Appendix 6 - Terrestrial Fauna Survey and Black Cockatoo Habitat Assessment for Huntly Mine – Myara North (GHD, 2021)

Terrestrial Fauna Survey and Black Cockatoo Habitat Assessment for Huntly Mine - Myara North

Pinjarra Alumina Refinery Revised Proposal

Alcoa of Australia Limited

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Executive summary

Alcoa of Australia Limited (Alcoa) is proposing to increase production at the Pinjarra Alumina Refinery by 5 per cent from 5 million tonnes per annum (Mtpa) to 5.25 Mtpa and transition the Huntly Bauxite Mine to the proposed Myara North and Holyoake mine regions (the Proposal). The Proposal is located in the Peel Region of Western Australia (WA), approximately 100 km south-east of Perth

The Proposal will be subject to environmental impact assessment under Part IV of the WA *Environmental Protection Act 1986* (EP Act), and the *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act). The environmental impact assessment will be via a Public Environmental Review (PER).

This Terrestrial Vertebrate Fauna Survey and Black Cockatoo Habitat Assessment (the Survey) has been prepared to support the EPA assessment of the Proposal and addresses the Myara North mine region of the Proposal.

Survey Area

The Survey Area comprises the Myara North Development Envelope (DE) and adjacent conveyor and haul road corridors. The Survey Area lies in Jarrahdale State Forest and is bordered by Jarrahdale town and Serpentine National Park to the west, Monadnocks Conservation Park to the east, and the existing Myara mine region to the south. The Survey Area covers approximately 18,000 hectares (ha).

The Survey included a desktop assessment, a consolidation of previous fauna studies, and a detailed and targeted vertebrate fauna survey undertaken in the Myara North region in winter (June/July) and spring (November) of 2020. The Survey included a Black Cockatoo habitat assessment in accordance with Commonwealth guidance and a targeted assessment of Carter's Freshwater Mussel.

Survey Results

The Survey Area consists of eight broad fauna habitat types: Bullich forest, Granite outcrop, Blackbutt forest, Flooded Gum woodland, Jarrah -Marri forest, Melaleuca dampland. Mine rehabilitation and Pine plantation. Jarrah-Marri forest predominated at 83% of the Survey Area. A small portion of the Survey Area comprises rural cleared land.

The conservation value of each fauna habitat type is specific to the locally occurring conservation significant fauna species and the type of usage by those species. All three Black Cockatoos were recorded primarily throughout the Marri-Jarrah forest, however all habitat types will be utilised for foraging by either one or all of the species. Melaleuca Damplands and riparian areas comprising Bullich Forest, Blackbutt Forest and Marri-Jarrah Forest support a Quokka population with records scattered throughout the Survey Area. Chuditch are wide ranging and expected to use all habitat types at a relatively low density.

In total 13 conservation significant species were recorded in the Survey Area including the Quokka, Chuditch, Brush-tailed Phascogale, Western Brush Wallaby, Forest Red-tailed Black Cockatoo, Baudin's Cockatoo, Carnaby's Cockatoo, Western False Pipistrelle, Southern Death Adder, Quenda, Rakali, Masked Owl and Peregrine Falcon. All species identified are likely to have significant populations and habitat present within the Survey Area. With regard to migratory shorebirds, the Survey Area lacks open water bodies that feature shallow shorelines for foraging habitat. The creek lines and vegetated dampland areas within the Survey Area are not suitable for migratory shorebirds.

Carter's Freshwater Mussel was targeted during the survey but no presence was recorded. The species is known to reside in the Serpentine Dam on the southern edge of the Survey Area and while mussels may disperse upstream from the Dam during winter/spring flows, all streams are seasonal and any dispersing mussels are unlikely to survive the extended dry summer period. Therefore, significant populations are unlikely in the Survey Area.

The DBCA NatureMap search identified 185 vertebrate fauna taxa previously recorded within 20 km radius of the Survey Area. This total included 28 mammals, 113 birds, 32 reptiles and 12 amphibians.

The detailed and targeted program recorded 132 vertebrate fauna species utilising the Survey Area, including 23 mammals, 76 birds, 26 reptiles and seven amphibians. Of these, eight introduced species (mammals and birds) were identified.

Fire was observed to cause substantial impact to fauna habitats of the Survey Areas. Large areas of the Survey Area had been burnt within the last 2 to 3 years impacting fauna habitat. During the Survey the north west portion of the Survey Area was prescribed burned in October 2020.

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Acronyms

DE	Development Envelope
DBCA	Department of Biodiversity, Conservation and Attractions
DBH	Diameter Breast Height
DAWE	The Department of Agriculture Water and Energy
DEE	Department of the Environment and Energy
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities
DSEWHA	Department of Environment, Water, Heritage and the Arts (Canberra)
EMRC	Environmental Management and Research Consultants
EPA	Environmental Protection Authority
EPBC	Environment Protection Biodiversity Conservation
EP	Environmental Protection
ERD	Environmental Review Document
ESD	Environmental Scoping Document
FRTBC	Forest Red-tail Black Cockatoo
GoWA	Government of Western Australia
IBSA	Index of Biodiversity Surveys for Assessments
LOO	Likelihood of Occurrence
LTFMP	Long Term Fauna Monitoring Program
MNES	Matters of National Environmental Significance
PMST	Protected Matters Search Tool
SM	Song Meter
SOP	Standard Operating Procedure
SRE	Short-Range Endemic

1. Introduction

1.1 Project background

Alcoa of Australia Limited (Alcoa) is proposing to increase production at the Pinjarra Alumina Refinery by 5 per cent from 5 million tonnes per annum (Mtpa) to 5.25 Mtpa and transition the Huntly Bauxite Mine to the proposed Myara North and Holyoake mine regions (the Proposal). The Proposal is located in the Peel Region of Western Australia (WA), approximately 100 km south-east of Perth

The Proposal will be subject to environmental impact assessment under Part IV of the WA *Environmental Protection Act 1986* (EP Act), and the *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act). The environmental impact assessment will be via a Public Environmental Review (PER).

This Terrestrial Vertebrate Fauna Survey and Black Cockatoo Habitat Assessment (the Survey) has been prepared to support the EPA assessment of the Proposal and addresses the Myara North region of the Proposal. Separate reports address the Holyoake region, Pinjarra Refinery, Short-Range Endemic (SRE) invertebrate fauna, aquatic fauna, and subterranean fauna.

1.2 Purpose and scope of this report

The purpose of the surveys was to support the environmental assessment of the Project under Part IV of the *Environmental Protection Act 1986* (EP Act) and under *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Specifically, the survey was to identify ecological values to support environment impact assessment of the Project against the EPA's Terrestrial Fauna factor and on MNES, including threatened and migratory fauna. The surveys will inform mine planning to avoid and minimise impacts to conservation values, enable quantification of impacts, and inform mine management arrangements.

This Survey report has been prepared in accordance with the Environmental Scoping Document (ESD) prepared for the Proposal under Part IV of the EP Act. The Survey has been undertaken in accordance with EPA (2020) *Technical Guidance – Terrestrial vertebrate fauna surveys for environmental impact assessment* and relevant Commonwealth guidance on surveys for relevant threatened and migratory species.

This Survey report details the results of desktop assessment, a consolidation of previous fauna studies, and the findings of a detailed and targeted vertebrate fauna surveys undertaken in the Myara North region in winter (June/July) and spring (November) of 2020. The Survey includes a black cockatoo habitat assessment in accordance with Commonwealth guidance.

1.3 Survey Area

The Survey Area comprises the Myara North Development Envelope (DE) and adjacent conveyor and haul road corridors, as presented in Figure 1, Appendix A. The Survey Area lies in Jarrahdale State Forest and is bordered by Jarrahdale town and Serpentine National Park to the west, Monadnocks Conservation Park to the east, and the existing Myara mine region to the south. The Survey Area covers approximately 18,000 ha (refer Figure 1, Appendix A).

The Study Area comprises the Survey Area with a 10 km buffer and defines the limits of desktop database searches as described in Section 2.2.

1.4 Scope of works

The scope of works was to:

– Complete a comprehensive desktop assessment comprising terrestrial vertebrate fauna database search for the Study Area to determine the presence, or likely presence, of conservation significant vertebrate fauna species
– Review relevant literature relating to terrestrial vertebrate fauna within Alcoa's ML1SA mineral lease, with particular focus on conservation significant fauna

– Undertake a two-season detailed and targeted (Forest Red-tailed Black Cockatoo, Carnaby's Cockatoo, Baudin's Cockatoo, Chuditch, Quokka, and other priority species) vertebrate fauna survey within the Survey Area
– Provide a technical report (this document) detailing the results and findings of the survey
– Submit fauna survey data to the Index of Biodiversity Surveys for Assessments (IBSA) in accordance with Statutory requirements.
– Though not a vertebrate species, a targeted survey was undertaken for the threatened aquatic invertebrate Carters Freshwater Mussel as part of the field survey program. The targeted survey was undertaken further to the findings of a desktop aquatic fauna assessment (WRM 2021) which identified the potential presence of the species in the Survey Area.

1.5 Limitations and assumptions

This report: has been prepared by GHD for Alcoa of Australia Limited and may only be used and relied on by Alcoa of Australia Limited for the purpose agreed between GHD and Alcoa of Australia Limited as set out in section 1.4 of this report.

GHD otherwise disclaims responsibility to any person other than Alcoa of Australia Limited arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. Site conditions may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. The opinions, conclusions and recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Alcoa of Australia Limited and others who provided information to GHD (including Government authorities)], which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

1.6 Project terminology and definitions

Some common project terminology are described below in Table 1.

Table 1 Project terminology and definitions

Term (Abbreviation)	Definition/Use
Alcoa of Australia Limited (Alcoa)	Proponent of the Project and client of GHD for this Project.
GHD Pty Ltd (GHD)	Consultant engaged by Alcoa to prepare environmental approvals documentation and supporting technical studies for the Proposal.
Mining region	Sub-regions that comprise the Huntly Mine, including current (Myara), past (Del Park, Huntly 1 & 2, White, McCoy and O'Neil) and future (Myara North, Holyoake), etc.
Survey Area	Myara North Development Envelope and associated infrastructure corridor.
Study Area	The Survey Area with a 10 km buffer used to define the limits of desktop database searches.
Haul Road	Truck and mine infrastructure access road linking into existing corridors.
Conveyor Corridor	New conveyor through the Myara region connecting to the Myara North Development Envelope.
Detailed fauna survey	As per EPA 2020 describing the type of survey required, replaces wording from EPA 2016 for Level 2 assessment.
Targeted fauna survey	As per EPA 2020 describing the type of survey required, refers to undertaking targeted assessments for specific fauna species.

2. Methodology

2.1 Relevant legislation, conservation codes and background information

In WA some ecological communities, flora and fauna are protected under both Australian Government and State Government legislation. In addition, regulatory authorities provide a range of guidance and information on expected standards and protocols for environmental surveys.

An overview of key legislation and guidelines, conservation codes and background information relevant to the Survey is provided in Appendix B.

2.2 Desktop assessment

The desktop assessment comprises a review of various databases and literature sources (listed below) related to the environmental and ecological nature of the Survey Area.

The desktop assessment included a review of:

– The Department of Agriculture Water and Energy (DAWE), formerly Department of the Environment and Energy (DEE) Protected Matters Search Tool (PMST) to identify communities and species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) potentially occurring within the Study Area (DAWE 2020) (Appendix C).
– The DBCA *NatureMap* database for fauna species previously recorded within the Study Area (DBCA 2007–) (Appendix C).
– Existing datasets including previous broad-scale vegetation mapping of the Survey Area, aerial photography, geology/soils and hydrology information to provide background information on the variability of the environment, likely vegetation units and fauna habitats and to identify areas with the potential to contain Threatened and Priority fauna species.
– Literature provided by Alcoa and relating to fauna recorded in Alcoa's ML1SA mining lease within the Northern Jarrah Forest, (refer Table 19).

Due to the varying complexity of the reviewed data, various search extents were used to best display the targeted information. The extent used on each database as well as the literature review is displayed in Table 2.

Table 2 Extent of data searches

Component	Extent	Rationale
Regional biogeography	Region	This is a regional characterisation.
Climate	Karnet	Closest reliable weather station
Geology	Study Area	Broad classification with low number of outputs in Study Area
Land systems	Study Area	Broad classification with low number of outputs in Study Area
Surface water and hydrology	Study Area	Considered important to include surface water sources in proximity to the survey are which may be used by fauna as a drinking water supply and which may impact habitat type and availability.
Conservation reserves	Study Area	To consider protected land in and in proximity to the Survey Area.
DBCA Managed Lands	Study Area	To consider protected land in and in proximity to the Survey Area.
Environmentally Sensitive Areas	Study Area	To consider protected land in and in proximity to the Survey Area.
Regional Ecological Linkages	Study Area	To consider protected land in and in proximity to the Survey Area.
Broad vegetation mapping	Survey Area	Fairly detailed and complex data
Fauna species databases	Study Area	Search area extended due to motile nature of some fauna
Literature review	Region	Much of the literature was from Alcoa's Huntly Mine sites and surrounding forest to the south of the current Survey Area. Available literature was reviewed if applicable to terrestrial fauna.

2.3 Field survey

2.3.1 Survey details and timing

Field surveys were performed between 25 June and 13 November 2020 and consisted of five site visits from one to eleven days in duration. Most of the survey timing falls within the recommended survey timing for the southern climatic region for all species groups (EPA 2020). However, the first phase was undertaken in winter 2020 outside of the recommended period. This was undertaken to fulfil the survey schedule and the ability to maximise reptile detection via hand searches during seasonally low activity periods. It is unlikely that this survey timing adversely influenced the potential detection of mammal, bird or amphibian via the captures and recording methods used as these fauna groups remain active throughout the year and are detectable during winter. Survey timing and personnel are represented in Table 3.

Table 3 Myara North survey details and timing

Field Trip	Dates	Task	Duration	Zoologist/Ecologist	Years of experience of field personnel
1	25 June 2020	Reconnaissance, camera and bat detector deployment	1 day	Principal Zoologist	20
				Senior Zoologist	20
2	29 June - 9 July 2020	Phase 1 Survey: Detailed and Targeted fauna surveys (including trapping) within the Survey Area, identification and mapping of potential Black Cockatoo breeding trees and selected large hollows.	11 days	Senior Zoologist	20
				Senior Zoologist	20
				Zoologist	5
				Ecologist	10
				Ecologist	3
				Graduate Ecologist	2
				Graduate Ecologist	2
				Hydrologist (field hand)	2
3	24 June, 16, 20-21, 27 July, 23 August 2020	Assessment of black cockatoo trees and habitat identified in Myara North	6 days	Black cockatoo specialist	20
4	7 September -16 September 2020	Collection of cameras deployed during Phase 1 survey	7 days	Zoologist	5
				Graduate Ecologist	2
	28-29 October, 11 November 2020	Assessment of black cockatoo trees and habitat identified in proposed Myara North facilities location	3 days	Black cockatoo specialist	20
5	3 November – 13 November 2020 (excluding weekend due to car rally)	Phase 2 Survey: Detailed and Targeted fauna surveys (including trapping) within the Survey Area, Carters Freshwater Mussel assessment, Quokka assessment, Chuditch assessment, Black Cockatoo assessment.	10 days	Principal Zoologist	20
				Senior Zoologist	20
				Senior Zoologist	20
				Zoologist	5
				Graduate Ecologist	2
				Graduate Ecologist	2
6	22 December 2020	Collection of cameras deployed in Phase 2 survey.	2 days	Senior Zoologist	20
				Zoologist	5
				Ecologist	3
				Graduate Ecologist	2

2.3.2 Guiding documents

The Survey methodology and data collection employed was scoped according to EPA *Technical Guidance – Sampling methods for terrestrial vertebrate fauna* (EPA 2016a) and *Technical Guidance –Terrestrial Fauna Surveys* (EPA 2016b). However, during mobilisation of the Survey the updated *Technical Guidance –Terrestrial vertebrate fauna surveys for environmental impact assessment* (EPA 2020) was released. Where practicable the EPA (2020) guidance was followed.

The following Commonwealth survey guidance was adopted where relevant:

– EPBC Act Referral guidelines for three threatened black cockatoo species: Carnaby's cockatoo, Baudin's cockatoo and Forest red-tailed black cockatoo (Commonwealth Department of the Sustainability, Environment, Water, Population and Communities 2012a).
– Survey guidelines for Australia's threatened birds (Commonwealth Department of the Environment, Water, Heritage and the Arts 2010).
– Survey guidelines for Australia's threatened mammals (Commonwealth Department of the Sustainability, Environment, Water, Population and Communities 2011).
– Survey guidelines for Australia's threatened reptiles (Commonwealth Department of the Sustainability, Environment, Water, Population and Communities 2011).

2.3.3 Permits and ethics

A Section 40 Authorisation to Take or disturb threatened Fauna (Licence Number: 2020-0075), and a Regulation 27 (Licence No. BA27000269) to take Fauna for biological assessment was obtained from DBCA prior to undertaking the fauna surveys. The fauna survey (specifically trapping and animal handling) was undertaken in accordance with Standard Operating Procedures (SOPs) which were required to be followed under the conditions of GHD's fauna trapping permit. At the time of survey, compliance with these SOPs was accepted by DBCA as evidence of ethical treatment of animals.

2.3.4 Habitat assessment

The Survey Area was assessed for fauna habitat type based on floristic species, structural complexity, connectivity, hydrology, disturbance, type and extent of resource availability and value for fauna. Specifically, the assessment included:

– Habitat structure (e.g. vegetation type, presence/absence of overstorey, midstorey, understorey, and ground cover).
– Description of geomorphology, topography and substrate where applicable.
– Presence/absence of refuge including: fallen timber (coarse woody debris), hollow-bearing trees and stags and rocks/breakaways, and the type and extent of each refuge.
– Location of the habitat within the Survey Area in comparison to the habitat within the surrounding landscape.
– Habitat connectivity of refugia i.e. low dense vegetation associated with drainage lines and damplands within the Jarrah Forest, and identification of wildlife corridors for habitat specialist fauna, namely Quokka and Quenda within and immediately adjacent to the Survey Area.
– Identification and evaluation of key habitat features and types identified during the desktop assessment relevant to fauna of conservation significance.
– Evaluation of the likelihood of occurrence of conservation significant fauna within the environments present (based on presence of suitable habitats and species recorded)
– A representative photograph of each habitat type to complement description of habitat characteristics.

Habitat types have been delineated to align with Mattiske (2021) vegetation community types. That is, each habitat type represents one or more vegetation types. Refer to section 4.1.

2.3.5 Fauna identification and nomenclature

Identification of fauna species was made in the field using available field guides and electronic guides (Table 4). Where identification was not possible, photographs of specimens were collected to be later identified.

Table 4 Fauna references

Fauna group	Field guide
Mammals	Menkhorst and Knight (2010), Van Dyck and Strahan (2008)
Bats	Churchill (2008), Menkhorst and Knight (2010)
Birds	Morcombe (2004)
Reptiles	Wilson and Swan (2017), Storr *et al*. (1999), Storr *et. al*. (2002)
Amphibians	Tyler and Doughty (2009)

Nomenclature

Nomenclature used in this report follows that used by the WA Museum as reported on *NatureMap*. This nomenclature is deemed the most up-to-date species information for WA fauna, with the exception of birds, which follows Christidis and Boles (2008).

2.3.6 Trapping program

The same sampling techniques and trap layouts were used during both phases of the Survey and involved a series of standardised systematic trapping quadrat sites comprising pit-fall traps, Elliott box traps, cage traps and funnel traps. Details of each trap type used are provided below. During both phases, a total of twelve quadrats were established across the Survey Area and each quadrat was systematically surveyed (trapped) for seven to eight nights. Trap quadrat details are presented in Table 15 and locations shown in Figure 3,Appendix A.

The trap quadrats were selected to sample across the major habitat types occurring within the Survey Area. Traps sites were established during the first phase of trapping and closed upon survey completion, before being reopened during the second phase of trapping and removed upon survey completion. During Phase 2 of the survey, traps were closed for three nights after four nights of being opened, and then reopened again for a further four nights (see section 2.3.11). Initial design focused on undertaking a detailed assessment (EPA 2020) however through refinement, it developed into a targeted focused survey for conservation significant species identified in the Likelihood of Occurrence assessment (section 3.6.2) as discussed below.

Potential SRE fauna bycatch was collected throughout the Phase 2 survey and provided to Phoenix Environmental for identification and assessment of SRE fauna (Phoenix 2021). Specimens collected were only those from SRE candidate groups such as isopods, mygalomorphs, scorpions, millipedes, and planarians.

Pit-trap with drift fence

Seven (7) pit-traps were established at each quadrat within the Survey Area. Pit-traps comprised of 20 litre (L) plastic buckets (30 cm diameter, 40 cm deep) at each quadrat. A 50 m long flywire drift fence (30 cm high) bisected the pits; directing fauna into them. Pits were spaced at seven metre intervals along the fence. Soil and an egg carton were placed within each pit to provide shade and protection for captured animals.

Species targeted through this method were the Dell's Skink (*Ctenotus delli*) and Southern Death Adder (*Acanthophis antarcticus*). There are no specific guidelines on the assessment of these reptiles specifically in Western Australia, however detection methods were derived from DSEWPaC (2011a).

Funnel traps

Twelve (12) funnel traps were used along the drift fence at each quadrat. Traps were placed such that animals were directed into them from the drift fence in between the pit traps. Funnel traps were covered with insulating materials to minimise heat or cold exposure to animals.

Species targeted through this method were the Dell's Skink and Southern Death Adder. There are no specific guidelines on the assessment of these reptiles specifically in Western Australia, however detection methods derived from DSEWPaC (2011a).

Elliot box traps

One line of ten (10) Elliot ® box traps was established at each quadrat and positioned approximately 50 m away (and parallel to) the drift fence. Traps were placed approximately ten metres apart and baited with universal bait (a mixture of peanut butter, rolled oats and sardines). Elliott traps were located within shady areas or covered with vegetation to minimise exposure to captured animals. Where practicable Elliot traps were placed (strapped) in trees and onto logs to increase the likelihood of arboreal mammal captures.

Species targeted through this method include Brush-tailed Phascogale (*Phascogale tapoatafa wambenger*). The techniques utilised for this species were derived from Orell (2004), Scida and Gration (2017) and DSEWPaC (2011b).

Cage traps

Two (2) cage traps (with approximate dimensions 26 by 23 by 66 cm) were located at each quadrat site. These traps were placed at each end of the line of Elliot traps approximately 100 m apart. Cage traps were baited with universal bait and chicken wings.

Species targeted through this method include Brush-tailed Phascogale, Chuditch (*Dasyurus geoffroii*) and Quenda (*Isoodon fusciventer*). Specific survey guidelines exist for the Chuditch and this technique derived from DSEWPaC (2011b). Brush-tailed Phascogale and Quenda are also trapped via cage traps (Orell 2004).

Targeted cage trap lines

Cage traps (with approximate dimensions 26 by 23 by 66 cm) were deployed for a minimum of seven nights along five transects during both survey phases to target Brush-tailed Phascogale, Chuditch and Quenda. Each transect consisted of ten cage traps. These cages were baited with chicken wings as per recommendations from Alcoa (McGregor *et al*. 2014). For each trap deployed, the time and date deployed and recovered, as well as the GPS coordinates were recorded (see Table 5). Cage trap locations are presented in Figure 3, Appendix A.

Captured Chuditch were to be capture-marked-released to assess population size. Upon capture, gender, reproductive stage and health index would be recorded. Health index was rated on a scale from 1 to 3 after feeling the base of the Chuditch tail where a scale of 1 meant that bones could be felt and the Chuditch may be in poor health, and a scale of 3 meant that tail vertebrates could not be felt due to a layer of fat and the Chuditch was considered in excellent health. Photographs would then be taken of the Chuditch's head and back, one spot on the back would then be coloured with permanent marker before a second dorsal photograph was recorded and the Chuditch was released in a suitable hollow or burrow.

Cages would be closed if females carrying pouch young were recaptured, or any Chuditch was re-captured three consecutive nights in a row.

Table 5 Targeted Chuditch cage trap lines summary

Transect Number	Site name I.D	Habitat type	Location		Nights deployed	
			Easting	Northing	Phase 1	Phase 2
Transect 1	Cage trap 1	Jarrah Marri forest	419221	6422973	7 nights per cage trap	7 nights per cage trap
	Cage trap 2		419394	6422892		
	Cage trap 3		419514	6422675		
	Cage trap 4		419509	6422420		
	Cage trap 5		419565	6422228		
	Cage trap 6		419650	6422018		
	Cage trap 7		419761	6421852		
	Cage trap 8		419942	6421709		
	Cage trap 9		420119	6421576		
	Cage trap 10		420454	6421525		
Transect 2	Cage trap 11	Blackbutt forest	421648	6419061	7 nights per cage trap	7 nights per cage trap
	Cage trap 12		421627	6418960		
	Cage trap 13		421566	6418876		
	Cage trap 14		421507	6418709		
	Cage trap 15		421512	6418688		
	Cage trap 16		421542	6418576		
	Cage trap 17		421588	6418460		
	Cage trap 18		421554	6418336		
	Cage trap 19		421622	6418278		
	Cage trap 20		421670	6418167		
Transect 3	Cage trap 21	Jarrah Marri forest	428918	6412191	7 nights per cage trap	7 nights per cage trap
	Cage trap 22		429050	6412366		
	Cage trap 23		429269	6412380		
	Cage trap 24		429411	6412288		
	Cage trap 25		429604	6412250		
	Cage trap 26		429777	6412335		
	Cage trap 27		429896	6412492		
	Cage trap 28		430073	6412581		
	Cage trap 29		430240	6412663		
	Cage trap 30		430324	6412836		
Transect 4	Cage trap 31	Jarrah Marri forest	426343	6421760	7 nights per cage trap	7 nights per cage trap
	Cage trap 32		426311	6421557		
	Cage trap 33		426318	6421336		
	Cage trap 34		426370	6421155		
	Cage trap 35		426408	6420976		
	Cage trap 36		426292	6420861		
	Cage trap 37		426092	6420769		
	Cage trap 38		425938	6420749		
	Cage trap 39		425737	6420688		

Transect Number	Site name I.D	Habitat type	Location		Nights deployed	
			Easting	Northing	Phase 1	Phase 2
	Cage trap 40		425617	6420560		
Transect 5	Cage trap 41	Bullich and Blackbutt forest (for phase 2 this site was moved slightly due to a prescribed burn scar) to Jarrah Marri forest	418126	6419947	7 nights per cage trap	7 nights per cage trap
	Cage trap 42		418053	6420152		
	Cage trap 43		418040	6420333		
	Cage trap 44		418048	6420531		
	Cage trap 45		418030	6420734		
	Cage trap 46		417907	6420899		
	Cage trap 47		417881	6421081		
	Cage trap 48		417737	6421205		
	Cage trap 49		417716	6421245		
	Cage trap 50		417657	6421297		
Total of each Phase					**350**	**350**
Combined Total Effort					**700**	

Avifauna

Avifauna surveys were undertaken at each of the quadrat sites and opportunistically for a combined total of 2340 minutes. Avifauna surveys were undertaken at each of the quadrat sites. Each survey comprised of a 20 minute census of birds within an unbounded 2 ha area, which is the standard method used by Birds Australia for the Bird Atlas project. Birds detected visually (using binoculars) and/or aurally over a 20 minute period were recorded. Numbers of each species observed were also recorded.

All systematic bird surveys were undertaken either within four hours of dawn or two hours of dusk, as these are the times of day when birds are most active. In addition to systematic surveys, observations of birds were also made opportunistically throughout the survey activities. These are not part of the systematic quadrat surveys but add a significant proportion of the bird species observed.

Avifauna survey effort is displayed in Table 6.

Table 6 Avifauna survey effort

Site Type	Location		Habitat type	Survey effort (minutes)
	Easting	Northing		
Phase 1				
TL1	419173	6422951	Jarrah Marri forest	90
TL2	421559	6418605	Blackbutt forest	90
TL3	424227	6416681	Melaleuca dampland	90
TL4	426987	6413519	Jarrah Marri forest	90
TL5	427900	6412972	Granite outcrop Assoc.	90
TL6	427604	6410609	Flooded Gum woodland	90
TL7	428302	6417251	Jarrah Marri forest	90
TL8	426279	6422853	Jarrah Marri forest	90
TL9	424253	6425012	Jarrah Marri forest	90
TL10	424816	6421905	Jarrah Marri forest	90
TL11	420735	6417238	Granite outcrop	90
TL12	413197	6421772	Jarrah Marri forest	90

Site Type	Location		Habitat type	Survey effort (minutes)
	Easting	Northing		
Opportunistic	415684	6414906	Not recorded	30
Opportunistic	414570	6418045	Not recorded	30
Opportunistic	429971	6410176	Not recorded	30
Opportunistic	414320	6420879	Not recorded	30
Opportunistic	418523	6417302	Not recorded	30
Opportunistic	416068	6422764	Not recorded	30
Phase 1 Total				**1,260**
Phase 2				
TL1	419173	6422951	Jarrah Marri forest (recently burnt)	90
TL2	421559	6418605	Blackbutt forest	90
TL3	424227	6416681	Melaleuca dampland	90
TL4	426987	6413519	Jarrah Marri forest	90
TL5	427900	6412972	Granite outcrop Assoc.	90
TL6	427604	6410609	Flooded Gum woodland	90
TL7	428302	6417251	Jarrah Marri forest	90
TL8	426279	6422853	Jarrah Marri forest	90
TL9	424253	6425012	Jarrah Marri forest	90
TL10	424816	6421905	Jarrah Marri forest	90
TL11	420735	6417238	Granite outcrop Assoc.	90
TL12	413197	6421772	Jarrah Marri forest	90
Phase 2 Total				**1,080**
Phase 1 and Phase 2 Combined Total				**2,340**

Camera traps

Thirty-three remote cameras (Reconyx-Hyperfire ® and Reconyx-Pro ®) were deployed during Phase 1 for a total of 2,375 trap nights, and 20 remote cameras were deployed for 547 trap nights during Phase 2. In total 2,922 nights were undertaken. The duration of trap nights for each camera ranged from 21 to 89 trap nights. Remote cameras were deployed to target the conservation significant Chuditch (VU), Quokka (*Setonix brachyurus*, VU), Quenda (P4), Rakali (*Hydromys chrysogaster*, P4), Western Brush Wallaby (*Macropus irma*, P4), Brush-tailed Phascogale (CD) and general fauna (birds, reptiles and mammals). This was done by positioning cameras within the core habitat of targeted species, i.e. for Quokka, creek lines and damplands were investigated and cameras placed low in dense vegetation (within runnels if present). Conversely in upland habitat, Chuditch were targeted by utilising logs and hollows to position cameras. To target Brush-tailed Phascogale, cameras were set up similar to that described in Scida and Gration (2017). Cameras were baited with universal animal bait (a combination of peanut butter, oats and sardines) to attract fauna species within the Survey Area. For each camera location the number of nights deployed, and the GPS coordinates were recorded (Table 7). Cameras were used in this instant to supplement other trapping techniques and sample for more cryptic species such as the Quokka. The use of cameras also reduces the invasive impacts of trapping on species (DEC 2011).

Camera setup included fast trigger speed (faster than 0.5 sec) and colour photographs during the day and monochrome at night. The highest mega pixel possible, frames per second (>1) with capture set to three pictures per trigger with a one second delay.

Data from the cameras were downloaded to a computer and manually analysed for the presence of fauna following the field survey.

Species targeted through this method include Chuditch, Quokka, Quenda, Rakali, Western Brush Wallaby and Brush-tailed Phascogale.

Table 7 Camera trap locations

Camera Number	Habitat Type	Location		Deployed		Trap Nights Deployed
		Easting	Northing	Set	Collected	
Phase 1						
CAM 1	Jarrah Marri Forest	418864	6418040	6/07/2020	9/09/2020	65
CAM 4	Melaleuca dampland	416403	6416995	7/07/2020	9/09/2020	64
CAM 5	Jarrah Marri Forest	414533	6418380	7/07/2020	8/09/2020	64
CAM 6	Blackbutt forest	421796	6420180	4/07/2020	11/09/2020	69
CAM 7	Jarrah Marri Forest	417930	6422313	24/06/2020	11/09/2020	79
CAM 8	Jarrah Marri Forest	422863	6419611	4/07/2020	11/09/2020	69
CAM 10	Blackbutt forest	421279	6420885	4/07/2020	11/09/2020	69
CAM 11	Jarrah Marri Forest	413643	6419215	7/07/2020	9/09/2020	64
CAM 12	Blackbutt forest	421719	6418205	24/06/2020	11/09/2020	79
CAM 13	Jarrah Marri Forest	425487	6419041	4/07/2020	11/09/2020	69
CAM 14	Jarrah Marri forest	412543	6421508	7/07/2020	9/09/2020	64
CAM 15	Jarrah Marri Forest	418879	6417211	6/07/2020	9/09/2020	65
CAM 15b	Bullich forest	417973	6420573	24/06/2020	11/09/2020	79
CAM 16	Jarrah Marri Forest	423744	6415834	24/06/2020	11/09/2020	79
CAM 27	Bullich forest	417762	6421235	24/06/2020	11/09/2020	79
CAM 18	Bullich forest	417972	6420590	24/06/2020	11/09/2020	79
CAM 19	Granite outcrop Assoc.	427821	6410903	24/06/2020	11/09/2020	79
CAM 20	Jarrah Marri Forest	423469	6421514	4/07/2020	11/09/2020	69
CAM 21	Jarrah Marri Forest	426592	6419221	4/07/2020	11/09/2020	69
CAM 23	Jarrah Marri Forest	423494	6420401	4/07/2020	11/09/2020	69
CAM 24	Jarrah Marri Forest	419237	6423010	24/06/2020	11/09/2020	79
CAM 25	Jarrah Marri Forest	423668	6418484	4/07/2020	11/09/2020	69
CAM 28	Jarrah Marri Forest	426306	6417290	24/06/2020	11/09/2020	79
CAM 29	Blackbutt forest	422981	6418491	4/07/2020	11/09/2020	69
CAM 31	Melaleuca dampland	424732	6423215	4/07/2020	11/09/2020	69
CAM 41	Jarrah Marri Forest	415169	6416938	7/07/2020	9/09/2020	64
CAM 43	Melaleuca dampland	415525	6419259	7/07/2020	9/09/2020	64
CAM 44	Jarrah Marri Forest	413126	6420315	7/07/2020	9/09/2020	64
CAM 1	Melaleuca dampland	424674	6423235	6/07/2020	9/09/2020	65
CAM 4	Bullich forest	417780	6421235	7/07/2020	9/09/2020	64
CAM 77	Blackbutt forest	420846	6407514	14/09/2020	11/12/2020	89
CAM 7	Jarrah Marri Forest (conveyor corridor)	419320	6404938	14/09/2020	11/12/2020	89
CAM 24	Jarrah Marri Forest (conveyor corridor)	423753	6411977	14/09/2020	11/12/2020	89
Phase 1 Total						**2,375**

Camera Number	Habitat Type	Location		Deployed		Trap Nights Deployed
		Easting	Northing	Set	Collected	
Phase 2						
CAM 19	Jarrah Marri Forest	422598	6417606	4/11/2020	2/12/2020	28
CAM 26	Melaleuca dampland	425849	6413871	4/11/2020	2/12/2020	28
CAM 31	Melaleuca dampland	429026	6413236	4/11/2020	2/12/2020	28
CAM 27	Jarrah Marri Forest	423076	6417283	4/11/2020	2/12/2020	28
CAM 13	Melaleuca dampland	424219	6416023	4/11/2020	2/12/2020	28
CAM 16	Jarrah Marri Forest	422187	6417758	4/11/2020	2/12/2020	28
CAM 25	Melaleuca dampland	413390	6421527	4/11/2020	2/12/2020	28
CAM 12	Melaleuca dampland	420665	6414911	4/11/2020	2/12/2020	28
CAM GHDa	Jarrah Marri Forest	421144	6415089	4/11/2020	2/12/2020	28
CAM 18	Jarrah Marri Forest	419843	6416674	4/11/2020	2/12/2020	28
CAM 1	Blackbutt forest	414557	6419520	4/11/2020	2/12/2020	28
CAM 11	Bullich forest	417382	6419424	3/11/2020	2/12/2020	29
CAM 44	Melaleuca dampland	415880	6417989	5/11/2020	2/12/2020	27
CAM 6	Jarrah Marri Forest	426620	6416720	5/11/2020	2/12/2020	27
CAM 28	Jarrah Marri Forest	426043	6415364	5/11/2020	2/12/2020	27
CAM 15B	Jarrah Marri Forest	427392	6415617	5/11/2020	2/12/2020	27
CAM 14	Jarrah Marri Forest	428306	6416019	5/11/2020	2/12/2020	27
CAM 115	Granite outcrop Assoc.	426358	6425914	5/11/2020	2/12/2020	27
CAM 166	Granite outcrop Assoc.	426466	6426032	5/11/2020	2/12/2020	27
CAM 10	Melaleuca dampland	422643	6422180	11/11/2020	2/12/2020	21
Phase 2 Total						**547**
Combined Phase 1 and 2 Total						**2,922**

Bat Surveys

Bat Detectors (SM2 and SM4 SongMeters ®) were deployed for a period of between two and six nights at each survey location during both survey phases. Bat detectors were positioned in areas where bats might be recorded, i.e., utilising water bodies, fly ways, hill tops or open areas associated with damplands or granite outcrops. Bat detectors were set to record from 30 minutes pre-dusk to 30 minutes post-dawn. Detectors were set to record full spectrum and assessed using Kaleidoscope Pro (Wildlife Acoustics) and Anabat Insight (Titley Electronics). For each detector, the time and date deployed and recovered, and the GPS coordinates were recorded (Table 8). Bat detector locations are presented in Figure 3, Appendix A.

Data from the bat detectors were downloaded to a computer and analysed by Craig Grabham, GHD Principal Ecologist, for the presence of bats following the field survey.

Species targeted through this method include the Western False Pipistrelle (*Falsistrellus mackenziei*) with guidance on survey design from DSEWHA (2010) and Burgar *et al* (2017).

Table 8 Bat detector locations

Bat detector	Habitat type	Location		Deployed		Nights deployed
		Easting	Northing	Set	Collected	
Phase 1						
SM4-1	Jarrah Marri Forest	426282	6417199	24/06/2020	30/06/2020	6
SM4-1	Granite outcrop Assoc.	427915	6412940	30/06/2020	2/07/2020	2
SM4-1	Jarrah Marri Forest	425818	6421856	2/07/2020	4/07/2020	2
SM4-4	Jarrah Marri Forest	417931	6422315	24/06/2020	30/06/2020	6
SM4-4	Jarrah Marri Forest	425197	6414173	30/06/2020	2/07/2020	2
SM4-4	Jarrah Marri Forest	421309	6416290	3/07/2020	6/07/2020	3
SM4-5	Jarrah Marri Forest	419249	6423008	24/06/2020	29/06/2020	5
SM4-5	Blackbutt forest	421589	6418754	29/06/2020	2/07/2020	3
SM4-5	Granite outcrop Assoc.	427860	6411147	2/07/2020	6/07/2020	4
SM2-3	Bullich forest	417973	6420593	24/06/2020	30/06/2020	6
SM2-3	Melaleuca dampland	424270	6416696	30/06/2020	2/07/2020	2
Total Phase 1						**41**
Phase 2						
SM4-4	Granite outcrop Assoc.	415676	6414950	3/11/2020	5/11/2020	2
SM4-1	Granite outcrop Assoc.	420798	6417251	3/11/2020	6/11/2020	3
SM4-4	Jarrah Marri Forest	420771	6417263	3/11/2020	6/11/2020	3
SM4-1	Jarrah Marri Forest	426302	6422178	6/11/2020	9/11/2020	3
SM4-2	Jarrah Marri Forest	425097	6426021	6/11/2020	9/11/2020	3
SM2-3	Jarrah Marri Forest	423254	6417433	6/11/2020	9/11/2020	3
SM4-4	Blackbutt forest	421492	6418891	6/11/2020	9/11/2020	3
SM4 -1	Melaleuca dampland	422176	6420640	9/11/2020	11/11/2020	2
Total Phase 2						**22**
Combined Phase 1 and 2 Total						**63**

Nocturnal Bird Acoustics and Bird Census

Song Meter SM4 (Wildlife Acoustics) acoustic recorders were deployed at 13 sites throughout the Survey Area and recorded a combined total of 47 nights during both survey phases. Acoustics were positioned in areas where birds might be recorded, i.e. utilising water bodies, flyways and specifically targeted the Masked Owl (*Tyto novaehollandiae*). For each acoustic recorder site, the number of nights deployed, and the GPS coordinates were recorded (see Table 9). Acoustic recorder's locations are depicted in Figure 3, Appendix A.

Data from the acoustic recorders were downloaded to a computer and analysed for the presence of birds following the field survey. Data from the acoustic recorders was assessed by Nigel Jackett (Bird Specialist) for the presence of bird species. The methods of his assessment and results are provided in detail in Appendix D.

Table 9 Bird acoustics recorder locations

Bird Acoustics recorder site name	Habitat type	Location		Deployed		Nights deployed
		Easting	Northing	Set	Collected	
Phase 1						
SM4-AC1	Blackbutt forest	417220	6419709	4/07/2020	9/07/2020	5
SM4-AC1	Blackbutt forest	424795	6421966	1/07/2020	4/07/2020	3
SM4-AC2	Granite outcrop Assoc.	420722	6417160	4/07/2020	6/07/2020	2
SM4-AC2	Jarrah Marri forest	415306	6415314	7/07/2020	9/07/2020	2
SM4-AC3	Jarrah Marri forest	414389	6420890	1/07/2020	9/07/2020	8
SM4-AC4	Jarrah Marri forest (adjacent clearing/farmland)	415635	6419757	1/07/2020	9/07/2020	8
Total Phase 1						**28**
Phase 2						
SM4-AC3	Jarrah Marri forest	421995	6417174	3/11/2020	6/11/2020	3
SM4-AC1	Bullich forest	417415	6419370	3/11/2020	5/11/2020	2
SM4-AC2	Jarrah Marri forest	415679	6414947	3/11/2020	5/11/2020	2
SM4-AC2	Jarrah Marri forest (adjacent clearing/farmland)	424811	6426489	6/11/2020	9/11/2020	3
SM4-AC3	Jarrah Marri forest	426584	6421732	6/11/2020	9/11/2020	3
SM4-AC4	Jarrah Marri forest	423237	6417434	6/11/2020	9/11/2020	3
SM4-AC1	Blackbutt forest	421492	6418887	6/11/2020	9/11/2020	3
Total Phase 2						**19**
Combined Phase 1 and 2 Total						**47**

Carter's Freshwater Mussel assessment

Carter's Freshwater Mussel (*Westralunio carteri*) assessments were conducted during the Phase 2 survey. The survey approach was based on a method used by Klunzinger *et al.* (2012) to study Carter's Freshwater Mussel populations in the lower Vasse River. This method is aimed at detecting individual presence. Due to the ephemeral nature of the water bodies within the Survey Area this method was based on the assumption of low density of individuals

Eleven locations were selected for assessment prior to the field survey based on potential direct impacts from clearing and crossing construction over stream zone areas. Potential survey locations focussed on streams likely to have water present in order to maximise detection to confirm presents/absence. For each survey location zoologists walked 100 m upstream and 200 m downstream assessing 10 (1 x 1 m) quadrats at regular 30 metre intervals. While traversing the stream zone opportunistic searching for mussels was also done between each quadrat. In situations where stream zones may have become inaccessible due to dense riparian vegetation, the maximum number of quadrats was surveyed along the accessible stream zone. The following was recorded:

– Any evidence of Carter's Freshwater Mussel including live mussels and dead shell remains within the water, as well as any shell evidence on banks
– Presence of water and if so, still or flowing, size of water body and depth if determinable
– Riparian vegetation, bank/bed condition including evidence of bank erosion, bed sediment deposition and disturbance (i.e. tramping by pigs, dumped material etc.)
– Riparian vegetation condition
– Evidence of riparian terrestrial fauna including Rakali middens, quokka tracks/runnels/scat etc.
– For standing water the following was recorded:

- Approximate depth, width and (for pools) length
- Substrate (rocky, sandy etc)
- Water quality (clear, turbid, sheen etc)
- Opportunistic observations for aquatic fauna (fish, crayfish, frogs etc).

In total eleven (11) Carters Freshwater Mussel transects were surveyed over the Survey Area. Locations of these transects are presented in Table 10. Greater details on the assessment can be found in Appendix D.

Table 10 Carter's Freshwater Mussel transect summary

Site Type	Location		Date completed	Number of quadrats
	Easting	Northing		
CFM 1	423948	6412155	11/11/2020	10
CFM 2	427574	6410425	4/11/2020	9
CFM 3	425341	6413891	11/11/2020	10
CFM 4	424312	6416058	5/11/2020	10
CFM 5	425273	6419128	5/11/2020	10
CFM 6	421589	6418319	5/11/2020	10
CFM 7	416100	6417674	5/11/2020	10
CFM 8	417932	6419996	3/11/202010	10
CFM 9	420847	6407516	11/11/2020	10
CFM 10	419321	6404937	11/11/2020	10
CFM 11	419791	6417772	4/11/2020	11

Rakali assessment

Due to similarity of habitat preference, Rakali habitat assessments were performed in conjunction with the Carter's Freshwater Mussel assessments. Each Carter's Freshwater Mussel transect (ten 1 x 1m quadrats over a 300 metre distance) was also searched for the presence of middens, tracks and scat as well as an overall assessment of habitat quality (permanent water, presence of food species, refuge habitat, fire history etc.). In addition to those mentioned above, an additional three locations were actively searched for the presence of Rakali. The locations of these active searches are presented in Table 11.

Remote cameras were also set to target Rakali in areas considered potentially suitable to support their presence such as alongside streams and creeks. Remote cameras are considered unreliable to capture Rakali (due to cool temperatures a wet Rakali maintains). However, cameras placed slightly away from water with sufficient bait to keep the species present longer also yield results (GHD *pers comm*. Cockatoo Island Fauna Surveys). Remote camera locations are presented in Table 7 and Figure 3,Appendix A. Greater details on the assessment can be found in Appendix D.

Table 11 Additional Rakali active search summary

Site name	Location		Date completed	Survey effort (minutes)
	Easting	Northing		
R1	423948	6412155	11/11/2020	30
R2	427574	6410425	4/11/2020	30
R3	425341	6413891	11/11/2020	30
R4	424312	6416058	5/11/2020	30
R5	425273	6419128	5/11/2020	30
R6	421589	6418319	5/11/2020	30
R7	416100	6417674	5/11/2020	30
R8	417932	6419996	3/11/2020	30
R9	420847	6407516	11/11/2020	30
R10	419321	6404937	11/11/2020	30
R11	419791	6417772	4/11/2020	30
Additional searches	424220	6416019	4/11/2020	20
	425346	6413895	4/11/2020	20
	424902	6413431	5/11/2020	20
Total				390

Quokka Assessments

Quokka assessments were performed during the Phase 1 and 2 surveys (Table 12). Assessments were conducted by targeting potential Quokka habitat (primarily medium-long unburnt riparian vegetation with dense undergrowth and melaleuca dampland). Areas of potential Quokka habitat were searched for presence of runnels, tracks and scat as well as the extent of habitat and connectivity to surrounding potentially suitable habitat. Each identified habitat was searched (meandered) by two ecologists for approximately 60 minutes. This methodology (Quokka habitat assessment) was extracted from Bain (DEC 2013) and where habitat is considered suitable or quokka detected (due to evidence found) remote cameras were placed. In total approximately 31 hours of Quokka assessments were undertaken spread over 31 sites.

Targeted remote cameras were set during both survey phases at locations deemed to be suitable to support Quokkas to confirm their presence (see Table 6 and associated habitat type of Melaleuca damplands). Suitability of camera location was based on habitat characteristics. Habitat with relatively high density of shrubs associated with creeklines and / or Melaleuca damplands. As these habitats provide shelter and movement corridors under cover for Quokkas. Camera location were also selected in proximity to secondary Quokka evidence detected during Quokka assessments such as scats, runnels and footprints. Remote camera locations are presented in Table 7 and Figure 3, Appendix A.

Table 12 Quokka assessment summary

Site Type	Location		Date completed	Habitat type	Survey effort (minutes)
	Easting	Northing			
Quokka assessment	417780	6421235	24/6/2020	Bullich forest at creek	60
	423934	6412206	14/09/2020	Melaleuca dampland	60
	419322	6404957	14/09/2020	Melaleuca dampland	60
	420847	6407512	14/09/2020	Melaleuca dampland	60
	420884	6407494	14/09/2020	Melaleuca dampland	60
	418020	6420561	9/7/2020	Bullich forest	60
	427636	6410541	9/7/2020	Flooded Gum Woodland	60
	417973	6420573	24/6/2020	Bullich forest	60
	423744	6415834	24/6/2020	Bullich forest	60
	417972	6420590	24/6/2020	Bullich forest	60
	429043	6413217	4/11/2020	Melaleuca dampland	60
	425848	6413873	4/11/2020	Melaleuca dampland	60
	424220	6416021	4/11/2020	Melaleuca dampland	60
	420662	6414911	4/11/2020	Melaleuca dampland	60
	419747	6417722	4/11/2020	Jarrah Marri forest	60
	417388	6419420	4/11/2020	Bullich forest at creek	60
	414559	6419466	4/11/2020	Blackbutt forest at creek	60
	421923	6415255	4/11/2020	Melaleuca dampland	60
	421967	6417010	4/11/2020	Melaleuca dampland	60
	413396	6421535	4/11/2020	Melaleuca dampland	60
	423637	6418272	5/11/2020	Melaleuca dampland	60
	425397	6419091	5/11/2020	Jarrah Marri forest at creek	60
	428728	6414402	5/11/2020	Melaleuca dampland	60
	427394	6415618	5/11/2020	Jarrah Marri forest	60
	417343	6419328	5/11/2020	Melaleuca dampland	60
	424374	6416090	5/11/2020	Melaleuca dampland	60
	422647	6422250	5/11/2020	Bullich forest at creek	60
	419434	6405119	11/11/2020	Jarrah Marri forest at creek	60
	420860	6407493	11/11/2020	Melaleuca dampland	60
	426048	6412319	11/11/2020	Blackbutt forest at creek	60
	423869	6412250	11/11/2020	Blackbutt forest at creek	60
Total					**1860**

Brush-tailed Phascogale assessment

Brush-tailed Phascogales were targeted using remote cameras, cages and Elliot box traps. Remote cameras were deployed in habitats deemed potentially suitable to support phascogales and were deployed within key habitat features important to the Brush-tailed Phascogale such as in trees and facing onto logs. Cameras were deployed during both phases of the survey to increase the capture potential.

Elliot box traps deployed at the traplines were adapted to target Brush-tailed Phascogale during the Phase 2 survey. Elliot traps were strapped into trees and on logs to target phascogale which are largely arboreal (tree dwelling). The Elliot traps were baited with universal bait (a combination of peanut butter, oats and sardines) and covered with bark, leaves or Sheoak needles.

2.3.7 Black Cockatoo habitat assessment

A Black Cockatoo habitat assessment (for Carnaby's Cockatoo, Forest Red-tailed Black Cockatoo and Baudin's Cockatoo) was undertaken over the Survey Area to assess the presence, quality and extent of habitat. The assessment involved visual and aural assessment of the Survey Area, identifying breeding habitat (presence/absence of actual and potential breeding trees), foraging habitat, roosting areas, current activity and any other signs of use by Black Cockatoos. For the purpose of this assessment, the DSEWPaC (2012) Black Cockatoo referral guidelines were used to define breeding, foraging and night roosting habitat.

The number and type of potential breeding trees within the Survey Area was estimated by surveying thirty one (31) plots (60 m by 500 m = 3 ha each) across the Survey Area (93 ha total). Each plot was traversed on foot and all potential Black Cockatoo breeding trees (based on Diameter Breast Height (DBH) recorded. Plots were selected to sample across all the vegetation complexes occurring locally based on vegetation mapping by Mattiske and Havel (1998). The number of plots within each vegetation complex was roughly proportional to the relative amount of each complex within the Survey Area. For example, the extensive Jarrah Marri forest habitat type had proportionately more plots than Bullich forest habitat type which comprised a small proportion of the Survey Area.

Breeding habitat was extrapolated using averaged results from these plot surveys per fauna habitat type throughout the Survey Area. This method was undertaken due to the large extent of the Survey Area and the commitment by Alcoa to undertaking detailed pre-clearing surveys of potential breeding trees in mining and haul road footprints once these are confirmed. For each potential breeding tree, details of the tree location, species, DBH, size and number of hollows observed, evidence of use and any other significant observations were recorded. Where trees were recorded to have a suitable large hollow that could be used or had signs of being used (potential or likely), trees were revisited by Tony Kirkby (Black Cockatoo Specialist) where the hollows were checked for Black Cockatoo use by using a drone, pole camera and telephoto lens.

Information collected during the field survey included:

– Foraging habitat - the location and extent of suitable Black Cockatoo species foraging habitat was identified and mapped for the Survey Area, based on the vegetation associations and presence/absence of known foraging species. During the field surveys any direct or indirect evidence of foraging by Black Cockatoos was recorded via GPS.
– Breeding habitat - suitable breeding habitat for Black Cockatoos is defined by DSEWPaC (2012) as trees of species known to support breeding within the range of the species which either have a suitable nest hollow or are of a suitable Diameter at Breast Height (DBH) to develop a nest hollow. For most tree species, suitable DBH is greater than 500 mm. For Salmon Gum (*Eucalyptus salmonophloia*) and Wandoo (*Eucalyptus wandoo*), suitable DBH is greater than 300 mm (DSEWPaC 2012), however in this Survey Area no wandoo were present. On average, Carnaby's Cockatoos are known to nest in hollows with an entrance diameter greater than 20 - 30 cm (Johnstone and Storr 1998; Groom 2011). While the Forest Red-tailed Black Cockatoo is known to nest in hollows with an entrance of greater than 12 cm (Johnstone and Storr 1998). Therefore, during the field survey hollows size, as well as position, chew evidence and tree species was a guide for potential and likely use.
– Night roosting habitat - suitable roosting habitat is defined by DSEWPaC (2012). Suitable roosting habitat was identified based on the presence of suitable tall trees, evidence of roosting (feathers, twig clips etc.) and proximity of known roosting sites in the Survey Area and extended Survey Area. There was one suspected location of roosting within the Survey Area. This can be seen in Appendix D.

– Opportunistic observations - both visual and aural observations of Black Cockatoos within the Survey Area and surrounding region were noted during the survey. This information was used to provide context to the use of the Survey Area by all three Black Cockatoo species.

This information was used to calculate the amount of foraging habitat, potential breeding habitat and night roosting habitat within the Survey Area and a guide to the habitats available within the extended Survey Area. A summary of this information is presented below in Table 26.

2.3.8 Other Searches

Rare and threatened species may have a patchy, disparate distribution through landscapes. To provide the best opportunity to determine the presence and relative prevalence of these species, this study employed a variety of sampling methods. Systematic sampling sites were also assessed using non-systematic methods to ensure thorough coverage of the sites, and non-systematic techniques were used to sample the broader Survey Area and increase survey effort.

Diurnal searching

Each trapping site was surveyed for amphibians, reptiles, and mammals. Surveys comprised of active searching of potential shelter sites (overturning logs, rocks and leaf litter) and low vegetation (under bark and in tree stumps) and recording all individuals observed with a focus on conservation significant species. Species presence was also detected and identified via secondary evidence, in the form of scats, tracks, feathers, burrows and skeletal remains. A minimum of one hour was spent at each trap line including the general area around it. Diurnal (active) searching is known to be highly productive during optimal weather in selected habitat types and can account for a significant proportion of reptile species recorded. This method targeted granite outcrops during Phase 1 to maximise effectiveness. A summary of the diurnal search effort completed is provided below in Table 13 with survey locations shown in Figure 3, Appendix A.

Table 13 Active diurnal search summary

Site name	Location		Habitat type	Survey effort (minutes)
	Easting	Northing		
Phase 1				
Active search	419166	6422868	Jarrah Marri forest	30
	427925	6412801	Melaleuca dampland	135
	426545	6422105	Jarrah Marri forest	30
	427854	6411179	Granite Outcrops Assoc.	30
	419111	6417875	Granite Outcrops Assoc.	30
	412511	6421533	Jarrah Marri forest	30
	415502	6415131	Jarrah Marri forest	120
	414359	6417984	Jarrah Marri forest	30
	427872	6410860	Granite Outcrops Assoc.	40
	418184	6422052	Granite Outcrops Assoc.	240
	420791	6417282	Granite Outcrops Assoc.	60
	428228	6418114	Granite Outcrops Assoc.	60
	427273	6417099	Jarrah Marri forest	60
	419542	6419115	Jarrah Marri forest	60
	427821	6418300	Granite Outcrops Assoc.	60
	420750	6417139	Granite Outcrops Assoc.	60
	418020	6422080	Granite Outcrops Assoc.	60
	426554	6425723	Granite Outcrops Assoc.	60
	430136	6410618	Jarrah Marri forest	30
	426378	6425909	Granite Outcrops Assoc.	120
	418557	6417351	Granite Outcrops Assoc.	140
	414085	6422412	Jarrah Marri forest	30
	420803	6417126	Granite Outcrops	60
Total Phase 1				**1,575**
Phase 2				
Active search	424329	6416182	Granite Outcrops	30
	428008	6410850	Jarrah Marri forest	120
	424219	6416025	Jarrah Marri forest	20
	424876	6414720	Jarrah Marri forest	60
	424609	6413211	Granite Outcrops	20
	419909	6424636	Jarrah Marri forest	60
	427714	6411184	Jarrah Marri forest	20
	428399	6413891	Jarrah Marri forest	20
	427103	6414267	Jarrah Marri forest	60
	426591	6421728	Jarrah Marri forest	60
	426543	6422105	Jarrah Marri forest	30
	426290	6422164	Jarrah Marri forest	20
	418184	6415922	Jarrah Marri forest	90

Site name	Location		Habitat type	Survey effort (minutes)
	Easting	Northing		
	418431	6415399	Granite Outcrops	180
	422622	6422820	Jarrah Marri forest	20
	426935	6413464	Jarrah Marri forest	20
	422059	6423729	Jarrah Marri forest	20
	419286	6419772	Jarrah Marri forest	60
	425697	6424851	Jarrah Marri forest	20
	416087	6422641	Jarrah Marri forest	60
	414743	6421898	Jarrah Marri forest	30
	426174	6423113	Jarrah Marri forest	30
	415025	6422056	Jarrah Marri forest	30
	414082	6422386	Jarrah Marri forest	20
Total Phase 2				**1,100**
Combined Phase 1 and 2 Total				**2,675**

Nocturnal searching

Spot lighting was undertaken to detect nocturnal species that may otherwise remain undetected using other survey techniques. Handheld or head mounted spotlights were used for a minimum of 15 minutes at each trap line for each survey phase and within the general area. Nocturnal searches involved spot lighting for a minimum of 200 m traversed at each location and recording all species observed during the exercise. A summary of the nocturnal searches completed is provided below in Table 14 with survey locations displayed in Figure 3, Appendix A.

Table 14 Nocturnal search summary

Site Type	Location		Habitat type	Survey effort (minutes)
	Easting	Northing		
Phase 1				
Frog / Nocturnal search	424263	6416733	Melaleuca dampland	15
Frog / Nocturnal search	427726	6410729	Blackbutt forest	30
Frog / Nocturnal search	425272	6413885	Jarrah Marri forest	15
Frog / Nocturnal search	424331	6416842	Melaleuca dampland	15
Frog / Nocturnal search	428035	6412958	Granite Outcrops Assoc	15
Frog census	424347	6415981	Melaleuca dampland	15
Nocturnal search	423543	6418321	Melaleuca dampland	30
Nocturnal search	417782	6421118	Bullich / Blackbutt forest	30
Nocturnal search	421610	6418810	Blackbutt forest	30
Nocturnal search	427636	6410541	Flooded Gum woodland	30
Nocturnal search	427615	6410458	Blackbutt forest	90
Nocturnal search	427616	6410462	Blackbutt forest	90
Nocturnal search	425445	6416692	Jarrah Marri forest	60
Nocturnal search	429006	6412852	Jarrah Marri forest	30
Total Phase 1				**495**
Phase 2				

Site Type	Location		Habitat type	Survey effort (minutes)
	Easting	Northing		
Nocturnal search	419178	6422955	Jarrah Marri forest	60
Nocturnal search	421550	6418600	Blackbutt forest	80
Nocturnal search	420745	6417248	Granite Outcrops Assoc	60
Nocturnal search	413297	6421782	Melaleuca dampland	60
Nocturnal search	417415	6419370	Bullich / Blackbutt forest	60
Nocturnal search	417781	6421118	Bullich / Blackbutt forest	60
Nocturnal search	421609	6418809	Blackbutt forest	60
Nocturnal search	427636	6410541	Flooded Gum woodland	60
Total Phase 2				**500**
Combined Phase 1 and 2 Total				**995**

Opportunistic observations

Opportunistic observations involve the recording of fauna taxa (physical presence and/or signs of presence) spatially throughout the Survey Area. These observations are gathered throughout the survey duration during all in-situ activities including travel, and generally account for a substantial proportion of the species assemblage recorded including conservation significant fauna. Opportunistic observations include physical observations (sighting or hearing fauna), and indirect evidence (scats, tracks, diggings, nests, feathers, slough, skeletal remains, pellets) which indicate the current or recent activity of a species present. Wherever possible, numbers of individuals, microhabitat use and other relevant information was recorded. Opportunistic observations were recorded outside of the diurnal, nocturnal or general trap site surveys (for example when driving, walking to a site, checking camera traps and bat detectors).

2.3.9 Summary of survey effort

Survey effort is described as the amount and type of survey that is undertaken during an assessment. Table 15 provides detail on the type and amount of survey time undertaken during both survey phases. Each of the trapping sites were sampled for a minimum of seven (7) trap-nights per survey phase including bucket, cages (both at general trap lines and cage trap transects), funnel and Elliott traps. The total trapping effort across both survey phases consisted of 6,412 trap nights. Additionally, over both survey phases remote cameras were deployed for a total of 2,922 nights, 2,340 minutes of bird census was undertaken (Table 5), 63 nights were sampled for bat acoustics (Table 7), 47 nights were sampled for bird acoustics (Table 8), 2,675 minutes of diurnal active searching was completed (Table 13), 995 minutes of nocturnal searching was completed (Table 14). Additionally, 390 minutes for Rakali (Table 11) and 1,860 minutes (Table 12) of Quokka assessments were undertaken.

Table 15 Summary of fauna survey effort

Fauna trapping sites Phase 1 2020				**Elliot traps**		**Pit traps**		**Cage traps**		**Funnel traps**	
Sites Phase 1	Easting	Northing	nights open	# of traps	trap nights	# of traps	trap nights	# of traps	trap nights	# of traps	trap nights
TL 1	426987	6413519	7	10	70	7	70	2	14	12	84
TL 2	424252	6425012	7	10	70	7	70	2	14	12	84
TL 3	427900	6412972	7	10	70	7	70	2	14	12	84
TL 4	426279	6422853	7	10	70	7	70	2	14	12	84
TL 5	419173	6422951	7	10	70	7	70	2	14	12	84
TL 6	420734	6417238	7	10	70	7	70	2	14	12	84
TL 7	421559	6418605	7	10	70	7	70	2	14	12	84
TL 8	428302	6417251	7	10	70	7	70	2	14	12	84
TL 9	427604	6410609	7	10	70	7	70	2	14	12	84
TL 10	413197	6421772	7	10	70	7	70	2	14	12	84
TL 11	424815	6421905	7	10	70	7	70	2	14	12	84
TL 12	418020	6420561	7	10	70	7	70	2	14	12	84
Total –Phase 1				**120**	**840**	**84**	**840**	**24**	**168**	**144**	**1,008**
Fauna trapping sites Phase 2 2020				**Elliot traps**		**Pit traps**		**Cage traps**		**Funnel traps**	
Sites Phase 2	Easting	Northing	nights open	# of traps	trap nights	# of traps	trap nights	# of traps	trap nights	# of traps	trap nights
TL 1	426987	6413519	7	10	70	7	70	2	14	12	84
TL 2	424252	6425012	7	10	70	7	70	2	14	12	84
TL 3	427900	6412972	7	10	70	7	70	2	14	12	84
TL 4	426279	6422853	7	10	70	7	70	2	14	12	84
TL 5	419173	6422951	7	10	70	7	70	2	14	12	84
TL 6	420734	6417238	7	10	70	7	70	2	14	12	84
TL 7	421559	6418605	7	10	70	7	70	2	14	12	84
TL 8	428302	6417251	7	10	70	7	70	2	14	12	84
TL 9	427604	6410609	7	10	70	7	70	2	14	12	84
TL 10	413197	6421772	7	10	70	7	70	2	14	12	84
TL 11	424815	6421905	7	10	70	7	70	2	14	12	84
TL 12	418020	6420561	7	10	70	7	70	2	14	12	84
Total Phase 2				**120**	**840**	**84**	**840**	**24**	**168**	**144**	**1,008**
Total Phase 1 and 2 combined				**240**	**1,680**	**168**	**1,680**	**48**	**336**	**288**	**2,016**

2.3.10 Species accumulation

The number and type of species trapped each day was recorded and a species accumulation curve was created for the Survey Area using PRIMER v6 (Clarke and Gorley 2006). The species accumulation curve represents the successfulness of the trapping program for its duration. Typically, the longer the trapping program the more complete the representation of species sampled per trapping location or habitat type. Accumulation curves should show “levelling” of the groups species counts prior to the completion of the survey. Many limitations can influence the results of a curve and should be observed as a guide to the project’s success. This curve is presented in Plate 10 in Section 4.3.1.

The data was run through Primer v6 against 8 existing models, these models are:

– Sobs - Curve of observed species counts
– Chao 1 - Chao's estimator based on number of rare species
– Chao 2 - Chao's estimator using just presence-absence data
– Jacknife 1 - Jacknife estimator based on species that only occur in one sample
– Jacknife 2 - Second order jacknife estimator
– Bootstrap - Bootstrap estimator based on proportion of quadrats containing each species
– MM (Michaelis-Menton) - Curve fitted to observed Sobs curve
– UGE - Calculated species accumulation curve based on Ugland, Gray and Ellingsen (2003)

2.3.11 Fauna survey limitations

EPA (2020) states that fauna and faunal assemblage survey reports for environmental impact assessment in Western Australia should contain a section describing the limitations of the survey methods used. The limitations and constraints associated with the fauna component of this field survey are discussed in Table 16.

Table 16 Fauna survey limitations

Limitations	Constraints	Impact on Survey outcomes
Scope (what fauna groups were sampled and were some sampling methods not able to be employed because of environmental constraints)	Nil	All fauna groups were able to be sampled. During the Phase 2 survey the traps had to be closed for three nights due to a car rally in the Survey Area. The traps were re-opened following the rally and were open for a minimum of 7 nights (combined) each.
Seasonal environmental conditions	Minor	The surveys were scoped and designed around EPA (2016a) guidelines; however they were modified and completed when EPA (2020) guidelines was released. This document provides recommended survey timing for the Southern Climatic Region for amphibians, birds and mammals. The recommended survey timing for reptiles in accordance with these guidelines include a primary survey being undertaken between October-December (completed) and a secondary survey to be completed between February-March (not completed). The first survey undertaken for the Myara North Survey Area was completed in June/July 2020 which is outside of the recommended survey timing for reptiles (EPA 2020). The survey was arranged prior to the release of the EPA (2020) guidelines; however, the survey incorporated extensive active searching in habitats deemed suitable for the Dell Skink and Southern Death Adder - conservation significant reptiles identified in the desktop assessment as potentially occurring within the Survey Area. Raking of leaf litter and active searching in granite is considered particularly useful during the winter months to detect reptiles lying dormant in the cooler weather. A high proportion of the reptile species recorded were detected via active searching. The survey timing discrepancy is not considered a major limitation to this survey due to the effort applied to active searching with particular focus on the conservation significant reptiles. The survey timing had no impact of recording mammals and birds.
Proportion of fauna identified, recorded and/or collected	Nil	All fauna were identified and released on site.
Proportion of the task achieved and further work which might be needed.	Nil	All scoped work was completed successfully.
Remoteness and/or access problems	Nil	No issues were encountered with the exception of the aforementioned car rally resulting in the traps being closed for three consecutive nights.
Accordance to EPA guidelines	Minor	Change of EPA guidelines from 2016 vertebrate guidance to 2020 during Phase 1 survey. Original scoping was to perform a detailed terrestrial fauna survey over the Survey Area in accordance with EPA (2016a). Following the release of the EPA (2020) guidelines the survey was adapted to take on more of a targeted approach. Chuditch and Black Cockatoo were targeted during both phases of the survey, while targeted Carters Freshwater Mussel and Quokka assessments were included into the Phase 2 survey.

2.4 Climate data for survey period

Weather conditions during the Phase 1 survey were generally cool and damp with rainfall occurring most days. The Phase 2 survey period also experienced rainfall at the beginning and end of the survey duration; however experienced dry and warm conditions for the majority of the survey. An overview of the weather experienced

during the survey is presented in Table 17. Weather data was obtained from the Bureau of Meteorology website closest weather station to the site, Karnet (Station ID: 009111) located approximately 5 km southwest of the Survey Area.

Table 17 Weather data for survey period (Phase 1 and 2)

Date	Minimum temp (°C)	Maximum temp (°C)	Rainfall (mm)
Phase 1			
29 June 2020	10.2	15.0	34.1
30 June 2020	11.2	15.0	2.0
1 July 2020	9.2	14	7.4
2 July 2020	6.5	15.4	0
3 July 2020	5.9	17.4	0.3
4 July 2020	8.3	20.5	0.5
5 July 2020	9.7	21.6	0
6 July 2020	11	15.9	4.8
7 July 2020	9.5	15	22.3
8 July 2020	6	14.6	9.6
9 July 2020	5.2	14.9	0.3
Phase 2			
2 November 2020	13.4	16.5	15.8
3 November 2020	11.1	-	7.3
4 November 2020	-	20.3	0
5 November 2020	10.4	22.5	0
6 November 2020	10	27.4	0
9 November 2020	12.4	25.6	0
10 November 2020	13.7	26.6	0
12 November 2020	12.1	22.8	0
13 November 2020	10.4	22.5	5.6

3. Desktop Assessment

3.1 Climate

The Survey Area is located within the Northern Jarrah Forest subregion of Western Australia. The climate of this region is classified as Warm Mediterranean, with two distinct seasons: a warm and dry summer (December to February) and a cool wet winter (June to August) (Williams & Mitchell 2001).

The region is characterised spatially by rainfall, with rainfall being greatest on the scarp and decreasing to the east and north (Williams & Mitchell 2001). The majority of all rainfall received occurs during winter months and is a result of low pressure systems associated with westerly winds. The closest operating weather station is Serpentine Karnet (Station ID: 009111) located approximately 5 km southwest of the Survey Area.

Climate data (Bureau of Meteorology 2020) from this station indicates:

– Mean maximum temperature ranges from 15.5 °C in July to 30.6 °C in January
– Mean minimum temperature ranges from 6.3 °C in July and August to 15.8 °C in February
– Mean annual rainfall is 1,153 mm with average of 98.5 rain days/year.

3.2 Geology and land systems

3.2.1 Geology

The Australian continent is made up of four continental blocks: the Yilgarn, Pilbara and Gawler Cratons and the Wilyama Block. The Survey Area is located within the South West Terane of the Yilgarn Craton. The Yilgarn Craton is comprised of geological formation from the Archaean (2.5 billion years ago) to Cainozoic ages (66 million years ago to present) and bounded by the Murgoo Gneiss Complex of the Western Gneiss Terrane in the west and the Southern Cross Province in the east. The South West Terrane is composed of granitic rocks classified into groups based on characteristics. The Study Area overlays two geological units:

– South West Terrane greenstones – granulite and migmatite
– Yilgarn Craton Granites - granitic rock, undivided; metamorphosed

3.2.2 Land systems

The Survey Area is located within two land systems:

– Darling Plateau System - Lateritic plateau. Duplex sandy gravels, loamy gravels and wet soils. Jarrah-Marri-wandoo forest and woodland.
– Murray Valleys System - Western Darling Range from the Avon Valley to Harvey. Deeply incised valleys with Red loamy earths, shallow duplexes and rock outcrop and Jarrah-Marri-wandoo forest and woodland with mixed shrubland.

3.3 Surface water and hydrology

The Survey Area lies predominantly within the Serpentine River catchment and lies adjacent to the Serpentine River and Serpentine Dam and Pipehead Dam Reservoirs. Tributaries of the Serpentine River and Serpentine Dam Reservoir include 39 Mile Brook, Banksia Gully and Gold Mine Gully, which flow in a roughly south-west direction through the Survey Area. The north west portion of the Survey Area drains to Honour Brook, which flows west through Jarrahdale and discharges into the Serpentine River downstream of the Pipehead Dam. The north-east portion of the Survey Area lies within the Wungong Brook catchment, which drains into Wungong Dam Reservoir approximately 4 km to the north-west.

The Serpentine Dam, Pipehead Dam and Wungong Dam are public drinking water reservoirs. The south-west extent of the Survey Area lies within the Reservoir Protection Zone of the Serpentine Dam and Pipehead Dam reservoirs.

The Serpentine Dam and Pipehead Dam are man-made perennial water bodies. The Serpentine River, Wungong Brook and tributaries within the Survey Area are ephemeral and flow for periods of several months during winter and spring. Drainage floors occur in areas of alluvial deposits along the Serpentine River and tributaries and form ephemeral waterlogged damplands during the winter and spring.

3.4 Land use

3.4.1 Crown reserves and estates

There are three reserves located within the Survey Area (see Table 18 and Figure 2, Appendix A).

Table 18 Reserves within the Survey Area

Reserve number	Name	Class	Use	Approximate location relative to Survey Area
R 16634	Jarrahdale State Forest	Class C	State Forest	Covering majority of the Survey Area with the exception of the north eastern-most portion
R 335	Un-named	Class C	Waterway, resting place	Lies within a small portion of the eastern Survey Area, adjacent to Albany Highway
R 5913	Jarrahdale State Forest	Class C	State Forest	Lies within the south-eastern boarder of the Survey Area

The following DBCA managed lands lie adjacent to the Survey Area:

– Serpentine National Park (Class A) to the west
– Monadnocks Conservation Reserve (Class A) to the east.

3.4.2 Environmentally Sensitive Areas

Three Environmentally Sensitive Areas (ESAs) lie within the western portion of the Survey Area (Figure 2, Appendix A). An additional 51 ESAs lie within 10 km of the Survey Area.

3.4.3 Regional Ecological linkages

Three ecological linkages lie within the Survey Area, as presented in Figure 2, Appendix A. The ecological linkages are interpreted to be in association with riparian corridors of the Serpentine River, Wungong Brook and Gold Mine Brook-39 Mile Brook. An additional 11 ecological linkages lie within the Study Area.

3.5 Vegetation

3.5.1 Broad vegetation mapping and extents

Vegetation associations

Broad scale (1:250,000) pre-European vegetation mapping of the Study Area has been completed by Beard (1979) at an association level. The mapping indicates the Survey Area intersects two vegetation associations:

– West Darling_3 (association 3): Mainly Jarrah and Marri *Eucalyptus marginata*, *Corymbia calophylla*
– West Darling_128 (association 128): Rock

Vegetation complexes

Regional vegetation complex mapping has been completed by Mattiske & Havel (1998) with updates from Webb *et al.* (2016) based on major landform boundaries within the South West Forest and forested region of south-west Western Australia. The mapping indicates eight vegetation complexes are present within the Survey Area:

– Dwellingup (D1): Open forest of *Eucalyptus marginata* subsp. *marginata-Corymbia calophylla* on lateritic uplands in mainly humid and subhumid zones.
– Dwellingup (D2): Open forest of *Eucalyptus marginata* subsp. *marginata-Corymbia* calophylla on lateritic uplands in subhumid and semiarid zones.
– Yarragil 1 (Yg1): Open forest of *Eucalyptus marginata* subsp. *marginata-Corymbia calophylla* on slopes with mixtures of *Eucalyptus patens* and *Eucalyptus megacarpa* on the valley floors in humid and subhumid zones.
– Yarragil 2 (Yg2): Open forest of *Eucalyptus marginata* subsp. *thalassica-Corymbia calophylla* on slopes, woodland of *Eucalyptus patens-Eucalyptus rudis* with *Hakea prostrata* and *Melaleuca viminea* on valley floors in subhumid and semiarid zones.
– Cooke (Ce): Mosaic of open forest of *Eucalyptus marginata* subsp. *marginata-Corymbia* calophylla (subhumid zone) and open forest of *Eucalyptus marginata* subsp. *thalassica-Corymbia calophylla* (semiarid and arid zones) and on deeper soils adjacent to outcrops, closed heath of Myrtaceae-Proteaceae species and lithic complex on granite rocks and associated soils in all climate zones, with some *Eucalyptus laeliae* (semiarid), and *Allocasuarina huegeliana* and Eucalyptus wandoo (mainly semiarid to prearid zones).
– Swamp (S): Mosaic of low open woodland of *Melaleuca preissiana-Banksia littoralis*, closed scrub of *Myrtaceae* spp., closed heath of *Myrtaceae* spp. and sedgelands of *Baumea* and *Leptocarpus* spp. on seasonally wet or moist sand, peat and clay soils on valley floors in all climatic zones.
– Murray 1 (My1): Open forest of *Eucalyptus marginata* subsp. *marginata-Corymbia* calophylla-*Eucalyptus patens* on valley slopes to woodland of *Eucalyptus rudis-Melaleuca rhaphiophylla* on the valley floors in humid and subhumid zones.
– Goonapping: Mosaic of open forest of *Eucalyptus marginata* subsp. *marginata* (humid zones) and *Eucalyptus marginata* subsp. *thalassica* (semiarid to perarid zones) on the sandy-gravels, low woodland of *Banksia attenuata* on the drier sandier sites (humid to perarid zones) with some *Banksia menziesii* (northern arid and perarid zones) and low open woodland of *Melaleuca preissiana-Banksia littoralis* on the moister sandy soils (humid to perarid zones).

3.6 Fauna

3.6.1 Fauna diversity

The *NatureMap* database identified 185 terrestrial vertebrate fauna species previously recorded within the Study Area. This total comprised of 113 birds, 32 reptiles, 28 mammals and 12 amphibians. Of the 185 fauna species previously recorded, 177 are native species and eight are naturalised (introduced) species. The EPBC Act PMST search detected an additional four threatened bird species as potentially occurring within the Study Area and the DBCA Threatened and Priority Fauna database returned one additional mammal within the Survey Area.

The *NatureMap* and PMST database search is provided in Appendix C. DBCA Threatened and Priority Fauna results are displayed in Figure 2, Appendix A.

3.6.2 Conservation Significant Fauna

Based on the above database searches, 13 conservation significant terrestrial vertebrate taxa were identified as likely to occur or known to be present within the Survey Area.

These species included:

– Two species listed as Endangered under the EPBC Act and BC Act including Baudin's Cockatoo (*Calyptorhynchus baudini*) and Carnaby's Cockatoo (*C. latirostris*)
– Three species listed as Vulnerable under the EPBC Act and BC Act including Forest Red-tailed Black Cockatoo (*C. banksii naso*), Chuditch (*Dasyurus geoffroii),* and Quokka (*Setonix brachyurus*)

– One species, Peregrine Falcon (*Falco peregrinus*) listed as 'Other specially protected' under the BC Act
– Six species listed as Priority 3 or 4 by DBCA
– *Phascogale tapoatafa wambenger* listed as 'Conservation Dependent' by the DBCA.

Desktop assessment for aquatic fauna (WRM 2021) identified the invertebrate species Carter's Freshwater Mussel (*Westralunio carteri*) as potentially present within the Survey Area. This species listed as Vulnerable under the EPBC Act and BC Act.

All conservation significant species identified as potentially occurring are presented in the Likelihood of Occurrence (LOO) assessment in Appendix D and further discussed regarding survey results in Section 4.3.

3.7 Previous Studies

A literature review was performed on previous terrestrial fauna studies considered relevant to the current Survey Area, to inform the basis of the fauna surveys. The review focuses on conservation significant species recorded during surveys on Alcoa mining lease and surrounding areas. A review of 26 existing reports that are considered relevant to the current study is provided in Table 19.

Table 19 Previous studies considered relevant to Myara North Survey Area

Project	Location and key findings	Location in relation to this Survey Area
Environmental Management and Research Consultants (EMRC) (1992) Long term fauna monitoring program 1992 (draft)	Location: 20 plots between Jarrahdale, Huntly and Karnet (control) Alcoa conducted numerous surveys as part of a monitoring program which included trapping (five successive trap nights in July, August and September), avifauna (quantitative and inventory surveys in summer and winter), reptile survey (trapping over five consecutive nights in Summer with toenail clippings to indicate recapture) opportunistic survey, nocturnal surveys and active searches. A total of 16 mammals, 61 birds, 21 reptiles, 6 frog and 80 ant species were recorded. Recorded threatened fauna comprise: • Quenda – trapped at Jarrahdale • Baudin's Cockatoo (recorded at all sites) • Red-eared Firetail (delisted) • Carpet Python (delisted)	8 survey plots established in Jarrahdale, 8 plots established in Huntly and four control plots at Karnet. Exact locations are not shown in report but Jarrahdale plots are expected to be adjacent or within the current Survey Area.
EMRC (1995) Long term fauna monitoring program 1995	Location: 20 plots between Jarrahdale, Huntly and Karnet (control) Alcoa conducted numerous surveys as part of a monitoring program which included trapping (five successive trap nights in July, August and September), avifauna (quantitative and inventory surveys in summer and winter), reptile survey (trapping over five consecutive nights in Summer with toenail clippings to indicate recapture) opportunistic survey, nocturnal surveys and active searches. A total of 19 mammals (six introduced), 57 birds, 20 reptiles, 5 frog and 52 ant species were recorded. Recorded threatened fauna comprise: • Quenda – four individuals were trapped • Chuditch – all opportunistic sightings (one near Phillips Road/Nettleton Road and seven ay Huntly Mine in 1995).	8 survey plots established in Jarrahdale, 8 plots established in Huntly and four control plots at Karnet. Exact locations are not shown in report but Jarrahdale plots are expected to be adjacent or within the current Survey Area.
EMRC (2003). McCoy Long Term Fauna Monitoring Program 2003	Location: six plots established, two in the Cameron catchment, two in the Gordon control catchment and two between these and the current Huntly Mine McCoy region crusher site. The monitoring program surveyed all terrestrial vertebrate species and ants. Mammal trapping occurred over four successive trap nights in both summer and winter using 10 pit traps, 16 medium Elliot traps, four large Elliot traps and four cage traps. Reptiles were targeted using five PVC pot traps with drift fence during summer. Traps were open on 29th Jan (summer) and 13 Aug (winter). Birds were surveyed using quantitative methods (two permanent bird transects surveyed on three consecutive days in summer and winter) and inventory methods (opportunistic recordings at each plot during the trapping program). A total of six mammals (one introduced), 39 birds, 7 reptiles, 9 frog and 37 ant species were recorded. Recorded threatened fauna comprise: • Chuditch – two trapped plus sightings or signs • Baudin's Cockatoo - sightings	Approximately 31 km south of the current Survey Area.
EMRC (2006) Long term fauna monitoring program 2006	Location: 20 plots between Jarrahdale, Huntly and Karnet (control) Alcoa conducted numerous surveys as part of a monitoring program which included trapping (five successive trap nights in July, August and September), avifauna (quantitative and inventory surveys in summer and winter), reptile survey (trapping over five consecutive nights in Summer with toenail clippings to indicate recapture) opportunistic survey, nocturnal surveys and active searches. A total of 18 mammals (six introduced), 49 birds, 21 reptiles, 5 frog and 70 ant species were recorded. Recorded threatened fauna comprise: • Chuditch – opportunistic sightings at Huntly • Quokka – opportunistic sighting at Huntly • Baudin's Cockatoo – sighted at Jarrahdale, Huntly and Karnet • Carpet Python (delisted) • Quenda - trapped at Jarrahdale and Karnet • Western Brush Wallaby - sighted at Jarrahdale and Huntly	8 survey plots established in Jarrahdale, 8 plots established in Huntly and four control plots at Karnet. Exact locations are not shown in report but Jarrahdale plots are expected to be adjacent or within the current Survey Area.
EMRC (2007a) McCoy Long Term Fauna Monitoring Program – results of the 2007 survey	Location: six plots established, two in the Cameron catchment, two in the Gordon control catchment and two between these and the current Huntly McCoy crusher site. Methods used were identical to those used in the 2003 survey (above). A total of seven mammal (two introduced), 41 bird, seven reptile, five frog and 54 ant species was recorded. Recorded threatened fauna comprise: • Baudin's Cockatoo –sightings • Western Brush Wallaby – multiple sightings	Approximately 31 km south of the current Survey Area.
ALCOA World Alumina Australia (2010) No 40. Threatened fauna species management plans for Alcoa's bauxite mining operations in the Jarrah forest	Location: Mining Lease ML1sa Management Plan for seven species of fauna known to occur within the mining lease: • Chuditch • Quokka • Noisy Scrub-bird • Baudin's Black Cockatoo • Forest Red-tailed Black Cockatoo • Peregrine Falcon • Carpet Python (delisted)	The current Survey Area is within the 1sa Mining Lease

Project	Location and key findings	Location in relation to this Survey Area
Stokes (2011) Orion Long Term Fauna Monitoring Program	Location: six monitoring sites within Alcoa's Orion mine region comprising two typical upland forest areas, two associated with stream zones and two within rehabilitated forest (8 years old). Mammals, birds, reptiles and frogs were surveyed during both summer (March) and winter (July), and ground dwelling invertebrates were sampled in summer only. Survey methods were similar to those used in EMRC (2006) with the addition of a single large trapping transect designed to specifically target Chuditch and species of goanna. This transect covered approx. 880 ha and comprised 40 wire cage traps spaced 300 m apart and was trapped over four successive nights at the same time as the generic mammal survey. A total of 10 mammals (three introduced), 38 birds, 9 reptiles, two frogs, 22 ground invertebrates, 49 ant species was recorded. • Recorded threatened fauna comprise: • Chuditch – five males trapped in summer • Quenda – one trapped • Western Brush Wallaby – multiple sightings • Baudin's Cockatoo – sightings • Forest Red-tailed Black Cockatoo - sightings	Within 20 km of the far western boundary of the Study Area
Stokes (2012) Vertebrate Fauna Survey of Planted Mining Areas at Alcoa's Keats Mining Region 2011/2012	Location: Keats mining region. Fauna were surveyed using a range of techniques, including trapping, remote sensitive cameras, tracking tunnels, observational surveys and spotlighting. Pitfall traps were not used. Five areas were trapped for mammals comprising two dieback free Jarrah forest areas and three stream zones. One landscape trapping transect was deployed to target Chuditch and goanna and this encompasses upland Jarrah forest, stream zones, low lying open forest, dieback graveyards and Sheoak forest. Black Cockatoo habitat survey was also undertaken. Surveys were only undertaken in summer due to time constraints. Recorded threatened fauna comprise: • Forest Red-tailed Black Cockatoo – flock sighted (up to 11 individuals) • Baudin's Cockatoo – 2 individuals sighted • Western Brush Wallaby – sightings and recorded on remote camera • Chuditch – one male trapped • Carpet Python (delisted)	Approximately 37 km southwest of the current Survey Area.
Way *et al*. (2013), McCoy Long Term Fauna Monitoring Program Report of the 2013 Field Survey	Location: six plots established, two in the Cameron catchment, two in the Gordon control catchment and two between these and the current Huntly McCoy crusher site and an additional three sites established in two year old rehabilitation within the McCoy Intermediate Rainfall Zone. In 2013 the McCoy Long Term Fauna Monitoring Program involved survey of terrestrial vertebrates (including mammals, birds and reptiles) and ground invertebrates, using the same methods used in previous LTFMP at McCoy (EMRC 2003, 2007a). Mammals, birds, reptiles, and frogs were surveyed in both winter (July-August 2013) and summer December 2013-January 2014). Additional survey methods were also implemented including a single large trapping transect to sample highly mobile species, remote sensor cameras and all invertebrates collected in pitfall traps were identified to taxonomic order. A total of 13 mammal species (four introduced), 46 birds, five frog, 31 invertebrates, and 64 ant species was recorded. Recorded threatened fauna comprise: • Western Quoll – one adult male trapped • Quenda – recorded on remote cameras • Western Brush Wallaby – multiple sightings and on remote cameras • Baudin's Cockatoo – multiple sightings • Forest Red-tailed Black Cockatoo – multiple sightings	Approximately 31 km south of the current Survey Area.
Chuditch survey raw data Myara 2013	This is an excel data file along with short summary document with the location description as 'Myara west' and 'Myara east'. Shows details of eight quoll captures at 'Myara west' and one quoll captured at 'Myara east' between 18-22 March 2013. Myara West excel data provides 8 GPS capture locations (in cage traps). Myara East excel data provides 40 locations with coordinates however according to the report only 1 capture location was recorded at Cage 26. The coordinates of this location were unable to be identified. Total number of captures comprised of five males and four females.	Location described as Myara west and east and general area surrounding Karnet Prison which is approximately within 10 km of the Survey Area. GPS coordinates provided: • 410458 E, 6409663 N • 410839 E, 6408964 N • 411357 E, 6408290 N • 411766 E, 6410671 N • 411138 E. 6407725 N • 412384 E, 6408752 N • 414231 E. 6408816 N • 414362 E, 6409006 N
McGregor *et al*. (2014). Does forest restoration in fragmented landscapes provide habitat for a wide-ranging carnivore?	Location: Huntly and Willowdale mines Fourteen Chuditch trapping sessions (13 at Huntly, one at Willowdale) across 9 trapping transects (8 at Huntly, one at Willowdale) were undertaken between June 2009 and Dec 2010. Radio collars with a two-stage transmitter and mortality mode were attached to 14 adult Chuditch (9 female, 5 males – all trapped at Huntly). Chuditch were tracked to their dens during the day. Spool and line tracking was also used. In total 29 individual Chuditch were captured on 60 occasions. Of the 14 individuals fitted with radio collars, three were found dead on the Huntly mine access road with evidence of road trauma. Another three Chuditch were also found dead from vehicle strikes along this road. The study identified 138 den sites from 11 tracked animals: 75 in unmined forest and 63 in restored forest ranging from 2-32 years old. In unmined forest, dens were mostly in hollow logs and ground burrows beneath tree stumps, but these substrates were never used in restored forest where dens were mostly ground burrows, usually associated with rock piles at the surface.	Huntly Mine and Willowdale Mine approx. 40 km and 55 km respectively southwest of the Survey Area.
Burgar *et al.* (2015) The importance of mature forest as bat roosting habitat within the production landscape	Location: forest surrounding Huntly mine site, for both restored and unmined forest. *Nyctophilus gouldii* and *Vespadelus regulus* were trapped and tracked during maternity and mating seasons using harp traps and position-sensitive radio transmitters. Few bats were captured in restored forest so traps were relocated to water sources. Study aimed at identifying roost habitat within restored forest vs unmined forest. Findings indicate that habitat restoration in production forest landscapes is unlikely to play a significant role in conserving species that rely on slow developing microhabitats such as tree hollows for decades or centuries and that retaining and managing forest remnants would be a more effective strategy to conserve populations of these species.	Huntly mine, approximately 40 km southwest of the current Survey Area.

Project	Location and key findings	Location in relation to this Survey Area
Burgar *et al.* (2017) Habitat features act as unidirectional and dynamic filters to bat use of production landscapes	Location: five forest types around the Huntly mine (four restored forest with different stages of vegetation succession, and one unmined forest) Ultrasonic detectors (Anabat Titley Electronics) were set at 64 sites four times per year between Oct and March 2010/2011 and 2011/2012 for a total of 512 survey nights. 31,347 bat call files were recorded over both years of which 22,520 were identified to species/species group. *Vespadelus regulus* was detected most frequently (15,833 call files) and *Falsistrellus mackenziei* least frequently (167 call files). Six species/groups were detected. Recorded threatened fauna comprise: • Western False Pipistrelle	Huntly Mine site, approximately 40 km southwest of the Survey Area
Craig *et al*. (2017) Can postmining revegetation create habitat for a threatened mammal?	Location: Jarrah Forest (Huntly mine site approximately 10 km north of Dwellingup) Most revegetation conducted for biodiversity conservation aims to mimic reference ecosystems present predisturbance. However, revegetation can overshoot or undershoot targets, particularly in the early stages of a recovery process, resulting in conditions different from the reference model. Revegetation that has, as yet, failed to fully meet revegetation targets may, nonetheless, provide habitat for threatened species not present in reference ecosystems. To investigate this possibility a survey of the Quokka (Setonix brachyurus), a threatened macropod, in a mining landscape in south-western Australia was conducted. Four sites in each of riparian forest (the preferred habitat of quokkas) but is not mined, mid-slope forest, which is the premining reference ecosystem but is not suitable habitat for quokkas, and revegetated forest on mine pits 16–21 years postmining. Quokkas were recorded in all riparian forest sites and two revegetated forest sites but not in any mid-slope forest sites. Occupied revegetated sites had greater cover between 0 and 2 m and were spatially closer to riparian forest than unoccupied revegetated sites, suggesting predation pressure was likely influencing which mine pits were occupied. The study demonstrated postmining revegetation can provide new habitat for a threatened species and suggested that revegetating a small proportion of sites to provide new habitat for threatened species could be considered as a management option in some scenarios. This could improve landscape connectivity and increase both the area of available habitat and between-site heterogeneity, which could all potentially increase the ability of revegetation to conserve biodiversity.	Huntly Mine site, approximately 40 km southwest of the Survey Area
EMRC (2015) Long Term Fauna Monitoring Program Summary of Results at Orion Mining Region.	Location: Numerous plots over the Willowdale Mine area Results of the 3rd survey of the LTFMP. Same methodology and plot locations as 2010 survey of the area. Additionally a large trapping transect targeting Chuditch and remote sensing cameras also deployed. Trapping conducted over 4 nights in both winter and summer seasons. The study results: • Twelve mammal species were trapped • Thirty five bird species recorded • Thirteen reptile species recorded • Three frog species recorded Results were indicative of some species being affected (not present afterwards or in lower numbers) by the January 2016 wildfire that burnt through the Willowdale Mine and surrounding areas including four of the six Orion sites.	Within 20 km of the far southern boundary of the Study Area.
Doherty *et al.* (2016). Successional changes in feeding activity by threatened cockatoos in revegetated mine sites.	Location: Numerous plots over the Huntly Mine, Boddington Bauxite Mine and Newmont Boddington Gold Mine. 232 plots were surveyed in revegetated forest and 480 plots were surveyed in unmined forest to determine whether there were successional patterns in cockatoo feeding activity in revegetation aged between 4 to 23 years. The study concludes that black cockatoos feed in vegetation at all three mine sites, despite variations in vegetation age, structure and floristics. Black cockatoos begun feeding on proteaceous and myrtaceous food plants within 4 and 7 years following revegetation, indicating that some food sources are restored quickly after mining disturbance of the Jarrah forest. The results highlight the importance of monitoring fauna recolonization over appropriate time scales to understand how successional processes in revegetation influence fauna persistence in production landscapes.	Huntly Mine approx. 40 km southwest of current Survey Area, Boddington Bauxite Mine approximately 60 km southeast of the current Survey Area, and Newmont Boddington Gold Mine 27 km southeast of current Survey Area.
Mastrantonis *et al.* (2019) Climate change indirectly reduces breeding frequency of a mobile species through changes in food availability	Location: the Northern Jarrah Forest of South West Western Australia over both the Swan and Murray River Catchments. Using a dataset of annual breeding frequency spanning 19 years, in combination with hydrological, climatological, and remotely sensed data, the effects of environmental variation on the annual breeding frequency of Forest Red-tailed Black Cockatoo's (FRTBC) were modelled. In total, 143 unique trees were surveyed over the 19 year period. A total of 173 breeding events were observed during this time with 104 and 71 events observed in the Swan and Murray River catchments respectively. On average there were 5.83 breeding events recorded per year with events ranging from 0 to 21 annually. Results found several significant relationships between annual breeding frequency of FRTBCs and environmental variation. While the model, which included a proxy for the availability of the cockatoo's primary food source and the previous season's rain, explained 49% of annual breeding frequency, there were also direct and indirect effects of heatwaves and forest productivity. FRTBC breeding was found to appear be linked to the spatiotemporal availability of its primary food sources, the fruit from the tree species, Marri *Corymbia calophylla* and Jarrah *Eucalyptus marginata*. However, due to climate change experienced and predicted to be experienced in the future in Western Australia it is expected that the food resources during the breeding season for cockatoos will become increasingly limited in time and space, thus threatening their persistence.	The Survey Area is within the bounds of the literature Study Area.
Burn (2000) A survey of the impact of burning on mammals and birds in Alcoa's rehabilitated Bauxite mines at Jarrahdale	Location: Jarrahdale forest (two unmined and four rehabilitated bauxite mine pits) To ascertain the impact of burning on birds and mammals at the above location pre burning monitoring took place 1997, and post burn monitoring commenced in 1998 in both burnt and unburnt, rehabilitated and unmined forest sites. Low numbers of mammals were caught making it difficult to conclude with certainty whether burning had an effect on most species. New epicormic growth may have attracted possums into one rehabilitated area, while mice invaded the dense rehabilitated site after the burn. There was a large decline in the numbers of birds and bird species following the burn in the dense rehabilitation. Burning sparse rehabilitation only resulted in a small decline while fire had little effect on bird populations of unmined forest. It was concluded that more time was needed to define the longer-term effects of burning on mammals and birds. The present survey was therefore undertaken in 2000 to assess the situation three years after burning.	Approximately 9 km north of the northern boundary of the Study Area.

Project	Location and key findings	Location in relation to this Survey Area
Huntly rehabilitation (2000)	As no long term monitoring of fauna has been conducted at Huntly since 1998, it was decided a repeat of the 1994 survey using identical methods would occur to gain a better understanding of the extent to which vertebrate fauna colonise older rehabilitation. The sites ranged from 14 to 22 years. Sixteen mammal species are known to inhabit rehabilitation at Huntly including 10 native and 6 feral species. Thirty four bird species were recorded in the rehabilitated areas surveyed (similar to the 36 recorded in the 1994 survey. Eight reptile species and one frog species were recorded in the rehabilitated areas surveyed. Fourteen recommendations came about which if implemented should encourage the return of fauna species in similar number to which they occur in surrounding unmined forest. Some recommendations are identical to the 1994 study; they have either not been implemented or they should continue. Key recommendations include; • Where it is not yet known about species recolonisation follow up monitoring in rehabilitated areas will reveal whether they have recolonised. • Surrounding forest if the source of all fauna recruitment. It is important that fauna habitat be protected so that species are available to recolonise.	Huntly Mine - approximately 35 km south .
EMRC (2007b) A Vertebrate Fauna Survey of Rehabilitated Areas at Alcoa's Huntly Minesite. (Final report)	Provides an overview of the 1994, 2000 and 2007 vertebrate fauna surveys of Alcoa's rehabilitated bauxite mines at Huntly. Mammals, birds and reptiles were surveyed in six rehabilitated pits ranging in age from 8 to 16 years. In total 16 mammal species (11 indigenous and 5 introduced), 34 birds and 8 reptiles were recorded. Rare or specially protected species either recorded in the present survey or recently sighted or trapped in rehabilitation at Huntly include the Brush-tailed Phascogale, Chuditch, Quokka, Baudin's Cockatoo, Forest Red-tailed Black Cockatoo and Carpet Python. Other species recorded in rehabilitation during the survey included the Echidna, Brush-tailed Phascogale and Common Brushtail Possum, while Western Brush Wallaby, Chuditch and Quenda have also recently been either trapped or sighted in rehabilitation at Huntly. Total bird species numbers recorded have remained similar to those in 2000 and in 1994, however in individual rehabilitated sites, the numbers of bird species and bird diversity have both decreased. Numbers of reptile species remained similar to those of previous years, with the Specially Protected Carpet Python seen in rehabilitation on a number of occasions. Thirteen recommendations were given as a result including; protection of adjacent fauna habitat, construction of fauna habitats and corridors, control of feral species, construction of suitable habitat specific to mammals and reptiles.	Huntly Mine - approximately 40 km south
EMRC (2001a) Alcoa World Alumina Australia Ltd. Long Term Fauna Monitoring Program. (V2)	The Alcoa Long Term Fauna Monitoring Program was designed in 1991. Monitoring events took place in 1992, 1995, 1998 and 2001 (Nichols 1992) using identical methods each time (except for the baseline). The program is designed to monitor fauna every three years at twenty plots located in rehabilitation and nearby forest at Jarrahdale, Huntly and Karnet (remote from mining). A total of 16 mammal (10 indigenous, six introduced), 50 bird, 17 reptile, 7 frog and 73 ant species was recorded. In 1998, the corresponding figures were 18 mammal, 53 bird, 21 reptile, 7 frog and 56 ant species. Mammals recorded included one officially gazetted rare species, the Chuditch. Two of the species recorded in 1998 were not detected in 2001. These were the Brush-tailed Phascogale and an unidentified bat species. Numbers of several species appear to have changed significantly with some mammal and bird species declining, possibly due to very dry summer followed by very low winter rainfall. .Common brushtail possum and frog species increased. Baudin's Cockatoo was recorded at both Jarrahdale and Huntly. The reptile fauna included one 'Specially Protected' species, viz. the Carpet Python. Quantitative data showed that the composition of all rehabilitated sites was becoming more similar to that of the unmined sites. However, they remain linked to each other, particularly JR1 and JR2, which have become even more similar to each other.	Jarrahdale plots are expected to be adjacent or within the current Survey Area, Huntly (approximately 40 km south) and Karnet (approximately 10km north)
EMRC (1998) Alcoa of Australis Ltd. Long Term Fauna Monitoring Program (1998)	Location: Plots located in rehabilitation and nearby forest at Jarrahdale, Huntly and Karnet. This report provides the results of the 1998 fauna monitoring program. Methods used were identical to the 1995 monitoring program. Results are then compared to previous monitoring programs (1992 and 1995) in detail and the influence of mining and successional processes on fauna can be assessed. A total of 18 mammal (12 indigenous, six introduced), 53 bird, 20 reptile, 5 frog and 56 ant species was recorded. Mammals recorded included two officially gazetted rare species, viz. the Chuditch and the Quokka. Two of the species recorded (Dunnart *Sminthopsis gilberti* and the Honey Possum) in 1995 were not detected in 1998. A number of species have increased since the previous monitoring event (Mardo and Quenda). There wasn't any evidence of any mammal species declining due to proximity of mining. All bird species recorded in 1992 and 1995 were recorded in 1998. Only one rare bird species, Baudin's Cockatoo was recorded and this was present at all sites. One new skink species was collected - *Glaphyromorphus gracilipes* was trapped at stream site HS1 (Banya Road) during the summer trapping program. Insufficient reptile numbers were collected to determine trends over time.	Jarrahdale plots are expected to be adjacent or within the current Survey Area Huntly (approximately 40 km south) and Karnet (approximately 10km north)
EMRC (2004) Orion LTFMP report 2004 Final	Location: Willowdale -north east portion of Orion region (two healthy forest and two dieback forest plots, two steam zone plots and two plots in rehabilitation) The LTMFP was reviewed in 2003 (Majer, 2003) which included a recommendation for a similar program to be established at Orion so that any differences in faunal successional processes taking place at Willowdale could be detected. Similar techniques to those used at Jarrahdale, Huntly and McCoy. Mammals recorded during the survey included the Chuditch, Quokka, Mardo, Dunnart, Common Brushtail Possum, Western Brush Wallaby. Only one mammal species was recorded in the young rehabilitation (Feral Mouse). Forty one bird species was recorded including the Baudin's Cockatoo. Bird numbers were highest at steam sites and lowest at rehabilitated sites. Six reptile species were recorded compared with 15 species recorded in the 1999 pre-mining survey. Three frog species were recorded. Fifty ant species were recorded. Further monitoring was recommended to determine successional patterns.	Willowdale (within 20 km of the far southern boundary of the Study Area)
EMRC (1999) A fauna survey of planned mining areas at Alcoa's Orion Mining region	Location: Orion mining region at Willowdale This report provides the results of the fauna survey conducted between February and November 1999. The habitats monitored were poorly surveyed in current mining areas, extensive dieback affected areas, small dieback free areas and on sites where mining operations are planned. A total of 46 bird species, nine mammals (6 native, 3 introduced), 13 reptiles and five frogs was recorded. These included three rare species (the Chuditch, Baudin's Cockatoo and possibly the Quokka) and one Specially Protected species (the Carpet Python). As well as these, the Noisy Scrub-bird has been reintroduced into the area and the uncommon Brush-tailed Phascogale is present albeit in low densities. The fauna of the Orion area was largely comparable to that of existing Willowdale mining areas. Results emphasise the need for ongoing fox control. Rehabilitation using Jarrah and other indigenous species offers the best prospects of successfully recreating suitable habitat for the species. Eleven recommendations were given for managing the area's faunal diversity including; protection of adjacent fauna habitat, construction of fauna habitats and corridors, control of feral species, construction of suitable habitat specific to mammals and reptiles.	Willowdale (within 20 km of the far southern boundary of the Study Area)

Project	Location and key findings	Location in relation to this Survey Area
EMRC (2007c) A Vertebrate Fauna Survey of Rehabilitated Areas at Alcoa's Willowdale Minesite	Location: Willowdale (rehabilitated bauxite mine sites) This report details the 2007 results of the long term fauna monitoring. Previous monitoring events occurred in 1994, 2000 (following fox control) and again in 2007. In the 2007 survey a total of 25 bird species, 10 mammals (seven indigenous, three introduced) and five reptiles was recorded in rehabilitation. They included three rare species, viz. the Chuditch, Brush-tailed Phascogale and Forest Red-tailed Black Cockatoo. Numbers of native mammals trapped in rehabilitation were higher than in previous years, with Yellow-footed Antechinus increasing from 0 in 1994 to 6 in 2007; Brush-tailed Phascogales increased from 0 to 1 and Chuditch increased from 0 to 3. Bird species had declined since the 2000 survey. Total numbers of both insectivores and honeyeaters both showed large declines between 1994 and 2000. There was a gradual decline in numbers of the skink *Acritoscincus trilineatum* as the rehabilitated sites become more like upland forest habitat and less suitable for this species. Fifteen recommendations were given for managing the area's faunal diversity including; protection of adjacent fauna habitat, construction of fauna habitats and corridors, control of feral species, construction of suitable habitat specific to mammals and reptiles	Willowdale (within 20 km of the far southern boundary of the Study Area)
EMRC (2001b) A Vertebrate Fauna Survey of rehabilitated areas at Alcoa's Willowdale Minesite	Location: Willowdale (rehabilitated bauxite mine sites) This report details the 2000 fauna monitoring event results after the introduction of fox control following the 1994 monitoring event. A total of 31 bird species, nine mammals (five introduced, four indigenous) and five reptiles was recorded. Although not trapped or recorded in the present survey, both the rare Chuditch and the specially protected Carpet Python have been recently recorded in rehabilitation at Willowdale. Numbers of native mammals trapped in rehabilitation were low, as in 1994. Some evidence suggests that Fox predation may still be a problem near farmland. The 31 bird species recorded in the 2000 survey is less than the 45 recorded in 1994. The five reptile species recorded indicate that the rehabilitation has not yet become more suitable for this fauna group. Fifteen recommendations were given for managing the area's faunal diversity including; protection of adjacent fauna habitat, construction of fauna habitats and corridors, control of feral species, construction of suitable habitat specific to mammals and reptiles.	Willowdale (within 20 km of the far southern boundary of the Study Area)

4. Survey Results

4.1 Fauna Habitats

There were eight broad fauna habitat types delineated in the Survey Area during the field survey. These habitat types are categorised based on flora species, hydrology, soil and topography. They align with the vegetation types identified by Mattiske (2021). The habitat types recorded in the Survey Area are described in Table 20 and mapped in Figure 5a and 5b, Appendix A. The broad fauna habitat types are:

– Jarrah-Marri forest
– Bullich forest
– Granite outcrop
– Blackbutt forest
– Flooded Gum woodland
– Melaleuca dampland
– Mine rehabilitation
– Pine plantation.

In addition to the fauna habitats listed above, a small proportion (0.7%) of the Survey Area comprised cleared rural land. These areas are included in Figure 5a and 5b, Appendix A. They have limited habitat values due to lack, paucity, or low quality of intact native vegetation.

4.1.1 Fauna habitat linkages

The Survey Area represents a large continuous tract of forest with good connectivity to all habitats directly adjacent.

4.1.2 Quality of habitat

Whilst the vegetation is mostly intact the impact by logging, frequent and extensive fire and dieback in some areas were evident. Despite this the habitat presents a large contiguous intact forest with multiple habitat types suitable for large ranging species such as the Chuditch, Brush-tailed Phascogale and Western Brush Wallaby.

The granite outcrop habitat provides quality resources (refuge, breeding, feeding and disbursal) for a diverse suite of fauna particularly reptiles. However some areas of granite outcrop are damaged in the form of broken/shattered rocks with tyre tracks observed over portions of outcrops. This may impede on species density as damaged habitat reduces the opportunity for species to hide or create refuge.

The forested areas covering the majority of the Survey Area were in very good to excellent condition (with respect to disturbance) with the exception of some areas of dieback infestation and some areas of recent timber harvesting. The forested habitats provided an array of micro-habitats such as logs, hollows, leaf litter, soft sand and dense foliage with a broad range of floristic species providing a range of foraging, roosting, denning and sheltering habitat. However prescribed burning in spring of 2020 destroyed several known Black Cockatoo breeding hollows in a patch of Bullich forest in the northern portion of the Survey Area (Tony Kirkby pers.comm). The same burn destroyed known Quokka habitat along the densely vegetated drainage line. This is based on Quokka detection during the current survey. Inappropriate fire frequency, intensity and extent can have adverse impacts on habitat quality for significant species and broader fauna assemblages.

Small streams were recorded throughout the Survey Area which provide accessible drinking water to fauna. Most of the streams appear to be seasonal however the Serpentine Dam lies adjacent south of the Survey Area which provides accessible drinking water year-round, particularly to birds. Floodplains were associated with some of the streams that provide suitable Quokka habitat as well as where frogs were recorded during both survey phases.

Table 20 Major habitat types within the Survey Area

Description	Corresponding Vegetation Type Code (Mattiske 2021)	Extent in the Mine Development Envelope Survey Area (ha)	Extent in the Conveyor/Haul Road Corridor Survey Area (ha)	Total Survey Extent (ha)	Percentage of Total Survey Area	Representative Images
Blackbutt Forest Blackbutt open forest with occasional Bullich, and Marri over sparse *Banksia littoralis* over *Trymalium, Macrozamia, Xanthorrhoea preissi*, over *Lepidospermum tetraquetrum*, *Astartea scoparia* and areas of dense Swamp peppermint (*Taxandria linearifolia*). This habitat is limited to localised patches often associated with creeks and drainage lines. Disturbance factors include frequent fire, feral pigs, dieback, damage caused rock removal, trail bike and 4WD on granite. **Fauna Species recorded during survey:** Provides habitat for a range of small forest and woodland birds such as Rufous Treecreeper, Golden Whistler, and Grey Shrike Thrush. Low dense understory provides shelter and suitable corridors for Quokka and Quenda. Forest reptiles recorded include Rosenburg Monitor and Southern Carpet Python. **Habitat for conservation significant species** Western Brush Wallaby, Quenda, Quokka, Chuditch and Western False Pipistrelle. Breeding and roosting habitat for all three Black Cockatoo species.	CW, AW, AW/AX, AX/CW, C	673	14	687	3.9%	
Bullich forest. Valleys and drainage areas dominated by Bullich (*Eucalyptus megacarpa*) and with some Black Butt (*E. patens*), occasional Marri (*Corymbia calophylla*), over Sheoak (*Allocasuarina fraseriana*), *Banksia littoralis* over Grass trees (*Xanthorrhoea preissii*), Bracken fern, patches of dense *Gahnia trifida* shrubland over *Lasiopetalum floribundum*, sedges and herbs. Substrate is dark clayloam soil. These areas are associated with seasonal creeks and drainage areas. This habitat is limited in extent to localised patches within the Survey Area. Disturbance factors include frequent fire, feral pigs, dieback. **Fauna species recorded during survey:** Provides habitat for a range of forest and woodland birds and frogs such as Ticking frog. Quokka and Quenda were recorded via camera within dense understory and shrub areas of this habitat. Potential breeding habitat for Black Cockatoo species, and nesting has been confirmed in areas of old growth Bullich (Tony Kirkby pers.comm). **Habitat for conservation significant species:** Black Cockatoos, Chuditch, Quokka, Quenda, Western Brush Wallaby, Masked Owl, Brush-tailed Phascogale, Western False Pipistrelle.	W, WA	239	28	267	1.5%	

Description	Corresponding Vegetation Type Code (Mattiske 2021)	Extent in the Mine Development Envelope Survey Area (ha)	Extent in the Conveyor/Haul Road Corridor Survey Area (ha)	Total Survey Extent (ha)	Percentage of Total Survey Area	Representative Images
Flooded Gum woodland Flooded Gum (*E. rudis*) open woodland with occasional Blackbutt, over open to open to sparse *Banksia littoralis* over Prickly Moses (*Acacia pulchella*), myrtaceous species such as Swamp peppermint (*Taxandria linearifolia*), *Astertea scoparia Trymalium odoratissimum*, low shrub/sedgeland. Substrate varies from dark grey to grey brown sandy clays. Associated with poorly drained broad valleys forming seasonal swamps and occasionally tall open forest along drainage lines. Disturbance factors include frequent fire, feral pigs. **Fauna Species recorded during survey:** Provides habitat for a range of woodland shrubland birds such as Scrubwrens, Fairy-wrens, and nectar feeding birds such as Honeyeaters, wattlebirds and parrots. **Habitat for conservation significant species** Chuditch and potential foraging habitat for Black Cockatoos. Favoured areas for Western Brush Wallaby. In areas of dense Myrtaceous thicket (low fire frequency) this provides refuge and movement corridors for Quokka and Quenda.	AC, AD, AX	674	13	688	2.9%	
Granite outcrop Granite outcrops with associated lithic vegetation complexes and adjacent associated fringing open Jarrah and Marri areas with scattered Sheoak, Melaleuca, *Banksia ilicifolia* over occasional Grass trees over mixed open heath communities of Myrtaceous and Proteaceous low shrubs. Soils are pale grey to yellowish fine sand or sandy clay. Granite outcrops often associated with seasonal watercourse and seasonally damp areas. This habitat found as localised patches throughout the Survey Area. Disturbance factors include frequent fire, feral pigs, dieback, damage caused by rock removal, trail bike and 4WD on granite. **Fauna Species recorded during survey:** Provides shelter and foraging for a range of reptile and frog fauna e.g. Ornate Crevice-dragon, Barking Gecko, Speckled stone gecko, Gould's hooded snake, Southern Carpet Python, and Black-headed Monitor. Associated water courses provide seasonal breeding for locally common frog species such as Quacking froglet and Moaning frog. Two Death Adders were also recorded on this habitat. **Habitat for conservation significant species:** Foraging and denning habitat for Chuditch. Habitat for Western Brush Wallaby, Southern Death Adder, and Dell's Ctenotus. Fringing open forest provides foraging and potential breeding habitat for Black Cockatoo species.	R, G, G1, G2, RG	366	7	373	2.1%	

Description	Corresponding Vegetation Type Code (Mattiske 2021)	Extent in the Mine Development Envelope Survey Area (ha)	Extent in the Conveyor/Haul Road Corridor Survey Area (ha)	Total Survey Extent (ha)	Percentage of Total Survey Area	Representative Images
Jarrah – Marri forest *E. marginata* and *C. calophylla* open forest over Grass trees (Xanthorrhoea preissi), *Lasiopetalum floribundum*, Macrozamia mid shrubland. Patches have dominance of understory *Allocasuarina fraseriana* and *Banksia grandis*. Often with complex mosaic of low shrubs such as Fabaceae , Hibbertia, Leucopogon, Adenanthos, and Pteridium. This is the most extensive habitat identified and comprises a number of vegetation types dominated by Jarrah on upper, mid and low slopes and broad valleys. Soils range from well drained gravely sand to sandy clay loam. Historical logging is a significant disturbance factor: extensive areas of forest are at varying ages of regeneration. Other disturbances include frequent fire (significant), feral pigs, dieback, trail bike, 4WD and dumped rubbish including weed plants. **Fauna species recorded during survey:** Provides habitat for a range forest and woodland birds such as Thornbills, Rufous Treecreeper, Pardalotes, Sitella, and Purple-crowned Lorikeet. All three Black cockatoo species observed feeding extensively throughout. Forest reptiles include Crevice Skink (*Egernia napoleonis*). Gould's Monitor (*Varanus gouldii*), *Lerista distinguenda*, and Southern Blind Snake (*Anilios australis*). Small mammals include forest micro-bats, and Mardo (*Antechinus flavipes*). Other species include Echidna, Western Brush Wallaby, Peregrine Falcon and Western Grey kangaroo. **Habitat for conservation significant species:** Chuditch, Brush-tailed Phascogale, Western Brush Wallaby, Peregrine Falcon, Masked Owl, Western False Pipistrelle, Dell's Skink, Southern Death Adder. Foraging and potential roosting habitat for all three locally occurring Black Cockatoo (*Calyptorhynchus*) species. Breeding habitat for all three Black Cockatoo species.	D, DA, DG, E, J, M, P, PG, PJ, PT, PS, PW, S, SP, ST, T, SW, TP, TS, Q	14,601	121	14722	83.2%	
Melaleuca dampland. Paperbark (*Melaleuca pressiana*) over sparse isolated *Banksia littoralis* over open Hakea, occasional Woody Pear (Xylomelum), Grass trees and over mixed shrublayer of Cyperaceae, Restionaceae, Babingtonia, Jacksonia and Acacia, over low shrubs, sedges and herbs. There are areas of sparse to occasional stunted Jarrah and Marri however these are limited to lowland transitional zones adjacent to slightly higher elevation and drainage open forest areas. Generally limited to areas of poor drainage and subject to winter inundation such as broad valleys and swamps. Substrate is grey gravely clay and clay loam. Disturbance factors include frequent fire and feral pigs. **Fauna species recorded:** Provides habitat for a range forest and woodland birds. Black cockatoo species forage on Banksia, Hakea and occasional Jarrah and Marri. Several frog species breed seasonally such as Glauert's Froglet (*Crinia glauerti*) and Moaning Frog (*Heleioporus eyrei*). Reptiles include Cool Skink (*Acritoscincus trilineatum*), and Earless Skink (*Hemiergis initialis*). Small mammals include forest micro-bats, and Mardo (*Antechinus flavipes*). Other species include Echidna, Western Brush Wallaby and Western Grey kangaroo. **Habitat for conservation significant species during survey:** Western Brush Wallaby, Western False Pipistrelle. Foraging habitat for all three locally occurring Black Cockatoo (*Calyptorhynchus*) species although Jarrah and Marri are generally stunted and sub-optimal for potential breeding habitat. Where creek lines or dense vegetation is present Quokka and Quenda reside.	A	130 ha	0	130	0.7%	

Description	Corresponding Vegetation Type Code (Mattiske 2021)	Extent in the Mine Development Envelope Survey Area (ha)	Extent in the Conveyor/Haul Road Corridor Survey Area (ha)	Total Survey Extent (ha)	Percentage of Total Survey Area	Representative Images
Mine rehabilitation Historic mine rehabilitation (> 20 years old) of the Jarrahdale Mine. This is historic rehabilitation under previous completion criteria and not representative of current or future rehabilitation programs. These areas are Jarrah dominated trees. These areas generally have high value foraging habitat for Black Cockatoo species but lack trees of suitable age (trunk diameter) to have developed hollows of sufficient diameter and depth to be considered potentially suitable breeding trees for Black Cockatoos. These areas do however provide continuity of forest or woodland connectivity allowing fauna movement and foraging habitat for a range of species ground such as terrestrial reptiles, birds, small mammals.	Rehab	387	14	402	2.4%	Image not available
Pine plantation These are monocultures of Pine timber tree species (Pinus). They represent very high quality foraging habit for Carnaby's and Baudin's Cockatoos. They tend to be devoid of understory and ground layer vegetation and lack habitat values for most other native vertebrates.	PL	162	0	162	0.9%	Image not available

4.2 Fauna Diversity

The combined fauna surveys (Phase 1 and Phase 2) recorded 132 vertebrate fauna species utilising the Survey Area, including 23 mammals, 76 birds, 26 reptiles and 7 amphibians. A breakdown of the fauna assemblage is provided below.

4.2.1 Mammals

The combined surveys recorded 23 mammal species from 12 families within the Survey Area including six species of introduced mammals and 17 native mammal species. The most specious family was the Dasyuridae and Vespertilionidae (both with four species) and Macropod (three species). Six micro-chiropteran bats were positively identified from call analysis and further two species were unconfirmed. Seven of the mammal species recorded are listed as conservation significant and are further discussed in section 4.3.

A breakdown of mammal families recorded during the surveys is provided in Table 21.

Table 21 Mammal families recorded during the field survey

Mammal Family	Number of species	
	Phase 1	Phase 2
Canidae (Fox)	1	1
Dasyuridae (Dasyurid mammals)	3	4
Felidae (Cat) (domestic)	1	1
Leporidae (Rabbit)	1	1
Macropodidae (Kangaroo)	3	3
Molossidae (Free-tail Bat)	2	2
Muridae (Rodent)	2	3
Peramelidae (Quenda)	1	1
Phalangeridae (Possum)	1	1
Suidae (Wild pig)	1	1
Tachyglossidae (Short-billed Echidna)	1	1
Vespertilionidae (Simple-nosed Bats)	4	4
Total	**21**	**23**

4.2.2 Birds

Bird surveys identified 76 bird species from 36 families over the combined Phase 1 and Phase 2 surveys. The most specious families were the Meliphagidae (8 species), Acanthizidae (6 species) and Psittaculidae (6 species). Five of the bird species recorded are listed as conservation significant and are further discussed in section 4.3.

No migratory shorebirds were recorded during the survey. The phase 2 survey coincided with the seasonal occurrence of shorebirds across the southwest region. The survey area lacks open water including shallow shorelines for foraging habitat. The creek lines and vegetated dampland areas within the survey area are not suitable. Therefore, they are unlikely to occur within the survey area, and any occurrence would be as vagrant visitation due to proximity of Serpentine Reservoir.

A breakdown of bird families recorded during the survey is provided in Table 22.

The Masked Owl (*Tyto novaehollandiae*) was specifically targeted for assessment utilising SM4 Acoustic Song Meters in suspected habitat areas as shown in Table 6 and Figure 3, Appendix A. Song Metres recorded 25 opportunistic bird species and detected the presence of Masked Owl during the Phase 1 survey with no detections during the Phase 2 survey. A comprehensive detailed summary of the results of the Acoustic Song meters is provided in Appendix D.

It should be noted that Song Meters were placed at targeted Masked Owl habitat during the Phase 1 survey and deployed to fill in ‘gaps’ in the Phase 2 survey to increase coverage over the Survey Area and indicate distribution of Masked Owl.

Table 22 Bird families recorded during the field surveys

Bird Family	Number of species	
	Phase 1	Phase 2
Acanthizidae (Weebill/Gerygone)	5	6
Accipitridae (Diurnal birds of prey)	1	2
Aegothelidae (Nightjar)	0	1
Alcedinidae (Kingfisher)	1	2
Anatidae (Duck)	2	1
Artamidae (Magpie group)	3	5
Cacatuidae (Cockatoo group)	3	4
Campephagidae (Cuckoo-shrikes)	1	1
Casuariidae (Emu)	1	1
Charadriidae (Lapwing)	1	0
Climacteridae (Tree Creeper)	1	2
Columbidae (Pigeon)	2	1
Corvidae (Crow, Raven)	2	1
Cuculidae (Cuckoos)	1	1
Dicaeidae (Flowerpeckers)	1	0
Estrildidae (Finches)	0	1
Falconidae (Falcons)	0	1
Hirundinidae (Swallows)	2	1
Locustellidae (Songlark)	1	0
Maluridae (Wrens)	3	2
Meliphagidae (Honeyeaters)	3	8
Meropidae (Bee-eater)	0	1
Monarchidae (Lark)	1	1
Neosittidae (Sitellas)	0	1
Pachycephalidae (Whistlers)	3	3
Pardalotidae (Pardalotes)	0	2
Petroicidae (Robin)	3	3
Podargidae (Frogmouths)	1	1
Psittaculidae (Parrots)	3	6
Rhipiduridae (Fantail)	1	1
Rallidae (Rails)	1	0
Strigidae (True Owls)	1	1
Threskiornithidae (large wading birds)	0	1
Turnicidae (Quail)	1	1
Tytonidae (Owl)	1	0
Zosteropidae (Silvereye)	1	1

Bird Family	Number of species	
	Phase 1	Phase 2
Total	**51**	**64**

4.2.3 Amphibians

A combined total of seven amphibians from three families were recorded during the Phase 1 and Phase 2 surveys. The most species family was Myobatrachidae (three species). No conservation significant amphibians were recorded during this time. A breakdown of amphibians recorded during the survey is provided in Table 23.

Table 23 Amphibian families recorded during the field surveys

Amphibian Family	Number of species	
	Phase 1	Phase 2
Myobatrachidae (Quacking/Bleating Frog)	3	2
Limnodynastidae (Moaning Frog)	1	1
Pelodryadidae (Slender tree Frog)	1	1
Total	**5**	**4**

4.2.4 Reptiles

A combined total of 26 reptile species from nine families were recorded during the Phase 1 and Phase 2 surveys. The most specious family was Scincidae (10 species) followed by Elapidae (four species). One conservation significant reptile was recorded during the survey which is further discussed in section 4.3.

A breakdown of reptile families recorded during the survey is provided in Table 24.

Table 24 Reptile families recorded during the field surveys

Reptile Family	Number of species	
	Phase 1	Phase 2
Agamidae (Dragons)	1	2
Boidae (Pythons)	1	1
Carphodactylidae (Terrestrial Geckoes)	1	0
Elapidae (Snakes)	2	4
Gekkonidae (Geckos)	1	2
Pygopodidae (Legless Lizards)	0	1
Scincidae (Skinks)	8	9
Typhlopidae (Blind Snakes)	0	1
Varanidae (Monitors)	3	2
Total	**17**	**22**

4.2.5 Introduced Species

Mammals comprised the main group in which introduced fauna were recorded. In total eight species were observed and included:

– Feral Pig (*Sus scrofa*)
– European Fox (*Vulpes vulpes*)
– European Rabbit (Oryctolagus cuniculus)
– Black Rat (Rattus rattus)

– House Mouse (*Mus musculus*)
– Feral cat (*Felis catus*)
– Rainbow Lorikeet (*Trichoglossus moluccanus*)
– Laughing Kookaburra (*Dacelo novaeguineae*).

These species are considered feral to the region.

4.3 Conservation Significant Fauna

Thirteen conservation significant fauna species were recorded within the Survey Area during the surveys. This includes:

– Baudin's Cockatoo (*Calyptorhynchus baudinii*) – listed as Endangered under the BC Act and Endangered under the EPBC Act.
– Carnaby's Cockatoo (*Calyptorhynchus latirostris*) – listed as Endangered under the BC Act and Endangered under the EPBC Act.
– Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) listed as Vulnerable under the BC Act and Vulnerable under the EPBC Act.
– Quokka (*Setonix brachyurus*) – listed as Vulnerable under the BC Act and the EPBC Act.
– Chuditch (*Dasyurus geoffroii*) listed as Vulnerable under the BC Act and Vulnerable under the EPBC Act.
– Peregrine Falcon (*Falco peregrinus*) listed as Special Protection (Schedule 7) under the BC Act.
– Brush-tailed Phascogale (*Phascogale tapoatafa wambenger*) listed as Conservation Dependent by DBCA.
– Masked Owl Southwest (*Tyto novaehollandiae novaehollandiae*) listed as Priority 3 by the DBCA.
– Rakali (*Hydromys chrysogaster*) listed as Priority 4 by the DBCA.
– Quenda (*Isoodon fusciventer*) – listed as Priority 4 by the DBCA.
– Western Bush Wallaby (*Notamacropus Irma*) – listed as Priority 4 by the DBCA.
– Southern Death Adder (*Acanthophis antarcticus*) listed as Priority 3 by the DBCA.
– Western False Pipistrelle (*Falsistrellus mackenziei*) listed as Priority 4 by the DBCA.

Likelihood of occurrence assessment

In addition to the field survey results, an assessment of the likelihood of conservation significant species occurring in the Survey Area was undertaken. This assessment is based on species' biology, habitat requirements, the quality and availability of suitable habitat as determined during the field survey and records of the species in the Survey Area and locality. The *NatureMap* database identified 185 terrestrial vertebrate fauna species previously recorded within the Study Area. This total comprised of 113 birds, 32 reptiles, 28 mammals and 12 amphibians. Of the 185 fauna species previously recorded, 177 are native species and eight are naturalised (introduced) species. The EPBC Act PMST search detected an additional four threatened bird species as potentially occurring within the Study Area and the DBCA Threatened and Priority Fauna database returned one additional mammal within the Survey Area. Based on the above database searches and GHD observations, fourteen conservation significant terrestrial vertebrate taxa were identified as likely to occur or present within the Survey Area.

With regard to migratory shorebirds, the survey area lacks open suitable foraging habitat, namely shorelines or extensive shallow open water. The creek lines and vegetated seasonal dampland areas within the survey area are not considered suitable foraging habitat and in most cases are dry during the period of migratory bird use in the south west of Western Australia. Therefore, they are unlikely to occur within the survey area, and any occurrence would be as rare vagrant.

Table 25 summarises the species of conservation significance that are either known or considered likely to occur in the Survey Area. A brief description of these species and their associated habitat types within the Survey Area are described below. The parameters of assessment for this likelihood of occurrence assessment and the full likelihood of occurrence assessment are provided in Appendix D.

Table 25 Summary of likelihood of occurrence assessment for conservation significant fauna

Species	EPBC Act	BC Act/ DBCA	Assessment outcome
Birds			
Baudin's Cockatoo (*Calyptorhynchus baudinii*)	EN	EN	Known. The species was recorded during the survey and shown in Figure 4d, Appendix A.
Carnaby's Cockatoo (*C. latirostris*)	EN	EN	Known. The species was recorded during the survey and shown in Figure 4d,Appendix A.
Forest Red-tailed Black Cockatoo (*C. banksii naso*)	VU	VU	Known. The species was recorded during the survey and shown in Figure 4b, Appendix A.
Peregrine Falcon (*Falco peregrinus*)	-	SP	Known. One individual was recorded during the survey and the Jarrah Marri forest within the Survey Area is suitable nesting habitat.
Masked Owl (southwest) (*Tyto novaehollandiae novaehollandiae*)	-	P3	Known. The species was recorded on acoustic recorders during the survey and shown in Figure 4c, Appendix A.
Mammals			
Western False Pipistrelle (*Falsistrellus mackenziei*)	-	P4	Known. This species was recorded on Song Meters in both the Phase 1 and Phase 2 surveys. Suitable habitat is available to support this species.
Chuditch (*Dasyurus geoffroii*)	VU	VU	Known. This species was recorded on two remote cameras during Phase 1 and Phase 2 of the survey. The Survey Area contains suitable breeding and foraging habitat to support this species.
Quenda (*Isoodon fusciventer*)	-	P4	Known. The species was recorded via cage trapping, remote cameras and diggings during the survey and shown in Figure 4c, Appendix A.
Quokka (*Setonix brachyurus*)	VU	VU	Known. The species was recorded on remote camera during the Phase 1 and Phase 2 of the survey shown in Figure 4a, Appendix A. The species appears to be wide spread and associated with riparian areas and damplands.
Brush tailed Phascogale (*Phascogale tapoatafa wambenger*)	-	CD	Known. At least three individuals were recorded on one remote camera within the Survey Area. Suitable habitat occurs within Survey Area.
Western Brush Wallaby (*Notamacropus irma*)	-	P4	Known. The species was recorded throughout the Survey Area as shown in Figure 4c, Appendix A.
Rakali (*Hydromys chrysogaster*)		P4	Known. The species was recorded on one remote camera along a flowing stream section of Big Brook that bisects the proposed conveyor location shown in Figure 4c, Appendix A.
Reptiles			
Southern Death Adder (*Acanthophis antarcticus*)	-	P3	Known. The species was recorded during the survey near granites near to Serpentine Dam and shown in Figure 4c, Appendix A. Suitable forest and rocky habitat occurs within Survey Area.
Dell's Skink (*Ctenotus Delli*)		P4	Likely. The species has previously been recorded in the region and habitat is present for the species.

Legend:
CD= Conservation dependent fauna
CR = Critically endangered under the EPBC Act or BC Act
EN = Endangered under the EPBC Act or BC Act
VU = Vulnerable under the EPBC Act or BC Act
SP (S7) = Schedule 7, Special Protection under BC Act
P3 = Priority 2 under DBCA, poorly known species.
P4 = Priority 4 under DBCA, rare, near threatened and other species in need of monitoring.

Fauna species recorded in the Survey Area

Forest Red-tailed Black Cockatoo (Calyptorhynchus banksii naso)

The Forest Red-tailed Black Cockatoo is listed as Vulnerable under the EPBC Act and BC Act.

The Forest Red-tailed Black Cockatoo is endemic to the south-west humid and sub-humid zones of Western Australia (Mawson and Johnstone 1997). It inhabits the dense Jarrah, Karri (*E. diversicolor*) and Marri forests receiving more than 600 mm of annual average rainfall. The current distribution is north of Perth and east to Mount Helena, Christmas Tree Well, North Banister, Mt Saddleback, Rocky Gully and the upper King River (Johnstone 1997). More recently the species has been utilising and persisting on the northern portions of the Swan Coastal Plain and is now considered a regular sighting (Johnstone *et al* 2017). Habitats in which Forest Red-tailed Black Cockatoos occur at Bungendore Park and Jarrahdale, have an understorey of Bull Banksia (*Banksia grandis)*, Snottygobble (*Persoonia longifolia)*, Sheoak (*Allocasuarina fraseriana)* and *Banksia* spp., with scattered Blackbutt (*E. patens)* and Wandoo (*E. wandoo)* (Johnstone & Kirkby 1999). Forest Red-tailed Black Cockatoos roost in Jarrah-Marri-Blackbutt habitat on road-sides, paddocks or forest blocks. While the Forest Red-tailed Black Cockatoo feeds on the seeds of other species, around 90 per cent of its diet is made up of the seeds from Marri and Jarrah fruits.

Forest Red-tailed Black Cockatoos have been recorded breeding in both Myara and Myara North, particularly at the Yamba area at the west of Myara and near the Tuart/Acacia Road area at the north-west of Myara North (T. Kirby, pers. comm.). Breeding is recorded in Jarrah, Marri (majority), Bullich and Blackbutt. Breeding has been recorded from adjacent areas including Serpentine National Park, Wungong Catchment, 39 Mile Brook area and Monadnocks Nature Reserve.

Significant Forest Red-tailed Black Cockatoos roost sites are known from the Myara North region at Jarrahdale Road/Albany Highway (350 birds but usually 50-60) and Jarrahdale Road near Jarrahdale (100 birds) (Johnstone and Kirkby unpublished data).

Forest Red-tailed Black Cockatoos were recorded at 149 locations throughout the Survey Area with approximately 280 physical observations recorded during Phase 1 and 91 physical observations during Phase 2. Individuals were recorded in flight, feeding or calling throughout the Survey Area. Foraging evidence, predominantly chewed Marri and Jarrah pods, was recorded throughout the Survey Area. All observations have been mapped and are presented in Figure 4b and 4d, Appendix A.

Plate 1: Forest Red-tailed Black Cockatoo image captured during winter survey

Baudins Cockatoo (Calyptorhynchus baudinii)

Baudin's Cockatoo is listed as Endangered under the EPBC Act and BC Act.

Baudin's Cockatoo is endemic to the south-west of Western Australia. The range of Baudin's Cockatoo varies considerably between the breeding and non-breeding seasons. During the breeding season (from October to January), the species nests in the far south-west of WA within Jarrah, Marri and karri forests which receive an average of 750 mm of rainfall annually. Breeding generally occurs in woodland or forest, but may also occur in former woodland or forest now present as isolated trees. Breeding has been recorded at Perth Hills, Lowden (Johnstone & Storr 1998), Serpentine (hills area), and to the east at Kojonup (Johnstone & Kirkby 2008). Nesting occurs in hollows of live or dead karri, Marri, wandoo and tuart (*Eucalyptus gomphocephala*) trees (DSEWPaC 2012). During the breeding season feeding primarily occurs in native vegetation, particularly Marri (DSEWPaC 2012). The range then expands during the non-breeding season (from February) as flocks forage more widely, congregating on the central and northern parts of the Darling plateau, as far as Mundaring and Gidgegannup (DSEWPaC 2012; Saunders 1974 & 1979). Some pockets of breeding have also been recorded around Augusta, Northcliffe, Walpole, Denmark and Albany (DSEWPaC 2012).

Baudin's Cockatoo has been recorded breeding in both the Myara and Myara North regions, though only in low numbers. Most breeding appears to be in the Solus Road area at the border of the Myara and Myara North regions (Alcoa, T. Kirkby unpublished data). Limited breeding also occurs in Bullich and Marri at the border of the Wungong Catchment and 39 Mile Brook Catchment areas approximately 5 km to the north of the Survey Area.

Within close proximity of the Survey Area Baudin's Cockatoo are known to roost in Bullich at Dirk Brook Road and Gobby Road (up to 350 birds) at the west of Myara (Johnstone and Kirkby unpublished data). The species is known to roost in Bullich at the Karnet area north of Kingsbury Drive (100 birds) and in smooth white barked exotic eucalypts at Turner Road (150 birds) south of Jarrahdale at Myara North (Alcoa, T. Kirkby unpublished data).

Flocks of between one and 40 Baudin's Cockatoo were observed during the surveys, including some mixed Baudin's - Carnaby's Cockatoo flocks noted based on bill length. All observations have been mapped and are presented in Figure 4a and 4d, Appendix A.

Carnaby's Cockatoo (Calyptorhynchus latirostris)

Carnaby's Cockatoo is listed as Endangered under the EPBC Act and BC Act.

Carnaby's Cockatoo (*C. latirostris*) is endemic to the south-west of Western Australia with a wide-spread distribution. Carnaby's Cockatoo nest in hollows of live or dead eucalypts, primarily smooth-barked Salmon Gum and Wandoo (Saunders 1979, 1982) though breeding has been reported in other Wheatbelt tree species and some tree species on the Swan Coastal Plain and Jarrah forest (Saunders 1979, 1982; Storr 1991; Johnstone and Storr 1998). Success in breeding is dependent on the quality and proximity of feeding habitat within 12 km of nesting sites (Saunders 1977, 1986; Saunders and Ingram 1987). Along with the trees that provide nest hollows, the protection, management and increase of this feeding habitat that supports the breeding of Carnaby's Cockatoo is a critical requirement for the conservation of the species.

Carnaby's Cockatoos have been recorded breeding in the Myara region and two nests are present in Marri at the west of the area near Scarp Road. Breeding is expected to occur at the south of Myara North in the vicinity of Solus Road and Mountain Road based on seasonal observations (Alcoa, T. Kirkby unpublished data). Breeding has been recorded in Marri at the Wungong Catchment and 39 Mile Brook Catchment approximately 5 km to the north (Johnstone and Kirkby unpublished data). More breeding may be recorded with greater survey effort as there are records of lone males in a few areas during the breeding season which may indicate that females are at the hollow either incubating an egg or brooding a chick (T. Kirby, pers. comm.). Carnaby's Cockatoos foraging evidence was recorded with foraging activity observed throughout all forest and woodlands habitats. A range of plants in utilised including Eucalyptus, Corymbia, Banksia, and records of foraging on *Hakea undulata* and Jarrah, along Frollett Road and Albany Highway at Myara North (Alcoa/T.Kirkby unpublished data). Pine plantation (Pinus) within the Study Area also represent a high value seasonal foraging resource. Foraging resources across the site are of high value particularly given the presents of potential and known breeding trees present within and in proximity to the foraging habitat.

Carnaby's Cockatoo were recorded at several locations throughout the Survey Area with a total of approximately 443 birds observed during the winter survey. Observations of flocks ranging from 5 and 200 Carnaby's Cockatoo were recorded. More individuals were recorded in the northern portion of the Survey Area; however evidence of them was observed throughout the entire Survey Area. Their locations were present in pine trees (feeding, calling and flying to and from). All observations have been mapped and are presented in Figure 4b and 4d, Appendix A.

Plate 2: Carnaby's Cockatoo image captured during winter survey

Masked Owl (southwest) (Tyto novaehollandiae novaehollandiae)

The Masked Owl is listed as Priority 3 by DBCA.

The Masked Owl occurs in open forest and woodland, and roosts among dense foliage in gullies, or in caves or tree hollows (Peake *et al* 1993, Kavanagh & Murray 1996, Liddelow, Wheeler and Kavanagh, 2002). Habitat is known to be woodland or open forest with cleared agricultural land nearby. The Masked Owl occurs mainly in the woodland region or where agricultural land intrudes into the heavier forest (Liddelow, Wheeler and Kavanagh, 2002).

During the winter field survey, a total of 132 calls attributable to Masked Owls were recorded at two locations within the middle portion of the Survey Area. Their locations were present in Jarrah Marri forest associated to properties along Kingsbury Drive near to Serpentine Dam. One of the locations where the Masked Owl was detected (SM4-AC2 – Object ID 119) was near Serpentine Dam on the northern side. Due to the distance apart, timing of calls and numbers of calls the data is likely at least one pair of Masked Owl is present (see Appendix D). No other locations were recorded for the species despite the entire Survey Area being suitable for the species. All observations have been mapped and are presented in Figure 4c, Appendix A.

A detailed summary of the acoustic recordings of the Masked Owl is provided in Appendix D.

Quenda (Isoodon fusciventer)

The Quenda is listed as Priority 4 by DBCA.

The Quenda has patchy distribution through the Jarrah and Karri forest and on the Swan Coastal Plain. Its habitat is generally dense scrubby, often swampy, vegetation with dense cover up to one metre high, often feeds in adjacent forest and woodland that is burnt on a regular basis and in areas of pasture and cropland lying close to dense cover. Populations inhabiting Jarrah and Wandoo forests are usually associated with watercourses (Braithwaite, 1995).

Over the course of the surveys Quenda was recorded at 21 locations within the Survey Area via trapping, remote cameras and opportunistically. Three of these locations are within cage traps, 13 are on cameras and five are opportunistic sightings. Quenda locations are spread widely across the Survey Area; however almost half (ten) records are from the northwest portion. Habitat preference tends to be associated with areas of low dense vegetation along drainage lines and damplands. These areas are providing adequate cover from predators.

All observations have been mapped and are presented in Figure 4c, Appendix A.

Plate 3: Quenda recorded on a remote camera during the Phase 1 survey

Quokka (Setonix brachyurus)

The Quokka is listed as Vulnerable under the BC Act and the EPBC Act.

The current distribution of the mainland quokka includes areas through the south-west forests from Jarrahdale to Walpole. The mainland quokka lives in the Darling Range and south-west regions of Western Australia, mostly inhabiting densely vegetated swamps and sometimes tea-tree thickets on sandy soils along creek systems and dense heath on slopes. Mainland quokkas tend to hide in runs among vegetation during the day and forage along the swamp margins at night (Kitchener, D.J, 1995).

In the southern forest, quokkas occupy a range of forest, woodland and wetland ecotypes. The most commonly occupied sites comprise Jarrah (*Eucalyptus marginata*), Marri (*Corymbia calophylla*), karri (*E. diversicolor*) or tingle (*E. jacksonii* or *E. guilfoylei)* forest and riparian habitats with a sedge dominated understorey (DEC 2013). Habitat supporting a low density of near-surface fuel, a complex vegetation structure and burn patchiness are the factors favouring quokka occupancy in the southern forest (DEC 2013). The habitat critical to survival for the south coast subpopulation includes a wider range of vegetation types (floristically and structurally) than in the northern Jarrah forest, including swamps, riparian areas, incised gullies and dense coastal heath (de Tores *et al.* 2007). Habitat occupied at the Swan Coastal Plain site at Muddy Lakes consists of fringing wetland vegetation of dense bulrush (*Typha orientalis*)/pale rush (*Juncus pallidus*) sedgeland with other sedges including jointed rush (*Baumea articulata*), *Typha domingensis* and coast sword-sedge (*Lepidosperma gladiatum*) (Keighery *et al*. 2002) (DEC 2013).

During the surveys Quokkas were recorded at a total of 16 locations across the Survey Area, each associated with riparian vegetation or damplands (Figure 4a, Appendix A). This comprises the presence of Quokka from signs (scat, prints or runnels) at three locations and the recordings of Quokka on 13 remote cameras. During phase 1, 16 individual Quokka (from 20 hits) were recorded and Phase 2 20 individuals (from 76 hits) on camera based on camera independence, animal size, pouch young size, hair loss and ear damage. Some individuals can be seen below in Plate 4 and Plate 5. Between 1 and 6 individuals were recorded per site based on independent characteristics, with the number of individuals likely higher due to animals being similar. During both phases a number of females either had pouch young or young at foot suggesting recruitment across the Survey Area.

Quokka detection locations were widespread across the Survey Area but limited to areas of dense vegetation associated with drainage lines and damplands. These areas are providing sufficient cover for shelter from predators, food and are movement corridors through the landscape. It is likely Quokka are present in the region wherever drainage lines and damplands are present with long unburnt vegetation. During this survey it was found animals were persisting in dense regrowth of approximately 5-6 years old after fire. This is probably occurring due to baiting in the region under western shield as few foxes were recorded on camera.

Plate 4: Quokka adult and juvenile captured on camera during Phase 1 survey

Plate 5: Quokka adult and juvenile captured on camera during Phase 2 survey

Western Brush Wallaby (Notamacropus irma)

The Western Brush Wallaby is listed as Priority 4 by DBCA.

Western Brush Wallaby are locally common in dry sclerophyll forest and woodlands in the southwest of Western Australia (Menkhorst & Knight 2010). They are predominantly diurnal, grazing on grasses and forbs.

Western Brush Wallaby were recorded throughout much of the Survey Area with a total of 62 observations of individuals (predominantly opportunistic) recorded during the surveys. Sightings occurred mainly amongst the Jarrah Marri forest, the dominant fauna habitat type, and were more prevalent in the southern and mid portions of the Survey Area. Remote cameras recorded approximately 21 records of Western Brush Wallaby over the deployment period.

Locations of Western Brush Wallaby observations recorded during the survey are presented in Figure 4c, Appendix A.

Plate 6: Western Brush Wallaby recorded during Phase 1 survey

Southern Death Adder (Acanthophis antarticus)

The Southern Death Adder is listed as Priority 3 by DBCA.

The Southern Death Adder lives in forests and woodlands, grasslands and heath. The species is a highly cryptic generally only visible if active or sunbaking. Generally the species requires thick litter to hide.

During the Phase 1 survey two Southern Death Adders were opportunistically recorded by Mattiske Consulting at one location (or generally in the same region) within close proximity to each other during the vegetation and flora survey being undertaking for this Project. This observation have been mapped and are presented in Figure 4c, Appendix A. This species was not detected by any other method throughout either of the surveys.

Plate 7: Southern Death Adder recorded by Mattiske in winter 2020 (Image by Zac Sims)

Chuditch (Dasyurus geoffroii)

The Western Quoll or Chuditch is listed as Vulnerable under the BC Act and EPBC Act.

The Chuditch is Western Australia's largest carnivorous marsupial and is endemic to south-west Western Australia. It has mostly brown fur with distinctive white spots (40-70 white spots on its body but not on its tail). The tail is 21-35 cm long. The Chuditch is a carnivore and feeds mostly on large invertebrates. It also easts small lizards, birds and mammals. They are also known to consume the red pulp on Zamia seeds, small fruits and part of flowers. They utilise hollow logs or burrows during the day and hunt at night. It is an excellent climber, which makes it easier to catch tree-dwelling animals. Historically, Chuditch inhabited a wide range of habitats, but today it survives mostly in Jarrah *Eucalyptus marginata* forests and woodlands, mallee shrublands and heathlands (DBCA 2017a).

During the field survey the Chuditch was recorded on two remote cameras in the central north-eastern and central north-western portion of the Survey Area (Figure 4a, Appendix A). Despite the extensive survey effort (cages and cameras) no other individuals were recorded. The Survey Area contains suitable breeding and foraging/hunting habitat to support this species and a population of the species in the Survey Area.

Plate 8: Chuditch recorded on remote cameras during Phase 1 survey

Rakali (Hydromys chrysogaster)

The Rakali is listed as Priority 4 by DBCA.

Rakali live in the vicinity of permanent bodies of fresh, brackish, or marine water, lakes and farm dams, and on sheltered coastal beaches, mangroves and offshore islands. In the south-west of WA they have been shown to prefer areas with riparian vegetation, better water quality and a degree of habitat complexity. Woody debris, rock ledges and wetland islands are likely to be important areas for feeding and refuge (DEC 2012). It is an occasional vagrant to temporary waters. Water Rat's dens are made at the end of tunnels in banks and occasionally in logs (Van Dyck & Strahan 2008).

One Rakali was recorded during Phase 1 of the survey via remote camera along a flowing stream section of Big Brook that bisects the proposed conveyor alignment (Figure 4c, Appendix A). A 300 m portion of the stream (Big Brook) was actively searched for Carters Freshwater Mussel and Rakali. No Rakali middens were recorded however a small amount of Yabbi remains were discovered on a bank which indicates recent use by Rakali. Big Brook is a seasonal Brook but a main tributary of Serpentine Dam, which is likely the source origin of Water Rat in the Survey Area. A further 13 locations were assessed for Rakali (See Appendix D for Rakali Assessment results) with an additional three creeks identified as potentially suitable for Rakali. Two of these areas had cameras deployed but no additional animals were detected. No other creeks in the Survey Area were assessed as suitable for the species due to the lack of permanent water within upper sections of creeks.

Plate 9: Rakali recorded on a remote camera during Phase 1 survey

Peregrine Falcon (Falco peregrinus)

The Peregrine Falcon is listed as Special Protection (Schedule 7) under the BC Act.

The Peregrine Falcon is a large falcon species which predominantly preys aerially on medium sized birds such as Pigeon, Galah and ducks. The species prefers areas with deep gorges or large cliff faces with riparian or plain habitat surrounding. Within the south-west this species utilised forest trees as suitable nest habitat, foraging in surrounding forests and clearings. The Peregrine Falcon nests primarily on ledges of cliffs, shallow tree hollows, and ledges of buildings in cities (Morcombe 2004). The Peregrine Falcon is wide ranging, mobile and aerial in nature, and therefore is likely to utilise forest and woodland habitats within the Survey Area.

During the Phase 2 survey one Peregrine Falcon was recorded roosting in a tree at Trapline 3 (Figure 4c, Appendix A) in the south of the Survey Area. The Survey Area contains suitable breeding and hunting habitat to support this species.

Western False Pipistrelle (Falsistrellus mackenziei)

The Western False Pipistrelles is listed as Priority 4 under DBCA managed species list.

The Western False Pipistrelles is a vespertilionid bat that occurs in Southwest Australia. It is an insectivore associated with old growth forest that provides the species with its preferred foraging opportunities. Namely, flying insects are hunted around tall forest canopy in the valley between trees tops or the open areas above the mid-storey (Kitchener, Caputi & Jones, 1986). Their range is dominated by wet sclerophyll eucalypt forest and semi woodland of the southwest. Roosting sites are usually associated with old growth eucalypts containing hollows as well as within branches or tree stumps. The Western False Pipistrelle has been recorded on the Swan Coastal Plain in Banksia woodland (Kitchener, Caputi & Jones 1986).

The Western False Pipistrelle was recorded at 13 sites during both phases of the Survey Area (Figure 4c, Appendix A), suggesting a large portion of the Survey Area, including eucalyptus forest and woodland habitats are utilised for foraging and roosting.

Brush tailed Phascogale (Phascogale tapoatafa)

The Brush tailed Phascogale is listed as Conservation Dependent (CD) under the BC Act.

It occurs at low densities in the northern Jarrah forest with highest densities occurring in the Perup/Kingston area, Collie River valley and near Margaret River and Busselton. This species has been observed in dry sclerophyll forests and open woodlands that contain hollow-bearing trees but a sparse ground cover. Records are less common from wetter forests. They are most active between dusk and dawn (though emerging later in mid-winter) and forage almost exclusively among the tree canopy. Nest sites include hollow tree limbs, rotten stumps and even bird's nests. Lactating females show a preference for large tree cavities with small entrances. They are opportunistic feeders including invertebrates, nectar, small birds and small mammals (DBCA, 2017b).

The Brush-tailed Phascogale was detected during phase 2 of the survey via remote camera from Jarrah – Marri forest with Sheoak understory within the central portion of the Survey Area (Plate 10 and Figure 4c, Appendix A.). Three individuals were identified on the same camera and all appear to be sub adult and likely from the same litter. This indicates a breeding population is present in the Survey Area.

Plate 10: Brush-tailed Phascogale recorded on remote camera

4.3.1 Accumulation curve

An accumulation curve was run for the data collected during the field survey within 8 models in Primer V6 (Plate 11). Jacknife1, Chao 1, Chao2 and Jacknife2 curves demonstrate poor fit to the data, while the remaining curves reach a curve asymptote (very few new species were recorded) after trap night 10-12. For, Bootstrap, MM, Sobs and UGE somewhat model levelling is demonstrated by the end of the survey indicating that of the species active at the time of the survey a majority of them were sampled prior to the end of the project. This is also comparable to the raw data of which the known species in the region (of native reptile, small mammal and frogs) approximately 51 could utilise the habitats present in the Survey Area (based on NatureMap records) where this study recorded 41.

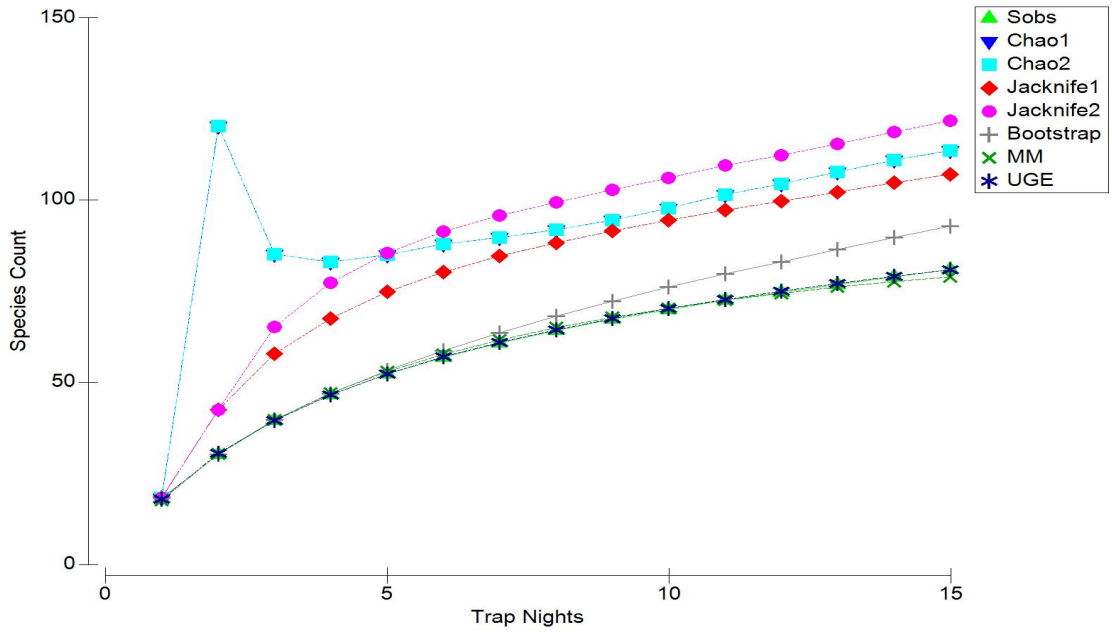

Plate 11: Species accumulation over time

4.3.2 Black cockatoo habitat assessment

The Black Cockatoo habitat assessment focussed on qualifying and quantifying the breeding habitat values for Black Cockatoo species occurring within the Survey Area. Due to the scale of the Survey Area, thirty one (31) three hectare habitat assessment plots were sampled to determine habitat usage and potential value for Baudin's, Carnaby's, and Forest Red-tailed Black Cockatoo as described in Section 2.3.7. Table 26 presents results on potential and actual usage of cockatoo breeding habitat within the Study Area. Table 27 provides a comparison of potential breeding habitat values for the fauna habitats across the Survey Area. Table 28 presents a quality assessment of the foraging habitat within the different habitat types.

4.3.2.1 Foraging habitat

In total 112 foraging sites were recorded consisting of 106 sites of Forest Red-tailed Black Cockatoo, nine sites of Carnaby's Cockatoo and one site from Baudin's Cockatoo. Throughout the six habitat types foraging quality is either low, medium or high depending on impacts of fire and dieback (Table 28). Melaleuca Damplands appears to be particularly impacted by recent fires in the region with few foraging species present at the time of the Survey. All six habitats are useable by either one or more Black Cockatoo species as a food source which is dominated by foraging species or has scattered foraging species present throughout the habitat type.

Table 28 presents a quality assessment of the foraging habitat within the different habitat types.

4.3.2.2 Breeding habitat

From this study and Alcoa's existing data from the Study Area it is known that two main areas appear to be where most of the current breeding activity has been recorded. These areas are within and around the Bullich habitat in the central northern western portion of the Study Area and central southern portion of the Study Area (see

Figure 4d). Several scattered other breeding trees are also known. The northern western portion appears to be more Forrest Red-tailed Black dominated breeding while the other region Baudin's Cockatoo. Breeding trees are mostly in Marri however Bullich and Blackbutt are also utilised in the Study Area.

Transect data undertaken within the Study Area identified that Flooded Gum Woodland and Jarrah/Marri Forest had the greatest number of trees per hectare with a DBH of >50cm at 12 and 9 respectively. Blackbutt Forest and Melaleuca Dampland had 7, while Granite Outcrop Association and Bullich Forest had 6 and 2 respectively (Table 27). The high density of trees in Melaleuca Damplands and Granite Outcrop Association is due to ecotone vegetation, that is Blackbutt fringing Melaleuca Dampland and Marri fringing granite outcrops. During the Survey at least four nests of Forest Red-tailed Black Cockatoo were lost to a prescribed burn in the northern western portion of the Study Area.

4.3.2.3 Roosting habitat

One roost site was recorded during the Survey Area in the vicinity of the Balmoral Anzac camp. The area had evidence of roosting.ie scat and leaf and twig clips and on nocturnal investigation identified at least 4 birds were roosting at the site. It is highly likely more roost locations are present in the Survey Area due to the large numbers of birds (854 consisting of 443 Carnaby's, 40 Baudin's and 371 Forrest Red-tailed Black Cockatoo) recorded in the Survey Area. It is likely that the location of roosting site is dependent on habitat quality in relation to fire history, timber harvesting, dieback or other anthropomorphic behaviour.

Table 26 Black Cockatoo habitat usage

Habitat usage	Presence within the Survey Area	Evidence
Foraging habitat	Yes, Marri, Jarrah and Banksia	Chewed Marri and/or Jarrah nuts, feeding evidence at Casuarina and Banksia trees at 112 locations however the entire Survey Area excluding granite outcrops (actual granite not supportive vegetation) is assessed as foraging habitat.
Actual Breeding Events	No	Historical breeding events were recorded at 8 locations (see Figure 4d). Two sites recorded with evidence of Baudin's Cockatoo breeding and six sites recorded with evidence of Forest Red-tailed Black Cockatoos breeding.
Potential breeding hollows	Yes, this data is based on transect surveys only	19 potential breeding trees > 500 mm DBH of either Jarrah, Marri, Flooded Gum, Blackbutt or Bullich in the Survey Area. Four large Jarrah with large hollows (>200 mm) suitable for breeding. Two of these had chews present however no actual breeding events were recorded.
Likely Breeding hollows	Yes, this data is based on transect surveys only	Ten trees in total were identified as being likely/suitable breeding hollows. Four large Marri trees, one large Jarrah tree with large hollows (>200 mm), two large blackbutt trees and three large Bullich trees with large hollows (>200mm). These trees identified had chews present at the entrance to the hollow however no actual breeding events were recorded.
Roosting habitat	Yes	One suspected roost location recorded in the Balmoral Anzac camp had evidence of roosting.
Potential breeding trees per hectare	Yes	Potential breeding trees identified derived from transect data (see Table 27 for further detail). Trees with hollows per habitat type per hectare: Jarrah-Marri forest: 3 Marri trees/ha, 6 Jarrah trees/ha Flooded Gum woodland: 12 Flooded Gum trees/ha Bullich forest: 2 Bullich trees/ha Blackbutt forest: 7 Blackbutt trees/ha:
Legend: Potential breeding hollow: breeding hollow of an adequate size for use. Likely breeding hollow: breeding hollow previously known/recorded to have been used, active chew marks present or other evidence hollow has been used.		

Table 27 Black Cockatoo potential breeding trees from transect data

	Area (ha) of habitat within Survey Area	Area (ha) of habitat within cockatoo assessment transects	Number of trees >50cm DBH within transects	Mean density trees >50cm DBH (trees/ha) within transects	Number of trees identified with potential hollows within transects	Number of trees identified with likely hollows within transects	Range of density potential breeding trees (DBH>50cm)/ha
Bullich Forest	267	0.66	1	2	0	0	0
Granite Outcrop Association	373	2.7	17	6	0	0	0
Blackbutt Forest	687	7.8	53	7	0	1	0-1
Flooded Gum Woodland	688	8.7	105	12	5	4	0-6
Melaleuca Dampland	130	2.5	17	7	0	0	0
Jarrah Marri Forest	14,722	81.7	723	9	5	14	0-2
Pine Plantation	162	0	0	<1	0	0	0
Cleared areas	259	0	0	<1	0	0	0
Rehabilitation areas	402	0.04	0	<1	0	0	0
Total	**17690**	**104.1**	**916**	**9**	**10**	**19**	**0**

Legend:
Potential breeding hollow: breeding hollow of an adequate size for use.
Likely breeding hollow: breeding hollow previously known/recorded to have been used, active chew marks present or other evidence hollow has been used.

Table 28 Black cockatoo foraging habitat assessment

Habitat type	Vegetation type	Baudin's Cockatoo			Carnaby's Cockatoo			Forest Red-tailed Black Cockatoo		
		Foraging species present	Evidence of foraging	Quality of foraging habitat	Foraging species present	Evidence of foraging	Quality of foraging habitat	Foraging species present	Evidence of foraging	Quality of foraging habitat
Bullich Forest	W, WA	Limited However scattered Marri proteaceous trees and shrubs	None	medium	Limited However scattered Marri proteaceous trees and shrubs	None	medium	Limited	None	medium
Granite Outcrop Association	R, G, RG, G1, G2	Limited However scattered Marri proteaceous trees and shrubs	None	low	High Associated proteaceous species	None	low	None	None	low
Blackbutt Forest	CW, AW, AW/AX, AX/CW, C	Limited	None	medium	Limited	Evidence of feeding in *Banksia littoralis*	medium	High Blackbutt	Numerous locations of the species feeding on Blackbutt seed	high
Flooded Gum Woodland	AC, AD, AX	Limited	None	medium	Limited	None	medium	None	None	medium
Melaleuca Dampland	A	Limited However scattered Marri proteaceous trees and shrubs	None	low	High Associated proteaceous species	None	low	None	None	none
Jarrah Marri Forest	D, DA, DG, E, J, M, P, PG, PJ, PT, PS, PW, S, SP, ST, T, SW, TP, TS, Q	High Dominant feeding habitat for this species, mainly Jarrah, Marri.	The species was recorded feeding in Marri nuts	high	High Jarrah, Marri, Banksia, and proteaceous species	The species was recorded feeding in Jarrah, Marri, Banksia, and records of foraging on *Hakea undulata*	high	High Dominant feeding habitat for this species, mainly Jarrah, Marri and Casuarina. Flowers of Banksia,	The species was recorded feeding in Marri, Jarrah, Casuarina nuts. A small flock was also observed feeding on nectar of Banksia grandis.	high
Mine rehabilitation	Rehab	Jarrah, Marri, exotic eucalyptus	none	high	Jarrah, Marri, exotic eucalyptus	none	high	Jarrah, Marri, exotic eucalyptus	none	high
Pine plantation	PL	Growing tips of mature pine trees (Pinus)	none	medium	Cones of mature pine trees (Pinus)	Chewed cones and cockatoos observed feeding	medium	none	none	none

Legend: Evidence of foraging- none (no feeding habitat present), limited (some species present but not dominant), high (habitat is dominated with feeding species).

4.3.3 Carter's Freshwater Mussel

Eleven locations (with between 9 and 11 transects per location) were searched for Carter's Freshwater Mussel within the Survey Area with no signs of mussels (alive or dead) recorded (see Appendix D for results). Of the surveyed transects, most were dry or reduced to small standing water puddles at the time of survey (November 2020) indicating that the waterways are dry for over four months of the year. The duration of dry streams is noted to be well outside of the five day exposure experiments undertaken in controlled conditions (Klunzinger 2012). However, under protected muddy conditions in a creek bed they are likely to survive longer.

Some transects also contained rocky substrate which may be sub-optimal for Carter's Freshwater Mussel as it requires sandy and clay substrate in which to bury. Three locations (of the 11) had water features suitable enough to maintain Carter's Freshwater Mussel; however none of the transects identified any live mussels or shell remains the species on banks. In these areas the species may be present albeit in very low numbers or below detectable numbers. When adequate stream water is present, the species may occasionally or sporadically be present following dispersal of young mussels up stream within host fish, however the dispersing mussels are unlikely to survive long term due to the dry nature of this portion of the forest. This is demonstrated by the lack of adult shells (dead animals) normally present when undertaking Carter Freshwater Mussel surveys, when they are present.

5. Conclusions

The Survey Area consists of eight broad fauna habitat types: Bullich forest, Granite outcrop, Blackbutt forest, Flooded Gum woodland, Jarrah -Marri forest, Melaleuca dampland. Mine rehabilitation and Pine plantation. Jarrah-Marri forest predominated at 83% of the Survey Area. A small portion of the Survey Area comprises rural cleared land.

The conservation value of each fauna habitat type is specific to the locally occurring conservation significant fauna species and the type of usage by those species. All three Black Cockatoos were recorded primarily throughout the Marri-Jarrah forest, however all habitat types will be utilised for foraging by either one or all of the species. Melaleuca Damplands and riparian areas comprising Bullich Forest, Blackbutt Forest and Marri-Jarrah Forest support a Quokka population with records scattered throughout the Survey Area. Chuditch are wide ranging and expected to use all habitat types at a relatively low density.

In total 13 conservation significant species were recorded in the Survey Area including the Quokka, Chuditch, Brush-tailed Phascogale, Western Brush Wallaby, Forrest Red-tailed Black Cockatoo, Baudin's Cockatoo, Carnaby's Cockatoo, Western False Pipistrelle, Southern Death Adder, Quenda, Rakali, Masked Owl and Peregrine Falcon. All species identified are likely to have significant populations and habitat present within the Survey Area.

The survey area was assessed in terms of habitat suitability for migratory shorebirds. No shorebirds were recorded during the survey. The survey area lacks open water bodies that feature shallow shorelines for foraging habitat. The creek lines and vegetated seasonal dampland areas within the survey area are not considered suitable foraging habitat due to the dense forest vegetation associated with these riparian areas, and the lack of extensive shallow shoreline. Therefore, they are unlikely to occur within the survey area, and any occurrence would be as rare vagrant.

Carter's Freshwater Mussel was targeted during the survey but no presence was recorded. This is expected given that the streams are seasonal and dry up for several months of the year. The species is known to reside in the Serpentine Dam on the southern edge of the Survey Area and while mussels may disperse upstream from the Dam during winter/spring flows, all streams are seasonal, and any dispersing mussels are unlikely to survive the extended dry summer period. Therefore, significant populations are unlikely in the Survey Area.

The DBCA NatureMap search identifies that 185 vertebrate fauna taxa previously recorded within 20 km radius of the Survey Area. This total included 28 mammals, 113 birds, 32 reptiles and 12 amphibians.

The detailed and targeted program recorded 132 vertebrate fauna species utilising the Survey Area, including 28 mammals, 76 birds, 26 reptiles and seven amphibians. Off these, eight introduced species (mammals and birds) were identified.

Fire was observed to cause substantial impact to fauna habitats of the Survey Areas. Large areas of the Survey Area had been burnt within the last 2 to 3 years impacting fauna habitat. During the survey the north west portion of the Survey Area was prescribed burned in October 2020.

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Appendices

Appendix A

Map figures

Figure 1 Location of Survey Area

Figure 2 Environmental constraints

Figure 3 Fauna survey methods

Figure 4a Threatened fauna

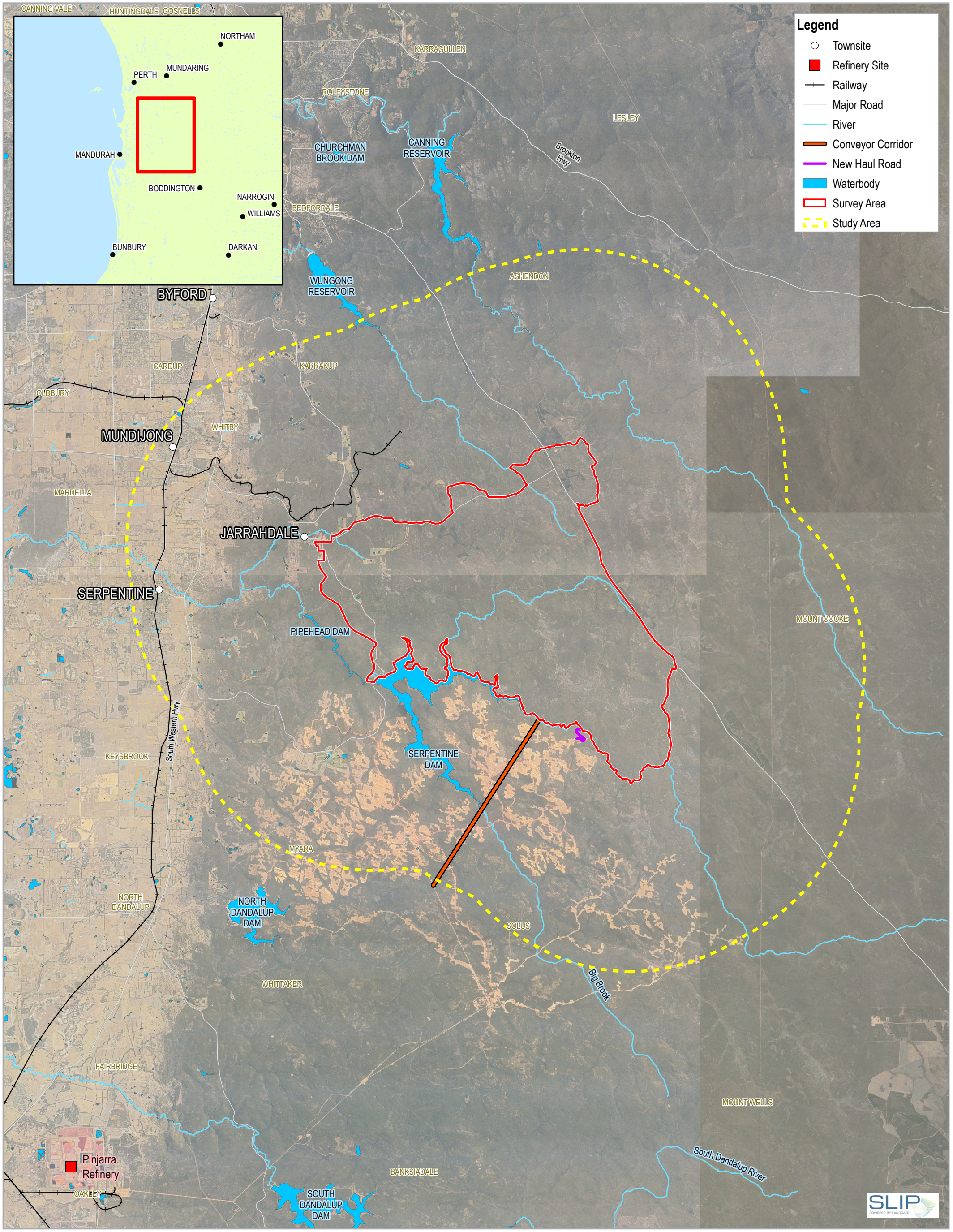
Figure 4b Forest Red tail black cockatoo recordings

Figure 4c Priority and other conservation dependent fauna

Figure 4d Black cockatoo results (*Calyptorhynchus spp.*)

Figure 5a Fauna habitats (Development Envelope)

Figure 5b Fauna habitats (Conveyor and Haul Road Corridor)



Paper Size ISO A3

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Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

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Alcoa of Australia Limited
Pinjarra Alumina Refinery Revised Proposal

Location of Survey Area

Project No. **12520591**
Revision No. **0**
Date **8/26/2021**

FIGURE 1

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CHURCHMAN BROOK DAM
CANNING RESERVOIR
WUNGONG RESERVOIR
Albany Hwy
Brookton Hwy
BYFORD
MUNDIJONG
SERPENTINE
PIPEHEAD DAM
SERPENTINE DAM
South Western Hwy

Legend

- Townsite

Fauna Conservation Categories

- Critically Endangered Species (CR)
- Endangered Species (EN)
- Vulnerable Species (VU)
- Species of Special Conservation Interest (CD)
- Other Specially Protected Species (OS)
- Priority 3 (P3)
- Priority 4 (P4)
- Railway
- River
- Conveyor Corridor
- New Haul Road
- Waterbody
- Survey Area
- Regional Ecological Linkage
- Environmentally Sensitive Area

DBCA Legislated Lands and Water

- Conservation Park
- National Park
- Nature Reserve
- State Forest
- Section 5(1)(g) Reserve
- Section 5(1)(h) Reserve

Vegetation Complex

- Cooke
- Darling Scarp
- Dwellingup
- Goonaping
- Helena 1
- Murray 1
- Pindalup
- Swamp
- Yalanbee
- Yarragil 1
- Yarragil 2

Vegetation Association

- 3
- 4
- 128
- 946
- 968
- 1000
- 1001

SLIP POWERED BY LANDGATE

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Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

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Alcoa of Australia Limited
Pinjarra Alumina Refinery Revised Proposal

Environmental Constraints

Project No. **12520591**
Revision No. **0**
Date **8/26/2021**

FIGURE 2

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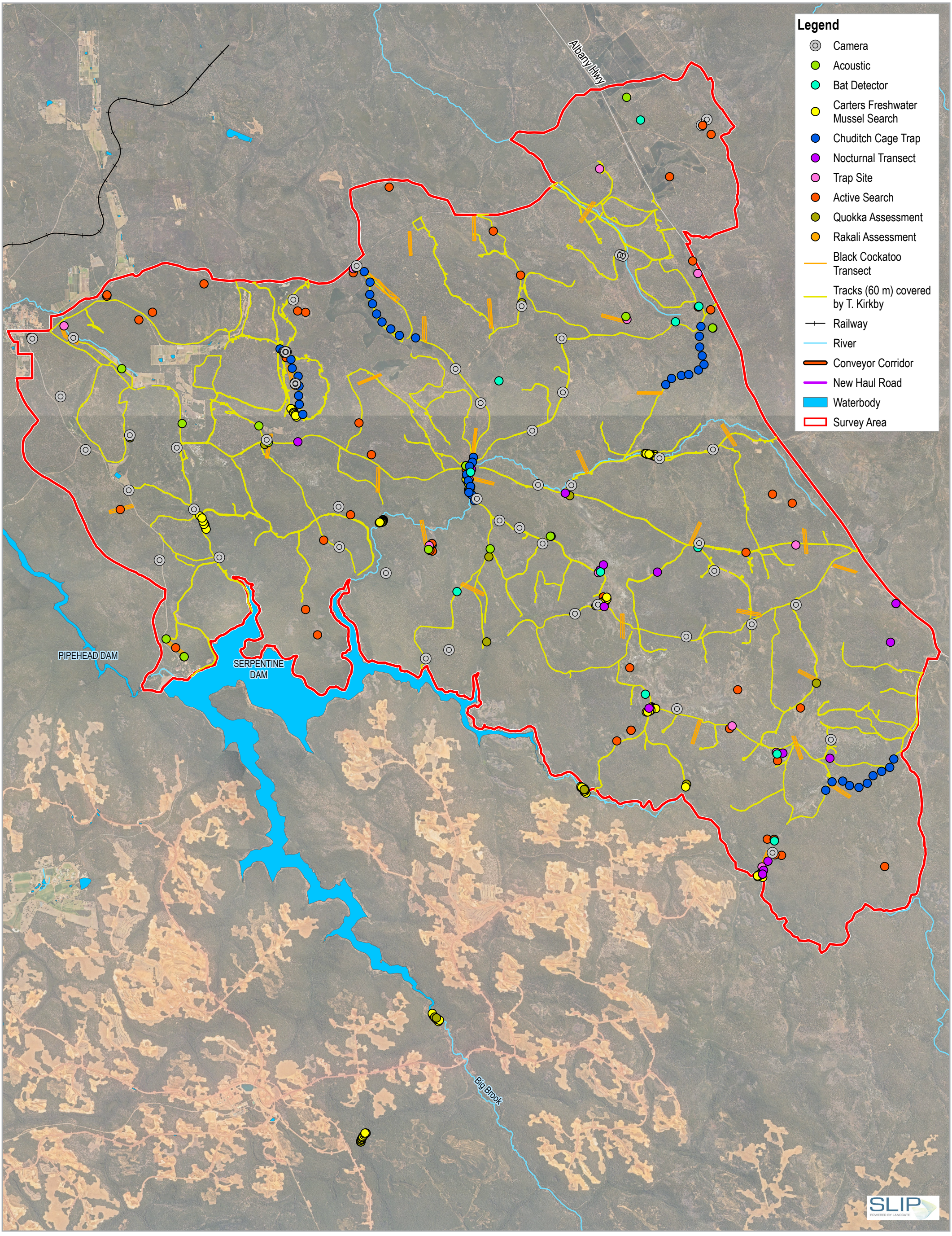
Data source: Myara North Boundary - 20200611; DBCA: Ecological Linkages, Environmentally Sensitive Areas - 20200710, Legislated Lands and Water - 20180606, Threatened and Priority Fauna - 20200612; DoW: Rivers, Reservoir - 2200221; Landgate: Locality - 20180319, Railway - 20190304, Roads - 20190128, WANow: Landgate / SLIP. Created by: htaniza



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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

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Alcoa of Australia Limited
Pinjarra Alumina Refinery Revised Proposal

Fauna Survey Methods

Project No. **12520591**
Revision No. **0**
Date **8/26/2021**

FIGURE 3

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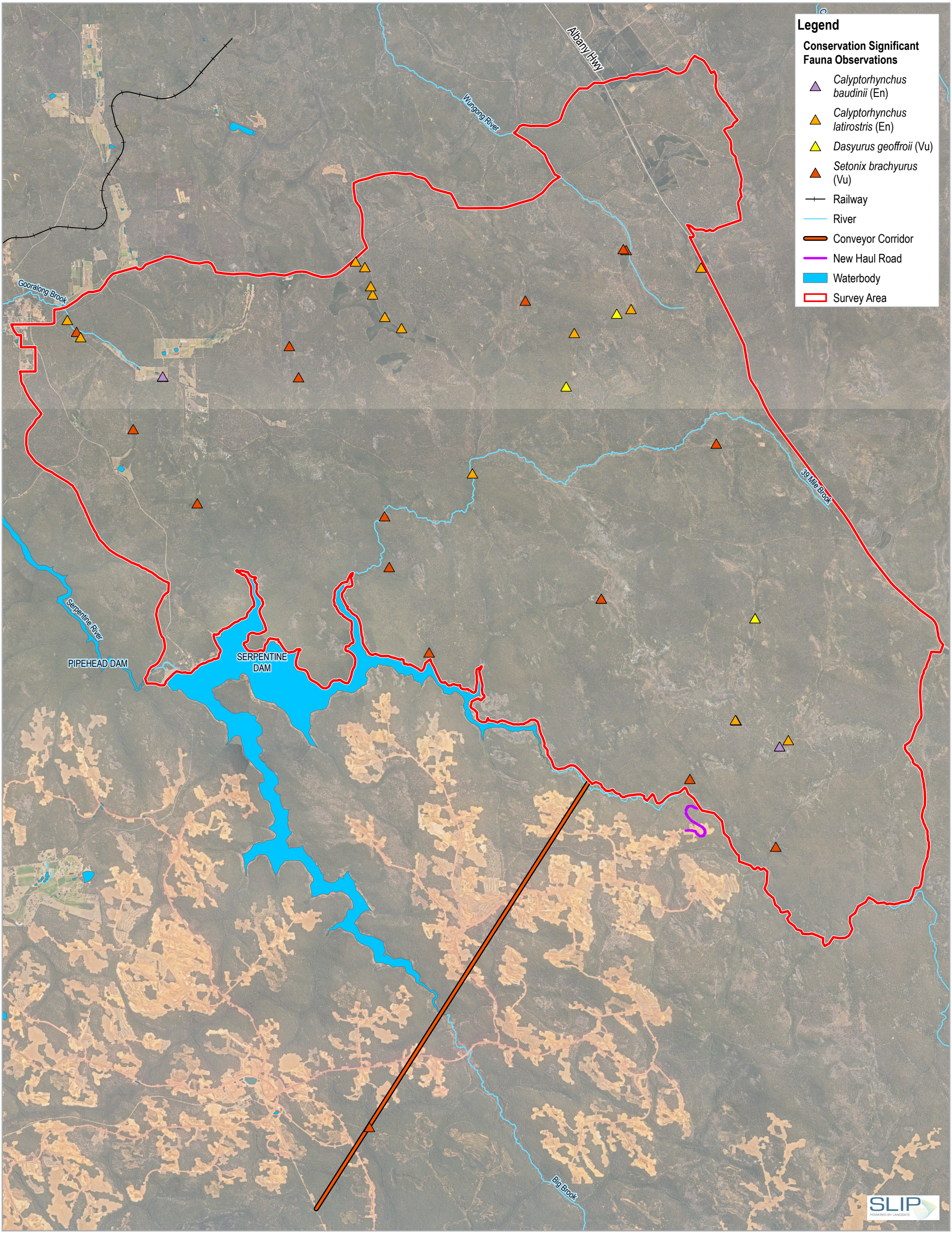

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Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

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Alcoa of Australia Limited
Pinjarra Alumina Refinery Revised Proposal

Threatened Fauna species

Project No. **12520591**
Revision No. **0**
Date **8/26/2021**

FIGURE 4A

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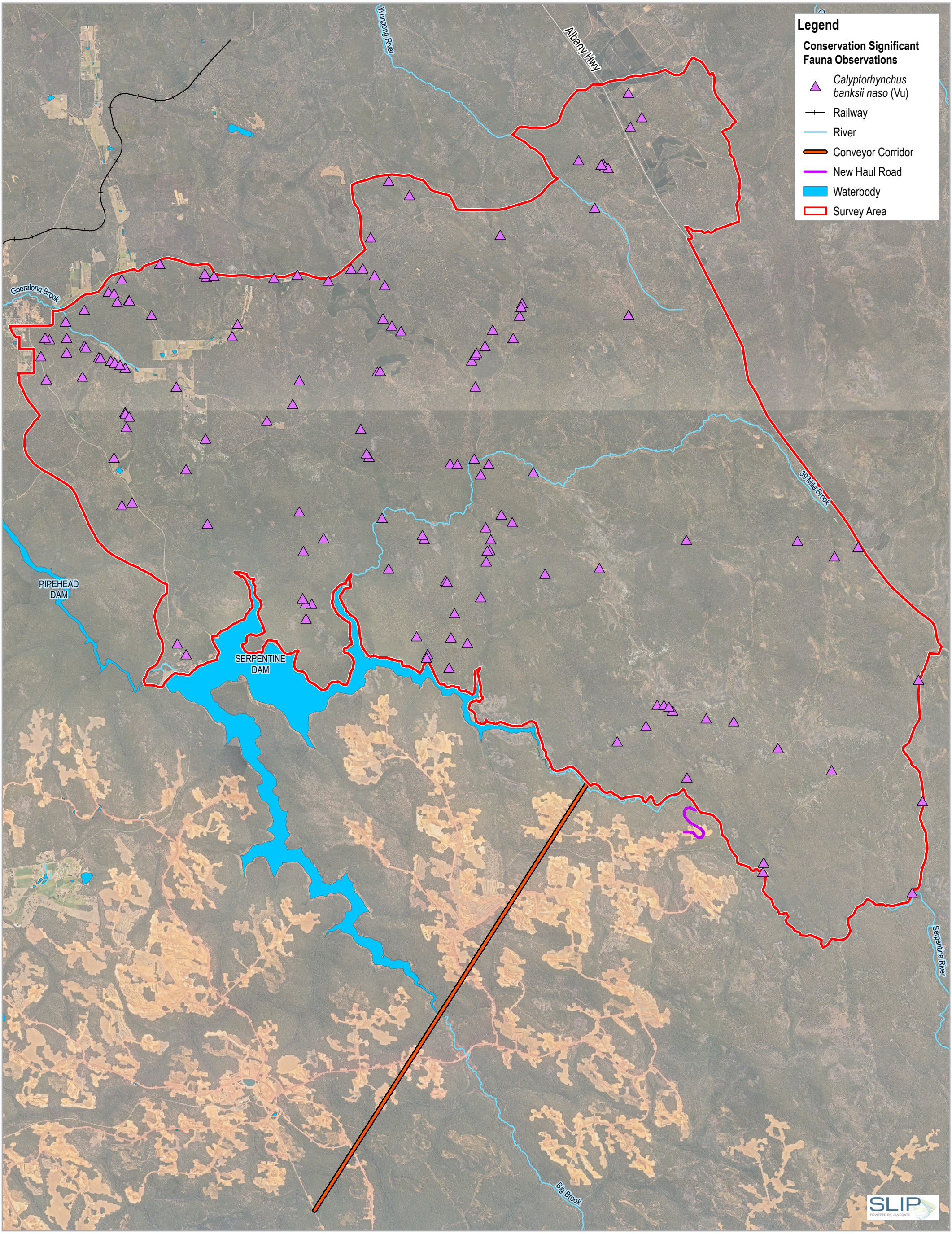

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Grid: GDA 1994 MGA Zone 50

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Alcoa of Australia Limited
Pinjarra Alumina Refinery Revised Proposal

Forest Red-tailed Black Cockatoo recordings

Project No. **12520591**
Revision No. **0**
Date **8/26/2021**

FIGURE 4B

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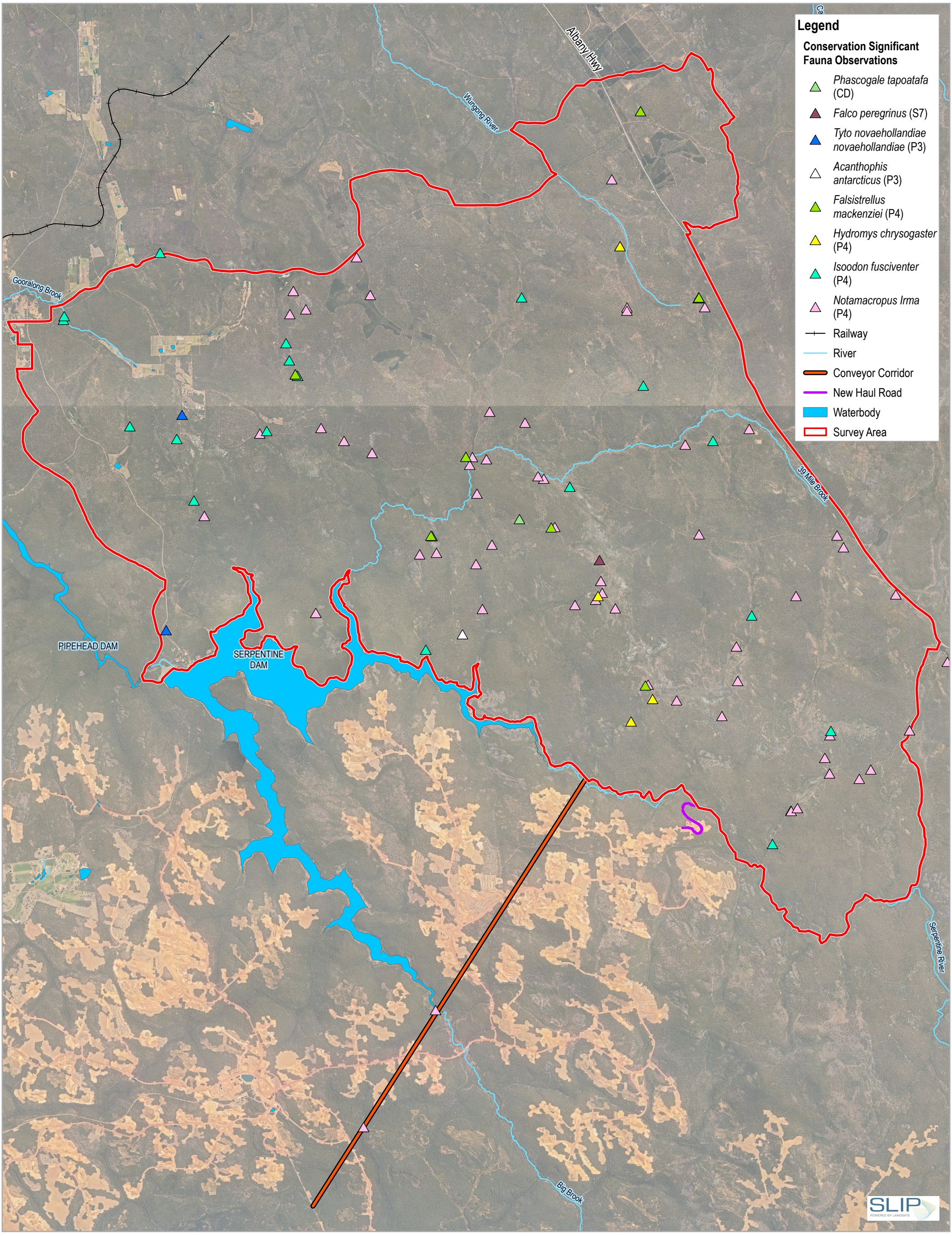

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Kilometres

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Grid: GDA 1994 MGA Zone 50

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Alcoa of Australia Limited
Pinjarra Alumina Refinery Revised Proposal

Priority and Other Conservation Dependent Fauna

Project No. **12520591**
Revision No. **0**
Date **8/26/2021**

FIGURE 4C

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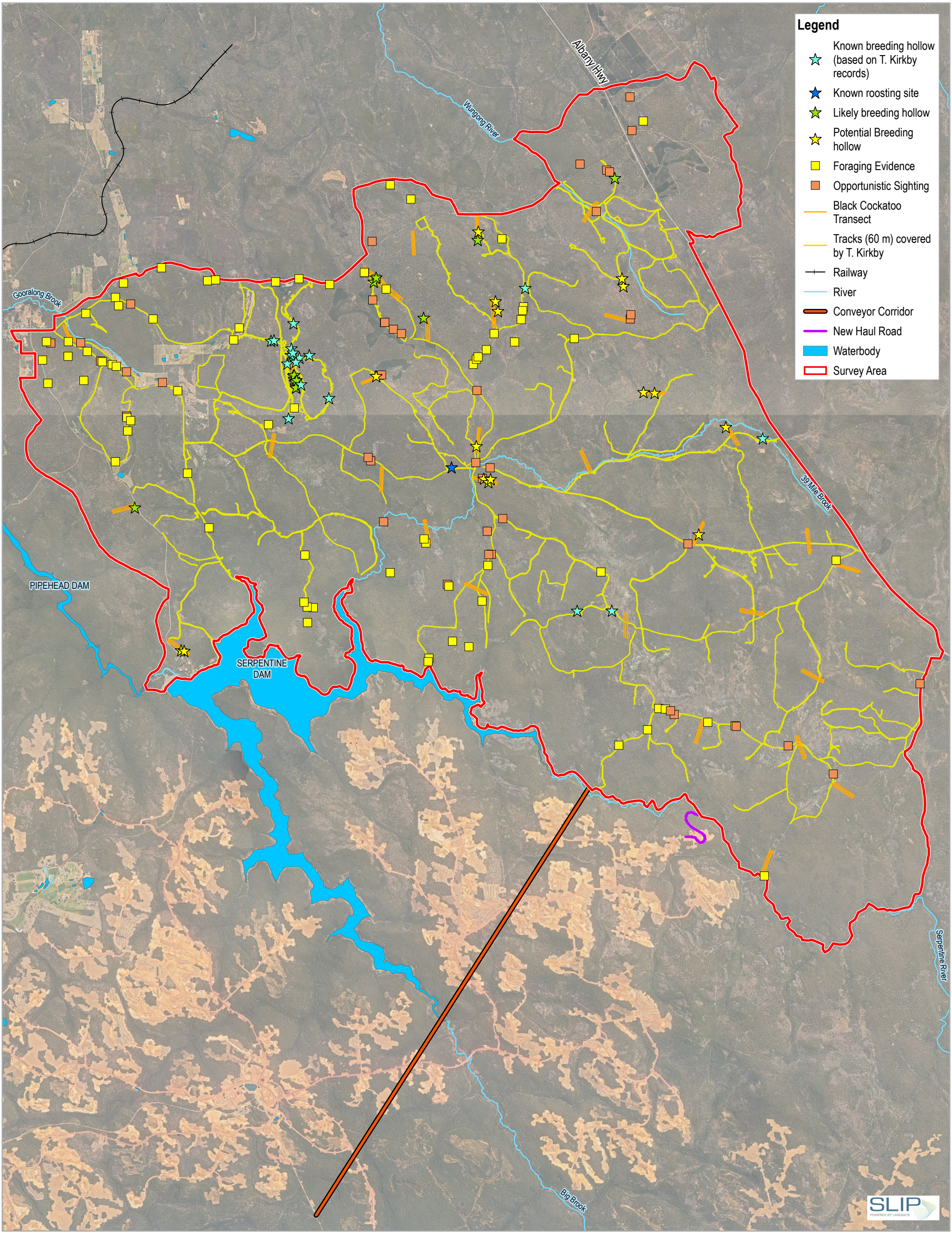

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Grid: GDA 1994 MGA Zone 50

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Alcoa of Australia Limited
Pinjarra Alumina Refinery Revised Proposal

Black Cockatoo Results (Calyptorhynchus species)

Project No. **12520591**
Revision No. **0**
Date **8/26/2021**

FIGURE 4D

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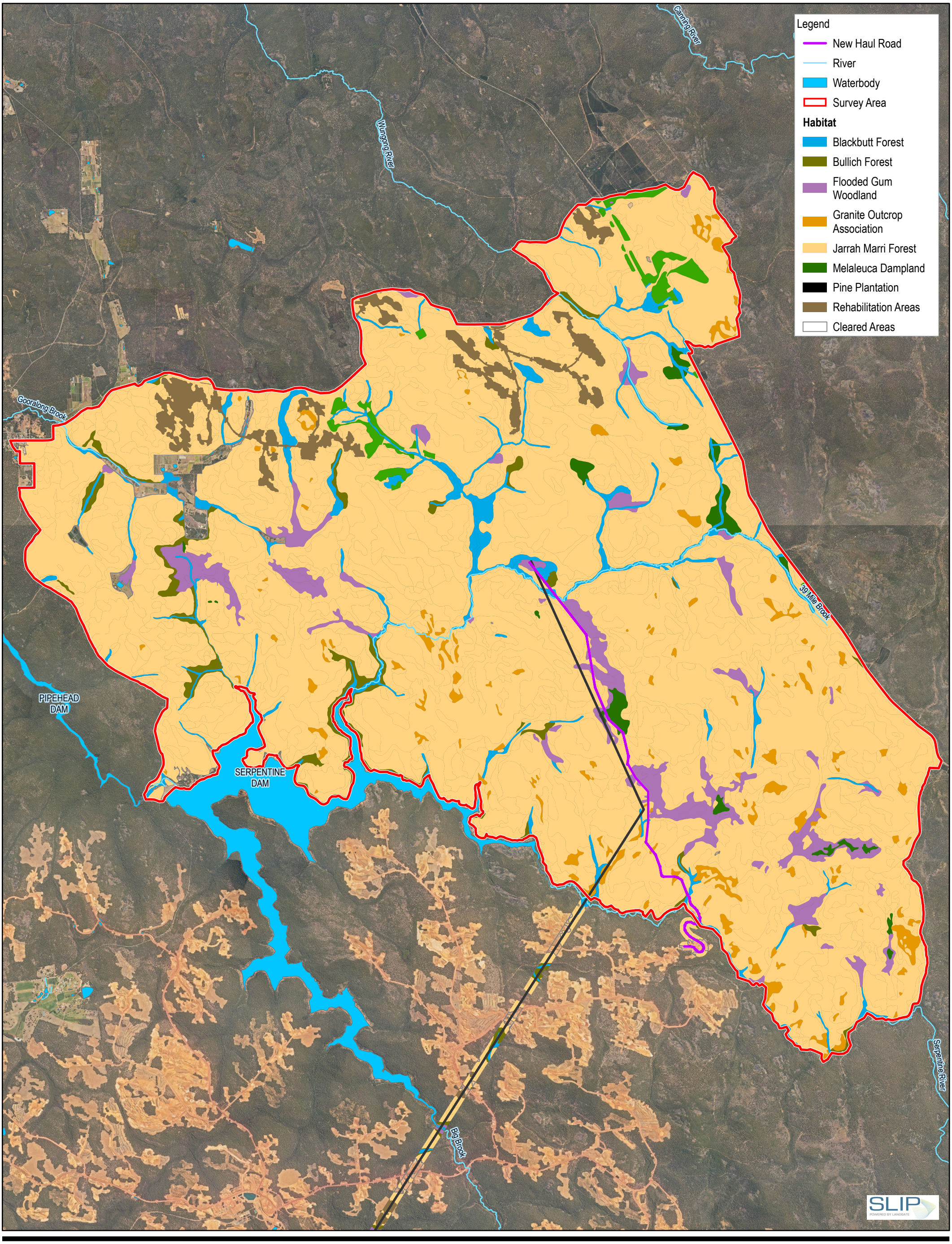

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Kilometres

Map Projection: Transverse Mercator
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Pinjarra Alumina Refinery Revised Proposal

Fauna Habitats (Development Envelope)

Project No. **12520591**
Revision No. **0**
Date **8/26/2021**

FIGURE 5A

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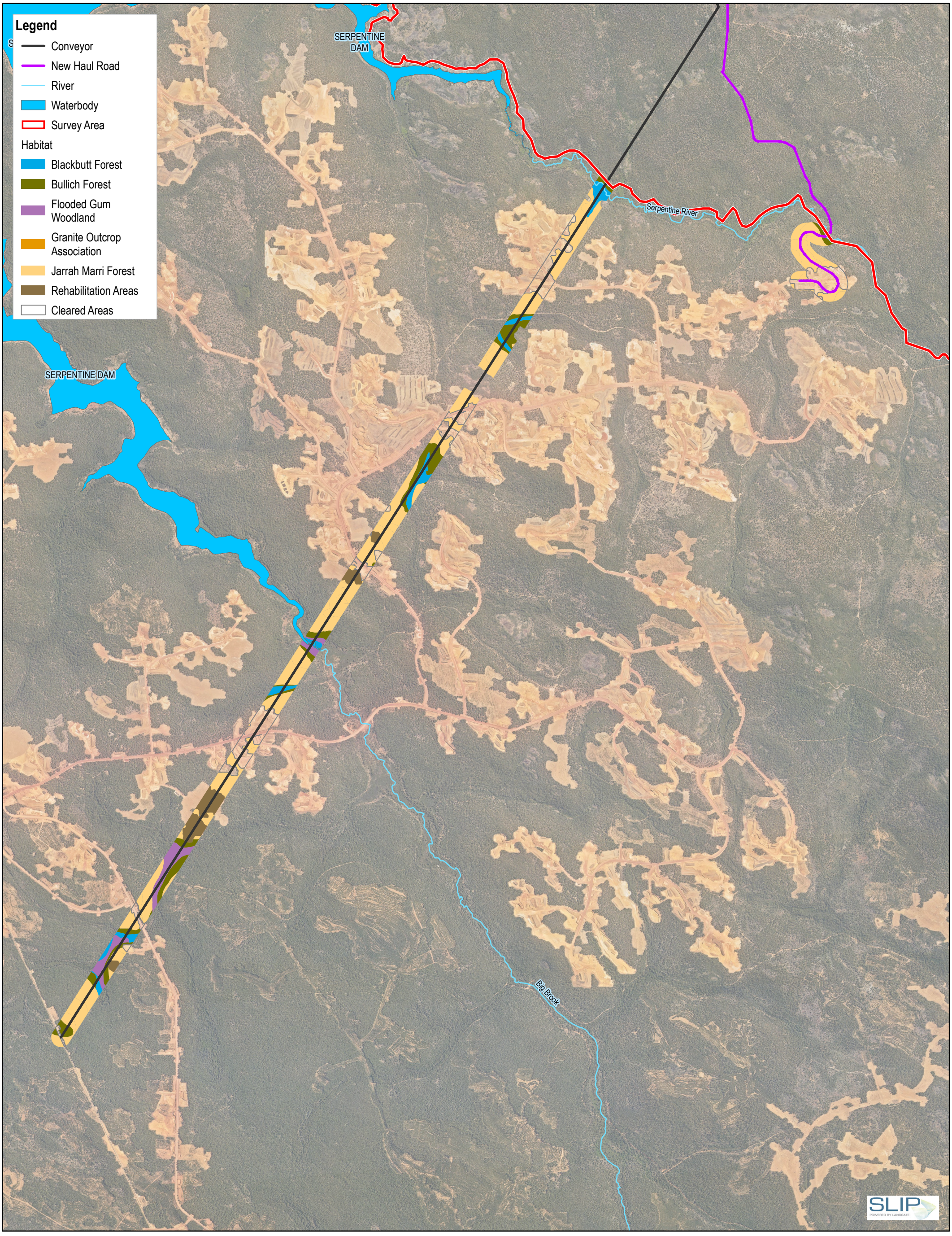

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Alcoa of Australia Limited
Pinjarra Alumina Refinery Revised Proposal

Fauna Habitats
(Conveyor and Haul Road Corridor)

Project No. **12520591**
Revision No. **0**
Date **8/26/2021**

FIGURE 5B

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Print date: 26 Aug 2021 - 18:09

Data source: Alcoa: Refinery Site - 20200221, Myara North Boundary - 20200611; DoW: Rivers, Reservoir - 2200221; Landgate: Locality - 20180319, Railway - 20190304, Roads - 20190128, WANow: Landgate / SLIP. Created by: htaniza

Appendix B

Relevant legislation, background information and conservation codes

Relevant legislation

Federal *Environment Protection and Biodiversity Conservation Act 1999*

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the Federal Government's central piece of environmental legislation. It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places, which are defined in the EPBC Act as Matters of National Environmental Significance (MNES).

The biological aspects listed as MNES include:

– Nationally threatened flora and fauna species and ecological communities
– Migratory species

A person must not undertake an action that has, will have, or is likely to have a significant impact (direct or indirect) on MNES, without approval from the Federal Minister for the Environment.

The EPBC Act is administered by the Department of the Environment and Energy (DEE).

State *Environment Protection Act 1986*

The *Environmental Protection Act 1986* (EP Act) is the primary legislative Act dealing with the protection of the environment in Western Australia. The Act allows the Environmental Protection Authority (EPA), to prevent, control and abate pollution and environmental harm, for the conservation, preservation, protection, enhancement and management of the environment and for matters incidental to or connected with the foregoing. Part IV of the EP Act is administered by the EPA and makes provisions for the EPA to undertake environmental impact assessment of significant proposals, strategic proposals and land use planning schemes.

The Department of Water and Environment Regulation (DWER) is responsible for administering the clearing provisions of the EP Act (Part V). Clearing of native vegetation in Western Australia requires a permit from the DWER, unless exemptions apply. Applications for clearing permits are assessed by the Department and decisions are made to grant or refuse the application in accordance with the Act. When making a decision the assessment considers clearing against the ten clearing principles as specified in Schedule 5 of the EP Act:

a. Native vegetation should not be cleared if it comprises a high level of biodiversity.
b. Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a significance habitat for fauna indigenous to Western Australia.
c. Native vegetation should not be cleared if it includes, or is necessary, for the continued existence of rare flora.
d. Native vegetation should not be cleared if it comprises the whole or part of native vegetation in an area that has been extensively cleared.
e. Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.
f. Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.
g. Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.
h. Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.
i. Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.

j. Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence of flooding.

Exemptions for clearing include clearing that is a requirement of a written law or authorised under certain statutory processes (listed in Schedule 6 of the EP Act) and exemptions for prescribed low impact day-to-day activities (prescribed in the Environmental Protection (Clearing of Native Vegetation) Regulations 2004); these exemptions do not apply in environmentally sensitive areas (ESAs).

State *Biodiversity and Conservation Act 2016*

The *Biodiversity Conservation Act 2016* (BC Act) provides for the conservation and protection of biodiversity and biodiversity components, as well as the promotion of the ecologically sustainable use of biodiversity components in Western Australia. The BC Act replaces both the repealed *Wildlife Conservation Act 1950* (WC Act) and the *Sandalwood Act 1929* (Sandalwood Act), as well as their associated regulations. To attain the objectives of the BC Act, principles of ecological sustainable development have been established:

– Decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations
– If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation
– The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations
– The conservation of biodiversity and ecological integrity should be a fundamental consideration indecision-making
– Improved valuation, pricing and incentive mechanisms should be promoted.

The BC Act is administered by the Department of Biodiversity Conservation and Attractions (DBCA).

State *Biosecurity and Agriculture Management Act 2007*

The *Biosecurity and Agriculture Management Act 2007* (BAM Act) and associated regulations are administered by the Department of Primary Industries and Regional Development (DPIRD) and replace the repealed *Agriculture and Related Resources Protection Act 1976*. The main purposes of the BAM Act and its regulations are to:

Prevent new animal and plant pests (vermin and weeds) and diseases from entering WA Manage the impact and spread of those pests already present in the state

Safely manage the use of agricultural and veterinary chemicals

Increased control over the sale of agricultural products that contain violative chemical residues.

The Western Australian Organism List (WAOL) provides the status of organisms which have been categorised under the BAM Act. A Declared Pest is a prohibited organism or an organism for which a declaration under Section 22(2) of the Act is in force. Declared Pests may be assigned a control category including: C1 (exclusion), C2 (eradication) and C3 (management). The category may apply to the whole of the State, LGAs, districts, individual properties or even paddocks, and all landholders are obliged to comply with the specific category of control. Categories of control are defined below.

DPIRD Categories for Declared Pests under the BAM Act

Control class code	Description
C1 (Exclusion)	Pests will be assigned to this category if they are not established in Western Australia and control measures are to be taken, including border checks, in order to prevent them entering and establishing in the State.
C2 (Eradication)	Pests will be assigned to this category if they are present in Western Australia in low enough numbers or in sufficiently limited areas that their eradication is still a possibility.
C3 (Management)	Pests will be assigned to this category if they are established in Western Australia but it is feasible, or desirable, to manage them in order to limit their damage. Control measures can prevent a C3 pest from increasing in population size or density or moving from an area in which it is established into an area which is currently is free of that pest.

Fauna Conservation codes

Conservation significant fauna

The Federal conservation level of fauna species and their significance status is assessed under the EPBC Act. The significance levels for fauna used in the EPBC Act align with the International Union for Conservation of Nature (IUCN) Red List criteria, which are internationally recognised as providing best practice for assigning the conservation status of species. The EPBC Act also protects land and migratory species that are listed under International Agreements. The list of migratory species established under section 209 of the EPBC Act comprises:

– Migratory species which are native to Australia and are included in the appendices to the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals Appendices I and II)
– Migratory species included in annexes established under the Japan-Australia Migratory Bird Agreement (JAMBA) and the China–Australia Migratory Bird Agreement (CAMBA)
– Native, migratory species identified in a list established under, or an instrument made under, an international agreement approved by the Minister, such as the republic of Korea–Australia Migratory Bird Agreement (ROKAMBA)

The State conservation level of fauna species and their significance status also follows the IUCN Red List criteria. Under the BC Act fauna can be listed as Threatened, Extinct and as Specially Protected species.

Threatened species are those are species which have been adequately searched for and are deemed to be, in the wild, either rare, under identifiable threat of extinction, or otherwise in need of special protection, and have been gazetted as such. The assessment of the conservation status of Threatened species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria. Specially protected species meet one or more of the following categories: species of special conservation interest; migratory species; cetaceans; species subject to international agreement; or species otherwise in need of special protection. Species that are listed as Threatened or Extinct species under the BC Act cannot also be listed as Specially Protected species.

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

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

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

For the purposes of this assessment, all species listed under the EPBC Act, BC Act and DBCA Priority species are considered conservation significant.

Conservation categories and definitions for EPBC Act and BC Act listed fauna species

Conservation category	Definition
Threatened species	
Critically Endangered (CR)	Threatened species considered to be "facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as critically endangered under section 19(1)(a) of the BC Act in accordance with criteria set out in section 20 and the ministerial guidelines.
Endangered (EN)	Threatened species considered to be "facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as endangered under section 19(1)(b) of the BC Act in accordance with the criteria set out in section 21 and the ministerial guidelines.
Vulnerable (VU)	Threatened species considered to be "facing a high risk of extinction in the wild in the medium term future as determined in accordance with criteria set out in the ministerial guidelines". Listed as vulnerable under section 19(1)(c) of the BC Act in accordance with the criteria set out in section 22 and the ministerial guidelines.
Extinct species	
Extinct (EX)	Species where "there is no reasonable doubt that the last member of the species has died", and listing is otherwise in accordance with the ministerial guidelines (section 24 of the BC Act).
Extinct in the Wild (EW)	Species that "is known only to survive in cultivation, in captivity or as a naturalized population well outside its past range, and it has not been recorded in its known habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its lifecycle and form", and listing is otherwise in accordance with the ministerial guidelines (section 25 of the BC Act).
Specially protected species	
Migratory (MI)	Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth; and listing is otherwise in accordance with the ministerial guidelines (section 15 of the BC Act). Includes birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and fauna subject to the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), an environmental treaty under the United Nations Environment Program. Migratory species listed under the BC Act are a subsetof the migratory animals, that are known to visit Western Australia, protected under the international agreements or treaties, excluding species that are listed as Threatened species.
Species of special conservation interest (conservation dependent fauna) (CD)	Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened.
Other specially protected fauna (OS)	Fauna otherwise in need of special protection to ensure their conservation, and listing is otherwise in accordance with the ministerial guidelines (section 18 of the BC Act).

Conservation codes for DBCA listed Priority fauna

Priority category	Definition
Priority 1	Poorly-known taxa Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.
Priority 2	Poorly-known taxa Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements andappear to be under threat from known threatening processes. Such species are in urgent need of further survey.
Priority 3	Poorly-known taxa Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.
Priority 4	Rare, Near Threatened and other taxa in need of monitoring Rare: Taxa that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could beif present circumstances change. These taxa are usually represented on conservation lands. Near Threatened. Taxa that are considered to have been adequately surveyed and that do not qualifyfor Conservation Dependent, but that are close to qualifying for Vulnerable. Taxa that have been removed from the list of threatened taxa during the past five years for reasonsother than taxonomy.

Other significant fauna

Fauna species may be significant for a range of reasons other than those protected by international agreement or treaty, Specially Protected or Priority Fauna. Significant fauna may include short-range endemic species, species that have declining populations or declining distributions, species at the extremes of their range, or isolated outlying populations, or species which may be undescribed (EPA 2010).

References

ANZECC 2000, *Core Environmental Indicators for Reporting on the State of Environment*, ANZECC State of the Environment Reporting Task Force.

Commonwealth of Australia 2001, *National Targets and Objectives for Biodiversity Conservation 2001–2005*, Canberra, AGPS.

EPA 2010, *Technical Guide – Terrestrial Fauna Surveys*, EPA, Perth, WA

Appendix C

Desktop searches

NatureMap Species Report

EPBC Act Protected Matter Search Tool Report

NatureMap
Mapping Western Australia's biodiversity

NatureMap Species Report

Created By Guest user on 18/06/2020

Kingdom	Animalia
Current Names Only	Yes
Core Datasets Only	Yes
Method	'By Circle'
Centre	116° 11' 35" E,32° 22' 24" S
Buffer	20km
Group By	Species Group

Species Group	Species	Records
Amphibian	12	235
Bird	115	5344
Fish	9	15
Invertebrate	360	1981
Mammal	30	509
Reptile	35	412
TOTAL	**561**	**8496**

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Amphibian					
1.	25398	*Crinia georgiana (Quacking Frog)*			
2.	25399	*Crinia glauerti (Clicking Frog)*			
3.	25400	*Crinia insignifera (Squelching Froglet)*			
4.	25401	*Crinia pseudinsignifera (Bleating Froglet)*			
5.	25404	*Geocrinia leai (Ticking Frog)*			
6.	25409	*Heleioporus barycragus (Hooting Frog)*			
7.	25410	*Heleioporus eyrei (Moaning Frog)*			
8.	25411	*Heleioporus inornatus (Whooping Frog)*			
9.	25415	*Limnodynastes dorsalis (Western Banjo Frog)*			
10.	25378	*Litoria adelaidensis (Slender Tree Frog)*			
11.	25426	*Neobatrachus pelobatoides (Humming Frog)*			
12.	25433	*Pseudophryne guentheri (Crawling Toadlet)*			
Bird					
13.	24260	*Acanthiza apicalis (Broad-tailed Thornbill, Inland Thornbill)*			
14.	24261	*Acanthiza chrysorrhoa (Yellow-rumped Thornbill)*			
15.	24262	*Acanthiza inornata (Western Thornbill)*			
16.	24560	*Acanthorhynchus superciliosus (Western Spinebill)*			
17.	25535	*Accipiter cirrocephalus (Collared Sparrowhawk)*			
18.	25536	*Accipiter fasciatus (Brown Goshawk)*			
19.	25755	*Acrocephalus australis (Australian Reed Warbler)*			
20.	25544	*Aegotheles cristatus (Australian Owlet-nightjar)*			
21.	24312	*Anas gracilis (Grey Teal)*			
22.	24316	*Anas superciliosa (Pacific Black Duck)*			
23.	47414	*Anhinga novaehollandiae (Australasian Darter)*			
24.	24561	*Anthochaera carunculata (Red Wattlebird)*			
25.	24562	*Anthochaera lunulata (Western Little Wattlebird)*			
26.	25670	*Anthus australis (Australian Pipit)*			
27.	24285	*Aquila audax (Wedge-tailed Eagle)*			
28.	24340	*Ardea novaehollandiae (White-faced Heron)*			
29.	24341	*Ardea pacifica (White-necked Heron)*			
30.	25566	*Artamus cinereus (Black-faced Woodswallow)*			
31.	24353	*Artamus cyanopterus (Dusky Woodswallow)*			
32.		*Barnardius zonarius*			
33.	24319	*Biziura lobata (Musk Duck)*			
34.	25714	*Cacatua pastinator (Western Long-billed Corella)*			
35.	24724	*Cacatua pastinator subsp. pastinator (Muir's Corella, Muir's Corella (Western Corella SW WA))*		S	
36.	25715	*Cacatua roseicapilla (Galah)*			
37.	25716	*Cacatua sanguinea (Little Corella)*			
38.	25598	*Cacomantis flabelliformis (Fan-tailed Cuckoo)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
39.	42307	*Cacomantis pallidus (Pallid Cuckoo)*			
40.	25717	*Calyptorhynchus banksii (Red-tailed Black-Cockatoo)*			
41.	24731	*Calyptorhynchus banksii subsp. naso (Forest Red-tailed Black Cockatoo)*		T	
42.	24733	*Calyptorhynchus baudinii (Baudin's Cockatoo, White-tailed Long-billed Black Cockatoo)*		T	
43.	24734	*Calyptorhynchus latirostris (Carnaby's Cockatoo, White-tailed Short-billed Black Cockatoo)*		T	
44.	48400	*Calyptorhynchus sp. (white-tailed black cockatoo)*		T	
45.	24321	*Chenonetta jubata (Australian Wood Duck, Wood Duck)*			
46.	25601	*Chrysococcyx lucidus (Shining Bronze Cuckoo)*			
47.	25675	*Colluricincla harmonica (Grey Shrike-thrush)*			
48.	25568	*Coracina novaehollandiae (Black-faced Cuckoo-shrike)*			
49.	25592	*Corvus coronoides (Australian Raven)*			
50.	25595	*Cracticus tibicen (Australian Magpie)*			
51.	25596	*Cracticus torquatus (Grey Butcherbird)*			
52.	30901	*Dacelo novaeguineae (Laughing Kookaburra)*	Y		
53.	25673	*Daphoenositta chrysoptera (Varied Sittella)*			
54.	25607	*Dicaeum hirundinaceum (Mistletoebird)*			
55.	24470	*Dromaius novaehollandiae (Emu)*			
56.		*Egretta novaehollandiae*			
57.		*Elanus axillaris*			
58.		*Eolophus roseicapillus*			
59.	25692	*Eopsaltria australis (Yellow Robin)*			
60.	24651	*Eopsaltria australis subsp. griseogularis (Western Yellow Robin)*			
61.	24652	*Eopsaltria georgiana (White-breasted Robin)*			
62.	25621	*Falco berigora (Brown Falcon)*			
63.	25622	*Falco cenchroides (Australian Kestrel, Nankeen Kestrel)*			
64.	25623	*Falco longipennis (Australian Hobby)*			
65.	25624	*Falco peregrinus (Peregrine Falcon)*		S	
66.	24616	*Falcunculus frontatus subsp. leucogaster (Western Shrike-tit, Crested Shrike-tit)*			
67.	25727	*Fulica atra (Eurasian Coot)*			
68.	42314	*Gavicalis virescens (Singing Honeyeater)*			
69.	25530	*Gerygone fusca (Western Gerygone)*			
70.	24443	*Grallina cyanoleuca (Magpie-lark)*			
71.	47965	*Hieraaetus morphnoides (Little Eagle)*			
72.	24491	*Hirundo neoxena (Welcome Swallow)*			
73.	24557	*Leipoa ocellata (Malleefowl)*		T	
74.	25661	*Lichmera indistincta (Brown Honeyeater)*			
75.		*Lophoictinia isura*			
76.	25650	*Malurus elegans (Red-winged Fairy-wren)*			
77.	24551	*Malurus pulcherrimus (Blue-breasted Fairy-wren)*			
78.	25654	*Malurus splendens (Splendid Fairy-wren)*			
79.	25758	*Megalurus gramineus (Little Grassbird)*			
80.	47997	*Melanodryas cucullata (Hooded Robin)*			
81.	25663	*Melithreptus brevirostris (Brown-headed Honeyeater)*			
82.	24587	*Melithreptus chloropsis (Western White-naped Honeyeater)*			
83.	24598	*Merops ornatus (Rainbow Bee-eater)*			
84.		*Microcarbo melanoleucos*			
85.	25693	*Microeca fascinans (Jacky Winter)*			
86.	24738	*Neophema elegans (Elegant Parrot)*			
87.	25564	*Nycticorax caledonicus (Rufous Night Heron)*			
88.	24407	*Ocyphaps lophotes (Crested Pigeon)*			
89.	25680	*Pachycephala rufiventris (Rufous Whistler)*			
90.	25681	*Pardalotus punctatus (Spotted Pardalote)*			
91.	24625	*Pardalotus punctatus subsp. punctatus (Spotted Pardalote)*			
92.	25682	*Pardalotus striatus (Striated Pardalote)*			
93.	24630	*Pardalotus striatus subsp. westraliensis (Striated Pardalote)*			
94.	48061	*Petrochelidon nigricans (Tree Martin)*			
95.	48066	*Petroica boodang (Scarlet Robin)*			
96.	24659	*Petroica goodenovii (Red-capped Robin)*			
97.	24409	*Phaps chalcoptera (Common Bronzewing)*			
98.	25587	*Phaps elegans (Brush Bronzewing)*			
99.	48071	*Phylidonyris niger (White-cheeked Honeyeater)*			
100.	24596	*Phylidonyris novaehollandiae (New Holland Honeyeater)*			
101.	25720	*Platycercus icterotis (Western Rosella)*			
102.	24745	*Platycercus icterotis subsp. icterotis (Western Rosella)*			
103.	24747	*Platycercus spurius (Red-capped Parrot)*			
104.	25721	*Platycercus zonarius (Australian Ringneck, Ring-necked Parrot)*			
105.	25703	*Podargus strigoides (Tawny Frogmouth)*			
106.	25722	*Polytelis anthopeplus (Regent Parrot)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
107.	25731	*Porphyrio porphyrio (Purple Swamphen)*			
108.	24771	*Porzana tabuensis (Spotless Crake)*			
109.	24702	*Pterodroma brevirostris (Kerguelen Petrel)*			
110.		*Purpureicephalus spurius*			
111.	48096	*Rhipidura albiscapa (Grey Fantail)*			
112.	25614	*Rhipidura leucophrys (Willie Wagtail)*			
113.	25534	*Sericornis frontalis (White-browed Scrubwren)*			
114.	30948	*Smicrornis brevirostris (Weebill)*			
115.	24645	*Stagonopleura oculata (Red-eared Firetail)*			
116.	25597	*Strepera versicolor (Grey Currawong)*			
117.	25589	*Streptopelia chinensis (Spotted Turtle-Dove)*	Y		
118.	25590	*Streptopelia senegalensis (Laughing Turtle-Dove)*	Y		
119.	25705	*Tachybaptus novaehollandiae (Australasian Grebe, Black-throated Grebe)*			
120.	24331	*Tadorna tadornoides (Australian Shelduck, Mountain Duck)*			
121.	24845	*Threskiornis spinicollis (Straw-necked Ibis)*			
122.	25549	*Todiramphus sanctus (Sacred Kingfisher)*			
123.	25723	*Trichoglossus haematodus (Rainbow Lorikeet)*			
124.	48147	*Turnix varius (Painted Button-quail)*			
125.	25764	*Tyto novaehollandiae (Masked Owl)*			
126.	24855	*Tyto novaehollandiae subsp. novaehollandiae (Masked Owl (southwest))*		P3	
127.	25765	*Zosterops lateralis (Grey-breasted White-eye, Silvereye)*			

Fish

128.		*? ?*			
129.		*Acentrogobius bifrenatus*			
130.		*Aldrichetta forsteri*			
131.		*Bostockia porosa*			
132.	34028	*Galaxias occidentalis (Western Minnow)*			
133.	34030	*Geotria australis (Pouched Lamprey)*		P3	
134.		*Nannoperca vittata*			
135.		*Neosilurus hyrtlii*			
136.		*Tandanus bostocki*			

Invertebrate

137.		*Acariformes sp.*			
138.		*Acritoptila margaretae*			
139.		*Acritoptila sp.*			
140.		*Adoxotoma chionopogon*			
141.		*Adoxotoma embolica*			Y
142.		*Adoxotoma nitida*			Y
143.		*Adversaeschna brevistyla*			
144.		*Aeshnidae sp.*			
145.		*Agraptocorixa sp.*			
146.		*Ainudrilus nharna*			
147.		*Allodessus bistrigatus*			
148.		*Allothereua maculata*			
149.		*Alotanypus dalyupensis*			
150.		*Ambicodamus marae*			
151.		*Amblyomma triguttatum*			
152.		*Aname mainae*			
153.		*Aname tepperi*			
154.		*Anax papuensis*			
155.		*Anisops hackeri*			
156.		*Anisops hyperion*			
157.		*Antiporus gilberti*			
158.		*Antiporus sp.*			
159.		*Arachnura higginsi*			
160.		*Araneus amblycyphus*			Y
161.		*Araneus cyphoxis*			
162.		*Araneus eburneiventris*			
163.		*Araneus eburnus*			
164.		*Araneus senicaudatus*			
165.		*Araneus stolidus*			
166.		*Archaeosynthemis occidentalis*			
167.		*Archaeosynthemis spiniger*			
168.		*Archiargiolestes pusillus*			
169.		*Archichauliodes sp.*			
170.		*Argiope trifasciata*			
171.		*Arkys alticephala*			
172.		*Arkys walckenaeri*			
173.		*Arrenuridae sp.*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
174.		*Artoria flavimana*			
175.		*Artoria flavimanus*			
176.		*Artoria schizocoides*			
177.		*Artoria taeniifera*			
178.		*Asadipus kunderang*			
179.		*Athericidae sp.*			
180.		*Aturidae sp.*			
181.		*Austracantha minax*			
182.		*Australomimetus aurioculatus*			
183.		*Australomimetus dunlopi*			
184.		*Australomimetus ovidi*			
185.		*Australopelopia prionoptera*			
186.		*Australotiphys barmutai*			
187.		*Austroagrion coeruleum*			
188.		*Austrochthonius muchmorei*			
189.		*Austrogomphus collaris*			
190.		*Austrolestes analis*			
191.		*Austrosynthemis cyanitincta*			
192.		*Backobourkia brounii*			
193.		*Backobourkia heroine*			
194.		*Baiami volucripes*			
195.		*Ballarra longipalpus*			
196.		*Berosus approximans*			
197.		*Berosus discolor*			
198.		*Bibulmena kadjina*			
199.		*Botryocladius bibulmun*			
200.		*Botryocladius freemani*			
201.		*Botryocladius petrophilus*			
202.		*Calanoida sp.*			
203.		*Carabidae sp.*			
204.		*Ceinidae sp.*			
205.		*Ceratopogonidae sp.*			
206.		*Cercophonius granulosus*			
207.		*Cercophonius sulcatus*			
208.		*Cethegus fugax*			
209.	33939	*Cherax cainii (Marron)*			
210.		*Cherax quinquecarinatus*			
211.		*Cheumatopsyche sp. AV2 (SAP)*			
212.		*Chironominae sp.*			
213.		*Chironomus aff. alternans (V24) (CB)*			
214.		*Chironomus tepperi*			
215.		*Chrysomelidae sp.*			
216.		*Cladocera (unident.)*			
217.		*Cladopelma curtivalva*			
218.		*Cladotanytarsus sp. A (SAP)*			
219.		*Cliotrombium antares*			Y
220.		*Cloeon sp.*			
221.		*Cloeon sp. 2 (SFM)*			
222.		*Clynotis albobarbatus*			
223.		*Clynotis severus*			
224.		*Coenagrionidae sp.*			
225.		*Condocerus aptus*			
226.		*Copepoda sp.*			
227.		*Corduliidae sp.*			
228.		*Corixidae sp.*			
229.		*Cormocephalus aurantiipes*			
230.		*Cormocephalus hartmeyeri*			
231.		*Cormocephalus michaelseni*			
232.		*Cormocephalus rubriceps*			
233.		*Cormocephalus turneri*			
234.		*Cricotopus 'brevicornis'*			
235.		*Cricotopus 'parbicinctus'*			
236.		*Crustulina bicruciata*			
237.		*Cryptochironomus aff griseidorsum*			
238.		*Cryptochironomus griseidorsum*			
239.		*Cryptoerithus melindae*			
240.		*Culicidae sp.*			
241.		*Curculionidae sp.*			
242.		*Cyclosa bacilliformis*			Y
243.		*Cyrtophora parnasia*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
244.		*Demadiana cerula*			
245.		*Diaprograpta striola*			
246.		*Dicrotendipes conjunctus*			
247.		*Dicrotendipes jobetus*			
248.		*Dicrotendipes pseudoconjunctus*			
249.		*Dicrotendipes sp.*			
250.		*Dicrotendipes sp. A (V47) (SAP)*			
251.		*Dinocambala ingens*			
252.		*Diplacodes bipunctata*			
253.		*Dolichopodidae sp.*			
254.		*Dytiscidae sp.*			
255.		*Ecnomina F group*			
256.		*Empididae sp.*			
257.		*Enchytraeidae sp.*			
258.		*Ephydridae sp.*			
259.		*Erigone prominens*			
260.		*Eriophora biapicata*			
261.		*Ero aphana*			
262.		*Eucyrtops latior*			
263.	48579	*Euoplos inornatus (inornate trapdoor spider (northern Jarrah Forest))*		P3	
264.		*Exocelina ater*			
265.		*Geogarypus taylori*			
266.	34114	*Glacidorbis occidentalis (Jarrah forest freshwater snail, freshwater snail)*		P3	
267.		*Gomphidae sp.*			
268.		*Gripopterygidae sp.*			
269.		*Gymnometriocnemus sp. 1 (=V44 = ortho sp. C & R)*			
270.		*Gyrinidae sp.*			
271.		*Halacaridae sp.*			
272.		*Haliplidae sp.*			
273.		*Haliplus fuscatus*			
274.		*Haliplus gibbus*			
275.		*Haliplus sp.*			
276.		*Harrisius sp. A (SAP)*			
277.		*Harrisius sp. B (SFM)*			
278.		*Hellyethira litua*			
279.		*Hellyethira sp.*			
280.		*Helochares tenuistriatus*			
281.		*Hemicordulia australiae*			
282.		*Hemicordulia tau*			
283.		*Henicops dentatus*			
284.		*Hirudinea sp.*			
285.		*Histiosoma feroniarum*			Y
286.		*Hogna crispipes*			
287.		*Holoplatys dejongi*			
288.		*Hyderodes sp.*			
289.		*Hydrobiosella michaelseni*			
290.		*Hydrobiosidae sp.*			
291.		*Hydrodromidae sp.*			
292.		*Hydrophilidae sp.*			
293.		*Hydroptila losida*			
294.		*Hydroptilidae sp.*			
295.		*Hydryphantidae sp.*			
296.		*Hygrobatidae sp.*			
297.		*Hyphydrus elegans*			
298.		*Hypomegalopsalis tanisphyros*			
299.		*Idiommata blackwalli*			
300.		*Isometroides vescus*			
301.		*Isopeda leishmanni*			
302.		*Karaops ellenae*			
303.		*Kiefferulus intertinctus*			
304.		*Kiefferulus martini*			
305.		*Lampona brevipes*			
306.		*Lampona yanchep*			
307.		*Lamponella ainslie*			
308.		*Lamponusa gleneagle*			
309.		*Lancetes lanceolatus*			
310.		*Laperousea blattifera*			
311.		*Larsia albiceps*			
312.		*Latrodectus hasseltii*			
313.		*Lectrides parilis*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
314.		*Lepidoptera (non-pyralid)*			
315.		*Leptoceridae sp.*			
316.		*Leptoperla australica*			
317.		*Leptophlebiidae sp.*			
318.		*Lestidae sp.*			
319.		*Limbodessus inornatus*			
320.		*Limbodessus shuckhardi*			
321.		*Limnesiidae sp.*			
322.		*Limnophyes vestitus (V41)*			
323.		*Limnoxenus zelandicus*			
324.		*Longepi woodman*			
325.		*Longrita insidiosa*			
326.		*Lopescladius? V35 (=SO3 sp. D)*			
327.		*Lycosa ariadnae*			
328.		*Macrogyrus angustatus*			
329.		*Macrogyrus sp.*			
330.		*Maratus pavonis*			
331.		*Maydenoptila baynesi*			
332.		*Maydenoptila sp.*			
333.		*Megaloptera sp.*			
334.		*Megapodagrionidae sp.*			
335.		*Megaporus sp.*			
336.		*Microctenonyx subitaneus*			
337.		*Micronecta gracilis*			
338.		*Micronecta robusta*			
339.		*Micronecta sp.*			
340.		*Missulena granulosa*			
341.		*Missulena hoggi*			
342.		*Missulena occatoria*			
343.		*Mituliodon tarantulinus*			
344.		*Miturga agelenina*			Y
345.		*Miturga catograpta*			
346.		*Molycria quadricauda*			
347.		*Muscidae sp.*			
348.		*Muziris carinatus*			
349.		*Myandra bicincta*			
350.		*Naididae sp.*			
351.		*Necterosoma darwini*			
352.		*Necterosoma penicillatus*			
353.		*Necterosoma regulare*			
354.		*Necterosoma sp.*			
355.		*Nematoda sp.*			
356.		*Nemertini sp.*			
357.		*Neostorena vituperata*			Y
358.		*Nephila edulis*			
359.		*Newmanoperla exigua*			
360.		*Nicodamus mainae*			
361.		*Notalina nr. sp. AV14*			
362.		*Notalina sp. AV15 (PSW)*			
363.		*Notalina sp. AV17 (RCM)*			Y
364.		*Notalina spira*			
365.		*Notoperata sp. AV1 (SFM)*			
366.		*Notoperata tenax*			
367.		*Nousia sp. AV16*			
368.		*Novakiella trituberculosa*			
369.		*Nunciella aspera*			
370.		*Nunciella karriensis*			Y
371.		*Nyungara bunni*			
372.		*Occiperipatoides gilesii*			
373.		*Oecetis sp.*			
374.		*Oecobius putus*			
375.		*Offadens soror (ex genus 1 WA sp. 1)*			
376.		*Oligochaeta sp.*			
377.		*Oniscidae sp.*			
378.		*Opisthopora sp.*			
379.		*Oribatida sp.*			
380.		*Orthetrum caledonicum*			
381.		*Orthocladiinae 'woodminer' (SAP)*			
382.		*Orthocladiinae SO3 sp. A (SAP)*			
383.		*Orthocladiinae SO3 sp. C (V31) (SAP)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
384.		*Orthocladiinae sp.*			
385.		*Ostearius melanopygius*			
386.		*Ostracoda (unident.)*			
387.		*Oxidae sp.*			
388.		*Oxyethira sp.*			
389.		*Oxyopes gracilipes*			
390.		*Ozarchaea harveyi*			
391.		*Ozarchaea westraliensis*			
392.		*Parachironomus sp. 1 (VSCL35) (SAP)*			
393.		*Paracladopelma M1 [SFM)*			
394.		*Paracymus pygmaeus*			
395.		*Parakiefferiella sp. S1*			
396.		*Parakiefferiella variegatus*			
397.		*Paralampona marangaroo*			
398.		*Paralimnophyes pullulus (V42)*			
399.		*Paramelitidae sp.*			
400.		*Paramerina levidensis*			
401.		*Paraplatoides nigrum*			
402.		*Parastacidae sp.*			
403.		*Penemideopsis pusilla*			Y
404.		*Pentaneurini genus V20*			
405.		*Pentasteron securifer*			
406.		*Perthiidae sp.*			
407.		*Phenasteron longiconductor*			
408.		*Phreodrilidae sp.*			
409.		*Phryganoporus nigrinus*			
410.		*Pinkfloydia harveii*			
411.		*Planorbidae sp.*			
412.		*Platorish gelorup*			
413.		*Platynectes sp.*			
414.		*Podonomopsis sp. 1*			
415.		*Poecilipta smaragdinea*			
416.		*Polypedilum nr. convexum (SAP)*			
417.		*Polypedilum nubifer*			
418.		*Polypedilum watsoni*			
419.		*Prionosternum nitidiceps*			
420.		*Prionosternum scutatum*			
421.		*Procladius DEC sp. P1 (formerly P.paludicola P1 no U-claws)*			
422.		*Procladius paludicola*			
423.		*Procladius sp.*			
424.		*Procordulia affinis*			
425.		*Pseudolampona jarrahdale*			
426.		*Pyralidae sp.*			
427.		*Raveniella cirrata*			
428.		*Raveniella peckorum*			
429.		*Rhantus suturalis*			
430.		*Rheotanytarsus juliae*			
431.		*Rheotanytarsus sp. (SFM)*			
432.		*Rheotanytarsus trivittatus*			
433.		*Rheotanytarsus underwoodi*			
434.		*Riekoperla occidentalis*			
435.		*Riethia v4*			
436.		*Riethia v5*			
437.		*Sandalodes scopifer*			
438.		*Scirtidae sp.*			
439.		*Scolopendra laeta*			
440.		*Sellnickiella biunguiculata*			
441.		*Simaetha thoracica*			Y
442.		*Simuliidae sp.*			
443.		*Siphonotus michaelseni*			Y
444.		*Skusella/"V12 ex-WA" (Cranston)*			
445.		*Sondra aurea*			
446.		*Sondra tristicula*			
447.		*Sternopriscus browni*			
448.		*Sternopriscus marginatus*			
449.		*Sternopriscus minimus*			
450.		*Sternopriscus sp.*			
451.		*Stictocladius occidentalis*			
452.		*Storena formosa*			
453.		*Storosa tetrica*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
454.		*Stratiomyidae sp.*			
455.		*Supunna funerea*			
456.		*Supunna picta*			
457.		*Symphytognatha picta*			
458.		*Synothele harveyi*			
459.		*Synothele longbottomi*			
460.		*Synothele michaelseni*			
461.		*Synsphyronus mimulus*			
462.		*Synthemistidae sp.*			
463.		*Tabanidae sp.*			
464.		*Tamopsis darlingtoniana*			
465.		*Tamopsis distinguenda*			
466.		*Tamopsis perthensis*			
467.		*Tanypodinae sp.*			
468.		*Tanytarsus aff manleyensis*			
469.		*Tanytarsus b1*			
470.		*Tanytarsus fuscithorax/semibarbitarsus*			
471.		*Tanytarsus nr K5*			
472.		*Tanytarsus palmatus*			
473.		*Tanytarsus sp. I (SAP)*			
474.		*Taschorema pallescens*			
475.		*Tasmanicosa leuckartii*			
476.		*Tasmanocoenis tillyardi*			
477.		*Temnocephalidea sp.*			
478.		*Tetragnatha maeandrata*			Y
479.		*Tetragnatha valida*			
480.		*Thienemanniella sp. (V19) (SAP)*			
481.		*Tinytrema yarra*			
482.		*Tipulidae sp.*			
483.		*Trachycosmus sculptilis*			
484.		*Trachytrema castaneum*			
485.		*Triplectides australis*			
486.		*Triplectides sp. AV1 (SFM)*			
487.		*Triplectides sp. AV21 (SFM)*			
488.		*Turbellaria sp.*			
489.		*Urodacus novaehollandiae*			
490.		*Urodacus planimanus*			
491.		*Venator immansueta*			
492.	34113	*Westralunio carteri (Carter's Freshwater Mussel)*		T	
493.		*Westrarchaea spinosa*			
494.		*Wheenyoides cooki*			
495.		*Xanthagrion erythroneurum*			
496.		*Zebraplatys fractivittata*			

Mammal

497.	25449	*Antechinus flavipes (Yellow-footed Antechinus)*			
498.	24088	*Antechinus flavipes subsp. leucogaster (Yellow-footed Antechinus, Mardo)*			
499.	47713	*Austronomus australis (White-striped Free-tailed Bat)*			
500.	24162	*Bettongia penicillata subsp. ogilbyi (Woylie, Brush-tailed Bettong)*		T	
501.	24086	*Cercartetus concinnus (Western Pygmy-possum, Mundarda)*			
502.	24186	*Chalinolobus gouldii (Gould's Wattled Bat)*			
503.	24187	*Chalinolobus morio (Chocolate Wattled Bat)*			
504.	24092	*Dasyurus geoffroii (Chuditch, Western Quoll)*		T	
505.	24189	*Falsistrellus mackenziei (Western False Pipistrelle, Western Falsistrelle)*		P4	
506.	24041	*Felis catus (Cat)*	Y		
507.	24215	*Hydromys chrysogaster (Water-rat, Rakali)*		P4	
508.	48588	*Isoodon fusciventer (Quenda, southwestern brown bandicoot)*		P4	
509.	24132	*Macropus fuliginosus (Western Grey Kangaroo)*			
510.	24223	*Mus musculus (House Mouse)*	Y		
511.	24146	*Myrmecobius fasciatus (Numbat, Walpurti)*		T	
512.	48022	*Notamacropus irma (Western Brush Wallaby)*		P4	
513.	24194	*Nyctophilus geoffroyi (Lesser Long-eared Bat)*			
514.	24195	*Nyctophilus gouldi (Gould's Long-eared Bat)*			
515.	24085	*Oryctolagus cuniculus (Rabbit)*	Y		
516.	24166	*Pseudocheirus occidentalis (Western Ringtail Possum, ngwayir)*		T	
517.	24245	*Rattus rattus (Black Rat)*	Y		
518.	24145	*Setonix brachyurus (Quokka)*		T	
519.	24108	*Sminthopsis crassicaudata (Fat-tailed Dunnart)*			
520.	24111	*Sminthopsis gilberti (Gilbert's Dunnart)*			
521.	24207	*Tachyglossus aculeatus (Short-beaked Echidna)*			
522.	24167	*Tarsipes rostratus (Honey Possum, Noolbenger)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
523.	25521	*Trichosurus vulpecula (Common Brushtail Possum)*			
524.	24158	*Trichosurus vulpecula subsp. vulpecula (Common Brushtail Possum)*			
525.	24206	*Vespadelus regulus (Southern Forest Bat)*			
526.	24040	*Vulpes vulpes (Red Fox)*	Y		
Reptile					
527.	25242	*Acanthophis antarcticus (Southern Death Adder)*		P3	
528.	42368	*Acritoscincus trilineatus (Western Three-lined Skink)*			
529.	24990	*Aprasia pulchella (Granite Worm-lizard)*			
530.	24980	*Christinus marmoratus (Marbled Gecko)*			
531.	30893	*Cryptoblepharus buchananii*			
532.	25020	*Cryptoblepharus plagiocephalus*			
533.	24883	*Ctenophorus ornatus (Ornate Crevice-Dragon)*			
534.	24884	*Ctenophorus pictus (Painted Dragon)*			
535.	25035	*Ctenotus delli (Dell's skink, Darling Range southwest Ctenotus)*		P4	
536.	25047	*Ctenotus impar*			
537.	25049	*Ctenotus labillardieri*			
538.	25766	*Delma fraseri (Fraser's Legless Lizard)*			
539.	24939	*Diplodactylus polyophthalmus*			
540.	25096	*Egernia kingii (King's Skink)*			
541.	25100	*Egernia napoleonis*			
542.	25474	*Hemiergis initialis*			
543.	25115	*Hemiergis initialis subsp. initialis*			
544.	25131	*Lerista distinguenda*			
545.	25005	*Lialis burtonis*			
546.	41416	*Liopholis pulchra subsp. pulchra (South-western Rock Skink, Spectacled Rock Skink)*			
547.	25184	*Menetia greyii*			
548.	25240	*Morelia spilota subsp. imbricata (Carpet Python)*			
549.	25191	*Morethia lineoocellata*			
550.	25192	*Morethia obscura*			
551.	25253	*Parasuta gouldii*			
552.	25255	*Parasuta nigriceps*			
553.	25510	*Pogona minor (Dwarf Bearded Dragon)*			
554.	24907	*Pogona minor subsp. minor (Dwarf Bearded Dragon)*			
555.	25511	*Pseudonaja affinis (Dugite)*			
556.	25259	*Pseudonaja affinis subsp. affinis (Dugite)*			
557.	25203	*Tiliqua occipitalis (Western Bluetongue)*			
558.	25519	*Tiliqua rugosa*			
559.	24983	*Underwoodisaurus milii (Barking Gecko)*			
560.	25218	*Varanus gouldii (Bungarra or Sand Monitor)*			
561.	25225	*Varanus rosenbergi (Heath Monitor)*			

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

Australian Government
Department of the Environment and Energy

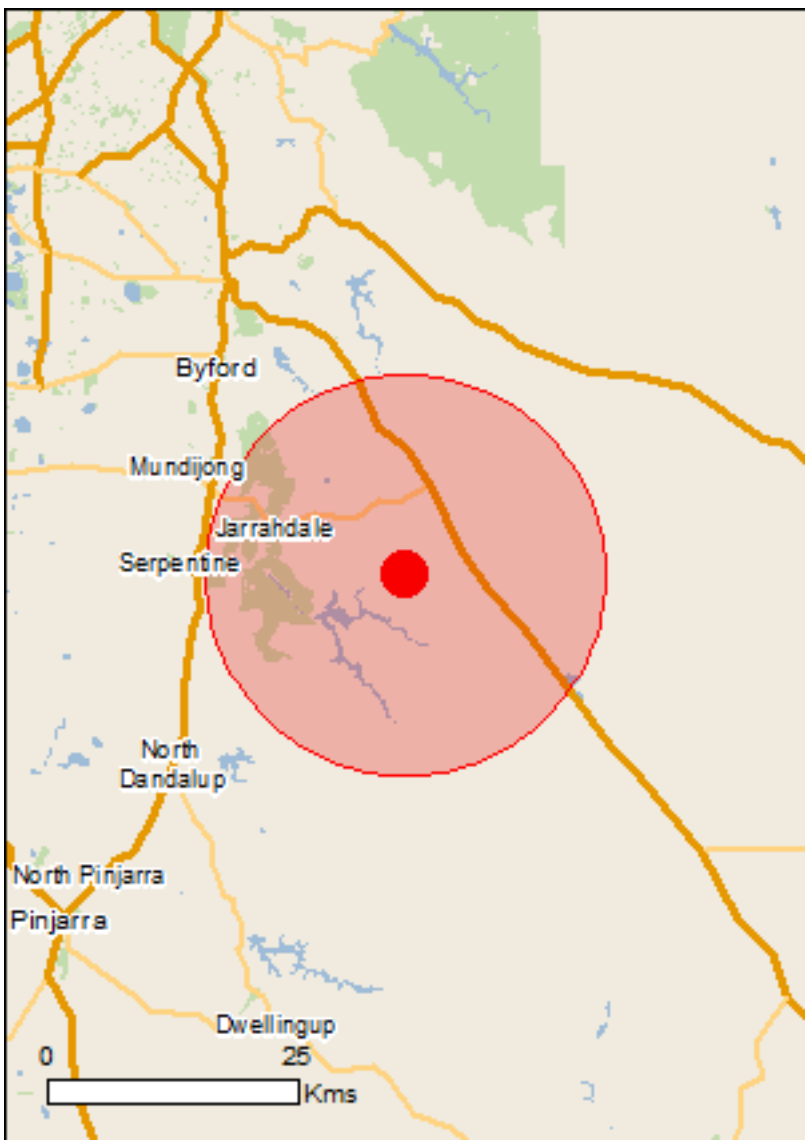
EPBC Act Protected Matters Report

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

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

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 18/06/20 15:49:43



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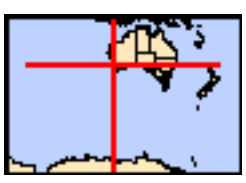
Coordinates
Buffer: 20.0Km



Summary

Matters of National Environmental Significance

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

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	1
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	2
Listed Threatened Species:	27
Listed Migratory Species:	8

Other Matters Protected by the EPBC Act

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

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

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

Commonwealth Land:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	14
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

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

State and Territory Reserves:	7
Regional Forest Agreements:	1
Invasive Species:	38
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar)	[Resource Information]
Name	Proximity
Peel-yalgorup system	20 - 30km upstream

Listed Threatened Ecological Communities		[Resource Information]

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

Name	Status	Type of Presence
	Critically Endangered	Community may occur within area
Banksia Woodlands of the Swan Coastal Plain ecological community	Endangered	Community likely to occur within area

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo, Karrak [67034]	Vulnerable	Species or species habitat known to occur within area
Calyptorhynchus baudinii Baudin's Cockatoo, Long-billed Black-Cockatoo [769]	Endangered	Breeding known to occur within area
Calyptorhynchus latirostris Carnaby's Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Species or species habitat known to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Mammals		
Bettongia penicillata ogilbyi Woylie [66844]	Endangered	Species or species habitat known to occur within area

Name	Status	Type of Presence
[Dasyurus geoffroii](#) Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat known to occur within area
[Pseudocheirus occidentalis](#) Western Ringtail Possum, Ngwayir, Womp, Woder, Ngoor, Ngoolangit [25911]	Critically Endangered	Species or species habitat may occur within area
[Setonix brachyurus](#) Quokka [229]	Vulnerable	Species or species habitat known to occur within area
Other		
[Westralunio carteri](#) Carter's Freshwater Mussel, Freshwater Mussel [86266]	Vulnerable	Species or species habitat known to occur within area
Plants		
[Anthocercis gracilis](#) Slender Tailflower [11103]	Vulnerable	Species or species habitat may occur within area
[Diuris micrantha](#) Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat known to occur within area
[Diuris purdiei](#) Purdie's Donkey-orchid [12950]	Endangered	Species or species habitat likely to occur within area
[Drakaea elastica](#) Glossy-leafed Hammer Orchid, Glossy-leaved Hammer Orchid, Warty Hammer Orchid [16753]	Endangered	Species or species habitat likely to occur within area
[Eleocharis keigheryi](#) Keighery's Eleocharis [64893]	Vulnerable	Species or species habitat may occur within area
[Eucalyptus x balanites](#) Cadda Road Mallee, Cadda Mallee [87816]	Endangered	Species or species habitat may occur within area
[Grevillea flexuosa](#) Zig Zag Grevillea [2957]	Vulnerable	Species or species habitat likely to occur within area
[Lasiopetalum pterocarpum](#) Wing-fruited Lasiopetalum [64922]	Endangered	Species or species habitat known to occur within area
[Synaphea sp. Fairbridge Farm (D. Papenfus 696)](#) Selena's Synaphea [82881]	Critically Endangered	Species or species habitat likely to occur within area
[Synaphea sp. Serpentine (G.R. Brand 103)](#) [86879]	Critically Endangered	Species or species habitat may occur within area
[Tetraria australiensis](#) Southern Tetraria [10137]	Vulnerable	Species or species habitat likely to occur within area
[Thelymitra dedmaniarum](#) Cinnamon Sun Orchid [65105]	Endangered	Species or species habitat may occur within area
[Thelymitra stellata](#) Star Sun-orchid [7060]	Endangered	Species or species habitat may occur within area
[Verticordia fimbrilepis subsp. fimbrilepis](#) Shy Featherflower [24631]	Endangered	Species or species habitat known to occur

Name	Status	Type of Presence within area

Listed Migratory Species [Resource Information]

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

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

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

Name
Commonwealth Land -

Listed Marine Species [Resource Information]

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

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species

Name	Threatened	Type of Presence
		habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat may occur within area

Extra Information

State and Territory Reserves	[Resource Information]
Name	State
Gooralong	WA
Karnet	WA
Monadnocks	WA
NTWA Bushland covenant (0011)	WA
NTWA Bushland covenant (0076)	WA
Serpentine	WA
Unnamed WA50643	WA

Regional Forest Agreements	[Resource Information]

Note that all areas with completed RFAs have been included.

Name	State
South West WA RFA	Western Australia

Invasive Species	[Resource Information]

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

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Funambulus pennantii Northern Palm Squirrel, Five-striped Palm Squirrel [129]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Brachiaria mutica Para Grass [5879]		Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Genista monspessulana Montpellier Broom, Cape Broom, Canary Broom, Common Broom, French Broom, Soft Broom [20126]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Solanum elaeagnifolium Silver Nightshade, Silver-leaved Nightshade, White Horse Nettle, Silver-leaf Nightshade, Tomato Weed, White Nightshade, Bull-nettle, Prairie-berry, Satansbos, Silver-leaf Bitter-apple,		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Silverleaf-nettle, Trompillo [12323]		
Tamarix aphylla		
Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus		
Asian House Gecko [1708]		Species or species habitat likely to occur within area

Caveat

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

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

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

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

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

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

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

- migratory and
- marine

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

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

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

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

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

Coordinates

-32.37319 116.18017

Acknowledgements

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

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

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

Please feel free to provide feedback via the Contact Us page.

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Appendix D

Fauna field data

Fauna likelihood of occurrence assessment guideline and definitions

Fauna likelihood of occurrence assessment

Combined phase species list

Phase 1 survey data

Phase 2 survey data

Trap Line habitat assessment

Results from bird acoustic analysis

Results from bat acoustic analysis

Carters Freshwater Mussel transect data

Rakali transect data

Species recorded from studies and database searches

The table presents all vertebrate fauna species recorded in previous studies within or in proximity to the Survey Area, and database searches within a 20 kilometre radius of the Survey Area.

Fauna likelihood of occurrence assessment guidelines

Assessment outcome	Description
Known	Species recorded during the field survey or from recent, reliable records from within or close proximity to the Survey Area.
Likely	Species are **likely** to occur in the Survey Area where there is suitable habitat within the Survey Area and there are recent records of occurrence of the species in close proximity to the Survey Area. OR Species known distribution overlaps with the Survey Area and there is suitable habitat within the Survey Area.
Unlikely	Species assessed as **unlikely** include those species previously recorded within 40 km of the Survey Area however: There is limited (i.e. the type, quality and quantity of the habitat is generally poor or restricted) habitat in the Survey Area. The suitable habitat within the Survey Area is isolated from other areas of suitable habitat and the species has no capacity to migrate into the Survey Area. OR Those species that have a known distribution overlapping with the Survey Area however: There is limited habitat in the Survey Area (i.e. the type, quality and quantity of the habitat is generally poor or restricted). The suitable habitat within the Survey Area is isolated from other areas of suitable habitat and the species has no capacity to migrate into the Survey Area.
Highly unlikely	Species that are considered **highly unlikely** to occur in the Survey Area include: Those species that have no suitable habitat within the Survey Area. Those species that have become locally extinct, or are not known to have ever been present in the region of the Survey Area.

Source information - desktop searches

NM – DBCA *NatureMap* (accessed May 2020)

PMST – DAWE Protected Matters Search Tool (PMST) to identify fauna listed under the EPBC Act potentially occurring within the Survey Area (accessed June 2020)

Definitions

Term	Description
Database search area	a 10 km buffer around the Survey Area
Survey Area	the area subject to the current survey
CR	Critically endangered under the EPBC Act or BC Act
EN	Endangered under the EPBC Act or BC Act
VU	Vulnerable under the EPBC Act or BC Act
IA	Migratory birds protected under an international agreement
MI, MA	Migratory, Marine
CD	Conservation dependent fauna
OS	Other specially protected fauna under the BC Act
P1	Priority 1: Poorly known fauna. Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.
P2	Priority 2: Poorly known species. Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.
P3	Priority 3: Poorly known species. Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.
P4	Priority 4: Rare, Near Threatened and other species in need of monitoring. (a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands. (b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for Vulnerable, but are not listed as Conservation Dependent. (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

Fauna likelihood of occurrence assessment of conservation significant species identified in the desktop assessment as potentially occurring within the Survey Area.

Species name	Common name	Status		Source			Habitat requirements	Likelihood of occurrence
		State	Federal	NatureMap	PMST	DBCA threatened fauna		
Birds								
Actitis hypoleucos	Common Sandpiper	MI	MI		X		Habitat for the Common Sandpiper is varied: coastal and interior wetlands – narrow muddy edges of billabongs, river pools, mangroves, among rocks and snags, reefs or rocky beaches. Avoids wide open mudflats. This species is widespread and scattered, common on the north and west coasts and uncommon in the south-east and interior (Morcombe 2004).	**Unlikely** Suitable habitat such as open shallow flood plain or tidal mud flat is not present to support this species. However, the species may occasionally occur along the shore of the nearby Serpentine Dam. Occurrence within the Survey Area would be as a vagrant at best.
Apus pacificus	Fork-tailed Swift	MI	MI		X		In Western Australia, there are sparsely scattered records of the Fork-tailed Swift along the south coast, ranging from near the Eyre Bird Observatory and west to Denmark. They are widespread in coastal and subcoastal areas between Augusta and Carnarvon, including some on nearshore and offshore islands. They are scattered along the coast from south-west Pilbara to the north and east Kimberley region, near Wyndham. There are sparsely scattered inland records, especially in the Wheatbelt, from Lake Annean and Wittenoom. They are found in the north and north-west Gascoyne Region, north through much of the Pilbara Region, and the south and east Kimberley. They are also recorded in the Timor Sea, both at sea and around islands such as the Ashmore Reef. Isolated records occur at Neale Junction in the Great Victoria Desert and on the Nullarbor Plain (Higgins 1999).	**Unlikely** Suitable habitat is not available to support this species however the species may occasionally occur in the Survey Area as a vagrant.

Species name	Common name	Status		Source			Habitat requirements	Likelihood of occurrence
		State	Federal	NatureMap	PMST	DBCA threatened fauna		
Atrichornis clamosus	Noisy Scrub-bird	EN	EN	X			The Noisy Scrub-bird inhabits areas with dense understorey or lower stratum of sedges and shrubs, dense leaf litter and abundant litter-dwelling invertebrates. It mainly occurs in low closed forests 5–15 m in height that are dominated by *Eucalyptus* or *Agonis* and *Banksia littoralis*, and occur in the steep and wetter gullies, and drainage lines of hills and granite mountains (Eucalyptus), and on the margins of freshwater lakes (*Agonis* and *B. littoralis*). It is also common in low closed forests up to 5 m in height that are dominated by *Hakea elliptica*, *Eucalyptus* or *Agonis* and *B. littoralis* and occur around granite outcrops, in shallower and drier gullies and on the margins of freshwater lakes. It mostly occurs at sites that have not been burnt for 10 or more years. It occurs at two locations in the south west; on the mainland in coastal areas from Two Peoples Bay Nature Reserve to Cheyne Beach, and on Bald Island (DAWE 2021a).	**Unlikely** Previously known from small populations in the Jarrah Forest however this population is now considered locally extinct.
Botaurus poiciloptilus	Australasian Bittern	EN	EN		X		The Australasian Bittern occurs mainly in densely vegetated freshwater wetlands and, rarely, in estuaries or tidal wetlands. The species favours foraging in tall, dense vegetation in shallow permanent or seasonal fresh water. In the southwest of Western Australia the Bittern is now largely confined to coastal areas especially along the south coast where it is found in beds of tall rush mixed with or near short fine sedge or open pools (Burbidge 2004). It also occurs around swamps, lakes, pools, rivers and channels fringed with lignum Muehlenbeckia, canegrass Eragrostis or other dense vegetation (Marchant & Higgins 1990). It occasionally ventures into areas of open water or onto banks.	**Unlikely** Suitable habitat such as expansive wetland with emergent native reeds is not available to support this species however the Survey Area boarders habitat which may be suitable (Serpentine Dam) and the species may occur in the Survey Area as a vagrant.
Cacatua pastinator pastinator	Muir's Corella	CD		X		X	Muir's Corella lives in woodland on the drier, eastern side of the main forest block in the south west, in woodlands that are dominated by Wandoo (E. wandoo), Marri, (*Corymbia calophylla*), or Jarrah, (*Eucalyptus marginata*). Most suitable habitat for this species now consists of remnant patches that occur in or adjacent to farmland, or along roadsides, paddock boundaries or watercourses, and sometimes as a few, isolated shade trees in otherwise cleared paddocks (Garnett & Crowley 2000). The bird nests in large hollows in trees at least 160 years old. Its now has a restricted distribution in the Tone Bridge, Rocky Gully, Frankland River and Lake Muir area (TSSC 2016).	**Highly unlikely** This species is not known from the region.

Species name	Common name	Status		Source			Habitat requirements	Likelihood of occurrence
		State	Federal	NatureMap	PMST	DBCA threatened fauna		
Calidris acuminata	Sharp-tailed Sandpiper	MI	MI		X		In Australasia, the Sharp-tailed Sandpiper prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. This includes lagoons, swamps, lakes and pools near the coast, and dams, waterholes, soaks, bore drains and bore swamps, saltpans and hypersaline saltlakes inland. They also occur in saltworks and sewage farms. They use flooded paddocks, sedgelands and other ephemeral wetlands, but leave when they dry. They use intertidal mudflats in sheltered bays, inlets, estuaries or seashores, and also swamps and creeks lined with mangroves. Sometimes they occur on rocky shores (DAWE 2021b). They are found throughout many wetlands on the Swan Coastal Plain, in Perth lakes with wet grassed margins and receding waters, Vasse and Harvey Estuaries, and the Busselton wetlands, but are less common on the south coast until the Esperance region (Nevill 2013).	**Unlikely** Suitable habitat such as open shallow flood plain or tidal mud flat is not present to support this species. However, the species may occasionally occur along the shore of the nearby Serpentine Dam. Occurrence within the Survey Area would be as a vagrant at best.
Calidris canutus	Red Knot	EN, MI	EN, MI		X		In Australasia the Red Knot mainly inhabits intertidal mudflats, sandflats and sandy beaches of sheltered coasts, in estuaries, bays, inlets, lagoons and harbours; sometimes on sandy ocean beaches or shallow pools on exposed wave-cut rock platforms or coral reefs. They are occasionally seen on terrestrial saline wetlands near the coast, such as lakes, lagoons, pools and pans, and recorded on sewage ponds and saltworks, but rarely use freshwater swamps. They rarely use inland lakes or swamps (DAWE 2021b). They are found near mudflats and estuaries from Murchison to Bunbury but are then uncommon from Wilson Inlet to Esperance. In the Perth region they are mainly found in Alfred Cove and Peel Inlet (Nevill 2013).	**Unlikely**. Suitable habitat such as open shallow flood plain or tidal mud flat is not present to support this species. However, the species may occasionally occur along the shore of the nearby Serpentine Dam. Occurrence within the Survey Area would be as a vagrant at best.

Species name	Common name	Status		Source			Habitat requirements	Likelihood of occurrence
		State	Federal	NatureMap	PMST	DBCA threatened fauna		
Calidris ferruginea	Curlew Sandpiper	MI	MI		X		Curlew Sandpipers mainly occur on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms. They are also recorded inland, though less often, including around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand. They occur in both fresh and brackish waters. Occasionally they are recorded around floodwaters (DAWE 2020).	**Unlikely** Suitable habitat such as open shallow flood plain or tidal mud flat is not present to support this species. However, the species may occasionally occur along the shore of the nearby Serpentine Dam. Occurrence within the Survey Area would be as a vagrant at best.
Calidris melanotos	Pectoral Sandpiper	MI	MI		X		In Australia, the Pectoral Sandpiper prefers shallow fresh to saline wetlands. The species is found at coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands. The species is usually found in coastal or near coastal habitat but occasionally found further inland. It prefers wetlands that have open fringing mudflats and low, emergent or fringing vegetation, such as grass or samphire. The species has also been recorded in swamp overgrown with lignum (DAWE 2021e). The bird can be seen on the Swan Coastal Plain but is rare to scarce on Lake Thompson, and as well on any freshwater wetland in the southwest with shallow, well-grassed margins. They are seen at Lake Warden, Esperance, and at Lake McLarty (Nevill 2013).	**Unlikely** Suitable habitat such as open shallow flood plain or tidal mud flat is not present to support this species. However, the species may occasionally occur along the shore of the nearby Serpentine Dam. Occurrence within the Survey Area would be as a vagrant at best.

Species name	Common name	Status		Source			Habitat requirements	Likelihood of occurrence
		State	Federal	NatureMap	PMST	DBCA threatened fauna		
Calyptorhynchus banksii naso	Forest Red-tailed Black Cockatoo	VU	VU	X	X	X	The Forest Red-tailed Black Cockatoo inhabits the dense Jarrah, karri, and Marri forests receiving more than 600 mm annual average rainfall but also occurs in a range of other forest and woodland types, including Blackbutt (*E. patens*), Wandoo (*E. wandoo*), Tuart (*E. gomphocephala*), Albany Blackbutt (*E. staeri*), Yate (*E. cornuta*), and Flooded Gum (*E. rudis*) (DAWE 2021c). Habitats tend to have an understorey of balga (Xanthorrhoea spp.), kingia (*Kingia australis*), snottygobble (*Persoonia* spp.), parrot bush (*Banksia sessillis*), holly-leaved mirbelia (*Mirbelia dilatata*), bull banksia (*B. grandis*), bullich (*Taxandria* spp.) and sheoak (*Allocasuraina fraseriana*). They are most common in the Jarrah forest region of the northern Darling Range from Collie north to Mundaring and are very local throughout the lower south-west. They can be found on the Swan Coastal Plain, mainly in search of food the exotic white cedar (*Melia azedarach*). There are also several small isolated populations in the eastern parts of its range (DAWE 2021c).	**Known** This species was recorded during both phases of the survey. The Survey Area contains suitable breeding and foraging habitat to support this species.
Calyptorhynchus baudinii	Baudin's Black Cockatoo	EN	EN	X	X	X	Baudin's Black Cockatoo mainly occurs in eucalypt forests, especially Jarrah, Marri and karri forest that receives 750 mm of annual rainfall. The species is less frequently in woodlands of wandoo (*Eucalyptus wandoo*), blackbutt (*E. patens*), flooded gum (*E. rudis*), yate (*E. cornuta*), partly cleared farmlands and urban areas. The range of the species extends from Albany northward to Gidgegannup and Mundaring (east of Perth), and inland to the Stirling Ranges and near Kojonup. Preferred roosts are in areas with a dense canopy close to permanent sources of water (DAWE 2021d).	**Known** This species was recorded during both phases of the survey. The Survey Area contains suitable breeding and foraging habitat to support this species.
Calyptorhynchus latirostris	Carnaby's Black Cockatoo	EN	EN	X	X	X	Carnaby's Cockatoo occurs in uncleared or remnant native eucalypt woodlands, especially those that contain salmon gum, wandoo, Marri, Jarrah and karri, and in shrubland or kwongan heathland dominated by Hakea, Dryandra, Banksia and Grevillea species. Breeding activity is restricted to eucalypt woodlands mainly in the semiarid and subhumid interior, from Kalbarri in the north, Three Springs District south to the Stirling Range, west to Cockleshell Gully and east to Manmanning. The species has expanded its breeding range westward and south into the Jarrah-Marri forests of the Darling Scarp and into the tuart forests of the Swan Coastal Plain, including the Yanchep area, Lake Clifton and near Bunbury. It ness in trees older than 120-150 years (DAWE 2021e).	**Known** This species was recorded during both phases of the survey. The Survey Area contains suitable breeding and foraging habitat to support this species.

Species name	Common name	Status		Source			Habitat requirements	Likelihood of occurrence
		State	Federal	NatureMap	PMST	DBCA threatened fauna		
Falco peregrinus	Peregrine Falcon	OS		X		X	The Peregrine Falcon is found on and near cliffs, gorges, timbered watercourses, riverine environments, wetlands, plains, open woodlands, and pylons and spires of buildings, though less frequently in desert regions (Morcombe 2004; Pizzey & Knight 2012). They are not common but can be found almost anywhere throughout WA and in the southwest, including particularly at Fitzgerald River, Stirling Range, Porongurup National Parks, Kondinin, and Peak Charles, with many more locations north of Perth (Nevill 2013).	**Known** One individual of this species was recorded during the Phase 2 survey and suitable habitat is available within the Survey Area.
Leipoa ocellata	Malleefowl	VU	VU & MI	X	X	X	The Malleefowl generally occurs in semi-arid areas of Western Australia, in shrublands and low woodlands that are dominated by mallee vegetation, as well as native pine Callitris woodlands, Acacia shrublands, paperbark, sheoak, Broombush *Melaleuca uncinata* vegetation, eucalypt woodlands, or coastal heathlands. Mostly they are found where there are sandy or gravel soils. The nest is a large mound of sand or soil and organic matter (Jones & Goth 2008; Morcombe 2004; Nevill 2013). In WA they are found from the southwest Nullarbor to Albany, north, and then west from Moore River up to Shark Bay, past Cue, across to Wiluna and east to the northern Victoria Desert south of the Blackstone Ranges (Nevill 2013; Pizzey & Knight 2012).	**Highly unlikely** The Survey Area does not contain suitable habitat to support this species.
Motacilla cinerea	Grey Wagtail	MI	MI		X		The Grey Wagtail is strongly associated with water, particularly rocky substrates along water courses but also lakes and marshes. It breeds from Western Europe to Asia, migrates to Africa, Malaysia, Indonesia and New Guinea. In the nonbreeding season the species may visit northern Australia and Christmas Island (Pizzey & Knight 2012)	**Highly Unlikely** This species des not frequent southern Australia and is not considered likely to be vagrant within the Survey Area.
Numenius madagascariensis	Eastern Curlew	CR	CR & MI	X	X		The Eastern Curlew is most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass. Occasionally, the species occurs on ocean beaches (often near estuaries), and coral reefs, rock platforms, or rocky islets. The birds are often recorded among saltmarsh and on mudflats fringed by mangroves, sometimes within the mangroves, and in coastal saltworks and sewage farms. In the south west, Eastern Curlews are recorded from Eyre, and there are scattered records from Stokes Inlet to Peel Inlet (Marchant & Higgins 1993). They are uncommon further south of	**Unlikely** Suitable habitat such as open shallow flood plain or tidal mud flat is not present to support this species. However, the species may occasionally occur along the shore of the nearby Serpentine Dam. Occurrence within the

Species name	Common name	Status		Source			Habitat requirements	Likelihood of occurrence
		State	Federal	NatureMap	PMST	DBCA threatened fauna		
							Geraldton, but can be spotted in Alfred Cove, Peel Inlet and the Albany region (Nevill 2013).	Survey Area would be as a vagrant at best.
Pandion haliaetus	Osprey	MI	MI		X		Ospreys occur in littoral and coastal habitats and terrestrial wetlands of tropical and temperate Australia and offshore islands. They are mostly found in coastal areas but occasionally travel inland along major rivers, particularly in northern Australia. They require extensive areas of open fresh, brackish or saline water for foraging. They frequent a variety of wetland habitats including inshore waters, reefs, bays, coastal cliffs, beaches, estuaries, mangrove swamps, broad rivers, reservoirs and large lakes and waterholes. They exhibit a preference for coastal cliffs and elevated islands in some parts of their range but may also occur on low sandy, muddy or rocky shores and over coral cays. They may occur over atypical habitats such as heath, woodland or forest when travelling to and from foraging (DSEWPaC 2016)	**Unlikely** Suitable habitat such as open estuarine inlets or lakes is not available to support this species however the Survey Area boarders habitat which may be suitable (Serpentine Dam) and the species may occur in the Survey Area as a vagrant.
Rostratula australis	Australian Painted Snipe	EN	EN		X		The Australian Painted Snipe generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans. Australian Painted Snipe breeding habitat requirements may be quite specific: shallow wetlands with areas of bare wet mud and both upper and canopy cover nearby. The species rarely occurs in south-western Australia, where it was once more common (Marchant & Higgins 1993; Garnett & Crowley 2000).	**Unlikely** Suitable habitat is not available to support this species however the Survey Area boarders habitat which may be suitable (Serpentine Dam) and the species may occur in the Survey Area as a vagrant.
Tyto novaehollandiae subsp. novaehollandiae	Masked Owl (southern subsp)	P3		X		X	The Masked Owl is found in forests (wet and dry sclerophyll, non-eucalypt dominated), open woodlands, farmlands or scrub with large trees (12-20 m) and adjacent cleared country, timbered watercourses, paperbark woodlands, and caves (Pizzey & Knight 2012). It requires large hollows in old growth eucalypts or bare sand or the earth of a cave for nesting, and often favours areas with dense understorey or ecotones comprising dense and sparse ground cover. It is often recorded foraging within 100-300 m of the boundary of two vegetation types (Bell & Mooney 2002). The bird is restricted to the thicker humid forests of the south west region, particularly in the Pemberton and Manjimup area and along the Murray River in the Lane Poole area. It nests in hollows in large Karri (*Eucalyptus diversicolor*), Marri (*Corymbia calophylla*) and Jarrah (*E. marginata*) trees (Nevill 2013).	**Known** This species was detected at two locations within the Survey Area during the Phase 1 survey.

Species name	Common name	Status		Source			Habitat requirements	Likelihood of occurrence
		State	Federal	NatureMap	PMST	DBCA threatened fauna		
Mammals								
Falsistrellus mackenziei	Western False Pipistrelle	P4		X		X	The Western False Pipistrelle occurs in wet sclerophyll forest dominated by Karri (*Eucalyptus diversicolor*), and in the high rainfall zones of the Jarrah (*E. marginata*) and Tuart (*E. gomphocephala*) dry sclerophyll forests. The species is restricted to areas in or adjacent to stands of old growth forest. It has also been recorded in mixed Tuart-Jarrah tall woodlands on the adjacent coastal plain. Marri (*Corymbia calophylla*), Sheoak (*Casuarina heugeliana*) and Peppermint (*Agonis flexuosa*) trees are often co-dominant at its collection localities (Churchill 2008; McKenzie & Start 1999).	**Known** This species was recorded on bat detectors during both Phase 1 and Phase 2 surveys and suitable habitat is available to support this species.
Bettongia penicillata ogilbyi	Woylie	CR	EN	X	X	X	Preferred habitat for the Woylie includes dense undergrowth, logs and rock-cavities and occasionally in burrows (Burbidge 2004). Scattered Woylie populations may be found throughout the Jarrah forest in the south-west corner of WA. Extant naturally occurring populations of the species are restricted to three small wheatbelt reserves – Dryandra Woodland, Tutanning Nature Reserve and Perup Forest. All are characterised by the presence of thickets of the plant *Gastrolobium* (Van Dyck and Strahan 2008). The species is now restricted to forests and areas where predation has been controlled (or excluded). It rests during the day in a well-concealed nest, built over a shallow depression. The nest is most commonly built using long strands, of grasses, but other material such as strips of bark are also used (in the forest) or dried seagrass and/or triodia (in arid coastal areas) (Freegard 2007).	**Unlikely** Suitable habitat is present within the Survey Area however the species is not expected to occur within, or vagrant to, the Survey Area due to the presence of predators such as foxes and cats.
Dasyurus geoffroii	Chuditch	VU	VU	X	X	X	The Chuditch inhabits eucalypt forest (especially Jarrah, *Eucalyptus marginata*), dry woodland, mallee shrublands, heaths, and desert, particularly in the south coast of WA. They also occur at lower densities in drier woodland and mallee shrubland in the goldfields and wheatbelt, as well as in Kalbarri National Park (translocated). Chuditch require adequate numbers of suitable den and refuge sites (horizontal hollow logs or earth burrows) to survive (DEC 2011b). In Jarrah forest, Chuditch populations occur in both moist, densely vegetated, steeply sloping forest and drier, open, gently sloping forest (Van Dyck & Strahan 2008). The species can travel large distances, and for this reason requires habitats that are of a suitable size and not excessively fragmented.	**Known** This species was recorded during the survey on two remote cameras. The Survey Area provides suitable denning and foraging/hunting habitat to support this species.

Species name	Common name	Status		Source			Habitat requirements	Likelihood of occurrence
		State	Federal	NatureMap	PMST	DBCA threatened fauna		
Hydromys chrysogaster	Rakali, Water-rat	P4		X		X	The Water Rat lives in the vicinity of permanent bodies of fresh, brackish, or marine water, lakes and farm dams, and on sheltered coastal beaches, mangroves and offshore islands. In the south-west of WA they have been shown to prefer areas with riparian vegetation, better water quality and a degree of habitat complexity. Woody debris, rock ledges and wetland islands are likely to be important areas for feeding and refuge (DEC 2012). It is an occasional vagrant to temporary waters. Water Rat's dens are made at the end of tunnels in banks and occasionally in logs (Van Dyck & Strahan 2008).	**Known** This species was recorded on one remote camera deployed on a flowing stream section of Big Brook that bisects the proposed conveyor location.
Phascogale calura	Red-tailed Phascogale	CD	VU		X		The Red-tailed Phascogale inhabits Wandoo (Eucalyptus wandoo) and dense Sheoak (Allocasuarina huegeliana) woodland associations, with populations being most dense in the latter vegetation type. The species prefers vegetation that is unburnt for a long time, which provides continuous canopy cover to assist their arboreal habits. Trees need to be of a sufficient age to provide hollows for nesting in limbs or logs, and grass trees need to have ample skirts to provide cover. Small, scattered populations still occur in remnant vegetation in the Wheatbelt (DEC 2007).	**Unlikely**. Not recorded during the survey. The Survey Area is beyond the known range of this species.
Phascogale tapoatafa	Brush Tailed Phascogale	CD				X	The Brush-tailed Phascogale is sparsely distributed outside the semi-arid zone in dry sclerophyll forest and monsoonal forest and woodland. The species is generally rare and threatened by habitat fragmentation in the south west of Western Australia.	**Known** This species was detected at one remote camera within the south-eastern portion of the Survey Area and suitable habitat is available to support this species.
Pseudocheirus occidentalis	Western Ringtail Possum	CR	CR	X	X		The Western Ringtail Possum occurs in coastal and near coastal and Peppermint Tree (*Agonis flexuosa*) forest and Tuart (*Eucalyptus gomphocephala*) dominated forest with a Peppermint Tree understorey from Bunbury to Albany. Also occurs in Jarrah (*E. marginata*) forest and Jarrah-Marri *(Corymbia calophylla*) forest associated with Peppermint Tree (Van Dyck & Strahan 2008).	**Unlikely** Suitable habitat Tuart over peppermint understory is not present to support this species and the Study Area is beyond the current natural range of the species.

Species name	Common name	Status		Source			Habitat requirements	Likelihood of occurrence
		State	Federal	NatureMap	PMST	DBCA threatened fauna		
Isoodon fusciventer	Quenda (Southern Brown Bandicoot)	P4		X		X	The Quenda prefers dense scrubby, often swampy, vegetation with dense cover up to one metre high. However, it also occurs in woodlands, and may use less ideal habitat where this habitat occurs adjacent to the thicker, more desirable vegetation. The species often feeds in adjacent forest and woodland that is burnt on a regular basis and in areas of pasture and cropland lying close to dense cover (Van Dyck & Strahan 2008).	**Known** This species was recorded during the survey via both remote cameras, diggings and trapping. The Survey Area provides suitable breeding and foraging habitat to support this species.
Myrmecobius fasciatus	Numbat	EN	EN	X		X	Current Numbat populations occupy several different habitat types: upland Jarrah forest, open eucalypt woodland, banksia woodland and tall closed shrubland. The only remaining original subpopulations are at Dryandra Woodland and the Upper Warren area (including Tone Perup Nature Reserve, Greater Kingston National Park and adjoining State Forest). In WA there are nine translocation sites, including Boyagin Nature Reserve, Tutanning Nature Reserve, Batalling block and Karroun Hill Nature Reserve (see DPaW 2015 for complete list and details). At Dryandra, numbats inhabit brown mallet (*Eucalyptus astringens*) plantations. Habitats usually have an abundance of termites in the soil, and hollow logs, tree hollows, burrows and branches for shelter (DAWE 2021e; Van Dyck & Strahan 2008).	**Highly unlikely** Suitable habitat is not available to support this species. The Survey Area is outside the current known range of the Numbat however it has previously been recorded at Jarrahdale.
Notamacropus irma	Western Brush Wallaby	P4		X		X	The Western Brush Wallaby is found primarily in open forest or woodland, particularly favouring open, seasonally- wet flats with low grasses and open scrubby thickets. It is also found in some areas of mallee and heathland and is uncommon in karri forest (DEC 2011b; Van Dyck & Strahan 2008).	**Known** This species was recorded numerously during the survey. The Survey Area provides suitable breeding and foraging habitat to support this species.

Species name	Common name	Status		Source			Habitat requirements	Likelihood of occurrence
		State	Federal	NatureMap	PMST	DBCA threatened fauna		
Setonix brachyurus	Quokka	Vu	Vu	X	X	X	The current distribution of the Quokka includes Rottnest and Bald Islands, and at least 25 sites on the mainland, including Two Peoples Bay Nature Reserve and Torndirrup, Mt Manypeaks and Walpole-Nornalup National Parks, and swamp areas through the south-west forests from Jarrahdale to Walpole. The last known population on the Swan Coastal Plain occurs in Muddy Lakes near Bunbury. Quokkas have also been reintroduced to Karakamia Sanctuary (DEC 2013). They occupy dense forests and thickets, streamside vegetation, heaths, shrublands, *Agonis linearifolia*-dominated swamps in the Jarrah (*Eucalyptus marginata*) forest, and sometimes tea-tree thickets on sandy soils along creek systems. The northern extent on the mainland is in the Jarrah forest immediately south-east of the Perth metropolitan area, from where it extends southward through the southern Jarrah, Marri and Karri forests to the south coast, but largely confined throughout to areas receiving an annual rainfall of 1,000 mm or more (DEC 2013; Van Dyck & Strahan 2008).	**Known** This species was recorded during the survey on remote cameras. The Survey Area provided suitable breeding and foraging habitat to support this species.
Reptiles								
Acanthophis antarcticus	Southern Death Adder	P3		X		X	The Southern Death Adder habitat ranges from rainforest to shrublands and heaths. This species is declining in many areas, probably due to habitat destruction and altered fire regimes (Wilson & Swan 2013).	**Known** Two individuals were recorded during the Mattiske vegetation and flora survey (2020).
Ctenotus delli	Dell's Skink	P4		X		X	Dell's Skink is associated with Jarrah-Marri woodland that has a shrub-dominated understorey, on laterite, sandy or clay soils. It is found in the north Darling Range and inhabits dry sclerophyll forest on granite outcrops, stony hills and ranges. It is absent from the Swan Coastal Plain (Cogger 2014; Wilson & Swan 2013).	**Likely** The Survey Area contains suitable breeding and foraging habitat to support this species however it was not detected during the surveys.
Geotria australis	Pouched Lamprey	P3		X			This species utilises freshwater streams in the south west (Perth to Albany) to breed and grow before migrating to the ocean to mature (Allen *et al*. 2002). Dams and weirs are the main obstacles for the species. Sporadic records exist throughout the South West Coast Drainage Division between Perth and Albany including the Swan, Canning, Serpentine, Margaret, Donnelly, Warren and Goodga rivers.	**Highly Unlikely** Permanent suitable habitat was not recorded during the survey and no creeks are linked to coastal water due to Serpentine Dam.

Species name	Common name	Status		Source			Habitat requirements	Likelihood of occurrence
		State	Federal	NatureMap	PMST	DBCA threatened fauna		
Westralunio carteri	Carter's Freshwater Mussel	Vu	Vu		X		Carter's Freshwater Mussel is usually found in freshwater river pools. They are most common in areas with muddy, silty and sandy bottoms and flowing permanent water. Environmental tolerances of W. carteri are not precisely known but they can be found where water temperatures range from 4° C to over 30° C. Formerly this species occurred widely through the southwest including interior rivers of southwest such as Avon, Murray and Blackwood, however Salination of many waterways has severely reduced this species distribution.	**Known.** Occurs in the adjacent Serpentine Reservoir however the Survey Area lacks adequate permanent streams to provide suitable aquatic habitat.

Combined Phase Species List

Family	Scientific Name	Species	EPBC listing	DBCA listing	Phase 1	Phase 2
Mammals						
Canidae	*Vulpes vulpes*	Fox	Int	Int	X	X
Dasyuridae	*Sminthopsis gilberti*	Gilberts Dunnart			X	X
Dasyuridae	*Phascogale tapoatafa*	Brush-tailed Phascogale		CD		X
Dasyuridae	*Antechinus flavipes*	Mardo			X	X
Dasyuridae	*Dasyurus geoffroii*	Chuditch	Vu	Vu	X	X
Felidae	*Felis catus*	Feral Cat	Int	Int	X	X
Leporidae	*Oryctolagus cuniculus*	European Rabbit	Int	Int	X	X
Macropodidae	*Notamacropus irma*	Western Brush Wallaby		P4	X	X
Macropodidae	*Macropus fuliginosus*	Western Grey Kangaroo			X	X
Macropodidae	*Setonix brachyurus*	Quokka	Vu	Vu	X	X
Molossidae	*Austronomus australis*	White-striped Free-tailed Bat				X
Molossidae	*Ozimops kitcheneri*	South-western Free-tailed Bat			X	X
Muridae	*Hydromys chrysogaster*	Rakali		P4	X	
Muridae	*Mus musculus*	House Mouse	Int	Int	X	X
Muridae	*Rattus rattus*	Black Rat	Int	Int	X	X
Peramelidae	*Isoodon fusciventer*	Quenda		P4	X	X
Phalangeridae	*Trichosurus vulpecula*	Common Brushtail Possum			X	X
Suidae	*Sus scrofa*	Feral Pig	Int	Int	X	X
Tachyglossidae	*Tachyglossus aculeatus*	Short-beaked Echidna			X	X
Vespertilionidae	*Chalinolobus gouldii*	Gould’s Wattled Bat			X	X
Vespertilionidae	*Chalinolobus morio*	Chocolate Wattled Bat			X	X
Vespertilionidae	*Falsistrellus mackenziei*	Western False Pipistrelle		P4	X	X
Vespertilionidae	*Vespadelus regulus*	Southern Forest Bat			X	X
Birds						
Acanthizidae	*Acanthiza apicalis*	Inland Thornbill			X	X

Family	Scientific Name	Species	EPBC listing	DBCA listing	Phase 1	Phase 2
Acanthizidae	*Smicrornis brevirostris*	Weebill			X	X
Acanthizidae	*Gergoyne fusca*	Western Gerygone			X	X
Acanthizidae	*Acanthiza inornata*	Western Thornbill			X	X
Acanthizidae	*Sericornis frontalis*	White-browed Scrubwren			X	X
Acanthizidae	*Acanthiza chrysorrhoa*	Yellow-rumped Thornbill				X
Accipitridae	*Aquila audax*	Wedge-tailed Eagle			X	X
Accipitridae	*Accipiter fasciatus*	Brown Goshawk				X
Aegothelidae	*Aegotheles cristatus*	Australian Owlet-nightjar				X
Alcedinidae	*Dacelo novaeguineae*	Laughing Kookaburra		Int	X	X
Alcedinidae	*Todiramphus sanctus*	Sacred Kingfisher				X
Anatidae	*Chenonetta jubata*	Australian Wood Duck			X	X
Anatidae	*Anas superciliosa*	Pacific Black Duck			X	
Artamidae	*Cracticus torquatus*	Grey Butcherbird			X	X
Artamidae	*Strepera versicolor*	Grey Currawong			X	X
Artamidae	*Cracticus tibicen*	Australian Magpie			X	X
Artamidae	*Artamus cinereus*	Black-faced Wood Swallow				X
Artamidae	*Artamus cyanopterus*	Dusky Woodswallow				X
Cacatuidae	*Calyptorhynchus baudinii*	Baudin’s Cockatoo	En	En	X	X
Cacatuidae	*Calyptorhynchus latirostris*	Carnaby's Cockatoo	En	En	X	X
Cacatuidae	*Calyptorhynchus banksii*	Forest Red-tailed Black Cockatoo	Vu	Vu	X	X
Cacatuidae	*Eolophus roseicapilla*	Galah				X
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike			X	X
Casuariidae	*Dromaius novaehollandiae*	Emu			X	X
Charadriidae	*Vanellus tricolor*	Banded Lapwing			X	
Climacteridae	*Climacteris rufus*	Rufous Tree Creeper			X	X
Climacteridae	*Climacteris affinis*	White-browed Treecreeper				X
Columbidae	*Phaps elegans*	Brush Bronzewing			X	

Family	Scientific Name	Species	EPBC listing	DBCA listing	Phase 1	Phase 2
Columbidae	*Phaps chalcoptera*	Common Bronzewing			X	X
Corvidae	*Corvus coronoides*	Australian Raven			X	X
Corvidae	*Corvus bennetti*	Little Crow			X	
Cuculidae	*Cacomantis flabelliformis*	Fan-tailed Cuckoo			X	
Cuculidae	*Chrysococcyx lucidus*	Shining Bronze-cuckoo				X
Dicaeidae	*Dicaeum hirundinaceum*	Mistletoebird			X	
Estrildidae	*Stagonopleura oculata*	Red-eared Firetail Finch				X
Falconidae	*Falco peregrinus*	Peregrine Falcon		OS		X
Hirundinidae	*Petrochelidon ariel*	Fairy Martin			X	
Hirundinidae	*Petrochelidon nigricans*	Tree Martin			X	X
Locustellidae	*Megalurus cruralis*	Brown Songlark			X	
Maluridae	*Malurus elegans*	Red-winged Fairywren			X	X
Maluridae	*Malurus splendens*	Splendid Fairywren			X	X
Maluridae	*Stipiturus malachurus*	Southern Emu-wren			X	
Meliphagidae	*Phylidonyris novaehollandiae*	New Holland Honeyeater			X	X
Meliphagidae	*Anthochaera carunculata*	Red Wattlebird			X	X
Meliphagidae	*Acanthorhynchus superciliosus*	Western Spinebill			X	X
Meliphagidae	*Lichmera indistincta*	Brown Honeyeater				X
Meliphagidae	*Melithreptus brevirostris*	Brown-headed Honeyeater				X
Meliphagidae	*Lichenostomus virescens*	Singing Honeyeater				X
Meliphagidae	*Anthochaera lunulata*	Western Wattlebird				X
Meliphagidae	*Melithreptus lunatus*	White-napped Honeyeater				X
Meropidae	*Merops ornatus*	Rainbow Bee-eater				X
Monarchidae	*Myiagra inquieta*	Restless Flycatcher			X	
Monarchidae	*Grallina cyanoleuca*	Magpie-lark				X
Neosittidae	*Daphoenositta chrysoptera*	Varied Sitella				X
Pachycephalidae	*Pachycephala occidentalis*	Western Whistler			X	X

Family	Scientific Name	Species	EPBC listing	DBCA listing	Phase 1	Phase 2
Pachycephalidae	*Colluricincla harmonica*	Grey Strike Thrush			X	X
Pachycephalidae	*Pachycephala rufiventris*	Rufous Whistler			X	X
Pardalotidae	*Pardalotus punctatus*	Spotted Pardalote				X
Pardalotidae	*Pardalotus striatus*	Striated Pardalote				X
Petroicidae	*Petroica boodang*	Scarlet Robin			X	X
Petroicidae	*Eopsaltria griseogularis*	Western Yellow Robin			X	X
Petroicidae	*Eopsaltria georgiana*	White-breasted Robin			X	X
Podargidae	*Podargus strigoides*	Tawny Frogmouth			X	X
Psittaculidae	*Platycercus zonarius*	Australian Ringneck Parrot			X	X
Psittaculidae	*Purpureicephalus spurius*	Red-capped Parrot			X	X
Psittaculidae	*Platycercus icterotis*	Western Rosella			X	X
Psittaculidae	*Neophema elegans*	Elegant Parrot				X
Psittaculidae	*Parvipsitta porphyrocephala*	Purple-crowned Lorikeet				X
Psittaculidae	*Trichoglossus moluccanus*	Rainbow Lorikeet		Int		X
Rallidae	*Fulica atra*	Eurasian coot			X	
Rhipiduridae	*Rhipidura albiscapa*	Grey Fantail			X	X
Strigidae	*Ninox boobook*	Southern Boobook			X	X
Threskiornithidae	*Threskiornis spinicollis*	Straw-necked Ibis				X
Turnicidae	*Turnix varius*	Painted Button Quail			X	X
Tytonidae	*Tyto novaehollandiae*	Masked Owl		P3	X	
Zosteropidae.	*Zosterops lateralis*	Silvereye			X	X
Reptiles						
Agamidae	*Ctenophorus ornatus*	Ornate Crevice-dragon			X	X
Agamidae	*Pogona minor*	Western Bearded Dragon				X
Boidae	*Morelia spilota*	Carpet Python			X	X
Carphodactylidae	*Underwoodisaurus milii*	Barking Gecko			X	
Elapidae	*Acanthophis antarcticus*	Southern Death Adder		P3	X	

Family	Scientific Name	Species	EPBC listing	DBCA listing	Phase 1	Phase 2
Elapidae	*Pseudonaja affinis*	Dugite				X
Elapidae	*Parasuta gouldii*	Gould's Hooded Snake			X	X
Elapidae	*Suta nigriceps*	Mallee Black-backed Snake				X
Elapidae	*Notechis scutatus*	Tiger Snake				X
Gekkonidae	*Christinus marmoratus*	Marbled Gecko				X
Gekkonidae	*Diplodactylus lateroides*	Speckled stone gecko			X	X
Pygopodidae	*Aprasia pulchella*	Pretty Worm-lizard				X
Scincidae	*Tiliqua rugosa*	Bobtail			X	
Scincidae	*Cryptoblepharus buchananii*	Buchanan's Snake-eyed Skink			X	X
Scincidae	*Menetia greyii*	Common Dwarf Skink			X	X
Scincidae	*Ctenotus labillardieri*	Common south-west Ctenotus			X	X
Scincidae	*Egernia kingii*	King's Skink				X
Scincidae	*Egernia napoleonis*	Napoleon Skink				X
Scincidae	*Morethia obscura*	Shrubland Skink			X	X
Scincidae	*Acritoscincus trilineatus*	South-western cool-skink			X	X
Scincidae	*Hemiergis initialis*	South-western earless skink			X	X
Scincidae	*Lerista distinguenda*	South-western Orange-tailed Slider			X	X
Typhlopidae	*Anilios australis*	Southern Blind Snake				X
Varanidae	*Varanus tristis*	Black-headed Monitor			X	
Varanidae	*Varanus gouldii*	Gould's Monitor			X	X
Varanidae	*Varanus rosenbergi*	Rosenburg's Monitor			X	X
Amphibians						
Limnodynastidae	*Heleioporus eyrei*	Moaning Frog			X	X
Myobatrachidae	*Crinia pseudinsignifera*	Bleating Froglet			X	
Myobatrachidae	*Crinia georgiana*	Quacking Frog			X	X
Myobatrachidae	*Crinia glauerti*	Rattling Froglet				X
Myobatrachidae	*Crinia pseudinsignifera*	False western froglet			X	

Family	Scientific Name	Species	EPBC listing	DBCA listing	Phase 1	Phase 2
Myobatrachidae	*Geocrinia leai*	Leas (ticking) frog			X	X
Pelodryadidae	*Litoria adelaidensis*	Slender Tree Frog			X	X

Phase 1 (June/July 2020): Species recorded during the trapping program including bat detection, bird acoustic, bird census, opportunistic observations, active searches and remote cameras

Family	Taxa	Common name	TL 1	TL2	TL3	TL4	TL5	TL6	TL7	TL8	TL9	TL10	TL11	TL12	Cage Line 1	Cage Line 2	Cage Line 3	Cage Line 4	Cage Line 5	Other (eg. active search etc)	Bird acoustic	Bat acoustic	Camera	Total
Mammals																								
Canidae	*Vulpes vulpes*	Fox	0	0	0	0	0	0	0	0	0	0	0	0						0			3	3
Dasyuridae	*Sminthopsis gilberti*	Gilberts Dunnart	0	0	0	0	0	0	0	0	0	0	0	0						1			6	7
Dasyuridae	*Antechinus flavipes*	Mardo	2	2	0	0	4	5	5	21	0	5	4	1						0			287	336
Dasyuridae	*Dasyurus geoffroii*	Chuditch	0	0	0	0	0	0	0	0	0	0	0	0						1			1	2
Felidae	*Felis catus*	Domestic Cat	0	0	0	0	0	0	0	0	0	0	0	0						0			2	2
Leporidae	*Oryctolagus cuniculus*	European Rabbit	0	0	0	0	0	0	0	0	0	0	0	0						0			1	1
Macropodidae	*Notamacropus irma*	Western Brush Wallaby	0	0	0	0	0	0	0	0	0	0	0	0						47			18	65
Macropodidae	*Macropus fuliginosus*	Western Grey Kangaroo	0	0	0	0	0	0	0	0	0	0	0	0						19			76	95
Macropodidae	*Setonix brachyurus*	Quokka	0	0	0	0	0	0	0	0	0	0	0	0						0			54	54
Molossidae	*Austronomus australis*	White-striped Free-tailed Bat	0	0	0	0	0	0	0	0	0	0	0	0								4		4
Molossidae	*Ozimops kitcheneri*	South-western Free-tailed Bat	0	0	0	0	0	0	0	0	0	0	0	0								20		20
Muridae	*Hydromys chrysogaster*	Rakali	0	0	0	0	0	0	0	0	0	0	0	0									1	1
Muridae	*Mus musculus*	House Mouse	0	0	0	0	0	0	0	0	0	0	0	0						0			38	38
Muridae	*Rattus rattus*	Black Rat	0	0	0	0	0	0	0	0	0	0	0	0						2			61	63
Peramelidae	*Isoodon fusciventer*	Quenda	0	0	0	0	0	0	0	0	0	0	0	1						7			81	89
Phalangeridae	*Trichosurus vulpecula*	Common Brushtail Possum	0	0	0	0	0	0	0	0	0	0	0	0						1			19	20
Suidae	*Sus scrofa*	Feral Pig	0	0	0	0	0	0	0	0	0	0	0	0						2			22	24
Tachyglossidae	*Tachyglossus aculeatus*	Short-beaked Echidna	0	0	0	0	0	0	0	0	0	0	0	0						1			30	31
Vespertilionidae	*Chalinolobus gouldii*	Gould's Wattled Bat	0	0	0	0	0	0	0	0	0	0	0	0								6		6
Vespertilionidae	*Chalinolobus morio*	Chocolate Wattled Bat	0	0	0	0	0	0	0	0	0	0	0	0								2		2
Vespertilionidae	*Falsistrellus mackenziei*	Western False Pipistrelle	0	0	0	0	0	0	0	0	0	0	0	0								3		3
Vespertilionidae	*Vespadelus regulus*	Southern Forest Bat	0	0	0	0	0	0	0	0	0	0	0	0								28		28
Birds																								
Acanthizidae	*Acanthiza apicalis*	Inland Thornbill	0	2	0	3	0	0	0	0	0	0	0	0						4	X			9
Acanthizidae	*Smicrornis brevirostris*	Weebill	2	0	0	1	0	4	0	0	6	4	1	0						9	X			27
Acanthizidae	*Gerygone fusca*	Western Gerygone	1	0	0	0	0	0	0	0	0	0	0	0						2	X			3
Acanthizidae	*Acanthiza inornata*	Western Thornbill	1	0	0	0	0	0	0	0	0	0	0	0						2	X			3
Acanthizidae	*Sericornis frontalis*	White-browed Scrub-wren	0	0	0	0	0	0	0	0	0	0	1	0						2			5	3
Accipitridae	*Aquila audax*	Wedge-tailed Eagle	0	0	0	0	1	0	0	0	0	0	0	0						0				1
Alcedinidae	*Dacelo novaeguineae*	Laughing Kookaburra	0	0	0	0	1	0	0	0	0	1	0	0						10	X		8	20
Anatidae	*Chenonetta jubata*	Australian Wood Duck	0	0	0	0	0	0	0	0	0	0	0	0						0	X		3	3
Anatidae	*Anas superciliosa*	Pacific Black Duck	0	0	0	0	0	2	0	0	0	0	0	0						2			2	6
Artamidae	*Cracticus torquatus*	Grey Butcherbird	0	1	0	0	0	0	0	0	0	0	0	0						0			0	1
Artamidae	*Strepera versicolor*	Grey Currawong	0	0	0	0	0	0	1	4	2	0	1	1						10			1	20
Artamidae	*Cracticus tibicen*	Magpie	1	0	0	0	0	0	0	0	0	0	0	2						9			8	20
Cacatuidae	*Calyptorhynchus baudinii*	Baudin's Cockatoo	0	0	0	0	0	0	0	0	0	0	0	0						49	X			49
Cacatuidae	*Calyptorhynchus latirostris*	Carnaby's Cockatoo	2	0	0	0	0	0	0	0	0	0	0	0						524	X			526
Cacatuidae	*Calyptorhynchus banksii*	Forest Red-tailed Black Cockatoo	10	2	1	0	0	0	0		25	0	1	4						233			4	280

Family	Taxa	Common name	TL 1	TL2	TL3	TL4	TL5	TL6	TL7	TL8	TL9	TL10	TL11	TL12	Cage Line 1	Cage Line 2	Cage Line 3	Cage Line 4	Cage Line 5	Other (eg. active search etc)	Bird acoustic	Bat acoustic	Camera	Total
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike	0	0	0	0	0	0	0	0	0	0	0	0						2			0	2
Casuariidae	*Dromaius novaehollandiae*	Emu	0	0	0	2	0	0	0	0	0	0	0	0						4	X		2	8
Charadriidae	*Vanellus tricolor*	Banded Lapwing	0	0	0	0	0	0	0	0	0	0	0	0						0	X		1	1
Climacteridae	*Climacteris rufus*	Rufous Tree Creeper	0	1	2	1	0	0	0	0	0	0	0	0						1			0	5
Columbidae	*Phaps elegans*	Brush Bronzewing	0	0	0	0	0	0	0	0	0	0	0	0						0			1	1
Columbidae	*Phaps chalcoptera*	Common Bronzewing	0	0	0	0	0	0	0	0	0	0	0	0						3	X		1	4
Corvidae	*Corvus coronoides*	Australian Raven	0	1	15	1	1	0	1	2	5	0	0	2						6			15	49
Corvidae	*Corvus bennetti*	Little Crow	0	0	0	0	0	0	0	0	0	0	0	0						0	X		4	4
Cuculidae	*Cacomantis flabelliformis*	Fan-tailed Cuckoo	0	1	0	0	0	0	0	0	0	0	1	0						1	X		0	3
Dicaeidae	*Dicaeum hirundinaceum*	Mistletoebird																		1				1
Hirundinidae	*Petrochelidon ariel*	Fairy Martin	0	0	0	0	0	0	0	0	0	0	0	0						4	X		0	4
Hirundinidae	*Petrochelidon nigricans*	Tree Martin																		1				1
Locustellidae	*Megalurus cruralis*	Brown Songlark	0	0	0	0	0	0	0	0	0	0	0	0						0	X		3	3
Maluridae	*Malurus elegans*	Red-winged Fairywren	0	0	0	0	0	0	0	0	0	0	0	0						0	X		2	3
Maluridae	*Malurus splendens*	Splendid Fairywren	2	2	0	0	0	0	0	0	1	0	6	0						1	X		76	88
Maluridae	*Sericornis maculatus*	Spotted Scrubwren	0	0	0	0	0	0	0	0	0	0	0	0						0			2	2
Maluridae	*Malurus lamberti*	Variegated Fairy Wren	0	0	0	0	0	0	0	0	0	0	0	0						0	X		23	23
Meliphagidae	*Phylidonyris novaehollandiae*	New Holland Honeyeater	0	0	0	0	0	0	0	0	0	0	0	0						1			1	2
Meliphagidae	*Anthochaera carunculata*	Red Wattlebird	2	0	0	0	1	0	0	0	0	2	1	0						5	X		0	11
Meliphagidae	*Acanthorhynchus superciliosus*	Western Spinebill	0	0	1	0	0	0	0	0	0	0	0	0						0	X		1	2
Monarchidae	*Myiagra inquieta*	Restless Flycatcher	0	0	0	1	0	0	0	0	0	0	0	0						0	X		0	1
Pachycephalidae	*Pachycephala pectoralis*	Golden Whistler	0	0	0	0	0	0	0	0	0	1	0	0						3	X		0	4
Pachycephalidae	*Colluricincla harmonica*	Grey Strike Thrush	2	0	1	0	0	0	0	0	0	0	2	1						5			0	11
Pachycephalidae	*Pachycephala occidentalis*	Western Whistler	0	0	0	0	0	0	0	0	0	0	0	0						0	X		1	1
Petroicidae	*Petroica boodang*	Scarlet Robin	0	0	0	1	0	0	0	0	0	0	1	0						9			17	28
Petroicidae	*Eopsaltria griseogularis*	Western Yellow Robin	2	0	0	0	0	0	0	0	0	0	0	0						6			0	8
Petroicidae	*Eopsaltria georgiana*	White-breasted Robin	0	0	0	0	0	0	0	0	0	0	1	0						2			1	4
Podargidae	*Podargus strigoides*	Tawny Frogmouth																		2				2
Psittaculidae	*Platycercus zonarius*	Australian Ringneck Parrot	0	1	1	0	0	3	0	4	2	2	5	0						4			1	23
Psittaculidae	*Purpureicephalus spurius*	Red-capped Parrot	0	0	0	0	0	0	0	0	1	0	0	0						4			1	6
Psittaculidae	*Platycercus icterotis*	Western Rosella	0	0	0	0	0	0	0	0	0	0	0	0						6	X		5	11
Rallidae	*Fulica atra*	Eurasian coot	0	0	0	0	0	0	0	0	0	0	0	0						0	X		1	1
Rhipiduridae	*Rhipidura albiscapa*	Grey Fantail	0	2	0	3	0	0	0	0	2	0	1	1						3			0	12
Strigidae	*Ninox boobook*	Southern Boobook	0	0	0	0	0	0	0	0	0	0	0	0						0	X		2	2
Turnicidae	*Turnix varius*	Painted Button Quail	0	0	0	0	0	0	0	0	0	0	0	0						0	X		7	7
Tytonidae	*Tyto novaehollandiae*	Masked Owl	0	0	0	0	0	0	0	0	0	0	0	0						0			2	2
Reptiles																								
Agamidae	*Ctenophorus ornatus*	Ornate Crevice-dragon	0	0	0	0	5	0	0	0	0	0	0	0						15			0	20
Boidae	*Morelia spilota imbricata*	Carpet Python	0	0	0	0	0	0	0	0	0	0	0	0						2			0	2
Carphodactylidae	*Underwoodisaurus milii*	Barking Gecko	0	0	0	0	2	0	0	0	0	0	5	0						45			0	52

Family	Taxa	Common name	TL 1	TL2	TL3	TL4	TL5	TL6	TL7	TL8	TL9	TL10	TL11	TL12	Cage Line 1	Cage Line 2	Cage Line 3	Cage Line 4	Cage Line 5	Other (eg. active search etc)	Bird acoustic	Bat acoustic	Camera	Total
Elapidae	*Acanthophis antarcticus*	Southern Death Adder	0	0	0	0	0	0	0	0	0	0	0	0						2			0	2
Elapidae	*Suta gouldii*	Gould's hooded snake	0	0	0	0	0	0	0	0	0	0	0	0						2			0	2
Gekkonidae	*Diplodactylus lateroides*	Speckled stone gecko	0	0	0	0	0	0	0	0	0	0	0	0						2			0	2
Scincidae	*Tiliqua rugosa*	Bobtail	0	0	0	0	0	0	0	0	0	0	0	0						0			5	5
Scincidae	*Cryptoblepharus buchananii*	Buchanan's Snake-eyed Skink	0	0	0	0	0	0	0	0	0	0	0	0						2				2
Scincidae	*Menetia greyii*	Common Dwarf skink	0	0	0	0	0	0	0	0	0	0	1	0						0			0	1
Scincidae	*Ctenotus labillardieri*	Common south-west Ctenotus	0	0	0	0	0	0	0	0	0	0	0	0						4			0	4
Scincidae	*Morethia obscura*	Shrubland Skink	0	0	0	0	0	0	0	0	1	1	0	0						0			0	2
Scincidae	*Acritoscincus trilineatus*	South western cool-skink	0	0	0	0	0	0	0	0	0	0	0	3						0			0	3
Scincidae	*Hemiergis initialis*	Southwestern earless skink	0	0	0	0	0	0	0	0	1	1	0	0						5			0	7
Scincidae	*Lerista distinguenda*	South-western Orange-tailed Slider	0	0	0	0	0	0	0	0	0	0	0	0						1				1
Varanidae	*Varanus gouldii*	Gould's Monitor	0	0	0	0	0	0	0	0	0	0	0	0						0			1	1
Varanidae	*Varanus tristis*	Black-headed Monitor	0	0	0	0	0	0	0	0	0	0	0	0						1				1
Varanidae	*Varanus rosenbergi*	Rosenberg's Monitor	0	0	0	0	0	0	0	0	0	0	0	0						0			1	1
Amphibians																								
Limnodynastidae	*Heleioporus eyrei*	Moaning Frog	0	0	0	0	1	0	0	0	0	0	1	0						0			0	2
Myobatrachidae	*Crinia pseudinsignifera*	Bleating Froglet	1	0	0	0	2	0	0	0	0	0	0	1						0			0	4
Myobatrachidae	*Crinia georgiana*	Quacking Frog	0	1	0	0	2	2	0	0	0	0	1	3						54			0	63
Myobatrachidae	*Crinia glauerti*	Glauert’s Froglet	0	0	0	0	0	0	0	0	0	0	0	0						51			0	51
Myobatrachidae	*Geocrinia leai*	Lea’s (ticking) frog	0	0	0	0	0	0	0	0	0	0	0	0						22			0	22
Pelodryadidae	*Litoria adelaidensis*	Slender Tree Frog	0	0	0	0	0	0	0	0	0	0	0	1						0			0	1

*Note: numbers per trap line include animals physically captured in traps as well as those detected via active search, bird census or opportunistically at that trap site.

X – indicates the presence of a species detected either by signs (scat, tracks, feathers, etc.) as well as those detected on an acoustic recorder where number of individuals could not be determined however presence of species could be confirmed.

Trap Line habitat assessment summary

Trap Line I.D	Location		Habitat type/structure	Veg condition	Aspect	Slope	Soil type	Soil colour	Drainage	Bare ground cover	Litter cover	Last fire	Disturbance
	Easting	Northing											
Trap Line 1	426987	6413519	Upland Jarrah Marri forest over mid storey shrubland. Mid to upper slope areas on gravel-lateritic clay loam soil.	Excellent	North/ East	none	gravel sandy clay	orange/ brown	Good	2-10%	31-70%	Moderate (3 to 5 yr) but for phase 2 the site was burnt 3 weeks prior	road
Trap Line 2	424252	6425012	Blackbutt forest over sparse *Banksia littoralis*.	Excellent	south	gentle	clay loam	brown	Good	2-10%	31-70%	Moderate (3 to 5 yr)	frequent fire
Trap Line 3	427900	6412972	Melaleuca dampland - with isolated Jarrah over sparse isolated *Banksia littoralis* low shrubs on grey clay loam.	Excellent	Flat	none	clay	pale brown	poor	2-10%	50-10%	Moderate (3 to 5 yr)	negligible
Trap Line 4	426279	6422853	Upland Jarrah Marri forest over mid storey shrubland. Mid to upper slope areas on gravel-lateritic clay loam soil.	Excellent	Flat	none	gravel sandy clay	orange/ brown	Good	2-10%	31-70%	Old (6+ yr)	road
Trap Line 5	419173	6422951	Granite Outcrop with *Banksia* woodland - *Melaleuca pressiana*, Jarrah Marri forest, over mid shrubland.	Very Good	Flat	none	Sand	grey	Good	2-10%	31-70%	Moderate (3 to 5 yr)	fire
Trap Line 6	420734	6417238	Flooded Gum woodland - tall open forest associated with drainage lines. Low sparse woodland over long low shrub/sedgeland	Very Good	Flat	none	Clay	brown	Seasonal wet	2-10%	11-30%	Moderate (3 to 5 yr)	negligible
Trap Line 7	421559	6418605	Jarrah Marri forest with Sheoak over low closed shrub	Excellent	Flat		Gritty sand	yellow/ brown	Good	11-30%	11-30%	Moderate (3 to 5 yr)	negligible

Trap Line 8	428302	6417251	Upland Jarrah Marri forest with Sheoak.	Excellent	West	gentle	Gritty sand	yellow	Good	2-10%	31-70%	Old (6+ yr)	road
Trap Line 9	427604	6410609	Jarrah Marri forest with Sheoak over low open woodland and shrubland	Excellent	North/ East	none	Gritty sand	orange	Good	11-30%	31-70%	Old (6+ yr)	negligible
Trap Line 10	413197	6421772	Jarrah Marri forest Low Hills - occasional Sheoak, over *Banksia grandis*, low-mid shrubland.	Excellent	East	gentle	Gritty sand	yellow	Good	2-10%	31-70%	Old (6+ yr)	negligible
Trap Line 11	424815	6421905	Granite Outcrop amongst Jarrah Marri forest with Sheoak	Excellent	North/ East	moderate	Gritty sand	yellow	Good	<2%	31-70%	Old (6+ yr)	Dieback (?) uphill
Trap Line 12	418020	6420561	*Banksia littoralis* Riparian, Jarrah Marri forest, with Sheoak over shrubs	Very Good	Flat	gentle	Gritty sand	orange	Seasonal wet	2-10%	11-30%	Old (6+ yr)	road

Results from bird acoustic analysis

Bat call analysis summary report

Call identification was assisted by consulting distribution information for potential species (Armstrong 2011; Churchill 2008; Van Dyck *et al.* 2013) and records from NatureMap (2020). No reference calls were collected during the survey.

Data was processed and analysed using a combination of manual review and automated processes using Kaleidoscope Pro (Wildlife Acoustic, version 5.3.6) and Anabat Insight (Titley Scientific, version 1.9.2) using the following process:

1. Files were downloaded from the units and saved to an external hard drive (back up copy) following the survey for later processing and analysis
2. For compressed .wav4 and .wac files (full spectrum) collected using the Song Meter units, files were converted to standard .wav using the conversion function in Kaleidoscope Pro
3. For each night data was manually reviewed for bat calls using Kaleidoscope Pro or Anabat Insight from sunset onwards for approximately 30 minutes by visually comparing the time-frequency graph and call characteristics (e.g. peak frequency, characteristic frequency and call shape) with species call descriptions from published guidelines (e.g. Webala *et al*. 2010, Burgar *et al* various dates)
4. Data was then processed using Wildlife Acoustic Kaleidoscope Pro signal parameter batch processing, then cluster analysis features
5. Data from the cluster analysis process was then labelled and reviewed against the data labelled during step 3 for validation purposes to accurately identify species.

A call (pass) was defined as a sequence of three or more consecutive pulses of similar frequency. Calls with less than three defined consecutive pulses of similar frequency and shape were not unambiguously identified to a species but may be used as part of the activity count for the Survey Area. Due to variability in the quality of calls and the difficulty in distinguishing some species the identification of each call was assigned a confidence rating (see Mills *et al.* 1996 & Duffy *et al*. 2000) during the manual validation process as summarised in the table below.

Confidence rating applied to calls

Identification	Description
D - Definite	Species identification not in doubt.
PR - Probable	Call most likely to represent a particular species, but there exists a low probability of confusion with species of similar call type or call lacks sufficient detail.
SG - Species Group	Call made by one of two or more species. Call characteristics overlap, particularly poor quality calls or mixed species calls making it difficult to distinguish between species.

Bat detector effort and site location

Bat detector site	Phase	Detector name	Start Date	End Date	Easting	Northing	Location details
1	1	sm4-1	24/06/20	30/06/20	426282	6417199	Along cage line 41-50
2	1	sm4-5	24/06/20	29/06/20	419249	6423008	TL1
3	1	sm2-3	24/06/20	30/06/20	417973	6420593	Drainage line
4	1	sm4-4	24/06/20	30/06/20	417931	6422315	Drainage line
5	1	sm4-5	29/06/20	2/07/20	421589	6418754	Near TL2 in blackbutt
6	1	sm4-1	30/06/20	2/07/20	427915	6412940	TL5
7	1	sm4-4	30/06/20	3/07/20	425197	6414173	open Jarrah between tl2 and tl3
8	1	sm2-3	30/06/20	2/07/20	424270	6416696	near TL3 - melaleuca lowland/Jarrah
9	1	sm4-5	2/07/20	6/07/20	427860	6411147	on granite boulder, surface water present, near tl6
10	1	sm4-1	2/07/20	4/07/20	425818	6421856	upland Jarrah/Marri woodland
11	1	sm4-4	3/07/20	6/07/20	421309	6416290	Jarrah woodland
12	2	SM4-4	3/11/20	5/11/20	415676	6414950	Granite
13	2	SM4-1	3/11/20	6/11/20	420798	6417251	Granite
14	2	SM4-4	3/11/20	6/11/20	420771	6417263	Serpentine Dam carpark
15	2	SM4-1	6/11/20	9/11/20	426302	6422178	Near eastern survey boundary
16	2	SM4-2	6/11/20	9/11/20	425097	6426021	Northern Survey Area
17	2	SM2-3	6/11/20	9/11/20	423254	6417433	Undulating low hills
18	2	SM4-4	6/11/20	9/11/20	421492	6418891	TL2
19	2	SM4 -1	9/11/20	11/11/20	422176	6420640	Central north - drainage line?

Results

Approximately 59,516 full spectrum .wav files were analysed (all sites all nights combined) of which approximately 68% were identified as bat call of some description. At least seven species were positively (Definite) identified of the 11 or so species that are known to occur from the locality of the Study Area. As many as two other species may also have been recorded, but poor data quality and/or interspecific call similarities precluded reliable identification of additional species. Table 3, 4, 5 and 3 provides a list of definite and probable species recorded for each night.

No threatened species listed under the *Biodiversity Conservation Act 2016* and *Environment Protection and Biodiversity Conservation Act 1999* were recorded (Definite) as a result of call analysis.

Myara North Phase 1 bat call analysis results per site

Site / date	White-striped Free-tailed Bat *Austronomus australis*	South-Western Free-tailed Bat *Ozimops kitcheneri*	Gould's Wattled Bat *Chalinolobus gouldii*	*C. gouldii/O. kitcheneri*	Western False Pipistrelle *Falsistrellus mackenziei*	Southern Forest Bat *Vespadelus regulus*	Chocolate Wattled Bat *Chalinolobus morio*	Long-eared Bat sp *Nyctophilus geoffroyi/gouldi/major*
SM2-3								
24/06/2020	D					D		
25/06/2020						D		
26/06/2020	D				D	D		
27/06/2020					D	D		
SM4-1								
26/06/2020		D				D		
27/06/2020		D		SG		D		
28/06/2020				SG				
30/06/2020		D	D			D		
1/07/2020		D	D		PR	D		SG
3/07/2020						D		
SM4-4								
24/06/2020		D		SG		D		
25/06/2020	D					D		
26/06/2020		D		SG		D	PR	
27/06/2020			D	SG		D		
28/06/2020						PR		
30/06/2020		PR	PR					
1/07/2020		PR				D		
3/07/2020						D		SG
4/07/2020		D		SG		D		
5/07/2020		D	D		D	D		
6/07/2020						PR		
SM4-5								
24/06/2020						D		
25/06/2020		PR				PR		
27/06/2020	D					D	PR	
28/06/2020						D		SG
29/06/2020				SG				
30/06/2020						D		SG
1/07/2020						D		
2/07/2020						D		
3/07/2020						D		
4/07/2020		D	D			D		

Myara North Phase 2 bat call analysis results per site

Site / date	White-striped Free-tailed Bat *Austronomus australis*	South-Western Free-tailed Bat *Ozimops kitcheneri*	Gould's Wattled Bat Chalinolobus gouldii	C. gouldii/ F. mackenzie	Western False Pipistrelle *Falsistrellus mackenziei*	Southern Forest Bat *Vespadelus regulus*	Chocolate Wattled Bat *Chalinolobus morio*
SM2-3							
6/11/2020	D	PR	D	SG		D	D
7/11/2020	D	D	D	SG	PR	D	D
8/11/2020	D	D	D	SG	PR	D	D
9/11/2020		PR	D	SG		D	
SM4-1A							
3/11/2020		D				D	
4/11/2020	D	PR				D	
5/11/2020	D	D		SG		D	
6/11/2020	D	D	D	SG	D	D	D
7/11/2020		PR	D	SG	D	D	D
8/11/2020	D	D	D	SG	D	D	PR
9/11/2020	D					PR	
SM4-2							
6/11/2020	D	PR		SG	PR	D	
7/11/2020	D		D	SG	D	D	
8/11/2020	D	D	D	SG		D	
9/11/2020	D	PR	D	SG	PR	D	
SM4-4							
3/11/2020	D	PR				D	
4/11/2020		D				D	
5/11/2020	D	PR		SG	D	D	
6/11/2020	D	D	D	SG	D	D	D
7/11/2020	D	D	D	SG	PR	D	D
8/11/2020	D	D	D	SG	D	D	D
9/11/2020		PR				D	PR

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Rakali transcript data

Myara North Rakali												Rakali evidence			Other evidence							Suitability	
Plot	date	Lats	Long	type	size	bank	substrate	vegetation	TsFire	water prnt/ size	condition	shtig	print	midn.	tdpls	frogs	Crust.	fish	Roo	Pig	water plant	Rakali	Comments
					(width)	(height)	(type)	(Broad type)	(years)														
R1	11/11/20	423939	6412164	creek	4m	1.8m	mud	mixed shrubs/sedge over Marri, Jarrah, Blackbutt	3-5y	yes-pool 4x1.5m x 15cm	Excellent						burrow, shells			trots		Potential seasonally	Mid Serpentine River
R2	11/11/20	427580	6410417	creek	4m	1.6m	mud	mixed shrubs/sedge over *E. rudis* and Blackbutt	3-5y	yes-pool 6x0.5m x 10cm	Excellent						burrow				yes	Too seasonal	Upper reaches Serpentine River
R3	10/11/20	425302	6413889	creek	3.5m	1m	mud	Low mixed shrubs over Marri, Jarrah, Melaleuca	3-5y	yes-pool 15x3m x 20cm	excellent				2		burrow					Too seasonal	
R4	10/11/20	424314	6416065	creek	2m	0.6m	rock/sand	regrowth mixed shrub	2y	dry	excellent									digs		Too seasonal	
R5	10/11/20	425384	6419120	creek	2.5m	1.2m	rock/sand	Mixed shrubs and sedge over Jarrah, Marri	3-5y	dry, damp soil	excellent				3	3					yes	Too seasonal	
R6	10/11/20	421498	6418609	creek	3m	1.6m	rocky/mud	Mixed shrub/ Bracken over Blackbutt, Marri	5-10y	dry	excellent											Too seasonal	
R7	10/11/20	416107	6417671	creek	2m	1m	loam	mixed shrub/sedge/Banksia over Marri/Jarrah	3-5y	dry	excellent				2							Too seasonal	
R8	10/11/20	417942	6420003	creek	3m	0.6m	bauxite	nothing	1y	yes-pool 3x10mx20cm	burnt					2						Too seasonal	
R9	11/11/20	420847	6407516	creek	20m	0.6m	rock/loam	regrowth mixed shrub and sedge	3-5y	yes -flow 1m deep	excellent					2	shells		scat	trot		suitable, large water body, specimen recorded on camera	Section of Big Brook
R10	11/11/20	419328	6404941	creek	3m	0.8m	rock/loam	mixed shrub/sedge/Banksia over Marri/Jarrah	5-10y	yes -flow to 3m deep	excellent					1			scat			suitable	
R11	5/11/20	419780	6417774	creek	5m	1.5m	mud/sand	mixed shrubs over Jarrah/Marri	10y	yes -flow 1m deep	pristine				6				2			suitable	
R12	4/11/2020	424220	6416019	creek	2m	0.6m	rock/sand	regrowth mixed shrub	2y	dry	excellent											Too seasonal	
R13	4/11/2020	425346	6413895	creek	4m	1.2m	rock/sand	mixed shrubs on granite	3-5y	yes-pool 4x3mx 40 cm	excellent											Too seasonal	
R14	5/11/2020	424902	6413431	creek	5m	1.5m	rock/sand	mixed shrubs on granite	3-5y	yes-pool 6 x 5mx 50 cm	excellent				4		burrow					Too seasonal	

Carters Freshwater Mussel transect data

Myara North Carters Freshwater Mussel												Mussel evidence			Other evidence							Suitability
Plot	date	Easting	Northing	type	size	bank	substrate	vegetation	TsFire	water present/ size	condition	sighting	shells	shells	tdpls	frogs	Yabbie	fish	Roo	Pig	wtrplnt	Mussel
					(wdth)	(hght)	(type)	(Broad type)	(yrs)	(cm)		(Live)	(water)	(bank)								
CFM1																						
1	11/11/20	423939	6412164	creek	4m	1.8m	mud	mixed shrubs/sedge over Marri/Jarrah/Blackbutt	3-5y	water 4x1.5m x 15cm	Excellent						burrow					Not suitable, too seasonal
2	11/11/20	423959	6412148	creek	4m	1.8m	mud	mixed shrubs/sedge over Marri/Jarrah/Blackbutt	3-5y	dry, damp	Excellent											Not suitable, too seasonal
3	11/11/20	423965	6412141	creek	4m	1.8m	mud	mixed shrubs/sedge over Marri/Jarrah/Blackbutt	3-5y	dry, damp	Excellent											Not suitable, too seasonal
4	11/11/20	423973	6412134	creek	4m	1.8m	mud	mixed shrubs/sedge over Marri/Jarrah/Blackbutt	3-5y	dry, damp	Excellent											Not suitable, too seasonal
5	11/11/20	423948	6412176	creek	4m	1.8m	mud	mixed shrubs/sedge over Marri/Jarrah/Blackbutt	3-5y	dry, damp	Excellent											Not suitable, too seasonal
6	11/11/20	423953	6412203	creek	4m	1.8m	mud	mixed shrubs/sedge over Marri/Jarrah/Blackbutt	3-5y	dry, damp	Excellent											Not suitable, too seasonal
7	11/11/20	423934	6412229	creek	4m	1.8m	mud/rock	mixed shrubs/sedge over Marri/Jarrah/Blackbutt	3-5y	dry, damp	Excellent											Not suitable, too seasonal
8	11/11/20	423906	6412241	creek	4m	1.8m	mud/rock	mixed shrubs/sedge over Marri/Jarrah/Blackbutt	3-5y	dry, damp	Excellent						shells					Not suitable, too seasonal
9	11/11/20	423887	6412256	creek	4m	1.8m	mud	mixed shrubs/sedge over Marri/Jarrah/Blackbutt	3-5y	dry, damp	Excellent									trot		Not suitable, too seasonal
10	11/11/20	423867	6412273	creek	4m	1.8m	mud	mixed shrubs/sedge over Marri/Jarrah/Blackbutt	3-5y	dry, damp	Excellent											Not suitable, too seasonal
CFM2																						
1	11/11/20	427580	6410417	creek	4m	1.6m	mud	mixed shrubs/sedge over *E.rudis*/Blackbutt	3-5y	water 6x0.5m x 10cm	Excellent						burrow				yes	Not suitable, too seasonal and small
2	11/11/20	427593	6410412	creek	4m	1.6m	mud	mixed shrubs/sedge over *E.rudis*/Blackbutt	3-5y	dry, damp	Excellent											Not suitable, too seasonal and small
3	11/11/20	427612	6410413	creek	4m	1.6m	mud	mixed shrubs/sedge over *E.rudis*/Blackbutt	3-5y	dry, damp	Excellent						burrow					Not suitable, too seasonal and small
4	11/11/20	427620	6410395	creek	4m	1.6m	mud	mixed shrubs/sedge over *E.rudis*/Blackbutt	3-5y	dry, damp	Excellent											Not suitable, too seasonal and small
5	11/11/20	427556	6410443	creek	4m	1.6m	mud	mixed shrubs/sedge over *E.rudis*/Blackbutt	3-5y	dry, damp	Excellent											Not suitable, too seasonal and small
6	11/11/20	427531	6410448	creek	4m	1.6m	mud	mixed shrubs/sedge over *E.rudis*/Blackbutt	3-5y	dry, damp	Excellent											Not suitable, too seasonal and small
7	11/11/20	427532	6410420	creek	4m	1.6m	mud	mixed shrubs/sedge over *E.rudis*/Blackbutt	3-5y	dry, damp	Excellent											Not suitable, too seasonal and small
8	11/11/20	427519	6410412	creek	4m	1.6m	mud	mixed shrubs/sedge over *E.rudis*/Blackbutt	3-5y	water 15x4m x 50cm	Excellent						burrow					Not suitable, too seasonal and small
9	11/11/20	427511	6410427	creek	4m	1.6m	mud	mixed shrubs/sedge over *E.rudis*/Blackbutt	3-5y	water 15x4m x 50cm	Excellent						burrow					Not suitable, too seasonal and small
CFM3																						

Myara North Carters Freshwater Mussel												Mussel evidence			Other evidence							Suitability
Plot	date	Easting	Northing	type	size	bank	substrate	vegetation	TsFire	water present/ size	condition	sighting	shells	shells	tdpls	frogs	Yabbie	fish	Roo	Pig	wtrplnt	Mussel
					(wdth)	(hght)	(type)	(Broad type)	(yrs)	(cm)		(Live)	(water)	(bank)								
1	10/11/20	425302	6413889	creek	3.5m	1m	mud	Low mixed shrubs over Marri/Jarrah/Melaleuca	3-5y	water 15x3m x 20cm	excellent											Not suitable, too seasonal and small
2	10/11/20	425328	6413913	creek	3.5m	1m	mud	Low mixed shrubs over Marri/Jarrah/Melaleuca	3-5y	water 4x3m x 10cm	excellent				2		burrow					Not suitable, too seasonal and small
3	10/11/20	425349	6413897	creek	3.5m	1m	granite	Low mixed shrubs over Marri/Jarrah/Melaleuca	3-5y	water 12x3m x 30cm	excellent						burrow					Not suitable, too seasonal and small
4	10/11/20	425383	6413884	creek	3.5m	1m	granite	Low mixed shrubs over Marri/Jarrah/Melaleuca	3-5y	dry	excellent											Not suitable, too seasonal and small
5	10/11/20	425411	6413878	creek	3.5m	1m	granite	Low mixed shrubs over Marri/Jarrah/Melaleuca	3-5y	dry	excellent											Not suitable, too seasonal and small
6	10/11/20	425306	6413865	creek	3.5m	1m	sand/rock	Low mixed shrubs over Marri/Jarrah/Melaleuca	3-5y	dry, damp soil	excellent											Not suitable, too seasonal and small
7	10/11/20	425312	6413842	creek	3.5m	1m	sand/rock	Low mixed shrubs over Marri/Jarrah/Melaleuca	3-5y	dry, damp soil	excellent											Not suitable, too seasonal and small
8	10/11/20	425283	6413823	creek	3.5m	1m	sand/rock	Low mixed shrubs over Marri/Jarrah/Melaleuca	3-5y	dry, damp soil	excellent											Not suitable, too seasonal and small
9	10/11/20	425246	6413809	creek	3.5m	1m	sand/rock	Low mixed shrubs over Marri/Jarrah/Melaleuca	3-5y	dry, damp soil	excellent											Not suitable, too seasonal and small
10	10/11/20	425217	6413809	creek	3.5m	1m	sand/rock	Low mixed shrubs over Marri/Jarrah/Melaleuca	3-5y	dry, damp soil	excellent											Not suitable, too seasonal and small
CFM4																						
1	10/11/20	424314	6416065	creek	2m	0.6m	rock/sand	regrowth mixed shrub	2y	dry	excellent											Not suitable, too seasonal and small
2	10/11/20	424340	6416092	creek	2m	0.6m	rock/sand	regrowth mixed shrub	2y	dry	excellent											Not suitable, too seasonal and small
3	10/11/20	424368	6416108	creek	3m	0.6m	rock/sand	regrowth mixed shrub	2y	dry	excellent											Not suitable, too seasonal and small
4	10/11/20	424404	6416136	creek	2m	0.6m	sand	regrowth mixed shrub	2y	dry	excellent											Not suitable, too seasonal and small
5	10/11/20	424400	6416176	creek	2m	0.6m	sand	regrowth mixed shrub	2y	dry	excellent											Not suitable, too seasonal and small
6	10/11/20	424291	6416034	creek	2m	0.6m	sand damp	regrowth mixed shrub	2y	dry	excellent											Not suitable, too seasonal and small
7	10/11/20	424269	6416056	creek	2m	1m	sand damp	regrowth mixed shrub	2y	dry	excellent									digs		Not suitable, too seasonal and small

Myara North Carters Freshwater Mussel												Mussel evidence			Other evidence							Suitability
Plot	date	Easting	Northing	type	size	bank	substrate	vegetation	TsFire	water present/ size	condition	sighting	shells	shells	tdpls	frogs	Yabbie	fish	Roo	Pig	wtrplnt	Mussel
					(wdth)	(hght)	(type)	(Broad type)	(yrs)	(cm)		(Live)	(water)	(bank)								
8	10/11/20	424231	6416035	creek	2m	1m	sand damp	regrowth mixed shrub	2y	dry	excellent									digs		Not suitable, too seasonal and small
9	10/11/20	424197	6416010	creek	2m	1m	rock/sand	regrowth mixed shrub	2y	dry	excellent									digs		Not suitable, too seasonal and small
10	10/11/20	424176	6416000	creek	2m	1m	rock/sand	regrowth mixed shrub	2y	dry	excellent									digs		Not suitable, too seasonal and small
CFM5																						
1	10/11/20	425384	6419120	creek	2.5m	1.2m	rock/sand	Mixed shrubs and sedge over Jarrah/Marri	3-5y	dry, damp soil	excellent											Not suitable, too seasonal and small
2	10/11/20	425343	6419098	creek	2.5m	1.2m	rock/sand	Mixed shrubs and sedge over Jarrah/Marri	3-5y	water 6x4mx40cm	excellent				3	3					yes	Not suitable, too seasonal and small
3	10/11/20	425316	6419108	creek	2.5m	1.2m	rock/sand	Mixed shrubs and sedge over Jarrah/Marri	3-5y	dry, damp soil	excellent											Not suitable, too seasonal and small
4	10/11/20	425381	6419083	creek	2.5m	1.2m	rock/sand	Mixed shrubs and sedge over Jarrah/Marri	3-5y	dry, damp soil	excellent											Not suitable, too seasonal and small
5	10/11/20	425414	6419077	creek	2.5m	1.2m	rock/sand	Mixed shrubs and sedge over Jarrah/Marri	3-5y	dry, damp soil	excellent											Not suitable, too seasonal and small
6	10/11/20	425292	6419119	creek	2.5m	1.2m	rock/sand	Mixed shrubs and sedge over Jarrah/Marri	3-5y	water 6x4mx30cm	excellent				1	1					yes	Not suitable, too seasonal and small
7	10/11/20	425271	6419130	creek	2.5m	1.2m	rock/sand	Mixed shrubs and sedge over Jarrah/Marri	3-5y	water 3x3mx20cm	excellent				1	1					yes	Not suitable, too seasonal and small
8	10/11/20	425247	6419119	creek	2.5m	1.2m	rock/sand	Mixed shrubs and sedge over Jarrah/Marri	3-5y	dry, damp soil	excellent											Not suitable, too seasonal and small
9	10/11/20	425218	6419138	creek	2.5m	1.2m	rock/sand	Mixed shrubs and sedge over Jarrah/Marri	3-5y	water 35x2mx30cm	excellent				2						yes	Not suitable, too seasonal and small
10	10/12/20	425193	6419143	creek	2.5m	1.2m	rock/sand	Mixed shrubs and sedge over Jarrah/Marri	3-5y	dry, damp soil	excellent											Not suitable, too seasonal and small
CFM6																						
1	10/11/20	421498	6418609	creek	3m	1.6m	rocky/mud	Mixed shrub/ Bracken over Blackbutt/Marri	5-10y	dry	excellent											Not suitable, too seasonal and small
2	10/11/20	421539	6418540	creek	3m	1.6m	rocky/mud	Mixed shrub/ Bracken over Blackbutt/Marri	5-10y	dry	excellent											Not suitable, too seasonal and small
3	10/11/20	421557	6418506	creek	3m	1.6m	rocky/mud	Mixed shrub/ Bracken over Blackbutt/Marri	5-10y	dry	excellent											Not suitable, too seasonal and small
4	10/11/20	421592	6418460	creek	3m	1.6m	rocky/mud	Mixed shrub/ Bracken over Blackbutt/Marri	5-10y	dry	excellent											Not suitable, too seasonal and small

Myara North Carters Freshwater Mussel												Mussel evidence			Other evidence							Suitability
Plot	date	Easting	Northing	type	size	bank	substrate	vegetation	TsFire	water present/ size	condition	sighting	shells	shells	tdpls	frogs	Yabbie	fish	Roo	Pig	wtrplnt	Mussel
					(wdth)	(hght)	(type)	(Broad type)	(yrs)	(cm)		(Live)	(water)	(bank)								
5	10/11/20	421580	6418419	creek	3m	1.6m	rocky/mud	Mixed shrub/ Bracken over Blackbutt/Marri	5-10y	dry	excellent											Not suitable, too seasonal and small
6	10/11/20	421549	6418394	creek	3m	1.6m	rocky/mud	Mixed shrub/ Bracken over Blackbutt/Marri	5-10y	dry, moist	excellent											Not suitable, too seasonal and small
7	10/11/20	421559	6418365	creek	3m	1.6m	rocky/mud	Mixed shrub/ Bracken over Blackbutt/Marri	5-10y	dry	excellent											Not suitable, too seasonal and small
8	10/11/20	421573	6418340	creek	3m	1.6m	rocky/mud	Mixed shrub/ Bracken over Blackbutt/Marri	5-10y	dry	excellent											Not suitable, too seasonal and small
9	10/11/20	421585	6418327	creek	3m	1.6m	rocky/mud	Mixed shrub/ Bracken over Blackbutt/Marri	5-10y	dry	excellent											Not suitable, too seasonal and small
10	10/11/20	421596	6418303	creek	3m	1.6m	rocky/mud	Mixed shrub/ Bracken over Blackbutt/Marri	5-10y	dry	excellent											Not suitable, too seasonal and small
CFM7																						
1	10/11/20	416107	6417671	creek	2m	1m	loam	mixed shrub/sedge/Banksia over Marri/Jarrah	3-5y	dry	excellent											Not suitable, too seasonal and small
2	10/11/20	416107	6417651	creek	2m	1m	loam	mixed shrub/sedge/Banksia over Marri/Jarrah	3-5y	dry	excellent											Not suitable, too seasonal and small
3	10/11/20	416114	6417626	creek	2m	1m	loam	mixed shrub/sedge/Banksia over Marri/Jarrah	3-5y	dry	excellent											Not suitable, too seasonal and small
4	10/11/20	416122	6417597	creek	2m	1m	loam	mixed shrub/sedge/Banksia over Marri/Jarrah	3-5y	dry	excellent											Not suitable, too seasonal and small
5	10/11/20	416133	6417579	creek	2m	1m	loam	mixed shrub/sedge/Banksia over Marri/Jarrah	3-5y	water 3x1mx20cm	excellent				2							Not suitable, to seasonal and small
6	10/11/20	416093	6417700	creek	2m	1m	loam	mixed shrub/sedge/Banksia over Marri/Jarrah	3-5y	dry	excellent											Not suitable, too seasonal and small
7	10/11/20	416086	6417680	creek	2m	1m	loam	mixed shrub/sedge/Banksia over Marri/Jarrah	3-5y	dry	excellent											Not suitable, to seasonal and small
8	10/11/20	416068	6417739	creek	2m	1m	loam	mixed shrub/sedge/Banksia over Marri/Jarrah	3-5y	dry	excellent											Not suitable, too seasonal and small
9	10/11/20	416047	6417809	creek	2m	1m	loam	mixed shrub/sedge/Banksia over Marri/Jarrah	3-5y	dry	excellent											Not suitable, too seasonal and small
10	10/11/20	416002	6417853	creek	2m	1m	loam	mixed shrub/sedge/Banksia over Marri/Jarrah	3-5y	dry	excellent											Not suitable, too seasonal and small
CFM8																						
1	10/11/20	417942	6420003	creek	3m	0.6m	bauxite	nothing	1y	dry	burnt					1						Not suitable, too seasonal and rocky

Myara North Carters Freshwater Mussel												Mussel evidence			Other evidence							Suitability
Plot	date	Easting	Northing	type	size	bank	substrate	vegetation	TsFire	water present/ size	condition	sighting	shells	shells	tdpls	frogs	Yabbie	fish	Roo	Pig	wtrplnt	Mussel
					(wdth)	(hght)	(type)	(Broad type)	(yrs)	(cm)		(Live)	(water)	(bank)								
2	10/11/20	417924	6420010	creek	3m	0.6m	bauxite	nothing	1y	dry	burnt					1						Not suitable, too seasonal and rocky
3	10/11/20	417913	6420038	creek	3m	0.6m	bauxite	nothing	1y	puddle 30x 30cm	burnt											Not suitable, too seasonal and rocky
4	10/11/20	417906	6420057	creek	3m	0.6m	bauxite	nothing	1y	dry	burnt					1						Not suitable, too seasonal and rocky
5	10/11/20	417883	6420068	creek	3m	0.6m	bauxite	nothing	1y	dry	burnt					1						Not suitable, too seasonal and rocky
6	10/11/20	417937	6419988	creek	3m	0.6m	bauxite	nothing	1y	dry	burnt											Not suitable, too seasonal and rocky
7	10/11/20	417946	6419970	creek	3m	0.6m	bauxite	nothing	1y	dry	burnt											Not suitable, too seasonal and rocky
8	10/11/20	417969	6419946	creek	3m	0.6m	bauxite	nothing	1y	water 3x10mx20cm	burnt					2						Not suitable, too seasonal and rocky
9	10/11/20	417977	6419923	creek	3m	0.6m	bauxite	nothing	1y	dry	burnt					1						Not suitable, too seasonal and rocky
10	10/11/20	417998	6419892	creek	3m	0.6m	bauxite	nothing	1y	dry	burnt					1						Not suitable, too seasonal and rocky
CFM9																						
1	11/11/20	420847	6407516	creek	20m	0.6m	rock/loam	regrowth mixed shrub and sedge	3-5y	yes -flow 1m deep	excellent					2						Possibly suitable
2	11/11/20	420834	6407529	creek	20m	0.6m	rock/loam	regrowth mixed shrub and sedge	3-5y	yes -flow 1m deep	excellent											Possibly suitable
3	11/11/20	420821	6407540	creek	20m	0.6m	rock/loam	regrowth mixed shrub and sedge	3-5y	yes -flow 1m deep	excellent						shells			trot		Possibly suitable
4	11/11/20	420811	6407555	creek	20m	0.6m	rock/loam	regrowth mixed shrub and sedge	3-5y	yes -flow 1m deep	excellent											Possibly suitable
5	11/11/20	420799	6407589	creek	20m	0.6m	rock/loam	regrowth mixed shrub and sedge	3-5y	yes -flow 1m deep	excellent											Possibly suitable
6	11/11/20	420855	6407510	creek	20m	0.6m	rock/loam	regrowth mixed shrub and sedge	3-5y	yes -flow 1m deep	excellent											Possibly suitable
7	11/11/20	420884	6407472	creek	20m	0.6m	rock/loam	regrowth mixed shrub and sedge	3-5y	yes -flow 1m deep	excellent					1						Possibly suitable
8	11/11/20	420914	6407469	creek	20m	0.6m	rock/loam	regrowth mixed shrub and sedge	3-5y	dry bit	excellent									digs		Possibly suitable
9	11/11/20	420949	6407450	creek	20m	0.6m	rock/loam	regrowth mixed shrub and sedge	3-5y	dry bit	excellent									digs		Possibly suitable
10	11/11/20	420927	6407421	creek	20m	0.6m	rock/loam	regrowth mixed shrub and sedge	3-5y	dry bit	excellent									digs		Possibly suitable
CFM10																						
1	11/11/20	419328	6404941	creek	3m	0.8m	rock/loam	mixed shrub/sedge/Banksia over Marri/Jarrah	5-10y	yes -flow to 3m deep	excellent					1						suitable

Myara North Carters Freshwater Mussel												Mussel evidence			Other evidence							Suitability
Plot	date	Easting	Northing	type	size	bank	substrate	vegetation	TsFire	water present/ size	condition	sighting	shells	shells	tdpls	frogs	Yabbie	fish	Roo	Pig	wtrplnt	Mussel
					(wdth)	(hght)	(type)	(Broad type)	(yrs)	(cm)		(Live)	(water)	(bank)								
2	11/11/20	419327	6404972	creek	3m	0.8m	rock/loam	mixed shrub/sedge/Banksia over Marri/Jarrah	5-10y	yes -flow to 3m deep	excellent					1						suitable
3	11/11/20	419339	6404993	creek	3m	0.8m	rock/loam	mixed shrub/sedge/Banksia over Marri/Jarrah	5-10y	yes -flow to 3m deep	excellent					1						suitable
4	11/11/20	419344	6405002	creek	3m	0.8m	clay	mixed shrub/sedge/Banksia over Marri/Jarrah	5-10y	yes -flow to 3m deep	excellent					1						suitable
5	11/11/20	419356	6405027	creek	3m	0.8m	sand/clay	mixed shrub/sedge/Banksia over Marri/Jarrah	5-10y	yes -flow to 3m deep	excellent					1						suitable
6	11/11/20	419364	6405047	creek	3m	0.8m	rock/loam	mixed shrub/sedge/Banksia over Marri/Jarrah	5-10y	yes -flow to 3m deep	excellent					1			scat			suitable
7	11/11/20	419391	6405078	creek	3m	0.8m	sand/clay	mixed shrub/sedge/Banksia over Marri/Jarrah	5-10y	yes -flow to 3m deep	excellent					1						suitable
8	11/11/20	419407	6405105	creek	3m	0.8m	sand/clay	mixed shrub/sedge/Banksia over Marri/Jarrah	5-10y	yes -flow to 3m deep	excellent					1						suitable
9	11/11/20	419411	6405121	creek	3m	0.8m	sand/clay	mixed shrub/sedge/Banksia over Marri/Jarrah	5-10y	yes -flow to 3m deep	excellent					1			scat			suitable
10	11/11/20	419431	6405120	creek	3m	0.8m	sand/clay	mixed shrub/sedge/Banksia over Marri/Jarrah	5-10y	yes -flow to 3m deep	excellent					1						suitable
CFM11																						
1	5/11/20	419780	6417774	creek	5m	1.5m	mud/sand	mixed shrubs over Jarrah/Marri	10y	yes -flow 1m deep	pristine								2			suitable
2	5/11/20	419781	6417765	creek	5m	1.5m	mud/sand	mixed shrubs over Jarrah/Marri	10y	yes -flow 1m deep	pristine											suitable
3	5/11/20	419787	6417750	creek	5m	1.5m	mud/sand	mixed shrubs over Jarrah/Marri	10y	yes -flow 1m deep	pristine											suitable
4	5/11/20	419782	6417742	creek	5m	1.5m	mud/sand	mixed shrubs over Jarrah/Marri	10y	yes -flow 1m deep	pristine				2							suitable
5	5/11/20	419777	6417730	creek	5m	1.5m	mud/sand	mixed shrubs over Jarrah/Marri	10y	yes -flow 1m deep	pristine				2							suitable
6	5/11/20	419767	6417730	creek	5m	1.5m	mud/sand	mixed shrubs over Jarrah/Marri	10y	yes -flow 1m deep	pristine											suitable
7	5/11/20	419754	6417719	creek	5m	1.5m	mud/sand	mixed shrubs over Jarrah/Marri	10y	yes -flow 1m deep	pristine				2							suitable
8	5/11/20	419729	6417721	creek	5m	1.5m	mud/sand	mixed shrubs over Jarrah/Marri	10y	yes -flow 1m deep	pristine											suitable
9	5/11/20	419717	6417721	creek	5m	1.5m	mud/sand	mixed shrubs over Jarrah/Marri	10y	yes -flow 1m deep	pristine											suitable
10	5/11/20	419711	6417717	creek	5m	1.5m	mud/sand	mixed shrubs over Jarrah/Marri	10y	yes -flow 1m deep	pristine											suitable
11	5/11/20	419705	6417709	creek	5m	1.5m	mud/sand	mixed shrubs over Jarrah/Marri	10y	yes - ends granite	pristine											suitable

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The Power of Commitment