Fauna Assessment

Murchison Green Hydrogen Project

Murchison Hydrogen Renewables Pty Ltd as trustee for the Murchison Hydrogen Renewables Trust

4 June 2024

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Executive summary

This report is subject to, and must be read in conjunction with, the limitations set out in Section 1.2 and the assumptions and qualifications contained throughout the report.

Project Background

Murchison Hydrogen Renewables Pty Ltd as trustee for the Murchison Hydrogen Renewables Trust (MHR) is proposing to construct a combined onshore wind and solar energy farm for the production of green ammonia (the Project). The Project will comprise of a 5241 megawatt (MW) power-to-ammonia plant located in the vicinity of Kalbarri, Western Australia. GHD understands that environmental approvals are a critical path for achieving the Murchison Project team's objective of commencing construction of the project in Kalbarri in the near future. GHD will be undertaking environmental investigations to support environmental impact assessment of its future operations. The surveys will build on the terrestrial fauna data collected from within the survey Areas and include a targeted significant fauna survey. The surveys comprise:

- A detailed two-phase (autumn and spring) vertebrate fauna and invertebrate SRE survey including target survey to determine the suite of fauna species that occur within the survey area and expand the area of fauna habitat mapping
- A targeted significant fauna survey, for locally occurring significant vertebrate fauna.

MHR has engaged GHD as a preferred partner for providing assessment and approval services. As part of this engagement, GHD was authorised to conduct a Detailed and Targeted Fauna Assessment, the results of which are presented in this report.

Survey Area

The survey Area is north of Kalbarri and covers an area of approximately 80,000 ha. Figure 1, Appendix A presents a locality map showing the study Area.

Survey methods

Targeted vertebrate fauna surveys were undertaken between November 2021 and February 2023. A detailed two-phase and targeted vertebrate fauna survey was undertaken between August and October 2022, and September 2023. Phase 1 was a late winter season trapping program, with Phase 2 being a spring season trapping program (as well as targeted significant assessments). All surveys included remote camera, acoustic and bat recorder deployment. Trapping for terrestrial vertebrate fauna was undertaken using a series of standardised systematic trapping quadrat sites and non-systematic survey methods. Habitat assessment was conducted along side vegetation surveys.

Targeted assessments were undertaken for the following significant species considered likely to occur within the survey area;

– All Migratory Shorebirds and avian species
– Malleefowl
– Western Spiny-tailed Skink
– Zuytdorp Worm Lizard/Taper-tailed West Coast slider

Key Findings

Twelve broad fauna habitat types were recorded in the Survey Area and include; York Gum woodland, Jam shrubland, Mallee woodland, Mixed shrubland, Acacia shrubland, Coastal heathland, Beach/ Coastal dunes and ridges, Limestone hills and ridgelines, Coastal shrublands, Clay Pans/Lake Culcurdoo, Minor creeks and drainage line and Cleared areas/ Farmland. The habitats in the Survey Area were continuous in the landscape and extended beyond the survey area.

The grazing pressures from goats on the landscape had impacted areas of the survey area which was in poor to good condition depending on position in the landscape and water points within the area. The remainder of the survey area was in very good to pristine condition primarily due to the lack of goat and pig disturbance.

The fauna surveys conducted from November 2021 to February 2023 recorded 262 vertebrate fauna species comprising 28 mammals, 156 birds, 72 reptiles and 6 amphibians species. Of these seven were introduced fauna species.

Of the species recorded, the following significant vertebrate species were recorded within the survey area.

- Western Spiny-tailed Skink (*Egernia stokesii badia*) listed as Endangered under EPBC Act and Vulnerable under the BC Act.
- Taper-tailed West Coast slider (*Lerista humphriesi*) listed as Priority 3 under the BC Act
- Malleefowl (*Leipoa ocellata*) listed as Vulnerable under the BC and EPBC Act
- Carnaby's Cockatoo (*Zanda latirostris*) listed as Endangered under EPBC Act
- Western Grasswren (*Amytornis textilis*) possible sighting not confirmed, listed as Priority 4 under the BC Act

The following Migratory birds were recorded within the survey area:

- Fork-tailed Swift *(Apus pacificus*), listed as migratory/marine under the EPBC Act
- Greater Sand Plover (*Charadrius leschenaultia*), listed as migratory/marine under the EPBC Act
- Gull-billed Tern (*Sterna nilotica*), listed as migratory/marine under the EPBC Act
- Crested Tern (*Thalasseus bergii*), listed as migratory/marine under the EPBC Act
- Caspian Tern (*Hydroprogne caspia*), listed as migratory/marine under the EPBC Act
- Osprey (*Pandion cristatus*), listed as migratory/marine under the EPBC Act
- Red-necked Stint (*Calidris ruficollis*), listed as migratory/marine under the EPBC Act
- Wedge-tailed Shearwater (*Ardenna pacifica*), listed as migratory/marine under the EPBC Act
- Wilson's Storm Petrel (*Oceanites oceanicus*), listed as migratory/marine under the EPBC Act
- Sanderling (*Calidris alba*), listed as migratory/marine under the EPBC Act
- Bar-tailed Godwit (*Limosa lapponica menzbieri*), listed as migratory/marine and Vulnerable under the BC and EPBC Act
- Common Sandpiper (*Actitis hypoleucos*), listed as migratory/marine under the EPBC Act
- Common Greenshank (*Tringa nebularia*) Regional only, listed as migratory/marine under the EPBC Act

Fifteen other significant species are likely to be present in the survey area based on previous records in the region and habitat present, but were not recorded in this survey, these species are:

- Chuditch (*Dasyurus geoffroii*), listed as Vulnerable under the BC and EPBC Act
- Peregrine Falcon *(Falco peregrinus*), listed as Other special Protection under the BC Act
- Gilled Slender Bluetongue (*Cyclodomorphus branchialis*), listed as Vulnerable under the BC Act
- Woma Python (SW pop.) (*Aspidites ramsayi*), listed as Priority 1 under the BC Act
- Tammar Wallaby (*Notamacropus eugenii derbianus*), listed as Priority 4 under the BC Act
- Ruddy Turnstone (*Arenaria interpres*), listed as migratory/marine under the EPBC Act
- Sharp-tailed Sandpiper (*Calidris acuminata*), listed as migratory/marine under the EPBC Act
- Red Knot (*Calidris canutus*), listed as migratory/marine and Endangered under the BC and EPBC Act
- Eastern Curlew (*Numenius madagascariensis*), listed as migratory/marine and Critically Endangered under the BC and EPBC Act
- Whimbrel (*Numenius phaeopus*), listed as migratory/marine under the EPBC Act
- Pacific Golden Plover (*Pluvialis fulva*), listed as migratory/marine under the EPBC Act
- Grey Plover (*Pluvialis squatarola*), listed as migratory/marine under the EPBC Act
- Grey-tailed Tatler (*Tringa brevipes*), listed as migratory/marine under the EPBC Act
- Roseate Tern (*Sterna dougallii*), listed as migratory/marine under the EPBC Act

– Australian Fairy Tern (*Sternula nereis),* listed as migratory/marine and Vulnerable under the BC and EPBC Act
– Lesser Sand Plover (*Charadrius mongolus),* listed as migratory/marine and Endangered under the BC and EPBC Act
– Curlew Sandpiper (*Calidris ferruginea*), listed as migratory/marine and Critically Endangered under the BC and EPBC Act

Of the significant species identified above, the Western Spiny-tailed Skink and the Taper-tailed West Coast slider have specialised habitat requirements. The Western Spiny-tailed Skink relies on the York Gum woodland and associated debris/ logs and the Zuytdorp Worm Slider rely on deep sands with acacia shrubland to persist within the survey Area.

Off the significant fauna recorded the Malleefowl was most widespread with evidence consisting of mounds (active and in active), recent and old prints, feathers, scats and active birds. Malleefowl mounds identified during this project include 35 active mounds and 64 inactive mounds within the survey area with an additional 84 suspected mounds identified from LiDAR imagery not yet assessed (due to being inaccessible at the time of the surveys). This equates to approximately 50% of mounds assessed over the survey period being active The records of the species had been recorded in Mallee woodlands, York Gum woodlands, Banksia shrubland, Mixed shrubland, Acacia shrubland, Jam shrubland and on the edge of a claypan.

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1. Introduction

1.1 Background

Murchison Hydrogen Renewables Pty Ltd as trustee for the Murchison Hydrogen Renewables Trust (MHR) is proposing to construct a combined onshore wind and solar energy farm for the production of green ammonia (the Project). The Project will comprise of a 5241 megawatt (MW) power-to-ammonia plant located in the vicinity of Kalbarri, Western Australia. GHD understands that environmental approvals are a critical path for achieving the Murchison Project team's objective of commencing construction of the project in Kalbarri in the near future. GHD will be undertaking environmental investigations to support environmental impact assessment of its future operations. The data collected from within the Survey Area has added a greater understanding of fauna in particular significant fauna to the region. The surveys comprise:

- A reconnaissance survey in November 2021 including preliminary habitat assessment and establishment of migratory bird survey points and assessment.
- A targeted assessment in March 2022 for migratory birds and targeted transects for Western Spiny-tailed Skink. Basic fauna assessment over the survey area and deployment of remote cameras.
- A basic fauna assessment in April 2022 and establishment of additional remote cameras and rotation.
- A detailed two-phase (winter- August and spring- October) vertebrate fauna survey including targeted significant survey to determine the suite of fauna species that occur within the survey area and expand the area of fauna habitat mapping.
- A targeted significant fauna survey, for locally occurring conservation significant vertebrate fauna.

1.2 Purpose of this report

The purpose of the survey report is to support the assessment of the Proposal under Part IV of the EP Act and under the EPBC Act within the survey area. The contents of this report will assist MHR in the environmental approvals process and will inform project planning to avoid and minimise impacts to conservation values, enable quantification of impacts, and inform management arrangements. 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 report presents the results of the following:

– A Desktop Assessment comprising vertebrate fauna database search and literature review for the study area, to determine the presence, or likely presence, of significant species and communities
– A detailed multi-phase fauna survey to determine the suite of fauna and SRE fauna species that occur within the survey area
– Ascertain which significant fauna are utilising the survey area
– Identifying and mapping of fauna habitat including critical habitat for significant fauna species
– Present the results of the Detailed and Targeted Fauna Assessment (this report).

1.3 Location

The Project contains a development envelope (herein referred to as the survey area) which includes the construction footprint for the project, comprising of the wind and solar farm, a facility to produce green energy to ammonia, and an ammonia export facility including a pipeline, export vessel mooring and product transfer infrastructure.

The survey area is located within the Shire of Northampton, Western Australia (WA), approximately 20 km north of Kalbarri. The survey area is approximately 85,300 hectares (ha) in size, and extends from North West Coastal Highway in the east, to the Indian Ocean in the west. The survey area is presented in Figure 1, Appendix A.

A desktop study area (referred to as study area herein) was defined for the desktop-based searches undertaken within a 40-kilometre (km) buffer of the survey area.

1.4 Scope of works

The scope of works for the fauna assessment included:

– A desktop review of publicly available information and relevant reports to determine the fauna values of the survey area
– A detailed and targeted fauna survey to identify:
  - Fauna species present including SRE and introduced species
  - The presence or potential presence of any significant fauna.
– Preparation of technical report (this document) that documents the results of the desktop review and field surveys, including fauna habitat mapping.

1.5 Relevant legislation, conservation codes and background information

In Western Australia all native species and communities are protected under the Biodiversity Conservation Act 2016 (BC Act). Species of high conservation status (significant species) are further protected under Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). In addition, regulatory authorities also provide a range of guidance and information on expected standards and protocols for environmental surveys. An overview of these key legislation and guidelines, conservation codes and background information relevant to this fauna survey is provided in Appendix B.

1.6 Limitations and assumptions

This report: has been prepared by GHD for Murchison Hydrogen Renewables Pty Ltd as trustee for the Murchison Hydrogen Renewables Trust and may only be used and relied on by Murchison Hydrogen Renewables Pty Ltd as trustee for the Murchison Hydrogen Renewables Trust for the purpose agreed between GHD and Murchison Hydrogen Renewables Pty Ltd as trustee for the Murchison Hydrogen Renewables Trust as set out in section 1.2 of this report.

GHD otherwise disclaims responsibility to any person other than Murchison Hydrogen Renewables Pty Ltd as trustee for the Murchison Hydrogen Renewables Trust 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. 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 assumptions made by GHD described in this report (refer section(s) 1.6 of 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 *Murchison Hydrogen Renewables Pty Ltd as trustee for the Murchison Hydrogen Renewables Trust* 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.

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. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of access tracks and vegetation. As a result, not all relevant site features and conditions may have been identified in this 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 is also not responsible for updating this report if the site conditions change.

This report has assessed the fauna values within the Survey Area, as shown in Figure 1, Appendix A. Should the survey area change or be refined, further assessment may be required.

1.7 Terminology

Some common terminologies are described below in Table 1-1.

Table 1-1 Terminology and definitions

Term (Abbreviation)	Definition/Use
GHD Pty Ltd (GHD)	Consultant engaged to prepare the environmental approvals documentation and supporting technical studies.
Survey Area	The area in which the proponent proposes for future mining development activities that will be assessed by regulators.
Study Area	The survey area with a 40 km buffer used to define the limits of the desktop investigations.
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 Desktop assessment

Prior to the field survey a desktop assessment of the study area to identify environmental values and constraints was undertaken by viewing geographic information system (GIS) spatial files largely sourced from Government of Western Australia (GoWA) (2022) and reviewing publicly available, government managed databases. The information sources utilised in this assessment are presented below in Table 2-1.

Table 2-1 Desktop Information Sources

Aspect	Information source/Government Dataset
Climate	Bureau of Meteorology (BoM) Climate Data Online (2021)
Regional biogeography	Interim Biogeographic Regionalisation for Australia (IBRA) (DAWE 2012).
Geology, land systems and soil	1:500 000 State linear structures layer (DMIRS-015) (DMIRS 2018) Soil Landscape Mapping – Systems (DPIRD-064) (Geoscience 2019)
Environmentally Sensitive Areas (ESAs)	Clearing Regulations - Environmentally Sensitive Areas (DWER-046)
Conservation reserves and areas	DBCA – Legislated Lands and Waters (DBCA-011) DBCA – Lands of Interest (DBCA-012)
Hydrology	Public Drinking Water Source Areas (DWER-033) RIWI Act, Surface Water Areas and Irrigation Districts (DWER-037) RIWI Act, Groundwater Areas (DWER-034) RIWI Act, Rivers (DWER-036) Waterways Conservation Act Management Areas (DWER-072) Ramsar Sites (DBCA-010) Directory of Important Wetlands in Australia - Western Australia (DBCA-045)
Vegetation	Pre-European Vegetation (DPIRD 2020) (DPIRD-006) Native Vegetation Extent (DPIRD 2020) (DPIRD-005)
Significant fauna	DAWE PMST database to identify fauna species listed under the EPBC Act potentially occurring within the study area (Appendix C) DBCA *NatureMap* database (DBCA 2007–) (Appendix C) DBCA Threatened fauna database (DBCA 2021)
Literature review	Burbridge *et. al* (2000) fauna papers of the Carnarvon Basin Region

The fauna desktop assessment included a review of:

– DAWE PMST database to identify fauna species listed under the EPBC Act potentially occurring within the desktop study area (refer Appendix C)
– The DBCA Threatened and Priority Fauna database for the Study Area
– The DBCA *NatureMap* (DBCA 2007–) database for fauna species previously recorded within the study area (Appendix C). This database comprises the following composite datasets:
    - Atlas of Australian birds
    - Bird data -Birdlife Australia

- Fauna Survey Returns Database (New)
- WA Museum (WAM) databases (mammals, birds, reptiles)

– Aerial photography, geology/soils, land systems and hydrology information to provide background information on the variability of the environment and likely habitat types present

– A fauna likelihood of occurrence assessment (refer Appendix D).

2.2 Field survey

2.2.1 Survey timing and personnel

Field surveys comprised of several targeted assessments, including invertebrate surveys and a dual phase detailed fauna assessment for this project. All phases are detailed below in Table 2-2. The field survey was led by Senior Zoologist, Glen Gaikhorst and assisted by other GHD Zoologists/Ecologist. The experience of these staff members is presented in Table 2-2.

Table 2-2 Field survey timing, type and details

Phase/Survey type	Date	Tasks	Personnel
Reconnaissance survey, preliminary habitat assessment and migratory birds	15th – 19th November 2021	Preliminary habitat and access assessment Targeted migratory birds, sample site establishment.	Glen Gaikhorst Joel Collins
Targeted fauna Assessment	8th March – 15th March 2022	Migratory birds assessments and remote equipment deployment	Glen Gaikhorst Jeff Turpin
Targeted fauna Assessment	2nd April – 7th April 2022	Migratory birds assessments and remote equipment deployment	Glen Gaikhorst Jack Eastwood
Phase 1 (Winter trapping program and targeted assessment)	18th August – 30th August 2022	Trapping (vertebrate and invertebrate), remote equipment collection and redeployment (Camera, Bird Acoustic, Bat detector), Significant fauna searches and habitat mapping	Glen Gaikhorst Erin Lynch Brad Maryan Robert Browne-Cooper Emma de Mamiel Lynnette Greer Jack Eastwood Alon Ridgard Kristy Gaikhorst
Phase 2 (Spring trapping program and targeted assessment)	9th October – 21st October 2022	Trapping (vertebrate and invertebrate), remote equipment collection and redeployment (Camera, Bird Acoustic, Bat detector), Significant fauna searches and habitat mapping	Glen Gaikhorst Brad Maryan Robert Browne-Cooper Sarah Flemington Emma de Mamiel Jack Eastwood Dylan Goldspink Kristy Gaikhorst
Regional survey	31st October – 4th November 2022	Targeted Migratory birds, Nocturnal searches and remote camera collection	Glen Gaikhorst Brad Maryan Emma de Mamiel Lynnette Greer Jack Eastwood Dylan Goldspink
Malleefowl Mound Assessment	7th -13th February - 2023	Assess Malleefowl mounds identified via LiDAR	Glen Gaikhorst Robert Browne-Cooper

Table 2-3 Personnel experience

Name	Years of experience	Role	Phase
Glen Gaikhorst	20+	Senior Zoologist and field lead	All survey assessments
Jeff Turpin	20+	Senior Zoologist	SRE, migratory birds (March 2022)
Robert Browne-Cooper	20+	Senior Zoologist	Phase 1 and Phase 2 and Malleefowl
Brad Maryan	20+	Senior Zoologist	Phase 1, Phase 2 and Regional
Erin Lynch	10+	Senior Ecologist	Phase 1
Emma de Mamiel	5+	Zoologist	Phase 1, Phase 2 and Regional
Sarah Flemington	5+	Zoologist	Phase 2
Lynnette Greer	5+	Zoologist	Phase 1 and Regional
Jack Eastwood	2+	Graduate Zoologist	All survey assessments except March 2022
Dylan Goldspink	2+	Graduate Zoologist	Phase 2 and Regional
Alon Ridgard	2+	Graduate Environmental Scientist	Phase 1
Kristy Gaikhorst	10+	Field Assistant/Technician	Phase 1 and Phase 2

2.3 Guiding documents

The survey methodology and data collection that GHD employed was conducted in accordance with

– EPA Technical Guidance – Terrestrial vertebrate fauna surveys for environmental impact assessment (2020)
– EPA Technical Guidance - Sampling methods for terrestrial vertebrate fauna (2020)
– DEHWA (2010a) Survey Guidelines for Australia's Threatened Bats
– DEWHA (2010b) Survey Guidelines for Australia's Threatened Mammals
– DEWHA (2010c) Survey Guidelines for Australia's Threatened Reptiles
– National Heritage Trust (NHT) National manual for the Malleefowl monitoring system standards (2007)
– Other published literature, including recent advances in Night Parrot habitat and survey techniques

2.4 Permits and ethics

A Regulation 27 Licence for Fauna Taking (Biological Assessment) was obtained from DBCA prior to undertaking the fauna survey (Licence Number: BA27000594). This permit also allows vouchering a limited number of non-significant specimens for lodgement with the WAM. However, in general, only specimens of particular scientific interest or taxonomic significance are collected for the WAM. The fauna survey (specifically trapping and animal handling) was undertaken in accordance with DBCA 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.

This project was approved by GHD's ethics committee on the 11/2/2022 under ethics number 12553823-202202011555. This approval is covered under GHD's Standard Operating Procedures (SOP) which mostly aligns to DBCA's SOP's as part of our trapping permit. Where differentiation occurs GHD adopts the most relevant action according to the task.

2.5 Habitat assessment and data collection

A fauna habitat assessment was undertaken to document the type, ecological value and extent of habitats within the survey area. All field data was collected via the ArcGIS Online platform (Field maps) for all systematic fauna sampling sites, at significant species record sites and other locations as required to enable delineation and mapping of major fauna habitat types throughout the survey area.

Broad habitat types within the survey area were identified, mapped, and described based on the following:

- Location in survey area
- Landscape position
- Geomorphology, topography, and substrate
- Photos of representative habitat types
- Vegetation description and dominant structure
- Values to associated fauna including significant species (e.g., refuge, foraging, shelter)
- Ecological processes of importance
- Disturbances (weeds, fire, ground disturbance)
- Wider extent and connectivity of habitat type based on previous mapping
- Comparison between broad habitat types
- Evaluation of the likelihood of occurrence of significant fauna within the environments present (based on presence of suitable habitats and species recorded)

2.6 Fauna identification and nomenclature

Species Identification

Fauna was identified in the field using reference books, field guides and electronic guides (Table 2-4). Where identification was not possible, specific publications were utilised or photographs of specimens were collected to be later identified.

Table 2-4 Fauna references

Fauna group	Field guide
Mammals	Menkhorst and Knight (2010), Van Dyck and Strahan (2013)
Bats	Churchill (2008), Menkhorst and Knight (2010)
Birds	Morcombe (2014)
Reptiles	Wilson and Swan (2021), Storr *et. al.* (1999), Storr *et.al.* (2002)
Amphibians	Tyler and Doughty (2009)

Nomenclature

Nomenclature used in this report follows that used by WAM as reported on *NatureMap*. This nomenclature is deemed the most up-to-date species information for WA fauna.

2.7 Systematic trapping program

Systematic trapping programs are designed for recording an inventory of general species and significant species in a standardised approach where trapping and other survey effort is equal and quantifiable across all trapping quadrats. This allows comparison of species abundance and richness between sampling sites and habitat types and provides a robust and reproducible approach for analysing species accumulation data.

Trapping for terrestrial vertebrate fauna was undertaken over two seasons using a series of standardised systematic trapping quadrat sites comprising pit-fall traps, elliott box traps, cage traps and funnel traps. Traps were checked and cleared as per licence conditions within specified times each morning, with fauna identified and released in situ. For each quadrat timed bird survey and active searching was also carried out.

During both phases of the survey, a total of 20 quadrats were established within major representative habitat-types within the survey area. Each quadrat contained the trapping array and was opened for at least 7 nights. The trapping array is comprised of a number of different trapping methods and equipment which are described below. A breakdown of trapping and survey effort is summarised below in Table 2-5. Trap site locations are depicted in Figure 3a, Appendix A.

Pit-trap with drift fence

Seven pit-fall traps (buckets) were installed in a linear formation at approximately 7 metre intervals within each of the twenty trapping quadrats. Where the ground was too hard to establish a bucket a funnel trap was substituted. This gave a total of 140 pit-fall traps across the survey area per seasonal assessment. Buckets used were 20 litre plastic buckets (30 cm diameter by 40 cm deep). A 50 metre (m) long flywire drift fence (30 cm high) bisected the pits; directing fauna into them. Soil, leaf litter and/or an egg crate were placed within each pit to provide shade and protection to trapped fauna.

Funnel traps

Up to 14 funnel traps were set at each trapping quadrat with one funnel positioned at each side of drift fence in between each pitfall trap. Additional funnels were utilised at some sites where ground was particularly hard, as substitute for pit-fall traps. This gave a total of 274 funnel traps across the survey area per phase. Funnel traps were placed such that animals were directed into them from the drift fence. Funnel traps were covered with insulating and highly reflective materials to maximise shade, and minimise heat and cold exposure to animals

Elliot box traps

Ten Elliott box traps (medium size) were used at each trapping quadrat site. These traps target a range of small rodent and Dasyurid mammals such as *Sminthopsis* and *Pseudomys* species occurring locally. Traps were placed approximately 20 m apart, approximately 10 m from each respective pit-fall trap and are 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 heat and cold exposure to captured animals. A total of 200 Elliot box traps were set during each trapping phase.

Cage traps

Two cage traps were located at each quadrat site (a total of 40 cage traps). These traps were placed at each end of the fence line/pitfall traps. Cage traps were baited with universal bait and each was covered with a hessian sack to protect the captured animals from weather exposure.

Table 2-5 Survey Trapping Effort for Phases 1

Trap site number	Coordinates		Habitat description	Trapping nights	Pit traps/Buckets		Elliot traps		Funnel traps		Cage traps	
	Latitude	Longitude			Per site	Trap nights	Per site	Trap nights	Per site	Trap nights	Per site	Trap nights
Trap site 1	-27.27957	114.02133	Coastal heathland	7	7	49	10	70	12	84	2	14
Trap site 2	-27.25772	114.13676	Mallee woodland	8	7	56	10	80	14	112	2	16
Trap site 3	-27.25604	114.25782	Acacia shrubland	8	7	56	10	80	14	112	2	16
Trap site 4	-27.25869	114.34242	Mallee woodland	8	7	56	10	80	14	112	2	16
Trap site 5	-27.33565	114.45282	Jam shrubland	8	7	56	10	80	14	112	2	16
Trap site 6	-27.33811	114.43241	York Gum woodland	8	7	56	10	80	14	112	2	16
Trap site 7	-27.34967	114.27474	Mallee woodland	8	7	56	10	80	14	112	2	16
Trap site 8	-27.37146	114.21623	Mixed shrubland on dune	7	7	56	10	70	14	98	2	14
Trap site 9	-27.38731	114.27042	Mallee woodland	8	7	56	10	80	14	112	2	16
Trap site 10	-27.45834	114.23687	York Gum woodland	7	7	49	10	70	14	98	2	14
Trap site 11	-27.47942	114.22074	Limestone ridge	7	7	49	10	70	14	98	2	14
Trap site 12	-27.52590	114.20531	Mallee woodland	7	7	49	10	70	14	98	2	14
Trap site 13	-27.48689	114.14371	Limestone ridge	7	7	49	10	70	14	98	2	14
Trap site 14	-27.43140	114.19308	Banksia shrubland	7	7	49	10	70	14	98	2	14
Trap site 15	-27.43140	114.19308	Banksia shrubland	7	7	49	10	70	14	84	2	14
Trap site 16	-27.53676	114.13587	Acacia shrubland	7	7	49	10	70	12	84	2	14
Trap site 17	-27.36275	114.14939	Coastal heathland	7	7	49	10	70	14	98	2	14
Trap site 18	-27.42264	114.08417	Banksia shrubland	7	7	49	10	70	12	84	2	14
Trap site 19	-27.32634	114.07836	Coastal heathland	7	7	49	10	70	14	98	2	14
Trap site 20	-27.32975	114.04854	Mixed shrubland on dune	8	7	56	10	80	14	112	2	16
Total				**148**	140	**1043**	200	**1480**	274	**2016**	40	**296**

Table 2-6 Survey Trapping Effort for Phase 2

Trap site number	Coordinates		Habitat description	Trapping nights	Pit traps/Buckets		Elliot traps		Funnel traps		Cage traps	
	Latitude	Longitude			Per site	Trap nights	Per site	Trap nights	Per site	Trap nights	Per site	Trap nights
Trap site 1	-27.27957	114.02133	Coastal heathland	8	7	56	10	80	14	112	2	16
Trap site 2	-27.25772	114.13676	Mallee woodland	8	7	56	10	80	14	112	2	16
Trap site 3	-27.25604	114.25782	Acacia shrubland	8	7	56	10	80	14	112	2	16
Trap site 4	-27.25869	114.34242	Mallee woodland	8	7	56	10	80	14	112	2	16
Trap site 5	-27.33565	114.45282	Jam shrubland	7	7	49	10	70	14	98	2	14
Trap site 6	-27.33811	114.43241	York Gum woodland	7	7	49	10	70	14	98	2	14
Trap site 7	-27.34967	114.27474	Mallee woodland	8	7	56	10	80	14	112	2	16
Trap site 8	-27.37146	114.21623	Mixed shrubland on dune	7	7	56	10	70	14	98	2	14
Trap site 9	-27.38731	114.27042	Mallee woodland	8	7	56	10	80	14	112	2	16
Trap site 10	-27.45834	114.23687	York Gum woodland	8	7	56	10	80	14	112	2	16
Trap site 11	-27.47942	114.22074	Limestone ridge	8	7	56	10	80	14	112	2	16
Trap site 12	-27.52590	114.20531	Mallee woodland	8	7	56	10	80	14	112	2	16
Trap site 13	-27.48689	114.14371	Limestone ridge	7	7	49	10	70	14	98	2	14
Trap site 14	-27.43140	114.19308	Banksia shrubland	8	7	56	10	80	14	112	2	16
Trap site 15	-27.43140	114.19308	Banksia shrubland	7	7	49	10	70	14	98	2	14
Trap site 16	-27.53676	114.13587	Acacia shrubland	7	7	49	10	70	14	98	2	14
Trap site 17	-27.36275	114.14939	Coastal heathland	8	7	56	10	80	14	112	2	16
Trap site 18	-27.42264	114.08417	Banksia shrubland	7	7	49	10	70	14	98	2	14
Trap site 19	-27.32634	114.07836	Coastal heathland	8	7	56	10	80	14	112	2	16
Trap site 20	-27.32975	114.04854	Mixed shrubland on dune	8	7	56	10	80	14	112	2	16
Total				**153**	140	**1078**	200	**1530**	280	**2142**	40	**306**

Avifauna surveys

Avifauna surveys (aka bird census) were undertaken at each of the quadrat sites. Each survey comprised of at least 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 the 20-minute period were recorded. Numbers of each species observed were also recorded. All systematic bird surveys were undertaken 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. Avifauna surveys were also completed outside of quadrat sites but still within the survey area. Avifauna survey (bird census) locations are depicted in Figure 3a, Appendix A.

Active searches

Each trapping quadrat site was actively searched by hand and using cultivator rakes for amphibians, reptiles, and mammals. Searches comprised looking overturning logs, bark, rocks and leaf litter and low vegetation, and other ground debris to search for inactive fauna. All fauna, both inactive and active including abundance was recorded. Species presence was also determined via secondary evidence, in the form of scats, tracks, feathers, skeletal remains and burrows. A minimum of half an hour was spent at each quadrat and the general area around it. Additional active searches were undertaken independently of the quadrat site searches. The independent active searches were undertaken in areas of difficult access or in those habitats that may support significant species. Active search locations are depicted in Figure 3a, Appendix A.

2.8 Remote fauna recording devices

Remote cameras

Remote sensor cameras (Reconyx-Hyperfire and Scout Guard) were deployed throughout the survey area and regionally between March and November 2022. The program included 44 camera locations within the survey area totalling 2818 survey nights and 19 locations regionally scattered between Zuytdorp Nature Reserve, Kalbarri National Park (northern extremity) and other regional locations totalling 613 survey nights. In total 3431 camera nights were undertaken.

Cameras were used to target significant fauna species (Chuditch, Malleefowl, Western Spiny-tailed Skink) detection and adding to the general species inventory recording small to large mammals, birds, and reptiles. Where Chuditch were targeted, cameras were set in line with Chuditch survey Guidelines (Department of the Environment, Water, Heritage, and the Arts 2010b). Cameras were set in areas where significant species are more likely to be recorded e.g., woodland or rocky potential forage or den sites, at suspected active burrows, or along potential fauna movement corridors such as rocky ridgelines or runs through dense vegetation. Cameras were baited with sardines and/or universal animal bait to attract fauna species. For each camera location the time and date deployed and recovered, and the GPS coordinates were recorded (Table 2-7). Data from the cameras were downloaded to a computer and analysed for the presence of animals following the field survey. Camera locations are depicted in Figure 3a, Appendix A.

Table 2-7 Camera trap locations

Camera Number	Habitat type	Latitude	Longitude	Portion of survey area	Date deployed	Date collected	Nights deployed
Cameras in the Survey Area							
CAM 25	Limestone ridgeline	-27.50004	114.104	Southwest	9/03/2022	4/04/2022	26
CAM PRO3	Coastal heathland	-27.42235	114.086	West	9/03/2022	22/08/2022	166
CAM B1	Limestone ridgeline	-27.29916	114.006	Far Northwest	11/03/2022	22/08/2022	164
CAM PRO2	Claypan	-27.33841	114.227	Northeast	14/03/2022	5/04/2022	22
CAM YALGOO	Coastal heathland	-27.39480	114.076	West	10/03/2022	22/08/2022	165
CAM PRO4	York Gum woodland	-27.45867	114.237	Southeast	13/03/2022	6/04/2022	24
CAM 27	Coastal heathland	-27.28901	114.010	Far Northwest	11/03/2022	22/08/2022	164
CAM PRO1	Coastal heathland	-27.40429	114.090	West	9/03/2022	22/08/2022	166
CAM 21	Banksia shrubland	-27.32680	114.082	Northwest	10/03/2022	5/04/2022	26
CAM 50	Limestone ridgeline	-27.29613	114.004	Far Northwest	11/03/2022	22/08/2022	164
CAM GHD1	Coastal heathland	-27.37508	114.074	West	10/03/2022	5/04/2022	26
CAM 29	Limestone ridgeline	-27.58499	114.134	Far Southwest	14/03/2022	4/04/2022	21
CAM HP2	Coastal heathland	-27.46908	114.111	Southwest	9/03/2022	4/04/2022	26
CAM HP3	York Gum woodland	-27.45714	114.240	Southeast	13/03/2022	22/08/2022	162
CAM HP4	Banksia shrubland	-27.54083	114.136	Southwest	12/03/2022	4/04/2022	23
CAM 14	Coastal heathland	-27.33824	114.038	Southwest	11/03/2022	22/08/2022	164
CAM R41	Banksia shrubland	-27.52980	114.137	Southwest	12/03/2022	4/04/2022	23
CAM 0	Acacia shrubland	-27.33825	114.460	East (corridor)	15/03/2022	6/04/2022	22
CAM R41	Mallee woodland	-27.33674	114.568	East (corridor)	6/04/2022	21/08/2022	137
CAM PRO2	York Gum woodland	-27.33547	114.450	East (corridor)	6/04/2022	21/08/2022	137
CAM 28	Acacia shrubland	-27.33826	114.406	East (corridor)	5/04/2022	22/08/2022	139
CAM 51	Mallee woodland	-27.33811	114.385	East (corridor)	5/04/2022	22/08/2022	139
CAM 10	Mallee woodland	-27.35076	114.273	Northeast	5/04/2022	24/08/2022	141
CAM 24	Acacia shrubland	-27.37850	114.234	East	5/04/2022	24/08/2022	141

Camera Number	Habitat type	Latitude	Longitude	Portion of survey area	Date deployed	Date collected	Nights deployed
CAM 29	Banksia shrubland	-27.39976	114.207	East	4/04/2022	22/08/2022	140
CAM HP4	Banksia shrubland	-27.39843	114.146	Central	4/04/2022	23/08/2022	141
CAM 52	Acacia shrubland	-27.36191	114.124	Central	5/04/2022	22/08/2022	139
CAM 0	Acacia shrubland	-27.46504	114.144	South	4/04/2022	22/08/2022	140
CAM 25	Acacia shrubland	-27.43205	114.149	Central	4/04/2022	22/08/2022	140
CAM 53	Coastal heathland	-27.26028	114.012	Northeast	6/04/2022	21/08/2022	137
CAM 54	Banksia shrubland	-27.26002	114.048	Northeast	6/04/2022	21/08/2022	137
CAM 55	Acacia shrubland	-27.25660	114.177	Northeast	6/04/2022	21/08/2022	137
CAM 21	Banksia shrubland	-27.25559	114.283	Northeast	6/04/2022	21/08/2022	137
CAM 50	Mallee woodland	114.19793	-27.382	South	26/08/2022	13/10/2022	48
CAM 28	Limestone Ridge	114.16572	-27.371	South	26/08/2022	13/10/2022	48
CAM YALGOO	Mallee woodland	114.17655	-27.399	South	26/08/2022	13/10/2022	48
CAM 25	Mallee woodland	114.19180	-27.572	South	27/08/2022	13/10/2022	47
CAM HP3	Limestone ridge	114.10415	-27.500	South	27/08/2022	13/10/2022	47
CAM YALGOO	Banksia shrubland	-27.33850	114.305	Northeast	16/10/2022	2/11/2022	17
CAM 28	Banksia shrubland	-27.31976	114.331	Northeast	16/10/2022	2/11/2022	17
CAM HP3	Limestone ridge	-27.49817	114.103	Southwest	12/10/2022	19/10/2022	7
CAM 53	Acacia shrubland	-27.50494	114.174	East	16/10/2022	2/11/2022	13
CAM HP2	Mallee woodland	-27.26807	114.152	North	17/10/2022	2/11/2022	17
CAM 10	Acacia shrubland	-27.25968	114.192	North	17/10/2022	18/10/2022	16
Regional cameras					**Total Study Area**		**2818**
CAM B1	Acacia shrubland	-27.08159	114.12238	Zuytdorp NR	26/08/2022	15/10/2022	50
CAM 21	Acacia shrubland	-27.11533	114.16292	Zuytdorp NR	26/08/2022	15/10/2022	50
CAM O	Banksia shrubland	-27.12131	114.22886	Zuytdorp NR	26/08/2022	15/10/2022	50
CAM HP4	Banksia shrubland	-27.13500	114.27637	Zuytdorp NR	26/08/2022	15/10/2022	50
CAM R41	Banksia shrubland	-27.19623	114.28151	Zuytdorp NR	26/08/2022	15/10/2022	50

Camera Number	Habitat type	Latitude	Longitude	Portion of survey area	Date deployed	Date collected	Nights deployed
CAM 10	Coastal heathland	-27.23282	113.99076	Zuytdorp NR	26/08/2022	31/08/2022	5
CAM 52	Coastal heathland	-27.24126	113.99759	Zuytdorp NR	26/08/2022	31/08/2022	5
CAM 53	Coastal heathland	-27.22387	113.9854	Zuytdorp NR	26/08/2022	31/08/2022	5
CAM 55	Mallee woodland	-27.39383	114.3352	South of eastern Corridor	26/08/2022	13/10/2022	48
CAM 1	Mallee woodland	-27.36412	114.3431	South of eastern Corridor	26/08/2022	13/10/2022	48
CAM HP2	Banksia shrubland	-27.42431	114.2906	South of eastern Corridor	26/08/2022	13/10/2022	48
CAM 54	Mallee woodland	-27.42487	114.2745	South of eastern Corridor	26/08/2022	13/10/2022	48
CAM 14	Mallee woodland	-27.43877	114.2539	South of eastern Corridor	26/08/2022	13/10/2022	48
CAM 52	Mallee woodland	-27.39777	114.511	Northeast Of Survey Area	15/10/2022	2/11/2022	18
CAM 14	Mallee woodland	-27.31513	114.574	Northeast Of Survey Area	15/10/2022	2/11/2022	18
CAM 1	Mallee woodland	-27.36302	114.482	Kalbarri NP area	15/10/2022	2/11/2022	18
CAM 25	Mallee woodland	-27.38437	114.481	Kalbarri NP area	15/10/2022	2/11/2022	18
CAM 55	Mallee woodland	-27.40054	114.467	Kalbarri NP area	15/10/2022	2/11/2022	18
CAM 77	Mallee woodland	-27.31618	114.596	Kalbarri NP area	15/10/2022	2/11/2022	18
					Total Regional Survey		**613**
TOTAL NIGHTS							**3431**

Bird acoustic recorders

Bird acoustic recorders were set primarily for detection of vocal cryptic species (primarily birds). Acoustic detectors (SM4 ® Songmeter Acoustic recorders) were deployed in areas where species might be recorded i.e. utilising water bodies, Acacia shrubland areas or dense shrublands. The detectors were set for a maximum of four nights and programmed to record from 25 minutes pre-dusk to 25 minutes post-dawn. This timeline captures the period periods of avian species calling as well as cryptic nocturnal species. Data from recorders were downloaded to computer and analysed by Nigel Jackett, an ecologist with relevant experience in analysis and identification of avian acoustic data. Each detector the time/ date deployed and recovered, and the GPS coordinates were recorded (see Table 2-8). The acoustic detector locations are depicted in Figure 3a, Appendix A.

Table 2-8 Bird Acoustic locations

Bird acoustic	Habitat type	Latitude	Longitude	Portion of survey area	Date deployed	Date collected	Nights deployed
SM4- AC2	York Gum woodland	-27.45824	114.23702	East	26/08/2022	28/08/2022	2
SM4-AC4	Limestone ridge	-27.52606	114.20494	South	27/08/2022	28/08/2022	1
SM4-AO4	Mixed shrubland	-27.38288	114.23259	East	26/08/2022	28/08/2022	2
SM4- AC2	Mallee woodland	-27.34976	114.27459	East	19/08/2022	22/08/2022	3
SM4-AC4	Mixed shrubland	-27.29818	114.28523	Northeast	19/08/2022	22/08/2022	3
SM4-AC3	Mixed shrubland	-27.25601	114.25785	Northeast	19/08/2022	22/08/2022	3
SM4-AC1	Mallee woodland	-27.25774	114.13705	Northwest	18/08/2022	22/08/2022	4
SM4-AC1	Jam shrubland	-27.33569	114.45275	East	22/08/2022	24/08/2022	2
SM4- AC2	York gum woodland	-27.33830	114.43238	East	22/08/2022	24/08/2022	2
SM4-AO4	Mallee woodland	-27.25540	114.34147	Northeast	24/08/2022	26/08/2022	2
SM4- AC2	Mallee woodland	-27.39101	114.26942	East	24/08/2022	26/08/2022	2
SM4-AC3	Coastal heathland	-27.27921	114.02126	Northwest	22/08/2022	24/08/2022	2
SM4AC1	Coastal heathland	-27.32979	114.04866	Northwest	22/08/2022	24/08/2022	2
SM4-AC3	Mixed shrubland	-27.36288	114.14987	West	24/08/2022	26/8/2022	2
SM4-AC1	Mixed shrubland	-27.37154	114.21647	East	24/08/2022	26/8/2022	2
SM4-AC3	Mixed shrubland	-27.53670	114.13614	Southwest	26/08/2022	28/08/2022	2
SM4-AC1	Limestone ridge	-27.48712	114.14550	Southwest	26/08/2022	28/08/2022	2
SM4-AC1	Coastal heathland	-27.42297	114.08403	West	16/10/2022	19/10/2022	3
SM4-AC1	Banksia shrubland	-27.53563	114.13627	South	14/10/2022	16/10/2022	2
SM4-AC1	Mixed shrubland	-27.36252	114.14932	West	12/10/2022	13/10/2022	1
SM4- AC2	York Gum Woodland	-27.45815	114.23673	Southeast	16/10/2022	18/10/2022	2
SM4- AC2	Banksia shrubland	-27.43125	114.19327	Southeast	14/10/2022	16/10/2022	2
SM4- AC2	Mallee woodland	-27.52581	114.20508	Southeast	12/10/2022	14/10/2022	2
SM4-AC4	York Gum woodland	-27.33565	114.45243	East	12/10/2022	14/10/2022	2
SM4-AC4	Mallee woodland	-27.34985	114.27453	East	16/10/2022	18/10/2022	2
SM4-AC4	Mixed shrubland	-27.29829	114.28531	East	14/10/2022	16/10/2022	2
SM4-AC3	Coastal heathland	-27.39370	114.07323	West	16/10/2022	19/10/2022	3
SM4-AC3	Water -old material pit	-27.25628	114.21579	Northwest	14/10/2022	16/10/2022	2
SM4-AC3	Coastal heathland	-27.26973	114.01576	Northwest	12/10/2022	14/10/2022	2
Combined Total							63

Bat acoustic recorders

Bat calls were recorded during field surveys using in situ (stationary) full spectrum Song Meter (SM2 bat plus and SM4 FS) detectors (Wildlife Acoustics) and Full Spectrum Anabat Swift detectors (Titley Scientific). Thirty four detector locations were deployed for 1 to 4 nights at each location and programmed to record from 30 minutes pre-sunset to 30 minutes post-sunrise. In total 75 recorder nights were run within the survey area Bat detectors were positioned in areas where bat species were likely to be present i.e., water bodies, fly-ways such as limestone gullies, and potential roost caves. For each detector the time and date deployed and recovered, and the GPS coordinates were recorded (Table 2-9).

Data from the bat detectors were downloaded to a computer and analysed for the presence of bats following the field survey. Data from the detectors was analysed by Dr Erin Westerhuis (GHD). Appendix H provides a summary of the call analysis methods and results for each data collection period. Bat detector locations are depicted in Figure 3a, Appendix A.

Table 2-9 Bat detector locations

Bat detector	Habitat type	Latitude	Longitude	Portion of survey area	Date deployed	Date collected	Nights deployed
SWIFT 2	Coastal heathland	-27.39547	114.05589	West	15/11/2021	19/11/2021	4
SM4-4	Limestone ridge	-27.29083	114.00698	Northwest	16/11/2021	19/11/2021	3
SWIFT 1	Minor drainage line	-27.33856	114.22701	Northeast	15/11/2021	18/11/2021	3
SWIFT 1	Banksia shrubland	-27.55932	114.13394	West	5/04/2022	7/04/2022	2
SWIFT 1	Banksia shrubland	-27.33698	114.57150	West	3/04/2022	5/04/2022	2
SM4-5	Eucalyptus woodland	-27.45845	114.23677	East	26/08/2022	28/08/2022	2
SM4-7	York Gum Woodland	-27.52590	114.20523	South	27/08/2022	28/08/2022	1
SM4-7	Mixed shrubland	-27.38313	114.23203	East	26/08/2022	27/08/2022	1
SM4-5	Mallee woodland	-27.34981	114.27456	East	19/08/2022	22/08/2022	3
SM4-7	Mixed shrubland	-27.29817	114.28522	Northeast	19/08/2022	22/08/2022	3
SM4-4	Banksia shrubland	-27.25602	114.25804	Northeast	19/08/2022	22/08/2022	3
SM4-6	Mallee woodland	-27.25772	114.13706	Northwest	19/08/2022	22/08/2022	3
SM4-7	Jam Shrubland	-27.33573	114.45279	East	22/08/2022	24/08/2022	2
SM4-5	York Gum woodland	-27.33821	114.43237	East	22/08/2022	24/08/2022	2
SM4-7	Mallee woodland	-27.25540	114.34147	Northeast	24/08/2022	26/08/2022	2
SM4-5	Mallee woodland	-27.39107	114.26959	East	24/08/2022	26/08/2022	2
SM4-4	Coastal heathland	-27.27921	114.02112	Northwest	22/08/2022	24/08/2022	2
SM4-6	Coastal heathland	-27.32979	114.04866	Northwest	22/08/2022	24/08/2022	2
SM4-4	Mixed shrubland	-27.36289	114.14987	West	24/08/2022	26/8/2022	2
SM4-6	Mixed shrubland	-27.37154	114.21647	East	24/08/2022	26/8/2022	2
SM4-4	Mixed shrubland	-27.53660	114.13608	Southwest	26/08/2022	28/08/2022	2
SM4-6	Limestone ridge	-27.48716	114.14539	Southwest	26/08/2022	28/08/2022	2
SM4-5	Coastal heathland	-27.42259	114.08399	West	16/10/2022	19/10/2022	3
SM4-5	Banksia shrubland	-27.53655	114.13560	South	14/10/2022	16/10/2022	2
SM4-5	Mixed shrubland	-27.36256	114.14934	West	12/10/2022	13/10/2022	1
SM4-4	York Gum woodland	-27.45818	114.23662	Southeast	16/10/2022	18/10/2022	2
SM4-4	Banksia shrubland	-27.43124	114.19326	Southeast	14/10/2022	16/10/2022	2
SM4-4	Mallee woodland	-27.52581	114.20510	Southeast	12/10/2022	14/10/2022	2

Bat detector	Habitat type	Latitude	Longitude	Portion of survey area	Date deployed	Date collected	Nights deployed
SM4-6	Mallee woodland	-27.34980	114.27457	East	16/10/2022	18/10/2022	2
SM4-6	Mallee woodland	-27.33832	114.43235	East	12/10/2022	14/10/2022	2
SM4-6	Mallee woodland	-27.25551	114.34122	East	14/10/2022	16/10/2022	2
SM4 -10	Water, old material pit	-27.25641	114.21557	Northwest	14/10/2022	16/10/2022	2
SM4 -10	limestone ridge	-27.29061	114.00836	Northwest	12/10/2022	14/10/2022	2
SM4 -10	Coastal heathland	-27.39318	114.06498	West	16/10/2022	19/10/2022	3
Combined Total							**75**

2.9 Non-systematic fauna survey

Non-systematic survey methods are aimed at detecting significant species and boosting inventory species records by augmenting systematic trapping methods. These methods detect fauna by opportunistic observation and selectively searching particular habitat types and landform features in consideration of target species' habitat preferences, optimal seasonal and diurnal timing to record active fauna or opportunistic secondary evidence. Non-systematic methods described below, particularly opportunistic observations, generally account for a high proportion of the total fauna inventory and significant fauna recorded during surveys. Non-systematic survey method locations are shown in Figure 3a, Appendix A.

Nocturnal searching

Spot lighting was undertaken to locate nocturnal species such as reptiles, mammals and birds that may otherwise remain undetected using other survey techniques. Handheld or head mounted spotlights were used for a minimum of 30 minutes by two personnel in selected areas where possible. Timing depended on habitat suitability, weather conditions and site access in consideration of HSE requirements. Analogue nocturnal searching was carried out within comparable habitats within the Survey Area. Most trap locations were surveyed at least once during the surveys with 2490 nocturnal survey hours undertaken in total. Nocturnal survey effort is displayed in Table 2-10.

Table 2-10 Nocturnal search summary

Date	Habitat type/Site	Latitude	Longitude	Portion of survey area	Survey effort (minutes)
8/03/2022	Coastal heathland – near Site 17	-27.49653	114.10478	West	60
9/03/2022	Coastal heathland – Site 19 area	-27.39787	114.05605	West	60
10/03/2022	Coastal heathland – Site 1 area	-27.34311	114.03068	West	60
11/03/2022	Coastal limestone ridge – Site 19 area	-27.57609	114.12857	East	60
12/03/2022	Mallee woodland – Site 12	-27.55950	114.19389	East	180
13/03/2022	York Gum woodland – Site 10	-27.46038	114.23404	East	180
14/03/2022	Mallee woodland – Site 12	-27.33667	114.60850	East	60
6/04/2022	Mallee woodland – east Site 5	-27.33714	114.56120	East	180
4/04/2022	Mixed shrubland – Site 8 area	-27.37606	114.22645	Northwest	180
5/04/2022	Coastal heathland – Site 18 area	-27.33041	114.06804	West	180
3/04/2022	Banksia shrubland -Site 15 area	-27.55304	114.13361	Southwest	180
3/04/2022	Banksia shrubland -Site 15 area	-27.57702	114.13896	Southwest	180
13/10/2022	Mixed shrubland – Site 8 area	-27.37258	114.22020	Central	180
17/10/2022	Mixed shrubland – Site 8 area	-27.37940	114.23090	Central	60
2/11/2022	Mallee woodland -Site 9	114.2677	-27.39130	East	60
2/11/2022	Mixed Shrubland – Site 20	114.27562	-27.34914	Central	60

Date	Habitat type/Site	Latitude	Longitude	Portion of survey area	Survey effort (minutes)
2/11/2022	Zuytdorp Reserve region	114.37346	-27.25549	Regional	30
2/11/2022	Mixed shrubland – Site 3 area	114.25160	-27.25614	Northwest	60
2/11/2022	Mallee woodland – west Site 4	114.34325	-27.25597	North	60
2/11/2022	Banksia shrubland -Site 2 area	114.25704	-27.25598	Northwest	60
1/11/2022	Mallee woodland	114.44649	-27.33818	Regional	30
1/11/2022	Mixed shrubland	114.48205	-27.31185	Regional	30
1/11/2022	York Gum woodland – Site 6 area	114.4465	-27.33835	East corridor	30
1/11/2022	Jam Shrubland – Site 5 area	114.4825	-27.31185	East corridor	30
3/11/2022	Kalbarri National Park region	114.1295	-27.77213	Regional	120
3/11/2022	Kalbarri National Park region	114.12529	-27.80454	Regional	120
Total					2490

Active Searches

Active searches across the survey area were undertaken for amphibians, reptiles, birds and mammals. Surveys comprised of active searching of potential shelter sites (overturning logs, rocks and leaf litter), low vegetation (under bark and in tree stumps) and recording all individuals observed. Species presence was also detected and identified via secondary evidence, in the form of scats, tracks, feathers, burrows and skeletal remains. A summary of the diurnal search effort completed is provided below in Table 2-11.

Table 2-11 Locations of active searches undertaken

Date	Habitat type	Latitude	Longitude	Portion of survey area	Survey effort (minutes)
25/08/2022	Coastal heathland	114.02677	-27.28962	Northwest	30
23/08/2022	Acacia shrubland	114.10863	-27.27923	Northwest	30
23/08/2022	Acacia shrubland	114.10671	-27.31498	Northwest	30
25/08/2022	Acacia shrubland	114.12846	-27.32761	Northwest	30
25/08/2022	Claypan	114.14318	-27.35300	Northwest	60
22/08/2022	Limestone ridge	114.16197	-27.44721	East	120
23/08/2022	Mixed shrubland	114.26223	-27.42470	East	30
23/08/2022	Mallee woodland	114.27051	-27.42475	East	60
25/08/2022	Acacia shrubland	114.37615	-27.33816	East	30
25/08/2022	Limestone ridge	114.34862	-27.33753	East	60
26/08/2022	Claypan	114.20355	-27.35285	North	120
26/08/2022	York gum Woodland	114.19818	-27.38085	North	120
23/08/2022	Banksia shrubland	114.13657	-27.53380	North	30
23/08/2022	Banksia shrubland	114.13789	-27.53521	Southwest	30
24/08/2022	Limestone ridgeline	114.10057	-27.49296	Southwest	30
23/08/2022	Banksia shrubland	114.14944	-27.36367	Northwest	30
23/08/2022	Banksia shrubland	114.14617	-27.48661	Southwest	30
20/08/2022	Limestone ridge	114.14585	-27.48645	Southwest	30
25/08/2022	York gum woodland	114.35218	-27.33915	East	120
27/08/2022	Mallee woodland	114.48128	-27.37526	East	30

Date	Habitat type	Latitude	Longitude	Portion of survey area	Survey effort (minutes)
27/08/2022	Mallee woodland	114.48558	-27.35509	East	30
27/08/2022	Mallee woodland	114.34823	-27.33833	East	30
28/08/2022	Mallee woodland	114.19865	-27.38223	Northwest	30
2022-08-20	Banksia shrubland	114.19305	-27.43154	Southeast	30
22/08/2022	York gum woodland	114.43047	-27.33701	East	30
22/08/2022	York gum woodland	114.44794	-27.33828	East	30
22/08/2022	Jam shrubland	114.45376	-27.33620	East	120
23/08/2022	Mallee woodland	114.34153	-27.25542	Northeast	30
23/08/2022	York gum woodland	114.43236	-27.33819	East	30
23/08/2022	York gum woodland	114.45011	-27.34346	East	30
24/08/2022	Acacia shrubland	114.06968	-27.25856	South	30
28/08/2022	Gee Gei out camp area	114.14536	-27.35051	Northwest	30
28/08/2022	Gee Gei out camp area	114.14619	-27.35200	Northwest	30
28/08/2022	Gee Gei out camp area	114.14630	-27.35399	Northwest	30
28/08/2022	Acacia shrubland	114.10902	-27.26780	Northwest	60
28/08/2022	Mallee woodland	114.19340	-27.36587	Northwest	60
21/08/2022	Coastal heathland	114.00267	-27.29528	Northwest	30
21/08/2022	Coastal heathland	114.00395	-27.29530	Northwest	30
21/08/2022	Coastal heathland	114.02213	-27.28105	Northwest	30
21/08/2022	Coastal heathland	114.07394	-27.37557	West	30
22/08/2022	Coastal heathland	114.02076	-27.27872	Northwest	30
22/08/2022	Banksia shrubland	114.24690	-27.25513	North	30
22/08/2022	Banksia shrubland	114.07759	-27.32664	Northwest	30
22/08/2022	Coastal heathland	114.07528	-27.39440	Northwest	30
22/08/2022	Banksia shrubland	114.06471	-27.33146	Northwest	30
22/08/2022	Acacia shrubland	114.12437	-27.36265	West	30
22/08/2022	Acacia shrubland	114.14687	-27.39831	West	30
23/08/2022	Mallee woodland	114.13505	-27.25806	Northwest	30
23/08/2022	Coastal heathland	114.04810	-27.32908	Northwest	30
24/08/2022	Coastal heathland	114.01507	-27.26954	Northwest	60
24/08/2022	Limestone ridge	114.02294	-27.30109	Northwest	30
24/08/2022	Limestone ridge	114.02168	-27.30199	Northwest	30
24/08/2022	Limestone ridge	114.01972	-27.30214	Northwest	30
24/08/2022	Limestone ridge	114.01909	-27.30451	Northwest	30
24/08/2022	Limestone ridge	114.02251	-27.30167	Northwest	30
13/10/2022	Limestone ridge	114.10211	-27.49738	West	30
13/10/2022	Jam shrubland	114.27027	-27.33625	East	30
13/10/2022	Jam shrubland	114.27873	-27.34192	East	30
13/10/2022	Banksia shrubland	114.22020	-27.37258	East	30
13/10/2022	Mixed shrubland	114.23494	-27.37840	East	60

Date	Habitat type	Latitude	Longitude	Portion of survey area	Survey effort (minutes)
13/10/2022	Limestone ridgeline	114.19716	-27.51161	East	30
13/10/2022	York gum woodland	114.45432	-27.33047	East	30
13/10/2022	York gum woodland	114.43715	-27.32963	East	30
12/10/2022	Limestone ridgeline	114.01593	-27.28493	Northwest	30
12/10/2022	Acacia shrubland	114.06773	-27.25856	Northwest	30
13/10/2022	Mixed shrubland	114.28414	-27.28072	Northeast	30
16/10/2022	Coastal heathland	114.00113	-27.29548	Northwest	30
11/10/2022	Mixed shrubland	114.18034	-27.25864	Northwest	30
14/10/2022	Coastal heathland	113.99782	-27.26259	Northwest	30
14/10/2022	Acacia shrubland	114.14788	-27.34234	Northwest	30
12/10/2022	Acacia shrubland	114.09339	-27.25797	Northwest	30
14/10/2022	Acacia shrubland	114.14416	-27.34347	Northwest	30
12/10/2022	Acacia shrubland	114.11150	-27.25825	Northwest	30
14/10/2022	Acacia shrubland	114.14515	-27.34448	Northwest	30
01/11/2022	Acacia shrubland	114.15879	-27.50278	South	30
02/11/2022	Mallee woodland	114.26772	-27.39130	East	30
Total					**2940**

Opportunistic observations

Opportunistic observations involve the recording of fauna taxa (physical presence and/or signs of presence) spatially throughout the Survey Area. Opportunistic observations include physical observations (sighting or hearing fauna), and indirect evidence (scats, tracks, diggings, nests, feathers, skeletal remains, pellets) which indicate the current or recent activity of a species. 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, traversing the survey area, and during habitat assessment).

2.9.1 Targeted fauna searches

Throughout the survey targeted searches were completed for significant fauna. These were completed by the following methods:

– LiDAR (via Fugro)
– Transects/searches (completed on foot in suitable habitat type)
– Migratory Bird census
– Remote camera deployment
– Bird and Bat Acoustic deployment.

Details of the targeted assessments according to the significant species are presented below.

Western Spiny-tailed Skink (Egernia stokesii badia) transects/searches

Target searching for Western Spiny-tailed Skink (*Egernia stokesii badia*) was undertaken within the survey area focussing on Eucalypt woodlands such as York Gum Woodland. Western Spiny-tailed Skink in this region are known to require suitable woodland habitat for colonies to persist. Woodland habitat needs to have fallen trees or logs with hollows often with stems of multiple hollows and entrances. Where fallen trees and hollows are located searches were undertaken for latrines (fresh and old), which would indicate the presence of skinks or looking

inside hollows to visually capture skinks. Where latrines and/or skinks were detected, the location, latrine extent and photo were recorded for each. In total 1530 minutes of transects were walked within suitable habitat within the survey area.

A summary of transects (see Table 2-12) completed during all assessments and records of scat latrines/skinks detected during the surveys are presented in Section 5.8. Locations of transects are presented in Figure 3b, Appendix A.

Table 2-12 Summary of Western Spiny-tailed Skink survey effort (transects)

Date	Habitat type	Latitude	Longitude	Portion of survey area	Distance (km)	Effort (minutes)
14/03/2022	York Gum woodland	-27.33956	114.35166	East corridor	1	60
14/03/2022	York Gum woodland	-27.33877	114.35205	East corridor	2	120
14/03/2022	York Gum woodland	-27.33848	114.35075	East corridor	1.3	70
21/08/2022	York gum and Jam shrubland	-27.33268	114.44793	East corridor	2	120
21/08/2022	York gum and Jam shrubland	-27.34242	114.42915	East corridor	2.9	150
22/08/2022	York Gum woodland	-27.33737	114.43034	East corridor	1.86	120
22/08/2022	Jam shrubland	-27.33579	114.45376	East corridor	1.2	60
22/08/2022	York Gum woodland	-27.45823	114.23613	East corridor	3	180
23/08/2022	York Gum woodland	-27.34483	114.45153	East corridor	4	200
25/08/2022	York Gum woodland	-27.34115	114.35143	East corridor	3.3	240
28/08/2022	York Gum woodland	-27.52354	114.21212	Southeast	0.5	60
28/08/2022	York gum and Jam shrubland	-27.52442	114.2100	Southeast	0.2	30
2/11/2022	York Gum woodland	-27.40175	114.44642	East	2.1	120
Total					**25.36**	**1530**

Zuytdorp Worm Slider / Taper-tailed West Coast slider (Lerista humphriesi)

The Zuytdorp Worm Slider (*Lerista humphriesi*) is known only from the Murchison River district where it occurs in Acacia-dominated sandplains (Cogger 2014). Targeted searching for the Zuytdorp Worm Slider was undertaken within the survey area focusing on suitable habitat i.e. Acacia-dominated sandplain habitat. Each area was searched by carefully raking soil under leaf litter, logs and stumps. When the species was collected the GPS location was recorded and a representative photo was taken. A summary of active searches completed during the surveys are presented in Table 2-11. Locations of searches are presented in Figure 3a, Appendix A.

Malleefowl (Leipoa ocellata) LiDAR/transects/searches

During phase 1 and phase 2 surveys Malleefowl assessments were undertaken opportunistically in the survey area. This consists of malleefowl mounds (active and old), prints, scats and active birds. All malleefowl mounds recorded were assessed according to (Benshemesh 2007). Locations of malleefowl results are presented in Figure 4, Appendix A.

Due to the large survey area MHR commissioned Fugro to assess LiDAR data for Malleefowl mounds and provide locations of potential captures. Captures (mounds) were split into three categories Highly Likely, Can be and Unlikely, with 5,168 captures recorded (Fugro 2022). Only the “Highly likely” and “Can be” captures within the survey area were further assessed and included 589 features. “Unlikely” mounds were not assessed due to their very low probability of being a desired feature.

Category	Numbers in Survey Area	Numbers in the Region	Total Mounds Recorded
Highly likely	150	353	503
Can be	439	1466	1905
Unlikely	1148	1612	2760

The 589 (highly likely and can be) features were further refined to include only those located within the survey area. A manual/visual inspection of each feature using LiDAR and satellite imagery was also undertaken removing those that were clearly termite mounds or road side spoil heaps. Therefore the desired features after refinement are represented below into three categories Likely, Possible and Unlikely.

Category	Numbers in Survey Area
Likely	175
Possible	57
Unlikely	352

An example of the LiDAR output against satellite imagery is presented below for a likely mound (mound 2711) Plate 1 and unlikely mound (termite mound) (mound 2072) Plate 2. In February 2023 - 93 likely and possible mounds were ground truthed and assessed against Benshemesh 2007. Transects walked are presented on figure 3b, Appendix A. As part of this assessment mounds were classified as active or not active against Benshemesh 2007 with a mound profile assessment undertaken this method is presented below

	Mound profiles					
	Profile 1	**Profile 2**	**Profile3**	**Profile 4**	**Profile 5**	**Profile 6**
Basic look						
Basic description	Dugout and left, not recently used	Dug out in preparation of use, tracks, scat, shell, scratching often present	Dugout, mound filled with debris. Lots of tracks, scratching, scat often present	Capped mound often in thermo regulation. Lots of tracks, scat, scratching often present	Capped mound often in thermo regulation. Dug out sides for temperature regulation. Lots of tracks, scat, scratching often present	Ancient mound
Current use	**Inactive**	**Active**	**Active**	**Active**	**Active**	**Inactive**

All mound assessment results are described in section 5.8 with data on each mound presented in Appendix E and mapped in Figure 4.

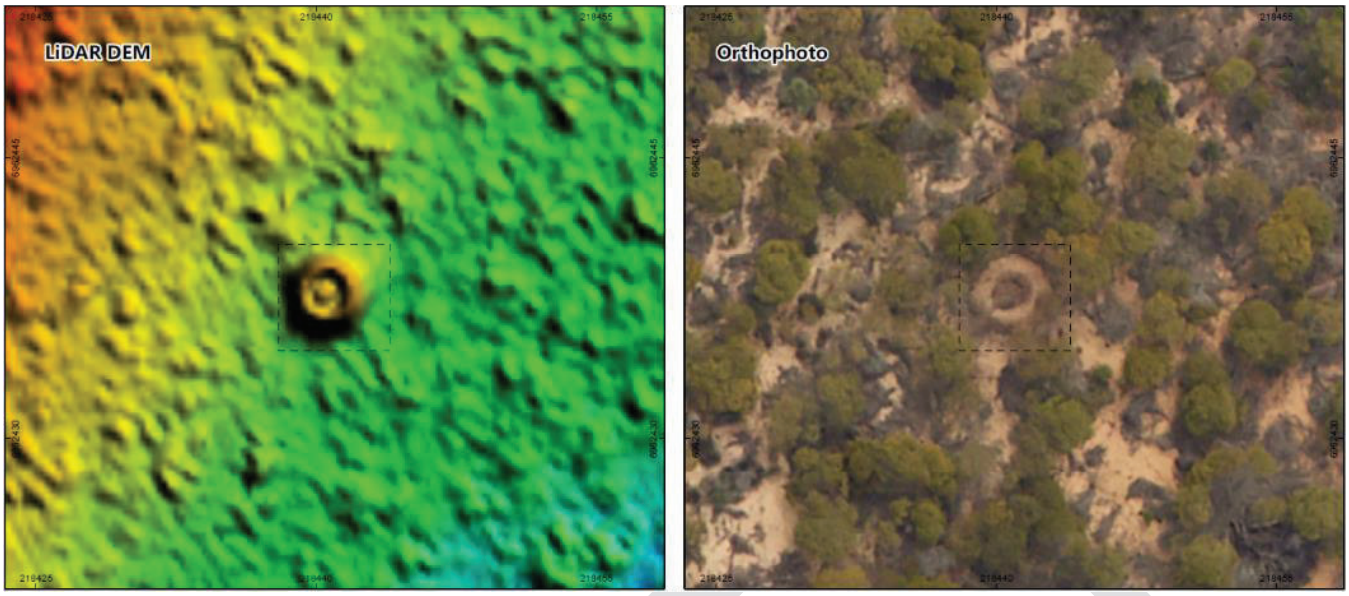

Plate 1 *Mound 2711 identified as likely on LiDAR and confirmed on imagery*

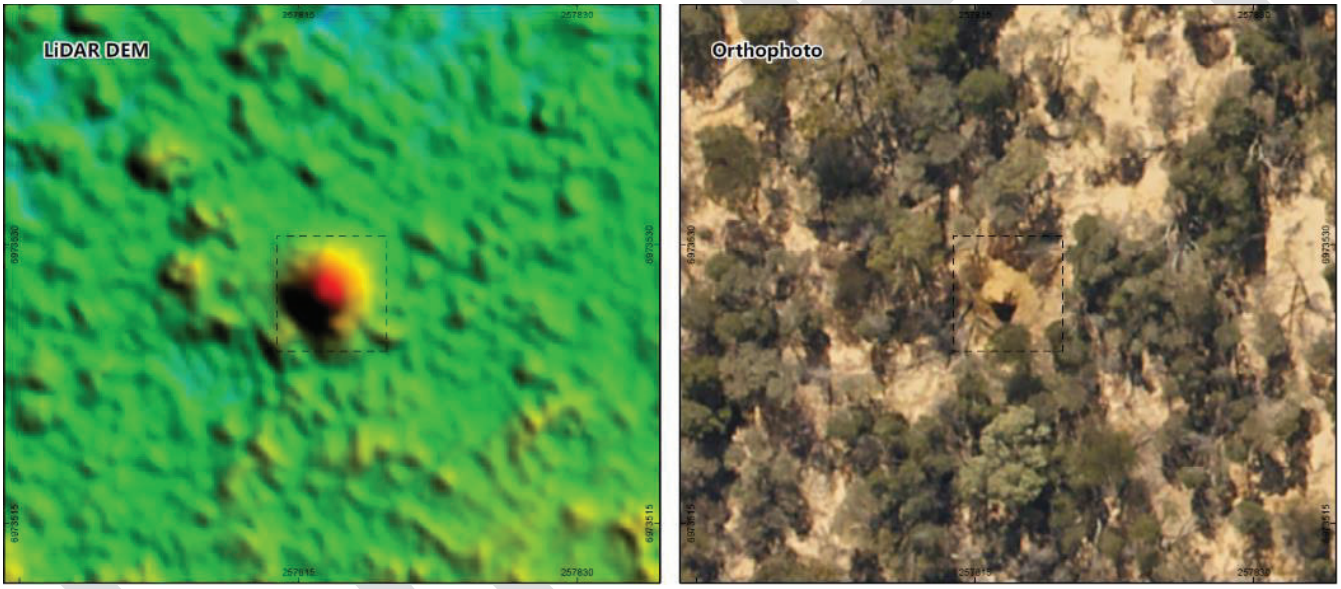

Plate 2 *Mound 2072 identified as possible on LiDAR and eliminated on imagery*

Migratory Birds census

Targeted Migratory Bird census were completed within the survey area at selected points focussing on coastal habitats including beaches, reef and rocky platforms. Additional points were also placed inland at Lake Cucurdoo where several man-made feature (dams) hold water for extended periods. The majority were completed along the western boundary of the survey area as this is situated adjacent to the ocean. Each survey point was visited between 1 and 4 times over the migratory bird presence period for the southwest of Western Australia (between October and April).

Binoculars were used to identify migratory birds, where distances were too far to positively identify a species a Nikon field scope was used. A summary of migratory bird census completed are presented below in Table 2-13. Locations of migratory birds recorded during these assessments are presented in Figure 3, Appendix A.

Table 2-13 Migratory Bird Census locations

Date	Habitat type	Latitude	Longitude	Portion of survey area	Effort (minutes)
19/11/2021	Beach	-27.42939	114.06990	Coastal strip	60
11/03/2022	Beach	-27.34097	114.02658	Coastal strip	60
9/03/2022	Beach	-27.43347	114.07158	Coastal strip	60
10/03/2022	Beach	-27.34701	114.0294	Coastal strip	60
10/03/2022	Beach	-27.36562	114.03740	Coastal strip	60
9/03/2022	Beach	-27.41825	114.06446	Coastal strip	60
10/03/2022	Beach	-27.33651	114.02382	Coastal strip	60
10/03/2022	Beach	-27.40215	114.0567	Coastal strip	60
8/03/2022	Beach	-27.49957	114.10285	Coastal strip	60
9/03/2022	Beach	-27.39936	114.05554	Coastal strip	60
11/03/2022	Beach	-27.29499	114.00046	Coastal strip	60
12/03/2022	Beach	-27.57668	114.12674	Coastal strip	60
9/03/2022	Beach	-27.49394	114.10012	Coastal strip	60
9/03/2022	Beach	-27.39220	114.05219	Coastal strip	60
19/10/2022	Beach	-27.4233	114.0666	Coastal strip	60
18/10/2022	Beach	-27.3999	114.0551	Coastal strip	60
12/10/2022	Claypan	-27.3969	114.1417	central	15
18/10/2022	Beach	-27.4994	114.1028	Coastal strip	60
12/10/2022	Claypan	-27.353	114.1411	central	15
10/10/2022	Claypan	-27.4188	114.1405	central	30
10/10/2022	Claypan	-27.4155	114.1366	central	30
13/10/2022	Beach	-27.5013	114.1035	Coastal strip	30
14/10/2022	Beach	-27.5776	114.1271	Coastal strip	30
14/10/2022	Beach	-27.5807	114.128	Coastal strip	30
18/10/2022	Beach	-27.5798	114.1276	Coastal strip	30
18/10/2022	Beach	-27.3665	114.0384	Coastal strip	30
17/10/2022	Beach	-27.2916	113.9993	Coastal strip	45
16/10/2022	Reef	-27.2941	114.0003	Coastal strip	45
15/10/2022	Sea	-27.2966	114.0017	Coastal strip	45
15/10/2022	Sea	-27.2916	113.9993	Coastal strip	45
15/10/2022	Sea	-27.3448	114.0286	Coastal strip	15
15/10/2022	Sea	-27.3382	114.0248	Coastal strip	60
17/10/2022	Beach	-27.3373	114.0242	Coastal strip	60
18/10/2022	Beach	-27.2653	113.9847	Coastal strip	30
3/11/2022	Beach	-27.6886	114.1669	Coastal strip	30
3/11/2022	Murchison River	-27.6832	114.1705	Regional	60
3/11/2022	Murchison River	-27.6783	114.1679	Regional	120
3/11/2022	Beach	-27.7064	114.1628	Coastal strip	60
3/11/2022	Beach	-27.7044	114.163	Coastal strip	60

Date	Habitat type	Latitude	Longitude	Portion of survey area	Effort (minutes)
1/11/2022	Beach	-27.4206	114.0652	Coastal strip	45
31/10/2022	Beach	-27.7086	114.1606	Coastal strip	60
3/11/2022	Murchison River - sand spit	-27.6565	114.1772	Regional	45
1/11/2022	Murchison River mouth	-27.7088	114.1603	Regional	30
31/10/2022	Mudflats	-27.6919	114.1775	Regional	30
3/11/2022	Sandflats	-27.6474	114.1765	Regional	30
3/11/2022	Murchison River	-27.6345	114.1972	Regional	45
31/10/2022	Beach	-27.5793	114.128	Coastal strip	45
3/11/2022	Mudflats	-27.6594	114.1728	Regional	45
3/11/2022	Murchison River	-27.6441	114.2154	Regional	30
3/11/2022	Sandflats	-27.6316	114.1924	Regional	45
1/11/2022	Beach	-27.4886	114.098	Coastal strip	60
31/10/2022	Beach	-27.683	114.1772	Coastal strip	30
1/11/2022	Beach	-27.3964	114.0539	Coastal strip	45
1/11/2022	Beach	-27.2896	113.9976	Coastal strip	30
1/11/2022	Beach	-27.366	114.0377	Coastal strip	30
1/11/2022	Beach	-27.3343	114.0226	Coastal strip	60
1/11/2022	Beach	-27.3482	114.03	Coastal strip	45
31/10/2022	Murchison River	-27.687	114.1757	Regional	45
1/11/2022	Beach	-27.2978	114.0019	Coastal strip	45
Total					2775

2.9.2 Total fauna samples effort

The total trapping effort consisted of 301 trap-nights (total trap effort of 9891 nights), 63 day/nights of bird census, 2940 minutes of active searches, 2490 minutes of night searches, 2818 camera nights were undertaken in the survey area (a further 613 nights regionally) and 75 nights of data analysed over 34 bat detector locations. Additionally, 1530 minutes of targeted Western spiny-tail skink (*Egernia stokesii badia)* searches covering 25.36 km, 2940 minutes of Taper-tailed West Coast slide (*Lerista humphriesi*), approximately 10 days of Malleefowl (*Leipoa ocellata)* mound assessment and 2775 minutes of Migratory Birds census were completed.

2.10 Data Analysis

2.10.1 Habitat Scatter Plots

PRIMER v6 (Clarke and Gorley 2006) was used to examine the similarity between trapping sites using collected data. A matrix was created of all species (based on presence) recorded at each trap site. The dissimilarity between sites was determined using the Bray-Curtis measure and the Resemblance function in PRIMER. A Cluster analysis (using Agglomerative Hierarchical Clustering technique) based on group average was undertaken using the Bray-Curtis similarity matrix and results presented as a dendrogram. In addition, a nonmetric multi-dimensional scaling analysis (MDS) was undertaken using the Bray-Curtis similarity matrix and results presented as a two-dimensional scatter plot. A factor was added to the output to define trap sites by habitat type.

The cluster analysis and resulting MDS dendrogram (

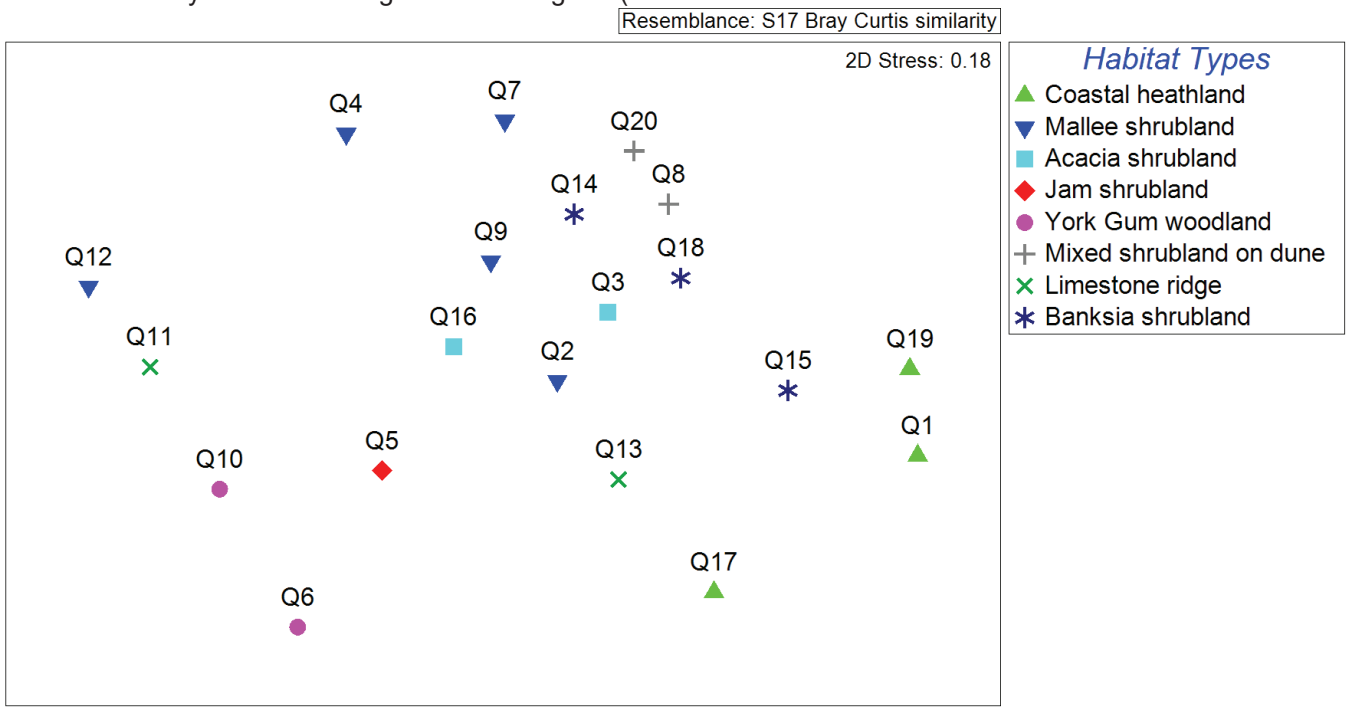

Chart 3 and

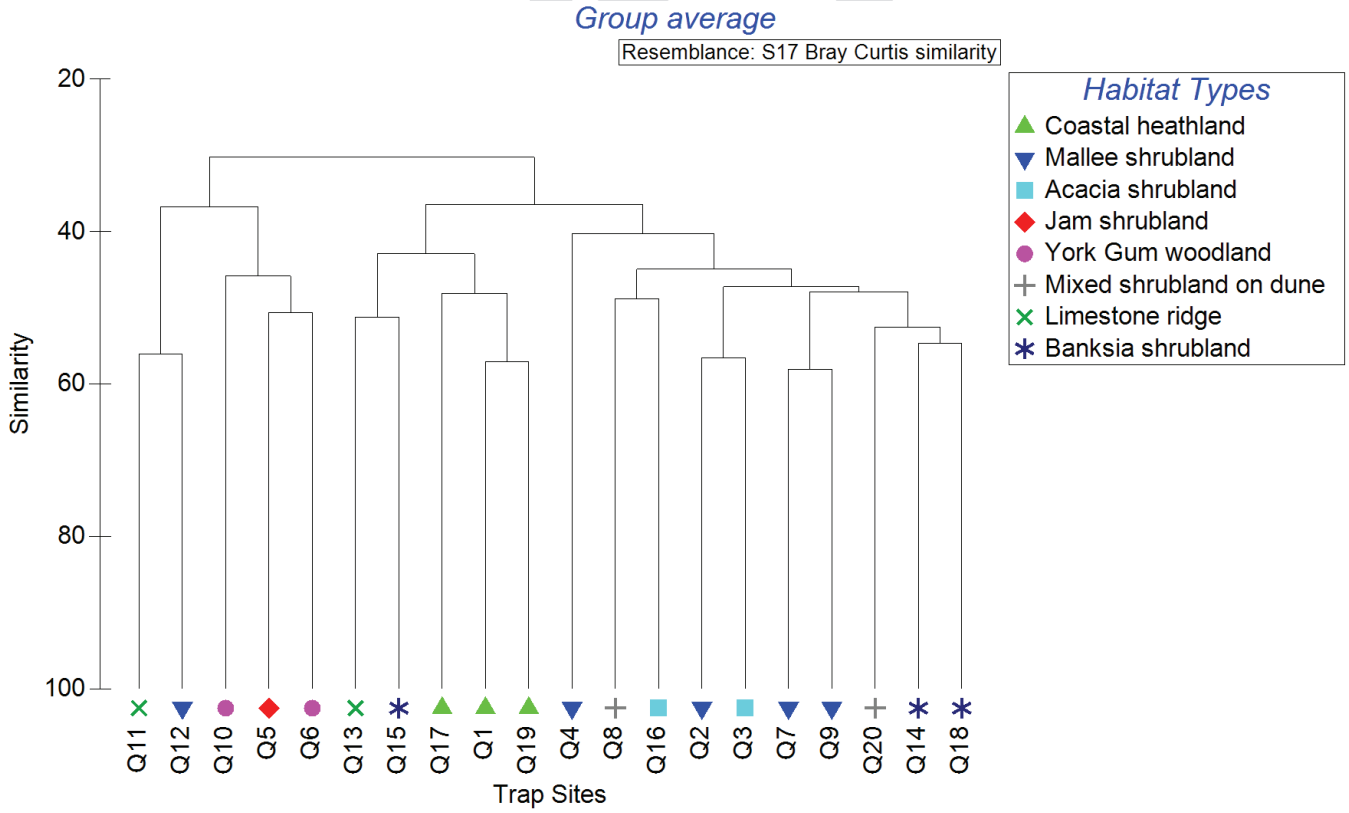

Chart 4) are presented in Section 4.3.

2.10.2 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. Only one curve was created for this survey within the Survey Area.

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).

The species accumulation curve (Chart 5) is presented in Section 5.10.

3. Desktop assessment

Prior to the field survey a desktop assessment was undertaken to collect relevant environmental and ecological information pertaining to the survey area and wider study area to assist survey design.

3.1 Climate

The survey area is within the mid-west region of Western Australia. The climate of this region is classified as Mediterranean, semi-arid to arid and warm, with distinct seasons. There is a hot and dry summer from December to February and a mild wet winter from June to August (Markey and Dillon 2008).

The Bureau of Meteorology (BoM) Kalbarri Station (Site Number 008251) is the nearest weather station to the survey area from which continuous long-term data have been collected. The Kalbarri Station is about 26 km away from Kalbarri National Park. Climatic data from that station indicates a mean maximum temperature ranging from 34.1 °C in February to 21.9 °C in July, and a mean minimum temperature ranging from 20.6°C in February to 9.8°C in July (BoM 2022).

The region is characterised by moderately variable rainfall, with rainfall events restricted to local areas rather than being widespread. Much of the annual rainfall occurs during the winter months and results from low-pressure systems associated with westerly winds. Summer rainfall also occurs, which results from thunderstorms and heavy downpours associated with remnant tropical cyclones (Markey and Dillon 2008).

The mean annual rainfall recorded at the BoM Kalbarri Station is 339.7 mm. The rainfall total for the previous 6 months to the detailed fauna survey is 274.4 mm (refer Table 3-1). A significant portion of the mean rainfall occurred the 6 months prior to the survey and heavy rainfall events were experienced immediately prior, during Phase 1 (August) and in between Phase 1 and 2 of the detailed fauna surveys.

Table 3-1 Average temperature and rainfall 6 months prior to and throughout the survey (BoM 2022)

Date (month and year)	Survey	Mean Max Temperature (ºC)	Mean Rainfall (mm)
March 2022	Preceding the detailed fauna assessment	35.6	14
April 2022		32.1	39.2
May 2022		28.5	31.9
June 2022		25.8	41.3
July 2022		24.4	52.3
August 2022		27.3	95.7
Total			**274.4**
August 2022	During detailed fauna assessment	27.3	95.7
September 2022		26.6	44.2
October 2022		29.3	14.2
November 2022	Regional fauna survey	32.9	2.7
Total			**337.1**

Both long-term and 2021 climate data for Kalbarri Station (Station ID: 008251) is presented below in Chart 1.

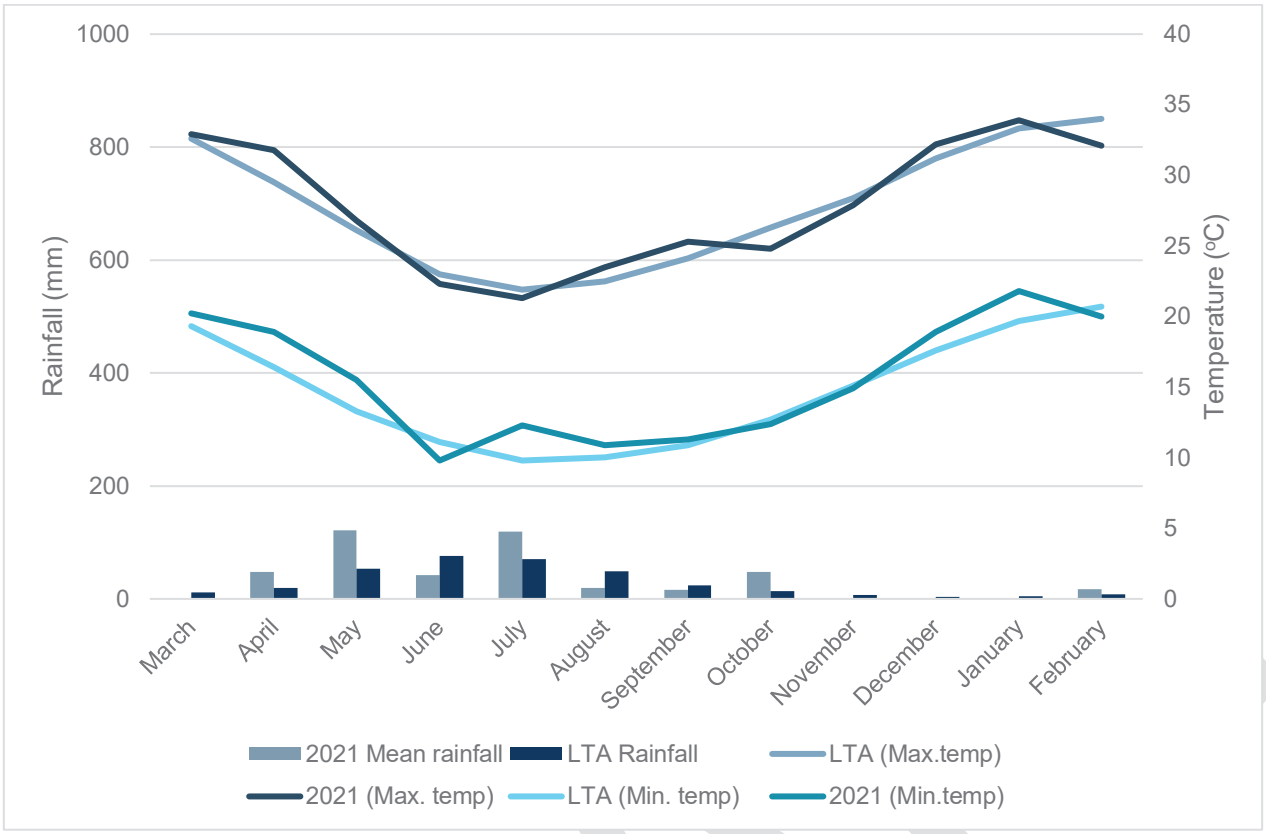

Chart 1 ***Climate data for Kalbarri Station (Station ID: 008251) (BOM 2021)***

Both long-term and 2021 climate data for Murchison Station (Station ID: 006099) is presented below in Chart 2.

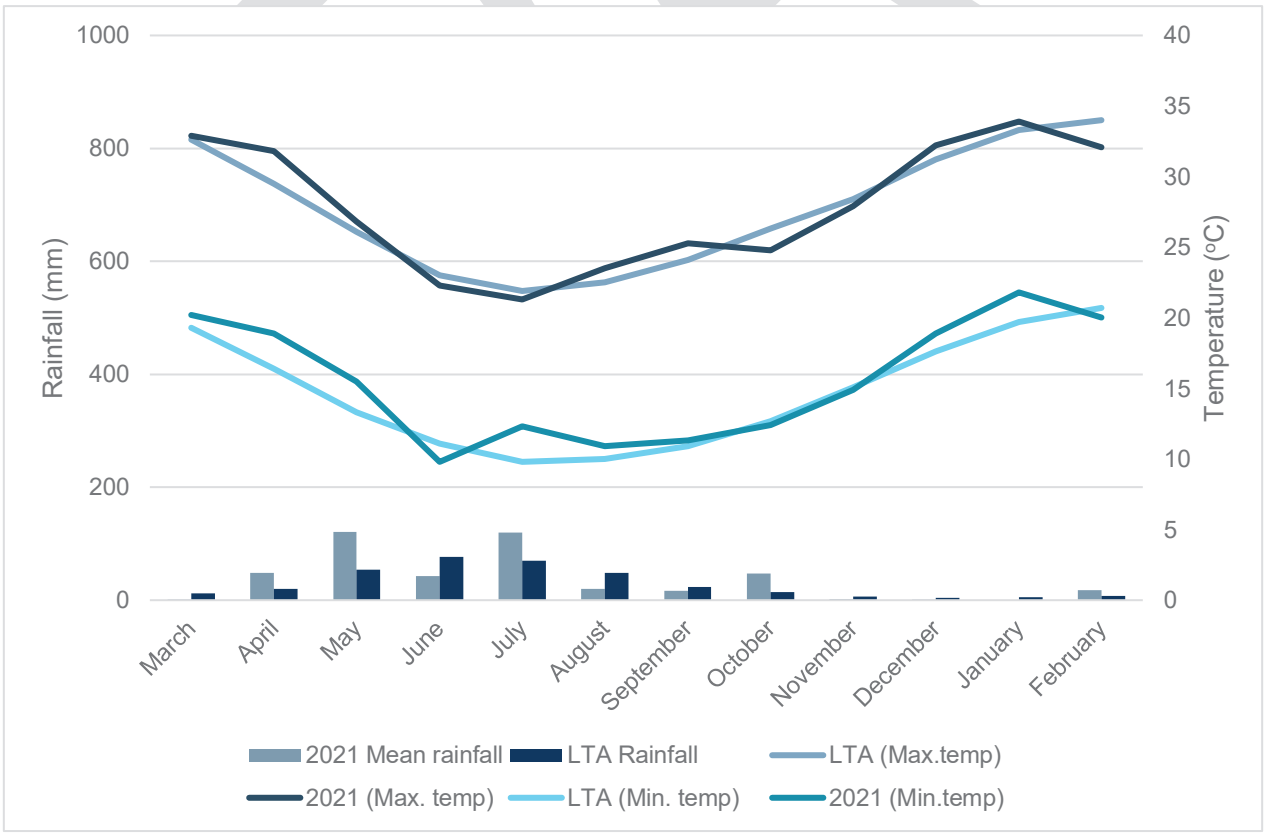

Chart 2 ***Climate data for Murchison Station (Station ID: 006099) (BOM 2021)***

3.2 Regional biogeography

Bioregions are large, geographically distinct areas of land with common characteristics such as geology, landform patterns, climate, ecological features and plant and animal communities. The bioregions are described in the interim Biogeographic Regionalisation for Australia (IBRA) The latest version of Interim Biogeographic Regionalisation of Australia (IBRA7) classifies Australia's landscapes into 89 large geographically distinct bioregions. The 89 bioregions are further refined to form 419 subregions which are more localised and homogenous geomorphological units in each bioregion (DAWE 2012).

The Carnarvon Region, located on the mid-west coast of Western Australia extends from north of Exmouth Gulf south to Shark Bay. To the south lies the Geraldton Sandplains Region. The boundary between these two regions is also part of the boundary between the South-West Province and Eremaean Province of Beard (1990), i.e., the boundary between the arid and southern mesic part of Western Australia.

The entire study area is situated within the Geraldton Sandplains bioregion (GES) and the Geraldton Sandplains sub region (GES01) and Edel Sub region (GS 1) as described by the Interim Biogeographic Regionalisation of Australia (IBRA) and (Desmond and Chant 2001). By combining the information about protected areas in Australia with the IBRA region, the level of protection of Australia's various landscapes can be measured. The average Protection Level for the above IBRA region is 15.01-30% (DAWE 2020).

The Geraldton Sandplains bioregion extends from Shark Bay south to the vicinity of Jurien and Badgingarra at about latitude 30 degrees (Beard, 1990). The region is composed mainly of proteaceous scrub-heaths (near the coast), rich in endemics on the sandy earths of an extensive, undulating, lateritic sandplain mantling Permian to Cretaceous sands. Extensive York Gum and Jam woodlands occur on outwash plains associated drainage (Desmond and Chant 2001). A particularly impressive feature of the area to the south of Shark Bay is the Zuytdorp Cliffs, which are topped with windblown, almost prostrate shrubland. Further inland these are replaced by Mallee, *Banksia* or *Callitris* shrubs and heaths with *Acacia-Allocasuarina* thickets still further inland. Small areas of Eucalyptus woodlands occur, mostly in the southern part of the region (Burbridge et al. 2000).

3.3 Geology and soils

The survey area is in the Gascoyne Sub-basin of the Carnarvon Basin, which comprises a substantial thickness of sedimentary rocks, potentially about 4 km thick, overlying Precambrian basement rocks. The sedimentary rocks comprise Silurian Tumblagooda Sandstone over which there is a westwards-thickening Cretaceous veneer of marine sediments, including Birdrong Sandstone, Windalia Radiolarite (siltstone), Alinga Formation (clayey siltstone to greensand) and Toolonga Calcilutite (chalky calcilutite to calcisiltite). These are in turn overlain by Tertiary sediments (Pindilya Formation – sandstone and conglomerate) and Quaternary sediments (calcrete, Tamala Limestone, colluvium and eolian and residual sands). There is considerable calcareous coastal-dune build-up along the coastal strip that is indurated, forming the Tamala Limestone (GoWA 2022)

The soil landscape changes from calcrete plateaux, mesas, hills and footslopes supporting annual grasslands, herbfields and degraded chenopod shrublands in the east through to elevated undulating limestone plains within thin sand cover, sea cliffs and low hills supporting low heath, mallee shrublands and paper bark thickets in the western coastal section. Throughout the mid-section, undulating sand plains and occasional dunes supporting shrub heath and tree heath vegetation is common (GoWA 2019).

3.3.1 Surface Geology

The geological unit’s observable at ground surface across the landside portion of the survey area are indicated on the 1:250,000 Ajana map sheet published by the Geological Survey of Western Australia (Sheet SG 50-13) (2019) (GoWA 2019).

The coastline comprises the Zuytdorp Cliffs, which comprise Quaternary “Lithified Tamala Limestone” (Qtl), with some areas along the coastal cliff area mapped as “Beaches and mobile coastal dunes – quartzose calcarenite” (Qs). Moving inland, the 5 to 10 km wide coastal strip is primarily mapped as Quaternary “Tamala Limestone – calcarenite with calcrete soils: eolian” (Qt) (GoWA 2022).

Further inland the map shows the following Quaternary and Tertiary units covering significant portions of the ground surface within the Survey Area:

– "Aeolian and residual sand – red-brown and yellow quartz sand" (Qe) across most of the northern half of the survey area, and some areas immediately east of the Tamala Limestone coastal strip in the southern half of the survey area.
– "Calcrete – lumpy, nodular and massive authigenic limestone; duricrust and valley fill" (Czk) in the south-eastern portion of the survey area, including portions of the southern half of the planned solar farm
– "Colluvium – clay, silt, sand and gravel; formed by sheet flood and deflation" (Qc) in isolated areas on the eastern boundary of the coastal Tamala Limestone, including the north-western side of the planned solar farm area, as well as portions of the eastern side of the survey area.

In addition, isolated portions of the survey area land surface are mapped as follows:

– "Larger playas – poorly sorted clay, silt, sand and gravel" (Ql, Quaternary) at an isolated location north-east of the planned solar farm area
– "Pindilya Formation – poorly sorted sandstone, conglomerate; fluviatile, includes minor authigenic silcrete" (Tp, Tertiary) at an isolated location in the north-western portion of the proposed solar farm area
– "Alinga Formation – glauconitic clayey siltstone to greensand; shallow marine" (Ka, Cretaceous) at an isolated location in the north-western portion of the proposed solar farm area (same general area where Pindilya Formation is mapped, as described above), as well as at an isolated location north of the solar farm area
– "Windalia Radiolarite (radiolarian siltstone; commonly porcellanised; marine) and Birdrong Sandstone (well sorted, friable sandstone; commonly glauconitic; shallow marine), undifferentiated" (Kl, Cretaceous) at an isolated area at the southern end of the site, adjacent to the coastline within the coastal limestone area

Land systems and landforms

Table 3-2 below provides a summary of the land systems and landforms that exist within the survey area.

Table 3-2 Land systems within the survey area

Land System	Description	Landform	Portion of Survey Area
Zuytdorp Land System	Elevated plains and low hills near the Zuytdorp coastline with varied assemblages of South-West Botanical Province vegetation; low heaths, mallee shrublands and paper bark thickets	Coastal plains, cliffs, dunes, mudflats, and beaches; various vegetation	Western portion
Nanga Land System	Undulating plains of aeolian sand supporting diverse assemblages of South-West Botanical Province vegetation, mostly shrub heath and tree heath dominated by proteaceous and myrtaceous species.	Sandplains with acacia, mallees, and heath	Far north-eastern corner, south western portion and a large eastern portion of the corridor (majority of Survey Area)
Bibra Land System	Plains and low rises on calcrete supporting dense tall Melaleuca and Acacia shrublands	Calcrete plains with acacia shrublands	Central to southeast portion
Pilawarra Land System	Plateaux, mesas, hills and foot slopes supporting annual grasslands, herb fields and degraded halophytic shrublands.	Low hills with eucalypt or acacia woodlands with halophytic undershrubs	Eastern portions on far north, south portion and west portion of corridor of Survey Area
Cooloomia Land System	Undulating sandplain and minor stony rises presenting a distinctive park-like landscape with clumped vegetation (discontinuous mallee woodlands and thickets of myrtaceous shrubs) mixed with open grassy slopes.	Sandplains with acacia, mallees, and heath	Far north-eastern portion
York Land System	Flat, low-lying clay plains, with minor areas of sandy-surfaced plains, supporting mainly open woodlands of York gum above low shrublands of saltbush and cottonbush	Alluvial plains with halophytic shrublands	Very small portion on far north-eastern side and mid portion of corridor
Tumblagooda Land System	Rugged plateaux crests, valleys, gorges, and slopes supporting patchy low to tall mixed shrublands of acacia, melaleuca and heath.	Hills and ranges with acacia shrublands	Three small portions on the far eastern and far south-eastern portions

Land System	Description	Landform	Portion of Survey Area
Stork Land System	Gently undulating stony plains supporting York gum woodlands and acacia tall shrublands.	Alluvial plains with eucalypt woodlands and halophytic undershrubs	Small western portion of the corridor

3.4 Hydrology

The Government of WA (GoWA) (2021a) data layers identified the water resource aspects present within the survey area (Table 3-3).

The lower reaches of Murchison River are situated 2 km south of the southern and south-eastern portions of the Survey Area. Several tributaries to the north and northeast run off the Murchison River into the southern and far eastern portions of the survey area. Lake Culcurdoo is present in the central portion of the survey area approximately 7km east of the coast and 12 km east of the coastal boundary of the survey area. No wetlands of International Importance (Ramsar) or nationally important wetlands intersect the survey area. No wetlands are located within or adjacent to the survey area.

Table 3-3 Hydrology aspects within the Survey Area

Aspect	Details	Results
Groundwater Areas	Groundwater areas proclaimed under the RIWI Act	Gascoyne Groundwater Area
Surface Water Areas	Surface water areas proclaimed under the RIWI Act	Lake Culcurdoo
Irrigation District	Irrigation Districts proclaimed under the RIWI Act	None present
Rivers	Rivers proclaimed under the RIWI Act	None present Murchison River situated approximately 2km south of the Survey Area.
Public Drinking Water Source Areas	PDWSA is a collective term used for the description of Water Reserves, Catchment Areas and Underground Pollution Control Areas declared (gazette) under the provisions of the *Country Area Water Supply Act 1947*	None present
Waterways Management Areas	Areas proclaimed under the *Waterway Conservation Act 1976*	None present

3.5 Land use

The dominant land use within the Geraldton Sandplains is dry-land agriculture (69.34%) with lesser area of conservation (17.6%) and UCL and Crown reserves (12.5%) (Desmond and Chant 2001). Much of the northern Geraldton Sandplain Region is used for pastoral purposes, with the remainder mostly being in conservation reserves.

Many Geraldton Sandplain reserves are becoming saline or encountering rising water tables. Wildfire management facilities are limited by resources, except for fire breaks and fire-access tracks which are installed and maintained except on Zuytdorp Nature Reserve, areas of Beekeepers Nature Reserve and Nature Reserves smaller than 200 ha. Feral herbivore grazing activities now (goats are common in north and east of the bioregion, pigs are undergoing drastic increases in numbers and spreading). Feral predator control systems are in place on Kalbarri, Badgingarra, and Nambung National Parks only (Desmond and Chant 2001).

3.6 Conservation estates and reserves

A search of the DBCA Legislated Lands and Waters database did not identify any reserves within the study area, however three reserves occur within five km of the study area, as presented in Table 3-4.

Table 3-4 DBCA conservation reserves and estates

Name of Reserve	Parcel Identifier	Class	Proximity to Study Area
Kalbarri National Park	R 27004	A	Located approximately 10 km southeast of the survey area.
Zuytdorp Nature Reserve	R 34771	IUCN Category 1a	Located approximately 3.5 km north of the survey area.
Toolonga Nature Reserve	R 40628	IUCN Category 1a	Located approximately 20 km northeast of the survey area.

Zuytdorp Nature Reserve exists approximately 3.5 km northeast and 5 km north west of the survey area. Several pastoral leases exist within the survey area including Tamala (near the coast) and Nanga situated east of Tamala (Burbridge et al 2000). The Kalbarri National Park is situated between 6 km (south of the corridor) and approximately 10 km (south and southeast) of the survey area.

3.7 Environmentally Sensitive Areas

There are two very small Environmentally Sensitive Areas (ESAs) at the far northern mid portion of the survey area (Ref no. 6451 and 6452). Additionally, there are two very small ESAs situated in the mid-western portion of the eastern corridor (Ref no. 6443, 6444 and 6448). Outside of the survey area, approximately 6 km north of the mid-section of the corridor are three very small ESAs (Ref no.6450, 6449).

Approximately 3 km north of the survey area is Zuytdorp Nature Reserve (ESA Ref no. 6914) and approximately 6km south and 10 km southeast of the survey Area is Kalbarri National Park (ESA Ref no.6433). Approximately 7 km southeast of the Survey Area is ESA Ref No.6413 and 5 km southeast of the Survey Area is ESA Ref No.6380.

3.8 Flora and Vegetation

Broad scale (1:1,000,000) pre-European vegetation mapping of the Murchison region was completed by Beard (1976) at an association level. The mapping indicates there are ten vegetation associations present within the survey area (refer Table 3-5).

Table 3-5 Pre-European Vegetation mapping of the Survey Area

System	Vegetation Association	Description	Portion of Survey Area
Zuytdorp	403	Scrub-heath - Mixed heath with scattered tall shrubs *Acacia spp*., Proteaceae and Myrtaceae.	Far western portion (Coastal strip)
	402	Heath – low shrubs of mixed composition.	Western strip east of VA403
	401	Scrub-heath - Mixed heath with scattered tall shrubs *Acacia spp*., Proteaceae and Myrtaceae.	Central portion of Survey Area, east of VA402.
	17	Thicket - *Acacia spp*., *Allocasuarina spp*., and tea tree acacia-Allocasuarina-melaleuca alliance	Eastern portion of Survey Area
Eurardy	380	Scrub-heath - Mixed heath with scattered tall shrubs *Acacia spp*., Proteaceae and Myrtaceae.	Western, Central and eastern portion and majority of the service corridor
	384	Thicket - *Acacia spp., Allocasuarina spp*., and teatree acacia-Allocasuarina-melaleuca alliance	A small section of the south eastern portion of the service corridor.
	406	Thicket - *Acacia spp., Allocasuarina spp*., and teatree acacia-Allocasuarina-melaleuca alliance.	A small section situated west of the VA384 on the service corridor.
Tamala	368	Tree-heath – Mixed heath with low trees *Banksia ashbyi*	Far north-eastern portion

System	Vegetation Association	Description	Portion of Survey Area
Murchison Gorge	386	Low woodland or open low woodland - Other acacia, banksia, peppermint, cypress pine, casuarina, York gum, *Acacia spp., Banksia spp., Agonis flexuosa, Callitris spp., Allocasuarina spp., Eucalyptus loxophleba.*	A small portion of the mid to eastern portion of the corridor
	387	Thicket - Wattle, casuarina and teatree acacia-Allocasuarina-melaleuca alliance	Small portion on north-eastern portion south of VA386 and far southern portion of the survey area
	17	Thicket - Wattle, casuarina and tea tree acacia-Allocasuarina-melaleuca alliance	Eastern portion, south of VA387 and far southern portion including western portion of the service corridor
	407	Scrub with open woodland or scattered trees - acacia with York gum, casuarina, mulga *Acacia spp.* with *Eucalyptus loxophleba, Allocasuarina spp. Acacia aneura.*	Eastern portion south of VA17
	408	Scrub-heath - Mixed heath with scattered tall shrubs *Acacia spp*., Proteaceae and Myrtaceae.	South-eastern and far southern portion of Survey Area

3.9 Fauna database searches

The *NatureMap* database (DBCA 2007-) identified 249 terrestrial vertebrate fauna previously recorded within the Study Area (40 km buffer) comprising 20 mammal, 67 reptile, 158 bird and 10 amphibian species. Of the 249 vertebrate fauna species previously recorded, 243 are native and 6 are naturalised (introduced). The *NatureMap* database search results are provided in Appendix C.

3.10 Conservation Significant fauna

The EPBC Act PMST (DAWE 2021a), *NatureMap* (DBCA 2007-) and DBCA Threatened and Priority fauna database identified the presence/potential presence of 65 significant fauna species (including invertebrate fauna) within the Study Area (Appendix D). Marine mammals and reptiles have been excluded from this assessment.

The species list included:

– Three species listed as Critically Endangered under the EPBC Act and/or BC Act
– Five species listed as Endangered under the EPBC Act and/or BC Act.
– Thirty-three bird species listed as Migratory only under the EPBC Act.
– Ten species listed as Priority under the BC Act.
– Eight species listed as Vulnerable under the BC Act.
– One species listed as Other Specially Protected Fauna under the BC Act.

The locations of significant fauna registered on the DBCA databases are mapped in Figure 2, Appendix A.

3.11 Literature review

The survey area remains largely unsurveyed and as such literature review of recent information is unavailable. Several fauna surveys papers contained within Burbridge et. al (2000) where historical fauna surveys were undertaken within the Carnarvon basin region were reviewed. A summary of these papers is provided below in Table 3-6.

Table 3-6 Literature review of previous fauna survey papers

Literature title	Authors	Published date	Survey type	Survey dates	Key publication findings	Key findings within Zuytdorp study area
Bats of the southern Carnarvon Basin, Western Australia	N.L. McKenzie & W.P. Muir	2000	Comprehensive fauna survey	Spring - Autumn 1994-1996	Two megabat and eleven microbat species were recorded. Sub-fossil records of the Ghost bat (*Macroderma gigas)* were noted; however, it is speculated this evidence of presence in the region is representative of vagrant behaviour with no evidence of roosting/breeding habitat has been utilized inside the survey area. Microbat assemblages were predicted using vegetation structure and local availability of roost sites and provided an explicit basis for assessing the reserve system from the perspective of microbats. Species recorded during the survey include: – *Saccolaimus flaviventris* – *Taphozous georgianus* – *Tadarida australis* – *Chaerephon jobensis* – *Mormoptems beccarii* – *Mormoptems planiceps* – *Chalinolobus gouldii* – *Scotorepens balstoni* – *Scotorepens greyii* – *Vespadelus finlaysoni* – *Nyctophilus geoffroyi* – *Pteropus scapulatus* (Kalbarri) – *Pteropus alecto* (recorded outside survey area)	Species recorded within the Zuytdorp study area include: – *Tadarida australis* – *Mormoptems planiceps* – *Chalinolobus gouldii* – *Vespadelus finlaysoni* – *Nyctophilus geoffroyi* All of which are common bat species
Terrestrial birds of the southern Carnarvon Basin, Western Australia: contemporary patterns of occurrence	A. H. Burbidge, R.E. Johnstone, P.J. Fuller & P. Stone	2000	Quadrat species census	Spring - Autumn 1994-1995	A total of 126 bird species at sixty-three sites in the northern Geraldton Sandplains and southern Carnarvon Regions, Western Australia. Classification of sites based on species present revealed the presence of five main groups of sites, each with at least two recognisable subgroups. Classification of bird species on the basis of the sites at which they occurred, revealed the presence of four main species groups, with some structuring within these:	Zuytdorp site classifications based on species assemblages listed as comprised of 3b and 5b. These nominal groupings share close similarities with Edel Land (Shark Bay) to the north and Nerren Nerren station sites to the east.

Literature title	Authors	Published date	Survey type	Survey dates	Key publication findings	Key findings within Zuytdorp study area
					– 75 passerines and 51 non-passerines were recorded at the 63 sites. – Classification of sites on the basis of passerine bird species alone (67 taxa) resulted in a dendrogram in which four groups could be distinguished. Groups were further analysed to distinguish two- three discrete subgroups	
Birds of the southern Carnarvon Basin, Western Australia: distribution, status and historical changes	R.E. Johnstone, A. H. Burbidge & P. Stone	2000	Western Australian Bird Data Bank	1970-1996	Geographic range and status was documented for the 279 bird species known to occur in the southern Carnarvon Basin, Western Australia. The 162 breeding species were mapped, and each was assessed for possible changes in abundance during the last century. For about 75% of breeding species populations changes were not detect. Around 13% of species were shown to have increased in abundance and 10-15% have decreased in abundance. Changes in breeding populations were comparable to those reported for nearby arid areas (the Murchison catchment) but are less than those reported for eastern Australian arid areas.	Zuytdorp sites recorded to display an intergrade zone for extreme northern and southern extent of species distributions. These patterns are noted to coincide with floristic and soil type compositions.
Non-volant mammals of the southern Carnarvon Basin, Western Australia	N.L. McKenzie, N. Hall & W.P. Muir	2000	Comprehensive fauna survey	Spring - Autumn 1994-1996	Sixty-three quadrats were chosen to represent the geographical extent and diversity of terrestrial habitats in the 75,000 km2 Carnarvon Basin study area. Twenty-three of the original 48 indigenous species to the southern Murchison Basin region were noted as now extinct, a decline that is considered precede the advent of foxes. Five mammal families were identified (excluding exotic taxa), comprised of: – *Macropus rufus* – *Macropus robustus* – *Macropus fuliginosus* – *Tarsipes rostratus* – *Antechinomys laniger* – *Dasykaluta rosamondae* – *Dasycercus cristicauda* – *Sminthopsis crassicaudata*	Species recorded within the Zuytdorp study area include: – *Tarsipes rostratus* – *Macropus fuliginosus* – *Sminthopsis dolichura* – *Sminthopsis granulipes* – *Sminthopsis hirtipes* – *Notomys alexis* – *Pseudomys albocinereus* – *Pseudomys hermannsburgensis*

Literature title	Authors	Published date	Survey type	Survey dates	Key publication findings	Key findings within Zuytdorp study area
					– *Sminthopsis dolichura* – *Sminthopsis granulipes* – *Sminthopsis hirtipes* – *Sminthopsis longicaudata* – *Sminthopsis macroura* – *Sminthopsis youngsoni* – *Tachyglossus aculeatus* – *Notomys alexis* – *Pseudomys albocinereus* – *Pseudomys hermannsburgensis*	
Herpetofauna of the Southern Carnarvon Basin, Western Australia	N.L. McKenzie, J.K. Rolfe, K.P. Aplin, M.A. Cowan & L.A. Smith	2000	Comprehensive fauna survey	Spring - Autumn 1994-1996	Frog and reptile species were sampled across sixty-three quadrats chosen to represent the geographical extent and diversity of terrestrial environments in a 75,000 km2 study area in the Carnarvon Basin. Twelve frog and 17 gecko, 10 pygopodid, 16 dragon, 58 skink, four goanna and 16 frog and snake species were recorded, an average of 16.3 species per quadrat. – Rich *Lerista* assemblages were associated with the Eucalyptus and/or Acacia litter-patches found on virtually all non-saline quadrats in the study area. – The arid-adapted genera *Diplodactylus*, *Ctenophorus*, *Ctenotus* and *Lerista* are very diverse with high levels of syntopy among *Ctenotus* and *Lerista* species, particularly on the 14 quadrats which represented the red sand-hummock grass environments – Little evidence suggests any herpetofauna species has become extinct in the study area during the last 200 years, despite extensive loss of topsoil, a major reduction in vegetative cover in most of the area. – Of the twelve frog species recorded, the arid adapted families of Limnodynastidae (5 species) and Myobatrachidae (4 species) were the most speciose groups of the taxa recorded.	Zuytdorp quadrats that had been regularly grazed by stock, feral goats and/or rabbits were not significantly poorer in species than those that showed no sign of these introduced herbivores. Rich *Lerista* assemblages were associated with the Eucalyptus and/or Acacia litter-patches found on virtually all non-saline quadrats in the study area, even quadrats with only a thin sandy soil A-horizon. Seven species were recorded on one Zuytdorp quadrat implying that there has been a significant radiation of *Lerista* taxa in the study area.

4. Results

4.1 Fauna habitats

Twelve broad fauna habitat types recorded during the field survey (including areas considered Cleared/Farmland). The 12 habitat types described in Table 4-1 and closely align with the different vegetation types (GHD 2023b) and landforms within the survey area and include:

- Coastal heathlands
- Minor Creek lines/drainage lines
- Beach and associated dunes and limestone ridge
- Limestone hills and ridgelines
- Clay Pans/Lake Culcurdoo
- Mallee woodland
- Mixed shrublands
- Banksia shrublands
- Acacia shrublands
- York Gum woodland
- Jam shrubland
- Cleared/Farmland

The habitat types recorded within the survey area are mapped in Figure 4 and 5, Appendix A.

Table 4-1 Fauna habitat types within the Survey Area

Habitat type	Extent (in Survey Area) (ha)	Representative Image
Coastal Heathlands **Vegetation types** – VT02 – (ArMcMlOk) Coastal shrublands – VT03 – (ArEaMc) Coastal *Exocarpos aphyllus* shrublands on low secondary dunes – VT04 – (McArSoMv) Coastal shrublands on flat coastal sand dunes – VT05 – (AbMcEa) Coastal *Alyxia buxifolia* shrublands on pale brown/pink sand on low dunes – VT06 – (AbOaOkTc) Coastal mixed shrublands on pale brown/pink sand on pale brown/pink sand over limestone on low dunes, gullies and limestone rocky ridges/outcrops The western (coastal) side of the Survey Area is dominated by low coastal heathlands on coastal dunes, moving sands or minor limestone ridges. Coastal heaths are continuous along the coast however the beach and associated limestone is described as a separate habitat type due to the possible uses by fauna species and features present. The coastal heathland vegetation is much lower (up to about 50cm) along the coast, than further inland which reaches up to 1.5m. The difference in vegetation growth structure appears to be influenced by winds and in some areas grazing by goats. It is also possible that changes in soil composition ie limestone capping or moving sands will influence growth and structure. This habitat supports a continuous homogonous vegetation belt along the coast which varies in species composition from the southern to northern portions of the survey area ie Lomandra densities much higher in the south. This is likely due to slight changes in rainfall as the habitat extends north. However, the environment supports mixed shrubs of *Olearia*, *Frankenia, Carpobrotus, Acacia*, *Thryptomene, Eremophila glabra, Ptilotus* and Lomandra. The environment has dominant ground covers, some litter and debris with few logs. This is possibly due to the lack of tall or structured vegetative material and/or by grazing from goats and rabbits. There was no evidence of fire within this habitat type. Other disturbances present include old farming fencing and yards, however these compromise small areas of the environment. Due to the habitat present specialised coastal species such as Western Heath Dragon (*Ctenophorus adelaidensis)*, West Coast Banded Snake (*Simoselaps littoralis),* Javelin Legless Lizard *(Delma concinna)* and White-spotted Ground Gecko (*Lucasium alboguttatum*) were present. Small passerine birds were also abundant which included White-winged Fairy-wren (*Malurus leucopterus*), Splendid Wren (*Malurus splendens*), Purple-backed Fairy-wren (*Malurus assimilis*), Southern Emu-wren (*Stipiturus malachurus*) and Rufous Field-wren (*Calamanthus campestris*). **Conservation significant fauna**	6731	 

Habitat type	Extent (in Survey Area) (ha)	Representative Image
Due to the close proximity to the coast numerous coastal avian species were recorded using or flying over the habitat type. This includes the Osprey (*Pandion cristatus*), Fork-tailed Swift (*Apus pacificus*), Crested Tern (*Thalasseus bergii*) and Gull-billed Tern (*Sterna nilotica*) and would be considered supportive habitat to the species needs. A brief unconfirmed sighting of the Western Grasswren (*Amytornis textilis*) was made in the eastern portion of this habitat type. This species was not confirmed during the remainder of the surveys however based on habitats available is likely to be present. The Peregrine Falcon (*Falco peregrinus*) is also likely to utilise this habitat for foraging along the coastal strip. **Moderate value**		
Beach and associated dunes and limestone ridge – VT01 (McOaRdSo) – Coastal low shrubland – VT07 – (ArReSc) Coastal foredunes The coastal strip comprises a mosaic of beaches, reef, rock shelf, pools, dunes and limestone ridges (with areas of breakaway or wind-swept ridgelines) creating a diverse sweet of micro environments for species. The vegetation consisted of coastal heathlands however the primary dune contains scattered areas of Beach Spinifex (*Spinifex longifolius*) and coastal Saltbush (*Atriplex cinerea*) as well as other low salt and wind tolerant plants. This habitat was diverse in structure and was evidently sculptured by wind, water and salt. Some areas were deep sands while others loam, shell or rock or combinations of all. There were high points in the environment and areas where water ran or pooled during large weather events. There was no evidence of fire in this environment. Most tracks leading to the coast had evidence of human use such as camping, fishing, old shacks and associated rubbish. Additionally goats were recorded on all habitat features and seen grazing on sea weed and drinking water. Some areas were degraded from goat use however large portions were in very good condition. This habitat provides a variety of habitat resources for fauna species, and patches had a greater structural diversity than the surrounding coastal heaths and shrublands. This habitat provides for burrowing species such as West Coast Banded Snake (*Simoselaps littoralis*), Northern Dotted-line Robust Slider (*Lerista miopus*) and rocky area provide for Barking Gecko (*Underwoodisaurus milli*). The Shark Bay Heath Dragon (*Ctenophorus butlerorum*) was only recorded in this habitat. **Conservation significant fauna** Eight conservation significant species were recorded in this habitat type and include Greater Sand Plover (*Charadrius leschenaultii*), Red-necked stint (*Calidris ruficollis*), Sanderling (*Calidris alba*), Bar-tailed Godwit (*Limosa lapponica menzbieri*), Gull-billed Tern (*Gelochelidon nilotica*), Osprey (*Pandion cristatus*), Caspian Tern (*Hydroprogne caspia*) and Crested Tern (*Thalasseus bergii*). All of these species were either feeding along the beach or loafing. The Gull-billed and Caspian Tern were seen flying along the coastline.	1,936	 

Habitat type	Extent (in Survey Area) (ha)	Representative Image
This habitat within the survey area is likely to support other migratory species opportunistically and include the Roseate Tern (*Sterna dougallii*), Fairy Tern (*Sternula nereis*), Common Sandpiper (*Actitis hypoleucos*), Common Greenshank (*Tringa nebularia*), Sharp-tailed Sandpiper (*Calidris acuminata*), Ruddy Turnstone (*Arenaria interpres*), Red Knot (*Calidris canutus*), Lesser Sand Plover (*Charadrius mongolus*), Grey Plover (*Pluvialis squatarola*), Pacific Golden Plover (*Pluvialis fulva*), Grey-tailed Tattler (*Tringa brevipes*), Eastern Curlew (*Numenius madagascariensis*), Whimbrel (*Numenius phaeopus*). The Common Sandpiper and Common Greenshank were recorded along the Murchison River while undertaking regional surveys and are likely to utilise the beach habitats. The Peregrine Falcon may also utilise the area for foraging only. Several oceanic avian species were recorded while undertaking the migratory bird survey, these birds were out to sea but were recorded within a few hundred meters of the coast foraging on the wing. These species included Wedge-tailed Shearwater (*Ardenna pacifica*) and Wilson's Storm Petrel (*Oceanites oceanicus*). **High Value**		
Limestone hills and Ridgelines – VT08 - Rocky limestone outcropping low hills and ridges – VT09 – (AoHrHs) Isolated shrubs on high limestone ridgeline, slopes and valley floor – VT14 (ArMc) *Acacia rostellifera* and *Melaleuca cardiophylla* open woodland on brown sand on limestone rocky slopes and ridges and brown sandy flats The majority of southern and south eastern portion of the Survey Area comprises a mosaic of limestone hills and ridgelines. The formations are usually associated with Melaleuca spp. vegetation types or other low shrubs probably due to the shallow soils and limestone cap rock. Other species associated include Acacia, Eremophila, Grevillia, Hakea, and Borya and an abundance of grasses and herbs. The environment had areas of good ground covers, litter and debris but lacked large logs due to vegetation present. This habitat appeared particularly use by feral goats and pigs with noticeable grazing present and large areas where rocks and surface soils were ploughed by pigs. However despite the disturbances the habitat provides a range of cover to fauna species of outcropping with exfoliating rock, crevices and large rocks. Numerous reptile species were recorded in this habitat and include Soft Spiny-tailed Gecko (*Strophurus spinigerus)*, Western Netted Dragon (*Ctenophorus reticulata*) and Yellow-faced Whipsnake (*Demansia reticulatus*). While mammals such as Sandy Inland Mouse (*Pseudomys hermannsburgensis*) were common. **Conservation significant fauna** The Malleefowl was recorded in this habitat type consisting of inactive and active mounds. Mounds however on taller ridgelines appeared all inactive possibly due to feral species disturbance. Peregrine Falcon may also utilise these areas for foraging. The Gilled Slender Blue-tongue (*Cyclodomorphus branchialis*) may utilise this	13,668	

Habitat type	Extent (in Survey Area) (ha)	Representative Image
habitat despite none recorded during the surveys. The Chuditch (*Dasyurus geoffroii*) may also periodically utilise this habitat due to the denning capabilities of limestone outcropping and capping. **High Value -provides shelter and breeding sites for habitat specialist species of conservation significance.**		
Clay Pans/ Lake Culcurdoo – VT30 – (CoMtRdTiTd) *Casuarina obesa* isolated trees over *Maireana tomentosa, Rhagodia drummondii, Tecticornia indica* and *Threlkeldia diffusa* chenopod open shrubland on seasonal claypan – VT31 – (AvEdPa) *Austrostipa variabilis, Eragrostis dielsii* and **Pentameris airoides* subsp. *airoides* tussock grassland on brown heavy clay on large claypan system (Lake Culcurdoo) – VT32 (Ec) *Eucalyptus camaldulensis* open woodland on white/cream sand near drainage clay pans Numerous small clay pans are scattered throughout the survey area. Additionally Lake Culcurdoo is in the central region and runs north /south. The clay pans and Lake Culcurdoo all show a level of historical disturbance from clearing, water point activity (including wells, old troughs, yards) as well as dams and tracks. These areas have weeds and grasses present and demonstrated high use by goats and native species like Western Grey Kangaroo (*Macropus fuliginosus*), Common Wallaroo (*Osphranter robustus*) and Emu (*Dromaius novaehollandiae*). This habitat comprise a relatively small portion of the Survey Area. The habitat comprised a mix of soils from fine sands or a layer of heavy loam with an over storey dominated by hardy, low and tall shrub species (primarily Acacia sp.) with herbs and grasses (mostly weeds). The dams - surface water along Lake Culcurdoo appeared to have some water present for most of the year and used as a drinking source for pastoral and native animals. As such in these areas bovine grazing (showing signs of heavy grazing, soil compaction and trampling) noticeably impacted the surrounding habitats. Being an open habitat birds such as Banded Lapwing (*Vanellus tricolor*) and Australasian Pipit (*Anthus novaeseelandiae*) were recorded breeding with use also recorded by White-fronted Chat (*Epthianura albifrons*) and Magpie-lark (*Grallina cyanoleuca*). Water retention also supports frogs such as Western Banjo Frog (*Limnodynastes dorsalis*), Crawling Toadlet (*Pseudophryne guentheri*) and Humming Frog (*Neobatrachus pelobatoides*). Other disturbances on Lake Culcurdoo include Gee Gei outcamp with historical yards and homestead. No fire was recorded in this habitat. **Conservation significant fauna**	397	

Habitat type	Extent (in Survey Area) (ha)	Representative Image
No conservation significant fauna were recorded in this habitat however some Zuytdorp Worm Slider (*Lerista humphriesi*) historical records are present in the surrounding supportive habitat. The Peregrine Falcon may also utilise these areas for foraging. Seasonally after large rain events migratory birds may utilise portions of this habitat if suitable. Areas that inundate including the dams maybe utilised as required. **Low Value**		
Mixed Shrublands – VT11 – (GeAcHs) *Grevillea eriostachya, Acacia chartacea* and *Hakea stenophylla* subsp. *notialis* open shrubland on red sandy plain and low rises – VT12 – (AcArAb) *Allocasuarina campestris, Acacia rostellifera* and *Acacia blakelyi* shrubland to closed shrubland on light brown sand flats and low rises – VT13 – (MaAr) *Melaleuca atroviridis* and *Acacia ramulosa* open shrubland on yellow sand plain – VT15 – (McMcAlAc) *Melaleuca concreta, Melaleuca campanae, Acacia lineolata* subsp. *lineolata* and *Allocasuarina campestris* shrublands on red/orange loamy clay on flats and depressions – VT21 – (AsMlBa) *Acacia spathulifolia*, *Melaleuca leiopyxis* and *Banksia attenuata* low open shrubland on pale yellow/white sand plains A variety of different mixed/diverse shrublands occur throughout the sand plain and dune systems present within the survey area. These shrublands are characterised by differing dominance of Acacia, Melaleuca, Hakea, Grevillea, Allocasuarina, Calytrix and Verticordia species. The composition and high structural diversity of these shrublands varies, ranging from open shrublands to areas with dense patches of shrubs, dependent on the position in the landscape, age since fire and level of disturbance. Typically there is a dominant mid-storey layer of shrubs, with few open patches of bare ground and scattered trees. Dominant ground covers included Lomandra spp. clumps or Triodia hummocks, sedges which provide excellent cover to small terrestrial reptiles. The shrublands provide high value habitat for birds, with foraging opportunities (flowers) and the dense patches of shrubs providing refuge areas. In areas with older fire history there are large amounts of non-vascular ground cover present, including fallen branches, bark and leaf litter. There are also numerous flowering species, in particular proteaceous and myrtaceous species (e.g. Grevillea, Hakea, Verticordia, Calytrix). Where dune systems and deep sands are present digging species such as Ash Grey Mouse	12,687	

Habitat type	Extent (in Survey Area) (ha)	Representative Image
(*Pseudomys albocinereus*), Smooth Knob-tailed Gecko (Nephrurus levis occidentalis) and Southern Sandhill Frog (*Arenophryne xiphorhyncha*) were recorded. This habitat type is well represented in the survey area, with limited similar vegetation communities within the region. **Conservation Significant Species** Malleefowl were recorded in this habitat type particularly where it fringes into Mallee Woodlands. Active birds, prints and mounds both active and inactive mounds were recorded in this habitat. Numerous species could potentially utilise this habitat and include the Taper-tailed West Coast slider (leaf litter), Carnaby's Cockatoo (foraging), Peregrine Falcon (foraging) and Tammar Wallaby (*Notamacropus eugenii derbianus*) (persistence in dense areas). **High Value**		
Mallee Woodland – VT25 – (EeEp) *Eucalyptus eudesmioides* and *Eucalyptus pallida* open mallee over *Melaleuca atroviridis, Acacia blakelyi* and *Melaleuca leiopyxis* shrubland on orange/brown sandy loam in areas near claypans and plains – VT26 – (EpErEg) *Eucalyptus pallida, Eucalyptus rigidula* and *Eucalyptus gittinsii* subsp. *gittinsii* open mallee woodland on orange/brown sandy loam on plains and near claypans/flats – VT27 – (EpBsXa) *Eucalyptus pallida* isolated mallee trees over *Banksia sceptrum* and *Xylomelum angustifolium* open woodland on pale yellow/cream sand plains and rises Mallee shrublands dominated characterised by single or multi-stemmed mallee eucalypt trees (5-10 m) typically over mixed shrubs, sedges, grasses and herbs with different levels of ground cover. Ground cover often consisted of bark and leaf litter of varying densities with denser patches typically occurring at the base of trees or taller shrubs. Where goat activity was higher the disturbance and scats present formed part of the ground cover. Fallen tree limbs and small hollow logs were common and scattered throughout this habitat type with only small tree hollows present. These hollows recorded species such as the striated Pardalote (*Pardalotus striatus*)- breeding and Owlet Nightjar (*Aegotheles cristatus*) -roosting. This is also the preferred habitat for Allan's Skink (*Ctenotus alleni*), Murchison Blindsnake (*Anilios leptosoma*) and Micro Three-toed Slider (*Lerista micra*) primarily distributed in this region. Termitaria were also present although scattered. This habitat appeared mostly long unburnt and was extensive in the southern and eastern portions of the survey area. **Conservation significant fauna** The Malleefowl was most commonly recorded in this habitat type with active birds, prints and mounds both active and non active mounds recorded. Where large trees and hollows are present the Chuditch, Woma (*Aspidites ramsayi*) or Western Spiny-tailed Skink (*Egernia stokesii badia*) may utilise however none were	9,118	

Habitat type	Extent (in Survey Area) (ha)	Representative Image
recorded in this habitat during the field surveys. The Gilled Slender Bluetongue may utilise this habitat and the Peregrine Falcon would utilise these well vegetated corridors for hunting/foraging. **High Value**		
Banksia Shrubland – VT17 – (BsCbAcHc) *Banksia sceptrum* isolated trees over open shrubland over *Calothamnus blepharospermus, Allocasuarina campestris* and *Hibbertia conspicua* open shrubland on yellow/cream sand plains and low rises – VT18 – (BsAcCaGe) *Banksia sceptrum* open woodland to isolated trees over *Allocasuarina campestris, Callitris arenaria* and *Grevillea eriostachya* open shrubland on yellow sandplains, sandy rises and low sandy hills – VT19 – (BsEg) *Banksia sceptrum* and *Eucalyptus gittinsii* subsp. *gittinsii* open woodland to isolated trees on yellow sand plains, rises and low dunes. Occurs within Kalbarri National Park, was not mapped within the survey area. Sampled for comparison with survey area sandplain and dune vegetation types. – VT20 – (BsCoSuHc) *Banksia sceptrum* open woodland to isolated trees over *Calothamnus oldfieldii, Scholtzia umbellifera* and *Hibbertia conspicua* low open shrubland on pale yellow/white sand plains, low rises and hills – VT22 – (BsArAbAc) *Banksia sceptrum* open woodland to isolated trees over *Acacia rostellifera, Acacia blakelyi* and *Allocasuarina campestris* open shrubland on yellow sandplains and low rises – VT23 – (McChSo) *Melaleuca concreta, Calytrix harvestiana* (P2) *Scholtzia oleosa* (P3) low shrubland on pink/orange sand on low depressions / water gaining areas within the sandplains The southern, western and eastern portions of the survey area is characterised by Banksia shrubland with dominant species of *Banksia ashbyi, B. sceptrum and B. prionotes*. The understorey is of mixed low proteaceous and myrtaceous shrubs, with ground cover of sedges, hummock grasses or low shrubs. This habitat is quite dense with some areas almost impenetrable. Banksia shrubland had areas of dense littler, fallen branches and debris over deep sands creating excellent habitat for fossorial reptile and amphibian species. Limited tree hollows are available in this habitat however dead banksia provides excellent exfoliating bark for sheltering species, particularly bats and arboreal reptiles. Most of this habitat appeared long unburnt with grazing from goats the biggest impact. This habitat is an important foraging resource for Carnaby's Cockatoo, and also provides nectar for many nectivorous species such as the 11 honeyeater species recorded. Additionally the flowering plants lure insects to the area and in turn predatory birds with large flocks of Masked and Black Faced Wood-swallows utilising the resource. **Conservation significant fauna** This habitat is the main feeding resource for the Carnaby's Cockatoo that utilise the region. The Banksia shrublands within the survey area fall within the known foraging range of the species therefore could be utilised during the breeding season. Malleefowl were also recorded utilising this habitat type particularly	36,432	

Habitat type	Extent (in Survey Area) (ha)	Representative Image
where it fringed or had scatted Mallee present with prints and mounds recorded. The Chuditch, Woma, Peregrine Falcon would utilise this habitat for hunting/foraging **High Value**		
Acacia shrubland – VT10 – (AcAaTd) *Allocasuarina campestris, Callitris arenaria* and *Thryptomene denticulata* shrubland on yellow sand and sandy loam low slope and hill. Mixed mid to tall Acacia shrublands dominated by Acacia species including *A. rostellifera, A. blakelyi*. Scattered *Allocasuarina campestris, Baeckea spp., Scholtzia spp.* and *Hakea stenophylla*. are present and in some areas even becomes dominant but typically in small groves. This habitat type occurs in the heavier sandy red soils within the central and eastern areas and is considered to be in very good to excellent condition. This habitat type provides shelter and food resources for small birds, ground dwelling reptiles and mammals particularly in areas that are very dense (almost impenetrable) reducing the impacts of feral species incursion. The ground dwelling Lozenge-marked Dragon (*Ctenophorus scutulatus*), Southern Scrub Robin (*Drymodes brunneopygia*) and Grey Shrike Thrush (*Colluricincla harmonica*) were particularly common in this habitat. Limited tree hollows are available in this habitat however dense leaf litter provides excellent ground cover for sheltering species, particularly the fossorial Lerista and other small reptiles. Most of this habitat appeared long unburnt with grazing from goats the biggest impact. **Conservation significant fauna** The Malleefowl was recorded in this habitat type with active birds, prints and mounds both active and inactive mounds recorded. Where dense habitat is present the Chuditch and/or Woma may utilise however none were recorded in this habitat during the field surveys. The Gilled Slender Bluetongue may utilise this habitat and the Peregrine Falcon would utilise these well vegetated corridors for hunting/foraging. **High Value**	342	
York Gum Woodland – VT28 – (ElAcAt) *Eucalyptus loxophleba* subsp. *supralaevis* open woodland on brown loam with limestone rocks on plains – VT29 – (ElMeAl) *Eucalyptus loxophleba* subsp. *supralaevis* open woodland to isolated trees over *Melaleuca eleuterostachya* and *Acacia lineolata* subsp. *lineolata* open shrubland on brown loamy clay flats between limestone low hills The York Gum woodland consists of an upper canopy dominated by *Eucalyptus loxophleba* (York Gum) over a low sparse chenopod shrubland. This habitat type ranges from very good to excellent condition and is situated in the eastern portion of the survey area as well as several small isolated patches. It contains good structural diversity and a variety of micro-habitat types including patches of thick leaf litter, fallen trees, logs and branches and tree hollows. This habitat is preferred grazing by goats and was the only location Red Kangaroos were recorded in the survey area. Most of this habitat appeared long unburnt with grazing from goats the biggest impact. **Conservation significant fauna**	649	

Habitat type	Extent (in Survey Area) (ha)	Representative Image
This is the only habitat where the Western Spiny-tailed Skink was recorded. Numerous colonies were identified along the eastern service corridor. Each colony ranged from about two to eight individuals located within large dead hollows in York Gum. Sub-adults and juveniles were also recorded demonstrating multigenerational colonies. There are numerous other areas of York Gum present throughout the survey area but no additional colonies were recorded. The species is likely to also utilise old growth mallee and mulga hollows if present. Malleefowl were recorded in this habitat type by mostly old mounds. The Gilled Slender Bluetongue may utilise this habitat and the Peregrine Falcon would utilise the well vegetated corridors for hunting/foraging. **High Value**		
Minor Creek line/drainage lines VT16 – (AaMeDi) *Acacia acuminata, Melaleuca eleuterostachya* and *Dodonaea inaequifolia* shrubland on brown loamy clay flats and minor drainage lines (Weerinoogudda creek). Due to the very sandy nature of much of the survey area very few drainage lines are present. Two main ephemeral creek/drainage lines (one being Weerinoogudda creek) run across the eastern corridor south towards the Murchison River (north to south). The ephemeral creeks support generally narrow, linear shrublands of Jam or cleared areas and was no more structurally diverse than the surrounding habitats. The vegetation along these drainage lines is dominated by Acacia species with scattered mixed shrubs including Callistemon, Eucalyptus, Scaevola with herbs and grasses. Areas had good litter and debris build-up present including large branches and logs creating numerous usable habitat options for fauna species. Lake Culcurdoo also has a drainage line running north to south. This area appears historically cleared with little vegetation remaining. The drainage line also has numerous dams bisecting it which impacts flow and pooling. The drainage lines have a mosaic of substrates with a complex and variable mix of rocky, stony and sandy profiles. The substrates would vary and erode in response to rainfall and flooding. There was no evidence of fire in this habitat. Disturbances were mainly due to minor roads, grazing effects of goats and rabbits. These linear patches of habitat provide a corridor for the movement of fauna through the local landscape. Small birds (such as the Zebra Finch (*Taeniopygia guttata*), Splendid Fairy-wren (*Malurus splendens*) and honeyeaters) would utilise this denser vegetation for foraging, movement and nesting. All species would utilise the water available when present. Numerous species of frog are likely to utilise these areas. **Conservation significant fauna** The Malleefowl (*Leipoa ocellata*) was recorded crossing the creek via prints in this habitat type and the species if likely to utilise the water source when available. Additionally Carnaby's Cockatoo (*Zanda latirostris*) may also utilise the creeks as a water source however the creeks maybe outside of the species range. The Peregrine Falcon would utilise these well vegetated corridors for hunting/foraging.	230 (combined hectare with Jam shrubland)	

Habitat type	Extent (in Survey Area) (ha)	Representative Image
High Value due to relatively high biodiversity occurring in these areas which have relatively high productivity associated with the seasonal hydrology and associated habitat productivity		
Jam Shrubland – VT16 – (AaMeDi) *Acacia acuminata, Melaleuca eleuterostachya* and *Dodonaea inaequifolia* shrubland on brown loamy clay flats The Jam (*Acacia acuminata*) shrubland habitat type comprises a small portion of the survey area. The habitat type has a sparse mid-storey of shrubs and with groundcover comprising clumps of native grasses and herbs. This habitat showed little disturbance and retains structural diversity despite goats being recorded. The environment had areas of good ground covers, litter, logs, rocks or debris. In areas where the shrubland is denser, this vegetation would provide suitable habitat for a variety of fauna species, in particular foraging opportunities, breeding habitat and refugia for bush birds and small mammals. Where the shrubland was more open, and on loamy soils, termitaria were present. Termitaria provide habitat and food source for numerous small reptiles, mammals and invertebrates. Scattered areas of rocks were also present providing habitat for digging reptiles and invertebrates. There was no evidence of fire in this habitat. **Conservation significant fauna** The Malleefowl was recorded in this habitat type with active birds, prints and mounds both active and inactive mounds recorded. Where dense habitat is present the Chuditch and/or Woma may utilise however none were recorded in this habitat during the field surveys. The Gilled Slender Bluetongue may utilise this habitat and the Peregrine Falcon would utilise the well vegetated corridors for hunting/foraging. **High value**	230 (combined hectare with minor creek and drainage line)	
Cleared/ Farmland Cleared areas including tracks, tank infrastructure and farmland, some scattered native shrubs/trees over weeds. Habitat value: Low to negligible	586	

4.2 Habitat linkages

The Survey Area represents a large continuous tract of fauna habitat that retains high connectivity to the habitats directly adjacent. Existing impacts to all habitat types in the Survey Area include damage from pastoralism (grazing, trampling of vegetation, soil compaction along cattle/goat trails, small amounts of clearing for tracks and artificial water sources) as well as grazing/rooting from feral animals and native kangaroos. While the structural complex of some habitat types shows stress signs of grazing and reduced water availability, most of the site is uncleared and represents good, intact habitat.

The habitats in the Survey Area have direct connectivity to surrounding habitats, although the yellow sand dune features and vegetation communities associated appear to be unique to the survey area. Two broad additional obvious habitat types were detected in immediately surrounding lands and consist of Sandstone ridges and Mulga shrublands that are not present within the Survey Area. Few riparian drainage lines channels area spread over the survey area which lie in the eastern corridor which comprises mainly grey/orange soils with surrounding Mallee, Acacia sandplain and scattered small hills of chert within York Gum woodlands. Being on pastoral stations, fences (mostly old and degraded) and dirt tracks run through some of the Survey Area reducing habitat linkages.

4.3 Habitat Scatter Plot

The similarity between sites based on the GHD trapping data was examined using PRIMER. The cluster analysis MDS of habitats (Chart 3) and resulting dendrogram (Chart 4) showed that according to the species recorded the Coastal heathland, York Gum woodland, and Jam shrubland demonstrate uniqueness (could be more or less species) in the species recorded and demonstrate isolating. The Mallee shrubland habitat type demonstrates uniqueness in species recorded to a lesser extent, evident in the isolation of some of the trap sites in the MDS plot and in the branching of the resulting dendrogram. The Coastal heathland and York Gum habitats demonstrated good species richness, lack-of species in this case have isolated them apart from the remaining sites. The Mallee Shrubland and Acacia shrubland and Banksia shrubland habitats demonstrated good species richness, unique to those sites, evident in the clustering of majority of the trap sites of those habitat types. habitat trap sites. The resulting dendrogram confirms the Mallee Shrubland and Acacia shrubland and Banksia shrubland species similarities, as do the York Gum and Jam shrubland as they cluster similarly.

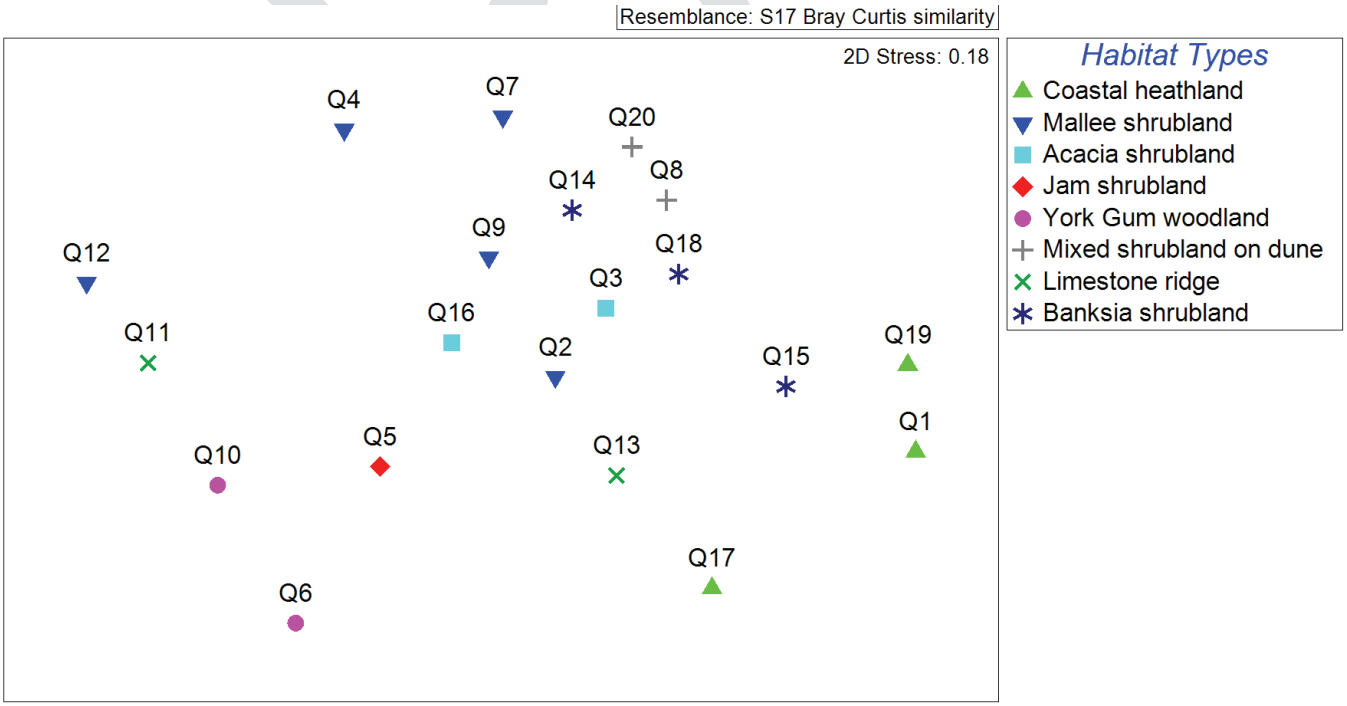

Chart 3 MDS of habitats based on species

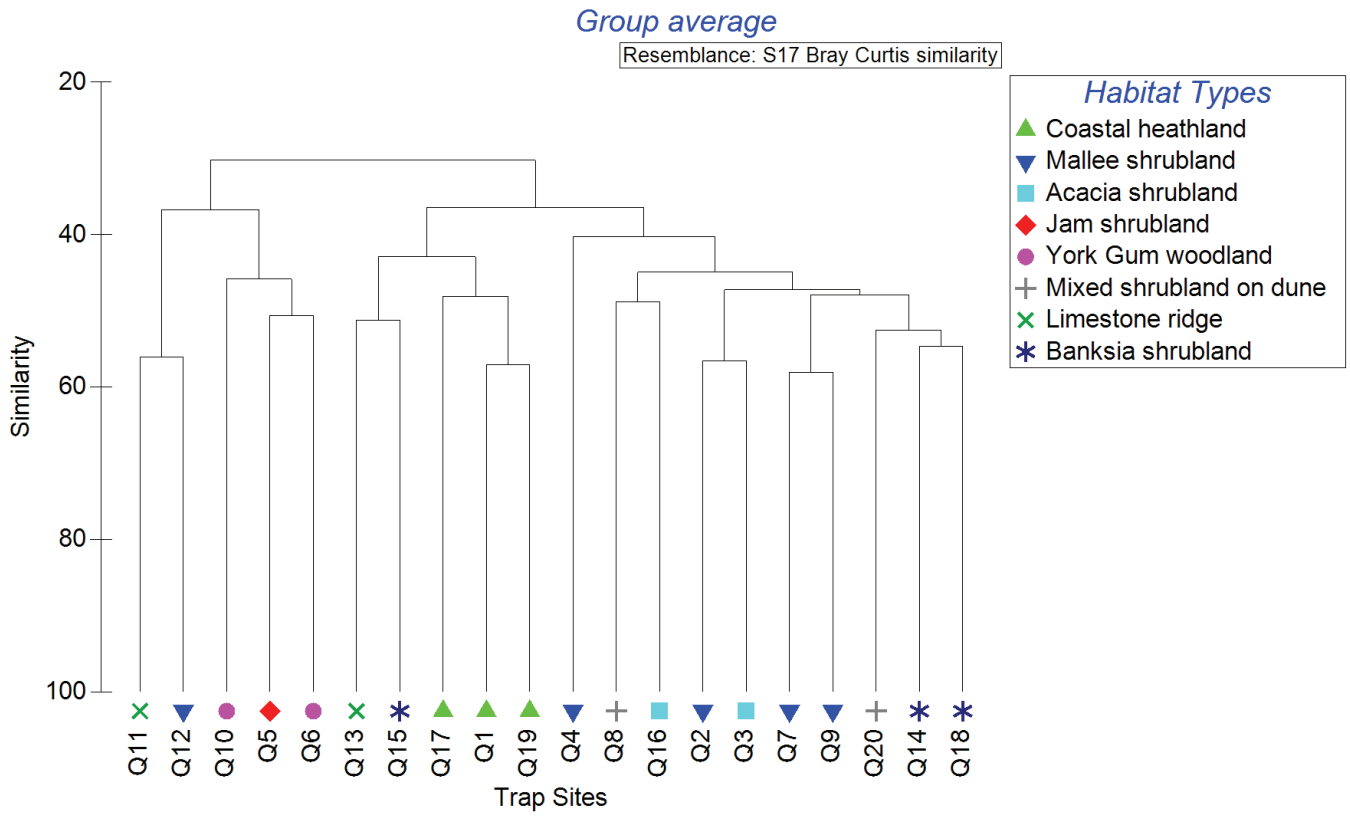

Chart 4 *Dendrogram of trap sites similarities*

5. Fauna diversity

The fauna survey recorded 262 vertebrate fauna species by trapping, hand searches, nocturnal searches, remote equipment and observations undertaken by GHD. This includes 28 mammals, 156 birds, 72 reptiles and 6 amphibians. Of these seven were introduced fauna species. A breakdown of the fauna assemblages for the survey results is provided below. A detailed species list is presented in Appendix E.

5.1 Mammals

The survey recorded 28 mammal species within the survey area, including seven introduced and 21 native mammals. A breakdown of mammal families recorded during the surveys is provided below in Table 5-1. The composition of species includes eight bats, three native rodents, three macropods, five dasyurids, and seven introduced mammals.

The most speciose native species family was Dasyuridae (five species). In total 986 individual native mammals (excluding bat call data as the actual number cannot be determined) were recorded over the trapping programs between 13 species. The most abundant species being the Western Grey Kangaroo with 395 records (40% of total native mammal recordings), Spinifex Hopping Mouse with 168 records (17% of total native mammal recordings) and Ash Grey Mice with 116 records (12% of total native mammal recordings).

Most bat species were only recorded via echolocations, therefore only presence or absence information could be collected. Some species overlap in call identification and therefore may represent multiple species (such as in the *Nyctophilus* group).

Table 5-1 Mammal families recorded during the field surveys

Mammal Family	Number of species	
	Phase 1	Phase 2
Bovidae (Goat)	1	1
Canidae (Fox)	2	2
Dasyuridae (Dunnart, Quoll)	3	5
Emballonuridae (Sheath tailed Bats)	1	0
Felidae (Cat)	1	1
Leporidae (Rabbit)	1	1
Macropodidae (Kangaroos)	2	3
Molossidae (Freetail Bats)	1	2
Muridae (Mouse, Rodents)	4	4
Suidae (Pig)	1	1
Tachyglossidae (Echidna)	1	1
Tarsipedidae (Honey Possum)	1	1
Vespertilionidae (Bats)	4	5
Total	23	27

5.2 Birds

The survey identified 156 bird species from 53 families. The most specious families were the Meliphagids (13 species), Accipitrids (12 species) and Acanthizids (9 species). In total 6964 individual birds were recorded over the survey period and associated additional assessments. The most abundant species were the Galah with 534 records (7.7% of total bird recordings), Crested Tern with 276 records (4% of total bird recordings) and Masked

Woodswallow with 262 records (3.8% of total bird recordings) and White-fronted Honeyeater with 250 records each (3% of total bird records). The low percentages represented above indicates a diverse array of species across the number of individuals recorded. Not one species was particularly common but rather many species were represented in good numbers. One hundred and fifty-six species of bird in a general region is particularly high and considered a diverse assemblage of avian fauna. A breakdown of bird families recorded during the survey is provided in Table 5-2

Table 5-2 Bird families recorded during the field surveys

Bird Family	Number of species		
	Phase 1	Phase 2	Additional species from other Assessments
Acanthizidae (Fieldwren)	9	7	0
Accipitridae (Eagle, Goshawk)	10	10	0
Aegothelidae (Owlet-nightjar)	1	1	0
Alcedinidae (Kingfisher)	0	2	1
Anatidae (Duck)	3	5	0
Accipitridae (Darter)	0	0	1
Apodidae (Swift)	0	0	1
Ardeidae (Great Egret)	2	4	2
Artamidae (Woodswallow)	2	3	0
Burhinidae (Stone Curlew)	1	0	0
Cacatuidae (Corella, Galah)	2	2	2
Campephagidae (Bellbird, Triller)	2	2	0
Charadriidae (Plover, Lapwing)	2	3	0
Columbidae (Dove, Pigeon)	4	3	1
Corvidae (Crow, Raven)	3	3	0
Cracticidae (Magpie, Butcherbird)	4	4	0
Cuculidae (Cuckoo)	5	4	0
Dromaiidae (Emu)	1	1	0
Estrildidae (Finch)	0	1	0
Eupetidae (Wedgebill)	1	0	0
Falconidae (Falcon, Kestrel)	2	3	0
Haematopodidae (Oystercatcher)	0	1	1
Hirundinidae (Fairy Martin)	2	2	1
Laridae (Gull, Tern)	0	4	2
Locustellidae (Songlark)	2	2	0
Maluridae (Fairy Wren)	5	5	1
Megapodiidae (Malleefowl)	1	1	0
Meliphagidae (Honeyeater, Miner)	11	8	2
Meropidae (Rainbow Bee-eater)	0	1	0
Monarchidae (Lark)	1	1	0
Motacillidae (Pipit)	1	1	0
Nectariniidae (Mistletoebird)	1	1	0
Neosittidae (Sittella)	0	0	1

Bird Family	Number of species		
	Phase 1	Phase 2	Additional species from other Assessments
Otididae (Bustard)	1	1	0
Pachycephalidae (Whistler)	4	4	0
Pardalotidae (Pardalote)	1	1	0
Pelecanidae (Pelican)	1	0	0
Petroicidae (Robin)	5	6	0
Phalacrocoracidae (Cormorant)	0	0	3
Phasianidae (Quail)	3	3	1
Podargidae (Frogmouth)	1	1	0
Pomatostomidae (Babbler)	1	1	0
Procellariidae (Shearwater)	1	0	1
Psittacidae (Parrot)	3	3	0
Rallidae (Rails)	0	0	1
Recurvirostridae (Stilt)	0	1	1
Rhipiduridae (Fantail, Wagtail)	2	1	0
Scolopacidae (Greenshank)	0	0	5
Strigidae (Owl)	1	1	0
Sulidae (Gannett)	0	1	0
Threskiornithidae (Ibis)	1	1	0
Tytonidae (Barn Owl)	1	0	0
Zosteropidae (Silvereye)	1	1	0
Total	105	111	28

5.3 Reptiles

A total of 72 reptile species were recorded in the survey area from nine families. The most specious families were the Scincids (25 species), Elapids (11 species), Agamids (9 species), Pygopods (8 species) and Diplodactylids with seven species. One thousand four hundred and eighty (1480) reptiles were recorded in the survey area over the field surveys. The most abundant species were Spotted Military Dragon with 276 records (19% of total reptile recordings), Soft Spiny-tailed Gecko with 88 records (6% of total reptile recordings) and West Coast Ctenotus with 80 records (5% of total reptile recordings each). The number of species recorded in this survey is considered high and comparable to other diverse regions such as the Pilbara or Kimberley in a detailed survey.

The survey detected several cryptic reptile species that have not been recorded in the area, including Shark Bay Heath Dragon (*Ctenophorus butlerorum*), Javelin lizard (southern sub spp.) (*Delma concinna concinna*), Western Spiny-tailed Skink (*Egernia stokesii badia*), Perentie (*Varanus giganteus*) and Yellow Spotted Monitor (*Varanus panoptes rubidus*). All of which represent a gap in their known distribution or a range extension west and/ or south. One species within the *Ctenotus australis* clade is potentially undescribed, differing by pattern and head shape from the southern population requiring further taxonomic studies to determine affinities. Additionally, some groups such as the pythons and worm lizards (genus *Aprasia*) were not recorded in this survey despite species known from the region. It is likely that additional survey effort in targeted areas would record species in these groups further adding to the high herpetofauna diversity of the area.

A breakdown of reptile families recorded during the survey is provided in Table 5-3.

Table 5-3 Reptile families recorded during the field surveys

Reptile Family	Number of species	
	Phase 1	Phase 2
Agamidae (Dragons)	6	9
Carphodactylidae (Robust Gecko's)	2	1
Diplodactylidae (Fat-tailed Geckos)	3	5
Elapidae (Venomous Land Snakes)	8	10
Gekkonidae (Cosmopolitan Geckos)	2	1
Pygopodidae (Legless Lizards)	4	8
Scincidae (Skinks)	23	24
Typhlopidae (Blind Snakes)	2	2
Varanidae (Monitors)	6	5
Total	**56**	65

5.4 Amphibians

Six amphibian species were recorded in the survey area from two families, Limnodynastidae and Myobatrachidae. Due to climatic conditions few species were active however Southern Sandhill Frogs were breeding (calling) and active (adults) during phase 1 and then metamorph dispersal during phase 2. They were the most common frog recorded with 521 individuals captured. This species was restricted to the deep sand sites. The Western Banjo frog was also recorded in good numbers primarily around a man-made water point in a clay pan amongst limestone. Most observed were metamorphing tadpoles leaving the water. Few individuals of other species were recorded while trapping. It is likely further wet season surveys would yield additional species. A breakdown of amphibian families recorded during the survey is provided in Table 5-4.

Table 5-4 Amphibian families recorded during the surveys

Amphibian Family	Number of species	
	Phase 1	Phase 2
Limnodynastidae (Large Ground Frogs)	3	0
Myobatrachidae (Small Ground Frogs)	3	1
Total	**6**	1

5.5 Introduced species

In total nine species, predominantly mammals were observed throughout the surveys. These included:

- Cat (*Felis catus*)
- Dog (*Canis familiaris*)
- Fox (*Vulpes vulpes*)
- European Rabbit (*Oryctolagus cuniculus*)
- Goat (*Capra hircus*)
- House Mouse (*Mus musculus*)
- Laughing Turtle Dove (*Streptopelia senegalensis*)
- Laughing Kookaburra (*Dacelo novaeguineae*)
- Pig (Sus scrofa)

All introduced species are considered feral or naturalised fauna species to the region.

5.6 Significant fauna

The following significant vertebrate species were recorded in the survey area.

- Western Spiny-tailed Skink (*Egernia stokesii badia*)
- Taper-tailed West Coast slider (*Lerista humphriesi*)
- Malleefowl (*Leipoa ocellata*)
- Carnaby's Cockatoo (*Zanda latirostris*)
- Greater Sand Plover (*Charadrius leschenaultia*)
- Bar-tailed Godwit (*Limosa lapponica menzbieri*)

The following Migratory birds (including Migratory\Marine and International Agreement) were recorded in the survey area:

- Crested Tern (*Thalasseus bergii*)
- Caspian Tern (*Hydroprogne caspia*)
- Fork-tailed swift *(Apus pacificus*)
- Gull-billed Tern (*Sterna nilotica*)
- Osprey (*Pandion cristatus*)
- Red-necked Stint (*Calidris ruficollis*)
- Common Sandpiper (*Actitis hypoleucos*)
- Common Greenshank (*Tringa nebularia*)
- Sanderling (*Calidris alba*)
- Wedge-tailed Shearwater (*Ardenna pacifica*)
- Wilson's Storm Petrel (*Oceanites oceanicus*)

Further information including a summary of each species listed above and their relative record within the survey area is detailed below in section 5.8.

The following species are listed as solely marine under the EPBC Act. These species are typically common species and not regarded as being conservation significant. Therefore although marine listed will not be discussed further in this report.

- Australasian Gannet (*Morus serrator*)
- Eastern Reef Heron (*Egretta sacra*)
- White-bellied Sea-eagle (*Haliaeetus leucogaster*)
- Cattle Egret (*Ardea ibis*)
- Whiskered Tern (*Chlidonias hybrida*)
- Pacific Gull (*Larus pacificus*)
- Rainbow Bee-eater (*Merops ornata*)
- Nankeen Night Heron (*Nycticorax caledonicus*)
- Straw-necked Ibis (*Threskiornis spinicollis*)
- Australian Pelican (*Pelecanus conspicillatus*)
- Brown Goshawk (*Accipiter fasciatus*)
- Swamp Harrier (*Circus approximans*)
- Whistling Kite (*Haliastur sphenurus*)
- Buff-banded Rail (*Gallirallus philippensis*)
- Black-winged Stilt (*Himantopus Himantopus*)
- Red-capped Plover (*Charadrius ruficapillus*)
- Silver Gull (*Chroicocephalus novaehollandiae*)
- Black-eared Cuckoo (*Chrysococcyx osculans*)

- Fan-tailed Cuckoo (*Cacomantis flabelliformis flabelliformis*)
- Pallid Cuckoo (*Cacomantis pallidus*)
- Shining Bronze-cuckoo (*Chalcites lucidus*)
- Horsfield's Bronze-cuckoo (*Chalcites basalis*)
- Sacred Kingfisher (*Todiramphus sanctus*)
- Black-faced Cuckoo-shrike (*Coracina novaehollandiae*)
- Australasian Pipit (*Anthus novaeseelandiae*)
- Welcome Swallow (*Hirundo neoxena*)
- Tree Martin (*Petrochelidon nigricans*)
- Silvereye (*Zosterops lateralis*)

5.7 Likelihood of occurrence assessment

An assessment on the likelihood of conservation significant species occurring in the survey area was undertaken for the reconnaissance field survey based on desktop literature. This assessment was refined over subsequent field surveys to its current status which includes, species identified in the field survey results, fauna species' biology and habitat requirements, quality and availability of suitable habitat as determined during the field survey and further examination of fauna database records and literature review. Some species identified in the Commonwealth Protected Matters Search Tool (PMST) such as "Marine" flyover or sole ocean inhabiting, and/or pelagic species have been omitted from the assessment. The full assessment is present in Appendix D.

Amongst several migratory birds the assessment also identified the likely presence of the Peregrine Falcon (*Falco peregrinus*), Gilled Slender Blue-tongue (*Cyclodomorphus branchialis*), Chuditch (*Dasyurus geoffroii*) and the Tammar Wallaby *((Notamacropus eugenii derbianus*) as the survey area provides suitable habitat for these regionally occurring species. The Western Grasswren was thought to be briefly observed in November 2021 but was not recorded/confirmed during subsequent surveys, therefore remains as likely until confirmed. A summary of the full assessment is presented below in Table 5-5.

A brief description of species classified as "known" or "likely" and their assessment outcome within the survey area are described below in section 5.9. The parameters of assessment for this likelihood of occurrence assessment and the full likelihood of occurrence assessment are provided in Appendix D.

Table 5-5 Likelihood of occurrence assessment

Species	BC Act/ DBCA	EPBC Act	Assessment Outcome
Birds			
Common Sandpiper ***(Actitis hypoleucos)***	MI	MI	**Known.** This species was recorded on the beach in the Northwest portion of the survey area and also regionally along the Murchison River.
Western Grasswren ***(Amytornis textilis subsp. textilis)***	P4		**Likely.** The species is known from north of the survey area (Coburn Station area). A possible sighting was recorded in November 2021 in coastal shrubland habitat of the survey area, however no other observations were made during other assessments to verify the account, therefore in this table likely status has been allocated.
Fork-tailed swift (***Apus pacificus***)	MI	MI	**Known.** The species was recorded on three separate occasions during the March survey with flocks of up to 40 birds being recorded within the survey area.
Ruddy turnstone (***Arenaria interpres)***	MI	MI	**Likely.** There are records of the species within the Survey area and 2 km east of the survey area. There is suitable habitat within the survey area.
Wedge-tailed Shearwater (***Ardenna pacifica***)	MI	MI	**Known.** The species was recorded on several occasions during the survey, with up to 30 individual birds within the survey area.
Sharp-tailed Sandpiper (***Calidris acuminata)***	MI	MI	**Likely.** There is some rocky shoreline habitat for this species within the survey area and the nearest record is 16 km east of the survey area (Murchison River). Typically this species occurs on inland water systems, therefore use may be opportunistic.
Sanderling (***Calidris alba)***	MI	MI	**Known.** This species was recorded on the beach in the Northwest portion of the survey area.
Red Knot (***Calidris canutus)***	EN	EN	**Likely.** There is suitable habitat within the survey area.
Red-necked Stint (***Calidris ruficollis)***	MI	MI	**Known.** There is suitable habitat within the survey area and the closest known record is 5 km south of the survey area. The species was also recorded on several occasions during the survey with up to 16 birds at a time.

Species	BC Act/ DBCA	EPBC Act	Assessment Outcome
Carnaby's Cockatoo (*Zanda latirostris)*	EN	EN	**Known.** Foraging evidence was recorded on the southern edge of the survey area. Additionally, up to four birds were heard calling during the Phase 1 assessment in the central east region.
Greater Sand Plover *(Charadrius leschenaultia)*	VU	VU	**Known.** The species was recorded during the survey. There is suitable habitat within the survey area on the coastal strip and the closest known record is 10km south of the survey area.
Lesser Sand Plover (*Charadrius mongolus)*	EN	EN	**Likely.** There are known records of the species at Chinaman's Rock Lookout approximately 10km south of the survey area.
Peregrine Falcon (*Falco peregrinus*)	OS	-	**Likely.** The species is known from the region (records within 4 km east of the Survey Area), however use would be opportunistic and utilised for foraging purposes only. No breeding habitat was present.
Malleefowl *(Leipoa ocellata)*	VU	VU	**Known.** Observations of active birds, tracks, scat and mounds recorded throughout the survey area.
Bar-tailed Godwit (*Limosa lapponica*)	MI	MI	**Known.** Species was recorded on the beach in the Northwest portion of the survey area and along the Murchison River.
Eastern Curlew *(Numenius madagascariensis)*	CR	CR	**Likely.** Suitable habitat is present within the survey area on the coastal strip and the closest known record is 17 km east of the survey area.
Curlew sandpiper (Calidris ferruginea)	CR	CR	**Likely.** Suitable habitat is present within the survey area on the coastal strip and the closest known record is 10 km of the survey area.
Whimbrel *(Numenius phaeopus)*	MI	MI	**Likely.** There is suitable habitat within the survey area on the coastal strip and the closest known record is 17 km east of the survey area.
Wilson's Storm Petrel (*Oceanites oceanicus*)	MI	MI	**Known.** The species was recorded on several occasions during the survey.
Pacific Golden Plover *(Pluvialis fulva*)	MI	MI	**Likely.** There is suitable habitat within the survey area on the coastal strip and the closest known record is 17 km east of the survey area.
Grey Plover (*Pluvialis squatarola)*	MI	MI	**Likely.** There is suitable habitat within the survey area on the coastal strip and the closest known record is 10 km east of the survey area.
Roseate Tern (*Sterna dougallii*)	MI	MI	**Likely.** There is suitable habitat within the survey area on the coastal strip and the closest record is 16 km east of the survey area.
Australian Fairy Tern (*Sternula nereis nereis)*	VU	VU	**Likely.** There is suitable habitat within the survey area on the coastal strip and the species has been identified from database searches as being in the survey area**.**
Crested Tern (*Thalasseus bergii)*	MI	MI	**Known.** The species was recorded on several occasions, in flocks of up to 30 birds during the survey within the southern and southwestern portions of the survey area.
Gull-billed Tern (*Gelochelidon nilotica)*	MI	MI	**Known.** The species was recorded during the survey flying along the coast. Additionally, there is numerous small claypans and dams that are habitat for the species within the survey area.
Caspian Tern (*Hydroprogne caspia)*	MI	MI	**Known.** This species was recorded on the beach in the Northwest and southwest portion of the survey area and also regionally along the Murchison River.
Eastern Osprey (*Pandion cristatus)*	MI	MI	**Known.** The species was recorded during the survey. Additionally, there is suitable habitat and known previous records within the survey area.

Species	BC Act/ DBCA	EPBC Act	Assessment Outcome
Grey-tailed Tattler (*Tringa brevipes*)	P4, MI	MI	**Likely.** There is suitable habitat within the survey area on the coastal strip and known records of the species 10 km south of the survey area.
Common Greenshank (*Tringa nebularia*)	MI	MI	**Known.** There is suitable habitat within the survey area on the coastal strip and specimens were recorded along the Murchison River during the survey.
Mammals			
Chuditch, Western Quoll (*Dasyurus geoffroii*)	VU	VU	**Likely.** There are known records of approximately 9 km south of the survey area within the Kalbarri gorge system. The species has also been recorded from Eurady Station to the east and Hamelin Station to the north.
Tammar wallaby (*Notamacropus eugenii derbianus*)	P4		**Likely**. There are known records of approximately 9 km south of the survey area near the Kalbarri gorge system.
Reptiles			
Gilled Slender Blue-tongue *(Cyclodomorphus branchialis)*	VU	VU	**Likely.** The species is known to be from the region, with the closest record approximately 30km southeast of the survey area in the Galena and Warribano areas**.** Habitat is present.
Western Spiny-tailed Skink (*Egernia stokesii badia)*	VU	EN	**Known.** The species is known to be from the region and was recorded (specimens and scats) at several locations on numerous occasions at the eastern portion of the survey area.
Woma (SW pop.) (*Aspidites ramsayi*)	P1		**Likely.** The species is known from the region and recently recorded approximately 80km north of the survey area. Habitat is present for this species.
Zuytdorp Worm Slider/ Taper-tailed West Coast slider *(Lerista humphriesi)*	P3		**Known**. There are known records from Murchison House Homestead north to the Vermin Proof Fence (Zuytdorp section) Additionally the species was recorded at two locations in the north western portion of the survey area.

Key

Status	Code	EPBC Act	BC Act (DBCA)
Critical	CR	X	X
International Agreement	IA	X	
Marine	MA	X	
Migratory	MI	X	X
Other Special Protection	OS		X
Vulnerable	VU	X	X
Endangered	EN	X	X
Priority 3	P3		X
Priority 4	P4		X

For breakdown of code meaning see Appendix B.

5.8 Significant fauna species recorded in survey area

Carnaby's Cockatoo (*Zanda latirostris)*

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 (which utilise River Gum) 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. It nests in trees older than 120-150 years (DotEE 2019). The closest known record of Carnaby's Cockatoo prior to this survey is approximately 6 km east of the survey area (DBCA 2021). This is also the closest known breeding site to the survey area along the Murchison River in the vicinity of Murchison House Station homestead. This small breeding population appears to be around 15 pairs (In large River Gums (*Eucalyptus camaldulensis*) and up to about 45 birds (NACC 2022).

Assessment in the Survey Area.

There is suitable habitat within the survey area and foraging evidence was recorded on the southern edge of the survey area in November 2021 (see Plate 3). During the spring 2022 survey Carnaby's Cockatoo were heard calling (up to 4 birds) in the central eastern portion of the survey area. These birds were likely moving between foraging areas. These records are presented in Figure 5, Appendix A.

The survey area lies in the northern most extremity of the Carnaby's Cockatoo distribution (DAWE 2022). The species is likely to utilise foraging habitats within the survey area and consist of Banksia Shrubland, Acacia Shrubland and Mixed Shrubland habitats. The survey area lies approximately 6-7 km north of known breeding locations along the Murchison River, therefore at least the southern portion of the survey area is likely to be utilised during the breeding season as a foraging resource for the species. No records or potential Carnaby's Cockatoo nests were recorded in any of the York Gum woodlands identified. This is probably due to the lack of natural water bodies in the northern portion of the survey area. With the Murchison River utilised as the primary permanent water source in the region, roosting is likely to reside along the river.

Table 5-6 Summary of Carnaby Cockatoo records

Date	Habitat type	Latitude	Longitude	Observation
16/11/2021	Banksia Shrubland	-27.530674	114.228162	Foraging on Banksia sp.
29/08/2022	N/A	-27.38612909	114.2511735	Up to 4 individuals calling

Plate 3 Carnaby's Cockatoo foraging evidence on Banksia spp.

Malleefowl (Leipoa ocellata)

The Malleefowl generally occurs in semi-arid areas of Australia. In Western Australia the species occurs 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 Western Australia 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 Great Victoria Desert south of the Blackstone Ranges (Nevill 2013; Pizzey & Knight 2012).

Assessment in the Survey Area.

There is suitable habitat present in the survey area and numerous known previous database records within the northern and north-western portion of the survey area (DBCA 2021). GHD identified many records of the Malleefowl (mounds, prints, scratching's, scats and sightings) present throughout the survey area, particularly through the central, southern and eastern portions. Sighting and prints were recorded and are presented below in Table 5-7 and Table 5-8. Scratching's and scats were recorded as part of mound assessments and presented in mound data below.

Malleefowl mounds were assessed via on ground searches and via LiDAR assessment (Fugro 2022). Each mound was assessed for presence and if identified classified against Benshemesh 2007. GHD via on ground truthing identified 30 mounds over the duration of the project. This consisted 13 active and 17 inactive mounds. LiDAR assessment identified the potential for 232 mounds within the survey area. Six of these mounds were those identified by GHD. An additional 55 mounds are located within non accessible portions of the survey area and 84 in remote locations, therefore 93 potential mounds were ground truthed and classified. Off these 10 were not mounds (termitaria or road spoil heaps) and the remainder consisted of 47 inactive and 26 active.

In total 35 active mounds and 64 inactive mounds have been recorded within the survey area with an additional 84 suspected mounds identified from LiDAR imagery not yet assessed (due to being inaccessible at the time of the surveys). Approximately 50% of mounds assessed over the survey period demonstrated profile stages (2,3,4,5) consistent with being active - recently used or currently laden with eggs undergoing thermoregulation. Those classified as profile stages 1 and 6 were considered ancient or long unused. Often long unused mounds were abandoned due to a branch falling onto the mound in which the birds could not move. Few mounds demonstrated predation events, but those that were recorded appeared to be from Red Fox based on holes dug and prints present. The records of the species were recorded in Mallee woodlands, York Gum woodlands, Banksia shrubland, Mixed shrubland, Acacia shrubland, Jam shrubland and on the edge of a claypan. From the data presented the Malleefowl population within the survey area would be considered excellent with recruitment evident and population high, likely due to the large tracts of undisturbed areas providing a mosaic of vegetation types and corridors throughout the region.

Malleefowl mounds assessed during the surveys are summarised in Appendix F and consists of GHD and LiDAR data and mapped in Figure 4, Appendix A. A pair of Malleefowl captured on remote camera during the survey is presented in Plate 4.

Table 5-7 Summary of Malleefowl Sightings

Date	Habitat type	Latitude	Longitude	Evidence	Comments
2/11/2022	Mallee Woodland	-27.3158	114.5951	sighting	
11/01/2022	Acacia Shrubland	-27.4278	114.1487	sighting	Active on road
1/04/2022	Acacia Shrubland	-27.4321	114.1487	camera	Recorded on Camera C25
1/04/2022	Mallee Woodland	-27.3785	114.2343	camera	Recorded on Camera C24
1/04/2022	Acacia Shrubland	-27.3383	114.4057	camera	Recorded on Camera C28
28/08/2022	Mallee Woodland	-27.3695	114.1942	calling	
22/08/2022	Acacia Shrubland	-27.3746	114.1716	sighting	sighting of individual on track.
24/08/2022	Acacia Shrubland	-27.3746	114.1714	sighting	bird on track, being harassed by brown falcon.

Date	Habitat type	Latitude	Longitude	Evidence	Comments
1/10/2022	Acacia Shrubland	-27.1962	114.2815	camera	Recorded on Camera C41
1/10/2022	Acacia Shrubland	-27.4005	114.4668	camera	Recorded on Camera C55
1/10/2022	Acacia Shrubland	-27.3619	114.1244	camera	Recorded on Camera C52
1/10/2022	Acacia Shrubland	-27.3385	114.3055	camera	Recorded on Camera yalgoo
10/10/2022	Mallee Woodland	-27.3387	114.2992	dead bird	Possibly predated
8/10/2022	Mallee Woodland	-27.2561	114.3079	sighting	flushed and flew away
9/10/2022	Mallee Woodland	-27.3165	114.5914	sighting	active bird on road
15/10/2022	Mallee Woodland	-27.4119	114.3999	sighting	Resting shade next to track
13/10/2022	Mallee Woodland	-27.5377	114.1908	sighting	
13/10/2022	Acacia Shrubland	-27.2555	114.3591	sighting	Single individual active on boundary fence.
11/02/2023	Mallee Woodland	114.1877	-27.5377	calling	Bird threat calling near mound

Table 5-8 Summary of Malleefowl tracks throughout the surveys

Date	Habitat type	Latitude	Longitude	Evidence	Comments
16/11/2021	Mallee woodland	-27.4439	114.1484	Track	
17/11/2021	Mallee woodland	-27.3896	114.2561	Track	
17/11/2021	Mallee woodland	-27.4258	114.1494	Track	
18/11/2021	Mallee woodland	-27.3988	114.1652	Track	
18/11/2021	Mallee woodland	-27.3768	114.1969	Track	
18/11/2021	Mallee woodland	-27.4194	114.1415	Track	
15/03/2022	Mallee woodland	-27.3367	114.6101	Track	fresh prints, every 50m
13/03/2022	Mallee woodland	-27.4310	114.1490	Track	0ld prints
14/03/2022	Mallee woodland	-27.4652	114.2280	Track	
13/03/2022	Mallee woodland	-27.4713	114.1938	Track	within last week
15/03/2022	Mixed shrubland	-27.3367	114.6079	Track	numerous fresh prints
8/03/2022	Mallee woodland	-27.5056	114.1794	Track	fresh track's
13/03/2022	Mallee woodland	-27.4968	114.2019	Track	fresh track's
15/03/2022	Mixed shrubland	-27.3367	114.6029	Track	fresh prints
13/03/2022	Mallee woodland	-27.4477	114.1494	Track	week old
8/03/2022	Mallee woodland	-27.5039	114.1711	Track	
13/03/2022	Mallee woodland	-27.4681	114.1929	Track	fresh
13/03/2022	Mallee woodland	-27.4704	114.1938	Track	fresh this morning
22/08/2022	Mixed shrubland	-27.3381	114.4057	Track	tracks
26/08/2022	Mallee woodland	-27.3643	114.3428	Track	
26/08/2022	Mallee woodland	-27.3938	114.3347	Track	
26/08/2022	Mallee woodland	-27.3944	114.3348	Track	
23/08/2022	Mallee woodland	-27.4247	114.2642	Track	
23/08/2022	Mallee woodland	-27.4248	114.2754	Track	fresh prints on track
26/08/2022	Mallee woodland	-27.4532	114.1857	Track	prints fresh
26/08/2022	Mixed shrubland	-27.4531	114.1852	Track	

5/04/2022	Mallee woodland	-27.3382	114.4052	Track	fresh this morning
26/08/2022	Mallee woodland	-27.3838	114.1894	Track	fresh prints
26/08/2022	Mallee woodland	-27.3793	114.1790	Track	fresh prints
26/08/2022	Mallee woodland	-27.3647	114.1532	Track	fresh prints
26/08/2022	Mallee woodland	-27.3985	114.1563	Track	fresh prints
26/08/2022	Mallee woodland	-27.3998	114.2053	Track	older prints
26/08/2022	Mallee woodland	-27.3936	114.2233	Track	over recent tyre tracks
27/08/2022	Mallee woodland	-27.5274	114.2029	Track	fresh tracks
27/08/2022	Mallee woodland	-27.5286	114.2006	Track	prints
27/08/2022	Mallee woodland	-27.5310	114.1963	Track	fresh prints
27/08/2022	Mallee woodland	-27.5362	114.1926	Track	
27/08/2022	Mallee woodland	-27.5432	114.1896	Track	
27/08/2022	Mallee woodland	-27.5580	114.1928	Track	fresh tracks
28/08/2022	Mallee woodland	-27.5120	114.2064	Track	old print along old fence
28/08/2022	Acacia shrubland	-27.4604	114.1892	Track	fresh
28/08/2022	Acacia shrubland	-27.4194	114.1444	Track	
12/10/2022	Acacia shrubland	-27.3882	114.2306	Track	prints fresh
7/10/2022	Mallee woodland	-27.4052	114.4094	Track	tracks
12/10/2022	Acacia shrubland	-27.3860	114.2312	Track	prints fresh
12/10/2022	Acacia shrubland	-27.3892	114.2308	Track	prints fresh
12/10/2022	Acacia shrubland	-27.3862	114.2309	Track	prints fresh
12/10/2022	Acacia shrubland	-27.3846	114.2312	Track	prints fresh
9/10/2022	Claypan	-27.4175	114.1364	Track	Prints on edge clay pan
16/10/2022	Mallee Woodland	-27.3288	114.3351	Track	fresh prints
11/10/2022	Mallee Woodland	-27.3382	114.4081	Track	tracks fresh
16/10/2022	Mallee Woodland	-27.3384	114.3355	Track	fresh prints
12/10/2022	Mallee Woodland	-27.3892	114.2308	Track	prints fresh
15/10/2022	Mallee woodland	-27.1136	114.1414	Track	fresh prints
16/10/2022	Mallee Woodland	-27.3387	114.3055	Track	fresh prints
15/10/2022	Banksia shrubland	-27.1253	114.2781	Track	fresh prints
13/10/2022	Mallee woodland	-27.5371	114.1905	Track	
17/10/2022	Jam shrubland	-27.3418	114.6213	Track	Outside survey area
17/10/2022	York Gum Woodland	-27.3418	114.6223	Track	Outside survey area
13/10/2022	Mallee Woodland	-27.5398	114.1908	Track	
14/10/2022	Mallee Woodland	-27.3942	114.3350	Track	
11/02/2022	Mallee Woodland	-27.6731	114.6613	Track	Recent
11/02/2022	Mallee Woodland	-27.6730	114.6613	Track	Recent
11/02/2022	Mallee Woodland	-27.3250	114.4822	Track	Recent
11/02/2022	Mallee Woodland	-27.2963	114.5088	Track	Fresh
11/02/2022	Mallee Woodland	-27.2974	114.5091	Track	Fresh
8/02/2023	Mallee Woodland	-27.3375	114.4075	Track	
12/02/2023	Mallee Woodland	-27.4437	114.1938	Track	

9/02/2023	Mallee Woodland	-27.3352	114.4080	Track	
11/02/2023	Mallee Woodland	-27.3480	114.1894	Track	
9/02/2023	Mallee Woodland	-27.3440	114.4044	Track	
11/02/2023	Mallee Woodland	-27.3448	114.1859	Track	
13/02/2023	Mallee Woodland	-27.5339	114.1938	Track	
11/02/2023	Mallee Woodland	-27.3165	114.0995	Track	
11/02/2023	Mallee Woodland	-27.3478	114.1907	Track	
11/02/2023	Mallee Woodland	-27.3227	114.1006	Track	
11/02/2023	Mallee Woodland	-27.3223	114.1004	Track	
13/02/2023	Mallee Woodland	-27.3831	114.2402	Track	
11/02/2023	Mallee Woodland	-27.3211	114.1004	Track	
9/02/2023	Mallee Woodland	-27.3382	114.3857	Track	
11/02/2023	Mallee Woodland	-27.3152	114.0991	Track	
13/02/2023	Mallee Woodland	-27.5357	114.1932	Track	
11/02/2023	Mallee Woodland	-27.3411	114.1862	Track	

Plate 4 Pair of Malleefowl captured on remote camera within the survey area

Western Grasswren (*Amytornis textilis subsp. textilis)*

The western subspecies of the Western Grasswren occurs in four types of semi-arid shrubland including:

– Acacia shrublands on coastal dunes, coastal plains and red sandplains, dominated by *Acacia ligulata, A. tetragonophylla, A. ramulosa* and *A. sclerosperma*, with chenopods such as *Rhagodia spp.* and *Threlkeldia*

diffusa, other species of shrubs 1-3 m tall with a recumbent growth form that support twining species, and an extensive ground-cover of low shrubs, grasses and herbs.

– Fire-affected shrublands dominated by *Ptilotus obovatus* and *Solanum orbiculatum*, which have replaced burnt-out Horse Mulga shrublands for at least 40 years following uncontrolled fires.
– Low (< 1.5 m high) shrublands on calcareous sandplains, dominated by Umbrella Bush, *Exocarpos spp*., and other shrubs such as *Thryptomene spp*., and *Ptilotus spp*., mixed with hummocks of spinifex *Triodia spp*., and sometimes with *Atriplex spp*.
– Dense thickets of *Muehlenbeckia cunninghamii*, *Atriplex spp*. and *Eremophila spp.* growing in drainage lines (DotE 2019).

The species is currently known only from the Shark Bay region (TSSC 2006) and more recently south to Coburn Station area and recent releases to Dirk Hartog Island (Parks and Wildlife 2022).

Assessment in the Survey Area.

Individuals of the species were observed by GHD in November 2021. The sighting was brief and unconfirmed with no other observations undertaken during the remainder of the surveys. The initial sighting was in coastal shrubland habitat type in the central western portion of the survey area. This record is presented in Figure 5, Appendix A. Habitat is present for this species particularly along the coastal strip therefore a population in low numbers is likely.

5.8.1 Significant migratory birds recorded in the survey area

Fork-tailed swift (Apus pacificus)

The Fork tailed swift is listed as Migratory under the BC and EPBC Acts. It occupies low to very high airspace over varied habitat, rainforest to semi-desert, mostly active just ahead of summer storm fronts. In flocks, rarely seen as individuals (Morcombe 2017). The species can be seen at any time however tropical storm events yield most observations.

Assessment in the Survey Area.

During the targeted assessment in March 2022 flocks of the Fork tailed swift were observed on three separate days with each flock consisting of up to 40 individuals within the limestone calcrete outcrops and coastal dune habitat types on the western side of the survey area. It is possible that the observed groups were in fact the same flock. These birds were recorded using the thermal coastal winds above the ridge and appeared to be sedentary less typical of the normal observation of a brief viewing while mobile at height. One observation was during the late afternoon with birds possibly roosting on the rocky ridgeline face, although this was not observed. These records are presented in Table 5-9 and Figure 5, Appendix A.

Table 5-9 Fork-tailed Swift records

Date	Habitat type	Latitude	Longitude	Observation
9/03/2022	Coastal Ridgelines	-27.5046622	114.1081735	30 birds observed.
8/03/2022	Coastal Ridgelines	-27.5008353	114.1068494	20 birds observed
12/03/2022	Coastal heath	-27.57509848	114.1313744	40 birds observed

Wedge-tailed Shearwater (Ardenna pacifica)

The Wedge tailed Shearwater is listed as Migratory under the BC and EPBC Acts. In WA, the Wedge-tailed Shearwater breeds mainly on vegetated islands, atolls and cays on the west coast and off-shore islands of Western Australia. The species usually excavates burrows on flat or flattish areas with dense grassy and tussocky vegetation but much depends on the nature of soil and terrain, as at some sites burrows are below the cover of trees and shrubs. In deep soft soil, burrows can be > 2 m long. At sites with sandy vegetated screes or stable dunes or on flats of shell grit, burrows are approximately 1.5 m long, parallel with the surface or steeply dipping (DotE 2016).

Assessment in the Survey Area.

In March 2022 the species was recorded on numerous occasions along the west coast of the survey area, in flocks of up to 30 birds. Birds did not reach land rather gliding and swooping the open ocean on gusty breeze foraging.

The closest recording to the mainland was approximately 300 m with most bird recorded beyond 500m. These records are presented in Table 5-10 and Figure 5, Appendix A.

Table 5-10 Wedge tailed Shearwater records

Date	Habitat type	Latitude	Longitude	Observation
10/03/2022	Ocean	-27.33829564	114.0211387	10 birds observed.
11/03/2022	Ocean	-27.29713298	113.9967014	10 birds observed
12/03/2022	Ocean	-27.57646737	114.1238033	1 bird observed
10/03/2022	Ocean	-27.4042567	114.054428	30 birds observed
9/03/2022	Ocean	-27.4172622	114.060518	5 birds observed
11/03/2022	Ocean	-27.34268142	114.0226466	12 birds observed

Wilson's Storm Petrel (Oceanites oceanicus)

The Wilson's Storm-Petrel is listed as Migratory under the BC and EPBC Acts. Distribution stretches north through the mid-latitudes of the Northern Hemisphere and south through the oceans surrounding Australian and the Australian Antarctic Territory (Marchant & Higgins 1990).

Assessment in the Survey Area.

The species was recorded the same time as the Wedge tailed Shearwater. The petrels were recorded on at least two occasions during the March survey, with one record being 4 individual birds. This species did not come close to the mainland and typically was seen approximately 500 m out to sea. All individuals appeared to be foraging. These records are presented in Table 5-11 and Figure 5, Appendix A.

Table 5-11 Wilson's Storm Petrel records

Date	Habitat type	Latitude	Longitude	Observation
10/03/2022	Ocean	-27.40312133	114.0530733	1 bird observed.
10/03/2022	Ocean	-27.33692571	114.0213589	4 birds observed

Red-necked stint (*Calidris ruficollis)*

The Red-necked Stint is listed as Migratory under the BC and EPBC Acts. The Red-necked Stint can be found in fresh and saline water, but primarily in coastal regions (Nevill 2013). It is mostly found in areas including sheltered inlets, bays, lagoons and estuaries with intertidal mudflats, often near spits, islets and banks and on sandy or coralline shores, exposed ocean beaches, and on stony or rocky shores, reefs or shoals. They also occur in saltworks and sewage farms; saltmarsh; ephemeral or permanent shallow wetlands near the coast or inland, including lagoons, lakes, swamps, riverbanks, waterholes, bore drains, dams, soaks and pools in saltflats. (DotEE 2019). The migratory period for this species lie between October to March with a shoulder of September to April.

Assessment in the Survey Area

The species was observed on several occasions in flocks of between three and sixteen birds within the western portion/ beach habitat type of the survey area. Additionally, there is a historical record 5 km south of the survey area. These records are presented in Table 5-12 and Figure 5, Appendix A

Table 5-12 Red-necked Stint Records

Date	Habitat type	Latitude	Longitude	Observation
8/03/2022	Beach	-27.50043159	114.103246	15 birds observed.
11/03/2022	Beach	-27.34154605	114.0245357	16 birds observed
9/03/2022	Beach	-27.50478283	114.1049837	15 birds observed

Date	Habitat type	Latitude	Longitude	Observation
12/03/2022	Beach	-27.49195083	114.099346	3 birds observed

Greater Sand Plover (Charadrius leschenaultii)

The Greater Sand Plover is listed as endangered under the BC and EPBC Acts. In Australasia the Greater Sand Plover is almost entirely coastal, inhabiting littoral and estuarine habitats. They mainly occur on sheltered sandy, shelly or muddy beaches with large intertidal mudflats or sandbanks, as well as sandy estuarine lagoons, and inshore reefs, rock platforms, small rocky islands or sand cays on coral reefs. They are occasionally recorded on near-coastal saltworks and saltlakes, including marginal saltmarsh, and on brackish swamps. (DotE 2016). The plover is mainly a northern species with decreased presence from north to south (Nevill 2013). The migratory period for this species lie between October to March with a shoulder of September to April.

Assessment in the Survey Area

During the targeted assessment in March 2022 one individual was recorded on a south beach in the survey area. Additional records were noted in phase 2 and regional surveys utilising beach habitats on the northern beaches of the survey area. In total at least four locations were identified to be utilised by the Greater Sand Plover all within beach or tidal habitats. This record is presented in Table 5-13 and Figure 5, Appendix A.

Table 5-13 Greater Sand Plover records

Date	Habitat type	Latitude	Longitude	Observation
12/03/2022	Beach	-27.57619295	114.1265724	1 bird observed.
17/10/2022	Beach	-27.3361503	114.0237517	3 birds observed
18/10/2022	Beach	-27.42236586	114.0660099	2 birds observed
11/01/2022	Beach	-27.36684935	114.0385098	2 birds observed
11/03/2022	Mudflats	-27.65647615	114.1771727	Regional survey 1 bird
11/03/2022	Mudflats	-27.63453661	114.1971596	Regional survey 1 bird
11/03/2022	Mudflats	-27.65936567	114.1728154	Regional survey 1 bird

Plate 5 Greater Sand Plovers on a northern beach in the survey area

Common Sandpiper (*Actitis hypoleucos*)

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). The nearest record is 8 km south of the Survey Area.

Assessment in the Survey Area

During the regional assessment in November 2022 numerous individuals were recorded along the Murchison River utilising the rocky shoreline, shell beaches and mudflat fringe habitats. The species is typically widespread and would utilise habitats within the survey area as required. This record is presented in Table 5-14 and Figure 5, Appendix A.

Table 5-14 Common Sandpiper records

Date	Habitat type	Latitude	Longitude	Observation
11/03/2022	Beach	-27.68676223	114.1760146	5 birds observed
11/03/2022	Mudflats	-27.67827246	114.1678895	Regional survey 3 birds observed

Sanderling (*Calidris alba)*

In Australia, the Sanderling is almost always found on the coast, mostly on open sandy beaches exposed to open sea-swell, and also on exposed sandbars and spits, and shingle banks, where they forage in the wave-wash zone and amongst beach wrack. Sanderlings also occur on beaches that may contain wave-washed rocky outcrops. Less often the species occurs on more sheltered sandy shorelines of estuaries, inlets and harbours. Rarely, they are recorded in near-coastal wetlands. There are rare inland records from sandy shores of ephemeral brackish lakes and brackish river-pools. They occur on most of the coast from Eyre to Derby, and also around Wyndham. They are more often recorded on the south and southwest coasts, north to around southern Shark Bay, with more sparsely scattered records further north in Gascoyne and Pilbara Regions and the Kimberley Division (DotEE 2019). There is suitable habitat within the Survey Area and previous records (DBCA) 10 km south of the Survey Area.

Assessment in the Survey Area

During the phase 2 assessment in October 2022 a small group of Sanderling was recorded on a northern beach in the survey area. This species prefers beach sand habitats and is known from the region. It is likely the species is a regular visitor in the region and within the survey area. This record is presented in Figure 5, Appendix A.

Table 5-15 Sanderlings recorded

Date	Habitat type	Latitude	Longitude	Observation
15/10/2022	Beach	-27.3366037	114.0236368	20 birds observed

Common Greenshank (Tringa nebularia)

The Common Greenshank is found in a wide variety of inland wetlands and sheltered coastal habitats of varying salinity. It occurs in sheltered coastal habitats, typically with large mudflats and saltmarsh, mangroves or seagrass. Habitats include embayments, harbours, river estuaries, deltas and lagoons and are recorded less often in round tidal pools, rock-flats and rock platforms. The species uses both permanent and ephemeral terrestrial wetlands, including swamps, lakes, dams, rivers, creeks, billabongs, waterholes and inundated floodplains, claypans and salt flats. It will also use artificial wetlands, including sewage farms and saltworks dams, inundated rice crops and bores. The edges of the wetlands used are generally of mud or clay, occasionally of sand, and may be bare or with emergent or fringing vegetation, including short sedges and saltmarsh, mangroves, thickets of rushes, and dead or live trees (Higgins & Davies 1996). There is suitable habitat within the survey area on the coastal strip and known records of the species is 2 km east of the survey area.

Assessment in the Survey Area

During the regional assessment in November 2022 numerous individuals were recorded along the Murchison River singularly or in small flocks. The species was recorded utilising the rocky shoreline, shell beaches and

mudflat fringe habitats. The species is typically widespread and would utilise habitats in the survey area as required. This record is presented in Table 5-16 and Figure 5, Appendix A.

Table 5-16 Common Greenshank recorded

Date	Habitat type	Latitude	Longitude	Observation
11/01/2022	Beach	-27.68652567	114.1757788	13 birds observed.
11/01/2022	Mudflats	-27.68208914	114.1767743	Regional survey 12 birds observed
11/03/2022	River	-27.67827246	114.1678895	Regional survey 1 bird observed
11/03/2022	Mudflats	-27.65647615	114.1771727	Regional survey 1 bird observed
11/03/2022	River	-27.6474055	114.1765156	Regional survey 1 bird observed
11/03/2022	River	-27.65936567	114.1728154	Regional survey 1 bird observed

Caspian Tern (Hydroprogne caspia)

The Caspian Tern is mostly found in sheltered coastal embayments (harbours, lagoons, inlets, bays, estuaries and river deltas) and those with sandy or muddy margins are preferred. They also occur on near-coastal or inland terrestrial wetlands that are either fresh or saline, especially lakes (including ephemeral lakes), waterholes, reservoirs, rivers and creeks. They also use artificial wetlands, including reservoirs, sewage ponds and saltworks. In offshore areas the species prefers sheltered situations, particularly near islands, and is rarely seen beyond reefs. In WA, the Caspian Tern is widespread in coastal regions, from the Great Australian Bight to the Dampier Peninsula (DotEE 2019). There is numerous small claypans and dams that could potentially be habitat for the species within the survey area.

Assessment in the Survey Area

During the regional assessment in November 2022 one individual was observed in the western portion of the survey area flying north to south. Additionally numerous specimens were also recorded at the Murchison River mouth loafing on a sandbar with other tern and gull species. The Caspian Tern is a widespread species and generally common along the Western Australian coast. These records are presented in Table 5-17 and Figure 5, Appendix A.

Table 5-17 Caspian Tern Recorded

Date	Habitat type	Latitude	Longitude	Observation
8/03/2022	Beach	-27.5003137	114.1014479	1 bird observed
11/03/2022	River mouth	-27.70855248	114.1605947	Regional survey 2 birds observed
31/10/2022	River mouth	-27.70883925	114.1602636	Regional survey 2 birds observed

Bar-tailed Godwit (*Limosa lapponica)*

The Bar-tailed Godwit is found mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. It is found often around beds of seagrass and, sometimes, in nearby saltmarsh. It has been sighted in coastal sewage farms and saltworks, saltlakes and brackish wetlands near coasts, sandy ocean beaches, rock platforms, and coral reef-flats (DotE 2016). They are uncommon in the south west, with most sightings occurring north of Geraldton (Nevill 2013).

Assessment in the Survey Area

During the Phase 2 assessment in October 2022 a small flock was observed within the north western portion of the survey area feeding on a beach. Additionally numerous specimens were also recorded during the regional surveys on the northern beaches and at the Murchison River feeding on mudflats with other species such as Common Greenshank. These records are presented in Table 5-18 and Figure 5, Appendix A.

Table 5-18 Bar-tailed Godwit records

Date	Habitat type	Latitude	Longitude	Observation
17/10/2022	Beach	-27.29117419	113.9987114	1 bird observed.

Date	Habitat type	Latitude	Longitude	Observation
11/01/2022	Mudflats	-27.68200205	114.1774733	Regional survey 1 bird observed
11/01/2022	Beach	-27.68712006	114.1754722	Regional survey 1 bird observed
11/03/2022	River	-27.68322225	114.1705106	Regional survey 10 birds observed
31/10/2022	Mudflats	-27.69194255	114.1774994	Regional survey 9 birds observed

Eastern Osprey (*Pandion cristatus*)

The Eastern Osprey is listed as Migratory under the BC and EPBC Acts. 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. The distribution of the species around the northern coast (south-western WA to south-eastern NSW) appears continuous except for a possible gap at Eighty Mile Beach (DotEE 2019). There is suitable habitat and known previous records in the survey area.

Assessment in the Survey Area

During the targeted assessment in March 2022 and phase 2 surveys the species was observed on numerous separate occasions within the western portion of the survey area and regionally along the Murchison River. Birds were either feeding or loafing in beach or mudflat habitats. These records are presented in Table 5-19 and Figure 5, Appendix A.

Table 5-19 Osprey Recorded

Date	Habitat type	Latitude	Longitude	Observation
11/03/2022	Beach	-27.29235884	113.9947485	1 bird observed.
12/03/2022	Beach	-27.63619295	114.1295724	1 bird observed
18/10/2022	Beach	-27.42450476	114.0672694	1 bird observed
11/01/2022	Beach	-27.36630115	114.0382776	Regional survey 1 bird observed

Gull billed Tern (Sterna nilotica)

The Gull-billed Tern is nomadic and migratory species in Australia listed as Migratory under the BC and EPBC Acts. Gull-billed Terns are found in freshwater swamps, brackish and salt lakes, beaches and estuarine mudflats, floodwaters, sewage farms, irrigated croplands and grasslands, where resources are favourable. They are only rarely found over the open ocean. Although essentially an inland species, outside breeding season it shows a distinct preference for saltmarshes and lagoons near the coast. Movements are not fully understood but it is common and widespread in Australia (Morcombe 2014). There are no nearby records of the species, the closest record is 17 km east of the survey area. There is numerous small claypans and dams that could potentially be habitat for the species within the survey area.

Assessment in the Survey Area

During the targeted assessment in March 2022 one individual bird was observed within the western portion of the survey area. This record is presented in Table 5-20 and Figure 5, Appendix A.

Table 5-20 Gull-billed Tern records

Date	Habitat type	Latitude	Longitude	Observation
10/03/2022	Beach	-27.40398385	114.0569165	1 bird observed

Crested Tern *(Thalasseus bergii)*

The Crested Tern is listed as Migratory under the BC and EPBC Acts. There are few stretches off the Australian coastline where the Crested Tern cannot be seen — it has been known as both the Bass Straits Tern and the Torres Straits Tern. They breed in colonies on small offshore islands where their nests are so densely packed together that adjacent owners can touch each other's bills. Though the Crested Tern is usually a strictly coastal species, there are occasional records in the arid interior of Australia, where birds were possibly blown by passing tropical cyclones (Birdlife Australia, 2021).

Assessment in the Survey Area

There are known records within the southern portion of the survey area as observed by GHD in November 2021, as well as up to 12 separate observations in the southwestern portion of the survey area during the March 2022 survey. Numerous sightings were recorded during the phase 1, 2 and regional assessments along the entire coastal strip. This species is general considered common and widespread. These records are presented in Table 5-21 and Figure 5, Appendix A.

Table 5-21 Crested Tern records

Date	Habitat type	Latitude	Longitude	Observation
1/11/2021	Beach	-27.4032628	114.0543757	1 bird observed.
11/03/2022	Beach	-27.29235884	113.9947485	30 birds observed
10/03/2022	Beach	-27.4032628	114.0543757	15 birds observed
8/03/2022	Beach	-27.5003137	114.1014479	3 birds observed
10/03/2022	Beach	-27.39245071	114.0500042	2 birds observed
9/03/2022	Beach	-27.41859156	114.0597937	2 birds observed
12/03/2022	Beach	-27.57713442	114.1268545	5 birds observed
10/03/2022	Beach	-27.33797818	114.0227553	2 birds observed
10/03/2022	Beach	-27.36690266	114.0316708	20 birds observed
11/03/2022	Beach	-27.3407014	114.0226114	12 birds observed
10/03/2022	Beach	-27.34822055	114.0278141	7 birds observed
9/03/2022	Beach	-27.50452859	114.1034255	2 birds observed
12/03/2022	Beach	-27.49543104	114.0994072	3 birds observed
15/10/2022	ocean	-27.29177868	113.9947721	5 birds observed
11/01/2022	Beach	-27.39684283	114.0522348	2 birds observed
11/01/2022	Beach	-27.29881005	114.001058	4 birds observed
11/01/2022	Beach	-27.36543475	114.0371472	10 birds observed
11/03/2022	Beach	-27.70437417	114.1629845	Regional survey 50 birds observed
11/01/2022	Beach	-27.42060804	114.0652308	Regional survey 1 bird observed
31/10/2022	River Mouth	-27.70855248	114.1605947	Regional survey 40 birds observed
11/01/2022	River Mouth	-27.70883925	114.1602636	Regional survey 100 birds observed
11/01/2022	Beach	-27.48861781	114.0980385	Regional survey 1 bird observed

Western Spiny-tailed Skink (*Egernia stokesii badia)*

The Western Spiny-tailed Skink (*Egernia stokesii badia*) is listed as Endangered under the EPBC Act and Vulnerable under the BC Act.

The Western Spiny-tailed Skink is known to occur in a broad semi-arid area in south-west WA, between Shark Bay and Minnivale and east to Cue. Most records of the reddish brown form Western Spiny-tailed Skink (southern

portion of the species range) are in York Gum (*Eucalyptus loxophleba*) woodland with some records in Gimlet (*E. salubris*) and Salmon Gum (*E. salmonophloia*) woodland. Populations persist in woodland patches as small as one hectare and completely surrounded by wheatfields. Sites with the greatest number of individuals contain numerous hollow logs subjected to low-intensity grazing by domestic stock that are used as primary basking and shelter sites in woodland habitats. Skinks will also utilise altered habitats under woodpiles, scrap metal, farm cars or under buildings on private property (DotE 2016).

Assessment in the Survey Area

The species is known from the region, with the closest record prior to the GHD surveys being approximately 65 km northeast at the Billabong Roadhouse (Gaikhorst pers.comms) and 30 km east on Eurardy Station. Therefore the below records do represent a slight range extension west and fill a distributional gap between the Shark Bay population and those east at Mullewa and south of Geraldton.

Numerous transects were completed within suitable habitat (primarily at the eastern portion of the survey area) within the York Gum/ Mallee woodland and Jam shrubland habitats throughout the survey periods. The Western Spiny-tailed Skink was recorded at several locations and evidence of the species included; both fresh and historical scats on the ground next to logs (Plate 6), or scats on logs, latrines as well as sightings of skinks basking in the sun on logs (see Plate 7). During one observation numerous adult, sub-adult and juvenile skinks were recorded estimating the colony at 8 individuals. The selection of logs by a colony appears complex as not every log is utilised. It is likely that their location in the environment, hollowness, aspect, size and degree of surrounding vegetation and type are key requirements for the species to persist.

A summary of each individual record of the species is presented below in Table 5-22 and presented in Figure 5, Appendix A.

Plate 6 ***Fresh scat of the Western Spiny-tailed Skink recorded during the August 2022 survey***

Plate 7 *Two sets of images of Western Spiny-tailed Skinks observed basking on fallen log during April and August 2022.*

Plate 8 *Juvenile Western Spiny-tailed Skink basking while an adult looks on.*

Table 5-22 Summary of Western Spiny-tailed Skink records

Date	Habitat type	Latitude	Longitude	Record type	Representative photo
14/03/2022	York gum woodland	-27.339564	114.35165	Scat (3x individuals)	 
14/03/2022	York gum woodland	-27.338773	114.35204	Scat (fresh and old) (more than 2 animals)	
14/03/2022	York gum woodland	-27.33847	114.3507	Scat (fresh) (2 x sizes)	 

Date	Habitat type	Latitude	Longitude	Record type	Representative photo
14/04/2022	York gum woodland	-27.339564	114.3516	8x individuals in a breeding colony	 
19/08/2022	York gum woodland	-27.338235	114.4272467	2x individuals likely a pair	
21/08/2022	York gum and Mallee woodland/ Jam Shrubland	-27.33946167	114.4353733	Scat (old) (1)	

Date	Habitat type	Latitude	Longitude	Record type	Representative photo
22/08/2022	York gum woodland	-27.33753	114.4302567	Scat (fresh) (2 individuals)	
17/10/2022	York gum woodland	-27.3380	114.3448	Scat (fresh)	
17/10/2022	York gum woodland	-27.3382	114.3446	Scat (fresh)	
17/10/2022	York gum woodland	-27.3381	114.3437	Scat (fresh)	
17/10/2022	York gum woodland	-27.3385	114.3435	Scat (fresh)	
17/10/2022	York gum woodland	-27.338	114.3438	Scat (fresh)	

Zuytdorp Worm Slider (Taper-tailed West Coast slider) *(Lerista humphriesi)*

The Zuytdorp Worm Slider is only known from the Murchison River district where it occurs in Acacia-dominated sandplains and other sandy habitats (Cogger 2014). There are known records from north of Kalbarri on Murchison House Station from 1979 and along the Vermin Proof Fence Zuytdorp section (Gaikhorst pers.obs. 2019).

Approximately 80 active searches were conducted throughout the survey area with the species recorded on two occasions. These collections were in the northwest portion of the survey area in the acacia shrubland on red sandplain habitat within or close to Limestone hills and ridgelines. The habitat for this species falls out in the Limestone hills and ridgelines due to the vegetation units present. However the species actual requires the deep sands in associated to this habitat type. Despite the amount of searches undertaken no pattern was observed between capture areas and similar active searches with no result. It appears this species is not abundant in the environment and patchily disbursed in suitable habitat.

Table 5-23 Summary of Lerista humphriesi records

Date	Habitat type	Latitude	Longitude	Portion of survey area	Observation
24/08/2022	Acacia shrubland on red sandplain (within Limestone hills and ridgelines)	-27.25858559	114.06934	East	Individual (alive) (3)
24/08/2022	Acacia shrubland on red sandplain (within Limestone hills and ridgelines)	-27.25854419	114.0702	Northwest	Individual (alive) (1)

Plate 9 Lerista humphriesi recorded during the survey during a targeted transect

5.9 Species Likely to be present within the Survey Area

Ruddy turnstone (*Arenaria interpres*)

The Ruddy Turnstone is found in most coastal regions with exposed rock coast lines or coral reefs, and also near platforms and shelves, often with shallow tidal pools and rocky, shingle or gravel beaches. It can be found on sand, coral or shell beaches, shoals, cays and dry ridges of sand or coral, and in occasionally near river beds, and on inland lakes and adjacent farmland. It strongly prefers rocky shores or beaches with large deposits of rotting seaweed. It has occasionally been sighted in estuaries, harbours, bays and coastal lagoons, among low saltmarsh or on exposed beds of seagrass, around sewage ponds and on mudflats. In south-west Australia, it may occur on pebble-strewn shores of saltlakes near the coast (DotE 2016). It is also common on all the larger islands south to Penguin Island (Nevill 2013). There is suitable habitat within the Survey Area and previous records 2 km east of the survey area.

Sharp-tailed Sandpiper (*Calidris acuminata*)

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 salt lakes 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. They are widespread from Cape Arid to Carnarvon, around coastal and subcoastal plains of Pilbara Region to south-west and east Kimberley Division. Inland records indicate the species is widespread and scattered from Newman, east to Lake Cohen, south to Boulder and west to Meekatharra (DotEE 2019). There is some rocky shoreline habitat for this species within the survey area and the nearest record is 16 km east of the survey area. Typically this species occurs on inland water systems, therefore use may be opportunistic.

Red Knot (*Calidris canutus)*

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. In WA there are scattered records in the south, and it is occasionally seen around Peron Peninsula and Carnarvon. It is widespread on the coast from Ningaloo and Barrow Island to the south-west Kimberley Division (DotE 2016). There is suitable habitat within the survey area.

Curlew Sandpiper (*Calidris ferruginea*)

Curlew Sandpipers mainly occur in areas with soft mud conditions, including 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 found inland 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. In WA, they are widespread around coastal and subcoastal plains from Cape Arid to south-west Kimberley Division, but are more sparsely distributed between Carnarvon and Dampier Archipelago (DotEE 2019). The nearest record is at Chinaman's Rock Lookout 10 km south of the survey area.

Lesser Sand Plover (*Charadrius mongolus)*

In non-breeding grounds in Australia, the Lesser Sand Plover usually occurs in coastal littoral and estuarine environments. It inhabits large intertidal sandflats or mudflats in sheltered bays, harbours and estuaries, and occasionally sandy ocean beaches, coral reefs, wave-cut rock platforms and rocky outcrops. It also sometimes occurs in short saltmarsh or among mangroves, in saltworks and near-coastal saltpans, brackish swamps and sandy or silt islands in river beds. The species is seldom recorded away from the coast, at margins of lakes, soaks and swamps associated with artesian bores (DotE 2016). The Lesser Sand Plover mainly occurs in northern regions, and becoming scarcer in the south west (Nevill 2013). There are known records of the species at Chinaman's Rock Lookout approximately 10km south of the survey area.

Peregrine Falcon (*Falco peregrinus*)

The Peregrine Falcon is listed as Other Special Protection 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. The Peregrine Falcon nests primarily on ledges of cliffs, tall tree hollows, and ledges of buildings in cities (Morcombe 2014). The Peregrine Falcon is wide ranging, mobile and aerial in nature, and therefore is likely to utilise all of the habitats within the survey area. No large rocky cliff faces or tall trees suitable for nesting are present within the survey area. The species is known from the region (records within 4 km east of the survey area), however use would be opportunistic and utilised for foraging purposes only. No breeding habitat was present.

Eastern Curlew (*Numenius madagascariensis)*

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 (Marchant & Higgins 1993). They are found commonly along the north coast of WA, but rarely south of Shark Bay (Morcombe 2004). They are uncommon further south of Geraldton (Nevill 2013). There is suitable habitat within the survey area on the coastal strip and the closest known record is 17 km east of the survey area.

Whimbrel (*Numenius phaeopus)*

The Whimbrel is often found on the intertidal mudflats of sheltered coasts. It is also found in harbours, lagoons, estuaries and river deltas, often those with mangroves, but also open, unvegetated mudflats. It is occasionally found on sandy or rocky beaches, on coral or rocky islets, or on intertidal reefs and platforms. It has been infrequently recorded using saline or brackish lakes near coastal areas. It also used saltflats with saltmarsh, or saline grasslands with standing water left after high spring-tides, and in similar habitats in sewage farms and saltfields. There are a small number of inland records from saline lakes and canegrass swamps. The Whimbrel is common and widespread from Carnarvon to the north-east Kimberley Division. It is occasionally seen on the south coast of WA and has occasionally been recorded in the south-west and further north to Shark Bay (DotEE 2019). There is suitable habitat within the survey area on the coastal strip and the closest known record is 17 km east of the survey area.

Pacific Golden Plover (*Pluvialis fulva)*

In Australia the Pacific Golden Plover usually inhabits coastal habitats, on beaches, mudflats and sandflats (sometimes in vegetation such as mangroves, low saltmarsh such as Sarcocornia, or beds of seagrass) in sheltered areas including harbours, estuaries and lagoons, and also in saltworks. It is sometimes recorded on islands, sand and coral cays and exposed reefs and rocks. They are less often recorded in terrestrial habitats but can be seen in habitats with short grass in paddocks, crops or airstrips, or ploughed or recently burnt areas. In WA, the species is seldom recorded along the southern or south-western coasts (DotEE 2019). There is suitable habitat within the survey area on the coastal strip and the closest known record is 17 km east of the survey area.

Grey Plover (*Pluvialis squatarola)*

Grey Plovers occur almost entirely in coastal areas, where they usually inhabit sheltered embayments, estuaries and lagoons with mudflats and sandflats, and occasionally on rocky coasts with wave-cut platforms or reef-flats, or on reefs within muddy lagoons. They also occur around terrestrial wetlands such as near-coastal lakes and swamps, or salt-lakes. The species is also very occasionally recorded further inland, where they occur around wetlands or salt-lakes (DotEE 2019). There is suitable habitat within the survey area on the coastal strip and the closest known record is 10 km east of the survey area.

Roseate Tern (*Sterna dougallii)*

The Roseate Tern occurs in coastal and marine areas in subtropical and tropical seas. The species inhabits rocky and sandy beaches, coral reefs, sand cays and offshore islands. Birds rarely occur in inshore waters or near the mainland, usually venturing into these areas only accidentally, when nesting islands are nearby. In WA, the subspecies is regularly recorded north from Mandurah to around Eighty Mile Beach. Around the Kimberley coastline, the subspecies occurs at scattered sites, north to the Bonaparte Archipelago and possibly further. The

subspecies used to be a sporadic visitor to the southwest but occurs regularly at present. In addition, breeding colonies have been established on Lancelin Island and Second Rock (DotEE 2019). There is suitable habitat in the survey area on the coastal strip and the closest record is 16 km east of the survey area.

Australian Fairy Tern (*Sternula nereis nereis)*

The Fairy Tern occurs along the coast of WA as far north as the Dampier Archipelago near Karratha, but mostly in the southern part of Australia including most of the coastline in the southwest. It nests on sheltered sandy beaches, coastal inlets, spits, and banks above the high tide line and below vegetation. It has been found in embayment's of a variety of habitats including offshore, estuarine, or lacustrine (lake) islands, wetlands, and mainland coastline (DotEE 2019; Nevill 2013). They can also be seen in salt fields, saline or brackish lakes, and sewage ponds near the coast (Pizzey & Knight 2012). There is suitable habitat within the survey area on the coastal strip and the species has been identified from database searches as being in the survey area.

Grey-tailed Tattler *(Tringa brevipes)*

The Grey-tailed Tattler is often found on sheltered coasts with reefs and rock platforms or with intertidal mudflats. It can also be found at intertidal rocky, coral or stony reefs as well as platforms and islets that are exposed at low tide. It has been found around shores of rock, shingle, gravel or shells and also on intertidal mudflats in embayments, estuaries and coastal lagoons, especially fringed with mangroves. It is less often on open flat sandy beaches or sandbanks, especially around accumulated seaweed or isolated clumps of dead coral. It is occasionally found around near-coastal wetlands, such as lagoons and lakes and ponds in sewage farms and saltworks. Inland records for the species are rare with sightings on riverbanks and the edges of rock pools. There are a few scattered records for the species along the south coast near the Eyre Bird Observatory, Point Malcolm, Rossiter Bay, Shark Lake Nature Reserve and surrounding swampland. It is found in the south-west between Augusta and Cervantes (DotEE 2019). There is suitable habitat within the survey area on the coastal strip and known records of the species 10 km south of the survey area.

Chuditch, Western Quoll (*Dasyurus geoffroii*)

The Chuditch inhabits eucalypt forest (especially Jarrah, E. 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 2012). In Jarrah forest, Chuditch populations occur in both moist, densely vegetated, steeply sloping forest and drier, open, gently sloping forest (Van Dyck and Strahan 2008). The species can travel large distances, and for this reason requires habitats that are of a suitable size and not excessively fragmented (DEC 2012; Van Dyck and Strahan 2008). There are known records of approximately 9 km south of the Survey Area within the Kalbarri gorge system. The species has also been recorded from Eurardy Station to the east and Hamelin Station to the north.

Tammar Wallaby (*Notamacropus eugenii derbianus*)

The Tammar Wallaby inhabits dense, low vegetation for daytime shelter and open grassy areas for feeding. It inhabits coastal scrub, heath, dry sclerophyll (leafy) forest and thickets in mallee and woodland. The tammar wallaby is currently known to inhabit three islands in the Houtman Abrolhos group, Garden Island near Perth, Middle and North Twin Peak Islands in the Archipelago of the Recherche, and at least nine sites on the mainland including Dryandra, Boyagin, Tutanning Batalling (reintroduced) Perup, private property near Pingelly, Jaloran Road timber reserve near Wagin, Hopetown, Stirling Range National Park, and Fitzgerald River National Park (DEC 2012; Van Dyck and Strahan 2008). There are known records of approximately 9 km south of the survey area near the Kalbarri gorge system.

Gilled Slender Blue-tongue (*Cyclodomorphus branchialis*)

The Gilled Slender Blue-tongue lizard is listed as Vulnerable under the BC Act. The Gilled Slender Bluetongue is a small distinctly patterned skink up to 16 cm long (Bush *et.al* 2007). The species is cryptic, and poorly known with relatively few specimens recorded throughout its range. The species is found in the mid-west region of WA between the Murchison and Irwin Rivers and extending inland to Mt Magnet area (Bush *et. al* 2007). It is a ground-dwelling lizard of largely crepuscular and nocturnal habits, sheltering by day below low vegetation, leaf-litter, and under fallen timber (Cogger 2017) and beneath rocks (B. Maryan pers. comm, 2018).

During the field survey the Gilled Slender Blue-tongue was not recorded however the species is known to be from the region, with the closest record approximately 60km southeast of the survey area in the Galena, Warribano Chimney and Ajana areas**.** From what is known about the species rocky areas comprising banded ironstone and

granitic formations in Acacia/Jam shrublands with scattered rock or heavy loam soils represent potentially suitable habitat.

Woma Python (SW pop.) (*Aspidites ramsayi*)

The Woma inhabits woodlands, heaths and shrublands, often with spinifex. It occurs in the sub-humid and arid areas across Australia's interior with a separate sub-populations occurring in the Wheatbelt where severely impacted by clearing, the Goldfields and Shark Bay of WA. The Woma shelters mainly in abandoned monitor and mammal burrows and in soil cracks (Wilson and Swan 2010) and/or can dig their own systems. The species is known to be from the region, with the closest record approximately 80km north of the survey area on Coburn Station.

5.10 Accumulation curve

An accumulation curve was run for the data collected during the field survey within 8 models in Primer V6. Sobs failed to register a curve with all remaining models demonstrating good fit to data however Jacknife1, Chao1, Chao2, Jacknife2 may have over predicted species at peak asymptote. Otherwise all curves reach a curve asymptote (very few new species were recorded) after trap night 8 to 10. For MM, UGE and Bootstrap somewhat model levelling is demonstrated by the end of the survey indicating that of the species active at the time of the survey, i.e. a majority of them were sampled prior to the end of the survey. This is also comparable to the raw data of which the known species in the region (of reptile, small mammal and frogs) approximately 97 could utilise the habitats present in the survey area (based on NatureMap records). However it should be noted that this area is highly under survey and 97 species is greatly reduced. This study recorded 106 species throughout the trapping program, somewhat less than MM and UGE predict. Therefore, we assume the species accumulation curve demonstrate adequate asymptote (leveling) of species and the effort of survey was sufficient to capture a good range of species within the survey area based upon two models, although being little historical data to compare or fully understand the true number of terrestrial species in the region. A study by Maryan and Gaikhorst (in press) looked at species that have been recorded in the great region with 116 species identified. This number is much closer to the predicted number presented by MM and UGE. However, the remaining models suggest further survey effort may result in additional species being recorded where the species count continues to increase as trapping nights increase.

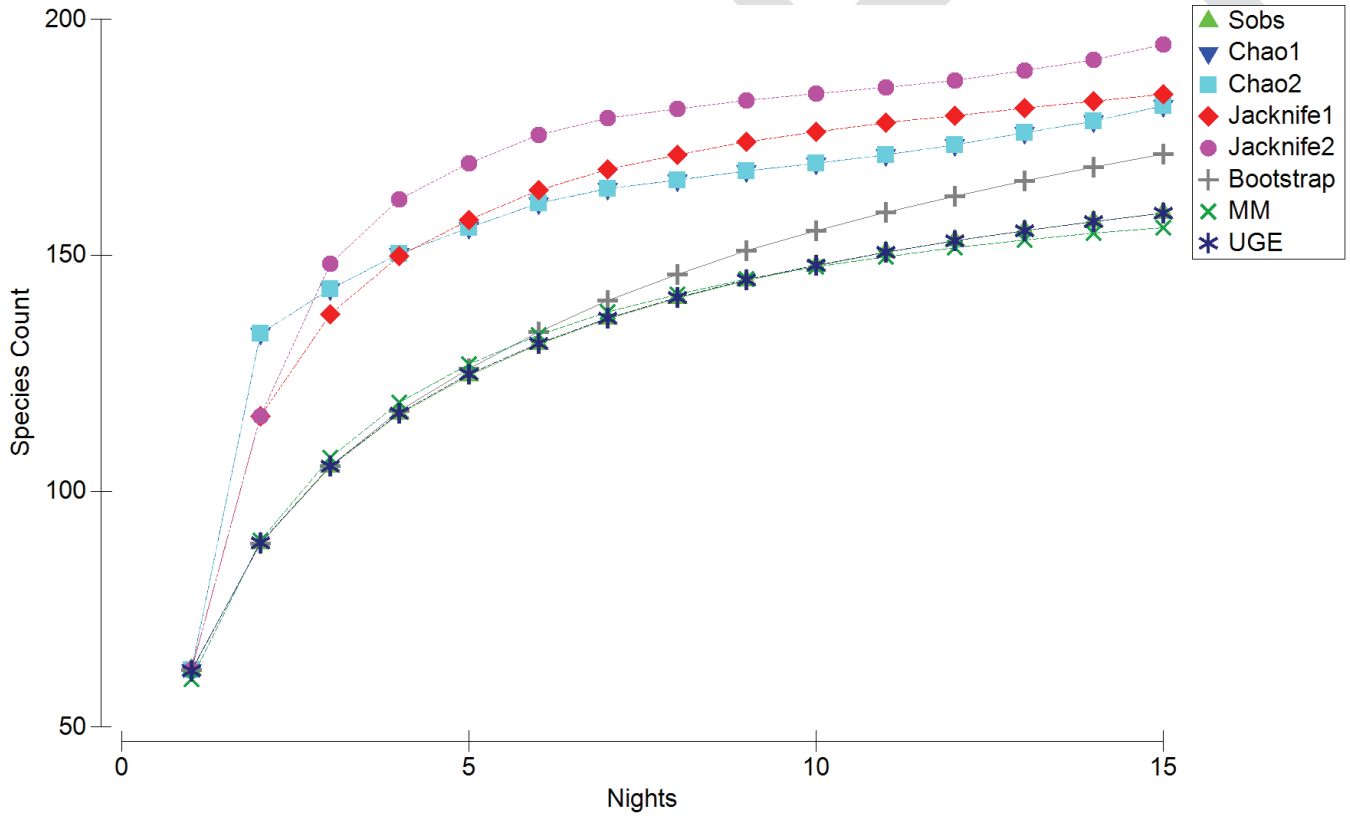

Chart 5 Accumulation curve for models representing the survey trapping data

5.11 Fauna survey limitations

5.11.1 Desktop limitations

The EPBC Act PMST is based on bioclimatic modelling for the potential presence of species. As such, this does not represent actual records of the species within the area. The records from the DBCA searches of threatened flora and fauna provide more accurate information for the general area. However, some records of collections, sightings or trappings cannot be dated and often misrepresent the current range of threatened species.

5.11.2 Field survey limitations

The EPA (2020) Technical Guide states that fauna survey reports for environmental impact assessment in WA should contain a section describing the limitations of the survey methods used. The limitations and constraints associated with this field survey are discussed in Table 5-24. Based on this assessment, the survey effort has not been subject to any constraints, which affect the thoroughness of the assessment and the conclusions were formed.

Table 5-24 Fauna survey limitations

Aspect	Constraint	Comments
Availability of data and information	Nil	The majority of the survey area lacks historical fauna data and information. However, Burbridge *et. al* (2000) consists of fauna studies undertaken in the Carnarvon basin area which provides a overview of the region. Additionally PMST, DBCA, Naturemap records and a recent 2019 fauna survey nearby (Gaikhorst and Maryan) provided baseline of data and information to confirm significant fauna species present within the region. Much of the survey area was previously un-surveyed and this study provided the first baseline information for the area.
Competency/experience of the survey team, including experience in the bioregion surveyed	Nil	The Zoologists and Ecologists who executed the survey are suitably qualified and experienced in their respective fields and all have experience conducting fauna surveys. Additionally, Gaikhorst and Maryan (Senior Zoologists involved in the surveys) have undertaken a recent fauna survey in 2019 within the region. The majority of the team deployed during the survey have experience conducting fauna surveys in the near vicinity. Their experience levels are presented in Table 2-3 of this report.
Scope (ability to sample all fauna groups and utilise sampling methods because of site conditions and constraints (e.g., pitfall trapping in waterlogged soils or inability to use pitfall traps because of rocky terrain)	Nil	The survey area was adequately surveyed during the field surveys in line with the scope. All fauna groups were able to be sampled however in areas which very hard clay substrate that were unable to be dug, pit traps were substituted with funnels. Where access was restricted by dense vegetation remote cameras were deployed.
Adequacy of the survey intensity and proportion of survey achieved, e.g. the extent to which the area was surveyed	Nil	The terrestrial fauna was sampled in accordance with EPA (2020). The detailed survey was successful, and most areas assessed however due to scale of the Survey Area extent not all areas within the survey area could be investigated. Where trapping sites were not established, remote cameras were deployed to counteract this constraint. The survey areas were sufficiently covered by GHD field staff during the survey. The Eastern portion of Rig Road (Proposed service corridor) was also not survey due to access not being granted by the land manager.
Timing, weather and seasonal conditions	Minor	The fauna surveys were undertaken from March 2022 to October 2022. The weather conditions pre-ceding the Autumn (August) survey was high amounts of rainfall. This delayed survey timing (by a few days) is deemed to be a minor constraint and is not considered to have impacted on fauna capture results in a significant way.
Disturbances (e.g. fire, flood, accidental human intervention)	Minor	The Survey Areas have been subjected to historical disturbance (e.g. pastoral clearing, cattle and fire) in particular with the high amount of goat disturbance. These disturbances are not considered to affect the survey results.

Aspect	Constraint	Comments
Proportion of fauna identified, recorded and/or collected	Minor	The fauna assessment sampled those species that can be easily seen, heard or have distinctive signs, such as tracks, scats, diggings, etc. Of the fauna species recorded, including invertebrate species, all were identified to at least a species level. The information available on the identification, distribution and conservation status of invertebrates is generally less extensive than vertebrate species. The fauna assessment was aimed at identifying habitat types and identified terrestrial vertebrate fauna utilising the survey area. Sampling of aquatic species did not occur. The portion of fauna identified was considered suitable for the purpose of the assessment.
Remoteness and/or access problems	Minor	The majority of the survey area was able to be accessed. Where landform imposed vehicle restrictions remote cameras were deployed.
Problems with data and analysis, including sampling biases	Nil	There were no issues with data or data analysis.
Mapping reliability	Minor	The fauna habitats were mapped using high-resolution aerial imagery obtained from Landgate (2021), topographical features, previous broad scale mapping (Beard, 1979) and field data. Data was recorded in the field using hand-held GPS tools (e.g. Samsung tablet and Garmin GPS). Certain atmospheric factors and other sources of error can affect the accuracy of GPS receivers. The Garmin ® GPS units and Android ® tablets used for this survey are accurate to within ±5 m on average. Therefore, the data points consisting of coordinates recorded from the GPS may contain slight inaccuracies.

6. Discussion and Conclusion

The Survey Area consists of 12 broad fauna habitat types: Coastal heathlands, Minor Creek lines/drainage lines, Beach and associated dunes and limestone ridge, Limestone hills and ridgelines, Clay Pans/Lake Culcurdoo, Mallee woodland, Mixed shrublands, Banksia shrublands, Acacia shrublands, York Gum woodland, Jam shrubland and Cleared/Farmland.

The conservation value of each habitat type has been rated based on condition, structural complexity, faunal diversity and habitat for conservation significant fauna (i.e., contains essential habitat for residence, breeding, shelter and/or feeding). Habitat values for the 12 types are all considered Low to high value. A small amount of the Survey Area is disturbed and comprises existing tracks, old fencing and historical cleared areas for stock water points, and feral goat grazing.

The NatureMap database search identified 249 terrestrial vertebrate fauna species previously recorded within the Study Area (40 km buffer). This includes; 20 mammal, 67 reptiles, 158 bird and 10 amphibian species. Of these 6 were introduced/naturalised.

In contrast the fauna surveys recorded 262 vertebrate fauna species by trapping, hand searches, nocturnal searches, remote equipment and observations undertaken by GHD. This includes 28 mammal, 156 bird, 72 reptile and 6 amphibian species. Of these seven were introduced/naturalised.

The survey area lies within and environmental ecotone between the world heritage area of Shark Bay and the northern extent of the south west bio-region. The south-west bio-region is regarded as a biodiversity hot spot for both flora and fauna and is globally recognised due to an exceptional level of biodiversity and endemism. Overall this region incorporating the survey area by virtue of its size and intact contiguous habitats provide excellent environments for species to persist virtually unimpeded by anthropogenic disturbance. Consequently more delicate species currently utilising this environment may become impacted by disturbance. Some of these species include Ash Grey Mouse, White-tailed Dunnart, Malleefowl, Western Spiny-tailed Skink and Honey Possum.

This fauna survey identified more species than the desktop assessment, most likely due to the lack of systematic surveys undertaken in the region. However it also appears that due to the ecotone effect, this area has numerous species that ranged north (northern limits of their range) ie. Javelin Legless Lizard, Pobblebonk Frog, White-cheeked Honeyeater, Varied Sittella, Brush Bronzewing, Painted Button Quail and Carnaby's Cockatoo. Or alternatively south (southern limits of their range) ie Blinking Broad-striped Slider, Shark Bay Heath Dragon, Black-necked Whipsnake and possibly the Western Grasswren. This combined with diverse habitats of coastal, heathlands, shrubland, woodland and limestone conduits to a greater level of diversity within the region. Off the species recorded the Southern Sandhill Frog and Zuytdorp Worm Slider are endemic to the region between the Murchison River and just south of Shark Bay. The Zuytdorp Worm Slider is already considered a priority 3 species under the BC Act and if impacted both species will require elevations of their conservation status.

The survey identified range extensions for numerous species, particularly those with distributions extending up from the south of the survey area. The most significant is the Southern Javelin Lizard (*Delma concinna concinna*) which extended north by approximately 300 km and even well known birds such as the Brush Bronzewing (*Phaps elegans*) north by approximately 60 km, Varied Sittella (*Daphoenositta chrysoptera*) west by approximately 130 km and potentially the Western Grasswren (*Amytornis textilis*) south by approximately 75 km. These distributional records further highlight the lack of research in the region and increase the diversity known within the survey area.

Seventeen conservation significant fauna species were recorded in the survey area, consisting of terrestrial reptiles and birds as well as migratory bird species.

Off the migratory species recorded the migratory shorebirds (5 species) appeared to utilise the coastline for feeding and resting. Small beach areas appeared to be utilised with no records encountered on Lake Culcurdoo or other small claypans. Currently the coastline in this region is relatively undisturbed. However disturbance is a key threat to important bird areas (IBA) and species that frequent them (Dutson 2009). The survey area also falls

within a inshore seabird important bird area feeding range, which radiates from the Houtman Abrolhos IBA (Dutson 2009). Six species identified would fall into using this area and include the Terns, Osprey, Shearwater and Petrel. Although the Osprey and some Terns are also a likely resident to the area.

Diurnal flight paths were recorded along the coast for the migratory birds recorded consisting of a north /south direction. During nocturnal surveys waders were also heard calling from above in flight but consisted of a north/south pattern as well as west/ east direction. These observations were made on limited data and species could not be verified however nocturnal movement across the survey area was noted.

The Western Grasswren was thought to be observed during the reconnaissance however no additional observations were made despite searches undertaken for this species. Habitat is available for this species along the coast in coastal heaths and associated shrublands and if present are likely present in very low numbers.

The Fork-tailed Swift was recorded in March 2022 via a group of approximately 30 birds along the coastal strip above limestone ridgelines utilising thermal winds each day over a three day period. Typically Fork-tailed Swift are almost exclusively aerial and either heard or visually recorded briefly as they move through the area. The unusual behaviour observed during this study suggests the species was sedentary and thought to be utilising the limestone ridgeline for roosting. Roost locations are extremely rare in Australia.

Malleefowl were identified via prints, scats, feathers, mounds and active birds. In total 35 active mounds were recorded comprising approximately 50% of total reported. In this region the species appears to be in excellent numbers with active mounds scattered across the site within Mallee woodlands, York Gum woodlands, Banksia shrubland, Mixed shrubland, Acacia shrubland, Jam shrubland and on the edge of a claypan. The high number may be attributed to the predator management regime that occurs in the region namely in Kalbarri National Park (to protect the gorge dwelling species), on Eurardy Station (Bush Heritage) (general predator management) and baiting along the predator proof fence (Department of Primary Industries and Regional Development - general canid management practices) all assisting in managing feral species. Additionally as discussed above, the region is contiguous and well-vegetated creating a diverse array of habitats, connectivity and structure within the environment for the species to utilise. There are very few large intact areas remaining in the south west of Western Australia where this species can maintain “free range” without restricting impacts impeding population maintenance or growth.

The survey area comprises the northern most limit of the Carnaby Cockatoo’s distribution. A breeding population is known from the Murchison River area with foraging habitat extending into the Kalbarri National Park and southern limits of this survey area. The species was recorded within the survey area flying over and some foraging evidence on Banksia sp. cones along the southern boundary. The lack of ground surface water beyond the Murchison River maybe the limiting resources the species has to extend further north. No roosting or breeding trees were recorded in the survey area therefore the survey area is likely utilised for foraging purposes only.

The Western Spiny-tailed Skink, was identified as present and only recorded in York Gum habitat which provides a range of hollow bearing logs and debris areas able to be utilised by this species. Observations included the presence of the species latrines or visually observing the species basking in the mornings. This species persists in colonies of adults and juveniles with the largest colony recorded in the survey area of 8 individuals. Four to five colonies were recorded with additional scat latrines recorded suggesting additional populations. Additionally, these records are considered a westerly range extension filling a gap in the species current distribution.

The Zuytdorp Worm Slider is a small fossorial skink endemic to the Zuytdorp region. Few records exist of this species with only 24 occurrences over 9 localities recorded (ALA 2023). The species is poorly understood with little understanding of habitat preference or even true distribution within the region. The species was recorded during this survey along the Zuytdorp predator proof fence line however when similar habitats were sampled none were detected. Currently the predicted distribution lies over most of the survey area.

A further 17 species conservation significant species are likely to occur in the survey area based on a combination of regional distribution, habitat assessment and records in the region.

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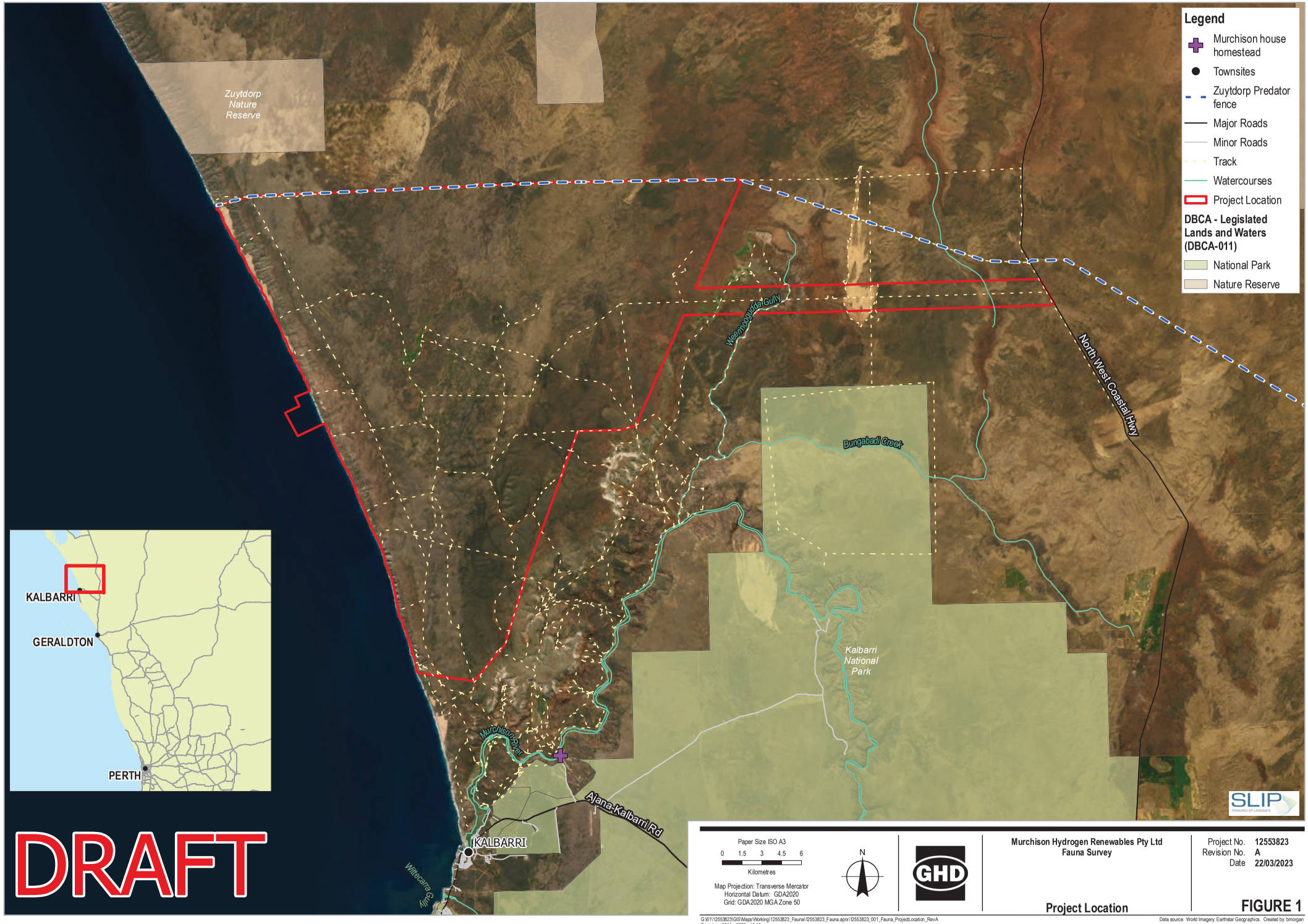
Appendix A

Figures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Major Roads
Minor Roads
Track
Watercourses
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National Park
Nature Reserve
Zuytdorp Nature Reserve
Weermoguddal Gully
North West Coastal Hwy
Bungabadi Creek
Kalbarri National Park
Murchison River
Ajana-Kalbarri Rd
KALBARRI
Wittecarra Gully
KALBARRI
GERALDTON
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Revision No. A
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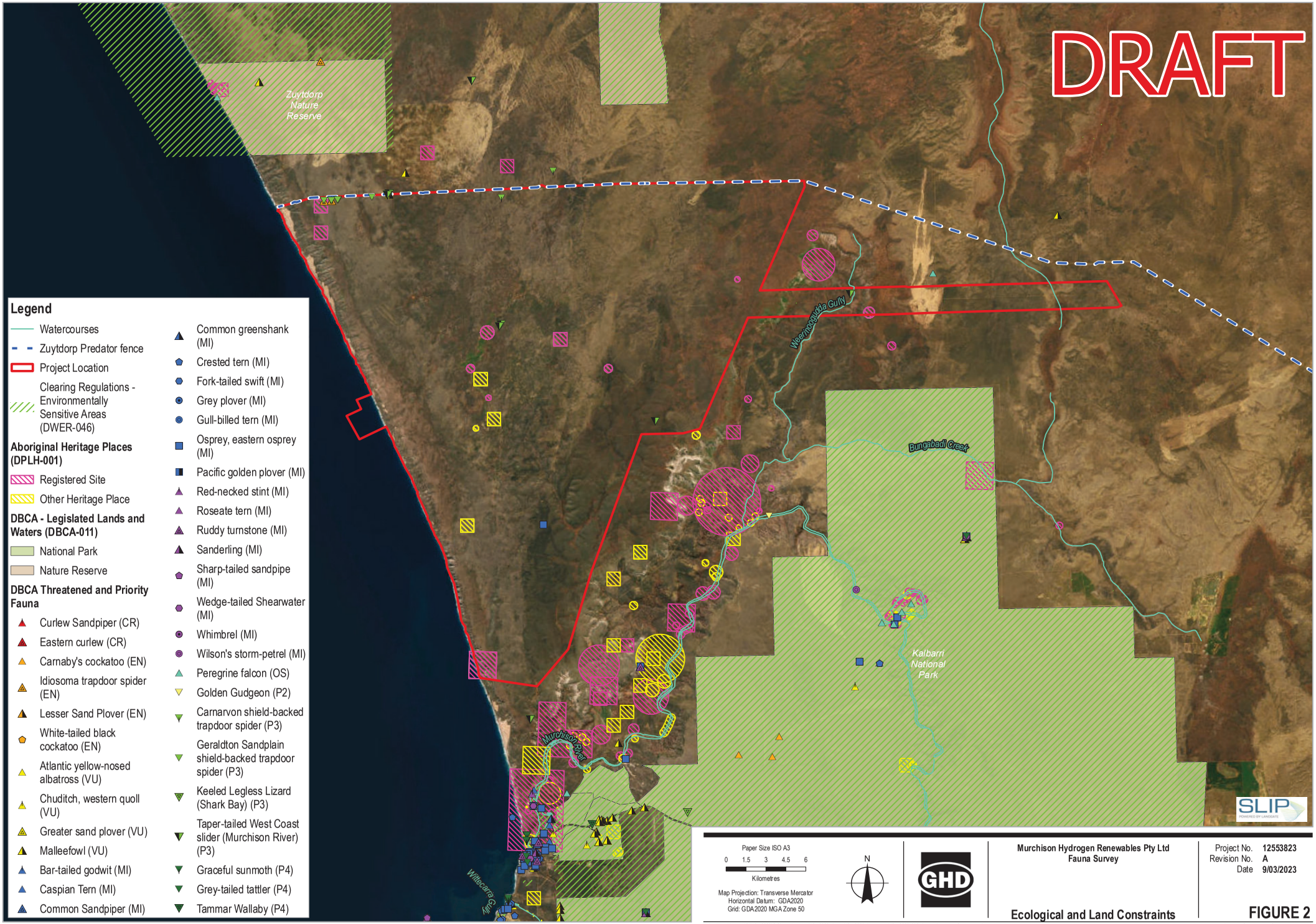
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Bungabadi Creek
Kalbarri National Park
Murchison River
Willecarra Gully
SLIP
Legend
Watercourses
Zuytdorp Predator fence
Project Location
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Aboriginal Heritage Places (DPLH-001)
Registered Site
Other Heritage Place
DBCA - Legislated Lands and Waters (DBCA-011)
National Park
Nature Reserve
DBCA Threatened and Priority Fauna
Curlew Sandpiper (CR)
Eastern curlew (CR)
Carnaby's cockatoo (EN)
Idiosoma trapdoor spider (EN)
Lesser Sand Plover (EN)
White-tailed black cockatoo (EN)
Atlantic yellow-nosed albatross (VU)
Chuditch, western quoll (VU)
Greater sand plover (VU)
Malleefowl (VU)
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Whimbrel (MI)
Wilson's storm-petrel (MI)
Peregrine falcon (OS)
Golden Gudgeon (P2)
Carnarvon shield-backed trapdoor spider (P3)
Geraldton Sandplain shield-backed trapdoor spider (P3)
Keeled Legless Lizard (Shark Bay) (P3)
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Revision No. A
Date 9/03/2023
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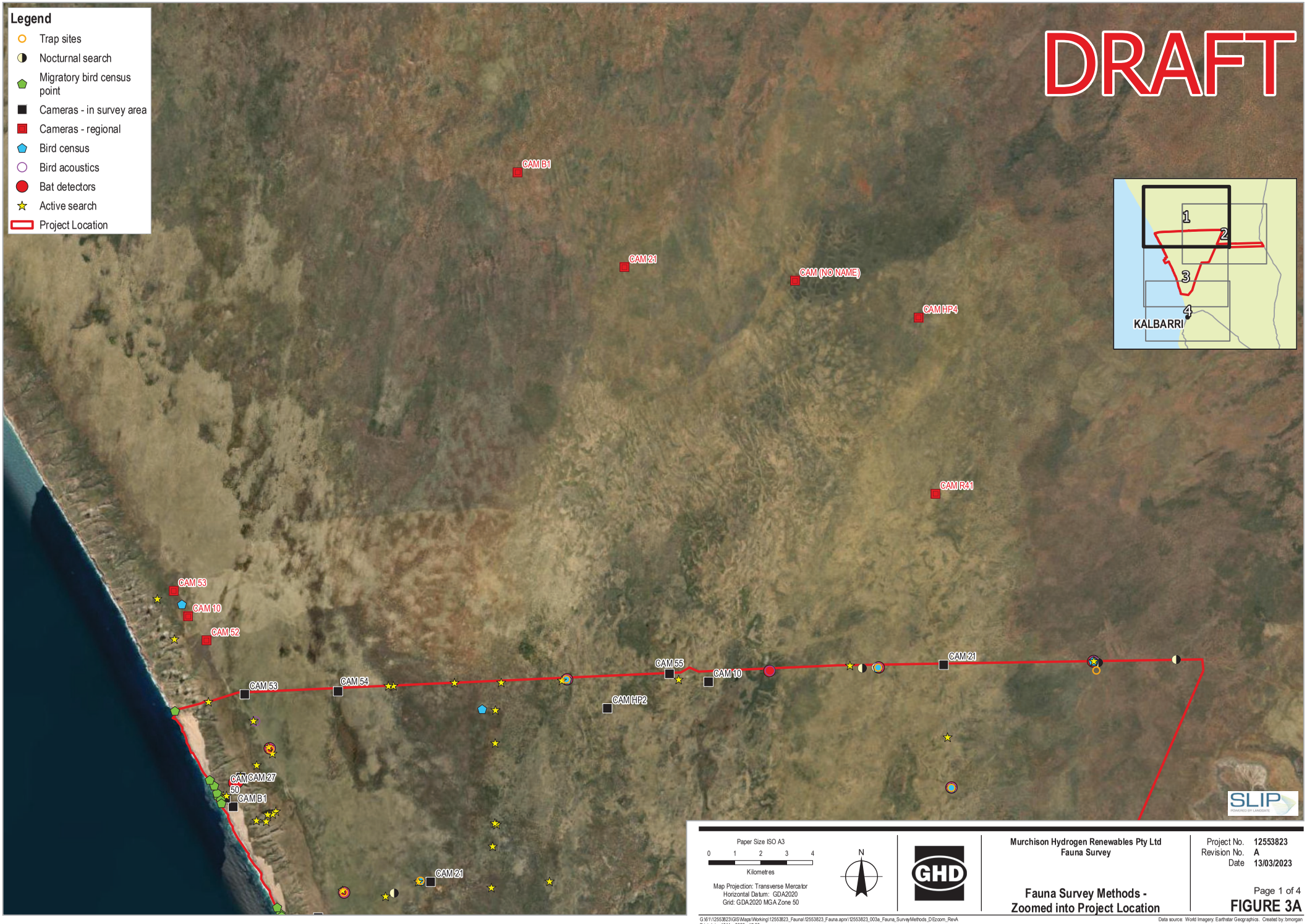

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Fauna Survey

Fauna Survey Methods - Zoomed into Project Location

Project No. **12553823**
Revision No. **A**
Date **13/03/2023**

Page 1 of 4

FIGURE 3A

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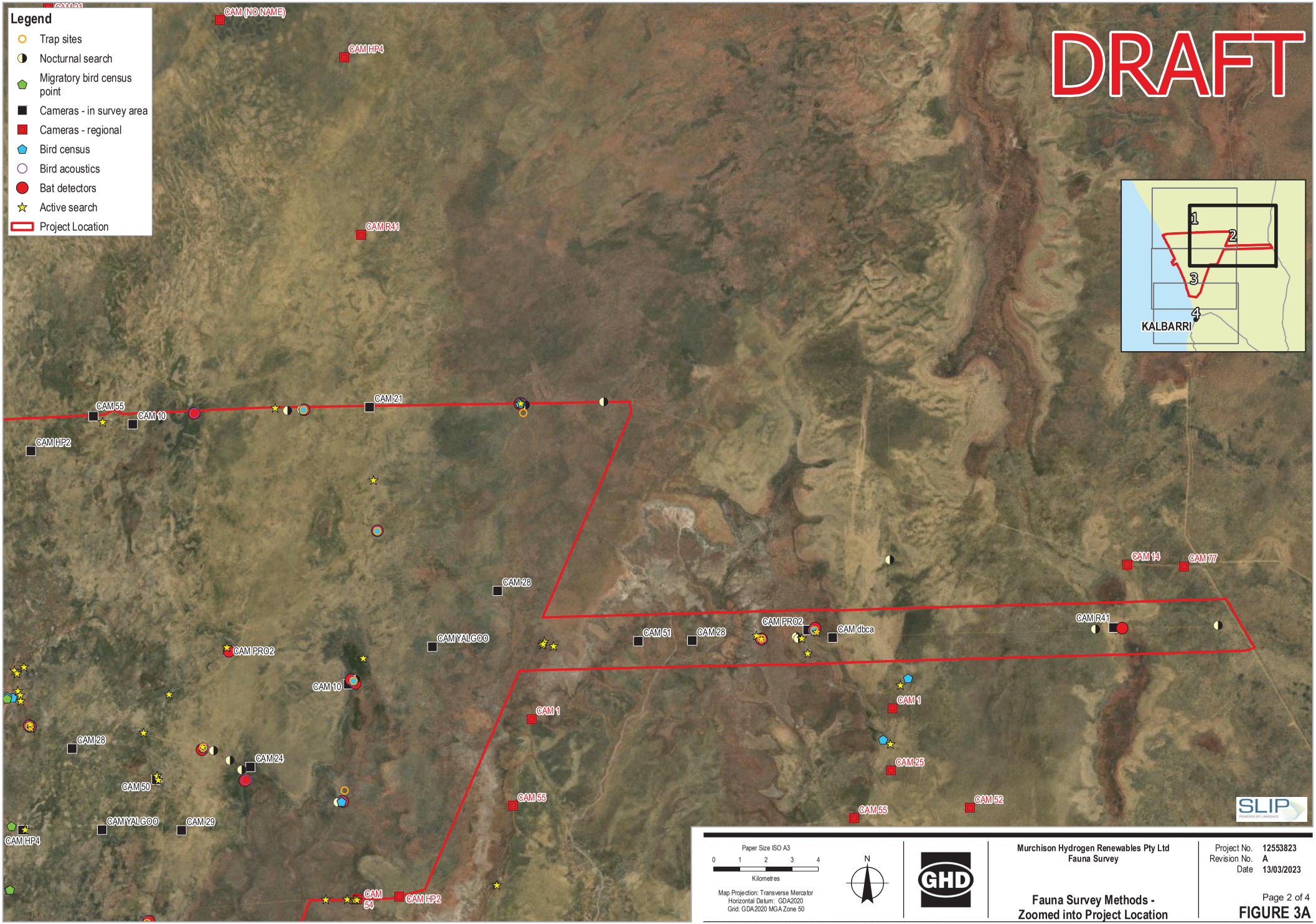
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Trap sites
Nocturnal search
Migratory bird census point
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Cameras - regional
Bird census
Bird acoustics
Bat detectors
Active search
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CAM R41
CAM 55
CAM 10
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CAM HP2
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Page 2 of 4
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Murchison Hydrogen Renewables Pty Ltd
Fauna Survey

Fauna Survey Methods - Zoomed into Project Location

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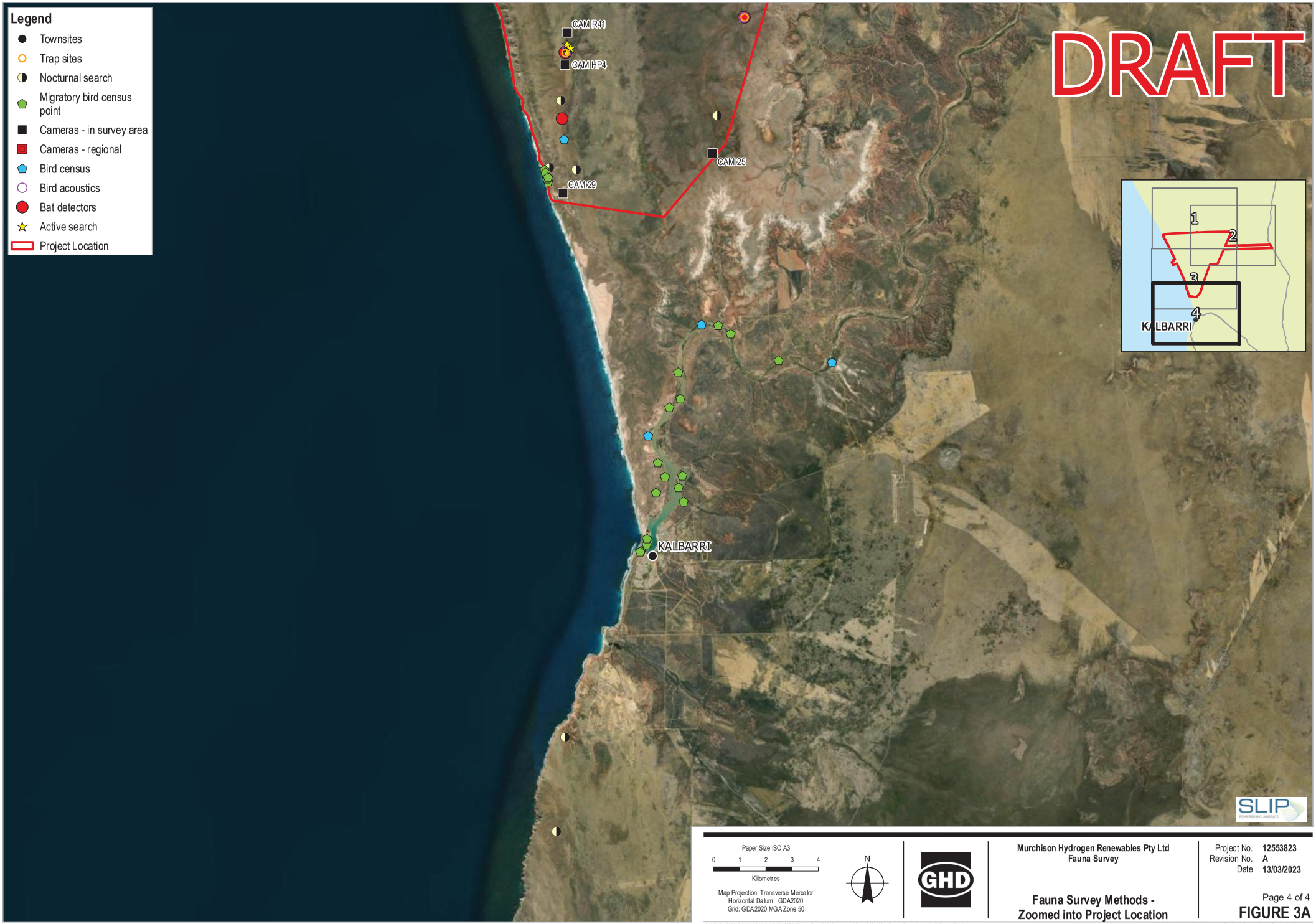

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Fauna Survey

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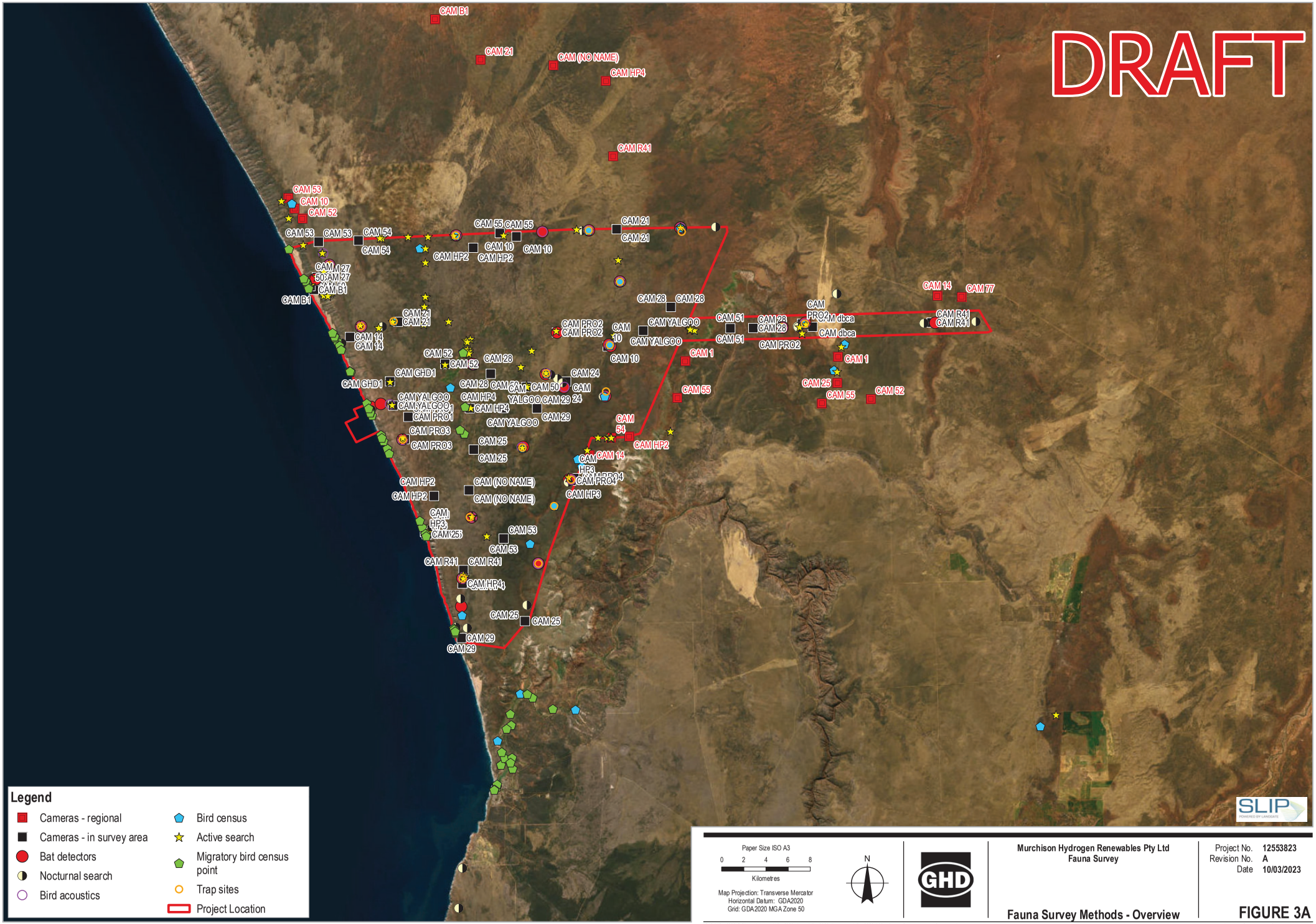
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CAM HP4
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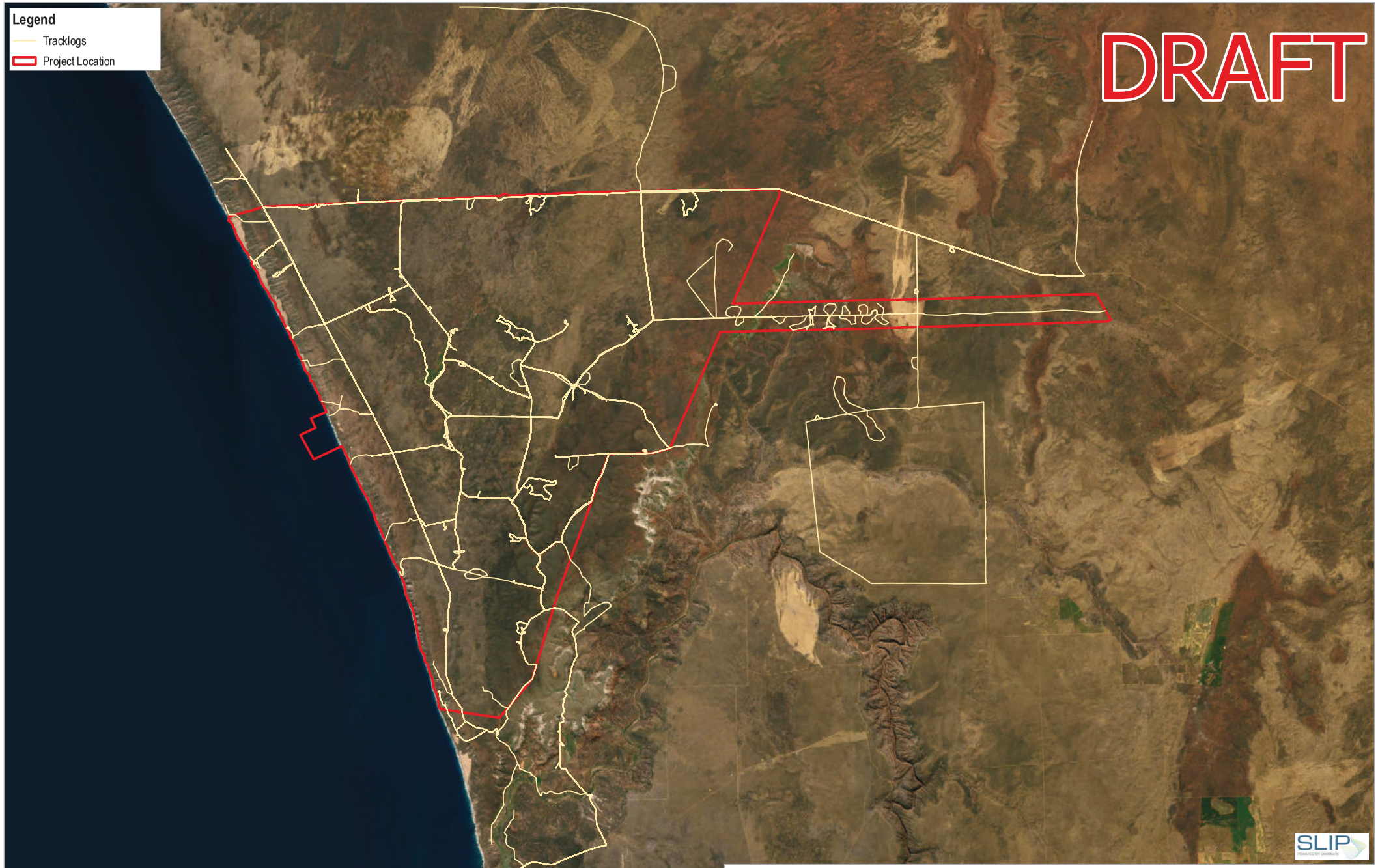

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Murchison Hydrogen Renewables Pty Ltd
Fauna Survey

Fauna Survey Methods - Tracklogs and Transects

Project No. 12553823
Revision No. A
Date 14/03/2023

FIGURE 3B

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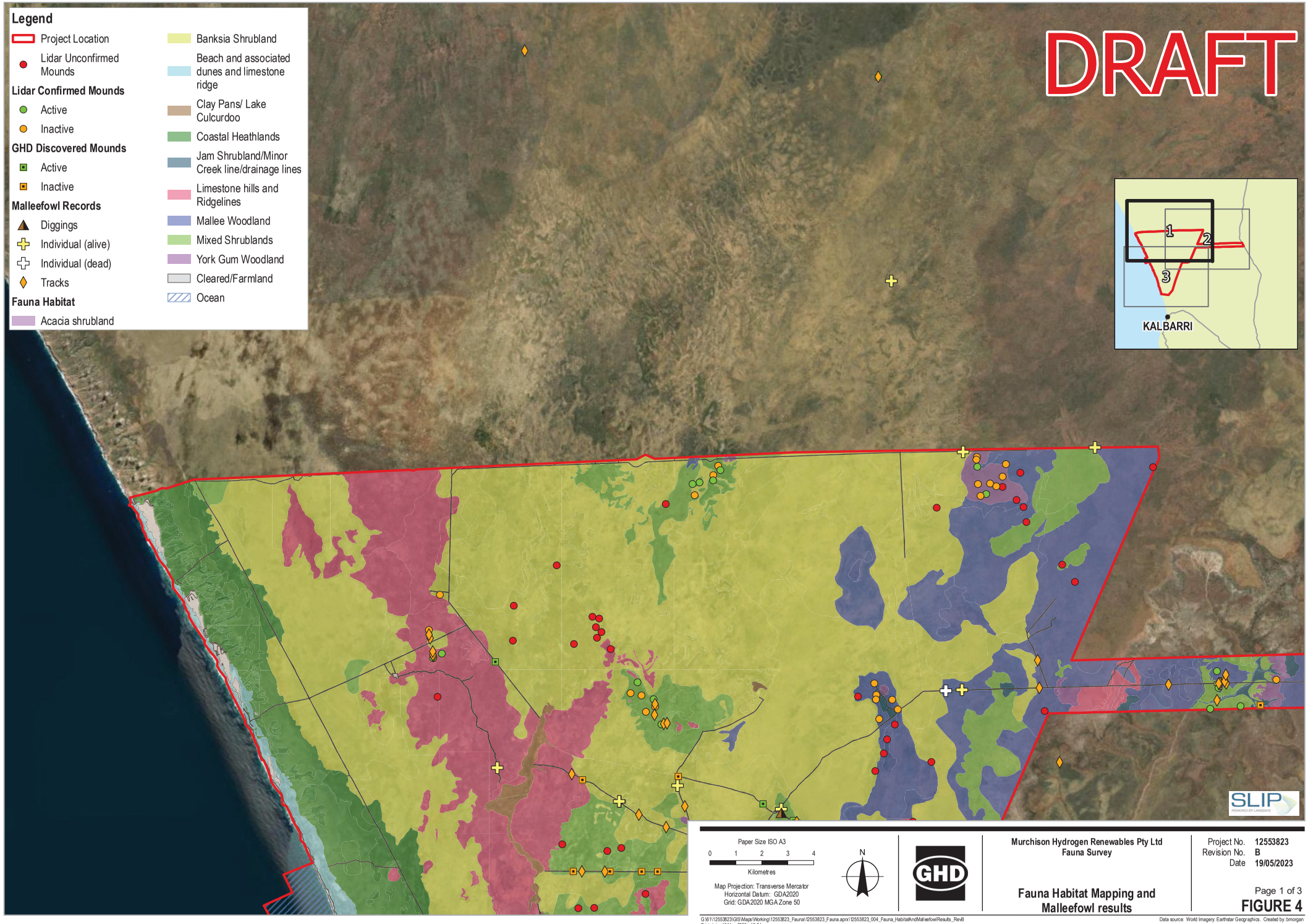

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Murchison Hydrogen Renewables Pty Ltd
Fauna Survey

Fauna Habitat Mapping and Malleefowl results

Project No. 12553823
Revision No. B
Date 19/05/2023

FIGURE 4

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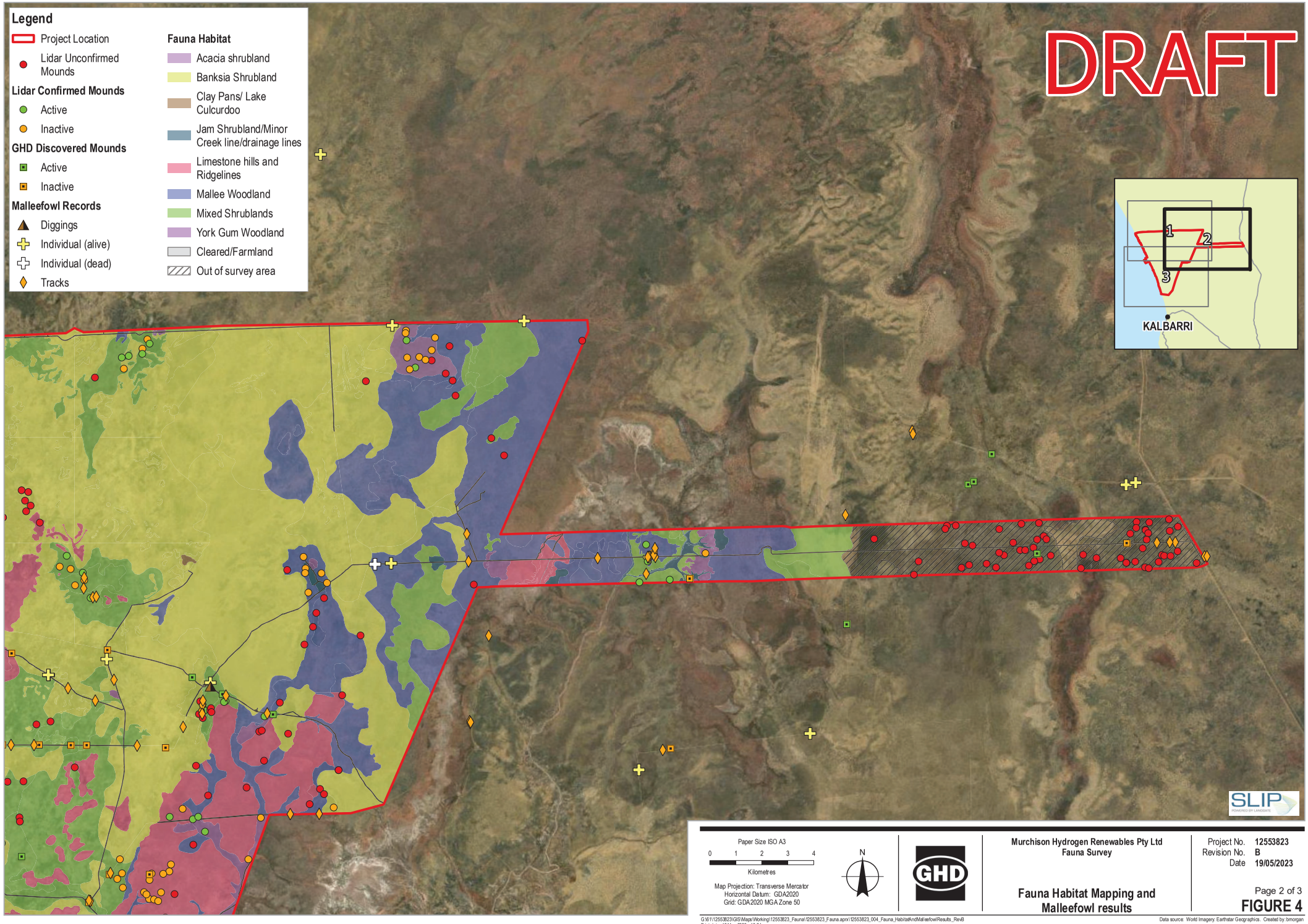

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Murchison Hydrogen Renewables Pty Ltd
Fauna Survey

Fauna Habitat Mapping and Malleefowl results

Project No. 12553823
Revision No. B
Date 19/05/2023

FIGURE 4

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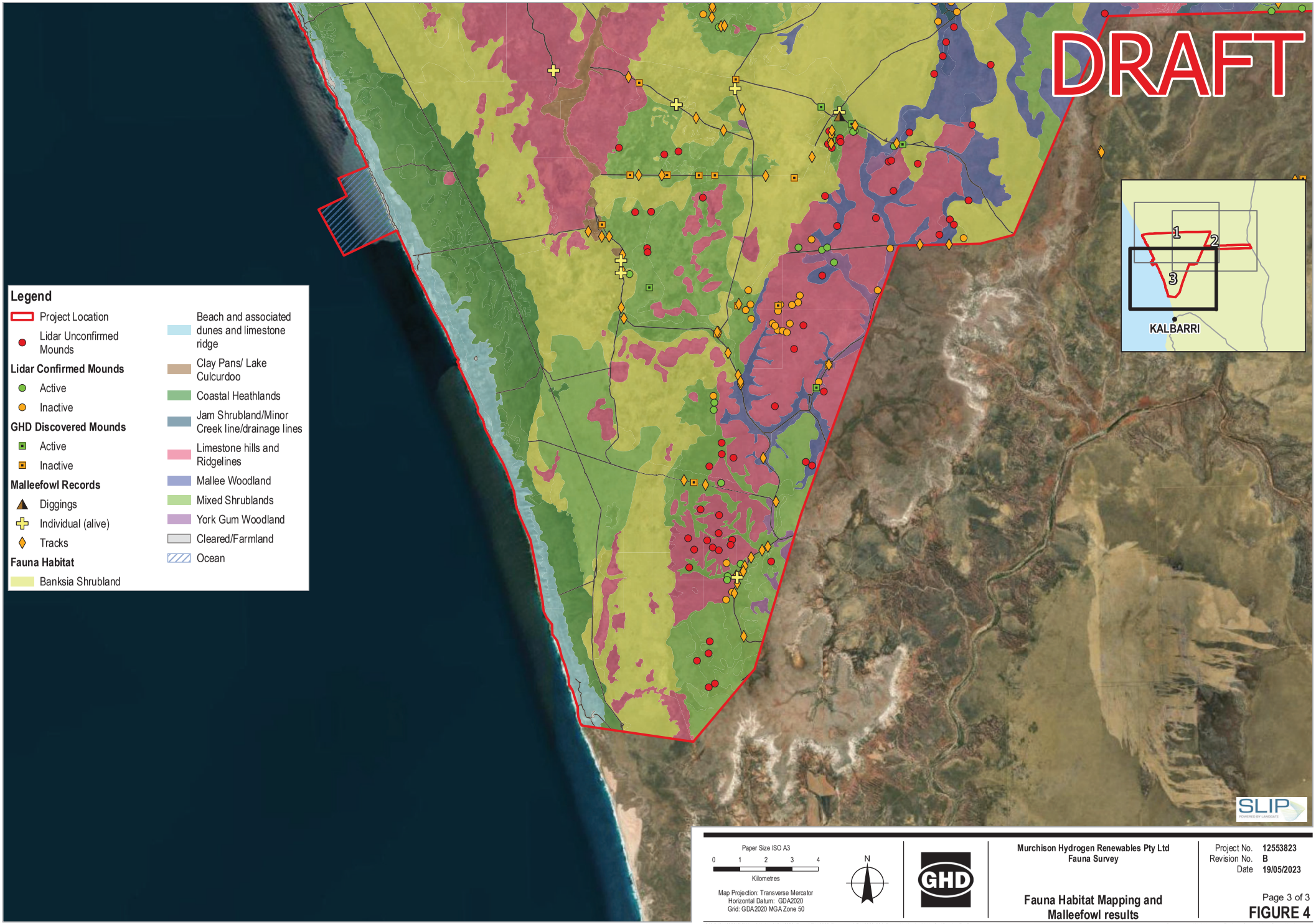

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Murchison Hydrogen Renewables Pty Ltd
Fauna Survey

Fauna Habitat Mapping and Malleefowl results

Project No. **12553823**
Revision No. **B**
Date **19/05/2023**

FIGURE 4

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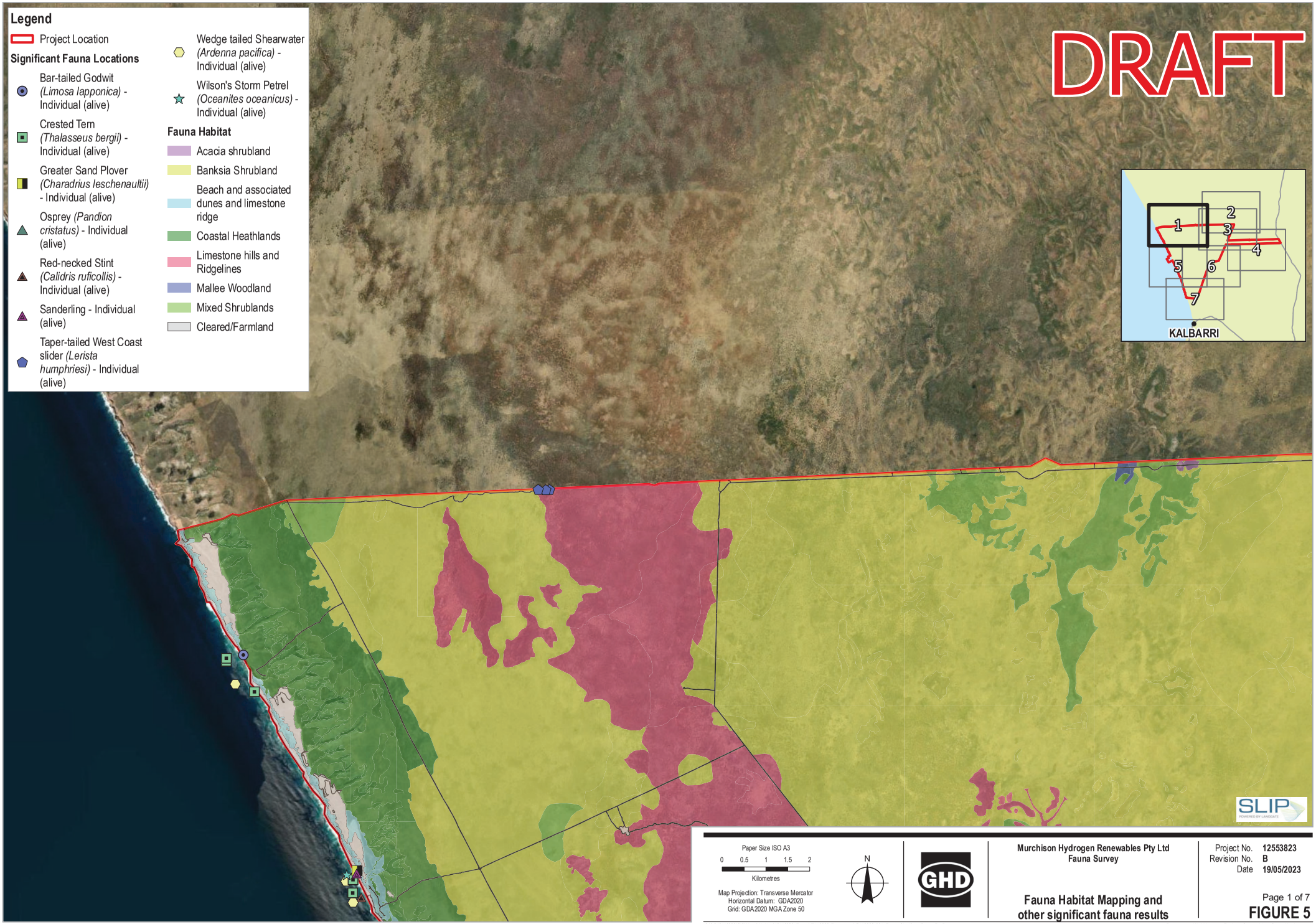
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Significant Fauna Locations
Bar-tailed Godwit (Limosa lapponica) - Individual (alive)
Crested Tern (Thalasseus bergii) - Individual (alive)
Greater Sand Plover (Charadrius leschenaultii) - Individual (alive)
Osprey (Pandion cristatus) - Individual (alive)
Red-necked Stint (Calidris ruficollis) - Individual (alive)
Sanderling - Individual (alive)
Taper-tailed West Coast slider (Lerista humphriesi) - Individual (alive)
Wedge tailed Shearwater (Ardenna pacifica) - Individual (alive)
Wilson's Storm Petrel (Oceanites oceanicus) - Individual (alive)
Fauna Habitat
Acacia shrubland
Banksia Shrubland
Beach and associated dunes and limestone ridge
Coastal Heathlands
Limestone hills and Ridgelines
Mallee Woodland
Mixed Shrublands
Cleared/Farmland
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Murchison Hydrogen Renewables Pty Ltd
Fauna Survey
Fauna Habitat Mapping and other significant fauna results
Project No. 12553823
Revision No. B
Date 19/05/2023
Page 1 of 7
FIGURE 5
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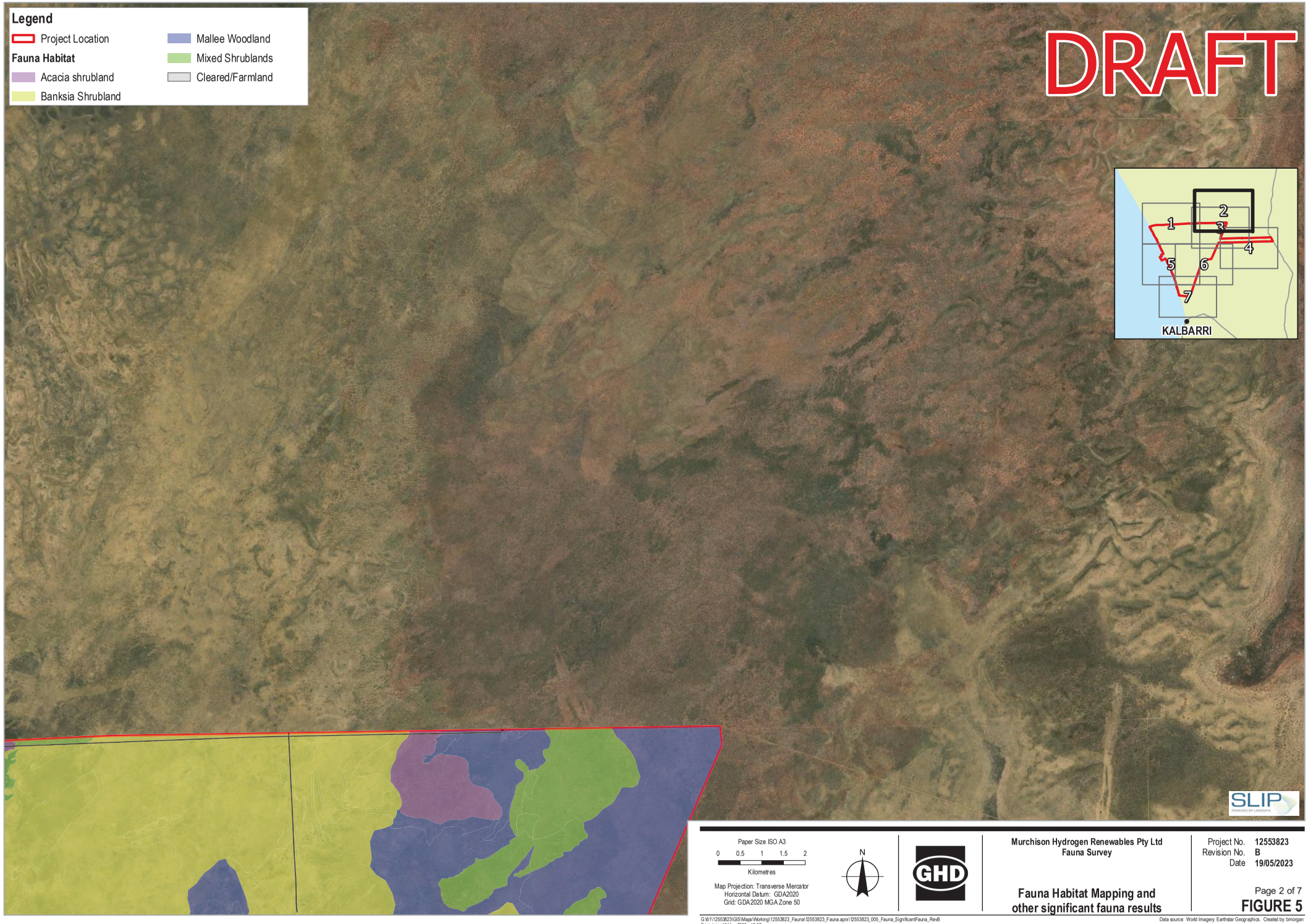

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Murchison Hydrogen Renewables Pty Ltd
Fauna Survey

Fauna Habitat Mapping and other significant fauna results

Project No. 12553823
Revision No. B
Date 19/05/2023

FIGURE 5

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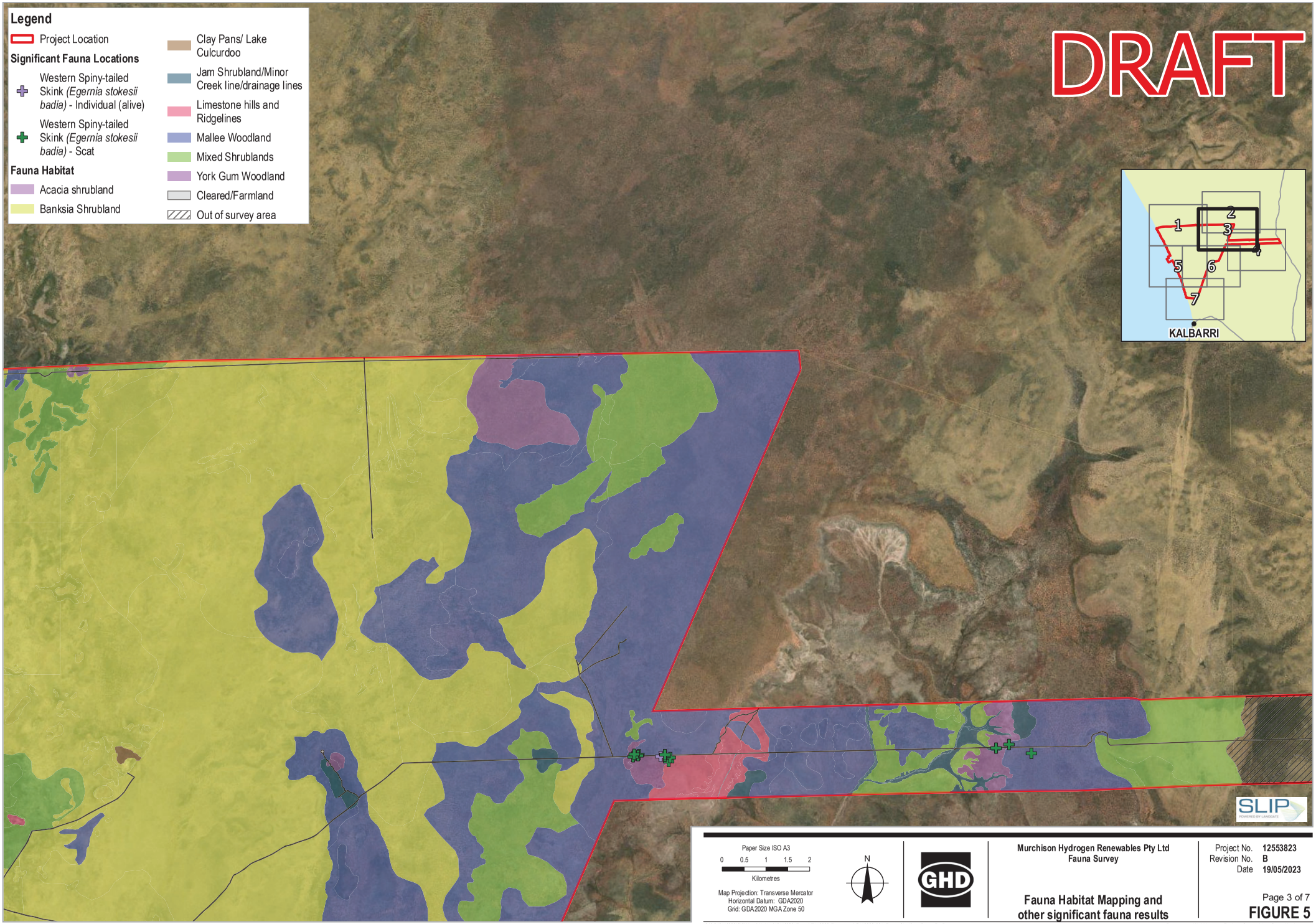
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Project Location
Significant Fauna Locations
Western Spiny-tailed Skink (Egernia stokesii badia) - Individual (alive)
Western Spiny-tailed Skink (Egernia stokesii badia) - Scat
Fauna Habitat
Acacia shrubland
Banksia Shrubland
Clay Pans/ Lake Culcurdoo
Jam Shrubland/Minor Creek line/drainage lines
Limestone hills and Ridgelines
Mallee Woodland
Mixed Shrublands
York Gum Woodland
Cleared/Farmland
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Murchison Hydrogen Renewables Pty Ltd
Fauna Survey
Fauna Habitat Mapping and other significant fauna results
Project No. 12553823
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FIGURE 5
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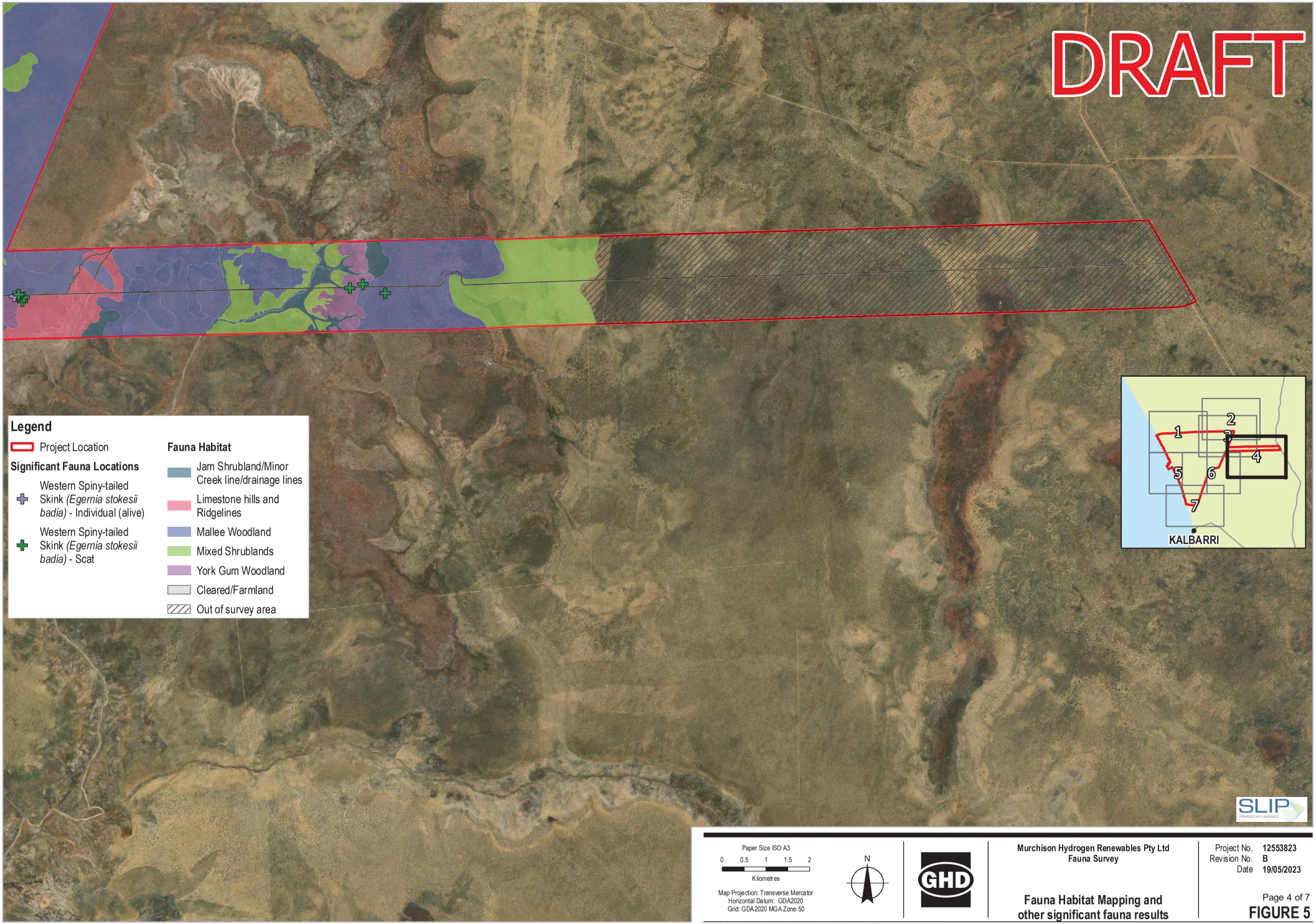
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Project Location
Significant Fauna Locations
Western Spiny-tailed Skink (Egernia stokesii badia) - Individual (alive)
Western Spiny-tailed Skink (Egernia stokesii badia) - Scat
Fauna Habitat
Jam Shrubland/Minor Creek line/drainage lines
Limestone hills and Ridgelines
Mallee Woodland
Mixed Shrublands
York Gum Woodland
Cleared/Farmland
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Murchison Hydrogen Renewables Pty Ltd
Fauna Survey
Fauna Habitat Mapping and other significant fauna results
Project No. 12553823
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FIGURE 5
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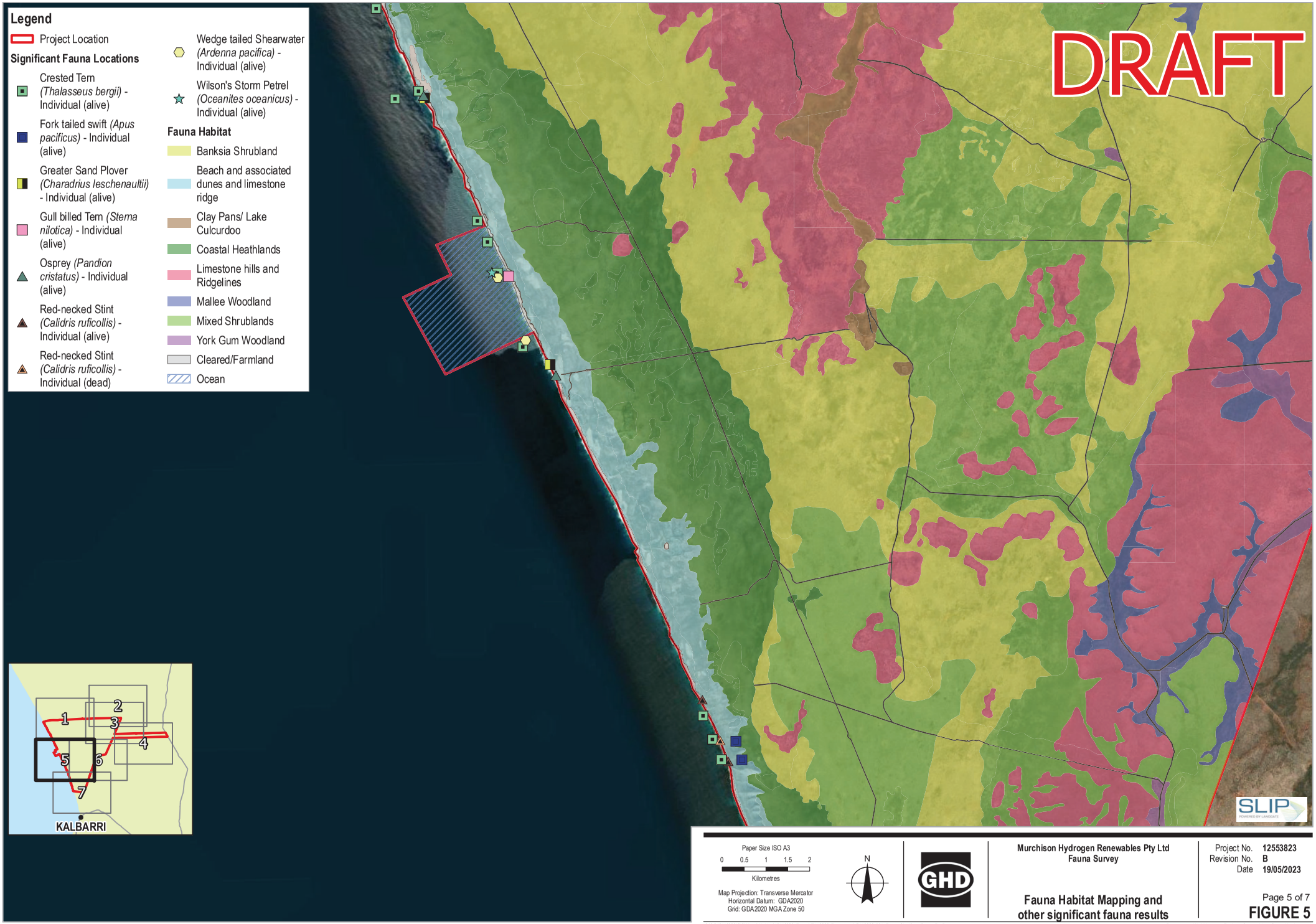
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Project Location
Significant Fauna Locations
Crested Tern (Thalasseus bergii) - Individual (alive)
Fork tailed swift (Apus pacificus) - Individual (alive)
Greater Sand Plover (Charadrius leschenaultii) - Individual (alive)
Gull billed Tern (Sterna nilotica) - Individual (alive)
Osprey (Pandion cristatus) - Individual (alive)
Red-necked Stint (Calidris ruficollis) - Individual (alive)
Red-necked Stint (Calidris ruficollis) - Individual (dead)
Wedge tailed Shearwater (Ardenna pacifica) - Individual (alive)
Wilson's Storm Petrel (Oceanites oceanicus) - Individual (alive)
Fauna Habitat
Banksia Shrubland
Beach and associated dunes and limestone ridge
Clay Pans/ Lake Culcurdoo
Coastal Heathlands
Limestone hills and Ridgelines
Mallee Woodland
Mixed Shrublands
York Gum Woodland
Cleared/Farmland
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Murchison Hydrogen Renewables Pty Ltd
Fauna Survey
Fauna Habitat Mapping and other significant fauna results
Project No. 12553823
Revision No. B
Date 19/05/2023
Page 5 of 7
FIGURE 5
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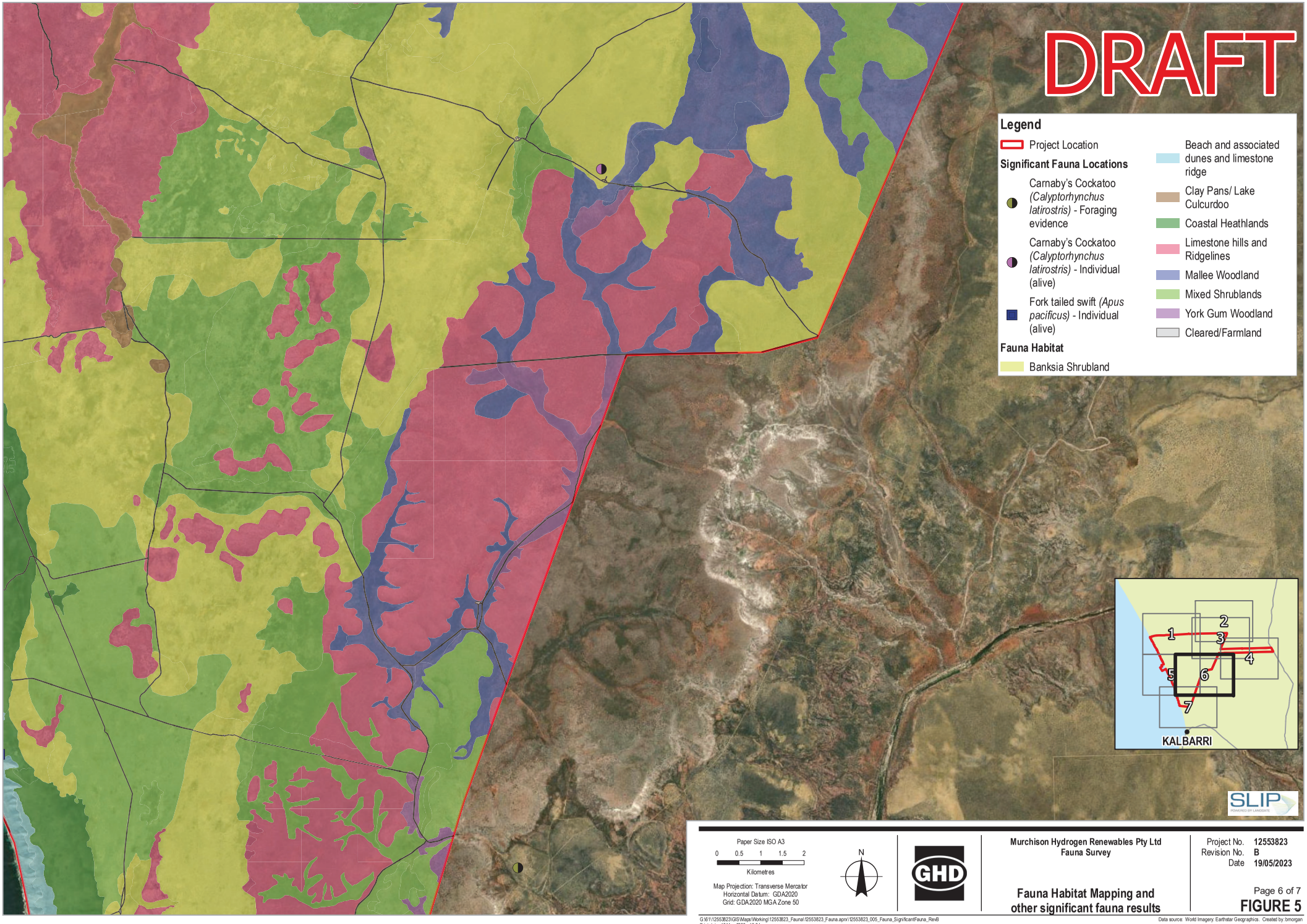

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Murchison Hydrogen Renewables Pty Ltd
Fauna Survey

Fauna Habitat Mapping and other significant fauna results

Project No. 12553823
Revision No. B
Date 19/05/2023

FIGURE 5

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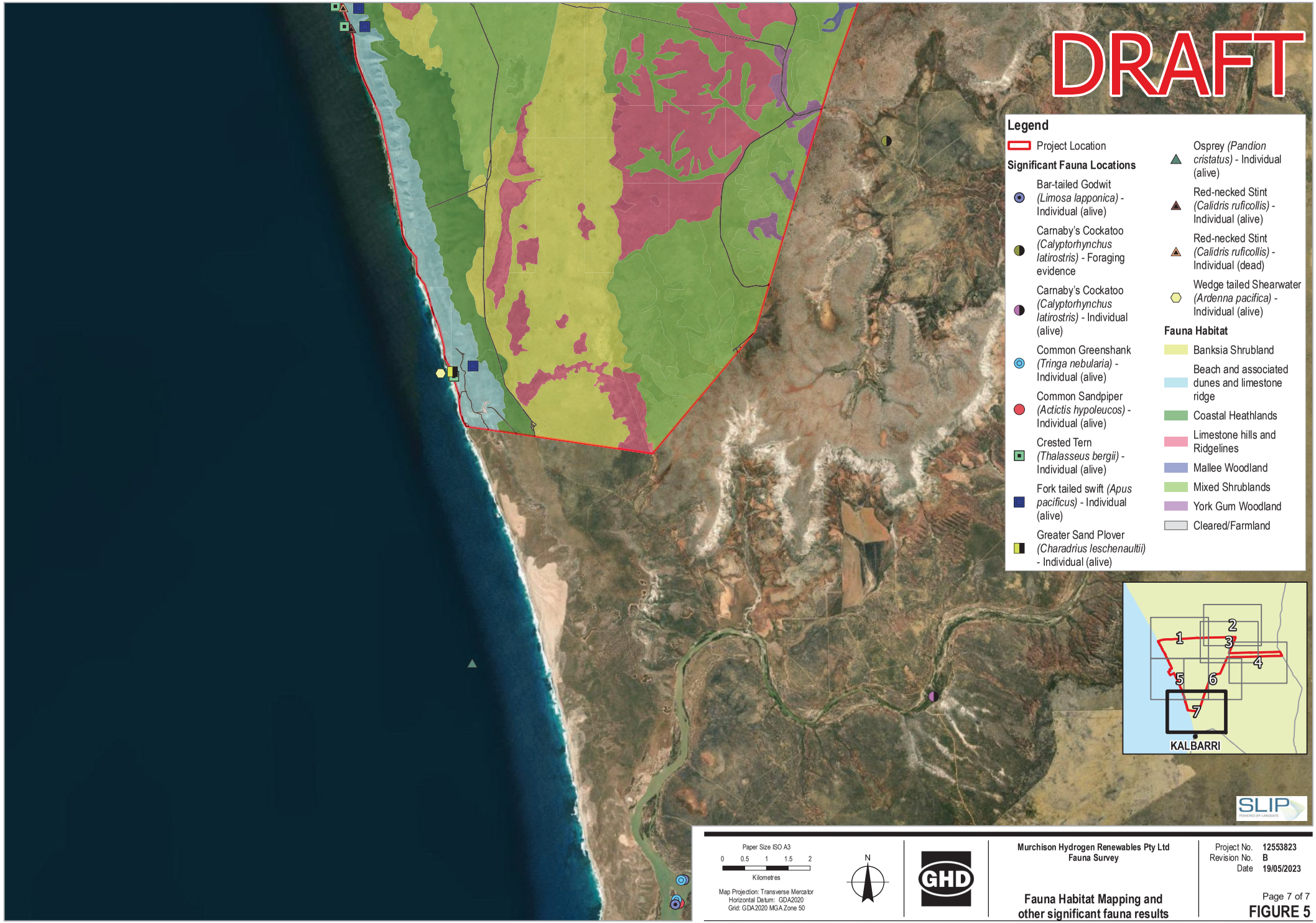
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Project Location
Significant Fauna Locations
Bar-tailed Godwit (Limosa lapponica) - Individual (alive)
Carnaby's Cockatoo (Calyptorhynchus latirostris) - Foraging evidence
Carnaby's Cockatoo (Calyptorhynchus latirostris) - Individual (alive)
Common Greenshank (Tringa nebularia) - Individual (alive)
Common Sandpiper (Actictis hypoleucos) - Individual (alive)
Crested Tern (Thalasseus bergii) - Individual (alive)
Fork tailed swift (Apus pacificus) - Individual (alive)
Greater Sand Plover (Charadrius leschenaultii) - Individual (alive)
Osprey (Pandion cristatus) - Individual (alive)
Red-necked Stint (Calidris ruficollis) - Individual (alive)
Red-necked Stint (Calidris ruficollis) - Individual (dead)
Wedge tailed Shearwater (Ardenna pacifica) - Individual (alive)
Fauna Habitat
Banksia Shrubland
Beach and associated dunes and limestone ridge
Coastal Heathlands
Limestone hills and Ridgelines
Mallee Woodland
Mixed Shrublands
York Gum Woodland
Cleared/Farmland
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Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
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Murchison Hydrogen Renewables Pty Ltd
Fauna Survey
Fauna Habitat Mapping and other significant fauna results
Project No. 12553823
Revision No. B
Date 19/05/2023
Page 7 of 7
FIGURE 5
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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:

1. Native vegetation should not be cleared if it comprises a high level of biodiversity.
2. 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.
3. Native vegetation should not be cleared if it includes, or is necessary, for the continued existence of rare flora.
4. Native vegetation should not be cleared if it comprises the whole or part of native vegetation in an area that has been extensively cleared.
5. Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.
6. Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.
7. 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.
8. Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.
9. 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.
10. 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, 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

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 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 subset of 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 and appear 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 need 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 be if 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 qualify for 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 reasons other 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

Database Searches

Dandjoo Search Results

DBCA Database Search Results

PMST Search Results

NatureMap
Mapping Western Australia's biodiversity

NatureMap Species Report

Created By Guest user on 01/12/2021

Kingdom Animalia
Current Names Only Yes
Core Datasets Only Yes
Species Group All Animals
Method 'By Circle'
Centre 114° 11' 32" E,27° 26' 32" S
Buffer 40km

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
1.		*Abudefduf sordidus*			
2.	24559	*Acanthagenys rufogularis (Spiny-cheeked Honeyeater)*			
3.		*Acanthistius pardalotus*			
4.		*Acanthistius serratus*			
5.	24260	*Acanthiza apicalis (Broad-tailed Thornbill, Inland Thornbill)*			
6.	24261	*Acanthiza chrysorrhoa (Yellow-rumped Thornbill)*			
7.	24265	*Acanthiza uropygialis (Chestnut-rumped Thornbill)*			
8.		*Acanthopagrus butcheri*			
9.	25535	*Accipiter cirrocephalus (Collared Sparrowhawk)*			
10.	24281	*Accipiter cirrocephalus subsp. cirrocephalus (Collared Sparrowhawk)*			
11.	25536	*Accipiter fasciatus (Brown Goshawk)*			
12.	41323	*Actitis hypoleucos (Common Sandpiper)*		IA	
13.		*Alboa worooa*			
14.		*Aldrichetta forsteri*			
15.		*Allenichthys glauerti*			
16.		*Amblyomma triguttatum*			
17.		*Amniataba caudavittata*			
18.	30833	*Amphibolurus longirostris (Long-nosed Dragon)*			
19.		*Aname mainae*			
20.	24312	*Anas gracilis (Grey Teal)*			
21.	24315	*Anas rhynchotis (Australasian Shoveler)*			
22.	24316	*Anas superciliosa (Pacific Black Duck)*			
23.	47414	*Anhinga novaehollandiae (Australasian Darter)*			
24.	25241	*Antaresia stimsoni subsp. stimsoni (Stimson's Python)*			
25.	24561	*Anthochaera carunculata (Red Wattlebird)*			
26.		*Apogon rueppellii*			
27.	24993	*Aprasia smithi (Black-tipped Worm-lizard)*			
28.		*Aprasia sp.*			
29.	24285	*Aquila audax (Wedge-tailed Eagle)*			
30.		*Aracana aurita*			
31.		*Araneus eburneiventris*			
32.		*Araneus senicaudatus*			
33.	41324	*Ardea modesta (great egret, white egret)*			
34.	24340	*Ardea novaehollandiae (White-faced Heron)*			
35.	24341	*Ardea pacifica (White-necked Heron)*			
36.	48573	*Ardenna pacifica (Wedge-tailed Shearwater)*		IA	
37.	24610	*Ardeotis australis (Australian Bustard)*			
38.	25736	*Arenaria interpres (Ruddy Turnstone)*		IA	
39.	41375	*Arenophryne xiphorhyncha (Southern Sandhill Frog)*			
40.		*Argiope protensa*			
41.		*Argiope trifasciata*			
42.	25566	*Artamus cinereus (Black-faced Woodswallow)*			
43.	24355	*Artamus minor (Little Woodswallow)*			
44.	24356	*Artamus personatus (Masked Woodswallow)*			
45.	24357	*Artamus superciliosus (White-browed Woodswallow)*			
46.		*Arthritica semen*			
47.		*Asadipus phaleratus*			
48.		*Aulonogyrus strigosus*			
49.		*Austracantha minax*			
50.		*Austroepigomphus (Xerogomphus) gordoni*			
51.		*Austrolabrus maculatus*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
52.	24318	*Aythya australis (Hardhead)*			
53.		*Backobourkia collina*			
54.		*Backobourkia heroine*			
55.		*Baetidae sp.*			
56.		*Barbuligobius boehlkei*			
57.		*Barnardius zonarius*			
58.		*Batrachomatus wingi*			
59.		*Bezzia sp. 2 (SAP)*			
60.		*Bigenditia zuytdorp*			
61.	24319	*Biziura lobata (Musk Duck)*			
62.		*Brachionus cf. nilsoni (SAP)*			
63.		*Brachionus quadridentatus cluniorbicularis*			
64.	42381	*Brachyurophis semifasciatus (Southern Shovel-nosed Snake)*			
65.	24359	*Burhinus grallarius (Bush Stone-curlew)*			
66.	24725	*Cacatua roseicapilla subsp. assimilis (Galah)*			
67.	25716	*Cacatua sanguinea (Little Corella)*			
68.	25598	*Cacomantis flabelliformis (Fan-tailed Cuckoo)*			
69.	24427	*Cacomantis flabelliformis subsp. flabelliformis (Fan-tailed Cuckoo)*			
70.	42307	*Cacomantis pallidus (Pallid Cuckoo)*			
71.		*Caenidae sp.*			
72.	24269	*Calamanthus campestris (Rufous Fieldwren)*			
73.	24780	*Calidris alba (Sanderling)*		IA	
74.	24784	*Calidris ferruginea (Curlew Sandpiper)*		T	
75.	24788	*Calidris ruficollis (Red-necked Stint)*		IA	
76.		*Callogobius mucosus?*			Y
77.	25717	*Calyptorhynchus banksii (Red-tailed Black-Cockatoo)*			
78.	24734	*Calyptorhynchus latirostris (Carnaby's Cockatoo, White-tailed Short-billed Black Cockatoo)*		T	
79.		*Candonocypris novaezelandiae*			
80.	24253	*Capra hircus (Goat)*	Y		
81.		*Centropogon australis*			
82.		*Ceratopogonidae sp.*			
83.		*Cercophonius granulosus*			
84.	24564	*Certhionyx variegatus (Pied Honeyeater)*			
85.	25575	*Charadrius leschenaultii (Greater Sand Plover)*		T	
86.	25576	*Charadrius mongolus (Lesser Sand Plover)*		T	
87.	24377	*Charadrius ruficapillus (Red-capped Plover)*			
88.		*Chelmonops curiosus*			
89.	24321	*Chenonetta jubata (Australian Wood Duck, Wood Duck)*			
90.	47909	*Cheramoeca leucosterna (White-backed Swallow)*			
91.		*Chironominae sp.*			
92.		*Chironomus aff. alternans (V24) (CB)*			
93.		*Chroicocephalus novaehollandiae*			
94.	24431	*Chrysococcyx basalis (Horsfield's Bronze Cuckoo)*			
95.	24288	*Circus approximans (Swamp Harrier)*			
96.	24289	*Circus assimilis (Spotted Harrier)*			
97.		*Cladotanytarsus sp. A (SAP)*			
98.		*Cleidopus gloriamaris*			
99.		*Cloeon sp.*			
100.		*Cocotropus? sp.*			Y
101.		*Coelopynia pruinosa*			
102.		*Coenagrionidae sp.*			
103.	25675	*Colluricincla harmonica (Grey Shrike-thrush)*			
104.	24613	*Colluricincla harmonica subsp. rufiventris (Grey Shrike-thrush)*			
105.	24399	*Columba livia (Domestic Pigeon)*	Y		
106.	25568	*Coracina novaehollandiae (Black-faced Cuckoo-shrike)*			
107.		*Corbiculidae sp.*			
108.		*Corduliidae sp.*			
109.		*Coris auricularis*			
110.		*Corixidae sp.*			
111.		*Cormocephalus aurantiipes*			
112.		*Cormocephalus turneri*			
113.	24416	*Corvus bennetti (Little Crow)*			
114.	25592	*Corvus coronoides (Australian Raven)*			
115.	24671	*Coturnix pectoralis (Stubble Quail)*			
116.	24420	*Cracticus nigrogularis (Pied Butcherbird)*			
117.	25595	*Cracticus tibicen (Australian Magpie)*			
118.	25596	*Cracticus torquatus (Grey Butcherbird)*			
119.		*Craterocephalus cuneiceps*			
120.	25456	*Crenadactylus ocellatus (Clawless Gecko)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
121.	24919	*Crenadactylus ocellatus subsp. horni (Clawless Gecko)*			
122.	24918	*Crenadactylus ocellatus subsp. ocellatus (Clawless Gecko)*			
123.	30893	*Cryptoblepharus buchananii*			
124.	25020	*Cryptoblepharus plagiocephalus*			
125.		*Cryptochironomus griseidorsum*			
126.		*Cryptoerithus halli*			
127.		*Cryptoerithus quobba*			
128.	30899	*Ctenophorus adelaidensis (Southern Heath Dragon, Western Heath Dragon)*			
129.	25460	*Ctenophorus maculatus (Spotted Military Dragon)*			
130.	24881	*Ctenophorus maculatus subsp. maculatus (Spotted Military Dragon)*			
131.	24882	*Ctenophorus nuchalis (Central Netted Dragon)*			
132.	24886	*Ctenophorus reticulatus (Western Netted Dragon)*			
133.	24889	*Ctenophorus scutulatus (Lozenge-marked Dragon)*			
134.	25027	*Ctenotus australis*			
135.	25039	*Ctenotus fallens*			
136.	25065	*Ctenotus pantherinus subsp. pantherinus (Leopard Ctenotus)*			
137.	25074	*Ctenotus schomburgkii*			
138.		*Culicidae sp.*			
139.		*Culicoides sp.*			
140.	25087	*Cyclodomorphus celatus (Western Slender Blue-tongue)*			
141.	24322	*Cygnus atratus (Black Swan)*			
142.		*Cypretta baylyi*			
143.		*Cypricercus sp. 415 'humped' (CB)*			
144.	24092	*Dasyurus geoffroii (Chuditch, Western Quoll)*		T	
145.	24995	*Delma australis*			
146.	25766	*Delma fraseri (Fraser's Legless Lizard)*			
147.	24999	*Delma grayii*			
148.	25004	*Delma tincta*			
149.	25296	*Demansia psammophis subsp. reticulata (Yellow-faced Whipsnake)*			
150.	25607	*Dicaeum hirundinaceum (Mistletoebird)*			
151.		*Dicrotendipes jobetus*			
152.		*Dingosa murata*			
153.		*Dingosa serrata*			
154.	24938	*Diplodactylus ornatus*			
155.	24940	*Diplodactylus pulcher*			
156.		*Dipulus caecus*			
157.	24470	*Dromaius novaehollandiae (Emu)*			
158.	24650	*Drymodes brunneopygia (Southern Scrub-robin)*			
159.		*Dytiscidae sp.*			
160.		*Egretta garzetta*			
161.		*Egretta novaehollandiae*			
162.		*Elanus axillaris*			
163.		*Eleotris aurea*			Y
164.	47937	*Elseyornis melanops (Black-fronted Dotterel)*			
165.		*Enigmapercis reducta*			
166.		*Enoplosus armatus*			
167.		*Eolophus roseicapillus*			
168.	24651	*Eopsaltria australis subsp. griseogularis (Western Yellow Robin)*			
169.		*Epinephelides armatus*			
170.		*Epinephelus coioides*			
171.		*Epinephelus rivulatus*			
172.		*Epinephelus tauvina*			
173.	24567	*Epthianura albifrons (White-fronted Chat)*			
174.	24570	*Epthianura tricolor (Crimson Chat)*			
175.	25109	*Eremiascincus richardsonii (Broad-banded Sand Swimmer)*			
176.		*Eriophora biapicata*			
177.		*Ethmostigmus rubripes*			
178.		*Euasteron carnarvon*			
179.	24368	*Eurostopodus argus (Spotted Nightjar)*			
180.		*Eviota bimaculata*			
181.	25621	*Falco berigora (Brown Falcon)*			
182.	25622	*Falco cenchroides (Australian Kestrel, Nankeen Kestrel)*			
183.	25623	*Falco longipennis (Australian Hobby)*			
184.	25624	*Falco peregrinus (Peregrine Falcon)*		S	
185.		*Ferrissia petterdi*			
186.	25727	*Fulica atra (Eurasian Coot)*			
187.	25730	*Gallirallus philippensis (Buff-banded Rail)*			
188.	24959	*Gehyra variegata*			
189.	24401	*Geopelia cuneata (Diamond Dove)*			
190.	25585	*Geopelia striata (Zebra Dove)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
191.	24403	*Geopelia striata subsp. placida (Peaceful Dove)*			
192.		*Gerres subfasciatus*			
193.		*Gerridae sp.*			
194.	25530	*Gerygone fusca (Western Gerygone)*			
195.	47962	*Glyciphila melanops (Tawny-crowned Honeyeater)*			
196.	24443	*Grallina cyanoleuca (Magpie-lark)*			
197.		*Gymnothorax woodwardi*			
198.	25627	*Haematopus fuliginosus (Sooty Oystercatcher)*			
199.	24487	*Haematopus longirostris (Pied Oystercatcher)*			
200.	24293	*Haliaeetus leucogaster (White-bellied Sea-Eagle)*			
201.	24295	*Haliastur sphenurus (Whistling Kite)*			
202.		*Halicampus brocki*			
203.		*Halichoeres brownfieldi*			
204.		*Halophryne ocellatus*			
205.		*Helcogramma decurrens*			
206.	25408	*Heleioporus albopunctatus (Western Spotted Frog)*			
207.	25412	*Heleioporus psammophilus (Sand Frog)*			
208.		*Hemicordulia tau*			
209.		*Hemigaleus australiensis*			
210.		*Heteroclinus sp.*			
211.		*Heteroclinus whitleyi (ms)*			
212.	24961	*Heteronotia binoei (Bynoe's Gecko)*			
213.	47965	*Hieraaetus morphnoides (Little Eagle)*			
214.	25734	*Himantopus himantopus (Black-winged Stilt)*			
215.	24491	*Hirundo neoxena (Welcome Swallow)*			
216.		*Histrio histrio*			
217.		*Hoggicosa alfi*			
218.		*Hoggicosa castanea*			
219.		*Hogna crispipes*			
220.		*Holoplatys fusca*			
221.		*Hydraenidae sp.*			
222.		*Hydrochus lateviridus*			
223.		*Hydrophilidae sp.*			
224.	25366	*Hydrophis elegans (Elegant Seasnake, Bar-bellied Seasnake)*			
225.	44656	*Hydrophis major (Olive-headed seasnake, greater seasnake)*			
226.	48587	*Hydroprogne caspia (Caspian Tern)*		IA	
227.		*Hyperlophus vittatus*			
228.		*Hyphydrus elegans*			
229.		*Hyporhamphus regularis*			
230.	34022	*Hypseleotris aurea (Golden Gudgeon)*		P2	
231.		*Hypseleotris compressa*			
232.		*Hypseleotris sp.*			
233.		*Idiommata blackwalli*			
234.	33917	*Idiosoma nigrum (Shield-backed Trapdoor Spider)*		T	
235.		*Ilyocypris australiensis*			
236.		*Indolpium sp.*			
237.		*Ischnura heterosticta heterosticta*			
238.		*Isometroides vescus*			
239.		*Isopedella saundersi*			
240.		*Istiblennius meleagris*			
241.		*Kyphosus cornelii*			
242.		*Laccophilus sharpi*			
243.		*Lampona cylindrata*			
244.		*Lamponina scutata*			
245.		*Larsia albiceps*			
246.	24511	*Larus novaehollandiae subsp. novaehollandiae (Silver Gull)*			
247.	25638	*Larus pacificus (Pacific Gull)*			
248.		*Latrodectus hasseltii*			
249.		*Leiopotherapon unicolor*			
250.	24557	*Leipoa ocellata (Malleefowl)*		T	
251.		*Leptoceridae sp.*			
252.	25129	*Lerista connivens*			
253.	25133	*Lerista elegans*			
254.	25141	*Lerista humphriesi (taper-tailed West Coast slider (Murchison River), skink)*		P3	
255.	25144	*Lerista kendricki*			
256.	25148	*Lerista lineopunctulata*			
257.	25151	*Lerista macropisthopus subsp. fusciceps*			
258.	30922	*Lerista micra*			
259.	25160	*Lerista planiventralis subsp. decora*			
260.	25165	*Lerista praepedita*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
261.		*Lethrinus nebulosus*			
262.		*Lethrinus punctulatus*			
263.		*Lethrinus sp.*			
264.	25005	*Lialis burtonis*			
265.		*Libellulidae sp.*			
266.	25661	*Lichmera indistincta (Brown Honeyeater)*			
267.	24582	*Lichmera indistincta subsp. indistincta (Brown Honeyeater)*			
268.	25415	*Limnodynastes dorsalis (Western Banjo Frog)*			
269.		*Limnogonus sp.*			
270.	30932	*Limosa lapponica (Bar-tailed Godwit)*		IA	
271.		*Liza subviridis*			
272.		*Longrita zuytdorp*			
273.		*Lophoictinia isura*			
274.		*Lotella rhacinus*			
275.	42414	*Lucasium alboguttatum*			
276.		*Lycosa australicola*			
277.		*Lycosa godeffroyi*			
278.		*Macrogyrus angustatus*			
279.	24132	*Macropus fuliginosus (Western Grey Kangaroo)*			
280.		*Mainosa longipes*			
281.	25651	*Malurus lamberti (Variegated Fairy-wren)*			
282.	24544	*Malurus lamberti subsp. assimilis (Variegated Fairy-wren)*			
283.	25652	*Malurus leucopterus (White-winged Fairy-wren)*			
284.	24549	*Malurus leucopterus subsp. leuconotus (White-winged Fairy-wren)*			
285.	24551	*Malurus pulcherrimus (Blue-breasted Fairy-wren)*			
286.	25654	*Malurus splendens (Splendid Fairy-wren)*			
287.	24583	*Manorina flavigula (Yellow-throated Miner)*			
288.		*Masasteron sampeyae*			
289.		*Meedo harveyi*			
290.	25758	*Megalurus gramineus (Little Grassbird)*			
291.	24051	*Megaptera novaeangliae (Humpback Whale)*		S	
292.	47997	*Melanodryas cucullata (Hooded Robin)*			
293.	25663	*Melithreptus brevirostris (Brown-headed Honeyeater)*			
294.	24736	*Melopsittacus undulatus (Budgerigar)*			
295.		*Menemerus bivittatus*			
296.	25184	*Menetia greyii*			
297.	25491	*Menetia surda*			
298.	25186	*Menetia surda subsp. cresswelli*			
299.	24598	*Merops ornatus (Rainbow Bee-eater)*			
300.		*Mesoveliidae sp.*			
301.		*Microcanthus strigatus*			
302.		*Microcarbo melanoleucos*			
303.	25693	*Microeca fascinans (Jacky Winter)*			
304.		*Microvelia (Austromicrovelia) peramoena*			
305.		*Missulena granulosa*			
306.		*Mituliodon tarantulinus*			
307.	24904	*Moloch horridus (Thorny Devil)*			
308.		*Molycria vokes*			
309.		*Monacanthus chinensis*			
310.	25191	*Morethia lineoocellata*			
311.	25192	*Morethia obscura*			
312.	48008	*Morus serrator (Australasian Gannet)*			
313.		*Mugil cephalus*			
314.		*Muraenichthys sp.*			
315.	24223	*Mus musculus (House Mouse)*	Y		
316.		*Myandra bicincta*			
317.	25420	*Myobatrachus gouldii (Turtle Frog)*			
318.		*Naididae (ex Tubificidae)*			
319.		*Neatypus obliquus*			
320.		*Necterosoma regulare*			
321.	25248	*Neelaps bimaculatus (Black-naped Snake)*			
322.		*Nematalosa come*			
323.		*Nematalosa vlaminghi*			
324.		*Nematoda sp.*			
325.	25425	*Neobatrachus kunapalari (Kunapalari Frog)*			
326.	25426	*Neobatrachus pelobatoides (Humming Frog)*			
327.	25428	*Neobatrachus wilsmorei (Plonking Frog)*			
328.		*Nephila edulis*			
329.	25497	*Nephrurus levis*			
330.	24967	*Nephrurus levis subsp. levis*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
331.	24968	*Nephrurus levis subsp. occidentalis*			
332.		*Nicodamus mainae*			
333.		*Nitocra near sp. 4 (SAP)*			
334.		*Notalina spira*			
335.	48024	*Notamacropus eugenii subsp. derbianus (Tammar Wallaby, Tammar)*		P4	
336.		*Notolabrus parilus*			
337.	24224	*Notomys alexis (Spinifex Hopping-mouse)*			
338.		*Notonectidae sp.*			
339.	25564	*Nycticorax caledonicus (Rufous Night Heron)*			
340.	24194	*Nyctophilus geoffroyi (Lesser Long-eared Bat)*			
341.	24742	*Nymphicus hollandicus (Cockatiel)*			
342.	24497	*Oceanites oceanicus (Wilson's Storm-petrel)*		IA	
343.	24407	*Ocyphaps lophotes (Crested Pigeon)*			
344.		*Odax acroptilus*			
345.		*Oecetis sp.*			
346.		*Oecobius navus*			
347.		*Orectolobus sp.*			
348.	24618	*Oreoica gutturalis (Crested Bellbird)*			
349.		*Orthetrum caledonicum*			
350.		*Orthocladiinae sp.*			
351.	25680	*Pachycephala rufiventris (Rufous Whistler)*			
352.	24624	*Pachycephala rufiventris subsp. rufiventris (Rufous Whistler)*			
353.	24692	*Pachyptila belcheri (Slender-billed Prion)*			
354.	48591	*Pandion cristatus (Osprey, Eastern Osprey)*		IA	
355.		*Parablennius postoculomaculatus*			
356.		*Paracladopelma sp. A (nr M2) (SAP)*			
357.		*Parapercis haackei*			
358.		*Paraplotosus albilabris*			
359.		*Parastenocarididae sp.*			
360.	25254	*Parasuta monachus*			
361.	25682	*Pardalotus striatus (Striated Pardalote)*			
362.		*Parma occidentalis*			
363.		*Parupeneus spilurus*			
364.		*Pediana occidentalis*			
365.	24648	*Pelecanus conspicillatus (Australian Pelican)*			
366.		*Pempheris klunzingeri*			
367.	48060	*Petrochelidon ariel (Fairy Martin)*			
368.	48061	*Petrochelidon nigricans (Tree Martin)*			
369.	24142	*Petrogale lateralis subsp. lateralis (Black-flanked Rock-wallaby, Black-footed Rock-wallaby)*		T	
370.	24659	*Petroica goodenovii (Red-capped Robin)*			
371.		*Petroscirtes breviceps*			
372.	25697	*Phalacrocorax carbo (Great Cormorant)*			
373.	24667	*Phalacrocorax sulcirostris (Little Black Cormorant)*			
374.	25699	*Phalacrocorax varius (Pied Cormorant)*			
375.	24409	*Phaps chalcoptera (Common Bronzewing)*			
376.		*Phryganoporus candidus*			
377.	48071	*Phylidonyris niger (White-cheeked Honeyeater)*			
378.	24841	*Platalea flavipes (Yellow-billed Spoonbill)*			
379.		*Plectorhinchus pictus*			
380.	25006	*Pletholax gracilis subsp. edelensis (Keeled Legless Lizard (Shark Bay))*		P3	
381.	25007	*Pletholax gracilis subsp. gracilis (Keeled Legless Lizard)*			
382.	24383	*Pluvialis squatarola (Grey Plover)*		IA	
383.	25703	*Podargus strigoides (Tawny Frogmouth)*			
384.	25704	*Podiceps cristatus (Great Crested Grebe)*			
385.	25510	*Pogona minor (Dwarf Bearded Dragon)*			
386.	24907	*Pogona minor subsp. minor (Dwarf Bearded Dragon)*			
387.	24681	*Poliocephalus poliocephalus (Hoary-headed Grebe)*			
388.		*Polypedilum leei*			
389.		*Polypedilum watsoni*			
390.		*Pomatomus saltatrix*			
391.	24683	*Pomatostomus superciliosus (White-browed Babbler)*			
392.		*Priolepis nuchifasciata*			
393.		*Procladius paludicola*			
394.		*Prodidomus woodleigh*			
395.		*Protonibea sp.*			Y
396.	25261	*Pseudechis australis (Mulga Snake)*			
397.		*Pseudochromis wilsoni*			
398.		*Pseudogobius olorum*			
399.		*Pseudolampona boree*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
400.	24230	*Pseudomys albocinereus (Ash-grey Mouse)*			
401.	24237	*Pseudomys hermannsburgensis (Sandy Inland Mouse)*			
402.	42416	*Pseudonaja mengdeni (Western Brown Snake)*			
403.	25263	*Pseudonaja modesta (Ringed Brown Snake)*			
404.	25433	*Pseudophryne guentheri (Crawling Toadlet)*			
405.		*Pseudophryne sp.*			
406.		*Pseudorhombus jenynsii*			
407.	24390	*Psophodes occidentalis (Western Wedgebill, Chiming Wedgebill)*			
408.		*Pteragogus enneacanthus*			
409.	24173	*Pteropus scapulatus (Little Red Flying-fox)*			
410.	42344	*Purnella albifrons (White-fronted Honeyeater)*			
411.	25008	*Pygopus lepidopodus (Common Scaly Foot)*			
412.	25009	*Pygopus nigriceps*			
413.	24278	*Pyrrholaemus brunneus (Redthroat)*			
414.		*Rachycentron canadum*			
415.		*Radfordia notomys*			
416.	24245	*Rattus rattus (Black Rat)*	Y		
417.	24776	*Recurvirostra novaehollandiae (Red-necked Avocet)*			
418.		*Rhabdosargus sarba*			
419.	48096	*Rhipidura albiscapa (Grey Fantail)*			
420.	25614	*Rhipidura leucophrys (Willie Wagtail)*			
421.		*Scirtidae sp.*			
422.		*Scobinichthys granulatus*			
423.		*Scolopendra laeta*			
424.		*Scolopendra morsitans*			
425.		*Scorpaena gasta*			
426.		*Scorpaenodes steenei*			
427.	25534	*Sericornis frontalis (White-browed Scrubwren)*			
428.	24280	*Sericornis frontalis subsp. balstoni (White-browed Scrubwren)*			
429.	24279	*Sericornis frontalis subsp. maculatus (White-browed Scrubwren)*			
430.		*Serpulidae sp.*			Y
431.		*Siganus sp.*			
432.		*Sillago schomburgkii*			
433.		*Sillago sp.*			
434.	25266	*Simoselaps bertholdi (Jan's Banded Snake)*			
435.	25267	*Simoselaps littoralis (West Coast Banded Snake)*			
436.		*Simuliidae sp.*			
437.	30948	*Smicrornis brevirostris (Weebill)*			
438.	24108	*Sminthopsis crassicaudata (Fat-tailed Dunnart)*			
439.	24109	*Sminthopsis dolichura (Little long-tailed Dunnart)*			
440.	24112	*Sminthopsis granulipes (White-tailed Dunnart)*			
441.	24114	*Sminthopsis hirtipes (Hairy-footed Dunnart)*			
442.		*Solegnathus lettiensis*			
443.		*Spinasteron westi*			
444.		*Staphylinidae sp.*			
445.		*Stenochironomus sp.*			
446.	48594	*Sternula nereis (Fairy Tern)*			
447.		*Storena formosa*			
448.	25590	*Streptopelia senegalensis (Laughing Turtle-Dove)*	Y		
449.	25518	*Strophurus spinigerus*			
450.	24942	*Strophurus spinigerus subsp. spinigerus*			
451.	24946	*Strophurus strophurus*			
452.	24259	*Sus scrofa (Pig)*	Y		
453.		*Synchiropus sp.*			
454.	33992	*Synemon gratiosa (Graceful Sunmoth)*		P4	
455.		*Tabanidae sp.*			
456.	25705	*Tachybaptus novaehollandiae (Australasian Grebe, Black-throated Grebe)*			
457.	24331	*Tadorna tadornoides (Australian Shelduck, Mountain Duck)*			
458.	30870	*Taeniopygia guttata (Zebra Finch)*			
459.		*Tanypodinae sp.*			
460.		*Tanytarsus fuscithorax/semibarbitarsus*			
461.	24167	*Tarsipes rostratus (Honey Possum, Noolbenger)*			
462.		*Tasmanicosa leuckartii*			
463.		*Tasmanocoenis tillyardi*			
464.		*Tetragnatha nitens*			
465.	48597	*Thalasseus bergii (Crested Tern)*		IA	
466.		*Thalassoma septemfasciata*			
467.		*Thereuopoda lesueurii*			
468.		*Thiaridae sp.*			
469.	24845	*Threskiornis spinicollis (Straw-necked Ibis)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
470.	25203	*Tiliqua occipitalis (Western Bluetongue)*			
471.	25207	*Tiliqua rugosa subsp. rugosa*			
472.		*Tipulidae sp.*			
473.	25549	*Todiramphus sanctus (Sacred Kingfisher)*			
474.		*Trachichthys australis*			
475.		*Triaenodes sp. P1=P2 (PSW)*			
476.		*Trichocyclus nigropunctatus*			
477.		*Trichonotus sp.*			
478.	24803	*Tringa brevipes (Grey-tailed Tattler)*		P4	
479.	24808	*Tringa nebularia (Common Greenshank, greenshank)*		IA	
480.		*Triplectides australis*			
481.	24983	*Underwoodisaurus milii (Barking Gecko)*			
482.		*Upeneichthys stotti*			
483.		*Urodacus hartmeyeri*			
484.		*Urodacus mckenziei*			
485.		*Urolophus sp.*			
486.	24386	*Vanellus tricolor (Banded Lapwing)*			
487.	25212	*Varanus eremius (Pygmy Desert Monitor)*			
488.	25218	*Varanus gouldii (Bungarra or Sand Monitor)*			
489.	25526	*Varanus tristis (Racehorse Monitor)*			
490.		*Venator immansueta*			
491.		*Venator koyuga*			
492.		*Venatrix arenaris*			
493.	24205	*Vespadelus finlaysoni (Finlayson's Cave Bat)*			
494.		*Xanthagrion erythroneurum*			
495.		*Zephyrichthys barryi*			
496.	25765	*Zosterops lateralis (Grey-breasted White-eye, Silvereye)*			

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.

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. Please see the caveat for interpretation of information provided here.

Report created: 24-Jan-2022

Summary

Matters of National Environment 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:	1
National Heritage Places:	1
Wetlands of International Importance (Ramsar	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	1
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	58
Listed Migratory Species:	47

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

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 Lands:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	80
Whales and Other Cetaceans:	14
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	2
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

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

State and Territory Reserves:	9
Regional Forest Agreements:	None
Nationally Important Wetlands:	1
EPBC Act Referrals:	6
Key Ecological Features (Marine):	2
Biologically Important Areas:	16
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

World Heritage Properties [Resource Information]

Name	State	Legal Status	Buffer Status
Shark Bay, Western Australia	WA	Declared property	In feature area

National Heritage Places [Resource Information]

Name	State	Legal Status	Buffer Status
Natural			
Shark Bay, Western Australia	WA	Listed place	In feature area

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside a Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area.

Feature Name	Buffer Status
EEZ and Territorial Sea	In feature area

Listed Threatened Species [Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text	Buffer Status
BIRD			
Anous tenuirostris melanops			
Australian Lesser Noddy [26000]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Calidris canutus			
Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area	In feature area
Calidris ferruginea			
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Charadrius leschenaultii			
Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat may occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered	Species or species habitat likely to occur within area	In feature area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Species or species habitat may occur within area	In feature area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat known to occur within area	In feature area
Limosa lapponica menzbieri Northern Siberian Bar-tailed Godwit, Russkoye Bar-tailed Godwit [86432]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In feature area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area	In feature area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area	In feature area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area	In feature area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Sternula nereis nereis			
Australian Fairy Tern [82950]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Thalassarche carteri			
Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat may occur within area	In feature area
Thalassarche cauta			
Shy Albatross [89224]	Endangered	Species or species habitat may occur within area	In feature area
Thalassarche impavida			
Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area	In feature area
Thalassarche melanophris			
Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area	In feature area
Thalassarche steadi			
White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Zanda latirostris listed as Calyptorhynchus latirostris			
Carnaby's Black Cockatoo, Short-billed Black-cockatoo [87737]	Endangered	Species or species habitat known to occur within area	In feature area
FISH			
Thunnus maccoyii			
Southern Bluefin Tuna [69402]	Conservation Dependent	Species or species habitat likely to occur within area	In feature area
MAMMAL			
Balaenoptera borealis			
Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Balaenoptera musculus			
Blue Whale [36]	Endangered	Migration route known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Bettongia penicillata ogilbyi Woylie [66844]	Endangered	Species or species habitat known to occur within area	In buffer area only
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat known to occur within area	In feature area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area	In feature area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area	In feature area
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Endangered	Species or species habitat may occur within area	In feature area
Petrogale lateralis lateralis Black-flanked Rock-wallaby, Moororong, Black-footed Rock Wallaby [66647]	Endangered	Species or species habitat known to occur within area	In buffer area only
PLANT			
Androcalva bivillosa Straggling Androcalva [87807]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Beyeria lepidopetala Small-petalled Beyeria, Short-petalled Beyeria [18362]	Endangered	Species or species habitat known to occur within area	In buffer area only
Caladenia barbarella Small Dragon Orchid, Common Dragon Orchid [68686]	Endangered	Species or species habitat known to occur within area	In feature area
Caladenia bryceana subsp. cracens Northern Dwarf Spider-orchid [64556]	Vulnerable	Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Caladenia elegans Elegant Spider-orchid [56775]	Endangered	Species or species habitat known to occur within area	In feature area
Caladenia hoffmanii Hoffman's Spider-orchid [56719]	Endangered	Species or species habitat known to occur within area	In feature area
Caladenia wanosa Kalbarri Spider-orchid [5878]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Drakaea concolor Kneeling Hammer-orchid [56777]	Vulnerable	Species or species habitat known to occur within area	In feature area
Eucalyptus beardiana Beard's Mallee [18933]	Vulnerable	Species or species habitat known to occur within area	In feature area
Eucalyptus cuprea Mallee Box [56773]	Endangered	Species or species habitat likely to occur within area	In buffer area only
Glyceria drummondii Nangetty Grass [14008]	Endangered	Species or species habitat known to occur within area	In buffer area only
Hypocalymma longifolium Long-leaved Myrtle [8081]	Vulnerable	Species or species habitat known to occur within area	In feature area
Lechenaultia chlorantha Kalbarri Leschenaultia [16763]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Stachystemon nematophorus Three-flowered Stachystemon [81447]	Vulnerable	Species or species habitat known to occur within area	In feature area
Wurmbea tubulosa Long-flowered Nancy [12739]	Endangered	Species or species habitat may occur within area	In feature area
REPTILE			

Scientific Name	Threatened Category	Presence Text	Buffer Status
Aipysurus foliosquama Leaf-scaled Seasnake [1118]	Critically Endangered	Species or species habitat likely to occur within area	In feature area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area	In feature area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area	In feature area
Egernia stokesii badia Western Spiny-tailed Skink, Baudin Island Spiny-tailed Skink [64483]	Endangered	Species or species habitat likely to occur within area	In feature area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area	In feature area
SHARK			
Carcharias taurus (west coast population) Grey Nurse Shark (west coast population) [68752]	Vulnerable	Species or species habitat known to occur within area	In feature area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area	In feature area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area	In feature area
Sphyrna lewini Scalloped Hammerhead [85267]	Conservation Dependent	Species or species habitat likely to occur within area	In feature area
SPIDER			
Idiosoma nigrum Shield-backed Trapdoor Spider, Black Rugose Trapdoor Spider [66798]	Vulnerable	Species or species habitat known to occur within area	In feature area

Listed Migratory Species			[Resource Information]
Scientific Name	Threatened Category	Presence Text	Buffer Status
Migratory Marine Birds			
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area	In feature area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area	In feature area
Ardenna carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Species or species habitat likely to occur within area	In feature area
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered	Species or species habitat likely to occur within area	In feature area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Species or species habitat may occur within area	In feature area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area	In feature area
Hydroprogne caspia Caspian Tern [808]		Foraging, feeding or related behaviour known to occur within area	In feature area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In feature area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Onychoprion anaethetus Bridled Tern [82845]		Foraging, feeding or related behaviour likely to occur within area	In feature area
Sterna dougallii Roseate Tern [817]		Foraging, feeding or related behaviour likely to occur within area	In buffer area only
Sternula albifrons Little Tern [82849]		Species or species habitat may occur within area	In feature area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat may occur within area	In feature area
Thalassarche cauta Shy Albatross [89224]	Endangered	Species or species habitat may occur within area	In feature area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area	In feature area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area	In feature area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Migratory Marine Species			
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area	In feature area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Carcharhinus longimanus Oceanic Whitetip Shark [84108]		Species or species habitat likely to occur within area	In feature area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area	In feature area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area	In feature area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area	In feature area
Eubalaena australis as Balaena glacialis australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area	In feature area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area	In buffer area only
Isurus paucus Longfin Mako [82947]		Species or species habitat likely to occur within area	In buffer area only
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area	In feature area
Mobula alfredi as Manta alfredi Reef Manta Ray, Coastal Manta Ray [90033]		Species or species habitat known to occur within area	In feature area
Mobula birostris as Manta birostris Giant Manta Ray [90034]		Species or species habitat likely to occur within area	In feature area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area	In feature area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area	In feature area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area	In feature area
Migratory Terrestrial Species			
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area	In feature area
Migratory Wetlands Species			
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area	In feature area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area	In feature area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area	In feature area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area	In feature area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area	In feature area
Pandion haliaetus Osprey [952]		Breeding known to occur within area	In feature area

Other Matters Protected by the EPBC Act

Listed Marine Species			[Resource Information]
Scientific Name	Threatened Category	Presence Text	Buffer Status
Bird			
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area	In feature area
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area	In feature area
Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Ardenna carneipes as Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Species or species habitat likely to occur within area	In feature area
Bubulcus ibis as Ardea ibis Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area	In feature area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area	In feature area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area overfly marine area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area overfly marine area	In feature area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area overfly marine area	In feature area
Chalcites osculans as Chrysococcyx osculans Black-eared Cuckoo [83425]		Species or species habitat known to occur within area overfly marine area	In feature area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered	Species or species habitat likely to occur within area	In feature area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Species or species habitat may occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Species or species habitat may occur within area	In feature area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area	In feature area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area	In feature area
Hydroprogne caspia as Sterna caspia Caspian Tern [808]		Foraging, feeding or related behaviour known to occur within area	In feature area
Larus pacificus Pacific Gull [811]		Foraging, feeding or related behaviour known to occur within area	In feature area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area	In feature area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In feature area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area	In feature area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area	In feature area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area	In feature area
Onychoprion anaethetus as Sterna anaethetus Bridled Tern [82845]		Foraging, feeding or related behaviour likely to occur within area	In feature area
Pandion haliaetus Osprey [952]		Breeding known to occur within area	In feature area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area	In feature area
Puffinus assimilis Little Shearwater [59363]		Foraging, feeding or related behaviour known to occur within area	In feature area
Rostratula australis as Rostratula benghalensis (sensu lato) Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area overfly marine area	In feature area
Stercorarius skua as Catharacta skua Great Skua [823]		Species or species habitat may occur within area	In feature area
Sterna dougallii Roseate Tern [817]		Foraging, feeding or related behaviour likely to occur within area	In buffer area only
Sternula albifrons as Sterna albifrons Little Tern [82849]		Species or species habitat may occur within area	In feature area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat may occur within area	In feature area
Thalassarche cauta Shy Albatross [89224]	Endangered	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area	In feature area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area	In feature area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Fish			
Acentronura australe Southern Pygmy Pipehorse [66185]		Species or species habitat may occur within area	In buffer area only
Campichthys galei Gale's Pipefish [66191]		Species or species habitat may occur within area	In feature area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area	In feature area
Festucalex scalaris Ladder Pipefish [66216]		Species or species habitat may occur within area	In feature area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area	In feature area
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within area	In feature area
Haliichthys taeniophorus Ribboned Pipehorse, Ribboned Seadragon [66226]		Species or species habitat may occur within area	In feature area
Hippocampus angustus Western Spiny Seahorse, Narrow-bellied Seahorse [66234]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Hippocampus breviceps Short-head Seahorse, Short-snouted Seahorse [66235]		Species or species habitat may occur within area	In buffer area only
Hippocampus histrix Spiny Seahorse, Thorny Seahorse [66236]		Species or species habitat may occur within area	In feature area
Hippocampus planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area	In feature area
Hippocampus subelongatus West Australian Seahorse [66722]		Species or species habitat may occur within area	In buffer area only
Hippocampus trimaculatus Three-spot Seahorse, Low-crowned Seahorse, Flat-faced Seahorse [66720]		Species or species habitat may occur within area	In feature area
Lissocampus fatiloquus Prophet's Pipefish [66250]		Species or species habitat may occur within area	In feature area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area	In buffer area only
Mitotichthys meraculus Western Crested Pipefish [66259]		Species or species habitat may occur within area	In buffer area only
Nannocampus subosseus Bonyhead Pipefish, Bony-headed Pipefish [66264]		Species or species habitat may occur within area	In feature area
Phycodurus eques Leafy Seadragon [66267]		Species or species habitat may occur within area	In buffer area only
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Pugnaso curtirostris Pugnose Pipefish, Pug-nosed Pipefish [66269]		Species or species habitat may occur within area	In buffer area only
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area	In feature area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area	In feature area
Stigmatopora argus Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]		Species or species habitat may occur within area	In feature area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area	In buffer area only
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area	In feature area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area	In feature area
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area	In buffer area only
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area	In buffer area only
Mammal			
Arctocephalus forsteri Long-nosed Fur-seal, New Zealand Fur-seal [20]		Species or species habitat may occur within area	In buffer area only
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Endangered	Species or species habitat may occur within area	In feature area
Reptile			

Scientific Name	Threatened Category	Presence Text	Buffer Status
Aipysurus foliosquama Leaf-scaled Seasnake [1118]	Critically Endangered	Species or species habitat likely to occur within area	In feature area
Aipysurus laevis Olive Seasnake [1120]		Species or species habitat may occur within area	In buffer area only
Aipysurus pooleorum Shark Bay Seasnake [66061]		Species or species habitat may occur within area	In feature area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area	In feature area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area	In feature area
Disteira kingii Spectacled Seasnake [1123]		Species or species habitat may occur within area	In feature area
Disteira major Olive-headed Seasnake [1124]		Species or species habitat may occur within area	In feature area
Emydocephalus annulatus Turtle-headed Seasnake [1125]		Species or species habitat may occur within area	In buffer area only
Ephalophis greyi North-western Mangrove Seasnake [1127]		Species or species habitat may occur within area	In buffer area only
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area	In feature area

Whales and Other Cetaceans [Resource Information]

Current Scientific Name	Status	Type of Presence	Buffer Status
Mammal			
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area	In feature area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area	In feature area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area	In feature area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area	In feature area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area	In feature area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area	In feature area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area	In feature area

Current Scientific Name	Status	Type of Presence	Buffer Status
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area	In feature area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area	In buffer area only
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area	In feature area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area	In feature area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area	In feature area

Australian Marine Parks [Resource Information]

Park Name	Zone & IUCN Categories	Buffer Status
Abrolhos	Multiple Use Zone (IUCN VI)	In feature area
Abrolhos	Special Purpose Zone (IUCN VI)	In buffer area only

Extra Information

State and Territory Reserves [Resource Information]

Protected Area Name	Reserve Type	State	Buffer Status
Eurardy	Conservation Reserve	WA	In buffer area only
Kalbarri	National Park	WA	In buffer area only
Kalbarri Blue Holes	Fish Habitat Protection Area	WA	In buffer area only
Nanga Station	NRS Addition - Gazettal in Progress	WA	In buffer area only
Nerren Nerren	NRS Addition - Gazettal in Progress	WA	In feature area
Part Murchison house	NRS Addition - Gazettal in Progress	WA	In feature area
Tamala Pastoral Lease (Part)	NRS Addition - Gazettal in Progress	WA	In buffer area only

Protected Area Name	Reserve Type	State	Buffer Status
Toolonga	Nature Reserve	WA	In buffer area only
Zuytdorp	Nature Reserve	WA	In feature area

Nationally Important Wetlands [Resource Information]

Wetland Name	State	Buffer Status
Murchison River (Lower Reaches)	WA	In buffer area only

EPBC Act Referrals [Resource Information]

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Controlled action				
Coburn Mineral Sand Project	2003/1221	Controlled Action	Post-Approval	In buffer area only
Not controlled action				
Hadda 1,Flying Foam 1,Magnat 1 exploration drill	2004/1697	Not Controlled Action	Completed	In buffer area only
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed	In feature area
INDIGO West Submarine Telecommunications Cable, WA	2017/8126	Not Controlled Action	Completed	In buffer area only
Not controlled action (particular manner)				
INDIGO Marine Cable Route Survey (INDIGO)	2017/7996	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Westralia SPAN Marine Seismic Survey, WA & NT	2012/6463	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only

Key Ecological Features [Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region	Buffer Status
Commonwealth marine environment surrounding the Houtman Abrolhos Islands	South-west	In buffer area only
Western rock lobster	South-west	In buffer area only

Biologically Important Areas

Scientific Name	Behaviour	Presence	Buffer Status
Seabirds			

Scientific Name	Behaviour	Presence	Buffer Status
Anous stolidus Common Noddy [825]	Foraging (provisioning young)	Known to occur	In buffer area only
Ardenna pacifica Wedge-tailed Shearwater [84292]	Breeding	Known to occur	In feature area
Ardenna pacifica Wedge-tailed Shearwater [84292]	Foraging (in high numbers)	Known to occur	In buffer area only
Hydroprogne caspia Caspian Tern [808]	Foraging (provisioning young)	Known to occur	In buffer area only
Larus pacificus Pacific Gull [811]	Foraging (in high numbers)	Known to occur	In buffer area only
Onychoprion anaethetus Bridled Tern [82845]	Foraging (in high numbers)	Known to occur	In buffer area only
Pelagodroma marina White-faced Storm petrel [1016]	Foraging (in high numbers)	Known to occur	In buffer area only
Puffinus assimilis tunneyi Little Shearwater [59363]	Foraging (in high numbers)	Known to occur	In feature area
Sterna dougallii Roseate Tern [817]	Foraging (provisioning young)	Known to occur	In buffer area only
Sternula nereis Fairy Tern [82949]	Foraging (in high numbers)	Known to occur	In buffer area only
Whales			
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Distribution	Known to occur	In feature area
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Known Foraging Area	Known to occur	In buffer area only

Scientific Name	Behaviour	Presence	Buffer Status
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Migration	Known to occur	In buffer area only
Megaptera novaeangliae Humpback Whale [38]	Migration	Known to occur	In buffer area only
Megaptera novaeangliae Humpback Whale [38]	Migration (north)	Known to occur	In buffer area only
Megaptera novaeangliae Humpback Whale [38]	Migration (north and south)	Known to occur	In feature area

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and 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

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

Where little information is available for a 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 detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

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

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

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

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

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

Likelihood of Occurrence Assessment

Fauna likelihood of occurrence assessment guidelines

Assessment outcome	Description
Known	Species recorded during the field survey or from recent, reliable records from within or 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 10 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.

Term	Description
study area	a 40 km buffer around the survey area
Survey area	the area subject to the current development envelope for the project
locality	the area within an approximate 40 km radius of the survey area
CR	Critically endangered
EN	Endangered
VU	Vulnerable
IA	International agreement
INT	Introduced species
MI, MA	Migratory, Marine
CD	Conservation dependent
OS	Other specially protected fauna
P1 – P4	Priority 1 – Priority 4. Threatened and Priority fauna rankings
Pr	Probable record of species via bat detection or calls overlap with another species. Record could be either or both species
SP	Special Protection under BC Act
EPBC Act	*Environmental Protection and Biodiversity Conservation Act 1999*
DBCA	Department of Biodiversity and Conservation Attractions
BC Act	*Biodiversity Conservation Act 2016*

Fauna likelihood of occurrence assessment

Taxa	Common Name	Status		Description and habitat requirements	Likelihood of occurrence within the project area	Source
		BC Act	EPBC Act			
Birds						
Actitis hypoleucos	Common Sandpiper	MI	MI	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).	**Known**. The species was recorded along the Murchison River and on the coast in the survey area	DBCA
Anous stolidus	Common Noddy	MI	MI	The Common Noddy usually occurs on or near islands, on rocky islets and stacks with precipitous cliffs, or on shoals or cays of coral or sand. When not at the nest, individuals will remain close to the nest, foraging in the surrounding waters. Birds may nest in bushes, saltbush, or other low vegetation. They may also nest on the ground in Pigface (*Carpobrotus spp.*) or grass, on bare rock, on top of rocks protruding above vegetation, on shingle beaches, among coral rubble or in sand close to grassy areas. The species has also been recorded nesting in the forks of tall trees, in holes in dead timber and on tree-stumps. It occurs off the north-west and central Western Australia coast and the closest breeding population occurs in the Abrolhos Islands (DotEE 2019).	**Highly Unlikely.** Coastal habitat is present however species is known to utilise offshore islands and atolls.	PMST
Anous tenuirostris melanops	Australian Lesser Noddy	VU	VU	The Australian Lesser Noddy is usually found only around its breeding islands in the Houtman Abrolhos Islands. It usually occupies coral-limestone islands that are densely fringed with White Mangrove (*Avicennia marina*). It occasionally occurs on shingle or sandy beaches. The bird roosts mainly in mangroves, especially at night, but may sometimes rest on a beach (DotEE 2019).	**Highly Unlikely.** Coastal habitat is present however species is known to utilise offshore islands and atolls.	PMST
Amytornis textilis subsp. textilis	Western Grasswren	P4		The Western Grasswren occurs in semi-arid shrubland of the Shark Bay region generally consisting of open saltbush and bluebush shrublands or Acacia shrublands on coastal dunes, coastal plains and red sandplains. Other areas include fire-affected shrublands dominated by *Ptilotus obovatus* and *Solanum orbiculatum*, which have replaced burnt-out Horse Mulga shrublands for at least 40 years following uncontrolled fires or low (< 1.5 m high) shrublands on calcareous sandplains, dominated by Umbrella Bush and other shrubs mixed with hummocks of spinifex. The species is currently only known from the Shark Bay region (TSSC 2006) south to coburn.	**Likely**. The species was thought to be observed by GHD (2021) in the coastal dune shrublands habitat type of the survey area. However could not be verified during additional surveys.	Naturemap
Apus pacificus	Fork-tailed Swift	MI	MI	The Fork-tailed Swift is a migratory species that follows large storm fronts and are almost exclusively areal species. In Western Australia, there are sparsely scattered records of the Fork-tailed Swift along the south coast,	**Known.** This species was recorded in the survey area in March	DBCA

Taxa	Common Name	Status		Description and habitat requirements	Likelihood of occurrence within the project area	Source
		BC Act	EPBC Act			
				ranging from near the Eyre Bird Observatory and west to Denmark, in coastal and subcoastal areas between Augusta and Carnarvon, including some on nearshore and offshore islands. Scattered records are present in the Midwest region. Records are scattered throughout WA including the Pilbara, Kimberley, Wheatbelt, Gascoyne and deserts (Higgins 1999).	2022. A group of approximately 30 individuals was recorded daily for three days in the central and south coastal strip of the survey area.	
Ardenna carneipes	Flesh-footed Shearwater	MI	MI	The Flesh-footed Shearwater is a trans-equatorial migrant. The species is widely distributed across the southern Indian and south-western Pacific Oceans during the breeding season with colonies located on Saint Paul Island (France) in the southern Indian Ocean (Jouventin, 1994; Roux, 1985), on 41 islands off the coast of south-western Western Australia (Burbidge & Fuller, 1996), on Smith Island off the coast of Eyre Peninsula in South Australia (Robinson *et al.,* 1986), on Lord Howe Island (Priddel *et. al* 2006) and on approximately 20 islands around the eastern and western coasts of the North Island of New Zealand to Cook Strait (Brooke, 2004; Marchant & Higgins, 1990; Taylor, 2000). The Flesh-footed Shearwater nests in colonies in burrows under trees or shrubs. On Lord Howe Island it favours the flatter areas in the central lowlands (Priddel *et al.* 2006). Most feeding is undertaken offshore over continental shelves where it feeds on fish and squid, mostly caught by pursuit-plunging (Marchant & Higgins, 1990). The Flesh-footed Shearwater readily takes baits from longlines (Baker & Wise, 2005).	**Unlikely.** There is. coastal habitat present however species is known to utilise offshore islands.	PMST
Ardenna pacifica	Wedge-tailed Shearwater	MI	MI	The Wedge-tailed Shearwater nests in burrows on offshore islands during November-April. Research has indicated more than one million shearwaters migrate to the Pilbara islands each year to nest (DBCA, 2017).	**Known.** This species was recorded along the coast in March 2022.	DBCA
Arenaria interpres	Ruddy turnstone	MI	MI	The Ruddy Turnstone is found in most coastal regions with exposed rock coast lines or coral reefs, and also near platforms and shelves, often with shallow tidal pools and rocky, shingle or gravel beaches. It can be found on sand, coral or shell beaches, shoals, cays and dry ridges of sand or coral, and in occasionally near riverbeds, and on inland lakes and adjacent farmland. It strongly prefers rocky shores or beaches with large deposits of rotting seaweed. It has occasionally been sighted in estuaries, harbours, bays and coastal lagoons, among low saltmarsh or on exposed beds of seagrass, around sewage ponds and on mudflats (DotE 2016). It is also common on all the larger islands south to Penguin Island (Nevill 2013).	**Likely.** There is suitable habitat within the survey area and previous records 2 km east of the survey area	DBCA
Calidris acuminata	Sharp-tailed Sandpiper	MI	MI	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	**Likely.** There is some rocky shoreline habitat for this species within the	DBCA

Taxa	Common Name	Status		Description and habitat requirements	Likelihood of occurrence within the project area	Source
		BC Act	EPBC Act			
				and pools near the coast, and dams, waterholes, soaks, bore drains and bore swamps, saltpans and hypersaline salt lakes 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. They are widespread from Cape Arid to south-west and east Kimberley. Inland records indicate the species is widespread and scattered from the Pilbara, mid west and goldfields (DotEE 2019).	survey area and the nearest record is 16 km east of the survey area. Typically this species occurs on inland water systems, therefore use may be opportunistic.	
Calidris alba	Sanderling	MI	MI	In Australia, the Sanderling is almost always found on the coast, mostly on open sandy beaches exposed to open sea-swell, and also on exposed sandbars and spits, and shingle banks, where they forage in the wave-wash zone and amongst rotting seaweed. Sanderlings also occur on beaches that may contain wave-washed rocky outcrops. They are more often recorded on the south and southwest coasts, north to around southern Shark Bay, with more sparsely scattered records further north in Gascoyne and Pilbara Regions and the Kimberley Division (DotEE 2019).	**Known.** This species was recorded on a beach in the northwest portion of the survey area.	DBCA
Calidris canutus	Red Knot	MI	EN	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. In WA there are scattered records in the south, and it is occasionally seen around Peron Peninsula to Carnarvon. It is widespread on the coast from Ningaloo and Barrow Island to the south-west Kimberley Division (DotE 2016).	**Likely.** There is suitable habitat within the survey area.	PMST
Calidris ferruginea	Curlew Sandpiper	CR	CR	Curlew Sandpipers mainly occur in areas with soft mud conditions, including 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 found inland 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. In WA, they are widespread around coastal and subcoastal plains from Cape Arid to south-west Kimberley (DotEE 2019).	**Likely** The nearest record is at Chinaman's Rock Lookout 10 km south-of the survey area.	DBCA, NatureMap & PMST
Calidris ruficollis	Red-necked stint	MI	MI	The Red-necked Stint can be found in fresh and saline water, but primarily in coastal regions (Nevill 2013). It is mostly found in areas including sheltered inlets, bays, lagoons and estuaries with intertidal mudflats, often	**Known.** This species was recorded on a beach in the northwest	DBCA

Taxa	Common Name	Status		Description and habitat requirements	Likelihood of occurrence within the project area	Source
		BC Act	EPBC Act			
				near spits, islets and banks and, sometimes, on protected sandy or coralline shores. Occasionally they have been recorded on exposed or ocean beaches, and on stony or rocky shores, reefs or shoals. They also occur in saltworks and sewage farms; saltmarsh; ephemeral or permanent shallow wetlands near the coast or inland, including lagoons, lakes, swamps, riverbanks, waterholes, bore drains, dams, soaks and pools in saltflats (DotEE 2019).	portion of the survey area.	
Zanda latirostris	Carnaby's cockatoo	EN	EN	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 nests in trees older than 120-150 years (DotEE 2019).	**Known.** There is suitable habitat within the survey area and foraging evidence on the southern edge of the survey area. One pair was heard calling in the central eastern portion of the survey area.	DBCA, NatureMap & PMST
Charadrius leschenaultii	Greater Sand Plover	VU	MI	In Australasia the Greater Sand Plover is almost entirely coastal, inhabiting littoral and estuarine habitats. They mainly occur on sheltered sandy, shelly or muddy beaches with large intertidal mudflats or sandbanks, as well as sandy estuarine lagoons, and inshore reefs, rock platforms, small rocky islands or sand cays on coral reefs. They are occasionally recorded on near-coastal saltworks and saltlakes, including marginal saltmarsh, and on brackish swamps. They seldom occur at shallow freshwater wetlands (DotE 2016). Some come down the coast from Geraldton as far as Busselton but numbers decrease from north to south (Nevill 2013).	**Known.** This species was recorded at several locations on beaches in the survey area.	DBCA, NatureMap & PMST
Charadrius mongolus	Lesser Sand Plover	EN	EN	In non-breeding grounds in Australia, the Lesser Sand Plover usually occurs in coastal littoral and estuarine environments. It inhabits large intertidal sandflats or mudflats in sheltered bays, harbours and estuaries, and occasionally sandy ocean beaches, coral reefs, wave-cut rock platforms and rocky outcrops. It also sometimes occurs in short saltmarsh or among mangroves, in saltworks and near-coastal saltpans, brackish swamps and sandy or silt islands in riverbeds. The species is seldom recorded away from the coast, at margins of lakes, soaks and swamps associated with artesian bores (DotE 2016). The Lesser Sand Plover mainly occurs in northern regions, is scarcer in the south (Nevill 2013).	**Likely.** There are known records of the species at Chinaman's Rock Lookout approximately 10km south of the survey area.	DBCA, NatureMap
Diomedea amsterdamensis	Amsterdam Albatross		EN	Albatross and giant petrel species exhibit a broad range of diets and foraging behaviours, and hence their at-sea distributions are diverse.	**Unlikely**. It is unlikely that the species occurs	PMST

Taxa	Common Name	Status		Description and habitat requirements	Likelihood of occurrence within the project area	Source
		BC Act	EPBC Act			
				Combined with their ability to cover vast oceanic distances, all waters within Australian jurisdiction can be considered foraging habitat, however the most critical foraging habitat is considered to be those waters south of 25 degrees where most species spend the majority of their foraging time (DotEE 2019).	within the survey area but opportunistically it may occur within inland waters during extreme weather events	
Diomedea epomophora	Southern Royal Albatross	MI	VU	Albatross and giant petrel species exhibit a broad range of diets and foraging behaviours, and hence their at-sea distributions are diverse. Combined with their ability to cover vast oceanic distances, all waters within Australian jurisdiction can be considered foraging habitat, however the most critical foraging habitat is considered to be those waters south of 25 degrees where most species spend the majority of their foraging time (DotEE 2019).	**Unlikely**. It is unlikely that the species occurs within the survey area but opportunistically it may occur within inland waters during extreme weather events.	PMST
Diomedea exulans	Wandering Albatross	MI	VU	Albatross and giant petrel species exhibit a broad range of diets and foraging behaviours, and hence their at-sea distributions are diverse. Combined with their ability to cover vast oceanic distances, all waters within Australian jurisdiction can be considered foraging habitat, however the most critical foraging habitat is considered to be those waters south of 25 degrees where most species spend the majority of their foraging time (DoTEE, 2019).	**Unlikely**. It is unlikely that the species occurs within the survey area but opportunistically it may occur within inland waters during extreme weather events.	PMST
Falco peregrinus	Peregrine Falcon	OS		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 2014; 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).	**Likely**. The species is known from the region (records within 4 km east of the survey area), however use would be opportunistic and utilised for foraging purposes only. No breeding habitat was present.	PMST, Naturemap and DBCA
Falco hypoleucos	Grey Falcon	VU	VU	The Grey Falcon inhabits lightly timbered country, especially stony, inland plains and Acacia scrub, gibber deserts, sand ridges, pastoral lands, and timbered watercourses, but seldom in driest deserts. Its distribution is centred on inland drainage systems. It also hunts in treeless areas and frequents tussock grassland and open woodland, especially in winter (Morcombe 2004; Pizzey & Knight 2012). It can mostly be seen on the northwest coast from Shark Bay to east Kimberley, and in the Pilbara and desert regions (Nevill 2013; Pizzey & Knight 2012).	**Unlikely.** There are no nearby records of the species. Its distribution is Shark Bay, Pilbara and desert regions.	PMST
Fregata ariel	Lesser Frigatebird	MI	MI	The Lesser Frigatebird breeds on small, remote tropical and sub-tropical islands, in mangroves or bushes, and even on bare ground. Major	**Unlikely**. It is unlikely that the species occurs	PMST

Taxa	Common Name	Status		Description and habitat requirements	Likelihood of occurrence within the project area	Source
		BC Act	EPBC Act			
				breeding populations of the Lesser Frigatebird are found in tropical waters of the Indian and Pacific Ocean (excluding the east Pacific), as well as one population in the South Atlantic. Outside the breeding season it is sedentary, with immature and non-breeding individuals dispersing throughout tropical seas, especially off the Indian and Pacific Ocean (IUCN Redlist 2016).	within the survey area but opportunistically it may occur within inland waters during extreme weather events.	
Gelochelidon nilotica	Gull-billed tern	MI	MI	The Gull-billed Tern is a nomadic/ migratory species in Australia. Gull-billed Terns are found in freshwater swamps, brackish and salt lakes, beaches and estuarine mudflats, floodwaters, sewage farms, irrigated croplands and grasslands, where resources are favourable. They are rarely found over open ocean. Although essentially an inland species, outside breeding season it shows a distinct preference for saltmarshes and lagoons near the coast. Movements are not fully understood but it is common and widespread in Australia (Morcombe 2014).	**Known.** This species was recorded along the beach in the northwest portion of the survey area in March 2022.	DBCA
Hydroprogne caspia	Caspian Tern	MI	MI	The Caspian Tern is mostly found in sheltered coastal embayments (harbours, lagoons, inlets, bays, estuaries and river deltas) and those with sandy or muddy margins are preferred. They also occur on near-coastal or inland terrestrial wetlands that are either fresh or saline, especially lakes (including ephemeral lakes), waterholes, reservoirs, rivers and creeks. They also use artificial wetlands, including reservoirs, sewage ponds and saltworks. In offshore areas the species prefers sheltered situations, particularly near islands, and is rarely seen beyond reefs. In WA, the Caspian Tern is widespread in coastal regions, from the Great Australian Bight to the Dampier Peninsula (DotEE 2019).	**Known.** This species was recorded flying along the coast in the survey area. Additional records were from the Murchison River is several locations with birds both flying and loafing.	DBCA
Leipoa ocellata	Malleefowl	VU	VU	The Malleefowl generally occurs in semi-arid areas of WA, in shrublands and low woodlands that are dominated by mallee vegetation, as well as native pine Callitris woodlands, Acacia shrublands, paperbark, sheoak, Broom bush (*Melaleuca uncinate)* 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).	**Known.** Numerous individuals were recorded active and captured on remote cameras. Evidence of the species (mounds, scat, scratching and prints) were sighted across the survey area.	PMST, Naturemap, DBCA, GHD
Limosa lapponica	Bar-tailed Godwit	MI	MI	The Bar-tailed Godwit is found mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. It is found often around beds of seagrass and, sometimes, in nearby saltmarsh. It has been sighted in coastal sewage	**Known.** This species was recorded on a beach in survey area.	DBCA & PMST

Taxa	Common Name	Status		Description and habitat requirements	Likelihood of occurrence within the project area	Source
		BC Act	EPBC Act			
				farms and saltworks, saltlakes and brackish wetlands near coasts, sandy ocean beaches, rock platforms, and coral reef-flats (DotE 2016). They are uncommon in the south west, but can be sighted from Geraldton to Bunbury, at Alfred Cove, and then at a few estuaries on the south coast including Kalgan River Mouth and Oyster Harbour (Nevill 2013).		
Macronectes giganteus	Southern Giant-Petrel	MI	EN	Albatross and giant petrel species exhibit a broad range of diets and foraging behaviours, and hence their at-sea distributions are diverse. Combined with their ability to cover vast oceanic distances, all waters within Australian jurisdiction can be considered foraging habitat, however the most critical foraging habitat is considered to be those waters south of 25 degrees where most species spend the majority of their foraging time (DotEE 2019).	**Unlikely**. It is unlikely that the species occurs within the survey area but opportunistically it may occur within inland waters during extreme weather events.	PMST
Macronectes halli	Northern Giant Petrel	MI	VU	Albatross and giant petrel species exhibit a broad range of diets and foraging behaviours, and hence their at-sea distributions are diverse. Combined with their ability to cover vast oceanic distances, all waters within Australian jurisdiction can be considered foraging habitat, however the most critical foraging habitat is considered to be those waters south of 25 degrees where most species spend the majority of their foraging time (DotEE 2019).	**Unlikely**. It is unlikely that the species occurs within the survey area but opportunistically it may occur within inland waters during extreme weather events.	PMST
Numenius madagascariensis	Eastern Curlew	CR	CR	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 (Marchant & Higgins 1993). They are found commonly along the north coast of WA, but rarely south of Shark Bay (Morcombe 2004). They are uncommon further south of Geraldton (Nevill 2013).	**Likely.** There is suitable habitat within the survey area on the coastal strip and the closest known record is 17 km east of the survey area.	DBCA & Naturemap
Numenius phaeopus	Whimbrel	MI	MI	The Whimbrel is often found on the intertidal mudflats of sheltered coasts. It is also found in harbours, lagoons, estuaries and river deltas, often those with mangroves, but also open, unvegetated mudflats. It is occasionally found on sandy or rocky beaches, on coral or rocky islets, or on intertidal reefs and platforms. It has been infrequently recorded using saline or brackish lakes near coastal areas. It also used saltflats with saltmarsh, or saline grasslands with standing water left after high spring-tides, and in similar habitats in sewage farms and salt fields. There are a small number of inland records from saline lakes and canegrass swamps. The Whimbrel is common and widespread from Carnarvon to the north-east Kimberley	**Likely.** There is suitable habitat within the survey area on the coastal strip and the closest known record is 17 km east of the survey area.	DBCA

Taxa	Common Name	Status		Description and habitat requirements	Likelihood of occurrence within the project area	Source
		BC Act	EPBC Act			
				Division. It is occasionally seen on the south coast of WA and has occasionally been recorded in the south-west and further north to Shark Bay (DotEE 2019).		
Oceanites oceanicus	Wilson's Storm-Petrel	MI	MI	Wilson's storm petrel is a small seabird that is dark brown in all plumages, except for the white rump and flanks. The species has a diffuse pale band along the upper wing coverts and lacks the distinctive white underwing lining. The webbing between the toes is yellow with black spots in pre-breeding age individuals. The species is one of the most abundant bird species in the world and has a circumpolar distribution mainly in the seas of the southern hemisphere but extending northwards during the summer of the northern hemisphere. The species rarely visit mainland areas however can breed on mainland Antarctica and associated islands. The species will come into coastal waters to feed.	**Known**. This species was recorded at during the migratory bird assessments.	DBCA
Onychoprion anaethetus	Bridled Tern	MI	MI	Bridled Terns occupy tropical and subtropical seas, breeding on islands, including vegetated coral cays, rocky continental islands and rock stacks. They are only rarely found in inshore continental waters and along mainland coastlines, though the species is reported to breed on the mainland of far southern WA. In WA, breeding is widespread from islands off Cape Leeuwin (extending round the southern coast to Seal Rocks) north to Shark Bay and in Pilbara region and Kimberley Division. At sea, distribution extends from Cape Leeuwin north to Dirk Hartog Island, with isolated mainland coastal records at Point Maud and Ningaloo, and from Barrow Island to the Dampier Archipelago, and at sea off the Kimberley coast from waters west of the Dampier Peninsula to Ashmore Reef and Joseph Bonaparte Gulf (DotEE 2019).	**Unlikely.** Coastal habitat is present however species is known to utilise offshore islands and atolls.	PMST
Pandion cristatus	Eastern Osprey	MI	MI	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. The distribution of the species around the northern coast (south-western WA to south-eastern NSW) appears continuous except for a possible gap at Eighty Mile Beach (DotEE 2019).	**Known.** This species was recorded at numerous locations of the survey area.	DBCA

Taxa	Common Name	Status		Description and habitat requirements	Likelihood of occurrence within the project area	Source
		BC Act	EPBC Act			
Pluvialis fulva	Pacific Golden Plover	MI	MI	In Australia the Pacific Golden Plover usually inhabits coastal habitats, on beaches, mudflats and sandflats (sometimes in vegetation such as mangroves, low saltmarsh such as *Sarcocornia spp*., or beds of seagrass) in sheltered areas including harbours, estuaries and lagoons, and also in saltworks. It is sometimes recorded on islands, sand and coral cays and exposed reefs and rocks. They are less often recorded in terrestrial habitats, but can be seen in habitats with short grass in paddocks, crops or airstrips, or ploughed or recently burnt areas. In WA, the species is seldom recorded along the southern or south-western coasts (DotEE 2019).	**Likely.** There is suitable habitat within the Survey Area on the coastal strip and the closest known record is 17 km east of the survey area.	DBCA
Pluvialis squatarola	Grey Plover	MI	MI	Grey Plovers occur almost entirely in coastal areas, where they usually inhabit sheltered embayments, estuaries and lagoons with mudflats and sandflats, and occasionally on rocky coasts with wave-cut platforms or reef-flats, or on reefs within muddy lagoons. They also occur around terrestrial wetlands such as near-coastal lakes and swamps, or salt-lakes. The species is also very occasionally recorded further inland, where they occur around wetlands or salt-lakes (DotEE 2019).	**Likely.** There is suitable habitat within the Survey Area on the coastal strip and the closest known record is 10 km east of the survey area.	DBCA
Pterodroma mollis	Soft-plumaged Petrel	MI	VU	Albatross and giant petrel species exhibit a broad range of diets and foraging behaviours, and hence their at-sea distributions are diverse. Combined with their ability to cover vast oceanic distances, all waters within Australian jurisdiction can be considered foraging habitat, however the most critical foraging habitat is considered waters south of 25 degrees where most spend the majority of their foraging time (DotEE 2019).	**Unlikely**. It is unlikely that the species occurs within the survey area but may occur within inland waters during extreme weather events.	PMST
Rostratula australis	Australian Painted Snipe	EN	EN	The Australian Painted Snipe generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans. They also use inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms and bore drains. Typical sites include those with rank emergent tussocks of grass, sedges, rushes or reeds, or samphire; often with scattered clumps of lignum, canegrass, or sometimes tea-tree. It sometimes uses areas that are lined with trees, scattered fallen or washed-up timber (DotEE 2019). In the south west it can be found around Carnarvon and wetlands north of Perth, particularly those west of Moora and Gingin (Nevill 2013).	**Unlikely** There are no known records within or nearby the survey area. Claypan and dam habitat is present however these areas are impacted by goat grazing and lack fringing vegetation	PMST
Sterna dougallii	Roseate Tern	MI	MI	The Roseate Tern occurs in coastal marine areas in subtropical and tropical seas. The species inhabits rocky and sandy beaches, coral reefs, sand cays and offshore islands. Birds rarely occur in inshore waters or near the mainland, usually venturing into these areas only accidentally, when nesting islands are nearby. In WA, the subspecies is regularly	**Likely.** There is suitable habitat within the survey area on the coastal strip and the closest record is 16 km east of the survey area	DBCA

Taxa	Common Name	Status		Description and habitat requirements	Likelihood of occurrence within the project area	Source
		BC Act	EPBC Act			
				recorded north from Mandurah to around Eighty Mile Beach (North Pilbara) (DotEE 2019).		
Sternula nereis nereis	Australian Fairy Tern	Mi	VU	The Fairy Tern occurs along the coast of WA as far north as the Dampier Archipelago near Karratha, but mostly in the southern part of Australia including most of the coastline in the southwest. It nests on sheltered sandy beaches, coastal inlets, spits, and banks above the high tide line and below vegetation. It has been found in embayment's of a variety of habitats including offshore, estuarine, or lacustrine (lake) islands, wetlands, and mainland coastline (DotEE 2019; Nevill 2013). They can also be seen in salt fields, saline or brackish lakes, and sewage ponds near the coast (Pizzey & Knight 2012).	**Likely.** There is suitable habitat within the survey area on the coastal strip and the species has been identified from database searches as being in the survey area.	PMST
Thalassarche carteri	Indian Yellow-nosed Albatross	MI	VU	Albatross and giant petrel species exhibit a broad range of diets and foraging behaviours, and hence their at-sea distributions are diverse. Combined with their ability to cover vast oceanic distances, all waters within Australian jurisdiction can be considered foraging habitat, however the most critical foraging habitat is considered to be those waters south of 25 degrees where most species spend the majority of their foraging time (DotEE 2019).	**Unlikely**. It is unlikely that the species occurs within the survey area but opportunistically it may occur within inland waters during extreme weather events	PMST
Thalassarche cauta	Shy Albatross	MI	EN	Albatross and giant petrel species exhibit a broad range of diets and foraging behaviours, and hence their at-sea distributions are diverse. Combined with their ability to cover vast oceanic distances, all waters within Australian jurisdiction can be considered foraging habitat, however the most critical foraging habitat is considered to be those waters south of 25 degrees where most species spend the majority of their foraging time (DotEE 2019).	**Unlikely**. It is unlikely that the species occurs within the survey area but opportunistically it may occur within inland waters during extreme weather events	PMST
Thalassarche chlororhynchos	Atlantic yellow-nosed Albatross	VU	MI	Albatross and giant petrel species exhibit a broad range of diets and foraging behaviours, and hence their at-sea distributions are diverse. Combined with their ability to cover vast oceanic distances, all waters within Australian jurisdiction can be considered foraging habitat, however the most critical foraging habitat is considered to be those waters south of 25 degrees where most species spend the majority of their foraging time (DotEE 2019).	**Unlikely**. It is unlikely that the species occurs within the survey area but opportunistically it may occur within inland waters during extreme weather events	DBCA & Naturemap
Thalassarche impavida	Campbell Albatross	MI	VU	Albatross and giant petrel species exhibit a broad range of diets and foraging behaviours, and hence their at-sea distributions are diverse. Combined with their ability to cover vast oceanic distances, all waters within Australian jurisdiction can be considered foraging habitat, however the most critical foraging habitat is considered to be those waters south of	**Unlikely**. It is unlikely that the species occurs within the survey area but opportunistically it may occur within inland	PMST

Taxa	Common Name	Status		Description and habitat requirements	Likelihood of occurrence within the project area	Source
		BC Act	EPBC Act			
				25 degrees where most species spend the majority of their foraging time (DotEE 2019).	waters during extreme weather events	
Thalassarche melanophris	Black-browed Albatross	MI	VU	Albatross and giant petrel species exhibit a broad range of diets and foraging behaviours, and hence their at-sea distributions are diverse. Combined with their ability to cover vast oceanic distances, all waters within Australian jurisdiction can be considered foraging habitat, however the most critical foraging habitat is considered to be those waters south of 25 degrees where most species spend the majority of their foraging time (DotEE 2019).	**Unlikely**. It is unlikely that the species occurs within the survey area but opportunistically it may occur within inland waters during extreme weather events	PMST
Thalassarche steadi	White-capped Albatross	MI	VU	Albatross and giant petrel species exhibit a broad range of diets and foraging behaviours, and hence their at-sea distributions are diverse. Combined with their ability to cover vast oceanic distances, all waters within Australian jurisdiction can be considered foraging habitat, however the most critical foraging habitat is considered to be those waters south of 25 degrees where most species spend the majority of their foraging time (DotEE 2019).	**Unlikely**. It is unlikely that the species occurs within the survey area but opportunistically it may occur within inland waters during extreme weather events	PMST
Thalasseus bergii	Crested Tern	MI	MI	There are few stretches off the Australian coastline where the Crested Tern cannot be seen — it has been known as both the Bass Straits Tern and the Torres Straits Tern. They breed in colonies on small offshore islands where their nests are so densely packed together that adjacent owners can touch each other's bills. Though the Crested Tern is usually a strictly coastal species, there are occasional records in the arid interior of Australia, where birds were possibly blown by passing tropical cyclones (Birdlife Australia, 2021).	**Known.** Numerous records along the coast and along the Murchison River	DBCA & GHD (2021 and 2022)
Tringa brevipes	Grey-tailed Tattler	P4	MI	The Grey-tailed Tattler is often found on sheltered coasts with reefs and rock platforms or with intertidal mudflats. It can also be found at intertidal rocky, coral or stony reefs as well as platforms and islets that are exposed at low tide. It has been found around shores of rock, shingle, gravel or shells and also on intertidal mudflats in embayments, estuaries and coastal lagoons, especially fringed with mangroves. It is occasionally found around near-coastal wetlands, such as lagoons and lakes and ponds in sewage farms and saltworks. Inland records for the species are rare with sightings on riverbanks and the edges of rock pools. It is found in the south-west between Augusta to Cervantes (DotEE 2019).	**Likely.** Uncommon some suitable habitat within the survey area on the coastal strip and known records of the species 10 km south of the survey area.	DBCA & Naturemap
Tringa nebularia	Common Greenshank	MI	MI	The Common Greenshank is found in a wide variety of inland wetlands and sheltered coastal habitats of varying salinity. It occurs in sheltered coastal habitats, typically with large mudflats and saltmarsh, mangroves or seagrass. Habitats include embayments, harbours, river estuaries, deltas	**Known.** Numerous records along the Murchison River only	DBCA

Taxa	Common Name	Status		Description and habitat requirements	Likelihood of occurrence within the project area	Source
		BC Act	EPBC Act			
				and lagoons and are recorded less often in round tidal pools, rock-flats and rock platforms. The species uses both permanent and ephemeral terrestrial wetlands, including swamps, lakes, dams, rivers, creeks, billabongs, waterholes and inundated floodplains, claypans and salt flats. It will also use artificial wetlands, including sewage farms and saltworks dams, inundated rice crops and bores. The edges of the wetlands used are generally of mud or clay, occasionally of sand, and may be bare or with emergent or fringing vegetation, including short sedges and saltmarsh, mangroves, thickets of rushes, and dead or live trees (Higgins & Davies 1996).		
Mammal						
Bettongia penicillata ogilbyi	Woylie		EN	Woylies originally inhabited a wide range of landscapes. In the western deserts, Indigenous people reported that they occupied sand plains and dunes with Triodia spp. (spinifex) hummock grassland. The remnant subpopulations in south-western Australia inhabit woodlands and adjacent heaths with a dense understorey of shrubs, particularly Gastrolobium spp. (poison pea), which contain monofluoroacetic acid (from which the compound present as sodium monofluoroacetate in the vertebrate pesticide '1080' is derived (DotEE 2019). The species is not currently known to persist in the Kalbarri region and now only occurs in several predator managed areas in the south west such as Dryandra and Perup.	**Highly unlikely.** The species is extinct in this region.	PMST
Dasyurus geoffroii	Chuditch, Western Quoll	VU	VU	The Chuditch inhabits eucalypt forest (especially Jarrah, E. 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 (rocky areas, horizontal hollow logs or earth burrows) to survive (DEC 2012). The species can travel large distances, and for this reason requires habitats that are of a suitable size and not excessively fragmented (DEC 2012). The translocated population at Kalbarri National park is expanding in numbers and individuals have been recorded on Eurardy and Hamlin Stations to the east and north of the survey area.	**Likely.** There are known records of approximately 9 km south of the survey area within the Kalbarri gorge system. The species has also been recorded from Eurardy Station to the east and Hamelin Station to the north.	Naturemap, DBCA and PMST
Notamacropus eugenii derbianus	Tammar wallaby	P4		The Tammar Wallaby inhabits dense, low vegetation for daytime shelter and open grassy areas for feeding. It inhabits coastal scrub, heath, dry sclerophyll (leafy) forest and thickets in mallee and woodland. The tammar wallaby is currently known to inhabit three islands in the Houtman Abrolhos group, Garden Island near Perth, Middle and North Twin Peak Islands in the Archipelago of the Recherche, and numerous managed sites around	**Likely.** There are known records of approximately 9 km south of the survey area near the Kalbarri gorge system.	Naturemap & DBCA

Taxa	Common Name	Status		Description and habitat requirements	Likelihood of occurrence within the project area	Source
		BC Act	EPBC Act			
				the south west (DEC 2012; Van Dyck and Strahan 2008). The species is known from Kalbarri National park which supports the same heath and shrublands present in the survey area.		
Petrogale lateralis subsp. Lateralis	Black-flanked Rock-wallaby	VU	EN	Known Black-flanked Rock-wallaby populations remain restricted to suitable habitat in the Little Sandy Desert, Cape and Calvert Ranges, with seven populations in the Wheatbelt region, Barrow and Salisbury Islands, and Ningaloo Station. The closest population to the survey area is that within the Kalbarri National Park within the rocky gorges of the Murchison River. Habitat varies between colonies but always involves grassland foraging habitat in close proximity to cliffs, rock-pile, talus or escarpment refuge habitat. Rock cliffs or other steep substrates with adequate shelter and refuge are essential for breeding (Van Dyck & Strahan 2008).	**Unlikely.** There is no suitable habitat within the survey area. Species is only known from the Murchison River gorge system.	PMST
Reptile						
Cyclodomorphus branchialis	Gilled Slender Blue-tongue	VU	VU	The Gilled Slender Bluetongue is found in the lower west coastal regions on WA, between the Murchison and Irwin Rivers. It is a ground-dwelling lizard of largely crepuscular and nocturnal habits. The species has little information available but is thought to sheltering by day in porcupine grass, leaf-litter, and under fallen timber (Cogger 2017). However the author has recorded the species under rocks and in loamy spoil heaps.	**Likely.** The species is known to be from the region, with the closest record approximately 30km southeast of the survey area in the Galena and Warribano areas.	DBCA.
Aspidites ramsayi	Woma (SW pop.)	P1		The Woma inhabits woodlands, heaths and shrublands, often with spinifex. It occurs in the sub-humid and arid areas across Australia's interior with a separate sub-population occurring in the Wheatbelt and Goldfields, extending the Shark Bay of WA. The Woma shelters mainly in abandoned monitor and mammal burrows and in soil cracks (Wilson and Swan 2010).	**Likely.** The species is known to be from the region, with the closest record approximately 80km north of the survey area on Coburn Station.	DBCA.
Egernia stokesii subsp. badia	Western Spiny-tailed Skink	VU	EN	The Western Spiny-tailed Skink is known to occur in a broad semi-arid area in south-west WA, between Shark Bay and Minnivale and east to Cue. Most records of the brown form Western Spiny-tailed Skink are in York Gum (*Eucalyptus loxophleba*) woodland with some records in Gimlet (*E. salubris*) and Salmon Gum (*E. salmonophloia*) woodland. Populations persist in woodland patches as small as one hectare and completely surrounded by wheatfields. Sites with the greatest number of individuals contain numerous fallen logs and were subjected to low-intensity grazing by domestic stock. Hollow logs are used as refuge sites in woodland habitat. Preferred refuges consist of piles of several, overlapping, hollow logs providing a combination of basking and shelter sites. An increasing	**Known.** The species was recorded during GHD surveys in the eastern portion of the survey area.	PMST

Taxa	Common Name	Status		Description and habitat requirements	Likelihood of occurrence within the project area	Source
		BC Act	EPBC Act			
				number of skinks are being located in altered habitat under piles of wood, scrap metal or under buildings on private property (DotEE 2019).		
Lerista humphriesi	Zuytdorp Worm Slider, Taper-tailed West Coast slider	P3		The Taper-Tailed West-Coast Slider is known only from the Murchison River district. Current records lie in an area between Murchison House station homestead north to Coburn Station including records in Nerren Nerren. The survey area lay within most of this species distribution. It occurs in Acacia-dominated sandplains and other habitats. (Cogger 2014).	**Known.** There are known records from Kalbarri area from 1995 and along the Vermin Proof Fence Zuytdorp section (Maryan & Gaikhorst, 2019). Additionally the species was recorded within the Northwest portion of the survey area.	Naturemap, Maryan & Gaikhorst, (2019)
Pletholax gracilis edelensis	Keeled legless lizard (Shark Bay)	P3		The Keeled Legless Lizard is mostly found in the Shark Bay region of WA and is not known from this region.	**Unlikely.** Only known from the Edel lands, specimen trapped during this survey is the southern sub species.	Naturemap
Fish						
Hypseleotris aurea	Golden Gudgeon	P2		The Golden Gudgeon inhabits rocky pools amongst dense clumps of submerged water weeds and dead branches (Ref. 2906, 44894). Presumably the species has a high tolerance to increased salinity levels and water temperatures, which typically occur in the habitat during drought periods (Allen *et. al* 2002)	**Highly Unlikely.** There are previous records 4 km southeast of the survey area (Murchison River). As there are no permanent water bodies within the survey area habitat is unsuitable for the species.	DBCA

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Appendix E

Fauna species list

Combined Species List

Combined Fauna Species List

Species name	Common name	Listing	Database searches			Burbridge *et al.* 2000	Gaikhorst and Maryan 2019	Reccon. Nov 2021	Targeted survey March 2022	Targeted survey April 2022	Detailed survey Phase 1 August 2022	Detailed survey Phase 2 October 2022	Regional survey November 2022
		BC/EPBC Act	Nature Map	PMST	DBCA record								
Birds													
Acanthizidae													
Acanthiza apicalis	Inland Thornbill		X			X		4	6	4	35	1	
Acanthiza chrysorrhoa	Yellow-rumped Thornbill		X			X		10	8		10	17	18
Acanthiza uropygialis	Chestnut-rumped Thornbill		X					6	8	8	22	15	5
Acanthiza robustirostris	Slaty-backed Thornbill										4		
Gerygone fusca	Western Gerygone		X			X		1	1		2		
Sericornis frontalis maculatus	White-browed Scrubwren		X			X		2	38	14	20	19	14
Calamanthus campestris	Rufous Fieldwren		X			X		4	32	12	12	19	
Pyrrholaemus brunneus	Redthroat		X						4	4	3	RRD	
Smicrornis brevirostris	Weebill		X					4	20	6	95	40	8
Accipitridae													
Accipiter cirrocephalus	Collared Sparrowhawk		X			X		1	1	1	5	2	
Accipiter fasciatus	Brown Goshawk	MA	X							1	5	6	2
Aquila audax	Wedge-tailed Eagle		X			X		3	5	1	16	20	2
Circus approximans	Swamp Harrier	MA	X								1		
Circus assimilis	Spotted Harrier		X			X					1		
Elanus caeruleus	Black Shouldered Kite					X					1	2	
Hamirostra melanosternon	Black-breasted Buzzard							1			2	2	
Hieraaetus morphnoides	Little Eagle		X					2		1	5	3	1
Haliaeetus leucogaster	White-bellied Sea-Eagle	MA	X	X				2	4			1	1
Lophoictinia isura	Square-tailed Kite							1			1	4	
Haliastur sphenurus	Whistling Kite	MA	X					1	2	1	7	4	2
Pandion cristatus	Osprey	MI, MA	X	X	X				1			1	1
Aegothelidae													
Aegotheles cristatus	Australian Owlet-nightjar							1	2	1	14	1	1
Alcedinidae													
Dacelo novaeguineae	Laughing Kookaburra	INT										1	
Todiramphus pyrrhopygius	Red-backed Kingfisher							1					
Todiramphus sanctus	Sacred Kingfisher	MA	X						1			5	2
Anatidae													
Aythya australis	Hardhead		X										
Biziura lobata	Musk Duck		X										
Chenonetta jubata	Australian Wood Duck		X					8				23	6
Anas gracilis	Grey Teal		X					4		3	8	9	
Anas rhynchotis	Australasian Shoveler		X										
Anas superciliosa	Pacific Black Duck		X								9	4	2
Cygnus atratus	Black Swan		X								1		24
Malacorhynchus membranaceus	Pink-eared Duck											4	
Tadorna tadornoides	Australian Shelduck		X									3	27
Anhingidae													
Anhinga novaehollandiae	Australian Darter		X										6
Apodidae													

Species name	Common name	Listing	Database searches			Burbridge *et al.* 2000	Gaikhorst and Maryan 2019	Reccon. Nov 2021	Targeted survey March 2022	Targeted survey April 2022	Detailed survey Phase 1 August 2022	Detailed survey Phase 2 October 2022	Regional survey November 2022
		BC/EPBC Act	Nature Map	PMST	DBCA record								
Apus pacificus	Fork-tailed Swift	IA		X	X				100				
Ardeidae													
Nycticorax caledonicus	Nankeen Night Heron	MA	X									RRD	
Ardea ibis	Cattle Egret	MA		X				4					5
Ardea pacifica	White-necked Heron		X					3			4	7	3
Ardea modesta	Eastern Great Egret		X					1					6
Egretta novaehollandiae	White-faced Heron		X					2	1		13	7	8
Egretta sacra	Eastern Reef Heron	MA							2			6	6
Artamidae													
Artamus cinereus	Black-faced Woodswallow		X			X		4	2	2	110	29	16
Artamus minor	Little Woodswallow		X									1	
Artamus personatus	Masked Woodswallow		X								220	32	10
Artamus superciliosus	White-browed Woodswallow		X										
Burhinidae													
Burhinus grallarius	Bush Stone-curlew		X								2		
Cacatuidae													
Cacatua sanguinea	Little Corella		X					4					
Calyptorhynchus banksii escondidus	Inland Red-tailed Black-Cockatoo		X					20			27	14	2
Zanda latirostris	Carnaby's Cockatoo	EN, EN	X	X	X			20					3
Eolophus roseicapilla	Galah		X			X		36	8	50	133	287	20
Nymphicus hollandicus	Cockatiel		X										
Campephagidae													
Coracina novaehollandiae	Black-faced Cuckoo-shrike	MA	X					1	2	1	32	17	2
Lalage tricolor	White-winged Triller					X					11	3	
Charadriidae													
Charadrius leschenaultii	Greater Sand Plover	VU, VU	X	X	X				1			2	3
Charadrius mongolus	Lesser Sand Plover	EN, EN	X	X	X								
Charadrius ruficapillus	Red-capped Plover	MA	X									2	4
Elseyornis melanops	Black-fronted Dotterel		X								2		
Pluvialis squatarola	Grey Plover	IA	X	X	X								
Pluvialis fulva	Pacific Golden Plover	MI			X								
Vanellus tricolor	Banded Lapwing		X								18	5	
Columbidae													
Columba livia	Domestic Pigeon	INT	X										
Geopelia cuneata	Diamond Dove		X								2		
Geopelia striata placida	Peaceful Dove		X										
Ocyphaps lophotes	Crested Pigeon		X			X		12	3	7	22	9	7
Phaps chalcoptera	Common Bronzewing		X			X		2	6	2	38	27	12
Phaps elegans	Brush Bronzewing										1	4	
Streptopelia senegalensis	Laughing Turtle-Dove	INT	X						4				1
Corvidae													
Corvus bennetti	Little Crow		X					25	40	18	17	27	22
Corvus coronoides	Australian Raven		X			X			12	2	21	6	4
Corvus orru	Torresian Crow							5			35	47	7
Cracticidae													

Species name	Common name	Listing	Database searches			Burbridge *et al.* 2000	Gaikhorst and Maryan 2019	Reccon. Nov 2021	Targeted survey March 2022	Targeted survey April 2022	Detailed survey Phase 1 August 2022	Detailed survey Phase 2 October 2022	Regional survey November 2022
		BC/EPBC Act	Nature Map	PMST	DBCA record								
Cracticus nigrogularis	Pied Butcherbird		X			X		1	2	1	5	8	
Cracticus tibicen	Australian Magpie		X					4	7	4	19	10	6
Cracticus torquatus	Grey Butcherbird		X			X		2	3	2	31	30	2
Strepera versicolor	Grey Currawong					X		3	4	1	22	14	
Cuculidae													
Cacomantis flabelliformis flabelliformis	Fan-tailed Cuckoo	MA	X			X					2		
Cacomantis pallidus	Pallid Cuckoo	MA	X			X		1			27	6	3
Chalcites lucidus	Shining Bronze-Cuckoo	MA									24	RRD	
Chalcites basalis	Horsfield's Bronze Cuckoo	MA	X			X			2	1	30	5	
Chrysococcyx osculans	Black-eared Cuckoo	MA		X		X				1	4	4	
Diomedeidae													
Diomedea amsterdamensis	Amsterdam Albatross	EN, EN		X									
Diomedea epomophora	Southern Royal Albatross	MI, VU		X									
Diomedea exulans	Wandering Albatross	VU, VU		X									
Thalassarche carteri	Indian Yellow-nosed Albatross	VU, VU		X									
Thalassarche cauta	Shy Albatross	EN, EN		X									
Thalassarche impavida	Campbell Albatross	VU, VU		X									
Thalassarche melanophris	Black-browed Albatross	VU, VU		X									
Thalassarche steadi	White-capped Albatross	VU, VU		X									
Dromaiidae													
Dromaius novaehollandiae	Emu		X			X		2	14	6	54	47	33
Estrildidae													
Taeniopygia guttata	Zebra Finch		X						4	2		11	13
Eupetidae													
Psophodes occidentalis	Chiming Wedgebill		X								1		
Eurostopodidae													
Eurostopodus argus	Spotted Nightjar		X										
Falconidae													
Falco berigora	Brown Falcon		X			X		4	2	3	45	17	5
Falco cenchroides	Nankeen Kestrel		X			X		5	5	2	30	15	2
Falco hypoleucos	Grey Falcon	VU, VU		X									
Falco longipennis	Hobby Falcon		X							1		1	
Falco peregrinus	Peregrine Falcon	SP	X		X								
Fregatidae													
Fregata ariel	Lesser Frigatebird	IA		X									
Haematopodidae													
Haematopus fuliginosus	Sooty Oystercatcher		X						10			5	8
Haematopus longirostris	Australian Pied Oystercatcher		X					2					
Hirundinidae													
Cheramoeca leucosterna	White-backed Swallow		X						2				
Hirundo neoxena	Welcome Swallow	MA	X			X			11	6	62	22	
Petrochelidon ariel	Fairy Martin		X										
Petrochelidon nigricans	Tree Martin	MA	X			X		36	25	30	12	4	4
Laridae													
Anous stolidus	Common Noddy	IA		X									
Anous tenuirostris melanops	Australian Lesser Noddy	VU, VU		X									

Species name	Common name	Listing	Database searches			Burbridge *et al.* 2000	Gaikhorst and Maryan 2019	Reccon. Nov 2021	Targeted survey March 2022	Targeted survey April 2022	Detailed survey Phase 1 August 2022	Detailed survey Phase 2 October 2022	Regional survey November 2022
		BC/EPBC Act	Nature Map	PMST	DBCA record								
Chroicocephalus novaehollandiae	Silver Gull	MA	X					8	20			15	37
Chlidonias hybrida	Whiskered Tern	MA										1	
Hydroprogne caspia	Caspian Tern	IA	X	X									4
Larus pacificus	Pacific Gull	MA	X	X					10			9	9
Onychoprion anaethetus	Bridled Tern	IA		X									
Sternula nereis	Fairy Tern	VU	X	X									
Sterna nilotica	Gull-billed Tern	MI			X				1				
Thalasseus bergii	Crested Tern	MI	X		X			1	40			27	208
Sterna dougallii	Roseate Tern	MI			X								
Locustellidae													
Cincloramphus cruralis	Brown Songlark							1			7	12	
Cincloramphus mathewsi	Rufous Songlark							1			21	1	1
Maluridae													
Malurus lamberti	Variegated Fairy-wren		X					16	15	6	26	8	4
Amytornis textilis	Western Grasswren	P4						4?					
Malurus assimilis	Purple-backed Fairy-wren										2	RRD	
Malurus leucopterus	White-winged Fairy-wren		X			X		16	100	34	44	10	
Malurus pulcherrimus	Blue-breasted Fairy-wren		X			X							
Malurus splendens	Splendid Fairy-wren		X					14	16	4	63	31	16
Stipiturus malachurus	Southern Emu-wren		X					2	38	7	6	5	
Megaluridae													
Megalurus gramineus	Little Grassbird		X										
Megapodiidae													
Leipoa ocellata	Malleefowl	VU, VU	X	X	X	X		print, mound	print, mound	print, mound	RRD, prints, mounds, 2	RRD, prints, mounds, 11	RRD, prints, mounds, 4
Meliphagidae													
Anthochaera carunculata	Red Wattlebird		X						2	2	1	1	
Lichenostomus penicillatus	White-plumed Honeyeater							4					
Lichmera indistincta	Brown Honeyeater		X			X		1	20	6	70	37	16
Purnella albifrons	White-fronted Honeyeater		X			X		4	20	12	97	95	22
Glyciphila melanops	Tawny-crowned Honeyeater		X			X		6	8	4	21	13	RRD
Acanthagenys rufogularis	Spiny-cheeked Honeyeater		X			X		18	16	10	109	48	18
Certhionyx variegatus	Pied Honeyeater		X			X		4			12		
Manorina flavigula	Yellow-throated Miner		X								21	5	
Melithreptus brevirostris	Brown-headed Honeyeater		X					4	4	2	7	7	
Lichenostomus virescens	Singing Honeyeater					X		4	52	3	55	22	4
Phylidonyris niger	White-cheeked Honeyeater		X						2				
Epthianura albifrons	White-fronted Chat		X						20	2	3		
Epthianura tricolor	Crimson Chat		X								2		
Meropidae													
Merops ornatus	Rainbow Bee eater	MA	X	X				12				30	5
Monarchidae													
Grallina cyanoleuca	Magpie-lark		X					8	6	2	7	2	2
Motacillidae													

Species name	Common name	Listing	Database searches			Burbridge *et al.* 2000	Gaikhorst and Maryan 2019	Reccon. Nov 2021	Targeted survey March 2022	Targeted survey April 2022	Detailed survey Phase 1 August 2022	Detailed survey Phase 2 October 2022	Regional survey November 2022
		BC/EPBC Act	Nature Map	PMST	DBCA record								
Anthus novaeseelandiae	Australasian Pipit	MA						6	22	3	23	29	20
Motacilla cinerea	Grey Wagtail	MI, MA		X									
Nectariniidae													
Dicaeum hirundinaceum	Mistletoebird		X						3		5	5	5
Neosittidae													
Daphoenositta chrysoptera	Varied Sittella								4				
Otididae													
Ardeotis australis	Australian Bustard		X							1	1	1	
Pachycephalidae													
Colluricincla harmonica	Grey Shrike-thrush		X			X		4	4	2	45	25	10
Oreoica gutturalis	Crested Bellbird		X			X			2	1	38	21	3
Pachycephala rufiventris	Rufous Whistler		X			X		4	5	2	43	12	2
Pachycephala fuliginosa	Western Whistler					X			5	1	7	11	3
Pardalotidae													
Pardalotus striatus	Striated Pardalote		X					2	2	1	27	10	2
Pelecanidae													
Pelecanus conspicillatus	Australian Pelican	MA	X								1		29
Petroicidae													
Drymodes brunneopygia	Southern Scrub-robin		X			X		3	4	4	27	18	12
Eopsaltria australis griseogularis	Western Yellow Robin		X			X			4	1	4	1	
Melanodryas cucullata	Hooded Robin		X					1			2	1	1
Microeca fascinans	Jacky Winter		X								3	4	
Petroica boodang	Scarlet Robin											2	2
Petroica goodenovii	Red-capped Robin		X						2		31	15	5
Phalacrocoracidae													
Phalacrocorax varius	Pied Cormorant		X										13
Phalacrocorax sulcirostris	Little Black Cormorant		X										20
Phalacrocorax carbo	Great Cormorant		X										8
Phasianidae													
Coturnix pectoralis	Stubble Quail		X						2				
Turnix varius	Painted Buttonquail										6	3	RRD
Turnix velox	Little Button-quail										12	3	RRD
Coturnix ypsilophora	Brown Quail							4			12	5	2
Podargidae													
Podargus strigoides	Tawny Frogmouth		X			X			5	1	6	3	5
Podicipedidae													
Podiceps cristatus	Great Crested Grebe		X										
Poliocephalus poliocephalus	Hoary-headed Grebe		X										
Tachybaptus novaehollandiae	Australasian Grebe		X										
Pomatostomidae													
Pomatostomus superciliosus	White-browed Babbler		X			X		6	12	6	34	22	16
Procellariidae													
Ardenna carneipes	Flesh-footed Shearwater	IA		X									
Ardenna pacifica	Wedge-tailed Shearwater	IA	X	X	X				100		1		
Pachyptila belcheri	Slender-billed Prion		X										
Oceanites oceanicus	Wilson's Storm Petrel	IA	X	X	X				4				

Species name	Common name	Listing	Database searches			Burbridge *et al.* 2000	Gaikhorst and Maryan 2019	Reccon. Nov 2021	Targeted survey March 2022	Targeted survey April 2022	Detailed survey Phase 1 August 2022	Detailed survey Phase 2 October 2022	Regional survey November 2022
		BC/EPBC Act	Nature Map	PMST	DBCA record								
Macronectes giganteus	Southern Giant Petrel	EN, EN		X									
Macronectes halli	Northern Giant Petrel	VU, VU		X									
Pterodroma mollis	Soft-plumaged Petrel	VU, VU		X									
Psittacidae													
Barnardius zonarius	Australian Ringneck		X			X		14	8	4	54	46	2
Melopsittacus undulatus	Budgerigar		X								69	5	
Psephotus varius	Mulga Parrot									RRD	2	1	RRD
Rallidae													
Gallirallus philippensis	Buff-banded Rail	MA	X										1
Fulica atra	Eurasian Coot		X										
Recurvirostridae													
Cladorhynchus leucocephalus	Banded Stilt												3
Himantopus himantopus	Black-winged Stilt	MA	X									2	
Recurvirostra novaehollandiae	Red-necked Avocet		X										
Rhipiduridae													
Rhipidura albiscapa	Grey Fantail		X			X					9		
Rhipidura leucophrys	Willie Wagtail		X			X		1	12	4	23	11	8
Scolopacidae													
Actitis hypoleucos	Common Sandpiper	IA	X	X	X								8
Arenaria interpres	Ruddy Turnstone	IA	X		X								
Calidris acuminata	Sharp-tailed Sandpiper	IA		X	X								
Calidris alba	Sanderling	IA	X		X								4
Calidris canutus	Red Knot	EN, EN		X									
Calidris ferruginea	Curlew Sandpiper	CR, CR	X	X	X								
Calidris melanotos	Pectoral Sandpiper	IA		X									
Calidris ruficollis	Red-necked Stint	IA	X		X				36				6
Limosa lapponica menzbieri	Bar-tailed Godwit	Vu, VU, IA	X	X									21
Numenius madagascariensis	Eastern Curlew	CR, CR	X		X								
Numenius phaeopus	Whimbrel	IA			X								
Rostratula australis	Australian Painted Snipe	EN, EN		X									
Tringa brevipes	Grey-tailed Tattler	P4	X		X								
Tringa nebularia	Common Greenshank	IA	X		X								29
Stercorariidae													
Catharacta skua	Greater Skua	MA		X									
Strigidae													
Ninox boobook	Boobook Owl								4	1	9	2	2
Sulidae													
Morus serrator	Australasian Gannet	MA	X						10			7	
Threskiornithidae													
Platalea flavipes	Yellow-billed Spoonbill		X										
Threskiornis spinicollis	Straw-necked Ibis	MA	X					4	1		53	1	3
Tytonidae													
Tyto javanica	Barn Owl								1		3		1
Zosteropidae													
Zosterops lateralis	Silvereye	MA	X			X		4	26	12	50	56	9

Species name	Common name	Listing	Database searches			Burbridge *et al.* 2000	Gaikhorst and Maryan 2019	Reccon. Nov 2021	Targeted survey March 2022	Targeted survey April 2022	Detailed survey Phase 1 August 2022	Detailed survey Phase 2 October 2022	Regional survey November 2022
		BC/EPBC Act	Nature Map	PMST	DBCA record								
Mammals													
Bovidae													
Capra hircus	Goat	INT	X	X			X	20	5000	100	255	161	100
Canidae													
Canus lupus familiaris	Dog	INT		X				prints	prints	prints	2	3	
Vulpes vulpes	Fox	INT		X				1	prints	prints	7	23	
Dasyuridae													
Dasyurus geoffroii	Chuditch	VU, VU	X	X	X								
Sminthopsis crassicaudata	Fat-tailed Dunnart		X									2	
Sminthopsis dolichura	Little long-tailed Dunnart		X			X						17	RRD
Sminthopsis granulipes	White-tailed Dunnart		X			X					6	29	
Sminthopsis hirtipes	Hairy-footed Dunnart		X								4	1	RRD
Sminthopsis macroura	Stripe-faced Dunnart										3	15	
Emballonuridae													
Saccolaimus flaviventris	Yellow-bellied Sheathtail Bat		X								RRD		
Felidae													
Felis catus	Cat	INT			X			X	2	1	5	20	1 RRD
Leporidae													
Oryctolagus cuniculus	Rabbit	INT				X		12	1	12	11	4	47 RRD
Macropodidae													
Osphranter robustus	Common Wallaroo							6	20	2	15	45	17 RRD
Macropus fuliginosus	Western Grey Kangaroo		X				X	2	100	20	180	70	23 RRD
Macropus rufus	Red Kangaroo											9	6
Notamacropus eugenii derbianus	Tammar Wallaby	P4	X		X								
Petrogale lateralis lateralis	Black-flanked Rock-wallaby	VU, EN		X									
Molossidae													
Austronomus australis	White-striped freetail Bat					X	X	RRD	2	1, RRD	RRD	RRD	
Ozimops petersi	Inland Freetail Bat					X						RRD	
Muridae													
Mus musculus	House Mouse	INT	X	X				2	1	3	81	119	RRD
Notomys alexis	Spinifex Hopping Mouse		X					RRD	RRD	6	23	139	RRD
Pseudomys albocinereus	Ash-grey Mouse		X			X					57	59	RRD
Pseudomys hermannsburgensis	Sandy Inland Mouse		X							2	28	36	RRD
Rattus rattus	Black Rat	INT	X	X									
Potoroidae													
Bettongia penicillata ogilbyi	Woylie	EN		X									
Pteropodidae													
Pteropus scapulatus	Little Red Flying-fox		X										
Suidae													
Sus scrofa	Pig	INT	X	X				digs	digs	digs	4	RRD	RRD
Tachyglossidae													
Tachyglossus aculeatus	Short-beaked Echidna							3	prints	RRD	5 RRD	9 RRD	3 RRD
Tarsipedidae													
Tarsipes rostratus	Honey Possum		X			X					15	9	
Vespertilionidae													
Chalinolobus gouldii	Gould's Wattle Bat					X				RRD	RRD	RRD	

Species name	Common name	Listing	Database searches			Burbridge *et al.* 2000	Gaikhorst and Maryan 2019	Reccon. Nov 2021	Targeted survey March 2022	Targeted survey April 2022	Detailed survey Phase 1 August 2022	Detailed survey Phase 2 October 2022	Regional survey November 2022
		BC/EPBC Act	Nature Map	PMST	DBCA record								
Chalinolobus morio	Chocolate Wattle Bat		X								RRD	RRD	
Nyctophilus geoffroyi	Lesser Long-eared Bat		X			X				RRD	RRD	RRD	
Scotorepens greyii	Little Broad-nosed Bat		X										
Scotorepens balstoni	Inland Broad-nosed Bat										RRD	RRD	
Vespadelus finlaysoni	Finlayson's Cave Bat		X			X				RRD		RRD	
Reptiles													
Agamidae													
Gowidon longirostris	Long-nosed Dragon		X					4	1	5		1	
Ctenophorus adelaidensis	Western Heath Dragon		X			X				1	4	2	
Ctenophorus butlerorum	Shark Bay Heath Dragon					X?						2	
Ctenophorus nuchalis	Central Netted Dragon		X			X			2	6		4	
Ctenophorus reticulatus	Western Netted Dragon		X					2	3	6	18	2	1
Ctenophorus scutulatus	Lozenge-marked Dragon		X					20	6	2	15	11	5
Ctenophorus maculatus maculatus	Spotted Military Dragon		X			X	1	10	100	10	78	53	24
Moloch horridus	Thorny Devil		X			X				1	8	11	3 RRD
Pogona minor minor	Dwarf Bearded Dragon		X			X		3	60	2	42	22	2
Boidae													
Antaresia childreni	Children's Python		X										
Carphodactylidae													
Nephrurus levis occidentalis	Smooth Knob-tailed Gecko		X			X			2	22	3	11	2
Underwoodisaurus milii	Thick-tailed Gecko		X					1	1		3		5
Diplodactylidae													
Crenadactylus occidentalis	Western Clawless Gecko		X			X	1						
Diplodactylus omatus	Ornate Gecko		X			X				3	3	1	1
Diplodactylus pulcher	Pretty Gecko		X							4		6	1
Lucasium alboguttatum	White-spotted Ground Gecko		X			X				6		3	4
Strophurus michaelseni	Robust Striped Gecko						1			1			
Strophurus spinigerus spinigerus	Soft Spiney-tailed Gecko		X			X				8	2	8	70
Strophurus strophurus	Western Spiney-tailed Gecko		X							1		3	1
Elapidae													
Demansia reticulata	Yellow-faced Whipsnake		X								7	3	
Demansia calodera	Black-necked Whipsnake										5	1	
Neelaps bimaculatus	Black-naped Snake		X			X						1	
Pseudechis australis	Mulga Snake		X								1	3	
Pseudonaja mengdeni	Gwardar		X					1		1	1	4	2
Pseudonaja modesta	Ringed Brown Snake		X								4	5	
Brachyurophis fasciolatus fasciolatus	Narrow-banded Shovel-nosed Snake											1	
Brachyurophis semifasciatus	Southern Shovel-nosed Snake		X				1				5	2	
Simoselaps bertholdi	Jan's Banded Snake		X				1					2	
Simoselaps littoralis	West Coast Banded Snake		X			X				2	4	8	
Suta monachus	Munk snake						1		1		3		
Gekkonidae													
Gehyra variegata	Tree Dtella		X			X	5	2	6	7	11	11	23
Heteronotia binoei	Bynoe's Gecko		X								11		
Pygopodidae													

Species name	Common name	Listing	Database searches			Burbridge *et al.* 2000	Gaikhorst and Maryan 2019	Reccon. Nov 2021	Targeted survey March 2022	Targeted survey April 2022	Detailed survey Phase 1 August 2022	Detailed survey Phase 2 October 2022	Regional survey November 2022
		BC/EPBC Act	Nature Map	PMST	DBCA record								
Aprasia smithi	Black-tipped Worm-lizard		X										
Delma australis	Marbled Face Delma		X			X						6	
Delma concinna concinna	Javelin lizard (southern sub spp.)										1	2	
Delma fraseri	Fraser's Legless Lizard		X								1	1	
Delma grayii	Side-barred Delma		X										
Delma tincta	Black-necked Delma		X									1	
Lialis burtonis	Burtons Legless Lizard		X			X					6	4	
Pletholax edelensis	Keeled Legless Lizard (Shark Bay)	P3	X		X	X							
Pletholax gracilis	Keeled Legless Lizard											1	
Pygopus lepidopodus	Common Scalyfoot		X			X		1	1		11	3	
Pygopus nigriceps	Western Hooded Scalyfoot											3	
Pythonidae													
Aspidites ramsayi	Woma (*SW pop.*)	P1			X								
Scincidae													
Cryptoblepharus buchananii	Buchanan's Snake-eyed Skink		X								3	1	
Cryptoblepharus plagiocephalus	Common Snake-eyed Skink		X			X		1	1		1		
Ctenotus alleni	Allen's Ctenotus										1	1	RRD
Ctenotus australis	West Coast Long-tailed Ctenotus		X			X					3	7	RRD
Ctenotus fallens	West Coast Ctenotus		X			X			1		14	65	RRD
Ctenotus pantherinus	Leopard Skink		X								4	12	
Ctenotus schomburgkii	Barred Wedge-snouted Ctenotus		X									7	
Cyclodomorphus branchialis	Gilled Slender Blue tongue	VU			X								
Cyclodomorphus celatus	Western Slender blue-tongue		X			X	3				9	12	
Egernia stokesii badia	Western Spiny-tailed Skink	VU, EN		X					latrines	latrines 8	5	10	
Eremiascincus richardsonii	Broad-banded Sand Swimmer		X									1	
Lerista axillaris	Striped-sided robust slider (Kalbarri)	P2			X								
Lerista connivens	Blinking Broad-striped Slider		X								4	2	
Lerista elegans	Elegant Slider		X			X					5	14	
Lerista humphriesi	Humphries Worm-slider	P3	X		X	X	5				16	1	
Lerista macropisthopus fusciceps	Unpatterned Robust Slider		X								1	2	
Lerista micra	Micro Three-toed Slider		X			X				1	8	6	
Lerista miopus	Northern Dotted-line Robust Slider		X			X	6				16	7	
Lerista planiventralis decora	Keeled Slider		X			X					13	10	
Lerista praepedita	West Coast Worm-slider		X			X	10			1	26	18	1
Lerista kendricki	Shark Bay Broad-striped slider		X			X	1				2	2	
Tiliqua occipitalis	Western Blue-tongued Skink		X					1			RRD	28	4
Tiliqua rugosa	Shingleback		X					2	1	1	8	21	10
Menetia greyii	Common Dwarf Skink		X			X	1	1	1	2	25	20	
Menetia surda	Surd's Dwarf Skink		X			X	1				4	8	
Morethia lineoocellata	West Coast Pale-flecked Morethia		X			X			1		6	3	
Morethia obscura	Shrubland Morethia Skink		X					1			7	1	RRD
Typhlopidae													
Anilios australis	Southern blind Snake		X					1			1		
Anilios hamatus	Pale-headed Blind Snake											5	
Anilios leptosoma	Murchison Blind Snake										4	1	

Species name	Common name	Listing	Database searches			Burbridge *et al.* 2000	Gaikhorst and Maryan 2019	Reccon. Nov 2021	Targeted survey March 2022	Targeted survey April 2022	Detailed survey Phase 1 August 2022	Detailed survey Phase 2 October 2022	Regional survey November 2022
		BC/EPBC Act	Nature Map	PMST	DBCA record								
Varanidae													
Varanus caudolineatus	Pygmy Striped Tailed Monitor									1	1	1	
Varanus eremius	Pygmy Desert Monitor		X							3	3	1	
Varanus giganteus	Perenties										RRD		
Varanus gouldii	Sand Goanna		X					3	1	1	RRD	21	2
Varanus panoptes rubidus	Yellow Spotted Monitor										RRD	RRD	
Varanus tristis	Racehorse Goanna		X							1	2	7	RRD
Amphibia													
Limnodynastidae													
Limnodynastes dorsalis	Western Banjo Frog		X						50	100	3		
Neobatrachus kunapalari	Kunapalari Frog		X								1		
Neobatrachus pelobatoides	Humming Frog		X			X					1		
Neobatrachus wilsmorei	Plonking Frog		X			X							
Myobatrachidae													
Arenophryne xiphorhyncha	Southern Sandhill Frog		X			X					269	252	
Heleioporus albopunctatus	Western Spotted Frog		X								8		
Heleioporus psammophilus	Sand Frog		X										
Myobatrachus gouldii	Turtle Frog		X										
Pseudophryne guentheri	Crawling Toadlet		X			X					1		
Freshwater Fishes													
Hypseleotris aurea	Golden Gudgeon	P2	X		X								

Legend:

X = includes all evidence of species presence (visual observations, scat, mounds, burrows or recorded on remote recording device including when species total numbers cannot be determined)

Pr- Probable recorded of species via bat detection or calls overlap with another species, ?- Nyctophilus sp. Recorded and could be either or both species

Priority 1-4 = Priority species 1 – 4 under DBCA

CR = Critically Endangered under the EPBC and/or BC Act

EN = Endangered under the EPBC and/or BC Act

VU = Vulnerable under the EPBC and/or BC Act

OS = Other Specially under the EPBC and/or BC Act

IA= International Agreement under the BC Act

MI = Migratory Species under the EPBC Act

MA = Marine Species under the EPBC Act

INT = Introduced/Naturalised species

SP = Special Protection listed under BC Act

RRD = Fauna recording devices includes: Remote cameras, bat detectors, bird acoustic records.

Appendix F

Malleefowl Mound assessments

Malleefowl Mounds found by GHD

Date	Habitat type	Latitude	Longitude	Class and profile	Diameter (cm)	Rim (cm)	Height (cm)	Deep (cm)	Comments	Representative photo
17/11/2021	Acacia shrubland	-27.3826	114.2389	Mound (active) 2	500	150	60	80	some egg shell present, re checked march dug out prints around LiDAR identified is MFMA2807	
15/11/2021	Acacia shrubland	-27.4731	114.223	Mound (active) 2	600	150	30	30	re checked march also and re-dug out with prints and feathers around	
16/11/2021	Acacia shrubland	-27.5047	114.1749	Mound (Inactive) 1	350	100	60	0	Surrounding fallen branch over mound likely abandoned due to impacts	

Date	Habitat type	Latitude	Longitude	Class and profile	Diameter (cm)	Rim (cm)	Height (cm)	Deep (cm)	Comments	Representative photo
14/03/2022	Mallee woodland	-27.4652	114.228	Mound (inactive) 6	700	200	45	15	mallee over acacia shrubland, extinct LiDAR identified is MFMA3403	
14/03/2022	Acacia shrubland	-27.3367	114.5912	Mound (inactive) 1	500	200	50	1200	dug out but inactive, acacia shrubland LiDAR identified is MFMA2003	
14/03/2022	Acacia shrubland	-27.39	114.2583	Mound (active) 2	700	200	70	40	Acacia shrubland crater fresh tracks recently excavated profile 2 LiDAR identified is MFMA2863	

Date	Habitat type	Latitude	Longitude	Class and profile	Diameter (cm)	Rim (cm)	Height (cm)	Deep (cm)	Comments	Representative photo
5/04/2022	Mixed Shrubland	-27.3765	114.2273	Mound (active) 2	500	150	120	50	dug out but inactive, sandplain	
5/04/2022	Acacia shrubland	-27.3664	114.1946	Mound (inactive) 6	400	150	60	0	ancient and inactive, sandplain shrubland no crater	
5/04/2022	Acacia shrubland	-27.3992	114.1857	Mound (inactive) 6	400	150	30	30	ancient and inactive, sandplain shrubland	

Date	Habitat type	Latitude	Longitude	Class and profile	Diameter (cm)	Rim (cm)	Height (cm)	Deep (cm)	Comments	Representative photo
4/04/2022	Mallee shrubland	-27.3991	114.1795	Mound (inactive) 6	400	180	30	30	inactive, sandplain shrubland	
5/04/2022	Mallee shrubland	-27.3987	114.1672	Mound (inactive) 6	500	200	40	20	ancient inactive, sandplain shrubland	
25/08/2022	Mallee shrubland	-27.3252	114.1246	Mound (active) 3	400	200	35	40	Malleefowl sighted at mound with fresh evidence of debris added.	

Date	Habitat type	Latitude	Longitude	Class and profile	Diameter (cm)	Rim (cm)	Height (cm)	Deep (cm)	Comments	Representative photo
26/08/2022	Acacia shrubland	-27.4537	114.1851	Mound (Inactive) 1	500	200	100	30	Looks to be mound dug from old spoil with prints on rim, not used but test dug.	
26/08/2022	Mallee shrubland	-27.3668	114.1573	Mound (Inactive) 1	350	100	70	60	On side of track, dug out, profile 1. Looks to have been use at least two years ago	
26/08/2022	Mallee shrubland	-27.4007	114.2163	Mound (Inactive) 6	550	200	100	0	old mound old shrubs growing on top of crater.	

Date	Habitat type	Latitude	Longitude	Class and profile	Diameter (cm)	Rim (cm)	Height (cm)	Deep (cm)	Comments	Representative photo
28/08/2022	Acacia shrubland	-27.4153	114.1417	Mound (Inactive) 6	500	200	40	30	Looks like a mound dug from old spoil heap	
28/08/2022	Acacia shrubland	-27.3985	114.1530	Mound (Inactive) 6	500	150	70	20	Very old mound almost no crater left	
17/10/2022	Mallee shrubland	-27.4048	114.4125	Mound (Inactive) 6	450	160	40	15	very old mound shrubs growing from crater	

Date	Habitat type	Latitude	Longitude	Class and profile	Diameter (cm)	Rim (cm)	Height (cm)	Deep (cm)	Comments	Representative photo
12/10/2022	Banksia shrubland	-27.3881	114.2313	Mound (active) 4	450	140	100	80	recently active full of egg shell, gg pic hat Also LiDAR found 2853	
15/10/2022	Banksia shrubland	-27.1254	114.2782	Mound (active) 2	300	80	60	30	Regional - spoil on road dugout by mf, lots prints and scat	
15/10/2022	Mallee shrubland	-27.3630	114.4818	Mound (active) 4	350	120	40	25	Regional - outside survey area. Extensive scratching, very fresh.	

Date	Habitat type	Latitude	Longitude	Class and profile	Diameter (cm)	Rim (cm)	Height (cm)	Deep (cm)	Comments	Representative photo
14/10/2022	Mallee shrubland	-27.3153	114.5301	Mound (active) 4	400	200	100	15	Excellent multiple season use active mound.	
14/10/2022	Mallee shrubland	-27.3049	114.5400	Mound (active) 3	600	150	90	45	recently inactive. looks to be used last season.	
13/10/2022	Mallee shrubland	-27.3397	114.5563	Mound (active) 4	450	150	120	20	Excellent active mound, signs this mound has been used multiple times lots scattered egg shell LiDAR identified is MFMA2075	

Date	Habitat type	Latitude	Longitude	Class and profile	Diameter (cm)	Rim (cm)	Height (cm)	Deep (cm)	Comments	Representative photo
14/10/2022	Mallee shrubland	-27.3144	114.5323	Mound (active) 4	600	150	800	15	Capped active multiple season mound with evidence of egg shell from past seasons	
10/10/2022	Acacia shrubland	-27.4373	114.159432	Mound (active) 4	300	100	1200	0	Capped active mound with prints and egg shell present	
8/02/2023	Mallee woodland	-27.3372	114.407635	Mound (Inactive) 6	500	150	45	10		

Date	Habitat type	Latitude	Longitude	Class and profile	Diameter (cm)	Rim (cm)	Height (cm)	Deep (cm)	Comments	Representative photo
9/02/2023	Mallee woodland	-27.346	114.421228	Mound (Inactive) 6	400	150	30	30	Two ancient mounds side by side	
12/02/2023	Acacia shrubland	-27.4445	114.208957	Mound (Inactive) 6	600	100	30	10		
12/02/2023	Mallee woodland	-27.4442	114.193387	Mound (Inactive) 6	500	100	30	10		

Malleefowl mounds identified via LiDAR (Fugro) and ground truthed

LiDAR code	Date	Habitat type	Latitude	Long.		Class and Profile	Diameter (cm)	Rim (cm)	Height (cm)	Deep (cm)	Comments	Representative photo
MFMA 186	11/2/2023	Mallee woodland	-27.3015	114.1037		Mound (Inactive) 1	300	50	20	60	Dug out of the side of a old mound	
MFMA 226	11/2/2023	Banksia shrubland	-27.3136	114.0991		Mound (Inactive) 6	600	100	50	10		
MFMA 267	11/2/2023	Mallee woodland	-27.3219	114.1039		Mound (Active) 5	500	100	100	30	mound off the side of old mound, large/old mound P1. old prints, feathers	

LiDAR code	Date	Habitat type	Latitude	Long.		Class and Profile	Diameter (cm)	Rim (cm)	Height (cm)	Deep (cm)	Comments	Representative photo
MFMA 273	11/2/2023	Mallee woodland	-27.3234	114.1005		Mound (Active) 4	500	50	150	0		
MFMA 411	9/2/2023		-27.2555	114.343							Mound of soil, not Malleefowl	
MFMA 447	10/2/2023	Mallee woodland	-27.2579	114.3132		Mound (Inactive) 6	500	100	65	50		
MFMA 452	10/2/2023	Mallee woodland	-27.2588	114.313		Mound (Inactive) 6	600	200	70	30		

LiDAR code	Date	Habitat type	Latitude	Long.		Class and Profile	Diameter (cm)	Rim (cm)	Height (cm)	Deep (cm)	Comments	Representative photo
MFMA 455	9/2/2023	Acacia shrubland	-27.259	114.2128		Mound (Inactive) 6	550	150	40	0	Ancient mound. over grown with shrubs	
MFMA 456	10/2/2023	Mallee woodland	-27.2606	114.3244		Mound (Inactive) 6	350	80	30	50	Ancient mound	
MFMA 462	10/2/2023	Mallee woodland	-27.2613	114.3133		Mound (Active) 5	400	80	90	40	Active mound currently brooding and being thermoregulated	

LiDAR code	Date	Habitat type	Latitude	Long.		Class and Profile	Diameter (cm)	Rim (cm)	Height (cm)	Deep (cm)	Comments	Representative photo
MFMA 467	9/2/2023	Acacia shrubland	-27.2605	114.2136		Mound (Active) 2	350	100	70	30	Recently dug out	
MFMA 477	9/2/2023	Mallee woodland	-27.2622	114.2108		Mound (Inactive) 6	500	150	70	5		
MFMA 494	10/2/2023	Mallee woodland	-27.2649	114.3230		Mound (Inactive) 6	550	100	40	90		

LiDAR code	Date	Habitat type	Latitude	Long.		Class and Profile	Diameter (cm)	Rim (cm)	Height (cm)	Deep (cm)	Comments	Representative photo
MFMA 498	9/2/2023	Mallee woodland	-27.2646	114.2054		Mound (Active) 2	500	150	120	20	Small area fresh dug out, lots egg shell, prints and scat	
MFMA 500	9/2/2023	Mallee woodland	-27.264	114.2107		Mound (Active) 2	600	200	120	100	Fresh dug out, deep, lots egg shell, prints and scat	
MFMA 507	10/2/2023	Mallee woodland	-27.2672	114.3181		Mound (Inactive) 1	400	100	70	120	Older mound old dig out	

LiDAR code	Date	Habitat type	Latitude	Long.		Class and Profile	Diameter (cm)	Rim (cm)	Height (cm)	Deep (cm)	Comments	Representative photo
MFMA 513	9/2/2023	Mallee woodland	-27.2651	114.2027		Mound (Active) 2	450	100	60	120	Fresh dug out, deep, lots egg shell, prints and scat	
MFMA 515	10/2/2023	Acacia shrubland	-27.2673	114.3134		Mound (Inactive) 1	500	100	100	800	Older mound old dig out	
MFMA 517	10/2/2023	Mallee woodland	-27.2682	114.3205		Mound (Inactive) 1	450	80	60	100	possible predation, old dig out but has shell, feathers and scat present	

LiDAR code	Date	Habitat type	Latitude	Long.		Class and Profile	Diameter (cm)	Rim (cm)	Height (cm)	Deep (cm)	Comments	Representative photo
MFMA 533	10/2/2023	Mallee woodland	-27.2708	114.3165		Mound (Active) 5	600	150	100	40	Active mound currently brooding and being thermoregulated. Scats, lots of prints, shell and feathers present	
MFMA 536	9/2/2023	Mallee woodland	-27.269	114.2034		Mound (Inactive) 6	450	100	30	60		
MFMA 540	10/2/2023	Acacia shrubland	-27.2714	114.3143		Mound (Inactive) 1	450	100	30	100		
MFMA 892	9/2/2023	Acacia Shrubland	-27.3339	114.4046		Mound (Active) 2	500	150	40	80		

LiDAR code	Date	Habitat type	Latitude	Long.		Class and Profile	Diameter (cm)	Rim (cm)	Height (cm)	Deep (cm)	Comments	Representative photo
MFMA 913	11/2/2023	Mallee woodland	-27.3334	114.1796		Mound (Active) 5	400	80	70	20		
MFMA 921	8/2/2023	York Gum Woodland	-27.3373	114.4276		Mound (Inactive) 6	600	200	30	50		
MFMA 923	10/2/2023	Mallee woodland	-27.3356	114.2715		Mound (Inactive) 6	600	150	50	5		

LiDAR code	Date	Habitat type	Latitude	Long.		Class and Profile	Diameter (cm)	Rim (cm)	Height (cm)	Deep (cm)	Comments	Representative photo
MFMA 937	8/2/2023	Mallee woodland	-27.3397	114.4051		Mound (Active) 5	400	150	70	40	Active mound being thermoregulated. Lots of prints and scratching	
MFMA 941	11/2/2023	Mallee woodland	-27.3371	114.1768		Mound (Inactive) 1	600	150	70	100	Active mound, breeding recent, lots of tracks around mound	
MFMA 888	9/2/2023		-27.3321	114.4086							Termite mound	
MFMA 891	9/2/2023		-27.3343	114.4034							Termite mound	
MFMA 895	8/2/2023		-27.3344	114.4358							Termite mound	
MFMA 907	8/2/2023		-27.3352	114.386							Termite mound	
MFMA 911	8/2/2023		-27.3367	114.4125							Termite mound	

LiDAR code	Date	Habitat type	Latitude	Long.		Class and Profile	Diameter (cm)	Rim (cm)	Height (cm)	Deep (cm)	Comments	Representative photo
MFMA 958	10/2/2023	Mallee woodland	-27.3396	114.2722		Mound (Inactive) 6	500	100	120	0	Ancient mound	
MFMA 968	11/2/2023	Mallee woodland	-27.3394	114.1857		Mound (Active) 5	500	150	120	30	Active mound being thermoregulated. Lots of prints and scratching	
MFMA 970	10/2/2023	Mallee woodland	-27.3412	114.272		Mound (Inactive) 1	400	80	80	80	Mound dug out and left	

LiDAR code	Date	Habitat type	Latitude	Long.		Class and Profile	Diameter (cm)	Rim (cm)	Height (cm)	Deep (cm)	Comments	Representative photo
MFMA 971	10/2/2023	Mallee woodland	-27.3414	114.2783		Mound (Inactive) 6	500	100	30	50	Ancient mound	
MFMA 975	9/2/2023		-27.3439	114.4068							Termite mound	
MFMA 984	9/2/2023		-27.3454	114.4161							Termite mound	
MFMA 985	9/2/2023		-27.3453	114.4226							Termite mound	
MFMA 993	9/2/2023	Mallee woodland	-27.3462	114.4135		Mound (Active) 4	400	100	100	0	Active mound, capped and thermoregulating. Dead chick, predation	
MFMA 999	10/2/2023	Mallee woodland	-27.3448	114.2804		Mound (Inactive) 6	500	100	30	60	Ancient mound	

LiDAR code	Date	Habitat type	Latitude	Long.		Class and Profile	Diameter (cm)	Rim (cm)	Height (cm)	Deep (cm)	Comments	Representative photo
MFMA 1007	9/2/2023	Mallee woodland	-27.3469	114.4017		Mound (Active) 3	350	100	70	30	digs in mound, possible test holes for re digging	
MFMA 1011	9/2/2023		-27.34683	114.4210							Termite mound	
MFMA 1014	11/2/2023	Mallee woodland	-27.3437	114.1826		Mound (Inactive) 6	500	100	80	5	Ancient mound	
MFMA 1035	10/2/2023	Mallee woodland	-27.348	114.2731		Mound (Inactive) 6	550	150	70	5	Ancient mound	

LiDAR code	Date	Habitat type	Latitude	Long.		Class and Profile	Diameter (cm)	Rim (cm)	Height (cm)	Deep (cm)	Comments	Representative photo
MFMA 1040	11/2/2023	Mallee woodland	-27.3482	114.1885		Mound (Active) 5	400	100	70	20	Active mound capped, being thermoregulated. Lots of prints and scratching	
MFMA 2711	13/2/2023	Mallee woodland	-27.4325	114.1519		Mound (Active) 3	600	150	120	30	litter but not currently active, has been used	
MFMA 2830	13/2/2023	Mallee woodland	-27.385	114.24		Mound (Active) 2	600	120	80	150	active mound, appears to have finished for the season and dug out nest chamber. Lots of egg shell, scats and scratching	

LiDAR code	Date	Habitat type	Latitude	Long.		Class and Profile	Diameter (cm)	Rim (cm)	Height (cm)	Deep (cm)	Comments	Representative photo
MFMA 2831	13/2/2023	Mallee woodland	-27.3853	114.2394		Mound (Active) 2	350	80	80	60	Active mound, appears to have finished for the season and dug out nest chamber. Lots of egg shell, scats, feathers and scratching	
MFMA 2869	13/2/2023	Mallee woodland	-27.3906	114.255		Mound (Active) 5	400	50	100	15	Active mound currently brooding and being thermoregulated. Scats, lots of prints, shell present	
MFMA 3101	12/2/2023	Mallee woodland	-27.422	114.2224		Mound (Inactive) 6	400	80	50	10	Ancient mound	

LiDAR code	Date	Habitat type	Latitude	Long.		Class and Profile	Diameter (cm)	Rim (cm)	Height (cm)	Deep (cm)	Comments	Representative photo
MFMA 3103	12/2/2023	Mallee woodland	-27.4227	114.2811		Mound (Inactive) 1	450	100	80	50	Old dig out and left, still has shell and old prints present	
MFMA 3137	12/2/2023	Mixed woodland	-27.4247	114.2173		Mound (Active) 2	450	80	100	70	Fresh dug out, deep, lots egg shell, prints and scat	
MFMA 3139	12/2/2023	Mallee woodland	-27.4257	114.2263		Mound (Active) 2	400	80	100	120	Fresh dug out, deep, lots egg shell, prints and scat	

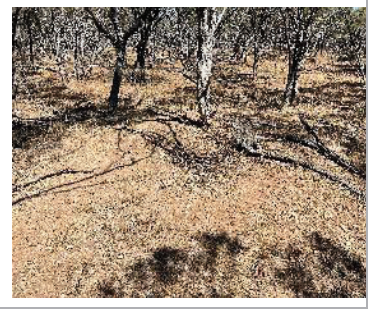
LiDAR code	Date	Habitat type	Latitude	Long.		Class and Profile	Diameter (cm)	Rim (cm)	Height (cm)	Deep (cm)	Comments	Representative photo
MFMA 3140	12/2/2023	Mallee woodland	-27.4249	114.2284		Mound (Active) 2	400	70	50	110	Fresh dug out, deep, lots egg shell, prints and scat	
MFMA 3148	12/2/2023	Mixed Shrubland	-27.4257	114.2527		Mound (Inactive) 1	500	100	60	50	Old dig out and left, still has shell and old prints present	
MFMA 3182	12/2/2023	Mallee woodland	-27.4301	114.2309		Mound (Active) 2	600	120	100	120	Fresh dug out, deep, lots egg shell, prints and scat	

LiDAR code	Date	Habitat type	Latitude	Long.		Class and Profile	Diameter (cm)	Rim (cm)	Height (cm)	Deep (cm)	Comments	Representative photo
MFMA 3226	12/2/2023	Acacia shrubland	-27.439	114.1976		Mound (Inactive) 6	450	100	60	40	Ancient mound	
MFMA 3227	12/2/2023	Mixed Shrubland	-27.44	114.2475		Mound (Inactive) 6	600	150	120	10	Likely abandoned due to fire impacts	
MFMA 3234	12/2/2023	Mallee woodland	-27.4412	114.2174		Mound (Inactive) 6	500	90	30	30	Ancient mound	

LiDAR code	Date	Habitat type	Latitude	Long.		Class and Profile	Diameter (cm)	Rim (cm)	Height (cm)	Deep (cm)	Comments	Representative photo
MFMA 3240	12/2/2023	Mallee woodland	-27.4436	114.2167		Mound (Inactive) 6	550	120	40	10	Ancient mound	
MFMA 3250	12/2/2023	Mallee woodland	-27.4439	114.1983		Mound (Inactive) 1	450	80	50	110	Previous dug out and left	
MFMA 3251	12/2/2023	Mallee woodland	-27.4442	114.2098		Mound (Inactive) 6	600	120	100	20	Ancient mound, possible scratching present but old	

LiDAR code	Date	Habitat type	Latitude	Long.		Class and Profile	Diameter (cm)	Rim (cm)	Height (cm)	Deep (cm)	Comments	Representative photo
MFMA 3252	12/2/2023	Mallee woodland	-27.4444	114.2143		Mound (Inactive) 6	600	150	60	20	Ancient mound	
MFMA 3255	12/2/2023	Acacia shrubland	-27.4458	114.1964		Mound (Inactive) 1	450	70	40	50	Birds dug out amongst shrubs but not used	
MFMA 3260	12/2/2023	Mallee woodland	-27.44641	114.2089		Mound (Inactive) 6	600	100	60	50	Ancient mound	

LiDAR code	Date	Habitat type	Latitude	Long.		Class and Profile	Diameter (cm)	Rim (cm)	Height (cm)	Deep (cm)	Comments	Representative photo
MFMA 3278	12/2/2023	Mallee woodland	-27.4489	114.1985		Mound (Inactive) 1	400	100	50	70	Previous dug out and left	
MFMA 3287	12/2/2023	Mallee woodland	-27.4506	114.2067		Mound (Inactive) 6	600	120	100	50	Ancient mound	
MFMA 3289	12/2/2023	Mallee woodland	-27.4508	114.2133		Mound (Inactive) 6	600	150	70	50	Ancient mound	

LiDAR code	Date	Habitat type	Latitude	Long.		Class and Profile	Diameter (cm)	Rim (cm)	Height (cm)	Deep (cm)	Comments	Representative photo
MFMA 3816	13/2/2023	Mallee woodland	-27.5331	114.1922		Mound (Active) 4	450	120	100	0	Active mound currently brooding and being thermoregulated. Lots of prints, shell present	
MFMA 3811	13/2/2023	Mallee woodland	-27.5327	114.1868		Mound (Inactive) 6	550	120	150	60	Ancient mound	
MFMA 3314	12/2/2023	Mallee woodland	-27.4530	114.2086		Mound (Inactive) 6	700	200	120	40	Ancient mound	

LiDAR code	Date	Habitat type	Latitude	Long.		Class and Profile	Diameter (cm)	Rim (cm)	Height (cm)	Deep (cm)	Comments	Representative photo
MFMA 3315	12/2/2023	Mallee woodland	-27.4532	114.2105		Mound (Inactive) 6	500	100	90	50	Ancient mound	
MFMA 3325	12/2/2023	Mallee woodland	-27.4538	114.2121		Mound (Inactive) 6	700	200	120	80	Ancient mound	
MFMA 3468	12/2/2023	Mallee woodland	-27.4711	114.224		Mound (Inactive) 6	350	60	50	60	Ancient mound	

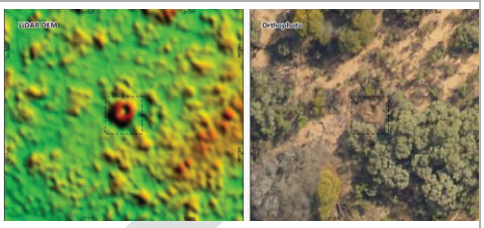
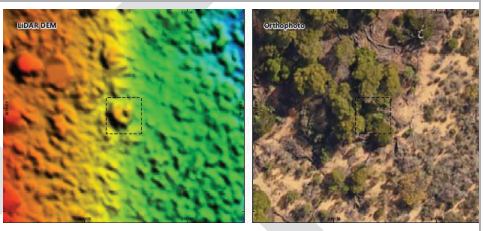
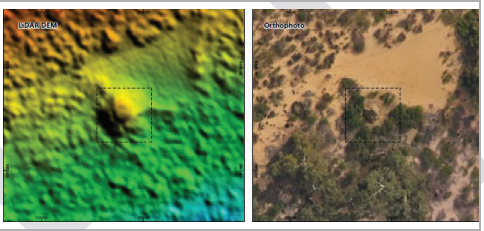
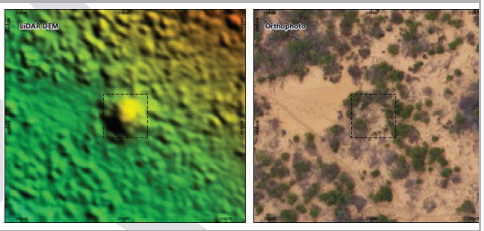
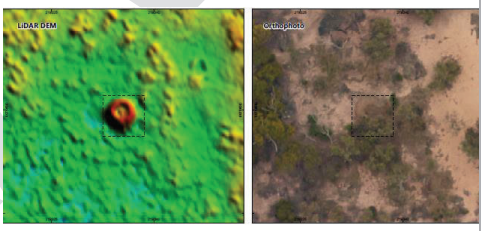
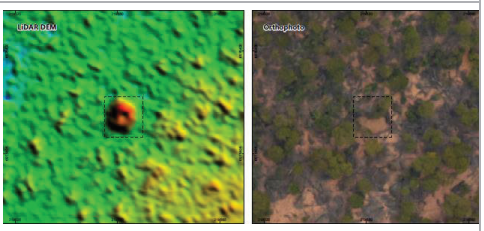
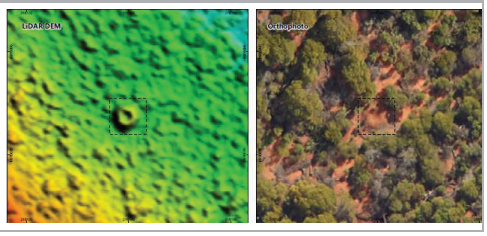
LiDAR code	Date	Habitat type	Latitude	Long.		Class and Profile	Diameter (cm)	Rim (cm)	Height (cm)	Deep (cm)	Comments	Representative photo
MFMA 3511	13/2/2023	Mallee woodland	-27.4751	114.1832		Mound (Inactive) 1	450	80	70	30	Previously dug out and left	
MFMA 3525	13/2/2023	Mallee woodland	-27.4774	114.1835		Mound (Active) 2	500	150	60	60	Dug out and left in preparation	
MFMA 3542	13/2/2023	Mallee woodland	-27.4799	114.1832		Mound (Active) 2	400	60	50	70	Dug out and left in preparation, old prints	

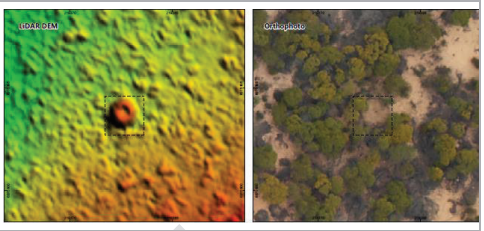
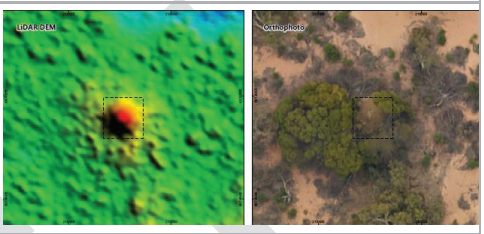
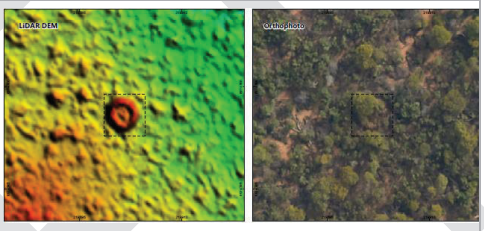
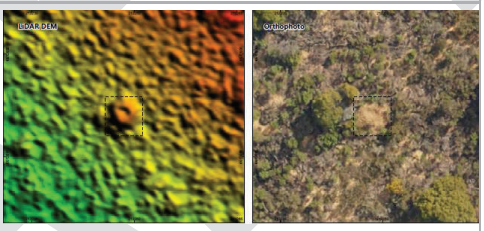
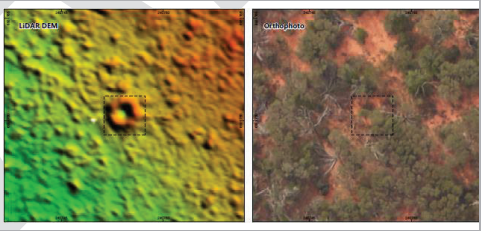
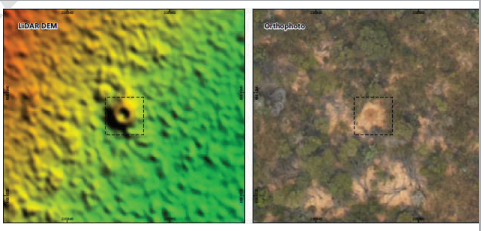
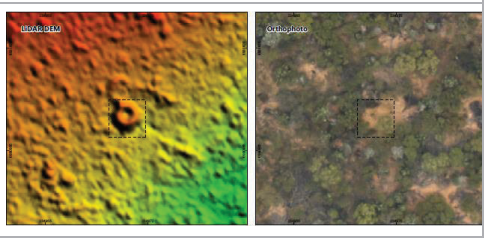
LiDAR code	Date	Habitat type	Latitude	Long.		Class and Profile	Diameter (cm)	Rim (cm)	Height (cm)	Deep (cm)	Comments	Representative photo
MFMA 3693	13/2/2023	Mallee woodland	-27.5051	114.1854		Mound (Active) 5	500	70	120	10	Active mound currently brooding and being thermoregulated. Scats, lots of prints, shell present	
MFMA 3830	13/2/2023	Mallee woodland	-27.5372	114.1871		Mound (Active) 3	450	100	70	5	Still capped with litter but not currently active, has been used scratching present	
MFMA 3833	13/2/2023	Mallee woodland	-27.5385	114.1869		Mound (Active) 4	400	80	120	0	Active mound and capped for thermoregulation, lots of prints and shell present	

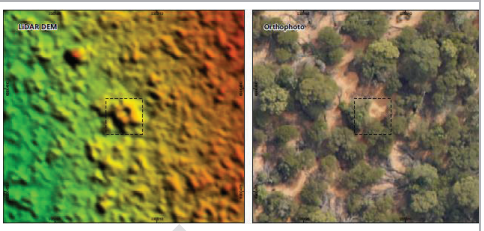
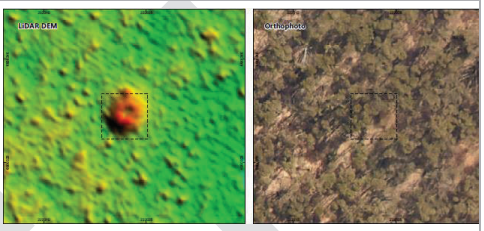
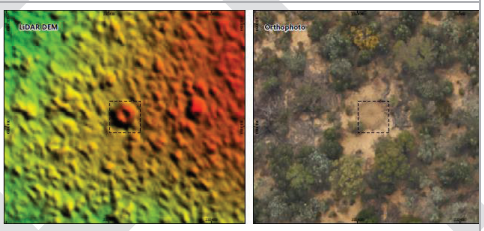
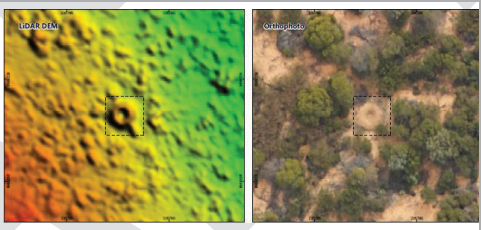
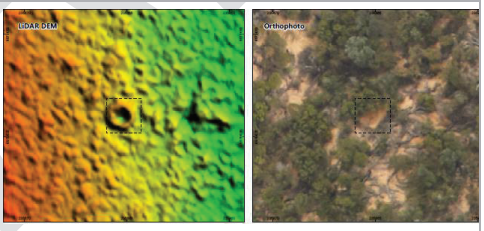
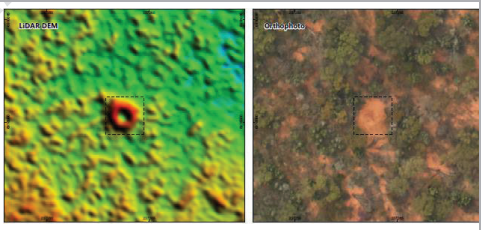
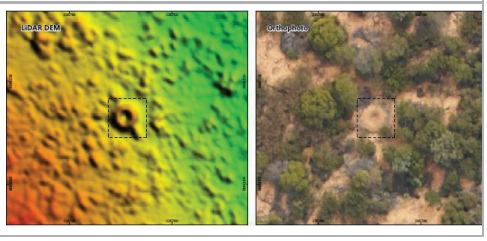
LiDAR code	Date	Habitat type	Latitude	Long.		Class and Profile	Diameter (cm)	Rim (cm)	Height (cm)	Deep (cm)	Comments	Representative photo
MFMA 3842	13/2/2023	Mallee woodland	-27.5427	114.1887		Mound (Inactive) 1	400	80	60	50	Previous dug out and left	
MFMA 3849	13/2/2023	Mallee woodland	-27.5453	114.1863		Mound (Inactive) 1	350	60	40	100	Previously dug out then abandoned	
MFMA 5151	11/2/2023	Mallee woodland	-27.342	114.1862		Mound (Inactive) 6	450	120	60	20	Ancient mound	

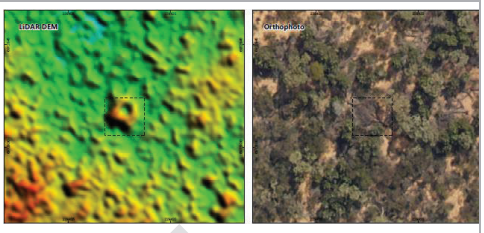
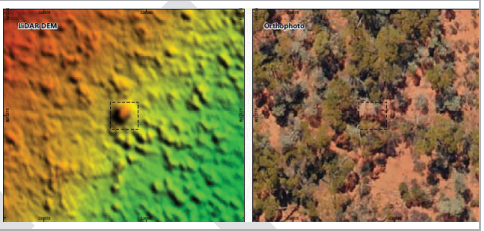
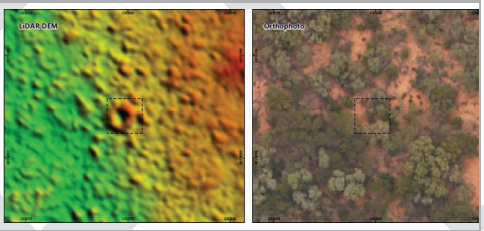
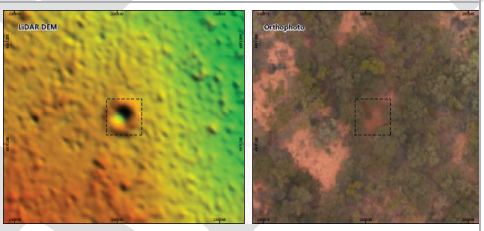
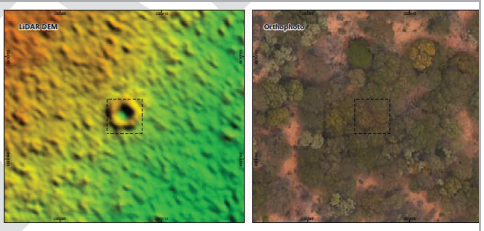
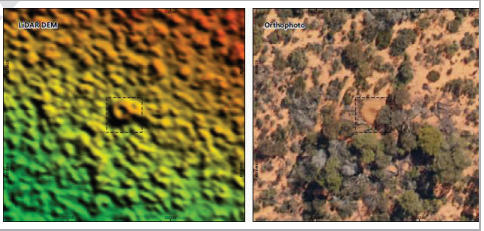
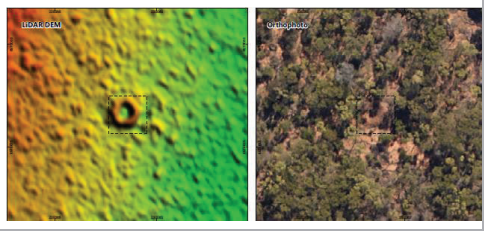
LiDAR code	Date	Habitat type	Latitude	Long.		Class and Profile	Diameter (cm)	Rim (cm)	Height (cm)	Deep (cm)	Comments	Representative photo
MFMA 5152	11/2/2023	Mallee woodland	-27.338	114.181		Mound (Inactive) 1	350	80	60	20	Dug out and abandoned, looks to have predation event and branch in nest	
MFMA 5166	12/2/2023	Mallee woodland	-27.4514	114.2076		Mound (Inactive) 6	500	100	50	10	Ancient mound	

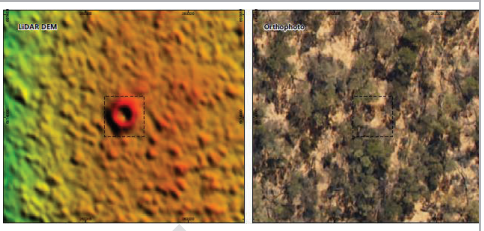
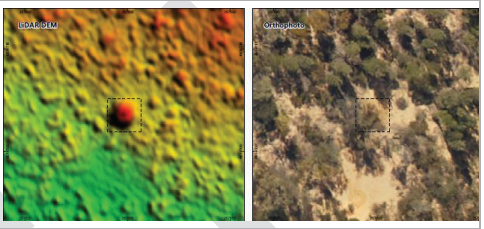
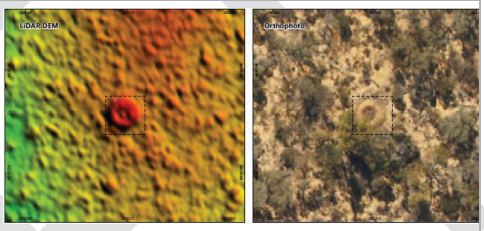
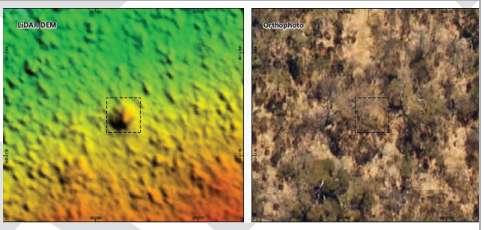
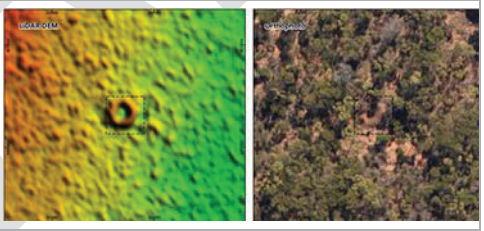
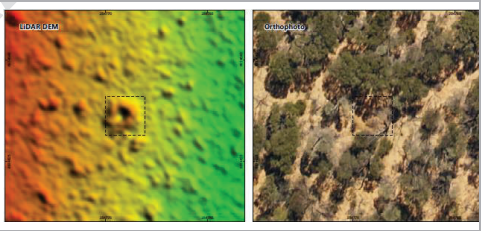
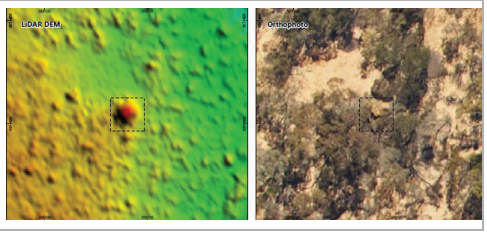
Malleefowl Mounds identified via LiDAR but not ground truthed/assessed.

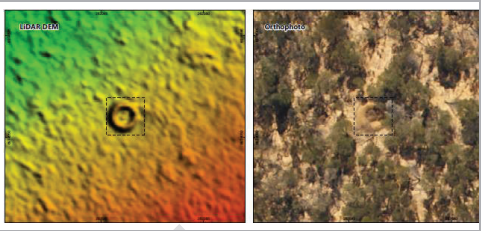
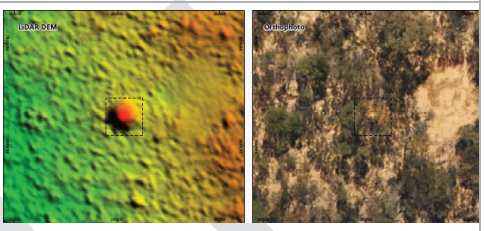
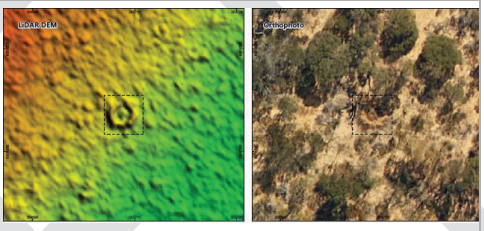
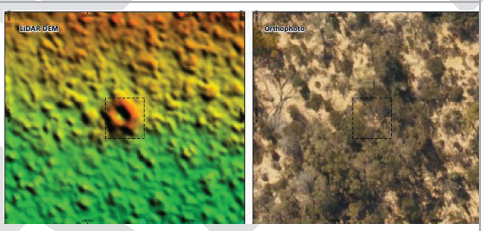
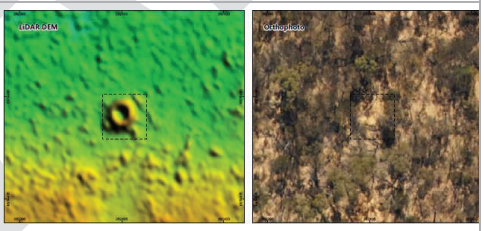
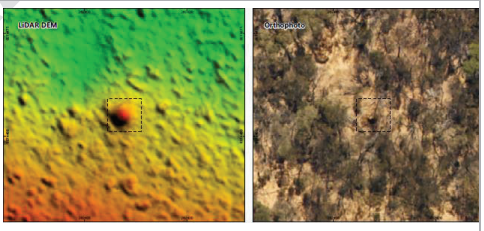
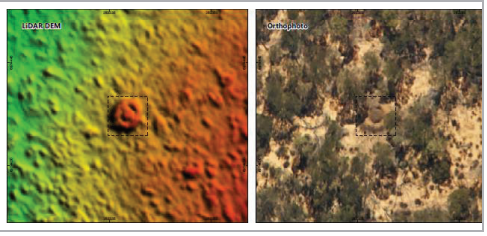
LiDAR Code	Latitude	Longitude	GHD review	Representative photo (Fulgro 2022)
MFMA_00150	114.149272	-27.292224	Likely	
MFMA_00200	114.132263	-27.305875	Possible	
MFMA_00216	114.162664	-27.310337	Possible	
MFMA_00217	114.165254	-27.31099	Likely	
MFMA_00230	114.163919	-27.313962	Likely	
MFMA_00236	114.16605	-27.315709	Likely	
MFMA_00250	114.13159	-27.317981	Likely	

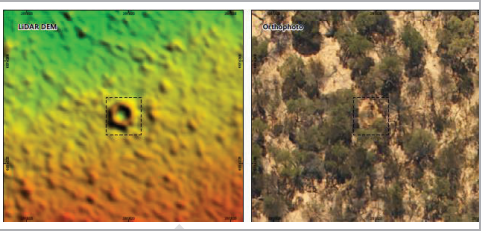
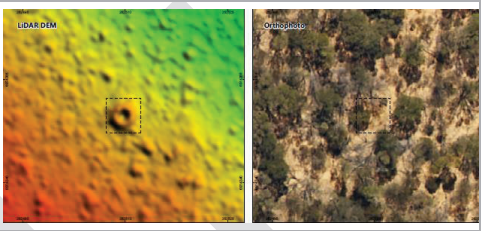
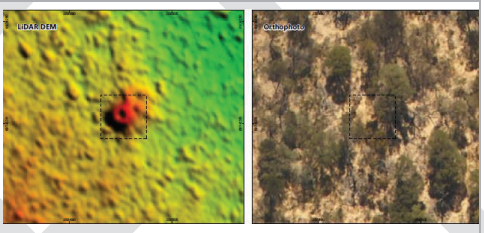
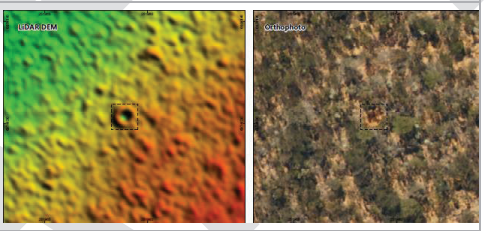
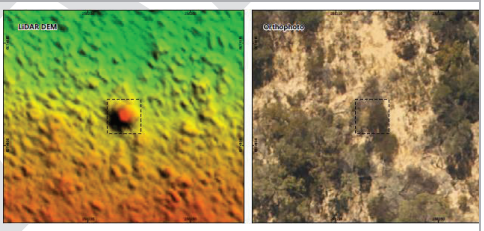
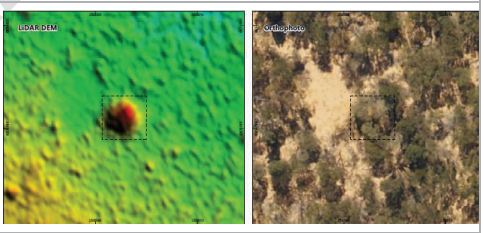
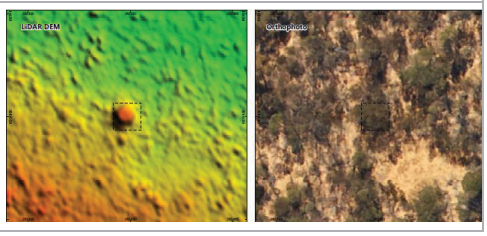
LiDAR Code	Latitude	Longitude	GHD review	Representative photo (Fulgro 2022)
MFMA_00252	114.164254	-27.317652	Likely	
MFMA_00258	114.155265	-27.319627	Likely	
MFMA_00266	114.169441	-27.321682	Likely	
MFMA_00295	114.101845	-27.33685	Likely	
MFMA_00465	114.381465	-27.262706	Likely	
MFMA_00471	114.329942	-27.263664	Likely	
MFMA_00518	114.322897	-27.268464	Likely	

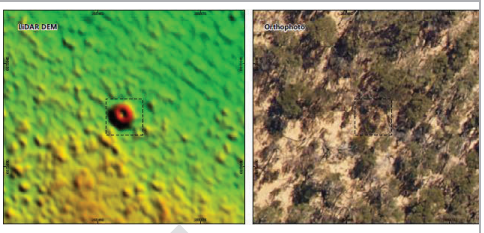
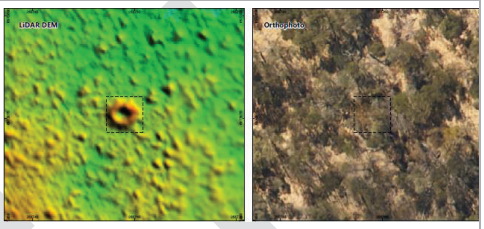
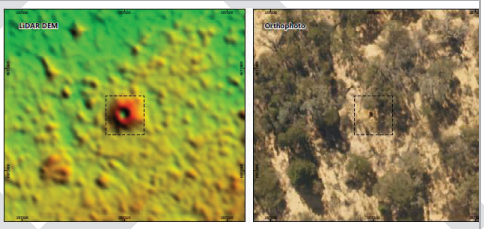
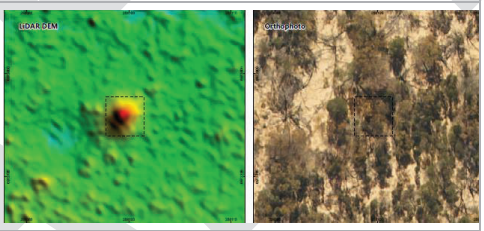
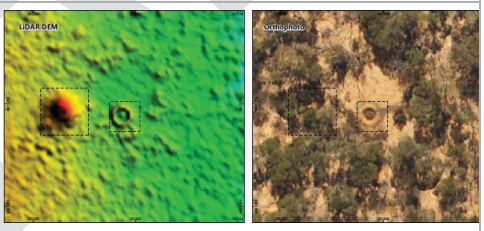
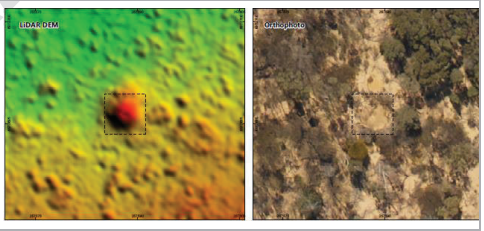
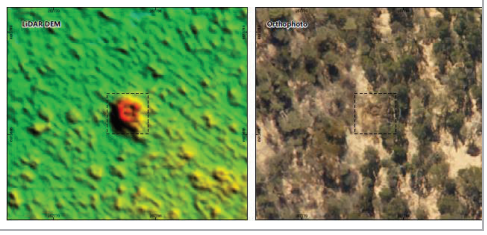
LiDAR Code	Latitude	Longitude	GHD review	Representative photo (Fulgro 2022)
MFMA_00546	114.328219	-27.273111	Possible	
MFMA_00552	114.192112	-27.271836	Likely	
MFMA_00561	114.297193	-27.275172	Likely	
MFMA_00563	114.330869	-27.27561	Likely	
MFMA_00594	114.331866	-27.280831	Likely	
MFMA_00662	114.345412	-27.295859	Likely	
MFMA_00704	114.35021	-27.301928	Likely	

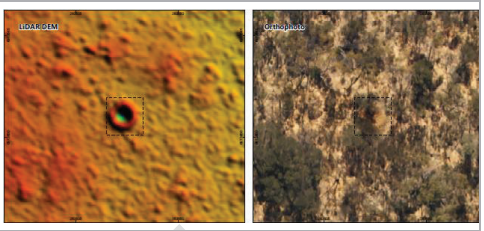
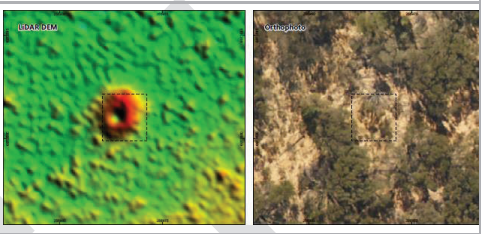
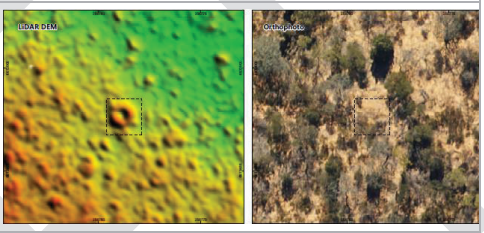
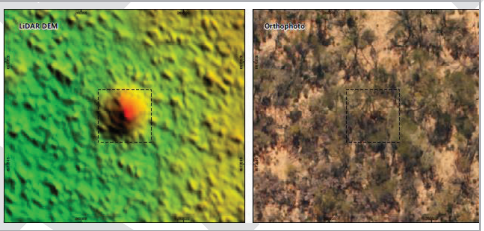
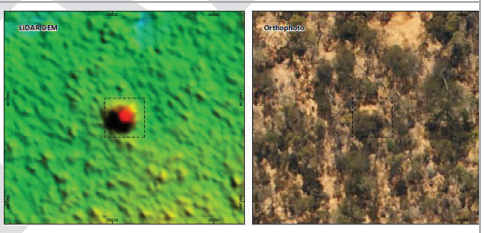
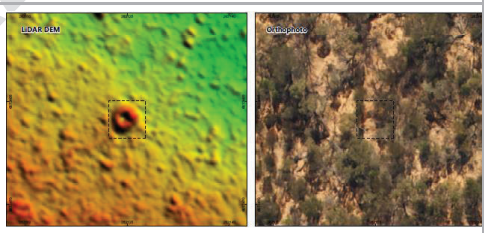
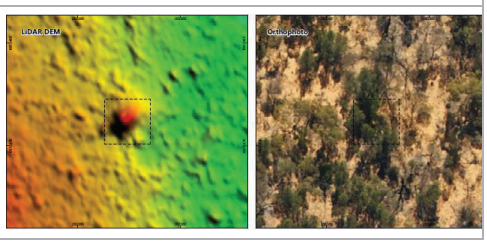
LiDAR Code	Latitude	Longitude	GHD review	Representative photo (Fulgro 2022)
MFMA_00957	114.265068	-27.340021	Possible	
MFMA_01019	114.337389	-27.346467	Possible	
MFMA_01043	114.279132	-27.350025	Likely	
MFMA_01108	114.275991	-27.355126	Likely	
MFMA_01135	114.274595	-27.35995	Likely	
MFMA_01149	114.292993	-27.363269	Likely	
MFMA_01173	114.271124	-27.365986	Likely	

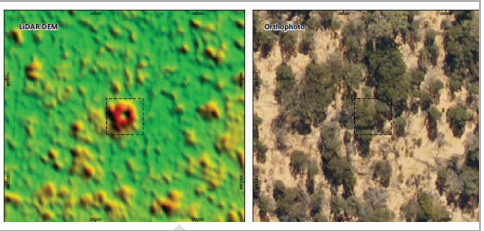
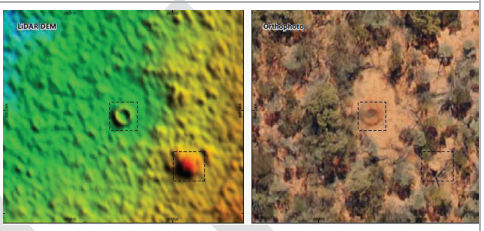
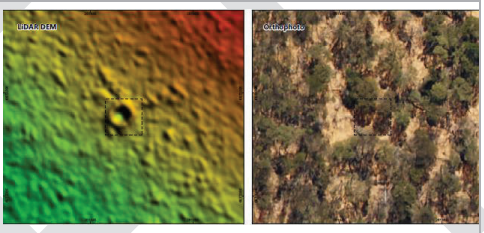
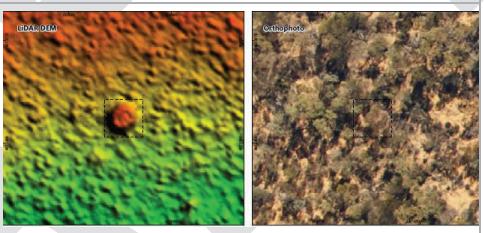
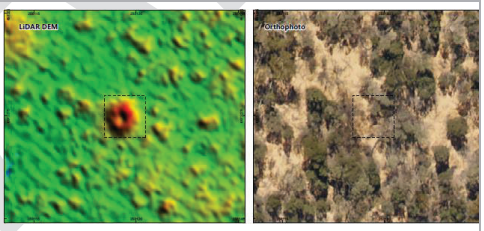
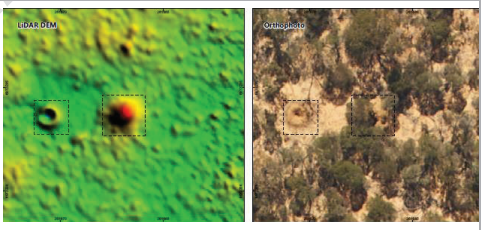
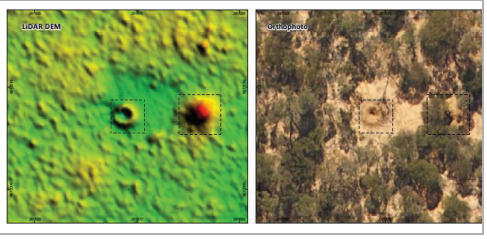
LiDAR Code	Latitude	Longitude	GHD review	Representative photo (Fulgro 2022)
MFMA_01853	114.607802	-27.328759	Likely	
MFMA_01866	114.550441	-27.329341	Possible	
MFMA_01867	114.557266	-27.329163	Likely	
MFMA_01874	114.595192	-27.329437	Possible	
MFMA_01876	114.600119	-27.329688	Likely	
MFMA_01885	114.521526	-27.329495	Likely	
MFMA_01886	114.524954	-27.329469	Possible	

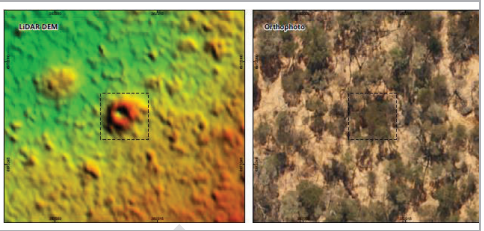
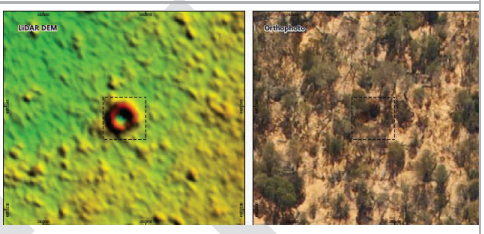
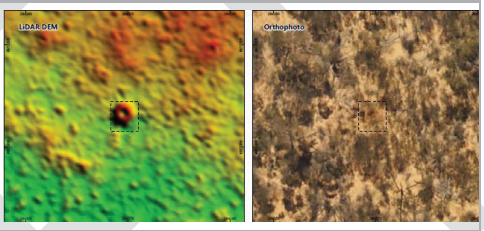
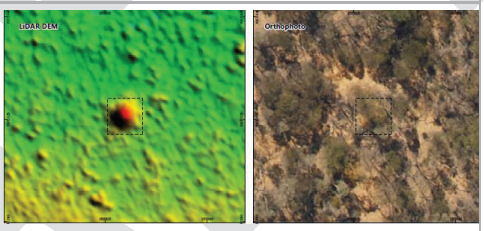
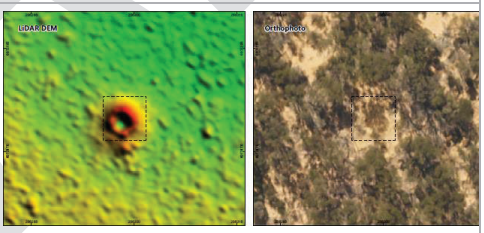
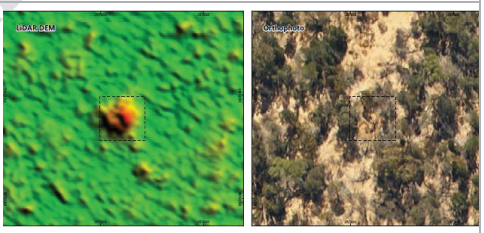
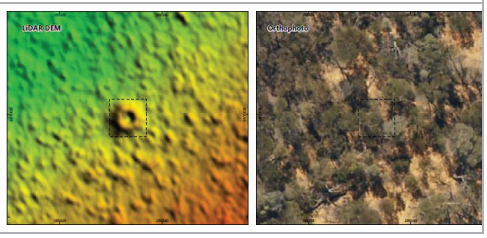
LiDAR Code	Latitude	Longitude	GHD review	Representative photo (Fulgro 2022)
MFMA_01889	114.594991	-27.331489	Likely	
MFMA_01890	114.611185	-27.331351	Possible	
MFMA_01901	114.52085	-27.330578	Likely	
MFMA_01903	114.541827	-27.331001	Likely	
MFMA_01908	114.598583	-27.332147	Likely	
MFMA_01909	114.598633	-27.332364	Possible	
MFMA_01911	114.60799	-27.332758	Likely	

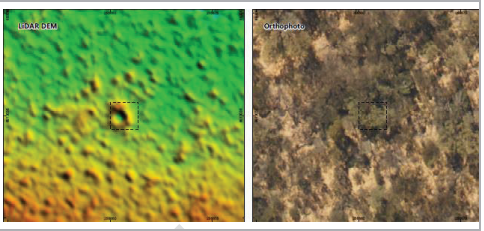
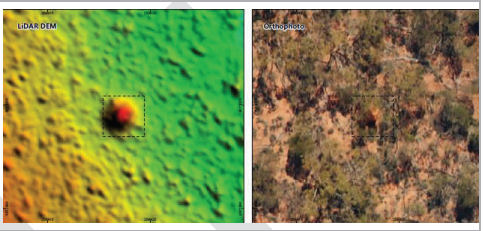
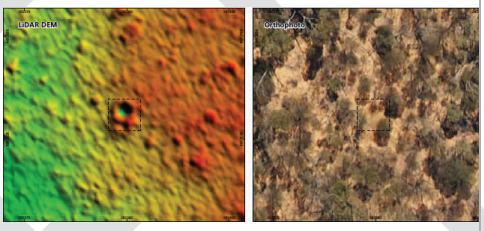
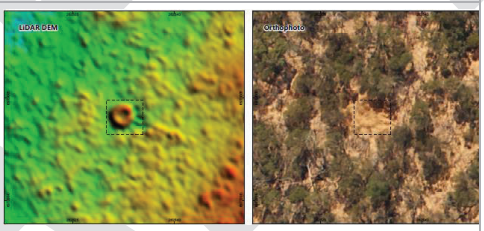
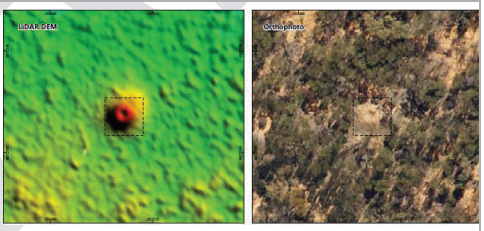
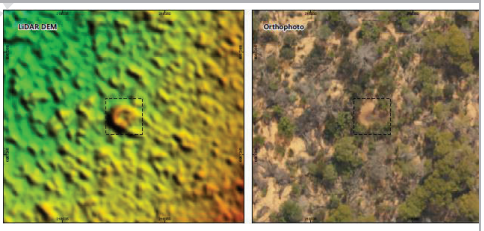
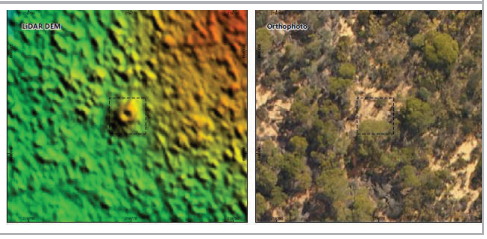
LiDAR Code	Latitude	Longitude	GHD review	Representative photo (Fulgro 2022)
MFMA_01930	114.592633	-27.333444	Likely	
MFMA_01932	114.59961	-27.333403	Likely	
MFMA_01942	114.559068	-27.333727	Likely	
MFMA_01958	114.493185	-27.333507	Likely	
MFMA_01964	114.55644	-27.33487	Possible	
MFMA_01967	114.560068	-27.334822	Possible	
MFMA_01973	114.598953	-27.335646	Possible	

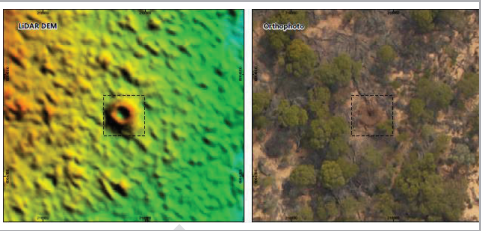
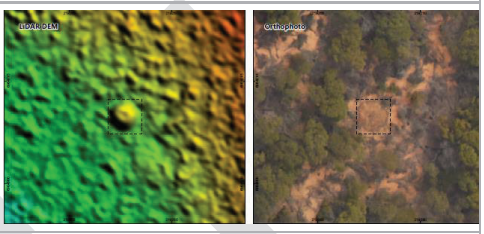
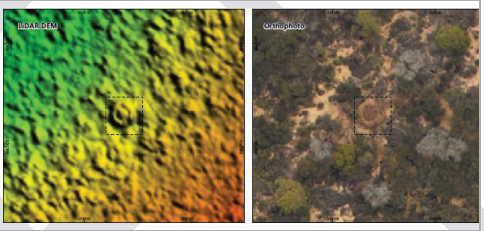
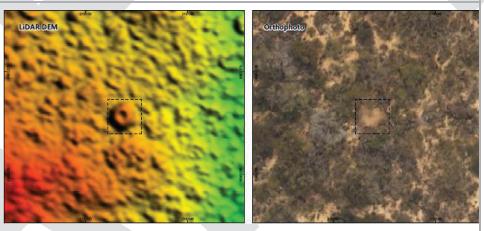
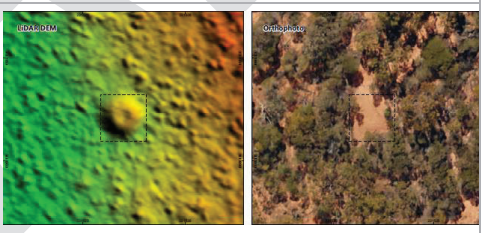
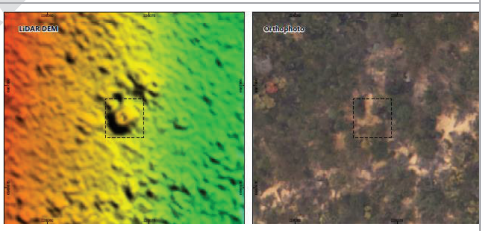
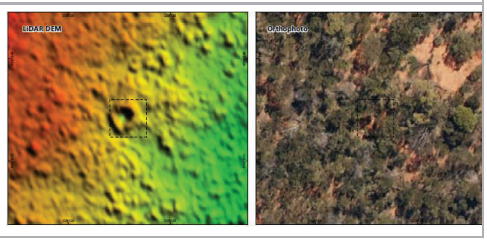
LiDAR Code	Latitude	Longitude	GHD review	Representative photo (Fulgro 2022)
MFMA_01988	114.528369	-27.335703	Likely	
MFMA_01990	114.531329	-27.336492	Likely	
MFMA_01993	114.547123	-27.335754	Likely	
MFMA_02019	114.554956	-27.337646	Possible	
MFMA_02026	114.597362	-27.338613	Likely	
MFMA_02045	114.549773	-27.338433	Possible	
MFMA_02047	114.551719	-27.338452	Likely	

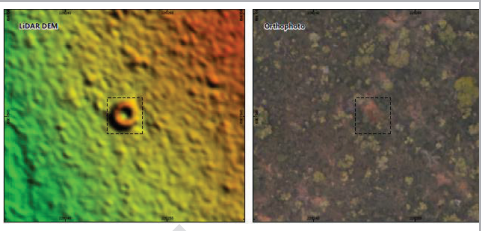
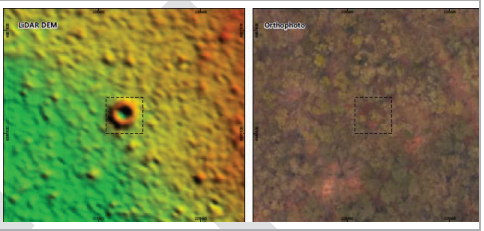
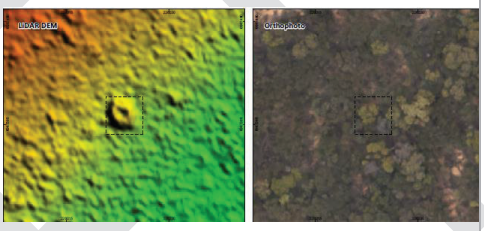
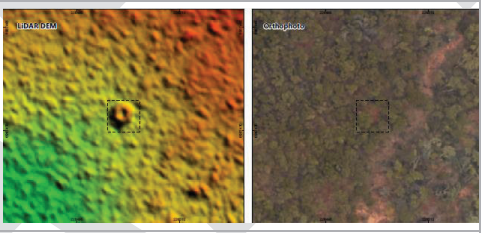
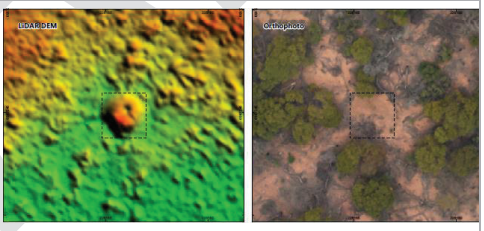
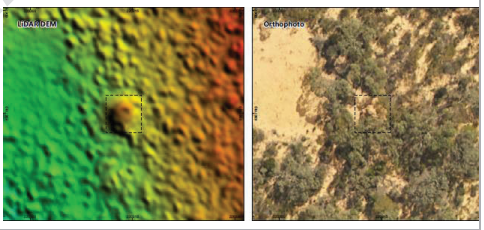
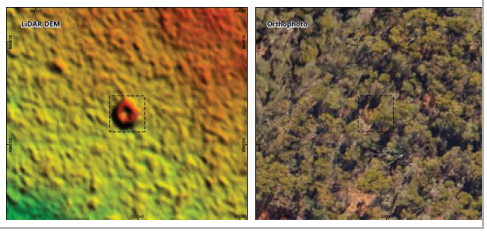
LiDAR Code	Latitude	Longitude	GHD review	Representative photo (Fulgro 2022)
MFMA_02054	114.610913	-27.339884	Likely	
MFMA_02068	114.543485	-27.340067	Likely	
MFMA_02078	114.561606	-27.340477	Likely	
MFMA_02079	114.574214	-27.340433	Possible	
MFMA_02085	114.604771	-27.341049	Possible	
MFMA_02086	114.605656	-27.341334	Likely	
MFMA_02089	114.608152	-27.341457	Possible	

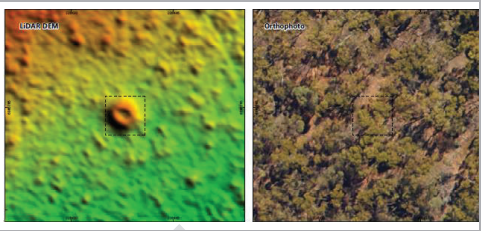
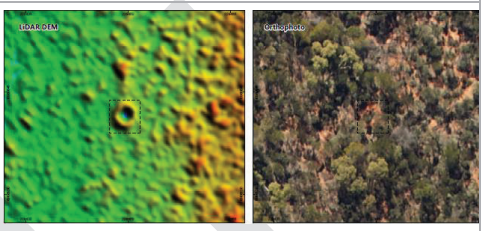
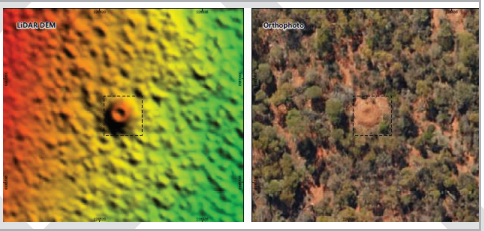
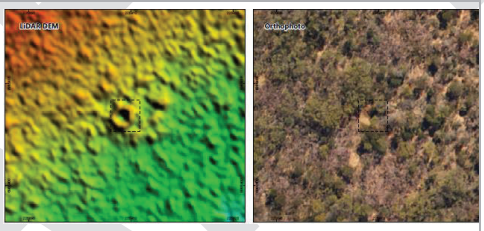
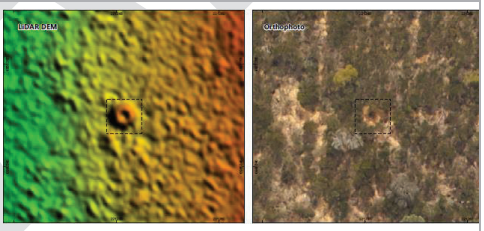
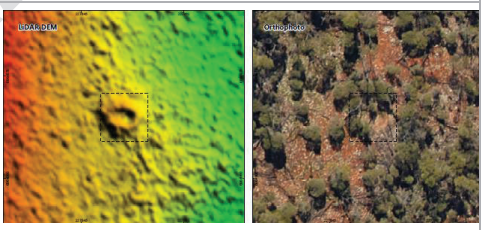
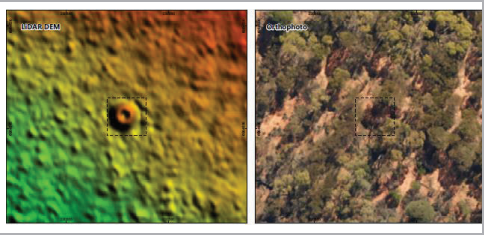
LiDAR Code	Latitude	Longitude	GHD review	Representative photo (Fulgro 2022)
MFMA_02105	114.55734	-27.341741	Possible	
MFMA_02107	114.579355	-27.341677	Likely	
MFMA_02110	114.588718	-27.341863	Likely	
MFMA_02127	114.510243	-27.341639	Likely	
MFMA_02131	114.555145	-27.342331	Likely	
MFMA_02134	114.590999	-27.343531	Likely	
MFMA_02135	114.590892	-27.343532	Likely	

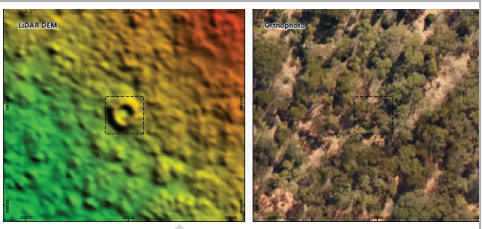
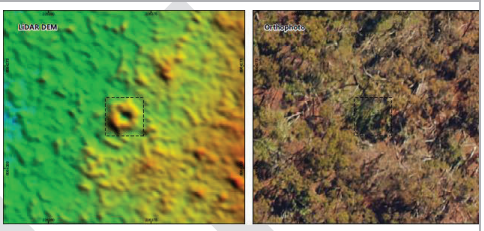
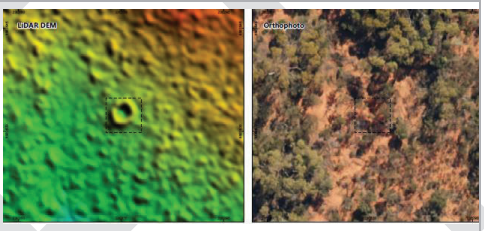
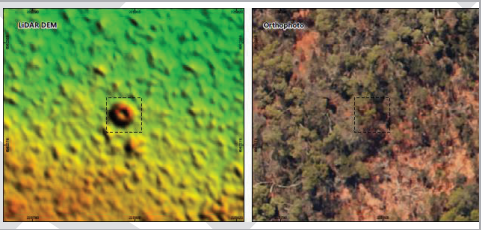
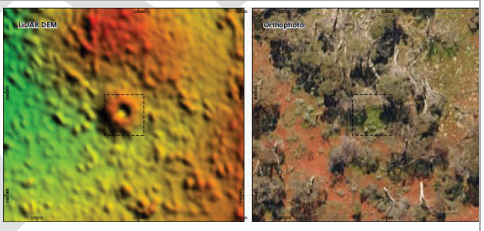
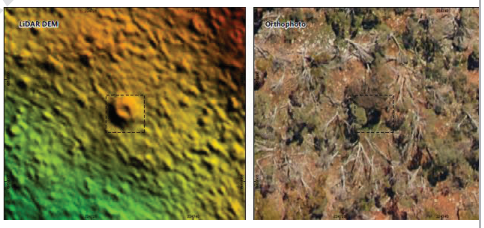
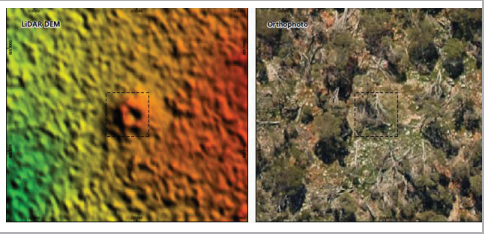
LiDAR Code	Latitude	Longitude	GHD review	Representative photo (Fulgro 2022)
MFMA_02139	114.594351	-27.343218	Likely	
MFMA_02141	114.603457	-27.343454	Likely	
MFMA_02149	114.618173	-27.344056	Likely	
MFMA_02157	114.52986	-27.343235	Possible	
MFMA_02160	114.536644	-27.342909	Likely	
MFMA_02165	114.55304	-27.343813	Possible	
MFMA_02187	114.526879	-27.344138	Likely	

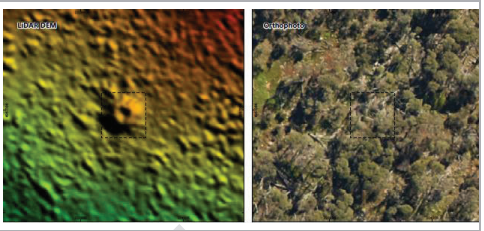
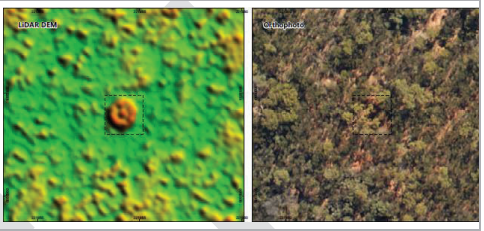
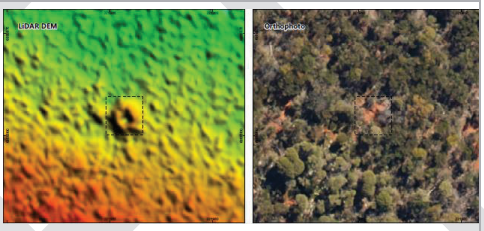
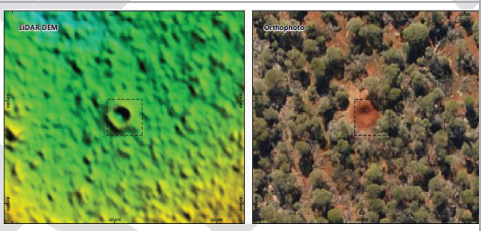
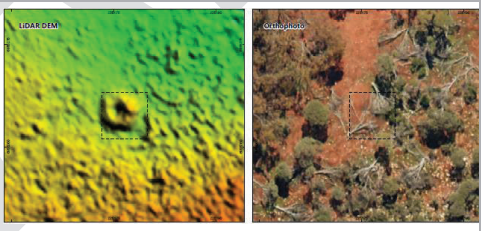
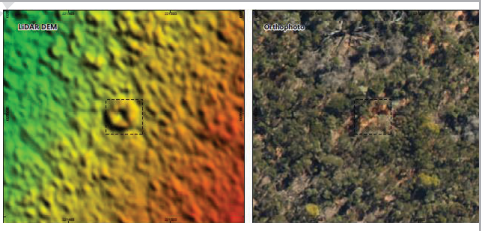
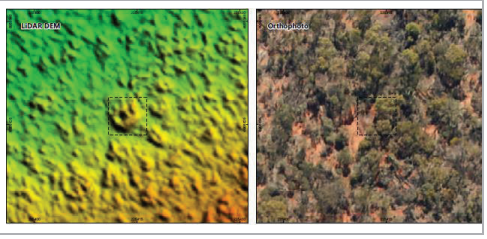
LiDAR Code	Latitude	Longitude	GHD review	Representative photo (Fulgro 2022)
MFMA_02188	114.540287	-27.344235	Possible	
MFMA_02193	114.573251	-27.345097	Possible	
MFMA_02199	114.598142	-27.34521	Likely	
MFMA_02201	114.599579	-27.345563	Likely	
MFMA_02249	114.50835	-27.346192	Likely	
MFMA_02636	114.148953	-27.388975	Likely	
MFMA_02640	114.166375	-27.391632	Possible	

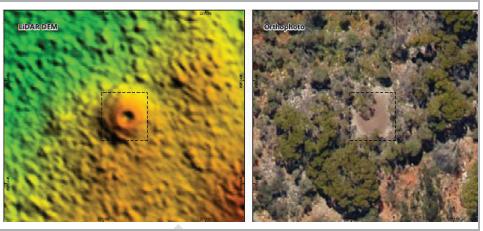
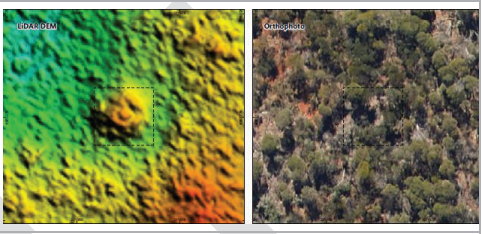
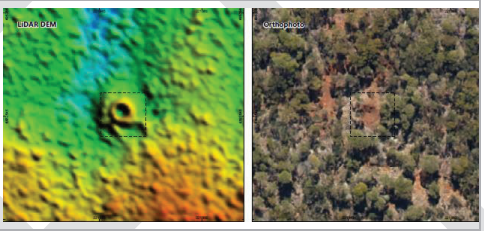
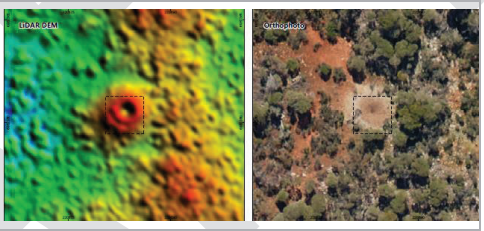
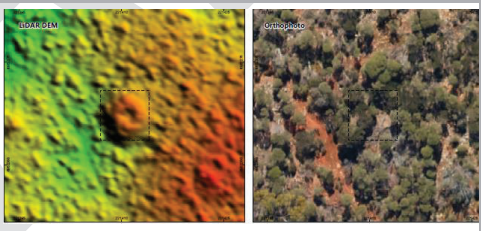
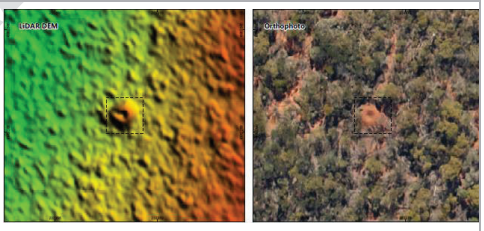
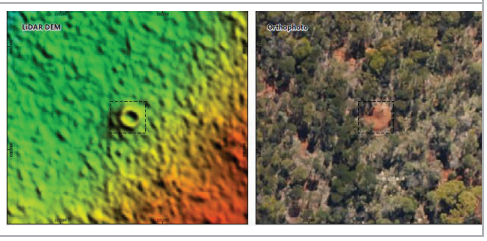
LiDAR Code	Latitude	Longitude	GHD review	Representative photo (Fulgro 2022)
MFMA_02678	114.154627	-27.411254	Likely	
MFMA_02679	114.160806	-27.411237	Likely	
MFMA_02700	114.158948	-27.423697	Likely	
MFMA_02702	114.159061	-27.425152	Likely	
MFMA_02809	114.285343	-27.383843	Likely	
MFMA_02829	114.230188	-27.384888	Likely	
MFMA_02832	114.261064	-27.385939	Likely	

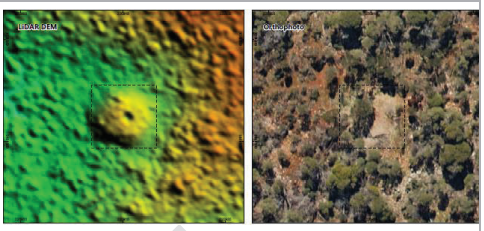
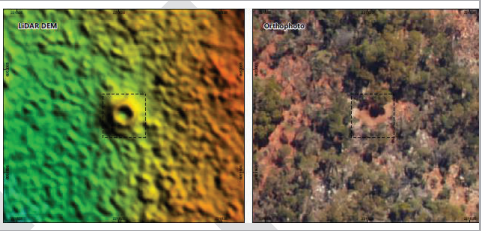
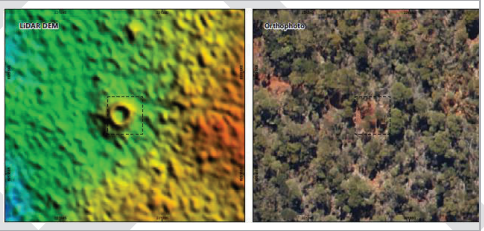
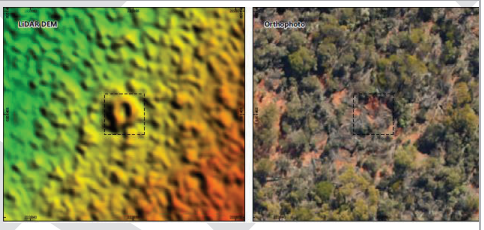
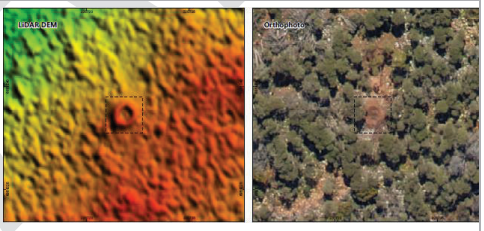
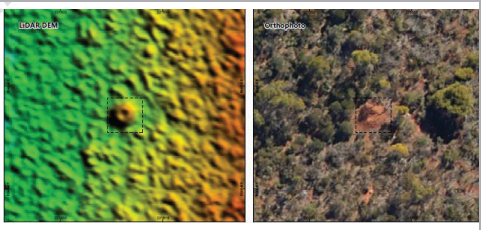
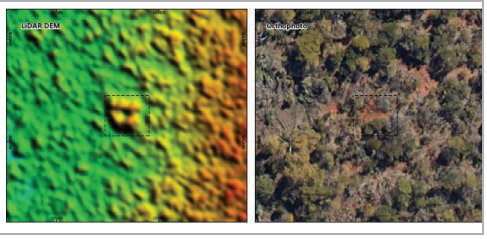
LiDAR Code	Latitude	Longitude	GHD review	Representative photo (Fulgro 2022)
MFMA_02852	114.231904	-27.38799	Likely	
MFMA_02854	114.234296	-27.387338	Likely	
MFMA_02861	114.229594	-27.389287	Likely	
MFMA_02862	114.234444	-27.388699	Likely	
MFMA_02868	114.231017	-27.390684	Likely	
MFMA_02878	114.171848	-27.390711	Possible	
MFMA_02897	114.252831	-27.395807	Likely	

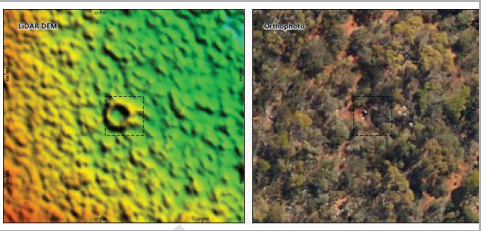
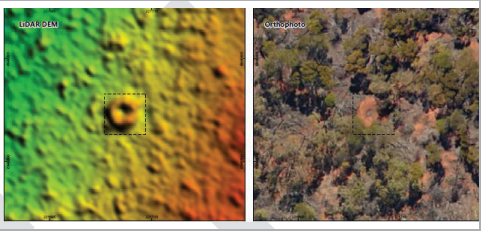
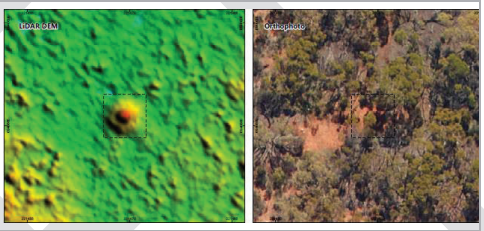
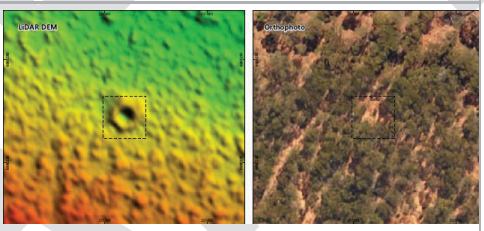
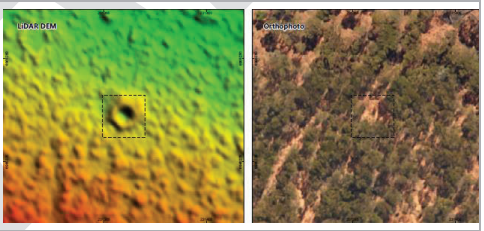
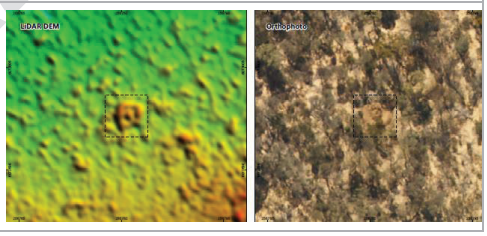
LiDAR Code	Latitude	Longitude	GHD review	Representative photo (Fulgro 2022)
MFMA_02898	114.253845	-27.395473	Likely	
MFMA_02914	114.264038	-27.396778	Likely	
MFMA_02990	114.254451	-27.405943	Likely	
MFMA_03001	114.227993	-27.407173	Likely	
MFMA_03013	114.180864	-27.406795	Likely	
MFMA_03053	114.247428	-27.415148	Likely	
MFMA_03061	114.275938	-27.416179	Likely	

LiDAR Code	Latitude	Longitude	GHD review	Representative photo (Fulgro 2022)
MFMA_03076	114.277466	-27.418	Likely	
MFMA_03080	114.232403	-27.41757	Likely	
MFMA_03094	114.271781	-27.421371	Likely	
MFMA_03198	114.22624	-27.434527	Likely	
MFMA_03298	114.218527	-27.451494	Likely	
MFMA_03363	114.214757	-27.459554	Possible	
MFMA_03502	114.22585	-27.474433	Likely	

LiDAR Code	Latitude	Longitude	GHD review	Representative photo (Fulgro 2022)
MFMA_03534	114.206843	-27.479114	Likely	
MFMA_03618	114.185963	-27.491301	Likely	
MFMA_03634	114.185909	-27.495169	Likely	
MFMA_03639	114.19042	-27.496526	Likely	
MFMA_03651	114.218294	-27.498513	Likely	
MFMA_03657	114.181009	-27.499295	Likely	
MFMA_03658	114.22066	-27.499808	Possible	

LiDAR Code	Latitude	Longitude	GHD review	Representative photo (Fulgro 2022)
MFMA_03735	114.177243	-27.514013	Likely	
MFMA_03743	114.18436	-27.516139	Possible	
MFMA_03763	114.184017	-27.522355	Likely	
MFMA_03767	114.172186	-27.523867	Likely	
MFMA_03769	114.179522	-27.524773	Possible	
MFMA_03771	114.189184	-27.524741	Likely	
MFMA_03779	114.18853	-27.526466	Likely	

LiDAR Code	Latitude	Longitude	GHD review	Representative photo (Fulgro 2022)
MFMA_03787	114.174432	-27.527814	Possible	
MFMA_03788	114.181587	-27.527241	Likely	
MFMA_03790	114.183927	-27.528232	Likely	
MFMA_03812	114.20405	-27.532505	Likely	
MFMA_03822	114.172356	-27.533932	Likely	
MFMA_03898	114.179635	-27.559521	Likely	
MFMA_04113	114.179083	-27.563632	Possible	

LiDAR Code	Latitude	Longitude	GHD review	Representative photo (Fulgro 2022)
MFMA_04122	114.174549	-27.566065	Possible	
MFMA_04147	114.181254	-27.574068	Likely	
MFMA_04151	114.178825	-27.575286	Possible	
MFMA_04510	114.283313	-27.409784	Likely	
MFMA_04511	114.283313	-27.409784	Likely	
MFMA_05156	114.541598	-27.339178	Likely	

Appendix G

Night Parrot Acoustics Assessment by Nigel Jackett

Results of an acoustic survey conducted for birds near Kalbarri – August 2022

Report to:

GHD

Prepared by:

Nigel Jackett

Adaptive NRM

10 October 2022

1. Summary

During August 2022, autonomous recording units (ARUs) were deployed near Kalbarri to record the vocalisations of birds. Kaleidoscope Pro v5.4.6 was used to automatically detect vocalisations within the recordings. A total of 54 species were identified during the analysis.

2. Survey effort

GHD conducted sampling for birds in August 2022. Four Song Meter 4 (Wildlife Acoustics, MA, USA) bioacoustic recording unit were deployed, with daily schedules programmed to record predominantly at night, but commenced at 4:00 pm and terminated at 8:30 AM. A total of 28.5 recording sessions were made (Table 1). The analysed dataset comprised 481 sound files (wav format) totalling 150.5 GB.

Table 1. Bioacoustic recordings analysed from the August 2022 survey near Kalbarri

Song Meter	Recording start date (PM)	Recording end date (AM)	Total nights	Total nights without interference
S4A08277 / SM4-AC1	25/08/22	28/08/22	3.5	3.5
S4A08296 / SM4-AC2	19/08/22	28/08/22	9	7
S4A08291 / SM4-AC3	21/08/22	28/08/22	7	6
S4A029 / SM4-AC4	19/08/22	28/08/22	9	9
		Total	28.5	25.5

3. Data analysis

The analysis was undertaken using the software Kaleidoscope Pro v5.4.6, with the signal parameters listed in Table 2.

Table 2. Kaleidoscope Pro signal parameters used during the analysis

Minimum freq. (Hz)	Maximum freq. (Hz)	Minimum duration (s)	Maximum duration (s)	Intersyllable gap (s)	FFT window
350	8000	0.35	7.5	0.5	21.33

All resulting detections were manually assessed and compared to call recordings of birds previously recorded in the Midwest and Southwest regions of Western Australia.

4. Survey results

A total of 122,275 Kaleidoscope detections were manually assessed.

Noise interference (due to rain and wind) was limited to the mornings of the 27th and 28th of August at site S4A08296 / SM4-AC2, and the night of the 23rd of August at site S4A08291 / SM4-AC3.

A total of 54 species were identified during the analysis and are shown in Appendix 1 for each recording night.

Appendix 1 – Species detected during the analysis

Species	S4A08277 / SM4-AC1				S4A08296 / SM4-AC2									S4A08291 / SM4-AC3							S4A029 / SM4-AC4								
	24	25	26	27	19	20	21	22	23	24	25	26	27	21	22	23	24	25	26	27	19	20	21	22	23	24	25	26	27
Brown Quail *Coturnix ypsilophora*	•	•			•					•	•	•					•									•	•		•
Common Bronzewing *Phaps chalcoptera*					•								•																
Crested Pigeon *Ocyphaps lophotes*			•																										
Horsfield's Bronze Cuckoo *Chalcites basalis*	•		•		•	•				•	•	•	•				•	•	•	•	•	•	•			•			•
Black-eared Cuckoo *Chalcites osculans*																	•	•							•				
Shining Bronze Cuckoo *Chalcites lucidus*	•	•	•	•	•		•		•	•	•	•	•	•			•	•	•	•	•	•	•			•	•	•	•
Pallid Cuckoo *Heteroscenes pallidus*	•	•	•								•	•					•	•	•			•				•	•	•	•
Fan-tailed Cuckoo *Cacomantis flabelliformis*					•																						•		
Australian Owlet-nightjar *Aegotheles cristatus*					•	•	•		•	•	•	•	•					•							•	•	•		•
Painted Buttonquail *Turnix varius*						•				•	•	•	•														•		
Little Buttonquail *Turnix velox*			•			•				•	•	•					•									•	•		
Eastern Barn Owl *Tyto javanica*					•														•								•		
Australian Boobook *Ninox boobook*								•	•	•	•	•	•					•							•				•
Nankeen Kestrel *Falco cenchroides*															•									•					

Species	S4A08277 / SM4-AC1				S4A08296 / SM4-AC2									S4A08291 / SM4-AC3							S4A029 / SM4-AC4								
	24	25	26	27	19	20	21	22	23	24	25	26	27	21	22	23	24	25	26	27	19	20	21	22	23	24	25	26	27
Brown Falcon *Falco berigora*									•			•					•	•											
Red-tailed Black Cockatoo *Calyptorhynchus banksii*								•	•																•				
Galah *Eolophus roseicapilla*								•	•		•	•	•					•							•				
Australian Ringneck *Barnardius zonarius*	•							•	•	•	•	•	•				•												•
Purple-backed Fairywren *Malurus assimilis*			•																	•									
Splendid Fairywren *Malurus splendens*					•	•	•			•	•	•	•	•			•	•					•	•	•	•		•	•
White-winged Fairywren *Malurus leucopterus*	•	•														•													
White-fronted Honeyeater *Purnella albifrons*	•	•	•	•	•	•	•			•	•			•					•	•	•	•	•		•	•	•	•	
Yellow-throated Miner *Manorina flavigula*								•	•					•															
Spiny-cheeked Honeyeater *Acanthagenys rufogularis*		•	•	•	•			•	•	•	•	•	•	•			•	•	•	•	•	•	•	•	•		•		•
Singing Honeyeater *Gavicalis virescens*																	•			•						•	•		
Tawny-crowned Honeyeater *Gliciphila melanops*		•													•	•	•												
Brown Honeyeater *Lichmera indistincta*			•	•	•	•	•			•									•	•									

Species	S4A08277 / SM4-AC1				S4A08296 / SM4-AC2									S4A08291 / SM4-AC3							S4A029 / SM4-AC4								
	24	25	26	27	19	20	21	22	23	24	25	26	27	21	22	23	24	25	26	27	19	20	21	22	23	24	25	26	27
Striated Pardalote *Pardalotus striatus*									•	•			•											•	•				
Spotted Scrubwren Sericornis maculatus																	•	•		•									
Redthroat *Pyrrholaemus brunneus*																		•											
Rufous Fieldwren *Calamanthus campestris*	•	•												•	•	•													
Inland Thornbill *Acanthiza apicalis*					•	•	•										•	•			•								•
Yellow-rumped Thornbill *Acanthiza chrysorrhoa*													•							•									
Weebill *Smicrornis brevirostris*									•		•	•	•											•	•				•
White-browed Babbler *Pomatostomus superciliosus*																							•						
Black-faced Cuckoo-shrike *Coracina novaehollandiae*																				•									
Crested Bellbird *Oreoica gutturalis*					•	•				•	•							•			•	•				•	•		
Grey Shrikethrush *Colluricincla harmonica*			•	•	•	•	•	•			•	•		•			•	•	•					•	•	•	•	•	•
Western Whistler *Pachycephala fuliginosa*																												•	•

Species	S4A08277 / SM4-AC1				S4A08296 / SM4-AC2									S4A08291 / SM4-AC3							S4A029 / SM4-AC4								
	24	25	26	27	19	20	21	22	23	24	25	26	27	21	22	23	24	25	26	27	19	20	21	22	23	24	25	26	27
Rufous Whistler *Pachycephala rufiventris*					•	•						•	•											•	•				•
Masked Woodswallow *Artamus personatus*	•									•						•		•											
Black-faced Woodswallow *Artamus cinereus*																		•											
Grey Butcherbird *Cracticus torquatus*								•	•			•	•	•			•	•	•	•	•			•	•	•	•		•
Australian Magpie *Gymnorhina tibicen*	•	•						•	•				•					•										•	•
Grey Currawong *Strepera versicolor*					•		•				•	•	•				•												•
Willie Wagtail *Rhipidura leucophrys*								•	•		•	•					•	•	•	•								•	
Grey Fantail *Rhipidura albiscapa*					•	•				•																			•
Australian Raven *Corvus coronoides*					•	•		•	•	•	•	•	•					•		•					•		•		•
Corvus sp.																			•	•	•	•	•			•			
Jacky Winter *Microeca fascinans*																					•	•	•						
Red-capped Robin *Petroica goodenovii*												•												•	•				
Southern Scrub-robin *Drymodes brunneopygia*				•		•				•	•																•	•	•
Welcome Swallow *Hirundo neoxena*																		•											
Mistletoebird *Dicaeum hirundinaceum*					•																								

Species	S4A08277 / SM4-AC1				S4A08296 / SM4-AC2									S4A08291 / SM4-AC3							S4A029 / SM4-AC4								
	24	25	26	27	19	20	21	22	23	24	25	26	27	21	22	23	24	25	26	27	19	20	21	22	23	24	25	26	27
Australian Pipit *Anthus australis*																		•											
Total	10	9	10	6	19	14	8	11	15	18	20	21	18	8	3	4	18	23	11	14	9	8	8	9	15	13	16	9	20

Numeric below Song Meter name references day of the month in August 2022

Appendix H

Bat Detector Analysis by Dr Erin Westerhuis

Technical Memorandum

June 21, 2022

Bat call analysis for Project 12553823 - Kalbarri

Dr Erin Westerhuis, Senior Terrestrial Ecologist, GHD Alice Springs

1. Summary

To determine if habitat in the study area supports microbat species, one detector was deployed at two sites in the Kalbarri Region during April 2022. Detectors recorded for one nights at each location, with a total effort of 2 detector nights. Recorded data was analysed using a combination of manual and automated identification with specific analysis to identify bat fauna recorded. While no conservation significant bat fauna was identified from the call analysis, four least concern species were recorded. Three of these species are bats which roost and breed in tree hollows. One cave roosting species; *Vespadelus finlaysoni* was recorded on both nights. This suggests that habitat suitable for bat roosts is available in the survey area. This species is primarily cave roosting but also is known to roost in artificial habitat such as culverts, fairy martin nest and buildings. *Vespadelus* are small bats with slow fluttering flight and generally do not forage far from roosts (<2 km, Gonsalves et al. 2013). Although cave habitat may be nearby, *V. finlaysoni* is flexible with respect to cave roost choice.

2. Methods

2.1 Ultrasonic survey

Bat calls were recorded at five locations during each phase of field surveys using in situ (stationary) full spectrum bat detectors. SM4 Songmeters (Wildlife Acoustics) were used. Detectors were programmed to turn on 30 minutes before sunset and 30 minutes post sunrise.

2.2 Bat call analysis method

Erin Westerhuis (GHD) completed the analysis and presentation of all bat call data in this report.

Data was processed and analysed using a combination of manual review and automated techniques using Kaleidoscope Pro (Wildlife Acoustic, version 5.4.6) and Anabat Insight (Titley Scientific, version 2.0.1). The following process was used:

1. Calls were initially processed in Kaleidoscope Pro using a 4 – 150 kHz frequency range, 1 – 5000 ms minimum and maximum length of detected pulses, a maximum inter-syllable gap of 500 ms and with a minimum of 3 pulses detected. Files were split to standard 1 second intervals and noise files were moved to a subfolder.

2. For each night, the first hour of data passing the Kaleidoscope pro filter was manually reviewed for bat calls using Anabat Insight by visually comparing the time-frequency graph (spectrogram) and call characteristics (e.g. peak frequency, characteristic frequency and call shape) with species call descriptions from published guidelines (Armstrong and Cole 2007; McKenzie and Bullen 2009; Guppy et al. 1985; Hanrahan et al. 2021; Hourigan 2011). Species were manually labelled according to species
3. Manually labelled species identifications were used to build a custom species-specific filter and a decision tree in Anabat Insight. This was achieved by extracting the call metadata for all identified calls, then calculating the interquartile ranges of values per pulse. These values then informed the ranges used to build filters for automatic species identification using a decision tree.
4. Call identification was assisted by consulting distribution information for potential species (Armstrong 2011 and McKenzie et al various dates; Churchill 2008; Van Dyck et al. 2013) and records from Australasian Bat Society BatMap (June 2022). No reference calls were collected during the survey.

3. Summary of results

Desktop assessments of bat species likely to occur in the area indicated that six microbat species had the potential to occur (BatMap ausbats.org.au accessed online 20th June 2022). All are least concern under state and federal legislation:

- *Austronomus australis*
- *Chalinolobus morio*
- *Chalinolobus gouldii*
- *Nyctophilus geoffroyi*
- *Saccolaimus flaviventris*
- *Scotorepens greyii*
- *Vespadelus finlaysoni*

During the two nights of recording in April 2022, 4477 files were recorded, however the majority of recorded files consisted of false-triggers caused by insects such as cricket, katydids and cicadas. This is an unavoidable consequence of having to set detectors to record at the low frequency that both insects and lower frequency bat species such as *Austronomus australis* and *Saccolaimus flaviventris* call at.

After processing and filtering, 293 files were found to contain at least three echolocation pulses in a sequence (a pass). Of these, 193 were able to be positively identified to species level. Unidentified calls consisted of irregular vocalisations rather than search phase echolocation. These are likely a form of social calls and frequency suggested they were *Chalinolobus gouldii* calls. Ultimately, four species were positively identified of the six species that are known to occur from the locality of the study area (Table 1).

Overall, bat activity detected at the detector sites during phase 1 was low. Most calls recorded at both sites was attributed to *Chalinolobus gouldii*. Activity at the site recorded on the 3rd April was lower than on the 6th April. The site recorded on the 6th April also had *Austronomus australis* recorded while the site on the 3rd of April did not. *Austronomus australis* is a large tree roosting microbat which forages in open airspace and their presence at the detector site recorded on the 6th April suggests that suitable foraging habitat occurs in the area and potentially tree roosts. The remaining three species are smaller microbats which are relatively flexible with respect to roost choice, although *C. gouldii* and *N. geoffroyi* are typically tree roosting while *V.finlaysoni* roosts in caves, culverts and fairy martin nests.

Table 1 Kalbarri results per detector night.

Location	Night	*Austronomus australis*	*Chalinolobus gouldii*	*Nyctophilus geoffroyi*	*Vespadelus finlaysoni*	Grand Total
-27.336960, 114.568540	06/04/2022	12	59	2	2	75
-27.558430, 114.134460	03/04/2022		96	8	14	118
Grand Total		**12**	**155**	**10**	**16**	**193**

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5. Appendix A – Example Spectrograms for Bat Species identified Kalbarri survey

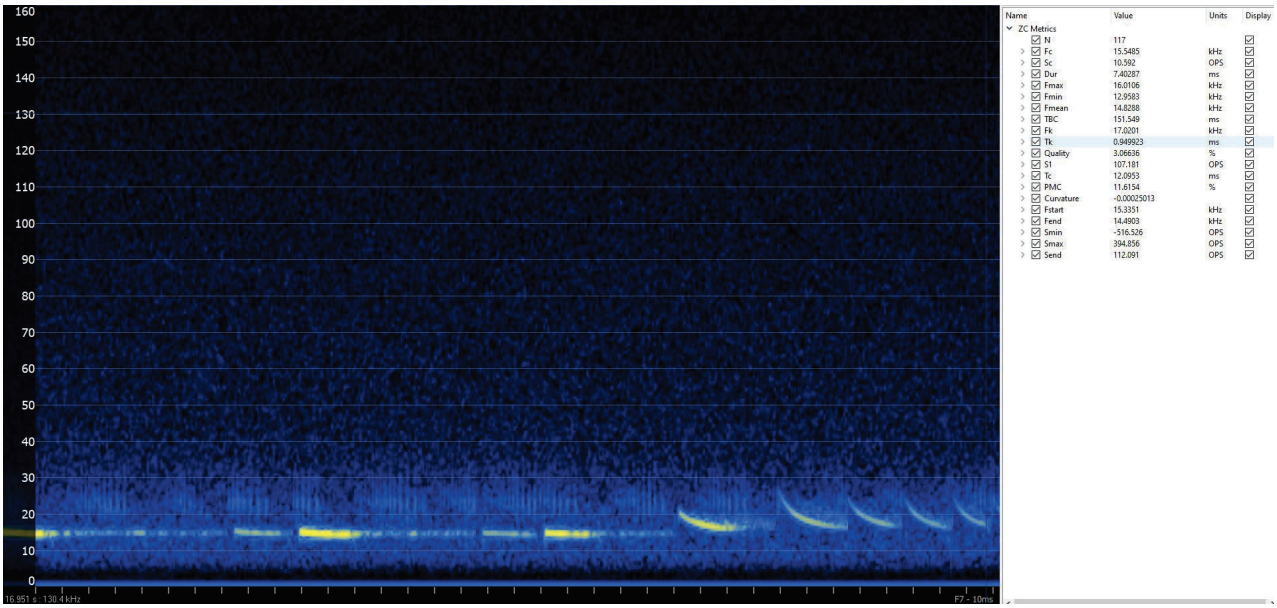

Figure 1 Example of Austronomus australis call sequence. Flat to curvilinear call below 20 kHz with widely spaced pulses helps distinguish this species from Chaerophon jobensis and Saccolaimus flaviventris. Where harmonics occur, the first harmonic is the strongest.

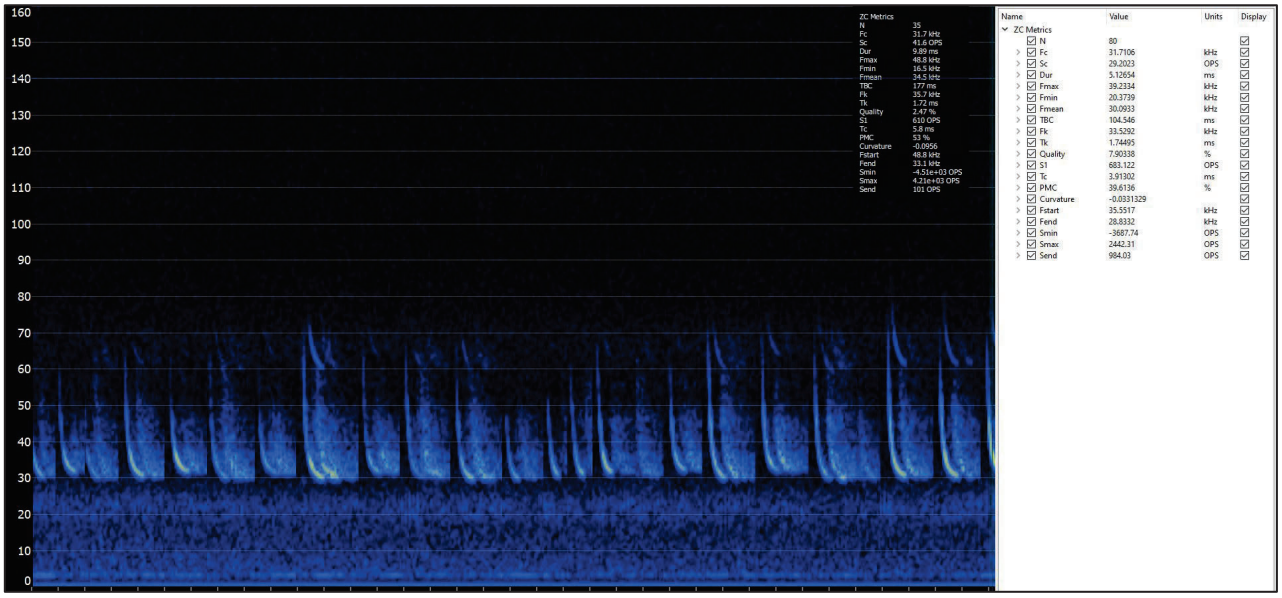

Figure 2 Call sequence of Chalinolobus gouldii. Alternation of frequency between successive pulses differentiates this from other species which echolocate at similar frequencies (~ 30 kHz). This does not always occur, however time between calls and the slope of the characteristic can be informative.

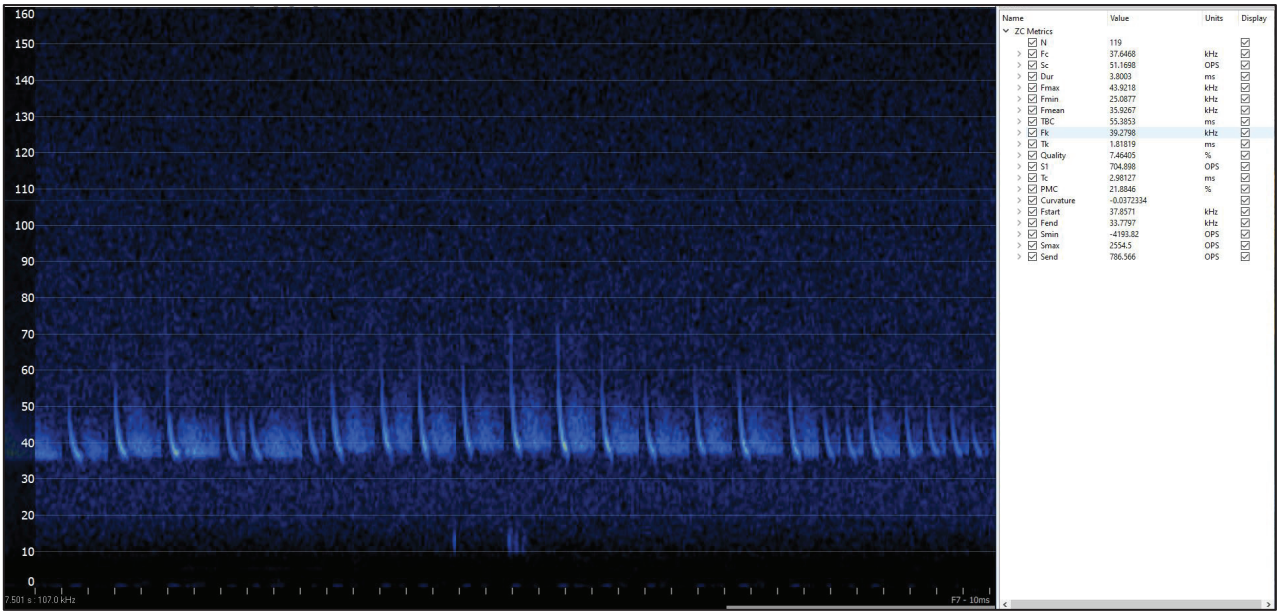

Figure 3 Example of Nyctophilus species call sequence. Low amplitude calls with broad frequency sweep culminating in a down swept tail help distinguish this from S. greyii calls at a similar frequency

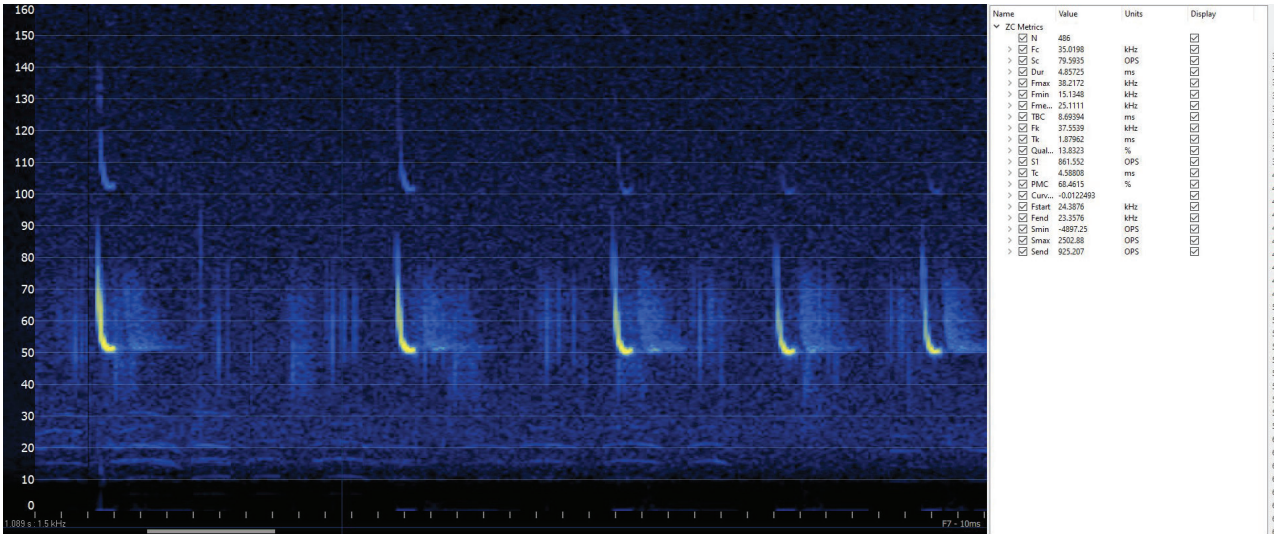

Figure 4 Example call sequence of a Vespadelus finlaysoni. Frequency between 50 – 55 khz and hocky stick shape separates this from other species in the Pilbara calling at a similar frequency.

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