LEONORA OPERATIONS

FLORA & VEGETATION SITE VISIT & BASIC TERRESTRIAL FAUNA ASSESSMENT

PREPARED FOR: TALIS CONSULTANTS | ST BARBARA LIMITED

Spectrum ECOLOGY & SPATIAL

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EXECUTIVE SUMMARY

St Barbara Limited (SBL), an Australian based company, has three gold mining operations, including their Leonora Operations. The Leonora Operations consists of Gwalia mine, located just south of Leonora, approximately 235 kilometres (km) north of Kalgoorlie in the Goldfields-Esperance region of Western Australia (WA). St Barbara have proposed recommissioning of mine sites around their Leonora Operations.

Spectrum Ecology & Spatial (Spectrum) undertook a comprehensive desktop assessment of the flora & vegetation, and terrestrial fauna (vertebrate and SRE invertebrate fauna) values of the Survey Area; a basic fauna survey; and a flora site visit. The areas surveyed include for distinct mining areas Gwalia, Tower Hill, Harbour Lights, Jaspers and two proposed railway corridors.

The current assessment was undertaken by Spectrum and completed by one ecologist and one zoologist over a four day period from 16 to 19 November 2021. A variety of survey techniques were employed during the survey period.

A total of 86 significant flora taxa were identified during the flora desktop searches. Of these, five were assigned a High Likelihood of occurrence, while ten were assigned a Medium Likelihood of occurrence.

No Threatened Ecological Communities (TEC) were recorded within 50 km of the Survey Area. However, the desktop assessment recorded two Priority Ecological Communities (PEC) within 50 km of the Survey Area which are both listed as Priority 1. One of PECs intersects the Survey Area at both Gwalia and Tower Hill: The Melita calcrete groundwater assemblage type on Raeside palaeodrainage on Melita (Sons of Gwalia) Station.

The desktop assessment identified 23 species of conservation significant fauna (four mammals, 17 birds, one reptile and one invertebrate) as potentially occurring at the Survey Area based on the database search results and literature review.

The West Australian Museum database search identified four Arachnid (one spider and three pseudoscorpions), one Crustacean (fairy shrimp; aquatic species, excluded from the assessment), and one Mollusc (snail) species of potential short range endemic invertebrates within 40 km of the Survey Area.

The survey and site visit identified 13 ecological communities within the Survey Area:

- Woodland of *Acacia* (Mulga) spp. over sparse shrubs and grasses on sandy-loams on flats and flowlines;
- Open woodland of *Acacia* (Mulga) spp. over sparse shrubs on sandy-loam on flats and lower slopes;
- Open shrubland of *Acacia* (Mulga) spp. over mixed chenopods with pebbles and quartz on flats and lower slopes;
- Low open shrubland of *Acacia* spp. over mixed chenopods and grasses on pebbles and quartz on lower slopes;
- *Acacia* (Mulga) spp. over mixed shrubs on quartz outcrop;
- Low chenopod shrubland on gravelly loam on flats and flowlines;
- Lake Raeside drainage with *Tecticornia* low open shrubland;
- Open woodland of *Acacia* and *Eremophila* over diverse chenopod shrubs on sand dunes fringing salt lake;
- Low chenopod shrubland on loam on flats;
- Open shrubland of *Acacia* spp. on ironstone gravel on flats;
- *Eremophila* over *Tecticornia* open plain on fine gravel;
- *Acacia* spp. over mixed shrubs on rocky ridges and outcrops; and

- Cleared/Disturbed areas.

The ecological communities within the Survey Area that contain rocky ridges, rocky outcropping, and chenopods such as *Tecticornia* spp. were noted as potentially significant due to the possibility for rare or threatened species to be present.

No conservation significant vertebrate fauna were recorded during the survey. However, seven species have a Medium to High likelihood of occurrence in the Survey Area:

- Malleefowl (*Leipoa ocellata*);
- Common Greenshank (*Tringa nebularia*);
- Common Sandpiper (*Tringa hypoleucos*);
- Sharp-tailed Sandpiper (*Calidris acuminata*);
- Wood Sandpiper (*Tringa glareola*);
- Long-tailed Dunnart (*Sminthopsis longicaudata*); and
- Peregrine Falcon (*Falco peregrinus*).

Approximately 25 trapdoor spider burrows were located at seven site assessment locations at Gwalia, Tower Hill, Harbour Lights and Railway Corridors. The trapdoor spider burrows recorded appeared to have the distinctive 'moustache-like' arrangement of twigs that the genus *Idiosoma* have. Further targeted surveys that include the collection of specimens are required to determine their identification to species level.

1. INTRODUCTION

1.1. Project Background

St Barbara Limited (SBL), an Australian based company, has three gold mining operations, including their Leonora Operations. The Leonora Operations consists of Gwalia mine, located just south of Leonora, approximately 235 kilometres (km) north of Kalgoorlie in the Goldfields-Esperance region of Western Australia (WA) (Map 1.1).

Talis Consultants (Talis) have recently completed an approvals strategy for St Barbara of the proposed recommissioning of mine sites around their Leonora Operations. It was identified that environmental approvals are required. Historical surveys were completed pre-2011, and it was recommended that updated surveys and studies be completed to reflect current guidelines and requirements.

The Leonora Operations expansion consists of four distinct mining areas: Gwalia, Tower Hill, Harbour Lights and Jaspers (Map 1.1). In addition, two areas are required for rail loading facilities (temporary and permanent) near the existing rail corridor, east of Gwalia mine. The Leonora Operations expansion area (Survey Area) covers approximately 3,628 hectares (ha).

1.2. Scope of Works

Talis commissioned Spectrum Ecology & Spatial (Spectrum) on behalf of SBL to undertake the following :

- A comprehensive desktop assessment of the flora, vegetation and terrestrial fauna (vertebrate and SRE invertebrate fauna) values of the Survey Area;
- A basic fauna survey; and
- A flora site visit.

The information collected during this assessment will inform the requirements and level of future surveys to be conducted in Autumn 2022.

1.3. Legislation & Guidelines

Flora and fauna in Western Australia are protected by various legislation, including:

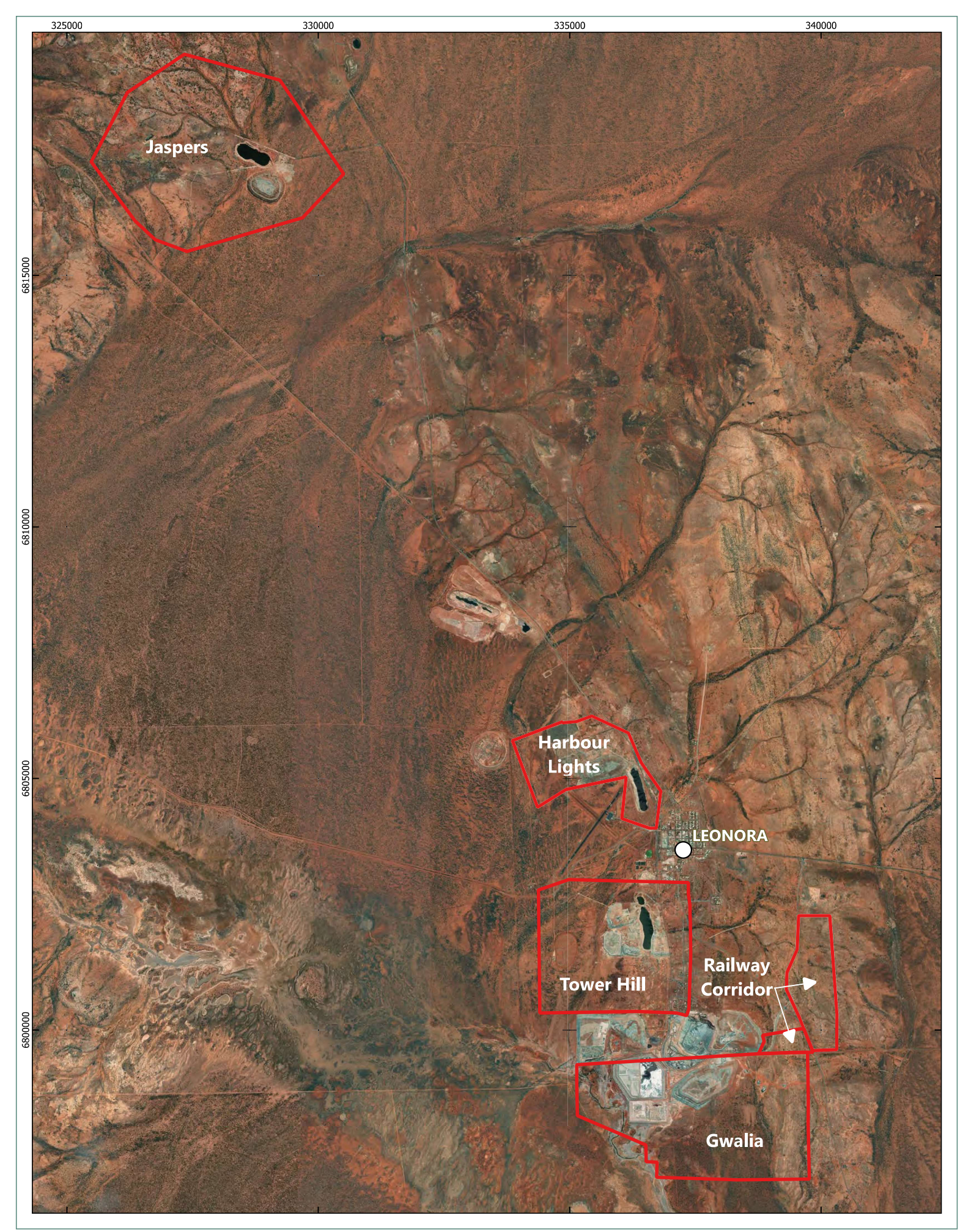
- *Biodiversity Conservation Act 2016* (BC Act);
- *Environmental Protection Act 1986* (EP Act); and
- *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The assessments completed within this report are compliant with a flora site visit and a basic fauna survey, as outlined in:

- Technical Guidance: Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA, 2020);
- Environmental Protection Authority (EPA) Statement of Environmental Principles, Factors, and Objectives (EPA 2018);
- EPA Environmental Factor Guideline: Fauna (EPA, 2016a);
- EPA Environmental Factor Guideline: Flora and Vegetation (EPA 2016b);
- EPA Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016c);
- Technical Guidance: Sampling of Short Range Endemic Invertebrate Fauna (EPA, 2016d);

Other survey and assessment guidelines that will be referred to include:

- DBCA Threatened and Priority Flora Report Form – Field Manual (DBCA 2017b);
- Survey Guidelines for Australia's Threatened Birds (DEWHA 2010);
- Survey Guidelines for Australia's Threatened Mammals (DSEWPC 2011a);
- Survey Guidelines for Australia's Threatened Reptiles (DSEWPC 2011b);
- Interim Guideline for Preliminary Surveys of Night Parrot (*Pezoporus occidentalis*) in Western Australia (DPaW 2017); and
- Guideline for the Survey of Arid Bronze Azure Butterfly (ABAB) in Western Australia (DBCA 2020).
- DBCA Threatened and Priority Flora Report Form – Field Manual (DBCA 2017b); and
- National Vegetation Information System (NVIS) Australian Vegetation Attribute Manual (ESCAVI, 2003).



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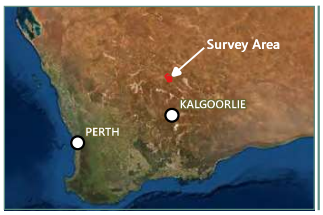
Survey Area



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Coordinate System: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Units: Meter

Spectrum

Author: EM Approved: AH Date: 09-12-2021

Location Map

Leonora Operations

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MAP 1.1

1.4. Bioregion

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

The Survey Area is situated in the Murchison IBRA region, which is characterised by low hills and mesas with vegetation consisting mainly of low Mulga woodlands. The Murchison is divided into the Eastern and Western Murchison subregions, and the Survey Area is located in the Eastern Murchison (Figure 1.1).

The Eastern Murchison subregion features internal drainage, and extensive areas of elevated red desert sandplains with minimal dune development. Vegetation is dominated by Mulga Woodlands often rich in ephemeral species; hummock grasslands, saltbush shrublands and *Tecticornia* shrublands. The subregion contains calcrete aquifers in the northern part of the subregion which are known to support a wide range of subterranean aquatic fauna that are short range endemics (McKenzie, May and McKenna, 2003).

Figure 1.1: IBRA Region

1.5. Climate

The Murchison region has an arid climate with bimodal rainfall that usually falls in winter. Spatially averaged median rainfall is 201 mm per year (McKenzie, May and McKenna, 2003).

Leonora experiences hot summers due to the arid climate, with mean maximum temperature peaking in January at 37°C and a mean minimum temperature of 22°C. July is the coolest month, with mean maximum temperature of 18°C and an average minimum temperature of 6°C. Leonora's mean annual rainfall recorded from 1898 to 2020 is 236.4 mm, with most rainfall occurring from January to June (BOM 2022).

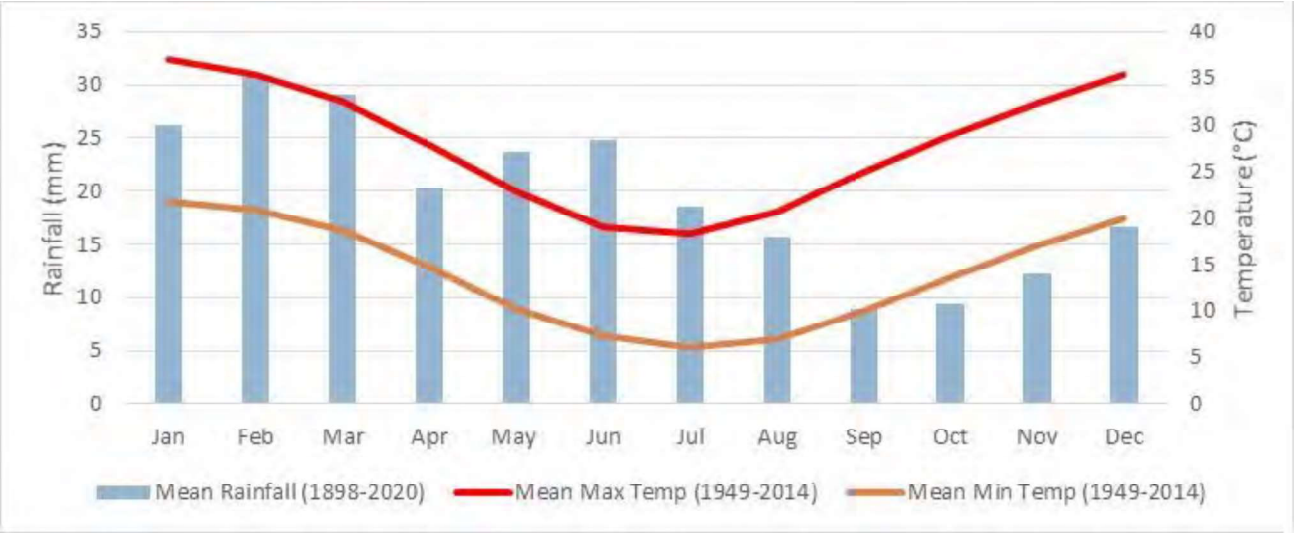


Figure 1.2: Leonora Climate Data (Leonora Station #012046) (BOM 2022)

1.6. Disturbance History

The Eastern Murchison subregion is mainly used for grazing native pastures (85.5%), with lesser areas of Unallocated Crown Land (UCL), and Crown Reserves (11.3%). Conservation lands constitute only 1.4% of the subregion. Mining interest in nickel and gold mining in particular are considerable; however, most mining leases still come under the Pastoral lands act and as such, are still required to be stocked (McKenzie, May and McKenna, 2003).

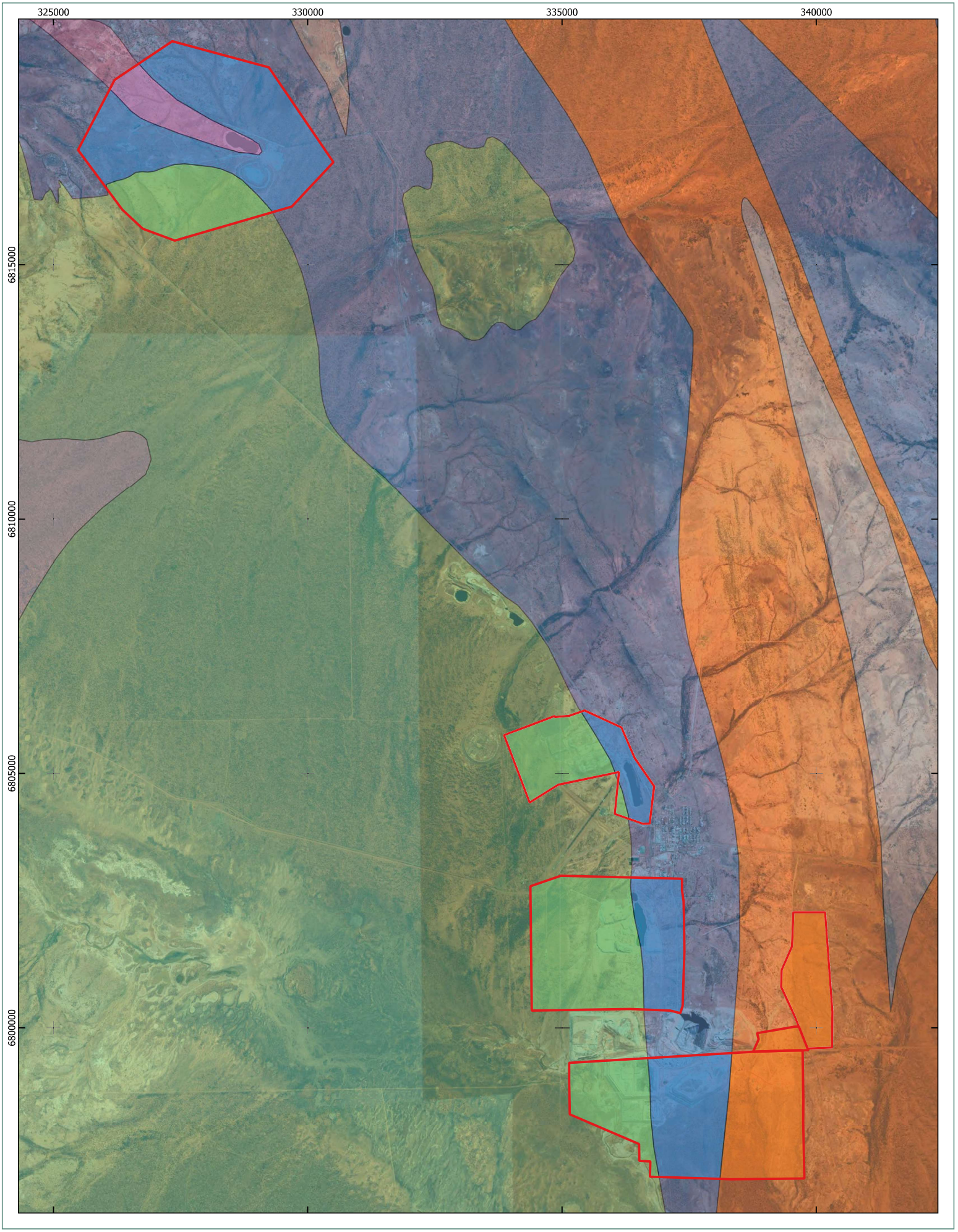
1.7. Geology

The surface geology of Western Australia has been mapped at a scale of 1:250,000 (DMIRS 2020), which is the finest-scale mapping available for the area. Four geological units (A-u-YEG, A-f-YEG, A-g-Y, A-b-YEG) have been mapped within the Survey Area and are listed in Table 1.1 and displayed in Map 1.2.

Unit A-b-YEG has the largest occurrence within the Survey Area, covering a total of 41.4%, which comprises 0.1% of the Eastern Murchison bioregion. The remaining three geological units have less than 0.1% of their total extents within the Survey Area (Table 1.1 and Map 1.2). None of the geological units are restricted to the Eastern Murchison IBRA region.

Table 1.1: Geological Units of the Survey Area

Unit	Description	Area in Survey Area (ha)	% of Survey Area	Total WA Extent (ha)	Total Eastern Murchison Extent (ha)	% of Eastern Murchison Extent Within Survey Area
A-u-YEG	Ultramafic volcanic rock dominant; metamorphosed.	169.7	4.7	279,290.7	120,603.4	0.1
A-f-YEG	Volcanic and volcaniclastic felsic rocks, undivided; andesite to rhyolite, minor basaltic andesite; local fragmental textures; metamorphosed.	620.7	17.1	1,275,988.2	968,910.2	0.1
A-g-Y	Granitic rock, undivided; metamorphosed.	1337.8	36.9	25,963,557.3	6,547,217.4	<0.1
A-b-YEG	Fine to very fine grained mafic rock with minor ultramafic rock, undivided; metamorphosed.	1500.9	41.4	2,288,281.1	1,706,323.5	0.1

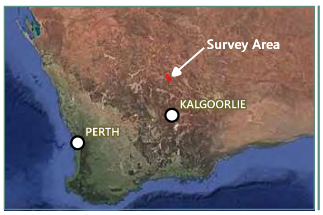


Legend

Survey Area

Geological Units

- A-b-YEG
- A-f-YEG
- A-g-Y
- A-u-YEG
- Not in Survey Area



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Units: Meter

Spectrum

Author: EM Approved: AH Date: 08-02-2022

Geology of the Survey Area (1:250,000)

Leonora Operations

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MAP 1.2

1.8. Land Systems

The land systems of Western Australia have been mapped at a scale of 1:250,000 (DAFWA 2016). Eleven land systems occur across the Survey Area. All land systems are well represented in the wider region, occur across multiple bioregions, and have less than 2% of their Eastern Murchison extent occurring within the Survey Area (Table 1.2 and Map 1.3). The most commonly occurring land system is the Gundockerta Land System, followed by the Felix Land System, covering 39.6% and 16.1% of the Survey Area, respectively. Although the Felix Land System covers only 16.1% within the Survey Area, it comprises 1.7% of the Eastern Murchison extent.

Table 1.2: Land Systems

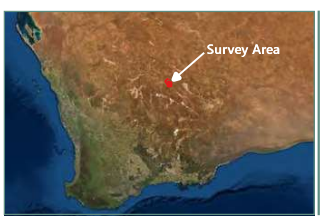
Description	Area in Survey Area (ha)	% of Survey Area	Total WA Extent (ha)	Total Eastern Murchison Extent (ha)	% of Eastern Murchison Extent Within Survey Area
Bevon Land System Irregular low ironstone hills with stony lower slopes supporting mulga shrublands.	23.6	0.7	239,287.9	223,993.6	<0.1
Brooking Land System Prominent ridges of banded iron formation supporting mulga shrublands and occasional minor halophytic communities.	283.3	7.8	96,668.2	95,991.2	0.3
Carnegie Land System Salt lakes with fringing saline alluvial plains, kopi dunes and sandy banks, supporting halophytic shrublands and acacia tall shrublands.	172.1	4.7	1,747,656.2	1,104,320.9	<0.1
Felix Land System Gently undulating plains with quartz mantles, supporting acacia-eremophila shrublands locally with wanderrie grasses.	583.9	16.1	35,408.1	34,104.4	1.7
Gundockerta Land System Extensive, gently undulating calcareous stony plains supporting bluebush shrublands.	1438.7	39.6	340,744.8	329,681.6	0.4
Jundee Land System Hardpan plains with variable gravelly mantles and minor sandy banks supporting weakly groved mulga shrublands.	48.4	1.3	665,060.0	508,923.4	<0.1
Leonora Land System Low greenstone hills and stony plains supporting mixed chenopod shrublands.	196.9	5.4	126,896.5	125,924.3	0.2
Monk Land System Hardpan plains with occasional sandy banks supporting mulga tall shrublands and wanderrie grasses.	387.7	10.7	997,994.6	994,080.9	<0.1
Rainbow Land System Hardpan plains supporting mulga tall shrublands.	160.4	4.4	258,701.6	235,036.2	0.1
Violet Land System: Gently undulating gravelly plains on greenstone, laterite and hardpan, with low stony rises and minor saline plains; supporting groved mulga and bowgada shrublands and occasionally chenopod shrublands.	202.1	5.6	548,629.9	418,040.7	<0.1
Windarra Land System Gently undulating stony plains and low rises with quartz mantles on granite, supporting acacia-eremophila shrublands.	132.1	3.6	229,967.9	227,243.4	<0.1

Legend

- Survey Area

Land Systems

- Bevon
- Brooking
- Carnegie
- Felix
- Gundockerta
- Jundee
- Leonora
- Monk
- Rainbow
- Windarra
- Violet
- Not in Survey Area



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Spectrum

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Land Systems

Leonora Operations

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MAP 1.4

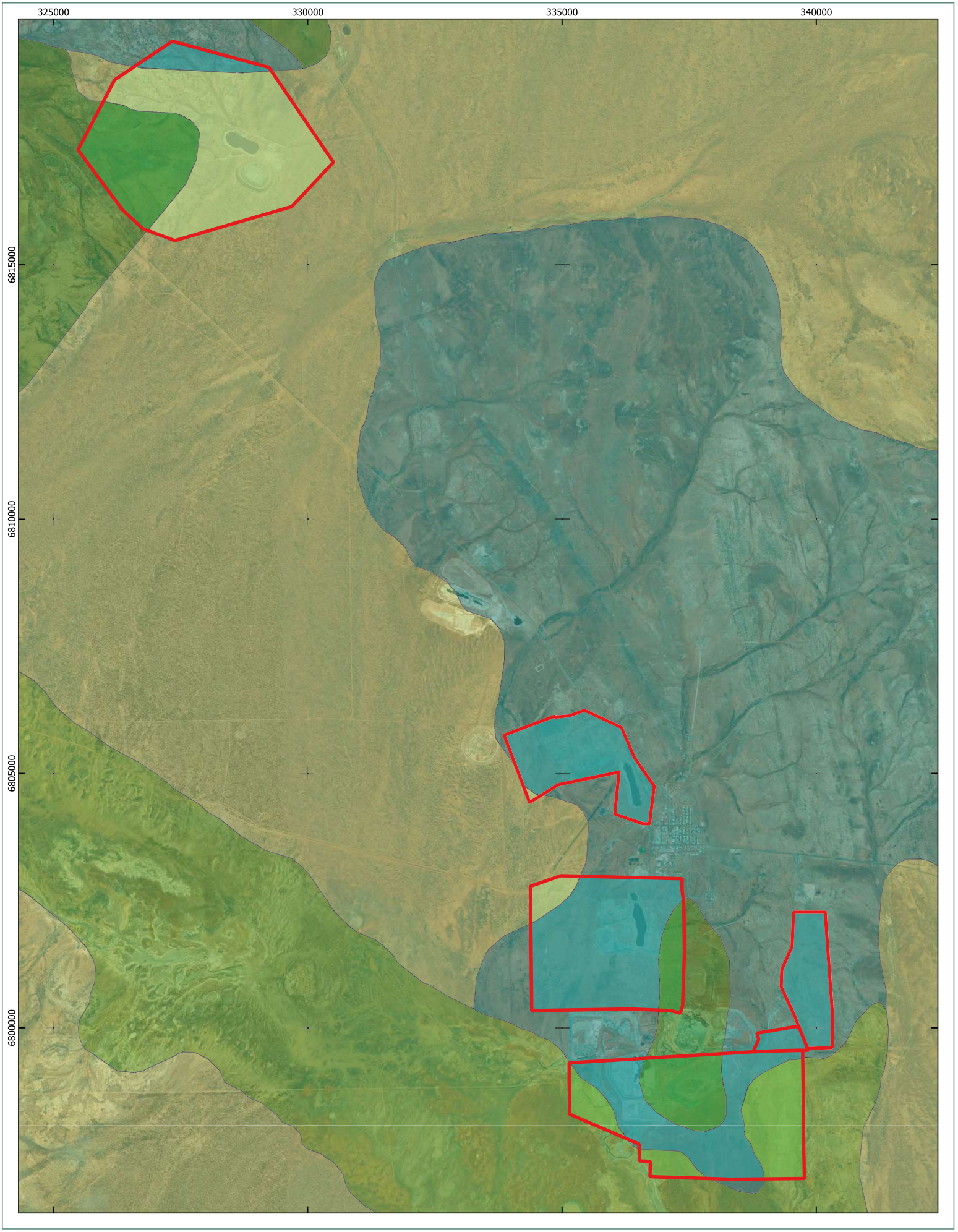
1.9. Beard Vegetation

Pre-European vegetation mapping was originally undertaken by Beard at various scales across the state and has since been updated to be consistent with NVIS descriptions a scale of 1:500,000 (DPIRD 2019). State-wide vegetation statistics are available from 2018, which lists pre-European extent, current extent, and area in DBCA managed lands, and is a useful tool to determine if a vegetation community is rare or otherwise significant (Government of Western Australia, 2019).

Four vegetation associations have been mapped within the Survey Area and are listed in Table 1.3 and displayed on Map 1.4. All four units have more than 97% of their pre-European extent remaining, with less than 0.5% of their extent occurring within the Survey Area (Table 1.3).

Table 1.3: Beard Vegetation Associations

Sub-Assoc.	Description	Area in Survey Area (ha)	% of Survey Area	Pre-European Extent	Current Extent	% Remaining	% of WA Current Extent in Survey Area
18.16	*Acacia aneura, Brachychiton gregorii, Alectryon oleifolius, Eucalyptus oleosa* open low woodland over *Eremophila margarethae, Eremophila granitica, Eremophila dielsiana, Eremophila fraseri, Eremophila abietina* tall sparse shrubland over *Eragrostis eriopoda, Danthonia bipartita, Aristida contorta, Enneapogon nigricans, Cephalipterum drummondii* low sparse tussock grassland.	884.5	24.4	WA: 2,539,657.3	WA: 2,524,495.7	WA: 99.4	<0.1
				Eastern Murchison: 2,536,021.0	Eastern Murchison: 2,520,869.5	Eastern Murchison: 99.4	
28	*Acacia aneura* open low woodland.	1,715.4	47.3	WA: 377,608.4	WA: 373,885.1	WA: 99	0.5
				Eastern Murchison: 141,411.3	Eastern Murchison: 137,703.1	Eastern Murchison: 97.3	
39.3	*Acacia aneura, Acacia quadrimarginea, Eremophila forresti* tall sparse shrubland over *Ptilotus obovatus* mid sparse forbland.	677.6	18.7	WA: 155,416.6	WA: 151,580.2	WA: 97.5	0.4
				Eastern Murchison: 155,416.6	Eastern Murchison: 151,580.2	Eastern Murchison: 97.5	
676.23	*Halosarcia* sp., *Rhagodia spinescens, Atriplex hymenotheca, Atriplex lindleyi, Aizoon quadrifidum* mid open samphire and chenopod shrubland.	350.8	9.7	WA: 221,870.3	WA: 221,809.0	WA: 99.9	0.2
				Eastern Murchison: 221,870.3	Eastern Murchison: 221,809.0	Eastern Murchison: 99.9	



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Survey Area

Beard Vegetation Associations

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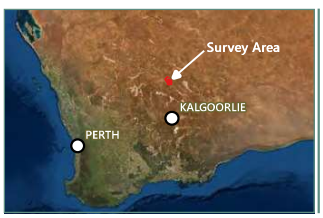
- 676.00000000000



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Units: Meter

Spectrum

Author: EM Approved: AH Date: 09-12-2021

Beard Vegetation Associations

Leonora Operations

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MAP 1.4

1.10. Significant Lands

Five significant lands are located within 100 km of the Survey Area. These are listed in Table 1.4, displayed on Map 1.5 and are described in the following sections.

Table 1.4: Environmentally Significant Areas within the Survey Area

Reserve Name (Protected Area ID)	Distance from Survey Area (km)
Conservation Estate	
Bulga Downs & Cashmere Downs Pastoral leases portions	100.2 km WNW
TECs/PECs	
Melita calcrete groundwater assemblage type on Raeside palaeodrainage on Melita (Sons of Gwalia) Station	Overlaps the Survey Area
Sturt Meadows calcrete groundwater assemblage type on Raeside palaeodrainage on Sturt Meadows Station	25 km WNW
Environmentally Sensitive Areas	
Lake Ballard	67.2 km S
Lake Marmion	81.1 km S
Wetlands	
Lake Ballard	67.2 km S
Lake Marmion	81.1 km S

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*. (DBCA 1984). The conservation estate is generally managed by the Parks and Wildlife Service of DBCA to protect Western Australia's biodiversity and includes National Parks, Nature Reserves, Conservation Reserves and other areas managed primarily for biodiversity conservation (DoEE 2016).

No conservation estates were identified from the Collaborative Australian Protected Area Database (CAPAD) within 100 km of the Survey Area. However, Bulga Downs & Cashmere Downs Pastoral leases portions, a Nature Reserve in progress, is located just outside of the 100 km buffer (Table 1.4 and Map 1.5).

1.10.2. Environmentally Sensitive Areas

Environmentally Sensitive Areas (ESA) that are associated with flora and vegetation are areas that are defined by the Department of Water and Environmental Regulation (DWER 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.

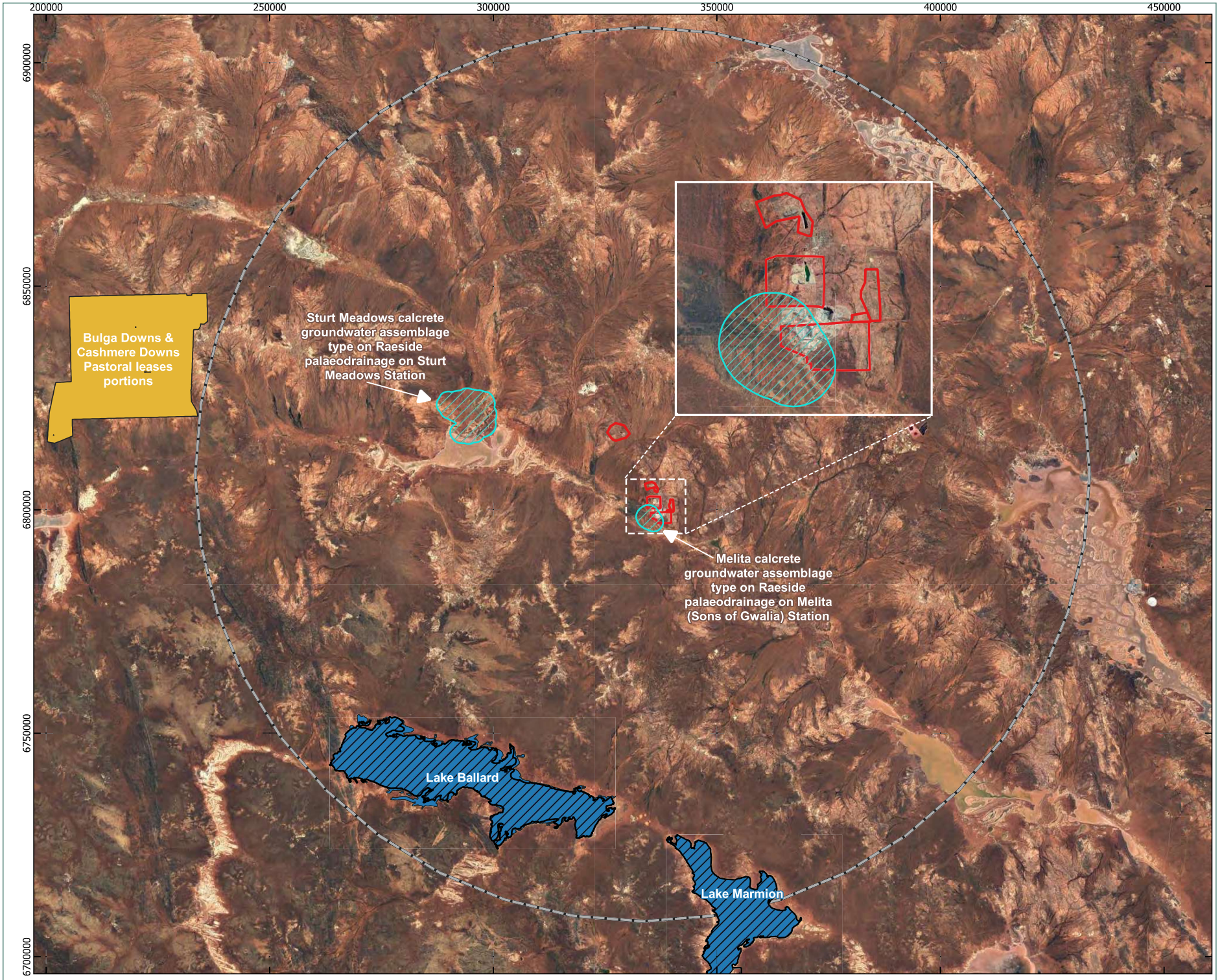
Two ESA's were found within 100 km of the Survey Area, Lake Ballard and Lake Marmion (Table 1.4 and Map 1.5). In addition, two TECs were recorded from within 50 km of the Survey Area and both are listed as

Priority 1 systems (Table 1.4 and Map 1.5). One of these TECs, Melita calcrete groundwater assemblage type on Raeside palaeodrainage on Melita (Sons of Gwalia) Station, overlaps the Survey Area.

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 (DoEE 2019).

Two nationally significant wetlands were found within 100 km of the Survey Area, Lake Ballard and Lake Marmion, located 67.2 km and 81.1 km south, respectively (Table 1.4 and Map 1.5).



Legend

- Survey Area
- Important Wetlands
- Conservation Estates
- Environmentally Sensitive Areas
- TECs/PECs - (Priority 1)
- 100 km buffer

N

0 5 10 15 20 25 km

Scale 1:775,000 @ A3

Coordinate System: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Units: Meter

Spectrum

Author: EM Approved: AH Date: 09-02-2022

Significant Lands in the Region

Leonora Operations

MAP 1.5

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2. METHODS

2.1. Desktop Assessment

A desktop review of all relevant and available biological data sources was undertaken prior to the field survey to assess the flora, vegetation, and fauna and SRE likely to occur in the Survey Area. A summary of the database searches completed is outlined in Table 2.1.

Table 2.1: Summary of Database Searches

Source	Custodian	Details
Threatened and Priority Flora (TPFL)	Department of Biodiversity Conservation and Attraction (DBCA)	Central point with 80 km buffer Date: 5/11/21
Western Australian Herbarium (WAHerb)	DBCA	Central point with 80 km buffer
Threatened and Priority Ecological Communities (TEC/PEC)	DBCA	Central point with 50 km buffer
Threatened Fauna Database	DBCA	Central point with 100 km Date: 3/11/21
Invertebrate Fauna Databases - Arachnida & Myriapoda/ Mollusca/ Crustacea	Western Australian Museum (WAM)	Polygon plus 40 km buffer Date: 21/10/21
NatureMap	Department of Parks and Wildlife (DPAW), WAM	Central point with 40 km buffer Date: 22/10/21
Protected Matters	EPBC	Central point with 40 km buffer
Index of Biodiversity Surveys and Assessments (IBSA)	DBCA	Central point with 100 km buffer

The DBCA database searches were requested with a 40 km buffer. However, due to the low records returned, DBCA adjusted each database search as needed to include records of additional potentially occurring species.

2.1.1. Previously Conducted Flora and Fauna Assessments

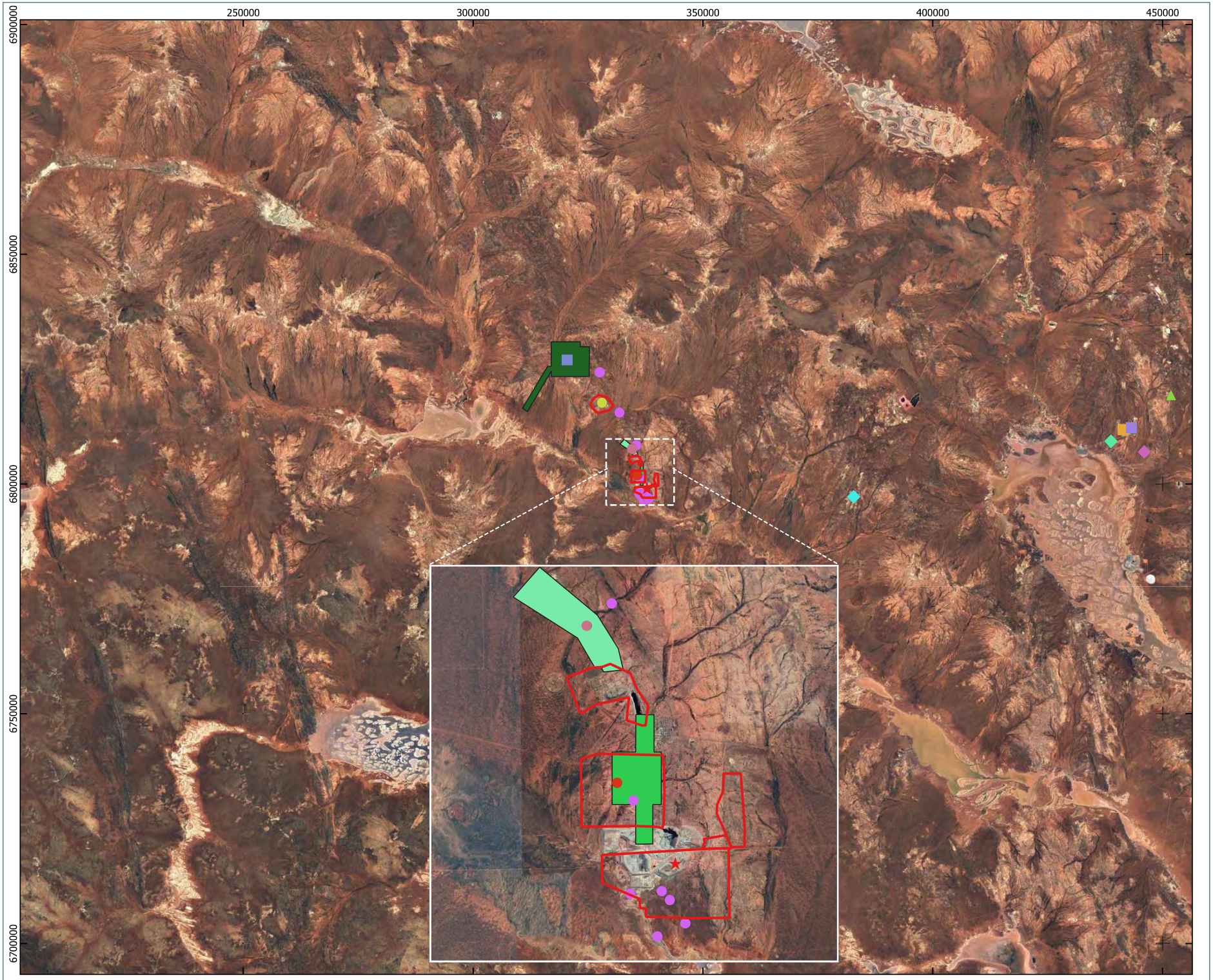
Surveys previously conducted in the vicinity of the Survey Area were reviewed for significant flora, vegetation, and fauna. This included surveys up to 125 km away due to the lack of records. Reports were incorporated if they were provided by the client or publicly available. The reports included in the desktop assessment are listed in Table 2.2, and the approximate location of the survey, where available, is displayed on Map 2.1.

Table 2.2: Summary of Previous Surveys Undertaken in the Vicinity of the Survey Area

Report	Reference	Location from Current Project	Survey Summary
Flora reports			
Assessment of Flora and Vegetation Values – King of the Hills Mine Expansion	(Mattiske Consulting Pty Ltd, 2020)	5 km north	One Priority 1 species, *Frankenia georgei*, was recorded. No other threatened species were recorded. Five vegetation communities were recorded, with no TECs or PECs identified.
Flora and Vegetation Survey of the Kallis – Trump and Poker – Forrest Lease Areas	Mattiske Consulting Pty Ltd, 2008	Overlaps a small portion of the current Survey Area	No species of conservation significance were recorded. Six vegetation communities were defined and affected by grazing and previous mining activities.

Report	Reference	Location from Current Project	Survey Summary
Flora and Vegetation Survey and Establishment of Baseline Transects for a Creek Diversion at Tower Hill	Mattiske Consulting Pty Ltd, 2007	Overlaps current Survey Area	Three vegetation communities were recorded; none are considered regionally or locally significant. Two 50 m monitoring transects were established.
Flora and Vegetation Survey of St Barbara, Leonora Pipeline Site	Mattiske Consulting Pty Ltd, 2006	Overlaps current Survey Area	No Declared Rare Flora or Priority species were recorded during the survey. Four plant communities were defined, no TECs were located.
Declared Rare and Priority Flora Search of Proposed Mining Areas at Ulysses and Gwalia Deeps	Mattiske Consulting Pty Ltd, 2000	Overlaps current Survey Area	Fifty-nine rare and endangered taxa identified as potentially occurring. No Declared Rare Flora or Priority species were recorded during the survey.
Fauna reports			
Level 2 Fauna Assessment: King of the Hills Project	Terrestrial Ecosystems, 2020a	4 km north	A Level 2/detailed vertebrate fauna assessment was completed for Red 5's King of the Hills mine expansion. No conservation significant fauna were recorded.
Vertebrate Fauna Risk Assessment: Granny Smith Tailing Storage Facility Expansion	Terrestrial Ecosystems, 2020b	102 km east	Terrestrial Ecosystems completed a basic vertebrate fauna assessment at the Granny Smith Mine. No conservation significant fauna species were recorded. However, three have the potential to occur.
Level 2 Fauna Risk Assessment for Granny Deeps Project Area	Terrestrial Ecosystems, 2011	102 km east	Terrestrial Ecosystems completed a level 2/ detailed vertebrate fauna assessment at the Granny Deeps Project Area. Long-tailed Dunnart were recorded.
Fauna Survey of the Leonora Area	Bamford Consulting Ecologists, 2010	Overlaps current Survey Area	A detailed fauna assessment was conducted based on an initial desktop review and detailed field surveys. Five conservation significant fauna species were recorded during the field surveys (Malleefowl, Rainbow Bee-eater, Bush Stone-curlew, Wood Sandpiper, Inland Greater Long-eared Bat).
Fauna Assessment of the Kailis Project	Bamford Consulting Ecologists, 2008	Overlaps part of the Survey Area	A level 1/ basic survey was completed, with 43 species recorded. No species of conservation significance were recorded. However, nine species of conservation significance are considered likely to occur in or utlise habitats present.
Fauna Assessment of the Tower Hill Project	Bamford Consulting Ecologists, 2007	Overlaps current Survey Area	A level 1/ basic survey was conducted. Forty-one fauna species recorded in the study area. No conservation significant fauna species were recorded.
A Vertebrate Fauna Survey of the North Lake Carey Region	Dunlop and Payne, 1999	100 km east	A detailed fauna assessment was conducted. No conservation significant fauna species were recorded.
Vertebrate Fauna Survey of the Murrin Murrin Expansion Project	Ninox Wildlife Consulting, 1998	42 km east	Ninox Wildlife Consulting completed a Level 2 fauna survey at Murrin Murrin in 1998. Both Malleefowl and Peregrine Falcon were recorded during this survey. No site locations were available.

Report	Reference	Location from Current Project	Survey Summary
Mt Weld Rare Earths Project	Kinhill Engineers, 1992	Approximately 105 km east	Public Environmental Review outlining results of a detailed fauna survey. No conservation significant fauna species were recorded.
Flora and Fauna reports			
Basic Flora and Fauna Survey (Internal database)	Spectrum Ecology, 2021	Over 100 km east	Spectrum Ecology undertook a Basic Flora and Fauna Survey. Two significant vegetation types identified; RD1 supports two P3 species: *Phyllanthus baeckeoides* and *Calytrix praecipua*. *Phyllanthus baeckeoides*, has a restricted distribution. No TECs or PECs identified. No fauna species of conservation significance were recorded.. However there are five species which were assigned a Medium to High likelihood of occurrence.
Targeted Threatened Flora and Malleefowl Mound Search – Leonora Exploration Targets of POW Application	Native Vegetation Solutions, 2019	Overlaps current Survey Area	No Threatened Flora or evidence of Malleefowl were recorded.
The Terrestrial Flora and Fauna of Lake Carey	Brearley, Dunlop and Osborne, 1997	115 km east	Curtin University completed a terrestrial flora and fauna survey at Lake Carey. No species of conservation significance were detected during this survey. Site locations were not provided.



Legend

- Survey Area

Previous Flora and Fauna Surveys

- Bamford Consulting Ecologist (2010)
- Bamford Consulting Ecologists (2008)
- Bamford Consulting Ecologists (2007)
- Brearley, Dunlop & Osborne (1997)
- Dunlop and Payne (1999)
- Kinhill Engineers (1992)
- Native Vegetation Solutions (2019)
- Ninox Wildlife Consulting (1998)
- Terrestrial Ecosystems (2020a)
- Terrestrial Ecosystems (2020b)
- Terrestrial Ecosystems (2011)
- Spectrum Ecology (2021)
- Mattiske Consulting Pty Ltd (2020)
- Mattiske Consulting Pty Ltd (2008)
- Mattiske Consulting Pty Ltd (2007, 2006)
- Mattiske Consulting Pty Ltd (2000)

N

0 5 10 15 20 25 km

Scale 1:750,000 @ A3

Coordinate System: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Units: Meter

Spectrum

Author: EM Approved: AH Date: 23-02-2022

Location of Previous Surveys

Leonora Operations

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MAP 2.1

2.1.2. Likelihood of Occurrence

An assessment of each significant species or community identified in the above desktop assessment was completed with the following information provided:

- Conservation status (EPBC Act, BC Act, DBCA listing);
- Description of species habitat requirements;
- Description of flowering period (flora only);
- Distance of record to the Survey Area;
- Summary of relevant records including source of record (DBCA, previous report etc.); and
- Likelihood of occurrence criteria assigned and justification of likelihood of occurrence that considers known habitats, survey effort etc.

A likelihood of occurrence assessment was conducted using the criteria listed in Table 2.3, which included:

- assessing the distance of the record from the Survey Area (historical database records considered not accurate were excluded if required);
- presence of appropriate habitats within the Survey Area (using land systems, geology, vegetation mapping, and/or aerial imagery); and
- the age of the record (fauna only).

Table 2.3: Likelihood of Occurrence Assessment Criteria

Likelihood	Flora & Vegetation Criteria	Fauna Criteria
Recorded	Species or community recorded within the Survey Area.	Species recorded within the Survey Area within the previous ten years.
High	Species or community recorded in 20 km of the Survey Area and suitable habitat occurs in the Survey Area.	Species recorded within or in proximity to the Survey Area within the previous 20 years. Suitable habitat occurs in the Survey Area.
Medium	Species or community recorded outside the Survey Area, within 40 km and suitable habitat occurs within.	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	Suitable habitat does not occur within or in proximity to the Survey Area.	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	N/A	Species not recorded within 50 km despite multiple recent surveys. Suitable habitat does not occur within the Survey Area. Species considered locally extinct.

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

The Environmental Protection Authority (EPA) has given instruction that all biological surveys collecting data on biodiversity submit the report and associated raw data to IBSA as an IBSA data package. All survey data collected for this project will be provided electronically to comply with IBSA data standards.

2.2. Field Survey Timing

The basic fauna and flora site visit was undertaken from 16 to 19 November 2021. Rainfall preceding a field survey typically influences the number and type of flora and fauna species recorded. Monthly rainfall was sourced from the nearest Bureau of Meteorology (BOM) station with complete data, Leonora (#012046) for long-term data and Leonora Aero (#12241) for recent observations, with both stations occurring within or near the Survey Area (BOM 2022). Rainfall recorded 12 months prior to the survey, median monthly rainfall, and mean maximum temperatures are presented in Figure 2.1.

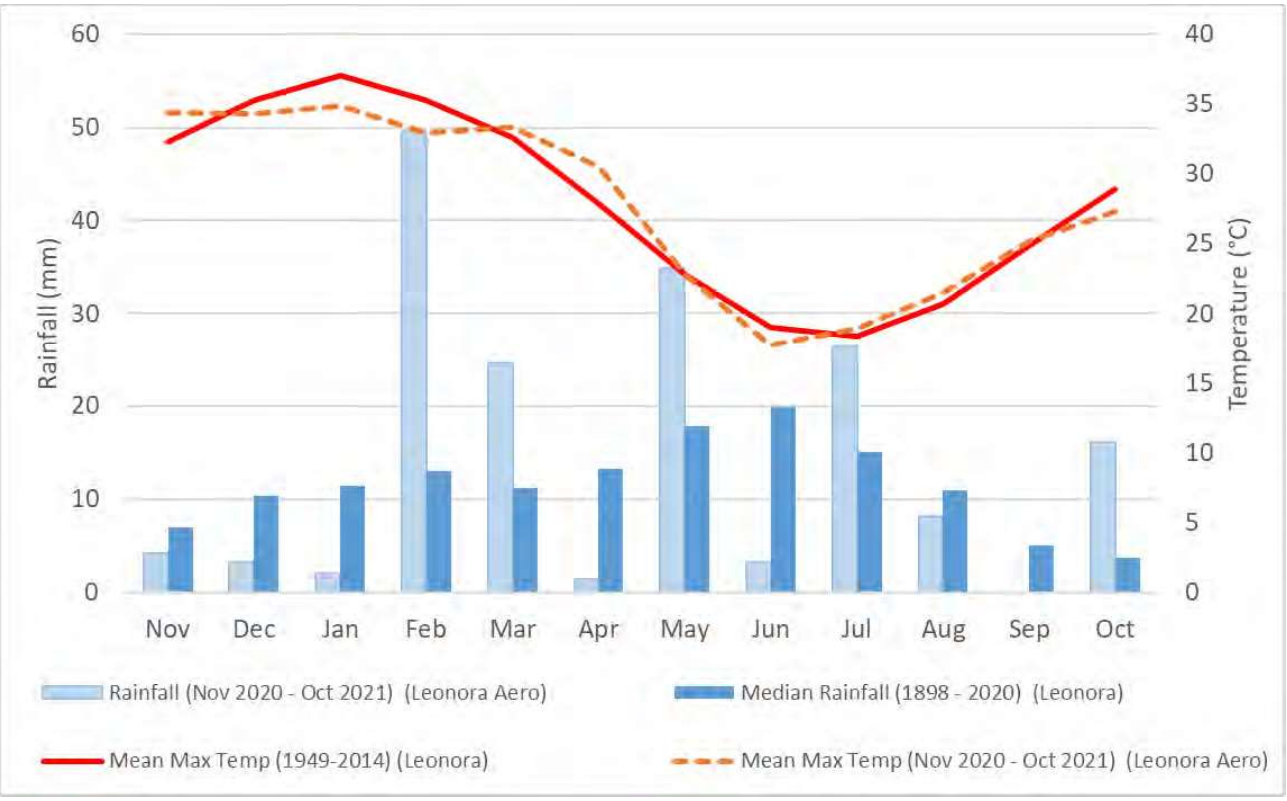


Figure 2.1: Monthly Rainfall and Temperature Data from Leonora (#12046) and Leonora Aero (#12241)

The following rainfall was recorded at Leonora prior to the survey:

- The 12 months preceeding the survey (November 2020 to October 2021) recorded 173.8 mm, 35.2 mm above the long-term median of 138.6 mm; and
- The three months preceding the survey (August – October 2021) recorded 24.4 mm, 4.7 mm higher than the long-term median of 19.7 mm.

The Survey Area is located within the Eremaean Botanical Province, as described by Beard (1980). From a faunal perspective, surveys are best conducted during peak fauna activity. The survey was undertaken at the recommended time for surveying reptiles: September to April, with the majority of the remaining faunal groups best surveyed following significant rainfall events, as outlined in the Technical Guidance (EPA, 2020).

2.3. Field Methods & Sampling Effort

2.3.1. Site Visit

Spectrum conducted a site visit of the Survey Area from the 16 to 19 November 2021. The survey was completed by one ecologist and one zoologist over four days. The site visit focused on ground truthing the desktop results and to highlight any areas of significance within the Survey Area.

A total of 46 site assessments were completed, and information was collected to inform future surveys within the Survey Area (Map 2.2). The information (such as vegetation type, substrate and significance) collected at each site is detailed in Appendix A.

2.3.2. Fauna Sampling Effort

The basic terrestrial fauna survey was carried out in accordance with the Technical Guidance: Terrestrial Fauna Surveys (EPA 2020). The guidance suggests selective low-intensity sampling of fauna and identification of fauna habitats (ecological communities) to verify the accuracy of the desktop assessment. The approach of the basic fauna survey was to describe and map the fauna habitats/ecological communities across the Survey Area and complete active searches to describe the vertebrate fauna assemblages, particularly any significant fauna identified as likely to be present.

Various survey techniques were used for vertebrate fauna, as outlined in Table 2.4. All survey data has been provided electronically with this report as an IBSA data package.

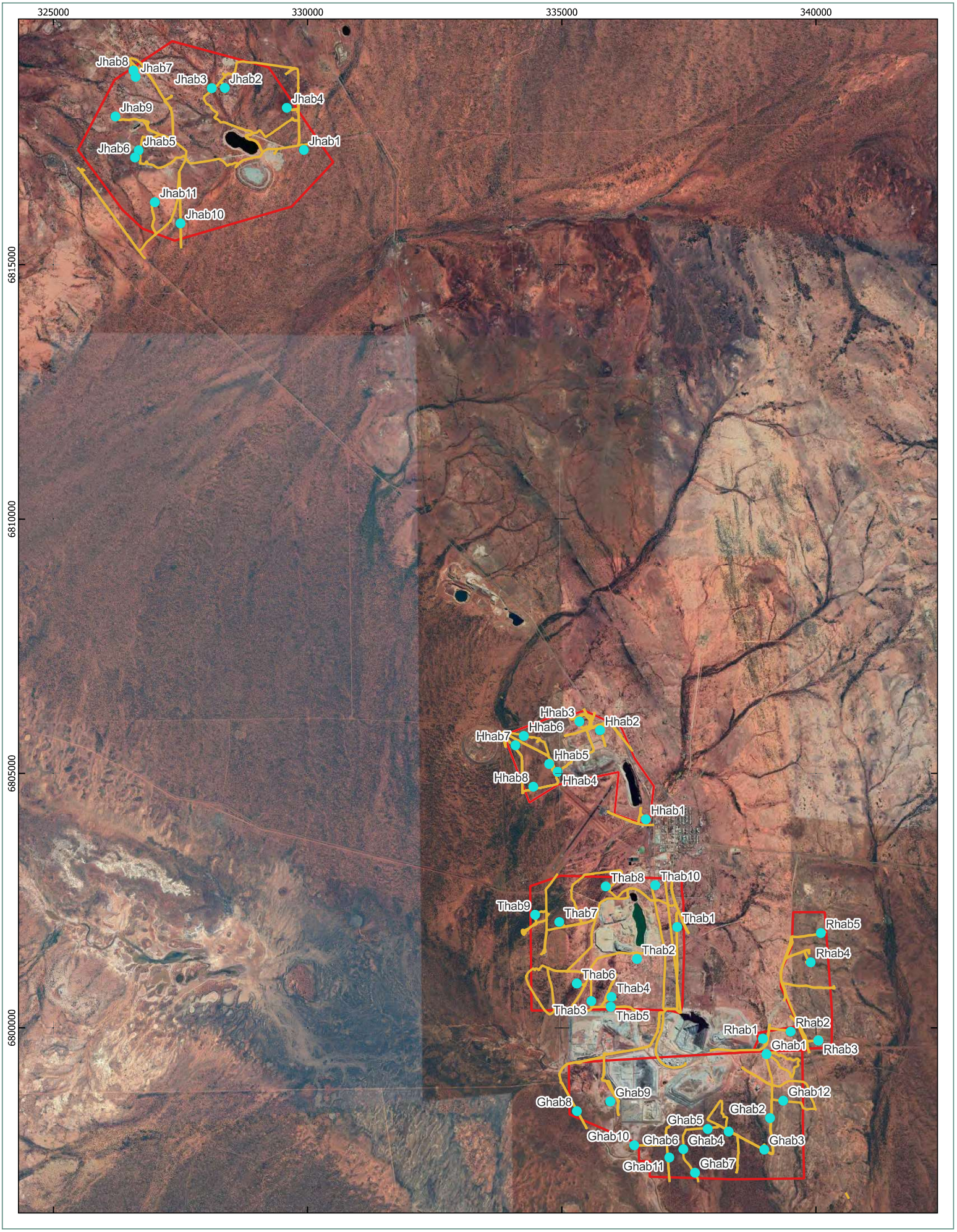
Table 2.4: Vertebrate Fauna Survey Techniques

Fauna	Survey Technique
Mammals	Direct sightings and indirect evidence such as tracks, scats and diggings were recorded across the Survey Area.
Birds	Direct sightings and calls, as well as indirect evidence such as feathers, pellets, and nests were recorded across the Survey Area. Search effort was focused on Malleefowl in areas of potential habitat.
Reptiles & Amphibians	Direct sightings and indirect evidence such as calls, tracks, diggings, skins, and latrines were recorded, and targeted searches were undertaken in areas with suitable habitat. Raking of leaf litter, if present, in an effort to detect leaf litter dwelling reptiles.
SRE Invertebrate Fauna	Litter beds and areas between litter beds were surveyed for the leaf arrangement burrow lids characteristic of trapdoor spiders (*Idiosoma* spp.) in the region.

2.4. Ecological Community Mapping

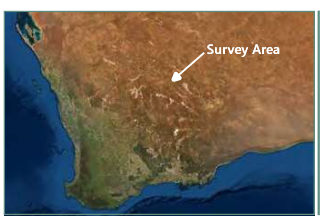
Ecological community mapping identifies areas of vegetation and land features that are distinguishable from other areas. Ecological communities were identified and mapped based on the following information:

- General vegetation type (Shepherd, Beeston and Hopkins, 2001);
- Vegetation types mapped within Survey Area (Mattiske 2006, 2007, 2008);
- Vegetation structure;
- Landforms;
- Geological units;
- Contours;
- Soil substrate;
- Aerial imagery;
- Fauna assemblage; and
- Field observations.



Legend

- Survey Area
- Ecological Community Assessment Sites
- Survey Effort - Tracks



N

0 1 2 km

Scale 1:65,000 @ A3

Coordinate System: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Units: Meter

Spectrum

Author: EM Approved: AH Date: 09-02-2022

Survey Effort

Leonora Operations

Talis Consultants | St Barbara

MAP 2.2

2.5. Significant Species & Vegetation Definitions

Significant flora can include (EPA 2016b):

- Being identified as Threatened: Critically Endangered, Endangered or Vulnerable (state listed BC Act and/or nationally listed EPBC Act);
- Being identified as Priority Flora species: Priority 1 to Priority 4 (DBCA 2019);
- Locally endemic or association with a restricted habitat type (e.g. surface water or groundwater dependent ecosystems);
- New species or anomalous features that indicate a potential new species;
- Representative of the range of a species (particularly, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range);
- Unusual species, including restricted subspecies, varieties or naturally occurring hybrids; or
- Relictual status, being representative of taxonomic groups that no longer occur widely in the broader landscape.

Significant vegetation can include (EPA 2016b):

- Threatened Ecological Community (TEC): Critically Endangered, Endangered or Vulnerable (state listed BC Act and/or nationally listed EPBC Act);
- Priority Ecological Community (PEC): Priority 1 to Priority 5 (DBCA 2017a);
- Restricted distribution;
- Degree of historical impact from threatening processes;
- A role as a refuge; or
- Providing an important function required to maintain ecological integrity of a significant ecosystem.

Significant fauna can include (EPA 2016a):

- 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.

Refer to Appendix B for further information on Conservation Codes.

2.6. Introduced Flora, Fauna & Declared Plants

Introduced flora, fauna or weeds can pose a threat to native vegetation and biodiversity. The Department of Primary Industries and Regional Development (DPIRD) keeps a database of Declared Plants in Western Australia which are considered environmentally significant weeds. This database is regulated under the Biosecurity and Agricultural Management Act (Government of Western Australia, 2007). Legal status and control requirements for these Declared Plants are defined in Appendix A.

2.7. 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. 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 2.5 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 2.5: 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.

2.7.1. 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 2016d):

- 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).

2.7.2. Determination of SRE Status

The SRE status of invertebrates is based on categories which were developed by the Western Australian Museum (WAM). The classifications listed in Table 2.6 are based on known information of the species group such as distribution, representation of records in collections, and distinct morphological features. Information gaps lead to classifying taxa as potential SRE, which is a requirement under the precautionary principle.

Table 2.6: 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 km^2. • Taxonomy is well understood. • Species is well represented in collections. • Region of occurrence has been comprehensively sampled.

2.8. Nomenclature

2.8.1. Flora

Flora nomenclature used in this report is consistent with the DBCA Census of Western Australian Plants database, provided through FloraBase (Western Australian Herbarium, 2020). All species are current at the time of report preparation. Species from previous reports have been checked for currency and updated.

2.8.2. Fauna

Nomenclature for mammals, birds, reptiles, and amphibians followed the Western Australian Museum Checklist of the Vertebrates of Western Australia (June 2021) (see Table 2.7). Nomenclature for SRE invertebrates is based on data provided by WAM and relevant experts.

Table 2.7: References Used for Identification of Fauna Species

Fauna	Survey Technique
Mammals	Menkhorst (2001) and Van Dyck (2008)
Birds	Menkhorst *et al.* (2019)
Reptiles & Amphibians	Wilson and Swan (2021), Cogger (2018), and Tyler and Doughty (2009)

2.9. Project Team and Licences

Spectrum staff involved with this assessment are listed in Table 2.8, along with their role, years of experience, and relevant licences.

Table 2.8: Project Team & Licences

Staff	Role	Project Tasks	Years of Experience	Fauna Licence
Astrid Heidrich	Principal Zoologist	Report review	14	BA27000561
Melissa Hay	Principal Botanist	Report review	15	-
Erica MacIntyre	Senior Zoologist	Field work, reporting	8	BA27000561
Nicola Palmer	Senior Zoologist / ecologist	Field work, report review	6	BA27000561
Gabrielle Beca	Zoologist	Reporting	1	BA27000561
Emily Crowther	Botanist	Reporting	2	-

2.10. Limitations & Constraints

Survey specific limitations and constraints are discussed in Table 2.9.

Table 2.9: Limitations & Constraints

Limitation	Constraint	Comment
Availability of the contextual information at a regional and local scale.	No	Beard vegetation, geology and land system mapping were used to determine regional significance of vegetation types. Database searches provided detailed information, adequate to guide field survey design and effort for the flora and fauna survey. Previous surveys in the vicinity and Survey Area were available.
Competency/ experience of the consultant carrying out the survey including experience in bioregion surveyed.	No	The ecologist, Nicola Palmer and zoologist, Erica MacIntyre involved in the field survey have extensive experience completing ecological surveys throughout Western Australia and are familiar with Murchison flora and fauna assemblages.
Timing/weather/ season/cycle.	No	The field survey was conducted during the optimal season for flora and fauna surveys conducted in the Murchison region and Eremaean Botanical Province. Seasonal conditions were around the mean, and rainfall was above the long-term median rainfall. The flora site visit was conducted at the optimal time for this region. Basic level fauna surveys are not dependent on seasonal timing.

Limitation	Constraint	Comment
Disturbances (e.g., fire, flood, accidental human intervention) which affected results of survey.	No	No disturbances were recorded at the Survey Area that have affected the results of the flora site visit and fauna assessment.
Remoteness and/or access problems.	No	There were no access restrictions at the Survey Area
Flora Specific		
Survey effort and extent.	No	The Survey Area was covered as completely as possible within four day period.
Proportion of flora recorded and/or collected, any identification issues.	Parital	The flora site visit did not include collection of flora records.
Fauna Specific		
Scope (what faunal groups were sampled and were some sampling methods not able to be employed because of constraints such as weather conditions).	No	Sampling techniques were adequate for a basic terrestrial fauna survey. All fauna groups were sampled, and no survey constraints were experienced. A total of 46 site assessments were completed within the Survey Area.
Proportion of fauna identified, recorded, and/or collected.	Partial	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 level. Trapdoor spiders specimens were not collected due to the low likelihood of male spiders being excavated, time constraints and no licence to extract.
The proportion of the task achieved and further work which might be needed.	No	All components of a basic fauna assessment 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 Area.
Completeness (was the relevant area fully surveyed.	No	A total of 46 site assessments were completed across the the five areas that make up the Survey Area. The coverage was good for a four day period.

3. RESULTS & DISCUSSION – DESKTOP ASSESSMENT

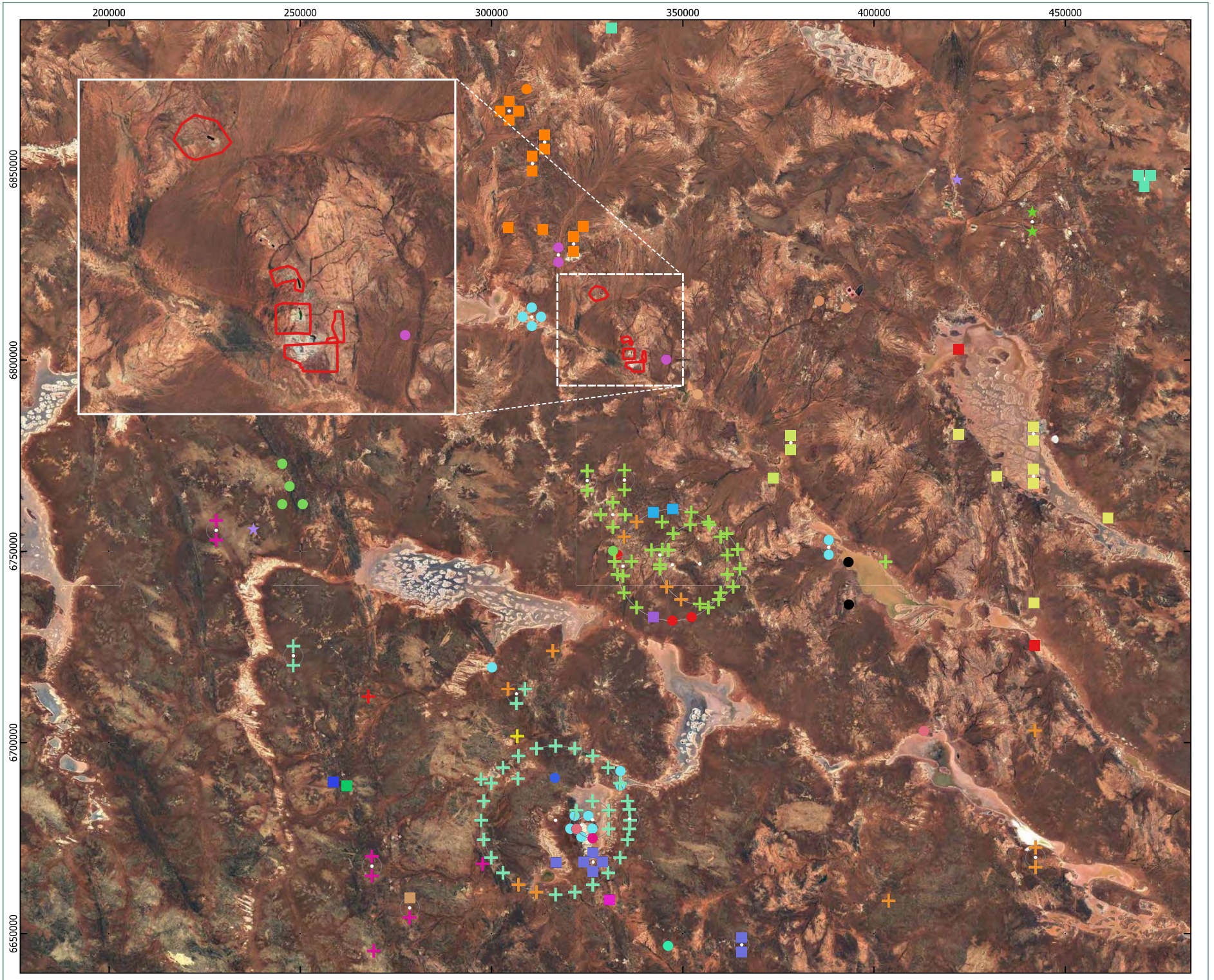
3.1. Conservation Significant Flora - Desktop

A total of eighty-six significant flora taxa were identified during the flora desktop searches. Of these, five were assigned a 'High Likelihood' of occurrence, while ten were assigned a 'Medium Likelihood' of occurrence.

The likelihood of each significant species is listed in Table 3.1. Significant flora locations are presented on Map 3.1 and Map 3.2. More details of each taxa, including distance to the Survey Area, and taxa with low likelihood to occur are listed in Appendix C.

Table 3.1: Significant Flora Results of the Desktop Assessment

Pre-survey Likelihood	Status	Taxon
Recorded	Threatened	N/A
	Priority 1	N/A
	Priority 2	N/A
	Priority 3	N/A
High	Threatened	N/A
	Priority 1	*Frankenia georgei, Stenanthemum patens*
	Priority 2	N/A
	Priority 3	*Angianthus prostratus, Acacia* sp. Marshall Pool (G. Cockerton 3024)
	Priority 4	*Frankenia glomerata*
Medium	Threatened	N/A
	Priority 1	*Calandrinia quartzitica, Lepidium xylodes*
	Priority 2	*Eremophila mirabilis*
	Priority 3	*Triglochin protuberans, Eremophila simulans* subsp. *megacalyx, Eremophila veronica, Phyllanthus baeckeoides, Hybanthus floribundus* subsp. *chloroxanthus*
	Priority 4	*Grevillea inconspicua, Hemigenia exilis*



Legend

- Survey Area

Sig Flora Locations

- T Eremophila viscida
- T Seringia exastia
- P1 Acacia epedunculata
- P1 Acacia websteri
- P1 Anacampseros sp. Eremaean
- P1 Calandrinia quartzitica
- P1 Drosera eremaea
- P1 Eremophila eversa
- P1 Frankenia georgei
- P1 Hemigenia obovata
- P1 Korthalsella leucothrix
- P1 Lepidium xylodes
- P1 Persoonia leucopogon
- P1 Philotheca linearis
- P1 Philotheca tubiflora
- P1 Pterostylis elegantissima
- P1 Pterostylis xerampelina
- P1 Ptilotus chortophytus
- P1 Ptilotus procumbens
- P1 Ptilotus rigidus
- P1 Ptilotus sp. Kookynie
- P1 Ptilotus tetrandrus
- P1 Rhodanthe uniflora
- P1 Stenanthemum patens
- P1 Tecticornia mellarium
- P1 Tecticornia sp. Lake Way (P. Armstrong 05/961)
- P2 Eremophila mirabilis
- P2 Eucalyptus educta
- P2 Malleostemon sp. Adelong
- P2 Newcastelia insignis
- P2 Thryptomene eremaea
- P2 Thysanotus brachyantherus

N

0 5 10 15 20 25 km

Scale 1:900,000 @ A3

Coordinate System: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Units: Meter

Spectrum

Author: EM Approved: AH Date: 10-02-2022

Desktop Significant Flora - Threatened, P1 & P2

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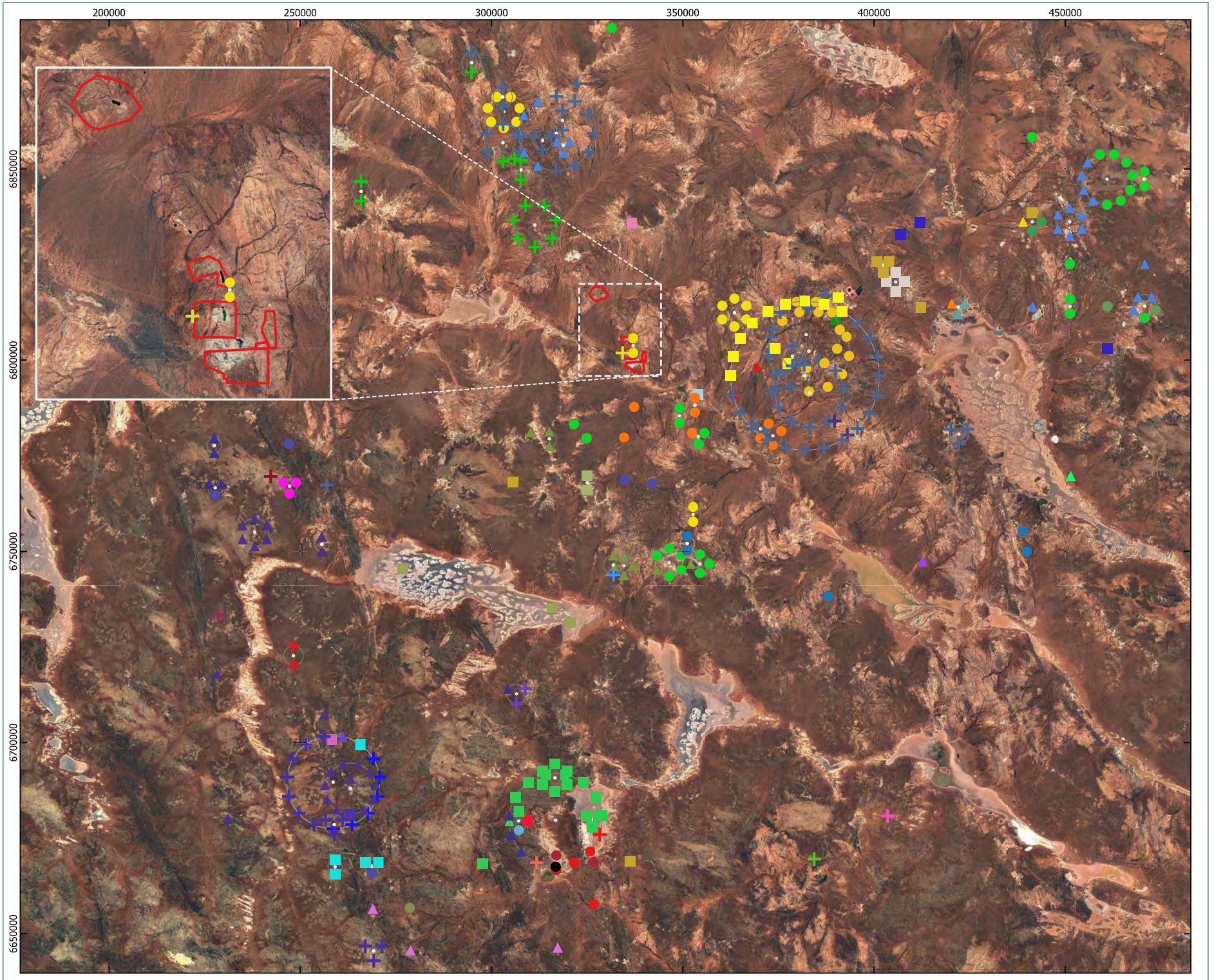
MAP
3.1



Legend

Survey Area

Significant Flora

- P3 Acacia sp. Marshall Pool
- P3 Alyxia tetanifolia
- P3 Angianthus prostratus
- P3 Atriplex flabelliformis
- P3 Austroparmelina macrospora
- P3 Austrostipa blackii
- P3 Bossiaea eremaea
- P3 Calandrinia sp. Menzies
- P3 Calotis latiuscula
- P3 Calotis sp. Perrinvale Station
- P3 Calytrix hislopii
- P3 Calytrix praecipua
- P3 Cratystylis centralis
- P3 Elatine macrocalyx
- P3 Eleocharis papillosa
- P3 Eremophila annosicaulis
- P3 Eremophila shonae subsp. diffusa
- P3 Eremophila simulans subsp. megacalyx
- P3 Eremophila veronica
- P3 Eutaxia nanophylla
- P3 Eutaxia rubricarina
- P3 Goodenia lyrata
- P3 Grevillea georgeana
- P3 Grevillea subterlineata
- P3 Gunniopsis propinqua
- P3 Homalocalyx grandiflorus
- P3 Hybanthus floribundus subsp. chloroxanthus
- P3 Leptospermum macgillivrayi
- P3 Meionectes tenuifolia
- P3 Melaleuca apostiba
- P3 Menkea draboides
- P3 Micromyrtus serrulata
- P3 Notisia intonsa
- P3 Olearia mucronata
- P3 Philotheca coateana
- P3 Phyllanthus baeckeoides
- P3 Placynthium nigrum
- P3 Pterostylis virens
- P3 Tecticornia cymbiformis
- P3 Triglochin protuberans
- P3 Vittadinia pustulata
- P3 Xanthoparmelia dayiana
- P4 Banksia arborea
- P4 Comesperma viscidulum
- P4 Conospermum toddii
- P4 Eucalyptus jutsonii subsp. jutsonii
- P4 Eucalyptus kruseana
- P4 Frankenia glomerata
- P4 Goodenia berringbinensis
- P4 Grevillea erectiloba
- P4 Grevillea inconspicua
- P4 Grevillea secunda
- P4 Hemigenia exilis
- P4 Lepidosperma lyonsii
- P4 Sowerbaea multicaulis
- P4 Wurmbea murchisoniana

N

0 5 10 15 20 25 km

Scale 1:900,000 @ A3

Coordinate System: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Units: Meter

Spectrum

Author: EM Approved: AH Date: 10-02-2022

Desktop Significant Flora - P3 & P4

Leonora Operations

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MAP
3.2

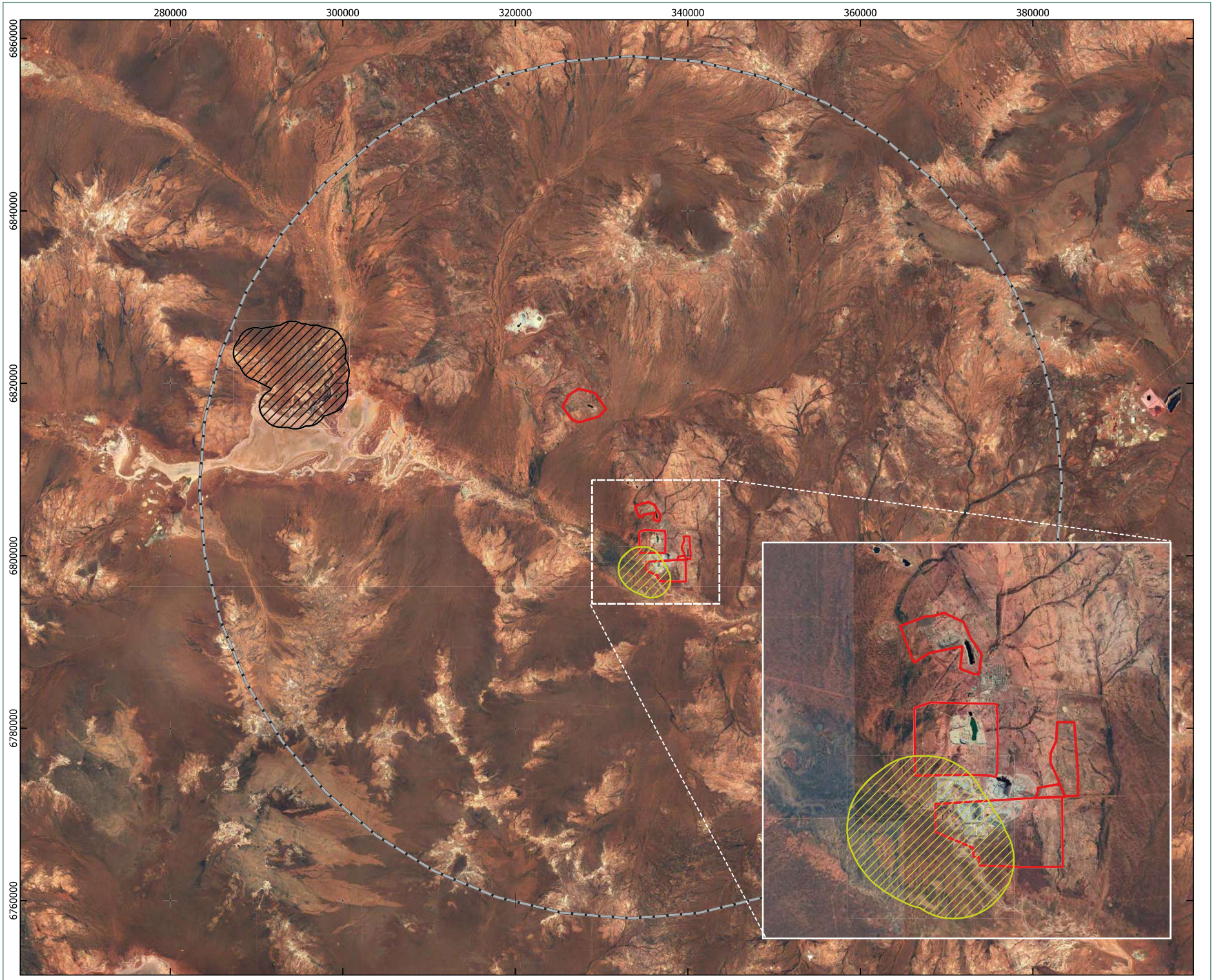
3.2. TEC & PEC – Desktop

The desktop assessment identified two Priority Ecological Communities (PEC) within 50 km of the Survey Area; both listed as Priority 1. One of PECs intersects the Survey Area at both Gwalia and Tower Hill: The Melita calcrete groundwater assemblage type on Raeside palaeodrainage on Melita (Sons of Gwalia) Station (Table 3.2). It is known for its unique assemblages of invertebrates in the groundwater calcretes, and is threatened by hydrological changes associated with mining. The remaining PEC is located 25 km to the west of the Survey Area (Map 3.3). It was assigned a 'Low likelihood' to occur based on the restriction to a paleodrainage system on Sturt Meadows Station.

No Threatened Ecological Communities (TEC) were recorded within 50 km of the Survey Area.

Table 3.2: TEC & PEC Results of the Desktop Assessment

Likelihood	Status	Name	Description	Proximity to the Survey Area
Recorded	Priority 1	Melita calcrete groundwater assemblage type on Raeside palaeodrainage on Melita (Sons of Gwalia) Station.	Unique assemblages of invertebrates have been identified in the groundwater calcretes.	PEC is within the Survey Area
Low	Priority 1	Sturt Meadows calcrete groundwater assemblage type on Raeside palaeodrainage on Sturt Meadows Station.	Unique assemblages of invertebrates have been identified in the groundwater calcretes.	25 km WNW



Legend

- Survey Area

PECs

- Melita calcrete groundwater assemblage type on Raeside palaeodrainage on Melita (Sons of Gwalia) Station
- Sturt Meadows calcrete groundwater assemblage type on Raeside palaeodrainage on Sturt Meadows Station
- 50 km Buffer

N

0 2.5 5 7.5 10 12.5 km

Scale 1:400,000 @ A3

Coordinate System: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Units: Meter

Spectrum

Author: EM Approved: AH Date: 10-02-2022

Priority Ecological Communities Recorded

Leonora Operations

MAP 3.3

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3.3. Terrestrial Fauna – Desktop

To provide information to support the current assessment, 11 fauna surveys and three public databases were accessed as part of the desktop assessment. Details of the completed database searches are listed in Table 2.1, and details of the previous assessments are listed in Table 2.2.

The literature review and database searches identified 16 non-volant native mammals, 13 introduced mammals, ten bats, 147 birds, 58 reptiles, and seven amphibians recorded in the region surrounding the Survey Area. A summary of the total number of species identified during the desktop assessment is presented in Table 3.3 with a detailed list of species recorded during relevant surveys (11 vertebrate fauna surveys) listed in Appendix D. Obligate marine species, seabirds, and aquatic species have been excluded from the assessment due to the absence of coastal or marine habitat within the Survey Area. It should be noted that a Streaked Shearwater was vouchered from approximately 90 km west of the Survey Area. This specimen corresponds with a group of Streaked Shearwaters recorded in Perth waters in early 2012 and were likely a vagrant group that were blown inland and further south from their usual distribution along the northern and eastern coast of Australia (non breeding) and up north into northwest pacific region (breeding).

Table 3.3: Summary of Terrestrial Fauna Species Previously Recorded in the Region

Data Source	Level of Survey	Included in	Mammals (Native/ Introduced)	Bats	Birds	Reptiles	Amphibians	Total
Spectrum Ecology, 2021a	Fauna – basic	✓	0/3	0	23	2	0	25
Terrestrial Ecosystems, 2020a	Fauna – detailed	✓	7/5	5	43	33	3	84
Terrestrial Ecosystems, 2020b	Fauna – basic	✓	5/0	0	23	11	1	35
Terrestrial Ecosystems, 2011	Fauna - detailed	✓	4/1	1	47	15	3	66
Bamford Consulting Ecologists, 2010	Fauna – detailed	✓	8/8	6	77	37	1	121
Bamford Consulting Ecologists, 2008	Fauna – basic	✓	4/6	1	30	7	1	39
Bamford Consulting Ecologists, 2007	Fauna – basic	✓	4/3	0	42	5	0	47
Dunlop and Payne, 1999	Fauna – detailed (single phase)	✓	1/0	0	36	13	0	49
Ninox Wildlife Consulting, 1998	Fauna – detailed	✓	3/7	0	60	16	3	79
Brearley, Dunlop and Osbourne, 1997	Fauna - detailed	✓	3/7	3	33	13	0	49
Kinhill Engineers, 1992	Fauna - basic	✓	2/5	1	2	8	0	11
DBCA Threatened Fauna Database	Database	✓	3/0	0	10	1	0	11
NatureMap	Database	✓	8/3	6	120	36	5	167
PMST	Database	✓	1/8	0	19	0	0	19
Total			**16/13**	**10**	**147**	**58**	**7**	**251**

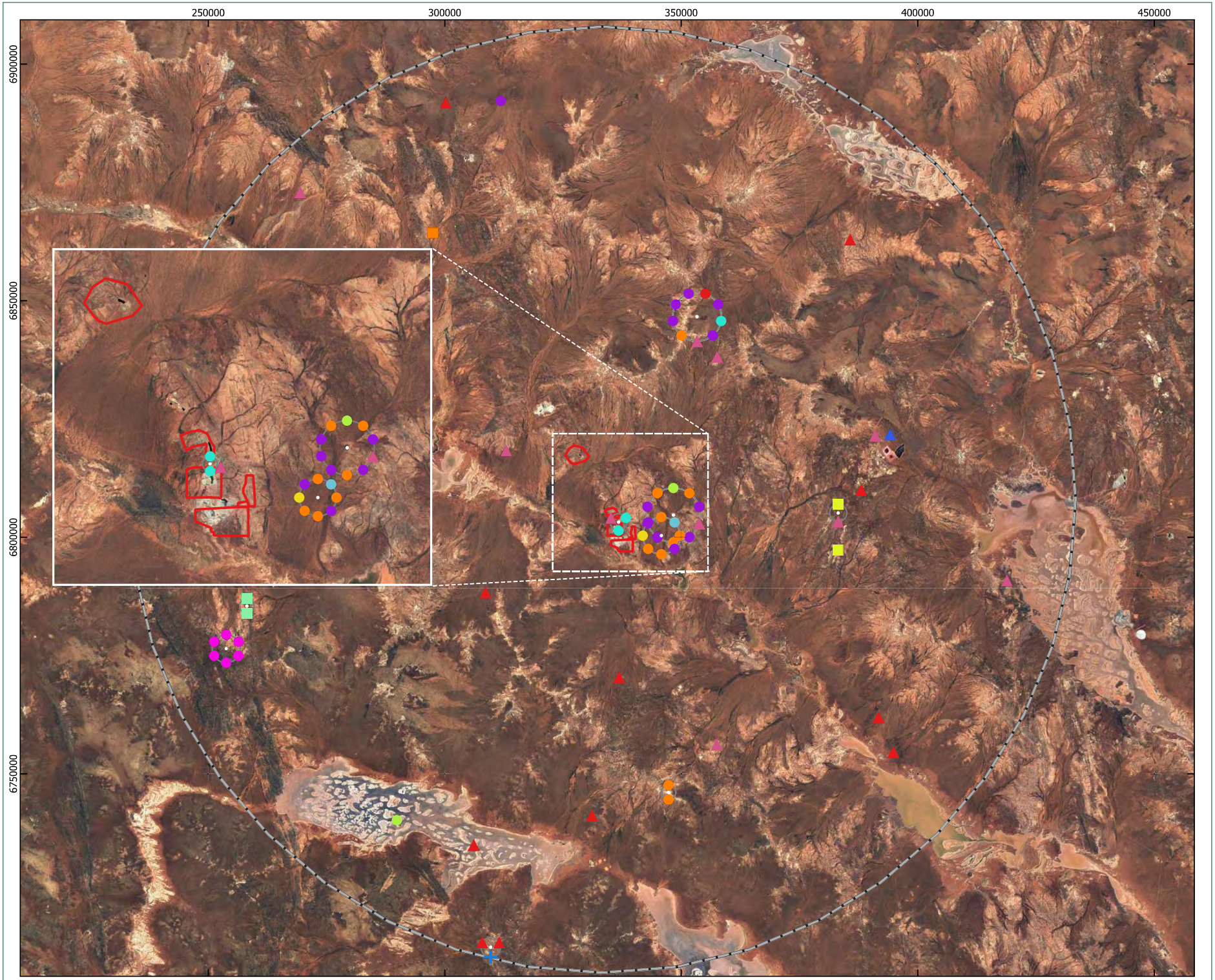
3.3.1. Conservation Significant Fauna

The desktop assessment identified 22 species of conservation significant fauna (four mammals, 17 birds, one reptile and one invertebrate) as potentially occurring at the Survey Area based on the database search results and literature review (DBCA Threatened Fauna, Naturemap and PMST). Ten of the 22 species have a Medium to High likelihood to occur at the Survey Area. The details and likelihood of occurrence are listed in Table 3.4 and DBCA records (DBCA database search) are shown on Map 3.4.

Table 3.4: Significant Fauna Recorded during Databases Searches

Species	Conservation Status			Database Record			No. Surveys Recorded	Likelihood of Occurrence
	EPBC Act	BC Act	DBCA	PMST	DBCA	NatureMap		
Mammals								
Western Quoll *Dasyurus geoffroii*	VU	VU	-	✓	-	-	0	Low
Greater Bilby *Macrotis lagotis*	VU	VU	-	-	✓	-	0	Low
Long-tailed Dunnart *Sminthopsis longicaudata*	-	-	P4	-	✓	-	5	High
Brush-tailed Mulgara *Dasycercus blythi*	-	-	P4	-	-	✓	0	Low
Birds								
Night Parrot *Pezoporus occidentalis*	EN	CR	-	✓	-	-	0	Low
Red Knot *Calidris canutus*	EN/MI	EN	-	-	✓	-	0	Very Low
Malleefowl *Leipoa ocellata*	VU	VU	-	✓	✓	✓	3	High
Princess Parrot *Polytelis alexandrae*	VU	-	P4	✓	-	-	0	Low
Grey Falcon *Falco hypoleucos*	-	VU	-	✓	✓	-	0	Medium
Fork-tailed Swift *Apus pacificus*	MI	MI	-	✓	-	-	1	Low
Oriental Plover *Charadrius veredus*	MI	MI	-	✓	-	-	1	Medium
Pacific Golden Plover *Pluvialis fulva*	MI	MI	-	-	✓	-	0	Low
Sharp-tailed Sandpiper *Calidris acuminata*	MI	MI	-	✓	✓	-	0	Medium
Pectoral Sandpiper *Calidris melanotos*	MI	MI	-	✓	-	-	0	Very Low

Species	Conservation Status			Database Record			No. Surveys Recorded	Likelihood of Occurrence
	EPBC Act	BC Act	DBCA	PMST	DBCA	NatureMap		
Common Sandpiper *Actitis hypoleucos*	MI	MI	-	✓	✓	✓	0	Medium
Wood Sandpiper *Tringa glareola*	MI	MI	-	-	-	✓	1	Medium
Common Greenshank *Tringa nebularia*	MI	MI	-	✓	✓	✓	0	Medium
Grey Wagtail *Motacilla cinerea*	MI	MI	-	✓	-	-	0	Very Low
Yellow Wagtail *Motacilla flava*	MI	MI	-	✓	-	-	0	Very Low
Hooded Plover (Hooded Dotterel) *Thinornis cucullatus*	-	-	P4	-	✓	-	1	Medium
Peregrine Falcon *Falco peregrinus*	-	OS	-	-	✓	✓	2	High
Reptiles								
Woma *Aspidites ramsayi*	-	-	P1	✓	-	-	0	Low
Invertebrates								
Arid Bronze Azure Butterfly *Ogyris subterrestris* subsp. *petrina*	CR	CR	-	-	✓	-	0	Very Low



Legend

- Survey Area

Threatened Fauna

- Bilby
- Brush-tailed Mulgara
- Long-tailed Dunnart
- Red Knot
- Malleefowl
- Grey Falcon
- Common Greenshank
- Common Sandpiper
- Pacific Golden Plover
- Sharp-tailed Sandpiper
- Streaked Shearwater
- Wood Sandpiper
- Hooded Plover
- Peregrine Falcon
- Woma (southwest subpop.)
- 100 km Buffer

N

0 5 10 15 20 25 km

Scale 1:730,000 @ A3

Coordinate System: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Units: Meter

Spectrum

Author: EM Approved: AH Date: 10-02-2022

Desktop Significant Vertebrate Fauna (DBCA)

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MAP 3.4

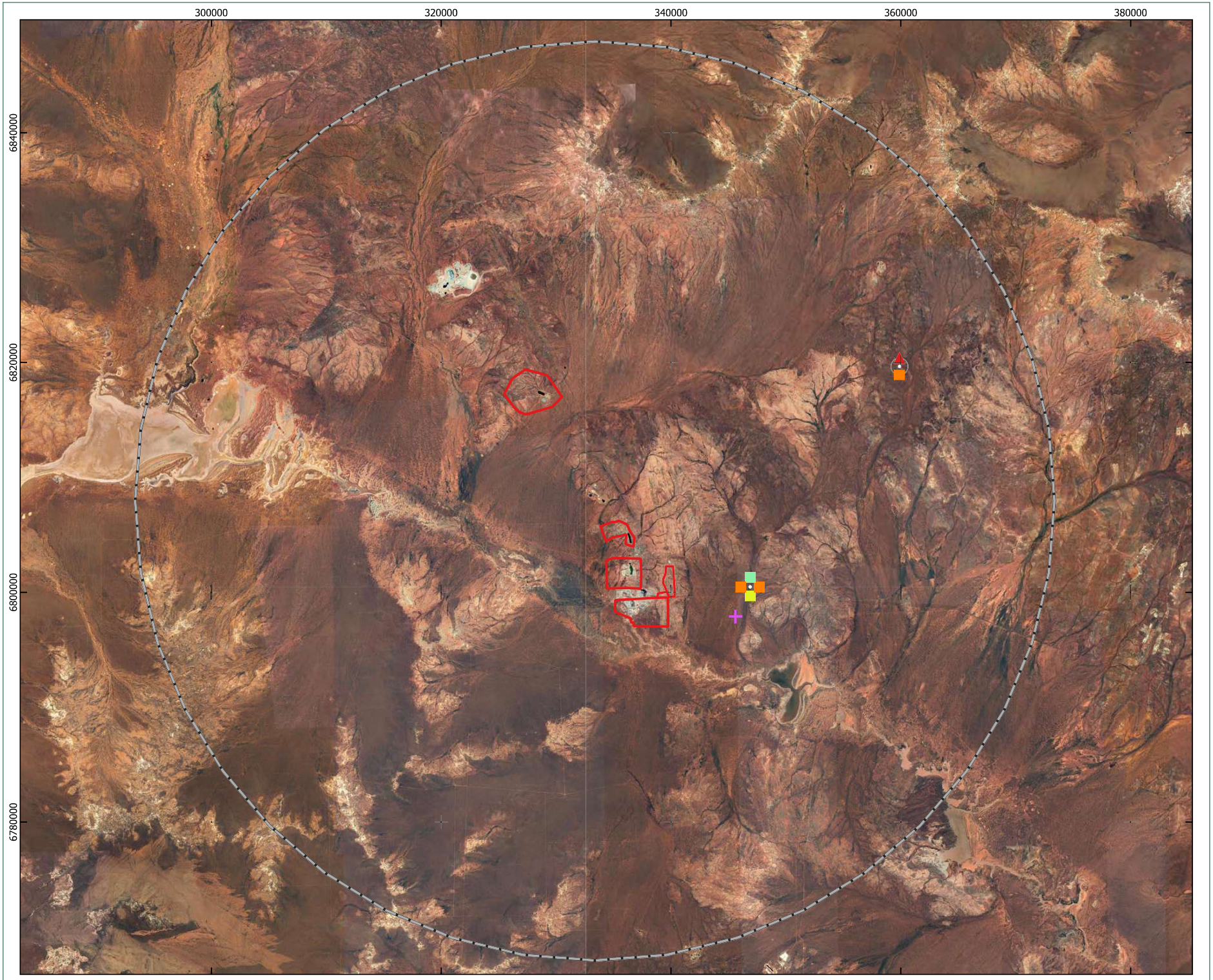
3.3.2. Short Range Endemic Invertebrates Desktop Assessment

The literature review did not identify any reports with an SRE component (Table 2.2). However, four databases were consulted (details provided in Table 2.1).

The West Australian Museum database search identified four Arachnid (one spider and three pseudoscorpions), one Crustacean (fairy shrimp; aquatic species, excluded from the assessment), and one Mollusc (snail) species of potential short range endemic invertebrates within 40 km of the Survey Area (Table 3.5, and Map 3.5).

Table 3.5: Western Australian Museum (WAM) Invertebrate Database Results

Class/ Order/ Family	Species	Record made Distance & Direction of Nearest Record from Survey Area - WAM Database
ARACHNIDS		
Mygalomorphae		
Barychelidae	*Idiommata* `sp. indet. (juvenile)`	27 km ENE
Pseudoscorpiones		
Olpiidae	`Genus indet.` `sp. indet. (juvenile)`	7 km E & 27 km ENE
	Austrohorus	7 km E
	Beierolpium `sp. 8/3`	7 km E
MOLLUSC (Snails)		
Gastropoda		
Succineidae	*Succinea* sp.	250 m – at Gwalia, outside of Survey Area

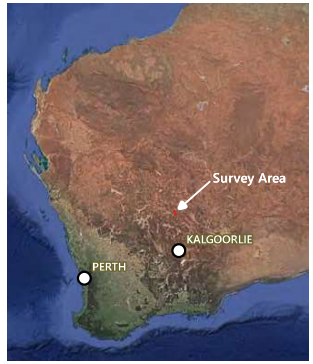


Legend

- Survey Area
- 40 km Buffer

WAM Potential SRE Species

- `Genus indet.` `sp. indet. (juvenile)`
- Austrohorus sp.
- Beierolpium `sp. 8/3`
- Idiommata `sp. indet. (juvenile)`
- Succinea sp.



N

0 2 4 6 8 10 km

Scale 1:300,000 @ A3

Coordinate System: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Units: Meter

Spectrum

Author: EM Approved: AH Date: 10-02-2022

SRE Database Search Results (WAM)

Leonora Operations

MAP 3.5

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4. RESULTS & DISCUSSION – SITE VISIT

4.1. Ecological Communities Recorded

A total of 13 ecological communities were recorded during the site visit to the Survey Area. The ecological communities were based on vegetation communities outlined from previous flora and vegetation surveys undertaken by Mattiske Consulting Pty Ltd (2006, 2008). The ecological communities recorded are outlined in Table 4.1 and shown on Map 4.1.

Table 4.1: Ecological Communities Recorded

EC No*.	Ecological Community	Mattiske Veg Comm Code	Disturbance Areas	Total Area (ha)
EC01	Woodland of *Acacia* (Mulga) spp. over sparse shrubs and grasses on sandy-loams on flats and flowlines	A1	All areas	261.5
EC02	Open woodland of *Acacia* (Mulga) spp. over sparse shrubs on sandy-loam on flats and lower slopes	A2	Gwalia, Harbour Lights, Jaspers and Tower Hill	723.0
EC03	Open shrubland of *Acacia* (Mulga) spp. over mixed chenopods with pebbles and quartz on flats and lower slopes	A3	All areas	1,287.7
EC04	Low open shrubland of *Acacia* spp. over mixed chenopods and grasses on pebbles and quartz on lower slopes	A4	Tower Hill	61.8
EC05	*Acacia spp. over mixed shrubs on rocky ridges and outcrops*	A11	Gwalia and Jaspers	34.0
EC06	Low chenopod shrubland on gravelly loam on flats and flowlines	NA	Gwalia	52.0
EC07	Lake Raeside drainage with *Tecticornia* low open shrubland	NA	Gwalia	50.0
EC08	Open woodland of *Acacia* and *Eremophila* over diverse chenopod shrubs on sand dunes fringing salt lake	NA	Gwalia	48.8
EC09	Low chenopod shrubland on loam on flats	NA	Gwalia	44.8
EC10	Open shrubland of *Acacia* spp. on ironstone gravel on flats	NA	Jaspers	15.1
EC11	*Eremophila* over *Tecticornia* open plain on fine gravel	NA	Tower Hill	6.5
EC12	*Acacia* (Mulga) spp. over mixed shrubs on quartz outcrop	NA	Tower Hill	1.9
EC13	Cleared/Disturbed	CL/D	All areas	1,041.2
Total Area				3,628.2

* EC = Ecological Community

The most common ecological community was open shrubland of *Acacia* (Mulga) spp. over mixed chenopods with pebbles and quartz on flats and lower slopes, covering 1,287.7 ha in the Survey Area. This ecological community was recorded in all proposed disturbance areas except the railway corridors. The second most common community was cleared or disturbed areas, accounting for 1,041.2 ha. The least common ecological community recorded was *Acacia* (Mulga) spp. over mixed shrubs on quartz outcrop (1.9 ha), which was only recorded at Tower Hill.

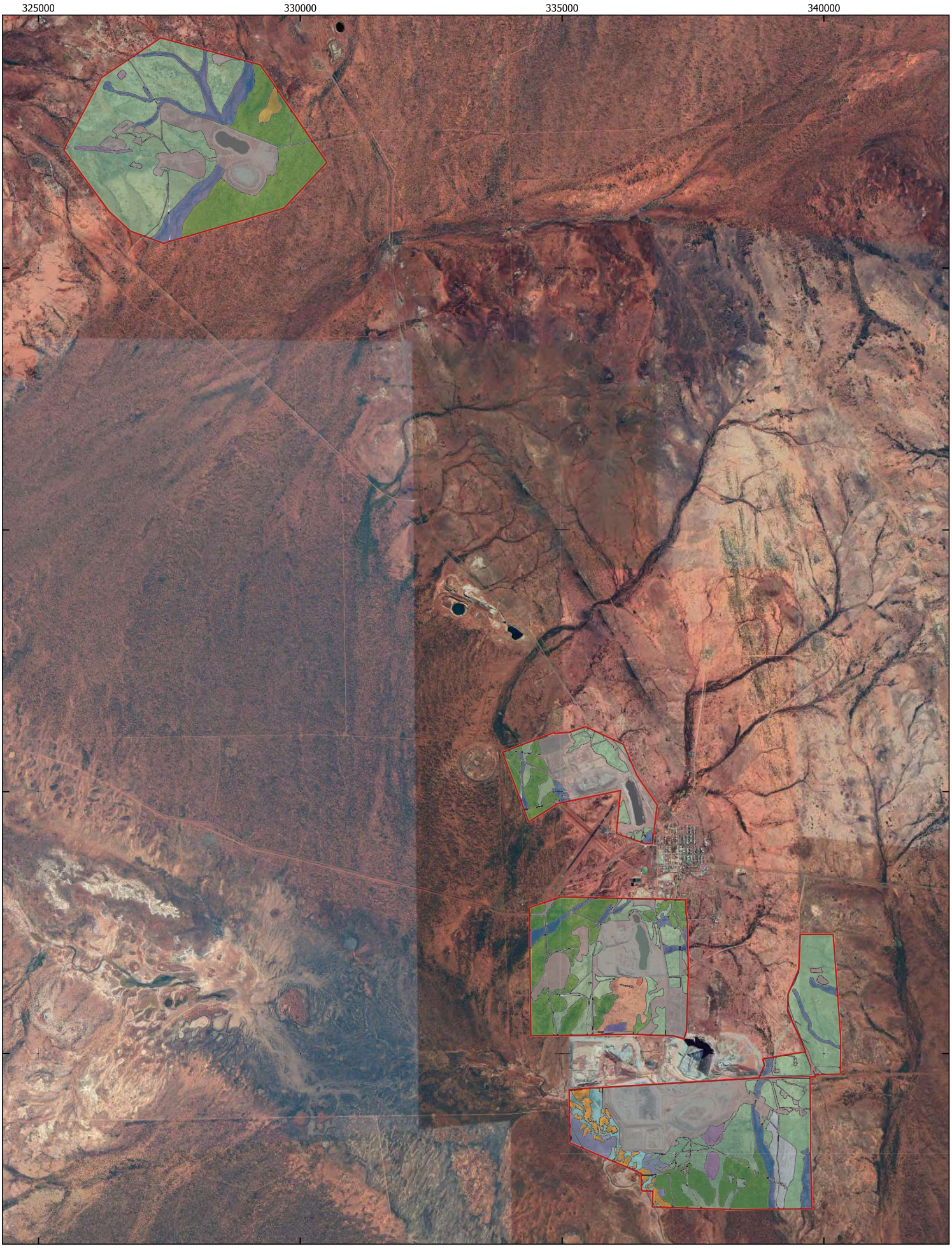
The ecological communities within the Survey Area were assessed and mapped based on the four distinct mining operational areas and the proposed railway corridors. The ecological communities present in each area are outlined in Table 4.2.

Table 4.2: Ecological Communities Recorded at each Operational Area

Operational Area/Railway Corridors	EC No.	Ecological Community	Mattiske Veg Comm Code	Total Area (ha)
Gwalia	EC05	*Acacia* spp. over mixed shrubs on rocky ridges and outcrops	A11?	24.5
	EC13	Cleared/Disturbed	CL/D	313.3
	EC07	Lake Raeside drainage with *Tecticornia* low open shrubland	NA	50.0
	EC06	Low chenopod shrubland on gravelly loam on flats and flowlines	CL/D	52.0
	EC09	Low chenopod shrubland on loam on flats	NA	44.8
	EC03	Open shrubland of *Acacia* (Mulga) spp. over mixed chenopods with pebbles and quartz on flats and lower slopes	A3	249.1
	EC08	Open woodland of *Acacia* and *Eremophila* over diverse chenopod shrubs on sand dunes fringing salt lake	NA	48.8
	EC02	Open woodland of *Acacia* (Mulga) spp. over sparse shrubs on sandy-loam on flats and lower slopes	A2	132.8
	EC01	Woodland of *Acacia* (Mulga) spp. over sparse shrubs and grasses on sandy-loams on flats and flowlines	A1	52.3
Harbour Lights	EC13	Cleared/Disturbed	CL/D	201.6
	EC03	Open shrubland of *Acacia* (Mulga) spp. over mixed chenopods with pebbles and quartz on flats and lower slopes	A3	70.3
	EC02	Open woodland of *Acacia* (Mulga) spp. over sparse shrubs on sandy-loam on flats and lower slopes	A2	61.8
	EC01	Woodland of *Acacia* (Mulga) spp. over sparse shrubs and grasses on sandy-loams on flats and flowlines	A1	16.1
Jaspers	EC05	*Acacia spp. over mixed shrubs on rocky ridges and outcrops*	A11	9.6
	EC13	Cleared/Disturbed	CL/D	227.4
	EC10	Open shrubland of *Acacia* spp. on ironstone gravel on flats	NA	15.1
	EC03	Open shrubland of *Acacia* (Mulga) spp. over mixed chenopods with pebbles and quartz on flats and lower slopes	A3	613.2
	EC02	Open woodland of *Acacia* (Mulga) spp. over sparse shrubs on sandy-loam on flats and lower slopes	A2	288.4
	EC01	Woodland of *Acacia* (Mulga) spp. over sparse shrubs and grasses on sandy-loams on flats and flowlines	A1	138.7
Railway Corridor	EC13	Cleared/Disturbed	CL/D	19.8
	EC03	Open shrubland of *Acacia* (Mulga) spp. over mixed chenopods with pebbles and quartz on flats and lower slopes	A3	202.1
	EC01	Woodland of *Acacia* (Mulga) spp. over sparse shrubs and grasses on sandy-loams on flats and flowlines	A1	18.8
Tower Hill	EC12	*Acacia* (Mulga) spp. over mixed shrubs on quartz outcrop	NA	1.9
	EC13	Cleared/Disturbed	CL/D	279.1
	EC11	*Eremophila* over *Tecticornia* open plain on fine gravel	NA	6.5
	EC04	Low open shrubland of *Acacia* spp. over mixed chenopods and grasses on pebbles and quartz on lower slopes	A4	61.8

Operational Area/Railway Corridors	EC No.	Ecological Community	Mattiske Veg Comm Code	Total Area (ha)
	EC03	Open shrubland of *Acacia* (Mulga) spp. over mixed chenopods with pebbles and quartz on flats and lower slopes	A3	153.0
	EC02	Open woodland of *Acacia* spp. (Mulga) over sparse shrubs on sandy-loam on flats and lower slopes	A2	240.0
	EC01	Woodland of *Acacia* (Mulga) spp. over sparse shrubs and grasses on sandy-loams on flats and flowlines	A1	35.5

Further details on the site assessments can be found in Appendix A.

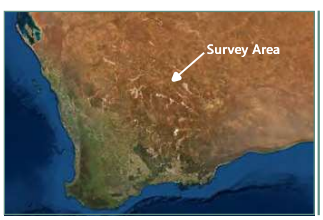


Legend

Survey Area

Ecological Communities

EC01
EC02
EC03
EC05
EC06
EC07
EC08
EC09
EC13
EC11
EC04
EC12
EC10



N

0 1 2 km

Scale 1:65,000 @ A3

Coordinate System: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Units: Meter

Spectrum

Author: EM Approved: AH Date: 10-02-2022

Ecological Communities

Leonora Operations

Talis Consultants | St Barbara

MAP
4.1

4.2. Terrestrial Fauna

A total of 38 vertebrate fauna species were recorded during the survey, this included 31 birds, one native mammal, four introduced mammals and two reptiles. The species recorded are detailed in Appendix D.

4.3. Significant Findings

No conservation significant flora species were recorded during the survey. However, two conservation significant flora species records, located within close proximity to the Survey Area, were investigated (Map 3.2). The findings are outlined in Table 4.3.

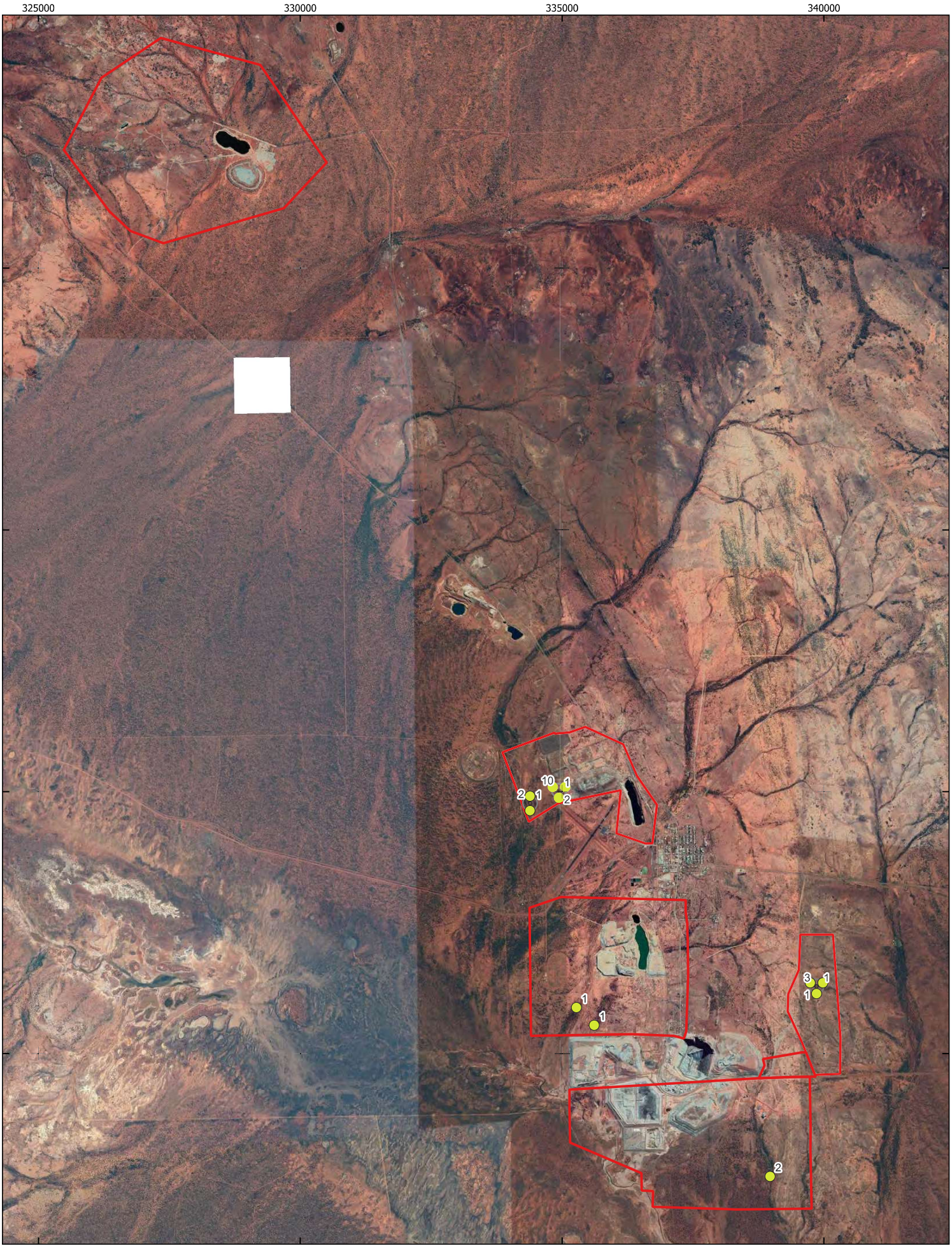
Table 4.3: Significant Findings

Taxon	Consevation Status	Findings
Acacia sp. Marshall Pool (G. Cockerton 3024)	P3	The precision rating for the coordinates is three, which indicates the individual is located within 10 km of the record location. Record was located in the middle of Leonora indicating that the locality of Leonora may have been used instead of an GPS location.
Frankenia glomerata	P3	Record was located just west of the Tower Hill boundary and the species could not be located. The accuracy of the location is questionable as the record was located in *Acacia* shrubland on red loam soils; however, the species preferred habitat is white sand with Samphire and pigface (around salt lakes etc.). This species is expected to occur around the Lake Raeside drainage where suitable habitat exists.

The ecological communities within the Survey Area that contain rocky ridges, rocky outcropping, and chenopods such as *Tecticornia* spp. were noted as potentially significant due to the possibility for rare or threatened species to be present.

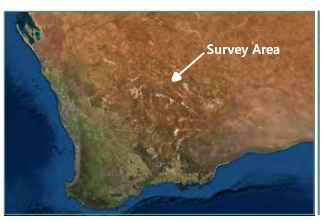
Approximately 25 trapdoor spider burrows were located at seven site assessment locations at Gwalia, Tower Hill, Harbour Lights and Railway Corridors (Map 4.2, Appendix E). The trapdoor spider burrows recorded, appeared to have the distinctive 'moustache-like' arrangement of twigs that the genus *Idiosoma* typically displays, see Figure 4.1 (Rix *et al.*, 2018). Further targeted surveys will be required to accurately identify these trapdoor spiders.

Figure 4.1: Potential *Idiosoma* spp. Burrow



Legend

- Survey Area
- Potential Idiosoma Locations & Number of Burrows



N

0 1 2 km

Scale 1:65,000 @ A3

Coordinate System: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Units: Meter

Spectrum

Author: EM Approved: AH Date: 17-02-2022

Location of Potential Idiosoma sp. Burrows

Leonora Operations

Talis Consultants | St Barbara

MAP 4.2

4.3.1. Conservation Significant Fauna

The conservation significant fauna species identified in the desktop assessment were given a likelihood of occurrence scoring following the field survey. The preliminary desktop assessment was reviewed and amended based on the following:

- Suitable fauna habitats recorded from the Survey Area;
- Distribution of previously recorded conservation significant species;
- Frequency of occurrence of conservation significant species in the region;
- Temporal distribution of conservation significant species; and
- Accuracy of record locations, date, and source of record (level of reliability).

The desktop assessment identified 22 conservation significant fauna species, including four mammals, 17 birds, one reptile and one invertebrate. Following the field survey, seven conservation significant fauna species are considered to have a Medium to High likelihood of occurrence based on the relevant species distributions and habitats occurring within the Survey Areas (Table 4.4). Fifteen species identified in the desktop assessment are considered to have a Low to Very Low likelihood of occurring in the Survey Area. Species descriptions for those assigned a High or Medium likelihood of occurrence are provided in Section 4.3.1.1 to Section 4.3.1.4. Definitions of the relevant conservation status codes are provided in Appendix B.

The likelihood of occurrence of each conservation significant species listed by the database searches was determined based on the criteria outlined in Table 2.3.

Table 4.4: Summary of Conservation Significant Fauna Species Identified Post Survey

Species	Conservation Status			Preferred Habitats	Previous Records	Likelihood of Occurrence
	EPBC Act	BC Act	DBCA			
Mammals						
Western Quoll Dasyurus geoffroii	VU	VU	-	Sclerophyll forest, riparian forest, dry woodland, heath and mallee shrubland (Van Dyck and Strahan, 2008).	No records from the surrounding region. Potential habitat is identified by PMST.	**Low** No suitable habitat exists in the Survey Area.
Greater Bilby *(Macrotis lagotis)*	VU	VU	-	In WA, the preferred habitat is Mulga scrub and hummock grasslands or sandplains or along drainage or salt lakes systems. Require sandy or loamy soil in which to burrow. Only found in areas where foxes are rare or absent.	One DBCA record exists from 1981, 53 km NW of the Survey Area.	**Low** Survey Area contains marginal habitat within the Lake Raeside drainage, however, no recent records, last record was over 50 km north-east the Survey Area over 90 years ago.
Long-tailed Dunnart (*Sminthopsis longicaudata*)	-	-	P4	Primarily rocky hills, breakaways, and plateaus with open mulga, but may also occur in open plains with a stony substrate.	DBCA has two records from 2011 and 2018 located 42 km E of the Survey Area.	**Medium** Some small areas of marginally suitable rocky habitat occurs within the Survey Area, with recent records less than 50 km away.
Brush-tailed Mulgara *(Dasycercus blythi)*	-	-	P4	Mature hummock grasslands of spinifex, especially *Triodia basedowii and T. pungens*. Colonies are thought to be influenced by the presence of well-watered areas such as drainage channels (Masters, Dickman and Crowther, 2003).	Two DBCA records from 2012 are located approximately 78 km SW of the Survey Area.	**Low** No suitable habitat exists within the Survey Area and records are over 50 km away.

Species	Conservation Status			Preferred Habitats	Previous Records	Likelihood of Occurrence
	EPBC Act	BC Act	DBCA			
Birds						
Night Parrot *Pezoporus occidentalis*	EN	CR	-	Recorded from long unburnt, ring forming *Triodia* grasslands in association with low lying saline lakes and drainages hosting chenopods/ samphire (Jackett *et al.*, 2017).	PMST lists habitat potentially present within the Survey Area. As outlined in DPaW (2017), the Survey Area is located within the High priority survey area (Eastern Murchison IBRA region), nearing the Medium priority survey area.	**Low** Suitable foraging habitat may have been present in the Survey Area historically, however livestock grazing has removed all areas of dense grass tussocks and hummocks (breeding habitat) in the region.
Red Knot *Calidris canutus*	EN/MI	EN	-	Migratory shorebird, usually restricted to coastal areas with large tidal flats, uncommon inland (Menkhorst *et al.*, 2019; Birdlife Australia, 2022)	Historic record (1978) from DBCA 37 km NE. No recent records.	**Very Low** Migratory shorebird that is usually restricted to coastal areas. No recent records or suitable habitat.
Malleefowl *Leipoa ocellata*	VU	VU	-	Semi-arid and arid mallee, mulga and other habitats with dense litter forming vegetation. Variety of dry forest, woodlands and shrublands dominated by eucalypts and acacias (Benshemesh, 2007).	Several historic and recent records in the region surrounding the Survey Area were returned from the DBCA search. The closest recent record is from 2011, located approximately 27 km S of the Survey Area.	**Medium** Some suitable habitat recorded from the Survey Area, however the vegetation density is low, minimizing the favourable habitat for this species. In addition, the Survey Area is disturbed from historic and current mining activities.
Princess Parrot (*Polytelis alexandrae*)	VU	-	P4	Western and central deserts. Typically, in sand dune country with scattered trees and good cover of shrubs and Triodia or stands of Mulga and Casuarina (Menkhorst *et al.*, 2019).	No previous records from within the vicinity of the Survey Area. PMST listed as species or species habitat known to occur within the area.	**Low** No recent records and only marginally suitable habitat is present inside the Survey Area.

Species	Conservation Status			Preferred Habitats	Previous Records	Likelihood of Occurrence
	EPBC Act	BC Act	DBCA			
Grey Falcon *Falco hypoleucos*	-	VU	-	Likely a nomadic species in the arid and semi-arid zones. Does not appear to be associated with any particular vegetation types (Schoenjahn, Pavey and Walter, 2020).	No confirmed records within 50 km. One historical record from over 25 years ago, located 58 km W (DBCA). PMST lists species or species habitat may occur within the Survey Areas.	**Low** No recent records in the vicinity. Suitable habitat could occur in the region and the Survey Area. Habitat preferences are not well known and the Survey Area occurs at the southern extent of the species known range.
Fork-tailed Swift *Apus pacificus*	MI	MI	-	Nomadic, almost entirely aerial lifestyle over a variety of habitats; associated with storm fronts (Australian Government & DAWE 2020).	No confirmed records within 50 km. PMST lists species or species habitat likely to occur within the Survey Area.	**Low** The Fork-tailed Swift is highly nomadic and can occur across Australia. Records are typically associated with suitable climatic conditions instead of habitat types.
Oriental Plover *Charadrius veredus*	MI	MI	-	Migrant to plains and grasslands of northern Australia. Prefers thinly vegetated plains such as recently burnt or heavily grazed areas (Menkhorst *et al.*, 2019).	No previous records from within the vicinity of the Survey Area from DBCA. PMST listed as a species or species habitat may occur within the area. ALA lists one record of this species from 2018 approximately 12 km to east (with a 10 km generalised locality).	**Low** Migratory shorebird rarely recorded in the region and limited sutiable habitat with the Survey Area and surrounds.
Pacific Golden Plover *Pluvialis fulva*	MI	MI	-	Migratory shorebird, mainly occurs in coastal areas with tidal flats or beaches and reefs, usually with seaweed. Also less commonly found inland at wetlands or sparse grasslands (Menkhorst *et al.*, 2019).	One historic record from DBCA.	**Very Low** No recent records and limited suitable habitat occurs within the Survey Area and surrounding region.

Species	Conservation Status			Preferred Habitats	Previous Records	Likelihood of Occurrence
	EPBC Act	BC Act	DBCA			
Sharp-tailed Sandpiper *Calidris acuminata*	MI	MI	-	Common migratory shorebird in Australia, regularly seen around fresh and saline inland wetlands. Also found around sewage farms, lagoons and temporary floodwaters (Morcombe, 2003).	Historic DBCA record from 1979, 5 km W of Survey Area. ALA has more recent records (2018, 2019) both less than 20 km W (with a 10 km generalised locality). PMST lists habitat to potentially be present within the Survey Area.	**Medium** Migratory shorebird. May occasionally visit the wetland areas associated with Lake Raeside drainage when inundated and the limited artificial waterbodies associated with mining and sewage located within or near the Survey Area.
Pectoral Sandpiper *Calidris melanotos*	MI	MI	-	Uncommon migrant. Grassy edges of freshwater wetlands or brackish wetlands with short saltmarsh fringes when no freshwater is available (Menkhorst *et al.*, 2019).	No confirmed records within 50 km. PMST lists habitat as potentially present within the Survey Area.	**Very Low** Uncommon migratory shorebird, with limited records inland within the vicinity of the Survey Area. No preferred habitat is present in the Survey Area.
Common Sandpiper *Tringa hypoleucos*	MI	MI	-	Migratory/waterbird species typically associated with narrow steep shorelines and mangrove lined creeks. This species also inhabits inland ephemeral wetland habitat types when present and sewage ponds and dams (Birdlife Australia, 2012; Menkhorst *et al.*, 2019).	Seven DBCA records within 8 km W of the Survey Area, with two recent records (2013 & 2016). PMST lists species or species habitat likely to occur within the Survey Area. ALA also has recent records from 2019 and 2020 at the Leonora Wastewater Treatment Plant.	**Medium** Migratory shorebird with some local records using nearby wetlands and sewage ponds. May occasionally visit the visit the wetland areas associated with Lake Raeside drainage when inundated and the limited artificial waterbodies associated with mining and sewage located within or near the Survey Area.

Species	Conservation Status			Preferred Habitats	Previous Records	Likelihood of Occurrence
	EPBC Act	BC Act	DBCA			
Wood Sandpiper *Tringa glareola*	MI	MI	-	Migratory shorebird. Freshwater wetlands, especially with emergent sedges or other small plants and taller fringe vegetation. Usually near shorelines on mudflats or in shallow water (Menkhorst *et al.*, 2019).	DBCA has two recent records (2015), <1 km from the Survey Area at the Leonora Waste Water Treatment Plant. ALA also has a records for this species from 2019 approximately 4.5 km E of the Survey Area (with a 10 km generalised locality).	**Medium** Migratory shorebird with some local records using nearby wetlands and sewage ponds. May occasionally visit the limited freshwater artificial waterbodies associated with mining and sewage located within or near the Survey Area.
Common Greenshank *Tringa nebularia*	MI	MI	-	Migratory shorebird. Shallow, coastal, and freshwater wetlands with open mudflats or still shallow water (Menkhorst *et al.*, 2019).	DBCA has a number of recent and historic records with five within the last 20 years, 8.5 km E of the Survey Area. Listed as a potential species for the area from PMST and Nature Map.	**Medium** Migratory shorebird with some local records using nearby wetlands. May occasionally visit the limited freshwater artificial waterbodies associated with mining and sewage located within or near the Survey Area.
Grey Wagtail *Motacilla cinerea*	MI	MI	-	Migratory species rarely reaching Australian fresh streams, mowed grass, ploughed land or sewage ponds (Morcombe, 2003).	No previous records from the vicinity of the Survey Area. PMST list the habitat as potentially occurring at the Survey Area.	**Very Low** The species has not been recorded in the wider region, and only marginal habitat exists within or near the Survey Area.
Yellow Wagtail *Motacilla flava*	MI	MI	-	Occurs across Europe, Western Asia, and Africa. Utilises a variety of damp or wet habitats with low vegetation, such as meadows, marshes, waterside pastures and sewage treatment plants (Menkhorst *et al.*, 2019).	No previous records from within the vicinity of the Survey Area. PMST listed them as a potential species for the area.	**Very Low** Rare visitor to Australia. No previous records and limited suitable habitat within the Survey Area and surrounds.

Species	Conservation Status			Preferred Habitats	Previous Records	Likelihood of Occurrence
	EPBC Act	BC Act	DBCA			
Hooded Plover *Thinornis rubricollis*	-	-	P4	Inland margins and shallows of salt lakes, estuaries, coastal lakes and ocean beaches (Morcombe, 2003; Menkhorst *et al.*, 2019).	One record from 2001 (DBCA) exists, approximately 8 km E of the Survey Area.	**Low** The species is rarely recorded in the region as it is at the north-eastern extent of it's range. Limited suitable habitat within the Survey Area.
Peregrine Falcon *Falco peregrinus*	-	OS	-	Occur across much of Australia inhabiting cliffs, coastal habitats, rivers, wooded water courses and lakes (Birdlife Australia, 2012).	Several historical and recent records from the surrounding region. One record from DBCA (2014) is 9 km E of Survey Area.	**Medium** Recently recorded from the region. The species may use foraging habitat within the Survey Area sporadically.
Reptiles						
Woma *Aspidites ramsayi*	-	-	P1	Generally restricted to arid and dry inland areas, preferably with sandy soils. A nocturnal species which shelters in dense vegetation such as spinifex, hollow logs and animal burrows during the day (Cogger, 2018).	Historic record from a roadkill specimen at Menzies, south of the Survey Area.	**Low** No recent records of this species and limited habitat present within the Survey Area.
Invertebrates						
Arid Bronze Azure Butterfly *Ogyris subterrestris* subsp. *petrina*	CR	CR	-	Associated with the sugar ant (*Camponotus* sp. nr. *terebrans*). Habitat present at known sites include mature mixed Salmon Gum (*Eucalyptus salmonophloia*) with Gimet (*E. salubris)* with an open understorey over red-brown soils (DBCA, 2020).	No records in the vicinity of the Survey Area. The Survey Area is located in the presumed range of the host ant (DBCA, 2020).	**Low** No preferred habitat recorded from the Survey Area. Any woodland habitat will be required to be surveyed

4.3.1.1. Malleefowl (*Leipoa ocellata*)

Conservation Status

- EPBC Act: Vulnerable.
- BC Act: Vulnerable.

Distribution, Habitat and Ecology: The Malleefowl is a large ground-dwelling bird species. It is restricted to the mainland of Australia where it inhabits semi-arid and arid habitats. In its range, the density of the Malleefowl is generally greater in areas of higher rainfall and where shrub diversity is greatest (Benshemesh, 2007; Malleefowl Recovery Team, 2018). In Western Australia, Malleefowl occur in *Acacia* shrublands as well as areas that are dominated by mallee, Wandoo (*Eucalyptus accedens*), Marri (*Corymbia calophylla*), Mallet (*Eucalyptus astringens*) or Broombush (*Melaleuca uncinata)*. The species is most abundant in undegraded areas with dense shrubs and trees that have a sandy substrate and plenty of leaf litter (Benshemesh, 2007).

The Malleefowl is a generalist feeder, consisting of seeds, fruits, flowers, fungi, invertebrates, herbs, legumes depending on location and season (Australian Government, 2018). The species mates for life and each pair builds large mounds (3-5 m in diameter) which are used as nests for the incubation of eggs. Egg laying typically begins in September when one egg is laid every 5-7 days (total of about 15-25 eggs) until the end of summer. The incubation period is approximately 60 days which depends on the temperature of the nest. The eggs are incubated by decomposition of leaf litter and plant material, as well as the heat from the sunlight later in the season (summer). Whilst the male predominantly attends the eggs and maintains the temperature for incubation, the females spends most of her time feeding for egg production and only rarely visits the nest (Benshemesh, 2007).

Occurrence in the Survey Area: The DBCA database search returned 11 historic and recent records, with the closest located 27 km south of the Survey Area in 2011. A survey conducted within the Survey Area and surrounds by Bamford Consulting Ecologists in (2010), recorded five Malleefowl mounds, with only one recently excavated with tracks. All five mounds were recorded within approximately 600 m of each other, located approximately 28 km south-west of the Survey Area. Additional Malleefowl tracks were also located around 22 km north-east of the Survey Area. All of the records appear to have been located in dense *Acacia* (Mulga) woodlands. The species was not recorded during the survey and suitable habitat present within the Survey Area is only marginal for the species due to the low density of vegetation and disturbance from historic and current mining activities. In addtion, as much of the Survey Area is in close vicinity to Leonora, this may increase the predation pressure on this species.

It has a Medium likelihood to occur based on the records in the region and that the species may use some of the marginal habitat present in the Survey Area for foraging.

4.3.1.2. EPBC Act/BC Act Migratory Shorebirds

Database searches returned eight shorebirds listed as Migratory under the EPBC Act that could potentially occur in the Study Area. The Red Knot is also listed as Endangered by both the EPBC and BC Acts. Four of these were scored a Medium likelihood of occurrence (Table 4.4) all of which are primarily associated with coastal or inland water bodies. The four shorebirds species names and their EPBC Act status are summarised in Table 4.5 below.

Table 4.5: 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
Sharp-tailed Sandpiper	*Calidris acuminata*	Migratory
Wood Sandpiper	*Tringa glareola*	Migratory

Distribution, Ecology and Habitat

There are 37 species of migratory shorebirds in Australia that utilise the East-Asian-Australasian Flyway (EAAF); four of which have been given a Medium likelihood of occurring in the Survey Area. 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 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 Study Area

All four shorebird species have been recorded outside but within close vicinity to the Survey Area from 1978 to 2020 (see Map 3.4 for DBCA records). The ephemeral salt-lake habitat associated with Lake Raeside drainage in the south of the Study Area is likely to provide foraging habitat for shorebirds that feed on aquatic invertebrates. In addition, a limited number of artificial freshwater waterbodies associated with mining and sewage occur within or in close proximity to the Survey Area. However, as these species are non-breeding migrants to Australia, their presence in the Survey Area is expected to be sporadic and temporary, depending on the availability of water.

4.3.1.3. Long-tailed Dunnart (*Sminthopsis longicaudata*)

Conservation Status

- DBCA: Priority 4.

Distribution, Habitat and Ecology: The Long-tailed Dunnart is a small, nocturnal, white-grey marsupial. It is the only Dunnart species with a tail more than twice the length of its body including a small terminal tuft of long hairs at the end. It occurs in the Pilbara, Murchison, north-eastern Goldfields, Ashburton and Gibson Desert region. In Western Australia, populations have been found to be relatively isolated indicating a very poor dispersal capability. The Long-tailed Dunnart is often found in rocky landscapes, such as lateritic plateaux, flat-topped hills and mesas as well as breakaways. The vegetation is often dominated by low open woodland or mixed shrubland of *Acacia* spp. over *Triodia* grassland (Government of Western Australia, 2018). It is a specialist rock dwelling species that has great agility climbing between rocks, using its striated foot pads and long tail for balance. The Long-tailed Dunnart feeds on a range of invertebrates including grasshoppers, beetles, ants, cockroaches and spiders (Burbidge, McKenzie and Fuller, 2008)

Occurrence in the Survey Area: The Long-tailed Dunnart was given a Medium likelihood of occurrence due to recent records from within 50 km of the Survey Area and the marginal rocky habitat that was recorded in the Survey Area.

4.3.1.4. Peregrine Falcon (*Falco peregrinus*)

Conservation Status

- BC Act: Other Specially Protected Fauna (OS)

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 throughout most of Australia though it is an uncommon species and rare across all states and territories (Birdlife Australia, 2012). The Peregrine Falcon is known to be both a nomadic and sedentary species and is 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*) (Birdlife Australia, 2012).

Occurrence in the Survey Area: The DBCA database search identified ten records from the surrounding region. The closest, and most recent record is from 2014, located 9 km east of the Survey Area. The Peregrine Falcon may use the Survey Area occasionally for foraging. This species is also known to nest in sheer cliffs of open pits, and may potentially use one of the numerous open pits in the Survey Area.

5. CONCLUSION

A total of 13 ecological communities were recorded from the Survey Area, these were:

- Woodland of *Acacia* (Mulga) spp. over sparse shrubs and grasses on sandy-loams on flats and flowlines;
- Open woodland of *Acacia* (Mulga) spp. over sparse shrubs on sandy-loam on flats and lower slopes;
- Open shrubland of *Acacia* (Mulga) spp. over mixed chenopods with pebbles and quartz on flats and lower slopes;
- Low open shrubland of *Acacia* spp. over mixed chenopods and grasses on pebbles and quartz on lower slopes;
- *Acacia* (Mulga) spp. over mixed shrubs on quartz outcrop;
- Low chenopod shrubland on gravelly loam on flats and flowlines;
- Lake Raeside drainage with *Tecticornia* low open shrubland;
- Open woodland of *Acacia* and *Eremophila* over diverse chenopod shrubs on sand dunes fringing salt lake;
- Low chenopod shrubland on loam on flats;
- Open shrubland of *Acacia* spp. on ironstone gravel on flats;
- *Eremophila* over *Tecticornia* open plain on fine gravel;
- *Acacia spp. over mixed shrubs on rocky ridges and outcrops*; and
- Cleared/Disturbed areas.

The most common ecological community in the Survey Area was open shrubland of *Acacia* (Mulga) spp. over mixed chenopods with pebbles and quartz on flats and lower slopes, covering 1,287.7 ha.

The ecological communities within the Survey Area that contain rocky ridges, rocky outcropping, and chenopods such as *Tecticornia* spp. were noted as potentially significant due to the possibility for rare or threatened species to be present.

Five significant flora species were assigned a High likelihood of occurrence:

- *Frankenia georgei;*
- *Stenanthemum patens;*
- *Angianthus prostrates;*
- *Acacia* sp. Marshall Pool (G. Cockerton 3024); and
- *Frankenia glomerata.*

No conservation significant vertebrate fauna were recorded during the survey. However, seven species have a Medium to High likelihood of occurrence in the Survey Area:

- Malleefowl (*Leipoa ocellata*);
- EPBC Act/BC Act Listed Shorebirds:
  - Common Greenshank (*Tringa nebularia*);
  - Common Sandpiper (*Tringa hypoleucos*);
  - Sharp-tailed Sandpiper (*Calidris acuminata*);
  - Wood Sandpiper (*Tringa glareola*);
- Long-tailed Dunnart (*Sminthopsis longicaudata*); and
- Peregrine Falcon (*Falco peregrinus*).

Approximately 25 trapdoor spider burrows were located at seven site assessment locations at Gwalia, Tower Hill, Harbour Lights and Railway Corridors. The trapdoor spider burrows recorded, appeared to have the distinctive 'moustache-like' arrangement of twigs that are typical of the genus *Idiosoma*. Further targeted surveys will be required to determine their identity.

5.1. Additional Survey Recommendations

Additional biological surveys are recommended for the Survey Area and these are discussed below. All recommendations should be discussed with relevant staff from the EPA/DBCA to confirm current expectations from these organisations.

It should also be noted that subterranean fauna have not been considered in this report (although the presence of the *Melita calcrete groundwater assemblage type on Raeside palaeodrainage on Melita (Sons of Gwalia) Station* PEC is a strong indication that a detailed subterranean fauna assessment may be required)

5.1.1. Flora & Vegetation

Due to the limited number of recent flora and vegetation surveys in the local region, it would be expected that a single season detailed flora and vegetation assessment (completed after significant rainfall) and targeted flora survey (completed in the correct season(s)) would be required. Additional assessments may be required if rainfall in 2022 is not sufficient to allow the assessment of annual species.

5.1.2. Vertebrate Fauna

Due to the size of the Survey Area and availability of recent regional vertebrate fauna assessments, a targeted vertebrate fauna survey is expected to be sufficient. The main species of concern will be Malleefowl, with any impact to the surrounding salt lakes and claypans potentially requiring an assessment of the migratory bird usage during periods of inundation.

5.1.3. SRE Invertebrate Fauna

No available SRE invertebrate fauna assessments have been identified from the surrounding region, therefore it is recommended that a detailed SRE invertebrate fauna assessment be completed. Survey timing is post significant rainfall, which can be either associated summer cyclones coming down from the north or winter rainfall that has pushed up from the south. The SRE survey can be completed at the same time as the vertebrate fauna assessment, which will potentially allow the detection of additional vertebrate fauna species.

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Appendix A: Site Visit – Assessment Sites

Site Visit - Assessment Notes

Site ID	Easting	Northing	EC No.	Ecological Community	Landform, Soil & Geology	Photograph
Ghab1	339026	6799482	EC03	Open shrubland of *Acacia* spp (Mulga). over mixed chenopods with pebbles and quartz on flats and lower slopes	Flat plain, red-orange sandy loam, quartz/granite/ Ironstone	
Ghab2	339096	6798226	EC09	Low chenopod shrubland on gravelly loam on flats and flowlines	Flat plain, red-orange sandy loam, quartz/granite/ ironstone	
Ghab3	338982	6797606	EC01	Woodland of *Acacia* (Mulga) spp. over sparse shrubs and grasses on sandy-loams on flats and flowlines	Minor drainage line, red-orange, sandy-clay-loam, quartz/granite	
Ghab4	338282	6797960	EC02	Open woodland of *Acacia* (Mulga) spp. over sparse shrubs on sandy-loam on flats and lower slopes	Flat plain, red-orange sandy-loam	

Site ID	Easting	Northing	EC No.	Ecological Community	Landform, Soil & Geology	Photograph
Ghab5	337871	6798011	EC05	*Acacia spp. over mixed shrubs on rocky ridges and outcrops*	Hill/Crest red-orange, ironstone, granite, quartz	
Ghab6	337390	6797612	EC02	Open woodland of *Acacia* (Mulga) spp. over sparse shrubs on sandy-loam on flats and lower slopes	Flat plain, red-orange sandy-loam	
Ghab7	337619	6797151	EC03	Open shrubland of *Acacia* (Mulga) spp. over mixed chenopods with pebbles and quartz on flats and lower slopes	Flat plain, red-orange sandy loam, quartz/granite/ Ironstone	
Ghab8	335298	6798362	EC09	Low chenopod shrubland on loam on flats	Flat plain, red-orange sandy-clay-loam	

Site ID	Easting	Northing	EC No.	Ecological Community	Landform, Soil & Geology	Photograph
Ghab9	335953	6798551	EC08	Open woodland of *Acacia* and *Eremophila* over diverse chenopod shrubs on sand dunes fringing salt lake	Sand dunes at edge of salt lake, red-orange sand	
Ghab10	336425	6797690	EC08	Open woodland of *Acacia* and *Eremophila* over diverse chenopod shrubs on sand dunes fringing salt lake	Sand dunes at edge of salt lake, red-orange sand	
Ghab11	337113	6797450	EC02	Open woodland of *Acacia* (Mulga) spp. over sparse shrubs on sandy-loam on flats and lower slopes	Flat plain, red-orange sandy-loam	
Ghab12	339358	6798566	EC03	Open shrubland of *Acacia* (Mulga) spp. over mixed chenopods with pebbles and quartz on flats and lower slopes	Flat to lower slopes, red-orange sandy loam, quartz/granite/ Ironstone	

Site ID	Easting	Northing	EC No.	Ecological Community	Landform, Soil & Geology	Photograph
Rhab1	338955	6799785	EC01	Woodland of *Acacia* (Mulga) spp. over sparse shrubs and grasses on sandy-loams on flats and flowlines	Minor drainage line, red-orange, sandy-clay-loam, quartz/granite	
Rhab2	339499	6799924	EC03	Open shrubland of *Acacia* (Mulga) spp. over mixed chenopods with pebbles and quartz on flats and lower slopes	Flat to lower slopes, red-orange sandy loam, quartz/granite	
Rhab3	340046	6799751	EC03	Open shrubland of *Acacia* (Mulga) spp. over mixed chenopods with pebbles and quartz on flats and lower slopes	Flat to lower slopes, red-orange sandy loam, quartz/granite/ Ironstone	
Rhab4	339899	6801289	EC01	Woodland of *Acacia* (Mulga) spp. over sparse shrubs and grasses on sandy-loams on flats and flowlines	Minor drainage line, red-orange, sandy-clay-loam, quartz/granite	

Site ID	Easting	Northing	EC No.	Ecological Community	Landform, Soil & Geology	Photograph
Rhab5	340095	6801864	EC03	Open shrubland of *Acacia* (Mulga) spp. over mixed chenopods with pebbles and quartz on flats and lower slopes	Flat to lower slopes, red-orange sandy loam, quartz/granite	
Thab1	337270	6801981	EC01	Woodland of *Acacia* (Mulga) spp. over sparse shrubs and grasses on sandy-loams on flats and flowlines	Minor drainage line, red-orange sandy-clay-loam	
Thab2	336479	6801353	EC12	*Acacia* (Mulga) spp. over mixed shrubs on quartz outcrop	Hill, crest, red-orange loam, quartz outcropping	
Thab3	335582	6800524	EC02	Open woodland of *Acacia* (Mulga) spp. over sparse shrubs on sandy-loam on flats and lower slopes	Flat, plain, red-orange sandy-loam, quartz	

Site ID	Easting	Northing	EC No.	Ecological Community	Landform, Soil & Geology	Photograph
Thab4	335979	6800605	EC04	Open woodland of *Acacia* (Mulga) spp. over sparse shrubs on sandy-loam on flats and lower slopes	Flats and lower slopes,red-orange sandy-loam, quartz	
Thab5	335963	6800413	EC11	*Eremophila* over *Tecticornia* open plain on fine gravel	Flat, plain, red-orange sandy-clay--loam, quartz	
Thab6	335297	6800870	E02	Open woodland of *Acacia* (Mulga) spp. over sparse shrubs on sandy-loam on flats and lower slopes	Flat, plain, red-orange sandy-loam, quartz	
Thab7	334952	6802080	E02	Open woodland of *Acacia* (Mulga) spp. over sparse shrubs on sandy-loam on flats and lower slopes	Flat, plain, red-orange sandy-loam, quartz	

Site ID	Easting	Northing	EC No.	Ecological Community	Landform, Soil & Geology	Photograph
Thab8	335866	6802777	EC01	Woodland of *Acacia* (Mulga) spp. over sparse shrubs and grasses on sandy-loams on flats and flowlines	Flat, plain, red-orange sandy-loam	
Thab9	334476	6802222	EC01	Woodland of *Acacia* (Mulga) spp. over sparse shrubs and grasses on sandy-loams on flats and flowlines	Flat, plain, red-orange sandy-loam	
Thab10	336838	6802803	EC02	Open woodland of *Acacia* (Mulga) spp. over sparse shrubs on sandy-loam on flats and lower slopes	Flat, plain, red-orange sandy-loam, quartz	
Hhab1	336654	6804098	EC01	Woodland of *Acacia* (Mulga) spp. over sparse shrubs and grasses on sandy-loams on flats and flowlines	Minor drainage line, red-orange sandy-loam	

Site ID	Easting	Northing	EC No.	Ecological Community	Landform, Soil & Geology	Photograph
Hhab2	335751	6805848	EC03	Open shrubland of *Acacia* (Mulga) spp. over mixed chenopods with pebbles and quartz on flats and lower slopes	Flat, plain, red-orange sandy-loam, quartz, granite, ironstone	
Hhab3	335349	6806021	EC03	Open shrubland of *Acacia* (Mulga) spp. over mixed chenopods with pebbles and quartz on flats and lower slopes	Flat, plain, red-orange sandy-loam, quartz, granite, ironstone	
Hhab4	334918	6805034	EC01	Woodland of *Acacia* (Mulga) spp. over sparse shrubs and grasses on sandy-loams on flats and flowlines	Minor drainage line, red-orange sandy-loam	
Hhab5	334752	6805187	EC03	Open shrubland of *Acacia* (Mulga) spp. over mixed chenopods with pebbles and quartz on flats and lower slopes	Flat, plain, red-orange sandy-loam, quartz, granite, ironstone	

Site ID	Easting	Northing	EC No.	Ecological Community	Landform, Soil & Geology	Photograph
Hhab6	334254	6805736	EC03	Open shrubland of *Acacia* (Mulga) spp. over mixed chenopods with pebbles and quartz on flats and lower slopes	Flat, plain, red-orange sandy-loam, quartz, granite, ironstone	
Hhab7	334088	6805555	EC02	Open woodland of *Acacia* (Mulga) spp. over sparse shrubs on sandy-loam on flats and lower slopes	Flat, plain, red-orange sandy-loam	
Hhab8	334440	6804739	EC02	Open woodland of *Acacia* (Mulga) spp. over sparse shrubs on sandy-loam on flats and lower slopes	Flat, plain, red-orange sandy-loam	
Jhab1	329927	6817257	EC02	Open woodland of *Acacia* (Mulga) spp. over sparse shrubs on sandy-loam on flats and lower slopes	Flat, plain, red-orange sandy-loam	

Site ID	Easting	Northing	EC No.	Ecological Community	Landform, Soil & Geology	Photograph
Jhab2	328371	6818478	EC03	Open shrubland of *Acacia* (Mulga) spp. over mixed chenopods with pebbles and quartz on flats and lower slopes	Flat, plain, red-orange sandy-loam, quartz	
Jhab3	328115	6818472	EC01	Woodland of *Acacia* (Mulga) spp. over sparse shrubs and grasses on sandy-loams on flats and flowlines	Minor drainage line, red-orange sandy-clay-loam	
Jhab4	329590	6818089	EC10	Open shrubland of Acacia spp. on ironstone gravel on flats	Flat, plain, red-orange sandy-loam, ironstone gravel	
Jhab5	326677	6817251	EC05	Acacia spp. over mixed shrubs on rocky ridges and outcrops	Hill, crest, red-brown sandy-loam, granitic rocky outcropping	

Site ID	Easting	Northing	EC No.	Ecological Community	Landform, Soil & Geology	Photograph
Jhab6	326603	6817110	EC03	Open shrubland of Acacia (Mulga) spp. over mixed chenopods with pebbles and quartz on flats and lower slopes	Hill, Mid slope, red-brown, granite, ironstone, quartz	
Jhab7	326616	6818694	EC05	*Acacia* spp. over mixed shrubs on rocky ridges and outcrops	Hill, crest, red-orange sandy-loam, granitic rocky outcropping	
Jhab8	326574	6818820	EC03	Open shrubland of *Acacia* (Mulga) spp. over mixed chenopods with pebbles and quartz on flats and lower slopes	Flat, plain, red-orange sandy-loam, quartz	
Jhab9	326218	6817917	EC03	Open shrubland of *Acacia* (Mulga) spp. over mixed chenopods with pebbles and quartz on flats and lower slopes	Flat, plain, red-orange sandy-loam, quartz	

Site ID	Easting	Northing	EC No.	Ecological Community	Landform, Soil & Geology	Photograph
Jhab10	327500	6815814	EC01	Woodland of *Acacia* (Mulga) spp. over sparse shrubs and grasses on sandy-loams on flats and flowlines	Flat, plain, red-orange sandy-loam	
Jhab11	326996	6816230	EC03	Open shrubland of *Acacia* (Mulga) spp. over mixed chenopods with pebbles and quartz on flats and lower slopes	Flat, plain, red-orange sandy-loam, quartz	

Appendix B: Conservation Codes

Appendix B1: 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 B2: 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.

Code	Definition (BC Act)
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.	
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.	

Code	Definition (BC Act)
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.
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 B3: Legal Status Definition of Listed Plants in Western Australia

Legal Status	Definition
Declared Pest, Prohibited – s12	Prohibited organisms are declared pests by virtue of section 22(1) and may only be imported and kept subject to permits.
Declared Pest – s22(2)	Declared pests must satisfy any applicable import requirements when imported and may be subject to control keeping requirements.
Permitted – s11	Permitted organisms must satisfy applicable import requirements and import permits (where required).
Permitted, Requires Permit – r73	Regulation 73 permitted organisms may be subject to restriction under legislation other than the BAM Act (2007).
Unlisted	Unlisted organisms are prohibited in WA.
Control Categories	**Definition**
C1 Exclusion	Organisms should be excluded from parts or all of WA.
C2 Eradication	Organisms should be eradicated from all or parts of WA.
C3 Management	Organisms should have some form of management applied that will alleviate the harmful impact of the organism, reduce the numbers or distribution of the organism or prevent or contain the spread of the organism.
Unassigned	Declared pest that are recognised as having a harmful impact under certain circumstances where their subsequent control requirements are determined by a plan or other legislative arrangements under the Act.
Keeping Categories	**Definition**
Prohibited keeping	Can only be kept under a permit for public display, education or scientific purposes.
Restricted keeping	Kept under a permit by private individuals due to a low risk of becoming a problem for the environment.
Exempt keeping	No permit or conditions are required for keeping. Organism may be subject to restrictions under the Wildlife Conservation Act (WCA, 1950).

Appendix C: Significant Flora Desktop Assessment

Status	Family	Taxon	Description	Lifeform	Flowering Time	Habitat	Closest Record (km)	Likelihood
Threatened	Scrophulariaceae	*Eremophila viscida*	Shrub, 1.2-4 m high. Fl. green-white-yellow	Shrub	Sep to Oct.	Granitic soils, sandy loam. Stony gullies, sandplains.	105.989	Low
Threatened	Malvaceae	*Seringia exastia*	Low shrub to 1 m. Pink flowers. All flora flowering well. Seringia 90% flowering, 0% in fruit.	-	Aug.	Pindan plain. Pink - orange pindan sand. Gently undulating pindan sandplain with deep red sands. 2-3 years post-burn.	92.8235	Low
Presumed extinct	Amaranthaceae	*Ptilotus caespitulosus*	Prostrate perennial, herb, presumed extinct. Fl. pink/white & other,	Herb	Nov.	Sandy clay. Around salt lakes.	105.989	Low
Priority 1	Fabaceae	*Acacia epedunculata*	Low spreading, becoming rounded, multi-stemmed shrub, 0.5-0.65 m high. Fl. yellow	Shrub	Aug.	Yellow sand. Sandplains.	150.294	Low
Priority 1	Fabaceae	*Acacia websteri*	Shrub, 1.2-5 m high, bark fibrous. Fl. yellow.	Shrub	May to June.	Red sand, clay or loam. Low-lying areas, flats.	46.5337	Low
Priority 1	Portulacaceae	*Anacampseros sp. Eremaean (F. Hort, J. Hort & J. Shanks 3248)*	Erect, single-stemmed tuberous, perennial, herb (with succulent green leaves), to 0.1 m high. Fl. white,	Herb	Sep.	Sand patches inside rocks, brown sandy clay, granite. Depressions in rock outcrops, breakaways, flats.	51.2936	Low
Priority 1	Montiaceae	*Calandrinia quartzitica*	Scrambling erect perennial herb, height 12-25 cm, width 7-14 cm, very succulent basal leaves, petals 5, creamy white blushed with pink, stigmas 3 and numerous stamens.	herb	Oct.	Flats adjacent to lake edge, soil red-brown silty loam with occasional quartz stones. Floodplain of nearby lake. Red brown clayey sand.	16.0931	Medium
Priority 1	Droseraceae	*Drosera eremaea*	Pink flowers, sweet vanilla fragrance. Aborted flowers and one young plant with basal rosette	Herb	Jul to Oct.	Low banded ironstone ridge, W facing slope, growing in soil pockets on BIF outcrop. Exfoliating granite outcrop.	47.1914	Low
Priority 1	Scrophulariaceae	*Eremophila eversa*	Shrub. Fl.	Shrub	Sep.	-	73.1342	Low
Priority 1	Frankeniaceae	*Frankenia georgei*	Small shrub. Fl. pink,	Shrub	Dec.	Rocky slopes.	3.96054	High
Priority 1	Lamiaceae	*Hemigenia obovata*	Erect compact shrub to 40 cm. Mauve flowers.	Shrub	Nov.	Flat plain. At roadside in wet sand. Black sand below white. Wetland; bare to littered moist sedgy black clay soil.	117.679	Low
Priority 1	Santalaceae	*Korthalsella leucothrix*	Host Acacia various sp. Including ramulosa & aneura var. microcarpa. Unusual bright green cladodes, in bud or fruit. Tufted, erect, dark green hemi-parasite on the smaller twigs of the host. Ripe fruits green.	Herb	-	Coarse reddish sandy loam, lateritic.	54.6177	Low

Status	Family	Taxon	Description	Lifeform	Flowering Time	Habitat	Closest Record (km)	Likelihood
Priority 1	Brassicaceae	*Lepidium xylodes*	Erect shrub, 0.4-1.5 m high, stems becoming spinescent. Fl. white/cream,	Shrub	Aug or Nov.	Gravelly loam, clayey sand.	14.9518	Medium
Priority 1	Proteaceae	*Persoonia leucopogon*	Erect or decumbent shrub, 0.3-0.6 m high. Fl. yellow/green-yellow,	Shrub	Oct to Dec.	Yellow sand or sandy clay.	117.679	Low
Priority 1	Rutaceae	*Philotheca linearis*	Shrub, to 2 m high. Fl. white,	Shrub	Jul.	Yellow sand. Base of granite outcrop.	108.191	Low
Priority 1	Rutaceae	*Philotheca tubiflora*	Compact, much-branched shrub, 0.2-0.6 m high. Fl. pink-white,	Shrub	Jun to Oct.	Rocky rises & hills, outcrops.	67.5677	Low
Priority 1	Orchidaceae	*Pterostylis elegantissima*	Deciduous terrestrial orchid, plants tall and slender; lateral sepals brown; galea green; flowers semi-erect.	Herb	Sep.	Gentle to steep slopes, S aspect. Granitic sand over granite.	132.794	Low
Priority 1	Orchidaceae	*Pterostylis xerampelina*	Tuberous perennial herb to 150 mm with several hooded brown flowers.	Herb	Sep to Nov.	Huge granite dome to 100 m high overlooking salt lake. Small pockets and soil in rock crevices otherwise mostly bare granite.	131.592	Low
Priority 1	Amaranthaceae	*Ptilotus chortophytus*	Erect herb, 10 cm high x 15 cm wide. Flowers cream / yellow.	Herb	Nov.	Breakaway. Rocky brown loam with shale.	52.1072	Low
Priority 1	Amaranthaceae	*Ptilotus procumbens*	Spreading procumbent annual, herb, ca 0.1 m high. Fl. pink-white.	Herb	Nov.	Red clay.	151.816	Low
Priority 1	Amaranthaceae	*Ptilotus rigidus*	Shrubs, stems several, more or less prostrate	Shrub	Oct.	Ironstone outcrop on the edge of a salt lake. Red soil. Gentle E facing hillslope with abundant quartzite stones on the edge of a saline flat, orange sand.	128.71	Low
Priority 1	Amaranthaceae	*Ptilotus sp. Kookynie (J. Jackson & B. Moyle 261)*	Small perennial herb to 12 cm high, 12 cm wide, green flowers, small succulent basal leaves. This is the population Weber collected from in 1975. Growing on and around an old area of mining/prospecting.	Herb	Sep.	On rock on rocky hill. Area of dense quartz.	51.028	Low
Priority 1	Amaranthaceae	*Ptilotus tetrandrus*	Annual, herb, 0.15-0.3 m high. Fl.	Herb	Oct.	Loamy sand.	42.1309	Low
Priority 1	Asteraceae	*Rhodanthe uniflora*	Erect, woolly annual, herb, 0.02-0.1(-0.3) m high. Fl. Yellow.	Herb	Aug to Oct.	Brown earth. Open eucalyptus woodland.	138.346	Low
Priority 1	Rhamnaceae	*Stenanthemum patens*	Shrub, ca 0.5 m high.	Shrub	Aug.	Rocky hillside.	12.4645	High
Priority 1	Chenopodiaceae	*Tecticornia mellarium*	Shrub, 0.5 m high.	Shrub	-	Sand dune by salt lake. Brown, red-orange sand, sandy clay.	82.7613	Low

Status	Family	Taxon	Description	Lifeform	Flowering Time	Habitat	Closest Record (km)	Likelihood
Priority 1	Chenopodiaceae	*Tecticornia sp. Lake Way (P. Armstrong 05/961)*	Small upright shrub 30 to 40 cm tall with a spread to 10 cm.	Shrub	-	Lake bed. Level that would occasionally be inundated. Grey loamy clay sand.	80.3735	Low
Priority 2	Scrophulariaceae	*Eremophila mirabilis*	Shrub, 0.3-2 m high. Fl. yellow,	Shrub	Jul to Sep.	Clay sand, stony clayey loam. Granite country.	28.4806	Medium
Priority 2	Myrtaceae	*Eucalyptus educta*	Mallee to 3 m tall. Bark minni-ritchi, red - brown. Leaves consistently small, dull, greyish, +/- pruinose. Branchlets, buds and new fruits pruinose. Opercula conical (longer than wide), to long - beaked.	Tree	April.	On low stony rise of red loam. Greenstone hills, basalt. On ironstone hill.	115.335	Low
Priority 2	Myrtaceae	*Malleostemon sp. Adelong (G.J. Keighery 11825)*	Spreading shrub, 0.1-0.3 m high. Fl. white	Shrub	Oct.	Red sand.	99.9854	Low
Priority 2	Lamiaceae	*Newcastelia insignis*	Much-branched shrub, 0.3-0.9(-1.5) m high. Fl. yellow-white,	Shrub	Sep to Nov.	Red or yellow sandy soils.	89.5397	Low
Priority 2	Myrtaceae	*Thryptomene eremaea*	Erect open shrub, 0.5-1.5 m high. Fl. pink/white,	Shrub	Jul to Sep.	Red or yellow sand. Sandplains.	49.9448	Low
Priority 2	Asparagaceae	*Thysanotus brachyantherus*	Caespitose perennial, herb (with roots becoming tuberous), 0.1-0.4 m high. Fl. purple,	Herb	Oct to Dec.	Clay over limestone, loam.	109.42	Low
Priority 3	Fabaceae	*Acacia sp. Marshall Pool (G. Cockerton 3024)*	Shrub. Foliage dull green. Flowers golden spikes, 30 mm long.	Shrub	April to May.	Low basalt hill. Dry brown clayey sand.	0.30322	High
Priority 3	Apocynaceae	*Alyxia tetanifolia*	Erect, rigid, pungent shrub, 1-2 m high, to 2.5 m wide. Fl. white-cream	Shrub	May to June, Nov.	Sandy clay, loam, concretionary gravel. Drainage lines, near lakes.	128.71	Low
Priority 3	Asteraceae	*Angianthus prostratus*	Prostrate annual, herb. Fl. white-yellow,	Herb	Jul to Sep.	Red clay or loamy soils. Saline depressions.	9.28433	High
Priority 3	Chenopodiaceae	*Atriplex flabelliformis*	Monoecious, erect, rounded perennial, herb, to 0.35 m high.	Herb	May to June.	Clay loam, loam. Saline flats or marshes.	105.989	Low
Priority 3	Poaceae	*Austrostipa blackii*	Tufted perennial, grass-like or herb, 1 m high.	Herb	Fl. Sep to Nov.	West north-west facing gently inclined lower slope of basalt with red-brown deep sandy clay loam soils.	151.816	Low
Priority 3	Fabaceae	*Bossiaea eremaea*	Divaricately-branched, spreading shrub, to 1.2 m high. Fl. red-yellow-purple-brown,	Shrub	Jul to Sep.	Deep red sand.	120.119	Low

Status	Family	Taxon	Description	Lifeform	Flowering Time	Habitat	Closest Record (km)	Likelihood
Priority 3	Portulacaceae	*Calandrinia sp. Menzies (F. Hort et al. FH 4100)*	Semi erect to erect annual herb, height 3-6.5 cm,	herb	August.	Flat. Few quartz and ironstone pebbles. Orange sand/loam/gravel. No sign of fire. Stony hardpan plain with saline inclusions.	46.3924	Low
Priority 3	Asteraceae	*Calotis latiuscula*	Erect herb, to 0.5 m high. Fl. yellow,	Herb	Jun to Oct.	Sand, loam. Rocky hillsides, floodplains, rocky creeks or river beds.	41.3845	Low
Priority 3	Asteraceae	*Calotis sp. Perrinvale Station (R.J. Cranfield 7096)*	Annual to 5 cm high, green leaves, red spikey heads.	Herb	-	Flat. Red-orange sandy clay-loam over Banded Ironstone Formation. Plain. Red clay loam over laterite.	92.9814	Low
Priority 3	Myrtaceae	*Calytrix hislopii*	Ridge. Red/brown loam/clay over laterite ridge.	Shrub	Sep.	Top of lateritic breakaway. Soil lateritic rubble and cap rock. Aspect E. Ridge. Red/brown loam/clay over laterite ridge.	28.4806	Low
Priority 3	Myrtaceae	*Calytrix praecipua*	Shrub, 0.3-0.7 m high. Fl. pink-white,	Shrub	Jun to Nov.	Skeletal sandy soils over granite or laterite. Breakaways, outcrops.	14.846	Low
Priority 3	Asteraceae	*Cratystylis centralis*	Much-branched, brittle, greyish shrub, to 1 m high.	Shrub	Aug to Nov.	Red sandy loam with ironstone gravel. Flat plains, breakaway country.	40.959	Low
Priority 3	Elatinaceae	*Elatine macrocalyx*	Prostrate, glabrous, mat-forming annual, herb, sepals 2-3mm long, fruit indehiscent. Fl. white,	Herb	May to Oct.	Shallow sands over clay. Margins of playa lakes and clay pans.	119.067	Low
Priority 3	Cyperaceae	*Eleocharis papillosa*	Annual, herb. Fl. Brown.	Sedge	Nov.	Red clay over granite, open clay flats. Claypans.	119.067	Low
Priority 3	Scrophulariaceae	*Eremophila annosicaulis*	Small, upright and spreading shrub up to 0.5 m high x 0.5 m wide. Very dry. Flowers purple / violet.	Shrub	June.	Stony, flat, sandy plain. Red sand. Rocky sloping plain in rangeland with brown loam / rocky soil. Frequency: over 50 plants.	66.8542	Low
Priority 3	Scrophulariaceae	*Eremophila shonae subsp. diffusa*	Perennial erect open shrub 75 cm high x 75 cm wide. Purple flowers.	Shrub	Aug.	Footslope below breakaway, soil deep red-brown loamy sand with quartzite strew on surface.	57.2052	Low
Priority 3	Scrophulariaceae	*Eremophila simulans subsp. megacalyx*	Shrub, 0.9-2 m high. Fl. violet,	Shrub	Aug to Sep.	East facing gently inclined mid slope of laterite banded ironstone with yellow brown shallow sandy loam soils. Rangeland plain. Road	18.4764	Medium

Status	Family	Taxon	Description	Lifeform	Flowering Time	Habitat	Closest Record (km)	Likelihood
						verge with red, sandy gravel laterite.		
Priority 3	Scrophulariaceae	*Eremophila veronica*	Spreading, erect shrub, 0.5-1 m high. Fl. Purple.	Shrub	Apr to May.	Stony clay, clay loam. Lateritic breakaways.	30.868	Medium
Priority 3	Fabaceae	*Eutaxia nanophylla*	Straggly, rounded shrub, to 0.35 m high. Fl. yellow&orange&red,	Shrub	Oct to Nov.	Clayey sand, red clay, stoney clayey loam. Low-lying areas, damp flats, slopes, undulating plains, low stony ridges.	124.124	Low
Priority 3	Fabaceae	*Eutaxia rubricarina*	Shrub to 0.5 m tall.	Shrub	Jul to Oct.	Midslope, gentle slope. Red sandy loam, cracking clay, with calcrete and quartz.	121.218	Low
Priority 3	Goodeniaceae	*Goodenia lyrata*	Prostrate herb, with lyrate leaves. Fl. yellow, Aug.	Herb	Aug.	Red sandy loam. Near claypan. Clay soiled broad drainage tract in hardpan plain.	73.023	Low
Priority 3	Proteaceae	*Grevillea georgeana*	Erect to widely spreading shrub, 1-3 m high, up to 4 m wide. Fl. red/red & pink & cream.	Shrub	Jan, Mar, Sept to Nov.	Stony loam/clay. Ironstone hilltops & slopes.	132.794	Low
Priority 3	Proteaceae	*Grevillea subterlineata*	Shrub, to 2.5 m high. Fl. white,	Shrub	Aug.	Landform: flat. Soil type: sand. Soil colour: red. Above creek bed. Brown, gravelly clayey - sand. Low rises of siltstone. Red powdery loam over sandy siltstone.	65.3896	Low
Priority 3	Aizoaceae	*Gunniopsis propinqua*	Prostrate annual or perennial, herb, 0.03-0.1 m high. Fl. white/pink,	Herb	Aug to Sep.	Stony sandy loam. Lateritic outcrops, winter-wet sites.	42.2074	Low
Priority 3	Myrtaceae	*Homalocalyx grandiflorus*	Spreading shrub, 0.2-0.5(-2) m high. Fl. purple-red-pink,	Shrub	Oct to Dec.	Yellow sand. Sandplains.	108.191	Low
Priority 3	Violaceae	*Hybanthus floribundus subsp. chloroxanthus*	Shrub 0.8 m high. Flowers white.	Shrub	Mar.	Drainage line. Well drained dry red clay loam over. Rock type meta-gabbro, basalt. Red-brown silty sand. Slope 5 degrees. Aspect westerly.	39.5372	Medium
Priority 3	Myrtaceae	*Leptospermum macgillivrayi*	Divaricate shrub, to 1 m high. Fl. probably	Shrub	Aug to Sep.	Loam. Decaying granite outcrops.	131.716	Low
Priority 3	Haloragaceae	*Meionectes tenuifolia*	Erect herb, 20-25 cm high x ca. 5 cm wide. Prostrate aquatic herb, red/green, in bud.	Herb	Nov to Dec.	Seasonally wet poorly drained flat. Grey sand. Granite flats, shallow soil at margins, inundated.	14.9518	Low

Status	Family	Taxon	Description	Lifeform	Flowering Time	Habitat	Closest Record (km)	Likelihood
Priority 3	Myrtaceae	*Melaleuca apostiba*	Spreading shrub, to 2 m high, with grey fissured bark and dull green leaves. Fl. red,	Shrub	Jun.	Low lying salt flats, at edge of salt lake in dry red loam sands, seasonally inundated. Red clayey sand. Sandy dune / flat, growing around a smaller wetland. Red / brown sand.	113.803	Low
Priority 3	Brassicaceae	*Menkea draboides*	Prostrate, spreading annual, herb, to 0.6 m wide. Fl. white/cream,	Herb	Aug to Sep.	Red sand or clay, granite.	132.794	Low
Priority 3	Myrtaceae	*Micromyrtus serrulata*	Erect or somewhat spreading shrub, 0.4-1.5 m high. Fl. white,	Shrub	Jun to Nov.	Brownish sandy and clayey soils over granite.	27.5194	Low
Priority 3	Asteraceae	*Notisia intonsa*	Annual herb.	Herb	Sep.	Moist red sand. Lake bank.	151.879	Low
Priority 3	Asteraceae	*Olearia mucronata*	Densely branched, unpleasantly aromatic shrub, 0.6-1 m high. Fl. white & yellow, Aug to Dec or Jan.	Shrub	Jul to Aug.	Schistose hills. Drainage channels.	81.4279	Low
Priority 3	Rutaceae	*Philotheca coateana*	Shrub, 0.3-0.5 m high, branchlets glabrous; leaf blades 3-4 mm long; flowers terminal, solitary; petals 7-9 mm long. Fl. white & pink,	Shrub	Aug to Sep.	Red sand.	89.5397	Low
Priority 3	Phyllanthaceae	*Phyllanthus baeckeoides*	Shrub, 0.5-1.5 m high. Fl. white-yellow/green-yellow,	Shrub	Jul to Sep.	Red lateritic & sandy clay soils. Granite outcrops.	37.0891	Medium
Priority 3	Orchidaceae	*Pterostylis virens*	Deciduous terrestrial orchid, plants dwarf; flowers green, nodding.	Herb	Sep to Oct.	Granite dome with low open granite surround.	92.0809	Low
Priority 3	Chenopodiaceae	*Tecticornia cymbiformis*	Erect, perennial shrub, 0.3-0.5 m high.	Shrub	Aug.	Saline soils. Along the edge of creeklines.	81.4279	Low
Priority 3	Juncaginaceae	*Triglochin protuberans*	Annual, herb, 0.03-0.13 m high.	Herb	Aug to Oct.	Red loam, grey mud over clay. Winter-wet sites, claypans, near salt lakes, margins of pools.	23.5768	Medium
Priority 3	Asteraceae	*Vittadinia pustulata*	Low annual, herb (sometimes persisting as an under-shrub), 0.1-0.3 m high. Fl.	Herb / Shrub	Sep.	-	105.989	Low
Priority 4	Proteaceae	*Banksia arborea*	Tree or shrub (large), 2-8 m high. Fl. yellow,	Shrub	Mar to May, Sept to Oct.	Stony loam. Ironstone hills.	124.803	Low
Priority 4	Polygalaceae	*Comesperma viscidulum*	Shrub, to ca 0.7 m high.	Shrub	Sep.	On sandplain with gravel at depth. Red sandplain.	132.614	Low
Priority 4	Proteaceae	*Conospermum toddii*	Spreading shrub, 1.2-2 m high. Fl. white/white-yellow,	Shrub	Jul to Oct.	Yellow sand. Sand dunes.	50.5223	Low
Priority 4	Myrtaceae	*Eucalyptus jutsonii subsp. jutsonii*	Mallee to 7 m, sprawling, foliage lush green and linear leaves semi glossy, flowers creamy,	Tree	Nov.	Flat, red sand, sandplain.	50.8613	Low

Status	Family	Taxon	Description	Lifeform	Flowering Time	Habitat	Closest Record (km)	Likelihood
			smooth above and stocking base, rough. Ornamental for form.					
Priority 4	Myrtaceae	*Eucalyptus kruseana*	(Straggly mallee), 2-3.5 m high, bark smooth. Fl. yellow,	Tree	Jun to Sep.	Sandy loam. Granite outcrops & hills.	135.106	Low
Priority 4	Frankeniaceae	*Frankenia glomerata*	Prostrate shrub. Fl. pink-white.	Shrub	Nov.	White sand.	0.88866	High
Priority 4	Goodeniaceae	*Goodenia berringbinensis*	Ascending annual, herb, 0.1-0.3 m high. Fl. yellow,	Herb	Oct.	Red sandy loam. Along watercourses.	132.794	Low
Priority 4	Proteaceae	*Grevillea erectiloba*	Shrub, 1-3 m high. Fl. red,	Shrub	Sep to Oct.	Gravelly loam. Lateritic ridges.	89.5397	Low
Priority 4	Proteaceae	*Grevillea inconspicua*	Intricately branched, spreading shrub, 0.6-2 m high. Fl. white/pink-white,	Shrub	Jun to Aug.	Loam, gravel. Along drainage lines on rocky outcrops, creeklines.	21.0121	Medium
Priority 4	Proteaceae	*Grevillea secunda*	Low spreading shrub, 0.3-0.8 m high. Fl. red,	Shrub	Sep to Oct.	Yellow or red sand. Sand dunes, sandplains.	115.197	Low
Priority 4	Lamiaceae	*Hemigenia exilis*	Erect, multi-stemmed shrub, 0.5-2 m high. Fl. blue-purple/white,	Shrub	Apr or Sep to Nov.	Laterite. Breakaways, slopes.	31.6451	Medium
Priority 4	Cyperaceae	*Lepidosperma lyonsii*	Tufted rhizomatous, perennial, herb (sedge), leaves 0.31-0.53 m high, culms and leaves distichous.	Sedge	Jun.	Pale orange skeletal sandy loam with banded ironstone gravel & rock, well-drained shallow stony loamy with quartz. Gentle hill slopes, upper slopes of large hill.	95.8768	Low
Priority 4	Asparagaceae	*Sowerbaea multicaulis*	Tufted perennial, herb, 0.075-0.25 m high. Fl. purple-violet,	Herb	Oct to Dec or Jan.	Yellow-brown sand.	119.067	Low
Priority 4	Colchicaceae	*Wurmbea murchisoniana*	Cormous, perennial, herb, 0.1-0.26 m high, hermaphrodite. Fl. white,	Herb	Jul to Sep.	Clay, sandy clay, loam. Seasonally inundated clay hollows, rock pools.	132.794	Low

Appendix D: Fauna Regional Appendix

Family & Scientific Name	Common Name	Conservation Status			Database Searches			Literature Review											This Survey
		EPBC Act	BC Act	DBCA	Naturemap	DBCA Threatened Fauna	PMST	Kinhill Engineers (1992)	Brearley, Dunlop, and Osborne 1997	Nino• Wildlife Consulting (1998)	Dunlop and Payne (1999)	Bamford Ecological Consulting (2007)	Bamford Consulting Ecologists (2008)	Bamford Ecological Consulting (2010)	Terrestrial Ecosystems (2011)	Terrestrial Ecosystems (2020b)	Terrestrial Ecosystems (2020a)	Spectrum (2021)	
MAMMALS																			
TACHYGLOSSIDAE																			
Tachyglossus aculeatus	Short-beaked Echidna								•	•		•	•	•			•		
DASYUIRIDAE																			
Antechinomys laniger	Kultarr											•			•	•			
Dasycercus blythi	Brush-tailed Mulgara			P4	•	•													
Dasyurus geoffroii	Western Quoll	VU	VU				•												
Ningaui ridei	Wongai Ningaui				•						•			•			•		
Pseudantechinus woolleyae	Woolley's Pseudantechinus				•							•		•					
Sminthopsis crassicaudata	Fat-tailed Dunnart								•	•				•					
Sminthopsis dolichura	Little Long-tailed Dunnart				•			•						•	•	•	•		
Sminthopsis longicaudata	Long-tailed Dunnart			P4		•									•	•			
Sminthopsis macroura	Stripe-faced Dunnart				•										•	•	•		
THYLACOMYIDAE																			
Macrotis lagotis	Greater Bilby	VU	VU			•													

Family & Scientific Name	Common Name	Conservation Status			Database Searches			Literature Review											This Survey
		EPBC Act	BC Act	DBCA	Naturemap	DBCA Threatened Fauna	PMST	Kinhill Engineers (1992)	Brearley, Dunlop, and Osborne 1997	Nino• Wildlife Consulting (1998)	Dunlop and Payne (1999)	Bamford Ecological Consulting (2007)	Bamford Consulting Ecologists (2008)	Bamford Ecological Consulting (2010)	Terrestrial Ecosystems (2011)	Terrestrial Ecosystems (2020b)	Terrestrial Ecosystems (2020a)	Spectrum (2021)	
MACROPODIDAE																			
Osphranter robustus	Euro, Biggada				•								•	•			•		•
Osphranter rufus	Red Kangaroo				•							•	•	•			•		
MURIDAE																			
Notomys alexis	Spinifex Hopping-mouse												•						
Pseudomys desertor	Desert Mouse													•					
Pseudomys hermannsburgensis	Sandy Inland Mouse				•					•						•	•		
MOLOSSIDAE																			
Austronomus australis	White-striped Free-tail Bat								•					•					
Ozimops kitcheneri	Western Free-tailed Bat																•		
VESPERTILIONIDAE																			
Chalinolobus gouldii	Gould's Wattled Bat				•				•					•			•		
Chalinolobus morio	Chocolate Wattled Bat													•	•				
Nyctophilus geoffroyi	Lesser Long-eared Bat				•			•	•										
Nyctophilus major tor	Central Long-eared Bat													•					
Scotorepens balstoni	Inland Broad-nosed Bat				•									•			•		

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Taphozous hilli	Hill's Sheathtail-bat				•															
Vespadelus baverstocki	Inland Forest Bat				•												•			
Vespadelus finlaysoni	Finlayson's Cave Bat				•								•	•			•			
INTRODUCED MAMMALS																				
**Mus musculus*	House Mouse				•		•		•	•				•	•	•				
**Oryctolagus cuniculus*	Rabbit				•		•	•	•	•		•	•	•			•	•	•	
**Sus scrofa*	Pig				•															
**Canis familiaris dingo*	Dingo									•			•	•						
**Canis lupus familiaris*	Domestic Dog						•										•			
**Vulpes vulpes*	Red Fox						•	•	•	•			•	•						
**Felis catus*	Cat						•		•				•	•			•		•	
**Ovis aries*	Sheep											•								
**Equus asinus*	Donkey						•			•				•					•	
**Equus caballus*	Horse																	•		
**Camelus dromedarius*	Dromedary, Camel						•		•											
**Bos taurus*	European Cattle									•			•	•			•	•	•	

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*Capra hircus	Goat						•			•		•	•	•			•		
BIRDS																			
CASUARIIDAE																			
Dromaius novaehollandiae	Emu				•			•	•	•	•	•	•	•	•		•		
ANATIDAE																			
Anas gracilis	Grey Teal				•					•	•				•				
Anas superciliosa	Pacific Black Duck				•					•				•	•				
Aythya australis	Hardhead				•										•				
Biziura lobata	Musk Duck				•										•				
Chenonetta jubata	Australian Wood Duck				•									•	•				
Cygnus atratus	Black Swan				•					•									
Malacorhynchus membranaceus	Pink-eared Duck				•					•					•				
Tadorna tadornoides	Australian Shelduck				•					•									
MEGAPODIIDAE																			
Leipoa ocellata	Malleefowl	VU	VU		•	•	•			•		•		•					

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PHASIANIDAE																			
Coturnix pectoralis	Stubble Quail				•									•					
PODARGIDAE																			
Podargus strigoides	Tawny Frogmouth				•					•				•					
CAPRIMULGIDAE																			
Eurostopodus argus	Spotted Nightjar				•									•					
AEGOTHELIDAE																			
Aegotheles cristatus	Australian Owlet-nightjar				•				•										
APODIDAE																			
Apus pacificus	Fork-tailed Swift	MI	MI				•					•							
OTIDIDAE																			
Ardeotis australis	Australian Bustard				•				•			•							
CUCULIDAE																			
Chalcites basalis	Horsfield's Bronze-cuckoo				•					•				•				•	
Chalcites osculans	Black-eared Cuckoo									•				•					
Cacomantis pallidus	Pallid Cuckoo				•				•						•				

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COLUMBIDAE																			
**Columba livia*	Rock Dove				•		•												
Geopelia cuneata	Diamond Dove				•														
Ocyphaps lophotes	Crested Pigeon				•					•	•	•	•	•		•	•	•	•
Phaps chalcoptera	Common Bronzewing				•				•	•	•		•	•		•	•	•	•
**Streptopelia senegalensis*	Laughing Dove				•		•												
RALLIDAE																			
Fulica atra	Eurasian Coot				•														
Tribonyx ventralis	Black-tailed Nativehen				•			•		•	•								•
PODICIPEDIDAE																			
Podiceps cristatus	Great crested Grebe				•														
Poliocephalus poliocephalus	Hoary-headed Grebe				•														
Tachybaptus novaehollandiae	Australasian Grebe				•														
BURHINIDAE																			
Burhinus grallarius	Bush Stone-curlew				•							•		•					

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RECURVIROSTRIDAE																			
Cladorhynchus leucocephalus	Banded Stilt								•			•		•					
Recurvirostra novaehollandiae	Red-necked Avocet				•					•									
CHARADRIIDAE																			
Vanellus tricolor	Banded Lapwing				•					•				•					
Erythrogonys cinctus	Red-kneed Dotterel				•														
Pluvialis fulva	Pacific Golden Plover	MI	MI			•													
Charadrius ruficapillus	Red-capped Plover				•					•		•		•					
Charadrius veredus	Oriental Plover	MI	MI				•					•							
Thinornis cucullatus	Hooded Plover (Hooded Dotterel)			P4		•						•							
Elseyornis melanops	Black-fronted Dotterel				•					•					•				
SCOLOPACIDAE																			
Calidris canutus	Red Knot	EN	EN			•													
Calidris acuminata	Sharp-tailed Sandpiper	MI	MI			•	•												
Calidris melanotos	Pectoral Sandpiper	MI	MI				•												
Actitis hypoleucos	Common Sandpiper	MI	MI		•	•	•												

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Tringa glareola	Wood Sandpiper	MI	MI		•	•								•					
Tringa nebularia	Common Greenshank	MI	MI		•	•	•												
LARIDAE																			
Chlidonias hybrida	Whiskered Tern				•														
Larus novaehollandiae	Silver Gull				•														
THRESKIORNITHIDAE																			
Platalea flavipes	Yellow-billed Spoonbill				•														
Threskiornis spinicollis	Straw-necked Ibis				•														
ANHINGIDAE																			
Anhinga novaehollandiae	Australasian Darter				•														
PHALACROCORACIDAE																			
Microcarbo melanoleucos	Little Pied Cormorant				•														
Phalacrocorax carbo	Great Cormorant				•														
Phalacrocorax sulcirostris	Little Black Cormorant				•														
PELECANIDAE																			
Pelecanus conspicillatus	Australian Pelican				•														

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ARDEIDAE																				
Ardea alba	Great White Egret											•								
Ardea modesta	Eastern Great Egret				•															
Ardea pacifica	White-necked Heron				•					•										
Egretta novaehollandiae	White-faced Heron				•															
ACCIPITRIDAE																				
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				•															
Milvus migrans	Black Kite				•				•											
Haliastur sphenurus	Whistling Kite				•								•	•						•
TYTONIDAE																				
Tyto alba subsp. delicatula	Barn Owl				•															

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ALCEDINIDAE																				
Todiramphus pyrrhopygius	Red-backed Kingfisher				•									•			•			
Todiramphus sanctus	Sacred Kingfisher				•				•											
MEROPIDAE																				
Merops ornatus	Rainbow Bee-eater				•		•			•		•		•			•	•	•	
FALCONIDAE																				
Falco cenchroides	Australian (Nankeen) Kestrel				•				•	•	•			•	•	•	•		•	
Falco longipennis	Australian Hobby				•				•	•		•		•		•				
Falco berigora	Brown Falcon				•				•	•				•	•	•				
Falco hypoleucos	Grey Falcon	VU	VU			•	•													
Falco peregrinus	Peregrine Falcon		OS		•	•				•		•								
CACATUIDAE																				
Nymphicus hollandicus	Cockatiel				•				•		•									
Cacatua roseicapilla	Galah				•				•	•	•			•				•	•	
Cacatua sanguinea	Little Corella													•						

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PSITTACIDAE																			
Polytelis alexandrae	Princess Parrot	VU		P4			•												
Platycercus varius	Mulga Parrot				•				•	•				•	•				
Barnardius zonarius	Australian Ringneck				•				•	•		•	•	•			•	•	•
Pezoporus occidentalis	Night Parrot	EN	CR				•												
Neophema bourkii	Bourke's Parrot				•					•									•
Neophema splendida	Scarlet-chested Parrot											•		•					
Melopsittacus undulatus	Budgerigar				•													•	•
PTILONORHYNCHIDAE																			
Ptilonorhynchus maculatus subsp. *guttatus*	Western Bowerbird				•						•	•	•	•	•	•	•		
CLIMACTERIDAE																			
Climacteris affinis	White-browed Treecreeper																•		
MALURIDAE																			
Malurus lamberti	Variegated Fairywren												•	•					
Malurus leucopterus	White-winged Fairywren				•					•	•	•		•	•	•	•	•	•
Malurus pulcherrimus	Blue-breasted Fairywren				•														

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Malurus splendens	Splendid Fairywren				•					•		•	•	•	•		•	•	•
MELIPHAGIDAE																			
Acanthagenys rufogularis	Spiny-cheeked Honeyeater				•				•	•	•	•		•	•	•	•		•
Anthochaera carunculata	Red Wattlebird				•					•				•					
Certhionyx variegatus	Pied Honeyeater				•					•					•				
Epthianura albifrons	White-fronted Chat				•														
Epthianura aurifrons	Orange Chat				•														
Epthianura tricolor	Crimson Chat				•						•				•	•	•		•
Gavicalis virescens	Singing Honeyeater								•	•	•	•	•	•	•	•	•	•	•
Lacustroica whitei	Grey Honeyeater											•							
Purnella albifrons	White-fronted Honeyeater				•					•									
Lichmera indistincta	Brown Honeyeater				•									•					
Lichenostomus penicillatus	White-plumed Honeyeater													•					
Manorina flavigula	Yellow-throated Miner				•				•	•	•	•	•	•	•	•	•	•	•
PARDALOTIDAE																			
Pardalotus striatus	Striated Pardalote				•					•					•		•	•	

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ACANTHIZIDAE																				
Smicrornis brevirostris	Weebill				•									•			•			
Pyrrholaemus brunneus	Redthroat									•	•	•	•	•			•	•		
Acanthiza apicalis	Broad-tailed (Inland) Thornbill				•				•		•		•	•			•	•		•
Acanthiza uropygialis	Chestnut-rumped Thornbill				•					•		•		•		•	•	•		
Acanthiza chrysorrhoa	Yellow-rumped Thornbill				•				•	•	•		•	•			•			
Acanthiza iredalei iredalei	Western Slender-billed Thornbill											•								
Acanthiza robustirostris	Slaty-backed Thornbill				•					•			•	•	•		•			
Aphelocephala leucopsis	Southern Whiteface				•					•		•	•	•	•	•	•			
Aphelocephala nigricincta	Banded Whiteface											•								
POMATOSTOMIDAE																				
Pomatostomus superciliosus	White-browed Babbler				•					•		•		•	•		•	•		•
PSOPHODIDAE																				
Psophodes occidentalis	Chiming Wedgebill				•															
CINCLOSOMATIDAE																				

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Cinclosoma castaneothorax	Chestnut-breasted Quail-thrush				•							•		•						
ARTAMIDAE																				
Artamus cinereus	Black-faced Woodswallow				•				•		•	•	•	•	•	•	•			•
Artamus personatus	Masked Woodswallow				•				•		•			•	•					
Cracticus nigrogularis	Pied Butcherbird				•				•	•	•	•	•	•	•	•	•			
Cracticus torquatus	Grey Butcherbird				•				•	•	•	•	•	•	•	•		•		
Gymnorhina tibicen	Australian Magpie				•				•	•	•		•	•	•		•			
Strepera versicolor	Grey Currawong									•	•			•						
CAMPEPHAGIDAE																				
Coracina maxima	Ground Cuckoo-shrike				•				•		•			•	•	•				
Coracina novaehollandiae	Black-faced Cuckoo-shrike				•				•	•	•			•	•	•		•		•
Lalage tricolor	White-winged Triller				•						•			•	•					
NEOSITTIDAE																				
Daphoenositta chrysoptera	Varied Sittella																•			
OREOICIDAE																				
Oreoica gutturalis subsp. gutturalis	Crested Bellbird (southern)				•							•	•	•			•			•

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PACHYCEPHALIDAE																				
Pachycephala rufiventris	Rufous Whistler				•					•		•	•	•	•		•	•	•	
Colluricincla harmonica	Grey Shrikethrush				•					•	•	•	•	•	•		•	•	•	
RHIPIDURIDAE																				
Rhipidura albiscapa	Grey Fantail				•					•				•			•			
Rhipidura leucophrys	Willie Wagtail				•					•	•		•	•	•	•	•	•		
MONARCHIDAE																				
Grallina cyanoleuca	Magpie-lark				•					•	•	•	•	•	•	•			•	
CORVIDAE																				
Corvus bennetti	Little Crow				•				•	•	•	•	•	•	•		•			
Corvus coronoides	Australian Raven				•									•			•			
Corvus orru	Torresian Crow				•				•	•	•			•	•		•	•	•	
PETROICIDAE																				
Melanodryas cucullata	Hooded Robin				•					•			•	•	•	•	•	•	•	
Microeca fascinans	Jacky Winter				•				•											
Petroica goodenovii	Red-capped Robin				•				•	•		•	•	•	•	•	•		•	

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HIRUNDINIDAE																				
Cheramoeca leucosterna	White-backed Swallow				•					•				•	•				•	
Hirundo neoxena	Welcome Swallow				•				•		•			•	•		•			
Petrochelidon ariel	Fairy Martin				•									•						
Petrochelidon nigricans	Tree Martin				•						•			•	•					
DICAEIDAE																				
Dicaeum hirundinaceum	Mistletoebird				•								•	•	•					
ESTRILDIDAE																				
Taeniopygia guttata	Zebra Finch				•					•		•		•	•					•
MOTACILLIDAE																				
Motacilla flava (tschutschensis)	Yellow Wagtail	MI	MI				•													
Motacilla cinerea	Grey Wagtail	MI	MI				•													
Anthus novaeseelandiae	Australasian Pipit				•					•	•	•		•	•	•	•			•
REPTILES																				
CARPHODACTYLIDAE																				
Nephrurus vertebralis	Midline Knob-tail				•						•						•	•		

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Nephrurus wheeleri subsp. wheeleri	Banded knob-tailed gecko				•														
Underwoodisaurus milii	Barking Gecko				•				•	•							•	•	
DIPLODACTYLIDAE																			
Diplodactylus conspicillatus	Fat-tailed Gecko				•														
Diplodactylus granariensis subsp. rex	Giant Stone Gecko				•									•			•		
Diplodactylus pulcher	Fine-faced Gecko				•			•		•				•	•	•	•		
Lucasium squarrosum	Mottled Ground Gecko										•			•					
Rhynchoedura ornata	Western Beaked Gecko				•			•	•					•	•		•		
Strophurus assimilis	Goldfields Spiny-tailed Gecko				•														
Strophurus strophurus	Western Spiny-Tailed Gecko				•									•					
Strophurus wellingtonae	Western Shield Spiny-tailed Gecko				•					•				•	•		•		
GEKKONIDAE																			
Heteronotia binoei	Bynoe's Gecko				•				•	•	•		•	•	•		•		
Gehyra variegata	Variegated Gehyra				•			•	•	•	•	•	•	•	•		•		
PYGOPODIDAE																			
Pygopus nigriceps	Western Hooded Scaly-foot				•									•			•		

Family & Scientific Name	Common Name	Conservation Status			Database Searches			Literature Review											This Survey
		EPBC Act	BC Act	DBCA	Naturemap	DBCA Threatened Fauna	PMST	Kinhill Engineers (1992)	Brearley, Dunlop, and Osborne 1997	Nino• Wildlife Consulting (1998)	Dunlop and Payne (1999)	Bamford Ecological Consulting (2007)	Bamford Consulting Ecologists (2008)	Bamford Ecological Consulting (2010)	Terrestrial Ecosystems (2011)	Terrestrial Ecosystems (2020b)	Terrestrial Ecosystems (2020a)	Spectrum (2021)	
AGAMIDAE																			
Ctenophorus caudicinctus subsp. *infans*	Ring-tailed Dragon				•														
Ctenophorus fordi	Mallee Dragon				•					•		•		•					
Ctenophorus nuchalis	Central Netted Dragon				•					•	•			•					
Ctenophorus reticulatus	Western Netted Dragon				•			•	•		•					•	•		
Ctenophorus salinarum	Salt Pan Dragon								•		•			•		•			
Ctenophorus scutulatus	Lozenge-marked Dragon							•				•	•	•			•		•
Diporiphora amphiboluroides	Mulga Snake																•		
Pogona minor subsp. minor	Western Bearded Dragon				•				•	•			•	•			•		
SCINCIDAE																			
Cryptoblepharus australis	Inland Snake-Eyed Skink				•														
Cryptoblepharus buchananii	Buchanan's Snake-eyed Skink				•					•							•		
Ctenotus leonhardii	Leonhard's Ctenotus								•	•	•			•	•	•			
Ctenotus schomburgkii	Barred Wedgesnout Ctenotus																•		
Ctenotus severus	Stern Ctenotus				•									•			•		
Ctenotus uber	Spotted Ctenotus				•									•			•		

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Egernia depressa	Southern Pygmy Spiny-tailed Skink				•			•		•		•		•	•	•	•		
Eremiascincus richardsonii	Broad-banded Sand Swimmer				•										•	•	•		
Lerista desertorum	Central Desert Robust Slider				•						•			•	•	•	•		
Lerista kingi	King's Tree-Toed Slider													•					
Lerista muelleri	Wood Mulch Slider																•		
Lerista timida	Timid Slider				•														
Liopholis inornata	Desert Skink				•														
Liopholis striata	Night Skink													•					
Morethia adelaidensis	Saltbush Morethia Skink													•					
Morethia butleri	Woodland morethia skink									•				•	•	•	•		
Menetia greyii	Common Dwarf Skink				•				•	•	•			•	•	•	•		
Tiliqua occipitalis	Western Bluetongue												•	•					
VARANIDAE																			
Varanus caudolineatus	Stripe-tailed Pygmy Monitor				•				•	•	•			•	•	•	•		
Varanus gouldii	Bungarra or Sand Monitor				•			•	•		•			•					•

Family & Scientific Name	Common Name	Conservation Status			Database Searches			Literature Review												This Survey
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Varanus panoptes	Yellow-spotted Monitor				•					•		•	•	•	•	•	•		
TYPHLOPIDAE																			
Anilios bicolor	Dark-spined Blind Snake												•	•	•				
Anilios waitii	Beaked Blind Snake													•					
PYTHONIDAE																			
Antaresia childreni	Children's Python													•			•		
Aspidites ramsayi	Woma (south-west population)			P1		•								•					
ELAPIDAE																			
Brachyurophis semifasciatus	Southern Shovel-Nosed Snake													•			•		
Parasuta monachus	Monk Snake													•			•		
Pseudechis australis	Mulga Snake				•				•										
Pseudechis butleri	Spotted Mulga Snake																•		
Pseudonaja mengdeni	Western Brown Snake				•														
Pseudonaja modesta	Ringed Brown Snake				•									•			•		
Pseudonaja nuchalis	Gwardar													•					

Family & Scientific Name	Common Name	Conservation Status			Database Searches			Literature Review											This Survey
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Simoselaps bertholdi	Jan's Banded Snake										•			•			•		
Suta fasciata	Rosen's Snake				•									•					
Suta monachus	Monk Snake				•			•	•	•					•		•		
Suta punctata	Spotted Snake																•		
AMPHIBIANS																			
PELODRYADIDAE																			
Cyclorana maini	Sheep Frog				•					•					•	•			
Cyclorana occidentalis	Western Water-holding Frog				•										•				
Litoria rubella	Little Red Tree Frog				•								•	•			•		
MYOBATRACHIDAE																			
Pseudophryne occidentalis	Western Toadlet																•		
LIMNODYNASTIDAE																			
Neobatrachus kunapalari	Kunapalari Frog				•					•									
Neobatrachussutor	Shoemaker Frog				•					•							•		
Notaden nichollsi	Desert Spadefoot				•					•					•				

Appendix E: Potential *Idiosoma* sp. Burrow Locations

Potential *Idiosoma* sp. Burrow Locations

GPS Waypoint	Survey Area	Site Assessment Location	Taxon Name	No. of Burrows
SPI02	Railway Corridor Area (new)	Rhab4	*Idiosoma* sp.	1
SPI05	Railway Corridor Area (new)	Rhab4	*Idiosoma* sp.	1
SPI07	Tower Hill	Thab6	*Idiosoma* sp.	1
SPI08	Harbour Lights	Hhab4	*Idiosoma* sp.	1
SPI09	Harbour Lights	Hhab4	*Idiosoma* sp.	2
SPI10	Harbour Lights	Hhab4	*Idiosoma* sp.	10
SPI11	Harbour Lights	Hhab8	*Idiosoma* sp.	2
SPI13	Harbour Lights	Hhab8	*Idiosoma* sp.	1
SPI01	Gwalia	Ghab3	*Idiosoma* sp.	2
SPI06	Tower Hill	Thab3	*Idiosoma* sp.	1
TRAP3	Railway Corridor Area (new)	Rhab4	*Idiosoma* sp.	3