MDIOM SOLAR FARM, HAUL ROAD & PIPELINE

VERTEBRATE & SHORT-RANGE ENDEMIC TERRESTRIAL FAUNA ASSESSMENT

PREPARED FOR: JBS&G | HPPL

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EXECUTIVE SUMMARY

The proposed Mulga Downs Iron Ore Mine (MDIOM, the Proposal) lies within the Pilbara Bioregion of Western Australia (WA), 180 kilometres (km) north-west of Newman. JBS&G Pty Ltd (JBS&G) on behalf of Hancock Prospecting Pty Ltd (HPPL) commissioned Spectrum Ecology and Spatial (Spectrum) to undertake a basic and targeted terrestrial vertebrate fauna assessment, and Level 1 short-range endemic (SRE) invertebrate fauna assessment for the following components of the Mulga Downs Iron Ore Mine:

- Revised Pipeline Route (Pipeline) – approximately 256.1 ha;
- Revised Haul Road (Haul Road) – approximately 13.2 ha; and
- Solar Farm – approximately 101.4 ha.

The objective of the fauna assessment was to undertake a desktop review, a basic and targeted vertebrate and SRE invertebrate fauna survey to describe the fauna and fauna habitat values across the Survey Areas in order to inform environmental approvals.

The literature review and database searches identified a total of 45 mammals (including eight introduced), 177 bird, 119 reptile, and 10 amphibian species that have previously been recorded in the Study Area (Survey Areas with 50 km buffer applied). Of the species identified in the desktop assessment, 36 species were of conservation significance (eight mammals, 23 birds, five reptiles) that have previously been recorded from the Study Area. Of these, one species, Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*; EPBC & BC Act Vu), was previously recorded from the Pipeline Survey Area (Biologic 2022a).

To provide regional context for the assessment of the SRE invertebrate fauna values within the Survey Areas, a desktop review was conducted of Western Australian Museum invertebrate database records and previous SRE surveys in the Study Area.

The database search and literature review identified 20 Mygalomorph (trapdoor) spiders, one Opiliones (harvestman), 19 pseudoscorpions, 11 scorpions, two millipedes, 39 isopods (slaters) and one mollusc (snails), that have previously been recorded from within 50 km of the Survey Area

A total of six fauna habitat types were recorded during the assessment, none of which are restricted to the Survey Areas, these were:

- Stony Spinifex Plains and Hillslopes;
- Mulga Woodland;
- Alluvial Clay Plain;
- Chenopod/Cracking Clay Floodplain;
- Mixed Eucalypt/Mulga Floodplain; and
- Drainage Lines/Floodplains.

Two species of conservation significance were recorded during the survey:

- Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*; EPBC & BC Act Vulnerable) was recorded foraging in the Pipeline Survey Area; and
- Western Pebble-mound Mouse (DBCA Priority 4) was recorded from secondary evidence (old disused mound) in the Solar Farm Survey Area.

Following the survey, the conservation significant vertebrate fauna which could potentially occur within the Survey Areas were reviewed and a total of 26 species (eight mammals, 15 birds and three reptiles) have either been recorded (Pilbara Leaf-nosed Bat and Western Pebble-mound Mouse) or have a Medium to High likelihood of occurrence in the Survey Areas based on habitat preferences, survey results and

regional records. An additional 10 species have a Low to Very Low likelihood to occur at the Survey Areas (eight birds, two reptiles). The species that have either been recorded or have a Medium to High likelihood to occur are listed in Table 0.1.

Table 0.1: Conservation Significant Fauna Species Likely to Occur and Suitable Habitat

Species	Con Sig Status			Likelihood of Occurrence & Suitable Habitat		
	EPBC Act	BC Act	DBCA	Pipeline	Haul Road	Solar Farm
Mammals						
Northern Quoll (*Dasyurus hallucatus*)	EN	EN	-	**Low**	**Medium** Suitable Fauna Habitat: Drainage Lines (foraging & dispersal only)	**Medium** Suitable Fauna Habitat: Drainage Lines (foraging & dispersal only)
Bilby (*Macrotis lagotis*)	VU	VU	-	**Medium** Suitable Fauna Habitat: Drainage Lines/Floodplains and Mulga Woodland	**Low**	**Low**
Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*)	VU	VU	-	**Recorded** Suitable Fauna Habitat: Foraging only – Priority 4 - Drainage Lines/Floodplains and Priority 5 - Mulga Woodland, Stony Spinifex Plains and Hillslopes, Chenopod/Cracking Clay Floodplain, Alluvial Clay Plain, Mixed Eucalypt/Mulga Floodplain	**Medium** Suitable Fauna Habitat: Foraging only –Priority 4 - Drainage Lines/Floodplains and Priority 5 - Mulga Woodland, Stony Spinifex Plains and Hillslopes	**Medium** Suitable Fauna Habitat: Foraging only – Priority 4 - Drainage Lines/Floodplains and Priority 5 - Mulga Woodland, Stony Spinifex Plains and Hillslopes
Ghost Bat (*Macroderma gigas*)	VU	VU	-	**Medium** Suitable Fauna Habitat: Drainage Lines/Floodplains (no caves recorded, foraging only).	**Medium** Suitable Fauna Habitat: Drainage Lines/Floodplains (no caves recorded, foraging only).	**Medium** Suitable Fauna Habitat: Drainage Lines/Floodplains (no caves recorded, foraging only).
Brush-tailed Mulgara (*Dasycercus blythi*)	-	-	P4	**Medium** Suitable Fauna Habitat: Stony Spinifex Plains and Hillslopes (north-east area only)	**Low**	**Low**
Spectacled Hare-wallaby (*Lagorchestes conspicillatus leichardti*)	-	-	P4	**Medium** Suitable Fauna Habitat: Stony Spinifex Plains and Hillslopes and Drainage Lines/Floodplains	**Low**	**Low**
Short-tailed Mouse (*Leggadina lakedownensis*)	-	-	P4	**High** Stony Spinifex Plains and Hillslopes, Mulga Woodland and Drainage Lines/Floodplains	**Low**	**Low**

Species	Con Sig Status			Likelihood of Occurrence & Suitable Habitat		
	EPBC Act	BC Act	DBCA	Pipeline	Haul Road	Solar Farm
Western Pebble-mound Mouse (*Pseudomys chapmani*)	-	-	P4	Low	High Suitable Fauna Habitat: Stony Spinifex Plains and Hillslopes	Recorded Suitable Fauna Habitat: Stony Spinifex Plains and Hillslopes
Birds						
Night Parrot (*Pezoporus occidentalis*)	EN	CR	-	Medium	Low	Low
Grey Falcon (*Falco hypoleucos*)	VU	VU	-	Medium Suitable Fauna Habitat: Drainage Lines/Floodplains (foraging) Infrastructure corridors – potential breeding habitat	Medium Suitable Fauna Habitat: Drainage Lines/Floodplains (foraging)	Medium Suitable Fauna Habitat: Drainage Lines/Floodplains (foraging)
Pacific Swift (*Apus pacificus*)	MI	MI	-	Medium Suitable Fauna Habitat: aerial species, unlikely to use habitats present.	Medium Suitable Fauna Habitat: aerial species, unlikely to use habitats present.	Medium Suitable Fauna Habitat: aerial species, unlikely to use habitats present.
Common Greenshank (*Tringa nebularia*)	MI	MI	-	Medium Suitable Fauna Habitat: Alluvial Clay Plains and Drainage Lines/Floodplains, when inundated	Low	Low
Common Sandpiper (*Actitis hypoleucos*)	MI	MI	-			
Glossy Ibis (*Plegadis falcinellus*)	MI	MI	-			
Red-necked Stint (*Calidris ruficollis*)	MI	MI	-			
Oriental Pratincole (*Glareola maldivarum*)	MI	MI	-			
Pectoral Sandpiper (*Calidris melanotos*)	MI	MI	-			
Sharp-tailed Sandpiper (*Calidris acuminata*)	MI	MI	-			
Wood Sandpiper (*Tringa glareola*)	MI	MI	-			
Gull-billed Tern (*Gelochelidon nilotica*)	MI	MI	-			
Caspian Tern (*Hydroprogne caspia*)	MI	MI	-			
Little Tern (*Sternula albifrons*)	MI	MI	-			
Peregrine Falcon (*Falco peregrinus*)	OS	OS	-	High Suitable Fauna Habitat: all habitats	Medium Suitable Fauna Habitat: all habitats	Medium Suitable Fauna Habitat: all habitats
Reptiles						
Pilbara Olive Python (*Liasis olivaceus barroni)*	VU	VU	-	Low	Medium Suitable Fauna Habitat: Drainage Lines/Floodplains	Medium Suitable Fauna Habitat: Drainage Lines/Floodplains
Gane's Blind Snake (*Anilios ganei*)	-	-	P1	Low	Medium	Medium

Species	Con Sig Status			Likelihood of Occurrence & Suitable Habitat		
	EPBC Act	BC Act	DBCA	Pipeline	Haul Road	Solar Farm
					Suitable Fauna Habitat: Mulga Woodland and Drainage Lines/Floodplains	Suitable Fauna Habitat: Mulga Woodland and Drainage Lines/Floodplains
Lined Soil-crevice Skink (*Notoscincus butleri*)	-	-	P4	Low	Medium Suitable Fauna Habitat: Stony Spinifex Plains and Hillslopes and Drainage Lines/Floodplains	Medium Suitable Fauna Habitat: Stony Spinifex Plains and Hillslopes and Drainage Lines/Floodplains

A total of 69 invertebrate specimens were collected from 10 invertebrate taxa, which included seven potential SRE taxa. The potential SRE taxa included one scorpion, four pseudoscorpions, one millipede, two isopods and two snails. The majority of the specimens were collected from Mulga Woodland habitat, with the remainder in Drainage Lines/Floodplains, Stony Spinifex Plains and Hillslopes and Alluvial Clay Plain. None of these habitats are restricted to the Survey Areas, which indicates SRE species that occur within the Survey Areas, could also occur outside.

1. INTRODUCTION

1.1. Background

The proposed Mulga Downs Iron Ore Mine (MDIOM, the Proposal) lies within the Pilbara Bioregion of Western Australia (WA), 180 kilometres (km) north-west of Newman. JBS&G Pty Ltd (JBS&G) on behalf of Hancock Prospecting Pty Ltd (HPPL) commissioned Spectrum Ecology and Spatial (Spectrum) to undertake a basic and targeted terrestrial vertebrate fauna assessment, and Level 1 short-range endemic (SRE) invertebrate fauna assessment for the following components of the Mulga Downs Iron Ore Mine:

- Revised Pipeline Route (Pipeline) – approximately 256.1 hectares (ha);
- Revised Haul Road (Haul Road) – approximately 13.2 ha; and
- Solar Farm – approximately 101.4 ha.

All components are herein referred to as the Survey Areas. The total area surveyed was 370.7 ha.

The Solar Farm and Revised Haul Road are located within the Mulga Downs Pastoral Station, which is owned by HPPL and occupies a total area of 384,451 hectares (ha). The Solar Farm is intended to support the MDIOM. The Haul Road will allow access to the MDIOM from the west. The majority of the proposed Revised Pipeline is located within the Mulga Downs Pastoral Station, with a small portion in the north-west situated in the Hooley Pastoral Lease. Details of the Survey Areas are displayed in Map 1.1.

The terrestrial fauna survey is required to provide supporting information for the environmental impact assessment of the Proposal for both the State and Commonwealth approvals process.

1.2. Scope

The objective of the fauna assessment was to undertake a desktop review, a basic, and targeted vertebrate and SRE invertebrate fauna survey to describe the fauna and fauna habitat values across the Survey Areas in order to inform environmental approvals.

The scope of work for this assessment included:

- Desktop assessment of the wider Study Area (the initial Survey Areas with a buffer of 50 km);
- Basic terrestrial vertebrate fauna survey;
- Targeted terrestrial vertebrate fauna survey for conservation significant vertebrate fauna species; and
- Level 1 SRE invertebrate fauna survey.

500000
550000
600000
650000
700000
750000
800000
7650000
7600000
7550000
7500000
7450000

Millstream Chichester National Park
Yandeyarra Reserve
Mungaroona Range Nature Reserve
GREAT NORTHERN HIGHWAY
Marble Bar
Goodiadarrie Swamp
Karijini (Hamersley Range) Gorges
Karijini National Park
Fortescue Marsh
Karijini National Park
GREAT NORTHERN HIGHWAY
Newman

Legend
- Pipeline
- Haul Road
- Solar Farm
- MDIOM Development Envelope
- Yandeyarra Reserve
- Locality/Town
- Railway
- FMG Railway
- Roy Hill Railway
- Great Northern Highway
- Nature Reserves/National Parks

N
0 10 20 30 40 km
Scale 1:950,000 @ A3

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum ECOLOGY + SPATIAL

Author: GF
Date: 13-04-2023

Location of Survey Areas

MDIOM Solar Farm, Haul Road & Pipeline

MAP 1.1

Prepared for JBS&G | HPPL

1.3. Legislation & Guidelines

Terrestrial fauna (vertebrate fauna and SREs) in Western Australia are protected under various legislation (Appendix A), including:

- *Biodiversity Conservation Act 2016* (BC Act, WA);
- *Environmental Protection Act 1986* (EP Act, WA); and
- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act, Commonwealth).

The survey was compliant with survey guidelines, as outlined in:

- EPA Environmental Factor Guideline: Terrestrial Fauna (Environmental Protection Authority, 2016a);
- EPA Technical Guidance Technical Guidance – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (Environmental Protection Authority, 2020); and
- EPA Technical Guidance: Sampling Methods for Short Range Endemic Invertebrate Fauna (EPA 2016c).

In addition to the above, species-specific guidelines were also followed:

- Survey guidelines for Australia's threatened mammals (Department of Sustainability Environment Water Population and Communities, 2011a);
- Survey guidelines for Australia's threatened birds (Department of the Environment Water Heritage and the Arts, 2010b);
- Survey guidelines for Australia's threatened bats (DEWHA 2010a);
- Survey guidelines for Australia's threatened reptiles (DSEWPaC 2011b);
- EPBC Act referral guideline for the endangered northern quoll *Dasyurus hallucatus* (Department of the Environment, 2016a);
- Guidelines for surveys to detect the presence of bilbies, and assess the importance of habitat in Western Australia (Department of Biodiversity Conservation and Attractions, 2017); and
- Interim guideline for preliminary surveys of night parrot (*Pezoporus occidentalis*) in Western Australia (Department of Parks and Wildlife, 2017a).

1.4. Bioregion

The Interim Biogeographic Regionalisation for Australia (IBRA) classifies Australia into regions based on dominant landscape, climate, lithology, geology, landform and vegetation (Thackway and Cresswell, 1995).

The Survey Areas are located in the Pilbara Craton IBRA Bioregion (Figure 1.1). The Pilbara Craton is made up of four subregions; the Chichester, Fortescue Plains, Hamersley and Roebourne. The Survey Areas are located in two subregions, Chichester (Solar Farm) and Fortescue Plains (Pipeline and Haul Road) (red, green and blue areas in Figure 1.1).

The Chichester subregion is characterised by undulating Archaean granite and basalt plains with significant areas of basaltic ranges (Kendrick, 2001a; McKenzie, May and McKenna, 2003). The plains of this subregion support hummock grasslands characterised by shrub steppe of *Acacia pyrifolia* over *Triodia pungens*. The ranges are dominated by *Eucalyptus leucophloia* tree steppes (Kendrick, 2001a; McKenzie, May and McKenna, 2003).The bioregion is geologically complex with great mineral wealth and is also biologically special. There are high levels of species endemism and species-rich ecosystems including persisting populations of threatened and endangered species (McKenzie, May and McKenna, 2003).

The main geomorphological driver in the Fortescue Plain subregion is the Fortescue River. The subregion is characterised by alluvial plains with extensive salt marsh, Mulga, and grassland communities. It is generally recognised as the northern limit of Mulga woodlands in Western Australia (Kendrick, 2001b). The Chichester subregion is characterised by granite and basalt plains, which support a shrub steppe dominated by *Acacia inaequilatera* over *Triodia wiseana* hummock grasslands, while *Eucalyptus leucophloia* tree steppes occur on ranges (Kendrick and Mckenzie, 2001). The dominant current and historical land uses across the Fortescue and Chichester subregions is grazing on native pastures and mining leases.

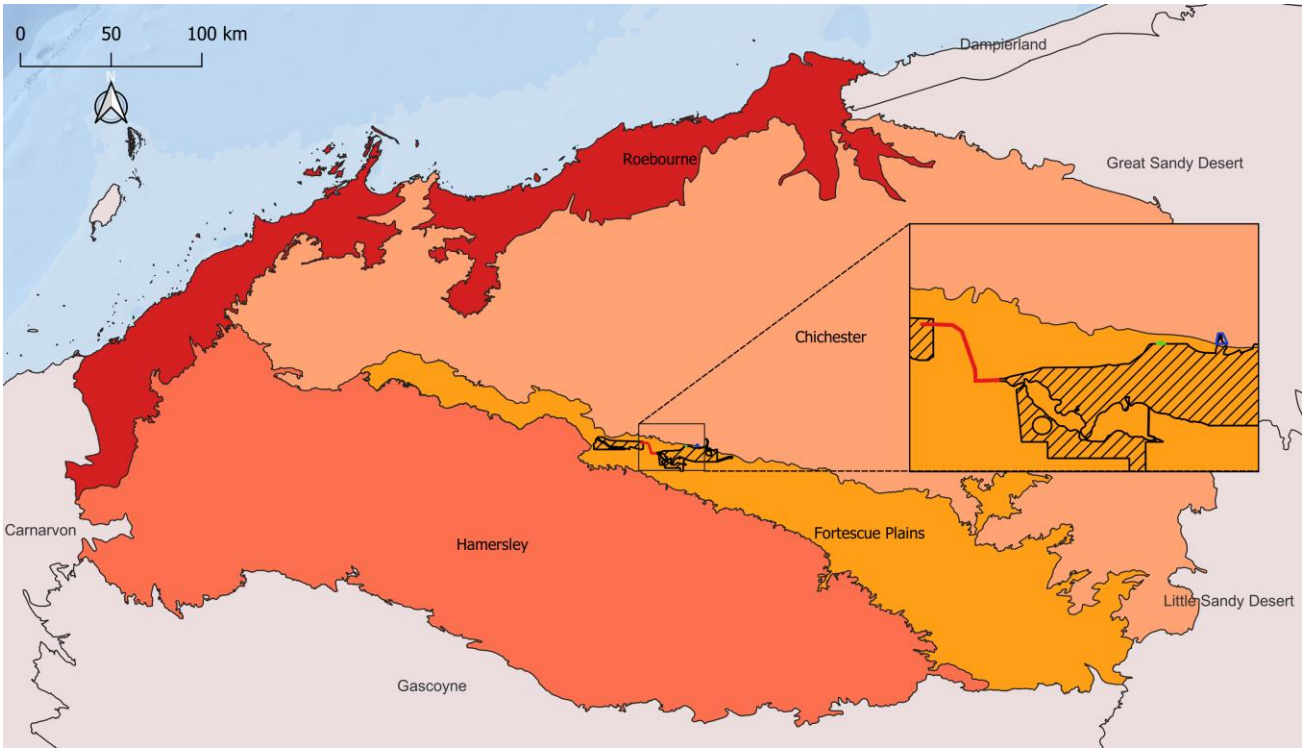


Figure 1.1: IBRA subregions (Survey Areas shown in insert)

1.5. Climate

The climate of the Pilbara bioregion is classified as tropical, arid to semi-arid, with a median annual rainfall of 300 mm. Rainfall for the region can be variable, falling mainly in summer cyclonic events from December to February (Thackway and Cresswell, 1995b).

Two broad climatic zones occur across the Pilbara region. Semi-desert tropical climatic conditions occur in coastal areas, as well as some higher-rainfall inland areas, which experience nine to 11 months of dry weather, with hot humid summers and warm winters. Dry desert climatic conditions occur across the remaining inland areas, which typically experience higher temperatures and lower rainfall, with hot dry summers and mild winters with up to 12 months of dry weather (Leighton, 2004). The Survey Areas are located within the dry inland area.

Annual rainfall is highly variable, but generally follows an inland-to-coastal and southern-to-northern increasing trend (Leighton, 2004). The driest months are in spring (September to October), with tropical cyclones and local thunderstorms producing much of the summer and early autumn rainfall (Mckenzie, Van Leeuwen and Pinder, 2009). Winter rainfall is also highly variable, generally decreasing from the coast to inland areas (Leighton, 2004).

Monthly maximum temperatures in the Pilbara region range from an average of 25°C in July to 37°C in January, while minimum temperatures range between 12°C in July and 25°C in January (Mckenzie, Van Leeuwen and Pinder, 2009). According to the Köppen-Geiger climate classification, the Survey Areas experience a hot desert climate (Class BWh) (Peel, Finlayson and McMahon, 2007). This classification includes arid regions where annual evaporation exceeds annual precipitation, and have a mean annual temperature ≥18°C.

1.6. Disturbance History

The dominant current and historical land uses across the Pilbara region involves grazing of native pasture, conservation, crown reserves, mining leases, and Aboriginal lands and reserves. Historically, pastoralism has been the most significant land use within the Pilbara. Since the 1960s mining, predominantly iron ore, has become a significant land use with much of the Pilbara now under mining tenure (Kendrick, 2001c).

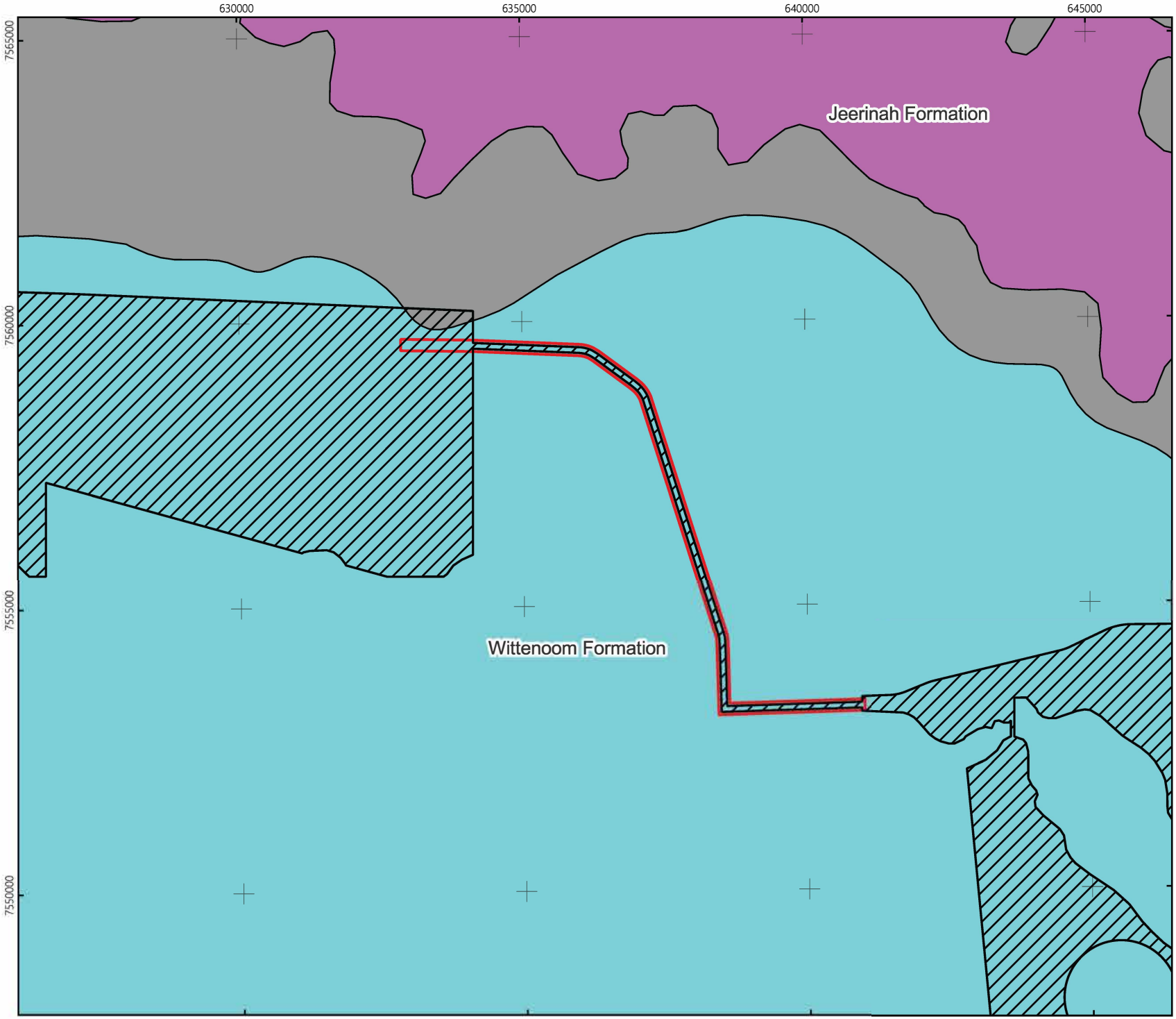
1.7. Geology

The geology of Western Australia has been mapped at a scale of 1:50,000, 1:100,000, 1:250,000, and 1:500,000. The Survey Areas occur in the central west of the 1:500,000 scale geological mapping (DMIRS, 2020), which is the finest-scale digital mapping available for the area mapped to the state extent.

Geological mapping was completed within the Survey Areas, recording two units. The Wittenoom Formation covers the largest extent of these units, representing 69.1% of the Survey Areas and the entirety of the revised Pipeline. The Jeerinah Formation covers the remaining 30.9%, including the entirety of the revised Haul Road and Solar Farm Survey Areas. These units may be considered restricted as they occur only within the Pilbara region. The units are listed in Table 1.1 and mapped on Map 1.2 and Map 1.3.

Table 1.1: Surface Geology of the Survey Areas

Unit Name	Unit Code	Description	Area (ha) & % Pipeline	Area (ha) & % in Haul Rd	Area (ha) & % in Solar Farm	Total Area (ha) & % in Survey Areas	% of Pilbara Extent Within Pipeline	% of Pilbara Extent Within Haul Rd	% of Pilbara Extent Within Solar Farm	Total Pilbara Extent (ha)
Wittenoom Formation	A-HAd-kd	Thinly bedded dolomite and dolomitic shale, with minor black chert, shale, banded iron formation and sandstone	256.1 (100%)	N/A	N/A	256.1 (69.1%)	<0.1%	N/A	N/A	1,353,161.8
Jeerinah Formation	A-FOj-xs-b	Siliciclastic sedimentary rocks, mafic volcanic rocks and minor felsic volcanic rocks; local carbonate rocks, chert, and dolerite sills	N/A	13.2 (100%)	101.4 (100%)	114.6 (30.9%)	N/A	<0.1%	<0.1%	637,799.4



Legend

Survey Areas

- Pipeline
- MDIOM Development Envelope

Geological Unit

- Jeerinah Formation
- Wittenoom Formation
- Unit not Within Survey Area

N

0 1 2 3 km

Scale 1:100,000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum ECOLOGY • SPATIAL

Author: GF

Date: 21-04-2023

Surface Geology - Pipeline

MDIOM Solar Farm, Haul Road & Pipeline

MAP 1.2

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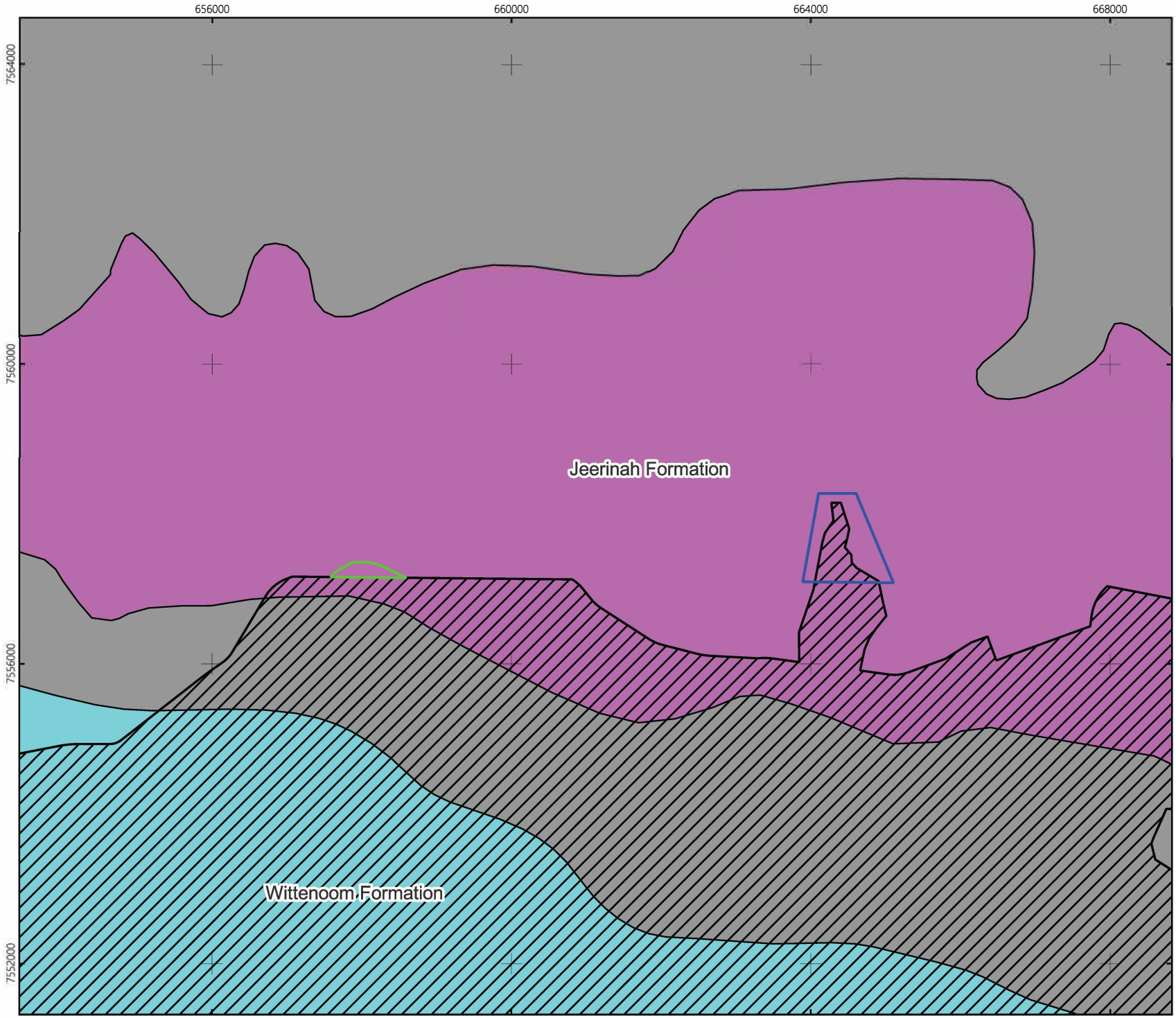


Legend

Survey Areas

- Haul Road
- Solar Farm
- MDIOM Development Envelope

Geological Unit

- Jeerinah Formation
- Wittenoom Formation
- Unit not Within Survey Areas

N

0 1 2 km

Scale 1:70,000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum ECOLOGY • SPATIAL

Author: GF

Date: 21-04-2023

Surface Geology - Haul Road & Solar Farm

MDIOM Solar Farm, Haul Road & Pipeline

MAP 1.3

Prepared for
JBS&G | HPPL

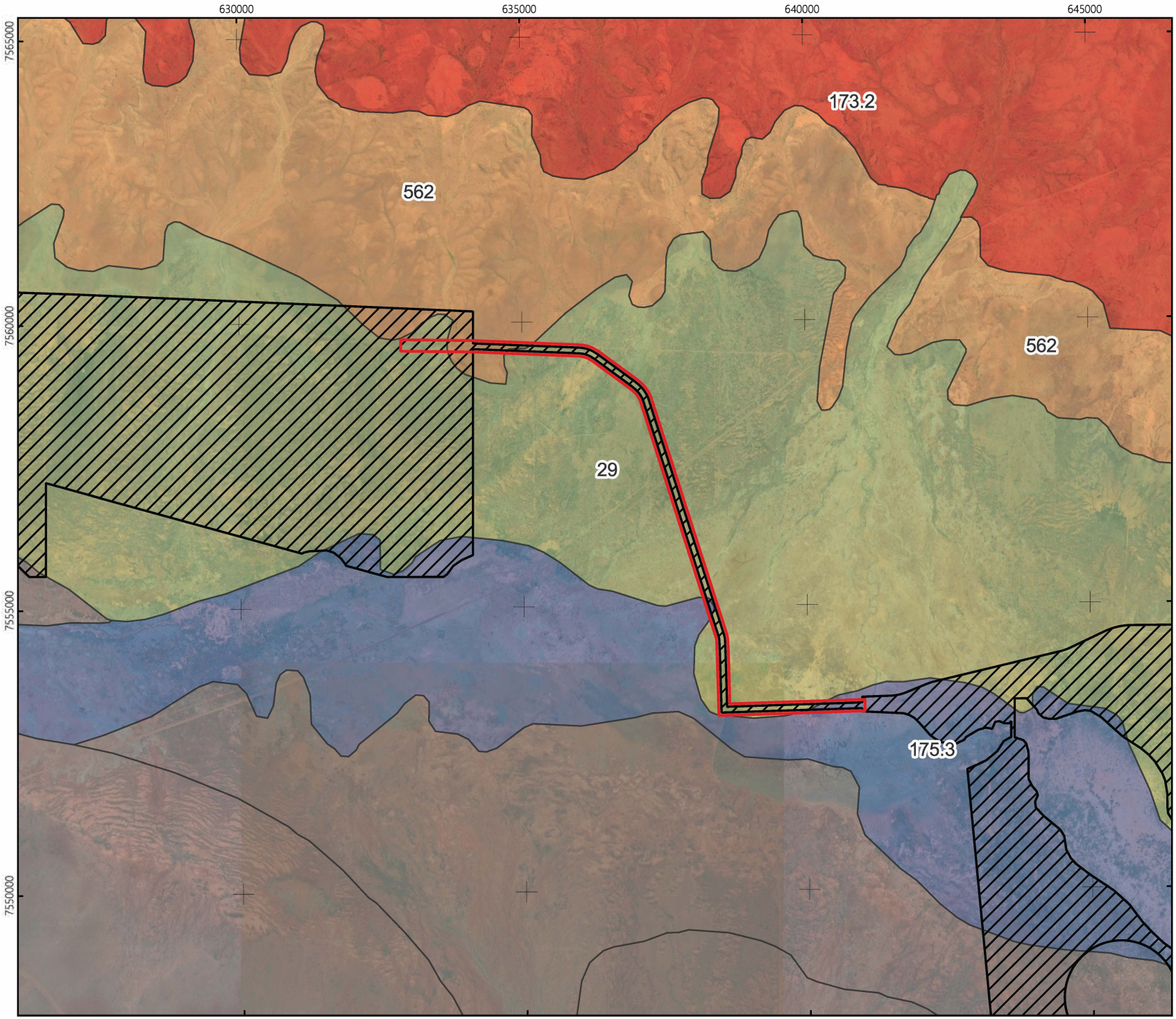
1.8. Beard Vegetation Mapping

Pre-European vegetation mapping was originally undertaken by John Beard (Beard *et al.*, 2013) at various scales across the state and has since been updated to be consistent with the National Vegetation Information System (NVIS) descriptions at a scale of 1:250,000 (Department of Primary Industries and Regional Development, 2019). State-wide vegetation statistics are available from 2018 for these associations, which lists pre-European extent, current extent, area in DBCA managed lands and is a useful tool to determine if a vegetation association is rare or otherwise significant (Government of Western Australia, 2019).

Four vegetation sub-associations (SAs), including one mosaic (SA 562), have been mapped within the Survey Areas (Table 1.2; Map 1.4; Map 1.5). The most common was SA 29 which was mapped as 56.3% of the Survey Areas followed by SA 173.2 and SA 562 representing 27.2% and 10.7%, respectively. The remaining SA, 175.3 accounts for only 5.8% and only occurs in the Revised Pipeline Survey Area. Three of the SAs, 173.2, 175.3 and 562, are restricted to the Pilbara region. Over 99% of the pre-European vegetation extent remains for all four sub-associations.

Table 1.2: Beard Vegetation Sub Associations of the Survey Areas

SA	NVIS Level V Description	Area (ha) & % in Pipeline	Area (ha) & % in Haul Rd	Area (ha) & % in Solar Farm	Total Area (ha) & % in Survey Areas	Pre-European Extent WA (ha)	Current Extent WA (ha)	Current Pilbara Extent WA (ha)	% Remaining	% of Current WA Extent in Survey Areas	% of Current Pilbara Extent in Survey Areas
29	Mid isolated clumps of *Acacia aneura* shrubs.	208.7 (81.5%)	N/A	N/A	208.7 (56.3%)	3,530,311.5	3,529,439.8	902,864.4	99.9%	<0.1%	<0.1%
173.2	*Eucalyptus dichromophloia* open woodland over *Acacia pyrifolia*, *Grevillea pyramidalis*, and *Hakea lorea* sparse shrubland over *Triodia wiseana* and *Triodia pungens* open hummock grassland.	N/A	N/A	100.8 (99.5%)	100.8 (27.2%)	1,125,813.1	1,124,734.2	1,124,734.2	99.9%	<0.1%	<0.1%
175.3	*Aristida/Eragrostis* open tussock grassland.	21.6 (8.5%)	N/A	N/A	21.6 (5.8%)	68,175.0	68,175.0	68,175.0	100.0	<0.1%	<0.1%
562 (Mosaic)	*Acacia aneura* low isolated trees. *Eucalyptus brevifolia* low isolated trees, over *Triodia wiseana* mid open hummock grasslands.	25.8 (10.0%)	13.2 (100%)	0.6 (0.5%)	39.6 (10.7%)	103,606.8	103,606.8	103,606.8	100.0	<0.1%	<0.1%



Legend

Survey Areas

- Water Pipeline
- MDIOM Development Envelope

Beard Vegetation Sub-Assocations

- 29
- 173.2
- 175.3
- 562
- Sub-Association not in Survey Area

N

0 1 2 3 km

Scale 1:100,000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum ECOLOGY • SPATIAL

Author: GF

Date: 21-04-2023

Beard Vegetation - Pipeline

MDIOM Solar Farm, Haul Road & Pipeline

MAP

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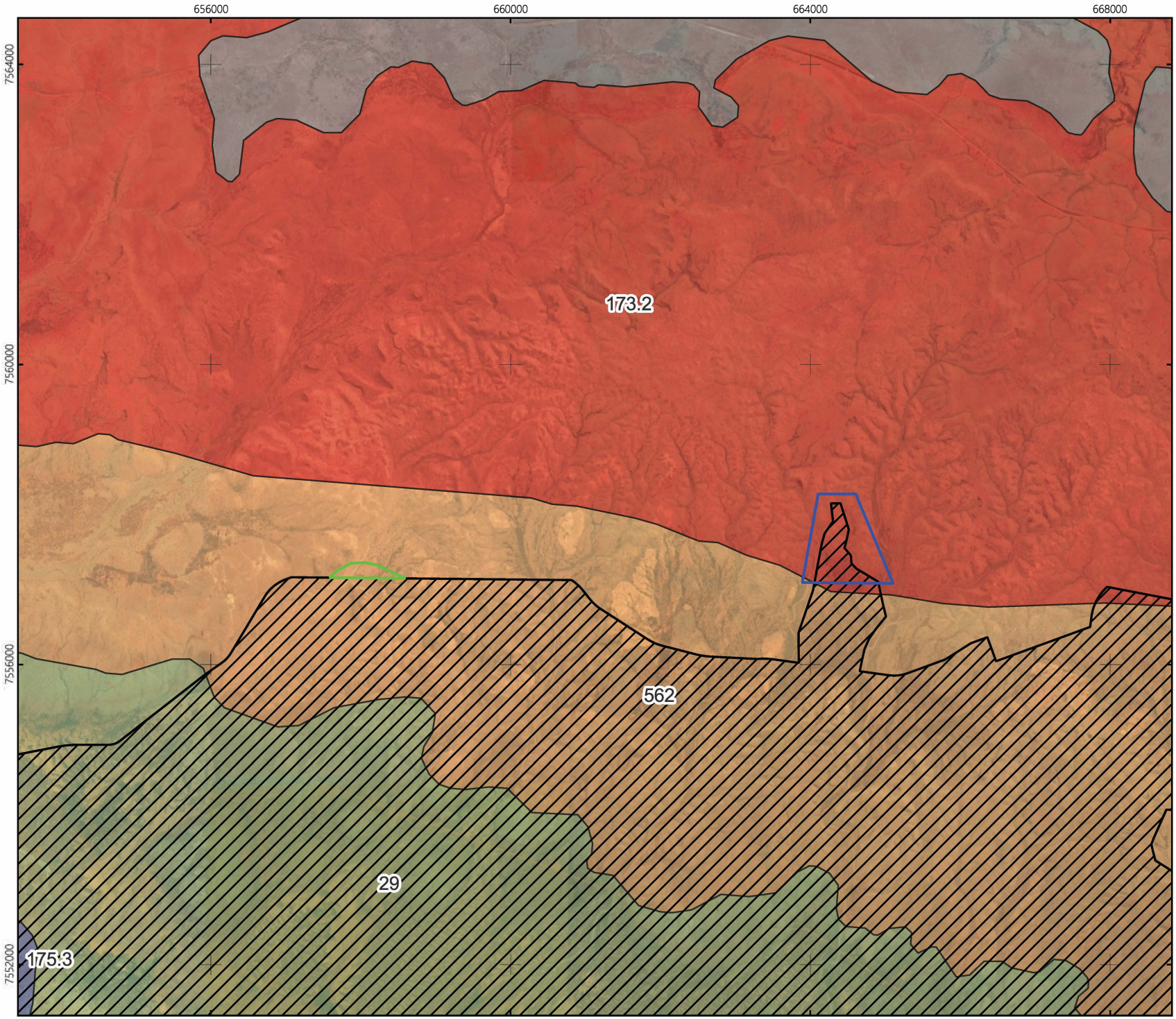
1.4



Legend

Survey Areas

- Haul Road
- Solar Farm
- MDIOM Development Envelope

Beard Vegetation Sub-Associations

- 29
- 173.2
- 175.3
- 562
- Sub-Association not in Survey Areas

N

0 1 2 km

Scale 1:70,000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum ECOLOGY • SPATIAL

Author: GF

Date: 21-04-2023

Beard Vegetation - Haul Road & Solar Farm

MDIOM Solar Farm, Haul Road & Pipeline

MAP 1.5

Prepared for
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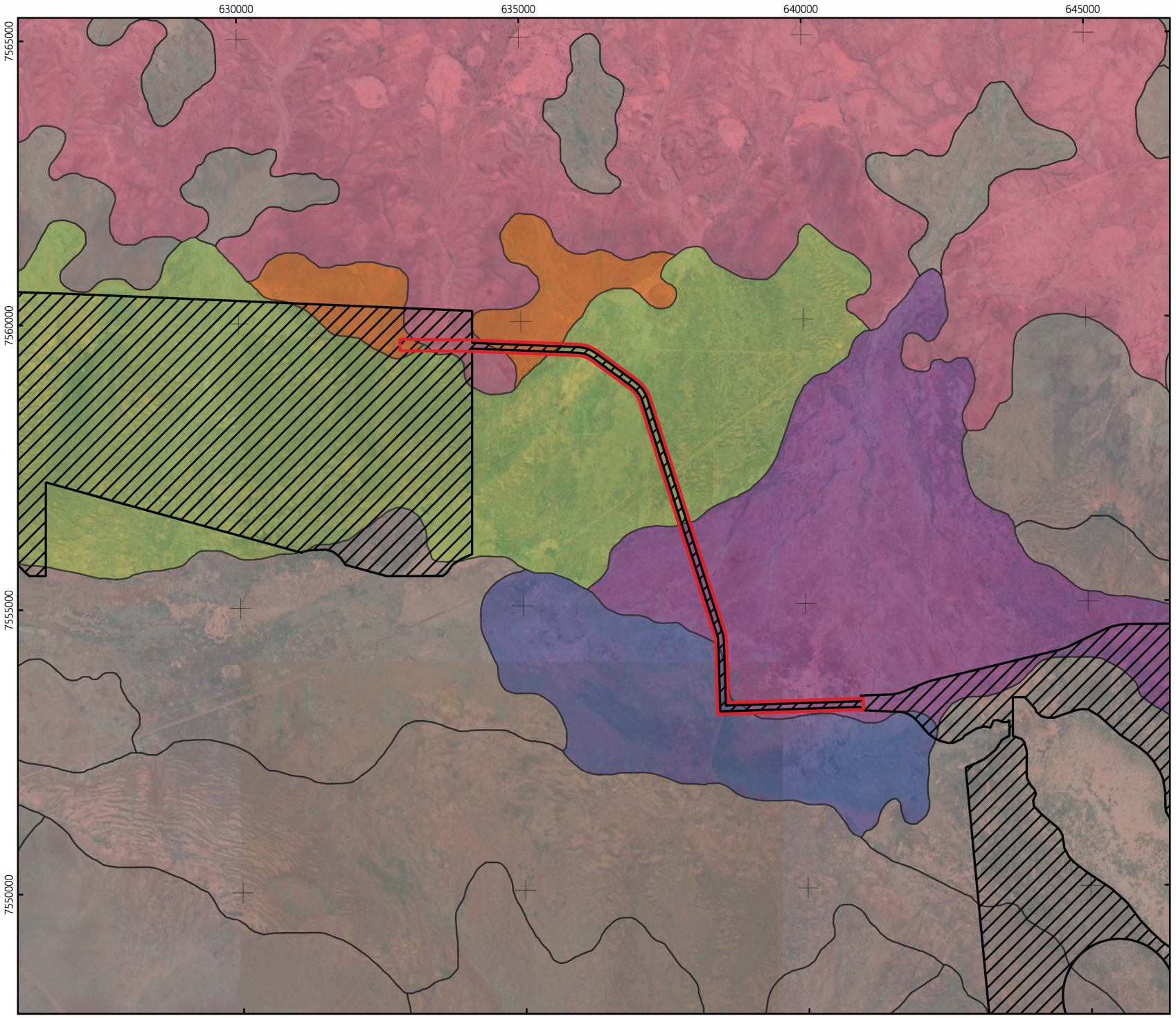
1.9. Land Systems

The land systems of Western Australia have been mapped at a scale of 1:250,000 (DAFWA 2016).

Land Systems mapping was completed within the Survey Areas recording five units, one of which – the McKay Land System, was dominant covering 28.3% (Table 1.3; Map 1.6; Map 1.7). The Hooley, Jurrawarrina and Boolgeeda Land Systems cover 24.5%, 23.1% and 17.1%, respectively. A small area of the Brockman Land System (7.0%) was also found within the Survey Areas and restricted to the Revised Pipeline. All land systems are well represented in the region with the Survey Areas covering less than 1% of the land systems extent in WA (Table 1.3).

Table 1.3: Land Systems of the Survey Areas

Land System	Description	Area (ha) & % in Pipeline	Area (ha) & % in Haul Rd	Area (ha) & % in Solar Farm	Total in Survey Areas (ha) & %	Total Pilbara Extent (ha)	% of Pilbara Extent Within Solar Farm	% of Pilbara Extent Within Haul Rd	% of Pilbara Extent Within Pipeline
Hooley	Alluvial clay plains supporting a mosaic of snakewood shrublands and tussock grasslands.	90.9 (35.5%)	N/A	N/A	90.9 (24.5%)	59,118	N/A	N/A	<0.1%
Jurrawarrina	Hardpan plains and alluvial tracts supporting mulga shrublands with tussock and spinifex grasses.	85.5 (33.4%)	N/A	N/A	85.5 (23.1%)	66,498	N/A	N/A	<0.1%
Brockman	Gilgai alluvial plains with cracking clay soils supporting tussock grasslands and low woodlands.	26 (10.2%)	N/A	N/A	26.0 (7.0%)	74,120	N/A	N/A	<0.1%
McKay	Hills, ridges, plateaux remnants and breakaways of meta sedimentary and sedimentary rocks supporting hard spinifex grasslands with acacias and occasional eucalypts.	24.4 (9.5%)	N/A	80.3 (79.3%)	104.7 (28.3%)	425,967	<0.1%	N/A	<0.1%
Boolgeeda	Stony lower slopes and plains below hill systems supporting hard and soft spinifex grasslands or mulga shrublands.	29.3 (11.4%)	13.2 ha (100%)	21.0 (20.7%)	63.5 (17.1%)	961,848	<0.1%	<0.1%	<0.1%



Legend

Survey Areas

- Pipeline
- MDIOM Development Envelope

Land Systems

- Boolgeeda Land System
- Brockman Land System
- Hooley Land System
- Jurrawarrina Land System
- McKay Land System
- Land System not in Survey Areas

N

0 1 2 3 km

Scale 1:100,000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum ECOLOGY • SPATIAL

Author: GF

Date: 21-04-2023

Land Systems - Pipeline

MDIOM Solar Farm, Haul Road & Pipeline

MAP 1.6

Prepared for
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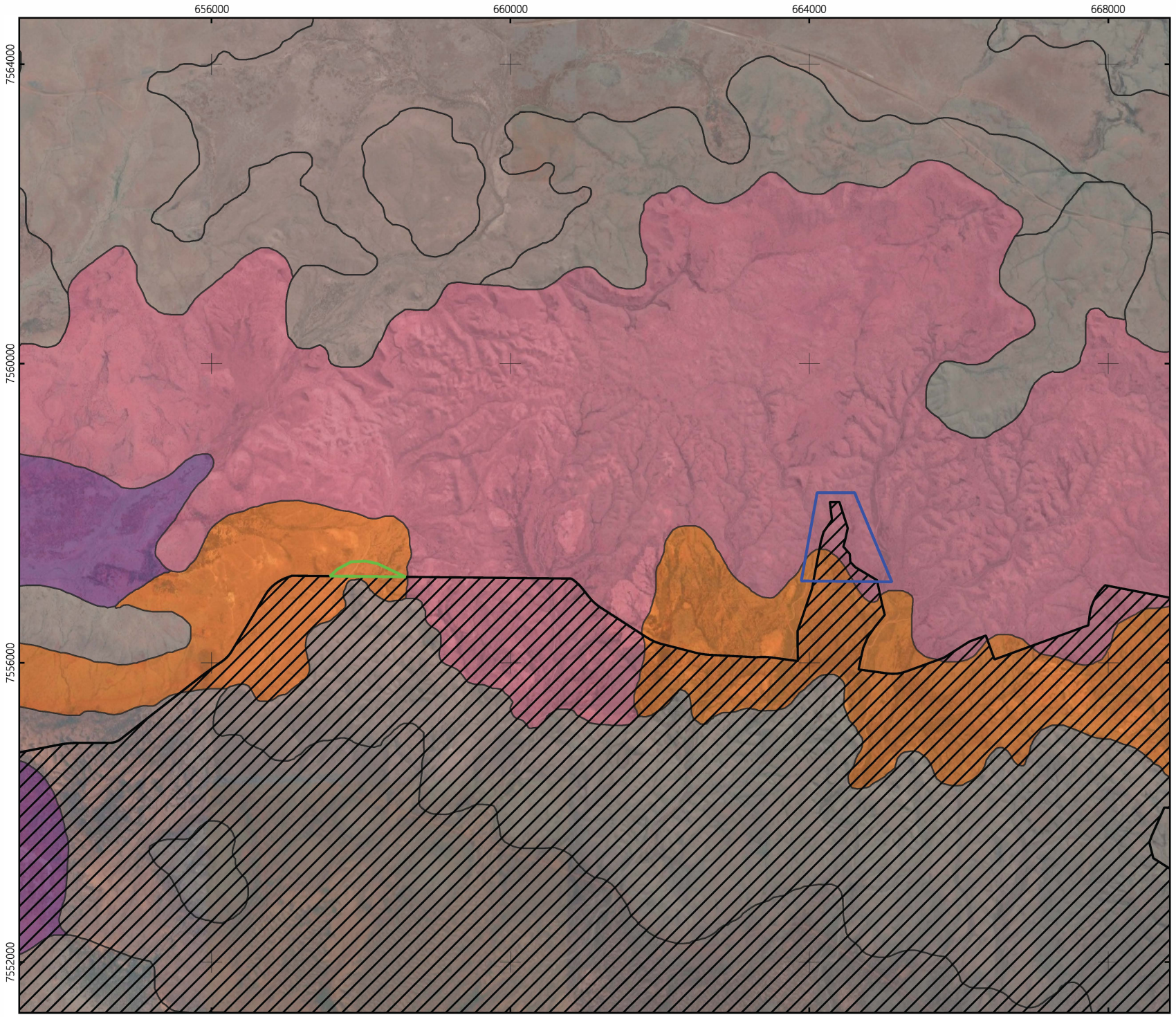

Legend

Survey Areas

- Haul Road
- Solar Farm
- MDIOM Development Envelope

Land Systems

- Boolgeeda Land System
- Hooley Land System
- McKay Land System
- Land System not in Survey Areas

N

0 1 2 km

Scale 1:70,000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum ECOLOGY • SPATIAL

Author: GF

Date: 21-04-2023

Land Systems - Haul Road & Solar Farm

MDIOM Solar Farm, Haul Road & Pipeline

MAP 1.7

Prepared for
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1.10. Significant Lands

Six significant lands are located in the desktop Study Area (50 km buffer of the Survey Areas). These are listed in Table 1.4 and displayed on Map 1.8 and are described in the following sections.

Table 1.4: Environmentally Significant Areas within the Study Area

Reserve Name (Protected Area ID)	Distance and Direction from Pipeline	Distance and Direction from Haul Road	Distance and Direction from Solar Farm
Conservation Estate			
Mungaroona Range Nature Reserve	18 km N	14 km N	12 km N
Karijini National Park	16 km S	22 km S	25 km S
Environmentally Sensitive Areas			
Mungaroona Range Nature Reserve	18 km N	14 km N	12 km N
Karijini National Park	16 km S	22 km S	25 km S
Fortescue Marsh	0 km	6 km S	7 km S
Karijini (Hamersley Range) Gorges	21 km S	24 km S	26 km S
Threatened Flora*	19 km S	32 km SW	37 km SW
Wetlands			
Karijini (Hamersley Range) Gorges	21 km S	24 km S	26 km S
Fortescue Marshes (DIWA WA066)	0 km	6 km S	7 km S

*Threatened Flora ESA in the location provided refers to either *Aluta quadrata* or *Thryptomene wittweri*.

1.10.1. Conservation Estate

The Western Australian conservation estate includes land and waters vested in the Conservation and Parks Commission under the *Conservation and Land Management Act 1984*. The conservation estate is managed by the Department of Biodiversity, Conservation and Attractions (DBCA) to protect Western Australia's biodiversity and includes National Parks, Nature Reserves, Conservation Reserves, and other areas managed primarily for biodiversity conservation (Department of the Environment and Energy, 2016). No conservation estates occur within the Survey Areas (Table 1.4), however, two occur within the Study Area (Survey Areas with 50 km buffer):

- Mungaroona Range Nature Reserve; and
- Karijini National Park.

1.10.2. Environmentally Sensitive Areas

Environmentally Sensitive Areas (ESA) are defined by the Department of Water and Environmental Regulation (Department of Water and Environmental Regulation, 2019) as:

- A defined wetland and the area within 50 m of a wetland;
- The area covered by vegetation within 50 m of Threatened flora, to the extent to which the vegetation is continuous with the vegetation in which the Threatened flora is located;
- The area covered by a Threatened Ecological Community (TEC);
- A Bush Forever site;
- Areas covered by the Gnangara Mound Crown Land Policy and Western Swamp Tortoise Policy; and
- Areas covered by lakes, wetlands, and fringing vegetation of the Swan Coastal Plain Lakes Policy, including South-west Agricultural Zone Wetlands Policy and Swan and Canning Rivers Policy.

Five ESA's are located within the Study Area (Table 1.4), including:

- Mungaroona Range Nature Reserve;
- Karijini National Park;
- Fortescue Marsh;
- Karijini (Hamersley Range) Gorges; and
- One Threatened flora (*Aluta quadrata* or *Thryptomene wittweri* locations).

The southern extent of the Pipeline Survey Area overlaps within the Fortescue Marsh (Map 1.8).

1.10.3. Australian Wetlands Database

The Australian Wetlands Database includes nationally significant wetlands (as listed in the directory of important wetlands), wetlands listed under the Ramsar convention, wetlands that are representative, rare, or unique, or wetlands that are considered of international importance (Department of the Environment and Energy, 2019).

Two nationally significant wetlands were mapped within the Study Area (Table 1.4):

- Karijini (Hamersley Range) Gorges; and
- Fortescue Marshes (DIWA WA066).

A small portion (16.9 ha) of the Pipeline Survey Area overlaps with the Fortescue Marshes (DIWA WA066) (Map 1.8).

600000
630000
660000
690000
720000
7590000
7560000
7530000
7500000
Mungaroona Range
Goodiadarrie Swamp
Goodiadarrie Swamp
Karijini (Hamersley Range) Gorges
Karijini National Park
Fortescue Marsh

Legend

Survey Areas
- Pipeline
- Haul Road
- Solar Farm
- MDIOM Development Envelope

Conservation Estates
- Karijini
- Mungaroona Range

Important Wetlands
- Fortescue Marsh
- Karijini (Hamersley Range) Gorges
- RAMSAR Wetlands
- Environmentally Sensitive Areas
- DRF

N

0 5 10 15 km

Scale 1:450,000 @ A3

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum ECOLOGY • SPATIAL

Author: GF

Date: 31-05-2023

Significant Lands Search Results

MDIOM Solar Farm, Haul Road & Pipeline

MAP

Prepared for
JBS&G | HPPL

1.8

1.11. Short-Range Endemic Target Groups

Short-range endemic invertebrate species are defined as species with naturally small distributions (<10,000 km^2) that possess ecological, morphological and life history characteristics that affect their range (Harvey, 2002). Poor powers of dispersal, confinement to discontinuous habitats, slow growth rates and low levels of fecundity often result in fragmented or severely restricted distributions. Many species appear to be Gondwanan relicts now isolated in pockets of mesic habitat that was once more widespread and contiguous prior to the aridification of the Australian landscape. A low level of taxonomic resolution, lack of detailed ecological information and difficulties identifying many taxa via morphological means further complicates the assessment of potential SRE species. In many taxa, such as *Antichiropus* sp. millipedes, male only characters (e.g. gonopod morphology) are the primary diagnostic features used when identifying species (Wojcieszek, Harvey and Rix, 2010). If female or juvenile specimens are collected, identification to species level or alignment with known undescribed morphospecies using morphological characters is not possible. The use of DNA barcoding is gradually addressing this issue though the database of known sequences is still limited for many taxa (Western Australian Museum, 2014).

The combination of these factors make SRE species particularly vulnerable to threatening processes such as habitat loss, degradation and climate change (Harvey *et al.*, 2011). The taxa detailed in Table 1.5 have been identified as displaying one or more of the characteristics known to cause short-range endemism (Harvey, 2002) and as such are targeted during field assessment.

Table 1.5: SRE Target Groups

Phylum or Subphylum	Class	Order	Details
Annelida	Oligochaeta	Haplotaxida	Earthworms.
Chelicerata	Arachnida	Araneae	Spiders, particularly those belonging to the infraorder Mygalomorphae (trapdoor spider).
		Opiliones	Harvestmen.
		Pseudoscorpiones	False scorpion or book scorpion.
		Schizomida	Micro whip scorpions, mostly known from troglobitic species.
		Scorpiones	Scorpions.
Crustacea	Malacostraca	Isopoda	Terrestrial Isopods, also known as slaters or woodlice.
Mollusca	Gastropoda	Stylommatophora	Land snails.
Myriapoda	Chilopoda	Geophilomorpha	Elongate soil centipedes.
		Scolopendromorpha	Centipedes from the family Cryptopidae.
	Diplopoda	Not specified	Millipedes
Onychophora	Udeonychophora	Euonychophora	Velvet worms, family Peripatopsidae.

1.11.1. SRE Habitat

Sheltered, isolated, and often relictual mesic habitats have an increased likelihood of hosting SRE taxa. The gradual aridification of the Australian continent that began in the early Miocene has resulted in the contraction and isolation of mesic habitats and by association those relictual faunal groups that utilise them (Harvey, 2002). The following are examples or habitat types that have been recognised as potentially harbouring SRE species (Harvey, 2002; Durrant, 2011; EPA 2016c):

- Deep gorges;
- Isolated ranges, mesas, and rock outcrops;
- Rainforest patches;
- Islands;
- Drainage systems;
- Vine thickets;
- Hillslopes with south-west facing aspects; and
- Fire refuge areas such as cliffs and rock piles.

Many SRE species are associated with permanently moist, shaded, and sheltered microhabitats. In arid landscapes such as the ranges of the Pilbara region, these habitat types are typically limited and isolated by barriers of exposed, dry habitat not conducive to the dispersal SRE species. This isolation restricts or eliminates gene flow between populations and may result in speciation via selective pressures, genetic drift, and mutation. Even where speciation has not yet occurred, the geographical distribution of these species has severely contracted and fragmented. Isolated gorges and gullies that host complex microhabitats (heavy vegetation, deep leaf litter beds and varied rock cover) and protect relictual mesic habitat characteristics are more likely to host SRE taxa than simple widespread habitats exposed to climatic extremes. Isolated freshwater habitats associated with springs are also likely to provide conditions suitable for SRE taxa. Regionally extensive and exposed habitat types with high connectivity such as spinifex grassland are unlikely to host SRE taxa (Durrant, 2011).

Vegetation, geological, land system, and topographic mapping as well as aerial imagery may be used as surrogates to estimate habitat connectivity and distributional boundaries of potential SRE species. This is to be considered in circumstances where further survey is deemed unlikely to yield more specimens and further taxonomic or distributional information is not available via the museum and subject matter specialists (Environmental Protection Authority, 2016c).

2. METHODS

2.1. Desktop Assessment

A desktop review of relevant and available biological data sources for the Desktop Study Area was undertaken prior to the field survey, to assess the fauna and SRE likely to occur within the Survey Areas. The Desktop Study Area includes a buffer of approximately 50 km surrounding the Survey Areas, or as listed in Table 2.1.

2.1.1. Biological Database Searches

The following databases were searched and incorporated into the desktop assessment (Table 2.1).

Table 2.1: Summary of Database Searches

Database		Custodian	Species Group	Details
Commonwealth Protected Matters Search Tool (PMST)		Department of Climate Change, Energy, the Environment and Water (DCCEEW)	EPBC Act listed vertebrate and invertebrate fauna species	Date: 9/02/2023 Buffer: 50 km Survey Area Polygon
Threatened Fauna Database Search		Department of Biodiversity, Conservation and Attractions (DBCA)	Threatened and Priority vertebrate and invertebrate fauna species	Date: 9/02/2023 Details: Polygon plus 80 km Reference: #7549
Dandjoo			Vertebrate and invertebrate fauna species	Date: 8/02/2023 Buffer: 50 km Centre Point: -22.09452, 118.46403
Atlas of Living Australia (ALA)		National Research Infrastructure for Australia (NCRIS) / Commonwealth Scientific and Industrial Research Organisation (CSIRO) / Global Biodiversity Information Facility (GBIF)	Vertebrate fauna species	Date: 8/02/2023 Buffer: 50 km Centre Points: -22.0874, 118.3346 -22.0789, 118.5940
Invertebrate Fauna Databases	Mollusc Database	Western Australian Museum (WAM)	SRE and Invertebrate fauna species	Date: 9/02/2023 Search Area: Top Left Corner: -21.811, 118.018 Bottom Right Corner: -22.311, 118.900 Top Left Corner: -21.941, 118.138 Bottom Right Corner: -22.208, 118.744
	Arachnida & Myriapoda Database			
	Crustacea Database			
Index of Biodiversity Surveys and Assessments (IBSA) Database		Department of Water and Environmental Regulation (DWER)	Vertebrate and invertebrate fauna species	Date: 9/02/2023 Buffer: 50 km

2.1.2. Literature Review

Previously conducted biological assessments within the Desktop Study Area were reviewed for significant fauna and SREs. Reports were incorporated if they were provided or if they were publicly available. The nine reports incorporated into the desktop assessment are listed in Table 2.2. Ten detailed vertebrate fauna surveys, and six SRE surveys previously completed within the surrounding region were reviewed to provide information to support the current assessment.

Table 2.2: Surveys Previously Conducted in the Vicinity

Title	Title & Full Reference	Survey Level	Distance to Pipeline (km)	Distance to Haul Rd (km)	Distance to Solar Farm (km)
Mulga Downs (Terrestrial Ecosystems 2013a)	Level 2 Fauna Assessment for the Mulga Downs Project Area (Terrestrial Ecosystems 2013a).	Detailed – vertebrate fauna	13.6	0.8	2.4
Stage A (Biota 2004)	Fauna Habitats and Fauna Assemblage of the Proposed FMG Stage A Rail Corridor (Biota 2004).	Detailed – vertebrate fauna & Basic – SRE	65.1	47.3	41.0
Mulga East (ecologia 2020a)	Hancock Prospecting Pty Ltd Mulga East Baseline Terrestrial Fauna Assessment (ecologia 2020a).	Detailed – vertebrate fauna & SRE	0	0	1.8
Brockman Rail (ecologia 2011)	Brockman Resources Limited Rail Proposal Area Level 2 Vertebrate Fauna Survey (ecologia 2011).	Detailed – vertebrate fauna	69.7	52.4	46.0
Investigator Project (ecologia 2014)	Fortescue Metals Group Ltd Investigator Project Terrestrial Vertebrate Fauna Assessment (ecologia 2014).	Detailed – vertebrate fauna & SRE	0	11.2	17.4
Marillana Project (ecologia 2009)	Brockman Resources Ltd Marillana Iron Ore Project Vertebrate Fauna Assessment (ecologia 2009).	Detailed – vertebrate fauna	99.0	86.5	81.4
Christmas Creek (ENV 2012)	Christmas Creek Terrestrial Vertebrate Fauna and Fauna Habitat Assessment (ENV 2012).	Detailed – vertebrate fauna	122.2	105.9	99.7
Mulga Downs Hub and Rail Spur (Spectrum 2022)	RHIL Mulga Downs Hub and Rail Spur – Eastern Portion of Alignments 8B & 1B Basic & Targeted Terrestrial Fauna Assessment (Spectrum 2022).	Detailed – vertebrate fauna & SRE	43.2	25.4	18.9
Mulga Downs Transport Corridor (Biologic 2022b)	Mulga Downs Transport Corridor to Great Northern Hwy Terrestrial Fauna Survey (Biologic 2022b).	Detailed – vertebrate fauna & SRE	21.0	3.08	0
Mulga Downs West Borefield and Southern Corridor (Biologic 2022a)	Mulga Downs Iron Ore Mine: Mulga West Borefield and Mulga East Southern Corridor Terrestrial Fauna Survey (Biologic 2022a)	Detailed – vertebrate fauna & SRE	0	16.8	23.1

2.1.3. Likelihood of Occurrence of Significant Fauna

The following information was collated for each significant fauna taxon identified during the desktop assessment:

- Conservation status (EPBC Act, BC Act, DBCA listing);
- Description of habitat requirements;
- Description of previous records; and
- Distance of record to the Project.

A likelihood of occurrence assessment was then conducted using the criteria listed in Table 2.3. This included assessing the distance of the record from the Project (historical database records considered not accurate were excluded if required), presence of appropriate habitats within the Survey Area (using geology, vegetation mapping, and/or aerial imagery), and time passed since the record (fauna only).

Table 2.3: Likelihood of Occurrence Criteria

Likelihood	Fauna
Recorded	Species recorded within the Survey Area within the previous ten years.
High	Species recorded within or near the Survey Area within the previous 20 years. Suitable habitat occurs in the Survey Area.
Medium	Species recorded within or in proximity to the Survey Area more than 20 years ago. Species recorded outside the Survey Area but within 50 km. Suitable habitat occurs in the Survey Area.
Low	Species rarely or not recorded within 50 km of the Survey Area. Suitable habitat does not occur within or in proximity to the Survey Area.
Very Low	Species not recorded within 50 km despite multiple recent surveys. Suitable habitat does not occur within the Survey Area. Species considered locally extinct.

Note: the species' biology, detectability and frequency of records are considered in the likelihood assessment (e.g. an elusive species that is very rarely recorded may be rated more likely to occur than a species that is easily detectable)

2.2. Field Assessment

2.2.1. Survey Timing

The field assessment was undertaken over a seven-day period from 14 – 20 March 2023.

To characterise the prevailing conditions of the Survey Areas, monthly rainfall and mean temperature data were sourced from the nearest Bureau of Meteorology (BoM) weather stations - Karijini North (BoM #005098) approximately 21 km south of the Survey Areas was used for data 12 months prior to the survey. Auski Munjina Roadhouse (BoM #005093) approximately 33 km south of the Survey Areas was used to obtain long-term median rainfall (Bureau of Meteorology, 2023). Rainfall data from Mt Florance (BoM #005014) was utilised to fill gaps in rainfall data. Rainfall recorded since 2021, median monthly rainfall, and temperature are presented in Figure 2.1.

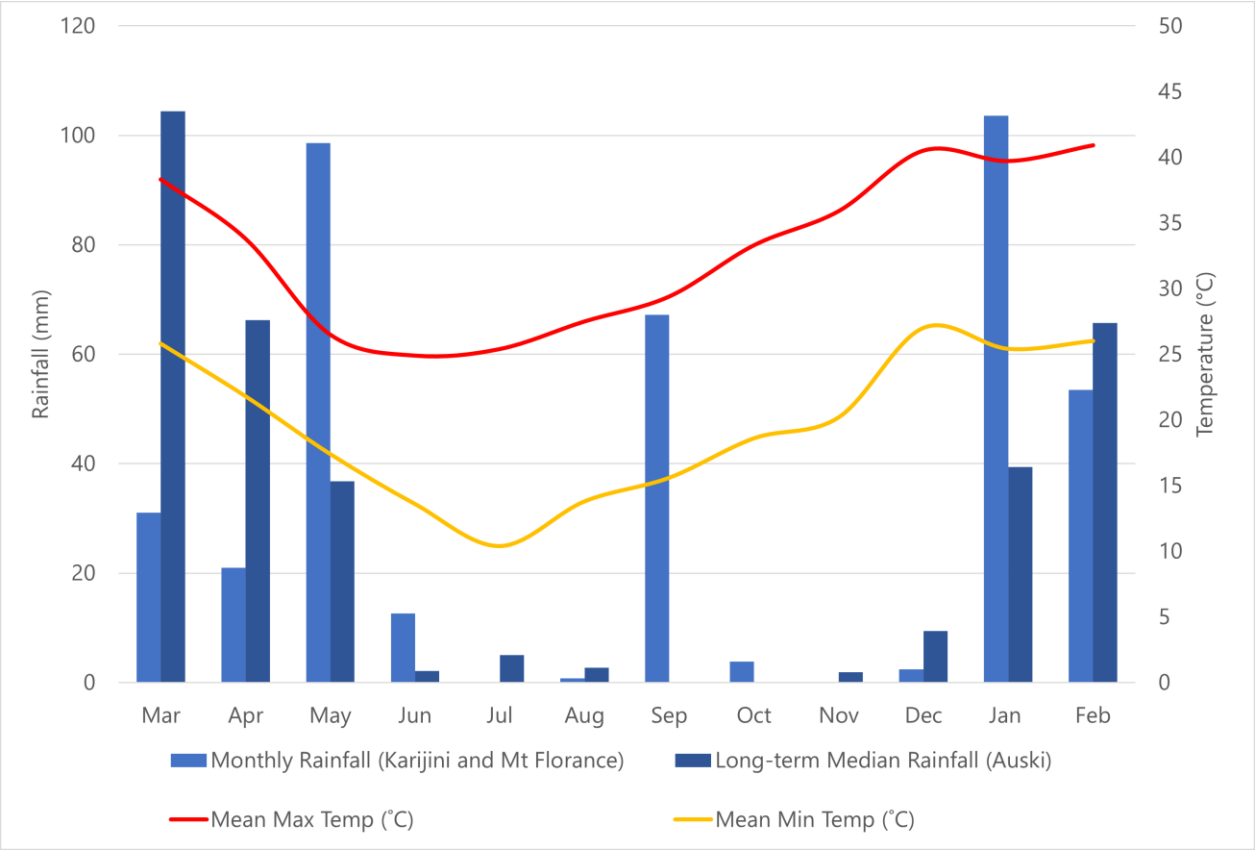


Figure 2.1: Mean temperature and rainfall for the 12 months preceding the surveys

The following rainfall was recorded at Karijini North (5098) 12 months prior to the survey:

- In the 12 months preceding the field surveys (March 2022 to February 2023), 345 mm of rainfall was recorded at Karijini North, 12 mm higher than the sum of the long-term annual median of 333 mm at Auski Munjina Roadhouse; and
- During the three months preceding the field survey (December 2022- February 2022), 159.5 mm of rainfall was recorded from Karijini North, 45.5 mm lower than the sum of the long-term annual median at Auski Munjina Roadhouse for the same three months (114 mm).

Conditions on site were slightly above average and following long-term rainfall patterns typical for the region.

2.2.1.1. Basic Terrestrial Fauna Assessment

The survey timing was appropriate for a basic survey of bird, mammal and reptile assemblages in the Pilbara region, however basic fauna assessments are not timing dependant (EPA 2020). The Survey Area is located within the Eremaean Botanical Province as described by Beard 1980. Technical Guidance (EPA 2020) recommends terrestrial fauna surveys in this region be completed between September to April (the period of highest reptile activity), preferably immediately after rain events (rain season) to coincide with peak amphibian and bird activity. There is no recommendation on survey timing for mammals.

2.2.1.2. Targeted Survey – Significant Vertebrate Fauna

The survey timing for targeted conservation significant fauna followed relevant species-specific guidelines (DEWHA 2010b, DEWHA 2010a; DSEWPaC 2011a, DSEWPaC 2011b; DEWHA 2016a; DBCA 2017) in particular those for EPBC-Act listed species such as the Northern Quoll and threatened bat species which are known from the wider area. The preferred timing for the terrestrial fauna assessments relevant to this project are:

- A reconnaissance survey for Northern Quoll can be completed any time of the year using non-invasive techniques such as motion cameras.
- Threatened bat species can be surveyed at any time, however the population contracts to areas around roost caves during the cooler dry season and then expands out during the warmer wet season.
- Pilbara Olive Python can be surveyed at any time, however they are considered to be more active in the warmer wet season, and move to rocky areas with suitable caves and crevices during the cooler dry season.
- Bilbies can be surveyed any time of the year using non-invasive techniques such as targeted searches for secondary evidence.

2.2.1.3. SRE Fauna

The EPA's Technical Guidance (EPA 2016c) states that conditions for SRE surveys are suitable between November and April to coincide with enhanced activity levels of key groups, such as mygalomorph spiders and snails. Where adults, in particularly males are required for the identification of the taxa, survey timing should be completed during seasonally wet conditions. The guidance however recognises the issues around unpredictable rainfall in some regions of WA and that survey work can therefore take place outside the recommended months.

2.2.2. Field Methods & Sampling Effort

2.2.2.1. Basic Survey

Spectrum conducted a basic terrestrial fauna assessment and targeted significant fauna survey. The survey was completed over a seven-day period from 14 – 20 March 2023, by two zoologists.

The approach of the basic fauna survey was to describe and map the fauna habitats across the Survey Areas and complete active searches to describe the vertebrate fauna assemblages, particularly any significant fauna identified as likely to be present.

A total of 45 fauna habitat assessment sites were established within the Survey Areas, with 12 in the Haul Road, 18 in the Pipeline and 15 in the Solar Farm. These sites also included two motion camera sites (five cameras at each site); five bat recorder sites, two acoustic recorder sites and 20 SRE sites.

A variety of survey techniques were used for fauna as outlined in Table 2.4. Survey site locations are outlined in Table 2.5 and shown on Map 2.1, Map 2.2 and Map 2.3.

Table 2.4: Fauna Survey Techniques

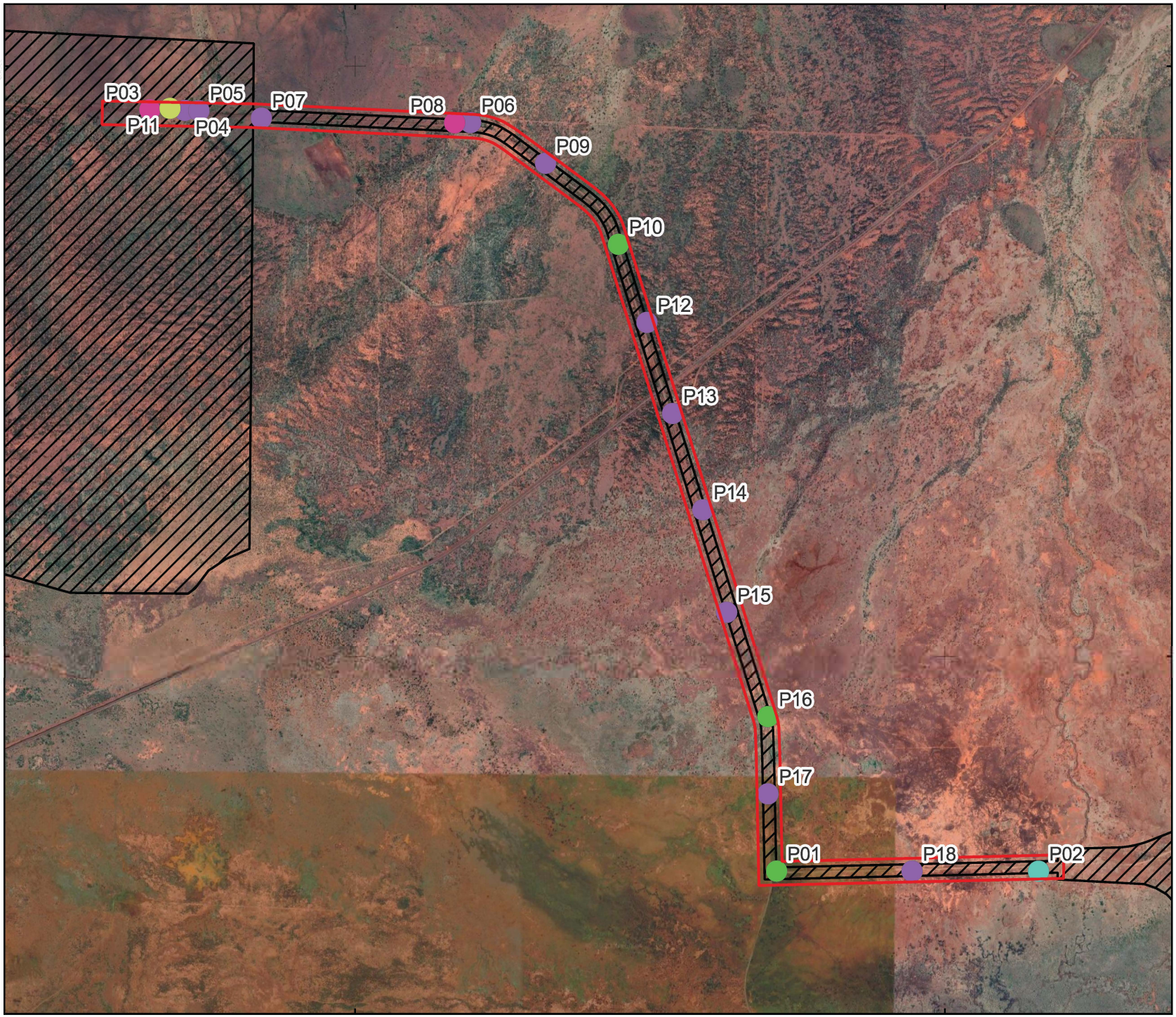
Technique	Application & Purpose	Target Group
Fauna Site	The following is undertaken at a fauna site (described in full in the sections below): • Site code, date, location, zoologist; • A photograph; • Vegetation condition and disturbances (including fire); • Landform including; slope, soil, rock type, aspect; and • Vegetation community type and density.	• Habitat Assessment • Mammals • Reptiles • Birds • Amphibians • Conservation Significant Fauna • SRE Invertebrates
Mapping Note	Note taken with the location and fauna habitat present. Can include photographs or descriptions.	• Habitat Assessment
Opportunistic Sampling	Fauna species not recorded through other sampling methods are opportunistically sampled as encountered in the Survey Area. Opportunistic sampling also included recording locations of significant and introduced species.	• Mammals • Reptiles • Birds • Amphibians • Conservation Significant Fauna • SRE Invertebrates
Targeted Sampling	Areas likely to support significant fauna are targeted during the survey. Areas are selected based on existing records from previous surveys, database searches, geology, aerial images, and vegetation mapping. Known significant fauna species may be targeted and methods will be dependent on the species. Targeted sampling methods can include: • Habitat assessment and mapping; • Acoustic recording; • Motion cameras in suitable habitat; • Active searches for direct and indirect evidence in suitable habitat; and • Systematic trapping.	• Conservation Significant Fauna • SRE Invertebrates
Sieving (Leaf Litter and Topsoil)	The leaf litter and topsoil of suitable microhabitats (such as underneath trees and shrubs) was collected and sieved through graduated geology sieves. The content of each sieve was placed into a white tray and searched for SRE target groups (Plate 2.1) which were then placed into a vial and preserved in 100% ethanol.	• SRE Invertebrates
Leaf Litter Collections	Three 1 m^2 quadrats were collected from each site (eight total) containing suitable leaf litter or soil. The samples were initially processed using a leaf litter reducer, with the smaller leaf litter components placed into plastic zip-lock bags and transported back to Perth where they were placed in Tullgren funnels in order to extract the invertebrates (Plate 2.1). Leaf litter samples were processed immediately following the field survey to ensure maximum survivorship before the samples were placed in Tullgren funnels.	• SRE Invertebrates
Motion Cameras	Ten motion sensitive cameras capable of recording both normal (day) and infra-red (night) images were deployed in areas of interest to record cryptic or targeted species not normally recorded by other survey methods. In addition, suitable habitat for conservation significant fauna likely to occur was targeted to determine their presence or absence.	• Mammals • Reptiles • Birds • Conservation Significant Fauna

Technique	Application & Purpose	Target Group
	Motion Cameras were baited with non-food reward baits (cotton rope soaked in fish oil) and left in place for three nights.	
Passive Ultrasonic Recording Units	Bat echolocation calls were recorded using Wildlife Acoustics SM4BAT ultrasonic recorders. The PUR devices record the full spectrum of calls allowing greater accuracy and sensitivity when identifying bat species. Each PUR device was programmed to record from 30 minutes pre-dusk to 30 minutes post-dawn for each night and deployed for a minimum of four nights.	• Bats • Conservation Significant Bats
Passive Acoustic Recording Units	Wildlife Acoustics Song Meter SM4 recording units were deployed in suitable foraging habitat. Each recorder was programmed to record from 30 minutes pre-dusk to 30 minutes post-dawn for each night and deployed for six nights.	• Conservation Significant Birds

Plate 2.1: Leaf litter and Topsoil Sieving & Tullgren Funnel Set-up

Table 2.5: Survey Site Locations

Survey Site Name	Easting	Northing
Pipeline		
P01	638575	7553184
P02	640796	7553183
P03	633261	7559623
P04	633556	7559626
P05	633676	7559624
P06	635980	7559523
P07	634201	7559561
P08	635844	7559521
P09	636615	7559178
P10	637233	7558494
P11	633431	7559644
P12	637475	7557833
P13	637692	7557062
P14	637949	7556248
P15	638151	7555380
P16	638501	7554491
P17	638508	7553838
P18	639726	7553200
Haul Road		
HL01	657900	7557219
HL02	657836	7557288
HL03	657685	7557189
HL04	657647	7557164
HL05	657753	7557177
HL06	657994	7557187
HL07	658086	7557246
HL08	658165	7557163
HL09	658470	7557170
HL10	658308	7557269
HL11	658255	7557249
HL12	658016	7557351
Solar Farm		
SF01	664059	7557325
SF02	664980	7557118
SF03	664716	7557505
SF04	664589	7557752
SF05	664559	7557887
SF06	664463	7558147
SF07	664174	7558068
SF08	664315	7557796
SF09	664608	7557381
SF10	664244	7557383
SF11	664352	7557227
SF11	664399	7557198
SF12	664038	7557245
SF13	664103	7557650
SF14	664331	7557476
SF15	664510	7557213



Legend

- Pipeline
- MDIOM Development Envelope

Survey Sites

- Habitat Assessment
- Habitat Assessment, SRE
- Habitat Assessment, Bat Recorder, SRE
- Habitat Assessment, Night Parrot Recorder
- Habitat Assessment, Night Parrot Recorder, SRE

N

0 0.5 1 1.5 km

Scale 1:45,000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum ECOLOGY + SPATIAL

Author: GF

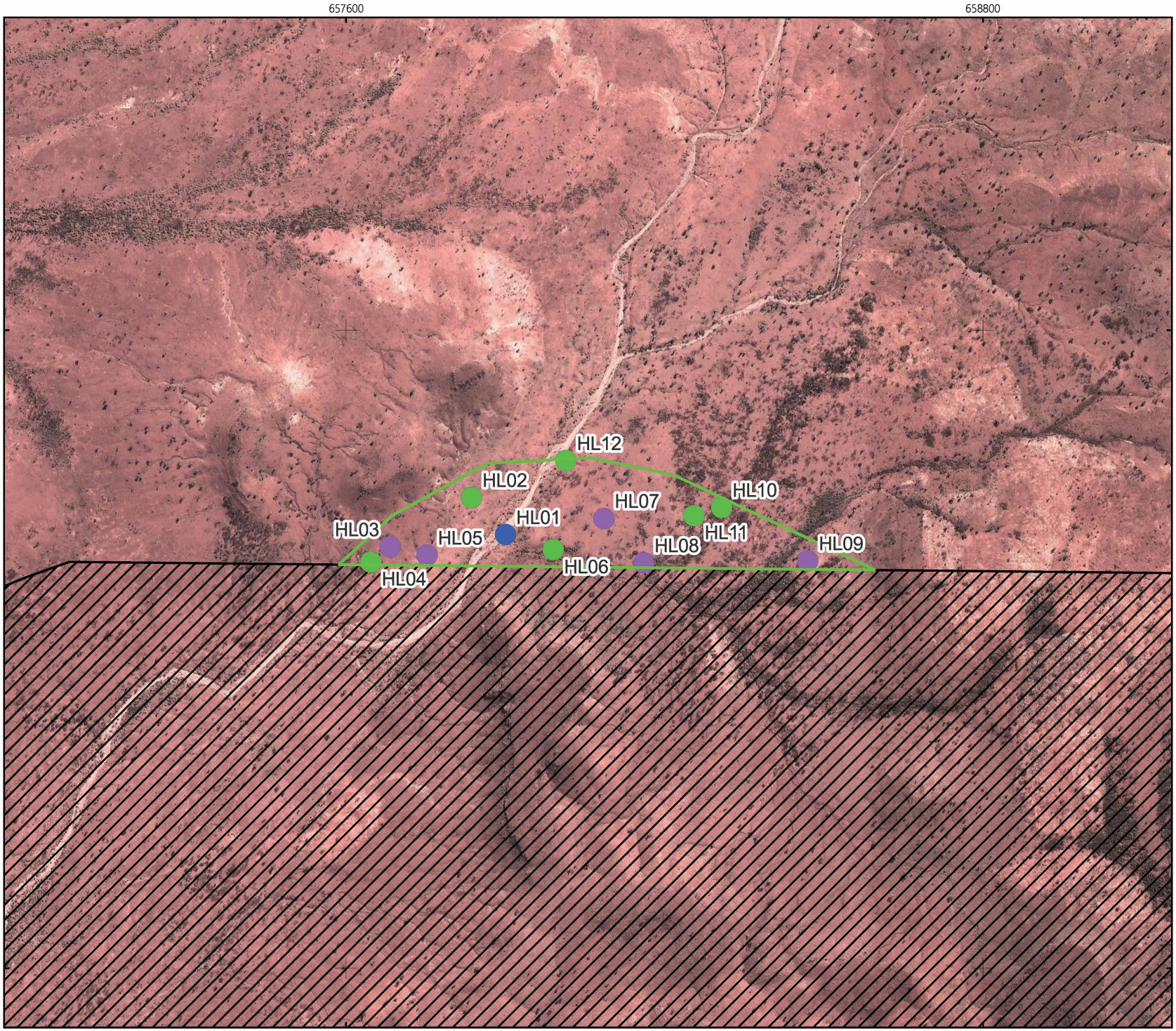
Date: 17-04-2023

Survey Site Locations - Pipeline

MDIOM Solar Farm, Haul Road & Pipeline

MAP 2.1

Prepared for
JBS&G | HPPL



Legend

- Haul Road
- MDIOM Development Envelope

Survey Sites

- Habitat Assessment
- Habitat Assessment, SRE
- Habitat Assessment Bat Recorder, Motion Camera, SRE

N

0 0.2 0.4 km

Scale 1 :0,00 0 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum ECOLOGY • SPATIAL

Author: GF

Date: 17-04-2023

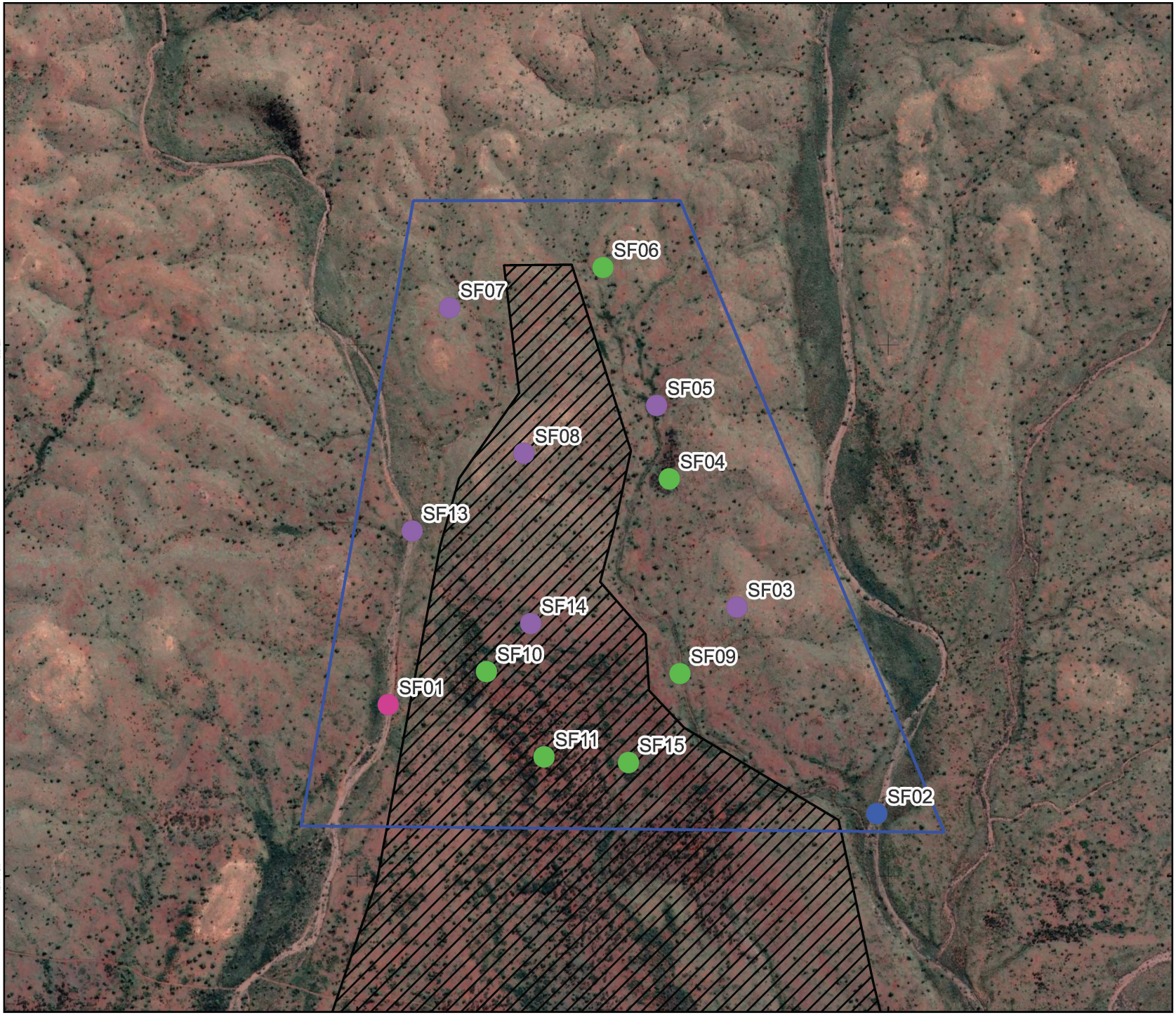
Survey Site Locations - Haul Road

MDIOM Solar Farm, Haul Road & Pipeline

MAP

Prepared for
JBS&G | HPPL

2.2



Legend

- Solar Farm
- MDIOM Development Envelope

Survey Sites

- Habitat Assessment
- Habitat Assessment, SRE
- Habitat Assessment, Bat Recorder, SRE
- Habitat Assessment, Bat Recorder, Motion Camera, SRE

N

0 0.2 0.4 km

Scale 1:10,000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum ECOLOGY • SPATIAL

Author: GF

Date: 17-04-2023

Survey Site Locations - Solar Farm

MDIOM Solar Farm, Haul Road & Pipeline

MAP

Prepared for
JBS&G | HPPL

2.3

2.2.3. Targeted Fauna Surveys

Thirty-seven species (eight mammals, 23 birds and six reptiles) listed under the EPBC Act, gazetted under the BC Act or listed under the DBCA priority fauna categories were identified during the desktop assessment. These were specifically targeted using the field survey techniques as listed in Table 2.6 which follow the Threatened species guidelines (where applicable).

Table 2.6: Conservation Significant Species – Targeted Survey Methods

Species	Conservation Status			Survey Method
	EPBC Act	BC Act	DBCA	
Mammals				
Northern Quoll (*Dasyurus hallucatus)*	EN	EN	-	• Desktop assessment and literature review • Habitat assessment during the survey • Opportunistic sightings and secondary evidence of species • Ten motion cameras for three nights
Bilby (*Macrotis lagotis*)	VU	VU	-	• Desktop assessment and literature review • Habitat assessment during the survey • Six targeted searches in Pipeline Survey Area. • Opportunistic sightings and secondary evidence of species
Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*)	VU	VU	-	• Desktop assessment and literature review • Habitat assessment during the survey • Ultrasonic bat recorders at five sites for a minimum of four nights
Ghost Bat (*Macroderma gigas*)	VU	VU	-	• Desktop assessment and literature review • Habitat assessment during the survey • Ultrasonic bat recorders at five sites for a minimum of four nights
Brush-tailed Mulgara (*Dasycercus blythi*)	-	-	P4	• Desktop assessment and literature review • Habitat assessment during the survey • Opportunistic sightings and secondary evidence of species
Spectacled Hare-wallaby (*Lagorchestes conspicillatus leichardti*)	-	-	P4	• Desktop assessment and literature review • Habitat assessment during the survey • Opportunistic sightings and secondary evidence of species
Short-tailed Mouse (*Leggadina lakedownensis*)	-	-	P4	• Desktop assessment and literature review • Habitat assessment during the survey
Western Pebble-mound Mouse (*Pseudomys chapmani*)	-	-	P4	• Desktop assessment and literature review • Habitat assessment during the survey • Opportunistic sightings and secondary evidence of species
Birds				

Species	Conservation Status			Survey Method
	EPBC Act	BC Act	DBCA	
Curlew Sandpiper (*Calidris ferruginea*)	CR/MI	CR	-	• Desktop assessment and literature review • Habitat assessment during the survey • Opportunistic sightings
Night Parrot (*Pezoporus occidentalis*)	EN	CR	-	• Desktop assessment and literature review • Habitat assessment during the survey • Opportunistic sightings • Two Song Meter acoustic recorders in potential habitat for six nights
Australian Painted Snipe (*Rostratula australis*)	EN	EN	-	• Desktop assessment and literature review • Habitat assessment during the survey • Bird surveys and opportunistic sightings
Common Greenshank (*Tringa nebularia*) Common Sandpiper (*Actitis hypoleucos*) Fork-tailed Swift (*Apus pacificus*) Glossy Ibis (*Plegadis falcinellus*) Grey Wagtail (*Motacilla cinerea*) Red-necked Stint (*Calidris ruficollis*) Oriental Plover (*Charadrius veredus*) Oriental Pratincole (*Glareola maldivarum*) Pectoral Sandpiper (*Calidris melanotos*) Sharp-tailed Sandpiper (*Calidris acuminata*) Wood Sandpiper (*Tringa glareola*) Osprey (*Pandion heliaetus*) Gull-billed Tern (*Gelochelidon nilotica*) Caspian Tern (*Hydroprogne caspia*) Little Tern *(Sternula albifrons*) Barn Swallow (*Hirundo rustica*) Eastern Yellow Wagtail (*Motacilla tschutschensis*)	MI	MI	-	• Desktop assessment and literature review • Habitat assessment during the survey • Bird surveys and opportunistic sightings
Peregrine Falcon (*Falco peregrinus*)	OS	OS	-	• Desktop assessment and literature review • Habitat assessment during the survey • Bird surveys and opportunistic sightings
Grey Falcon (*Falco hypoleucos*)	VU	VU	-	• Desktop assessment and literature review • Habitat assessment during the survey • Bird surveys and opportunistic sightings
Letter-winged Kite (*Elanus scriptus*)	-	-	P4	• Desktop assessment and literature review • Habitat assessment during the survey • Bird surveys and opportunistic sightings
Reptiles				
Pilbara Olive Python (*Liasis olivaceus barroni*)	VU	VU	-	• Desktop assessment and literature review • Habitat assessment during the survey • Active searches

Species	Conservation Status			Survey Method
	EPBC Act	BC Act	DBCA	
Pin-striped Ctenotus (*Ctenotus nigrilineatus*)	-	-	P1	• Desktop assessment and literature review • Habitat assessment during the survey • Active searches
Gane's Blind Snake (*Anilios ganei*)	-	-	P1	• Desktop assessment and literature review • Habitat assessment during the survey • Active searches
Pilbara Barking Gecko (*Underwoodisaurus seorsus*)	-	-	P2	• Desktop assessment and literature review • Habitat assessment during the survey • Active searches
Lined Soil-crevice Skink (*Notoscincus butleri*)	-	-	P4	• Desktop assessment and literature review • Habitat assessment during the survey • Active searches

2.3. Reporting and Data Analysis

2.3.1. Fauna Taxonomy & Nomenclature

Nomenclature for mammals, birds, reptiles, and amphibians followed the Western Australian Museum Checklist of the Vertebrates of Western Australia (Western Australian Museum, 2022). Fauna species identifications were completed based on information provided in references listed in Table 2.7.

Table 2.7: Species Identification References

Fauna	Survey Techniques
Mammals	Churchill (2009a), Menkhorst and Knight (2001a), van Dyck and Strahan (2008a)
Birds	Menkhorst *et al.* (2019a), Simpson and Day (2017), Morcombe and Stewart (2013a)
Reptiles & Amphibians	Wilson and Swan (2017), Cogger (2014), Tyler and Doughty (2009)

2.3.2. Bat Call Analysis

Raw bat call data was sent to Kyle Armstrong (Specialised Zoological), where it was processed and analysed using a combination of manual review and automated processes using Kaleidoscope Pro (Wildlife Acoustic, version 5.1.8) and Anabat Insight (Titley Scientific, version 1.8.3) using the following process:

1. Following the survey, data files were downloaded from the units and saved to an external hard drive for processing and analysis.
2. For compressed .wav and .wac files (full spectrum) collected using the Song Meter units, files were converted to standard .wav using the conversion function in Kaleidoscope Pro.
3. For each night data was manually reviewed for bat calls using Kaleidoscope Pro or Anabat Insight from sunset onwards for approximately 45 mins by visually comparing the time-frequency graph and call characteristics (e.g. peak frequency, characteristic frequency and call shape) with species call descriptions from published guidelines (see species descriptions below and McKenzie and Bullen 2009 and 2012).
4. Data was then processed using Wildlife Acoustic Kaleidoscope signal parameter batch processing. Further manual data review was also completed for validation purposes which was repeated several times to accurately identify species.

5. Data was then processed using the Wildlife Acoustic Kaleidoscope cluster analysis function to provide information regarding Pilbara Leaf-nosed Bat call activity patterns for each night.

Steps 3 and 4 were completed for all nights for Pilbara Leaf-nosed Bats however due to the constraints associated with automating the analysis of Ghost Bat calls (due to complexity of vocalisations) additional validation was necessary. Validation of these calls was aligned with the process detailed in Hanrahan *et al.* (2021).

A call (pass) was defined as a sequence of three or more consecutive pulses of similar frequency and shape over a period of one second with the exception of the Pilbara Leaf-nosed Bat where at least one clear pulse was acceptable. Calls with less than three defined consecutive pulses of similar frequency and shape were not unambiguously identified to a species but may be used as part of the activity count for the survey area. Due to variability in the quality of calls and the difficulty in distinguishing some species the identification of each call was assigned a confidence rating (Mills *et al.*, 1996; Duffy *et al.*, 2000) during the manual validation process (see Appendix D).

Pilbara leaf-nosed Bat: Echolocation calls are distinctive, having a CF-FM (constant frequency - frequency modulated) structure, and with a characteristic frequency between 117 and 125 kHz (DAWE 2020a). The mean characteristic frequency of the loudest (second) emitted harmonic is 121 kHz in the Pilbara, which is around 6 kHz higher than in the northern distribution of the species. Each pulse consists of a constant frequency tone of c. 8 milliseconds duration, followed by a very brief broadband downwards sweep through c. 20 kHz (Armstrong and Coles, 2007). It is possible to identify the species unambiguously from good quality echolocation calls.

Ghost Bat: Ghost Bats make several social calls that are audible to humans ('chirps', 'squabbles' and 'twitters' (Kulzer *et al.*, 1984; Guppy, Coles and Pettigrew, 1985; Pettigrew *et al.*, 1986)). When free flying, echolocation calls are characterised by steep linear frequency modulated pulses at 45-56 kHz, of low intensity and short duration (0.8-2.3 ms) (Guppy, Coles and Pettigrew, 1985). Echolocation calls have up to four harmonics but most of the strength is in the 2nd or 3rd harmonic (Guppy, Coles and Pettigrew, 1985). More recently studies (Hanrahan, 2020; Hanrahan *et al.*, 2021) reviewed and revised the social vocalisations of the species as 'chirp-trill', 'squabble' and 'ultrasonic social'.

2.3.3. Significant Fauna Definitions

Significant fauna can include (Environmental Protection Authority, 2016b):

- Being identified as a Threatened or Priority species;
- Species with restricted distribution;
- Degree of historical impact from threatening processes; or
- Providing an important function required to maintain the ecological integrity of a significant ecosystem.

2.3.4. Fauna Habitat Mapping

Fauna habitat mapping identifies areas of vegetation and land features that are distinguishable from other areas. Typically, each fauna habitat supports a characteristic fauna assemblage that is adapted to the features of the fauna habitat. Fauna habitat types are identified and mapped based on the following information:

- General vegetation type (Department of Primary Industries and Regional Development, 2019);
- Vegetation types mapped within the Survey Area;
- Vegetation structure;
- Landforms;

- Geological units;
- Soil substrate;
- Aerial imagery;
- Potential fauna assemblage; and
- Field observations.

The fauna habitat was recorded at each fauna site and opportunistically while traversing the Survey Areas.

2.3.5. SRE Invertebrate Fauna Identification

Invertebrate specimens collected in the field were initially sorted by Spectrum staff. All specimens were prepared following WA Museum guidelines and standards before being passed on to Biologic for identification. Specimens were identified to the lowest possible taxonomic level.

2.3.6. Determination of SRE Status

The SRE status of invertebrates is based on categories which were developed by the Western Australian Museum (WAM). For consistency purpose, identifications completed by Biologic followed the WAM categories (Table 2.8). Following the precautionary principle, all data deficient species from known SRE target groups are regarded as potential short-range endemics.

Table 2.8: SRE Categories

Categories	Defining Characteristics
Confirmed SRE	• Known distribution of <10,000 $km^{2.}$ • Taxonomy is well understood. • Species is well represented in collections. • Region of occurrence has been comprehensively sampled.
Potential SRE	• Limited sampling has resulted in incomplete knowledge of the species distribution. • Poor or limited taxonomic resolution. Species not well represented in collections.
Not SRE	• Known distribution of >10,000 km2. • Taxonomy is well understood. • Species is well represented in collections. • Region of occurrence has been comprehensively sampled.

2.4. Data for the Index of Biodiversity Surveys for Assessment (IBSA)

The EPA has given instruction that all biological surveys collecting data on biodiversity will submit the report and associated raw data to IBSA as an IBSA data package. All survey data collected at the Survey Areas has been provided electronically to comply with IBSA and Roy Hill data standards.

2.5. Project Team and Licences

Spectrum staff involved with this assessment are listed in Table 2.9 along with their role, years of experience, and relevant licence.

Table 2.9: Project Team & Licences

Staff	Role	Project Tasks	Years of Experience	Fauna Licence
Astrid Heidrich	Principal Zoologist	Report review	15	BA27000804
Erica MacIntyre	Senior Zoologist	Field survey, data management, reporting	10	
Georgia Ford	Zoologist	Field survey, data management, reporting	5	

2.6. Limitations and Constraints

Details of limitations are listed below in Table 2.10.

Table 2.10: Limitations and Constraints

Limitation	Constraint	Comment
Availability of the contextual information at a regional and local scale.	No	Beard vegetation and geology mapping were used to determine the regional significance of vegetation types. Database searches provided detailed information, adequate to guide field survey design and effort for the fauna survey.
Competency/experience of the consultant carrying out the survey including experience in bioregion surveyed.	No	The zoologists involved in the field survey have extensive experience completing fauna surveys throughout Western Australia and are familiar with Pilbara fauna assemblages.
Timing/weather/season/cycle.	No	The survey was conducted during the optimal season for fauna surveys in the Pilbara region and Eremaean Botanical Province. A thunderstorm on the afternoon of the 19th March limited the number of SRE sampling sites in the Pipeline Survey Area, however survey effort was adequate.
Disturbances (e.g., fire, flood, accidental human intervention) which affected results of survey.	No/partially	An SM4BAT Ultrasonic Recorder in the Pipeline Survey Area was vandalised (wire cut) during the installation period which prevented the unit from recording calls after it was damaged (only recorded for 2 nights). Areas of burnt vegetation were recorded which impacted the availability of suitable habitat for fauna. All habitat types were sampled adequately.
Remoteness and/or access problems.	No	There were no existing tracks within the Haul Road and Solar Farm Survey Areas, meaning access was only possible on foot. However, the survey effort was still adequate for the level of the survey.
Scope (what faunal groups were sampled and were some sampling methods not able to be employed because of constraints such as weather conditions).	No	For the basic and targeted terrestrial vertebrate fauna surveys, sampling techniques were adequate and all fauna groups were sampled, and no survey constraints were experienced.
Proportion of fauna identified, recorded, and/or collected.	No	All vertebrate fauna species encountered were identified in the field. Basic survey methods do not require the identification of all fauna species present within the project. Invertebrate fauna specimens were collected for identification by taxonomists and will be identified to the lowest possible level. Taxonomic resolution is limited by current knowledge of invertebrate species/taxa.

Limitation	Constraint	Comment
The proportion of the task achieved and further work which might be needed.	No	All components of the basic fauna assessment were completed. The targeted survey and SRE survey were completed.
Resources (degree of expertise available in animal identification to taxon level).	No	Fauna resources available were adequate and did not compromise the outcome of the survey.
Intensity (in retrospect, was the intensity adequate).	No	A basic fauna assessment was considered adequate to identify faunal assemblages and fauna habitat present within the Survey Areas. In addition, targeted surveys were undertaken for several vertebrate species and SRE invertebrate surveys. The survey levels conducted were considered adequate for the Survey Areas.
Completeness (was the relevant area fully surveyed).	No	All major fauna habitat types were sampled and defined. Habitat types that may host significant fauna species were surveyed.

3. RESULTS AND DISCUSSION

3.1. Desktop Assessment

3.1.1. Vertebrate Fauna

To provide regional context for the assessment of the terrestrial fauna values within the Survey Area, a desktop assessment was completed of the Study Area (Survey Area with 50 km buffer). The desktop assessment identified a total of 45 mammals (including eight introduced), 177 bird, 119 reptile, and ten amphibian species that have previously been recorded in the Study Area (Appendix B).

Table 3.1: Total Vertebrate Fauna Species Previously Recorded in the Region

Data Source	Mammals (native/introduced)	Birds	Reptiles	Amphibians	Total Vertebrates
Regional Surveys					
Mulga Downs (Terrestrial Ecosystems 2013a)	17/1	77	36	0	131
Stage A (Biota 2004)	14/5	67	41	5	132
Mulga East (ecologia 2020a)	21/3	85	45	0	154
Brockman Rail (ecologia 2011)	21/5	65	45	0	136
Investigator Project (ecologia 2014)	16/4	64	26	1	111
Marillana Project (ecologia 2009)	18/6	82	45	0	151
Christmas Creek (ENV 2012)	11/2	58	48	4	123
Mulga Downs Hub and Rail Spur (Spectrum 2022)	12/4	37	10	0	63
Mulga Downs Transport Corridor (Biologic 2022b)	16/3	61	31	1	112
Mulga Downs West Borefield and Southern Corridor (Biologic 2022a)	19/4	80	41	2	146
Database Searches					
DBCA Threatened Fauna Database	8/0	15	6	0	29
NatureMap	30/7	152	99	7	295
PMST	4/0	17	2	0	23
Atlas of Living Australia (Atlas of Living Australia, 2021)	1/0	128	7	0	136
Total of Species (refer to Appendix B)	**38/8**	**175**	**123**	**10**	**354**

3.1.2. Conservation Significant Fauna

The literature review and database searches identified 36 species (eight mammals, 23 birds, five reptiles) of conservation significance that have previously been recorded from the Study Area (Table 3.2). Of these, one species, Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*; EPBC & BC Act Vu), was previously recorded from the Pipeline Survey Area (Biologic 2022a).

The DBCA Threatened Fauna Database search results included records of species that have been excluded from the report as per the below details:

- Crest-tailed Mulgara (*Dasycercus cristicauda*, BC Act, Vu): no known Pilbara distribution;
- Striated Grasswren (*Amytornis striatus striatus* - sandplain subspecies; DBCA P 4): recently undergone taxonomic revision which resulted in a name change to *Amytornis whitei*. This species has been split into subspecies, with *Amytornis whitei whitei* occurring in the Pilbara. There is still some uncertainty as of this species status and is not currently listed; and
- Spotted Ctenotus *(Ctenotus uber johnstonei;* DBCA P2*)*: single record, however this subspecies is not currently known to occur in the Pilbara region.

Of the 36 species (seven mammals, eight birds and two reptiles) have a medium to high likelihood of occurrence pre-survey. This likelihood was re-assessed for each Survey Area after the survey was completed. The locations of the DBCA Threatened Database search results are shown on Map 3.1 and are listed in Appendix B.

Table 3.2: Significant Fauna Potentially Occurring at the Survey Area

Species	Con Sig Status			DBCA	PMST	ALA	No. Surveys Recorded	Pre-survey Likelihood of Occurrence
	EPBC Act	BC Act	DBCA					
Mammals								
Northern Quoll (*Dasyurus hallucatus)*	EN	EN		✓	✓		2	High
Bilby (*Macrotis lagotis*)	VU	VU		✓	✓		0	Medium
Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*)	VU	VU		✓	✓		1	High
Ghost Bat (*Macroderma gigas*)	VU	VU		✓	✓		1	Medium
Brush-tailed Mulgara (*Dasycercus blythi*)			P4	✓			0	High
Spectacled Hare-wallaby (*Lagorchestes conspicillatus leichardti*)			P4	✓			0	Low
Short-tailed Mouse (*Leggadina lakedownensis*)			P4	✓			3	High
Western Pebble-mound Mouse (*Pseudomys chapmani*)			P4	✓			4	High
Birds								
Curlew Sandpiper (*Calidris ferruginea*)	CR/MI	CR			✓		0	Very Low
Night Parrot (*Pezoporus occidentalis*)	EN	CR		✓	✓		0	Medium

Species	Con Sig Status			DBCA	PMST	ALA	No. Surveys Recorded	Pre-survey Likelihood of Occurrence
	EPBC Act	BC Act	DBCA					
Australian Painted Snipe (*Rostratula australis*)	EN	EN			✓		0	Very Low
Common Greenshank (*Tringa nebularia*)	MI	MI		✓		✓	1	Low
Common Sandpiper (*Actitis hypoleucos*)	MI	MI		✓	✓		0	Low
Fork-tailed Swift (*Apus pacificus*)	MI	MI		✓	✓		1	Medium
Glossy Ibis (*Plegadis falcinellus*)	MI	MI		✓		✓	0	Medium
Grey Wagtail (*Motacilla cinerea*)	MI	MI		✓	✓		0	Low
Red-necked Stint (Calidris ruficollis)	MI	MI				✓	1	Low
Oriental Plover (*Charadrius veredus*)	MI	MI			✓		0	Low
Oriental Pratincole (*Glareola maldivarum*)	MI	MI			✓		0	Low
Pectoral Sandpiper (*Calidris melanotos*)	MI	MI			✓		0	Low
Sharp-tailed Sandpiper (*Calidris acuminata*)	MI	MI			✓		0	Low
Wood Sandpiper (*Tringa glareola*)	MI	MI		✓		✓	1	Medium
Osprey (*Pandion heliaetus*)	MI	MI		✓			0	Low
Gull-billed Tern (*Gelochelidon nilotica*)	MI	MI		✓	✓	✓	0	Medium
Caspian Tern (*Hydroprogne caspia*)	MI	MI		✓			0	Medium
Little Tern (*Sternula albifrons*)	MI	MI		✓			0	Very Low
Barn Swallow (*Hirundo rustica*)	MI	MI			✓		0	Very Low
Eastern Yellow Wagtail (*Motacilla tschutschensis*)	MI	MI			✓		0	Very Low
Peregrine Falcon (*Falco peregrinus*)	OS	OS		✓			0	High
Grey Falcon (Falco hypoleucos)	VU	VU		✓	✓		2	High
Letter-winged Kite (*Elanus scriptus*)			P4	✓			0	Low
Reptiles								
Pilbara Olive Python (*Liasis olivaceus barroni*)	VU	VU		✓	✓		3	High
Pin-striped Ctenotus (*Ctenotus nigrilineatus*)			P1	✓			0	Low

Species	Con Sig Status			DBCA	PMST	ALA	No. Surveys Recorded	Pre-survey Likelihood of Occurrence
	EPBC Act	BC Act	DBCA					
Gane's Blind Snake (*Anilios ganei*)			P1	✓			1	Medium
Pilbara Barking Gecko (*Underwoodisaurus seorsus*)			P2	✓			0	Low
Lined Soil-crevice Skink (*Notoscincus butleri*)			P4	✓			0	Low

570000 600000 630000 660000 690000 720000 750000

7620000 7590000 7560000 7530000 7500000 7470000

Legend

Survey Areas

Pipeline

- Haul Road
- Solar Farm
- Pipeline
- MDIOM Development Envelope
- Northern quoll
- Bilby, dalgyte, ninu
- Brush-tailed mulgara
- Pilbara leaf-nosed bat
- Ghost bat
- Spectacled hare-wallaby (mainland)
- northern short-tailed mouse, Lakeland Downs mouse, kerakenga
- Western pebble-mound mouse, ngadji
- Caspian Tern
- Common greenshank
- Common Sandpiper
- Fork-tailed swift
- Glossy ibis
- Grey falcon
- Grey wagtail
- Gull-billed tern
- Letter-winged kite
- Little tern
- night parrot
- Osprey
- Wood sandpiper
- Peregrine falcon
- Pilbara barking gecko
- Pilbara olive python
- Pin-striped finesnout Ctenotus
- Gane's blind snake (Pilbara)
- Lined soil-crevice skink (Dampier)

N

0 5 10 15 20 25 km

Scale 1:650,000 @ A3

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum ECOLOGY + SPATIAL

Author: GF

Date: 14-05-2023

DBCA Threatened Fauna Database Results

MDIOM Solar Farm, Haul Road & Pipeline

MAP

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3.1

3.1.3. SRE Invertebrate Fauna

To provide regional context for the assessment of the SRE invertebrate fauna values within the Survey Areas, a desktop review was conducted of Western Australian Museum invertebrate database records and five previous SRE survey reports (Table 3.3).

The database search and literature review identified 20 Mygalomorph (trapdoor) spiders, one Opiliones (harvestman), 19 pseudoscorpions, 11 scorpions, two millipedes, 39 isopods (slaters) and one mollusc (snails), that have previously been recorded from within 50 km of the Survey Area (Table 3.3). The full species list and further details are presented in Appendix C. WAM database returns are displayed in Map 3.2 and Map 3.3.

As is typical for terrestrial invertebrate fauna assessments, numerous records may represent duplicates and specimens which are taxonomically unresolved were assigned different phrase names, or have since been described and assigned a different name. It is likely that the majority of these taxa belong to the same taxa, e.g. *Indolpium* sp. could be con-specific with *Indolpium* `sp. indet. (juvenile)`.

Table 3.3: Summary of SRE Target Groups Previously Recorded from the Study Area

Data Source	Type	Mygalomorphs	Opiliones	Pseudoscorpion	Scorpions	Millipedes	Isopods	Molluscs	Total Species
Mulga East (ecologia 2020a)	Wet Pitfall, Leaf litter & Foraging	1	1	6	5	1	9	0	23
Investigator Project (ecologia 2014)	Wet Pitfall, Leaf litter & Foraging	1	0	1	0	0	4	1	7
Mulga Downs Hub and Rail Spur (Spectrum 2022)	Wet Pitfall, Leaf litter & Foraging	0	0	4	2	0	0	0	20
Mulga Downs Transport Corridor (Biologic 2022b)	Dry pitfalls, Leaf litter & Foraging	1	0	2	1	0	3	0	7
Public Databases									
WAM Arachnida and Myriapoda Database Search	Database	19	1	9	7	0	0	0	36
WAM Mollusca Database Search	Database	0	0	0	0	0	0	1	1
WAM Crustacea and Annelida Database Search	Database	0	0	0	0	1	12	0	13
Total		22	2	19	11	2	39	1	96

630000

660000

7560000

7530000

Legend

Survery Areas

- Pipeline
- Haul Road
- Solar Farm
- MDIOM Development Envelope

Database Search Results - Crustacea

- Acanthodillo `sp. B14`
- Armadillidae `sp. B04`
- Armadillidae `sp. B05`
- Armadillidae `sp. B07`
- Buddelundia `sp. 14fm`
- Buddelundia `sp. B47`
- Buddelundia `sp. B48`
- Buddelundia `sp. B49`
- Buddelundia `sp. B50`
- Buddelundia `sp. B53`
- Buddelundia sp.
- Philosciidae `sp. B31`

Database Search Results - Mollusca

- Succinea sp.

N

0 4 8 km

Scale 1:210,000 @ A3

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum ECOLOGY • SPATIAL

Author: GF

Date: 17-04-2023

WAM SRE Database Search Results - Crustacea & Mollusca

MDIOM Solar Farm, Haul Road & Pipeline

MAP

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3.2

600000
630000
660000
690000
7590000
7560000
7530000

Legend

Survey Areas

- Pipeline
- Haul Road
- Solar Farm
- MDIOM Development Envelope

Database Search Results - Arachnida

- `Anidiops` `sp. B02`
- Aname mellosa
- Aurecocrypta `chichester`
- Barychelidae `MYG217A`
- Conothele `MYG716`
- Conothele `MYG279`
- Conothele `sp. indet. (female)`
- Idiommata `MYG382`
- Idiosoma `MYG083`
- Idiosoma `MYG085`
- Idiosoma `MYG300`
- Idiosoma `MYG404`
- Aname `sp. indet. (female)`,Aname `sp. indet. (juvenile)`
- Idiosoma `MYG767`
- Idiosoma `sp. B02 (Anidiops)`
- Idiosoma `sp. indet. (female)`
- Kwonkan sp.
- Synothele `MYG127`
- Synothele `MYG311`
- Synothele `sp. indet. (juvenile)`
- Dampetrus `HBI-6519`
- Beierolpium `8/4 sp. B12`
- Beierolpium `sp. 8/2`
- Beierolpium `sp. 8/3`
- `Genus 7/4` `PSE176`
- Indolpium `sp. 1`
- Indolpium `sp. 2`
- Indolpium `sp. B17`
- Indolpium `sp. indet. (juvenile)`
- Tyrannochthonius `sp. B33`
- Lychas `hairy tail complex`
- Lychas `hairy tail group`
- Lychas `marandoo 1"SCO036`
- Lychas `marandoo 1"SCO037`
- Lychas SCO046 (former L. multipunctatus complex)
- Urodacus `megamastigus long`
- Urodacus `sp. 1`
- Urodacus `sp. B09'(?'firetail')
- Austrohorus `chunky`

N

0 4 8 12 km

Scale 1:300,000 @ A3

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum ECOLOGY • SPATIAL

Author: GF

Date: 17-04-2023

WAM SRE Database Search Results - Arachnida

MDIOM Solar Farm, Haul Road & Pipeline

MAP

Prepared for
JBS&G | HPPL

3.3

3.2. Field Assessment

3.2.1. Fauna Habitat Types

The mapping previously completed during the Mulga East Assessment (ecologia 2020a), Mulga Downs Transport Corridor (Biologic 2022b) and Mulga Downs West Borefield and Transport (Biologic 2022a) was reviewed and matched where applicable. The broad scale of mapping, continuity of habitat types between the Survey Areas and the naming convention reflects those previously mapped in the adjacent Survey Areas (ecologia 2020a; Biologic 2022b, 2022a).

A total of six fauna habitat types were recorded from the three Survey Areas (Table 3.4):

- Stony Spinifex Plains and Hillslopes;
- Mulga Woodland;
- Alluvial Clay Plain;
- Chenopod/Cracking Clay Floodplain;
- Mixed Eucalypt/Mulga Floodplain; and
- Drainage Lines/Floodplains.

Fauna habitat types, their extents, vegetation compositions and fauna utilisation are displayed in Map 3.4 - Map 3.6. In the pipeline Survey Area, the most dominant habitat types are the Drainage Lines/Floodplains (41.0 %) and Mulga Woodland (31.6 %), whereas the Stony Spinifex Plains and Hillslopes habitat covers the majority of the Solar Farm (73.4 %) and the Haul Road (93.9 %) Survey Areas.

Table 3.4: Fauna Habitats in the Survey Areas

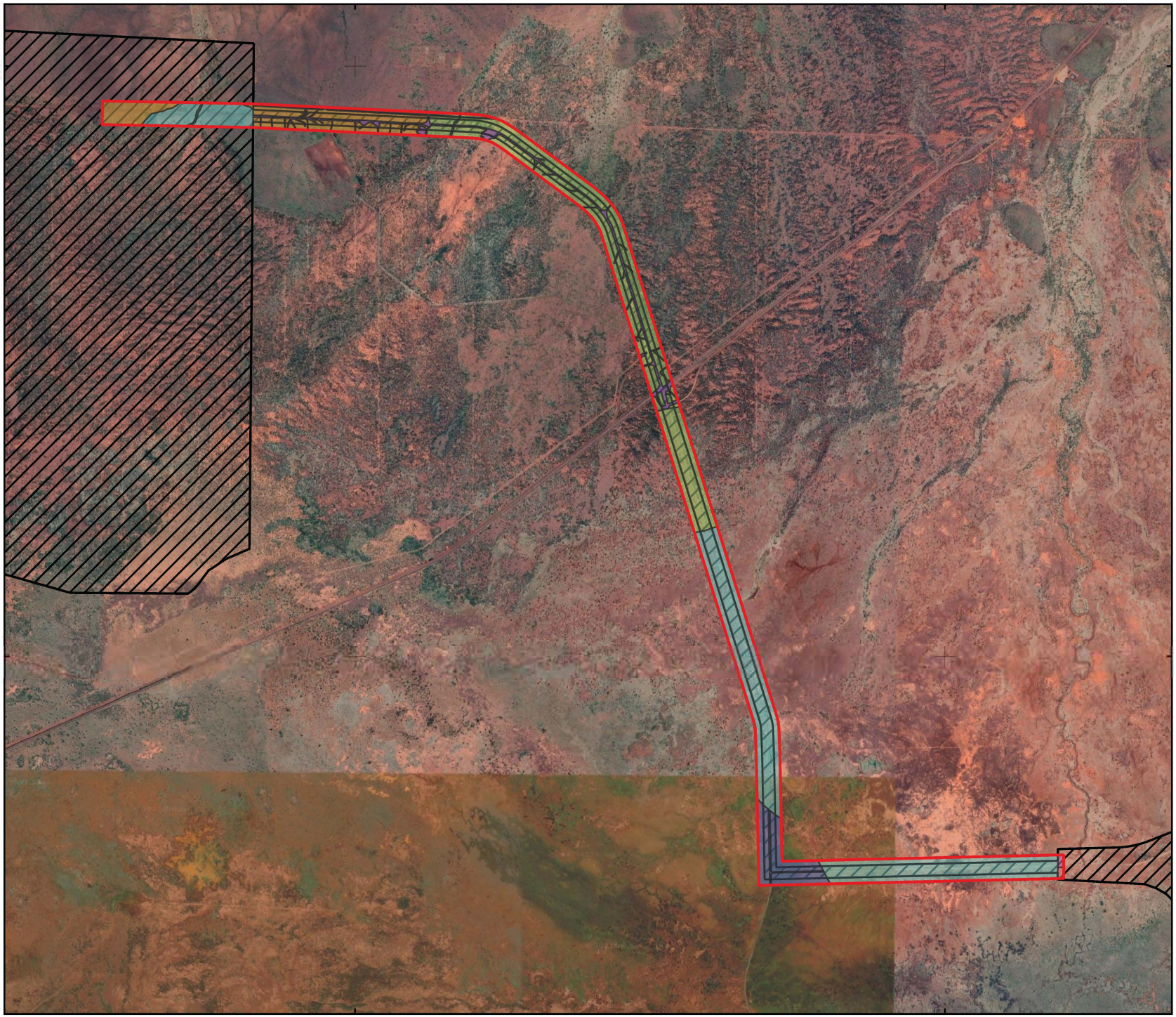
Habitat Type	Habitat Description	Habitat Photo	Area in Survey Areas (ha)*	% of Survey Area	Fauna Group	Potential Species (examples)
Alluvial Clay Plain	Alluvial plains with scattered patches of *Acacia xiphophylla* with some *Acacia aneura* and other *Acacia* spp. over scattered chenopods and tussock grasses on clay and cracking clay plains. Some patches of dense tussock grasses exist. Mosaic of very few to abundant ironstone gravel over clay and cracking clay. Some flat, drainage tracts are present, that hold pools of water. This habitat has been heavily grazed which has reduced its condition. Fauna microhabitats: cracks and crevices in clay, Snakewood, and other *Acacia* trees (bark and very limited leaf litter, some wood litter), inundation following rainfall events.		P – 18.6 HR – 0 SF – 0 T – 18.6	P – 7.3 HR – 0 SF – 0	Mammals	Sandy Inland Mouse (*Pseudomys hermannsburgensis*), Stripe-faced Dunnart (*Sminthopsis macroura*), Red Kangaroo (*Osphranter rufus*).
					Birds	Pied Butcherbird (*Cracticus nigrogularis*), Australasian Pipit (*Anthus australis)*, Zebra Finch (*Taeniopygia castanotis*), Spotted Harrier (*Circus assimilis*), Horsfield's Bushlark (*Mirafra javanica*), Australian Kestrel *(Falco cenchroides*), Australian Bustard (*Ardeotis australis).*
					Herpetofauna	Fortescue Pebble-mimic Dragon (*Tympanocryptis fortescuensis*), Desert Rainbow Skink (*Carlia triacantha*), Yellow-faced Whipsnake (*Demansia psammophis*), Sheep Frog (*Cyclorana maini),* Sharp-browed Ctenotus (*Ctenotus superciliaris*).
					Conservation Significant	Short-tailed Mouse (*Leggadina lakedownensis*; P4).
					SRE Invertebrates	Scorpions, isopods, pseudoscorpions, mygalomorph spiders.
Mulga Woodland (Biologic 2022a)	Mulga woodland of varying density, often associated with Drainage Area/Floodplain or minor drainage systems subject to sheet flow following rainfall. Vegetation dominated by open mulga with sparse to no understory of mixed small shrubs and tussock grasses. Mosaic of very few to abundant ironstone gravel over clay. Fauna microhabitats: leaf litter, woody debris, shrubs.		P – 80.9 HR – 0 SF – 19.1 T – 100	P – 31.6 HR – 0 SF – 18.9	Mammals	Stripe-faced Dunnart (*Sminthopsis macroura*), Sandy Inland Mouse (*Pseudomys hermannsburgensis*).
					Birds	Red-capped Robin (*Petroica goodenovii*), Tawny Frogmouth (*Podargus strigoides),* Chestnut-rumped Thornbill (*Acanthiza uropygialis*), Grey-crowned Babbler (*Pomatostomus temporalis*), Southern Whiteface (*Aphelocephala leucopsis*), Western-Chestnut Quail-thrush (*Cinclosoma clarum*), Grey Honeyeater (*Lacustroica whitei*).
					Herpetofauna	Western Fat-tailed Gecko (*Diplodactylus bilybara*), Western Shield Spiny-tailed Gecko (*Strophurus wellingtonae*), Mulga Dragon (*Diporiphora amphiboluroides*), Stripe-tailed Monitor (*Varanus caudolineatus*), Western Mottled-Gecko (*Lucasium squarrosum*).
					Conservation Significant	Bilby (*Macrotis lagotis*; VU).
					SRE Invertebrates	Mygalomorph spiders, scorpions, millipedes, snails.

Habitat Type	Habitat Description	Habitat Photo	Area in Survey Areas (ha)*	% of Survey Area	Fauna Group	Potential Species (examples)
Stony Spinifex Plains and Hillslopes (Biologic 2022a)	Comprises flat to low undulating areas and low hills. Much of the Stony Plain habitat occurs within the lower lying plains often subjected to sheet flow following large rainfall events. Vegetation is dominated by *Triodia* hummock grasses of various life stages with scattered eucalypts and patches of various small to medium shrub species on gravelly clay loam substrates. In some low-lying areas, isolated patches of sandy substrate occur. Fauna microhabitats: *Triodia* hummocks, leaf litter, shrubs.		P – 33.6 HR – 12.4 SF – 74.4 T – 120.4	P – 13.1 HR – 93.7 SF – 73.4	Mammals	Pilbara Ningaui (*Ningaui timealeyi*) & Euro (*Osphranter robustus*).
					Birds	Spinifex Pigeon (*Geophaps plumifera*), Little Buttonquail (*Turnix velox*), Weebill (*Smicrornis brevirostris*), Brown Falcon (*Falco berigora*), Whistling Kite (*Haliastur sphenurus*), Pilbara Death Adder (*Acanthophis wellsi*).
					Herpetofauna	Rock Ctenotus (*Ctenotus saxatilis*), Western Ring-tailed Dragon (*Ctenophorus caudicinctus*), Short-tailed Pygmy Monitor (*Varanus brevicauda*), Moon Snake (*Furina ornata*), Southern Phasmid Gecko (*Strophurus jeanae),* Pilbara Ground Gecko (*Lucasium wombeyi)*, Pilbara Death Adder (*Acanthophis wellsi*).
					Conservation Significant	Western Pebble-mound Mouse (*Pseudomys chapmani*; P4). Foraging only: Grey Falcon (*Falco hypoleucos*; EPBC & BC Act Vu). Night Parrot (*Pezoporus occidentalis*; EN) – in proximity to Samphire only.
					SRE Invertebrates	Scorpions, mygalomorph spiders.
Drainage Lines / Floodplains (Biologic 2022a)	Lower lying plain often subjected to sheet flow following large rainfall events. Vegetation and substrates of this habitat were variable, often comprising scattered *Eucalyptus* over *Acacia* and/or *Grevillea* shrubs with an understory dominated by *Triodia* hummock grasses and/or mixed tussock grasses on alluvial substrates, often comprising heavy clays and gravel. Fauna microhabitats: trees (flowers, leaf litter, bark, tree hollows), leaf litter, shrubs.		P – 104.9 HR – 0.8 SF – 7.8 T – 113.5	P – 41.0 HR – 6.3 SF – 7.7	Mammals	Delicate Mouse (*Pseudomys delicatulus*), Sandy Inland Mouse (*Pseudomys hermannsburgensis*), Desert Mouse (*Pseudomys desertor*), Short-tailed Mouse (*Leggadina lakedownensis*).
					Birds	Willie Wagtail (*Rhipidura leucophrys*), Chestnut-rumped Thornbill (*Acanthiza uropygialis*), Grey-crowned Babbler (*Pomatostomus temporalis*), White-winged Triller (*Lalage tricolor*), Crested Bellbird (*Oreoica gutturalis*), Brown Honeyeaters (*Lichmera indistincta*).
					Herpetofauna	Long-nosed Dragon (*Gowidon longirostris*), Sharp-snouted Delma (*Delma nasuta*), North-western Shovel-nosed Snake (*Brachyurophis approximans*), Common Dwarf Skink (*Menetia greyii*), Variegated Gehyra (*Gehyra variegata*).
					Conservation Significant	Foraging only: Ghost Bat (*Macroderma gigas*; VU), Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*; VU) & Peregrine Falcon (*Falco peregrinus*; OS). When inundated (MI): Common Greenshank (*Tringa nebularia*; MI), Common Sandpiper (*Actitis hypoleucos*; MI), Wood Sandpiper (*Tringa glareola*; MI), Oriental Pratincole (*Glareola maldivarum*; MI), Glossy Ibis (*Plegadis falcinellus*; MI).
					SRE Invertebrates	Snails, pseudoscorpions, scorpions, isopods, millipedes, mygalomorph spiders.

Habitat Type	Habitat Description	Habitat Photo	Area in Survey Areas (ha)*	% of Survey Area	Fauna Group	Potential Species (examples)
Chenopod/ Cracking Clay Floodplain (ecologia 2020)	Sparse chenopod shrubland of *Sclerolaena trigona*, *S. bicornis*, *S. densiflora* over low tussock grasses of *Eragrostis xerophila* on a substrate of cracking clays. Fauna microhabitats: shrubs, cracking clay.		P – 0.5 HR – 0 SF – 0 T – 0.5	P – 0.2 HR – 0 SF – 0	Mammals	Northern Free-tailed Bat (*Ozimops lumsdenae*), Common Sheath-tailed Bat (*Taphozous georgianus*), Northern Brushtail Possum (Pilbara Form) (*Trichosurus vulpecula arnhemensis*).
					Birds	White-plumed Honeyeater (*Ptilotula penicillata*), Weebill (*Smicrornis brevirostris*), Fairy Martins (*Petrochelidon ariel*), Australian Pipit (*Anthus australis*), Galah (*Eolophus roseicapilla*), Collared Sparrowhawk (*Accipiter cirrocephalus*).
					Herpetofauna	Long-nosed Dragon (*Gowidon longirostris*), Common Dwarf Skink (*Menetia greyii*), Variegated Gehyra (*Gehyra variegata*).
					Conservation Significant	Night Parrot (*Pezoporus occidentalis*; EN) – in proximity to mature spinifex only. When inundated: Common Greenshank (*Tringa nebularia;* MI), Common Sandpiper (*Actitis hypoleucos*, MI), Wood Sandpiper (*Tringa Glareola*, MI), Oriental Pratincole (*Glareola maldivarum*, MI).
					SRE Invertebrates	Snails, mygalomorph spiders, scorpions, pseudoscorpions.
Mixed Eucalypt/ Mulga Floodplain (ecologia 2020)	Associated with the Fortescue River floodplain, this habitat type is subject to inundation after major rainfall events and supports isolated to dense *Eucalyptus victrix* and *Acacia distans* over scattered understory over low grasses. Some open areas are associated with scattered tall trees with grasses and expanses of red sandy/clay soils in between. Fauna microhabitats: woody debris, trees (flowers, leaf litter, bark, tree hollows), leaf litter, shrubs.		P – 0.5 HR – 0 SF – 0 T – 0.5	P – 0.2 HR – 0 SF – 0	Mammals	Delicate Mouse (*Pseudomys delicatulus*), Sandy Inland Mouse (*Pseudomys hermannsburgensis*), Desert Mouse (*Pseudomys desertor*).
					Birds	Willie Wagtail (*Rhipidura leucophrys*), Chestnut-rumped Thornbill (*Acanthiza uropygialis*), Grey-crowned Babbler (*Pomatostomus temporalis*), White-winged Triller (*Lalage tricolor*), Crested Bellbird (*Oreoica gutturalis*), Brown Honeyeaters (*Lichmera indistincta*).
					Herpetofauna	Long-nosed Dragon (*Gowidon longirostris*), Sharp-snouted Delma (*Delma nasuta*), North-western Shovel-nosed Snake (*Brachyurophis approximans*), Common Dwarf Skink (*Menetia greyii*), Variegated Gehyra (*Gehyra variegata*).
					Conservation Significant	Foraging only: Ghost Bat (*Macroderma gigas*; VU), Peregrine Falcon (*Falco peregrinus*; OS) and Grey Falcon (*Falco hypoleucos*; EPBC & BC Act Vu) When inundated: Common Greenshank (*Tringa nebularia;* MI), Common Sandpiper (*Actitis hypoleucos*, MI), Wood Sandpiper (*Tringa Glareola*, MI), Oriental Pratincole (*Glareola maldivarum*, MI).
					SRE Invertebrates	Snails, pseudoscorpions, scorpions, isopods, millipedes, mygalomorph spiders.

Note: P = Pipeline, HR = Haul Road & SF = Solar Farm, T = Total

* Survey Area totals: Pipeline Survey Area = 256.1 ha, Haul Road Survey Area 13.2 ha, Solar Farm = 101.4 ha, total of all Survey Areas = 370.7 ha.



Legend

- Pipeline
- MDIOM Development Envelope

Fauna Habitats

- Alluvial Clay Plain
- Chenopod/ Cracking Clay Floodplain
- Cleared/Disturbed
- Drainage Lines/ Floodplains
- Mixed Eucalypt/ Mulga Floodplain
- Mulga Woodland
- Stony Spinifex Plains and Hillslopes

N

0 0.5 1 1.5 km

Scale 1:45,000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum ECOLOGY + SPATIAL

Author: GF

Date: 20-04-2023

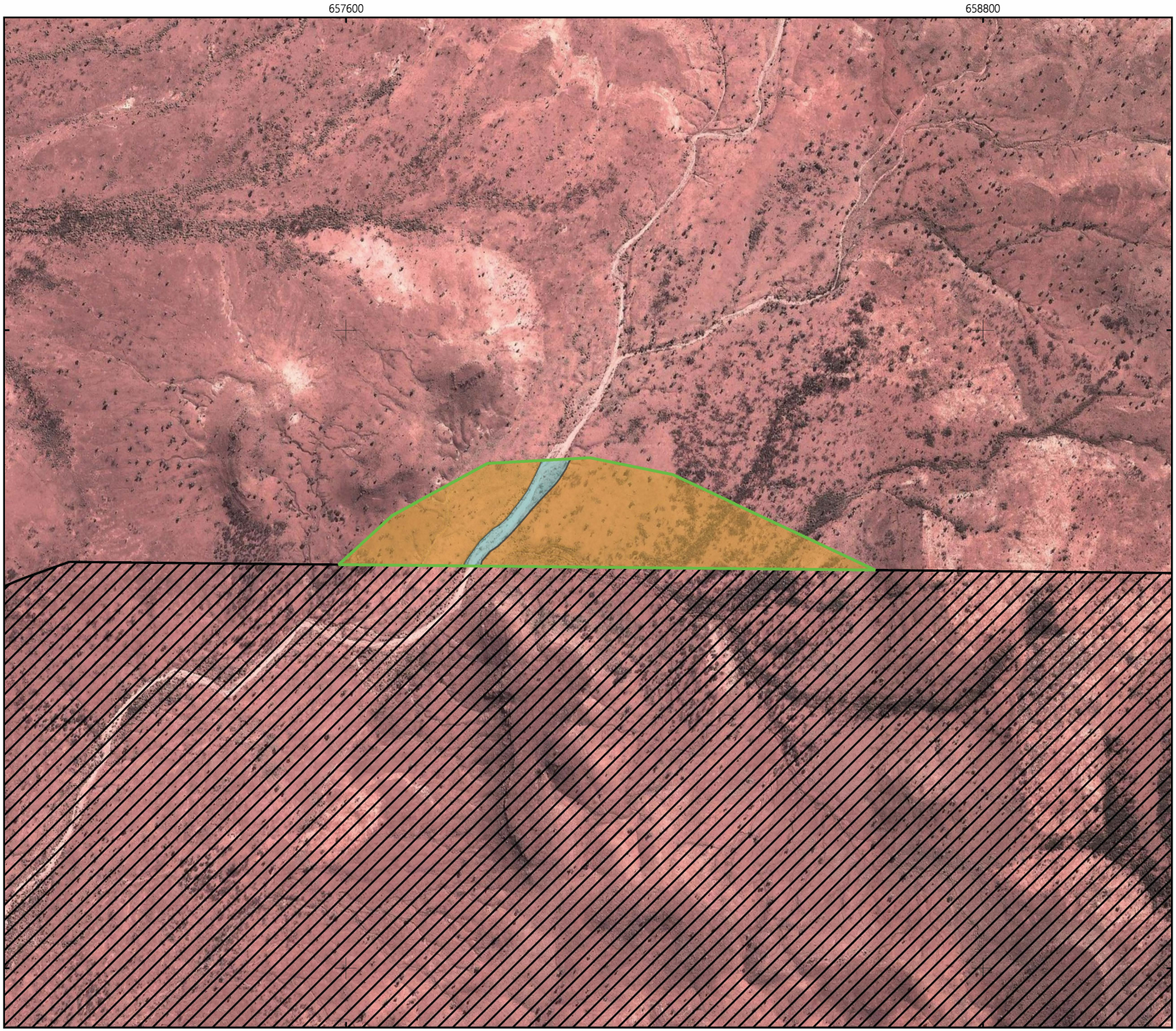
Fauna Habitat Types - Pipeline

MDIOM Solar Farm, Haul Road & Pipeline

MAP

Prepared for
JBS&G | HPPL

3.4



Legend

- Haul Road
- MDIOM Development Envelope

Fauna Habitats

- Drainage Lines/ Floodplains
- Stony Spinifex Plains and Hillslopes

N

0 0.2 0.4 km

Scale 1:10,000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum ECOLOGY • SPATIAL

Author: GF

Date: 20-04-2023

Fauna Habitat Types - Haul Road

MDIOM Solar Farm, Haul Road & Pipeline

MAP

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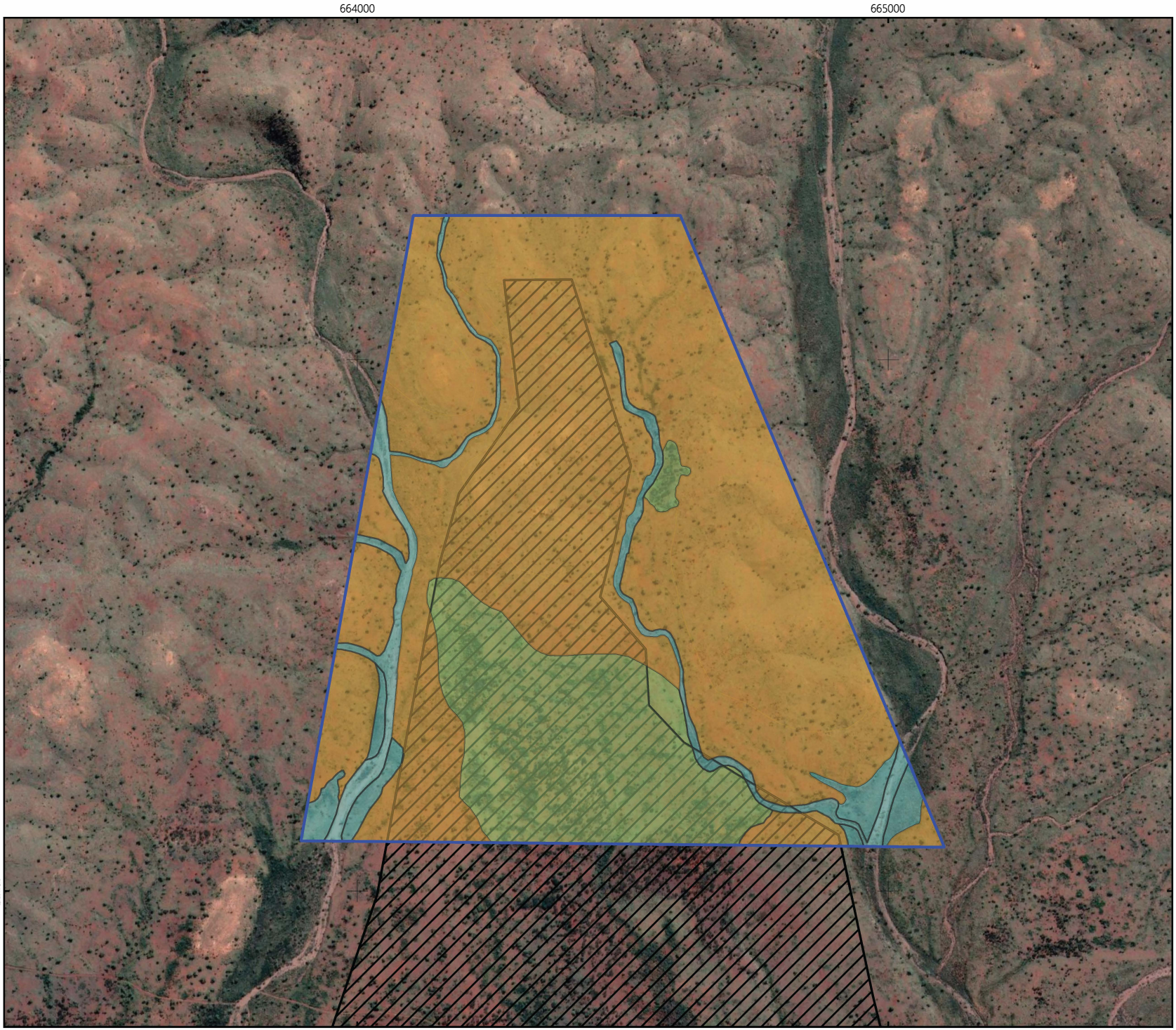
3.5



Legend

- Solar Farm
- MDIOM Development Envelope

Fauna Habitats

- Drainage Lines/ Floodplains
- Mulga Woodland
- Stony Spinifex Plains and Hillslopes

N

0 0.2 0.4 km

Scale 1:10,000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum ECOLOGY • SPATIAL

Author: GF

Date: 20-04-2023

Fauna Habitat Types - Solar Farm

MDIOM Solar Farm, Haul Road & Pipeline

MAP 3.6

Prepared for
JBS&G | HPPL

3.2.2. Vertebrate Fauna

A total of 63 vertebrate fauna species were recorded during the survey: one species of native non-volant mammal observed via secondary evidence, seven native volant mammals, four introduced mammals, 46 bird species and five reptiles. The Pipeline Survey Area was the most diverse out of the three Survey Areas, likely due to water availability (Table 3.5). Of the 63 species recorded overall, 57 were recorded from the Pipeline, 19 species were recorded from the Haul Road Survey Area and 21 species were recorded from the Solar Farm Survey Area.

Table 3.5: Vertebrate Fauna Recorded from the Survey Areas

Species	Common Name	Conservation Status			Comments	Pipeline Survey Area	Haul Road Survey Area	Solar Farm Survey Area
		EPBC Act	BC Act	DBCA				
Mammals								
Pseudomys chapmani	Western Pebble-mound Mouse			P4	One old, disused mound recorded.			✓
Rhinonicteris aurantia	Pilbara Leaf-nosed Bat	VU	VU			✓		
Saccolaimus flaviventris	Yellow-bellied Sheath-tailed Bat					✓	✓	✓
Taphozous georgianus	Common Sheath-tailed Bat					✓	✓	✓
Chalinolobus gouldii	Gould's Wattled Bat					✓	✓	✓
Scotorepens greyii	Little Broad-nosed Bat					✓	✓	✓
Vespadelus finlaysoni	Finlayson's Cave Bat					✓	✓	✓
Chaerephon jobensis	Greater Northern Free-tailed Bat						✓	✓
**Oryctolagus cuniculus*	Rabbit					✓		
**Canis familiaris*	Dog/Dingo					✓		
**Felis catus*	Cat					✓	✓	
**Bos taurus*	European Cattle					✓		
Birds								
Anas superciliosa	Pacific Black Duck					✓		
Synoicus ypsilophorus	Brown Quail					R		
Aegotheles cristatus	Australian Owlet-nightjar					R		
Ardeotis australis	Australian Bustard					✓		
Chalcites basalis	Horsfield's Bronze Cuckoo					R		
Heteroscenes pallidus	Pallid Cuckoo					R		
Ocyphaps lophotes	Crested Pigeon					✓	✓	✓
Geophaps plumifera	Spinifex Pigeon						✓	✓
Turnix velox	Little Button-quail					✓		
Burhinus grallarius	Bush Stone-curlew					R		
Threskiornis spinicollis	Straw-necked Ibis					✓		

Species	Common Name	Conservation Status			Comments	Pipeline Survey Area	Haul Road Survey Area	Solar Farm Survey Area
		EPBC Act	BC Act	DBCA				
Elanus axillaris	Black-shouldered Kite					✓		
Aquila audax	Wedge-tailed Eagle					✓	✓	
Circus assimilis	Spotted Harrier					✓	✓	
Haliastur sphenurus	Whistling Kite					✓		
Dacelo leachii	Blue winged Kookaburra					R		
Todiramphus pyrrhopygius	Red-backed Kingfisher					R		
Merops ornatus	Rainbow Bee-eater					✓	✓	
Falco cenchroides	Australian Kestrel					✓		
Falco berigora	Brown Falcon					✓		✓
Eolophus roseicapilla	Galah					✓		
Barnardius zonarius	Australian Ringneck					✓		✓
Melopsittacus undulatus	Budgerigar					✓	✓	✓
Malurus leucopterus	White-winged Fairywren					✓		✓
Gavicalis virescens	Singing Honeyeater					✓	✓	
Ptilotula keartlandi	Grey-headed Honeyeater						✓	✓
Manorina flavigula	Yellow-throated Miner					✓		
Smicrornis brevirostris	Weebill					✓		
Acanthiza apicalis	Inland Thornbill					✓		
Artamus personatus	Masked Woodswallow				Identified from recorded call, could also be White-browed Woodswallow	R		
Artamus cinereus	Black-faced Woodswallow					✓		✓
Cractius torquatus	Grey Butcherbird					R		
Cracticus nigrogularis	Pied Butcherbird					R		
Coracina novaehollandiae	Black-faced Cuckoo-shrike					✓		
Oreoica gutturalis	Crested Bellbird					✓	✓	✓
Pachycephala rufiventris	Rufous Whistler					✓		
Colluricincla harmonica	Grey Shrike-thrush					✓	✓	
Rhipidura leucophrys	Willie Wagtail					✓		
Grallina cyanoleuca	Magpie-lark					✓		
Corvus orru	Torresian Crow					✓		
Mirafra javanica	Horsfield's Bush Lark					R		

Species	Common Name	Conservation Status			Comments	Pipeline Survey Area	Haul Road Survey Area	Solar Farm Survey Area
		EPBC Act	BC Act	DBCA				
Poodytes carteri	Spinifexbird					R		
Cincloramphus mathewsi	Rufous Songlark					✓		
Emblema pictum	Painted Finch					✓	✓	
Taeniopygia guttata	Zebra Finch					✓	✓	✓
Anthus australis	Australian Pipit					✓		
Reptiles								
Gehyra variegata	Variegated Gehyra					✓		
Ctenophorus caudicinctus	Western Ring-tailed Dragon					✓		✓
Gowidon longirostris	Long-nosed Dragon					✓		✓
Ctenotus saxatilis	Rock Ctenotus							✓
Varanus gouldii	Bungarra or Sand Goanna							✓
Total						57	19	21

* = introduced species; R = Recorded on Acoustic Recorders

3.2.3. Conservation Significant Fauna

The literature review, database searches and survey results indicate that 36 species of conservation significant vertebrate fauna (nine mammals, 24 birds and three reptiles) have been recorded from the Survey Areas or occur in the region (Table 3.7).

Of these, 26 species (eight mammals, 15 birds and three reptiles) have a Medium to High post-survey likelihood to occur within the Survey Areas or have been recorded (Table 3.7). The remaining 10 species (eight birds and two reptiles) have a Low to Very Low likelihood to occur within the Survey Areas.

Of the species potentially occurring on site, two species of conservation significant fauna were recorded in the Survey Areas: Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*; EPBC & BC Act Vulnerable) and Western Pebble-mound Mouse (*Pseudomys chapmani*, DBCA Priority 4).

The Pilbara Leaf-nosed Bat was recorded from the Pipeline Survey Area over three nights with eight passes (Table 3.6, Appendix D). The Western Pebble-mound Mouse was recorded in the form of an old disused mound in the Solar Farm Survey Area (Plate 3.1). The locations are displayed on Map 3.7 and Map 3.8.

Table 3.6: Conservation Significant Fauna Species Recorded

Species	Conservation Status			Easting	Northing	Site	Detail
	EPBC Act	BC Act	DBCA				
Mammals							
Pilbara Leaf-nosed Bat *Rhinonicteris aurantia*	VU	VU	-	635844	7559526	P08	3 passes (17/03/2023, call times: 00:43)
							3 passes (18/03/2023, call times: 09:15 – 22:07)
							2 passes (19/03/2023, call times: 01:07 – 01:08)
Western Pebble-mound Mouse *Pseudomys chapmani*	-	-	P4	664491	7558096	PMM01	Secondary Evidence

Plate 3.1: Old Western Pebble-mound Mouse Mound Recorded

Table 3.7: Conservation Significant Fauna Species Likely to Occur

Species	Con Sig Status			Preferred Habitats	Closest Record to			Likelihood of Occurrence		
	EPBC Act	BC Act	DBCA		Pipeline	Haul Road	Solar Farm	Pipeline	Haul Road	Solar Farm
Mammals										
Northern Quoll (*Dasyurus hallucatus*)	EN	EN	-	Most common on dissected rocky escarpments, gorges and boulder piles. Typically prefers rocky areas with suitable denning sites and access to surface water. Major drainage lines and treed creek lines may be used for movement and dispersal (Department of the Environment, 2016b).	Recorded 11km SW in 2012, and numerous contemporary records 37km W from DBCA database search.	Recorded 10.4 km SW in 2012, from DBCA database search. Biologic recorded this species 4.1 km ESE in 2022 (Biologic 2022b).	Biologic recorded this species 2.1 km SW in 2022 (Biologic 2022b) and Ecologia recorded this species 5.5 km SE in 2020 (ecologia 2020). Numerous recent records (2013-2015) from DBCA database search 14 km E.	**Low** Suitable habitat does not occur within the Survey Area. Recent records >15 km away. This species was not observed during the survey.	**Medium** Recent records within 10 km. Suitable foraging habitat exists. This species was not observed during the survey.	**Medium** Recent records within 15 km. Suitable foraging habitat exists. This species was not observed during the survey.
Bilby (*Macrotis lagotis*)	VU	VU	-	A variety of habitats with suitable soil substrates and plant species that are fed on directly or host insect larvae. Habitats can include spinifex hummock grassland, acacia shrubland, open woodland and cracking clays (Dziminski and Carpenter, 2016, 2018).	Recorded 8.9 km NW in 1981 from DBCA database search.	Recorded 6.2 km WSW in 2001 from DBCA database search.	Recorded 12.3 NW in 1984 from DBCA database search.	**Medium** Marginal suitable habitat, historical nearby records.	**Low** Suitable habitat does not occur within the Survey Area. Closest recent record over >30 km away. No evidence of this species was observed during the survey.	**Low** Suitable habitat does not occur within the Survey Area. Closest recent record over >30 km away. No evidence of this species was observed during the survey.
Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*)	VU	VU	-	Dissected rocky escarpments with suitable roost caves with high humidity (85 - 100% RH) and stable temperatures (28 - 32°C). Forages in a variety of habitats, particularly along water bodies and riparian vegetation (Armstrong, 2001; Cramer *et al.*, 2016)	Biologic recorded this species within the Survey Area in 2022 (Biologic 2022a). Also recorded 15.8 km S in 2013 from DBCA database search.	Biologic recorded this species 11.5 km E in 2022 (Biologic, 2022b) and Ecologia recorded this species 11.2 km ESE in 2020 (ecologia 2020). Recent records ~28 km S from DBCA database search.	Biologic recorded this species 5.1 km E in 2022 (Biologic 2022b) and Ecologia recorded this species 5.5 km SE in 2020 (ecologia 2020). Recent records ~29 km S from DBCA database search.	**Recorded** Pilbara Leaf-nosed Bats were recorded during the survey. They were previously recorded in the Survey Area by Biologic in 2022 (Biologic 2022a). The Survey Area contains suitable foraging habitat for this species.	**Medium** The Survey Area contains suitable foraging habitat for this species. There are recent records within 12 km of the Survey Area.	**Medium** The Survey Area contains suitable foraging habitat for this species. There are recent records within 6 km of the Survey Area.
Ghost Bat (*Macroderma gigas*)	VU	VU	-	A variety of habitats including caves and rock piles. Abandoned mines may be utilized as transient roosts. Maternity/ breeding roosts require dark, warm and humid (>80% RH) microclimates (Armstrong and Anstee, 2000a). Will travel up to 2 km from a roost to hunt and will utilize other structures such as culverts, rock overhangs and trees for feeding roosts (Tidemann *et al.*, 1985).	Biologic recorded this species 15.9 km W in 2022 (Biologic 2022a). Historical record 11.1 km SW in 1996 from DBCA database search.	Ecologia recorded this species 8.2 km S in 2020 (ecologia 2020). Recent record ~33 km SE from DBCA database search.	Ecologia recorded this species 10.5 km SW in 2020 (ecologia 2020). Recent record ~27 km SE from DBCA database search.	**Medium** Records exist within 16 km of Survey Area. Suitable foraging habitat exists within the Survey Area. No roost habitat was recorded. No evidence of this species was observed/recorded during the survey.	**Medium** Records exist within 10 km of Survey Area. Suitable foraging habitat exists within the Survey Area. No roost habitat was recorded. No evidence of this species was observed/recorded during the survey.	**Medium** Records exist within 11 km of Survey Area. Suitable foraging habitat exists within the Survey Area. No roost habitat was recorded. No evidence of this species was observed/recorded during the survey.
Brush-tailed Mulgara (*Dasycercus blythi*)	-	-	P4	Sandy, loamy and sometimes stony/ gibber plains vegetated with spinifex and/ or tussock grasses. Has a preference for flats rather than the dune crests preferred by its congener *D. cristicauda* (Pavey *et al.*, 2011).	Recorded 55.8 km NE in 2016 from DBCA database search.	Recorded 37.2 km NE in 2016 from DBCA database search.	DBCA database search returned a record 31.3 km NE in 2016, other recent records 44.4 km NE.	**Medium** No sightings or evidence of this species was recorded during the survey Marginal suitable habitat, records > 55km from the Survey Area.	**Low** No sightings or evidence of this species was recorded during the survey. Suitable habitat does not occur within the Survey Area.	**Low** No sightings or evidence of this species was recorded during the survey. Suitable habitat does not occur within the Survey Area.
Spectacled Hare-wallaby (*Lagorchestes conspicillatus leichardti*)	-	-	P4	Acacia shrubland and spinifex in Tanami Desert and tropical grasslands, open forests and woodlands, shrublands with tussock grasses as well as inland areas of hummock grassland (Van Dyck and Strahan, 2008b).	Closest DBCA database search records, one with no associated date 66.6 km WSW and one in 2014 over 80 km NE of the Survey Area.	One DBCA database search record with no associated date over 65 km NNE. Additionally, one record in 2014 over 75 km N of the Survey Area.	One DBCA database search record with no associated date over 60 km NNE. Additionally, one record in 2014 over 75 km N of the Survey Area.	**Medium** No sightings or evidence of this species was recorded during the survey. Marginal suitable habitat. Species is under sampled and may be visiting infrequently. Records >60 km from the Survey Area.	**Low** Pilbara populations have drastically declined since the 1980's, species is most common in NT and QLD. It is considered rare and scattered in WA however, status and distribution in the region is poorly understood (DAWE 2008; Van Dyck and Strahan, 2008b). No sightings or evidence of this species was recorded during the survey	**Low** Pilbara populations have drastically declined since the 1980's, species is most common in NT and QLD. It is considered rare and scattered in WA however, status and distribution in the region is poorly understood (DAWE 2008; Van Dyck and Strahan, 2008b). No sightings or evidence of this species was recorded during the survey
Short-tailed Mouse (*Leggadina lakedownensis*)	-	-	P4	Spinifex and tussock grassland on cracking clays. Also acacia shrubland, samphire, woodlands and stony ranges in Northern Australia (Kutt and Kemp, 2005).	Two DBCA database search records ~2 km SW in 2013 and multiple	Biologic recorded this species 25.1 km E in 2022 (Biologic 2022b). Multiple	Biologic recorded this species 18.6 km E in 2022 (Biologic 2022b). Multiple	**High** Records in close proximity to Survey Area and suitable habitat is present.	**Low** Suitable habitat does not occur within the Survey Area. Records >25 km from the Survey Area.	**Low** Suitable habitat does not occur within the Survey Area. Records >18 km from the Survey Area.

Species	Con Sig Status			Preferred Habitats	Closest Record to			Likelihood of Occurrence		
	EPBC Act	BC Act	DBCA		Pipeline	Haul Road	Solar Farm	Pipeline	Haul Road	Solar Farm
					recent records >40 km SW of the Survey Area.	historical DBCA database search records >40 km E.	historical DBCA database search records >40 km E.			
Western Pebble-mound Mouse (*Pseudomys chapmani*)	-	-	P4	Rocky ranges and hills where suitably sized pebbles are available for mound construction. Most common on the lower slopes of ridges vegetated with spinifex hummock grassland (Dunlop and Pound, 1981).	Biologic recorded this species 4.4 km W in 2022, with multiple other records ~16 km W (Biologic 2022a). Multiple historical and contemporary DBCA database search records >20 km away.	Biologic recorded this species 4.9 km E in 2022 (Biologic 2022b). Multiple contemporary DBCA database search records >20 km away.	Biologic recorded this species 0.8 km S and 1.5 km E in 2022 (Biologic 2022b). Multiple contemporary DBCA database search records >20 km away.	**Low** No sightings or evidence of this species was recorded during the surveys. Suitable habitat does not occur within the Survey Area.	**High** There are records close to the Survey Area and suitable habitat is present.	**Recorded** Secondary evidence in the form of one old mound was observed during the Survey. There are further records close to the Survey Area and suitable habitat is present.
Birds										
Curlew Sandpiper (*Calidris ferruginea*)	CR/MI	CR	-	Tidal flat systems and freshwater to brackish wetlands. Ephemeral and permanent lakes, dams and waterholes, usually with bare edges, mud and sand (Morcombe, 2003; Menkhorst *et al.*, 2019b).	No previous records returned from DBCA database search. Included in PMST results only (Species or species habitat may occur within area).			**Very Low** Suitable habitat does not occur within the Survey Area, and there are no previous records from the region.	**Very Low** Suitable habitat does not occur within the Survey Area, and there are no previous records from the region.	**Very Low** Suitable habitat does not occur within the Survey Area, and there are no previous records from the region.
Night Parrot (*Pezoporus occidentalis*)	EN	CR	-	Long, unburnt Triodia hummock grassland in association with low lying saline lakes and drainages hosting chenopods/Samphire (Jackett *et al.*, 2017).	One previous record returned from DBCA database search in 2005 over 70 km SE of the Survey Areas. Included in PMST results only (Species or species habitat likely to occur within area). Recorded from Cloudbreak during Fortescue's monitoring.			**Medium** This species is very rare, and elusive however, it is known to occur at Fortescue Marsh (Davis and Metcalf, 2008). A call was also recorded in WA in 2017 (Bancroft *et al.*, 2017) and occurs near FMG's Cloudbreak mine (Fortescue Metals Group, 2021). Some suitable foraging habitat occurs within the Survey Area.	**Low** Suitable habitat does not occur within the Survey Area, and this species is very rare, and elusive.	**Low** Suitable habitat does not occur within the Survey Area, and this species is very rare, and elusive.
Australian Painted Snipe (*Rostratula australis*)	EN	EN	-	Shallow terrestrial freshwater wetlands, lakes, and swamps, typically with low, dense fringing vegetation. Favors sites with shallow water and exposed mud (Menkhorst et al., 2019).	No previous records returned from DBCA database search. Included in PMST results only (Species or species habitat may occur within area).			**Very Low** Suitable habitat does not occur within the Survey Area, and there are no previous records from the region.	**Very Low** Suitable habitat does not occur within the Survey Area, and there are no previous records from the region.	**Very Low** Suitable habitat does not occur within the Survey Area, and there are no previous records from the region.
Grey Falcon (*Falco hypoleucos*)	VU	VU	-	Varied and widespread habitat, usually within interior plains, patrolling low groundcover below treetop level (Morcombe, 2003). Distribution is centered inland on lightly timbered lowlands, particularly Acacia shrubland and drainage systems (Olson and Olson, 1986a).	Recorded by Ecologia 9.8 km E in 2020 (ecologia 2020). Multiple historical and contemporary DBCA database search records >30 km away.	Recorded by Ecologia 7.3 km W in 2020 (ecologia 2020). Multiple historical and contemporary DBCA database search records >30 km away.	Recorded by Ecologia 13.4 km W in 2020 (ecologia 2020). Multiple historical and contemporary DBCA database search records >20 km away.	**Medium** This species has the potential to occur in the Survey Area, predominately for foraging.	**Medium** This species has the potential to occur in the Survey Area, predominately for foraging.	**Medium** This species has the potential to occur in the Survey Area, predominately for foraging.
Common Greenshank (*Tringa nebularia*)	MI	MI	-	Variety of coastal to inland permanent and ephemeral wetlands, swamps, lakes, waterholes and well as open mudflats (Morcombe, 2003; Menkhorst *et al.*, 2019b).	Ecologia recorded this species 12.5 km ESE in 2020 (ecologia 2020). Three DBCA database search records in creek lines over 40 km N of Survey Area.	Ecologia recorded this species 9.7 km SSW in 2020 (ecologia 2020). Three DBCA database search records in creek lines over 40 km N of Survey Area.	Ecologia recorded this species 14 km SW in 2020 (ecologia 2020). Three DBCA database search records in creek lines over 40 km N of Survey Area.	**Medium** Marginal suitable habitat present in Survey Area, could occur if inundated.	**Low** Suitable habitat does not occur within the Survey Area, and there are no previous records from the region.	**Low** Suitable habitat does not occur within the Survey Area, and there are no previous records from the region.
Common Sandpiper (*Actitis hypoleucos*)	MI	MI	-	Coastal and inland ephemeral wetland habitat types. Sheltered, narrow and steep shorelines. Mangrove-lined creeks and varied wetland habitats including areas of mud with outcropping rocks, sewage ponds and dams (Morcombe, 2003; Menkhorst *et al.*, 2019b).	One historical DBCA database search record 26.5 km NW. Included in PMST results only (Species or species habitat may occur within area).	One historical DBCA database search record >45 km WNW. Included in PMST results only (Species or species habitat may occur within area).	One historical DBCA database search record >55 km WNW. Included in PMST results only (Species or species habitat may occur within area).	**Medium** Marginal suitable habitat present in Survey Area, could occur if inundated.	**Low** Suitable habitat does not occur within the Survey Area, and there are no previous records from the region.	**Low** Suitable habitat does not occur within the Survey Area, and there are no previous records from the region.
Pacific Swift (*Apus pacificus*)	MI	MI	-	Extremely diverse habitat; coastal, rainforest, semi-desert and inland plains. In Australia,	One DBCA database search result 12.7 km SW	Nine historical and contemporary DBCA	Nine historical and contemporary DBCA	**Medium**	**Medium**	**Medium**

Species	Con Sig Status			Preferred Habitats	Closest Record to			Likelihood of Occurrence		
	EPBC Act	BC Act	DBCA		Pipeline	Haul Road	Solar Farm	Pipeline	Haul Road	Solar Farm
				the species has an almost entirely aerial lifestyle and is associated with storm fronts (Morcombe, 2003; Menkhorst *et al.*, 2019b).	in 2012. Eight other historical and contemporary DBCA database search results in the vicinity of the Survey Area.	database search results in the vicinity of the Survey Area.	database search results in the vicinity of the Survey Area.	Association with storm fronts means there is potential for the species to occur in the Survey Area. However, it is an almost entirely aerial species and is unlikely to use the habitats present.	Association with storm fronts means there is potential for the species to occur in the Survey Area. However, it is an almost entirely aerial species and is unlikely to use the habitats present.	Association with storm fronts means there is potential for the species to occur in the Survey Area. However, it is an almost entirely aerial species and is unlikely to use the habitats present.
Glossy Ibis (*Plegadis falcinellus*)	MI	MI	-	Freshwater waterbodies, marshes, lakes and river lagoons, flood-plains, wet meadows, swamps, sewage ponds. Occasionally found in estuarine waters or dry grassland (Morcombe, 2003; Menkhorst *et al.*, 2019b).	Two DBCA database search records, one from 2004 13.5 km SE at Goodiadarrie Swamp and one from 2000, 21.0 km W.	One DBCA database search record from 2004 10.0 km S at Goodiadarrie Swamp.	One DBCA database search record from 2004 13.9 km SW at Goodiadarrie Swamp.	**Medium** Marginal suitable habitat present in Survey Area, could occur if inundated.	**Low** Suitable habitat does not occur within the Survey Area, and there are no previous records from the region.	**Low** Suitable habitat does not occur within the Survey Area, and there are no previous records from the region.
Grey Wagtail (*Motacilla cinerea*)	MI	MI	-	Migratory species rarely reaching Australian fresh streams, mowed grass, ploughed land or sewage ponds (Morcombe, 2003).	One DBCA database search record >75 km ESE in 2012.	One DBCA database search record 60.7 km ESE in 2012.	One DBCA database search record 54.8 km ESE in 2012.	**Low** Suitable habitat does not occur within the Survey Area.	**Low** Suitable habitat does not occur within the Survey Area.	**Low** Suitable habitat does not occur within the Survey Area.
Red-necked Stint (*Calidris ruficollis*)	MI	MI	-	Inhabit coastal areas, particularly tidal flats. Some species may also inhabit mangroves, ocean beaches and rocky shorelines (Menkhorst *et al.*, 2019b).	No previous records returned from DBCA database search. Recorded by Ecologia in 2020 12.5 km ESE (ecologia 2020).	No previous records returned from DBCA database search. Recorded by Ecologia in 2020 9.7 km SSW (ecologia 2020).	No previous records returned from DBCA database search. Recorded by Ecologia in 2020 14 km SW (ecologia 2020).	**Medium** No records returned from DBCA database search, however Ecologia recorded this species in 2020. Marginal suitable habitat present in Survey Area, could occur if inundated.	**Low** Suitable habitat does not occur within the Survey Area, and there are no previous records from the region.	**Low** Suitable habitat does not occur within the Survey Area, and there are no previous records from the region.
Oriental Pratincole (*Glareola maldivarum*)	MI	MI	-		No previous records returned from DBCA database search. Included in PMST results only (Species or species habitat may occur within area).			**Medium** Marginal suitable habitat present in Survey Area, could occur if inundated.	**Low** Suitable habitat does not occur within the Survey Area, and there are no previous records from the region.	**Low** Suitable habitat does not occur within the Survey Area, and there are no previous records from the region.
Oriental Plover (*Charadrius veredus*)	MI	MI	-	Open plains, bare, rolling country often far from water, margins of coastal marshes, inland swamps or tidal mudflats (Pizzey and Knight, 2012)	No previous records returned from DBCA database search. Included in PMST results only (Species or species habitat may occur within area).			**Low** No recent records and marginal suitable habitat present in Survey Area.	**Low** No recent records and marginal suitable habitat present in Survey Area.	**Low** No recent records and marginal suitable habitat present in Survey Area.
Pectoral Sandpiper (*Calidris melanotos*)	MI	MI	-	Coastal wetland, both fresh and saline but also inland on permanent and temporary wetlands. Prefers sites with mudflats, fringing vegetation or swamps with heavy vegetation (Morcombe, 2003).	No previous records returned from DBCA database search. Included in PMST results only (Species or species habitat may occur within area).			**Medium** Marginal suitable habitat present in Survey Area, could occur if inundated.	**Low** Suitable habitat does not occur within the Survey Area, and there are no previous records from the region.	**Low** Suitable habitat does not occur within the Survey Area, and there are no previous records from the region.
Sharp-tailed Sandpiper (*Calidris acuminata*)	MI	MI	-	Inland lakes, and coastal, along brackish and freshwater wetlands, saltmarsh, lakes and pools (Morcombe, 2003).	No previous records returned from DBCA database search. Included in PMST results only (Species or species habitat may occur within area).			**Medium** Marginal suitable habitat present in Survey Area, could occur if inundated.	**Low** Suitable habitat does not occur within the Survey Area, and there are no previous records from the region.	**Low** Suitable habitat does not occur within the Survey Area, and there are no previous records from the region.
Wood Sandpiper (*Tringa glareola*)	MI	MI	-	Well-vegetated, shallow freshwater wetlands, lakes, pools and swamps. Usually near shorelines either on mud or in shallow water (Morcombe, 2003; Menkhorst *et al.*, 2019b).	Recorded by Ecologia in 2020 12.5 km ESE (ecologia 2020). Three DBCA database search records from two drainage lines >40 km NE and ENE of the Survey Area.	Recorded by Ecologia in 2020 9.7 km SSW (ecologia 2020). Three DBCA database search records from two drainage lines >40 km NE and ENE of the Survey Area.	Recorded by Ecologia in 2020 14 km SW (ecologia 2020). Three DBCA database search records from two drainage lines >40 km NE and ENE of the Survey Area.	**Medium** Marginal suitable habitat present in Survey Area, could occur if inundated.	**Low** Suitable habitat does not occur within the Survey Area.	**Low** Suitable habitat does not occur within the Survey Area.
Osprey (*Pandion heliaetus*)	MI	MI	-	Coastal and terrestrial wetlands of tropical and temperate Australia and offshore islands, occasionally ranging inland along rivers (Menkhorst *et al.*, 2019b).	Four historical and contemporary DBCA database search records > 45 km S and > 60 km N of Survey Areas.			**Low** Suitable habitat does not occur within the Survey Area.	**Low** Suitable habitat does not occur within the Survey Area.	**Low** Suitable habitat does not occur within the Survey Area.
Gull-billed Tern (*Gelochelidon nilotica*)	MI	MI	-	Coastal – most species forage over water with depth and proximity to shore varying between species. Nesting occurs on	Recorded 13.6 km ESE from Fortescue Marsh in	Recorded 9.6 km S from Fortescue Marsh in 2003	Recorded 12.8 km SW from Fortescue Marsh in	**Medium** Marginal suitable habitat present in Survey Area, could occur if inundated.	**Very Low** Suitable habitat does not occur within the Survey Area.	**Very Low** Suitable habitat does not occur within the Survey Area.

Species	Con Sig Status			Preferred Habitats	Closest Record to			Likelihood of Occurrence		
	EPBC Act	BC Act	DBCA		Pipeline	Haul Road	Solar Farm	Pipeline	Haul Road	Solar Farm
				sandbars, spits, and rocky islands. Roosting on ocean beaches, rock platforms and man-made structures (Menkhorst *et al.*, 2019b).	2004 from DBCA database search.	from DBCA database search.	2003 from DBCA database search.			
Caspian Tern (*Hydroprogne caspia*)	MI	MI	-		Recorded 11.6 km ESE at Fortescue Marsh in 2007 from DBCA database search.	Recorded 9.5 km SSW at Fortescue Marsh in 2007 from DBCA database search.	Recorded 14.1 km SW at Fortescue Marsh in 2007 from DBCA database search.	**Medium** Marginal suitable habitat present in Survey Area, could occur if inundated.	**Very Low** Suitable habitat does not occur within the Survey Area.	**Very Low** Suitable habitat does not occur within the Survey Area.
Little Tern (*Sternula albifrons*)	MI	MI	-		Two historical DBCA database search records 12.3 km S at Fortescue Marsh.	Two historical DBCA database search records 21.5 km SW at Fortescue Marsh.	Two historical DBCA database search records 25.4 km SW at Fortescue Marsh.	**Medium** Marginal suitable habitat present in Survey Area, could occur if inundated.	**Very Low** Suitable habitat does not occur within the Survey Area.	**Very Low** Suitable habitat does not occur within the Survey Area.
Barn Swallow (*Hirundo rustica*)	MI	MI	-	Open country with low vegetation, farmlands and meadows (DoE 2020). Most often seen in open sites in towns, near water. Generally found along coast from Darwin to Broome (Morcombe and Stewart, 2013b).	No previous records returned from DBCA database search. Included in PMST results only (Species or species habitat may occur within area).			**Very Low** Suitable habitat does not occur within the Survey Area, and there are no previous records from the region.	**Very Low** Suitable habitat does not occur within the Survey Area, and there are no previous records from the region.	**Very Low** Suitable habitat does not occur within the Survey Area, and there are no previous records from the region.
Eastern Yellow Wagtail (*Motacilla tschutschensis*)	MI	MI	-	Open country near swamps, grassed areas, sewage ponds, salt marshes, bare ground and occasionally found on inland plains (Morcombe, 2003).	No previous records returned from DBCA database search. Included in PMST results only (Species or species habitat may occur within area).			**Very Low** Suitable habitat does not occur within the Survey Area, and there are no previous records from the region.	**Very Low** Suitable habitat does not occur within the Survey Area, and there are no previous records from the region.	**Very Low** Suitable habitat does not occur within the Survey Area, and there are no previous records from the region.
Peregrine Falcon (*Falco peregrinus*)	OS	OS	-	Widespread but uncommon; variety of habitats including open woodlands, grasslands with trees, lakes, timbered watercourses and urban areas (G. Pizzey and Knight, 2012). Cliff faces are preferred nesting sites (Morcombe, 2003; Menkhorst *et al.*, 2019b).	Biologic recorded this species 5.4 km W in 2022 (Biologic 2022a). Multiple historical and contemporary DBCA database search records >10 km away.	Recorded 9.5 km S in 2003 from DBCA database search. Multiple historical and contemporary DBCA database search records >20 km away.	Recorded 12.8 km SW in 2003 from DBCA database search. Multiple historical and contemporary DBCA database search records >15 km away.	**High** Records in close proximity to the Survey Area. This species occupies extremely diverse habitats and has the potential to occur in the Survey Area, predominately for foraging.	**Medium** This species has the potential to occur in the Survey Area, predominately for foraging.	**Medium** This species has the potential to occur in the Survey Area, predominately for foraging.
Letter-winged Kite (*Elanus scriptus*)	-	-	P4	Roost in leafy trees, hunts mostly at night. Usually found in desert/semi desert or along tree-lined creeks (Morcombe and Stewart, 2013b). Breeds after rodent populations peak (following good rains) (Menkhorst *et al.*, 2019b).	One record returned from DBCA database search 45.5 km E in 2000.	One record returned from DBCA database search 27.4 km E in 2000.	One record returned from DBCA database search 21.0 km E in 2000.	**Low** This species is not typically recorded in the region, and it was recorded as part of Bird Life's Atlas of Australian Birds. This program is open to the general public and therefore training and experience level of the surveyor(s) is unknown. Marginal suitable habitat occurs within the Survey Area.	**Low** This species is not typically recorded in the region, and it was recorded as part of Bird Life's Atlas of Australian Birds. This program is open to the general public and therefore training and experience level of the surveyor(s) is unknown. Marginal suitable habitat occurs within the Survey Area.	**Low** This species is not typically recorded in the region, and it was recorded as part of Bird Life's Atlas of Australian Birds. This program is open to the general public and therefore training and experience level of the surveyor(s) is unknown. Marginal suitable habitat occurs within the Survey Area.
Reptiles										
Pilbara Olive Python (*Liasis olivaceus barroni*)	VU	VU	-	Inhabits gorges, gullies, stony ranges, rock piles and along watercourses. Often associated with permanent and temporary water bodies though is not restricted to them. Habitat requirements are likely to vary throughout the year (DSEWPaC 2011c).	Recorded 12.3 km NE in 2012 from DBCA database search. Multiple historical and contemporary DBCA database search records >20 km away.	Recorded by Ecologia 2.1 km S in 2020 (ecologia 2020). Multiple historical and contemporary DBCA database search records >10 km away.	Recorded by Ecologia 7.2 km W in 2020 (ecologia 2020). Multiple historical and contemporary DBCA database search records >15 km away.	**Low** Suitable habitat does not occur within the Survey Area.	**Medium** Marginal suitable habitat occurs within the Survey Area.	**Medium** Marginal suitable habitat occurs within the Survey Area.
Pin-striped Ctenotus (*Ctenotus nigrilineatus*)	-	-	P1	Spinifex plains adjacent to granite outcrops and watercourses at hilly interior of Pilbara near Woodstock, Meentheena and Nullagine (Wilson and Swan, 2021).	One contemporary DBCA database search record >70 km NE.	One contemporary DBCA database search record >60 km N.	One contemporary DBCA database search record >55 km N.	**Low** Suitable habitat does not occur within the Survey Area, and there are no records in close proximity.	**Low** Suitable habitat does not occur within the Survey Area, and there are no records in close proximity.	**Low** Suitable habitat does not occur within the Survey Area, and there are no records in close proximity.
Gane's Blind Snake (*Anilios ganei*)	-	-	P1	A variety of habitats, thought to prefer moist gorges though habitat data is limited (Aplin, 1998a).	Ecologia recorded this species 24.0 km E in 2020 (ecologia 2020). Ten DBCA database search records >35 km away.	Ecologia recorded this species 24.0 km E in 2020 (ecologia 2020). Ten DBCA database search records >45 km away.	Biologic recorded this species 4.6 km E in 2022 (Biologic 2022b). Ten DBCA database search records >40 km away.	**Low** Suitable habitat does not occur within the Survey Area.	**Medium** Species recorded in proximity to the Survey Area.	**Medium** Species recorded in proximity to the Survey Area.

Species	Con Sig Status			Preferred Habitats	Closest Record to			Likelihood of Occurrence		
	EPBC Act	BC Act	DBCA		Pipeline	Haul Road	Solar Farm	Pipeline	Haul Road	Solar Farm
Lined Soil-crevice Skink (*Notoscincus butleri*)	-	-	P4	Associated with spinifex-dominated areas near creek and river margins (Wilson and Swan, 2021).	Three DBCA database search records >60 km away.	Three DBCA database search records >85 km away.	Three DBCA database search records >85 km away.	**Low** Suitable habitat does not occur within the Survey Area.	**Medium** Marginal suitable habitat occurs within the Survey Area.	**Medium** Marginal suitable habitat occurs within the Survey Area.
Pilbara Barking Gecko (*Underwoodisaurus seorsus*)	-	-	P2	Hamersley Range in Pilbara, rocky areas with spinifex and low tree cover (Wilson and Swan, 2021).	Eight DBCA database search records >25 km away.	Eight DBCA database search records >35 km away.	Eight DBCA database search records >40 km away.	**Low** Outside species' known distribution.	**Low** Outside species' known distribution.	**Low** Outside species' known distribution.

3.2.3.1. Mammals

Northern Quoll (*Dasyurus hallucatus*)

Conservation Status: EPBC Act & BC Act: Endangered.

Distribution, Habitat and Ecology: The Northern Quoll is the smallest of the four quoll species occurring in Australia (Oakwood, 2008). The species formerly occurred across the northern parts of Australia however, since the arrival of the Cane Toad (*Rhinella marina*) the Northern Quolls' distribution has declined significantly (DotE 2018a). The Pilbara population typically find refuge in rocky habitats during the day utilising crevices, cracks, and small caves. These critical denning habitats are found amongst rocky gorges, basalt hills, escarpments, mesas, plateaux, granite boulder piles, caves and adjacent cliff faces, as well as coastal fringes and beaches (DotE 2018a). Foraging occurs across any adjacent habitat that provides suitable cover and food resources, whilst drainage lines and rivers are also used for dispersal. The species is adaptable and has been recorded in artificial habitat such as rock armour, underneath bridges (Ecoscape 2018), quarries (Department of Mines and Petroleum, 2013), camp sites (ecologia Environment, 2012b) and along breakwaters (Ecoscape 2016a, Ecoscape 2016b). The species' diet varies widely, fluctuating based on available habitats and environmental conditions. The Northern Quoll is an opportunist feeder that mostly consumes insects, fruits, vegetation, molluscs but also a large number of vertebrate species (mammals, birds, reptiles and frogs) (Dunlop, Rayner and Doherty, 2017).

Occurrence in the Survey Areas: The Northern Quoll has a Medium likelihood to occur in the Haul Road and Solar Farm Survey Areas due to numerous recent records returned from the DBCA Threatened Fauna Database Search (Map 3.1), and Biologic (2022b) and Ecologia (2020) recorded this species within 10 km of the Survey Areas. Denning is restricted to rocky habitats with plenty of shelters, rocky crevices and caves. The Drainage Lines habitat present in the Survey Areas is suitable for foraging, species movement and dispersal of young (6.3% in the Haul Road and 7.7% in the Solar Farm). The species has a Low likelihood to occur at the Pipeline Survey Area due to the lack of suitable habitat.

Bilby (*Macrotis lagotis*)

Conservation Status: EPBC Act & BC Act: Vulnerable.

Distribution, Habitat & Ecology: The Bilby is a medium-sized marsupial that formerly inhabited the arid and semi-arid zones of 70% of Australia (Department of Environment and Conservation, 2012). Its distribution has declined to approximately 20% of its former range. In Western Australia, the Bilby is reported to inhabit sandplains, sand dunes, interdune corridors, mulga shrubland on loamy or stony plains, *Acacia* shrubland over *Triodia* grassland on stony plains, samphire shrubland on the edge of salt-lakes, and lower slopes or ranges (Pavey, 2006). In the Pilbara region it has been recorded from mulga shrubland on clay, salt lakes, and sandplain habitat that is dominated by grassland and/or shrubland (Department of Environment and Conservation, 2012). The size of the Bilby's home range is estimated to be between 0.18 km^2 and 3.16 km^2 depending on the location and availability of foraging habitat, and a single individual may regularly use several burrows (Pavey, 2006). Sudden shifts in spatial distribution can occur, particularly in sandy deserts, in response to changing food availability. Females appear to display long-term site fidelity whereas males display a roaming behaviour allowing them to mate with multiple females (Pavey, 2006).

Occurrence in the Survey Areas: The Bilby has a Medium likelihood to occur in the Pipeline Survey Area as there is marginal habitat present and a historical record 8.9 km north-west of the Survey Area returned from the DBCA Threatened Fauna Database Search. Additional records are located more than 15 km north-east, or near the Fortescue Marsh of which six records are considered recent (2010-2017) (Map 3.1). These records are mostly associated with Drainage Line habitat. No sightings or evidence of this species were recorded

within the Survey Areas during this survey. Within the Pipeline Survey Area, some suitable habitat exists within Drainage Lines/Floodplains (41.0%) and Mulga Woodland (31.6%). Some Mulga Woodland is also present in the Solar Farm (18.9%). However, the habitat in the Solar Farm is considered marginal, therefore the species has a Low likelihood to occur in the Haul Road and Solar Farm Survey Area.

Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia* (Pilbara form))

Conservation Status: EPBC Act & BC Act: Vulnerable.

Distribution, Habitat and Ecology: The Pilbara Leaf-nosed Bat is the Pilbara form of the Orange Leaf-nosed Bat, a small orange-coloured bat that occurs across northern Australia, with the other population located in the Kimberley (K.N. Armstrong, 2006). The two populations differ genetically, morphologically and in the frequency of their echolocation calls (Armstrong, 2001, 2003; Kyle N Armstrong, 2006).

The Pilbara Leaf-nosed Bat requires two different habitats, one for roosting during the day (typically a cave), and an external habitat for foraging at night. Roosting occurs in deep, warm and humid caves and adits (horizontal tunnels). Some caves are used all year around, whereas others are visited for a variety of purposes including specific maternity roost caves (Churchill, 2009b; Department of the Environment, 2018c). A standardised nomenclature for the different roost types has been established and includes four types of roosts:

- Permanent diurnal roost;
- Non-permanent breeding roost;
- Transitory diurnal roosts; and
- Nocturnal refuge.

Permanent diurnal roosts are occupied all year and are utilised for breeding and rearing of young. Non-permanent breeding roosts are also used for mating, and transitory diurnal roosts facilitate long-distance dispersal. These roost types are considered critical for the survival of the species. Nocturnal refuge roosts used for shelter and feeding and are considered important local level (Churchill, 2009b; Department of the Environment, 2018c). The Pilbara Leaf-nosed Bat is vulnerable to the loss of body heat and moisture, and therefore requires a stable warm microclimate. Their breeding cycle stretches over a 9-month period, with mating taking place in July and the dispersal of independent young in February/March (Churchill, 2009b; Department of the Environment, 2018c).

Occurrence in the Survey Areas: This species was recorded during this survey from an ultrasonic recorder at an ephemeral drainage line (water pools present) in the Pipeline Survey Area. The Pilbara Leaf-nosed Bat was recorded over three nights, with a total of eight passes (Map 3.7, Appendix D). This species has previously been recorded by Biologic in 2022 within the Pipeline Survey Area (Biologic 2022a). There are recent records within 6 km of the Solar Farm Survey Area and 12 km of the Haul Road Survey Area. Additional records from the DBCA Threatened Fauna Database Search are located more than 15 km from the Survey Areas (Map 3.1).

All detections during this survey, were well after sunset or before sunrise, suggesting the sites are not located close to a diurnal roost site and the species was foraging or dispersing. To date, no suitable roosts have been recorded within the Survey Areas.

The Conservation Advice for the Pilbara Leaf-nosed Bat has categorised critical foraging habitat based on number of encounters at night and the theory that the conditions of these habitats are important for supporting a neighbouring colony (Threatened Species Scientific Committee, 2016 [TSSC]). These habitats and priorities include:

- Priority 1 – rocky gorges with waterpools;
- Priority 2 – gullies;
- Priority 3 – rocky outcrops;
- Priority 4 – major watercourses; and
- Priority 5 – open grassland and woodland (TSSC 2016).

Based on the above, the fauna habitats present within the Survey Areas, fit into the following categories:

- Priority 4:
    - Drainage Lines/Floodplains habitat in the Survey Areas (Pipeline – 41.0%, Haul Road – 6.3%, and Solar Farm – 7.7%)
- Priority 5:
    - Mulga Woodland (Pipeline – 31.6%, and Solar Farm – 18.9%);
    - Stony Spinifex Plains and Hillslopes (Pipeline – 13.1%, Haul Road – 93.7%, and Solar Farm – 73.4%);
    - Chenopod/Cracking Clay Floodplain (Pipeline – 0.2%);
    - Alluvial Clay Plain (Pipeline – 7.3%); and
    - Mixed Eucalypt/Mulga Floodplain (Pipeline – 0.2%).

Ghost Bat (*Macroderma gigas*)

Conservation Status: EPBC Act & BC Act: Vulnerable.

Distribution, Habitat and Ecology: The Ghost Bat is a large, specialist carnivorous bat and is the sole member of its genus (Hoyle, Pople and Toop, 2001; Worthington Wilmer *et al.*, 2008). The species once occurred across of much of Australia but is now only known from isolated locations in northern Australia. (Armstrong and Anstee, 2000b; Bat Call WA, 2021).

Ghost Bats use a range of cave structures for short-term transient feeding roosts, long-term roosts and maternity roots (DoE 2018b). Short-term transient roosts can include overhangs, small shallow caves, granite boulders, and rail culverts. These sites have microclimates close to ambient conditions (Armstrong and Anstee, 2000b; Ecoscape 2017, 2018). Maternity roosts require a stable, warm, and humid climate with a relative humidity over 80%. They are usually deep, complex, or large domed caves or mine adits with an ideal isothermal zone (23-26°C) and a cavern size large enough for the species to manoeuvre in (Pettigrew *et al.*, 1986; Hall *et al.*, 1997). Medium-sized caves with suitable microclimates are used for a variety of activities such as foraging and long-term roosting. Caves that provide complete darkness are reported to be preferred for roosting (Schulz and Menkhorst, 1986).

Female Ghost Bats exhibit long-term philopatry, using the same roost caves, resulting in low mitochondrial DNA diversity (Worthington Wilmer *et al.*, 2008). Tracking studies have shown that up to 75% of the population disperse in winter with the remaining individuals (possibly pregnant females) occupying the warm caves over winter (Toop, 1985). The dispersing parties typically consist of small groups of paired Ghost Bats which can utilise smaller caves than those used during the breeding season. Females and males aggregate for breeding purposes at the end of the wet season (Pettigrew *et al.*, 1986) and females give birth to young between late August and November. The young are nursed in large maternity caves over the wet season (Toop, 1985).

The Ghost Bat is a carnivorous predator, feeding on other bats, rodents, invertebrates, and birds (Pettigrew *et al.*, 1986; Boles, 1999; Ecoscape 2018). Prey detection is through a combination of passive listening, vision, and echolocation. Detection through movement is thought to be the primary stimulus (Pettigrew *et al.*, 1988).

Occurrence in the Survey Areas: The Ghost Bat has a Medium likelihood to occur due to recent records within 16 km of the three Survey Areas by Biologic (2022a) and Ecologia (2020) (Map 3.1) and the presence of suitable foraging habitat, which exists in the form of Drainage Lines/Floodplains (41.0% for the Pipeline, 6.3% for the Haul Road and 7.7% for the Solar Farm). Additional records from the DBCA Threatened Fauna Database Search are located more than 11 km from the Survey Areas (Map 3.1). No critical habitat, including suitable roost habitat was recorded in the Survey Areas.

Brush-tailed Mulgara (*Dasycercus blythi*)

Conservation Status: DBCA: Priority 4.

Distribution, Habitat and Ecology: The Brush-tailed Mulgara is a medium sized carnivorous marsupial belonging to the family Dasyuridae. It occupies the arid and semi-arid interior of Australia with records from Western Australia, the Northern Territory, South Australia, and Queensland (Woolley, Haslem and Westerman, 2013). Preferred habitats include sandy and loamy flats vegetated with hummock and/ or tussock grasses. Brush-tailed Mulgara have also been recorded from stony gibber plains where wind-blown soil or sand has accumulated and allowed burrowing (Pavey *et al.*, 2011).

The Brush-tailed Mulgara excavates single entrance burrows (often at the edges of *Triodia* spp. hummocks) with multiple side tunnels that may terminate at surface 'pop-holes'. It is a nocturnal hunter, predating upon rodents, reptiles, and arthropods. Breeding takes place during the winter months with females recorded carrying young in September (Van Dyck and Strahan, 2008b).

Occurrence in the Survey Areas: The Brush-tailed Mulgara has a Medium likelihood to occur in the Pipeline Survey Area, as marginal suitable habitat exists within Stony Spinifex Plains and Hillslopes (13.1%) in the north-east. Records from the DBCA Threatened Fauna Database Search are located more than 55 km from the Pipeline Survey Area. There are additional DBCA Threatened Fauna Database Search records are over 30 km north-east of the Haul Road and Solar Farm Survey Areas. The species has a Low likelihood to occur in the Haul Road and Solar Farm.

Spectacled Hare-wallaby (*Lagorchestes conspicillatus leichardti*)

Conservation Status: DBCA: Priority 4.

Distribution, Habitat and Ecology: The Spectacled Hare-wallaby (*Lagorchestes conspicillatus leichardti*) is listed as Priority 4 by the DBCA due to the limited knowledge about the species' distribution and ecology. In some areas, the species was presumed extinct (East Pilbara and East Kimberley region) until recently when specimens were recorded as roadkill. The Spectacled Hare-wallaby is an elusive species that is rarely recorded, and if so, it is mostly found through secondary evidence (scats). The Spectacled Hare-wallaby are known to inhabit hummock grasslands with a mid-dense or sparse overstory and shelters under long, unburnt spinifex to evade predation and temperature extremes (Menkhorst and Knight, 2001b; Van Dyck and Strahan, 2008b). The Spectacled Hare-wallaby is solitary and well adapted to arid habitats, with a home range (of up to 177 ha). Their diet of grasses and herbs is dependent on climatic changes and individuals are expected to be nomadic in response to local environmental conditions (Burbidge and Johnson, 2008).

Occurrence in the Survey Areas: The Spectacled Hare-wallaby has a Medium likelihood of occurrence in the Pipeline Survey Area as marginal suitable habitat is present, particularly Stony Spinifex Plains and Hillslopes (13.1%) and Drainage Lines/Floodplains (41.0%). This species distribution and status is poorly understood in WA and is considered rare and scattered. Two records with no associated date were returned from the DBCA database search, located over 60 km west and north of the Pipeline Survey Area (Map 3.1). It has a Low likelihood to occur at the Haul Road and Solar Farm.

Short-tailed Mouse (*Leggadina lakedownensis*)

Conservation Status: DBCA: Priority 4.

Distribution, Habitat and Ecology: The Short-tailed Mouse has been recorded sporadically across northern Australia from the tropical coast extending to semi-arid regions (Moro and Kutt, 2008). They are found in a variety of habitats including spinifex and tussock grasslands, samphire shrublands, sedgelands and open woodlands. Most records are from seasonally inundated sandy clay or cracking clay soils in which it constructs simple, single chambered burrows (Kutt and Kemp, 2005). The Short-tailed mouse remains in burrows during the day, which provides them with shelter from extreme temperatures and is known to utilise different burrows during night time foraging (Watts and Aslin, 1981). Diet consists primarily of invertebrates but also plants, which supplement water requirements (Watts and Aslin, 1981). This species is sparsely distributed across Australia, with the most abundant population occurring on Thevenard Island and the recently established Serrurier Island (Moro and Morris, 2000).

Occurrence in the Survey Areas: The Short-tailed Mouse has a High likelihood to occur in the Pipeline Survey Area due to recent records within 2 km of the Survey Area (Map 3.1) and the presence of suitable habitat, which exists in the form of Stony Spinifex Plains and Hillslopes (13.1%), Mulga Woodland (31.6%), and Drainage Lines / Floodplain (41.0%). Additional records from the DBCA Threatened Fauna Database Search are located within 40 km from the Survey Areas (Map 3.1). The species has a Low likelihood to occur at the Haul Road and Solar Farm Survey Areas.

Western Pebble-mound Mouse (*Pseudomys chapmani*)

Conservation Status: DBCA: Priority 4.

Distribution, Habitat and Ecology: The Western Pebble-mound Mouse is endemic to the Pilbara region of Western Australia. Distribution extends from southern and central Pilbara to the Little Sandy Desert (Van Dyck and Strahan, 2008a) It is one of three species of Australian rodent that constructs an underground burrow system with a permanent arrangement of stones above ground at the entrances (Anstee, Roberts and Shea, 1997a). They are found on pebbled soil in arid tussock grassland and acacia woodland on gentle slopes of rocky ranges, with hard spinifex and scattered shrubs. The mice have a complex social structure and are known to occur in groups of up to 12 animals, who may utilise several burrow structures (Anstee, Roberts and Shea, 1997b). Male home ranges were found to be considerably larger than those of females, particularly during breeding season (Anstee, Roberts and Shea, 1997b).

Occurrence in the Survey Areas: The Western Pebble-mound Mouse was recorded during this survey in the Solar Farm Survey Area (Map 3.8) and has a High likelihood to occur in the Haul Road Survey Area. The likelihood at the Pipeline is Low. The presence of one inactive, disused mound was observed in the Solar Farm Survey Area, indicating that the habitat in this area is suitable for this species (Map 3.6). The old mound was recorded in the Stony Spinifex Plains and Hillslopes habitat type, which was the most dominant in both the Solar Farm (73.4%) and Haul Road (93.7%) Survey Areas. There are records within 5 km of these Survey Areas and multiple contemporary records from the DBCA Threatened Fauna Database Search over 20 km from all Survey Areas.

3.2.3.2. Birds

Night Parrot (*Pezoporus occidentalis*)

Conservation Status:

EPBC Act: Endangered & BC Act: Critically Endangered.

Distribution, Habitat and Ecology: The Night Parrot is a rarely encountered, elusive, nocturnal parrot that is primarily ground-feeding (Bamford Consulting Ecologists, 2005). Records are very rare and therefore the information about this species is limited (Department of Parks and Wildlife, 2017b). Historically, the species occurred over much of the semi-arid and arid zone of Australia (Garnett, Szabo and Dutson, 2011). Recently Night Parrots have been recorded from Pullen Pullen reserve in Queensland and from the central desert regions of Western Australia (Jackett *et al.*, 2017).

Based on the limited information and observations, it is thought that a range of habitats are utilised by the Night Parrot. Roosting and foraging habitats can differ in the composition of plants. Roosting sites are located in *Triodia* spp. grassland where the Night Parrot shelters in *Triodia* hummocks. Historical records also suggest that roosting may take place under dense succulent samphire shrubs (*Tecticornia* spp.) (Murphy *et al.*, 2018). Foraging sites are visited during the night and are in treeless non-*Triodia* open grasslands and herb fields. The foraging areas are often associated with drainage systems which concentrate limited rainfall and provide a rich floristic diversity (Murphy *et al.*, 2018). During hot weather, it appears the Night Parrot may require access to water sources or succulent food (>55% water). Radio-tracking studies have shown that the species can travel up to 40 km each night in a cumulative manner, with roost and feeding sites being not more than 10 km apart (Murphy *et al.*, 2018). They have been recorded visiting open water sources, including artificial water holes for drinking, during the night (Bamford Consulting Ecologists, 2005; McDougall *et al.*, 2009; Murphy *et al.*, 2018).

Ecological information is currently limited though studies are ongoing. Roosting and nesting appears to occur in long unburnt, often ring forming, *Triodia* spp. hummocks. An observation of nesting activity was made in 2017 in the East Murchison IBRA sub-region in Western Australia. The nest consisted of a chamber within a *Triodia* sp. hummock with a steep downward angled entrance and contained a single round, white egg (Jackett *et al.*, 2017). Breeding/ nesting activity may be triggered by above average rainfall. Historically, feeding habitat was thought to consist of chenopod vegetation, salt lake fringing *Triodia* hummock grasslands and other grasslands (Garnett *et al.*, 1993). Recent observations in Queensland confirm that chenopods, soft perennial grasses, *Triodia* hummock grass and herbs are used for foraging with no particular specialisation observed (Murphy *et al.*, 2018). There is no information on migration activities of the Night Parrot though literature suggests that the species may migrate in response to changing climatic conditions and associated changes in food resource availability (Fortescue Metals Group, 2005; Bamford Consulting Ecologists, 2008; Murphy *et al.*, 2018).

Occurrence in the Survey Areas: The Night Parrot has a Medium likelihood to occur in the Pipeline Survey Area. Although the database searches returned no records of the species, it is located within the Department of Parks and Wildlife (DPAW) (2017b) high priority area. This species is known to occur at the Fortescue Marsh (Davis and Metcalf, 2008) and a call was also recorded in WA in 2017 (Jackett *et al.*, 2017) indicating that the species is present in some areas and more recently from Fortescue's Cloudbreak mine area (Fortescue Metals Group, 2021).

Biologic (2022a) deployed song meters at seven locations within the West Borefield and Southern Corridor area, but no evidence of the Night Parrot was recorded. One of these locations was within the south-eastern

portion of the Pipeline Survey Area. In addition, Ecologia (2020a) also deployed 10 acoustic recorders throughout the adjacent Mulga East area and also returned no evidence of the Night Parrot.

During the current survey, two calls possibly attributable to Night Parrot were detected on one acoustic recorder in the Pipeline Survey Area but due to the low number (two) and timing of the potential calls (four seconds apart) and the limited suitable roosting habitat in the immediate vicinity, it was determined that they were unlikely to be from a Night Parrot (Adaptive NRM, 2023) (Appendix E). New survey guidelines are currently being assessed by the EPA which focus on habitat assessments, and limiting the use of acoustic recorders to areas that contain both habitats: long-unburnt spinifex and feeding/drinking habitat such as samphire shrubland, alluvial fans or drainage areas with abundant annuals and herbs (pers. comms, N. Leseberg, April 2023). Some small patches of long unburnt spinifex are limited to the northern part of the Pipeline Survey Area, however this habitat is considered marginal, due to the shrubby overstorey. Foraging and drinking habitat in the form of drainage lines and grasslands occurs in patches only when inundated within the Pipeline Survey Area in Alluvial Clay Plains (7.3%), Drainage Lines/Floodplains (41.0%) and Chenopod/Cracking Clay Floodplain (0.2%; Map 3.4), although this could be considered marginal habitat. There is a Low likelihood of this species occurring at the Haul Road and Solar Farm.

Grey Falcon (*Falco hypoleucos*)

Conservation Status: EPBC Act & BC Act: Vulnerable.

Distribution, Habitat and Ecology: The Grey Falcon is the rarest falcon in Australia with an estimated population size of <1000 individuals (Schoenjahn, 2013). They occur very sparsely in a wide variety of arid and semi-arid zones across an area of about 5 million km^2 (Schoenjahn, Pavey and Walter, 2020). They have not been found to be associated with any particular vegetation types, however climate characteristics such as temperature and rainfall appear to strongly influence the distribution of the species (Schoenjahn, Pavey and Walter, 2020). Breeding habitat appears to be localised in zones with the highest annual average temperatures, and areas with persistently dry and winter drought climatic conditions (Schoenjahn, 2013). Grey Falcons, like most falcons, typically use the nests of other large birds (typically corvids and raptors) in trees or on human infrastructure such as repeater towers or power-line pylons (Olson and Olson, 1986b). Nests are often used over several years and can be near nests of other falcons or raptor species (Schoenjahn, 2013). The Grey Falcon forages in open landscapes such as rocky plains with hummock grasslands, lower shrublands, and small drainage lines where they predominantly prey on birds, mainly pigeons and parrots (Olson and Olson, 1986b; Schoenjahn, 2013).

Occurrence in the Survey Areas: The Grey Falcon has a Medium likelihood to occur in the three Survey Areas. Ecologia (2020) recorded this species 7.3 km from the Haul Road Survey Area and twelve additional records from the DBCA Threatened Fauna Database Search are located within 85 km of the Survey Areas (Map 3.1). Suitable foraging habitat exists in the form of Drainage Lines/Floodplains (41.0% for the Pipeline, 6.3% for the Haul Road and 7.7% for the Solar Farm). However, this species could use other habitats present in the Survey Areas for foraging and dispersal. The Pipeline Survey Area contains infrastructure corridors where repeater towers and powerlines could provide suitable conditions for nesting.

EPBC Act/BC Act Listed Shorebirds

Database searches returned 14 shorebirds listed as Migratory under the EPBC Act and BC Act that could potentially occur in the Study Area. The Curlew Sandpiper is also listed as Critically Endangered by both the EPBC and BC Acts, and the Australian Painted Snipe is listed as Endangered by both the EPBC and BC Acts. However, these two species have a Very Low likelihood to occur at the Survey Areas and are therefore not

discussed in this section. The remaining 12 shorebird species, all of which are primarily associated with coastal or inland water bodies, and their EPBC Act and BC Act listing status are summarised in Table 3.8.

Table 3.8: EPBC Act Listed Migratory Bird Species

Common name	Species name	EPBC Act/BC Act Listing
Common Greenshank	*Tringa nebularia*	Migratory
Common Sandpiper	*Actitis hypoleucos*	Migratory
Glossy Ibis	*Plegadis falcinellus*	Migratory
Red-necked Stint	*Calidris ruficollis*	Migratory
Oriental Pratincole	*Glareola maldivarum*	Migratory
Oriental Plover	*Charadrius veredus*	Migratory
Pectoral Sandpiper	*Calidris melanotos*	Migratory
Sharp-tailed Sandpiper	*Calidris acuminata*	Migratory
Wood Sandpiper	*Tringa glareola*	Migratory
Gull-billed Tern	*Gelochelidon nilotica*	Migratory
Caspian Tern	*Hydroprogne caspia*	Migratory
Little Tern	*Sternula albifrons*	Migratory

Distribution, Habitat and Ecology: There are 37 species of migratory shorebirds in Australia that utilise the East-Asian-Australasian Flyway (EAAF). This flyway describes the migratory pattern whereby birds breed in the Northern hemisphere and migrate through Eastern Asia to spend a non-breeding period in the southern hemisphere (Hansen *et al.*, 2016). While movements vary between species, the non-breeding period spent in Australia is typically from the Austral spring to autumn (CoA 2015). Feeding and roosting habitats used by migratory shorebirds in Australia include coastal and inland wetlands, estuaries, mudflats, tidal flats, rocky inlets, sandy beaches, floodplains, artificial wetlands as well as farm and grassland areas. The non-breeding diet of most species consists of invertebrates, including crustaceans, gastropods and bivalves (CoA 2015).

Occurrence in the Survey Areas: The 12 migratory species were assessed as having a Medium likelihood of occurrence within the Pipeline Survey Area and a Low likelihood to occur at the Haul Road and Solar Farm. Eight of the twelve shorebird species have been recorded within the Study Area (Map 3.1) and the four remaining species have been included in the PMST results as species or species habitat may occur within area, but no results were returned from the DBCA Threatened Fauna Database Search. There is suitable habitat present in the form of Alluvial Clay Plains (7.3%) and Drainage Lines/Floodplains (41.0%) in the southern part of the Pipeline Survey Area, which is likely to provide foraging habitat for shorebirds that feed on aquatic invertebrates. However, as these species are non-breeding migrants to Australia, their presence in the Pipeline Survey Area is expected to be sporadic and temporary, depending on the availability of water.

Pacific Swift (*Apus pacificus*)

Conservation Status: EPBC Act & BC Act: Migratory.

Distribution, Habitat and Ecology: The Pacific swift is a migratory, non-breeding visitor to Australia. Within Western Australia, records are most abundant in coastal areas of the, southwest, Pilbara, and Kimberley regions (DAWE 2020). This medium sized swift is characterised by its forked tail and white rump, with back swept wings that taper to a fine point (Menkhorst *et al.*, 2019a). The species is known to be highly nomadic, rarely landing, spending much of their time foraging in large flocks high above the canopy. The species is known to be insectivorous, but its food source is relatively unknown within Australia (Menkhorst *et al.*, 2019a). Large flocks are often associated with low pressure storm systems (DAWE 2020).

Occurrence in the Survey Areas: The Pacific Swift has a Medium likelihood of occurrence across all Survey Areas due to its almost entirely aerial lifestyle. There are seven DBCA Threatened Fauna Database Search records from 2010, within 13 to 90 km (Map 3.1). It is associated with storm fronts which means the species could potentially fly over the Survey Areas when conditions are suitable, however, it is unlikely to use any of the habitats present in the Survey Areas (Map 3.4, Map 3.5 and Map 3.6).

Peregrine Falcon (*Falco peregrinus*)

Conservation Status: BC Act Other Specially Protected Fauna.

Distribution, Habitat and Ecology: The Peregrine Falcon is one of the most widespread birds in the world, breeding on all continents except Antarctica (Olsen *et al.*, 2006). It occurs across most of Australia though are an uncommon species and are rare across all states and territories (Bird Life Australia, 2012a). They are known to be both a nomadic and sedentary species and are uncommon in the Kimberley, Hamersley and Darling Ranges. They inhabit cliffs, coastal habitats, rivers, wooded water courses and lakes as well as urban environments. Peregrine Falcons usually nest by making a scrape on a high cliff edge but will also use stick nests of other large birds and tree hollows in some areas (Olsen *et al.*, 2006). Hunting is mainly done during the day and feeding is primarily on small to medium sized birds caught in flight, often above drainage lines and rivers. Favoured prey species include the Galah (*Eolophus roseicapilla)* and Sulphur-crested Cockatoo (*Cacatua galerita*) (Bird Life Australia, 2012b).

Occurrence in the Survey Areas: The Peregrine Falcon has a High likelihood to occur in the Pipeline Survey Area due to a recent record within 6 km by Biologic (2022a). It has a Medium likelihood to occur in the Haul Road and Solar Farm Survey Areas. Numerous additional records from the DBCA Threatened Fauna Database Search are located within 60 km of the Survey Areas (Map 3.1).

This species occupies extremely diverse habitats and has the potential to occur in the Survey Areas in all the habitats present, for foraging. No suitable nesting habitat was recorded within the Survey Areas.

3.2.3.3. Reptiles

Pilbara Olive Python (*Liasis olivaceus barroni*)

Conservation Status: EPBC Act & BC Act: Vulnerable.

Distribution, Habitat and Ecology: The Pilbara Olive Python is one of the largest python species in Australia, growing up to 4.5 m in length (Wilson and Swan, 2017) and are often seen near water or in pools where they ambush prey such as birds, rodents, bats and wallabies (Pearson, 2003; Ellis, 2010; Wilson, S., Swan, 2021). Male Pilbara Olive Pythons travel up to 4 km during the winter months in search of females to mate with, with home ranges thought to be up to 450 ha (Pearson, 2003). Habitat requirements of the Pilbara Olive Python are thought to vary throughout the year due to changes in temperature and breeding activities. Dispersal during the wet season occurs across rocky habitats supporting water sources and drainage lines (Pearson, 2003). Pools of surface water are utilised for hunting whilst nearby caves, crevices and sometimes debris or tree hollows are used for shelter. During the cooler months, the pythons will shelter in caves and rock crevices, away from water (DEWHA 2008). Reproduction is dependent upon environmental factors attributing to body condition. Where conditions are optimal, eggs are laid in Spring with young hatching at the start of the wet season (Dec-Jan). Once hatched, the young will disperse whilst foraging conditions for reptiles are ideal (Pearson, 2003).

Occurrence in the Survey Areas: The Pilbara Olive Python has a Medium likelihood of occurrence in the Haul Road and Solar Farm Survey Areas as marginal suitable habitat is present in the form of Drainage Lines/Floodplains (6.3% for Haul Road and 7.7% for Solar Farm). The likelihood in the Pipeline is Low. The

lack of permanent surface water and suitable rocky gorge habitat observed during the survey indicates any populations are expected to be at low abundance or comprise of individuals dispersing through the area.

Gane's Blind Snake (*Anilios ganei*)

Conservation Status: DBCA: Priority 1.

Distribution, Habitat and Ecology: The Gane's Blind Snake is an elusive, moderately robust blind snake that lives primarily underground. Due to its subterranean lifestyle, the species is rarely recorded and relatively little is known of its ecology. The Gane's Blind Snake has a rounded snout that is greyish on the upper side and cream on the underside (Wilson and Swan, 2017). Its distribution is limited to the Pilbara region between Newman and Pannawonica (Wilson and Swan, 2017; DBCA 2021). The species is likely to enter social insect nests to feed on termite and ants, as well as their eggs and pupae. The Gane's Blind Snake is thought to be associated with moist gullies and gorges though little published information exists (Aplin, 1998b). A specimen was recorded in the Hamersley Range from a stony clay-loam valley floor vegetated with *Triodia* sp. suggesting that the species may utilize moist gullies and gorges though is not restricted to them (Ecoscape 2011).

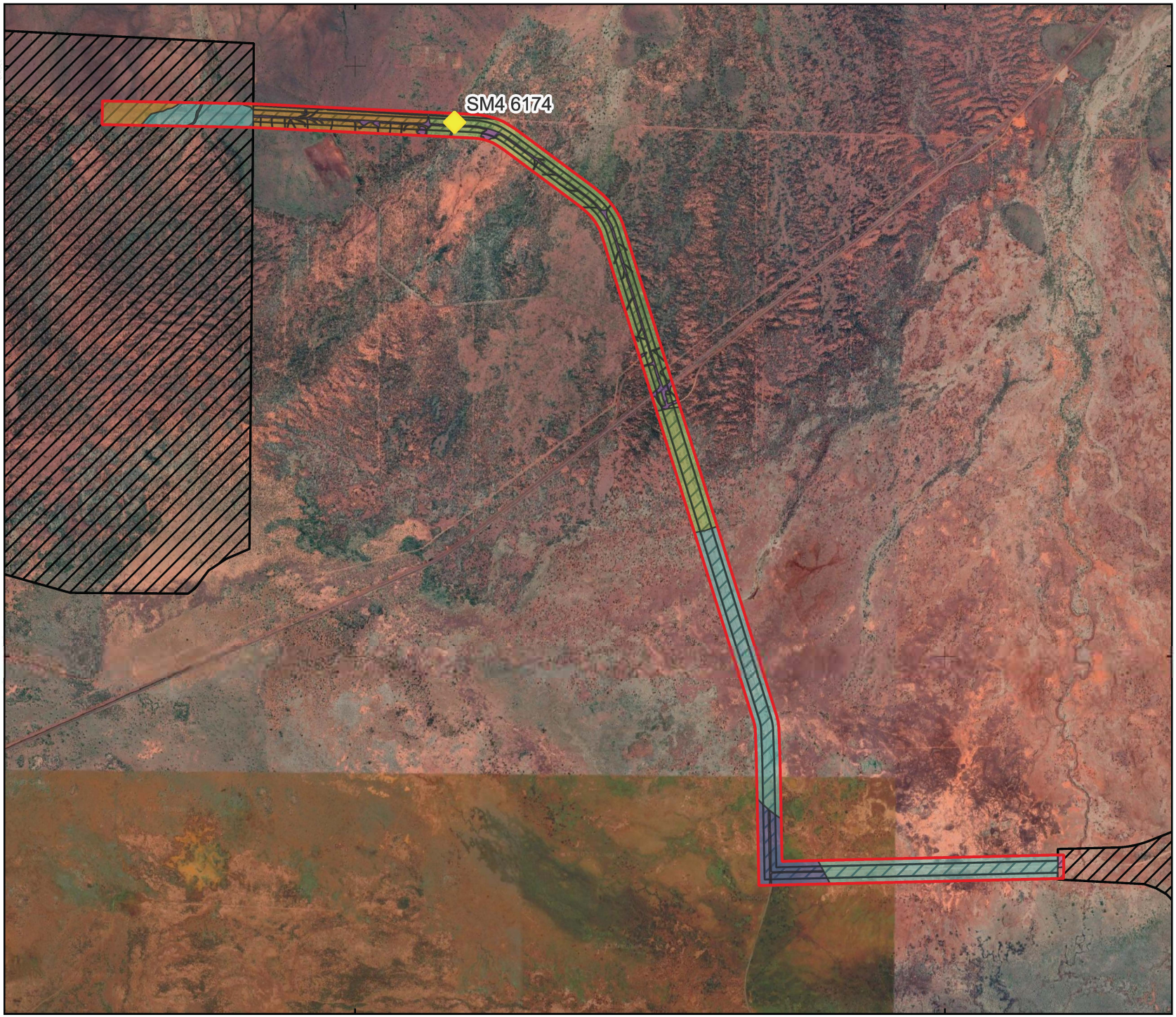
Occurrence in the Survey Areas: Gane's Blind Snake has a Medium likelihood of occurrence in the Haul Road and Solar Farm Survey Areas due to recent records within 9 km of the Survey Areas (Map 3.1) by Biologic (2022b) and Ecologia (2020). Additional records from the DBCA Threatened Fauna Database Search are located within 45 km from the Survey Areas (Map 3.1). Habitat preferences are not well known, but it has been recorded on Rocky Hills (Biologic 2022b), in Mulga Woodland (Ecologia 2020) and in gullies and gorges. Mulga Woodland represents 18.9% of the Solar Farm Survey Area while Drainage Lines/Floodplains represent 6.3% of the Haul Road and 7.7% of the Solar Farm Survey Areas. The likelihood to occur in the Pipeline is Low due to the lack of suitable habitat.

Lined Soil-crevice Skink (*Notoscincus butleri*)

Conservation Status: DBCA: Priority 4.

Distribution, Habitat and Ecology: The Lined Soil-crevice Skink is a small, pale coppery brown lizard with bold black vertebral, dorsal, and upper lateral stripes, a narrow dark ventrolateral stripe, and a white mid-lateral stripe. Historically known from the Karratha region, extensive natural resource driven environmental survey work in the Pilbara has extended its range south into the Chichester and Hamersley Ranges (Department of Biodiversity Conservation and Attractions, 2021). It is known to utilise a variety of habitats though is often found in arid, stony habitats vegetated with spinifex along creek and river margins.

Occurrence in the Survey Areas: The Lined Soil-crevice Skink has a Medium likelihood of occurrence in the Haul Road and Solar Farm Survey Areas as marginal suitable habitat is present in the form of Stony Spinifex Plains and Hillslopes (93.7% for Haul Road and 73.4% for Solar Farm) and Drainage Lines/Floodplains (6.3% for Haul Road and 7.7% for Solar Farm). However, the specific habitat requirement (rocky spinifex areas adjacent to drainage lines) of the Lined Soil-crevice Skink means that not all of the habitat extent is suitable. The skink has a Low likelihood to occur at the Pipeline.



Legend

- Pipeline
- MDIOM Development Envelope
- Pilbara Leaf-nosed Bat (calls)

Fauna Habitats

- Alluvial Clay Plain
- Chenopod/ Cracking Clay Floodplain
- Cleared/Disturbed
- Drainage Lines/ Floodplains
- Mixed Eucalypt/ Mulga Floodplain
- Mulga Woodland
- Stony Spinifex Plains and Hillslopes

N

0 0.5 1 1.5 km

Scale 1:45,000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum ECOLOGY + SPATIAL

Author: GF

Date: 08-05-2023

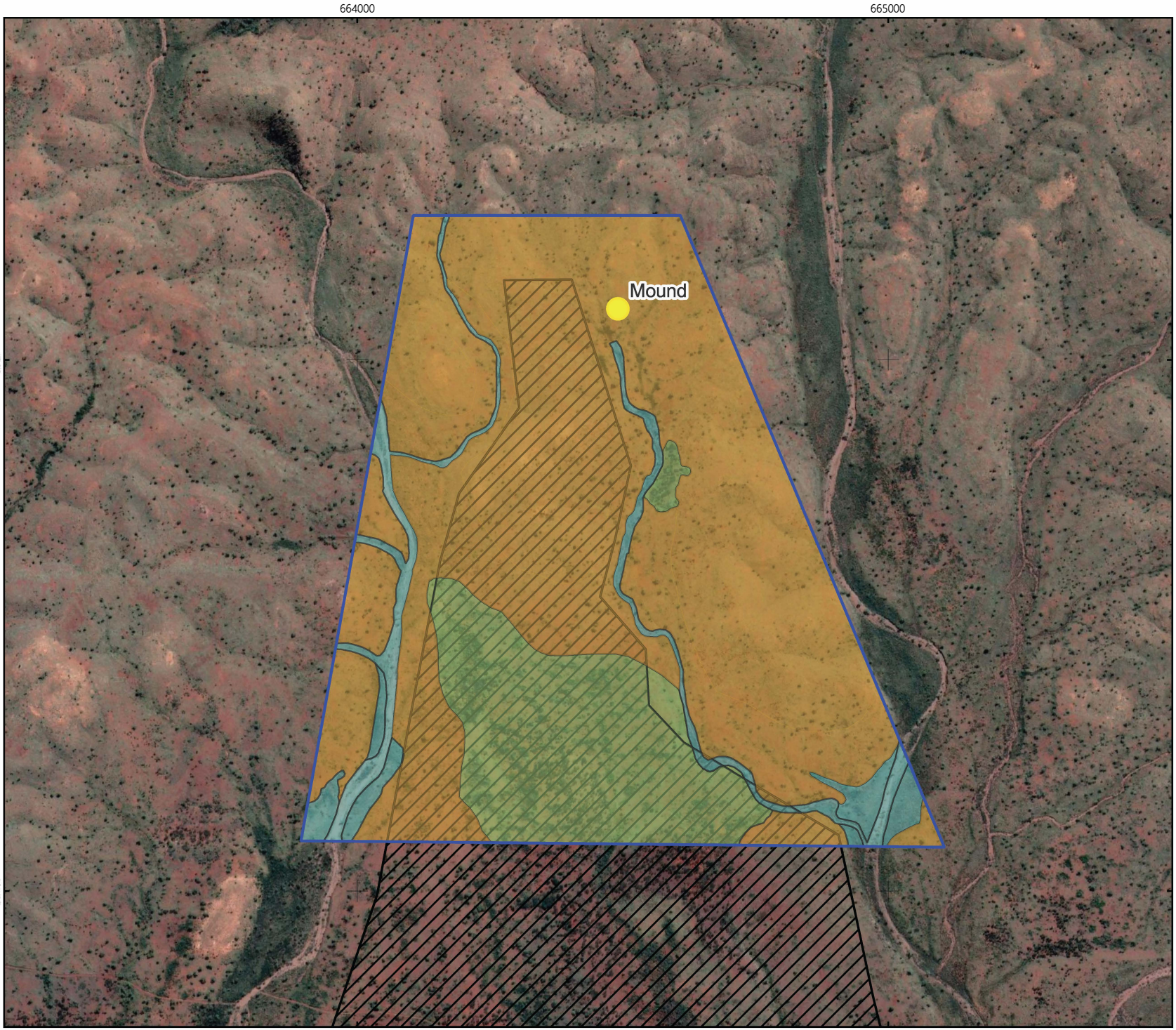
Significant Fauna Recorded - Pipeline

MDIOM Solar Farm, Haul Road & Pipeline

MAP

Prepared for
JBS&G | HPPL

3.7



Legend

- Solar Farm
- MDIOM Development Envelope
- Pebble-mound Mouse Mound Location

Fauna Habitats

- Drainage Lines/ Floodplains
- Mulga Woodland
- Stony Spinifex Plains and Hillslopes

N

0 0.2 0.4 km

Scale 1:10,000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum ECOLOGY • SPATIAL

Author: GF

Date: 08-05-2023

Significant Fauna Recorded - Solar Farm

MDIOM Solar Farm, Haul Road & Pipeline

MAP

Prepared for
JBS&G | HPPL

3.8

3.2.4. SRE Invertebrate Fauna

3.2.4.1. SRE Fauna Assemblage & Habitat

During this assessment, 69 specimens were collected from 10 invertebrate taxa, which were determined to include seven potential SRE taxa according to the categorisations outlined in Table 2.8 and shown on Map 3.9. The potential SRE taxa consisted of one scorpion, three pseudoscorpions, two isopods and one snail.

As is typical for SRE data, six taxa were recorded in very low abundance, being represented by one or two specimens. This significantly limits the ability to determine the distribution and habitat preferences of these species. All taxa recorded are summarised in Table 3.9 and described in further detail in Sections 3.2.5.1 to 3.2.5.5.

Although all the habitat types recorded in the Survey Areas may provide microhabitats for SRE species, only four of the six recorded potential SRE specimens: Mulga Woodland, Stony Spinifex Plains and Hillslopes, Drainage Lines/Floodplains, Alluvial Clay Plain. Most of the specimens were collected in Mulga Woodland (Table 3.9).

The majority of the collected specimens were determined to represent an SRE due to the lack of taxonomic resolution, and not because they were recorded from restricted habitats.

In order to better clarify taxonomic status and compare with regional records and the known distributions of potential SRE species, DNA sequence analysis was completed for 21 specimens. All were successful in producing conclusive results.

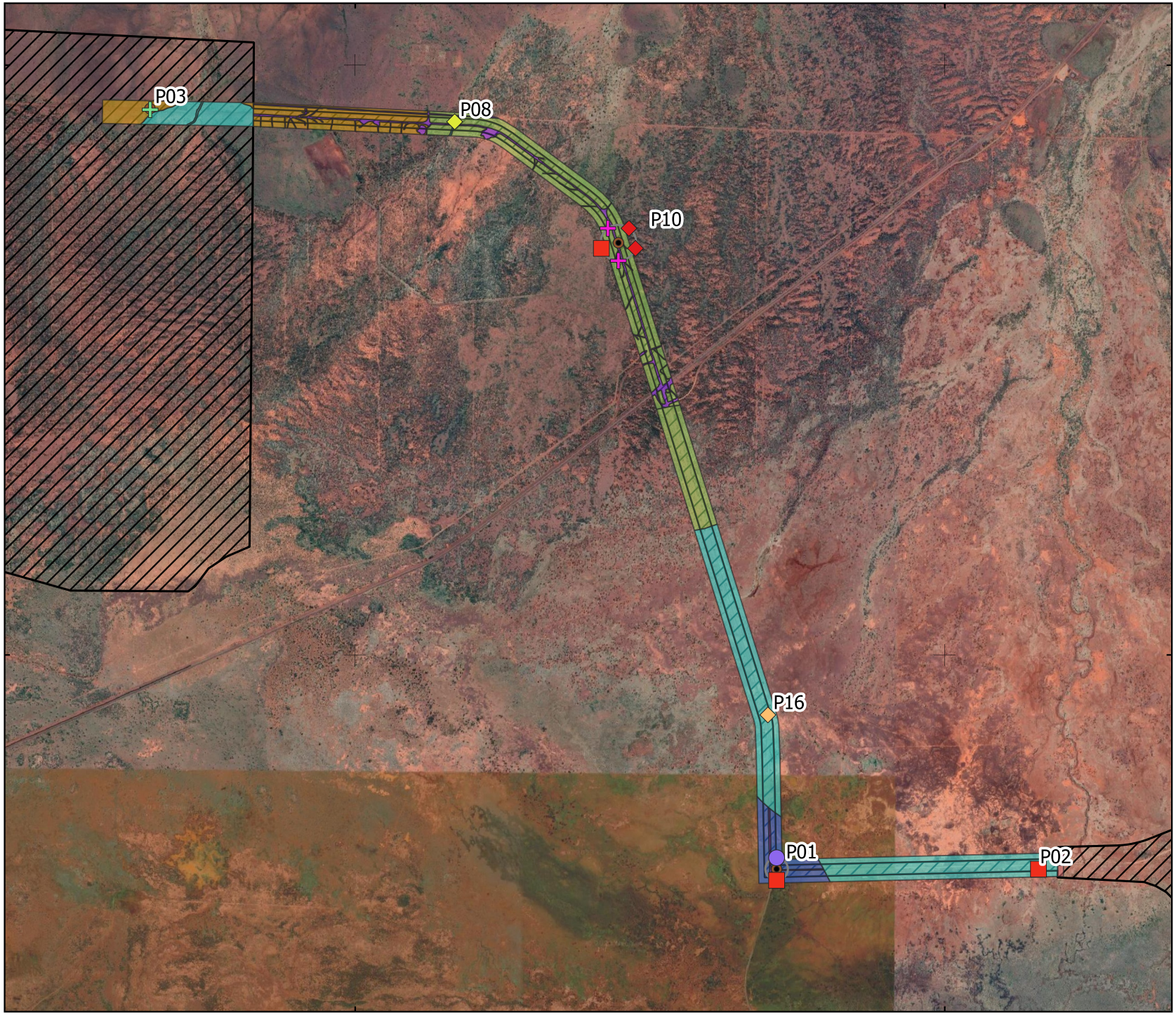
Table 3.9: SRE Target Group Invertebrates Recorded from the Survey Areas

Class/Order/Family	Species/Taxa	Sites	Collection Method	Abundance	Habitat	Comments	DNA Analysed#	SRE Status
Arachnida								
Scorpiones								
Buthidae	*Lychas* `sp. SCO024`	P01, P02, P10	Leaf Litter Sieving, Hand Collected	3	MW, DL/F, ACP	P02 was located in Alluvial Clay Plain which was classed as DL/F^ to match adjacent habitat types (ecologia 2020a; Biologic 2022b, 2022a).	Yes	Potential
Pseudoscorpiones								
Atemnidae	*Anatemnus* `sp. Biologic-PSEU081`	P10	Leaf Litter Collection	1	MW		Yes	Not SRE
Olpiidae	*Beierolpium* sp. PSE173	P16	Leaf Litter Sieving	1	DL/F		Yes	Potential
	Indolpium `sp. Biologic-PSEU079`	P10, HL01, HL06, HL10, HL11, SF04, SF11, SF12, SF15	Leaf Litter Collection, Leaf Litter Sieving, Hand Collected	14	DL/F, MW, SSP&H	HL sites were located in Mulga Woodland, which were classed as SSP&H^ to match adjacent habitats (ecologia 2020a; Biologic 2022b, 2022a).	Yes	Potential
	Indolpium sp. indet	P08, HL01, HL06, HL10, HL11, SF02, SF04, SF10, SF11, SF15	Leaf Litter	37	DL/F, MW, SSP&H		No	Potential

Class/Order/Family	Species/Taxa	Sites	Collection Method	Abundance	Habitat	Comments	DNA Analysed#	SRE Status
Isopoda								
Armadillidae	*Buddelundia* `sp. SJ_14FMa_DNA`	P03	Leaf Litter Sieving	1	SSP&H	P03 was located in Low Lying Depression (water present), which was classed/mapped as SSP&H^ to match adjacent habitats (ecologia 2020a; Biologic 2022b, 2022a)..	Yes	Potential
	Buddelundia `sp. SJ_15MD_DNA`	P10	Leaf Litter Sieving, Hand Collected	2	MW		Yes	Potential
Gastropoda (Snails)								
Pupillidae	*Pupoides* sp. indet.	HL11, SF11, SF15	Leaf Litter Collection, Leaf Litter Sieving	8	MW, SSP&H	No visible tissue in some of the shells HL11 was located in Mulga Woodland, which was classed as SSP&H^ to match adjacent habitat types (ecologia 2020a; Biologic 2022b, 2022a).	No	Not SRE
Succineidae	*Succinea* sp. indet.	P01	Leaf Litter Sieving	1	ACP	No visible tissue	No	Potential
Diplopoda (Millipedes)								
Trigoniulidae	*Austrostrophus* ` sp. Biologic-DIPL004`	SF10	Leaf Litter Sieving	1	MW		Yes	Not SRE

"No" indicates that the species was not sequenced, "Yes" indicates that the taxa was sequenced.

^ Habitat types were amended to match previous mapping completed by other consultants (ecologia 2020a; Biologic 2022b, 2022a).in adjacent and/or overlapping areas.



Legend

- Pipeline
- MDIOM Development Envelope

Potential SRE Species

- Lychas sp. SCO024
- Beierolpium sp. PSE173
- Indolpium `sp. Biologic-PSEU079`
- Indolpium sp. indet
- Buddelundia `sp. SJ_14FMa_DNA`
- Buddelundia `sp. SJ_15MD_DNA`
- Succinea sp. indet.

Fauna Habitats

- Alluvial Clay Plain
- Chenopod/ Cracking Clay Floodplain
- Cleared/Disturbed
- Drainage Lines/ Floodplains
- Mixed Eucalypt/ Mulga Floodplain
- Mulga Woodland
- Stony Spinifex Plains and Hillslopes

N

0 0.5 1 1.5 km

Scale 1:45,000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum ECOLOGY • SPATIAL

Author: EM

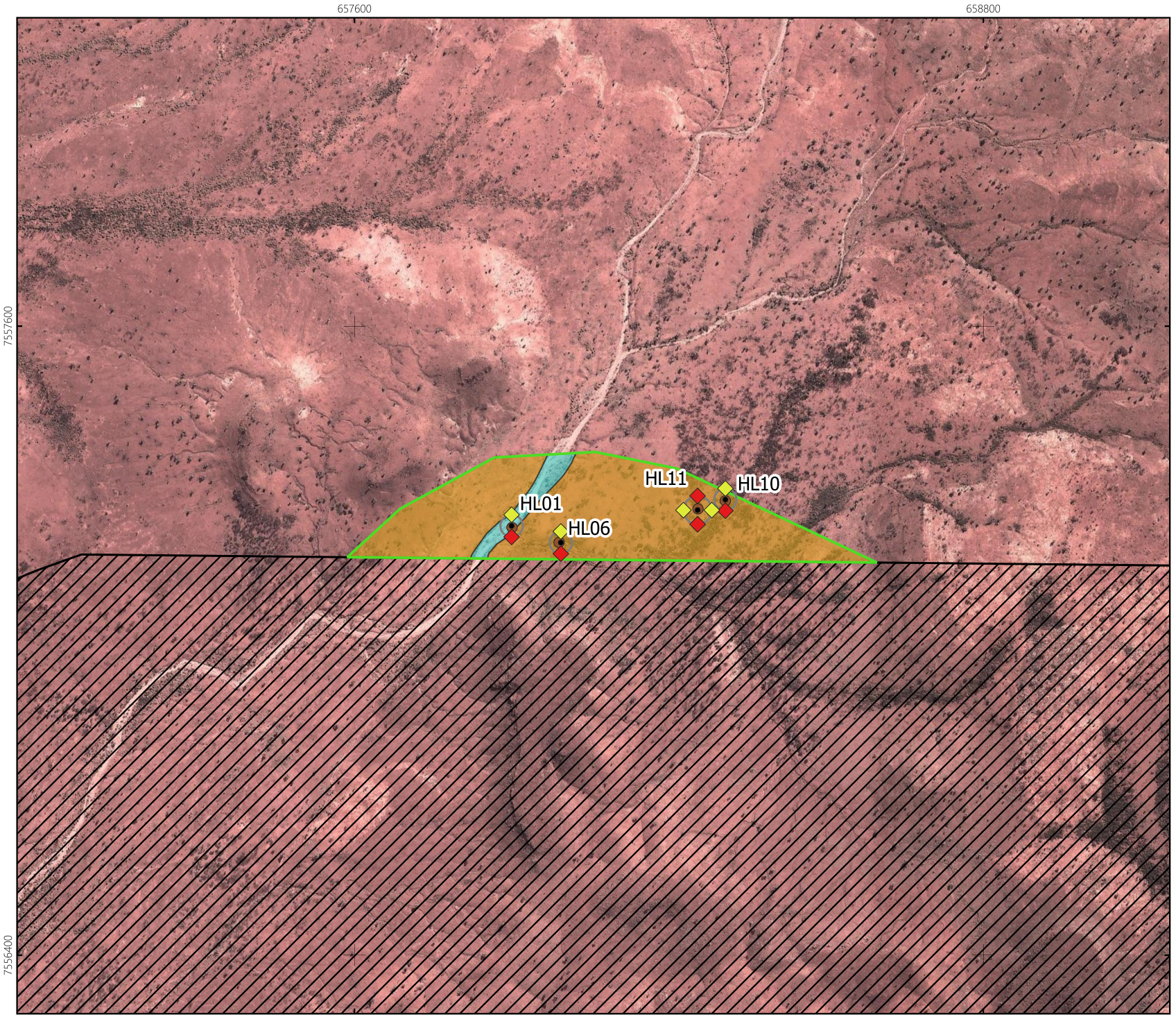
Date: 14-05-2023

Potential SREs Recorded - Pipeline

MDIOM Solar Farm, Haul Road & Pipeline

MAP 3.9

Prepared for
JBS&G | HPPL



Legend

- Haul Road
- MDIOM Development Envelope

Potential SRE Species

- Indolpium `sp. Biologic-PSEU079`
- Indolpium sp. indet

Fauna Habitats

- Drainage Lines/ Floodplains
- Stony Spinifex Plains and Hillslopes

N

0 0.2 0.4 km

Scale 1:10,000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum ECOLOGY • SPATIAL

Author: EM

Date: 14-05-2023

Potential SREs Recorded - Haul Road

MDIOM Solar Farm, Haul Road & Pipeline

MAP

Prepared for
JBS&G | HPPL

3.10

Legend

- Solar Farm
- MDIOM Development Envelope

Potential SREs Species

- Indolpium `sp. Biologic-PSEU079`
- Indolpium sp. indet
- Austrostrophus ` sp. Biologic-DIPL004

Fauna Habitats

- Drainage Lines/ Floodplains
- Mulga Woodland
- Stony Spinifex Plains and Hillslopes

N

0 0.2 0.4 km

Scale 1:10,000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum ECOLOGY • SPATIAL

Author: EM

Date: 14-05-2023

Potential SREs Recorded - Solar Farm

MDIOM Solar Farm, Haul Road & Pipeline

MAP

Prepared for
JBS&G | HPPL

3.11

3.2.5. SRE Target Taxa Recorded

3.2.5.1. Scorpiones

Lychas `sp. SCO024'.

Category: Potential SRE

Three specimens were collected by either leaf litter sieving or collection at three sites, P01, P02 and P10, in the Pipeline Survey Area. The three sites were located in Mulga Woodland, Alluvial Clay Plain or Drainage Line/ Floodplain habitat. The species belonging to the *Lychas* genus are generally considered a widespread, although, identification can often be challenging. All three individuals belonging to this operational taxonomic unit (OTU) was sent for DNA sequencing and have been assigned the phrase name *Lychas* `sp. SCO024'. This *Lychas* OTU closely matched sequences from previously collected specimens from the area (Spectrum Ecology, 2022) at a 1-2% difference. This OTU has only been collected in the Mulga Downs area, with a linear range of approximately 50 km. Further work is required for this genus as many of the 'species' are considered to be complexes of multiple species. Currently, all *Lychas* are considered Potential SREs.

3.2.5.2. Pseudoscorpiones

Anatemnus `sp. Biologic-PSEU081`.

Category: Not SRE

One specimen was collected from leaf litter in the Pipeline Survey Area from P10 in Mulga Woodland habitat. Species belonging to the Atemnidae family are generally considered widespread (Mark Harvey pers. comm). This specimen was sent off for DNA sequencing, and matched the sequences for *Anatemnus* `sp. Biologic-PSEU081`, found in the Mulga Downs area at 1-2% (Biologic Environmental Survey, 2022a; Spectrum Ecology, 2022), and also matched sequences from over 280 km away. Due to specimens in this family generally being considered widespread, it is unlikely that these specimens are considered SREs.

Beierolpium sp. PSE173

Category: Potential SRE

One specimen was collected from sieving leaf litter at P16, located in the Pipeline Survey Area in Drainage Line/Floodplain habitat. DNA sequencing was completed for this specimen. This specmen matched a sequence from Mulga Downs (ecologia Environment, 2020b). Olpiids are the most common and abundant family, and some occur in extremely exposed and hot habitats. There is currently no taxonomic framework beyond genus level for this family and advice is that the likelihood for short-range endemism is low, partly due to an expectation of very high diversity. However, as there are only two records for this OTU, it is considered a potential SRE.

Indolpium `sp. Biologic-PSEU079` & *Indolpium* sp. indet

Category: Potential SRE

Fifty-one specimens were collected from twelve sites and three collection methods from all three Survey Areas. The 12 sites were represented by three habitat types: Mulga Woodland, Drainage Line/ Floodplain and Stony Spinifex Plains and Hillslopes. Olpiidae is the most common and abundant family of Pseudoscorpions. Some of these species occur in extremely exposed and hot habitats. Fourteen specimens were sequenced and matched a sequence from Mulga Downs (Biologic Environmental Survey, 2022a), at a 1-3% difference. The additional 37 specimens were collected at the same sites or nearby to those sequenced and likely represent the same OTU. However, as they were not sequenced they are designated *Indolpium* sp. Indet. *Indolpium* `sp. Biologic-PSEU079` appears to be locally widespread, however, as there are no results beyond Mulga Downs, it remains a Potential SRE species.

3.2.5.3. Isopoda

Buddelundia `sp. SJ_14FMa_DNA`.

Category: Potential SRE

A single specimen was collected from leaf litter sieving at P03 in Stony Spinifex Plains and Hillslopes habitat. This is a relatively common type of *Buddelundia* found in the Pilbara region. *Buddelundia* 14FM is known from the Fortescue Marsh area. Erich Volschenk recently sequenced *Buddelundia* 14FM from a nearby project and the results suggest that this morphospecies represents up to four species. This specimen was DNA sequenced, and matched others collected from the Mulga Downs area (Biologic Environmental Survey, 2022a). The species currently has a linear range of 77 km. This taxon is considered a potential SRE.

Buddelundia `sp. SJ_15MD_DNA`.

Category: Potential SRE

Two specimens were collected by two methods at site P10, in the Mulga Woodland habitat type. Buddelundia 15 is an established morphospecies found in the Hamersley IBRA subregion. Buddelundia `15MD` differs in various characters from Buddelundia 15 and has been assigned its own species number. Specimens matched sequences for Buddelundia `sp. SJ_15MD_DNA`from Mulga Downs at only 3-4% difference (Biologic Environmental Survey, 2022a) .Buddelundia `15MD` is well recorded in the Mulga Downs area, with a 66 km linear range (ecologia Environment, 2020b). However, it is still considered a Potential SRE as it has not been recorded outside Mulga Downs.

3.2.5.4. Gastropoda

Pupoides sp. indet

Category: Not SRE

Eight specimens were collected from three sites, at the Haul Road (HL11) and Solar Farm Survey Areas (SF11 & SF15), located in Mulga Woodland and Stony Spinifex Plains and Hillslopes habitat. Snails from this genus are not considered to have SRE potential, so are considered widespread in the Pilbara region.

Succinea sp. indet

Category: Potential SRE

A single specimen was collected from leaf litter sieving at P01 located in Alluvial Clay Plain Habitat within the Pipeline Survey Area. Species in this genus can be short-ranging, however, a live specimen or residual tissue is required to assist identification further. Therefore, this specimen is a potential SRE.

3.2.5.5. Diplopoda

Austrostrophus ` sp. Biologic-DIPL004`

Category: Not SRE

The genus *Austrostrophus* was previously thought to contain only one species (*Austrostrophus stictopygus*), however, it has recently been shown to contain multiple distinct lineages. Recent sequencing work on *Austrostrophus* specimens at West Angeles yielded five clades (genetic groupings). One specimen from this current survey was sequenced and matched to publicly available sequences (~4.5% difference). This specimen was given the OTU name *Austrostrophus* `sp. Biologic-DPLO004`. The matched specimen was recorded from the Burrup Peninsula, over 200 km away. It is possible this specimen represents the widespread *Austrostrphus stictopygus* species, however, a sequence for the type specimen has not been generated and hence cannot be compared. This taxon is regarded as widespread.

4. CONCLUSION

4.1. Fauna Habitats

Six fauna habitats were recorded from the Survey Areas, and included:

- Stony Spinifex Plains and Hillslopes;
- Mulga Woodland;
- Alluvial Clay Plain;
- Chenopod/Cracking Clay Floodplain;
- Mixed Eucalypt/Mulga Floodplain; and
- Drainage Lines/Floodplains.

None of these habitat types were restricted to the Survey Area and were well represented elsewhere in the region (ecologia 2020a; Biologic 2022b, 2022a). All of these habitats may contain microhabitats that host species from SRE target groups.

4.2. Vertebrate Fauna

A total of 63 vertebrate fauna species were recorded during the survey and, including one species of native non-volant mammal (observed via secondary evidence), seven native volant mammals, four introduced mammals, 46 bird species, and five reptiles. The Pipeline Survey Area recorded 57 species, while the Haul Road and Solar Farm recorded 19, and 21, respectively. This included two species of conservation significance:

- Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*; EPBC & BC Act Vulnerable) was recorded foraging in the Pipeline Survey Area; and
- Western Pebble-mound Mouse (DBCA Priority 4) was recorded from secondary evidence (old disused mound) in the Solar Farm Survey Area.

An additional 24 species of conservation significant vertebrate fauna have a Medium to High likelihood of occurrence in the Survey Areas, none of which are likely to be restricted to the Survey Areas.

4.3. SRE Fauna

A total of 69 invertebrate specimens were collected from 10 invertebrate taxa, which included seven potential SRE taxa. The potential SRE taxa included one scorpion, three pseudoscorpions, two isopods and one snail. The majority of the specimens were collected from Mulga Woodland habitat, with the remainder in Drainage Lines/Floodplains, Stony Spinifex Plains and Hillslopes and Alluvial Clay Plain. None of these habitats are restricted to the Survey Areas, which indicates SRE species that occur within the Survey Areas, could also occur outside.

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Appendix A: Conservation Codes

Appendix A1: Definitions of Conservation Categories under the EPBC Act

Category	Definition
Extinct	A native species is eligible to be included in the extinct category at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.
Extinct in the Wild	A native species is eligible to be included in the extinct in the wild category at a particular time if, at that time: (a) it is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or (b) it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
Critically Endangered	A native species is eligible to be included in the critically endangered category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
Endangered	A native species is eligible to be included in the endangered category at a particular time if, at that time: (a) it is not critically endangered; and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
Vulnerable	A native species is eligible to be included in the vulnerable category at a particular time if, at that time: (a) it is not critically endangered or endangered; and (b) it is facing a high risk of extinction in the wild in the medium term future, as determined in accordance with the prescribed criteria.
Conservation Dependent	A native species is eligible to be included in the conservation dependent category at a particular time if, at that time: (a) the species is the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered, or critically endangered; or (b) the following subparagraphs are satisfied: (i) the species is a species of fish; (ii) the species is the focus of a plan of management that provides for management actions necessary to stop the decline of, and support the recovery of, the species so that its chances of long term survival in nature are maximised; (iii) the plan of management is in force under a law of the Commonwealth or of a State or Territory; (iv) cessation of the plan of management would adversely affect the conservation status of the species.

Appendix A2: Definitions of Conservation Categories Under the BC Act

Code	Definition (BC Act)
Threatened Species (T) Listed by order of the Minister as Threatened in the category of critically endangered, endangered or vulnerable under section 19(1), or is a rediscovered species to be regarded as threatened species under section 26(2) of the Biodiversity Conservation Act 2016 (BC Act). **Threatened fauna** is that subset of 'Specially Protected Fauna' listed under schedules 1 to 3 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for Threatened Fauna. **Threatened flora** is that subset of 'Rare Flora' listed under schedules 1 to 3 of the Wildlife Conservation (Rare Flora) Notice 2018 for Threatened Flora. The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria as detailed below.	
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 the criteria set out in section 20 and the ministerial guidelines. Published under **schedule 1** of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for critically endangered fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for critically endangered flora.
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. Published under **schedule 2** of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for endangered fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for endangered flora.
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. Published under **schedule 3** of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for vulnerable fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for vulnerable flora.
Extinct species Listed by order of the Minister as extinct under section 23(1) of the BC Act as extinct or extinct in the wild.	

Code	Definition (BC Act)
Extinct species (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). Published as presumed extinct under **schedule 4** of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for extinct fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for extinct flora.
Extinct in the wild species (EW)	Species that "is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; and it has not been recorded in its known habitat or expected habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its life cycle and form", and listing is otherwise in accordance with the ministerial guidelines (section 25 of the BC Act). Currently there are no threatened fauna or threatened flora species listed as extinct in the wild. If listing of a species as extinct in the wild occurs, then a schedule will be added to the applicable notice.
Specially protected species Listed by order of the Minister as specially protected under section 13(1) of the BC Act. Meeting 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 species (critically endangered, endangered or vulnerable) or extinct species under the BC Act cannot also be listed as Specially Protected species.	
Migratory species (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. Published as migratory birds protected under an international agreement under **schedule 5** of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.
Conservation Dependent (CD)	Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened, and listing is otherwise in accordance with the ministerial guidelines (section 14 of the BC Act). Published as conservation dependent fauna under **schedule 6** of the Wildlife Conservation (Specially Protected Fauna) Notice 2018
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). Published as other specially protected fauna under **schedule 7** of the Wildlife Conservation (Specially Protected Fauna) Notice 2018
Priority species (P) Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened fauna or flora. 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.	
Priority 1: Poorly-known species (P1)	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 species (P2)	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.

Code	Definition (BC Act)
Priority 3: Poorly-known species (P3)	Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.
Priority 4: Rare, Near Threatened and other species in need of monitoring (P4)	(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands. (b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as Conservation Dependent. (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

Appendix B: Regional Fauna Appendix

Family & Scientific Name	Common Name	Conservation Status			Database Searches				Literature Review									This survey
		EPBC Act	BC Act	DBCA	DBCA	NatureMap	PMST	Atlas of Living Australia	Terrestrial Ecosystems (2013)	Biota (2004)	Ecologia (2020)	Ecologia (2011)	Ecologia (2014)	Ecologia (2009)	ENV (2012)	Spectrum (2022)	Biologic (2022)	
MAMMALS																		
TACHYGLOSSIDAE																		
Tachyglossus aculeatus	Short-beaked Echidna									•	•	S				•		
DASYUIRIDAE																		
Dasycercus blythi	Brush-tailed Mulgara		P4		•	•												
Dasykaluta rosamondae	Kaluta					•				•	•	•	•	•			•	
Dasyurus hallucatus	Northern Quoll	EN	EN		•	•	•			•	•						S	
Ningaui ridei	Wongai Ningaui									•								
Ningaui timealeyi	Pilbara Ningaui					•			•	•	•	•	•				•	
Planigale ingrami	Long-tailed Planigale					•												
Pseudantechinus woolleyae	Woolley's Pseudantechinus					•												
Sminthopsis macroura	Stripe-faced Dunnart					•			•	•	•	•	•	•			•	
Sminthopsis youngsoni	Lesser Hairy-footed Dunnart									•				•				
THYLACOMYIDAE																		
Macrotis lagotis	Bilby	VU	VU		•	•	•											
PHALANGERIDAE																		
Trichosurus vulpecula arnhemensis	Northern Brushtail Possum (Pilbara Form)					•												

Family & Scientific Name	Common Name	Conservation Status			Database Searches				Literature Review									This survey
		EPBC Act	BC Act	DBCA	DBCA	NatureMap	PMST	Atlas of Living Australia	Terrestrial Ecosystems (2013)	Biota (2004)	Ecologia (2020)	Ecologia (2011)	Ecologia (2014)	Ecologia (2009)	ENV (2012)	Spectrum (2022)	Biologic (2022)	
MACROPODIDAE																		
Lagorchestes conspicillatus leichardti	Spectacled Hare-wallaby			P3	•													
Osphranter robustus	Euro, Biggada					•				•	•	•	•			•		
Osphranter rufus	Red Kangaroo					•					•	•	•	•		•	•	
Petrogale rothschildi	Rothschild's Rock-wallaby					•				•		•						
MURIDAE																		
Notomys alexis	Spinifex Hopping-mouse													•				
Leggadina lakedownensis	Short-tailed Mouse			P4	•	•				•		•	•				•	
Pseudomys chapmani	Western Pebble-mound Mouse			P4	•	•			S			•	S		S	S	S	S
Pseudomys delicatulus	Delicate Mouse					•												
Pseudomys desertor	Desert Mouse					•			•	•	•		•	•				
Pseudomys hermannsburgensis	Sandy Inland Mouse					•		•	•	•		•	•	•				
Zyzomys argurus	Common Rock-rat					•			•	•	•							
PTEROPODIDAE																		

Family & Scientific Name	Common Name	Conservation Status			Database Searches				Literature Review									This survey
		EPBC Act	BC Act	DBCA	DBCA	NatureMap	PMST	Atlas of Living Australia	Terrestrial Ecosystems (2013)	Biota (2004)	Ecologia (2020)	Ecologia (2011)	Ecologia (2014)	Ecologia (2009)	ENV (2012)	Spectrum (2022)	Biologic (2022)	
Pteropus alecto gouldii	Black Flying-fox					•							•					
RHINONYCTERIDAE																		
Rhinonicteris aurantia	Pilbara Leaf-nosed bat	VU	VU		•	•	•				•						•	
MEGADERMATIDAE																		
Macroderma gigas	Ghost Bat	VU	VU		•	•	•				•							
EMBALLONURIDAE																		
Saccolaimus flaviventris	Yellow-bellied Sheath-tailed Bat					•			•		•	•	•	•	•	•	•	
Taphozous georgianus	Common Sheath-tailed Bat					•			•		**	•		•	•	•	•	
Taphozous hilli	Hill's Sheath-tailed Bat					•					**			•			•	
MOLOSSINAE																		
Austronomus australis	White-striped Free-tailed Bat					•			•		•	•	•	•	•			
Chaerephon jobensis	Greater Northern Free-tailed Bat					•			•		•	•		•	•	•	•	
Ozimops lumsdenae	Northern Free-tailed Bat								•		•	•	•	•				
VESPERTILIONIDAE																		
Chalinolobus gouldii	Gould's Wattled Bat					•			•		•	•	•	•	•	•	•	

Family & Scientific Name	Common Name	Conservation Status			Database Searches				Literature Review									This survey
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Nyctophilus daedalus	Pallid Long-eared Bat								•			•		•	•	NC		
Nyctophilus geoffroyi	Lesser Long-eared Bat					•			•		•	•		•	•	NC		
Scotorepens greyii	Little Broad-nosed Bat					•			•		•	•	•	•	•	•	•	
Vespadelus finlaysoni	Finlayson's Cave Bat					•			•		•	•	•	•	•	•	•	
CANIDAE																		
**Canis familiaris*	Dog/Dingo						•			•	•	•	•	•		•	•	S
FELIDAE																		
**Felis catus*	Cat					•	•			•	•	•	•	•		•	•	•
EQUIDAE																		
**Equus ferus asinus*	Donkey					•	•			•		•	•					
**Equus ferus caballus*	Horse					•	•							•		•		
CAMELIDAE																		
**Camelus dromedarius*	Dromedary, Camel					•	•			•		•						
BOVIDAE																		
**Bos primigenius taurus*	European Cattle					•					•	•	•	•	•	•	•	•
MURIDAE																		
**Mus musculus*	House Mouse					•	•		•	•				•	•			
LEPORIDAE																		
**Oryctolagus cuniculus*	Rabbit					•	•							•				S

Family & Scientific Name	Common Name	Conservation Status			Database Searches				Literature Review									This survey
		EPBC Act	BC Act	DBCA	DBCA	NatureMap	PMST	Atlas of Living Australia	Terrestrial Ecosystems (2013)	Biota (2004)	Ecologia (2020)	Ecologia (2011)	Ecologia (2014)	Ecologia (2009)	ENV (2012)	Spectrum (2022)	Biologic (2022)	
BIRDS																		
CASUARIIDAE																		
Dromaius novaehollandiae	Emu					•		•	•	•	•			•			•	
ANATIDAE																		
Dendrocygna eytoni	Plumed Whistling-Duck					•			•						•		•	
Cygnus atratus	Black Swan					•		•										
Stictonetta naevos	Freckled Duck					•		•			•							
Tadorna tadornoides	Australian Shelduck					•		•										
Malacorhynchus membranaceus	Pink-eared Duck					•		•			•							
Chenonetta jubata	Australian Wood Duck					•		•						•				
Anas superciliosa	Pacific Black Duck					•		•		•					•			•
Anas gracilis	Grey Teal					•		•	•		•							
Aythya australis	Hardhead					•		•										
PHASIANIDAE																		
Coturnix ypsilophora	Brown Quail					•			•				•	•	•		•	
Coturnix pectoralis	Stubble Quail					•												

Family & Scientific Name	Common Name	Conservation Status			Database Searches				Literature Review									This survey
		EPBC Act	BC Act	DBCA	DBCA	NatureMap	PMST	Atlas of Living Australia	Terrestrial Ecosystems (2013)	Biota (2004)	Ecologia (2020)	Ecologia (2011)	Ecologia (2014)	Ecologia (2009)	ENV (2012)	Spectrum (2022)	Biologic (2022)	
PODARGIDAE																		
Podargus strigoides	Tawny Frogmouth					•		•	•	•		•		•				
CAPRIMULGIDAE																		
Eurostopodus argus	Spotted Nightjar					•		•	•			•		•		•	•	
AEGOTHELIDAE																		
Aegotheles cristatus	Australian Owlet-nightjar					•		•	•		•	•	•			•	•	
APODIDAE																		
Apus pacificus	Pacific Swift (Fork-tailed Swift)	MI	MI		•	•	•			•								
OTIDIDAE																		
Ardeotis australis	Australian Bustard					•		•	•	•	•	•	•	•	•	•	•	•
CUCULIDAE																		
Centropus phasianinus	Pheasant Coucal					•		•						•		•		
Chalcites basalis	Horsfield's Bronze-Cuckoo					•				•	•			•			•	
Chalcites osculans	Black-eared Cuckoo						•	•			•				•		•	
Cacomantis pallidus	Pallid Cuckoo					•		•		•	•			•	•		•	
COLUMBIDAE																		

Family & Scientific Name	Common Name	Conservation Status			Database Searches				Literature Review									This survey
		EPBC Act	BC Act	DBCA	DBCA	NatureMap	PMST	Atlas of Living Australia	Terrestrial Ecosystems (2013)	Biota (2004)	Ecologia (2020)	Ecologia (2011)	Ecologia (2014)	Ecologia (2009)	ENV (2012)	Spectrum (2022)	Biologic (2022)	
Phaps chalcoptera	Common Bronzewing					•		•	•		•	•	•	•	•	•	•	
Ocyphaps lophotes	Crested Pigeon					•		•	•	•	•	•	•	•	•	•	•	•
Geophaps plumifera	Spinifex Pigeon					•		•		•	•			•	•	•	•	•
Geopelia cuneata	Diamond Dove					•		•	•	•	•	•	•	•	•		•	
Geopelia striata	Peaceful Dove					•		•	•		•	•	•					
RALLIDAE																		
Gallirallus philippensis	Buff-banded Rail					•												
Tribonyx ventralis	Black-tailed Native-hen					•			•									
Fulica atra	Eurasian Coot					•		•							•			
Porphyrio melanotus	Australasian Swamphen					•												
Porzana tabuensis	Spotless Crake					•												
PODICIPEDIDAE																		
Tachybaptus novaehollandiae	Australasian Grebe					•		•										
Poliocephalus poliocephalus	Hoary-headed Grebe					•												
TURNICIDAE																		

Family & Scientific Name	Common Name	Conservation Status			Database Searches				Literature Review									This survey
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Turnix velox	Little Button-quail					•		•	•	•	•		•	•	•	•		•
BURHINIDAE																		
Burhinus grallarius	Bush Stone-curlew					•		•	•			•					•	
RECURVIROSTRIDAE																		
Himantopus himantopus	Black-winged Stilt					•		•			•							
Recurvirostra novaehollandiae	Red-necked Avocet							•			•							
CHARADRIIDAE																		
Vanellus tricolor	Banded Lapwing														•			
Vanellus miles	Masked Lapwing					•		•										
Erythrogonys cinctus	Red-kneed Dotterel					•		•		•	•							
Charadrius ruficapillus	Red-capped Plover					•		•			•							
Charadrius veredus	Oriental Plover	MI	MI				•											
Elseyornis melanops	Black-fronted Dotterel					•		•			•		•		•			
ROSTRATULIDAE																		
Rostratula australis	Australian Painted Snipe	EN	EN				•											
SCOLOPACIDAE																		

Family & Scientific Name	Common Name	Conservation Status			Database Searches				Literature Review									This survey
		EPBC Act	BC Act	DBCA	DBCA	NatureMap	PMST	Atlas of Living Australia	Terrestrial Ecosystems (2013)	Biota (2004)	Ecologia (2020)	Ecologia (2011)	Ecologia (2014)	Ecologia (2009)	ENV (2012)	Spectrum (2022)	Biologic (2022)	
Calidris acuminata	Sharp-tailed Sandpiper	MI	MI				•											
Calidris ferruginea	Curlew Sandpiper	CR & MI	CR				•											
Calidris ruficollis	Red-necked Stint	MI	MI					•			•							
Calidris melanotos	Pectoral Sandpiper	MI	MI				•											
Actitis hypoleucos	Common Sandpiper	MI	MI		•		•											
Tringa glareola	Wood Sandpiper	MI	MI		•			•			•							
Tringa nebularia	Common Greenshank	MI	MI		•			•			•							
GLAREOLIDAE																		
Glareola maldivarum	Oriental Pratincole	MI	MI				•											
LARIDAE																		
Gelochelidon nilotica	Gull-billed Tern	MI	MI		•	•		•										
Hydroprogne caspia	Caspian Tern	MI	MI		•	•												
Sternula albifrons	Little Tern	MI	MI		•	•												
Chlidonias hybrida	Whiskered Tern					•												
CICONIIDAE																		

Family & Scientific Name	Common Name	Conservation Status			Database Searches				Literature Review									This survey
		EPBC Act	BC Act	DBCA	DBCA	NatureMap	PMST	Atlas of Living Australia	Terrestrial Ecosystems (2013)	Biota (2004)	Ecologia (2020)	Ecologia (2011)	Ecologia (2014)	Ecologia (2009)	ENV (2012)	Spectrum (2022)	Biologic (2022)	
Ephippiorhynchus asiaticus	Black-necked Stork					•		•		•								
ANHINGIDAE																		
Anhinga novaehollandiae	Australasian Darter					•		•										
PHALACROCORACIDAE																		
Microcarbo melanoleucos	Little Pied Cormorant					•		•										
Phalacrocorax varius	Great Pied Cormorant					•												
Phalacrocorax sulcirostris	Little Black Cormorant					•		•										
Phalacrocorax carbo	Great Cormorant					•		•										
THRESKIORNITHIDAE																		
Threskiornis molucca	Australian White Ibis					•		•										
Threskiornis spinicollis	Straw-necked Ibis					•		•			•			•				•
Plegadis falcinellus	Glossy Ibis	MI	MI		•	•		•										
Platalea regia	Royal Spoonbill					•		•			•							
Platalea flavipes	Yellow-billed Spoonbill					•		•										

Family & Scientific Name	Common Name	Conservation Status			Database Searches				Literature Review									This survey
		EPBC Act	BC Act	DBCA	DBCA	NatureMap	PMST	Atlas of Living Australia	Terrestrial Ecosystems (2013)	Biota (2004)	Ecologia (2020)	Ecologia (2011)	Ecologia (2014)	Ecologia (2009)	ENV (2012)	Spectrum (2022)	Biologic (2022)	
Ixobrychus flavicollis	Black Bittern					•												
ARDEIDAE																		
Nycticorax caledonicus	Nankeen Night Heron (Rufous Night Heron)					•		•										
Bubulcus coromandus	Eastern Cattle Egret						•											
Ardea pacifica	White-necked Heron					•		•			•							
Ardea alba	Great Egret					•		•			•							
Egretta novaehollandiae	White-faced Heron					•		•		•			•	•				
Egretta garzetta	Little Egret					•		•										
PELECANIDAE																		
Pelecanus conspicillatus	Australian Pelican					•		•										
PANDIONIDAE																		
Pandion haliaetus	Osprey	MI	MI		•													
ACCIPITRIDAE																		
Elanus axillaris	Black-shouldered Kite					•		•	•				•	•				

Family & Scientific Name	Common Name	Conservation Status			Database Searches				Literature Review									This survey
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Elanus scriptus	Letter-winged Kite			P4	•	•												
Hamirostra isura	Square-tailed Kite					•		•	•									
Hamirostra melanosternon	Black-breasted Buzzard					•								•				
Hieraaetus morphnoides	Little Eagle					•		•		•	•		•	•				
Aquila audax	Wedge-tailed Eagle					•		•	•	•	•	•	•	•	•			•
Accipiter fasciatus	Brown Goshawk					•		•	•		•		•	•			•	
Accipiter cirrocephalus	Collared Sparrowhawk					•		•				•	•	•				
Circus approximans	Swamp Harrier					•		•										
Circus assimilis	Spotted Harrier					•		•	•	•	•		•	•				•
Milvus migrans	Black Kite					•		•	•		•			•	•			
Haliastur sphenurus	Whistling Kite					•		•	•	•	•	•	•	•	•			•
Haliaeetus leucogaster	White-bellied Sea-Eagle					•	•	•										
TYTONIDAE																		
Tyto javanica	Eastern Barn Owl					•		•	•		•			•				
STRIGIDAE																		

Family & Scientific Name	Common Name	Conservation Status			Database Searches				Literature Review									This survey
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Ninox boobook boobook	Southern Boobook					•		•	•		•	•		•		•		
HALCYONIDAE																		
Dacelo leachii	Blue-winged Kookaburra					•		•				•		•	•	•		
Todiramphus sanctus	Sacred Kingfisher					•		•	•	•		•		•	•	•		
Todiramphus pyrrhopygius	Red-backed Kingfisher					•		•	•	•	•	•	•	•	•	•	•	
MEROPIDAE																		
Merops ornatus	Rainbow Bee-eater					•	•	•		•	•	•	•	•	•	•	•	•
FALCONIDAE																		
Falco cenchroides	Nankeen Kestrel					•		•	•	•	•	•	•	•	•		•	•
Falco longipennis	Australian Hobby					•		•	•					•			•	
Falco berigora	Brown Falcon					•		•	•	•	•	•	•	•	•	•	•	•
Falco hypoleucos	Grey Falcon	VU	VU		•	•	•		•			•						
Falco subniger	Black Falcon							•			•							
Falco peregrinus	Peregrine Falcon			OS	•	•												
CACATUIDAE																		
Nymphicus hollandicus	Cockatiel					•		•	•	•	•		•	•	•	•	•	

Family & Scientific Name	Common Name	Conservation Status			Database Searches				Literature Review									This survey
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Eolophus roseicapillus	Galah					•		•	•	•	•	•	•	•	•	•	•	•
Cacatua sanguinea	Little Corella					•		•		•		•	•	•	•	•		
PSITTACULIDAE																		
Barnardius zonarius	Australian Ringneck					•		•	•	•	•	•	•	•	•		•	•
Pezoporus occidentalis	Night Parrot	EN	CR		•		•											
Neopsephotus bourkii	Bourke's Parrot					•		•	•		•							
Melopsittacus undulatus	Budgerigar					•		•	•	•	•		•	•	•	•	•	•
PTILONORHYNCHIDAE																		
Chlamydera guttata	Western Bowerbird					•		•	•		•	•					•	
Chlamydera nuchalis	Great Bowerbird										•							
CLIMACTERIDAE																		
Climacteris melanura	Black-tailed Treecreeper					•		•			•			•				
PTILONORHYNCHIDAE																		
Malurus assimilis	Purple-backed Fairywren					•		•	•	•	•	•	•	•	•	•	•	
Malurus splendens	Splendid Fairywren					•												
Malurus leucopterus	White-winged Fairywren					•		•	•	•	•	•	•	•	•	•	•	•

Family & Scientific Name	Common Name	Conservation Status			Database Searches				Literature Review									This survey
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Stipiturus ruficeps	Rufous-crowned Emu-wren					•												
Amytornis whitei (prev *A. striatus)*	Rufous Grasswren				•	•		•		•	•	•					•	
MELIPHAGIDAE																		
Epthianura tricolor	Crimson Chat					•		•	•	•	•		•	•	•		•	
Epthianura aurifrons	Orange Chat							•			•							
Certhionyx variegatus	Pied Honeyeater					•				•				•				
Sugomel niger	Black Honeyeater					•			•	•				•				
Lichmera indistincta	Brown Honeyeater					•		•	•	•	•		•	•			•	
Melithreptus gularis	Black-chinned Honeyeater									•		•					•	
Purnella albifrons	White-fronted Honeyeater					•		•			•							
Gavicalis virescens	Singing Honeyeater					•		•	•	•	•	•	•	•	•	•	•	•
Lichenostomus keartlandi	Grey-headed Honeyeater					•		•	•	•	•	•	•	•			•	•
Lichenostomus penicillatus	White-plumed Honeyeater					•		•	•	•	•	•	•	•	•	•	•	

Family & Scientific Name	Common Name	Conservation Status			Database Searches				Literature Review									This survey
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Acanthagenys rufogularis	Spiny-cheeked Honeyeater					•		•	•	•	•	•	•	•	•			
Manorina flavigula	Yellow-throated Miner					•		•	•	•	•	•	•	•	•	•	•	•
PARDALOTIDAE																		
Pardalotus rubricatus	Red-browed Pardalote					•		•	•	•	•	•	•	•	•		•	
Pardalotus striatus	Striated Pardalote					•				•			•	•				
ACANTHIZIDAE																		
Smicrornis brevirostris	Weebill					•		•	•	•	•	•	•	•	•		•	•
Pyrrholaemus brunneus	Redthroat					•			•									
Gerygone fusca	Western Gerygone					•		•				•	•	•	•			
Acanthiza apicalis	Inland Thornbill					•						•						•
Acanthiza uropygialis	Chestnut-rumped Thornbill					•		•	•	•	•	•	•	•			•	
Acanthiza chrysorrhoa	Yellow-rumped Thornbill					•												
Acanthiza robustirostris	Slaty-backed Thornbill					•		•	•	•	•	•						
POMATOSTOMIDAE																		

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Pomatostomus temporalis	Grey-crowned Babbler					•		•	•		•	•	•	•	•	•		
Pomatostomus superciliosus	White-browed Babbler					•		•	•		•	•	•				•	
PSOPHODIDAE																		
Psophodes occidentalis	Chiming Wedgebill					•												
ARTAMIDAE																		
Artamus personatus	Masked Woodswallow					•		•	•			•	•	•				
Artamus cinereus	Black-faced Woodswallow					•		•	•	•	•	•	•	•	•	•	•	•
Artamus minor	Little Woodswallow					•		•	•		•	•					•	
Cracticus tibicen	Australian Magpie					•		•	•	•		•	•	•		•	•	
Cracticus torquatus	Grey Butcherbird					•		•	•	•		•	•	•	•		•	
Cracticus nigrogularis	Pied Butcherbird					•		•	•	•	•	•	•	•	•	•	•	
CAMPEPHAGIDAE																		
Coracina maxima	Ground Cuckoo-shrike					•						•	•				•	
Coracina novaehollandiae	Black-faced Cuckoo-shrike					•		•	•	•	•	•	•	•	•	•	•	•

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Lalage sueurii	White-winged Triller					•		•	•	•	•	•	•	•	•		•	
NEOSITTIDAE																		
Daphoenositta chrysoptera	Varied Sittella					•												
OREOICIDAE																		
Oreoica gutturalis	Crested Bellbird					•		•	•	•	•	•	•	•	•		•	•
PACHYCEPHALIDAE																		
Pachycephala rufiventris	Rufous Whistler					•		•	•	•	•	•	•	•	•	•	•	•
Colluricincla harmonica	Grey Shrike-thrush					•		•	•	•	•	•		•	•	•	•	•
RHIPIDURIDAE																		
Rhipidura leucophrys	Willie Wagtail					•		•	•	•	•	•	•	•	•	•	•	•
MONARCHIDAE																		
Grallina cyanoleuca	Magpie-lark					•		•	•	•	•	•	•	•	•	•	•	•
CORVIDAE																		
Corvus bennetti	Little Crow					•		•			•	•			•			
Corvus orru	Torresian Crow					•		•	•	•	•	•	•	•	•	•	•	•
PETROICIDAE																		
Melanodryas cucullata	Hooded Robin					•		•	•		•	•	•	•			•	

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Petroica goodenovii	Red-capped Robin					•		•	•			•	•	•				
ALAUDIDAE																		
Mirafra javanica	Horsfield's Bushlark					•		•		•	•	•		•	•		•	
HIRUNDINIDAE																		
Hirundo rustica	Barn Swallow	MI	MI				•											
Hirundo neoxena	Welcome Swallow					•		•						•				
HIRUNDINIDAE																		
Petrochelidon ariel	Fairy Martin					•		•	•			•		•		•		
Petrochelidon nigricans	Tree Martin					•		•	•	•	•		•	•	•			
ACROCEPHALIDAE																		
Acrocephalus australis	Australian Reed-Warbler					•		•										
LOCUSTELLIDAE																		
Poodytes carteri	Spinifexbird					•		•	•	•	•	•	•	•			•	
Cincloramphus cruralis	Brown Songlark					•		•		•			•	•	•			
Cincloramphus mathewsi	Rufous Songlark					•		•	•	•	•		•	•			•	•
NECTARINIIDAE																		

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Dicaeum hirundinaceum	Mistletoebird					•		•	•	•			•	•			•	
ESTRILDIDAE																		
Neochmia ruficauda subclarescens	Star Finch (western)					•									•			
Emblema pictum	Painted Finch					•		•	•	•		•	•		•	•	•	•
Taeniopygia guttata	Zebra Finch					•		•	•	•	•	•	•	•	•	•	•	•
MOTACILLIDAE																		
Motacilla tschutschensis	Eastern Yellow Wagtail	MI	MI				•											
Motacilla cinerea	Grey Wagtail	MI	MI		•		•											
Anthus australis	Australian Pipit					•		•	•	•	•			•	•	•		•
REPTILES																		
CHELUIDAE																		
Chelodina steindachneri	Flat-shelled Turtle					•				•								
CARPHODACTYLIDAE																		
Nephrurus levis pilbarensis	Smooth Knob-tailed Gecko									•								
Nephrurus wheeleri	Southern Banded Knob-tailed Gecko					•			•		•			•				

Family & Scientific Name	Common Name	Conservation Status			Database Searches				Literature Review									This survey
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Underwoodisaurus seorsus	Pilbara Barking Gecko			P2	•													
DIPLODACTYLIDAE																		
Crenadactylus occidentalis	Western Clawless Gecko					•												
Diplodactylus conspicillatus	Variable Fat-tailed Gecko					•			•	•	•		•	•	•			
Diplodactylus galaxias	Northern Pilbara Beak-faced Gecko					•							•				•	
Diplodactylus laevis	Desert Fat-tailed Gecko										•							
Diplodactylus mitchelli	Pilbara Stone Gecko					•						•						
Diplodactylus pulcher	Pretty Gecko					•			•		•				•			
Diplodactylus savagei	Southern Pilbara Beak-faced Gecko					•			•		•	•			•		•	
Lucasium stenodactylus	Sand-plain Gecko					•			•	•	•	•	•	•	•			
Lucasium wombeyi	Pilbara Ground Gecko					•			•	•	•	•			•		•	
Oedura fimbria	Marbled Velvet Gecko					•												

Family & Scientific Name	Common Name	Conservation Status			Database Searches				Literature Review									This survey
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Rhynchoedura ornata	Western Beaked Gecko					•		•	•			•		•	•		•	
Strophurus assimilis	Goldfields Spiny-tailed Gecko					•												
Strophurus ciliaris	Northern Spiny-tailed Gecko					•												
Strophurus elderi	Jewelled Gecko					•				•								
Strophurus jeanae	Southern Phasmid Gecko					•												
Strophurus strophurus	Western Spiny-tailed Gecko													•				
Strophurus wellingtonae	Western-shield Spiny-tailed Gecko					•				•		•		•	•			
GEKKONIDAE																		
Gehyra crypta	Western Cryptic Dtella																•	
Gehyra micra	Small Pilbara Spotted Rock Dtella																•	
Gehyra pilbara	Pilbara Dtella					•							•					
Gehyra punctata	Spotted Pilbara Rock Dtella					•					•	•		•	•			

Family & Scientific Name	Common Name	Conservation Status			Database Searches				Literature Review									This survey
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Gehyra variegata	Variegated Dtella					•		•	•		•	•	•	•	•			•
Heteronotia binoei	Bynoe's Gecko					•		•	•	•	•	•	•	•	•		•	
Heteronotia spelea	Desert Cave Gecko					•									•			
PYGOPODIDAE																		
Delma butleri	Spinifex Delma					•									•			
Delma desmosa	Desert Delma										•							
Delma elegans	Pilbara Delma														•			
Delma nasuta	Sharp-snouted Delma					•				•	•	•			•			
Delma pax	Peace Delma					•				•		•		•	•			
Delma tincta	Black-necked Delma					•				•		•		•				
Lialis burtonis	Burton's Snake-lizard					•				•	•	•		•			•	
Pygopus nigriceps	Western Hooded Scaly-foot					•					•	•	•					
AGAMIDAE																		
Ctenophorus caudicinctus	Western Ring-tailed Dragon					•		•	•	•	•	•	•	•	•	•	•	•
Ctenophorus isolepis	Central Military Dragon					•			•	•		•	•	•				

Family & Scientific Name	Common Name	Conservation Status			Database Searches				Literature Review									This survey
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Ctenophorus nuchalis	Central Netted Dragon					•								•				
Ctenophorus reticulatus	Western Netted Dragon					•			•				•					
Diporiphora amphiboluroides	Mulga Dragon					•			•	•			•	•	•			
Diporiphora valens	Southern Pilbara Tree Dragon											•						
Gowidon longirostris	Long-nosed Dragon					•			•	•	•	•	•	•	•	•	•	•
Pogona minor	Dwarf Bearded Dragon					•		•	•			•		•	•			
Tympanocryptis cephalus	Pebble Dragon					•				•		•		•	•		•	
SCINCIDAE																		
Carlia munda	Striped Rainbow Skink					•			•	•		•	•	•	•		•	
Carlia triacantha	Desert Rainbow Skink					•				•	•	•						
Cryptoblepharus buchananii	Buchanan's Snake-eyed Skink					•			•				•					

Family & Scientific Name	Common Name	Conservation Status			Database Searches				Literature Review									This survey
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Cryptoblepharus ustulatus	Russet Snake-eyed Skink					•						•						
Ctenotus ariadnae	Ariadna's Ctenotus													•				
Ctenotus grandis	Giant Desert Ctenotus					•				•	•			•				
Ctenotus hanloni	Nimble Ctenotus					•												
Ctenotus helenae	Dusky Ctenotus					•			•	•	•	•	•	•				
Ctenotus leonhardii	Common Desert Ctenotus					•												
Ctenotus nigrilineatus	Pin-striped Ctenotus			P1	•													
Ctenotus pallasotus	Western Pilbara Lined Ctenotus					•				•					•	•		
Ctenotus pantherinus	Leopard Ctenotus					•			•	•	•	•	•	•	•		•	
Ctenotus robustus	Robust Striped Ctenotus					•							•			•		
Ctenotus rubicundus	Ruddy Ctenotus					•				•								
Ctenotus rutilans	Rusty-shouldered Ctenotus					•												
Ctenotus saxatilis	Rock Ctenotus					•			•	•	•	•	•	•	•	•		•

Family & Scientific Name	Common Name	Conservation Status			Database Searches				Literature Review									This survey
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Ctenotus schomburgkii	Barred Wedge-snouted Ctenotus										•							
Ctenotus uber johnstonei	Spotted Ctenotus			P2	•	•				•				•	•			
Cyclodomorphus melanops	Slender Blue-tongue					•				•	•	•	•	•	•			
Egernia cygnitos	Western Pilbara Spiny-tailed Skink										•							
Egernia depressa	Southern Pygmy Spiny-tailed Skink					•												
Egernia epsisolus	Eastern Pilbara Spiny-tailed Skink															•		
Egernia formosa	Goldfields Crevice-skink					•											•	
Egernia pilbarensis	Pilbara Crevice-skink																•	
Eremiascincus richardsonii	Broad-banded Sand Swimmer					•					•				•			
Lerista amicorum	Fortescue Three-toed Slider																•	
Lerista bipes	Western Two-toed Slider									•				•				

Family & Scientific Name	Common Name	Conservation Status			Database Searches				Literature Review									This survey
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Lerista chalybura	Pilbara Blue-tailed Slider					•												
Lerista flammicauda	Pilbara Flame-tailed Slider					•												
Lerista jacksoni	Jackson's Three-toed Slider					•												
Lerista labialis	Eastern Two-toed Slider					•												
Lerista muelleri	Mueller's Three-toed Slider					•			•			•		•	•			
Lerista timida	Dwarf Three-toed Slider					•									•			
Lerista verhmens	Powerful Three-toed Slider					•											•	
Liopholis kintorei	Great Desert Skink						•											
Menetia greyii	Common Dwarf Skink					•			•	•	•	•		•			•	
Menetia surda	Western Dwarf Skink					•							•					
Morethia ruficauda	Fire-tailed Skink					•		•			•	•			•	•	•	
Notoscincus butleri	Lined Soil-crevice Skink			P4	•													

Family & Scientific Name	Common Name	Conservation Status			Database Searches				Literature Review									This survey
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Notoscincus ornatus	Ornate Snake-eyed Skink					•		•				•						
Proablepharus reginae	Spinifex Snake-eyed Skink					•				•	•							
Tiliqua multifasciata	Central Blue-tongue					•			•	•	•	•		•	•			
VARANIDAE																		
Varanus acanthurus	Spiny-tailed Monitor					•		•	•	•	•	•	•	•	•		•	
Varanus brevicauda	Short-tailed Pygmy Monitor					•			•	•	•	•		•				
Varanus bushi	Pilbara Mulga Monitor					•			•			•	•	•				
Varanus caudolineatus	Stripe-tailed Monitor					•								•				
Varanus eremius	Pygmy Desert Monitor					•				•	•		•	•				
Varanus giganteus	Perentie					•			•		•	•				•		
Varanus gouldii	Gould's Monitor					•								•	•		•	•
Varanus panoptes	Yellow-spotted Monitor					•			•		•	•			•	•	•	

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Varanus pilbarensis	Pilbara Rock Monitor					•												
Varanus tristis	Racehorse Monitor					•			•			•			•	•		
TYPHLOPIDAE																		
Anilios ammodytes	Pilbara Blind Snake					•			•	•		•		•	•		•	
Anilios ganei	Gane's Blind Snake		P1		•						•						•	
Anilios grypus	Northern Beaked Blind Snake					•				•	•				•		•	
Anilios hamatus	Northern Hook-snouted Blind Snake					•					•				•			
Anilios pilbarensis	Pilbara Blind Snake					•												
PYTHONIDAE																		
Antaresia childreni	Children's Python					•		•			•	•						
Antaresia perthensis	Pygmy Python					•					•				•		•	
Aspidites melanocephalus	Black-headed Python					•					•							
Liasis olivaceus barroni	Pilbara Olive Python	VU	VU		•	•	•				•	•			•			
ELAPIDAE																		

Family & Scientific Name	Common Name	Conservation Status			Database Searches				Literature Review									This survey
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Acanthophis wellsi	Pilbara Death Adder					•												
Brachyurophis approximans	North-western Shovel-nosed Snake					•			•	•	•	•			•		•	
Demansia psammophis	Yellow-faced Whipsnake					•			•	•	•	•	•	•	•		•	
Demansia rufescens	Rufous Whipsnake					•									•		•	
Furina ornata	Moon Snake					•			•	•				•	•			
Pseudechis australis	Mulga Snake					•			•	•	•	•		•			•	
Pseudonaja mengdeni	Western Brown Snake					•			•		•			•	•			
Pseudonaja modesta	Ringed Brown Snake					•			•									
Pseudonaja nuchalis	Gwardar, Northern Brown Snake					•								•	•			
Suta fasciata	Rosen's Snake					•				•								
Suta monachus	Inland Hooded Snake					•						•	•	•				
Suta punctata	Spotted Snake					•							•	•	•			
Vermicella snelli	Pilbara Bandy Bandy					•												

Family & Scientific Name	Common Name	Conservation Status			Database Searches				Literature Review									This survey
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AMPHIBIANS																		
HYLIDAE																		
Cyclorana australis	Giant Frog																•	
Cyclorana maini	Sheep Frog					•				•			•		•			
Cyclorana platycephala	Water-holding Frog					•									•			
Litoria rubella	Little Red Tree Frog					•				•					•			
LIMNODYNASTIDAE																		
Neobatrachus aquilonius	Northern Burrowing Frog					•												
Notaden nichollsi	Desert Spadefoot									•								
Platyplectrum spenceri	Centralian Burrowing Frog					•				•								
MYOBATRACHIDAE																		
Pseudophryne douglasi	Gorge Toadlet					•									•			
Uperoleia russelli	Northwest Toadlet									•								
Uperoleia saxatilis	Pilbara Toadlet					•												

S = Secondary Evidence

** = *Taphozous georgianus/hilli* - call unable to be distinguished

NC = Need Confirmation, calls unable to be distingused, could be either or both species: *Nyctophilus geoffroyi/daedalus*

Appendix C: Regional SRE Invertebrate Fauna List

SRE Target Groups Previously Recorded from the Study Area

Class/Family	Species	Location	Sources/ Database Search				
			WAM	Mulga East (Ecologia, 2020)	Investigator (Ecologia, 2014)	Mulga Downs Hub and Rail Spur (Spectrum 2022)	Mulga Downs Transport Corridor (Biologic 2022)
Arachnida							
Mygalomorph							
Anamidae	*Aname* `sp. indet. (female)` & *Aname* `sp. indet. (juvenile)`	Karijini National Park, Murray Hill & Koodaideri Corridor West	✓				
	Aname mellosa	Koodaideri Corridor West	✓				
	Kwonkan sp.	Koodaideri Corridor West	✓				
Idiopidae	`Anidiops` `sp. B02`	ca. 40 km E. of Mt McRae	✓				
	Idiosoma sp. `MD1`	Mulga Downs					✓
	Idiosoma `MYG083` ('Aganippe')	FMG Nyidinghu Project, ca. 18 km N. of Wittenoom	✓				
	Idiosoma `MYG085` ('Aganippe')	Solomon Mine	✓				
	Idiosoma `MYG300` ('Aganippe')	Koodaideri Corridor West	✓				
	Idiosoma `MYG404` ('Aganippe')	Solomon Mine	✓				
	Idiosoma `MYG767` ('Aganippe')	Mt Florance Station	✓				
	Idiosoma `sp. B02 (Anidiops)`	Solomon Mine	✓				
	Idiosoma `sp. indet. (female)` & *Idiosoma* `sp. indet. (juvenile)`	FMG Nyidinghu Project, Koodaideri Western Corridor	✓				
Barychelidae	Aurecocrypta `chichester`	Mulga Downs Station	✓				
	Barychelidae `MYG217A`	Mt Florance Station	✓				
	Idiommata `MYG382`	Investigator, Solomon Mine & ca. 18 km N. of Wittenoom,	✓		✓		
	Synothele `MYG311`	Koodaideri Western Corridor	✓				
	Synothele `sp. indet. (juvenile)`	Karijini NP	✓				
Halonoproctidae	*Conothele* 'MYG279'	Fortescue Marsh, Koodaideri Corridor West	✓	✓			
	Conothele 'MYG716'	Mulga Downs Station	✓				
	Conothele `sp. indet. (female)`	Koodaideri Corridor West	✓				
Opiliones (Assamioidea)							
Assamiidae	*Dampetrus* 'OPI001'	Mulga East		✓			
	Dampetrus `HBI-6519`	Mulga Downs Station	✓				
Pseudoscorpions							
Olpiidae	*Beierolpium* 'PSE173' (formerly *B.* '8/3')	Mulga East		✓			
	Beierolpium `sp. 8/3`	Mulga Downs Station, Murray Hill	✓				
	Beierolpium `8/4 sp. B12`	Solomon Mine	✓				
	Beierolpium `sp. 8/2`	Karijini National Park & Koodaideri Corridor West	✓				
	Indolpium sp.`MD1`	Mulga Downs					✓

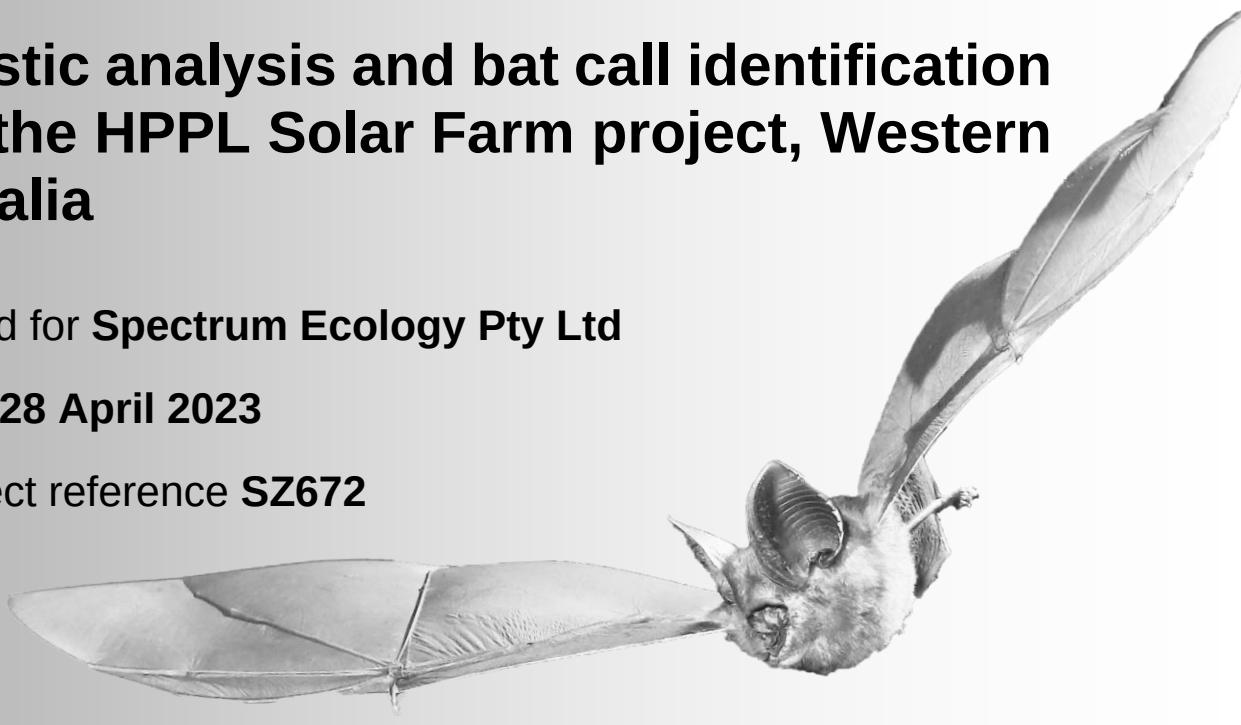
Class/Family	Species	Location	Sources/ Database Search				
			WAM	Mulga East (Ecologia, 2020)	Investigator (Ecologia, 2014)	Mulga Downs Hub and Rail Spur (Spectrum 2022)	Mulga Downs Transport Corridor (Biologic 2022)
	Genus 7/4 'PSE176' (formerly O. sp. 3)	Mulga East & Cloudbreak mine lease		✓			✓
	Indolpium sp.	Mulga East		✓			
	Indolpium 'PSE175' (formerly *Indolpium* sp. 1)	Mulga East	✓	✓			
	Indolpium 'PSE174' (formerly *Indolpium* sp. 2)	Mulga East	✓	✓			
	Indolpium `sp. B17`	Solomon Mine	✓				
	Indolpium `sp. indet. (juvenile)`	Chichester Range, Koodaideri Corridor West	✓				
	Olpiidae `Genus 7/4` `PSE176`	Mulga Downs Station	✓				
	Olpiidae sp. indet.	Inside current Survey Area				✓	
	Olpiidae `sp. Biologic-PSEU097`	Inside current Survey Area				✓	
	Olpiidae `sp. Biologic-PSEU098`	~5 km S of current Survey Area				✓	
	Olpiidae `sp. Biologic-PSEU099`	~2 km S of current Survey Area				✓	
	Xenolpium sp.	Mulga East		✓			
Chthoniidae	Austrochthonius sp.	Investigator			✓		
	Tyrannochthonius `sp. B33`	Solomon Mine	✓				
Scorpions							
Urodacidae	*Urodacus* `megamastigus long`	ca. 18 km N. of Wittenoom	✓				
	Urodacus `sp. 1`	Hope Downs proposed rail corridor	✓				
	Urodacus `sp. B09 (?`firetail`)`	Solomon Mine	✓				
	Urodacus sp.	Cloudbreak, Koodaideri Western Corridor, Mulga East		✓			
Buthidae	*Lychas* 'SCO024' (former *L.* 'bituberculatus complex')	Mulga East		✓		✓	
	Lychas 'hairy tail complex' (*Lychas* 'hairy tail group')	Mulga Downs Station, Karijini NP	✓	✓			
	Lychas 'SCO046' (former *L.* 'multipunctatus complex')	Mulga East, Mulga Downs	✓	✓			
	Lychas sp. 4	Mulga East		✓			
	Lychas `sp. SCO052`	Mulga East				✓	✓
	Lychas `marandoo 1``SCO036`	Marandoo Mine Expansion	✓				
	Lychas `marandoo 2``SCO036`	Marandoo Mine Expansion	✓				
Millipede							
Trigoniulidae	*Austrostrophus* sp.	Mulga East		✓			
	Austrohorus `chunky`	ca. 18 km N. of Wittenoom	✓				
Isopoda							
Armadillidae	*Acanthodillo* sp. indet.	Mulga East				✓	
	Acanthodillo `sp. B14`	Solomon, Mount Mcrae	✓				
	Armadillidae `sp. B.04`	I Deposit	✓				

Class/Family	Species	Location	Sources/ Database Search				
			WAM	Mulga East (Ecologia, 2020)	Investigator (Ecologia, 2014)	Mulga Downs Hub and Rail Spur (Spectrum 2022)	Mulga Downs Transport Corridor (Biologic 2022)
	Armadillidae `sp. B.05`	I Deposit	✓				
	Armadillidae `sp. B.07`	I Deposit	✓				
	Buddelundia `sp. indet. 1`	Mulga East		✓			
	Buddelundia sp.	Investigator, Mulga East	✓	✓	✓	✓	
	Buddelundiinae sp. indet.	Mulga East		✓			
	Buddelundiinae sp. indet. A	Mulga East		✓			
	Buddelundiinae sp. indet. B	Mulga East		✓			
	Buddelundia `sp. Biologic-ISOP084`	Mulga East				✓	
	Buddelundia sp. SJ13	Mulga East				✓	
	Buddelundia 'sp. SJ_14FMa_DNA`	Mulga East					✓
	Buddelundia 'sp. SJ_14FMc` and *Buddelundia* 'sp. SJ_14FMc`_DNA	Mulga Downs					✓
	Buddelundia 'sp. SJ_56_DNA`	Mulga East				✓	
	Buddelundiinae sp. indet.	Mulga East				✓	
	Buddelundiinae `sp. Biologic-ISOP085`	Mulga East				✓	
	Buddelundiinae `sp. Biologic-ISOP086`	Mulga East				✓	
	Buddelundiinae `sp. Biologic-ISOP090`	Mulga East				✓	
	Buddelundiinae NYI01	Mulga East				✓	
	Buddelundia `sp. B47`	Solomon	✓				
	Buddelundia `sp. B48`	Solomon	✓				
	Buddelundia `sp. B49`	Solomon	✓				
	Buddelundia `sp. B50`	Solomon	✓				
	Buddelundia `sp. B52`	Solomon					
	Buddelundia `sp. B53`	Solomon	✓				
	Buddelundia `56`	Investigator		✓	✓		
	Buddelundia `77`	Investigator			✓		
	Buddelundiinae 'EE1340'	Investigator			✓		
	Buddelundia 10BF (former B. sp. indet A)	Mulga East		✓			
	Buddelundia `sp. 14fm` (former B. '14')	Murray Hilll, Mulga Downs	✓	✓			
	Buddelundia 15MD	Mulga East		✓			
	Buddelundia `10MA` and *Buddelundia* `sp. SJ_10MA_DNA`	Mulga Downs					✓
Philosciidae	Philosciidae `sp. B07`	I Deposit					
	Philosciidae `sp. B31`	Solomon	✓				
	Laevophiloscia sp. indet.	Wodgina Mine Site, inside current Survey Area				✓	
	Laevophiloscia `sp. Biologic-ISOP088`	Inside current Survey Area				✓	

Class/Family	Species	Location	Sources/ Database Search				
			WAM	Mulga East (Ecologia, 2020)	Investigator (Ecologia, 2014)	Mulga Downs Hub and Rail Spur (Spectrum 2022)	Mulga Downs Transport Corridor (Biologic 2022)
	Laevophiloscia `sp. Biologic-ISOP088`	Inside current Survey Area				✓	
Paraplatyarthridae	Paraplatyarthrus `sp. Biologic-ISOP087`	Inside current Survey Area				✓	
Molluscs							
Succineidae	*Succinea* sp.	Investigator (400 m south of Water pipeline Survey Area)	✓		✓		

Appendix D: Acoustic Analysis & Bat Call Identification

Acoustic analysis and bat call identification from the HPPL Solar Farm project, Western Australia



Prepared for **Spectrum Ecology Pty Ltd**

Version **28 April 2023**

SZ project reference **SZ672**

Prepared by **Dr Kyle Armstrong and Yuki Konishi**

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This report should be included as an appendix in any larger submission to Government, and cited as:

Specialised Zoological (2023). Acoustic analysis and bat call identification from the HPPL Solar Farm project, Western Australia. Unpublished report by Specialised Zoological for Spectrum Ecology Pty Ltd, 28 April 2023, project reference SZ672.

Summary

Bat identifications from acoustic recordings are provided from the HPPL Solar Farm project area in the Pilbara region of Western Australia. The identification of bat species from full spectrum WAV-format recordings of their echolocation calls was based on measurements of characteristic frequency, observation of pulse shape, and the pattern of harmonics.

Particular attention was given to the detection of two bat species of conservation significance: Ghost Bat *Macroderma gigas* (Megadermatidae) and Pilbara Leaf-nosed Bat *Rhinonicteris aurantia* (Rhinonycteridae).

A total of 166,984 WAV format files from five recording sites (total 19 recording nights) was analysed (**Table 1**).

A total of seven species of bat was detected (**Tables 2** and **3**; **Figure 1**). The Ghost Bat was not detected.

The Pilbara Leaf-nosed Bat was recorded over three nights at one site, with a total of 8 passes being recorded (**Tables 1** and **4**). All detections of the Pilbara Leaf-nosed Bat were well after sunset, and well before sunrise (more than an hour in all cases), which suggests that each of these recording sites was not at, or very close to, a diurnal roost site.

Methods

The data provided were recorded in full spectrum W4V format with Wildlife Acoustics Song Meter SM4BAT bat detectors (sampling rate 384 kHz, set to turn on automatically at sunset and off at sunrise). All W4V format files were converted to WAV format. All WAV files exceeding five seconds were split into separate WAVs with a maximum of five seconds. Conversions were undertaken in Kaleidoscope version 5.1.9g.

A multi-step acoustic analysis procedure developed to process large full spectrum echolocation recording datasets from insectivorous bats (Armstrong et al. 2021a,b) was applied to the recordings made on the survey. Firstly, the WAV files were scanned for bat echolocation calls using several parameter sets in the software SCAN'R version 1.8.3 (Binary Acoustic Technology), which also provides measurements (SCAN'R parameters) from each putative bat pulse. The outputs were then used to determine if putative bat pulses measured in SCAN'R could be identified to species. This was done using a custom [R] language application that performed three tasks:

1. undertook a Discriminant Function Analysis on training data from representative calls in the Pilbara region;

2. from the measurements of each putative bat pulse from SCAN'R, calculated values for the first two Discriminant Functions that could separate the echolocation call types derived from the analysis of training data, and plotted these resulting coordinates over ellipses representing one standard deviation of the variation for the defined call types; and

3. facilitated an inspection in a spectrogram of multiple examples of each call type for each recording night by opening the original WAV files containing pulses of interest in Adobe Audition version 22.1 software.

Species were identified based on information in the author's own unpublished material. Nomenclature follows Jackson and Groves (2015).

All WAV files containing putative calls of the Pilbara Leaf-nosed Bat were inspected in Adobe Audition software, and listings of files containing false positive identifications were discarded. Custom R language scripts assisted with summarisation of the remaining data, and the calculation of times of first detection after sunset and last detection before sunrise.

References

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Armstrong K.N., Clarke S., Linke A., Scanlon A., Roetman P., Hitch, A.T. and Donnellan S.C. (2021b). Citizen science implements the first intensive acoustics-based survey of insectivorous bat species across the Murray-Darling Basin of South Australia. *Australian Journal of Zoology* 68: 364–381. https://doi.org/10.1071/ZO20051

DEWHA (2010). Survey guidelines for Australia's threatened bats. Guidelines for detecting bats listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999. Department of the Environment, Water, Heritage and the Arts, Canberra.

Jackson, S.M. and Groves, C.P. (2015). *Taxonomy of Australian mammals*. CSIRO Publishing, Victoria.

Limitations

The identifications presented in this report have been made within the following context:

1. The identifications made herein were based on the ultrasonic acoustic data recorded and provided by a 'third party' (the client named on the front of this report).
2. The scope of this report extended to providing information on the identification of the Ghost Bat and Pilbara Leaf-nosed Bat in bulk ultrasonic recordings. Further comment on these species and the possible impacts of a planned project on bat species were not part of the scope.
3. In the case of the present report, the recording equipment was not set up and supplied by Specialised Zoological. The equipment was operated by the third party during the survey.
4. Other than the general location of the study area, Specialised Zoological has not been provided with detailed information of the survey area, has not made a visit to observe the habitats available for bats, nor have we visited the specific project areas on a previous occasion.
5. Specialised Zoological has had no input into the overall design and timing of this bat survey, recording site placement, nor the degree of recording site replication.
6. While Specialised Zoological has made identifications to the best of our ability given the available materials, and reserves the right to re-examine the data and revise any identification following a query, it is the client's and / or proponent's responsibility to provide supporting evidence for any identification, which might require follow-up trapping effort or non-invasive methods such as video recordings. Specialised Zoological bears no liability for any follow-up work that may be required to support an identification based initially on the analysis of acoustic recordings undertaken and reported on here.
7. There are a variety of factors that affect the 'detectability' of each bat species, given the frequency, power and shape characteristics of their calls. Further information on the analysis and the various factors that can impinge on the reliability of identifications can be provided upon request.
8. The analysis of ultrasonic recordings is one of several methods that can be used to survey for bats, and comprehensive surveys typically employ more than one method. If an identification in the present report is ambiguous or in question, a trapping programme would help to resolve the presence of the possibilities in the project area.
9. The most reliable way of detecting the Ghost Bat with bat detectors is to place the equipment with the microphone facing into a potential cave roosting site. The echolocation calls of this species are of low amplitude, and therefore most detectable when a Ghost Bat flies close to the bat detector as it exits the underground structure. If there is uncertainty about whether Ghost Bats are present in a cave, then video recordings can be a useful addition to the survey. The detection of Ghost Bats with bat detectors away from cave entrances is less reliable.
10. Predictions about whether the Pilbara Leaf-nosed Bat roosts within a particular surveyed cave (where a bat detector was placed at the entrance), or somewhere nearby, based on the time of first detection should be considered indicative only. If unambiguous confirmation of diurnal roosting of this species is required, this should be undertaken using the entrance sheeting method that is described in DEWHA (2010).
11. This version of the document supersedes any previous version. Previous drafts are not authorised by us for submission to the regulator or the public domain.

Table 1. Summary of recordings made (Ra: number of nights where the Pilbara Leaf-nosed Bat was detected, plus total number of passes across all nights, per site).

Location	Site	Unit serial	Easting 50K	Northing	First night	Last night	Nights	WAVs	Ra nights, passes
Pipeline	P08	S4U06174	635844	7559526	15/03/2023	19/03/2023	5	44,622	3, 8
Solar Farm	SF02	S4U06260	664979	7557119	16/03/2023	19/03/2023	4	34,218	
Pipeline	P03	S4U06262	633262	7559639	15/03/2023	17/03/2023	2	17,900	
Solar Farm	SF01	S4U06270	664061	7557324	16/03/2023	19/03/2023	4	34,667	
Haul Road	HL01	S4U06273	657902	7557217	16/03/2023	19/03/2023	4	35,577	
Total							**19**	**166,984**	**3, 8**

Table 2. Species identified from all sites combined.

RHINONYCTERIDAE	
Pilbara Leaf-nosed Bat	*Rhinonicteris aurantia*
EMBALLONURIDAE	
Yellow-bellied Sheath-tailed Bat	*Saccolaimus flaviventris*
Common Sheath-tailed Bat	*Taphozous georgianus*
VESPERTILIONIDAE	
Gould's Wattled Bat	*Chalinolobus gouldii*
Little Broad-nosed Bat	*Scotorepens greyii*
Finlayson's Cave Bat	*Vespadelus finlaysoni*
MOLOSSIDAE	
Greater Northern Free-tailed Bat	*Chaerephon jobensis*

Table 3. Species identifications summarised for all nights across each recording site (see *Table 2* for full species names).

	C. gouldii	*C. jobensis*	*R. aurantia*	*S. flaviventris*	*S. greyii*	*T. georgianus*	*V. finlaysoni*
SM4BAT 6174	X	—	X	X	X	X	X
SM4BAT 6260	X	—	—	X	X	X	X
SM4BAT 6262	X	—	—	—	X	—	X
SM4BAT 6270	X	X	—	X	X	X	X
SM4BAT 6273	X	X	—	X	X	X	X

Table 4. Summary of detections of the Pilbara Leaf-nosed Bat from all sites.

Serial	Night of	Passes	Sunset	Dusk	Dawn	Sunrise	Time of first detection	Time of last detection	Time since sunset	Time until dawn
S4U06174	17/03/2023	3	17/03/2023 18:18	17/03/2023 18:40	18/03/2023 5:43	18/03/2023 6:05	0:43:34	0:43:54	6H 25M 23S	5H 21M 50S
S4U06174	18/03/2023	3	18/03/2023 18:17	18/03/2023 18:39	19/03/2023 5:43	19/03/2023 6:06	21:15:21	22:07:36	2H 58M 9S	7H 58M 31S
S4U06174	19/03/2023	2	19/03/2023 18:16	19/03/2023 18:38	20/03/2023 5:43	20/03/2023 6:06	1:07:56	1:08:11	6H 51M 43S	4H 58M 18S

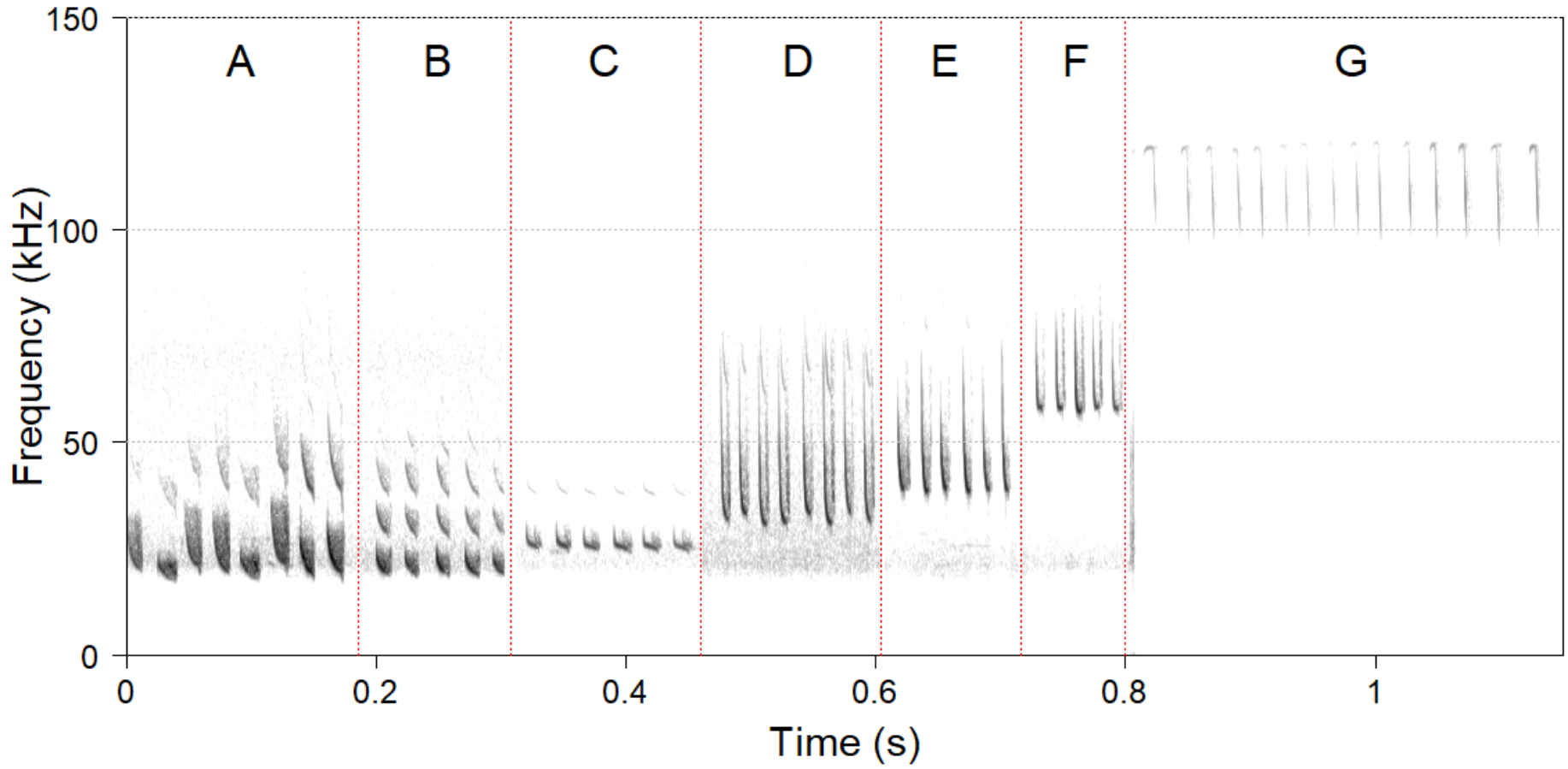

Figure 1. Representative echolocation call sequence portions of the species identified (**A**: *Chaerephon jobensis*; **B**: *Saccolaimus flaviventris*; **C**: *Taphozous georgianus*; **D**: *Chalinolobus gouldii*; **E**: *Scotorepens greyii*; **F**: *Vespadelus finlaysoni*; **G**: *Rhinonicteris aurantia*; time between pulses has been compressed).

Appendix E: Results of Acoustic Surveys Conducted for the Night Parrot

Results of acoustic surveys conducted for the Night Parrot (*Pezoporus occidentalis*) near Goodiadarrie Swamp
March 2023

Report to:

Spectrum Ecology

Prepared by:

Nick Leseberg

Adaptive NRM

27th April 2023

1. Summary

From 13-19 March 2023, autonomous recording units (ARUs) were deployed at two sites near Goodiadarrie Swamp, in the Fortescue bioregion of Western Australia, to survey for Night Parrots (*Pezoporus occidentalis*). Resulting acoustic data was analysed using signal parameters optimised for detecting Night Parrot calls. No Night Parrot calls were detected during the analysis.

2. Survey effort

Research in western Queensland has demonstrated Night Parrots occupy long-term stable roost sites for periods of up to several years. These long-term stable roost sites support both roosting and breeding. The birds also have predictable year-round calling periods at dusk and dawn (Murphy *et al*. 2017a, Leseberg *et al*. 2019). This ensures that if Night Parrots are roosting at a particular site, the likelihood of detecting them using ARUs is very high, provided the ARU is placed for a minimum of four nights in calm weather, and the recorder is set to record during the peak calling periods. During breeding, and following large rain events, calling is more frequent, extends throughout the night, and the likelihood of detection is increased (Murphy *et al*. 2017a). Preliminary results from research in central Western Australia suggest patterns of behaviour in that region are similar (Jackett *et al*. 2017).

Night Parrots are also known to call during the night at feeding and drinking sites (S. Murphy, N. Leseberg, N. Jackett unpubl. data). Anecdotal evidence suggests they may call when moving between these sites (N. Leseberg, N. Jackett, S. Murphy unpubl. data). However, the detection of birds away from roosting sites is likely to be a chance event given the large area over which birds range at night (Murphy *et al*. 2017b). Night Parrots are known to drink, and modelling suggests they may be reliant on free-standing water (or succulent food containing >55% water) during hot weather (Kearney *et al*. 2016). Birds have been detected in the Great Sandy Desert by focusing survey effort at water sources (J. Brown pers. comm.). It is likely this technique will be most effective during periods of water scarcity, when survey effort can focus on just a few possible locations.

The likelihood of detection is also influenced by the type of ARU being used. In calm conditions, a Song Meter 4 (Wildlife Acoustics, MA, USA) is known to be capable of reliably

detecting 95% of Night Parrot calls out to a range of around 205 m (Leseberg *et al*. 2022). For this survey, Song Meter 4s were used.

Table 1. Bioacoustic recordings analysed from the March 2023 survey.

Machine	Recording start date (PM)	Recording end date (AM)	Total recording nights
KU004	13-Mar-23	19-Mar-23	6
KU006	13-Mar-23	19-Mar-23	6
		Total	12

Spectrum Ecology conducted sampling for the Night Parrot at two sites near Goodiadarrie Swamp. Two Song Meter 4s were deployed at two different sites and recorded a combined total of 12 nights of data (Table 1). ARUs recorded from approximately 20 minutes after sunset until 35 minutes before sunrise. While the recommended recording period is from 20 minutes after sunset until 20 minutes before sunrise, it is still likely the key Night Parrot calling periods were captured. Recording conditions were good for the majority of the survey, and at least four non-windy nights were recorded at each site.

3. Data analysis

ANRM received the raw acoustic data in '.wav' format, as 60-minute files. These were scanned using the acoustic analysis software Kaleidoscope (Wildlife Acoustics, MA, USA), targeting the frequency range of 1500 – 3500 Hz, within which all known calls of the Night Parrot are distributed (Leseberg *et al*. 2019). Search parameters were optimised using a random selection of 250 Night Parrot call examples manually detected from both Great Sandy Desert and East Murchison datasets, of which 205 (82.0%) were automatically detected. Calls not detected were typically extremely faint. The probability of non-detection of a true-positive call was 18.0%; two true-positive calls was 3.2%; three true-positive calls was 0.6%; etc. Of the data tested, the median number of consecutive (spaced at < 5 minutes apart) calls in a sequence when Night Parrots were recorded was 5 (1–34, n = 29). The probability of at least one call being detected within a sequence of median length, assuming there was variation in the location of the source of the call, was > 99.9%.

Potential Night Parrot calls detected during the analysis were compared to a reference library comprising several thousand Night Parrot calls from Western Australia. This library consists of calls recorded at sites where Night Parrots have been confirmed using visual means and is therefore considered of high reliability. The library also comprises multiple examples of all known call types from Western Australia (Leseberg *et al*. 2019).

4. Survey results

A total of 11096 Kaleidoscope detections were manually assessed for Night Parrot vocalisations. No calls definitely attributable to Night Parrots were detected during the analysis. Two calls possibly attributable to Night Parrot were detected on the night of 14 March, at approximately 2341 h, on ARU at KU004. Each call was a four-syllable monotone whistle, somewhat similar to Night Parrot calls that have been detected in Queensland. However, the two calls were very close together (only four seconds apart) which would be unusual for a Night Parrot. Each call also increased in volume, also atypical for Night Parrot. We conclude that it is unlikely these calls were given by a Night Parrot. A total of 21 non-target species were detected during the analysis and are listed in Appendix 1.

5. Conclusion

It is unlikely long-term stable Night Parrot roosts exist within approximately 200 m of the points sampled during this survey at the time of sampling. Additionally, it is unlikely that Night Parrots were foraging in proximity to these surveyed points at the time of sampling. It is important to reinforce that these results pertain specifically to that area immediately surrounding the survey points, and only for the period during which the survey was conducted. The results of these surveys do not enable robust conclusions about the presence or absence of Night Parrots in the wider landscape.

A brief scan of high resolution satellite imagery for the area where the ARUs were placed suggests there is limited suitable roosting habitat for Night Parrots in the immediate vicinity. While this search was not exhaustive or methodical, it does suggest that the area may not represent suitable Night Parrot habitat. A more thorough desktop analysis would be required to confirm this conclusion.

6. References

Jackett, N. A., B. R. Greatwich, G. Swann, and A. Boyle. 2017. A nesting record and vocalisations of the Night Parrot *Pezoporus occidentalis* from the East Murchison, Western Australia. *Australian Field Ornithology* **34**: 144-150.

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Appendix 1 – Non-target species detected during analysis

Appendix 1. Non-target species detected during analysis. Note that this list is not exhaustive, and includes only species that were incidentally detected across all survey sites while manually checking detections made by the signal scanning algorithm. Taxonomy follows the Checklist of the Terrestrial Vertebrate Fauna of Western Australia (November 2022).

Brown Quail	*Synoicus ypsilophorus*
Australian Owlet-nightjar	*Aegotheles cristatus*
Horsfield's Bronze Cuckoo	*Chalcites basalis*
Pallid Cuckoo	*Heteroscenes pallidus*
Little Buttonquail	*Turnix velox*
Bush Stone-curlew	*Burhinus grallarius*
Blue winged Kookaburra	*Dacelo leachii*
Red-backed Kingfisher	*Todiramphus pyrrhopygius*
Rainbow Bee-eater	*Merops ornatus*
Brown Falcon	*Falco berigora*
Budgerigar	*Melopsittacus undulatus*
White-winged Fairywren	*Malurus leucopterus*
Singing Honeyeater	*Gavicalis virescens*
Masked Woodswallow*	*Artamus personatus*
Grey Butcherbird	*Cractius torquatus*
Pied Butcherbird	*Cracticus nigrogularis*
Willie Wagtail	*Rhipidura leucophrys*
Torresian Crow	*Corvus orru*
Horsfield's Bush Lark	*Mirafra javanica*
Spinifexbird	*Poodytes carteri*
Australian Zebra Finch	*Taenopygia castanotis*

* Likely this species, although White-browed Woodswallow cannot be ruled out on call alone.