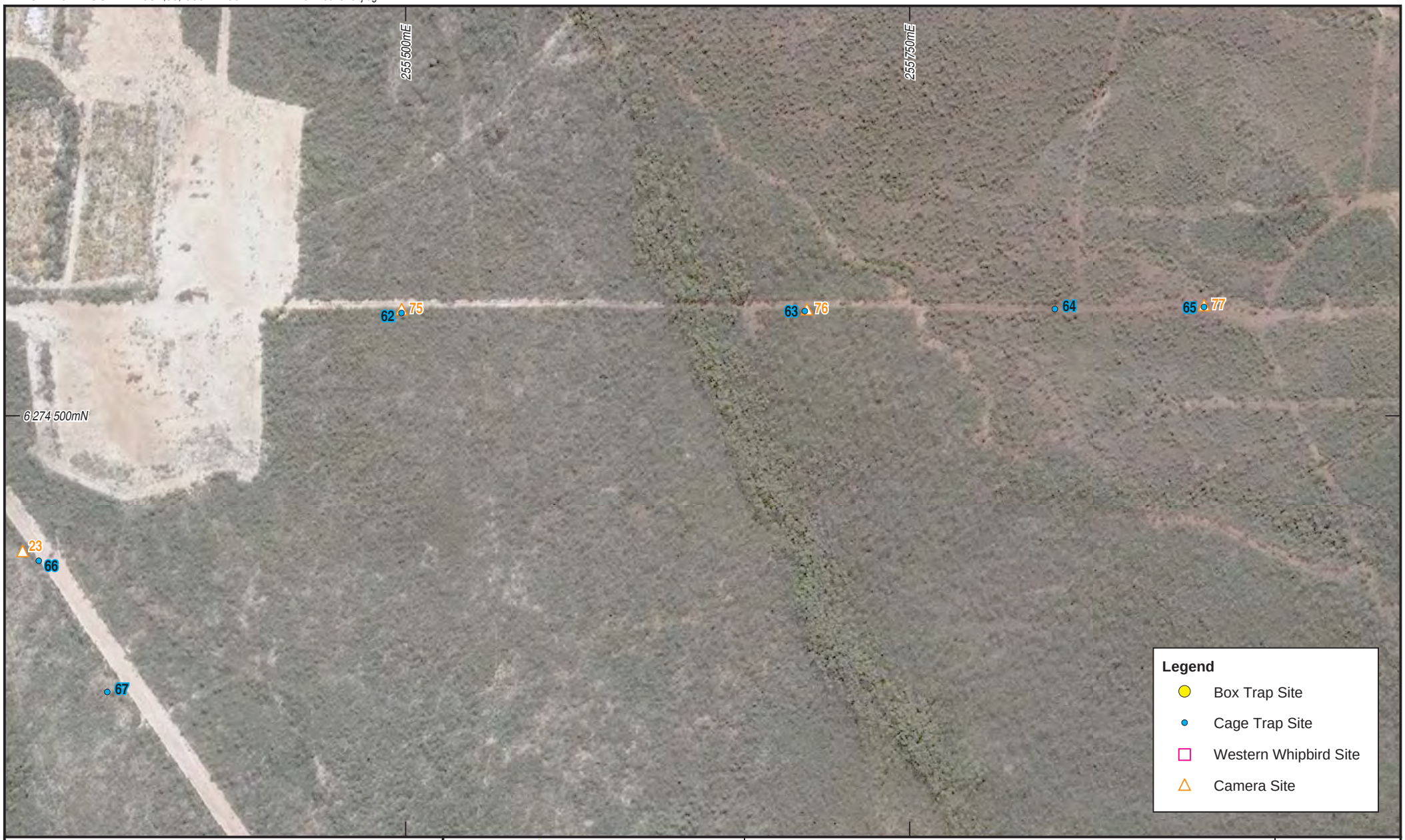

N

0 25 50 75 100m

SCALE 1 : 2 500 at A4 (MGA)

TERRESTRIAL ECOSYSTEMS

Drawn: G. Thompson

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CONSERVATION SIGNIFICANT VERTEBRATE FAUNA MONITORING 2017
FOR RAVENSTHORPE NICKEL OPERATIONS

TRAPPING SITES

Figure 2j

Job: 2017-0048

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TERRESTRIAL ECOSYSTEMS

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FOR RAVENSTHORPE NICKEL OPERATIONS

Figure 2k

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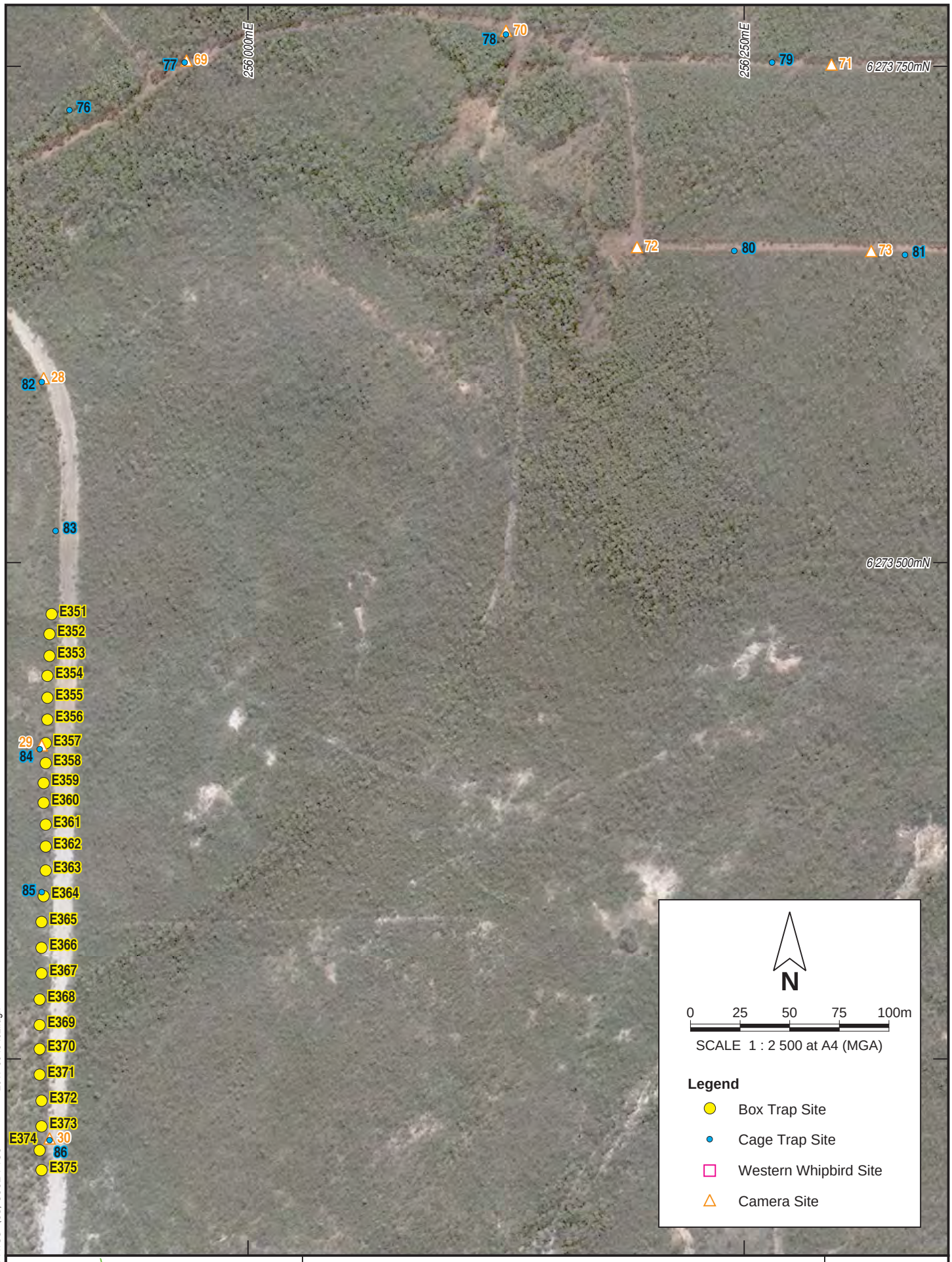

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TERRESTRIAL ECOSYSTEMS

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CONSERVATION SIGNIFICANT VERTEBRATE FAUNA MONITORING 2017
FOR RAVENSTHORPE NICKEL OPERATIONS

Figure 2l

TRAPPING SITES

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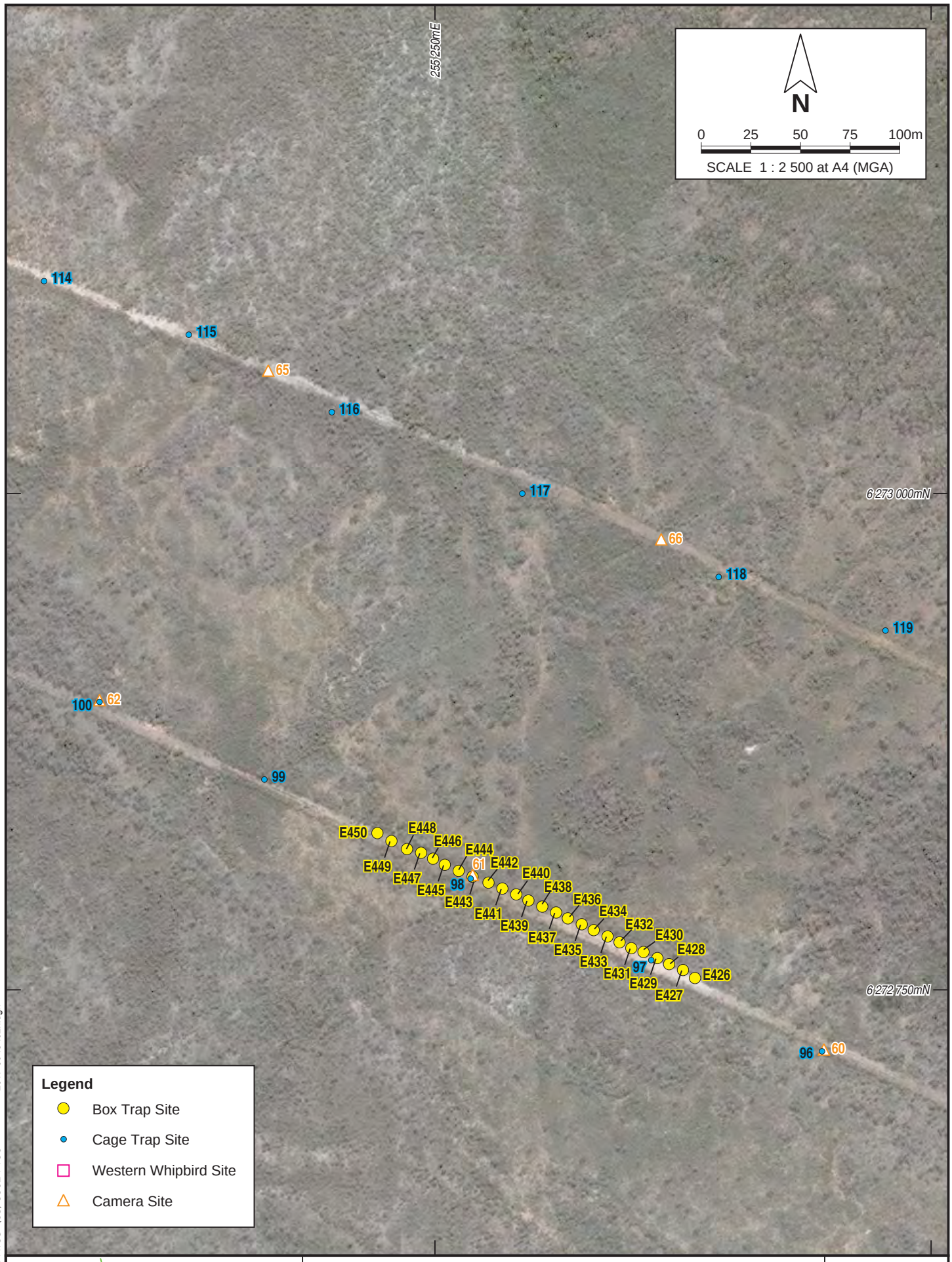
FOR RAVENSTHORPE NICKEL OPERATIONS

TRAPPING SITES

Figure 2m

Job: 2017-0048



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TERRESTRIAL ECOSYSTEMS

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FOR RAVENSTHORPE NICKEL OPERATIONS

TRAPPING SITES

Figure 2n

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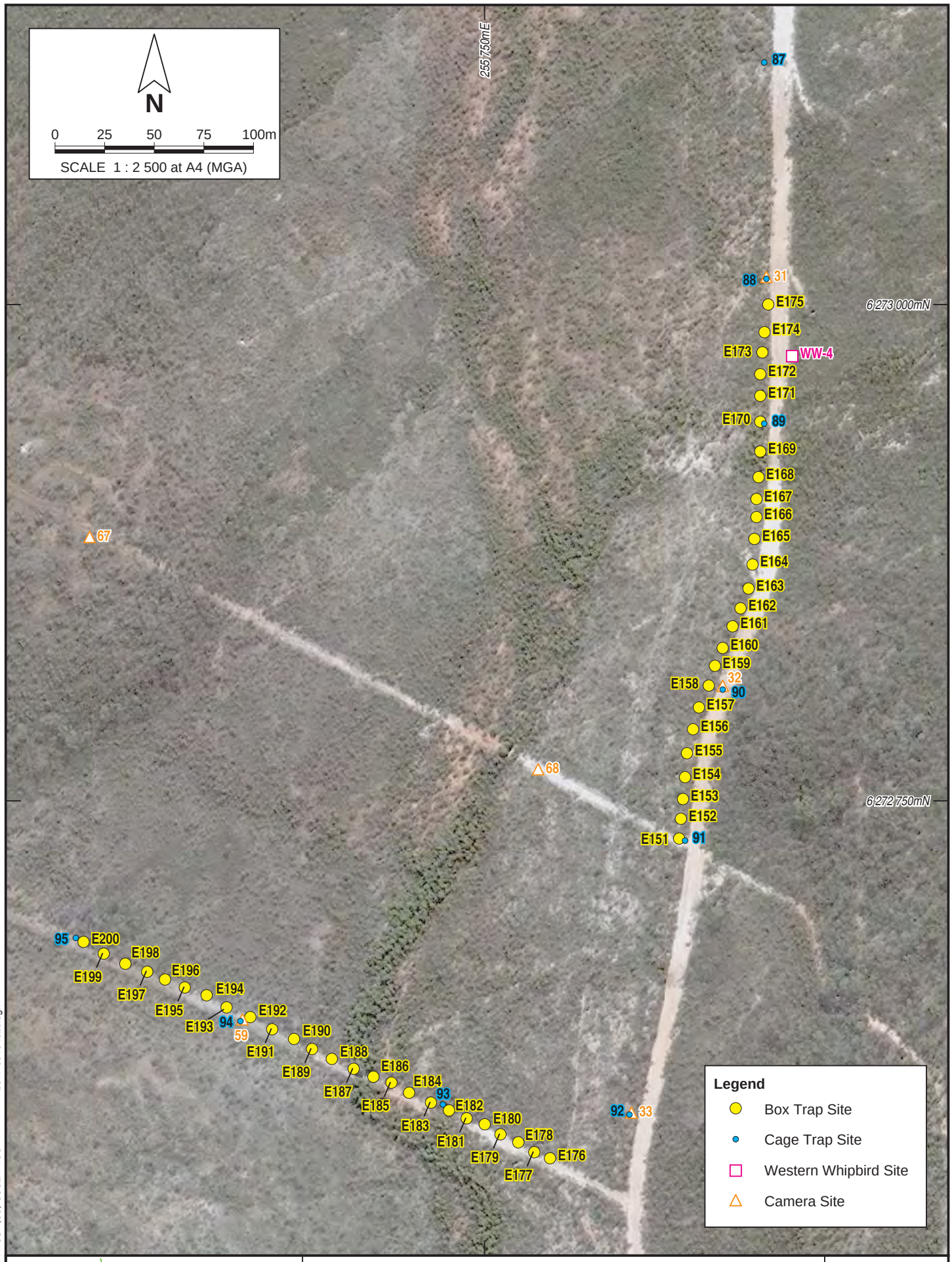

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TERRESTRIAL ECOSYSTEMS

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FOR RAVENSTHORPE NICKEL OPERATIONS

TRAPPING SITES

Figure 2o

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Job: 2017-0048

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N

0 25 50 75 100m

SCALE 1 : 2 500 at A4 (MGA)

TERRESTRIAL ECOSYSTEMS

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FOR RAVENSTHORPE NICKEL OPERATIONS

TRAPPING SITES

Figure 2p

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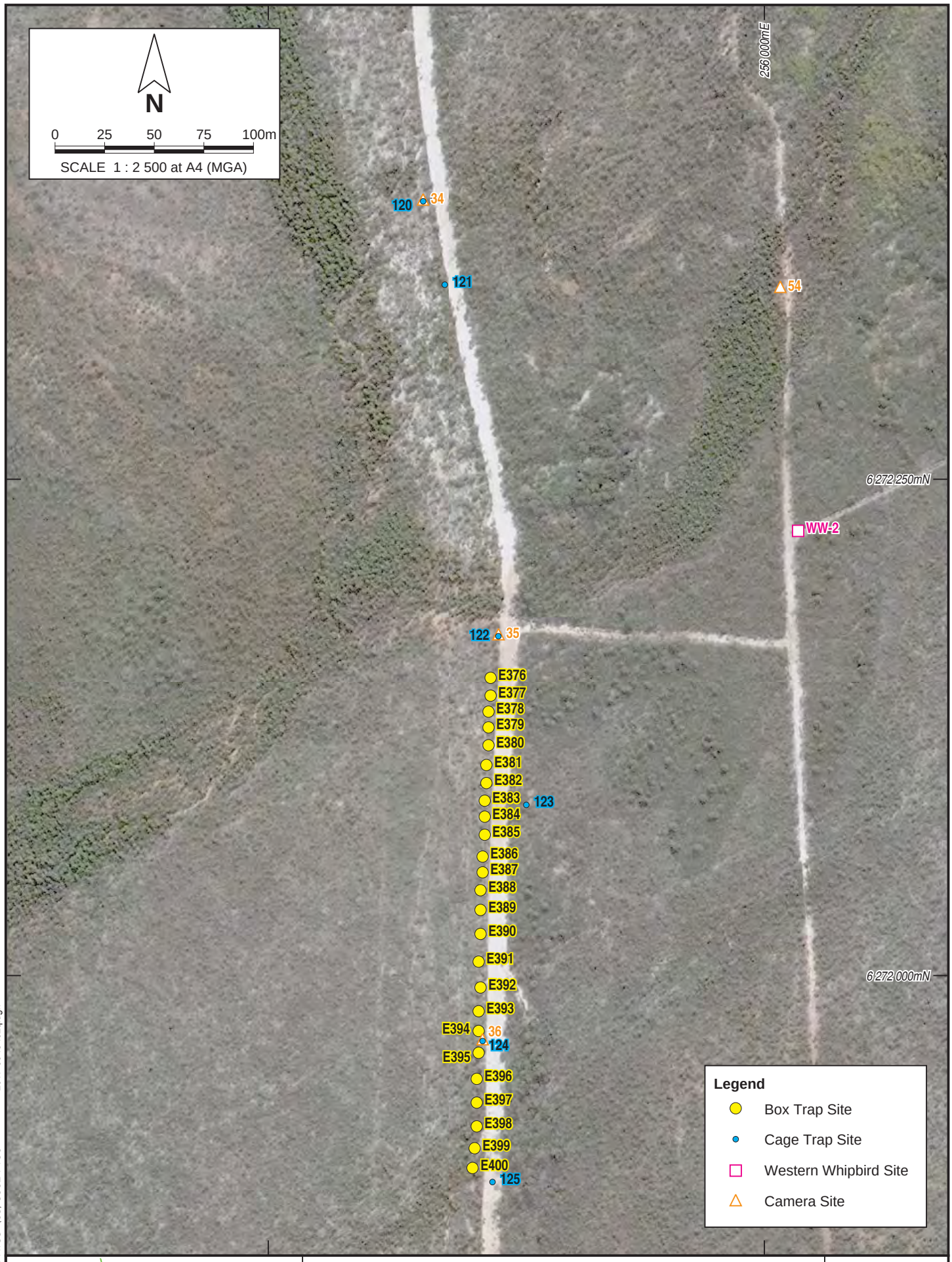

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TERRESTRIAL ECOSYSTEMS

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FOR RAVENSTHORPE NICKEL OPERATIONS

Figure 2q

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TERRESTRIAL ECOSYSTEMS

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Figure 2r

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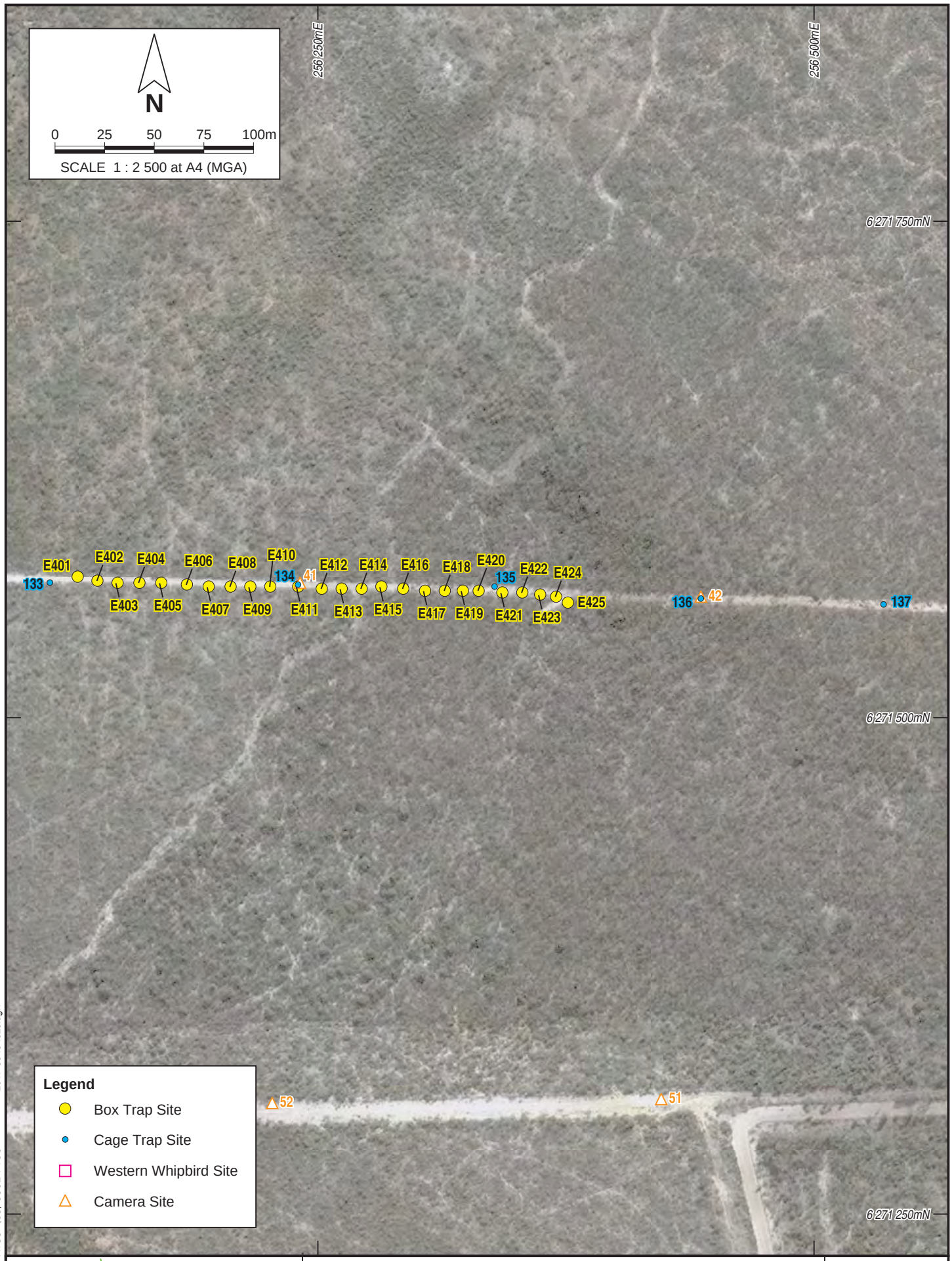

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TERRESTRIAL ECOSYSTEMS

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FOR RAVENSTHORPE NICKEL OPERATIONS

Figure 2s

TRAPPING SITES

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N

0 25 50 75 100m

SCALE 1 : 2 500 at A4 (MGA)

TERRESTRIAL ECOSYSTEMS

Drawn: G. Thompson

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CONSERVATION SIGNIFICANT VERTEBRATE FAUNA MONITORING 2017
FOR RAVENSTHORPE NICKEL OPERATIONS

TRAPPING SITES

Figure 2t

Job: 2017-0048

PINPOINT CARTOGRAPHICS (08) 9562 7136 2017-0048-f02u.dgn

N

0 25 50 75 100m

SCALE 1 : 2 500 at A4 (MGA)

TERRESTRIAL ECOSYSTEMS

Drawn: G. Thompson

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CONSERVATION SIGNIFICANT VERTEBRATE FAUNA MONITORING 2017
FOR RAVENSTHORPE NICKEL OPERATIONS

TRAPPING SITES

Figure 2u

Job: 2017-0048

Ravensthorpe Nickel Operations
Vertebrate Fauna Impact Assessment for Proposed Expansion
2017

Version 2. July 2017

Prepare for:

FQM Australia Nickel
Locked Bag 100,
Ravensthorpe, WA, 6346

By:

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WA 6010

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Front Cover: Chuditch (*Dasyurus geoffroii*)

EXECUTIVE SUMMARY

FQM Australia Nickel Pty Ltd (FQM) is proposing changes to the Ravensthorpe Nickel Operations (RNO) which include expansion of the mining area for approved footprint for the Shoemaker-Levy ore deposit, construction of a conveyor belt and haul road in an infrastructure corridor that is approximately 11km long, joining a ROM at Shoemaker-Levy with the existing main processing plant, and expansion of the existing approved pit at Hale Bopp North West. These three areas are subsequently referred to in this report as the 'project area'. For the purposes of this impact assessment, the width of the infrastructure corridor is an average of 60m wide. The combined size of the expansion to the Shoemaker-Levy mining area and infrastructure corridor footprint envelopes is approximately 631ha and the proposed Hale Bopp North West development footprint is 32ha.

This report provides an assessment of the primary risks and threats to vertebrate fauna in the project area, provides a metric for the interaction between the impacts and minimisation / mitigation / rehabilitation strategies to determine residual impacts of a development, and provides recommendations for a series of strategies to avoid, minimise, mitigate and compensate for the potential impacts of the proposed development.

Eight conservation significant fauna taxa have been recorded in recent surveys of the project area and surrounds: Carnaby's Black-Cockatoo [Endangered – Environment Protection and Biodiversity Conservation (EPBC) Act; Endangered – Wildlife Conservation (WC) Act], Chuditch (*Dasyurus geoffroii*; Vulnerable - EPBC Act; Vulnerable - WC Act), Malleefowl (*Leipoa ocellata*; Vulnerable - EPBC Act; Vulnerable - WC Act), Western Brush Wallaby [*Macropus irma*; Priority 4 – Department of Biodiversity, Conservation and Attractions (DBCA)], Western Mouse (*Pseudomys occidentalis*; Priority 4 - DBCA), Southern Brown Bandicoot (*Isoodon obesulus fusciventer*; Priority 4 - DBCA), Rainbow Bee-eater (*Merops ornatus*; Migratory - WC Act) and the Western Whipbird (*Psophodes nigrogularis oberon*; Priority 4 - DBCA). There are historical records of the Heath Rat (*Pseudomys shortridgei*; Endangered - EPBC Act, Vulnerable - WC Act). There are no Malleefowl mounds in the proposed infrastructure corridor or in the proposed Hale Bopp North West pit area, but there is one recently active mound in the Shoemaker-Levy mining area, one approximately 700m south-west of the expansion area, and an active mound north of the Shoemaker-Levy expansion area. Baudin's Black-Cockatoo (*Calyptorhynchus baudinii*; Endangered – EPBC Act, Endangered WC Act) have not been recorded in the project area but may forage in the project area.

All fauna habitats present in the project area are abundant in adjacent areas. If fauna assemblages are based on vegetation communities and no other factors, then the vertebrate fauna present in the project area should also be present in adjacent areas. The infrastructure corridor and the Shoemaker-Levy mine expansion area are located approximately 800m south of the State Barrier Fence within the Gondwana Link zone that joins the Great Western Woodlands to the Fitzgerald River National Park and also comprise part of the Department of Biodiversity, Conservation and Attractions' South Coast Macro Corridor Network.

There is evidence to suggest that there has been a significant decline in the abundance of small vertebrate fauna, and in particular threatened species, in the RNO tenements since the surveys in 2000. The most significant impact on vertebrate fauna in RNO tenements, and in particular threatened species, are predation by cats and foxes and vegetation clearing and habitat fragmentation. Primary threats to vertebrate fauna posed by the proposed changes to RNO are:

- Physical barrier to the movement of vertebrate fauna;
- Increases in predation caused by an increase in the abundance of feral and pest fauna (i.e. cats and foxes);
- Habitat fragmentation in the proposed mine expansion and infrastructure areas;
- Proposed vehicle activity on a haul road;
- Edge effects;
- Dust;
- Anthropogenic impacts such as unnatural light, noise and vibration;
- Altered fire regimes;
- Introduction and spread of weeds; and
- Cumulative effects of vegetation clearing.

For species listed under the EPBC Act, there are likely to be residual impacts to Heath Rat (if present), Malleefowl and Chuditch after the suggested mitigation strategies are implemented.

After all the proposed mitigation strategies are implemented there will also be a residual impact on the Western Mouse, Western Brush Wallaby and the vertebrate fauna assemblage.

It is recommended that:

1. A vertebrate fauna management plan is prepared and implemented for the entire RNO operations. This plan should focus on long-term management, protection and mitigation of impacts on the vertebrate fauna, including the monitoring of fauna assemblages, implementation of mitigation plans and the management of feral and pest species.
2. A two-stage pilot fox and feral cat reduction program has commenced, in autumn 2017. *Stage 1* is broad-scale distribution of buried 1080 baits with a follow up distribution at approximately 2, 4 and 6 weeks. Camera traps were be used to monitor bait uptake at selected sites. This program should achieve a reduction in the number of foxes. *Stage 2* is a trial of canid pest ejectors (CPE) as the basis for on-going fox management. CPEs should be deployed and activated for two months each year along established but little used tracks, to reduce and maintain fox numbers to a level lower than the current population. Again, bait uptake should be monitored during this trial using camera traps. The success of Stages 1 and 2 should be monitored with camera traps in conjunction with a modified annual conservation significant fauna monitoring program. Stages 1 and 2 should be complemented with a biannual trapping program for cats on RNO tenements, and a shooting program for cats and foxes in the paddocks around the RNO. Feral and pest animal management programs targeting cats and foxes should be implemented in autumn / winter when alternate food opportunities for cats and foxes are at the lowest level, thus increasing the bait uptake and reducing the probability that *Varanus rosenbergi* will be affected by the baits.
3. The fox and feral cat management program should be assessed after three years of operation, and amendments and adjustments made to improve its effectiveness. The fox and feral cat management program should be ongoing, as both introduced predators will continually move into the RNO tenements on an ongoing basis.
4. A shooting program targeting the couple of isolated rabbit populations around the RNO tenements.
5. Prior to vegetation clearing, an intensive trapping program should be implemented in areas to be cleared using large cage traps and aluminium box traps, with the purpose of relocating caught fauna.
6. A zoologist should be present to work with each machine operator during the clearing of vegetation to catch and relocate vertebrate fauna that are disturbed or displaced.
7. The relocation of each Chuditch is monitored with a GPS radio-tracking device to determine movement patterns and survival.
8. The saline water pipeline is elevated approximately every 100m to enable small vertebrate fauna to pass under the pipeline.
9. Rehabilitation is carried out once areas are no longer required for mining activities. The rehabilitation program should focus on creating habitat suitable for Carnaby's Black-Cockatoo, Chuditch, Malleefowl, Western Mouse, Heath Rats and Southern Brown Bandicoot. The success of rehabilitation programs to provide suitable habitat for conservation significant fauna, and whether these fauna return to the area, should be assessed as part of the ongoing fauna monitoring program.
10. Where practical, all vegetation is cleared from disturbed areas toward uncleared areas to increase the prospects of fauna fleeing from the disturbance and safely reaching bushland.
11. All drill holes are appropriately capped to prevent capturing fauna.

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1. Mallee shrubland with dense understorey of shrubland, grasses and herbs
2. Open mallee shrubland over low heath, grasses and herbs
3. Low heath and shrubs over grasses and herbs (very few trees)
4. Closed mallee shrubland with almost no understorey
5. Damp areas or drainage and creek lines with relatively dense shrubs to 2m high
6. Tall trees and sparse shrubland
7. Mitigation hierarchy
8. Gondwana Link
9. Other linkages within the Gondwana Link
10. South Coast Macro Corridor Network
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Figures

1. Regional location
2. Proposed Shoemaker-Levy expansion, infrastructure corridor and the Hale Bopp North West pit area

1 INTRODUCTION

FQM Australia Nickel Pty Ltd (FQM) has approval under Part IV of the *Environmental Protection Act 1986* (*EP Act*) and the Commonwealth *EPBC Act 1999* for its lateritic nickel mining operations near Ravensthorpe. FQM is proposing changes to the Ravensthorpe Nickel Operations (RNO), which comprise:

- An expansion of the Hale Bopp open pit into the Kunzea Community Conservation Area (KCCA);
- An expansion of the Shoemaker-Levy open pit and associated waste material landforms; and the
- Construction of a new transport and infrastructure corridor between the existing processing facilities and Shoemaker-Levy area.

1.1 Background

This project was referred to both the State and Commonwealth Governments and on 2/9/2016 it was determined to be a controlled action under the *EPBC 1999*, to be assessed under the Bilateral Agreement between the Commonwealth of Australia and the State of Western Australia under Section 45 of the *Environmental Protection Act*. The relevant vertebrate fauna matters of national environmental significance (MNES) for this proposal are:

- Clearing of native vegetation which is likely to contain habitat for the threatened species listed below:
  - Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) – Endangered
  - Heath Mouse (*Pseudomys shortridgei*) – Endangered
  - Chuditch (*Dasyurus geoffroii*) – Vulnerable
  - Malleefowl (*Leipoa ocellata*) – Vulnerable

FQM is proposing to extend its mining operations into an area previously reserved for the protection of the threatened *Kunzea similis* subsp. *mediterranea*, and to re-route its previously approved infrastructure corridor from the proposed Shoemaker-Levy deposit located on the northern side of the South Coast Highway to the existing processing plant and to expand the mining area for the proposed Shoemaker-Levy mine (Figures 1 and 2). The Western Australian Environmental Protection Authority (EPA) has determined that this additional development will be assessed at the level of a Public Environmental Review (PER).

The combined areas for the proposed Shoemaker-Levy mine expansion, the proposed infrastructure corridor and the proposed Hale Bopp North West pit area are subsequently described as the 'project area'. For the purposes of the vertebrate fauna impact assessment, the proposed infrastructure corridor width is an average of 60m (Figure 2). A buffer zone of approximately 50m was employed around the proposed Hale Bopp North West footprint for the purposes of field surveys.

1.1.1 Environmental Protection Authority approval

In 2003, a Section 46 amendment under the *EP Act* for RNO was approved (EPA Bulletin 1093) the construction of a conveyor belt connecting the proposed Shoemaker-Levy mine to the ore processing plant south of the South Coast Highway. In its review of this the Section 46 application, the EPA indicated the relevant factors to be considered addressed in that assessment were:

- priority flora and significant vegetation communities;
- the Bandalup Corridor (including fauna issues); and
- community liaison.

The EPA's assessment indicated that a proposed raised conveyor belt in a linear corridor would not impose a substantial barrier to the movement of fauna or connection of flora. The current proposal incorporates an alternative infrastructure corridor. The size and route of the proposed disturbance area and the design of the infrastructure corridor has the potential to have a significant impact on the terrestrial vertebrate fauna.

On 5 March 2017, in the Environmental Scoping Document for the current proposal, the EPA indicated the potentially significant vertebrate fauna factors to be considered for the proposed development to be:

- Direct loss of native vegetation, including habitat used by threatened fauna;
- Fragmentation of the Fitzgerald Biosphere and Bandalup Corridor;
- Death or displacement of threatened fauna as a result of vegetation clearing;
- Other indirect impacts, including fire, dust, introduction and spread of weeds; and

- Construction and operation of the infrastructure corridor resulting in limitations to fauna movement.

1.2 Legislative context

The EPA has published three documents that provide guidance for undertaking vertebrate fauna assessments in Western Australia which have been used in the preparation of this impact assessment, namely: *Statement of Environmental Principles, Factors and Objectives* (2016a); *Environmental Factor Guideline Terrestrial Fauna* (2016a) and *Technical Guidance Terrestrial Fauna Surveys* (2016b).

1.3 Vertebrate fauna assessment

Terrestrial Ecosystems was commissioned to undertake a review of the existing information, undertake some additional surveys and to assess the potential impact that vegetation clearing, the construction of an infrastructure corridor, the proposed Hale Bopp North West pit area and the expansion to the Shoemaker-Levy mine would have on the vertebrate fauna. The EPA has published three documents that provide guidance for undertaking vertebrate fauna assessments in Western Australia, namely: *Statement of Environmental Principles, Factors and Objectives* (2016a); *Environmental Factor Guideline Terrestrial Fauna* (2016a) and *Technical Guidance Terrestrial Fauna Surveys* (2016b). Terrestrial Ecosystems (2017) has reported on the vertebrate fauna known to be, and potentially present in the project area in a sister report: *Vertebrate fauna surveys for the Hale Bopp North West pit, an infrastructure corridor and extension to the proposed Shoemaker Levy mining area on vertebrate fauna at the Ravensthorpe Nickel Operations*. It has been assumed that the sister report is read in conjunction with this impact assessment, as the specific locations, ecology, geographic distribution and abundance of vertebrate fauna in the RNO tenements and surrounds contained in the sister report have not been repeated in this report.

1.3.1 Terrestrial fauna

The vertebrate fauna species known to be present or are potentially present in the terrestrial fauna assemblage in RNO tenements are listed in Table 1 (Terrestrial Ecosystems 2017).

Table 1. Terrestrial fauna species potentially found in the project area or surrounds

Family	Species	Common Name
Birds		
Accipitridae	*Elanus axillaris*	Black-shouldered Kite
	Lophoictinia isura	Square-tailed Kite
	Haliastur sphenurus	Whistling Kite
	Accipiter fasciatus	Brown Goshawk
	Accipiter cirrocephalus	Collared Sparrowhawk
	Aquila audax	Wedge-tailed Eagle
	Hieraaetus morphnoides	Little Eagle
Anatidae	*Chenonetta jubata*	Australian Wood Duck
	Malacorhynchus membranaceus	Pink-eared Duck
	Anas rhynchotis	Australasian Shoveler
	Anas gracilis	Grey Teal
	Anas castanea	Chestnut Teal
	Anas superciliosa	Pacific Black Duck
	Aythya australis	Hardhead
Aegothelidae	*Aegotheles cristatus*	Australian Owlet-nightjar
Podargidae	*Podargus strigoides*	Tawny Frogmouth
Casuariidae	*Dromaius novaehollandiae*	Emu
Charadriidae	*Elseyornis melanops*	Black-fronted Dotterel
Scolopacidae	*Tringa nebularia*	Common Greenshank
Turnicidae	*Turnix varius*	Painted Button-quail
Phalacrocoracidae	*Microcarbo melanoleucos*	Little Pied Cormorant
Ardeidae	*Egretta novaehollandiae*	White-faced Heron
Columbidae	*Phaps chalcoptera*	Common Bronzewing
	Phaps elegans	Brush Bronzewing
	Ocyphaps lophotes	Crested Pigeon
Meropidae	*Merops ornatus*	Rainbow Bee-eater
Cuculidae	*Chalcites basalis*	Horsfield's Bronze-Cuckoo
	Chalcites lucidus	Shining Bronze-Cuckoo
	Cacomantis flabelliformis	Fan-tailed Cuckoo
Caprimulgidae	*Eurostopodus argus*	Spotted Nightjar
Falconidae	*Falco cenchroides*	Nankeen Kestrel
	Falco berigora	Brown Falcon
Megapodiidae	*Leipoa ocellata*	Malleefowl
Phasianidae	*Coturnix ypsilophora*	Brown Quail
Rallidae	*Fulica atra*	Eurasian Coot
Acanthizidae	*Sericornis frontalis*	White-browed Scrubwren
	Hylacola cauta	Shy Heathwren
	Calamanthus campestris	Rufous Fieldwren
	Smicrornis brevirostris	Weebill
	Gerygone fusca	Western Gerygone
	Acanthiza chrysorrhoa	Yellow-rumped Thornbill
	Acanthiza apicalis	Inland Thornbill
Artamidae	*Artamus cyanopterus*	Dusky Woodswallow
	Cracticus torquatus	Grey Butcherbird
	Cracticus tibicen	Australian Magpie
	Strepera versicolor	Grey Currawong
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-Shrike
Corvidae	*Corvus coronoides*	Australian Raven
Hirundinidae	*Hirundo neoxena*	Welcome Swallow
	Petrochelidon nigricans	Tree Martin
Maluridae	*Malurus pulcherrimus*	Blue-breasted Fairy-wren
	Stipiturus malachurus	Southern Emu-wren
Meliphagidae	*Acanthorhynchus superciliosus*	Western Spinebill
	Lichenostomus leucotis	White-eared Honeyeater
	Lichenostomus cratitius	Purple-gaped Honeyeater
	Manorina flavigula	Yellow-throated Miner
	Anthochaera lunulata	Western Wattlebird
	Anthochaera carunculata	Red Wattlebird

Family	Species	Common Name
	Gliciphila melanops	Tawny-crowned Honeyeater
	Lichmera 4utturalis	Brown Honeyeater
	Phylidonyris novaehollandiae	New Holland Honeyeater
	Phylidonyris niger	White-cheeked Honeyeater
	Melithreptus brevirostris	Brown-headed Honeyeater
	Melithreptus lunatus	White-naped Honeyeater
Monarchidae	*Myiagra inquieta*	Restless Flycatcher
	Grallina cyanoleuca	Magpie-Lark
Motacillidae	*Anthus novaeseelandiae*	Australasian Pipit
Neosittidae	*Daphoenositta chrysoptera*	Varied Sittella
Pachycephalidae	*Pachycephala pectoralis*	Golden Whistler
	Colluricincla harmonica	Grey Shrike-thrush
	Oreoica gutturalis	Crested Bellbird
Pardalotidae	*Pardalotus punctatus*	Spotted Pardalote
	Pardalotus striatus	Striated Pardalote
Petroicidae	*Eopsaltria griseogularis*	Western Yellow Robin
	Drymodes brunneopygia	Southern Scrub-robin
Pomatostomidae	*Pomatostomus superciliosus*	White-browed Babbler
Psophodidae	*Psophodes nigrogularis*	Western Whipbird
Rhipiduridae	*Rhipidura albiscapa*	Grey Fantail
	Rhipidura leucophrys	Willie Wagtail
Timaliidae	*Zosterops lateralis*	Silvereye
Phalacrocoracidae	*Phalacrocorax varius*	Pied Cormorant
Podicipedidae	*Poliocephalus poliocephalus*	Hoary-headed Grebe
Cacatuidae	*Calyptorhynchus latirostris*	Carnaby's Black-Cockatoo
	Eolophus roseicapillus	Galah
Psittacidae	*Glossopsitta porphyrocephala*	Purple-crowned Lorikeet
	Barnardius zonarius	Australian Ringneck
	Purpureicephalus guttural	Red-capped Parrot
Strigidae	*Ninox novaeseelandiae*	Southern Boobook
Tytonidae	*Tyto alba*	Barn Owl
Reptiles		
Agamidae	*Amphibolurus norrisi*	
	Ctenophorus adelaidensis	Southern Heath Dragon
	Ctenophorus maculatus	Spotted Military Dragon
	Pogona minor	Bearded Dragon
Carphodactylidae	*Underwoodisaurus milii*	Barking Gecko
Diplodactylidae	*Crenadactylus ocellatus*	Clawless Gecko
	Diplodactylus granariensis	
	Oedura marmorata	Marbled Velvet Gecko
	Strophurus spinigerus	
Elapidae	*Echiopsis curta*	Bardick
	Elapognathus coronatus	Crowned Snake
	Notechis scutatus	Tiger Snake
	Parasuta gouldii	
	Pseudonaja affinis	Dugite
Gekkonidae	*Christinus marmoratus*	Marbled Gecko
Pygopodidae	*Aprasia repens*	
	Delma hebesa	Heath Delma
	Delma fraseri	
	Pygopus lepidopodus	Common Scaly Foot
	Pygopus nigriceps	
Scincidae	*Acritoscincus trilineatum*	
	Cryptoblepharus pulcher	
	Ctenotus gemmula	
	Ctenotus impar	
	Ctenotus labillardieri	
	Egernia multiscutata	
	Egernia richardi	
	Hemiergis initialis	
	Hemiergis peronii	

Family	Species	Common Name
	Lerista distinguenda	
	Lerista viduata	
	Menetia greyii	
	Morethia obscura	
	Tiliqua occipitalis	Western Bluetongue
	Tiliqua rugosa	Bobtail
Typhlopidae	*Anilios australis*	
Varanidae	*Varanus rosenbergi*	Heath Monitor, Rosenberg's goanna
Mammals		
Canidae	*Vulpes vulpes**	Red Fox
Felidae	*Felis catus**	House Cat
Emballonuridae	*Taphozous australis*	Coastal Sheath-tail Bat
Molossidae	*Austronomus australis*	White-striped Free-tail Bat
Vespertilionidae	*Chalinolobus gouldii*	Gould's Wattled Bat
	Chalinolobus morio	Chocolate Wattled Bat
	Vespadelus regulus	Southern Forest Bat
Dasyuridae	*Dasyurus geoffroii*	Chuditch
	Phascogale calura	Red-tailed Phascogale
	Sminthopsis crassicaudata	Fat-tailed Dunnart
	Sminthopsis granulipes	White-tailed Dunnart
	Sminthopsis griseoventer	Grey-bellied Dunnart
Burramyidae	*Cercartetus concinnus*	Southwestern Pygmy Possum
Macropodidae	*Macropus fuliginosus*	Western Grey Kangaroo
	Macropus irma	Western Brush Wallaby
	Macropus eugenii	Tammar Wallaby
Tarsipedidae	*Tarsipes rostratus*	Honey Possum
Leporidae	*Oryctolagus cuniculus**	European Rabbit
Tachyglossidae	*Tachyglossus aculeatus*	Short-beaked Echidna
Peramelidae	*Isoodon obesulus*	Southern Brown Bandicoot
Muridae	*Mus musculus**	House Mouse
	Notomys mitchellii	Mitchell's Hopping Mouse
	Pseudomys albocinereus	Ash-grey Mouse
	Pseudomys occidentalis	Western Mouse
	Pseudomys shortridgei	Heath Mouse
	Rattus fuscipes	Bush Rat
	*Rattus rattus**	Black Rat
Amphibians		
Hylidae	*Litoria cyclorhyncha*	Spotted-thighed Frog
Limnodynastidae	*Heleioporus albopunctatus*	Western Spotted Frog
	Heleioporus eyrei	Moaning Frog
	Heleioporus psammophilus	Sand Frog
	Limnodynastes dorsalis	Western Banjo Frog
	Neobatrachus albipes	White-footed Trilling Frog
	Neobatrachus kunapalari	Kunapalari Frog
Myobatrachidae	*Crinia pseudinsignifera*	Bleating Froglet
	Myobatrachus gouldii	Turtle Frog

* Introduced species

1.3.2 Conservation significant fauna

Table 2 lists the conservation significant fauna species known to be or likely to be in the surrounds of RNO and comments on the probability of them being in the project area (Terrestrial Ecosystems 2017).

Table 2. Conservation significant species known to be or potentially in the proposed impact area

Species	Common Name	EPBC Act	WA Wildlife Conservation Act	DBCA Priority species	Probability of being in the project area
Pezoporus flaviventris	Western Ground Parrot	Cr	Cr		Unlikely to be present in the project area.
Pseudocheirus occidentalis	Western Ringtail Possum	Vu	Cr		Unlikely to be present in the project area.
Bettongia penicillata	Woylie	En	En		Unlikely to be present in the project area.
Pezoporus occidentalis	Night Parrot	En	Cr		Highly unlikely to be present in the project area.
Botaurus poiciloptilus	Australian Bittern	En	En		Highly unlikely to be present in the project area.
Calyptorhynchus latirostris	Carnaby's Black-Cockatoo	En	En		Present and occasionally forages in the proposed Hale Bopp North West pit area, infrastructure corridor and the Shoemaker-Levy expansion area.
Calyptorhynchus banksia naso	Forest Red-tailed Black-Cockatoo	Vu	Vu		May be seen rarely near the project area.
Calyptorhynchus baudinii	Baudin's Black-Cockatoo	En	Vu		Not recorded in RNO tenement surveys, but may be seen near the project area.
Panantechinus apicalis	Dibbler	En	En		Highly unlikely to be present in the project area.
Myrmecobius fasciatus	Numbat	En	Vu		Highly unlikely to be present in the project area.
Phascogale calura	Red-tailed Phascogale	En	CD		Has been historically recorded in the region but is unlikely to be present in the project area.
Psophodes nigrogularis	Western Whipbird (western heath subspecies)	En	En		Unlikely to be present in the project area.
Pseudomys shortridgei	Heath Rat	En	En		There is a historical capture by Biota Environmental Sciences (2000) in the Shoemaker-Levy mining area. Not recently caught in the RNO tenements, but may be present in very low numbers in the general area.
Leipoa ocellata	Malleefowl	Vu	Vu		Present in the project area, with most records in the western side of Shoemaker-Levy mining area and in the dense shrubs west of the existing mining operations. There is a recently active Malleefowl mound (MW3) within the approved Shoemaker-Levy mining area; an active (MW4) and two inactive mounds (MW5 and MW2) just outside the Shoemaker-Levy mine expansion area, and another active mound (MW1) approximately 700m south-west of the proposed Shoemaker Levy expansion area. Although outside the clearing boundary, Malleefowl mound MW4 is likely to be directly impacted by the proposed Shoemaker-Levy expansion area.
Dasyurus geoffroii	Chuditch	Vu	Vu		Present in multiple habitats across the project area.
Setonix brachyurus	Quokka	Vu	Vu		Highly unlikely to be present in the project area.
Dasyornis longirostris	Western Bristlebird	Vu	Vu		Not recorded in the project area, but has been recorded to the south and west of RNO tenements.
Falco peregrinus	Peregrine Falcon		SP		May infrequently be present in the project area.
Lerista viduata	Ravensthorpe Range Slider			P1	Not recorded during any of the RNO surveys.
Ninox connivens	Barking Owl			P2	Unlikely to be present in the project area.

Species	Common Name	EPBC Act	WA Wildlife Conservation Act	DBCA Priority species	Probability of being in the project area
Acanthophis antarcticus	Southern Death Adder			P3	Not recorded in or near the project area.
Macropus eugenii	Tammar Wallaby			P4	Not recorded in or near the project area.
Platycercus icterotis xanthogenys	Western Rosella			P4	Unlikely to be present in the project area.
Psophodes nigrogularis oberon	Western Whipbird (western mallee subspecies)			P4	Present in the proposed Hale Bopp North West pit area, infrastructure corridor and the Shoemaker mining and mine expansion area.
Pseudomys occidentalis	Western Mouse			P4	Present in the proposed Hale Bopp North West pit area and the Shoemaker-Levy mine and mine expansion areas.
Macropus irma	Western Brush Wallaby			P4	Present and abundant in multiple habitats around the RNO mine and project area.
Isoodon obesulus fusciventer	Southern Brown Bandicoot			P4	Present in the infrastructure corridor and previously recorded in the Shoemaker-Levy mining area.
Motacilla cinerea	Grey Wagtail	Migratory	Migratory		Highly unlikely to be present in the project area.
Pandion haliaetus	Osprey	Migratory	Migratory		Unlikely to utilise the project area, but may infrequently be seen flying past.
Apus pacificus	Fork-tailed Swift	Migratory	Migratory		May infrequently be seen flying over the area.
Merops ornatus	Rainbow Bee-eater		Migratory		Present, but seasonal.

En - Endangered under the EPBC and Wildlife Conservation Acts; Vu - Vulnerable under the EPBC and Wildlife Conservation Acts; SP - Other specially protected species; P - Priority species recorded by DBCA

1.4 Fauna habitats

The project area supports the following six fauna habitat types {Terrestrial Ecosystems, 2017 #9330} and areas that have been cleared or are being rehabilitated:

- Habitat type 1 - Mallee shrubland with dense understorey of shrubland, grasses and herbs (Plate 1);
- Habitat type 2 - Open mallee shrubland over low heath, grasses and herbs (Plate 2);
- Habitat type 3 - Low heath and shrubs over grasses and herbs (very few trees; Plate 3));
- Habitat type 4- Closed mallee shrubland with almost no understorey (Plate 4);
- Habitat type 5 - Damp areas or drainage and creek lines with relatively dense shrubs to 2m high (Plate 5); and
- Habitat type 6 - Tall trees and sparse shrubland (Plate 6).

The fauna habitats can be broadly aligned with Woodman Environmental's (2017) vegetation mapping (Table 3)

Table 3. Relationship between habitat types and vegetation types and size and percentage of study area

Fauna habitat type	Vegetation type	Size (ha)	% of project area
Habitat Type 1	Vegetation type 3, 5 and 6	254.6	29.63
Habitat Type 2	Vegetation type 1, 7, 9, 10 and 14	479.3	55.80
Habitat Type 3	Vegetation type 2 and 4	93.3	10.86
Habitat Type 4	Vegetation type 8	12.6	1.47
Habitat Type 5	Vegetation type 11 and 12	14.1	1.64
Habitat Type 6	Vegetation type 13	5.2	0.6

Plates 1-6 show the diversity of fauna habitats in the project area.

Plate 1. Mallee shrubland with dense understorey of shrubland, grasses and herbs

Plate 2. Open mallee shrubland over low heath, grasses and herbs

Plate 3. Low heath and shrubs over grasses and herbs (very few trees)

Plate 4. Closed mallee shrubland with almost no understorey

Plate 5. Damp areas or drainage and creek lines with relatively dense shrubs to 2m high

Plate 6. Tall trees and sparse shrubland

2 MITIGATION HIERARCHY

Rio Tinto's (2014) illustration (Plate 7) adequately describes the mitigation hierarchy.

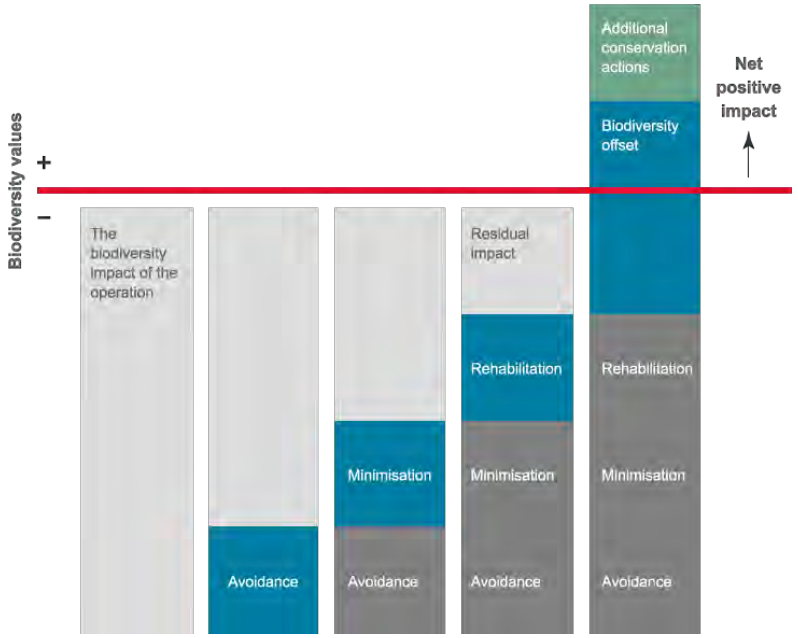

Plate 7. Mitigation hierarchy (Rio Tinto 2014)

Avoidance, minimisation and rehabilitation strategies can partially reduce the severity of an impact, or completely compensate for an impact, or can provide a net positive impact. For example, a fox and feral cat reduction program can result in the abundance of fauna, and in particular, conservation significant fauna, increasing beyond pre-development levels; this increase in a population as a direct result of this management action would contribute to a net positive impact.

To quantify the interaction between the impacts and the minimisation/rehabilitation strategies proposed, a scoring system and the criteria shown in Table 4 have been used. Impacts of most concern result in the loss or injury to fauna. Injuries either heal or the animal is debilitated and fails to survive or its capacity to reproduce is impacted. Loss of fauna has therefore been used as the primary criterion in assessing potential impacts. The potential loss or increase in the fauna as a consequence of a particular direct or indirect impact, and mitigation or minimisation strategy was a judgement that was made by the authors. This judgement was based on their significant combined experience surveying fauna at RNO and at other sites across Western Australia.

Table 4. Quantification criteria for impacts and minimisation / mitigation / rehabilitation strategies for a localised population[1,2]

Extent of impact or effectiveness of the minimisation / mitigation / rehabilitation strategy[1]	Score
>80% loss of individuals over a period of five years	-5
60-80% loss of individuals over a period of five years	-4
40-60% loss of individuals over a period of five years	-3
20-40% loss of individuals over a period of five years	-2
10-20% loss of individuals over a period of five years	-1
-10 to + 10% change in the abundance of fauna over a period of five years	0
10-20% increase in the number of individuals over a period of five years	+1
20-40% increase in the number of individuals over a period of five years	+2
40-60% increase in the number of individuals over a period of five years	+3
60-80% increase in the number of individuals over a period of five years	+4
>80% increase in the number of individuals over a period of five years	+5

[1] Assumes that the current vertebrate fauna population is at a suboptimal level.

[2] For the purposes of Table 4 and this impact assessment a 'localised population' refers to a population that was separated from another population by a natural or anthropogenic barrier (for example, a river system or farmland pasture that fauna will not readily cross). In the case of Chuditch and Western Brush Wallaby near Shoemaker-Levy and infrastructure corridor, the barrier might be the extensive area of cleared land between the South Coast Highway and the State Barrier Fence. For Southern Brown Bandicoots, the barrier for movement might be sparsely vegetated areas or open habitat between dense habitat patches of vegetation. If there are no natural barriers and the suitable habitat is continuous, a localised population would consist of the combined activity area of several individuals sufficient to maintain a genetically diverse population. It is acknowledged that fauna may occasionally disperse past these barriers, however, this is not considered to constitute normal daily movement patterns. For smaller species like the Western Mouse and Heath Rat, the localised population is a self-sustaining group of individuals that occupy a particular preferred habitat. It is also acknowledged that the localised population may not have sufficient individuals to maintain a genetically diverse sub-population over an extended period.

3 IMPACTS ON REGIONAL LINKAGES

3.1 Gondwana link

Various groups including Bush Heritage, the Wilderness Society, Greening Australia, Gillamii Centre and the Gnarjl Aboriginal Corporation have come together under the umbrella of Gondwana Link Ltd. The purpose of this agency and its supporters is to 'reconnect country across south-western Australia, from the Karri forest of the south-west corner to the woodlands and mallee bordering the Nullarbor plain, in which ecosystem function and biodiversity are restored and maintained (www.gondwanalink.org/aboutus/vision.aspx). The Gondwana Link, when it is established, will enable 'the more mobile species to move safely between populations, reducing the current wave of slow localised extinctions from isolated remnants' and it has the potential to 'provide some protection against the worst ecological impacts of climate change by enabling gradual genetic and species interchange on a broad front and by retaining elements of the longer term evolutionary forces that shaped the south west biota' (www.gondwanalink.org/aboutus/vision.aspx; Plates 8 and 9).

Plate 8. Gondwana Link

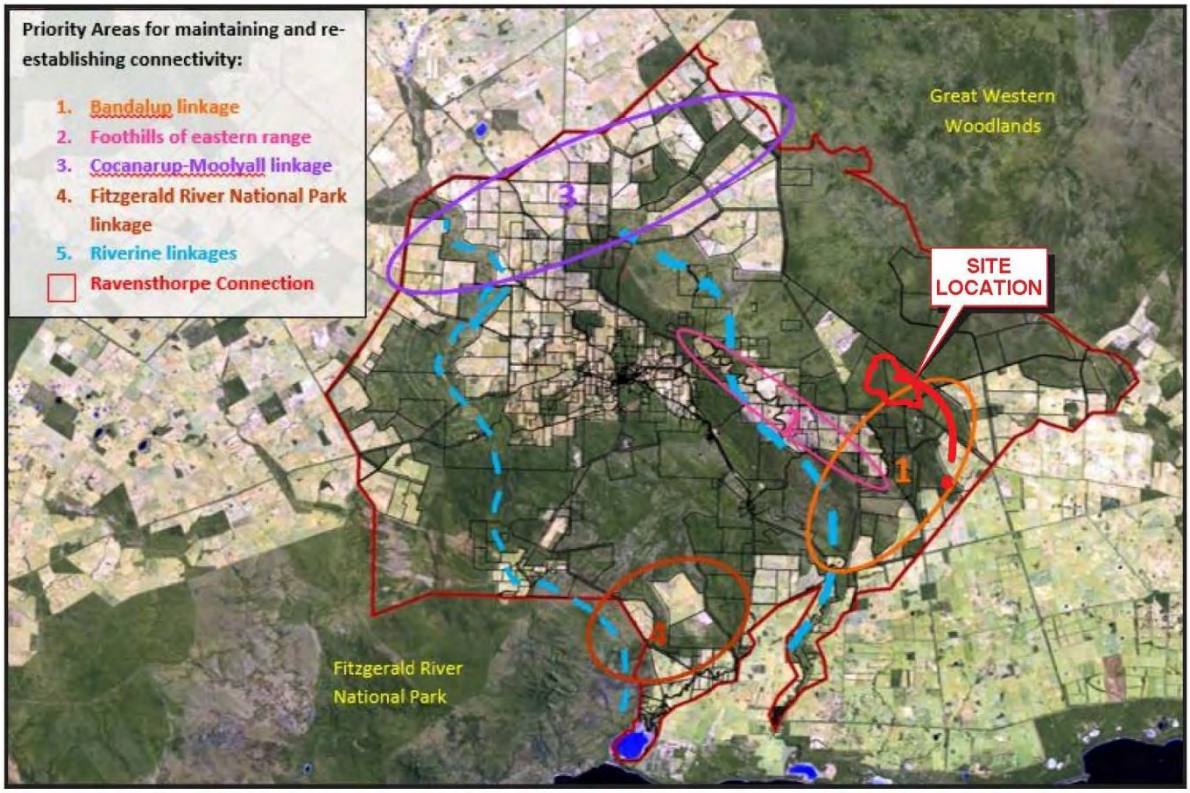

Plate 9. Other linkages within the Gondwana Link

Currently, the State Barrier Fence, if it was intact and maintained, acts as a significant barrier to mobile fauna movements in a south-west to north-east direction in the Gondwana link.

On a more localised scale, in the short-term it is important that mitigation plans enable mobile fauna to continue to move in a south-west to north-easterly direction past the proposed Shoemaker-Levy mine and infrastructure corridor and in the longer term, when mining has finished, the impacted areas are properly rehabilitated to recreate the native vegetation corridor between the Fitzgerald National Park and the Great Western Woodlands.

3.2 South Coast Macro Corridor Network

The predecessor of the Department of Biodiversity, Conservation and Attractions (DBCA; i.e. Department of Conservation and Land Management) endeavoured to increase connectivity among remnant plots of native vegetation along the south-coast of Western Australia (Wilkins et al. 2006). This proposed area was called the South Coast Macro Corridor Network. It is located within the South West Botanical Province, which is a recognised as a biodiversity hotspot of international importance (Wilkins et al. 2006). The area includes the catchments of all southerly flowing rivers from Walpole to Cape Arid National Park, and has an area of approximately 5.4 million hectares (Plate 10).

The DBCA has made a commitment to the development of long-term monitoring sites in the corridor. The report (Wilkins et al. 2006) indicates there has been numerous instances where undisturbed or regeneration of natural vegetation adjacent to or within the corridor has been purchased as public or private conservation reserve, or placed under a conservation covenant. The concept of the corridor is promoted for inclusion into other strategic plans for the general area (e.g. Lower Great Southern Regional Strategy).

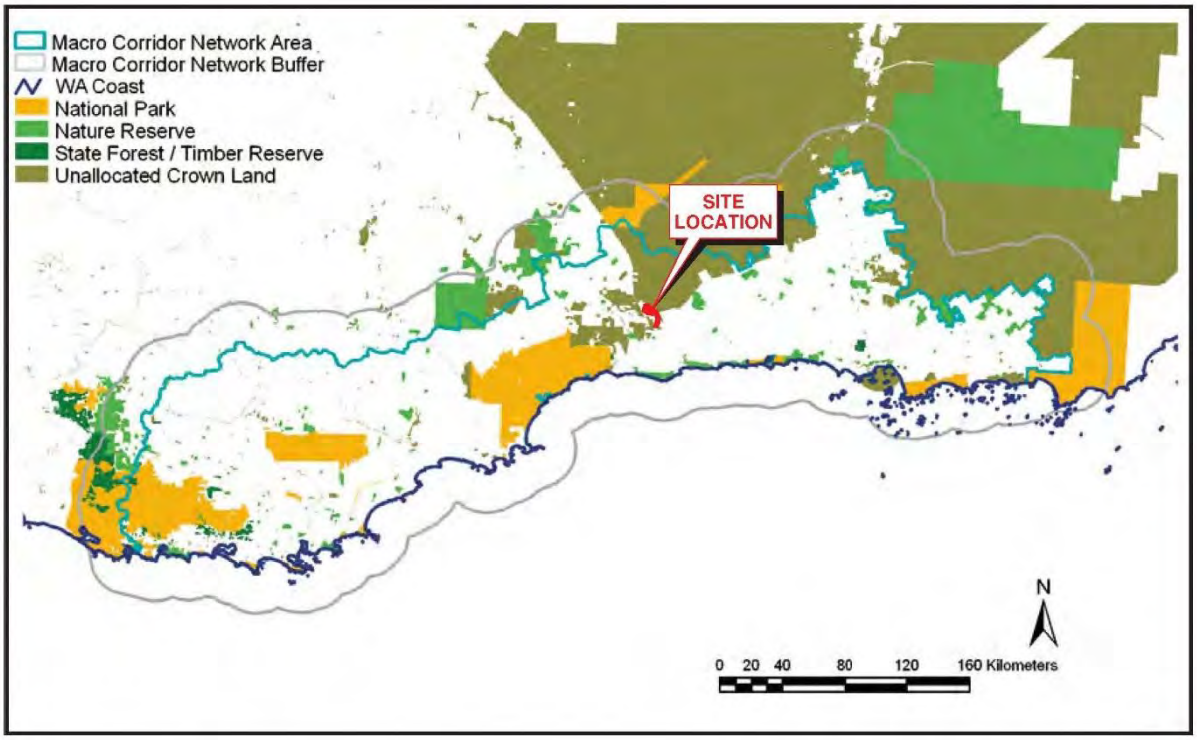

Plate 10. South Coast Macro Corridor Network

3.3 2015 Esperance fires

The Cascades and Merivale fires destroyed substantial areas of native vegetation and agricultural land (Nous Group 2016), however, these fires were over 100km east of the project area and there is no obvious impact of these fires on the vertebrate fauna in the project area (Plate 11). Terrestrial reptiles, amphibians and mammals would not travel this distance and avifauna have many thousand hectares suitable habitat between the fires and the project area.

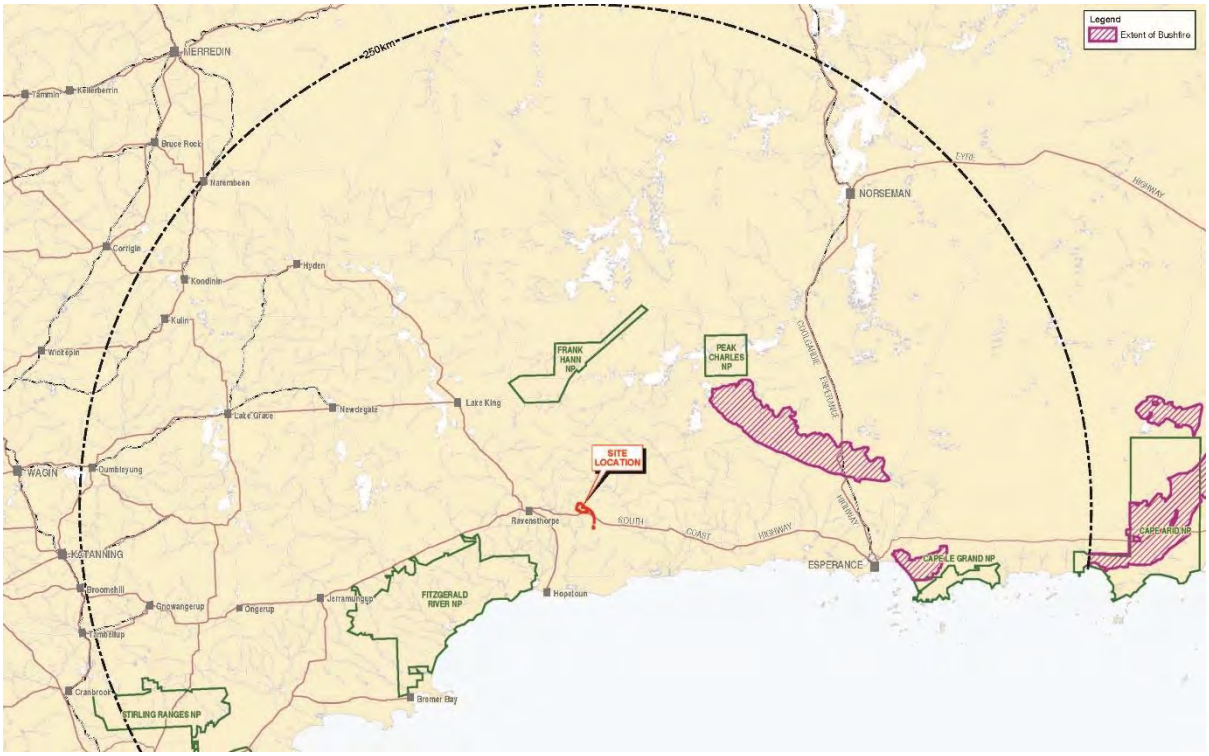

Plate 11. Location of the 2015 Esperance fires and the project area

TERRESTRIAL ECOSYSTEMS

4 POTENTIAL DIRECT PHYSICAL AND ENVIRONMENTAL IMPACTS

4.1 Vegetation clearing, loss of habitat and habitat fragmentation in the proposed new mining and infrastructure areas

The proposed Hale Bopp North West pit area is approximately 32ha and is located to the south of the existing mine operations. The topography is gently undulating with a south-facing slope draining into an area that becomes a dampland after rain. This area forms part of a substantial tract of vegetation west of the existing mining operations, to the east of which the vegetation has largely been cleared.

The proposed Hale Bopp North West pit mining area is known to support the Western Mouse, Western Whipbird, Western Brush Wallaby, Chuditch and Malleefowl, in addition to the vertebrate fauna assemblage typical of this habitat. Without the implementation of the recommended avoidance and mitigation strategies, larger animals are likely to be displaced and smaller animals are likely to be lost during the vegetation clearing program.

Clearing of vegetation in the proposed infrastructure corridor will reduce the native vegetation available to vertebrate fauna and will fragment existing fauna habitat. This area is known to support the Western Brush Wallaby, Southern Brown Bandicoot and Western Whipbirds, and could occasionally support Malleefowl, Chuditch and the Western Mouse, in addition to the vertebrate fauna assemblage typical of this habitat.

Clearing of vegetation for the expansion of the proposed Shoemaker-Levy mine site must be considered in conjunction with the impact of clearing the already approved Shoemaker-Levy mine site. This vegetation clearing will fragment existing fauna habitat. This area is known to support Malleefowl, Chuditch, Western Brush Wallaby, Southern Brown Bandicoot, Western Mouse and Western Whipbirds, and may support the Heath Rat, in addition to the vertebrate fauna assemblage typical of this habitat.

Nocturnal terrestrial fauna living in areas to be cleared are unlikely to be active when most of the vegetation clearing and construction work is taking place, resulting in these individuals being lost in their burrows, retreats, or when they attempt to escape. Therefore, without the implementation of mitigation strategies, it is likely that clearing of vegetation will result in the loss of most small fauna that retreat to burrows, such as reptiles, frogs and mammals.

The Chuditch, Southern Brown Bandicoot and Western Mouse are known to occur in the proposed Shoemaker-Levy expansion area, and the Heath Rat could also be found in these areas in very low numbers. If present, the Chuditch and Southern Brown Bandicoot will attempt to move to adjacent areas before they are directly impacted by vegetation clearing, however, whether they are successful will depend mostly on the nature of their retreat and their ability to escape from it during the vegetation clearing program. The response of the Western Mouse and the Heath Rat to vegetation clearing activities is unknown, but if they are surface active, then they will likely endeavour to escape a short distance to vegetation cover, and then they will probably hide under dense vegetation instead of continuing to flee. If this is the case, then they are likely to be lost. If they are in burrows, then they will be injured or killed during the vegetation clearing program.

Relocated Chuditch and Southern Brown Bandicoots are known to travel significant distances after being released in an attempt to return to their existing activity areas (Cannella and Henry 2017; unpublished data for Golden Bay). This movement through an unknown landscape exposes them to a higher risk of predation and, if near roads, death or injury due to vehicle impacts.

Western Whipbirds, Malleefowl and Western Brush Wallabies in areas to be cleared will readily move into adjacent areas once vegetation clearing commences and are therefore unlikely to be directly impacted. However, vegetation clearing will reduce their foraging areas, and could increase the risk of predation in the area into which they have been displaced. Malleefowl will be most vulnerable to predation unless they are able to find relatively dense vegetation quickly.

Vegetation clearing activities are likely to destroy reptile and mammal burrows that are currently in use, or that are currently unused but could be re-used in the future. Loss of vegetation that forms part of the activity area or home range of individuals has the potential to force these animals into adjacent areas, even if the entirety of their

home range is not cleared. These new areas may offer fewer resources, placing individuals under survival pressure. Vegetation clearing will also cause individuals to move into the territories of conspecifics, thereby increasing competition for resources. Forced relocations could increase the possibility of predation due to increased exposure to predators.

Although vegetation clearing seldom results in the death of avian species (except for eggs and chicks), clearing of vegetation reduces and alters avian foraging and nesting areas. The loss of foraging areas shifts individuals into adjacent areas and increases competition for resources, with the inevitable result that some of the migrants and some of the residents fail to thrive in the altered environment, with the consequential loss of individuals.

4.2 Physical barrier to the movement of vertebrate fauna

The proposed disturbance area for the infrastructure corridor is an arc that is approximately 11km long and on average 60m wide, with approximately 3km of the alignment south of the South Coast Highway running through farming land and areas that have already been cleared for development (Figure 2). The proposed Shoemaker-Levy mine site is located at the western end of the infrastructure corridor. The proposed vegetation clearing for the infrastructure corridor combined with the clearing for the Shoemaker-Levy mine will act as a barrier to the movement of vertebrate fauna.

There is a large tract of land containing similar habitat immediately to the north and north-east of the infrastructure corridor and the proposed Shoemaker-Levy mine. However, the State Barrier Fence, which is located approximately 800m to the north-east of the proposed Shoemaker-Levy mine, separates much of this relatively undisturbed habitat from the proposed Shoemaker-Levy mining area and the infrastructure corridor. If it was in good condition, the State Barrier Fence would be an effective barrier for the movement of medium and large terrestrial mammals (e.g. rabbits, kangaroos, Southern Brown Bandicoots), large reptiles (e.g. Rosenberg's Goanna) and mostly terrestrial birds (e.g. emus) in a north-east to south-west direction. Portions of the State Barrier Fence are in a state of disrepair and vertebrate fauna can move past this barrier at multiple locations. This is of concern as it enables wild dogs to access the RNO tenements and they will impact on native fauna as well as farm stock. It is likely that at some stage in the future the fence will be repaired and the barrier re-instated. When this occurs the impact of the proposed RNO development acting as a barrier to north-south fauna movement is likely to be diminished as the State Barrier Fence will stop the movement of fauna in a north-south direction.

There is also similar fauna habitat to the west of the proposed Shoemaker-Levy mine expansion area on the south-side of the State Barrier Fence. Terrestrial vertebrate fauna movement in an east-west direction is already partially restricted by the presence of cleared farming land on either side of a corridor of vegetation.

South of the proposed Shoemaker-Levy mine and the associated expansion area and infrastructure corridor the South Coast Highway runs in an east-west direction. This highway acts as a partial barrier to fauna movement, although it is unlikely to stop medium and large sized mammals, large reptiles and birds moving in a north-south direction. Therefore, the movement of the conservation significant Malleefowl, Chuditch, Western Mouse, Southern Brown Bandicoots and Heath Rat, if it is present, is already impacted. Kangaroos and Western Brush Wallabies are frequently hit by vehicles along this road as they attempt to move in a north-south direction.

The Hale Bopp North West pit area will extend the existing vegetation clearing in a north and south direction between existing mining areas (Figure 2). The cleared area east of the haul road that runs from the existing mine to the tailings is likely act as a significant barrier to the movement of fauna in an east-west direction. The construction of the Hale Bopp North West pit area will widen this cleared area and the barrier, but is unlikely to significantly increase the effects of the barrier, as it simply widens an existing substantial barrier.

4.3 Haul Road

Large trucks with trailers will move ore from the Shoemaker-Levy mine to RNO's existing processing plant. It is understood these trucks will operate 24 hours per day and on a frequent basis. Large ore trucks are incapable of stopping or swerving to avoid vertebrate fauna on the haul road. It is therefore likely that Malleefowl, Chuditch, Western Brush Wallabies, Western Grey Kangaroos, emus, goannas, and large snakes will be killed or injured on

this haul road. Water that pools on the edge of the haul road will attract mammals and birds to drink, and this will increase the risk of injury or death of these animals.

4.4 Altered fire regimes

A change in fire regimes is often associated with increased human activity (e.g. creation of natural barriers, fire suppression activities, increase in ignitions by machinery), leading to degradation of natural ecosystems. Uncontrolled, intensive bush fires in long-unburnt heath and mallee can result in little vegetation remaining after a fire. These fires not only destroy fauna habitat, but also kill and injure many of the terrestrial animals living in the area, and those that are able to flee are often displaced into unsuitable habitat or habitat that has a full complement of conspecifics. Other fauna that seek temporary shelter from the fire are subsequently predated on by feral cats, foxes, raptors and corvids when they attempt to move to more suitable habitat. Feral cats are also known to move towards areas after a fire, as fire events facilitate ease of predation (McGregor et al. 2017). The outcome is that many individuals die in the fire, immediately after the fire due to predation or later because of competition for limited resources.

Linear vegetation clearing, such as for the proposed infrastructure corridor, provide a barrier to naturally occurring fires and may alter the natural fire regimes that the fauna have evolved to accommodate. This can result in longer periods between fires that are more intense and destructive because of higher fuel loads. Intense fires often leave fewer unburnt patches where fauna can escape the fire and subsequently act as the founder population in recolonising the burnt area as it regenerates. Altered fauna recruitment and succession patterns alters the final composition of the fauna assemblage. Recruitment of fauna into regenerating burnt areas can also be affected by wide cleared linear barriers around burnt areas (e.g. linear infrastructure). These wide barriers inhibit some fauna more than others, thereby altering the composition of the faunal assemblage in the regenerated areas.

Mine management often suppress natural fires where it has potential to impact on mine infrastructure, which enables the fuel load to increase. Therefore, when a fire does start, it is more intense leaving fewer plants able to regenerate. This very often then alters the structure of the vegetation community and fauna habitat.

4.5 Anthropogenic activity

Unnatural noises, vibrations, artificial light sources and vehicle and human movement in an area may be sufficient to force some individuals or fauna species to move from areas adjacent to mining activities and infrastructure, or to alter their activity areas or periods.

As the mine will operate 24 hours per day, the night lighting will attract bats to the small invertebrates that cluster around lights sources and increase their population, and it can increase the risk of predation or injury. Lighting can also expose small terrestrial mammals to higher levels of predation in adjacent areas.

4.6 Cumulative effects of vegetation clearing

Substantial proportions of land around the RNO have been historically cleared for agriculture. This clearing of vegetation permanently removes habitat for fauna, and enables foxes, wild dogs and feral cat numbers to increase. Most of the land within 30km to the south and east of the project area has been cleared.

There remains two substantial native vegetation linkages between the natural vegetation north of the State Barrier Fence and the Great Western Woodlands and along the south coast in the Fitzgerald National Park. Clearing the vegetation in the proposed Shoemaker-Levy mining area, the infrastructure corridor and the Hale Bopp North West mining area will create a 20km long barrier to fauna movements in the Bandalup Corridor in a south-west to north-easterly direction.

5 POTENTIAL INDIRECT PHYSICAL AND ENVIRONMENTAL IMPACT

5.1 Introduced feral fauna

Camera trap images from Terrestrials Ecosystems' (2014, 2015, 2016, 2017) surveys in 2014, 2015, 2016 and 2017 indicated that foxes (*V. vulpes*) and feral cats (*F. catus*) are abundant and widespread in the RNO tenements. The conservation significant fauna monitoring program undertaken from 2013-2016 (Terrestrial Ecosystems 2013, 2014, 2015, 2016) indicated a decline in the small mammal population when compared with earlier survey data. Vehicle tracks and roads and other linear corridors in the natural vegetation provide movement corridors for foxes and feral cats through the landscape, which can increase predation on native species in adjacent areas. It is highly likely that foxes and cats have had a significant impact on the small vertebrate fauna in the RNO tenements, including conservation significant Western Mouse, Heath Rat, Southern Brown Bandicoot, Chuditch, Western Whipbird, Malleefowl and Western Brush Wallaby. The proposed vegetation clearing increases habitat fragmentation and increases fox and feral cat access to native fauna.

5.2 Edge effects

Clearing linear corridors and other large areas increases the edge area of fauna habitat. The vegetation near newly created edges is often altered and sometimes the composition is affected, and the vegetation has become more or less dense. Small mammals can respond both positively and negatively to edge effects depending on their ecological traits (Laurance 1991, 1994, Goosem and Marsh 1997, Goosem 2000). Edge and disturbance effects can lead to altered, and most often higher, levels of predation, restricting or increasing fauna movements and altering assemblage structure (Oxley et al. 1974, Paton 1994, Baker et al. 1998, Temple 1998, Luck et al. 1999, Goosem 2001). Goldingay and Whelan (1997) and Clarke and Oldland (2007) reported that edge effects can extend up to 150-200m from the edge for some species, meaning the impact area on vertebrate fauna is likely to be significantly larger than the vegetation clearing footprint.

5.3 Dust

Dust generated from vegetation clearing and construction activities can potentially degrade surrounding vegetation as it can coat the leaves of vegetation, thus reducing its ability to absorb sunlight and influencing photosynthetic rates. This impact is generally short-term and lasts only as long as the vegetation clearing program or until the next rainfall. More importantly, dust from heavy vehicles utilising the proposed haul road has the potential to impact adjacent native vegetation, and this impact may occur over a much longer period. Degradation of vegetation adjacent to the haul road could make the habitat unsuitable for some vertebrate fauna, as it could thin the vegetation community. The volume of traffic, speed of vehicles, and the frequency at which a dust suppressant is added will largely determine the impact of dust in that area.

5.4 Introduction and spread of weeds and pathogens

Clearing of native vegetation often provides opportunity for weeds to become established (Hakansson 2003). In addition, vehicle movement in these areas can also spread weeds and pathogens (Baraud et al. 2013, Dar et al. 2015). The presence of weeds can alter the composition and structure of vegetation communities, which in turn changes the structure of fauna habitat. This can be advantageous for some vertebrate fauna and disadvantageous for others; either way it alters the natural composition of the fauna assemblages.

6 CUMULATIVE IMPACTS

The quantity of vegetation clearing and loss of fauna habitat in the two relevant IBRA subregions (i.e. ESP1 Fitzgerald subregion and ESP2 Recherche subregion) is unknown. However, a review of Google aerial photography of these two subregions indicates there is a corridor of native vegetation from the Fitzgerald River National Park in the south-west stretching to the Great Western Woodlands in the north-east (Plates 7 and 8). Within this native vegetation corridor and to the west of RNO is a patch of land cleared for vegetation (Plate 8, marked as area 2).

The location of the proposed vegetation clearing is more important than the actual amount of fauna habitat to be cleared (i.e. 812ha). Clearing vegetation for the proposed new mining areas and infrastructure corridor will provide an additional barrier to long-term fauna movements and gene flow along this vegetated corridor as discussed above. Had the proposed clearing been situated adjacent to existing farm land, then these the impacts would have been less significant.

7 POTENTIAL IMPACTS AND MITIGATION STRATEGIES FOR CONSERVATION SIGNIFICANT SPECIES

In this section, each conservation significant fauna species that has been recorded or has potential to be recorded in the project area is assessed against the recognised threats for each species, the potential impacts of these threats and the residual impacts are assessed after applying appropriate avoidance and mitigation strategies with regard to the mitigation hierarchy presented above.

7.1 Carnaby's Black Cockatoo and Baudin's Black-Cockatoo

Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) is listed as Endangered under the *WC Act* and the *EPBC Act* and Baudin's Black Cockatoo (*Calyptorhynchus baudinii*) is listed as Vulnerable under the *WC Act* and the *EPBC Act.*

7.1.1 Threats

The Commonwealth Government SPRAT website (Department of the Environment and Energy 2017) and the Carnaby's Black-Cockatoo Recovery Plan (Department of Environment and Conservation 2013) indicated the following threats to Carnaby's Black-Cockatoo:

- Loss of breeding, foraging and roosting habitat and habitat degradation. The decline in Carnaby's Black-Cockatoo numbers is generally attributed to habitat loss (including a reduction in suitable nesting hollows) and habitat fragmentation. The SPRAT website (Department of the Environment and Energy 2017) reports a non-cited DBCA report that indicates 87% of Carnaby's Black-Cockatoo potential habitat has been lost from the Wheatbelt and 54% of its habitat has been lost from the Swan Coastal Plain;
- Competition for hollows – specifically from Australian Shelducks (*Tadorna tadornoides*), Australian Wood Ducks (*Chenonetta jubata*), Pacific Black Ducks (*Anas superciliosa*), Grey Teal (*A. gracilis*), Nankeen Kestrels (*Falco cenchroides*), Galahs (*Eolophus roseicapilla*), Western Corellas (*Cacatua pastinator*), Regent Parrots (*Polytelis anthopeplus*), Australian Ringnecks (*Barnardius zonarius*), Southern Boobooks (*Ninox novaeseelandiae*), Barn Owls (*Tyto alba*), Brushtail Possums (*Trichosurus vulpecular*) and honey bees (*Apis mellifera*), with Galahs and Western Corellas providing most competition;
- Illegal trade – robbing nests of eggs and chicks;
- Conflict with humans / vehicle strike – birds are shot when they damage nut and fruit crops or are hit by vehicles on the road (Department of Biodiversity Conservation and Attractions 2017);
- Tree health and disease - *Phytophthora cinnamomi* or 'dieback' is impacting on important foraging and breeding trees [e.g. tuart (*Eucalyptus gomphocephala*), wandoo (*E. wandoo*), jarrah (*E. marginata*), marri (*Corymbia calophylla*) and flooded gum (*E. rudis*)], thus reducing foraging and roosting sites;
- Climate change – in the longer term will alter the composition of vegetation communities impacting on foraging opportunities and it may also alter the breeding period resulting in fewer chicks fledging and joining the adult breeding population;
- Fire – resulting in the loss of foraging habitat and breeding hollows (Valentine et al. 2014);
- Poor recruitment – which can be associated with nest destruction, a lack of foraging opportunities around nesting sites, nests invaded by other species, etc (Williams et al. in review);
- Mining and substrate extraction activities in the south-west of WA that result in a reduction in foraging and roosting habitats; and
- Disease - infectious diseases such as beak and feather disease virus (BFDV), avian polyomavirus (APV) and chlamydophilosis may pose a threat to Carnaby's Black-cockatoo.

The SPRAT species profile for Baudin's Black-Cockatoo and the Recovery Plan for Baudin's and Forest Red-tailed Black-Cockatoos (Department of Environment and Conservation 2007) lists the following threats for Baudin's Black-Cockatoo:

- Nest hollow shortage, due to a lack of suitably aged trees and competition for hollows with Carnaby's Black-Cockatoo, Corellas, Wood Ducks and European bees;
- Vegetation clearing and habitat degradation; and
- Illegal shooting by orchardists.

7.1.2 Assessment of potential impacts

Table 5 provides a summary of the assessed potential impacts on Carnaby's and Baudin's Black-Cockatoos associated with the action of vegetation clearing for the purpose of the proposed development, based on the criteria set out in the Department of Sustainability, Environment, Water, Population and Communities (2012) referral guidelines for Black-Cockatoos. This is followed by a more detailed assessment to support Table 5. The Commonwealth referral guidelines (Department of Sustainability Environment Water Population and Communities 2011) are not specific with regard to defining quality foraging habitat for Black-Cockatoos, thus the criterion of clearing or degrading more than 1ha of quality foraging habitat is difficult to assess.

Table 5. Summary significant impact assessment for Black-Cockatoos

High risk of significant impacts: referral recommended	Carnaby's Black-Cockatoo	Baudin's Black-Cockatoo
Clearing of any known nesting tree.	No nesting or potential nesting trees were recorded in the project area.	No nesting or potential nesting trees were recorded in the project area.
Clearing or degradation of any part of a vegetation community known to contain breeding habitat.	The project is approximately 30km east of DBCAs mapped known breeding habitat. There are no nesting opportunities in the project area.	The Commonwealth Government referral guidelines for Black-Cockatoo (Department of Sustainability Environment Water Population and Communities 2012) indicate there are known breeding sites around Walpole, Demark and Albany, but none around the RNO tenements.
Clearing of more than 1ha of quality foraging habitat.	The corridor includes Banksia and Hakea species, and Carnaby's Black-Cockatoos have been seen foraging in adjacent areas with similar vegetation communities, so they are likely to occasionally forage in the project area.	The corridor contains eucalypt and proteaceous woodlands. Baudin's Black-Cockatoo have not been recorded in any of the surveys around RNO tenements, however, the DBCA threatened species database has numerous records along the south-coast to east of Esperance, so they potentially forage in the project area.
Clearing or degradation (including pruning the top canopy) of a known night roosting site.	Clearing will not impact on a known roosting site.	Clearing will not impact on a known roosting site.
Creating a gap of greater than 4km between patches of black cockatoo habitat (Breeding, foraging or roosting).	Clearing will not create a gap of greater than 4km between patches of Black-Cockatoo habitat.	Clearing will not create a gap of greater than 4km between patches of Black-Cockatoo habitat.
Uncertainty: referral recommended or contact the department		
Degradation (such as through altered hydrology or fire regimes) of more than 1ha of foraging habitat. Significance will depend on the level and extent of degradation and the quality of the habitat.	Clearing will impact on more than 1ha of low quality foraging habitat.	Clearing will impact on more than 1ha of low quality foraging habitat.
Clearing or disturbance in areas surrounding black-cockatoo breeding, foraging or night roosting habitat that has the	Vegetation clearing and the construction of infrastructure and expansion areas will increase human visitation to the area.	Vegetation clearing and the construction of infrastructure and expansion areas will increase human visitation to the area.

High risk of significant impacts: referral recommended	Carnaby's Black-Cockatoo	Baudin's Black-Cockatoo
potential to degrade habitat through introduction of invasive species, edge effect, hydrological changes, increased human visitation or fire.		
Actions that do not directly affect the listed species but that have a potential for indirect impacts such as increasing competitors for nest hollows.	No known actions that would potentially indirectly affect this species.	No known actions that would potentially indirectly affect this species.
Actions with the potential to introduce known plant disease such as *Phytophthor*a spp. To an area where the pathogen was not previously known.	With the implementation of appropriate hygiene standards during vegetation clearing and operations, diseases are unlikely to be introduced or spread through the project area.	With the implementation of appropriate hygiene standards during vegetation clearing and operations, diseases are unlikely to be introduced or spread through the project area.

Clearing of any known nesting tree (high risk)

There are no suitable trees with nesting hollows or large trees that could develop nesting hollows in the project area. The project area is located about 30km east of a circular area identified by DBCA that represents known nesting sites for Carnaby's Black-Cockatoos, and lies outside the reported breeding areas for Baudin's Black-Cockatoo (Department of Sustainability Environment Water Population and Communities 2012).

Clearing of any part or degradation of breeding habitat (high risk)

The project area does not contain breeding habitat for Carnaby's or Baudin's Black-Cockatoos.

Clearing of more than 1ha of quality foraging habitat (high risk)

The definition of 'quality habitat' is unknown, although some of the trees and shrubs in the project area are on the Commonwealth governments' list of foraging species for Carnaby's and Baudin's Black-Cockatoos. The project area contains more than 1ha of vegetation recorded as potential foraging habitat for Black-Cockatoos. There is an abundance of similar habitat to the south-west and north-east, therefore the clearing of the project area is unlikely to have a significant impact on Black-Cockatoos. On the scale provided by Terrestrial Ecosystems (2017), habitat in the project area has been rated as '0' or '1', with '0' meaning 'Black-Cockatoos are almost never seen foraging in the area and if they are, it isn't for very long' and '1' meaning 'Black-Cockatoos may infrequently be seen foraging in the area and they don't stay very long'.

Clearing or degradation including pruning the top canopy of a known roosting site (high risk)

There is no evidence to indicate that Carnaby's or Baudin's Black-Cockatoos roost in the project area. The lack of clumps of tall trees in the project area would strongly suggest that Black-Cockatoos are unlikely to roost in the project area in the future.

Degradation (such as through altered hydrology or fire regimes) of more than 1ha of foraging habitat. Significance will depend on the level and extent of degradation and the quality of the habitat (uncertainty)

It is proposed that more than 1ha of low quality Black-Cockatoo foraging habitat will be disturbed or cleared. There is an abundance of similar habitat in adjacent areas; therefore, this loss is not considered likely to significantly impact on the survival of individuals or populations in this region, although it will contribute to the cumulative impact.

Clearing or disturbance in areas surrounding black cockatoo habitat that has the potential to degrade habitat through the introduction of invasive species, edge effects, hydrological changes, increased human visitation or fire (uncertainty)

The area to be cleared will be used for the development of a proposed Shoemaker-Levy mine, Hale Bopp North West pit and an infrastructure corridor. This development will increase human visitation to the area as these developments are likely to operate 24 hours per day.

Actions that do not directly affect the listed species but that have the potential for indirect impacts such as increasing competitors for nest hollows (uncertainty)

The only foreseen potential impact is birds flying low from foraging in vegetation adjacent to the infrastructure corridor and colliding with trucks that are hauling ore or other vehicles. There will be a cleared barrier between haul trucks and the bushland, so there is a low risk of collisions between Black-Cockatoos and vehicles. There are no other obvious indirect actions that will impact on Black-Cockatoos other than those already discussed.

Action with the potential to introduce know plant diseases such as Phytophthora *spp. (uncertainty)*

Clearing of the vegetation is only likely to introduce or spread diseases such as *Phytophthora* spp. if appropriate standards of hygiene are not maintained for the equipment used to clear the vegetation and travel on site. This aspect can be effectively managed and controlled, and is addressed in the Fauna Management Plan for the mine.

7.1.3 Recovery plan – Carnaby's Black-Cockatoo

It is thought that Carnaby's Black-Cockatoo numbers are in serious decline, and has led to a recovery plan being released in 2012 (DEC 2012a, Department of Environment and Conservation 2013). This plan details the status of the cockatoo and provides conservation measures to increase the population. The six broad recovery actions in this recovery plan are:

- Protect and manage important habitat – identify, protect and manage habitat critical for survival (nesting, foraging and roosting) for Carnaby's Black-Cockatoos across their breeding and non-breeding range;
- Conduct research to inform management – undertake research into the biology, ecology, and conservation management of Carnaby's Black-Cockatoo;
- Undertake regular monitoring – monitor population parameters, habitat, threats and status of Carnaby's Black-Cockatoo;
- Manage other impacts – monitor the impacts and implement strategies to reduce other factors detrimentally affecting Carnaby's Black-Cockatoo, and support rehabilitation programs;
- Undertake information and communication activities – develop and distribute awareness raising and guidance materials for decision makers, establish joint management agreements and provide for improved sharing of information between agencies; and
- Engage with the broader community – engage with and involve stakeholders across the community regarding the conservation of Carnaby's Black-Cockatoo.

This proposed development is consistent with what is proposed in the Carnaby's Black-Cockatoo recovery plan (Department of Environment and Conservation 2013).

7.1.4 Recovery plan – Baudin's Black-Cockatoo

Proposed recovery actions for Baudin's Black-Cockatoo (Chapman 2007) includes:

- Determine and promote a non-lethal means of mitigating fruit damage by Baudin's Black-Cockatoo;
- Eliminate illegal shooting;
- Develop and implement ways of removing honeybees from nesting hollows;
- Identify factors affecting breeding success and manage nesting hollows to increase recruitment;
- Minimise the effects of habitat loss due to mining;
- Map feeding and breeding habitat critical to their survival; and
- Determine population numbers and distribution and movement patterns.

The proposed development will reduce foraging habitat due to vegetation clearing for mining activities. This is not considered to be a significant impact due to the lack of Baudin's Black-Cockatoo records in the RNO tenements, and the low-quality foraging habitat for Carnaby's Black-Cockatoo in the project area and the availability of large quantities of suitable foraging habitat in adjacent areas.

7.1.5 Avoidance and mitigation

Potential direct and indirect impacts on Carnaby's Black-Cockatoo are not considered to be significant (Table 6). The potential impact associated with vegetation clearing can be reduced by minimising areas of native vegetation to be cleared and rehabilitating areas once they are no longer required. Inclusion of plant species foraged by Carnaby's and Baudin's Black-Cockatoos in the seed mix used in the rehabilitation program will, in the long-term, provide a foraging resource for this species.

Table 6. Summary of threats, mitigation and level of impacts for Carnaby's and Baudin's Black Cockatoo

Significant threats and impacts	Impact score	Mitigation	Impact score	Residual impact
• Fire • Vegetation clearing	0 0	• Revegetation and rehabilitation	0	
				0

7.2 Heath Rat

Heath Rat (or Heath Mouse; *Pseudomys shortridgei*) is listed as Endangered under the *EPBC Act* and Vulnerable under the *WC Act.*

Heath Rats were present in the RNO tenements as recently as 2000 and perhaps 2010 (Biota Environmental Sciences 2000, Coffey Environments 2010). The Coffey Environments record was not vouchered, no photographs were taken, no tissue samples collected and the sole person that saw the specimen was the person that caught it. Given that this taxon is easily confused with *Rattus fuscipes,* which are plentiful in the area, there is some doubt about the correct identification of this specimen. No Heath Rats were caught in the extensive aluminium box trapping program undertaken in the Shoemaker-Levy mine and mine expansion area, the infrastructure corridor and the Hale Bopp North West pit area; therefore, it is considered that if this taxon is present, then it occurs in very low numbers.

7.2.1 Threats

Land clearing, habitat fragmentation and degradation, and feral cats and foxes are thought to be the primary reasons for contraction in the Heath Rat's geographic distribution (Smith et al. 2007, Woinarski et al. 2014). The Threatened Species Scientific Committee (2016) reported the following threats to the Heath Rat:

- Habitat clearing for agriculture and industry;
- Habitat fragmentation;
- Altered fire regimes, specifically increased frequency and intensity;
- Predation by feral cats and foxes;
- Habitat degradation by disease, specifically *Phytophthora cinnamomi* or invasive plants;
- Competition with Brushtail Possums (*Trichosurus vulpecula*), specifically competition for terrestrial resources in the absence of foxes; and
- Altered climate or reduced rainfall.

Like other small mammals and reptiles in the RNO tenements, predation by cats and foxes has probably had a significant impact on this species. Although this species has not been confirmed in the RNO tenements since 2000, it is Terrestrial Ecosystems' view that they could be present in very low densities in the long unburnt areas, including those areas around the proposed expansion area. However, such low-density populations often fail to survive as they fall below the minimum critical population threshold to successfully increase recruitment when threats are reduced. If Heath Rats are present they are highly likely to be injured or killed during the vegetation clearing process.

Direct impacts are expected from vegetation clearing, fire if large areas of available habitat are burnt and from vehicle impacts on tracks and haul roads. Indirect impacts are expected from predation by foxes and feral cats that will have improved access to Heath Rat habitat, loss of foraging habitat due to vegetation clearing, and if not adequately controlled, dust and anthropogenic activity.

7.2.2 Approved conservation advice

The conservation advice for *Pseudomys shortridgei* provided to the Commonwealth Minister by the Threatened Species Scientific Committee (2016) indicated that the conservation status of the Heath Rat should be changed from Vulnerable to Endangered as the extant population was progressively declining. However, there is insufficient data to accurately estimate the population size or the current rate of decline. There has been a notable decline in its area of occupancy, quality of habitat, number of subpopulations and number of mature individuals in each population, and the extant populations are highly fragmented. There will be no national recovery plan for this species, as the conservation advice provides sufficient direction to implement priority actions, mitigate key threats to enable recovery.

The primary conservation actions for the Heath Rat are (Threatened Species Scientific Committee 2016):

- Prevent further loss and degradation of habitat; and
- Maintain and increase connectivity between subpopulations.

There are multiple conservation and management priorities for Heath Rat. Those most relevant to the current proposal include (Threatened Species Scientific Committee 2016):

- Establish biodiversity corridors between habitat patches of known subpopulations;
- Develop and implement appropriate methods for increasing the amount of suitable habitat;
- Improved fire management, to ensure fires do not disrupt the life cycle of the Heath Rat, maintain post-fire age sufficient to provide adequate cover, avoid the use of physical and chemical damage to habitat associated with fires, and ensuring post-fire predator control programs;
- Limit weed infestations;
- Implement an integrated control program for foxes and cats, using baiting methods to control predators at known sites; and
- Survey sample populations to assess subpopulation size and monitor conservation actions.

7.2.3 Avoidance and mitigation

Minimising vegetation clearing, particularly in areas of relatively high-density vegetation, will limit expected impacts.

A fox and feral cat reduction program is expected to reduce predation on Heath Rats if they are present in RNO tenements. FQM has commenced a pilot fox and feral cat reduction program in 2017. Camera traps were deployed to determine target and non-target species uptake of buried 1080 baits and cats will be trapped biannually. This program will be modified based on the assessment of its effectiveness. This adaptive management approach will determine the most cost-effective long-term feral cat and fox reduction program. The existing annual conservation significant fauna monitoring program should be used to see whether changes to the fauna assemblage with a reduction in the number of cats and foxes are observed.

To reduce the potential loss of Heath Rats during the vegetation clearing program, all areas should be trapped immediately prior to the vegetation being removed. Any captured Heath Rats should be relocated a considerable distance from the capture location and into suitable habitat to discourage them from attempting to return. The presence of a zoologist when vegetation is being cleared to catch and relocate fauna will also reduce the possibility of Heath Rats being killed or injured during the vegetation clearing program.

Table 7. Summary of threats, mitigation and level of impacts for the Heath Rat

Significant threats and impacts	Impact score	Mitigation	Impact score	Residual impact
• Fire	-3			
• Predation by foxes and cats	-3	• Fox and feral cat reduction program	+4	
• Vegetation clearing	-2	• Trapping and relocation prior to and during vegetation clearing	+1	
				-3

7.3 Malleefowl

Malleefowl (*Leipoa ocellata*) is listed as Vulnerable under the *WC Act* and the *EPBC Act*.

7.3.1 Threats

Benshemesh (2007) and Birdlife International (2016) reported the following threats to Malleefowl:

- Vegetation clearing, loss of habitat from grazing by introduced herbivores and raised salinity levels leading to habitat loss and fragmentation;
- Predation by foxes and feral cats, as they both predate on chicks, and foxes are known to dig up mounds containing eggs;
- Fires resulting in medium-term loss of foraging and breeding habitat;
- Climate change resulting in reduced rainfall and a loss or reduction in the opportunity to successfully incubate eggs in decomposing vegetation in mounds; and
- Vehicle impact, particularly on road side verges where birds feed on spilt grain.

Prior to vegetation clearing for agriculture, Malleefowl were abundant in the WA Wheatbelt. Vegetation clearing for agriculture also opened adjacent bushland to predators, and in the south-west of WA, Malleefowl often only persist in isolated remnant patches of native vegetation. Sheep and other herbivores (e.g. goats, kangaroos) grazing in remnant vegetation removes or thins the undergrowth, and they also compete with Malleefowl for herbaceous foods and can cause changes to the structure and floristic diversity of foraging habitats (Benshemesh 2007).

Malleefowl and their eggs are vulnerable to predation by foxes, and newly hatched chicks are vulnerable to foxes, cats and raptors (Priddel and Wheeler 1990, Priddel and Wheeler 1997, Benshemesh and Burton 1999, Benshemesh 2007, Lewis and Hines 2014). It is highly likely that Malleefowl and their eggs are predated on by the abundance of foxes and cats at RNO.

Fires kill Malleefowl and remove the vegetation from Malleefowl habitat, displacing birds into other areas which are often unsuitable (Woinarski 1999, Benshemesh 2007). Fires occur predominantly during the breeding season, and even if the birds are not killed by fire, they will generally not return to an active mound in a burnt area that is exposed to predators, and where there is little protection from adjacent vegetation, with the consequence that the eggs are not successfully incubated.

Malleefowl have little road sense, and are prone to being hit on roads by vehicles as they are slow to move. In agricultural areas, Malleefowl can feed on grain dropped on the side of roads and are thus vulnerable to predation and vehicle strikes.

Malleefowl are expected to move into adjacent areas when vegetation clearing commences, causing an initial impact as individual birds are displaced, and continuing until each displaced bird establishes a new home range. This displacement exposes these individuals to higher levels of predation as they are likely to be unfamiliar with the area.

Malleefowl are expected to be injured and killed attempting to cross the infrastructure corridor as they will be directly impacted by haul trucks and vehicles.

7.3.2 Recovery plan

The approved recovery plan for Malleefowl (Benshemesh 2007) includes the following recovery strategies:

- Habitat protection via reserves, conservation parks, etc and limiting vegetation clearing;
- Fire management to restrict hot and intensive burns across large areas;
- Fencing native vegetation to restrict grazing activity by herbivores;
- Habitat rehabilitation, revegetation and increasing habitat connectivity;
- Predator control;
- Captive breeding programs, re-introductions and supplementation;
- Promotion of Malleefowl-friendly agriculture practices; and
- Research (e.g. distribution, population dynamics, habitat requirements, etc) and population monitoring.

7.3.3 Avoidance and mitigation

Minimising vegetation clearing, particularly in areas of high density vegetation, are expected to limit impacts on Malleefowl. Malleefowl are likely to cross the infrastructure corridor and will be at risk of collisions with trucks which are transporting ore, and with other vehicles.

The pilot fox and feral cat reduction program that commenced in autumn 2017 is expected to reduce predation pressure on Malleefowl. Camera traps were deployed to determine target and non-target species uptake of buried 1080 baits and cats will be trapped biannually. This program will be modified based on the assessment of its effectiveness. This adaptive management approach will determine the most cost-effective long-term feral cat and fox reduction program. The existing annual conservation significant fauna monitoring program should be modified to measure changes in the Malleefowl population.

Rehabilitating areas once mining activity has ceased, with the specific intention of creating suitable habitat for Malleefowl (e.g. areas of dense understorey with suitable feed plants, surface pebbles, abundance of leaf litter etc), will assist this species in the long-term.

Table 8. Summary of threats, mitigation and level of impacts for the Malleefowl

Significant threats and impacts	Impact score	Mitigation	Impact score	Residual impact
• Fire • Predation by foxes and cats • Vegetation clearing • Vehicle collisions on the haul road	-2 -3 -1 -1	• Fox and feral cat reduction program • Rehabilitation of fauna habitats	+4 0	
				-3

7.4 Western Quoll or Chuditch

Western Quoll or Chuditch (*Dasyurus geoffroii*) is listed as Vulnerable under the *EPBC Act* and the *WC Act.*

7.4.1 Threats

Smith *et al*. (2004), Glen et al. (2009), Morris et al. (2008) and the Department of Environment and Conservation (2012b) reported predation and competition for food by and with feral cats and foxes, and Smith *et al*. (2004), Morris et al. (2008) and the Department of Environment and Conservation (2012b) listed vegetation clearing and habitat fragmentation, particularly riparian vegetation and the removal of suitable den logs and den sites, mortality from poisoning, shooting and vehicle collisions as the factors that have contributed to a reduction in the Chuditch population. Morris et al. (2008) and the Department of Environment and Conservation (2012b) also indicated that more frequent and extensive fires resulted in a medium-term loss of Chuditch habitat.

It is expected that resident Chuditch are likely to attempt to move when vegetation clearing commences, however, as they are nocturnal it is unknown how many would be impacted in their diurnal shelters. This displacement is

an initial direct impact and will continue until each displaced individual establishes a new home range. This displacement is likely to expose these individuals to greater predation pressure as they could be unfamiliar with their new home range. Chuditch retreating to hollow logs, tree hollows and holes in the ground are expected to be lost during the vegetation clearing process because they are unable to escape. The increased habitat fragmentation is expected to indirectly impact on their movement and dispersal through the landscape and foraging areas.

It is expected that Chuditch will be injured or killed attempting to cross the infrastructure corridor by haul trucks and vehicles.

7.4.2 Recovery plan

The recovery plan (Department of Environment and Conservation 2012b) for Chuditch indicates that the proposed recovery actions are:

- Retain and improve habitat critical for their survival;
- Determine impacts of feral cats and feral cat controls on Chuditch;
- Continue, expand and improve baiting of foxes and feral cats;
- Determine population abundance and distribution of Chuditch populations;
- Establish reference sites for monitoring Chuditch population abundance to evaluate the effectiveness of fox and cat control;
- Undertake and monitor translocations to increase the extent of occurrence; and
- Increase public awareness through community education and enforcement of regulations.

Based on camera trapping records, the location of cameras (e.g. along tracks) and the trapping program in 2015, 2016 and 2017, the authors expect that a significant number of Chuditch will be directly and indirectly affected by the proposed vegetation clearing, construction and mining operations. The expected direct significant impacts are loss or injury during vegetation clearing and when attempting to cross the infrastructure corridor and tracks, and displacement into other habitats. The expected significant indirect impacts are predation by feral predators.

7.4.3 Avoidance and mitigation

Minimising vegetation clearing, particularly in areas of relatively high vegetation density and with suitable retreat sites will limit impacts.

The pilot fox and feral cat reduction program that commenced in 2017 is expected to reduce predation pressure on Chuditch. Camera traps were deployed to determine target and non-target species uptake of buried 1080 baits and feral cats will be trapped biannually. This program will be modified based on the assessment of its effectiveness. This adaptive management approach will determine the most cost-effective long-term feral cat and fox reduction program. The existing annual conservation significant fauna monitoring program should be modified to measure changes in the Chuditch population.

To reduce the expected loss of Chuditch during the vegetation clearing program, all habitat to be cleared should be trapped immediately prior to the vegetation being removed. This trapping should be undertaken for at least five days. All trapped Chuditch should be relocated a considerable distance from the capture site to avoid them attempting to return. Given that in the future FQM may wish to clear and develop other areas that support Chuditch, it is important to monitor and evaluate the success of any Chuditch relocation programs. This would typically be done by attaching a GPS radio-transmitter collar to relocated animals and monitoring their movements and survival. A zoologist should be present during the vegetation clearing program. The presence of a zoologist when vegetation is being cleared to catch and relocate fauna will also reduce the possibility of Chuditch being killed or injured during the vegetation clearing program.

Rehabilitating areas once mining activity has ceased with the specific intention of creating suitable habitat for Chuditch (e.g. retreat sites in hollow logs and rock piles, areas of dense understorey, etc) is expected to provide suitable habitat for Chuditch in the long-term.

Table 9. Summary of threats, mitigation and level of impacts for the Chuditch

Significant threats and impacts	Impact score	Mitigation	Impact score	Residual impact
• Fire	-1			
• Predation by foxes and cats	-2	• Fox and feral cat reduction program	+2	
• Vegetation clearing	-1	• Trapping and relocation plan prior to and during vegetation clearing	+1	
		• Rehabilitation of fauna habitats	0	
• Vehicle collisions on the haul road	-1			
				-2

7.5 Peregrine Falcon

Peregrine Falcon (*Falco peregrinus*) is listed as specially protected under the *WC Act.*

7.5.1 Threats

Loss of foraging habitat is the most significant threat for the Peregrine Falcon; however, given the very large activity area of this species, vegetation clearing in the project area is unlikely to significantly impact on this species.

7.5.2 Avoidance and mitigation

Minimising the area of native vegetation that is cleared will minimise the threat.

Table 10. Summary of threats, mitigation and level of impacts for the Peregrine Falcon

Significant threats and impacts	Impact score	Mitigation	Impact score	Residual impact
• Loss of habitat through vegetation clearing	0	• Rehabilitation of fauna habitats • Revegetation	0 0	
				0

7.6 Western Whipbird

Western Whipbird (Western Mallee race; *Psophodes nigrogularis oberon*) is listed as Priority 4 with the DBCA.

7.6.1 Threats

Major threats for *P. n. oberon* sister subspecies *P. n. nigrogularis* (Department of Parks and Wildlife 2014) are as follows and they are likely to be the same for *P. n. oberon*:

- Too frequent and extensive fires, as these birds mostly use dense long-unburnt areas;
- Predation by foxes and feral cats because they nest and forage close to the ground;
- Habitat destruction and fragmentation that limit movements among remnant patches of vegetation;
- Introduced herbivores disturb and alter native vegetation communities changing the floristic composition that leads to a reduction in suitable foraging habitats;
- Weed invasions result in changes in the floristic composition that leads to a reduction in suitable foraging habitats; and
- Climate change may lead to a loss of remnant vegetation and changes in the floristic composition that lead to a reduction in suitable foraging habitats.

Western Whipbirds are expected to move into adjacent areas when vegetation clearing commences. This is likely to cause an initial and ongoing direct impact until each of the displaced birds establishes a new home range. How disruptive this shift is and whether it impacts survival rates is unknown.

7.6.2 Avoidance and mitigation

There is little that can be done in the short-term to mitigate potential direct impacts on this species, other than to minimise the clearing of vegetation, particularly in areas of dense low-level vegetation. In the longer-term, rehabilitating disturbed areas may provide foraging and nesting habitat, presuming that the rehabilitated areas provide vegetation communities suitable for Western Whipbirds to forage in. A feral cat and fox reduction program is expected to reduce predation on this species.

Table 11. Summary of threats, mitigation and level of impacts for the Western Whipbird

Significant threats and impacts	Impact score -	Mitigation	Impact score	Residual impact
• Fire	-1			
• Predation by foxes and cats	0	• Fox and feral cat reduction program	+1	
• Vegetation clearing	-1	• Rehabilitate areas once they are no longer required for mining	0	
				-1

7.7 Western Mouse

Western Mouse (*Pseudomys occidentalis*) is listed as Priority 4 species with DBCA.

7.7.1 Threats

Morris et al. (2008) listed major threats to the Western Mouse as habitat loss, changes to fire regimes, predation by feral cats and weed invasion which would alter the composition of native vegetation communities.

The most significant direct threat to the Western Mouse is vegetation clearing and a major fire, and the most significant indirect impact is the increased access of foxes and feral cats to Western Mouse habitat as a consequence of additional areas and tracks being cleared.

7.7.2 Avoidance and mitigation

The potential impact associated with vegetation clearing can be reduced by minimising areas of native vegetation to be cleared and rehabilitating areas once they are no longer required.

The pilot fox and feral cat reduction program that commenced in 2017 is expected to reduce predation pressure on the Western Mouse. Camera traps were deployed to determine target and non-target species uptake of buried 1080 baits and cats will be trapped biannually. This program will be modified based on the assessment of its effectiveness. This adaptive management approach will determine the most cost-effective long-term feral cat and fox reduction program. The existing annual conservation significant fauna monitoring program should be modified to measure changes to the fauna assemblage including the Western Mouse with a reduction in the number of cats and foxes.

To reduce the potential loss of Western Mice during the vegetation clearing program, all areas should be trapped for five days immediately prior to the vegetation clearing program. Any trapped Western Mouse should be relocated a considerable distance from the capture location and into suitable habitat to avoid them attempting to return. The presence of a zoologist when vegetation is being cleared to catch and relocate fauna, would also reduce the possibility of a Western Mouse being killed or injured during the vegetation clearing program.

Table 12. Summary of threats, mitigation and level of impacts for the Western Mouse

Significant threats and impacts	Impact score	Mitigation	Impact score	Residual impact
• Fire	-3			
• Predation by foxes and cats	-3	• Fox and feral cat reduction program	+4	
• Vegetation clearing	-2	• Trapping and relocation prior to and during vegetation clearing	+1	
				-2

7.8 Western Brush Wallaby

Western Brush Wallaby (*Macropus irma*) is listed as Priority 4 species with DBCA.

7.8.1 Threats

Woinarski et al. (2014) and Woinarski and Burbidge (2016) reported threats to Western Brush Wallabies as predation by foxes, habitat loss and fragmentation, inappropriate fire regimes and vehicle impacts. Christensen (2000) suggested the fox was a major predator, particularly of joeys, and Woinarski and Burbidge (2016) reported that Western Brush Wallaby numbers have increased in areas of fox control.

The Western Brush Wallaby is expected to move into adjacent habitat areas once vegetation clearing commences, and there is adequate foraging habitat in adjacent areas. As the activity area for this species is quite large, for most individuals this will mean an adjustment to their home range, so impacts are likely to be short-term and not significant. Further fragmentation of their habitat will also restrict their movement.

It is expected that Western Brush Wallabies will frequently cross the infrastructure corridor and will be at risk of collisions with haul trucks and other vehicles. Increased vehicle traffic, particularly at night, in their activity area will result in some individuals being injured or killed on the roads.

Loss of habitat and habitat fragmentation is expected to indirectly impact on this species by reducing areas in which it can feed and limit movement between areas, which are particularly important during a fire or when feeding resources are limited.

7.8.2 Avoidance and mitigation

The potential impact associated with vegetation clearing can be reduced by minimising areas of native vegetation to be cleared and rehabilitating areas once they are no longer required.

The pilot fox reduction program that commenced in autumn 2017 is expected to reduce predation on Western Brush Wallabies. Camera traps were deployed to determine target species uptake of buried 1080. This program will be modified based on an assessment of its effectiveness. This adaptive management approach will determine the most cost-effective long-term fox reduction program.

The annual conservation significant fauna monitoring program should be used to see if there are changes to the fauna assemblage and the population of Western Brush Wallabies, with a reduction in the number of cats and foxes.

Table 13. Summary of threats, mitigation and level of impacts for the Western Brush-Wallaby

Significant threats and impacts	Impact score	Mitigation	Impact score	Residual impact
• Fire • Predation by foxes and cats • Vegetation clearing • Vehicle collisions on the haul road	0 -2 -1 -2	• Fox and feral cat reduction program • Rehabilitation of fauna habitats	+2 0	
				-3

7.9 Southern Brown Bandicoot

Southern Brown Bandicoot or Quenda (*Isoodon obesulus fusciventer*) is listed as a Priority 4 species with DBCA.

7.9.1 Threats

Major threats to Southern Brown Bandicoots include habitat fragmentation and loss of habitat, fire particularly in in fragmented habitat, predation by foxes and predation of young bandicoots by cats (Woinarski et al. 2014, Burbidge and Woinarski 2016).

If available, it is expected that Southern Brown Bandicoots will move into adjacent areas once vegetation clearing commences, however, this will depend on whether they can escape from their diurnal retreat without being injured. For most individuals, this will mean the establishment of a new home range, so there will an immediate and ongoing direct impact until this area can be established. This direct impact will be compounded if individuals attempt to return to their established, but now cleared activity area. All animals shifted to new areas are likely to be impacted by higher levels of predation pressure, until they become familiar with their new home range. For those unable to escape and flee the vegetation clearing program, they will be injured or killed.

Fires, particularly intensive and wide spread fires, are expected to kill Southern Brown Bandicoots and will also remove and fragment habitat. Fragmented habitat is an indirect impact as it reduces the opportunity for bandicoots to move among remanent patches of vegetation and maintain genetic diversity and long-term sustainable populations.

Southern Brown Bandicoots are expected to attempt crossing the infrastructure corridor and will be at risk of collisions with haul trucks and other vehicles.

7.9.2 Avoidance and mitigation

Minimising vegetation clearing, particularly in areas of relatively high-density vegetation will limit impacts.

Rehabilitating areas once they are no longer required for mining with habitat suitable for Southern Brown Bandicoots will reduce impacts in the long-term.

A fox and feral cat reduction program that commenced in autumn 2017 is expected to reduce predation on Southern Brown Bandicoots. Camera traps were deployed to determine target and non-target species uptake of buried 1080 baits and cats will be trapped biannually. This program will be modified based on an assessment of its effectiveness. This adaptive management approach will determine the most cost-effective long-term feral cat and fox reduction program.

To reduce the expected potential loss of Southern Brown Bandicoots during the vegetation clearing program, all areas should be trapped for five days immediately prior to the vegetation being removed. All trapped Southern Brown Bandicoots should be relocated into suitable habitat a considerable distance from the capture location to avoid them attempting to return.

Table 14. Summary of threats, mitigation and level of impacts for the Southern Brown Bandicoot

Significant threats and impacts	Impact score	Mitigation	Impact score	Residual; impact
• Fire	-3			
• Predation by foxes and cats	-2	• Fox and feral cat reduction program	+3	
• Vegetation clearing	-2	• Trapping and relocation plan prior to and during vegetation clearing	+1	
		• Rehabilitation of fauna habitats	0	
• Vehicle collisions on the haul road	-1			
				-4

7.10 Rainbow Bee-eater

Rainbow Bee-eater (*Merops ornatus*) is listed as a Migratory under the *EPBC Act*.

7.10.1 Threats

It is expected that vegetation clearing during the breeding season in areas in which the Rainbow Bee-eater digs its burrow will be the most significant threat, as nest burrows will be destroyed. Foxes are also known to dig up nest burrows to predate on the eggs and chicks.

7.10.2 Avoidance and mitigation

Suitable habitat in which the Rainbow Bee-eater would dig its nest burrow could be searched prior to vegetation clearing. The area around each nest burrow could be left until the chicks have fledged.

Table 15. Summary of threats, mitigation and level of impacts for the Rainbow Bee-eater

Significant threats and impacts	Impact score	Mitigation	Impact score	Residual impact
• Predation by foxes and cats	0	• Fox and feral cat reduction program	0	
• Vegetation clearing	0	• Searching and protecting nest burrows during the breeding season	0	
				0

7.11 Potential impacts and mitigation strategies for the vertebrate fauna assemblage in the project area

7.11.1 Threats

The vertebrate fauna assemblages will potentially be directly impacted in the following way:

- clearing of native vegetation and killing fauna in the process;
- killing fauna crossing the infrastructure corridor, haul road and internal roads and tracks; and
- killed or injured in fires;

and indirectly impacted by:

- predation by foxes and cats because of increased access to their habitat;
- increased barriers to fauna movement and gene flow in the long-term; and
- displacement into areas adjacent to the mining operations due to dust, unnatural noises, vibrations, artificial light sources and vehicle and human movement or competition from conspecifics.

Clearing vegetation

It is expected that most of the small reptiles, mammals and amphibians will be lost during the vegetation clearing process.

Western Grey Kangaroos, emus, large goannas and snakes, and other medium and large vertebrate fauna will attempt to leave the area once vegetation clearing commences. However, it is expected that some will not be able to escape or they will flee in an inappropriate direction and be injured or killed by machinery or predated on by raptors, corvids, cats and foxes.

To significantly reduce the potential loss of vertebrate fauna during the vegetation clearing program, all areas should be trapped (i.e. cage and aluminium box traps) for five days immediately prior to the vegetation being removed. A zoologist should be present during the vegetation clearing program to catch and relocate all live animals. All trapped vertebrate fauna should be relocated a considerable distance from the capture location to avoid them attempting to return.

Crossing the infrastructure corridor

It is expected that Western Grey Kangaroos, emus and other medium and large animals will attempt to cross the infrastructure corridor. These fauna are expected to be injured or killed by haul trucks and vehicles.

Feral cats and foxes

New tracks and habitat fragmentation in native bushland is expected to increase feral cat and fox access to native fauna and therefore increase predation pressure and further impact on the existing population(s). Feral cats and foxes are abundant in the RNO tenements; however, it is expected that a trapping program targeting cats and foxes will result in a significant increase in the abundance of small mammals and reptiles.

Fires

Wide spread and intensive fires are known to injure and killed a high proportion of the small vertebrate fauna, and many of those that escape the fire will be predated on by raptors, corvids, foxes and cats as they attempt to move to vegetated areas.

A fire management plan which uses an ecological modelling approach to design a mosaic fire burning strategy would reduce this potential direct impact. If prepared and implemented across the RNO tenements this integrated ecologically based fire management approach is likely to inhibit the build-up of large fuel loads in the native vegetation which result in intense and widespread fires.

Habitat fragmentation

Habitat fragmentation is both a short and long-term indirect impact. Vegetation clearing should always be done from cleared to uncleared areas. This enables fauna to move ahead of the clearing into native vegetation and reduces the creation of isolated patches of native vegetation that limit escape and safe movement options for fauna. Where isolated remnants of bushland are unavoidable, every attempt will be made to create movement corridors to adjacent bushland.

Anthropogenic impacts

Dust, unnatural noises, vibrations, artificial light sources and vehicle and human movement associated with vegetation clearing, construction and mine operations has the potential to disturb and displace vertebrate fauna living adjacent to the proposed development areas.

The abundance and diversity of the vertebrate fauna in areas adjacent to the mining operations should be monitored annually with a view to improving management practices to avoid and minimise impacts on fauna in adjacent areas. Following each vertebrate fauna monitoring program, a review of existing mining practices should be undertaken with a view to avoid and mitigate impacts on vertebrate fauna.

Rehabilitation

A rehabilitation program should be planned and implemented to rehabilitate disturbed habitats once they are no longer required for mining activities. The success of this rehabilitation program in recreating near-natural, self-sustaining, functional vertebrate fauna ecosystems should be assessed and monitored.

7.11.2 Avoidance and mitigation

The potential impact associated with vegetation clearing can be reduced by minimising areas of native vegetation to be cleared and rehabilitating areas once they are no longer required.

The proposed trapping program aimed at Chuditch, Southern Brown Bandicoots, Heath Rats and Western Mouse prior to vegetation clearing should catch a small proportion of the other small vertebrate fauna in areas to be cleared. A zoologist being available during the vegetation clearing program will assist in catching and relocating many of the small vertebrates once they are disturbed.

A pilot fox and feral cat reduction program that was implemented in autumn of 2017 should relieve some of the predation pressure on the small vertebrate fauna assemblage. Camera traps were deployed to determine target and non-target species uptake of buried 1080 baits and cats will be trapped twice yearly. This program will be modified based on an assessment of its effectiveness. This adaptive management approach will determine the most cost-effective long-term feral cat and fox reduction program.

Table 16. Summary of threats, mitigation and level of impacts for the vertebrate fauna assemblage

Significant threats and impacts	Impact score	Mitigation	Impact score	Residual impact
• Fire	-4	•		
• Predation by foxes and cats	-3	• Fox and feral cat reduction program	+2	
• Vegetation clearing	-4	• Trapping and relocation plan prior to and during vegetation clearing	+1	
		• Rehabilitation of fauna habitat	0	
• Vehicle collisions on the haul road	-1			
• Unnatural noises, vibrations, artificial light sources	0	• Fauna management plan (excluding above mitigation strategies)	+2	
				> -5

7.12 Summary of threats and impacts and mitigation strategies

Table 17 provides a summary of the potential significant threats and direct and indirect impacts on the conservation significant vertebrate fauna and fauna assemblage at RNO, and presents proposed avoidance, minimisation and mitigation strategies to address these impacts.

Table 17. A summary of the metrics of the potential threats and impacts on the vertebrate fauna and the avoidance, mitigation and minimisation strategies

Species	Status	Threats and impacts	Impact score	Mitigation	Impact score	Residual impact
Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) and Baudin's Black Cockatoo (*C. baudinii*)		• Fire • Vegetation clearing	0 0	• Revegetation and rehabilitation	0	0
Heath Rat (*Pseudomys shortridgei*)	En	• Fire • Predation by foxes and cats • Vegetation clearing	-3 -3 -2	• Fox and feral cat reduction program • Trapping and relocation prior to and during vegetation clearing	+4 +1	-3
Malleefowl (*Leipoa ocellata*)	Vu	• Fire • Predation by foxes and cats • Vegetation clearing • Vehicle collisions on the haul road	-2 -3 -1 -1	• Fox and feral cat reduction program • Rehabilitation of fauna habitats	+4 0	-3
Chuditch (*Dasyurus geoffroii*)	Vu	• Fire • Predation by foxes and cats • Vegetation clearing • Vehicle collisions on the haul road	-1 -2 -1 -1	• Fox and feral cat reduction program • Trapping and relocation plan prior to and during vegetation clearing • Rehabilitation of fauna habitats	+2 +1 0	-2
Peregrine Falcon (*Falco peregrinus*)	SP	• Loss of habitat through vegetation clearing	0	• Rehabilitation of fauna habitats • Revegetation	0 0	0
Western Whipbird (*Psophodes nigrogularis oberon)*	P4	• Fire • Predation by foxes and cats • Vegetation clearing	-1 0 -1	• Fox and feral cat reduction program • Rehabilitate areas once they are no longer required for mining	+1 0	-1
Western Mouse (*Pseudomys occidentalis*)	P4	• Fire • Predation by foxes and cats	-3 -3	• Fox and feral cat reduction program	+4	-2

Species	Status	Threats and impacts	Impact score	Mitigation	Impact score	Residual impact
		• Vegetation clearing	-2	• Trapping and relocation prior to and during vegetation clearing	+1	
Western Brush Wallaby (*Macropus irma*)	P4	• Fire • Predation by foxes and cats • Vegetation clearing • Vehicle collisions on the haul road	0 -2 -1 -2	• Fox and feral cat reduction program • Rehabilitation of fauna habitats	+2 0	-3
Southern Brown Bandicoot (*Isoodon obesulus fusciventer*)	P4	• Fire • Predation by foxes and cats • Vegetation clearing • Vehicle collisions on the haul road	-3 -2 -2 -1	• Fox and feral cat reduction program • Trapping and relocation plan prior to and during vegetation clearing • Rehabilitation of fauna habitats	+3 +1 0	-4
Rainbow Bee-eater (*Merops ornatus*)	P4	• Predation by foxes and cats • Vegetation clearing	0 0	• Fox and feral cat reduction program • Searching and protecting nest burrows during the breeding season	0 0	0
Vertebrate fauna assemblage		• Fire • Predation by foxes and cats • Vegetation clearing • Vehicle collisions on the haul road • Unnatural noises, vibrations, artificial light sources	-4 -3 -4 -1 0	• Fox and feral cat reduction program • Trapping and relocation plan prior to and during vegetation clearing • Rehabilitation of fauna habitat • Fauna management plan (excluding above mitigation strategies)	+2 +1 0 +2	> -5

En Endangered
Vu Vulnerable
P Priority species recorded by DBCA
SP Specially protected

8 POTENTIAL MANAGEMENT, MITIGATION AND OFFSET PROPOSALS

8.1 Vertebrate fauna management plan

The RNO tenements support multiple vertebrate fauna, and in particular conservation significant species. It is therefore important that mine management initiates actions for the long-term management, protection and mitigation of mining impacts on the vertebrate fauna. A vertebrate fauna management plan should be prepared, implemented and regularly updated based on the best available information (i.e. at least annually). The vertebrate fauna management plan should cover the entire RNO operations and should describe the management practices associated with vegetation clearing and infrastructure development, and ongoing mining operations.

This plan should have specific and measurable key performance objectives, triggers for specific actions and specific actions that should be implemented as and when required. The plan should detail an annual vertebrate fauna monitoring program to measure the health and relative abundance of conservation significant vertebrate fauna species. This monitoring program should utilise the relevant aspects of the existing monitoring program, so that the data already available might be used in a long-term dataset.

The fauna management plan should also document feral and pest animal control programs that will be implemented and the success (or otherwise) of these programs based on appropriate monitoring data.

The fauna management plan should detail the adaptive management processes to be implemented by the mine's management.

8.2 Fox and cat reduction

The most significant impact on vertebrate fauna in the RNO tenements and surrounds, in particular to conservation significant fauna species, is the predation pressure resulting from an abundance of cats and foxes. Clearing of vegetation increases feral cat and fox access to fauna habitat, and therefore increases the expected impact these introduced predators have on native fauna.

Broad-landscape scale baiting programs for cats and foxes have been undertaken with mixed success. The three primary problems with broad-scale aerial baiting programs are uncontrolled uptake of baits by non-target species and unpredictable ambient weather conditions prior to and during the distribution of the bait. For example, Dundas et al. (2014) reported that 99% of 1080 baits laid to control foxes in the northern Jarrah Forest and monitored by camera traps were taken by non-target species and in a field trial to compare the efficacy of Eradicat and Curiosity baits in the Cape Arid National Park and Nuytsland Nature Reserve inappropriate weather resulted in poor bait uptake due to reduced bait attractiveness/palatability (Algar et al. 2011). In the RNO tenements, non-target species such as *Varanus rosenbergi* (Heath Monitor), *Tiliqua rugosa* (Bobtail lizard), *Tiliqua occidentalis* (Western Blue-tongue Lizard), *Corvus coronoides* (Australian Raven), emus (*Dromaius novaehollandiae*), Chuditch (*D. geoffroii*) and *Strepera versicolor* (Grey Currawong) would potentially take most of the meat based baits. Terrestrial Ecosystems' trapping programs for conservation significant species were impacted by catching *V. rosenbergi, C. coronoides* and *S. versicolor* in the traps and by bait theft, and these animals were also frequently recorded at lures for the camera traps. The third and most significant issue is that the baits currently available are not sufficiently attractive for them to be taken by feral cats and foxes.

Cat and fox numbers should be significantly reduced to enable some recovery of small mammal and reptile populations. A two-stage pilot trial baiting program commenced in autumn 2017 to significantly reduce the population of foxes on the RNO tenements:

Stage 1 was wide scale distribution of buried 1080 baits (~200) with a follow up distribution at approximately 2, 4 and 6 weeks in autumn and early winter. Camera traps were used to monitor bait uptake at selected sites.

Stage 2 is the trial of canid pest ejectors (CPE). These ejectors will be placed along established tracks over a period of two months in each of two years with an expected reduction in the number of foxes. Again, bait uptake will be monitored using camera traps. Canid pest ejectors have been shown to be an effective tool for

delivering 1080 (Marks and Bloomfield 1999, Marks et al. 2003). This pilot program will be implemented in autumn and winter when food for cats and foxes is at its lowest level, thus increasing the bait uptake rate and reducing update by non-target species.

Burying 1080 meat baits is expected to reduce bait uptake by non-targeted species such as ravens, currawongs and goannas. It is expected that a well-planned and implemented program should have a significant impact on fox numbers, however, it is possible that a reduction in the fox population will result in the increased impact of cats (i.e. meso-predator release) on native fauna. It is therefore important that a concurrent cat reduction program is implemented. The following two strategies are being implemented:

a. baited cage traps will be deployed across the RNO tenements biannually (i.e. once with the fox baiting program and once with the fauna monitoring program); and
b. a shooting program is implemented in the paddocks that surround the mine site.

Given the abundance of cats and foxes currently recorded in the RNO tenements, it is highly likely that similar densities exist in the adjacent area, and an influx of cats and foxes from these areas will occur after the initial removal of foxes and cats on the RNO tenements. To reduce this influx, a cat and fox shooting program will be implemented in the paddocks around the RNO mine site to complement the trapping programs in conjunction with the fox trapping program.

The effectiveness of this program will be reviewed to determine bait uptake, and in the longer-term changes in the fauna assemblage. If effective, the annual fauna monitoring program should show an increase in small mammals, reptiles and amphibians. It would be anticipated that it would take at least three years to see an increase in the abundance of small mammals, reptiles and amphibians, if the cat and fox baiting program is successful.

8.3 Saline water pipeline bridges

The saline water pipeline should be lifted off the ground at least 100mm approximately every 100m to enable snakes, goannas, other reptiles and small mammals to pass the barrier. Plate 12 shows an example of a raised water pipeline.

Plate 12 Raised water pipeline

8.4 Trapping prior to vegetation clearing and a catch and relocate program during vegetation clearing

Immediately prior to vegetation clearing in the infrastructure corridor, Shoemaker-Levy mining area and the Hale Bopp North West pit area an intensive trapping program to catch and relocate vertebrate fauna, using aluminium box traps and large cage traps should be implemented. While vegetation clearing is being undertaken, a suitably experienced zoologist should be present to catch and relocate vertebrate fauna disturbed by the vegetation clearing program.

9 THREAT ABATEMENT PLANS

9.1 Threat abatement plan for feral cats

The *Threat abatement plan for predation by feral cats* (Department of the Environment 2015, p9) indicates that 'Control of cats is difficult as they are found in very low densities and have large home ranges, making them difficult to locate. They are also extremely cautious in nature, making them hard to cost-effectively control with traditional measures such as shooting and trapping.' The threat abatement plan indicates the feral cat population can be reduced by shooting and the use of cage traps, or broad scale baiting. Feral cats prefer live prey and will only take carrion (baits) when other resources are scarce (Christensen et al. 2012), so often broad scale baiting programs fail to have a significant impact because feral cats don't take the aerially dispersed baits.

Feral cats are relatively abundant in RNO tenements and are having a significant impact on the vertebrate fauna. Removing feral cats can result in an increase in the introduced rabbits, house mice and black rats, as well as native reptiles, amphibians, mammals and birds. The management strategies and recommendations in this report are consistent with the *Threat abatement plan for predation by feral cats* (Department of the Environment 2015).

9.2 Threat abatement plan for foxes

The *Threat abatement Plan for predation by the European red fox* (Department of the Environment 2008) indicates that 'Control of foxes is difficult; control methods include baiting, shooting, trapping, den fumigation or destruction, and exclusion fencing.' Foxes are a significant predator on reptiles, amphibians and small native mammals (Department of the Environment 2008) and are having a significant negative impact on the vertebrate fauna in RNO tenements.

The management strategies and recommendations in this report are consistent with the *Threat abatement Plan for predation by the European red fox* (Department of the Environment 2008).

9.3 Threat abatement plan for rabbits

The *Threat abatement plan for competition and land degradation by rabbits* (Department of the Environment and Energy 2016, p6) indicates that 'Rabbits inflict substantial damage upon both agricultural and environmental assets (e.g. native flora and fauna, vegetation communities, landforms, geomorphic processes and sensitive sites, and crops) and have been described as Australia's most costly vertebrate pest'. Pedler et al. (2016) reported that after the almost complete removal of the rabbit from the landscape in north-eastern arid inland South Australia with the rabbit haemorrhagic disease virus (RHDV) there was a significant increase in the abundance of the dusky hopping mouse (*Notomys fuscus*), spinifex hopping-mouse (*Notomys alexis*), plains mouse (*Pseudomys australis*), and the crest-tailed mulgara (*Dasycercus cristicauda*). Therefore, a reduction in the number of rabbits should result in a significant increase in the vertebrate fauna assemblage.

In a landscape context, there are very few rabbits on the RNO tenements, however, there are pockets which have quite dense rabbit populations. The proposed vegetation clearing for infrastructure development and mining is planned to impact one of the areas with a higher density of rabbits, however, the proposed development is unlikely to result in a significant increase in the population. However, a reduction in the number of foxes and feral cats may result in an increase in the rabbit population. At this stage, it is recommended that the shooting program for cats and foxes should be expanded to target these small pockets of higher densities of rabbits, but no broad scale management is required across the project area. Therefore the management strategies and recommendations in this report are not inconsistent with the *Threat abatement plan for competition and land degradation by rabbits* (Department of the Environment and Energy 2016). Should rabbit numbers increase, then it would be recommended that the latest K5 RHDV be released in the project area in combination with a shooting program.

9.4 Threat abatement plan for goats

The *Threat abatement plan for competition and land degradation by unmanaged goats* (Department of the Environment Water Heritage and the Arts 2008) indicates that 'Unmanaged goats can be a serious pest because of their ability to severely affect native flora and fauna'. No unmanaged or feral goats have been observed in the RNO tenements and it is highly unlikely that the proposed vegetation clearing for infrastructure development and

mining will result in an increase in the number of goats in the project area. At this stage, it is not proposed that any action is taken to manage goats in the project area. Therefore the management strategies and recommendations in this report are not inconsistent with the *Threat abatement plan for competition and land degradation by unmanaged goats* (Department of the Environment Water Heritage and the Arts 2008).

10 SIGNIFICANT RESIDUAL IMPACTS

If mitigation and minimisation strategies suggested above are adopted, and the scoring system outlined in Table 4 is used as a metric of the interaction between impacts and the minimisation / mitigation strategies, then a residual impact metric can be calculated for each species and the fauna assemblage. These residual impact metrics have been summarised in Table 18.

Table 18. Residual impacts on conservation significant species and the general fauna assemblage

Species	Status	Residual impact
Carnaby's (*Calyptorhynchus latirostris*) and Baudin's (*Calyptorhynchus baudinii*) Black-cockatoos	En	0
Heath Rat (*Pseudomys shortridgei*)	En	-3
Malleefowl (*Leipoa ocellata*)	Vu	-3
Chuditch (*Dasyurus geoffroii*)	Vu	-2
Peregrine Falcon (*Falco peregrinus*)	SP	0
Western Whipbird (*Psophodes nigrogularis oberon*)	P4	-1
Western Mouse (*Pseudomys occidentalis*)	P4	-2
Western Brush Wallaby (*Macropus irma*)	P4	-3
Southern Brown Bandicoot (*Isoodon obesulus fusciventer*)	P4	-4
Rainbow Bee-eater (*Merops ornatus*)	P4	0
Vertebrate terrestrial fauna assemblage		-5

Of the four-species relevant to MNES, it is expected that the proposal will have a residual impact on the Heath Rat, if present, and the Malleefowl and Chuditch, presuming the mitigation strategies are implemented. There will also be a residual impact on the Western Whipbird, Western Mouse, Western Brush Wallaby, Southern Brown Bandicoot and the vertebrate fauna assemblage as a whole. Should the proposed migration strategies not be implemented, then the residual impacts are expected to increase.

The mitigation strategies that are expected to lower the residual impact for most conservation threatened fauna are the fox and cat management program, a trapping program immediately prior to vegetation clearing, and a zoologist being present during the vegetation clearing program to catch and relocate disturbed and fleeing fauna.

11 RECOMMENDATIONS

1 A vertebrate fauna management plan is prepared and implemented for the entire RNO operations. This plan should focus on long-term management, protection and mitigation of impacts on the vertebrate fauna, including the monitoring of fauna assemblages, implementation of mitigation plans and the management of feral and pest species.

2 A two-stage pilot fox and feral cat reduction program is implemented, starting in autumn 2017. *Stage 1* is broad-scale distribution of buried 1080 baits with a follow up distribution at 2, 4 and approximately 6 weeks. Camera traps should be used to monitor bait uptake at selected sites. This should achieve a reduction in the number of foxes. *Stage 2* is a trial of canid pest ejectors (CPE) as the basis for on-going fox management. CPEs should be deployed along established but little used tracks, over a period of two years, to reduce and maintain fox numbers to a level lower than the current population. Again, bait uptake should be monitored during this trial using camera traps. The success of Stages 1 and 2 should be monitored with camera traps in conjunction with a modified annual conservation significant fauna monitoring program. Stages 1 and 2 should be complemented with a biannual trapping program for cats on RNO tenements, and a shooting program for cats and foxes in the paddocks around the RNO. Feral and pest animal management programs targeting cats and foxes should be implemented in autumn and winter when alternate food opportunities for cats and foxes are at the lowest level, thus increasing the bait uptake and reducing the probability that *Varanus rosenbergi* will be affected by the baits.

3 The fox and feral cat management program should be assessed after three years of operation, and amendments and adjustments made to improve its effectiveness. The fox and feral cat management program should be ongoing, as both introduced predators will continually move into the RNO tenements on an ongoing basis.

4 A shooting program targeting the couple of isolated rabbit populations around the RNO tenements.

5 Prior to vegetation clearing, an intensive trapping program should be implemented in areas to be cleared using large cage traps and aluminium box traps, with the purpose of relocating caught fauna.

6 A zoologist should be present to work with each machine operator during clearing vegetation to catch and relocate vertebrate fauna that are disturbed or displaced.

7 The relocation of each Chuditch is monitored with a GPS radio-tracking device to determine movement patterns and survival.

8 The saline water pipeline is elevated approximately every 100m to enable small vertebrate fauna to pass under the pipeline.

9 Rehabilitation is carried out once areas are no longer required for mining activities. The rehabilitation program should focus on creating habitat suitable for Carnaby's Black-Cockatoo, Chuditch, Malleefowl, Western Mouse, Heath Rats and Southern Brown Bandicoot. The success of rehabilitation programs to provide suitable habitat for conservation significant fauna, and whether these fauna return to the area, should be assessed as part of the ongoing fauna monitoring program.

10 A fire management plan is prepared and implemented to prevent, restrict and limit the movement of fires within the RNO tenements.

11 Where practical, all vegetation is cleared from disturbed areas toward uncleared areas to increase the prospects of fauna fleeing from the disturbance and safely reaching bushland.

12 All drill holes are appropriately capped to prevent capturing fauna.

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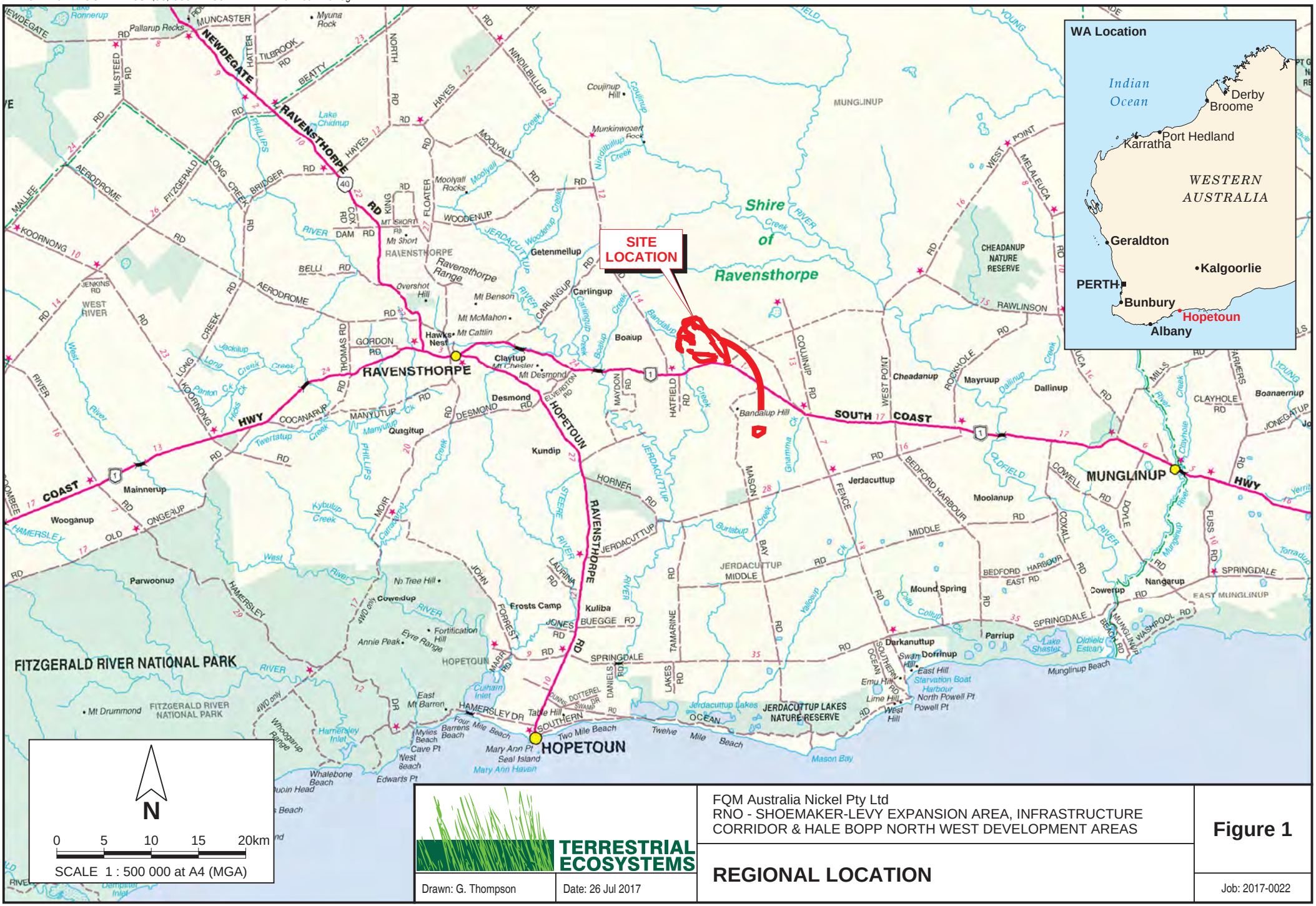
Figures

Vertebrate fauna impact assessment for proposed expansion



TERRESTRIAL ECOSYSTEMS

FQM Australia Nickel Pty Ltd
RNO - SHOEMAKER-LEVY EXPANSION AREA, INFRASTRUCTURE CORRIDOR & HALE BOPP NORTH WEST DEVELOPMENT AREAS

Figure 1

REGIONAL LOCATION

Drawn: G. Thompson

Date: 26 Jul 2017

Job: 2017-0022

Legend

- Development Envelope
- Development Footprint

N

0 0.5 1 1.5 2km

SCALE 1 : 40 000 at A3 (MGA)

TERRESTRIAL ECOSYSTEMS

Drawn: G. Thompson

Date: 26 Jul 2017

FQM Australia Nickel Pty Ltd
RNO - SHOEMAKER-LEVY EXPANSION AREA, INFRASTRUCTURE CORRIDOR & HALE BOPP NORTH WEST DEVELOPMENT AREAS

PROJECT AREA - SHOEMAKER-LEVY EXPANSION AREA, INFRASTRUCTURE CORRIDOR AND HALE-BOPP NORTH-WEST PIT AREA

Figure 2

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Conservation Significant Vertebrate Fauna Monitoring and Feral Cat Trapping Program for Ravensthorpe Nickel Operations - 2016

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Front Cover: Chuditch (*Dasyurus geoffroii*) captured in baited wire cage trap

EXECUTIVE SUMMARY

In accordance with Ministerial condition 7-1 of Statement 633, Ravensthorpe Nickel Operations (RNO) requested a vertebrate fauna monitoring survey be undertaken using the permanent trapping and camera trap sites established in 2013. Threatened terrestrial vertebrate fauna targeted in this monitoring survey included the Heath Rat (*Pseudomys shortridgei*), Western Mouse (*Pseudomys occidentalis*), Western Whipbird (*Psophodes nigrogularis oberon*), Chuditch (*Dasyurus geoffroii*), Malleefowl (*Leipoa ocellata*) and Southern Brown Bandicoot (*Isoodon obesulus fusciventer*).

Five hundred aluminium box traps and 100 wire cage traps were set at multiple locations in a variety of habitat types and in areas with two fire histories. Fifty camera traps were deployed at some of the trapping sites and in the two areas where Coffey Environments (2010) recorded Chuditch. Ten Western Whipbird monitoring sites that were used in 2013 were revisited and surveyed. In addition, 119 baited wire cage traps targeting cats were deployed along two linear corridors and in selected areas around the mining operations. A targeted cat trapping program was a new component to the annual monitoring program.

No Heath Rats, Western Mice or Southern Brown Bandicoots were recorded in the monitoring survey. Chuditch were recorded at Sites A (east), D, E, G and on the hill. There were new records for Chuditch at Sites A (east) and E which had previously been surveyed and along Mason Bay Road in cat traps which had not previously been surveyed. Malleefowl were recorded at Site A (east and west), D, E, G and on the hill. Malleefowl were recorded for the first time at sites D, E and on the hill. Western Whipbirds were recorded at eight of the 10 monitoring sites; the same as in 2014 and 2015. This survey also confirmed the presence of an established population of Western Brush Wallabies at all seven monitoring sites.

Foxes were present in six of the seven camera monitoring sites and cats were present at all monitoring sites.

The declining number of small mammals, and in particular no records of the Heath Rat, Western Mouse and Southern Brown Bandicoot is likely to be due, in part, to predation by the abundant cats and foxes in the project area. It is therefore recommended that an effective cat and fox reduction program is developed and implemented for the project area. A suggested feral predator control program is provided.

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1 INTRODUCTION

1.1 Background

In accordance with Ministerial condition 7-1 of Statement 633; Ravensthorpe Nickel Operations (RNO) requested a vertebrate fauna monitoring survey be undertaken using the permanent trapping sites established in 2013 and adjusted in 2014 to accommodate an expansion in mining activity, and camera trapping survey at sites established in 2014. The location of the project area is shown in Figure 1.

The approved fauna management plan requires:

- the establishment of permanent monitoring sites on and around rehabilitated areas, and for these sites to be included in the annual monitoring;
- maintain the fauna monitoring sites of the RNO and adjacent areas of the Bandalup Corridor;
- comparable trapping intensity to be applied in the monitoring program; and
- monitoring the population of rare fauna.

The rehabilitation program has commenced and is progressing but it is too early to undertake monitoring of the vertebrate fauna in these areas. Threatened terrestrial vertebrate fauna that require monitoring include the Heath Rat (*Pseudomys shortridgei*), Western Mouse (*Pseudomys occidentalis*), Western Whipbird (*Psophodes nigrogularis oberon*), Chuditch (*Dasyurus geoffroii*), Southern Brown Bandicoot (*Isoodon obesulus fusciventer*) and Malleefowl (*Leipoa ocellata*).

Malleefowl (*Leipoa ocellata*) mounds were present in the RNO tenements prior to the establishment of the mine, but these mounds were in the mining area and have been removed. Prior to this survey, Malleefowl had been recorded once (Coffey Environments 2010) in the project area since 2000 and on three occasions during the 2014 monitoring survey (Terrestrial Ecosystems 2014).

1.2 Previous monitoring surveys and fauna survey reports

There have been numerous previous fauna surveys undertaken for a variety of purposes on the RNO tenements. These include:

- Cancilla, D. and Johnson, B. (2013) The status and ecology of the *Pseudomys shortridgei* (Heath Mouse) in southern western Australia. Unpublished report for Murdoch University.
- Chapman A. (2000) Fauna Management Plan Year One 1999-2000. Unpublished report for Comet Resources, Ravensthorpe.
- Craig G.F. and Chapman A. (1998) Ravensthorpe Nickel Project. Comet Resources NL. Vegetation, Flora and Fauna Survey. Unpublished report for Ravensthorpe Nickel Project.
- Biota Environmental Sciences (2000) Ravensthorpe Nickel Project – Fauna Survey 2000. Unpublished report for Ravensthorpe Nickel Operations.
- Biota Environmental Sciences (2005) BHP Billiton Ravensthorpe Nickel Operations Fauna Trapping Program 2005. Unpublished report for BHP Billiton, Perth.
- Coffey Environments (2009) Terrestrial Vertebrate Fauna Risk Assessment for the Shoemaker-Levy Ore Body, Ravensthorpe Nickel Operations, Unpublished report for BHP Billiton Ravensthorpe Nickel, Ravensthorpe.
- Coffey Environments (2010) Fauna Monitoring, Ravensthorpe Nickel Operations, January 2010. Unpublished report for Ravensthorpe Nickel Operations, Ravensthorpe.
- Terrestrial Ecosystems (2013) Conservation Significant Vertebrate Fauna Monitoring for Ravensthorpe Nickel Operations, Ravensthorpe. Unpublished report for FQM Australia Nickel.
- Terrestrial Ecosystems (2014) Conservation Significant Vertebrate Fauna Monitoring for Ravensthorpe Nickel Operations - 2014. Unpublished report for FQM Australia Nickel.
- Terrestrial Ecosystems (2015) Conservation Significant Vertebrate Fauna Monitoring for Ravensthorpe Nickel Operations - 2015. Unpublished report for FQM Australia Nickel

The Craig and Chapman (1998) report for the fauna survey of the project area is unavailable, so it has not been possible to extract the relevant data on conservation significant fauna from this report.

A brief report by Cancilla and Johnson (2013) indicated that 720 trap-nights were used in an attempt to catch the Heath Rat at Bandalup Hill; no Heath Rats were caught. No other details of trapping sites were provided.

Chapman (2000) reported on surveys undertaken between 8-23 November 1999 and 4-17 April 2000 as the first year of a long term monitoring program for three threatened mammals and two threatened bird species that were known to be present in the project area. This survey followed on from the earlier survey work undertaken by Craig and Chapman (1998). Nine sites were established. Sites E1-E5 had 20 aluminium box traps and sites CMS1-CMS4 had one cage trap, 20 aluminium box traps and 12 pit traps. In addition, 12 cage traps were deployed in other locations. The total trapping effort was 480 pit trap-nights, 1,000 aluminium box trap nights and 200 cage trap nights. The trap type that captured the conservation significant fauna was not mentioned in the report. Conservation significant fauna recorded during these two surveys are as shown in Table 1.

Table 1. Conservation significant fauna recorded by Chapman (2000)

Species	Common Name	N°	Easting (AMG)	Northing (AMG)	Site
Psophodes nigrogularis	Western Whipbird	8	254881	6272874	E1
Psophodes nigrogularis	Western Whipbird	3	254916	6273037	E2
Psophodes nigrogularis	Western Whipbird	1	256141	6273526	E3
Psophodes nigrogularis	Western Whipbird	2	256922	6272980	E4
Psophodes nigrogularis	Western Whipbird	5	256813	6274885	E5
Psophodes nigrogularis	Western Whipbird	4	258863	6271850	CMS1
Psophodes nigrogularis	Western Whipbird	6	256612	6272327	CMS2
Psophodes nigrogularis	Western Whipbird	13	254881	6272874	CMS3
Psophodes nigrogularis	Western Whipbird	1	254662	6274642	CMS4
Psophodes nigrogularis	Western Whipbird	1	256065	6272214	
Leipoa ocellata	Malleefowl	1	255832	6273571	
Leipoa ocellata	Malleefowl	1	255769	6272758	
Leipoa ocellata	Malleefowl	1	253853	6273499	
Leipoa ocellata	Malleefowl	1	254881	6272874	
Pseudomys occidentalis	Western Mouse	5	258863	6271850	CMS1
Pseudomys occidentalis	Western Mouse	4	256612	6272327	CMS2
Pseudomys occidentalis	Western Mouse	7	254916	6273037	E2
Pseudomys occidentalis	Western Mouse	1	256922	6272980	E4
Pseudomys shortridgei	Heath Rat	4	256141	6273526	E3
Pseudomys shortridgei	Heath Rat	1	256813	6274885	E5
Pseudomys shortridgei	Heath Rat	1	254881	6272874	E1
Isoodon obesulus	Southern Brown Bandicoot	1	254881	6272874	E1

Biota Environmental Sciences (2000) undertook a survey for Sinclair Knight Merz as part of the preparation of an environmental impact assessment (EIA). Trapping was undertaken between 13-18 October 2000, with 20 aluminium box traps, 12 pit traps and two cage traps deployed at six sites (RNO01-06) mostly for five nights, and a seventh site (RNO07) had 12 pit-traps deployed for five nights. The total trapping effort was 600 aluminium box trap-nights, 534 pit-trap nights and 60 cage trap-nights. Conservation significant fauna recorded during this survey are shown in Table 2.

Table 2. Conservation significant fauna recorded by Biota Environmental Sciences (2000)

Species	Common Name	N°	Easting (AMG)	Northing (AMG)	Site
Leipoa ocellata	Malleefowl	1	258752	6272315	Site 5
Leipoa ocellata	Malleefowl	1	251832	6278164	
Psophodes nigrogularis	Western Whipbird		251997	6280520	Site 4
Psophodes nigrogularis	Western Whipbird		258494	6272294	Site 5
Psophodes nigrogularis	Western Whipbird		258808	6270857	Site 6
Psophodes nigrogularis	Western Whipbird		258805	6271802	Site 7
Psophodes nigrogularis	Western Whipbird		254881	6272874	E1
Psophodes nigrogularis	Western Whipbird		254916	6273037	E2
Psophodes nigrogularis	Western Whipbird		256922	6272980	E4
Psophodes nigrogularis	Western Whipbird		256813	6274885	E5
Psophodes nigrogularis	Western Whipbird		250688	6278164	
Psophodes nigrogularis	Western Whipbird		258822	6272248	
Pseudomys occidentalis	Western Mouse	1	254986	6273022	
Pseudomys occidentalis	Western Mouse	1	255037	6273031	
Pseudomys shortridgei	Heath Rat	1	251997	6280520	Site 4

Biota Environmental Sciences (2005) undertook a survey between 23-26 August 2005 for RNO with a focus on recording short-range endemic invertebrates in the project area. Six sites (RNOE1-E5, Elliott line) had 20 aluminium box traps set for three nights, one site had 50 cage traps set for two nights and there were eight sites with 12 pit-fall traps, eight aluminium box traps and two cage traps. The total trapping effort was 672 aluminium box trap-nights, 408 pit trap-nights and 168 cage trap-nights. There is no record of the trap type that caught the conservation significant fauna. Conservation significant fauna recorded during this survey are shown in Table 3.

Table 3. Conservation significant fauna recorded by Biota Environmental Sciences (2005)

Species	Common Name	N°	Easting (AMG)	Northing (AMG)	Site
Psophodes nigrogularis	Western Whipbird		256780	6272585	RNOCMS2
Psophodes nigrogularis	Western Whipbird		256922	6272980	RNOE4
Psophodes nigrogularis	Western Whipbird		257142	6273254	
Pseudomys occidentalis	Western Mouse	4	256922	6272980	RNOE4

Biota Environmental Sciences (2005) reported undertaking a fauna survey in December 2001 that has not been reported. Lines of 20 aluminium box traps were set at RNOE1, RNOE2, RNOE3, RNOE4 and RNOE5, and these were the same sites used by Chapman (2000). In addition, pit traps, cage traps and aluminium box traps were deployed at RNOCTS01, RNOCTS02, RNOCTS03, RNOCTS04, RNOCMS01, RNOCMS02, RNOCMS03, RNOCMS04 and cage traps were deployed at a cage trapping line.

Coffey Environments (2009) undertook a vertebrate fauna survey of the Halley's pit surrounds and Shoemaker–Levy area. In part, this survey was to meet the Ministerial conditions for on-going fauna monitoring of conservation significant fauna and to provide analogue sites for when fauna monitoring was undertaken in the rehabilitated areas. Pit-traps, aluminium box traps and cage traps were deployed. Conservation significant fauna recorded during this survey are as shown in Table 4. This report also indicated that a Chuditch had been killed on the access road into the mine, but no coordinates were available.

Table 4. Conservation significant fauna recorded by Coffey Environments (2009)

Species	Common Name	N°	Easting (WGS84)	Northing (WGS84)	Sites
Isoodon obesulus	Southern Brown Bandicoot	1	249835	6281541	CK5
Psophodes nigrogularis	Western Whipbird		257482	6276271	CK3
Psophodes nigrogularis	Western Whipbird		251701	6281945	ML1
Psophodes nigrogularis	Western Whipbird		257631	6276419	ML2

Coffey Environments (2010) undertook a second vertebrate fauna monitoring survey to comply with Ministerial conditions. Survey sites included those used in 2009 plus 14 additional sites (N1-N10 and C1-C4). These additional sites were used to provide a comparison with the existing 20 Shoemaker-Levy and Halley's pit sites. Pit-traps, aluminium box traps and cage traps were deployed at N1-N10, and cage traps where deployed at C1-C4. Chuditch were caught in cage traps, and the Western Mouse and Heath Rat were caught in pipe pit-traps. Conservation significant fauna recorded during this survey are as shown in Table 5. It is unknown whether the capture of nine Chuditch was a smaller number being repeatedly caught or nine individuals.

Table 5. Conservation significant fauna recorded by Coffey Environments (2010)

Species	Common Name	N°	Easting (WGS84)	Northing (WGS84)	Sites
Dasyurus geoffroii	Chuditch	9	256130	6272352	Cage 1
Dasyurus geoffroii	Chuditch	1	256872	6271544	Cage 2
Pseudomys occidentalis	Western Mouse	1	256777	6272598	N1
Pseudomys occidentalis	Western Mouse	1	258940	6272024	N8
Pseudomys shortridgei	Heath Rat	1	257631	6276419	ML2
Leipoa ocellata	Malleefowl	1	257482	6276271	

The Terrestrial Ecosystems (2013) survey established six trapping sites. These were adjusted in 2014 to accommodate an expansion in the mine's activity. Site A was split into east and west each containing 50 aluminium box traps and 10 cage traps. Sites C, D and E had 100 aluminium box traps and 20 wire cage traps, and sites G and F had 50 aluminium box traps and 10 wire cage traps. The location of all trapping sites was marked with a star picket. In addition, eleven sites that were also marked with a star picket were established to monitor the presence of Western Whipbirds. In 2014, 50 camera trapping sites were established to monitor the presence of Malleefowl, Chuditch, Western Brush Wallabies, cats and foxes.

1.3 Project objectives and scope of works

Using the established trapping sites, a fourth annual survey for Heath Rat, Western Mouse, Southern Brown Bandicoot, Chuditch and Western Whipbirds was undertaken in 2016. Camera traps were deployed at sites established in 2014 to survey for Malleefowl, Chuditch, Western Brush Wallabies, cats and foxes. For the first time in 2016, baited wire cage traps were deployed to specifically catch feral cats.

2 METHODS

Terrestrial Ecosystems (2013) outlined the rationale for the trapping program and Whipbird observations. This report recommended the use of camera traps to record the presence of Malleefowl, Chuditch, Western Brush Wallaby, cats and foxes in the project area. This recommendation was implemented in 2014, 2015 and 2016.

2.1 Survey sites

Five hundred aluminium box traps (10 x 10 x 33cm) and 100 wire cage traps (20 x 20 x 56cm) were set at multiple locations in a variety of habitat types and in areas with two fire histories (Plate 1; Appendix A). Figures 2a-j indicate the location of all trapping sites. Fifty camera traps (Reconyx HC500) were deployed in some of the trapping sites and in the two areas where Coffey Environments (2010) recorded Chuditch (Appendix A).

Plate 1. Star picket indicating an aluminium box and a wire cage trap site

Aluminium box traps were baited with universal bait (i.e. a mixture of peanut butter, sardines and rolled oats). Wire cage traps were baited with universal bait and a chicken neck. Because of bait theft by Australian Ravens and Currawong, chicken necks were wired into cage traps. Baits were replenished if taken and on day three of the survey.

2.2 Cameras

Fifty camera traps were deployed as follows:

- Trapping site A (east) – 3 cameras
- Trapping site A (west) – 3 cameras
- Trapping site D – 9 cameras
- Trapping site E – 10 cameras
- Trapping site F – 5 cameras
- Coffey Environments' (2010) Chuditch trapping site on the 'hill' – 10 cameras
- Trapping site G (Coffey Environments' (2010) Chuditch trapping site in the 'gully') – 10 cameras

Non-reward bait pods (Plate 2) contained a bolus of universal bait topped up with mullie oil before they were partially buried into the ground and secured with a metal stake. Cameras were mounted on a star picket (Plate 3) 2-4m from the bait pod and directed to capture images of fauna moving through the area or attracted to the non-reward bait lure.

Plate 2. Bait pod secured in the ground

Plate 3. Camera trap attached to a star picket

2.3 Western Whipbird observations

Ten Western Whipbird monitoring sites used in 2014 and 2015 were revisited. Surveys for Western Whipbirds were conducted within a two hour period following sunrise using the following protocol:

- initially listening for a period of 10 minutes;
- if no whipbirds were heard, then the call was played; and
- a further 10 minute listening period was undertaken after the call was played back.

As soon as a Western Whipbird was heard the survey was ended. The call playback was not initiated if a Western Whipbird was heard in the initial 10 minutes of listening. Western Whipbird surveys were undertaken between 13 and 18 September 2016.

Incidental observations of Western Whipbirds calling were also recorded while conducting other work.

2.4 Avian survey

Birds seen or heard while undertaking other tasks were recorded and used to create an avian species list for the project area during the deployment of camera traps, and trapping and collection of cameras (i.e. 12-27 September; and 15-21 November 2016).

2.5 Feral cat trapping

One hundred and nineteen baited wire cage traps (Plate 4) were set on 16/17 November 2016 and closed on 20/21 November 2016. Trap locations are shown in Appendix A (Figures 2i and j). Bait was an opened tin of tuna or sardines and rebaited with chicken necks and sardines.

Plate 4. Baited wire cage trap used to catch cats

2.6 Survey personnel

Five Terrestrial Ecosystems staff were involved in the field survey (Table 6). They were assisted by Nathan Ingate and Darius Hakayobe for the trapping survey and deployment of cameras. The support of on-site RNO environmental staff was much appreciated.

Cameras were deployed between 13 and 18 September 2016 and retrieved between 15 and 18 November 2016. Traps were laid out and opened on 15-16 November 2015. All traps were cleared daily and closed on 20 and 21 November 2016 for five nights of trapping. The report was prepared by Dr Graham Thompson and reviewed by Dr Scott Thompson.

Table 6. Qualifications and experience of Terrestrial Ecosystems survey team

Name	Qualifications	Experienced
Dr Graham Thompson	PhD (Zoology)	> 20 years
Dr Scott Thompson	BSc, MSc, PhD (Env Sci/Man)	> 15 years
Ray Turnbull	B Nat Sc, G.Dip Ornithology	> 7 years
Dr Margot Oorebeek	PhD (Zoology)	> 7 years
Edward Swinhoe	BA	> 5 years
Clare Beckett	BSc (Hons)	1 year

2.7 Weather

Table 7 shows the daily minimum and maximum temperatures and rainfall for the survey period as recorded at the Ravensthorpe weather station.

Table 7. Daily weather data record in the RNO project area

Date	Min. Temp. ^{o}C	Max. Temp. ^{o}C	Rainfall (mm)
14/11/2016	10	33	0
15/11/2016	18	38	0
16/11/2016	17	28	4
17/11/2016	10	20	16.5
18/11/2016	7.5	27.2	0
19/11/2016	12.2	35.8	0
20/11/2016	13.2	20	0
21/11/2016	5	21	0

2.8 Limitations

The weather was suitable for trapping and was generally warmer than in previous surveys, as the survey period was undertaken later in the year.

Terrestrial Ecosystems has not been able to verify the data from previous surveys undertaken by other consultants and is therefore not able to vouch for the accuracy of these records. All of these sources of data are known to contain errors, and this should be taken into account when reading this document.

Australia Ravens and Currawongs disturbed some of the aluminium box traps by taking the bait and removing the trap pins. Where possible, traps were rebaited late in the day, however, some traps would have been ineffective on some nights.

The EPA *Guidance for Assessment of Environmental Factors: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, No. 56* (2004) suggested that fauna surveys may be limited by many variables. Limitations associated with each of these variables are assessed in Table 8.

Table 8. Fauna assessment limitations and constraints

Possible limitations	Constraint (yes/no); significant, moderate or negligible	Comment
Competency and experience of the consultant carrying out this assessment	No	The zoologists that undertook the field survey and prepared this monitoring report are familiar with the vertebrate fauna of this bioregion, have completed the previous 3 years of surveys and are experienced in these types of surveys.
Scope	No	All aspects of the scope of works have been addressed.
Proportion of fauna identified, recorded and/or collected	No	Not applicable.
Accuracy of previous survey work	Yes, negligible	Terrestrial Ecosystems has reported fauna survey data recorded by various authors, but is not in a position to vouch for the accuracy of this information. It is acknowledged that the taxonomy of Western Australian vertebrates is continually being revised and the nomenclature of some previous captures may have changed since publication by the authors.
Sources of information	Yes, negligible	Vertebrate fauna information was available from unpublished and published reports of surveys conducted on site over a period of time. Many of these surveys employed a low level of trapping effort which significantly impacts on the capacity of these data to represent the fauna assemblages in the areas surveyed.
Timing/weather/ season/ cycle	No	Weather was suitable for a survey.
Disturbances which affected results of the survey	No	Ravens and Currawongs reduced the effectiveness of the aluminium box trapping, but this would not have significantly impacted the results. This level of disturbance has been taken into account in this assessment.
Intensity of survey effort	No	The survey effort is consistent with previous years, with the addition of 119 cat traps.
Resources	No	Adequate resources were available.
Remoteness and/or access problems	Yes, negligible	Access was not a significant limitation or constraint.
Availability of contextual information on the region	No	There is a reasonable quantity of historical fauna survey data available for this project area.

Negligible = less than 20%.

3 RESULTS

3.1 Aluminium box and cage trap captures

Trapping sites used in 2014 and 2015 remained unchanged for 2016, but an additional 119 baited wire cage traps targeting feral cats were also deployed.

Appendix B contains the complete list of vertebrate fauna caught and the location for each capture. Table 9 provides a summary of the number of individuals caught in the trapping program for each species across all sites.

Table 9. Number of individuals caught for each species

Taxa	Species	Common Name	Number caught
Amphibian	*Litoria cyclorhyncha*		1
Birds	*Corvus coronoides*	Australian Raven	2
	Strepera versicolor	Grey Currawong	1
Mammals	*Dasyurus geoffroii*	Chuditch	7
	Felis catus	Cat	3
	Rattus fuscipes	Bush rat	4
Reptiles	*Tiliqua occipitalis*	Western Bluetongue	3
	Tiliqua rugosa	Bobtail	68
	Varanus rosenbergi	Heath Monitor	24

3.2 Camera traps

Vertebrate fauna have been recorded for each camera trap and the data grouped by sites on a 'presence only' basis (Tables 10 and 11). Where possible we have provided an indicative number or minimum number of individuals present (i.e. based on colour patterns or number of individuals in one image), however this is not an accurate count. Australian Ravens, cats, echidna, Western Brush Wallabies, Brush Bronzewings were recorded at all sites (Table 12) and foxes were present in six of the seven sites. Of interest, Chuditch were recorded at sites A (east), D, E, G and on the hill (Table 12). Malleefowl were recorded at Site A (east and west), D, E, G and the hill. Unidentified rodents were recorded at fewer sites and less frequently than in 2014.

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Table 10. Fauna present as recorded on cameras at five trapping sites

	Sites	Site A - west			Site A - east			Site D									Site E										Site F				
	Camera N°	1	46	50	3	12	38	4	6	14	17	20	29	36	39	44	2	11	25	26	27	30	33	34	48	49	5	10	22	35	40
Accipiter fasciatus	Brown Goshawk	1																													
Aquila audax	Wedge-tailed Eagle																													2	
Corvus coronoides	Australian Raven	2+	1+	1+	4	7	1+	1+	1+	2+	1+	1+	3+	3+	3+	1+	11	1+	1+	1+	1+	2+	1+	1+	1+	2+	2+		1+	1+	3+
Dromaius novaehollandiae	Emu	22+	19+	24+	32	33	18+	2+	7+	1+	6+	4+	6+	5+	2+	6+	66	15+	24+	16+	18+	15+	12+	10+	13+	13+	17+	18+	28+	12+	34+
Drymodes brunneopygia	Southern Scrub-Robin													2	1																
Falco cenchroides	Nankeen Kestrel					1																									
Hylacola cauta	Shy Heathwren	1																													
Leipoa ocellata	Malleefowl		1	2	3	2	1		1	1	1				1+						1										
Ocyphaps lophotes	Crested Pigeon						2																								
Phaps chalcoptera	Common Bronzewing	1	1											1																	
Phaps elegans	Brush Bronzewing				1	1	2+						1							2+	1			1		1	2+				1
Phylidonyris novaehollandiae	New Holland Honeyeater	1	1																												
Rhipidura leucophrys	Willie Wagtail																													1	
Strepera versicolor	Grey Currawong	1	1+	1+				1+	1	1+	1		1+	1+	1+	1+											1+	1	1		1+
Dasyurus geoffroii	Chuditch				2	2	1	2	3	3	1+	1+	2+	2+	2	2+	1				1										
Felis catus	Feral Cat	4+	4	3+	7	5	1	1+	1+	2+	1+	1	2+	1+	1+	2+	1	1	1	1	2	1		1	1	1	3+	2	3+	1	2+
Macropus fuliginosus	Western Grey Kangaroo	2+	2+	2+	8	4	2+	5+	2+	1+	3+	4+	1+	1+	1	2+	18	4+	1+	4+	4+	3+	2+	3+	6+	3+	3+	4+	8+	4+	8+
Mus / Rattus sp.	Unidentifed Mouse/Rat																														
Notamacropus irma	Western Brush Wallaby	2+	2+	1+	6	7	3+	2+	1+	1	3+	3+	1+	2+	2+	1+	8		2+	4+	4+	2+	1+	3+	3+	2+	1	1+	2+	1+	1
Oryctolagus cuniculus	Rabbit																										1+		1		1+
Tachyglossus aculeatus	Echidna	1						1+	1+		1	1	2	1+	1+	1						1				1	1			1	1
Vulpes vulpes	Red Fox				1	1	1	1	1	1+	1		1			1+		1			1				1	1	2+	1+	1+		2+
Tiliqua occipitalis	Western Bluetongue							1																							
Tiliqua rugosa	Bobtail							1				2+			1+									2			1+				
Varanus rosenbergi	Heath Monitor														1+												1				

Table 11. Fauna present as recorded on cameras at the two sites trapping sites

	Sites	Site G										Hill									
	Camera N°	8	13	15	18	19	24	28	32	37	42	7	9	16	21	23	31	41	43	45	47
Anthochaera carunculata	Red Wattlebird														1						1
Anthochaera lunulata	Western Wattlebird														1		1				1+
Aquila audax	Wedge-tailed Eagle																				
Corvus coronoides	Australian Raven	1+	1+	1+	1+	2+	2+	2+	2+	2+	2+	1+	1+	1+	1+	1+	1+	1+	1+	1+	1+
Cracticus torquatus	Grey Butcherbird																				1
Dromaius novaehollandiae	Emu	10+	4+	2+	4	3+	12+	4+	14+	6+	5+										
Drymodes brunneopygia	Southern Scrub-Robin																1	1			
Gliciphila melanops	Tawny-crowned Honeyeater			1																	
Leipoa ocellata	Malleefowl	1+	1+	1+		1	1+	1	1	1	1								1		
Malurus sp.	Fairywren sp.																			1	
Phaps chalcoptera	Common Bronzewing	1+	1		1	1+		1		1											
Phaps elegans	Brush Bronzewing	1+		1+		1	1	2+		2+	1					1	1+		1+	1+	1+
Phylidonyris novaehollandiae	New Holland Honeyeater											1			1		1				1
Pomatostomus superciliosus	White-browed Babbler														1				1		
Sericornis frontalis	White-browed Scrubwren														1		2+	1			
Strepera versicolor	Grey Currawong	2+	3+	1+	1+	3+	1+	2+	1+	2+	1+							1+			1+
Turnix varius	Painted Button-quail		1+	1		2															
Dasyurus geoffroii	Chuditch	1										2	1+	2	1	2+	2	3	2+	2	3
Felis catus	Feral Cat	1		1+	1+	1	2	1	1						1	1	1	1			1
Macropus fuliginosus	Western Grey Kangaroo	6+	1+	1+	4+	3+	5+	5+	6+	4+	3+										1
Mus / Rattus sp.	Unidentifed Mouse/Rat	1										1+	1+	1	2+	1+	1+	1+	1+	1+	1+
Notamacropus irma	Western Brush Wallaby	2+		1	3+		3+		3+		3+				2+						3+
Tachyglossus aculeatus	Echidna	1	1	1								2	1		1+	1+	1+	1+	1+	1+	2+
Trichosurus vulpecula	Common Brushtail Possum														1	1					1
Vulpes vulpes	Red Fox			1+	1+	1		1													
Notechis scutatus	Tiger Snake															1					
Pseudonaja affinis	Dugite																			1	
Tiliqua occipitalis	Western Bluetongue																1				
Tiliqua rugosa	Bobtail			2+		2+	1	1	1+	2	2				1+	1+	1			1	2+
Varanus rosenbergi	Heath Monitor	1		1					1			1			1+	1	1			1	1

Table 12. Species recorded by camera traps in 2014, 2015 and 2016

	Trapping sites	Site A - east			Site A - west			Site D			Site E			Site F			Hill			Gully		
Species	Year	2014	2015	2016	2014	2015	2016	2014	2015	2016	2014	2015	2016	2014	2015	2016	2014	2015	2016	2014	2015	2016
Leipoa ocellata	Malleefowl			X	X		X			X			X						X	X		X
Dasycercus geoffroii	Chuditch			X					X	X			X		X			X	X		X	X
Felis catus	Feral Cat	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Macropus fuliginosus	Western Grey Kangaroo	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X
Macropus irma	Western Brush Wallaby	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Mus/Rattus sp.	Unidentifed Mouse/Rat				X			X		X	X				X	X	X	X	X	X	X	X
Oryctolagus cuniculus	Rabbit								X					X	X	X	X		X			
Tachyglossus aculeatus	Echidna	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Vulpes vulpes	Red Fox	X	X	X	X	X		X	X	X	X	X	X	X	X	X				X	X	X

Plate 5. Feral Cat

Plate 6. Chuditch

Plate 7. Western Grey Kangaroo

Plate 8. Western Brush Wallaby

Plate 9. Fox

Plate 10. Snake

Plate 11. Malleefowl

Plate 12. Echidna

3.3 Western Whipbirds

Surveys for Western Whipbirds were conducted between 12 and 14 September 2016 using the protocol described earlier and the results shown in the Table 13. A detailed account of any incidental observation is also provided. Western Whipbirds were recorded at eight of the 10 monitoring sites and as an incidental observation.

Table 13. Western Whipbird observations

Site	Findings
WW-1	Surveyed on 13-09-2016 (0741-0759). At 0759 a whipbird was heard calling 25m east of the site after the call playback was initiated. The bird was observed crossing the track.
WW-2	Surveyed on 13-09-2016 (0717-0726). A whipbird was heard calling at 0726 200m south east of the site.
WW-3	Surveyed on 13-09-2016 (0624-0635). A whipbird was heard calling at 0635 300m to the east just after the call playback was initiated. Surveyed again on 16-09-2016 (0738-0753). A probable whipbird was heard calling 100m south of the site after the call was played.
WW-4	Surveyed on 13-09-2016 (0613-0614). A whipbird was heard calling at 0614 about 100m to the east during the initial listening period.
WW-5	Surveyed on 14-09-2016 (0616-0636). No whipbirds recorded. Surveyed again on 26-09-2016 (0604-0624). No whipbirds recorded.
WW-6	Surveyed on 14-09-2016 (0645-0705). A whipbird was heard calling 100m west of the site during the initial listening period.
WW-8	Surveyed on 12-09-2016 (0605-0625). No whipbirds recorded. Whipbird heard calling at 0821 100m west of the site whilst installing camera traps on the same morning confirming their presence at this site.
WW-9	Surveyed on 12-09-2016 (0632-0652). No whipbirds recorded. Surveyed again on 17-09-2016 (0629-0632). A whipbird was heard calling 200m south-west of the site during the initial listening period.
WW-10	Surveyed on 12-09-2016 (0706-0726). No whipbirds recorded. Surveyed again on 17-09-2016 (0701-0702). No whipbirds recorded.
WW-11	Surveyed on 13-09-2016 (0643-0703). No whipbirds recorded. Surveyed again on 16-09-2016 (0724-0729). At 0729 a whipbird was heard calling 200m west of the site

Incidental Western Whipbird observations

13-09-2016

- At 0836 two whipbirds were heard calling simultaneously either side of the track, approximately 25m in, at D30 whilst installing camera traps (UTM 256636E, 6272529N).
- At 0850 a whipbird was heard calling 50m south of the track at D50 (UTM 256546E, 6272486N) whilst installing camera traps. Possibly one of the birds from above.
- At 0955 a whipbird was heard calling 100m south of the track (UTM 256155E, 6272292N).
- At 1355 a whipbird was heard calling 50m east of CM 51 (UTM 258184E, 6272359N) whilst installing camera traps.

17-09-2016

- At 0747 a whipbird was heard calling 100m east of WW-8 (UTM 251905E, 6280559N).

18-09-2016

- At 0840 a whipbird was heard calling 150m north-east of H132 (UTM 257833E, 6278668N) in the creek line.

21-09-2016

- At 0605 a whipbird was heard calling at Shoemaker Levy bag laydown (UTM 252133E, 6280559N).

22-09-2016

- At 0610 a whipbird was heard calling at Shoemaker Levy bag laydown (UTM 252133E, 6280559N).
- At 0759 a whipbird was heard calling in the creek line in the infrastructure corridor (UTM 2578778E, 6278457N).
- At 1414 a whipbird was heard calling on line 3 in the Hale-Bopp north-west pit area (UTM 258126E, 62772343).

3.4 Malleefowl

Malleefowl were recorded by camera traps at sites A (east and west), D, E, G and on the hill.

3.5 Western Brush Wallaby

Images were obtained of Western Brush Wallabies (*Macropus irma*) at all sites (Table 10 and 11).

3.6 Avian survey results

Fifty three species of birds were recorded during the fauna monitoring program (Table 14).

Table 14. Birds recorded during the fauna monitoring program

Family	Species	Common Name
Casuariidae	*Dromaius novaehollandiae*	Emu
Columbidae	*Phaps elegans*	Brush Bronzewing
	Phaps chalcoptera	Common Bronzewing
	Ocyphaps lophotes	Crested Pigeon
Accipitridae	*Aquila audax*	Wedge-tailed Eagle
	Accipiter fasciatus	Brown Goshawk
Falconidae	*Falco cenchroides*	Nankeen Kestrel
	Falco berigora	Brown Falcon
Turnicidae	*Turnix varius*	Painted Button-quail
Cacatuidae	*Calyptorhynchus latirostris*	Carnaby's Black-Cockatoo
	Eolophus roseicapillus	Galah
Psittacidae	*Glossopsitta porphyrocephala*	Purple-crowned Lorikeet
	Barnardius zonarius	Australian Ringneck
	Purpureicephalus spurius	Red-capped Parrot
Cuculidae	*Chalcites basalis*	Horsfield's Bronze-Cuckoo
	Cacomantis flabelliformis	Fan-tailed Cuckoo
Maluridae	*Malurus splendens*	Splendid Fairywren
	Malurus pulcherrimus	Blue-breasted Fairywren
	Stipiturus malachurus	Southern Emu-wren
Acanthizidae	*Sericornis frontalis*	White-browed Scrubwren
	Hylacola cauta	Shy Heathwren
	Smicrornis brevirostris	Weebill
	Acanthiza apicalis	Inland Thornbill
Pardalotidae	*Pardalotus punctatus*	Spotted Pardalote
	Pardalotus striatus	Striated Pardalote
Meliphagidae	*Lichenostomus leucotis*	White-eared Honeyeater
	Lichenostomus cratitius	Purple-gaped Honeyeater
	Manorina flavigula	Yellow-throated Miner
	Anthochaera lunulata	Western Wattlebird
	Anthochaera carunculata	Red Wattlebird
	Glyciphila melanops	Tawny-crowned Honeyeater
	Lichmera indistincta	Brown Honeyeater
	Phylidonyris novaehollandiae	New Holland Honeyeater
	Phylidonyris niger	White-cheeked Honeyeater
	Melithreptus brevirostris	Brown-headed Honeyeater
Pomatostomidae	*Pomatostomus superciliosus*	White-browed Babbler
Eupetidae	*Psophodes nigrogularis*	Western Whipbird
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike
Pachycephalidae	*Pachycephala pectoralis*	Golden Whistler
	Colluricincla harmonica	Grey Shrike-thrush
	Oreoica gutturalis	Crested Bellbird
Artamidae	*Artamus cinereus*	Black-faced Woodswallow
	Cracticus torquatus	Grey Butcherbird
	Cracticus tibicen	Australian Magpie
	Strepera versicolor	Grey Currawong
Rhipiduridae	*Rhipidura leucophrys*	Willie Wagtail
Corvidae	*Corvus coronoides*	Australian Raven

Family	Species	Common Name
Monarchidae	*Grallina cyanoleuca*	Magpie-lark
Petroicidae	*Drymodes brunneopygia*	Southern Scrub-robin
Timaliidae	*Zosterops lateralis*	Silvereye
Hirundinidae	*Hirundo neoxena*	Welcome Swallow
	Petrochelidon nigricans	Tree Martin

4 DISCUSSION

4.1 Western Whipbirds

Western Whipbirds were recorded at eight of the 10 monitoring sites (Table 13). Western Whipbirds were heard calling at similar locations to previous surveys by Chapman (2000), Coffey Environments (2009), Biota Environmental Sciences (2000, 2005) and Terrestrial Ecosystems (2013, 2014, 2015). Chapman (2000) reported Western Whipbirds at 10 sites and Biota Environmental Sciences (2000, 2005) reported Western Whipbirds at 10 and 3 sites in 2000 and 2005 respectively and Chapman, working for Coffey Environments, again recorded Western Whipbirds at three sites in 2009 (Table 15). Western Whipbirds therefore appear to be relatively abundant in the undisturbed and recently unburnt areas adjacent to the mining operations.

Table 15. Record of conservation significant species in recent surveys

Species Year	99/00	2000	2005	2009	2010	2013	2014	2015	2016
Western Whipbirds (sites)	10	10	3	3		10	8 sites	8 sites	8 sites
Malleefowl	4	2	-	-	1	-	2	-	5 sites
Western Mouse	17	2	4	-	2	-	-	-	-
Heath Rat	2	1	-	-	1	-	-	-	-
Southern Brown Bandicoot	1	-	-	1	-	-	-	-	-
Chuditch	-	-	-	-	10	-	-	5 sites	5 sites

4.2 Mammals

No Western Mice, Heath Rats or Southern Brown Bandicoots were caught or observed in the 2016 monitoring survey. House Mice, Mitchell's Hopping Mice and Ash Grey Mice were caught in 2014 but were not caught in 2015 and 2016, and the number of Bush Rats caught has decreased again from 16 in 2013 to 6 in 2014, 1 in 2015 to 4 in 2016 (Table 16). One cat was caught in 2013, three cats were caught in 2014, two cats were caught in 2015 and three cats were caught in 2016 with the addition of 119 traps to specifically target cats. Cats were visually recorded on cameras at all sites and foxes at six of seven sites. This is the same as for 2014, 2015 and 2016. The fox has been absent from the hill site for all camera trapping surveys and site has an abundance of mice or rats and echidnas.

In 2015 images of Chuditch were recorded by cameras at sites D20, D40, D70, D80, D90, F21, F25, seven of the cameras on the hill and one of the cameras at site G and in 2016 at sites Site A (east), D, E, G and 10 sites on the hill. These data indicate an increase in the number of Chuditch in the project area as they had not previously been recorded at site A. Chuditch were also caught in traps set to cat cats at trap 25 (near site A - east), 82, 95, 96 and 98 (Mason Bay Road).

Table 16. Comparison of the number of mammals caught in the 2013, 2104, 2015 and 2016 monitoring surveys

Species	Common Name	2013	2014	2015	2016
Felis catus	Cat	1	3	2	3
Mus musculus	House Mouse	5	5	-	-
Notomys mitchellii	Mitchell's Hopping Mouse	2	1	-	-
Pseudomys albocinereus	Ash Grey Mouse	1	1	-	-
Rattus fuscipes	Bush Rat	16	6	1	4
Sminthopsis griseoventer	Grey-bellied Dunnart	1	-	-	-
Tachyglossus aculeatus	Echidna	1	-	-	-

Given the trapping effort (i.e. 2,500 aluminium trap nights, 500 small wire cage trap nights and 400 large wire cage trap nights) the number of mammals caught is very low, and is progressively decreasing.

Except for Chuditch, a reduction in the number of conservation significant species below the detectable minimum level could be a valid reason for not catching any of these animals. It is interesting to note that Chapman (2000) recorded 17 Western Mice and six Heath Rats, Biota Environmental Sciences (2000, 2005) caught two Western Mice and one Heath Rat in 2000, and four Western Mice in 2005, Coffey Environments

caught no Western Mice or Heath Rats in 2009 and two Western Mice and one Heath Rat in 2010. Terrestrial Ecosystems (2013, 2014, 2015) caught no conservation significant mammals during the three monitoring surveys in 2013, 2014 and 2015. Chuditch had been seen in the project area before the first capture in 2010, but had not previously been caught. In total, seven Chuditch were caught in baited wire cage traps in 2016 set to catch cats, of these four were new individuals, and the others recaptures. Only two Southern Brown Bandicoots have been caught, one in 2000 and the other in 2009 and they have not subsequently been recorded in Terrestrial Ecosystems monitoring surveys.

Cooper et al. (2003) reported the Heath Rat in Western Australia to have a preference for long-unburnt areas (30-70 years) which contrasts with the same species in Victoria that has a preference for post-fire regrowth (Cockburn et al. 1981). Heath Rats are either rare across its range or difficult to trap. For example, Cooper et al. (2003) cited survey work in the Fitzgerald Biosphere Reserve between 1993 and 2001, with 77 captures from 11 sites from 4,460 aluminium box trap-nights and 1,494 pit trap-nights.

4.2.1 Trapping effort

The total trapping effort in 2016 of 2,500 aluminium box trap-nights and 500 cage trap-nights, plus 476 trap nights for cats significantly exceeds the trapping effort of Chapman (2000) and Biota Environmental Sciences (2000, 2005) and is comparable with Coffey Environments (2009, 2010) 1,680 aluminium box trap-nights and 560 cage trap nights in 2009 and 2,520 aluminium box trap-nights and 420 cage trap-nights in 2010 (Table 17 and 18). It appears as if the trapping effort was adequate and it is not the reason for the lack of captures of conservation significant fauna.

Table 17. Trapping effort for the Coffey Environment (2009)

Sites or Habitat Type	Site Code	No Sites	Trap Type				
			Bucket pit-trap nights	Pipe pit-trap nights	Funnel trap nights	Elliott trap nights	Cage traps
Heath on sand/laterite	H	5	420	420	840	420	140
Creek lines with dense vegetation	CK	5	420	420	840	420	140
Regrowth mallee on sand/rock/lateritic rock	ML	5	420	420	840	420	140
Mallee on sand/rock/lateritic rock	M	5	420	420	840	420	140
Total		20	1,680	1,680	3,360	1,680	560
Conservation significant fauna							
Heath Rat							
Western Mouse							
Southern Brown Bandicoot							1
Chuditch							

Table 18. Trapping effort for the Coffey Environment (2010)

Sites or Habitat Type	Site Code	No Sites	Trap Type				
			Bucket pit-trap nights	Pipe pit-trap nights	Funnel trap nights	Elliott trap nights	Cage traps
Heath on sand/laterite	H	5	420	420	840	420	
Creek lines with dense vegetation	CK	5	420	420	840	420	
Regrowth mallee on sand/rock/lateritic rock	ML	5	420	420	840	420	
Mallee on sand/rock/lateritic rock	M	5	420	420	840	420	
	N	10	798	798	1,680	840	
	Cages	4					420
Total		20	2,478	2,478	5,040	2,520	420
Conservation significant fauna							
Heath Rat				1			
Western Mouse				2			
Southern Brown Bandicoot							
Chuditch							10

Terrestrial Ecosystems monitoring program has used the same number of traps (excluding those specifically targeting cats) in the same location for the past four years, and there has been a steady decline in the number of small native mammals caught and observed.

4.2.2 Trap locations

Trapping locations were selected based on where Western Mice, Heath Rats, Chuditch and Southern Brown Bandicoots had been previously caught.

4.2.3 Bait

The universal bait used to trap the Western Mouse and Heath Rat is widely used and there is no evidence to indicate that it was unsuitable (Cockburn 1978, Quinlan et al. 2004). Wayne et al. (2008) concluded that chicken frames were superior to the universal bait for Chuditch, and Terrestrial Ecosystems routinely uses white bread and peanut butter to trap Southern Brown Bandicoots. Paull et al. (2011) compared three bait types for attracting small mammals to cameras: peanut butter with rolled oats, black truffle oil and live mealworms in bran. Overall, they concluded that peanut butter and rolled oats was a significantly superior bait type for *Antechinus*, *Isoodon*, *Perameles* and *Rattus*, relative to a control bait. Chuditch were attracted to bait pods containing sardines, rolled oats, peanut butter and mullie oil. So it does not appear as if the bait used was an issue. The use of tuna and sardines in the wire cage traps targeting feral cats attracted Chuditch, so it maybe that this bait is preferable to the universal bait or chicken necks.

4.2.4 Trap type

It is not known in what trap type the Western Mice and Heath Rats were caught in during the Chapman (2000) and Biota Environmental Sciences (2000, 2005) surveys, however, Coffey Environments caught both species in pipe pit-traps in 2010. Rodents are often targeted using aluminium box traps (Quinlan et al. 2004), however, based on a single survey by Coffey Environments (2010), the non-use of pit-traps may have been a factor in not catching Western Mice and Heath Rats.

4.2.5 Seasonal population fluctuations and fire

As discussed above, Dickman et al. (1999) reported all species of rodents monitored over a period of 7-9 years fluctuated dramatically, from being absent or in low numbers during droughts and erupting after rainfall. If Heath Rats and Western Mice are in low numbers in years when resources are plentiful or after a major wide spread fire, then it might be expected that they would be almost undetectable in years when resources were

limited. Rainfall prior to the 2016 survey had been sufficient for an abundance of native plants to flower, so if this is an indication of the available resources, then resources should not have been a limiting factor.

Much of the project area was significantly impacted by a severe fire in 2003, but this did not affect all areas. This fire might account for a reduction in Malleefowl, Heath Rat and Western Mice in areas that were burnt and adjacent areas. The regeneration of habitat in fire affected areas appears suitable to support all three species, but if source populations are not present, then their numbers will not increase until animals move in from adjacent areas.

Southern Brown Bandicoot numbers can be influenced by predation and a loss of suitable habitat. Coates and Wright (2003), for example, indicated that Southern Brown Bandicoots are susceptible to predation by foxes and cats, both of which are present in the project area.

4.2.6 Predators

When a reduction in the number of Western Mice and Heath Rat is considered in conjunction with a possible decline in Southern Brown Bandicoots this could suggest that predators are having a significant impact. The EPBC Species Profile and Threats Database documentation for the Heath Rat (http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=77) reported habitat loss and fragmentation, inappropriate fires and the cat and fox as significant predators as the primary threats, and for the Malleefowl (http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=934) a loss of vegetation, habitat fragmentation and predation by foxes. The DPaW brochure (http://www.google.com.au/url?sa=t&rct=j&q=&esrc=s&frm=1&source=web&cd=3&ved=0CDYQFjAC&url=http%3A%2F%2Fwww.dec.wa.gov.au%2Fpublications%2Fdoc_download%2F148-western-mouse.html&ei=DyBFUp3rJon8iQfr5IDYAw&usg=AFQjCNEvS7SqONLasg-Machy-NxoyYxk9g&bvm=bv.53217764,d.aGc) on the Western Mouse indicates habitat loss, changed fire regimes and possibly introduced predators are the main threats.

The presence of introduced predators, in particular the cat and fox, were surveyed using camera traps, and cats were recorded at every site and foxes at all but one site. Exploration activity that clears numerous tracks through the relatively dense undergrowth enables both of these two species to have much better access to a greater range of habitats. This access can result in a high level of predation which in turn leads to increased predator numbers.

4.3 Malleefowl

Malleefowl were reported by Chapman (2000) and Biota Environmental Sciences (2000) and a single bird was seen in 2010 by Coffey Environments (2010). The Coffey Environments (2009) and Terrestrial Ecosystems (2013) surveys covered large areas and habitat that was suitable for Malleefowl but they were not seen. The known Malleefowl mounds in the area were destroyed with the development of Halley's pit, waste dumps and tailings storage facilities. These data, although not systematically recorded, would suggest a decline in the number of Malleefowl in the project area that probably coincides with the widespread 2003 fire.

Malleefowl were recorded at two camera locations and on Mason Road during the 2014 survey, they were not recorded during the 2015 survey but were recorded at sites A (east and west), D, E, G and on the hill in 2016. The change between 2014 and 2015 may reflect error variance in observations, but the 2016 data suggests there has been an increase since 2014/15.

4.4 Western Brush Wallaby

Western Brush Wallabies (*Macropus irma*) were recorded at all camera survey sites. At many of these sites they were seen on multiple occasions. Some of these occasions would have been the same individual returning to the area or being recorded on multiple cameras deployed at a site.

4.5 Chuditch

The 50 camera traps did not record Chuditch in 2014, but did at sites D20, D40, D70, D80, D90, F20, F25 and seven of the cameras on the hill and one in site G in 2015. In 2016, Chuditch were recorded at sites D20, D40, D70, D80, D90, F20, F25 and seven of the cameras on the hill and one in site G. They appear to have a resident population on the hill, which moves out past site D and G, with a growing population at site A (east). There were two records for the first time at site E.

Chuditch numbers fluctuate and they are predated on by foxes, however, it is likely that there has been an increase in the local population in the last year as they are now being recorded at new locations.

4.6 Cats and foxes

Cats were recorded by camera traps at all sites and foxes were present in all sites except on the hill where the Chuditch were caught in 2010 (Coffey XXX) and recorded by camera traps in 2015 and 2016. In addition, three cats were caught in traps.

Burbidge (2004), in his book on threatened animals in Western Australia, indicated that the fox was a known predator of Chuditch, Heath Rat and Malleefowl, and the cat is a known threat to the Heath Rat. The national recovery plan for Malleefowl (Benshemesh 2007) records the fox, and to a lesser extent cats and raptors as a major cause of mortality of Malleefowl. Similarly, the national recovery plan for Chuditch lists predation by, and competition from, feral dogs, foxes and feral cats among other factors contributing to its decline.

An effective cat and fox management program should see a significant long-term increase in the malleefowl and Chuditch, and perhaps Southern Brown Bandicoots, Ash Grey Mice, Heath Rat and Western Mouse if residual populations still exist in the area.

Care needs to be exercised in baiting for foxes, as a significant decline in fox numbers could result in an increase in the number of cats (i.e. mesopredator release), which is highly undesirable. Therefore any management program to reduce fox numbers needs to be done in conjunction with a similar program to reduce the cat population. A two stage baiting program is recommended to significantly reduce the population of cats and foxes on the RNO tenements.

Stage 1 is wide scale distribution of buried 1080 baits with a follow up distribution at 2, 4 and approximately 6 week intervals in autumn. Camera traps should be used to monitor bait uptake at selected sites.

Stage 2 is the trial of canid pest ejectors (CPE) and this trial is implemented along established tracks for a period of two years to reduce the number of foxes. Again bait uptake is monitored by the use of camera traps. Canid pest ejectors are an effective tool for delivering 1080 (Marks et al. 1999, Marks et al. 2003). This program should be implemented in autumn and winter when food for cats and foxes is at its lowest level, thus increasing the bait uptake rate.

Burying 1080 meat baits reduces the bait uptake by non-targeted species such as ravens, currawongs and goannas. A well planned and implemented program should have a significant impact on fox numbers; however, it is possible that a reduction in the fox population will result in the increased impact of cats (meso-predator release) on native fauna. It is therefore important that a concurrent cat reduction program is implemented. Two strategies are recommended:

a. baited cage traps are deployed across the RNO tenements; and
b. a shooting program is implemented in the paddocks that surround the mine site.

Given the abundance of cats and foxes currently recorded in the RNO tenements, it is highly likely that similar densities exist in the adjacent area, and an influx of individuals from these areas will occur after the initial removal of some foxes and cats on the RNO tenements. To reduce this influx, it is recommended that a cat and fox shooting program is implemented in the paddocks around the RNO mine site to complement the trapping programs.

5 CONCLUSIONS AND RECOMMENDATIONS

A baseline monitoring program for the Heath Rat, Western Mouse, Southern Brown Bandicoot and Western Whipbirds was established in 2013 and 50 camera traps were deployed during the 2014 survey to establish baseline data that can now be used to monitor changes in the population of Western Brush Wallabies, Malleefowl, Chuditch, cats and foxes. The 2014, 2015 and 2016 survey results provide an indication of the number of mammals in the vicinity of the RNO project area.

The lack of captures for Heath Rat, Southern Brown Bandicoot and Western Mice in the monitoring survey and the recent decline in the number of Ash Grey Mouse, Mitchell's Hopping Mouse and Bush Rat suggests that feral predators are having a significant impact on the small native mammal population.

Cage traps set to catch cats in the Shoemaker-Levy area and along Mason Bay Road indicate that Chuditch are present at numerous locations. The use of large cage traps and different baits (e.g. partially opened tins of tuna and sardines) might have contributed to the number Chuditch images recorded.

Western Whipbirds are present in numerous locations that have not been recently burnt, with calls heard at a similar number of sites to that reported by Chapman (2000) and Terrestrial Ecosystems (2013, 2014, 2015).

The records of Malleefowl in 2016 were a good sign that their population in the project area is stable or increasing. Foxes, and to a lesser extent cats, can predate on Malleefowl, and their abundance is likely to place continual pressure on the survival of the Malleefowl around the mine.

Heath Rats, Southern Brown Bandicoots and Western Mice have not been caught in the 2013, 2014, 2015 and 2016 monitoring surveys, but were caught in some of the earlier surveys (Biota Environmental Sciences 2000, Chapman 2000, Biota Environmental Sciences 2005, Coffey Environments 2009, 2010). The number of House Mice (5 - 2013, 5 - 2014, 0 - 2015, 0 - 2016), Ash Grey Mice (1 - 2013, 1 - 2014, 0 - 2015, 0 - 2016), Bush Rats (16 - 2013, 6 - 2014, 1 - 2015, 6 - 2016) and Grey Bellied Dunnarts (1 - 2013, 0 - 2014, 0 - 2015, 0 - 2016) caught in the monitoring surveys has generally decreased since 2013. The number of small mammals caught in 2,500 baited aluminum box-trap nights (i.e. 4 Bush Rats) during this survey is lower than might have been expected.

Three cats were caught in November 2016. The abundance of feral cats and foxes in the areas monitored would clearly continue to suppress the abundance of small reptiles, mammals and amphibians in the surveyed areas, and would significantly contribute to the decline in Southern Brown Bandicoots, Heath Rats and Western Mice, and would restrict the growth in the number of Malleefowl and Chuditch.

5.1 Recommendation

The low abundance of small mammals caught during the survey is likely to be due, in part, to predation by the abundance of cats and foxes in the project area. Loss of vegetation due to the major fire across some of the RNO tenements in 2003 could also have had an impact in the small mammal population, but the surveys by Coffey Environments (2009, 2010) indicated that small mammals were present in areas that had been burnt approximately eight years earlier, suggesting that this is not a major factor.

Recommendation 1. An effective cat and fox reduction program is developed and implemented for the project area.

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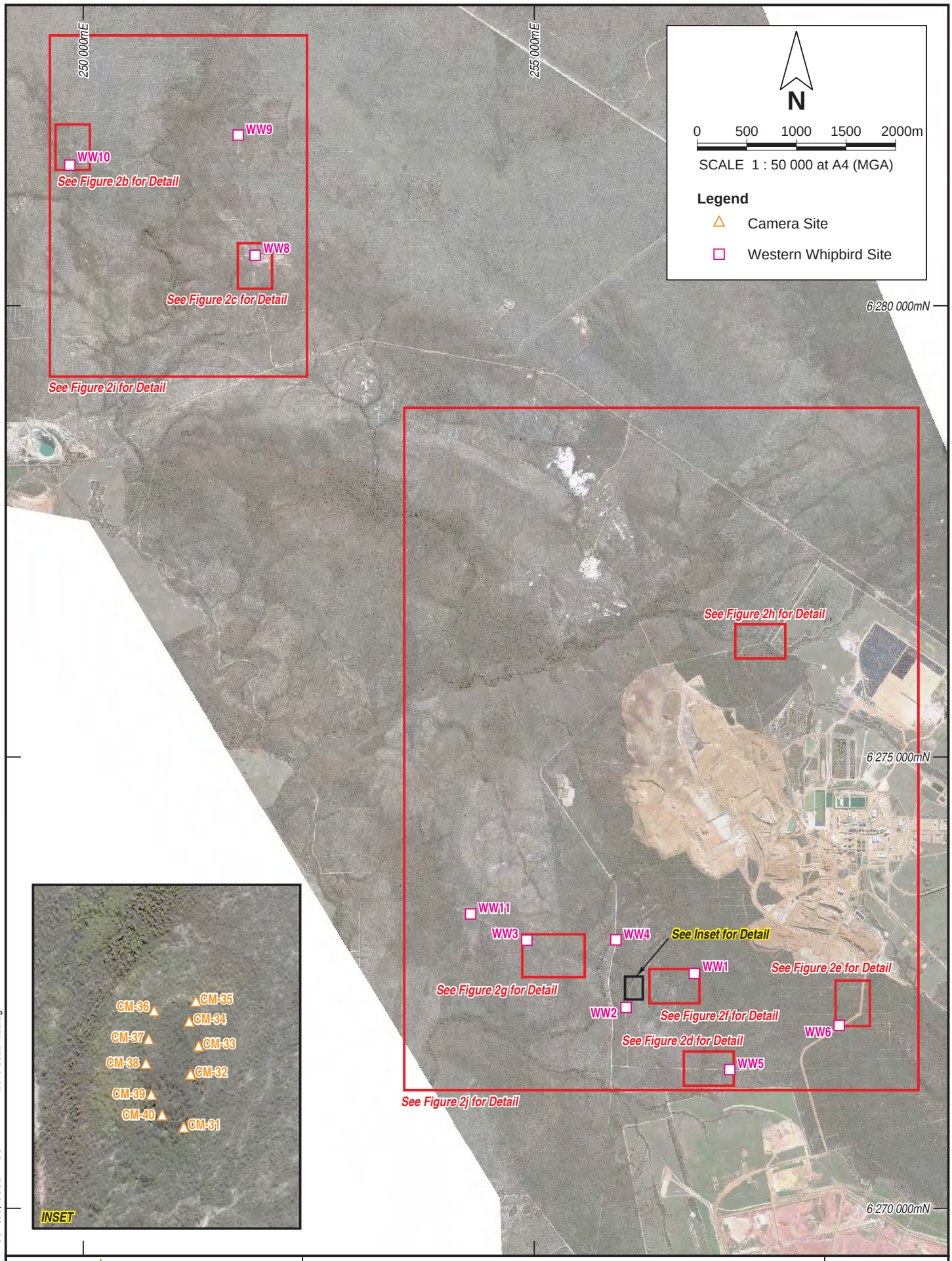
TERRESTRIAL ECOSYSTEMS

FQM Australia Nickel Pty Ltd
CONSERVATION SIGNIFICANT FAUNA SPECIES MONITORING
FOR RAVENSTHORPE NICKEL OPERATION

Figure 1

REGIONAL LOCATION

Drawn: G. Thompson | Date: 24 Oct 2016 | Job: 2016-0022



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TERRESTRIAL ECOSYSTEMS

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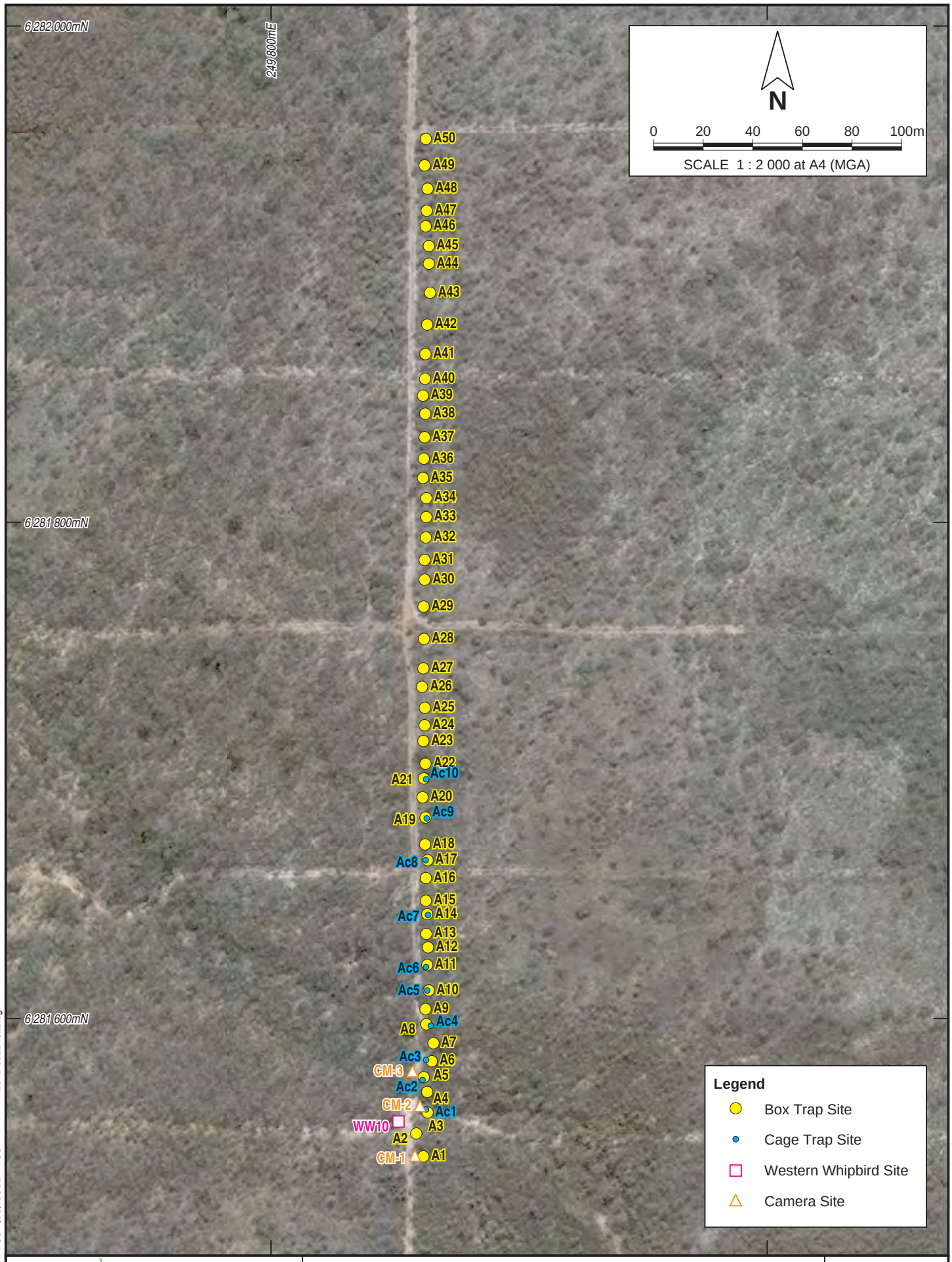
FOR RAVENSTHORPE NICKEL OPERATION

TRAPPING SITES

Figure 2a

Drawn: G. Thompson | Date: 9 Dec 2016 | Job: 2016-0022



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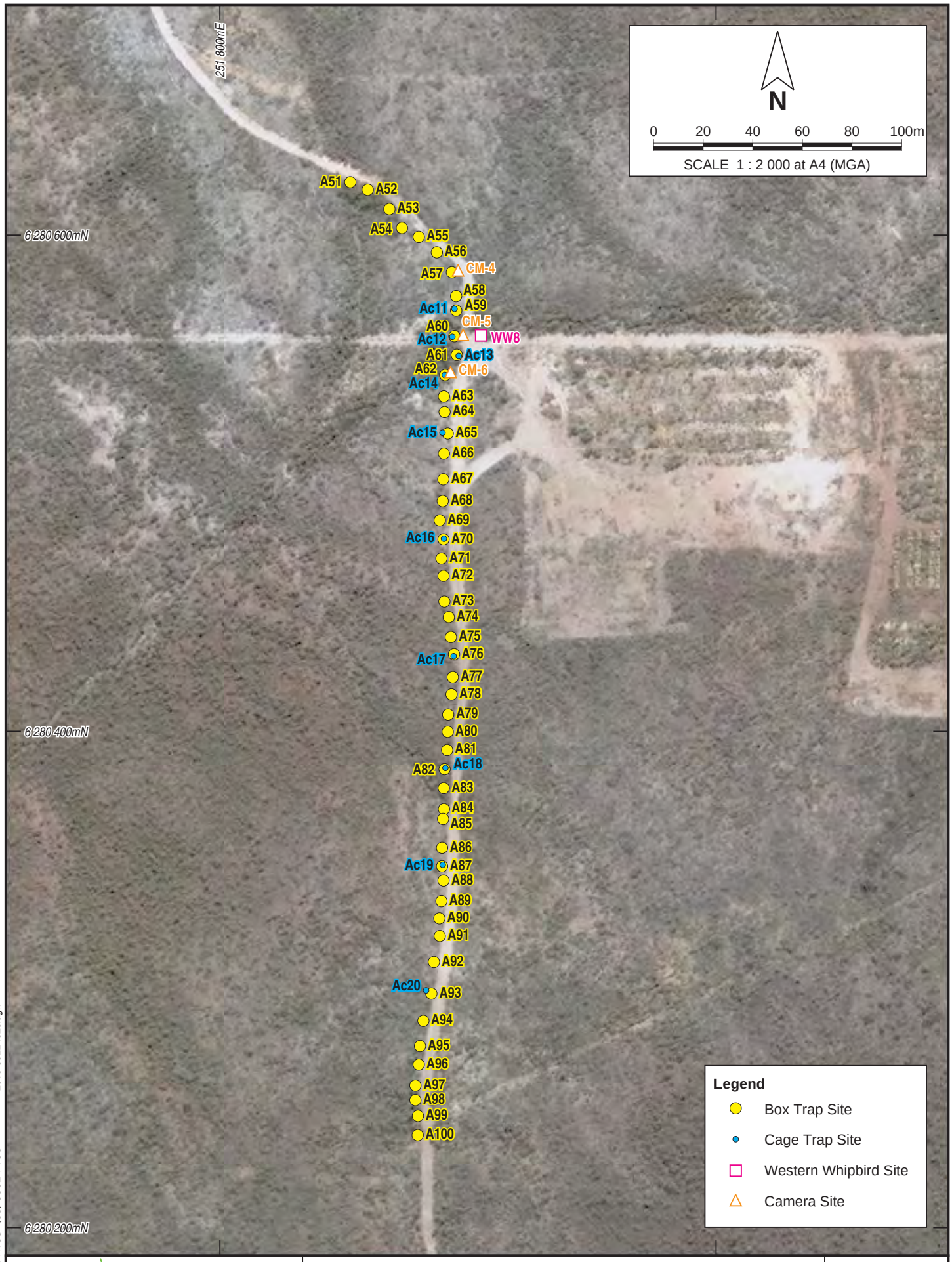
TERRESTRIAL ECOSYSTEMS

FQM Australia Nickel Pty Ltd
CONSERVATION SIGNIFICANT FAUNA SPECIES MONITORING
FOR RAVENSTHORPE NICKEL OPERATION

Figure 2b

TRAPPING SITES

Drawn: G. Thompson | Date: 24 Oct 2016 | Job: 2016-0022



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TERRESTRIAL ECOSYSTEMS

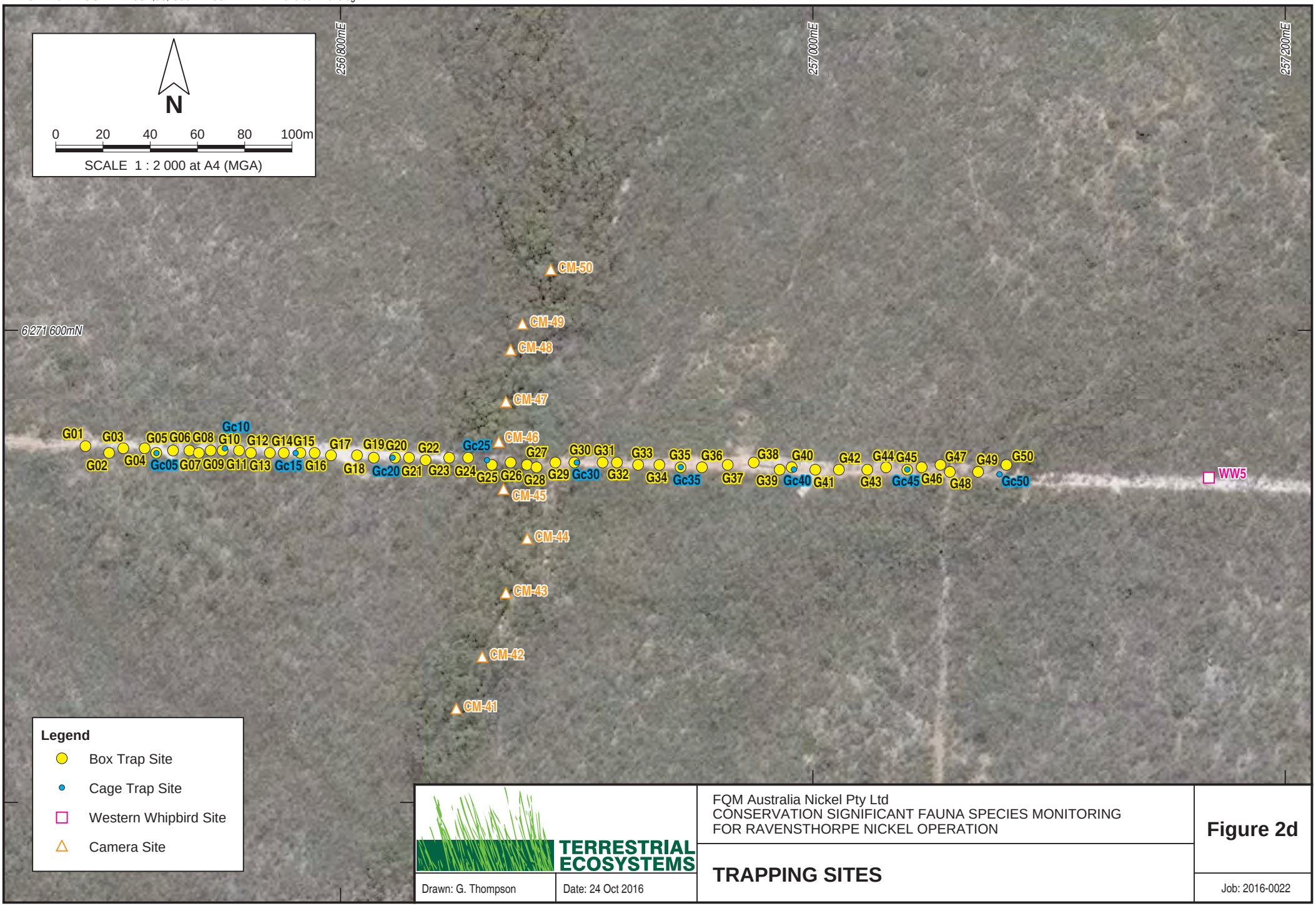
FQM Australia Nickel Pty Ltd
CONSERVATION SIGNIFICANT FAUNA SPECIES MONITORING
FOR RAVENSTHORPE NICKEL OPERATION

TRAPPING SITES

Figure 2c

Drawn: G. Thompson | Date: 24 Oct 2016 | Job: 2016-0022

PINPOINT CARTOGRAPHICS (08) 9562 7136 2016-0022-f02d.dgn



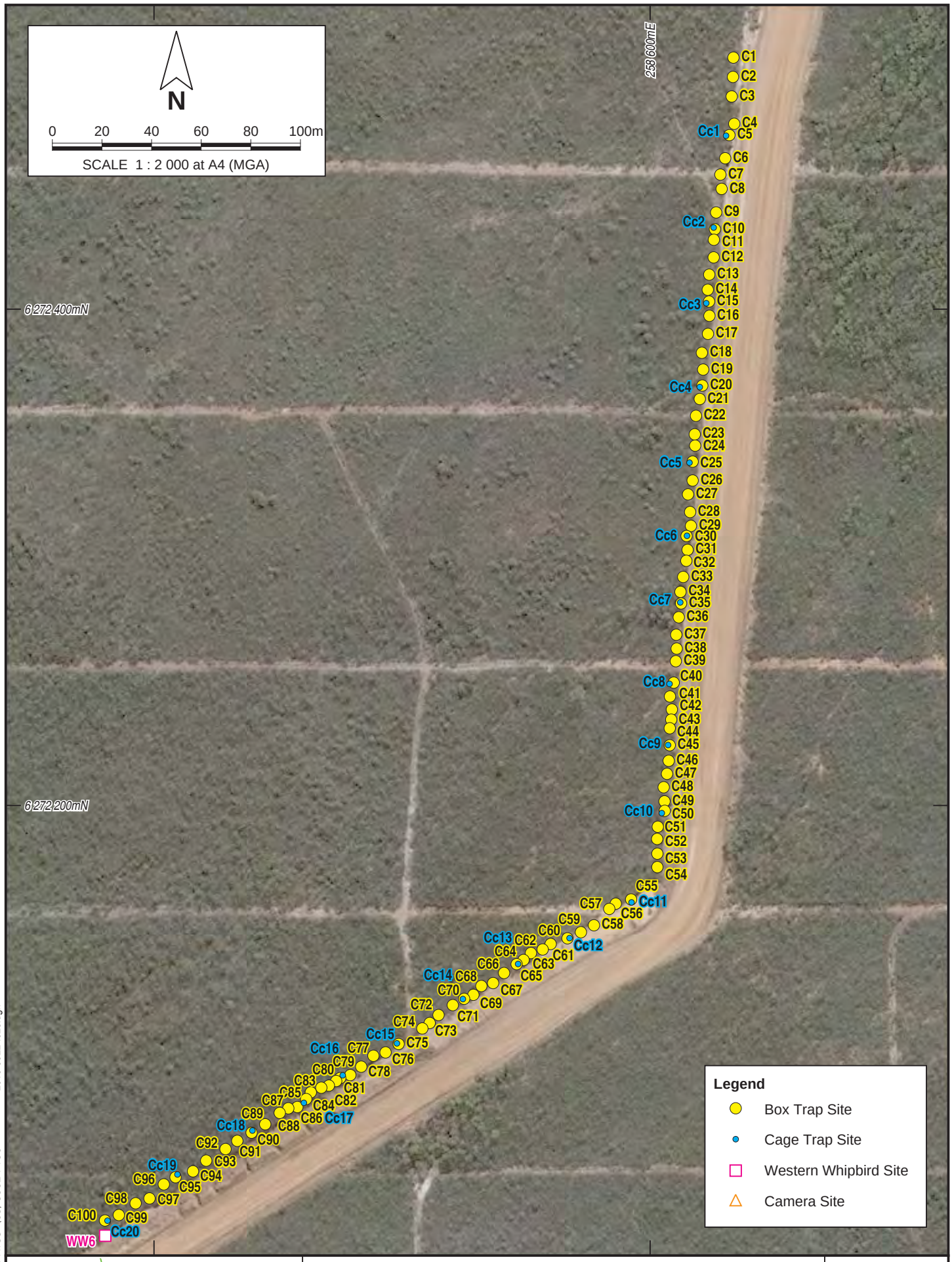
TERRESTRIAL ECOSYSTEMS

FQM Australia Nickel Pty Ltd
CONSERVATION SIGNIFICANT FAUNA SPECIES MONITORING
FOR RAVENSTHORPE NICKEL OPERATION

TRAPPING SITES

Figure 2d

Drawn: G. Thompson | Date: 24 Oct 2016 | Job: 2016-0022



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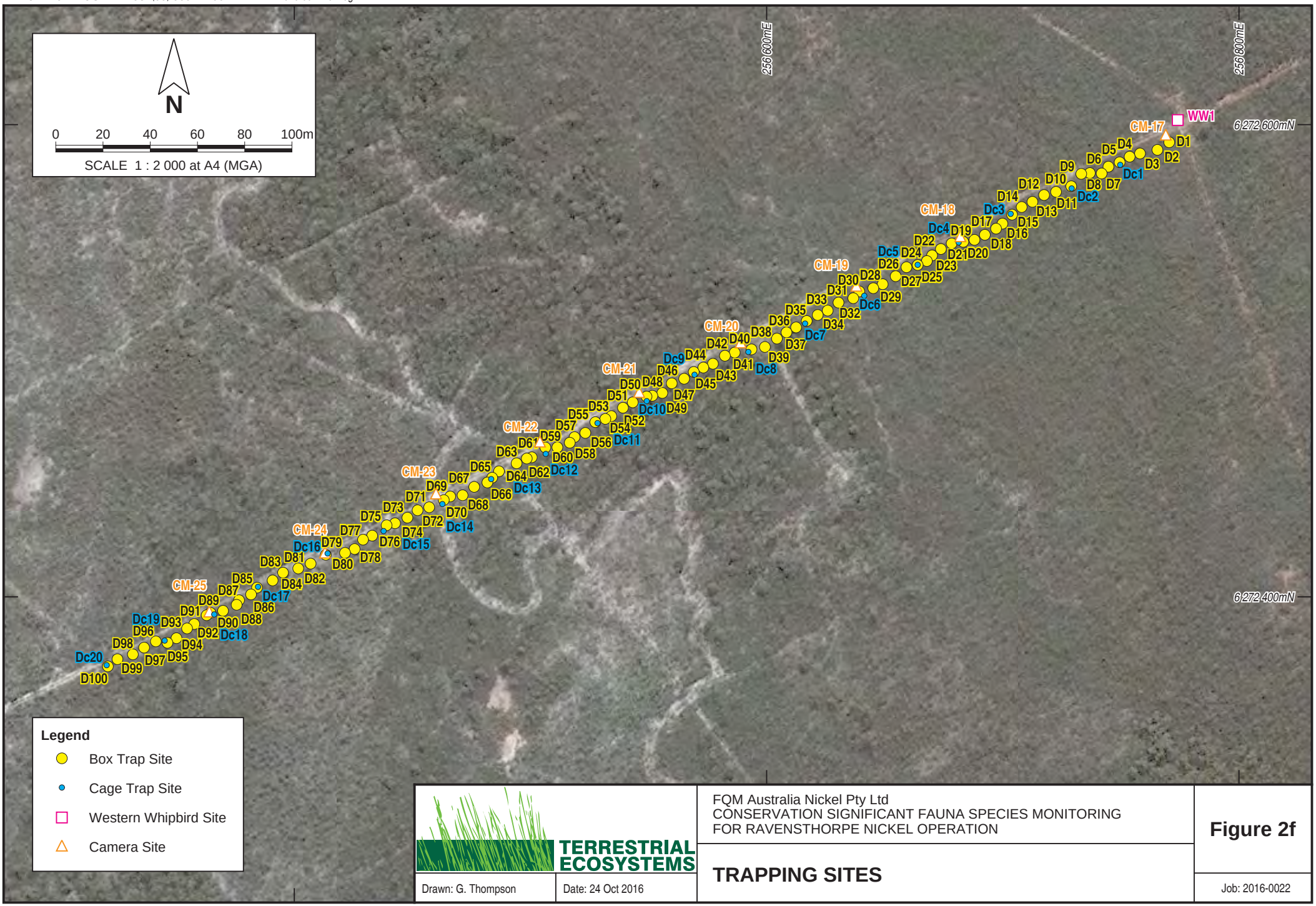
TERRESTRIAL ECOSYSTEMS

FQM Australia Nickel Pty Ltd
CONSERVATION SIGNIFICANT FAUNA SPECIES MONITORING
FOR RAVENSTHORPE NICKEL OPERATION

TRAPPING SITES

Figure 2e

Drawn: G. Thompson | Date: 24 Oct 2016 | Job: 2016-0022



TERRESTRIAL ECOSYSTEMS

FQM Australia Nickel Pty Ltd
CONSERVATION SIGNIFICANT FAUNA SPECIES MONITORING
FOR RAVENSTHORPE NICKEL OPERATION

TRAPPING SITES

Figure 2f

Drawn: G. Thompson | Date: 24 Oct 2016 | Job: 2016-0022

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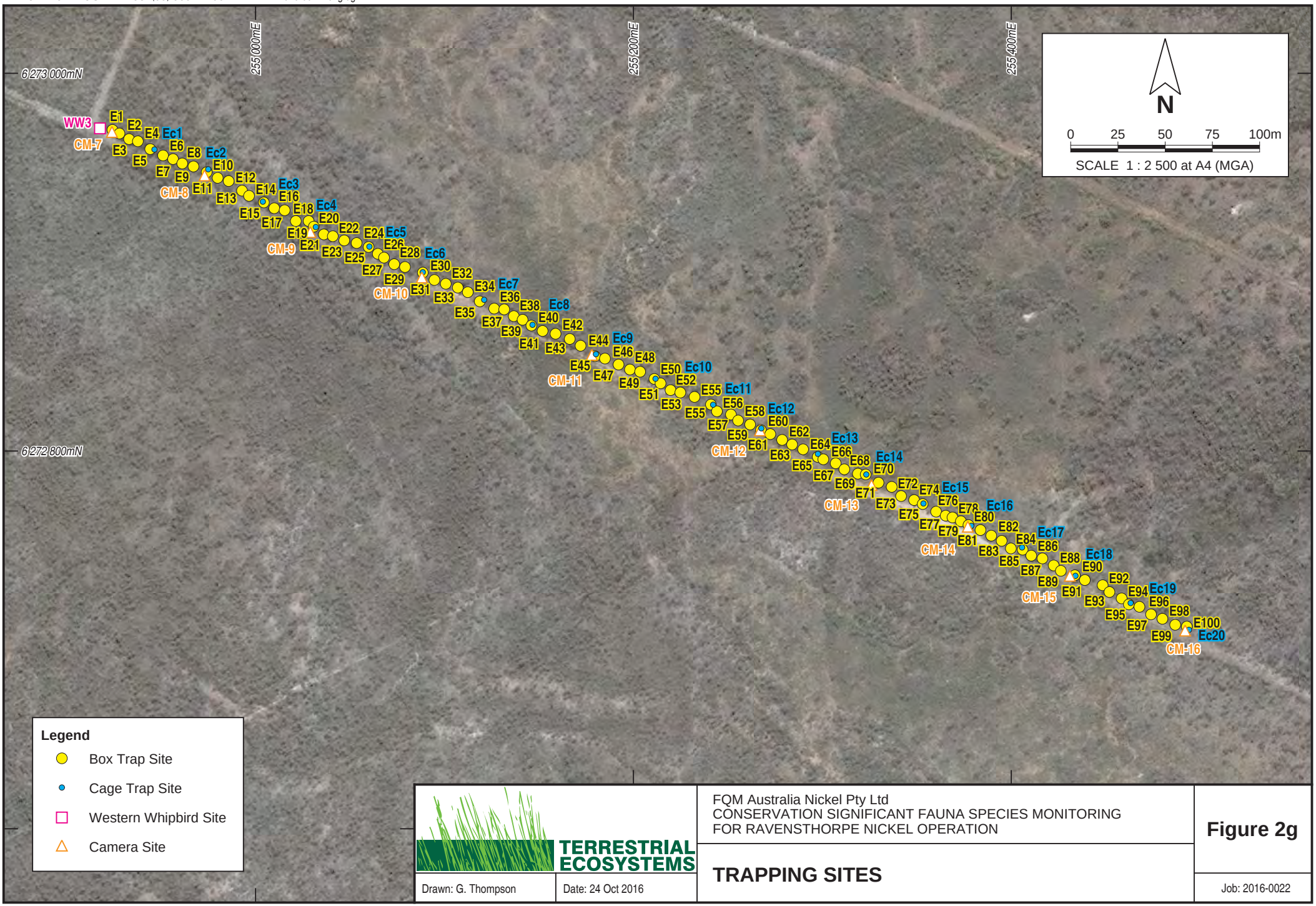

TERRESTRIAL ECOSYSTEMS

FQM Australia Nickel Pty Ltd
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FOR RAVENSTHORPE NICKEL OPERATION

TRAPPING SITES

Figure 2g

Drawn: G. Thompson | Date: 24 Oct 2016 | Job: 2016-0022

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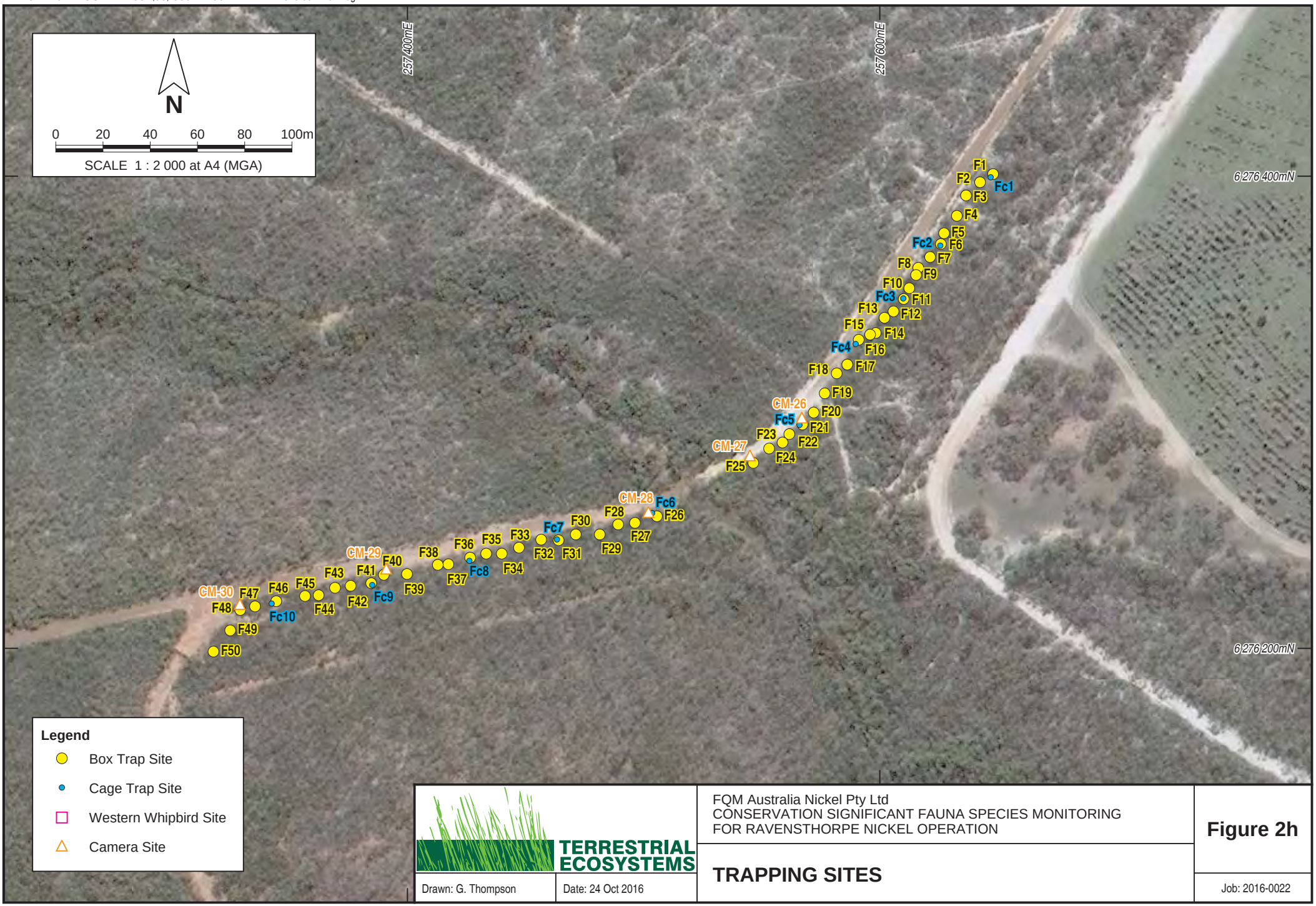

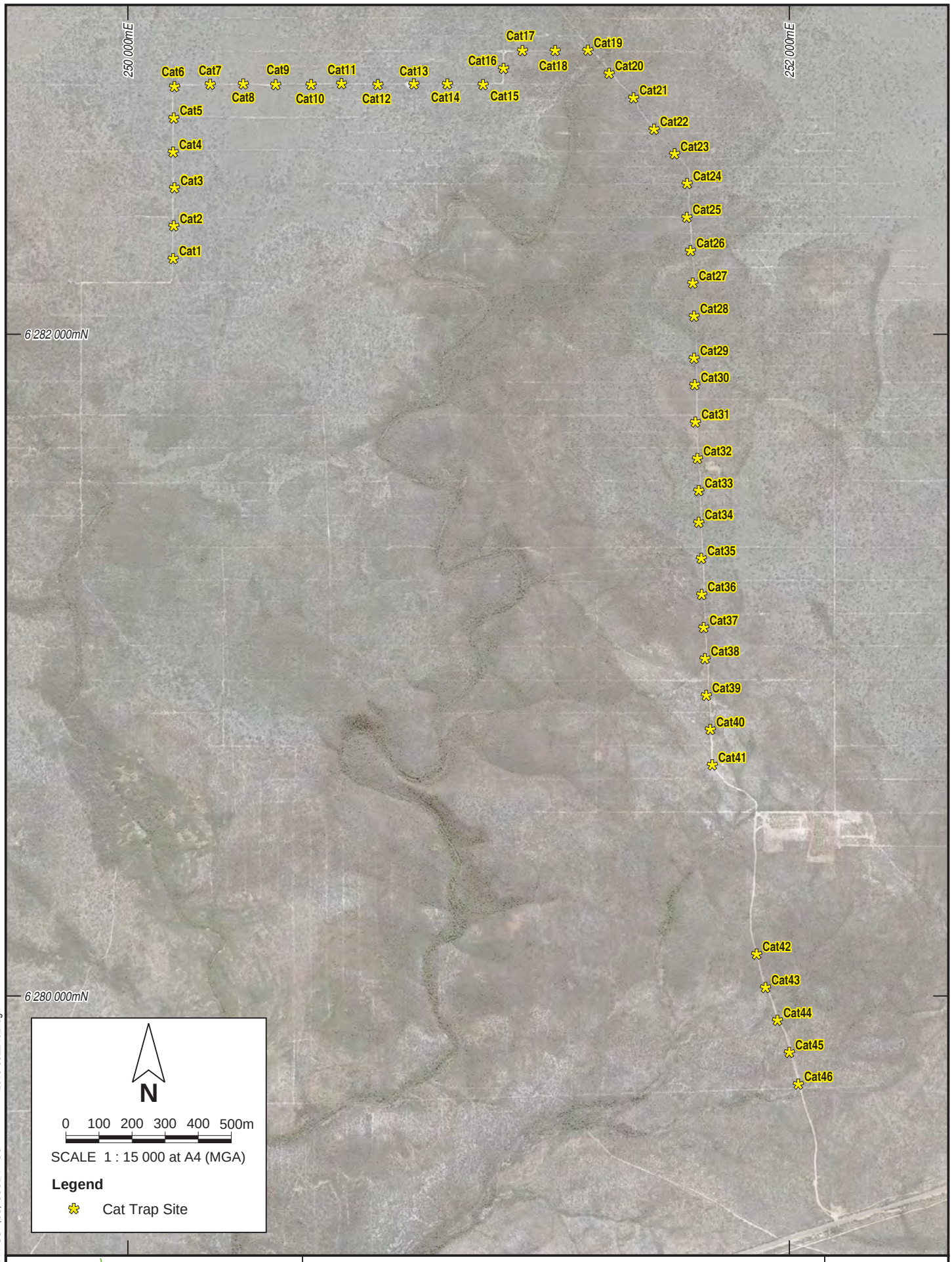

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TERRESTRIAL ECOSYSTEMS

FQM Australia Nickel Pty Ltd
CONSERVATION SIGNIFICANT FAUNA SPECIES MONITORING
FOR RAVENSTHORPE NICKEL OPERATION

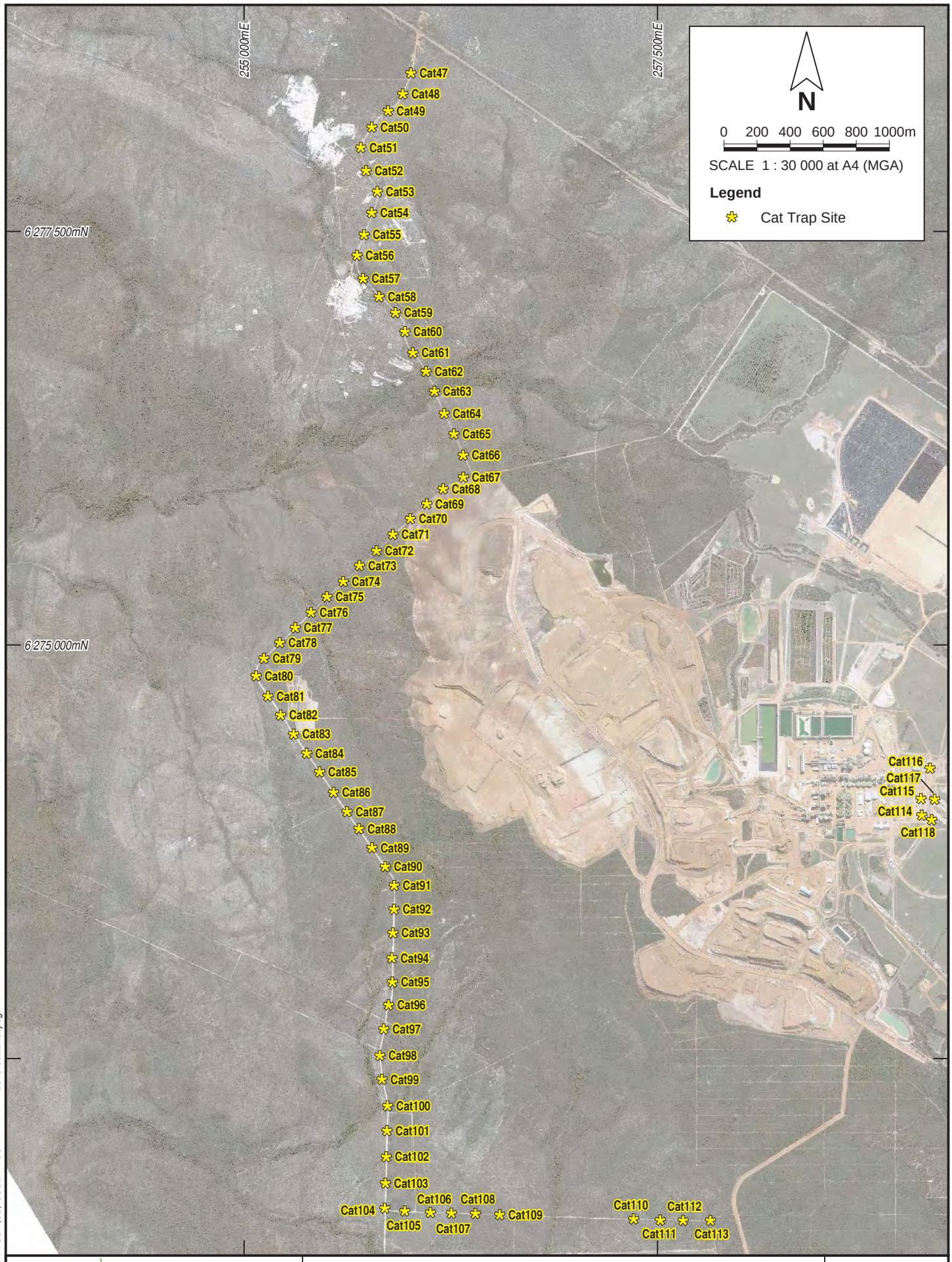
Figure 2i

TRAPPING SITES

Drawn: G. Thompson

Date: 9 Dec 2016

Job: 2016-0022



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TERRESTRIAL ECOSYSTEMS

FQM Australia Nickel Pty Ltd
CONSERVATION SIGNIFICANT FAUNA SPECIES MONITORING
FOR RAVENSTHORPE NICKEL OPERATION

Figure 2j

TRAPPING SITES

Drawn: G. Thompson | Date: 9 Dec 2016 | Job: 2016-0022

Appendix A
Trapping sites, Western Whipbird listening locations, camera trap locations and cat trapping locations

Datum	WGS84	
Site	Easting	Northing
A1	249858	6281544
A2	249855	6281553
AC1	249857	6281563
A3	249857	6281562
A4	249859	6281568
AC2	249857	6281575
A5	249858	6281576
AC3	249859	6281583
A6	249860	6281582
A7	249860	6281588
AC4	249859	6281596
A8	249857	6281597
A9	249857	6281603
A10	249860	6281609
AC5	249859	6281609
A11	249859	6281619
AC6	249859	6281618
A12	249858	6281627
A13	249857	6281634
A14	249859	6281640
AC7	249860	6281639
A15	249859	6281647
A16	249859	6281656
A17	249857	6281663
AC8	249857	6281663
A18	249856	6281668
A19	249859	6281679
AC9	249859	6281678
A20	249857	6281688
A21	249857	6281696
AC10	249857	6281696
A22	249857	6281700
A23	249856	6281709
A24	249858	6281718
A25	249858	6281725
A26	249857	6281731
A27	249856	6281739
A28	249858	6281751
A29	249858	6281766
A30	249856	6281776
A31	249856	6281782
A32	249859	6281791
A33	249858	6281800
A34	249857	6281809
A35	249856	6281817
A36	249858	6281825
A37	249858	6281832
A38	249857	6281841
A39	249856	6281849
A40	249858	6281857
A41	249859	6281867
A42	249857	6281879
A43	249861	6281890
A44	249860	6281902
A45	249858	6281910
A46	249857	6281919
A47	249857	6281923
A48	249859	6281932
A49	249858	6281941
A50	249857	6281952
A51	251852	6280621
A52	251861	6280618
A53	251868	6280608
A54	251875	6280603
A55	251881	6280597
A56	251887	6280593
A57	251895	6280583
A58	251896	6280573

Datum	WGS84	
Site	Easting	Northing
A59	251895	6280569
AC11	251894	6280570
A60	251896	6280559
AC12	251895	6280559
AC13	251898	6280550
A61	251897	6280550
A62	251890	6280542
AC14	251890	6280542
A63	251891	6280533
A64	251892	6280528
A65	251893	6280520
AC15	251891	6280520
A66	251890	6280511
A67	251890	6280501
A68	251891	6280491
A69	251888	6280483
A70	251890	6280477
AC16	251890	6280477
A71	251889	6280469
A72	251892	6280461
A73	251892	6280451
A74	251894	6280446
A75	251895	6280438
A76	251894	6280430
AC17	251894	6280429
A77	251894	6280420
A78	251895	6280415
A79	251891	6280406
A80	251891	6280399
A81	251892	6280390
A82	251892	6280382
AC18	251892	6280383
A83	251892	6280377
A84	251890	6280368
A85	251889	6280362
A86	251891	6280351
A87	251891	6280343
AC19	251891	6280346
A88	251892	6280339
A89	251889	6280330
A90	251890	6280322
A91	251890	6280317
A92	251886	6280307
A93	251887	6280292
A94	251881	6280281
A95	251882	6280271
A96	251882	6280263
A97	251878	6280255
A98	251878	6280251
A99	251880	6280243
A100	251881	6280237
AC20	251881	6280237
C1	258638	6272501
C2	258636	6272491
C3	258636	6272483
C4	258638	6272472
C5	258636	6272470
CC1	258633	6272469
C6	258632	6272460
C7	258633	6272452
C8	258633	6272448
C9	258629	6272439
C10	258629	6272432
CC2	258629	6272432
C11	258630	6272428
C12	258630	6272420
C13	258626	6272413
C14	258625	6272405

Datum	WGS84	
Site	Easting	Northing
C15	258626	6272402
CC3	258626	6272402
C16	258628	6272395
C17	258628	6272390
C18	258623	6272382
C19	258624	6272373
C20	258625	6272369
CC4	258624	6272366
C21	258624	6272363
C22	258621	6272355
C23	258620	6272348
C24	258621	6272343
C25	258621	6272336
CC5	258620	6272336
C26	258621	6272330
C27	258618	6272324
C28	258618	6272316
C29	258619	6272312
C30	258619	6272306
CC6	258619	6272306
C31	258619	6272303
C32	258619	6272296
C33	258616	6272292
C34	258616	6272284
C35	258617	6272281
CC7	258616	6272281
C36	258616	6272274
C37	258613	6272266
C38	258613	6272263
C39	258613	6272256
C40	258614	6272247
CC8	258612	6272247
C41	258612	6272243
C42	258611	6272236
C43	258611	6272234
C44	258610	6272231
C45	258611	6272224
CC9	258611	6272224
C46	258612	6272216
C47	258611	6272212
C48	258608	6272205
C49	258608	6272201
C50	258609	6272195
CC10	258609	6272195
C51	258607	6272191
C52	258607	6272185
C53	258605	6272178
C54	258605	6272175
C55	258594	6272158
CC11	258594	6272158
C56	258586	6272158
C57	258584	6272156
C58	258577	6272149
C59	258574	6272145
C60	258567	6272143
CC12	258570	6272143
C61	258562	6272142
C62	258559	6272138
C63	258552	6272137
C64	258551	6272136
C65	258548	6272134
CC13	258549	6272134
C66	258541	6272129
C67	258539	6272126
C68	258532	6272123
C69	258531	6272121
C70	258527	6272120
CC14	258527	6272120

Datum	WGS84	
Site	Easting	Northing
C71	258520	6272115
C72	258517	6272113
C73	258511	6272108
C74	258510	6272106
C75	258500	6272100
CC15	258499	6272100
C76	258495	6272098
C77	258488	6272097
C78	258486	6272092
C79	258479	6272089
C80	258477	6272086
CC16	258478	6272089
C81	258475	6272085
C82	258471	6272084
C83	258467	6272084
C84	258465	6272082
C85	258463	6272078
C86	258458	6272076
C87	258456	6272076
C88	258453	6272072
C89	258446	6272069
C90	258439	6272064
CC17	258460	6272077
CC18	258442	6272067
C91	258435	6272063
C92	258429	6272057
C93	258423	6272055
C94	258416	6272048
C95	258411	6272048
CC19	258411	6272048
C96	258404	6272044
C97	258400	6272039
C98	258394	6272035
C99	258386	6272033
C100	258382	6272031
CC20	258383	6272030
D1	256767	6272594
D2	256764	6272589
D3	256755	6272589
D4	256752	6272588
D5	256746	6272583
DC1	256746	6272583
D6	256742	6272583
D7	256740	6272581
D8	256733	6272579
D9	256731	6272578
D10	256727	6272575
DC2	256728	6272574
D11	256720	6272571
D12	256716	6272570
D13	256709	6272569
D14	256706	6272564
D15	256700	6272563
DC3	256700	6272563
D16	256698	6272557
D17	256696	6272555
D18	256689	6272555
D19	256686	6272550
D20	256680	6272550
DC4	256678	6272549
D21	256676	6272549
D22	256672	6272548
D23	256667	6272544
D24	256666	6272541
D25	256662	6272542
DC5	256662	6272542
D26	256656	6272541
D27	256653	6272535

Datum	WGS84	
Site	Easting	Northing
D28	256646	6272534
D29	256644	6272532
D30	256636	6272529
DC6	256640	6272527
D31	256633	6272528
D32	256629	6272526
D33	256622	6272521
D34	256620	6272521
D35	256613	6272516
DC7	256613	6272515
D36	256611	6272513
D37	256607	6272513
D38	256601	6272511
D39	256598	6272506
D40	256590	6272506
DC8	256589	6272505
D41	256585	6272505
D42	256579	6272501
D43	256576	6272500
D44	256570	6272497
D45	256567	6272494
DC9	256567	6272493
D46	256563	6272494
D47	256556	6272492
D48	256554	6272486
D49	256548	6272486
D50	256546	6272486
DC10	256546	6272484
D51	256542	6272482
D52	256536	6272480
D53	256533	6272478
D54	256530	6272475
D55	256524	6272473
DC11	256525	6272473
D56	256522	6272471
D57	256515	6272467
D58	256513	6272465
D59	256510	6272465
D60	256503	6272464
DC12	256503	6272460
D61	256499	6272459
D62	256497	6272459
D63	256491	6272458
D64	256483	6272452
D65	256480	6272452
DC13	256480	6272451
D66	256480	6272450
D67	256475	6272446
D68	256469	6272444
D69	256464	6272444
D70	256460	6272440
DC14	256459	6272438
D71	256456	6272438
D72	256449	6272438
D73	256446	6272433
D74	256439	6272432
D75	256435	6272432
DC15	256435	6272429
D76	256431	6272425
D77	256425	6272425
D78	256424	6272421
D79	256419	6272418
D80	256412	6272418
DC16	256413	6272418
D81	256403	6272413
D82	256400	6272411
D83	256392	6272411
D84	256389	6272406

Datum	WGS84	
Site	Easting	Northing
D85	256381	6272405
DC17	256381	6272405
D86	256380	6272402
D87	256373	6272398
D88	256372	6272397
D89	256368	6272395
D90	256361	6272392
DC18	256365	6272394
D91	256359	6272391
D92	256356	6272390
D93	256351	6272388
D94	256348	6272382
D95	256345	6272382
DC19	256344	6272383
D96	256338	6272382
D97	256335	6272378
D98	256328	6272376
D99	256324	6272375
D100	256318	6272370
DC20	256317	6272370
E1	254923	6272966
E2	254927	6272965
E3	254930	6272963
E4	254936	6272961
E5	254943	6272957
EC1	254943	6272957
E6	254948	6272952
E7	254955	6272950
E8	254959	6272948
E9	254964	6272946
E10	254973	6272944
EC2	254973	6272945
E11	254977	6272942
E12	254984	6272940
E13	254990	6272934
E14	254993	6272930
E15	255003	6272927
EC3	255003	6272927
E16	255007	6272925
E17	255014	6272924
E18	255020	6272919
E19	255025	6272919
E20	255030	6272916
EC4	255031	6272916
E21	255035	6272910
E22	255038	6272909
E23	255046	6272907
E24	255051	6272906
E25	255057	6272904
EC5	255058	6272904
E26	255063	6272902
E27	255067	6272900
E28	255070	6272894
E29	255078	6272895
E30	255085	6272890
EC6	255085	6272890
E31	255093	6272886
E32	255098	6272885
E33	255106	6272883
E35	255111	6272881
E35	255115	6272877
EC7	255118	6272878
E36	255125	6272871
E37	255129	6272870
E38	255133	6272867
E39	255140	6272865
E40	255145	6272863
EC8	255145	6272863

Datum	WGS84	
Site	Easting	Northing
E41	255149	6272861
E42	255157	6272860
E43	255163	6272857
E44	255171	6272853
E45	255176	6272846
EC9	255177	6272847
E46	255184	6272844
E47	255190	6272843
E48	255195	6272841
E49	255202	6272839
E50	255208	6272836
EC10	255208	6272836
E51	255211	6272831
E52	255218	6272828
E53	255222	6272826
E55	255231	6272824
E55	255238	6272821
EC11	255239	6272821
E56	255241	6272819
E57	255250	6272817
E58	255253	6272814
E59	255258	6272809
E60	255266	6272806
EC12	255266	6272807
E61	255269	6272804
E62	255277	6272802
E63	255283	6272801
E64	255287	6272798
E65	255296	6272794
EC13	255296	6272796
E66	255299	6272793
E67	255304	6272789
E68	255310	6272786
E69	255316	6272783
E70	255322	6272783
EC14	255322	6272783
E71	255328	6272781
E72	255333	6272778
E73	255340	6272774
E74	255346	6272769
E75	255350	6272767
EC15	255350	6272768
E76	255359	6272763
E77	255362	6272762
E78	255366	6272761
E79	255372	6272760
E80	255376	6272758
EC16	255376	6272758
E81	255380	6272755
E82	255388	6272753
E83	255392	6272748
E84	255396	6272744
E85	255405	6272743
EC17	255404	6272744
E86	255407	6272742
E87	255413	6272740
E88	255421	6272737
E89	255423	6272734
E90	255432	6272732
EC18	255433	6272729
E91	255438	6272727
E92	255447	6272724
E93	255451	6272722
E94	255455	6272719
E95	255459	6272716
EC19	255462	6272717
E96	255467	6272715
E97	255471	6272709

Datum	WGS84	
Site	Easting	Northing
E98	255479	6272707
E99	255485	6272704
E100	255490	6272702
EC20	255492	6272702
F1	257646	6276399
FC1	257645	6276398
F2	257639	6276397
F3	257635	6276390
F4	257629	6276381
F5	257625	6276376
F6	257622	6276371
FC2	257622	6276371
F7	257619	6276364
F8	257612	6276361
F9	257611	6276356
F10	257611	6276353
F11	257608	6276346
FC3	257608	6276346
F12	257602	6276343
F13	257600	6276338
F14	257594	6276334
F15	257593	6276333
F16	257589	6276329
FC4	257586	6276328
F17	257584	6276319
F18	257580	6276317
F19	257575	6276308
F20	257568	6276300
F21	257565	6276293
FC5	257564	6276294
F22	257558	6276291
F23	257557	6276285
F24	257549	6276285
F25	257545	6276278
F26	257503	6276257
FC6	257502	6276257
F27	257493	6276252
F28	257488	6276252
F29	257479	6276250
F30	257468	6276248
F31	257463	6276246
FC7	257462	6276246
F32	257454	6276247
F33	257444	6276242
F34	257439	6276241
F35	257430	6276241
F36	257424	6276238
FC8	257423	6276236
F37	257416	6276237
F38	257410	6276237
F39	257397	6276231
F40	257389	6276232
F41	257383	6276227
FC9	257383	6276226
F42	257373	6276226
F43	257368	6276227
F44	257359	6276222
F45	257355	6276222
F46	257343	6276221
FC10	257339	6276220
F47	257334	6276217
F48	257326	6276217
F49	257324	6276207
F50	257315	6276199
G50	257082	6271543
GC50	257078	6271538
G49	257070	6271539
G48	257058	6271540

Datum	WGS84	
Site	Easting	Northing
G47	257054	6271542
G46	257045	6271542
G45	257040	6271540
GC45	257040	6271540
G44	257031	6271541
G43	257022	6271540
G42	257010	6271541
G41	257000	6271541
G40	256991	6271541
GC40	256992	6271540
G39	256985	6271540
G38	256975	6271543
G37	256964	6271543
G36	256953	6271542
G35	256943	6271541
GC35	256943	6271541
G34	256934	6271542
G33	256926	6271542
G32	256916	6271544
G31	256911	6271544
G30	256899	6271544
GC30	256900	6271544
G29	256890	6271543
G28	256882	6271542
G27	256878	6271542
G26	256872	6271544
G25	256864	6271543
GC25	256862	6271545
G24	256853	6271546
G23	256846	6271546
G22	256836	6271544
G21	256828	6271545
G20	256823	6271545
GC20	256822	6271546
G19	256813	6271546
G18	256807	6271547
G17	256796	6271547
G16	256788	6271547
G15	256783	6271547
GC15	256781	6271547
G14	256775	6271547
G13	256770	6271547
G12	256761	6271548
G11	256757	6271549
G10	256749	6271549
GC10	256750	6271550
G9	256745	6271549
G8	256739	6271547
G7	256735	6271548
G6	256729	6271548
G5	256721	6271548
GC5	256721	6271548
G4	256717	6271550
G3	256707	6271550
G2	256701	6271547
G1	256692	6271551
CM-1	249858	6281544
CM-2	249858	6281564
CM-3	249857	6281577
CM-4	251896	6280583
CM-5	251896	6280559
CM-6	251891	6280542
CM-7	254924	6272966
CM-8	254973	6272944
CM-9	255027	6272913
CM-10	255086	6272889
CM-11	255176	6272848
CM-12	255267	6272808

Datum	WGS84	
Site	Easting	Northing
CM-13	255326	6272781
CM-14	255375	6272759
CM-15	255431	6272733
CM-16	255490	6272702
CM-17	256767	6272595
CM-18	256680	6272550
CM-19	256636	6272529
CM-20	256588	6272507
CM-21	256544	6272486
CM-22	256502	6272465
CM-23	256458	6272442
CM-24	256413	6272418
CM-25	256362	6272391
CM-26	257567	6276295
CM-27	257545	6276279
CM-28	257502	6276257
CM-29	257391	6276232
CM-30	257328	6276216
CM-31	256115	6272386
CM-32	256122	6272425
CM-33	256128	6272446
CM-34	256121	6272465
CM-35	256124	6272481
CM-36	256095	6272472
CM-37	256091	6272452
CM-38	256087	6272433
CM-39	256093	6272411
CM-40	256099	6272397
CM-41	256849	6271438
CM-42	256858	6271459
CM-43	256870	6271486
CM-44	256877	6271511
CM-45	256868	6271532
CM-46	256865	6271552
CM-47	256869	6271567
CM-48	256872	6271591
CM-49	256877	6271602
CM-50	256888	6271623
WB1	256774	6272600
WB2	256017	6272225
WB3	254916	6272969
WB4	255905	6272973
WB5	257166	6271537
WB6	258380	6272025
WB8	251905	6280559
WB9	251717	6281891
WB10	249851	6281558
WB11	254293	6273261
Cat1	250136	6282227
Cat10	250554	6282754
Cat100	255867	6272212
Cat101	255864	6272062
Cat102	255859	6271904
Cat103	255854	6271746
Cat104	255851	6271593
Cat105	255972	6271577
Cat106	256126	6271567
Cat107	256253	6271564
Cat108	256398	6271562

Datum	WGS84	
Site	Easting	Northing
Cat109	256546	6271555
Cat11	250646	6282756
Cat110	257356	6271529
Cat111	257517	6271522
Cat112	257655	6271519
Cat113	257819	6271519
Cat114	259098	6273970
Cat115	259092	6274070
Cat116	259148	6274253
Cat117	259176	6274065
Cat118	259158	6273941
Cat119	258851	6266205
Cat12	250755	6282754
Cat120	258932	6265823
Cat121	258938	6265793
Cat13	250864	6282755
Cat14	250965	6282756
Cat15	251073	6282753
Cat16	251135	6282802
Cat17	251192	6282857
Cat18	251292	6282856
Cat19	251390	6282858
Cat2	250138	6282327
Cat20	251454	6282787
Cat21	251529	6282714
Cat22	251591	6282619
Cat23	251653	6282545
Cat24	251690	6282455
Cat25	251689	6282353
Cat26	251700	6282252
Cat27	251708	6282153
Cat28	251711	6282054
Cat29	251712	6281927
Cat3	250140	6282441
Cat30	251714	6281846
Cat31	251716	6281734
Cat32	251721	6281623
Cat33	251726	6281527
Cat34	251725	6281430
Cat35	251734	6281322
Cat36	251735	6281213
Cat37	251741	6281112
Cat38	251744	6281019
Cat39	251748	6280908
Cat4	250136	6282550
Cat40	251761	6280804
Cat41	251767	6280698
Cat42	251900	6280125
Cat43	251928	6280025
Cat44	251964	6279926
Cat45	252000	6279829
Cat46	252026	6279732
Cat47	256008	6278456
Cat48	255960	6278330
Cat49	255870	6278228
Cat5	250138	6282652
Cat50	255772	6278129
Cat51	255706	6278005
Cat52	255737	6277866

Datum	WGS84	
Site	Easting	Northing
Cat53	255806	6277740
Cat54	255772	6277612
Cat55	255726	6277478
Cat56	255683	6277354
Cat57	255720	6277214
Cat58	255816	6277103
Cat59	255915	6277007
Cat6	250140	6282748
Cat60	255973	6276893
Cat61	256021	6276764
Cat62	256100	6276652
Cat63	256150	6276531
Cat64	256209	6276397
Cat65	256268	6276273
Cat66	256324	6276145
Cat67	256326	6276013
Cat68	256203	6275942
Cat69	256104	6275852
Cat7	250248	6282755
Cat70	256004	6275762
Cat71	255899	6275667
Cat72	255800	6275568
Cat73	255698	6275479
Cat74	255599	6275382
Cat75	255500	6275290
Cat76	255404	6275196
Cat77	255309	6275102
Cat78	255216	6275012
Cat79	255120	6274918
Cat8	250348	6282755
Cat80	255072	6274811
Cat81	255143	6274689
Cat82	255221	6274574
Cat83	255300	6274460
Cat84	255379	6274344
Cat85	255457	6274231
Cat86	255541	6274107
Cat87	255623	6273991
Cat88	255695	6273887
Cat89	255774	6273772
Cat9	250447	6282753
Cat90	255854	6273658
Cat91	255908	6273545
Cat92	255907	6273401
Cat93	255899	6273257
Cat94	255894	6273106
Cat95	255897	6272961
Cat96	255873	6272823
Cat97	255844	6272678
Cat98	255821	6272516
Cat99	255834	6272372

Appendix B
Trapping results

Date	Trap No	Species
16/11/2016	E49	*Tiliqua rugosa*
16/11/2016	EC17	*Tiliqua rugosa*
16/11/2016	F23	*Tiliqua rugosa*
16/11/2016	G33	*Tiliqua rugosa*
16/11/2016	GC2	*Tiliqua rugosa*
16/11/2016	GC3	*Tiliqua rugosa*
16/11/2016	GC4	*Tiliqua rugosa*
17/11/2016	AC10	*Varanus rosenbergi*
17/11/2016	AC13	*Varanus rosenbergi*
17/11/2016	AC17	*Tiliqua rugosa*
17/11/2016	Cat25	*Dasyurus geoffroii*
17/11/2016	Cat95	*Dasyurus geoffroii*
17/11/2016	CC17	*Corvus coronoides*
17/11/2016	D4	*Tiliqua rugosa*
17/11/2016	DC18	*Varanus rosenbergi*
17/11/2016	DC4	*Tiliqua rugosa*
17/11/2016	EC13	*Tiliqua rugosa*
17/11/2016	EC20	*Tiliqua rugosa*
17/11/2016	FC4	*Tiliqua rugosa*
17/11/2016	FC6	*Tiliqua rugosa*
17/11/2016	G13	*Tiliqua rugosa*
17/11/2016	GC20	*Tiliqua rugosa*
17/11/2016	GC30	*Tiliqua rugosa*
18/11/2016	A38	*Tiliqua rugosa*
18/11/2016	A99	*Tiliqua rugosa*
18/11/2016	AC1	*Varanus rosenbergi*
18/11/2016	AC20	*Tiliqua rugosa*
18/11/2016	AC3	*Tiliqua rugosa*
18/11/2016	C65	*Rattus fuscipes*
18/11/2016	CC1	*Tiliqua rugosa*
18/11/2016	CC12	*Corvus coronoides*
18/11/2016	CC20	*Tiliqua rugosa*
18/11/2016	CC5	*Felis catus*
18/11/2016	D92	*Tiliqua rugosa*
18/11/2016	DC10	*Tiliqua rugosa*
18/11/2016	DC19	*Tiliqua rugosa*
18/11/2016	DC20	*Varanus rosenbergi*
18/11/2016	EC16	*Tiliqua rugosa*
18/11/2016	EC20	*Tiliqua rugosa*
18/11/2016	FC10	*Varanus rosenbergi*
18/11/2016	GC10	*Tiliqua rugosa*
18/11/2016	GC25	*Tiliqua rugosa*
19/11/2016	AC1	*Tiliqua rugosa*
19/11/2016	AC12	*Rattus fuscipes*
19/11/2016	AC20	*Varanus rosenbergi*
19/11/2016	AC3	*Varanus rosenbergi*
19/11/2016	C67	*Tiliqua rugosa*
19/11/2016	Cat20	*Tiliqua occipitalis*
19/11/2016	Cat27	*Tiliqua rugosa* x 2
19/11/2016	Cat29	*Tiliqua rugosa*
19/11/2016	Cat4	*Tiliqua rugosa*
19/11/2016	Cat62	*Tiliqua rugosa*
19/11/2016	Cat63	*Tiliqua rugosa*
19/11/2016	Cat64	*Tiliqua rugosa* x 2
19/11/2016	Cat98	*Dasyurus geoffroii*
19/11/2016	Cat99	*Tiliqua rugosa*
19/11/2016	CC10	*Tiliqua rugosa*
19/11/2016	CC13	*Tiliqua rugosa*
19/11/2016	C30	*Tiliqua occipitalis*

Date	Trap No	Species
19/11/2016	C60	*Litoria cyclorhyncha*
19/11/2016	DC1	*Tiliqua rugosa*
19/11/2016	DC12	*Tiliqua rugosa*
19/11/2016	DC16	*Varanus rosenbergi*
19/11/2016	DC17	*Varanus rosenbergi*
19/11/2016	DC18	*Tiliqua rugosa*
19/11/2016	DC3	*Tiliqua occipitalis*
19/11/2016	DC6	*Tiliqua rugosa*
19/11/2016	E62	*Tiliqua rugosa*
19/11/2016	FC4	*Varanus rosenbergi*
19/11/2016	FC6	*Tiliqua rugosa*
19/11/2016	FC7	*Strepera versicolor*
19/11/2016	GC40	*Tiliqua rugosa*
19/11/2016	GC50	*Varanus rosenbergi*
20/11/2016	A90	*Mus musculus*
20/11/2016	AC1	*Varanus rosenbergi*
20/11/2016	AC11	*Tiliqua rugosa*
20/11/2016	AC14	*Varanus rosenbergi*
20/11/2016	AC15	*Tiliqua rugosa*
20/11/2016	AC16	*Varanus rosenbergi*
20/11/2016	AC19	*Varanus rosenbergi*
20/11/2016	AC2	*Varanus rosenbergi*
20/11/2016	AC3	*Varanus rosenbergi*
20/11/2016	AC5	*Varanus rosenbergi*
20/11/2016	AC9	*Felis catus*
20/11/2016	C92	*Tiliqua rugosa*
20/11/2016	Cat18	*Varanus rosenbergi*
20/11/2016	Cat8	*Tiliqua rugosa*
20/11/2016	Cat82	*Dasyurus geoffroii*
20/11/2016	Cat82	*Dasyurus geoffroii*
20/11/2016	Cat96	*Dasyurus geoffroii*
20/11/2016	Cat96	*Dasyurus geoffroii*
20/11/2016	CC10	*Tiliqua rugosa*
20/11/2016	CC13	*Tiliqua rugosa*
20/11/2016	CC17	*Tiliqua rugosa*
20/11/2016	CC18	*Tiliqua rugosa*
20/11/2016	CC19	*Tiliqua rugosa*
20/11/2016	CC20	*Varanus rosenbergi*
20/11/2016	DC14	*Varanus rosenbergi*
20/11/2016	DC2	*Tiliqua rugosa*
20/11/2016	E75	*Rattus fuscipes*
20/11/2016	F35	*Mus musculus*
20/11/2016	F42	*Tiliqua rugosa*
20/11/2016	FC4	*Tiliqua rugosa*
20/11/2016	FC7	*Varanus rosenbergi*
20/11/2016	FC8	*Varanus rosenbergi*
20/11/2016	GC25	*Tiliqua rugosa*
20/11/2016	GC35	*Tiliqua rugosa*
20/11/2016	GC40	*Tiliqua rugosa*
20/11/2016	GC45	*Tiliqua rugosa*
21/11/2016	AC12	*Rattus fuscipes*
21/11/2016	Cat19	*Felis catus*
21/11/2016	CC12	*Tiliqua rugosa*
21/11/2016	DC16	*Tiliqua rugosa*

Bennelongia Environmental Consultants

Ravensthorpe Nickel Operations
Short Range Endemic Invertebrates
Desktop and Field Assessment

Prepared for:

First Quantum Minerals Ltd

July 2017
Final Report

Short-Range Endemics | Subterranean Fauna
Waterbirds | Wetlands

Ravensthorpe Nickel Operations Short Range Endemic Invertebrates Desktop and Field Assessment

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EXECUTIVE SUMMARY

First Quantum Minerals Ltd mines nickel at the Ravensthorpe Nickel Operations (RNO) located approximately 35 km east of Ravensthorpe in south-western Australia. Proposed expansions (the Project) to current operations include increased development of pits and waste rock storage facilities at the Hale-Bopp and Shoemaker-Levy deposits and a revised alignment of the infrastructure corridor (conveyor belt) between Shoemaker-Levy and the main processing plant.

This assessment incorporated desktop and field survey to evaluate the likelihood that the Project will impact the conservation of short-range endemic (SRE) or listed invertebrate species that are of significant conservation value. A desktop review process was used to assess whether any SRE invertebrate species or listed invertebrate species was likely to occur in the Project area. The prospectivity of habitat types within the Project area for SRE invertebrates was assessed through a combination of habitat mapping and *in situ* observations during field survey. The field survey included targeted searches for SRE Groups (Chilopoda, Diplopoda, Selenopidae, Mygalomorphae, Scorpiones, Pseudoscorpiones, Opiliones, Platyhelminthes, Megadrilacea, Isopoda and Gastropoda) across 24 sites in five habitat types and 11 constituent habitat subunits. Survey methods included hand foraging, cup-trapping, UV spotlight searches, litter sieving and collection of litter samples for placement in Tullgren funnels.

A total of 150 taxa from SRE-groups have previously been recorded in the 10,000 km^2 vicinity of the Project defined by 32.446°S, 119.167°E and 34.246°S, 120.966°E. Fourteen species (9%) that have been recorded in the search area (four trapdoor spiders, nine millipedes and a land snail) are confirmed SREs. Approximately half the remaining species are classed as Potential SREs because of deficient data (mainly lack of collection records and associated sampling in suitable surrounding habitat). Most of these Potential SRE species are likely to be more widespread than records suggest and are unlikely to be actual SRE species. Sixty-two species (41%) are known to be widespread.

Although no formally-listed species are known to occur within the search area, one Priority (P1) species, the hemipteran *Budginmaya eulae*, has been recorded in a reference area near the Hale-Bopp deposit in the Project area. While the conservation status of all previously-recorded species in the search area is unlikely to be threatened by proposed development, because all species have been recorded from either outside the Project area or reference areas within the Project area, there may be a requirement for further investigation of the distribution of *Budginmaya eulae*.

Field survey at 24 sites across five habitat types and eleven subunits in the Project area yielded 574 specimens of 42 species belonging to SRE Groups. Ten recorded species are known to be widespread relative to SRE criteria and have been recorded outside the Project area (Table 4). The conservation status of these species will not be affected by proposed development. Eighteen species were classed as data deficient Potential SRE species and twelve species were classed as likely to be widespread for ecological or habitat reasons. In most cases, it is unlikely that these species are actually SREs. Two species were classed as confirmed SREs, the millipede *Antichiropus cuspis* and the land snail *Bothriembryon* cf. *balteolus*. Both confirmed SRE species collected during survey have been recorded outside the Project area and are unlikely to be threatened by the Project.

Nine potential SRE species were only recorded in Project impact areas: the mygalomorph spiders *Anidiops* sp. B14 (*villosus* group), *Anidiops* sp. B15, *Aname* sp. B29 (*mainae* group); the pseudoscorpions *Austrochthonius* sp. B08 and *Beierolpium* 8/4 sp. B16; the isopods *Acanthodillo* sp. B21, *Pseudodiploexochus* sp. B01 and *Trichorhina* sp. B32; and the centipede *Ribautia* sp. B05. Owing to the collection of species from multiple widespread habitat subunits or widespread subunits of low prospectivity, eight of the nine species are considered very unlikely to be restricted to the Project impact areas. In fact, many of the species are unlikely to actually be SREs and their conservation status will not be affected by the Project. However, it is considered that the isopod *Pseudodiploexochus* sp. B01 may be restricted to the Project impact areas and further investigation of its status is warranted.

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1. INTRODUCTION

First Quantum Minerals Ltd (FQM) operates Ravensthorpe Nickel Operations (RNO), which mines nickel from three deposits, Halleys, Hale-Bopp and Shoemaker-Levy. This ore is processed through the Operations' beneficiation plant to produce an end product of mixed hydroxide precipitate. The operation is located approximately 35 km east of Ravensthorpe in southwestern Australia (Figure 1). The Proponent proposes expansions (the Project) to current operations that include increased size of pits and waste rock storage facilities at the Hale-Bopp and Shoemaker-Levy deposits and a revised alignment of the infrastructure corridor (conveyor belt) between Shoemaker-Levy and the main processing plant (Figure 2).

This assessment incorporates desktop and field survey components to evaluate the likelihood of the Project impacting the conservation values of short-range endemic (SRE) invertebrate species and terrestrial invertebrate species listed as conservation significant under the *Wildlife Conservation Act 1950* (WC Act), *Biodiversity Conservation Act 2016* (BC Act) or *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (hereafter referred to as listed species). The assessment expands on a previous targeted survey of SRE invertebrates at the RNO by Biota (2005) that focused on mygalomorph spiders, millipedes and land snails, but did not included targeted searches for other SRE groups (selenopid spiders, scorpions, geophilid centipedes, pseudoscorpions and isopods).

The specific aims of assessment are:

- To describe and evaluate the prospectivity of potential SRE habitat in the Project area;
- To review known occurrences of SRE and listed invertebrate species in the vicinity of the Project area;
- To carry out a targeted field survey of SRE invertebrates in the Project area, aligning current taxonomy with that previously used where possible;
- To determine the likelihood that SRE and listed invertebrate species occur in the Project area; and
- To determine if the Project is likely to have significant conservation impacts on any SRE and listed invertebrate species.

2. BACKGROUND

2.1. Conservation Framework

Protection of native flora and fauna in Western Australia is provided at both state and national levels. At the national level, a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places is provided via the Commonwealth EPBC Act. At the state level, native flora and fauna are protected under the WC Act (in particular Section 14, pp. 8-9). The highest level of protection is given to Schedule 1 species that are considered rare, likely to become extinct, or otherwise in need of special protection (i.e. the 'threatened' species list). Following the passing of the *Biodiversity Conservation Act* 2016 (BC Act), the WC Act will soon be superseded by the contemporary BC Act, which will increase protection of the state's native species and important biodiversity assets. However, the time frame for the implementation of the BC Act remains largely unknown at this stage.

In addition to the threatened species list, the Department of Biodiversity, Conservation and Attractions (DBCA) also maintains a List of Threatened and Priority Fauna that are of conservation importance but, for various reasons, do not meet the criteria for listing as threatened. The current list from February 2017 includes 166 terrestrial invertebrate species including 32 insects, 40 arachnids, 2 crustaceans, 29 millipedes and 63 land snails. Ecological communities are not protected under the WC Act but the Minister for the Environment has endorsed a list of Threatened Ecological Communities (TECs) for protection, while DBCA also maintains a list of Priority Ecological Communities (PECs). Communities are listed as PECs if they are considered to have high conservation value but the documentation of

these values is incomplete. Currently, no TECs or PECS have been listed on the basis of SRE assemblages. A framework for SRE assessments is provided by *Technical Guidance: Sampling of Short range endemic invertebrate fauna* (EPA 2016a).

2.2. Regional Context

The RNO, including the Project area, is situated in the Fitzgerald subregion (ESP01), within the wider Esperance Plains Bioregion, characterised by "myrtaceous and proteaceous scrub and mallee heath on sandplain overlying Eocene sediments", "herbfields and heaths… on abrupt granite tors and quartzite ranges that rise from the plain" and "eucalypt woodlands… in gullies and alluvial foot-slopes" (Comer et al. 2001). The wider South West region is rich in endemic species and is recognised as a global biodiversity hotspot because of its plant diversity and the high level of threat to this diversity (Meyers et al. 2000). From a geological perspective, the Fitzgerald subregion has variable relief, with low sandplains in coastal areas punctuated with metamorphosed granite and quartzite ranges both inland and on coastal plains, as well as Archaean greenstone–sand sheets and gravel soils. Regional soils are predominantly duplex, sandy soils that are shallow in elevated areas. The regional vegetation is highly diverse, including cryptic and significantly localised vegetation types that occur within the overall vegetation mosaic (Comer et al. 2001). The regional climate is Temperate Mediterranean and the region receives 600–800 mm annual rainfall.

2.3. SRE Framework

SRE invertebrates are species with distributions of less than 10,000 km^2 and their occurrence within their distributions is usually patchy because they are confined to discontinuous habitats (Harvey 2002). The small ranges of SRE invertebrates, combined with poor dispersal capacities, slow growth and low fecundity, make them particularly vulnerable to habitat loss or disturbance (Harvey 2002; Ponder and Colgan 2002). The Environmental Protection Authority's (EPA) *Environmental Factor Guideline: Terrestrial Fauna* (EPA 2016b) mandates the consideration of SRE invertebrates in environmental impact assessment (EIA). In practice, assessment of risk to terrestrial SRE invertebrates in Western Australia is focused on ten taxonomic groups (the *SRE Groups*) that are known to contain high proportions of SRE species: flatworms (Platyhelminthes), earthworms (Megadrilacea), harvestmen (Opiliones), spiders (Araneae, particularly Mygalomorphae but also families such as Selenopidae), pseudoscorpions (Pseudoscorpiones), scorpions (Scorpiones) centipedes (Chilopoda), millipedes (Diplopoda), slaters (Isopoda) and snails (Gastropoda).

A major challenge in the assessment of SRE species is determining whether or not a species belonging to an SRE Group actually has a range <10,000 km^2. The Western Australian Museum (WAM) proposed a three-tier classification scheme for SRE species that we have applied to all species listed in this report:

Confirmed SREs are species with a known distribution range <10,000 km^2 that have well understood taxonomy and are well represented in collections or come from areas that have been well sampled.

Potential SREs are species with known distributions of <10,000 km^2 that belong to genus or other taxonomic grouping for which there are knowledge gaps, either because the taxon is not well represented in collections, the taxonomic framework is incomplete, or species distributions are imperfectly understood because sampling has been patchy.

Widespread (not SRE) species have a known distribution range >10,000 km^2. The taxonomy of the species is well understood and it is well represented in collections.

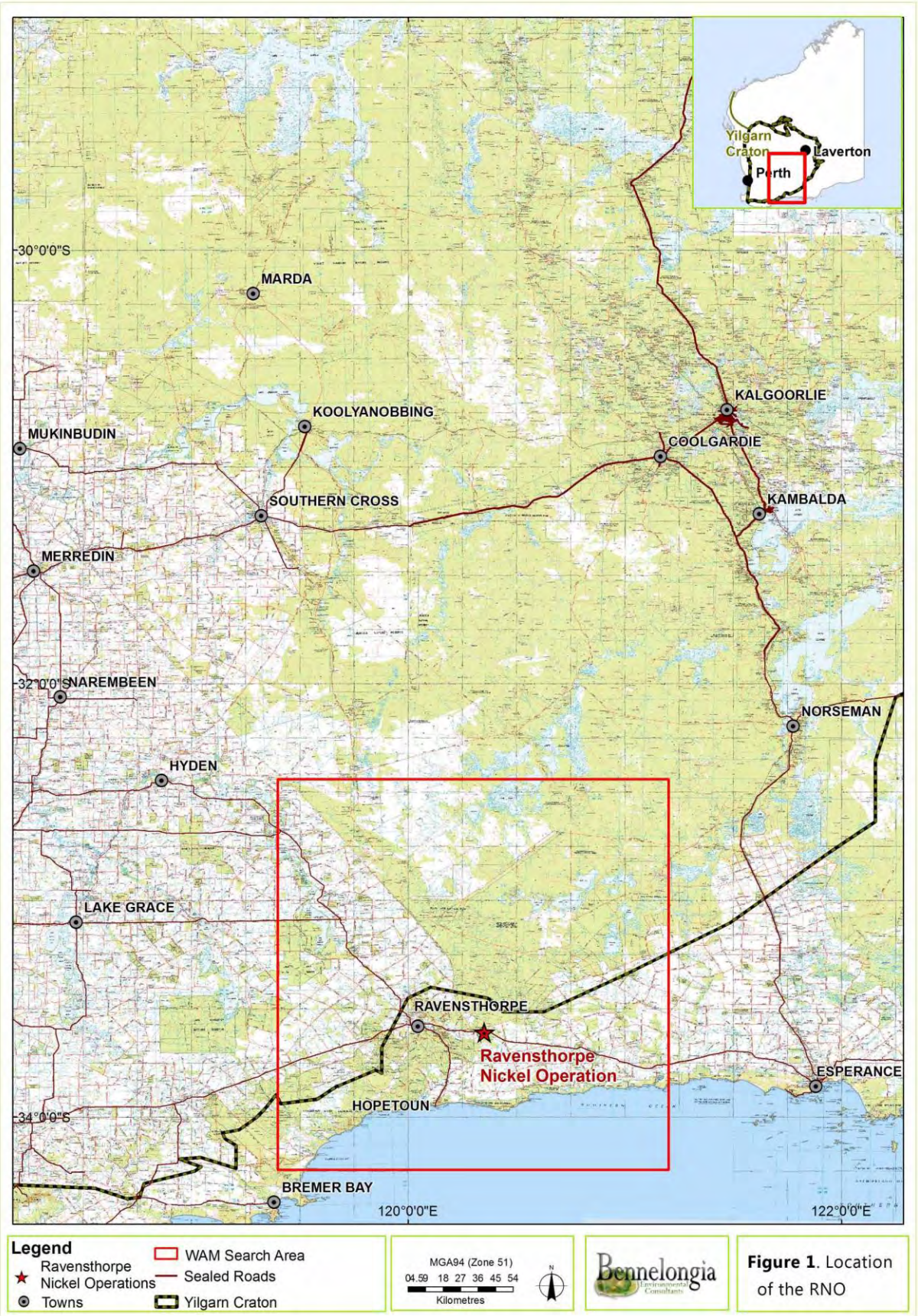

Figure 1. Location of the RNO and the search area encompassed by the current desktop review.

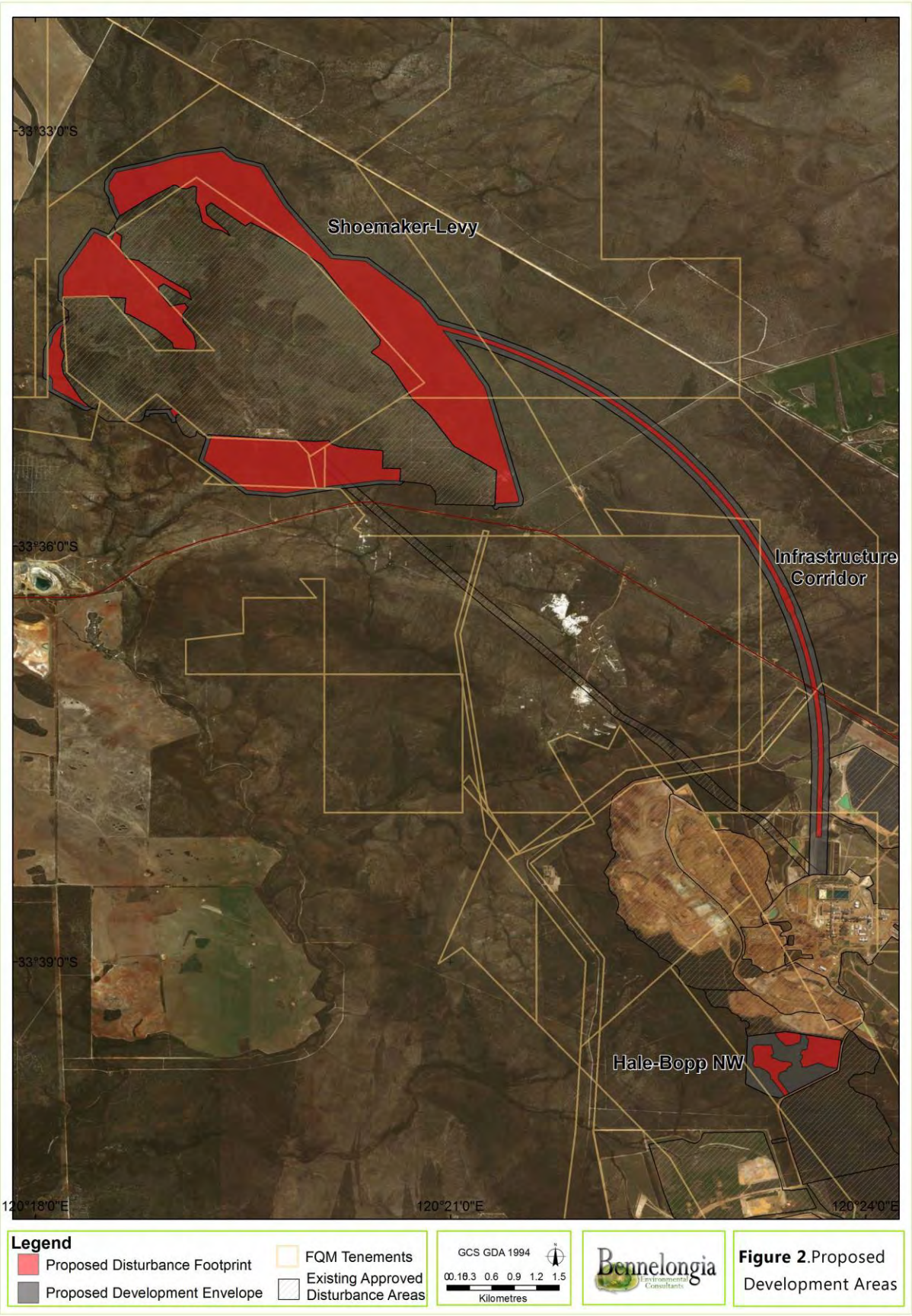

Figure 2. Proposed development (expansion) areas at the Project.

The WAM uses five qualifiers if a species is determined to be a Potential SRE. These relate to the reasons for treating a species as a Potential SRE:

1. Data deficient: This is a caveat reflecting that the species is treated as a Potential SRE because there are insufficient data available to determine SRE status. In most cases, such species will be widespread;
2. Habitat Indicators: Here and in the following cases, there is some evidence from which the likely SRE status of the species may be inferred. In this case, habitat indicators suggest the species is likely to be an SRE because of its close association with a particular habitat (conversely it may be inferred that the species is likely to be widespread because of its association with a widespread habitat);
3. Morphological Indicators: Morphological characteristics suggest the species possesses habitat specialisation or lack of dispersal capacity that make it likely to be an SRE;
4. Molecular Evidence: DNA sequences have patterns congruent with the species being localised in range; and
5. Research & Expertise: Available research data and/or specialist expertise suggest that a species is likely to be an SRE (or, conversely, widespread).

When considering the implications of a species being identified as a Confirmed or Potential SRE species, it should be recognised that identifying SRE species is only part of a filtering process used to determine whether species may be threatened by development. The actual level of threat to an SRE species depends on the relationship between the species' range and the development footprint. A species will be threatened only if its range lies entirely (or mostly) within an area of disturbance. Thus, the extent of the species' preferred habitat in the local area, the size of the disturbance footprint and whether other developments exist (or are proposed) in the local area are important factors when determining the level of threat to a species. In addition to being a SRE, an invertebrate species may be listed under the WC Act or EPBC Act, which increases the focus on protecting it.

3. DESKTOP ASSESSMENT

A desktop review process was used to assess whether any SRE invertebrate species or listed invertebrate species was likely to occur in the Project area. Records of listed species and species belonging to SRE Groups were compiled from the WAM databases for a search area of approximately 100 km by 100 km surrounding the Project (defined by 32.446°S, 119.167°E and 34.246°S, 120.966°E). The bounds of the search area were treated as being somewhat flexible to compensate for the defined search area extending into the Southern Ocean. Published research papers, available environmental reports and online resources such as the Atlas of Living Australia (ALA 2017) and the Australian Faunal Directory (ABRS 2009) were also reviewed. The search area included many habitats that are geologically, climatically and botanically similar to those in the Project area. The SRE status of the species known from the search was determined (following the WAM process outlined above) using in-house expertise of Bennelongia staff and publicly available information.

Land systems mapping prepared by the Department of Primary Industries and Regional Development (Pringle et al. 1994), high-resolution orthophotos (provided by Woodman Environmental Consulting), vegetation units described for the Project area (by Western Botanical 2005 and Terrestrial Ecosystems 2015) and observations made during field survey were used to assess the suitability of habitats in the Project area for SRE species. Habitats were assessed using five criteria: the availability of moisture; soil structure; geological diversity; vegetation type; and extent of shade and shelter. The emphasis was on identifying 'relictual' habitats (e.g. sheltered, moist for millipedes) and those that may contain specialist species (e.g. rocky outcrops for *Synsphyronus* pseudoscorpions and selenopid spiders). The extent of these habitat types beyond the Project area was evaluated, as well as the extent of habitat connectivity and the presence of habitat isolates, which might restrict dispersal of SRE species. Habitat mapping took into account current knowledge of the ecology of SRE invertebrates.

3.1. SRE Species in the Search Area

One hundred and fifty taxa (i.e. species, morphotypes and higher-order identifications where species level identification could not be achieved) belonging to SRE Groups have been recorded in the search area (Table 1, Figure 1). Of these, 14 species (9%) are confirmed SRE species. These include four trapdoor spiders, nine millipedes and a land snail. The distributions of these taxa in relation to the Project are discussed in Section 3.1.1.

Seventy-four species (49% of the fauna) were categorised as Potential SREs owing to deficient data (principally lack of information about likely range because of few species records). Sixty-two species (41%), including two invasive species, are known to be widespread, or are likely to be widespread based on ecological information or the distributions of closely-related species. In reality, most Potential SREs are also likely to be widespread.

Table 1. Records of SRE Group and listed invertebrate fauna in the search area.
The list includes confirmed and potential SRE species and species that are known to be widespread, but belong to SRE Groups. All Potential SRE species are data deficient (DD). Species shaded grey are confirmed SREs.

Higher Taxonomy	Lowest Classification	Records in Search Area	SRE Status
Mollusca			
Gastropoda			
Bothriembryontidae	*Bothriembryon* `attenuate` n.sp.	1	Potential (DD)
	Bothriembryon `East Hamersley Inlet` n.sp.	1	Potential (DD)
	Bothriembryon `Hammersley Inlet` n.sp.	2	Potential (DD)
	Bothriembryon `Hopetoun` n.sp.	2	Potential (DD)
	Bothriembryon `Magenta` n.sp.	2	Potential (DD)
	Bothriembryon `maini` n.sp.	1	Potential (DD)
	Bothriembryon `mini esperantium` n.sp.	2	Potential (DD)
	Bothriembryon `Mini-melo` n.sp.	1	Potential (DD)
	Bothriembryon `Mount Barren` n.sp. group	11	Potential (DD)
	Bothriembryon `Point Ann` n.sp.	1	Potential (DD)
	Bothriembryon `Ravensthorpe` n.sp.	2	Potential (DD)
	Bothriembryon aff. balteolus	1	Potential (DD)
	Bothriembryon balteolus	3	Confirmed SRE[2, 12]
	Bothriembryon cf. `Mount Barren` n.sp.	1	Potential (DD)
	Bothriembryon cf. balteolus	3	Potential (DD)
	Bothriembryon cf. bradshawi	2	Potential (DD)
	Bothriembryon cf. maxwelli	4	Potential (DD)
	Bothriembryon cf. notatus	1	Potential (DD)
	Bothriembryon dux	72	Widespread[3]
	Bothriembryon kingii	5	Widespread[3]
	Bothriembryon melo	3	Widespread[3]
	Bothriembryon sp.	10	Potential (DD)
	cf. *Bothriembryon* sp.	2	Potential (DD)
Helicidae	*Theba pisana*	1	Invasive, Widespread[2]
Punctidae	*Insullaoma* cf. *predicta*	1	Widespread[2]
	Paralaoma caputspinulae	2	Widespread[2]
	Westralaoma cf. *aprica*	1	Widespread[2]
	Westralaoma cf. *expicta*	1	Widespread[2]
	Westralaoma sp.	4	Widespread[2]
Pupillidae	*Gastrocopta bannertonensis*	1	Widespread[2]
	Gastrocopta margaretae	4	Widespread[2]
	Pupilla australis	3	Widespread[2]
	Pupilla cf. *australis*	1	Widespread[2]
	Pupoides adelaidae	6	Widespread[2]
	Pupoides cf. *adelaidae*	2	Widespread[2]
Succineidae	*Succinea* sp.	8	Widespread[2]
Arthropoda			
Chelicerata			
Arachnida			

Higher Taxonomy	Lowest Classification	Records in Search Area	SRE Status
Araneae			
Araneomorphae			
Selenopidae	*Karaops francesae*	8	Widespread[1]
Synotaxidae	*Microsynotaxus* `sp. indet.`	1	Potential (DD)
Mygalomorphae			
Actinopodidae	*Missulena* `MYG041`	1	Potential (DD)
	Missulena `MYG289-DNA`	1	Potential (DD)
	Missulena granulosa	1	Widespread[2]
	Missulena hoggi	1	Widespread[2]
	Missulena occatoria	2	Widespread[2]
Barychelidae	*Aurecocrypta* `sp. indet. (juvenile)`	1	Potential (DD)
	Idiommata `blackwalli?`	1	Potential (DD)
	Idiommata blackwalli	2	Widespread[2]
	Synothele `pseudidiommata`	1	Potential (DD)
	Synothele rastelloides	2	Widespread[3]
Ctenizidae	*Conothele* sp.	2	Potential (DD)
Idiopidae	`Eucanippe` `Biota sp. B`	1	Confirmed SRE[13]
	`Eucanippe` `MYG072` (ex. `Biota sp. A`)	6	Confirmed SRE[13]
	Aganippe `Biota sp. D`	2	Confirmed SRE[13]
	Aganippe `Biota sp. E`	3	Confirmed SRE[13]
	Aganippe `MYG075`	1	Potential (DD)
	Aganippe `rhaphiduca group`	3	Potential (DD)
	Aganippe `rhaphiduca?`	1	Potential (DD)
	Aganippe sp. B22	6	Potential (DD)
	Aganippe sp. B25	5	Potential (DD)
	Aganippe `sp. nov.`	1	Potential (DD)
	Aganippe `twig-lining sp.`	2	Potential (DD)
	Aganippe rhaphiduca	1	Widespread[2]
	Anidiops sp. B24	1	Potential (DD)
	Anidiops `sp. A`	1	Potential (DD)
	Anidiops `sp. E?`	1	Potential (DD)
	Anidiops `sp. E`	1	Potential (DD)
	Anidiops villosus	1	Widespread[2]
	Arbanitinae `Biota sp. C`	6	Potential (DD)
	Arbanitinae `Biota sp. D`	3	Potential (DD)
	Arbanitinae `Biota sp. E`	3	Potential (DD)
	Blakistonia `MYG451`	1	Potential (DD)
	Eucyrtops `MYG141`	2	Potential (DD)
	Euoplos sp.	4	Potential (DD)
Nemesiidae	`Proshermacha` `MYG346`	13	Potential (DD)
	`Proshermacha` `MYG349`	2	Potential (DD)
	Aname `Biota sp. B`	1	Potential (DD)
	Aname `Biota sp. F`	1	Potential (DD)
	Aname `Biota sp. I`	1	Potential (DD)
	Aname `kwonkoides spp. group.`	1	Potential (DD)
	Aname tepperi	5	Widespread[2]
	Chenistonia `MYG348`	5	Potential (DD)
	Chenistonia `sp. nov.`	1	Potential (DD)
	Kwonkan `sp. nov.`	1	Potential (DD)
	Merredinia `MYG454-DNA`	1	Potential (DD)
	Pseudoteyl sp.	2	Potential (DD)
	Pseudoteyl sp. (T72713)	1	Potential (DD)
	Teyl `Fitzgerald sp. 1`	1	Potential (DD)
	Teyl `MYG192`	1	Potential (DD)
	Teyl `MYG440`	1	Potential (DD)
	Teyl `MYG455`	2	Potential (DD)
	Teyl `MYG456`	1	Potential (DD)
	Teyl `sp. nov.`	1	Potential (DD)
	Yilgarnia `sp. indet. (female)`	1	Potential (DD)
Opiliones			
Neopilionidae	*Ballarra longipalpus*	1	Widespread[4]

Higher Taxonomy	Lowest Classification	Records in Search Area	SRE Status
	Enantiobuninae `Genus indet.` `sp. indet. (juvenile)`	2	Potential (DD)
Triaenonychidae	*Nunciella* sp.	2	Potential (DD)
Pseudoscorpiones			
Chthoniidae	*Austrochthonius* `duchaci`	18	Widespread[#]
	Austrochthonius `similis`	1	Widespread[#]
	Austrochthonius muchmorei	1	Widespread[3]
	Lagynochthonius australicus	12	Widespread[3]
Tridenchthoniidae	*Dithella* sp.	1	Potential (DD)
Panctenata			
Atemnidae	*Oratemnus* sp.	1	Widespread[#]
Cheliferidae	*Protochelifer* `PSE083`	1	Widespread[#]
Chernetidae	*Nesidiochernes* sp.	1	Widespread[#]
Garypidae	*Synsphyronus callus*	1	Widespread[5]
	Synsphyronus francesae	2	Widespread[6]
	Synsphyronus lathrius	2	Widespread[5]
	Synsphyronus mimulus	5	Widespread[5]
Garypinidae	*Amblyolpium* `sp. WA1`	2	Potential (DD)
	Protogarypinus giganteus	3	Widespread[3]
Geogarypidae	*Geogarypus taylori*	2	Widespread[7]
Olpiidae	*Austrohorus* sp.	1	Potential (DD)
	Beierolpium sp.	1	Potential (DD)
Scorpiones			
Bothriuridae	*Cercophonius sulcatus*	8	Widespread[2]
Buthidae	*Isometrus* `sp. (fem?)`	1	Widespread[#]
	Lychas `austroccidentalis`	17	Widespread[#]
	Lychas `austroccidentalis` ms	27	Widespread[#]
	Lychas jonesae	1	Widespread[2]
Urodacidae	*Urodacus* `armatus`	1	Widespread[#]
	Urodacus novaehollandiae	60	Widespread[#]
	Urodacus `novaehollandiae?`	11	Widespread[#]
	Urodacus `sp 1`	2	Widespread[#]
	Urodacus `twotone-spiny?`	1	Widespread[#]
	Urodacus novaehollandiae	20	Widespread[2]
	Urodacus sp.	1	Widespread[#]
Myriapoda			
Chilopoda			
Geophilida			
Chilenophilidae	*Ribautia* sp. B04	1	Potential (DD)
Mecistocephalidae	*Mecistocephalus* sp.	1	Potential (DD)
Lithobiomorpha			
Henicopidae	*Henicops dentatus*	1	Widespread[8]
Scolopendrida			
Scolopendridae	*Arthrorhabdus* sp.	2	Widespread[#]
	Cormocephalus hartmeryeri	2	Widespread[9]
	Cormocephalus michaelseni	2	Widespread[9]
	Cormocephalus strigosus	1	Widspread[2]
	Cormocephalus turneri	3	Widspread[2]
Scutigerida			
Scutigeridae	`Prothereura?` sp.	1	Widespread[#]
	Parascutigera `sp.`	3	Widespread[#]
Diplopoda			
Julida			
Julidae	*Ommatoiulus moreleti*	1	Invasive, Widespread[2]
Polydesmida			
Paradoxosomatidae	*Antichiropus* `East Mt Barren`	1	Confirmed SRE[13]
	Antichiropus `FNP`	1	Confirmed SRE[13]
	Antichiropus cuspis	22	Confirmed SRE[10]
	Antichiropus equinus	1	Confirmed SRE[10]
	Antichiropus exclamatus	1	Widespread[10]
	Antichiropus lacustrinus	1	Confirmed SRE[10]

Higher Taxonomy	Lowest Classification	Records in Search Area	SRE Status
	Antichiropus sp.	1	Potential (DD)
Polyxenida	Polyxenida sp.	13	Widespread[#]
Polyzoniida	Polyzoniida sp.	1	Potential (DD)
Spirostreptida			
Iulomorphidae	*Atelomastix* `psittacina? (female)`	3	Potential (DD)
	Atelomastix gibsoni	15	Confirmed SRE[11]
	Atelomastix lengae	2	Confirmed SRE[11]
	Atelomastix psittacina	21	Confirmed SRE[11]
	Podykipus `East Mt Barren`	5	Confirmed SRE[13]
Crustacea			
Malacostraca			
Isopoda			
Armadillidae	*Acanthodillo* sp. B20	1	Potential (DD)

[1]Crews and Harvey 2011; [2]ABRS 2009; [3]ALA; [4]Hunt and Cokendolpher 1991; [5]Harvey 1987; [6]Harvey 2010; [7]Harvey 1986; [8]Hollington and Edgecombe 2004; [9]Colloff et al 2005; [10]Car and Harvey 2014; [11]Edward and Harvey 2010; [12]Breure and Whisson 2012; [13]Framenau et al. 2008; [#]Based on ecological information or distributions of closely-related species.

3.1.1. Confirmed SRE Species

Trapdoor spiders

Mygalomorph spiders frequently have restricted distributions given their poor dispersal capabilities, sedentary habit and specific habitat requirements (Framenau et al. 2008). Four species from two genera of the family Idiopidae that have been recorded in the search area are Confirmed SREs. *Aganippe* `Biota sp. D` and *Aganippe* `Biota sp. E` have been recorded from two and three locations, respectively, within the vicinity of the Project area. Both species have been recorded in reference areas. `Eucanippe` `MYG072` (formerly recorded as `Biota sp. A`) is known from six sites in the vicinity of the Project area, including reference areas, while `Eucanippe` `Biota sp. B` is known from a single reference location near the Project area. It is noted that the family Idiopidae is currently under review by Dr. Michael Rix (WAM) and resolved systematics may implicate changes to the SRE status of some taxa.

***Bothriembryon* snails**

Species within the diverse, Australian-endemic land snail genus *Bothriembryon* commonly exhibit patchy distributions. The genus is currently under review by Corey Whisson (WAM) and resolved systematics may implicate changes to the SRE status of some taxa. There are a large number (23) of records of *Bothriembryon* from the search area, mostly identified by morphospecies codes. One confirmed SRE species, *B. balteolus*, may to occur at the Project. While the only confirmed record of the species is from the type locality, some 20 km east of the Project, two records that are likely to be conspecific (*B.* aff. *balteolus* and *B.* cf. *balteolus*) were collected 22 km and 27 km, respectively, west of the Project. Three other described *Bothriembryon* species (*B. dux*, *B. kingi* and *B. melo*) have been recorded inside the search area, but are confirmed to have widespread distributions.

***Antichiropus* millipedes**

Millipedes of the family Paradoxosomatidae, including those of the highly speciose genus *Antichiropus*, are litter dwellers that are susceptible to desiccation and generally depend on localised relict habitats with suitably moist microclimates (Sierwald and Bond 2007; Car and Harvey 2014). A high proportion of southwestern Australian *Antichiropus* species are SREs and have very limited distributions and poor capabilities of dispersal, with some species restricted to isolated granite outcrops that act as genetic islands within the landscape (Car and Harvey 2014), although one species (*A. variabilis*) is widespread.

Six *Antichiropus* species have been recorded within the search area. These include three confirmed SRE species: *A. cuspis*, *A. equinus* and *A. lacustrinus*. Based on 19 records in WAM databases *A. cuspis* may occur at the Project and has also been recorded some 117 km southeast of the Project at Bremer Bay (Car and Harvey 2014). *A. equinus* is known only from the type locality near Lake King approximately 62 km northwest of the Project and is considered unlikely to occur in the Project area. *A.*

lacustrinus is known from Lake King, approximately 62 km north of the Project, as well as the Helena-Aurora Range (Car and Harvey 2014) and is also unlikely to occur at the Project. In addition, two potential SRE species, *A.* `East Mt Barren` and *A.* `FNP`, have been recorded southwest of the Project in the Fitzgerald River National Park. The widespread *A. exclamatus*, which has a known linear range of 380 km, has been recorded northeast of the Project.

***Atelomastix* and *Podykipus* millipedes**

Like *Antichiropus*, a vast proportion of species within the extremely diverse genus *Atelomastix* (family Iulomorphidae) are known to be SREs, with few species occupying ranges of more than 1,000 km^2 (Edwards and Harvey 2010). At least 28 species have been described, including 27 southwestern Australian endemics and another species from Victoria. They are susceptible to desiccation, restricted to relict habitats that are commonly fragmented within the landscape and have low dispersal capabilities (Edwards and Harvey 2010).

Three or four species of *Atelomastix* have been collected within the search area (Table 2), three of which are confirmed SREs: *A. gibsoni*, *A. lengae* and *A. psittacina*. *Atelomastix gibsoni* has been recorded at a number of sites in the vicinity of the Project, including a location some 15 km to the northwest. *Atelomastix lengae* is only known from the type locality, some 40 km southwest of the Project in the Eyre Range within the Fitzgerald River National Park. *Atelomastix psittacina* has also been recorded 90 km southwest of the Project. A possible fourth species, *Atelomastix* 'psittacina? (female)', was represented by female specimens that could not definitively be assigned to a species, although it is considered likely they are *A. psittacina*.

Podykipus `East Mt Barren`, which also belongs to the family Iulomorphidae, is a confirmed SRE species (Framenau et al. 2008). It has been recorded from nine locations within a restricted area around Mt Barren southwest of the Project. Two of the existing records fall outside the search area.

3.2. Listed Species in the Search Area

No formally listed invertebrate species are known to occur within the search area. One Priority (P1) species, the planthopper *Budginmaya eulae* (family Flatidae) occurs in the vicinity of the Project. This species is symbiotic with the ant *Camponotus terebrans* and was discovered within a single ant nest under a rock (Fletcher and Moir 2009). *Budginmaya eulae* is therefore known only from the type locality that is close to, but outside, the proposed development envelope at the Hale-Bopp deposit in mallee heath on duplex clayey sand habitat (see Section 3.3). This habitat type is widespread in the study area.

3.3. Assessment of SRE Habitats

Habitat types, in the context of their prospectivity for SRE invertebrates, were characterised and mapped across the study area surrounding the Project (Figure 5) based on previous vegetation and habitat assessments by Western Botanical (2005) and Terrestrial Ecosystems (2015). Using soil, drainage and vegetation information, those two studies identified seven habitats types and 17 habitat subunits, within two landform categories, namely hills and upper slopes, and lower slopes and plains, gently undulating to flat. Habitat subunits are modified, amalgamated or refined here based on observations in the field and the relevance of habitat particular characteristics to SRE fauna (Figure 5; Table 2). For the purpose of the current assessment, 20 subunits in seven habitat types are recognised in the study area. A brief description of each habitat type, with reference to its suitability as SRE habitat, is given below.

Mallee shrubland or mallet woodland, impeded vertical drainage

This habitat type is located on hills and upper slopes and is characterised by vegetation dominated by small-to-medium (1–4 m) *Eucalyptus* over a moderately-dense understorey of diverse shrubs, grasses and herbs; relatively compact white-to-red lateritic soils; and impeded vertical drainage. Four subunits occur in this habitat type (Figure 5; Table 2), two of which were sampled in the current study (laterite

mallee shrubland, and mallee heath on komatiite). This habitat has little prospectivity for SRE fauna because of its uniformly exposed topography, poor moisture retention and lack of adequate moist microhabitats (deep leaf litter, decomposing logs, etc.) and specialist habitats (e.g. rock piles). One subunit, lateritic saprolite breakaway (LSBr), may have slightly higher prospectivity but was not surveyed.

Mallee shrubland, free draining

This habitat type containing a single subunit, sandy silcrete thicket (SST), occurs on hills and upper slopes and is characterised by small-to-medium (1-4 m) Eucalyptus over a dense understorey of Banksia and other shrubs; white, sandy soils with some laterite; and free drainage. Sites were observed to have substantial quantities of leaf litter but due to low moisture retention, moisture content and rates of decomposition were low, so that the habitat is inferred to have low SRE prospectivity. The habitat is moderately extensive throughout the southern portion of the study area (Figure 5; Table 2).

Carbonate influenced soils, free-draining

Small patches of this habitat type occur near the Halle-Bop deposit area, as well as off-tenement to the south of the Corridor. There was no sampling site within this habitat. One subunit, magnesite mallet woodland (with *Eucalyptus purpurata*) (WMp) is predicted to be moderately prospective for SRE invertebrates. Woodland sites elsewhere in the study area were observed to have moderate amounts of moist leaf litter and other detritus that may provide habitat for SRE groups. However, the woodland habitats sampled (DrW, WF and WC) were deemed to have moderate-to high prospectivity as they have impeded vertical drainage and probably retain moisture better than free-draining woodlands.

Heath, relatively free-draining

Free-draining heathland occurs on hills and upper slopes but is relatively rare within the study area, with a moderately-sized area in the corridor and several smaller patches in the central and southern portions of the study area. Vegetation within this habitat is dominated by low shrubs of low to moderate density. Four heathland subunits are recognised in the area and two were sampled in the current study. Two heathland sites (9 and 17) occur on free-draining, sandy soils over granite; the prospectivity of this subunit is low due to high exposure, low moisture retention and the lack of suitable refugia (leaf litter, etc.) or specialist microhabitats. In contrast, heathland on outcropping granite (HGO) is moderately to highly prospective for SRE fauna. Despite being exposed and sparsely-vegetated, granite outcrops often provide specialist microhabitats such as flat cobbles. Additionally, depressions in outcropping rocks may contain pockets of organic-rich soils that retain moisture and thus provide habitat for relict fauna (e.g. millipedes). Granite outcrops also tend to be isolated within the wider landscape, thus acting as islands between which gene flow is restricted, leading to a high prevalence of SRE species. Three heathland sites on granite outcrops were sampled (19, 20 and 21).

Mallee shrubland or woodland, impeded vertical drainage

This habitat type, which occurs on lower slopes and plains, is in fact quite diverse and contains four subunits that vary in terms of vegetation, soil and moisture retention. One subunit, mallee heath on duplex clayey sands (MHD), is widespread throughout the study area, particularly in the southern portion, and is considered to be of low SRE prospectivity due to high exposure, low moisture retention and relative lack of relictual specialist microhabitats. Conversely, the remaining three subunits are moderately to highly prospective for SRE invertebrates. The subunits are characterised by various woodlands, including low to medium mallee (DrW), medium-to-tall stands of mixed mallee/mallet (WC) and tall, open mallet (WF). All three subunits have relatively large amounts of moist soil leaf litter; and good moisture retention, including areas of surface pooling. The subunits are less-extensive across the study area than MHD (Figure 5; Table 2).

Table 2. Habitat types within the Project area (adapted from Terrestrial Ecosystems 2015).
Site codes in red text are impact sites.

Description of Habitat			Code	SRE Prospectivity	No. of Sites	Site Codes
Location	**Habitat Type**	**Subunit**				
Hills and upper slopes	Mallee shrubland or mallet woodland, impeded vertical drainage	Laterite mallee shrubland	LMS	Low	1	6
		Lateritic saprolite breakaway	LSBr	Low-moderate	-	-
		Mallee heath on komatiite	MHK	Low	2	14, 15
		Rocky calcareous loam woodland	RCLW	Low-moderate	-	-
	Mallee shrubland, free-draining	Sandy silcrete thicket	SST	Low	2	12, 13
	Carbonate influenced soils, free-draining	Magnesite mallee shrubland	MMS	Low	-	-
		Magnesite mallet woodland (with *Eucalyptus purpurata*)	WMp	Moderate	-	-
	Heath, relatively free-draining	Heath on sand over granite	HSG	Low	2	9, 17
		Heath on granite outcrop	HGO	Moderate-high	3	19, 20, 21
		Heath on silcrete	HS	Low	-	-
		Heath on Komatiite	HK	Low	-	-
Lower slopes and plains, gently undulating to flat	Mallee shrubland or woodland, impeded vertical drainage	Mallee heath on duplex clayey sand	MHD	Low	2	5, 7, 10, 18
		Woodland (*Eucalyptus cernua*) on clay	WC	Moderate-high	2	2, 22
		Drainage line woodland	DrW	High	4	1, 3, 4, 11
		Mallet woodland on floodplain	WF	High	1	8
	Free-draining sandplain	Sand sheet over laterite mallee shrubland	SLMS	Low	2	
		Sand sheet mallee shrubland in depressions	SSMS	Low	2	23, 24
		Sand sheet mallee shrubland over paleosol clay	SCMS	Low	1	16
		Sand sheet heath in depressions	SSH	Low	-	-
	Carbonate influenced soils, free-draining	Magnesite mallee shrubland	MMS	Low	-	-

Free-draining sandplain

Four subunits occur in this lowland habitat and are separated based on variation in soil type, although vegetation units are largely similar. All subunits are characterised by low vegetation; sandy, free-draining soils; and low moisture retention. Microhabitats suitable for SRE groups are lacking and all four subunits are of low prospectivity. Sandplains are extensive in the northern portion of the study area (Figure 5; Table 2).

Carbonate influenced soils, free-draining

This habitat containing a single subunit, magnesite mallee shrubland (MMS), was not sampled during the current study because most, if not all, occurrences are located outside the FQM tenement. Given the likely high exposure and low moisture retention of this habitat type, as well as the lack of suitable microhabitats in other shrubland subunits across the study area, MMS probably offers low prospectivity for SREs.

3.3.1. Overview of SRE Habitat Prospectivity

Landscapes in the Project area are heterogeneous, comprising a mosaic of units that are continuous with habitat units in the wider Esperance region. The majority of habitat subunits identified in the study area are exposed, relatively xeric and do not contain enough suitable relict or specialist microhabitats as to be considered particularly prospective for SRE invertebrates. However, several subunits offer more suitable habitats for relict and specialist SRE species. In particular, these include the three types of woodland (WC, DrW and WF), whose vegetation and impeded drainage are likely to provide better moisture retention than other habitats, and granite outcrops (HGO), which are isolated within the wider landscape and may provide habitat for specialist groups such as selenopid spiders and some pseudoscorpions.

4. FIELD SURVEY

4.1. Methods

A single-phase field survey in and around the Project area targeting SRE invertebrate groups was conducted between 28 March and 2 April 2017. The specific objectives of the survey were:

1. To further characterise habitat types identified during the desktop review and to appraise SRE prospectivity;
2. To characterise the SRE invertebrate fauna of the Project area by making targeted field collections; and
3. To assess the distribution and SRE status of recorded species relative to the Project and habitat units.

4.1.1. Field Methods

Survey design and methods were based on *Technical Guidance: Sampling of short range endemic invertebrate fauna* (EPA 2016a) and aimed to collect species within the recognised SRE Groups (Chilopoda, Diplopoda, Selenopidae, Mygalomorphae, Scorpiones, Pseudoscorpiones, Opiliones, Platyhelminthes, Megadrilacea, Isopoda and Gastropoda) from the suite of habitat types encompassed by proposed developments at the Project and corresponding reference areas. A total of 24 sites were surveyed, comprising 13 impact and 11 reference sites across three development areas: Shoemaker-Levy, Hale-Bopp and the conveyor-belt Corridor (Table 1; Figure 3). Sampling effort was concentrated in suitable microhabitats within each site, such as deposits of leaf litter, detritus and moist soil; under rocks and rock piles; in and under logs; and around the base of large vegetation. A complete summary of sampling site characteristics, methods and effort is given in Appendix 2.

Table 3. Distribution of sampling sites for SRE invertebrates at the Project in 2017.

	No. of Sites	Site Codes	Habitat Subunits
Reference	11		
Corridor	6	9, 10, 11, 18, 20, 21	HSG, MHD, DrW, HGO
Hale-Bopp	2	12, 15	SST, MHK
Shoemaker-Levy	3	4, 22, 24	DrW, WC, SSMS
Impact	13		
Corridor	4	8, 16, 17, 19	WF, SCMS
Hale-Bopp	2	13, 14	SST, MHK
Shoemaker-Levy	7	1, 2, 3, 5, 6, 7, 23	DrW, WC, LMS, MHD, SSMS

Specific sampling techniques employed included hand foraging, cup traps, turning over and breaking apart logs and rotting wood, turning over rocks, sieving leaf litter and other detritus, use of a blower vac to remove leaf litter and reveal burrows, excavating burrows with hand trowels, peeling bark and spotlighting for scorpions with ultraviolet (UV) head torches. At several sites it was impractical to excavate all burrows because of their frequency, so visual observations were used to estimate abundance of some species, particularly *Urodacus* scorpions. Sampling methods varied appropriately

at each site according to habitat, knowledge of the biology of specific taxa and visual observations of burrows or other tell-tale signs of the presence of SRE invertebrates. Collected specimens were placed in 100% ethanol and transported to the laboratory for identification. In addition to the specimens collected in the field, leaf litter samples (approximately 1 L per sample) were placed in calico bags and transported to the laboratory and placed in Tullgren funnels to collect soil invertebrates.

4.1.2. Climate

It is recognised that many SRE species are particularly active after rainfall (Harvey 2002) and recommended survey periods reflect this (EPA 2016a). In the four weeks prior to field survey (28 February–28 March), a total of 13.4 mm of rain was recorded at Bureau of Meteorology weather station no. 10633 (Ravensthorpe), although a total of 86 mm was recorded for the month of February. Daily maximum and nightly minimum temperatures during survey were 19.0–27.0°C and 7.5 –12.5°C, respectively.

4.1.3. Laboratory Methods

Specimens collected in the field were identified under dissecting and compound microscopes using appropriate taxonomic resources and in-house expertise. Every effort was made to align species recorded in the 2017 survey with those previously collected in the vicinity. This included comparing specimens from 2017 with those lodged at WAM from previous surveys if possible. However, some specimens at WAM were unavailable for comparison (J. Waldock, WAM, pers. comm., April 2017), including many mygalomorph spiders and particularly the family Idiopidae because they were on loan or could not be located in the WAM collections. A complete list of WAM specimens that were available for comparison is given in Appendix 3.

4.2. Personnel

Field survey was conducted by Michael Curran and Anton Mittra. Species identifications were completed by Jane McRae, Michael Curran and Anton Mittra. Reporting was completed by Anton Mittra and maps were compiled by Mike Scanlon and Michael Curran.

5. SURVEY RESULTS

A total of 574 specimens representing all seven targeted SRE Groups were collected at sites in and around the Project (Table 4). The specimens represent 42 species from SRE Groups. Eight higher-level taxa were also recorded (where species identification was not possible) but the specimens assigned to these taxa may belong to recorded species and were therefore not included in estimates of richness to avoid artificial inflation. A full list of species and collection locations, including higher-level taxa, is given in Appendix 3.

The most abundantly recorded species was the burrowing scorpion *Urodacus* sp. B13 (pale yellow). A high proportion of the recorded abundance of this species comes from visual observations of burrows rather than specimens collected. Isopods were also collected in relatively high abundance, with specimens mostly belonging to the family Philosciidae.

Two of the species collected are confirmed SREs. These are the millipede *Antichiropus cuspis* and the land snail *Bothriembryon* cf. *balteolus*. *Antichiropus cuspis* was recorded as single specimens at site 19 within the proposed Corridor impact area and at reference site 21. It has previously been recorded outside the Project area. *Bothriembryon* cf. *balteolus* was recorded at both impact and reference sites, with six specimens at two impact sites within the Hale-Bopp deposit and three specimens at two reference sites. The species has also been recorded outside the Project area.

Eighteen species (43%) were designated as Potential SREs owing to deficient data (mostly that the intensity of survey for the species outside the current survey has been so low that nothing can be said about their likely distribution). In most cases the species are probably quite widespread.

Ten species are known to be widespread and all of these were collected outside the Project area during the 2017 survey. These species are the scorpions *Isometroides vescus*, *Lychas* `austroccidentalis`, *Urodacus novaehollandiae* and *Urodacus* sp. B13 (pale yellow), introduced isopod *Armadillidium vulgare*, centipedes *Cryptops* cf. *australis* and *Lamyctes* nr *africanus*; and snails *Bothriembryon dux*, *Westralaoma experta* and *Gastrocopta bannertonensis* (Table 4). A further 12 species are highly likely to be widespread owing to the fact that they were recorded in a range of habitat types that were both mesic and xeric. The pseudoscorpion Cheliferidae sp. is likely to be widespread as members of this family are known to disperse by attaching to mobile insects such as flies and beetles (Gabbutt 1970).

5.1. Comparison of Yields Among Habitat Types

Abundance of SRE Group specimens was greatest in the drainage woodland subunit (DrW), from which 123 specimens were collected across four sites (30.8 specimens per site) (Figure 3A). Abundance was also high at granite outcrops (HGO, 82 specimens) and mallet woodland on floodplain (WF, 109 specimens). When abundance was corrected for the number of sites sampled within each subunit (Figure 3B), WF yielded the highest number of SRE Group specimens per sample (109.0), followed by SST (31.0), DrW (30.8) and HGO (27.3). Exposed habitats with poor moisture retention (heathland, shrubland and sandplains) generally yielded low abundances. Results broadly reflect that SRE Group species were more abundant in the habitat subunits that were predicted to be prospective (Section 3.3).

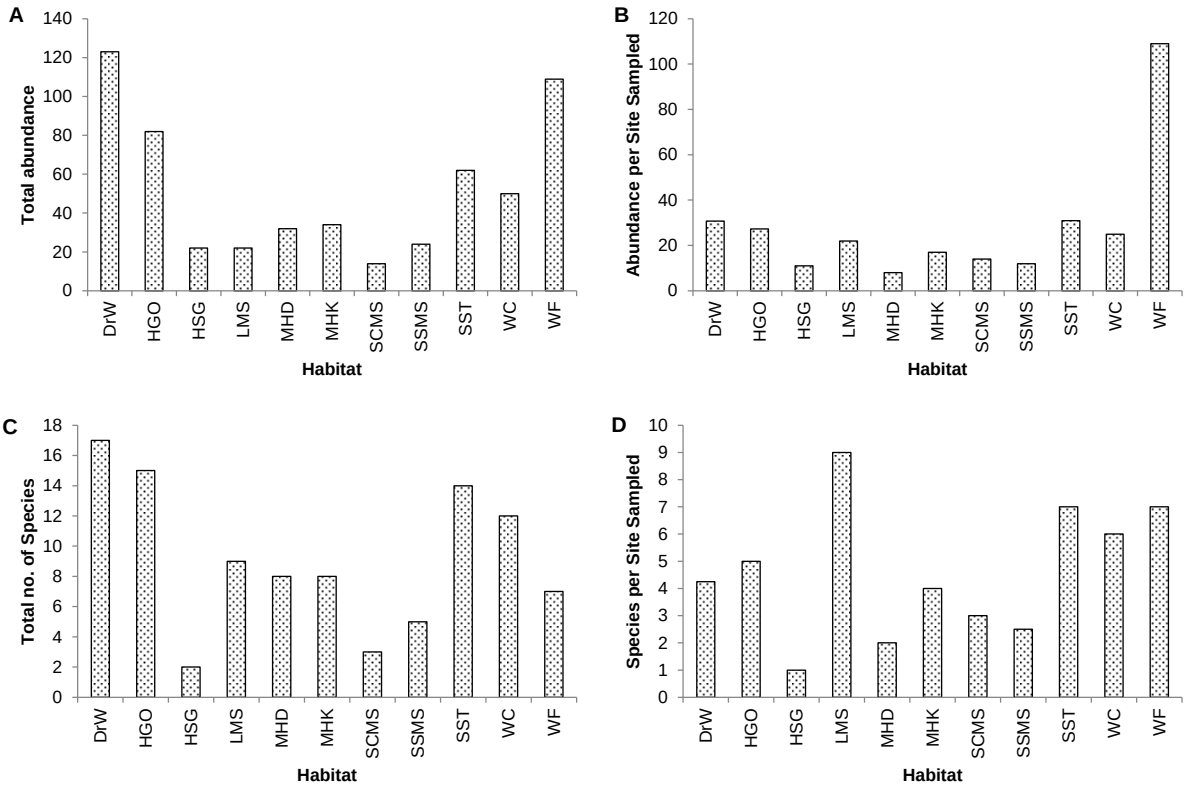

Figure 3. Yields of SRE invertebrates from each habitat subunit sampled.
(A) total abundance; (B) abundance per site sampled; (C) number of species; and (D) number of species per site.

Species richness was highest in the DrW subunit (17 species), while 15, 14 and 12 species were recorded in HGO, SST and WC, respectively (Figure 3C). Correcting for the number of sampling sites in each subunit (Figure 3D), laterite mallee shrubland (LMS) produced the highest number of species per sample (9), followed by SST and WF (both 7) and WC (6). Relatively high richness in woodland and granite outcrop habitats agrees with the relatively high predicted prospectivity of these areas. The high number of species in the un-prospective SST and LMS subunits does not. The richness in the SST

subunit may be associated with the piles of loose, rocky earth created as a result of the construction of drill tracks, or it may reflect an underestimation of the amount of shade cover at sites within the habitat. It is unclear why a relatively high number of SRE-group species were recorded in the LMS habitat subunit, in which a single site (site 6) was sampled. Based on field observations, site 6 offered very little SRE habitat and held little moisture; however, it was one of few sites situated on a south-facing slope and may be protected from direct sunlight during most of the year, thus offering a temporally-stable habitat for invertebrates.

5.2. Potentially Restricted Species

Thirteen species were recorded only in impact areas (Table 4). Three of these species are known to be widespread; the spider-hunting scorpion *Isometroides vescus* is distributed across much of Australia (ABRS 2009) and in addition, specimens highly likely to be this species (*Isometroides* cf. *vescus*) were recorded in reference areas. Both the isopod *Armadillidium vulgare* and the centipede *Lamyctes* nr *africanus* are introduced cosmopolitan species (ABRS 2009). The distributions and conservation implications of the remaining 10 species are discussed below. Nine of these species are classed as Potential SRE because they are data deficient and one, *Aname* sp. B28, is inferred to be widespread for habitat reasons.

Mygalomorphae

Four species of mygalomorph (trapdoor spiders) from two families were only recorded at sites within impact areas (Table 5; Figure 6). All specimens were excavated from burrows. Within the family Idiopidae, *Anidiops* sp. B14 (*villosus* group) was recorded as a singleton at site 3 (DrW subunit) in the north-western section of the Shoemaker-Levy deposit, while its congener *Anidiops* sp. B15 was recorded as a singleton at site 23 (SSMS subunit) in the south-eastern Shoemaker-Levy area. Both species are Potential SREs (data deficient).

Owing to a current taxonomic review of the family Idiopidae, WAM specimens were largely unavailable for morphological comparison, so it is not possible to determine whether these species have been previously collected from surrounding areas. However, it should be noted that 23 idiopid species, including five *Anidiops*, have previously been recorded in the search area of the desktop review (Table 1).

Records show that *Anidiops villosus* is a widespread species previously collected in the vicinity of the Project area but it is uncertain whether *Anidiops* sp. B14 (*villosus* group) is *Anidiops villosus* or a related species. A precautionary approach has been adopted in treating *A.* sp. B14 (*villosus* group) as a separate species. Even so, it is unlikely to be restricted to the Project impact area because the drainage line woodland habitat from which it was collected extends both north and south of the collection site along a continuous tributary. The same habitat occurs throughout Project area and wider region (Figure 5). The collection of *Anidiops* sp. B14 (*villosus* group) as a single specimen probably reflects its low abundance within the landscape, but the species' distribution is likely to cover many other areas of drainage line woodland habitat.

The collection of *Anidiops* sp. B15 as a single specimen at site 23 (SSMS) again probably reflects the low abundance of the species. Based on both habitat mapping and observations in the field, SSMS habitat occurs beyond the area encompassed by the collection site, including reference areas that are continuous with the collection location at site 23 (Figure 5). However, the SSMS habitat unit has little prospectivity for SRE species and it is likely for habitat reasons that *Anidiops* sp. B15 is actually widespread. Other widespread sandplain units (SCMS, SLMS, SSH) may provide suitable habitat for *A.* sp. B15.

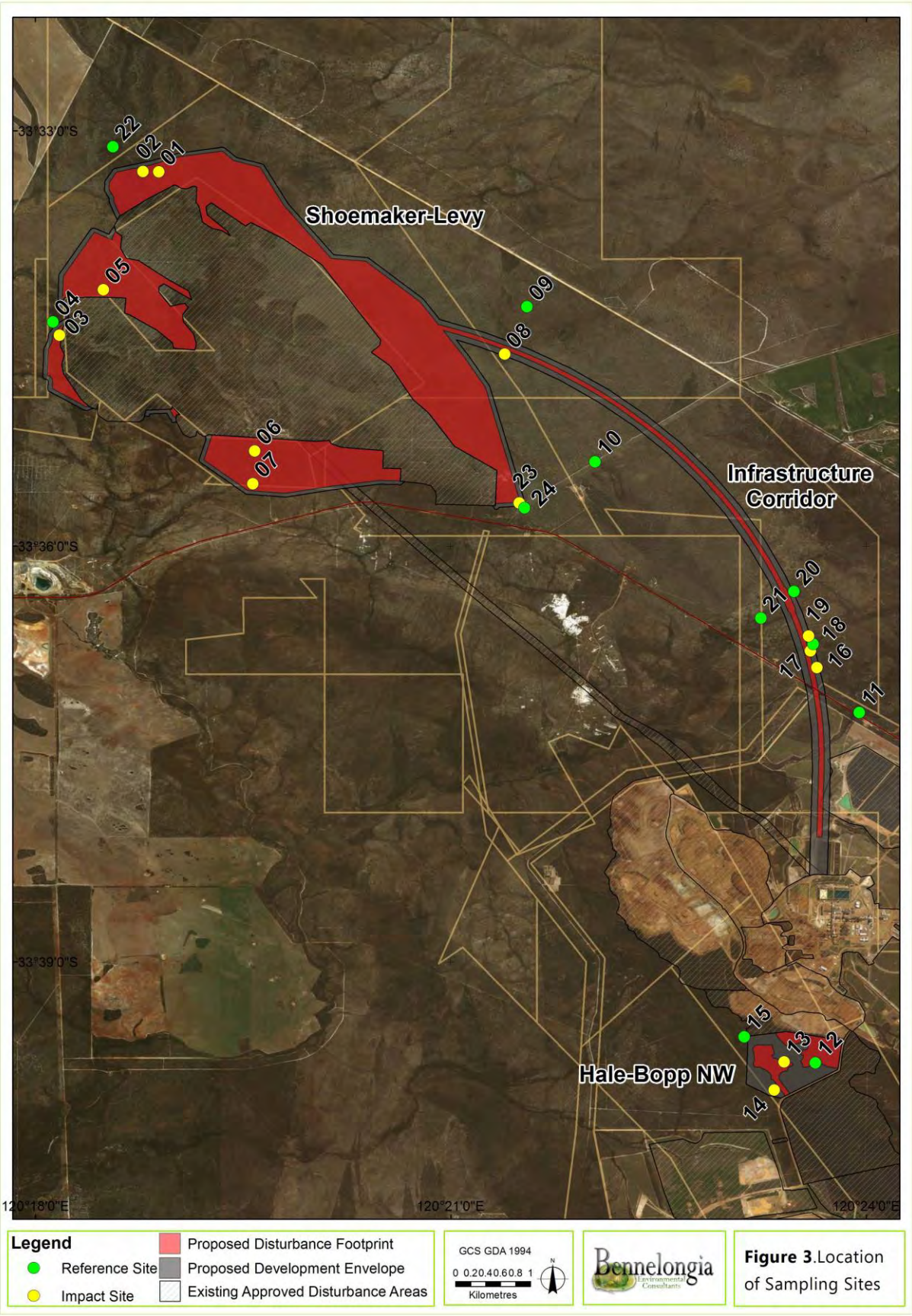

Figure 4. Locations of sampling sites throughout the Project area in 2017.

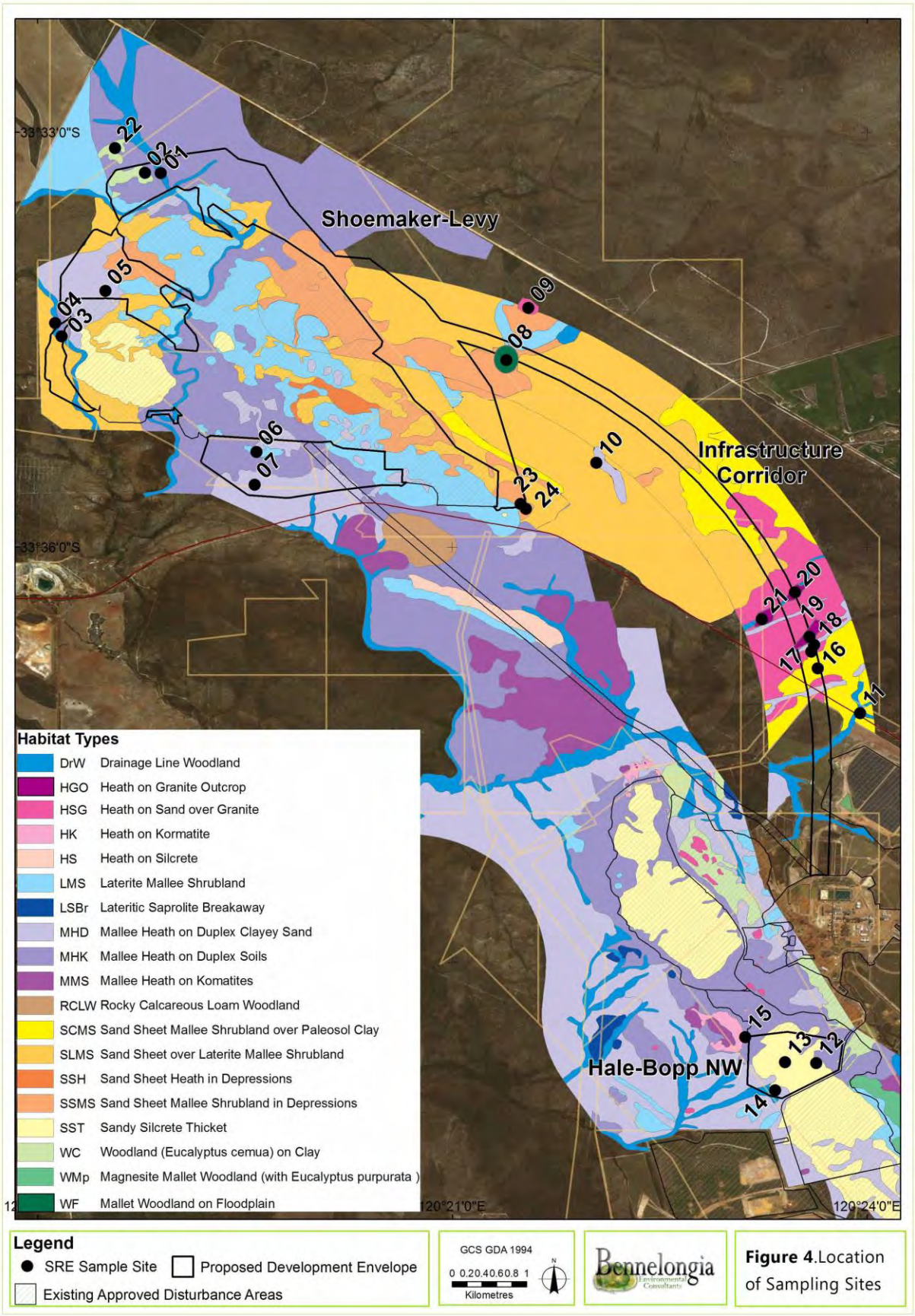

Figure 5. Sampling sites at the Project in 2017 in the context of habitat types.

Table 4. Invertebrates belonging to SRE groups recorded in and around the Project area in 2017.
Species shaded in grey were only recorded in Project impact areas. W= widespread; W^H= widespread based on collections in multiple habitats; W^E= widespread based on ecological information; DD= deficient data.

Higher Classification	Lowest Classification	SRE Status	Control		Impact	
			Total Abundance	No. of Sites	Total Abundance	No. of Sites
Chelicerata						
Arachnida						
Araneae						
Barychelidae	*Synothele* sp. B15 (*rastelloides* group)	W^H	2	2	3	3
Idiopidae	*Aganippe* sp. B22	W^H	1	1	1	1
	Aganippe sp. B23	Potential (DD)	1	1		
	Aganippe sp. B25	W^H	4	4	1	1
	Anidiops sp. B13	Potential (DD)	1	1		
	Anidiops sp. B14 (*villosus* group)	Potential (DD)			1	1
	Anidiops sp. B15	Potential (DD)			1	1
	Anidiops sp. B24	W^H	1	1	1	1
	Eucyrtops sp. B08	Potential (DD)	2	2	3	3
	Eucyrtops sp. B09	Potential (DD)	1	1		
	Eucyrtops sp. B10	Potential (DD)	1	1	2	2
Nemesiidae	*Aname* sp. B28	W^H			2	2
	Aname sp. B29 (*mainae* group)	Potential (DD)			1	1
Pseudoscorpiones						
Cheliferidae	Cheliferidae sp.	W^E	1	1		
Chthoniidae	*Austrochthonius* sp. B08	Potential (DD)			1	1
Olpiidae	*Beierolpium* 8/4 sp. B16	Potential (DD)			4	2
	Indolpium sp. B28	Potential (DD)	1	1		
Scorpiones						
Buthidae	*Isometroides vescus*	W^1			1	1
	Lychas `austroccidentalis` ms	W^1	7	5	13	4
Urodacidae	*Urodacus novaehollandiae*	W^1	4	2	1	1
	Urodacus sp. B13 (pale yellow)	W	78	8	165	11
Crustacea						
Malacostraca						
Isopoda						
Armadillidae	*Acanthodillo* sp. B18	Potential (DD)	1	1		
	Acanthodillo sp. B19	Potential (DD)	3	1		
	Acanthodillo sp. B20	W^H	1	1	4	1
	Acanthodillo sp. B21	Potential (DD)			2	1
	Armadillidium vulgare	W^1			1	1
	Buddelundia sp. B71	W^H	11	3	8	4
	Buddelundia sp. B73	W^H	1	1	1	1
	Pseudodiploexochus sp. B01	Potential (DD)			3	2
Philosciidae	Philosciidae sp. B37	W^H	15	1	6	1
	Philosciidae sp. B38	W^H	11	4	64	11
Platyarthridae	*Trichorhina* sp. B32	Potential (DD)			8	1

Higher Classification	Lowest Classification	SRE Status	Control		Impact	
			Total Abundance	No. of Sites	Total Abundance	No. of Sites
Myriapoda						
Chilopoda						
Geophilida						
Chilenophilidae	*Ribautia* sp. B04	Potential (DD)	1	1		
	Ribautia sp. B05	Potential (DD)			1	1
Mecistocephalidae	*Mecistocephalus* sp. B09	W^H	6	2	16	7
Lithobiomorpha						
Henicopidae	*Lamyctes* nr *africanus*	W^1			2	1
Scolopendrida						
Cryptopidae	*Cryptops* cf. *australis*	W^1	2	2	2	2
Diplopoda						
Polydesmida						
Paradoxosomatidae	*Antichiropus cuspis*	Confirmed SRE[2]	1	1	1	1
Mollusca						
Gastropoda						
Stylommatophora						
Placostylidae	*Bothriembryon* cf. *balteolus*	Confirmed SRE[1,3]	3	2	6	2
	Bothriembryon dux	W^2	2	1	32	3
Punctidae	*Westralaoma experta*	W^1	4	3	4	3
Pupillidae	*Gastrocopta bannertonensis*	W^1	2	2	5	2

[1]ABRS (2009); [2]Car and Harvey 2014; [3]Breure and Whisson 2012.

One species of the family Nemesiidae was recorded only from impact sites (Table 5; Figure 6). *Aname* sp. B29 (*mainae* group) is treated as a Potential SRE (data deficient). It was recorded as a singleton from site 17 (HSG) within the central Corridor impact area. This habitat subunit has little prospectivity for SRE species and occurs in and outside the Project area (Figure 5). Thus, *Aname* sp. B29 (*mainae* group) is considered unlikely to be restricted to the Project area or, in fact, to be an SRE species. The species probably occurs at low abundance (hence a single specimen was collected) across much of the Fitzgerald subregion of the wider Esperance Plains Bioregion.

Table 5. Distribution of species recorded in impact areas only.
Habitat types follow the system presented in Table 2.

Taxonomy	Total Abundance	No. of Sites	Site Code(s)	Habitat Types
Araneae : Mygalomorphae				
Idiopidae				
Anidiops sp. B14 (*villosus* group)	1	1	3	Drainage line woodland (DrW)
Anidiops sp. B15	1	1	23	Sand sheet mallee shrubland in depressions (SSMS)
Nemesiidae				
Aname sp. B29 (*mainae* group)	1	1	17	Heath on sand over granite (HSG)
Pseudoscorpiones				
Chthoniidae				
Austrochthonius sp. B08	1	1	3	Drainage line woodland (DrW)
Olpiidae				
Beierolpium 8/4 sp. B16	4	2	3, 14	Drainage line woodland (DrW); Mallee heath on komatiite (MHK)
Isopoda				
Armadillidae				
Acanthodillo sp. B21	2	1	6	Laterite mallee shrubland (LMS)
Pseudodiploexochus sp. B01	3	1	2	Woodland (*Eucalyptus cemua*) on clay (WC)
Platyarthridae				
Trichorhina sp. B32	8	1	6	Laterite mallee shrubland (LMS)
Chilopoda				
Chilenophilidae				
Ribautia sp. B05	1	1	6	Laterite mallee shrubland (LMS)

Pseudoscorpiones

Two potential SRE (data deficient) pseudoscorpion species were collected only from impact sites (Table 5). Ranges of species of the pseudoscorpion genus *Austrochthonius* are poorly documented, although some epigean species of the genus are widespread (Harvey and Mould 2006). *Austrochthonius* sp. B08 was collected as a singleton at site 3 (DrW) and probably as two nymphs at site 2 (WC subunit). While both subunits are prospective for SRE species, suggesting that *A.* sp. B08 may actually be an SRE species, the subunits are sufficiently widespread and continuous across and outside the Project area for it to be unlikely that *A.* sp. B08 is restricted to the impact area.

Beierolpium 8/4 sp. B16, which was collected in a decomposing log at site 3 (DrW) and under a cobble in a dry, minor tributary at site 14 (MHK) (Figure 6), belongs to the family Olpiidae. Given the contrast between the two collection locations for this species at both broad and microhabitat scales (see Table 2), it is inferred that *Beierolpium* 8/4 sp. B16 is able to utilise a wide spectrum of habitats and is unlikely to actually be an SRE species. The two collection sites are separated by approximately 12.9 km and are interspersed by numerous habitat types. It is unlikely that this species is restricted to the development envelope.

Isopoda

Three species belonging to two isopod families were recorded only from impact sites. These are the Potential SRE (data deficient) species *Acanthodillo* sp. B21 and *Pseudodiploexochus* sp. B01 (family Armadillidae) and *Trichorhina* sp. B32 (Platyarthridae) (Figure 6).

Two specimens of *Acanthodillo* sp. B21 were collected from site 6 in a pocket of LMS subunit, which has little prospectivity for SRE species. One specimen was collected by hand foraging in leaf litter, while the other was collected in a leaf litter sample that was processed in the laboratory. It is worth noting that leaf litter at the collection site was sparse and shallow, with no pockets of litter deeper than ca. 1 cm. This suggests that *Acanthodillo* sp. B21 is able to cope with relatively xeric microhabitats and is unlikely to actually be an SRE species. Habitat subunits abutting site 6 included MHD and MHK, both of which are likely to provide leaf litter of similar quality to site 6. Sampling intensity in the LMS subunit was low (one site) and the extent of LMS habitat in reference areas, as well in as similar mallee shrubland subunits (MMS, SCMS, SSMS), suggests that *Acanthodillo* sp. B21 occurs more widely in the study area.

Three specimens of *Pseudodiploexochus* sp. B01 were collected from leaf litter at site 2 in the WC subunit. This genus appears to be a rare constituent of the Western Australian isopod fauna, with the single species described in Western Australia, *P. australiensis*, being collected from a cave near Augusta. The WC habitat subunit, which is dominated by *Eucalyptus cernua* and is moderately-to-highly prospective for SRE fauna, is relatively uncommon within the study area (Figure 5) and its wider extent is unknown, although a small pocket of the WC that did not yield *Pseudodiploexochus* sp. B01 occurs to the northwest at site 22. It appears quite likely that *Pseudodiploexochus* sp. B01 is a SRE species with an unknown distribution in and around the Project area.

Eight specimens of *Trichorhina* sp. B32 were collected from site 6 in LMS subunit. Following the reasoning for *Acanthodillo* sp. B21 above, it is considered unlikely that *Trichorhina* sp. B32 is restricted to the Project area or, in fact, is a SRE species.

Chilopoda

One Potential SRE (data deficient) species, *Ribautia* sp. B05 (family Chilenophilidae) was recorded during survey as a singleton in leaf litter at impact site 6 in the LMS habitat subunit. Considering the low intensity of sampling in the LMS subunit (one site), it is unsurprising that only a single specimen of this species was collected. The LMS subunit occurs more widely in reference areas, as do analogous subunits (MMS, SCMS, SSMS), and considering the availability of leaf litter microhabitats in other areas, it is unlikely that *R.* sp. B05 is restricted to the collection location. The LMS subunit was of low SRE prospectivity and it is therefore unlikely that *Ribautia* sp. B05 is actually a SRE species.

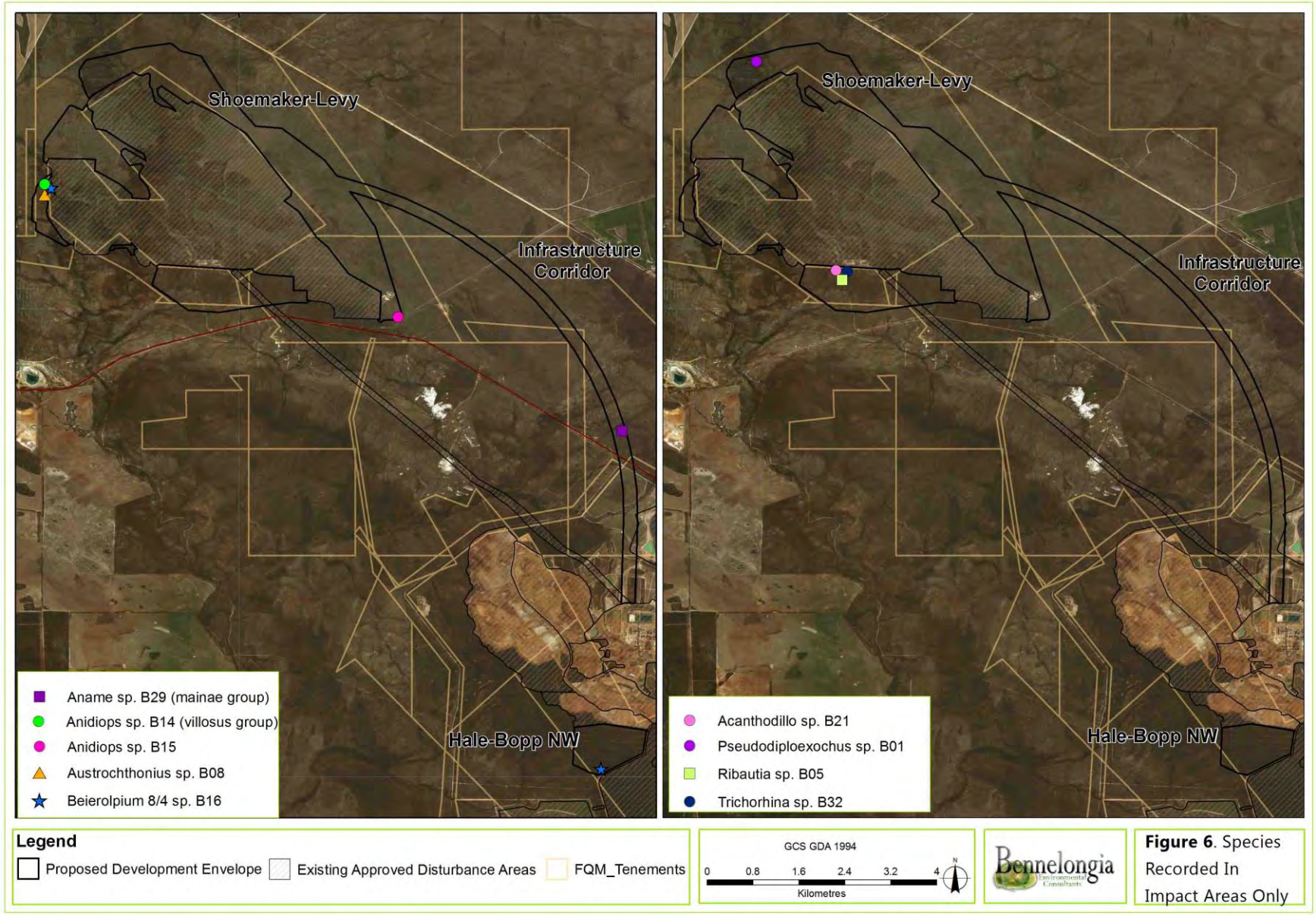

Figure 6. Collection locations of potential SRE species in the Project area.

6. CONCLUSIONS

This study, which included a desktop review and a field survey, was undertaken to evaluate the suitability of habitats in the Project area for SRE fauna, to review previous records of SRE-group or listed invertebrates in the vicinity of the Project area, and to determine whether the Project area harbours or is likely to harbour SRE or listed invertebrates whose conservation status will be significantly threatened by proposed developments.

The Project area comprises a heterogeneous mosaic of habitat types and smaller habitat subunits that differ in terms of vegetation, soil, drainage, provision of microhabitats and in turn, prospectivity for SRE species. Eleven of the 20 identified subunits were sampled for SRE fauna during field survey. Subunits varied in terms of their inferred suitability for SREs, however, most were deemed to be of low prospectivity because of high exposure, low moisture retention and shortage of suitable relict or specialist microhabitats. Subunits that were considered moderately-to-highly prospective included heath on granite outcrop (HGO), woodland (*Eucalyptus cernua*) on clay (WC), drainage line woodland (DrW) and mallet woodland on floodplain (WF).

A total of 150 taxa from SRE-groups (harvestmen, spiders, pseudoscorpions, scorpions, centipedes, millipedes, slaters and snails) have previously been recorded in the 10,000 km^2 vicinity of the Project defined by 32.446°S, 119.167°E and 34.246°S, 120.966°E. Fourteen species (9%) that have been recorded in the search area (four trapdoor spiders, nine millipedes and a land snail) are confirmed SREs. Approximately half the remaining species are classed as Potential SREs because of deficient data (mainly lack of collection records and associated sampling in suitable surrounding habitat). Most of these species are likely to be more widespread than records suggest and are unlikely to be actual SRE species. Sixty-two species are known to be widespread.

Although no formally listed species are known to occur within the search area, one Priority (P1) species, the hemipteran *Budginmaya eulae*, has been recorded in a reference area near the Hale-Bopp deposit in the Project area. While the conservation status of all previously-recorded species in the search area is unlikely to be threatened by proposed development, because all species have been recorded from either outside the Project area or reference areas within the Project area, there may be a requirement for further investigation of the distribution of *B. eulae*.

Field survey at 24 sites across five habitat types and eleven subunits in the Project area yielded 574 specimens of 42 species belonging to SRE Groups. Ten recorded species are known to be widespread relative to SRE criteria and have been recorded outside the Project area. The conservation status of these species will not be affected by proposed development. Eighteen species were classed as data deficient Potential SRE species and twelve species were classed as likely to be widespread for ecological or habitat reasons. In most cases, it is unlikely that these species are actually SREs. Two species were classed as confirmed SREs, the millipede *Antichiropus cuspis* and the land snail *Bothriembryon* cf. *balteolus*. Both confirmed SRE species collected during survey have been recorded outside the Project area and are unlikely to be threatened by the Project.

Nine potential SRE species were only recorded in Project impact areas: the mygalomorph spiders *Anidiops* sp. B14 (*villosus* group), *Anidiops* sp. B15, *Aname* sp. B29 (*mainae* group); the pseudoscorpions *Austrochthonius* sp. B08 and *Beierolpium* 8/4 sp. B16; the isopods *Acanthodillo* sp. B21, *Pseudodiploexochus* sp. B01 and *Trichorhina* sp. B32; and the centipede *Ribautia* sp. B05. Owing to the collection of species from multiple widespread habitat subunits or widespread subunits of low prospectivity, eight of the nine species are considered very unlikely to be restricted to the Project impact areas. In fact, many of the species are unlikely to actually be SREs and their conservation status will not be affected by the Project. It is considered, however, that the isopod *Pseudodiploexochus* sp. B01 may possibly be restricted to the Project impact areas and further investigation of its status is warranted.

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8. APPENDICES

Appendix 1. Habitat characteristics and sampling effort at survey sites.

Site	Latitude	Longitude	Type	Area/Deposit	Sample Date	Habitat	Shade Cover (%)	Litter bags	Leaf Litter			Habitat		Methods						
									<1 cm	1-5 cm	>5 cm	Logs	Rocks	Cup Traps	Forage	Log Turn	Rock Turn	Litter sieve	Leaf Blow	UV (mins)
1	-33.5549	120.3149	Impact	Shoemaker-Levy	28/03/2017	DrW	15	0	84.5	15.0	0.5	None	None	0	Y	Y	-	Y	Y	20
2	-33.5549	120.3130	Impact	Shoemaker-Levy	28/03/2017	WC	35	2	40.0	40.0	20.0	Many	None	0	Y	Y	-	Y	Y	30
3	-33.5746	120.3029	Impact	Shoemaker-Levy	29/03/2017	DrW	37.5	2	82.5	12.5	5.0	Many	Few	2	Y	Y	Y	Y	Y	30
4	-33.5730	120.3021	Control	Shoemaker-Levy	29/03/2017	DrW	35	1	82.5	12.5	5.0	Many	Few	0	Y	Y	Y	Y	Y	30
5	-33.5691	120.3082	Impact	Shoemaker-Levy	29/03/2017	MHD	17.5	1	75.0	25.0	0.0	Few	None	0	Y	Y	-	Y	Y	-
6	-33.5885	120.3264	Impact	Shoemaker-Levy	29/03/2017	LMS	20	1	100.0	0.0	0.0	Few	Few	0	Y	-	Y	Y	Y	-
7	-33.5925	120.3262	Impact	Shoemaker-Levy	29/03/2017	MHD	12.5	0	95.0	5.0	0.0	Few	Few	0	Y	-	-	Y	Y	-
8	-33.5769	120.3565	Impact	Corridor	30/03/2017	WF	17.5	1	85.5	12.5	2.0	Many	None	0	Y	Y	-	Y	Y	-
9	-33.5712	120.3592	Control	Corridor	30/03/2017	HSG	7.5	0	98.5	1.5	0.0	None	None	0	Y	-	-	Y	Y	-
10	-33.5898	120.3674	Control	Corridor	30/03/2017	MHD	20	1	96.5	3.5	0.0	Few	None	0	Y	-	-	Y	Y	-
11	-33.6200	120.3992	Control	Corridor	30/03/2017	DrW	32.5	1	52.5	35.0	12.5	Many	Few	0	Y	Y	-	Y	Y	30
12	-33.6622	120.3939	Control	Hale-Bopp	31/03/2017	SST	47.5	1	65.0	35.0	0.0	Sticks	Some	0	Y	Y	Y	Y	Y	-
13	-33.6621	120.3901	Impact	Hale-Bopp	31/03/2017	SST	17.5	2	84.5	15.0	0.5	Few	Many	0	Y	Y	Y	Y	Y	-
14	-33.6655	120.3889	Impact	Hale-Bopp	31/03/2017	MHK	10	2	94.5	5.0	0.5	None	Some	0	Y	Y	Y	Y	Y	-
15	-33.6590	120.3853	Control	Hale-Bopp	31/03/2017	MHK	15	2	94.0	6.0	0.0	None	Some	0	Y	Y	Y	Y	Y	-
16	-33.6146	120.3941	Impact	Corridor	1/04/2017	SCMS	7.5	1	94.5	5.0	0.5	Some	None	0	Y	-	-	Y		-
17	-33.6126	120.3933	Impact	Corridor	1/04/2017	HSG	1.5	0	99.0	1.0	0.0	None	None	0	Y	-	-	-	-	-
18	-33.6117	120.3936	Control	Corridor	1/04/2017	MHD	15	2	93.0	5.0	2.0	Many	Few	0	Y	Y	-	Y	Y	-
19	-33.6108	120.3931	Impact	Corridor	1/04/2017	HGO	1.5	1	98.0	2.0	0.0	Some	Many	0	Y		Y	Y		-
20	-33.6054	120.3913	Control	Corridor	1/04/2017	HGO	10	2	92.5	7.5	0.0	Few	Many	0	Y	Y	Y	Y	Y	-
21	-33.6086	120.3873	Control	Corridor	1/04/2017	HGO	22.5	2	65.0	35.0	0.0	None	Few	0	Y	Y	Y	Y	Y	45
22	-33.5519	120.3093	Control	Shoemaker-Levy	1/04/2017	WC	22.5	2	10.0	50.0	40.0	Some	None	0	Y	Y	-	Y	Y	-
23	-33.5948	120.3582	Impact	Shoemaker-Levy	2/04/2017	SSMS	15	0	83.0	10.0	7.0	Few	Few	0	Y	Y	-	Y	Y	-
24	-33.5954	120.3589	Control	Shoemaker-Levy	2/04/2017	SSMS	15	0	83.0	10.0	7.0	Few	Few	0	Y	Y	-	Y	Y	-

Appendix 2. Photographs of field sampling sites.

Site 01

Site 02

Site 03

Site 04

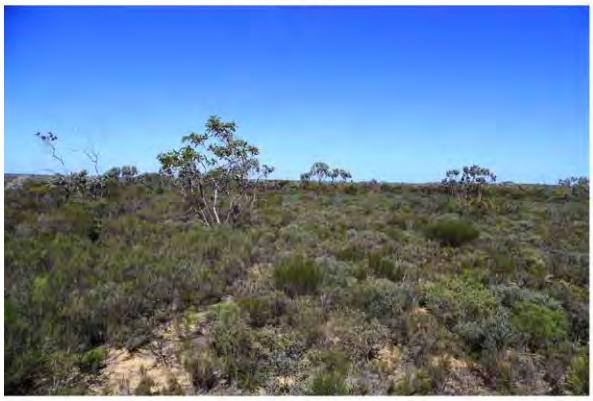
Site 05

Site 06

Site 07

Site 08

Site 09



Site 10

Site 11

Site 12

Site 13

Site 14

Site 15

Site 16

Site 17

Site 18

Site 19

Site 20

Site 21

Site 22

Site 23

Site 24

Appendix 3. Collection locations of all recorded species from SRE groups.

Higher-order identifications that probably belong to other species that were recorded are highlighted grey.

Taxonomy	Site code and habitat subunit																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	DrW	WC	DrW	DrW	MHD	LMS	MHD	WF	HSG	MHD	DrW	SST	SST	MHK	MHK	SCMS	HSG	MHD	HGO	HGO	HGO	WC	SSMS	SSMS
Arachnida																								
Araneae																								
Barychelidae																								
Synothele sp. B15 (rastelloides group)		1	1	1				1													1			
Idiopidae																								
Aganippe sp. B22			1																		1			
Aganippe sp. B23																						1		
Aganippe sp. B25														1	2							1		1
Anidiops sp. B13											1													
Anidiops sp. B14 (*villosus* group)			1																					
Anidiops sp. B15																							1	
Anidiops sp. B24					1							1												
Eucyrtops sp. B08		3																				2		
Eucyrtops sp. B09																						1		
Eucyrtops sp. B10		2																				1		
Nemesiidae																								
Aname sp. B28								1								1								
Aname sp. B29 (*mainae* group)																	1							
Nemesiidae sp.												1				1								
Pseudoscorpiones																								
Cheliferidae																								
Cheliferidae sp.																						1		
Chthoniidae																								
Austrochthonius sp.		2																						
Austrochthonius sp. B08			1																					
Olpiidae																								
Beierolpium 8/4 sp. B16			2											2										
Indolpium sp. B28																		1						
Olpiidae sp.												1		1										
Scorpiones																								
Buthidae																								
Isometroides cf. *vescus*			1	2																				
Isometroides vescus			1																					
Lychas `austroccidentalis` ms		7	3	1		1		2				1			2					1	2			
Urodacidae																								
Urodacus novaehollandiae			1																	2	2			
Urodacus sp. B13 (pale yellow)			33	23	15			101	20		29					12	1				3		3	3
Chilopoda																								
Geophilida																								
Geophilida sp.													1											

Taxonomy	Site code and habitat subunit																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	DrW	WC	DrW	DrW	MHD	LMS	MHD	WF	HSG	MHD	DrW	SST	SST	MHK	MHK	SCMS	HSG	MHD	HGO	HGO	HGO	WC	SSMS	SSMS
Chilenophilidae																								
Ribautia sp. B04											1													
Ribautia sp. B05						1																		
Mecistocephalidae																								
Mecistocephalus sp. B09		8	2			1		1					2						2	5	1			
Mecistocephalus sp.													1											
Lithobiomorpha																								
Henicopidae																								
Lamyctes nr *africanus*																			2					
Lithobiomorpha sp.			1	1																				1
Scolopendrida																								
Cryptopidae																								
Cryptops cf. *australis*						1					1		1							1				
Diplopoda																								
Polydesmida																								
Paradoxosomatidae																								
Antichiropus cuspis																			1		1			
Antichiropus sp.																			12		12			
Malacostraca																								
Isopoda																								
Armadillidae																								
Acanthodillo sp. B18																					1			
Acanthodillo sp. B19												3												
Acanthodillo sp. B20				1															4					
Acanthodillo sp. B21						2																		
Armadillidium vulgare													1											
Buddelundia sp. B71								2		1		1	3	2					1		9			
Buddelundia sp. B73						1									1									
Pseudodiploexochus sp. B01		3																						
Philosciidae																								
Philosciidae sp. B37													6											15
Philosciidae sp. B38		17	6	3	4	5					3		20	2	2				10		3			
Platyarthridae																								
Trichorhina sp. B32						8																		
Gastropoda																								
Stylommatophora																								
Placostylidae																								
Bothriembryon cf. *balteolus*												2	3	3	1									
Bothriembryon dux							8					2	9	15										
Punctidae																								
Westralaoma experta			1	1				1										1	2	2				
Pupillidae																								
Gastrocopta bannertonensis						2							3					1		1				

Appendix 4. WAM specimens used for comparisons to align taxonomy between this and previous studies.

Group	Species	Reg. No.	Compared (Y/N)
Mygalomorphae	Isopoda sp.		
Barychelidae	Barychelidae sp.	T95790	N
	Aurecocrypta `sp. indet. (juvenile)`	T132134	Y
	Idiommata `blackwalli?`	T81041	N
	Idiommata `sp. indet. (juvenile)`	T132294	Y
	`*Synothele*?` sp.	T81040	N
	Synothele rastelloides **(outside search area)**	T45913	Y
	Synothele rastelloides **(outside search area)**	99/1380	Y
	Synothele `pseudidiommata`	T72408	N
	Synothele `sp. indet. (juvenile)`	T132257	N
	Synothele `sp. indet. (juvenile)`	T132264	N
	Synothele `sp. indet. (juvenile)`	T132280	N
	Synothele `sp. indet. (juvenile)`	T132307	N
	Synothele rastelloides?	T31146	Y
	Synothele rastelloides?	T31896	Y
	Synothele sp.	T81274	N
Idiopidae	Idiopidae `Biota sp. C`	T72674	N
	Idiopidae `Biota sp. C`	T72675	N
	Idiopidae `Biota sp. C`	T72676	N
	Idiopidae `Biota sp. C`	T72677	N
	Idiopidae `Biota sp. C`	T72678	N
	Idiopidae `Biota sp. C`	T72679	N
	Idiopidae `Biota sp. C`	T72682	N
	Idiopidae `Biota sp. C`	T72683	N
	Idiopidae `Biota sp. C`	T72684	N
	Idiopidae `Biota sp. C`	T72685	N
	Idiopidae `Biota sp. C`	T72686	N
	Idiopidae `Biota sp. C`	T72689	N
	Idiopidae `Biota sp. C`	T72692	N
	Idiopidae `Biota sp. C`	T72694	N
	Idiopidae `Biota sp. D`	T72696	N
	Idiopidae `Biota sp. D`	T72698	N
	Idiopidae `Biota sp. D`	T72699	N
	Idiopidae `Biota sp. E`	T72702	N
	Idiopidae `Biota sp. E`	T72705	N
	Idiopidae `Biota sp. E`	T72707	N
	Idiopidae `Biota sp. E`	T72709	N
	`Eucanippe` `Biota sp. B`	T72672	N
	`Eucanippe` `MYG072`	T72650	N
	`Eucanippe` `MYG072`	T72651	N
	`Eucanippe` `MYG072`	T72653	N
	`Eucanippe` `MYG072`	T72654	N
	`Eucanippe` `MYG072`	T72655	N
	`Eucanippe` `MYG072`	T72656	N
	`Eucanippe` `MYG072`	T72657	N
	`Eucanippe` `MYG072`	T72658	N
	`Eucanippe` `MYG072`	T72659	N
	`Eucanippe` `MYG072`	T72660	N
	`Eucanippe` `MYG072`	T72669	N
	`Eucanippe` `MYG072`	T72670	N
	`Eucanippe` `MYG072`	T72671	N
	`Eucanippe` `MYG072`	T72T649	N
	Aganippe `Biota sp. D`	T72695	N
	Aganippe `Biota sp. D`	T72697	N
	Aganippe `Biota sp. D`	T72700	N
	Aganippe `Biota sp. D`	T72711	N
	Aganippe `Biota sp. E`	T72703	N
	Aganippe `Biota sp. E`	T72704	N
	Aganippe `Biota sp. E`	T72706	N
	Aganippe `Biota sp. E`	T72708	N
	Aganippe `Biota sp. E`	T72710	N
	Aganippe `MYG075`	T42349	N
	Aganippe `rhaphiduca group`	T72673	N
	Aganippe `rhaphiduca group`	T72680	N
	Aganippe `rhaphiduca group`	T72681	N
	Aganippe `rhaphiduca group`	T72690	N
	Aganippe `rhaphiduca group`	T72691	N

Group	Species	Reg. No.	Compared (Y/N)
	Aganippe `rhaphiduca group`	T72693	N
	Aganippe `sp. indet. (female)`	T132242	Y
	Aganippe `sp. indet. (female)`	T132245	Y
	Aganippe `sp. indet. (female)`	T132253	Y
	Aganippe `sp. indet. (female)`	T132262	Y
	Aganippe `sp. indet. (female)`	T132265	Y
	Aganippe `sp. indet. (female)`	T132267	Y
	Aganippe `sp. indet. (female)`	T132269	Y
	Aganippe `sp. indet. (female)`	T132282	Y
	Aganippe `sp. indet. (female)`	T132283	N
	Aganippe `sp. indet. (female)`	T132284	N
	Aganippe `sp. indet. (female)`	T132285	N
	Aganippe `sp. indet. (female)`	T132291	N
	Aganippe `sp. indet. (female)`	T132292	N
	Aganippe `sp. indet. (female)`	T132293	N
	Aganippe `sp. indet. (female)`	T132302	N
	Aganippe `sp. indet. (juvenile)`	T132244	Y
	Aganippe `sp. indet. (juvenile)`	T132251	Y
	Aganippe `sp. indet. (juvenile)`	T132258	Y
	Aganippe `sp. indet. (juvenile)`	T132261	Y
	Aganippe `sp. indet. (juvenile)`	T132286	N
	Aganippe `sp. indet. (juvenile)`	T132305	N
	Aganippe `sp. nov.`	T31308	N
	Aganippe sp.	T81038	N
	Aganippe sp.	T81047	N
	Anidiops `sp. indet. (female)`	T132266	N
	Anidiops `sp. indet. (female)`	T132270	N
	Anidiops `sp. indet. (female)`	T132275	N
	Anidiops `sp. indet. (juvenile)`	T132246	N
	Anidiops `sp. indet. (juvenile)`	T132252	N
	Anidiops `sp. indet. (juvenile)`	T132254	N
	Anidiops `sp. indet. (juvenile)`	T132255	N
	Anidiops `sp. indet. (juvenile)`	T132256	N
	Anidiops `sp. indet. (juvenile)`	T132259	N
	Anidiops `sp. indet. (juvenile)`	T132263	N
	Anidiops `sp. indet. (juvenile)`	T132276	N
	Anidiops `sp. indet. (juvenile)`	T132279	N
	Anidiops `sp. indet. (juvenile)`	T132281	N
	Anidiops `sp. indet. (juvenile)`	T132287	N
	Anidiops `sp. indet. (juvenile)`	T132288	N
	Anidiops `sp. indet. (juvenile)`	T132289	N
	Anidiops `sp. indet. (juvenile)`	T132296	N
	Anidiops `sp. indet. (juvenile)`	T132298	N
	Blakistonia `MYG451`	T72712	N
	Eucyrtops `MYG141`	T72647	N
	Eucyrtops `MYG141`	T72648	N
	Eucyrtops `sp. indet. (juvenile)`	T97709	Y
	Euoplos sp.	T31355	N
Nemesiidae	`Proshermacha` `MYG346`	T132271	Y
	`Proshermacha` `MYG346`	T132277	Y
	`Proshermacha` `MYG346`	T132303	Y
	`Proshermacha` `MYG346`	T64918	Y
	`Proshermacha` `MYG346`	T64919	Y
	`Proshermacha` `MYG346`	T64920	Y
	`Proshermacha` `MYG346`	T65202	Y
	`Proshermacha` `MYG346`	T65203	Y
	`Proshermacha` `MYG346`	T65204	Y
	`Proshermacha` `MYG346`	T65213	Y
	`Proshermacha` `MYG346`	T88469	Y
	`Proshermacha` `MYG349`	T137345	N
	`Proshermacha` `MYG349`	T72701	Y
	`Proshermacha` `MYG349`	T72716	Y
	`Proshermacha` `MYG349`	T72717	Y
	`Proshermacha` `sp. indet. (female)`	T132300	N
	`Proshermacha` `sp. indet.`	T88464	Y
	`Proshermacha` `sp. indet.`	T88466	Y
	`Proshermacha` MYG349 (not *C. tepperi*)	T72715	Y
	Aname `Biota sp. B`	T72714	Y
	Aname `Biota sp. F`	T72720	Y
	Aname `Biota sp. F`	T72721	Y
	Aname `Biota sp. I`	T72724	Y

Group	Species	Reg. No.	Compared (Y/N)
	Aname `kwonkoides spp. group.`	T31376	N
	Aname `kwonkoides spp. group.`	T31377	N
	Aname `kwonkoides spp. group.`	T31378	N
	Aname `kwonkoides spp. group.`	T31379	N
	Aname `sp. indet. (female)`	T132243	Y
	Aname `sp. indet. (female)`	T132247	Y
	Aname `sp. indet. (female)`	T132248	Y
	Aname `sp. indet. (female)`	T132250	Y
	Aname `sp. indet. (female)`	T132273	Y
	Aname `sp. indet. (female)`	T132295	Y
	Aname `sp. indet. (female)`	T132297	Y
	Aname `sp. indet. (female)`	T132306	Y
	Aname `sp. indet. (juvenile)`	T132249	Y
	Aname `sp. indet. (juvenile)`	T132260	Y
	Aname `sp. indet. (juvenile)`	T132268	Y
	Aname `sp. indet. (juvenile)`	T132274	Y
	Aname `sp. indet. (juvenile)`	T132278	Y
	Aname `sp. indet. (juvenile)`	T132304	Y
	Aname mainae	T95788	Y
	Aname mainae	T95789	Y
	Aname sp.	T115390	Y
	Aname sp.	T40712	N
	Aname sp.	T88458	Y
	Aname sp.	T88462	Y
	Aname sp.	T88463	Y
	Aname sp.	T88465	Y
	Aname sp.	T88467	Y
	Aname sp.	T88468	Y
	Aname sp.	T88470	Y
	Aname sp.	T88471	Y
	Chenistonia `MYG348`	T72687	Y
	Chenistonia `MYG348`	T72688	Y
	Chenistonia `sp. indet. (female)`	T132301	N
	Chenistonia `sp. indet. (juvenile)`	T81036	Y
	Chenistonia `sp. indet. (juvenile)`	T81037	Y
	Chenistonia `sp. indet. (juvenile)`	T81042	N
	Chenistonia `sp. indet. (juvenile)`	T81046	Y
	Chenistonia `sp. nov.`	T31208	N
	Chenistonia tepperi	T31210	N
	Kwonkan `sp. nov.`	T31209	N
	Merredinia `sp. indet. (female)`	T132126	Y
	Pseudoteyl (not *Teyl* `Biota sp. F`)	T72723	Y
	Pseudoteyl sp.	T72713	Y
	Pseudoteyl sp.	T98267	Y
	Teyl `MYG192`	T77552	Y
	Teyl `MYG440`	T64917	Y
	Teyl `MYG455`	T72718	Y
	Teyl `MYG455`	T72719	Y
	Teyl `MYG456`	T72722	Y
	Teyl `sp. indet. (juvenile)`	T132132	N
	Yilgarnia `sp. indet. (female)`	T132299	
Scorpiones			
Buthidae	*Isometroides* `sp. male`	T132315	N
	Isometroides `sp. male`	T132317	N
	Lychas `*austroccidentalis*`	T81267	Y
	Lychas `sp. indet. (juvenile)`	T132316	Y
	Lychas `sp. indet. (juvenile)`	T132321	Y
	Lychas `sp. indet. (juvenile)`	T132322	Y
	Lychas `sp. indet. (juvenile)`	T132323	Y
	Lychas `sp.`	T95583	N
	Lychas `sp.`	T95584	N
	Lychas `sp.`	T95585	N
	Lychas `sp.`	T95586	N
	Lychas jonesae	T93545	N
Urodacidae	*Urodacus* `*armatus*`	T31066	N
	Urodacus `*armatus*` **(outside search area)**	69-1947	Y
	Urodacus `*novaehollandiae*?`	T81035	N
	Urodacus novaehollandiae	T35923	N
	Urodacus novaehollandiae	T41047	N
	Urodacus novaehollandiae **(outside search area)**	T67016	Y
	Urodacus novaehollandiae **(outside search area)**	T82720	Y

Group	Species	Reg. No.	Compared (Y/N)
	Urodacus `sp 1`	T132319	N
	Urodacus `sp 1`	T132320	N
	Urodacus `sp 1`	T132324	N
	Urodacus `sp 1`	T132325	N
	Urodacus `sp.`	T69842	N
	Urodacus sp.	T76467	N
Symphyla	Symphyla `sp. indet.`	T136327	Y
	Symphyla sp.	T103455	Y
Chilopoda			
Chilenophilidae	Chilenophilidae sp.	T121069	Y
	Chilenophilidae sp.	T121075	Y
Mecistocephalidae	Mecistocephalidae sp.	T101086	Y
Isopoda			
Armadillidae	*Acanthodillo* sp. 1	C48136	Y
	Buddelundia 22	C62713	N
	Buddelundia 22	C62714	N
	Buddelundia sp.	C49028	Y
	Buddelundia sp.	C49029	Y
	Buddelundia sp.	C49030	Y
	Buddelundia sp.	C49031	Y
	Buddelundia sp.	C62715	N
	Pseudodiploexochus indet.	C48349	Y
	Pseudodiploexochus indet.	C48350	Y
	Pseudodiploexochus indet.	C48351	Y
	Pseudodiploexochus indet.	C48352	Y
Philosciidae	*Laevophiloscia* indet.	C48363	N
	Laevophiloscia indet.	C48364	N
	Laevophiloscia indet.	C48365	Y
	Laevophiloscia indet.	C48366	Y
	Laevophiloscia indet.	C48367	Y
	Laevophiloscia indet.	C48368	Y
	Laevophiloscia indet.	C48369	Y
	Laevophiloscia indet.	C48370	Y
	Laevophiloscia indet.	C48371	Y
	Laevophiloscia indet.	C48372	Y
	Laevophiloscia indet.	C48373	Y
	Laevophiloscia indet.	C48374	Y
	Laevophiloscia indet.	C48375	Y
	Philosciidae sp.	C49025	Y
	Philosciidae sp.	C49026	N
	Philosciidae sp.	C49027	Y
	Isopoda sp.	C50310	Y
	Isopoda sp.	C50311	Y
	Isopoda sp.	C50312	Y
	Isopoda sp.	C50313	Y
	Isopoda sp.	C50314	Y
	Isopoda sp.	C50315	Y
	Isopoda sp.	C50316	Y
	Isopoda sp.	C50317	Y
	Isopoda sp.	C50318	Y
	Isopoda sp.	C50319	Y
Gastropoda	*Bothriembryon dux*	S2354	Y
	Bothriembryon `Ravensthorpe` n.sp.	S88233	Y
	Bothriembryon `Ravensthorpe` n.sp.	S88241	Y
	Bothriembryon cf. `Ravensthorpe` n.sp.	S30842	Y
	Bothriembryon cf. `Ravensthorpe` n.sp.	S28532	Y
	Bothriembryon `Magenta` n. sp.	S1749	Y
	Bothriembryon `Point Ann` n. sp.	S9150	Y
	Bothriembryon balteolus	S1562	Y
	Bothriembryon balteolus	S34578	Y
	Bothriembryon balteolus	S84113	Y