

Granny Smith Gold Mine: Granny Smith Solar Farm Expansion Project – Native Vegetation Clearing Permit Report

PREPARED FOR GSM MINING COMPANY PTY LTD | April 2023

We design with community in mind

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Executive Summary

Project Title: Granny Smith Gold Mine: Granny Smith Solar Farm Expansion

Area Proposed to be Cleared: Up to 40 ha within a 391 ha boundary

Purpose of Clearing: Construction of a solar farm

GSM Mining Company Pty Ltd (GSM), a wholly owned subsidiary of Gold Fields Australia Ltd (GFA), own and operate the Granny Smith Gold Mine (GSGM) located approximately 720 km north-east of Perth and 24 km south of Laverton in Western Australia. The main electrical power supply for GSGM is an Aggreko owned and operated hybrid power station (HPS) consisting of an approximately 40 MW gas-fueled power station, a 7.7 MW solar power station, and a 2 MW/1 MWh battery energy storage system (BESS). As part of GFA's commitment to reduce carbon emissions by 30% by 2030 and to achieve net zero by 2050, the existing HPS at GSGM is being expanded by the addition of a 11.5 MW solar farm and a 6 MW/3 MW BESS (Solar Farm Expansion). The objective of the Solar Farm Expansion is to clear up to 40 ha of native vegetation in order to supplement site power generation, while minimising impacts on the environment, heritage, and social amenity.

The Solar Farm Expansion is anticipated to increase GSGM's renewable energy contribution from 9% to 20% of total MW hrs consumed, offsetting carbon emission by 12.29 kt/year and aligning with GFA's purpose "to create enduring value beyond mining". Up to 40 ha of native vegetation will be cleared (Proposed Clearing Permit Area) in order to construct and operate the Solar Farm Expansion, including access and infrastructure corridors to connect to the existing HPS and access roads. Six mining tenements, five miscellaneous tenements, and one prospecting tenement intersect the Proposed Clearing Permit Area. All tenements are currently held by GSM with the exception of L 39/227 which is held by AngloGold Ashanti Australia Ltd (AngloGold).

The clearing of native vegetation within the Proposed Clearing Permit Area requires submission of a Native Vegetation Clearing Permit (NVCP) application, and subsequent approval by the Department of Water and Environmental Regulation (DWER) and/or the Department of Mines, Industry Regulation and Safety (DMIRS), in accordance with s 51E of the *Environmental Protection Act 1986* (EP Act). The purpose of this report is to support the NVCP application, which seeks approval for the clearing of up to 40 ha of native vegetation within the Proposed Clearing Permit Area. An assessment against *Schedule 5 Principles for clearing native vegetation* of the EP Act (10 clearing principles) was undertaken and a precautionary approach was applied, which assumed that all habitats within the Proposed Clearing Permit Area have an equal likelihood of being cleared. Based on this assumption, the proposed Solar Farm Expansion is not at variance to clearing principles (a), (b), (c), (d), (e), (f), (g), (h), (i) and (j).

Granny Smith Gold Mine: Mining Proposal – Solar Farm Addition To GSM Gas Power Station was submitted to the DMIRS (Reg. ID 79025) in 2019; however, as the initial proposed design has since changed, and initial disturbance areas have been altered, a new Mining Proposal will be submitted concurrently with the NVCP application.



Table ES-1: Information recommended for the assessment of a NVCP application.

Information	Document Section
<ul style="list-style-type: none"> • Aerial photographs and site photographs of the area proposed to be cleared. 	Figure 2-1
<ul style="list-style-type: none"> • A flora and vegetation survey. Detail should include: <ul style="list-style-type: none"> ○ Mapping of vegetation types / associations / communities, their condition, and their representation in a regional context. Photographs of each vegetation type to be cleared are also recommended. ○ Declared rare and priority flora species present or likely to be present. Details should include the location/s and size of the population/s; the impact of the proposed clearing on the population/s and the likely impact of the proposed clearing on the continued existence of the species. 	Section 4
<ul style="list-style-type: none"> • A fauna assessment. Detail should include: <ul style="list-style-type: none"> ○ The fauna present or likely to be present, and their conservation significance. ○ An assessment of the significance of the vegetation and landform to be cleared, as a habitat for fauna; including mapping of any significant fauna habitats. 	Section 5
<ul style="list-style-type: none"> • A site overview, with a brief description of topography, landforms, soils and hydrology. 	Section 3
<ul style="list-style-type: none"> • A summary and/or map of the proposed developments on the site. 	Not available
<ul style="list-style-type: none"> • A hydrological summary, which includes discussion of the likelihood of impact from the clearing on riparian vegetation, wetlands, watercourses, surface water or groundwater. 	Section 3.8 Section 7.1 Table 7-1
<ul style="list-style-type: none"> • A vegetation degradation summary, which includes discussion of the likelihood of the spread of dieback disease and/or weeds. 	Section 4.2 Section 7.1 Table 7-1
<ul style="list-style-type: none"> • A land degradation summary, which includes discussion of the likelihood of land degradation, including waterlogging, acidification, salinization, deep subsoil compaction and erosion. 	Section 3.7 Section 7.1 Table 7-1
<ul style="list-style-type: none"> • An outline of environmental management measures and rehabilitation practices that will be undertaken during and subsequent to the completion of the project. Existing Management Plans and Mining Proposals should be submitted, if they are relevant to the clearing proposal. 	Section 6
<ul style="list-style-type: none"> • Copies of any correspondence with the Department of Biodiversity Conservation and Attractions (DBCA) or other government agencies regarding the proposal. 	Not available
<ul style="list-style-type: none"> • A statement against each of the 10 clearing principles. 	Section 7.1 Table 7-1



Abbreviations

Abbreviation	Definition
BC Act	<i>Biodiversity Conservation Act 2016</i>
BESS	Battery Energy Storage System
DMIRS	Department of Mines, Industry Regulation and Safety
DPIRD	Department of Primary Industries and Regional Development
DBCA	Department of Biodiversity, Conservation and Attractions
EPBC Act	<i>Environmental Protection and Biodiversity Conservation Act 1999</i>
EPA	Environmental Protection Authority
EP Act	<i>Environmental Protection Act 1986</i>
ESA	Environmentally Sensitive Area
GFA	Gold Fields Australia Pty Ltd
GSGM	Granny Smith Gold Mine
GSM	GSM Mining Company Pty Ltd
HPS	Hybrid Power Station
IBRA	Interim Biogeographic Regionalisation for Australia
MCP	Mine Closure Plan
NVCP	Native Vegetation Clearing Permit
PEC	Priority Ecological Community
TEC	Threatened Ecological Community
UCL	Unallocated Crown Land
WoNS	Weed of National Significance



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Appendix C	Terrestrial Ecosystems (2018)
Appendix D	Terrestrial Ecosystems (2022)



1 Introduction

GSM Mining Company Pty Ltd (GSM), a wholly owned subsidiary of Gold Fields Australia Ltd (GFA), owns and operates the Granny Smith Gold Mine (GSGM), located approximately 720 km north-east of Perth and 24 km south of Laverton in Western Australia (**Figure 1-1**). The main electrical power supply for GSGM is an Aggreko owned and operated hybrid power station (HPS) consisting of an approximately 40 MW gas-fueled power station, a 7.7 MW solar power station, and a 2 MW/1 MWh battery energy storage system (BESS). As part of GFA's commitment to reduce carbon emissions by 30% by 2030 and to achieve net zero by 2050, the existing HPS at GSGM is being expanded by the addition of a 11.5 MW solar farm and a 6 MW/3 MW BESS (Solar Farm Expansion).

The Solar Farm Expansion is anticipated to increase GSGM's renewable energy contribution from 9% to 20% of total MW hrs consumed, offsetting carbon emission by 12.29 kt/year and aligning with GFA's purpose "to create enduring value beyond mining". Up to 40 ha of native vegetation will be cleared (Proposed Clearing Permit Area) in order to construct and operate the Solar Farm Expansion, including access and infrastructure corridors to connect to the existing HPS and access roads. The objective of the Solar Farm Expansion is to clear up to 40 ha of native vegetation in order to supplement site power generation, while minimising impacts on the environment, heritage, and social amenity.

1.1 Report Purpose, Objective & Structure

The clearing of native vegetation within the Proposed Clearing Permit Area requires submission of a Native Vegetation Clearing Permit (NVCP) application, and subsequent approval by the Department of Water and Environmental Regulation (DWER) and/or the Department of Mines, Industry Regulation and Safety (DMIRS), in accordance with s 51E of the Environmental Protection Act 1986 (EP Act). The purpose of this report is to support the NVCP application, which seeks approval for the clearing of up to 40 ha of native vegetation within the Proposed Clearing Permit Area (Figure 1-1). It describes the environmental values of the Proposed Clearing Permit Area, outlines native vegetation clearing requirements, and identifies potential impacts and proposed mitigation for reducing and managing impacts of the Solar Farm Expansion. The report follows the broad structure summarised below:

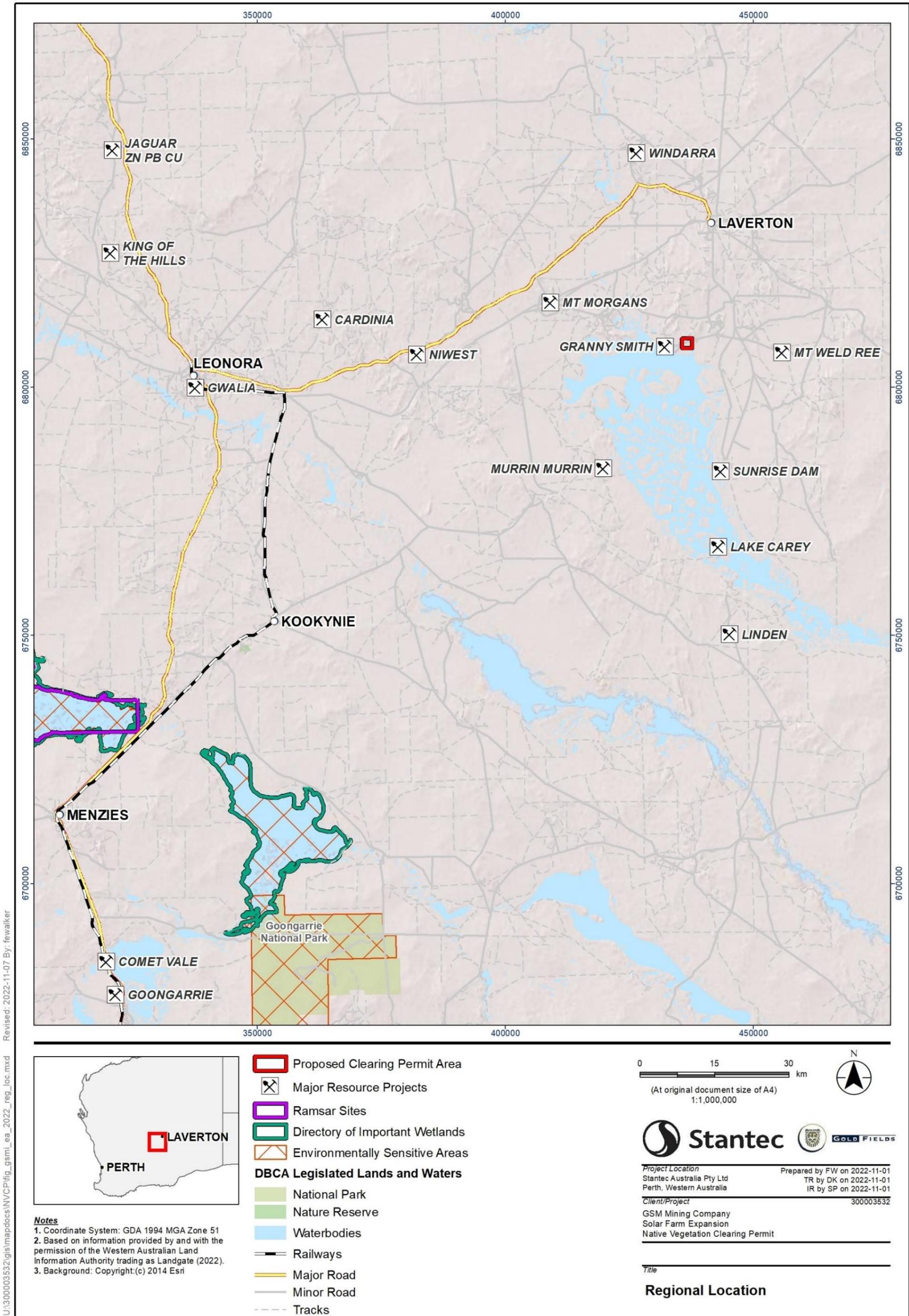
- Description and maps of the Proposed Clearing Permit Area to delineate location, size, and purpose.
- Site overview with a brief description of local climate, biogeographic region, geology, land use and land systems, soils, hydrology, and hydrogeology.
- Description of the Proposed Clearing Permit Area relative to vegetation type, condition, and representation in a regional context.
- Description of flora and fauna taxa present within the Proposed Clearing Permit Area and identification of any significant flora or fauna taxa.
- Discussion of the proposed vegetation clearing in relation to *Schedule 5 Principles for clearing native vegetation* of the EP Act (10 clearing principles).

Granny Smith Gold Mine: Mining Proposal – Solar Farm Addition To GSM Gas Power Station was submitted to the DMIRS (Reg. ID 79025) in 2019; however, as the initial design has since changed, and initial disturbance areas have been altered, a new Mining Proposal will be submitted concurrently with the NVCP application.

Studies undertaken to inform this NVCP report include:

- Reconnaissance Flora and Vegetation Survey of the Proposed GSM Solar Farm – October 2018 (**Appendix A**) (Native Vegetation Solutions 2018);
- Reconnaissance Flora and Vegetation Survey of the GSM Solar Farm Expansion Area – May 2022 (**Appendix B**) (Native Vegetation Solutions 2022);
- Vertebrate Fauna Risk Assessment for the Granny Smith Solar Power Farm Project (**Appendix C**) (Terrestrial Ecosystems 2018); and
- Desktop Vertebrate Fauna Assessment Expansion of the Solar Power Farm Project Area (**Appendix D**) (Terrestrial Ecosystems 2022).





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Figure 1-1: Regional location of the Proposed Clearing Permit Area and adjacent land use.



2 Project Background

2.1 Location, Tenure & Site Layout

Six mining tenements, five miscellaneous tenements, and one prospecting tenement intersect the Proposed Clearing Permit Area (**Table 2-1**). All tenements are currently held by GSM with the exception of for L 39/227 which is held by AngloGold Ashanti Australia Ltd (AngloGold). Tenements relevant to the Proposed Clearing Permit Area are located approximately 2 kms from the GSGM (**Figure 1-1**).

Table 2-1: Tenements relevant to the Proposed Clearing Permit Area.

Tenement	Area (ha)	Granted	Expires	Lessee
M 38/849	131.8	10/02/2009	9/02/2030	GSM Mining Company Pty Ltd
M 38/1298	14.5	26/11/2021	Pending Assessment*	GSM Mining Company Pty Ltd
M 38/397	157	20/10/1998	19/10/2040	GSM Mining Company Pty Ltd
M 38/691	81	2/03/2000	1/03/2042	GSM Mining Company Pty Ltd
M 38/1280	6.2	20/11/2018	28/11/2039	GSM Mining Company Pty Ltd
M 38/440	0.1	20/10/1998	19/10/2040	GSM Mining Company Pty Ltd
L 38/326	14.4	24/01/2019	23/01/2040	GSM Mining Company Pty Ltd
L 39/227	1.8	19/01/2015	18/01/2036	AngloGold Ashanti Australia Ltd
L 38/144	20.9	12/08/2009	11/08/2030	GSM Mining Company Pty Ltd
L 38/88	11.2	21/11/2000	20/11/2042	GSM Mining Company Pty Ltd
L 38/77	9.9	23/06/2000	22/06/2042	GSM Mining Company Pty Ltd
P 38/4407	13	14/11/2017	13/11/2021	GSM Mining Company Pty Ltd

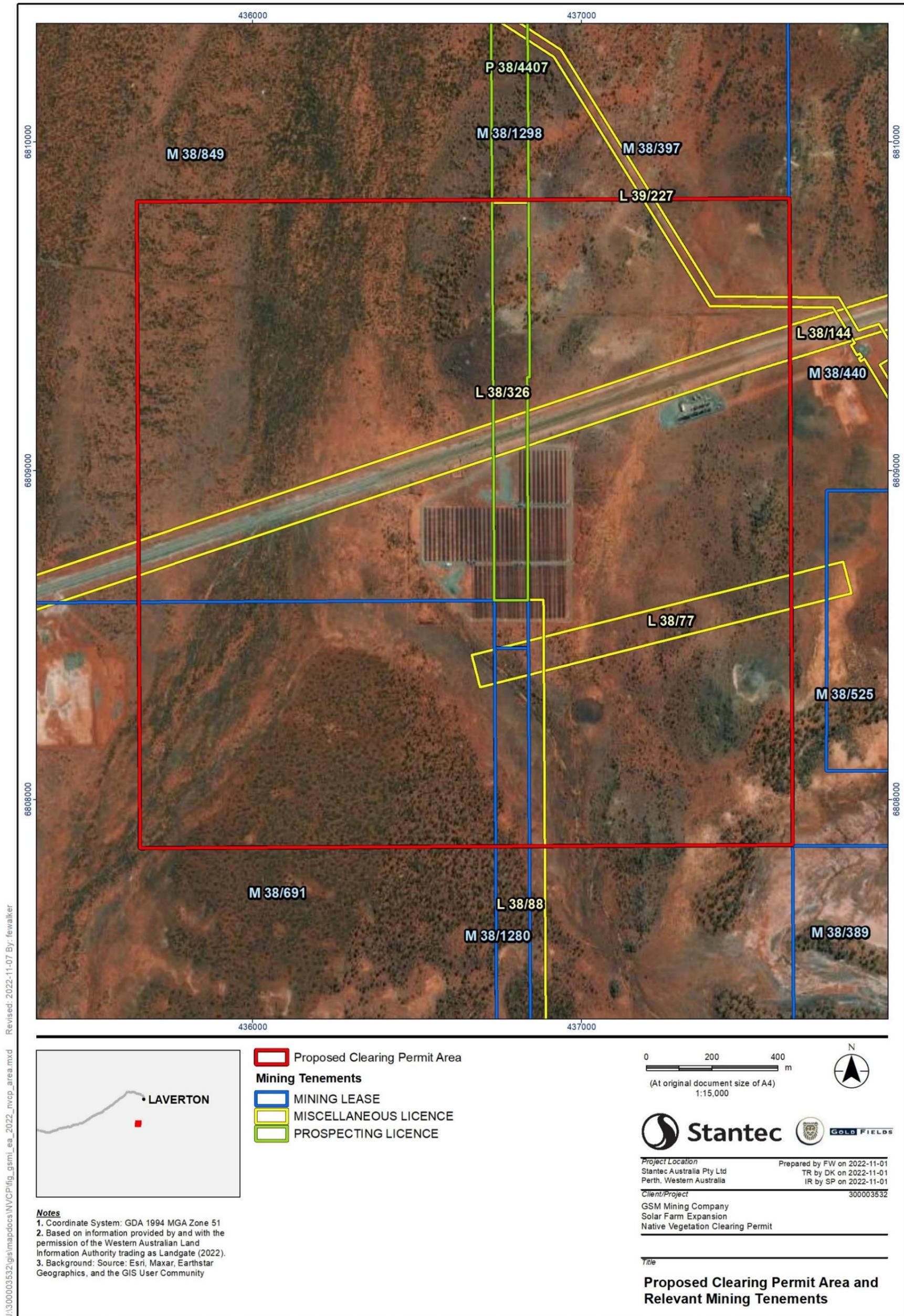
2.2 Applicant Details

2.2.1 Applicant Contact Details

Company Details	GSM Mining Company Pty Ltd
Name	Daniel Brierley Senior Engineer – Projects
Phone	0400 485 306
ABN/CAN	ABN 42 165 235 030 ACN 165 235 030
Postal Address	GPO Box 2731 Cloisters Square, WA, 6850

2.2.2 Contact Details for Enquiries

Company Details	GSM Mining Company Pty Ltd
Name	Tarant Borlase Senior Advisor – Environment
Phone	0408 690 061
ABN/CAN	ABN 42 165 235 030 ACN 165 235 030
Postal Address	GPO Box 2731 Cloisters Square, WA, 6850



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Figure 2-1: Proposed Clearing Permit Area and relevant mining tenements.



2.3 Proposed Clearing

2.3.1 Description of Proposed Clearing

Table 2-2: Proposed activity.

Aspect	Details
Total Clearing Area (ha)	Up to 40 ha within a 391 ha boundary
Proposed Clearing Method	Manual removed using a 60T dump truck and CAT 988
Period of Clearing	Q2 2023
Purpose of Clearing	Construction of a solar farm
Final Land Use	Solar power generation

2.3.2 Rehabilitation

Comprehensive mitigation approaches will be in place to meet environmental obligations as prescribed by current regulatory frameworks, approvals documents, and GSM internal practices. Refer to Section 6 for closure activities specific to power generation.

3 Existing Environment

3.1 Biogeographic Location

The Interim Biogeographic Regionalisation for Australia (IBRA) is a bioregional framework that divides Australia into 89 biogeographic regions and 419 subregions on the basis of climate, geography, landforms, vegetation and fauna (Thackway and Cresswell 1995). The Proposed Clearing Permit Area lies within the East Murchison (MUR01) IBRA subregion of the Murchison bioregion (**Figure 3-1**). The East Murchison subregion encompasses 7.8 million ha in the northern 'Southern Cross' and 'Eastern Goldfields' area of the Yilgarn Craton. The landscape is described as having extensive areas of elevated red desert sandplains with minimal dune development and internal drainage. Other features of the landscape include broad plains of red-brown soils, breakaway complexes, and red sandplains. Salt lakes are associated with the occluded Carey Palaeoriver. The vegetation is dominated by Mulga woodlands often rich in ephemerals, as well as hummock grasslands, saltbush shrublands and *Tecticornia* shrublands.

3.2 Land Use

The dominant land use (85%) within the East Murchison subregion is grazing of sheep and cattle on native pastures (Cowan 2001). Other land uses include Unallocated Crown Land (UCL), Crown reserves, freehold land held by the state of Western Australia, and mining (Cowan 2001). Mining in the East Murchison subregion is largely comprised of gold and nickel; most mining lease areas, including the Proposed Clearing Permit Area, are required to be stocked in accordance with the *Land Administration Act 1997* (WA). The National Land and Water Resources Audit (Department of the Environment and the Arts 2000) states that 1.4% of the Murchison bioregion comprises conservation estate, attributed to a comprehensive land acquisition program that contributed additional land for conservation purposes, with land vested in conservation reserves also increasing to 7.98% in 2009. The Murchison bioregion includes the Goongarrie National Park and the Wanjarri Nature Reserve. The closest inhabited townsite to the Proposed Clearing Permit Area is Laverton, located 24 km to the north. There are no Aboriginal communities currently located in the Proposed Clearing Permit Area, with Mt Margaret the closest located less than 20 km to the northwest. There are no known recreational land uses in the immediate area.

3.3 Pre-European Vegetation

The Proposed Clearing Permit Area occurs in the Eremaean Botanical Province (Beard 1976). Vegetation mapping of WA was completed on a broad scale (1:1,000,000 and 1:250,000) by Beard (1975), classifying vegetation into broad vegetation associations. These vegetation associations were re-assessed by Shepherd *et al.* (2002) to account for clearing in the intensive land use zone, and to divide some of the larger vegetation units. Shepherd *et al.* (2002) also developed a series of systems to assist in the removal of some mosaics. Vegetation system associations described by Shepherd *et al.* (2002) correspond with that of Beard (1975). One vegetation association intersects the Proposed Clearing Permit Area (Figure 3-2); the Laverton vegetation association.

The current extent of the Laverton vegetation association remaining is presented in Table 3-1. The significance of clearing a particular vegetation association can be determined by comparing current and pre-European vegetation extents. The required retention threshold of the pre-European extent of a vegetation association is 30% (Environmental Protection Authority 2000). Below this threshold, clearing is considered to compromise species diversity at an ecosystem level. The current remaining extent of the Laverton vegetation association exceeds 99% (**Table 3-1**) (Environmental Protection Authority 2000; Government of Western Australia 2019).

Table 3-1: Vegetation system association and extent within the Proposed Clearing Permit Area.

Vegetation Association	Description	Pre-European Extent (ha)	Current Extent (ha)	% Remaining in Class-I - IV Reserves
Laverton	Low woodland; Mulga (<i>Acacia aneura</i>)	4,308,335.74	4,290,594.35	99.59

3.4 Conservation Values

The Proposed Clearing Permit Area does not intersect with:

- an Environmentally Sensitive Area (ESA), listed within the Environmental Protection (Environmentally Sensitive Areas) Notice 2005 in accordance with s 51B of the EP Act; or
- conservation reserves (Australian Government 2023).

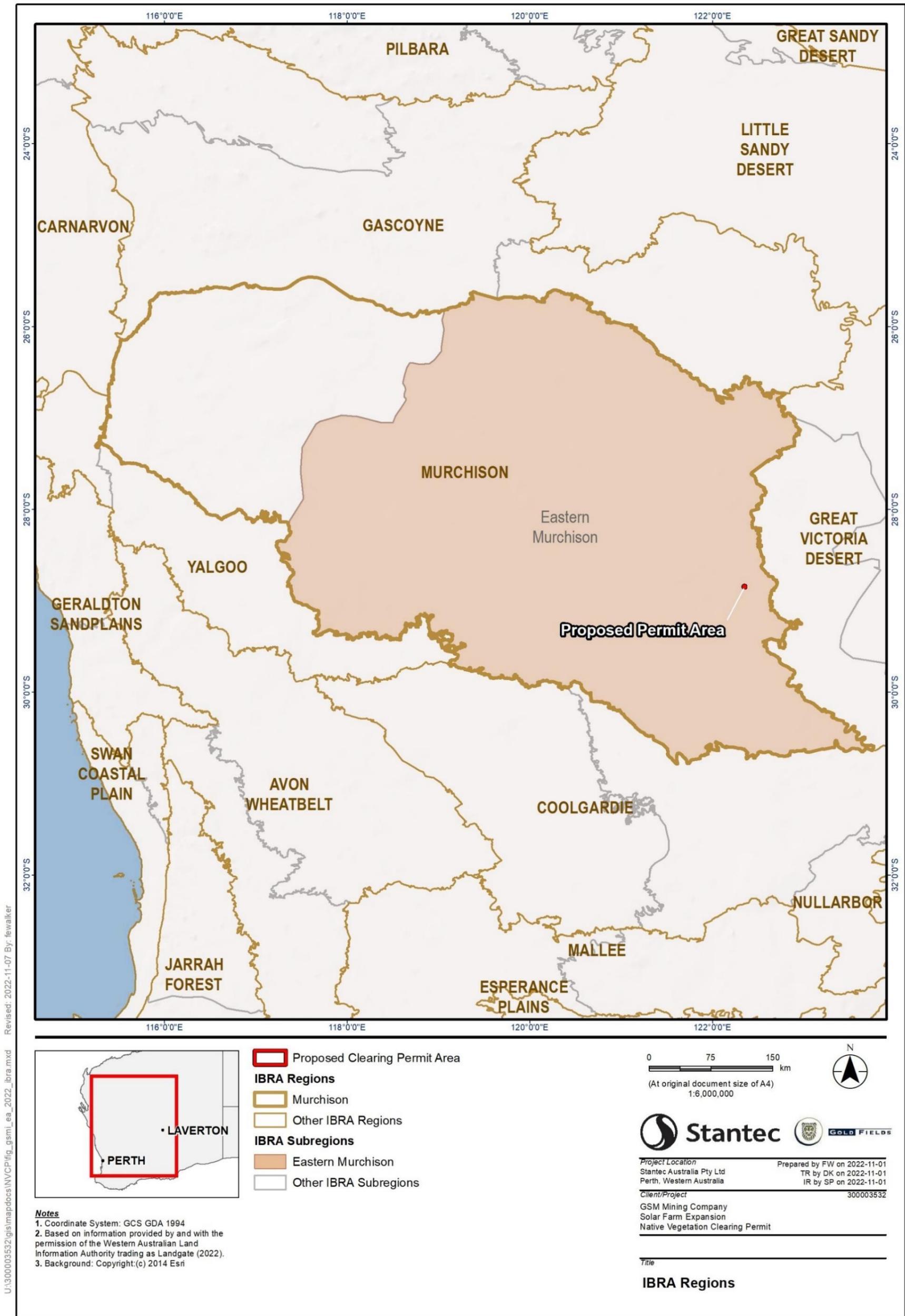
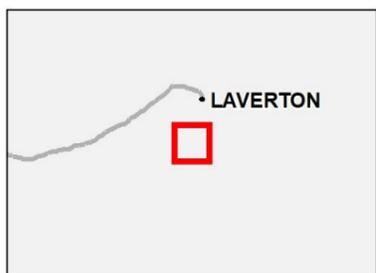
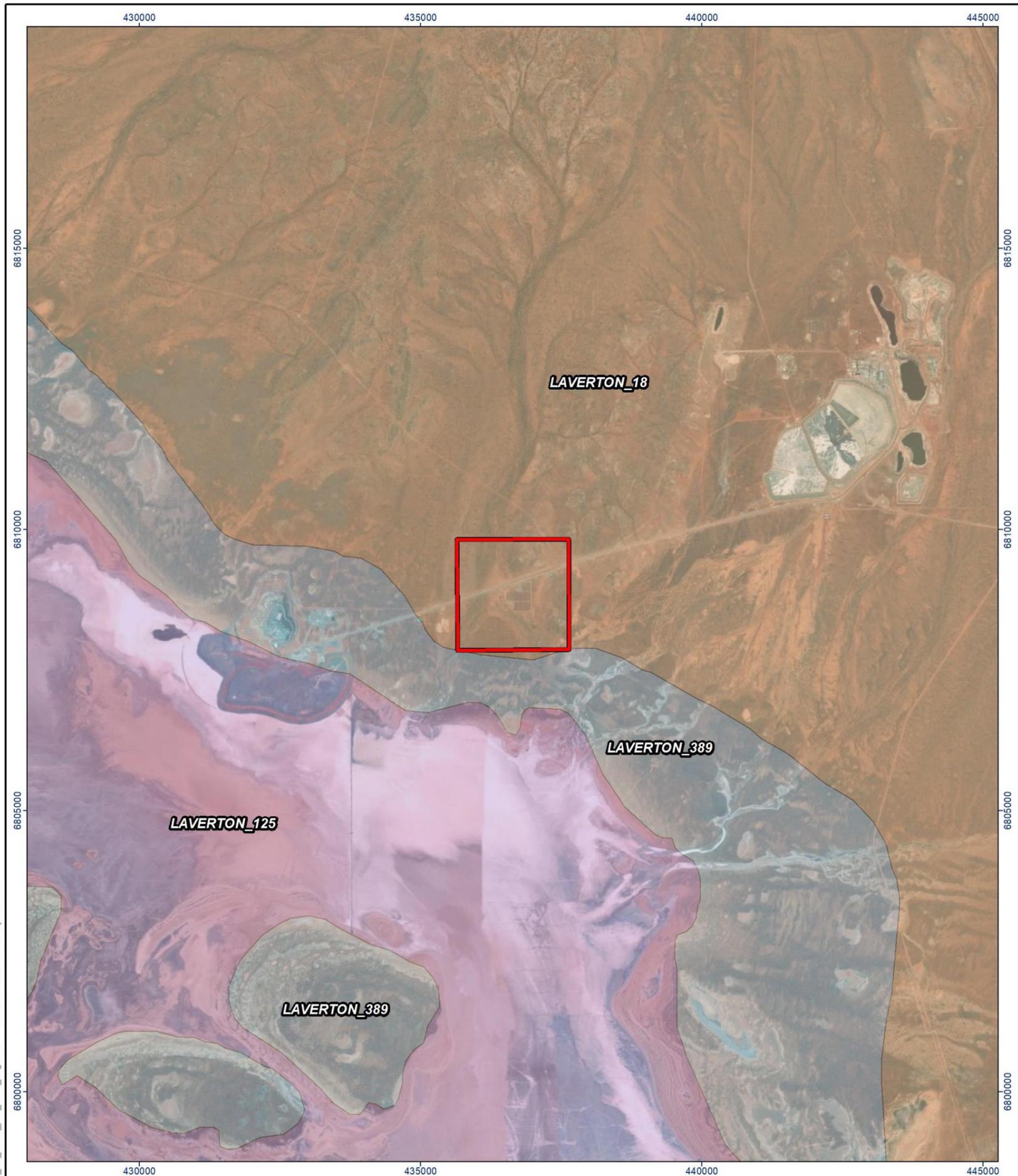
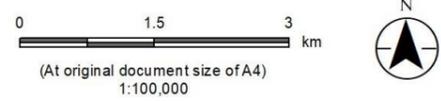


Figure 3-1: Location of the Proposed Clearing Permit Area in relation to the East Murchison subregion.



- Proposed Clearing Permit Area
- Pre-European Vegetation**
- LAVERTON_125
- LAVERTON_18
- LAVERTON_389



Project Location Stantec Australia Pty Ltd
Perth, Western Australia

Prepared by FW on 2022-11-01
TR by DK on 2022-11-01
IR by SP on 2022-11-01

Client/Project GSM Mining Company
Solar Farm Expansion
Native Vegetation Clearing Permit
300003532

Notes

1. Coordinate System: GDA 1994 MGA Zone 51
2. Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2022).
3. Background: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Title

Pre-European Vegetation

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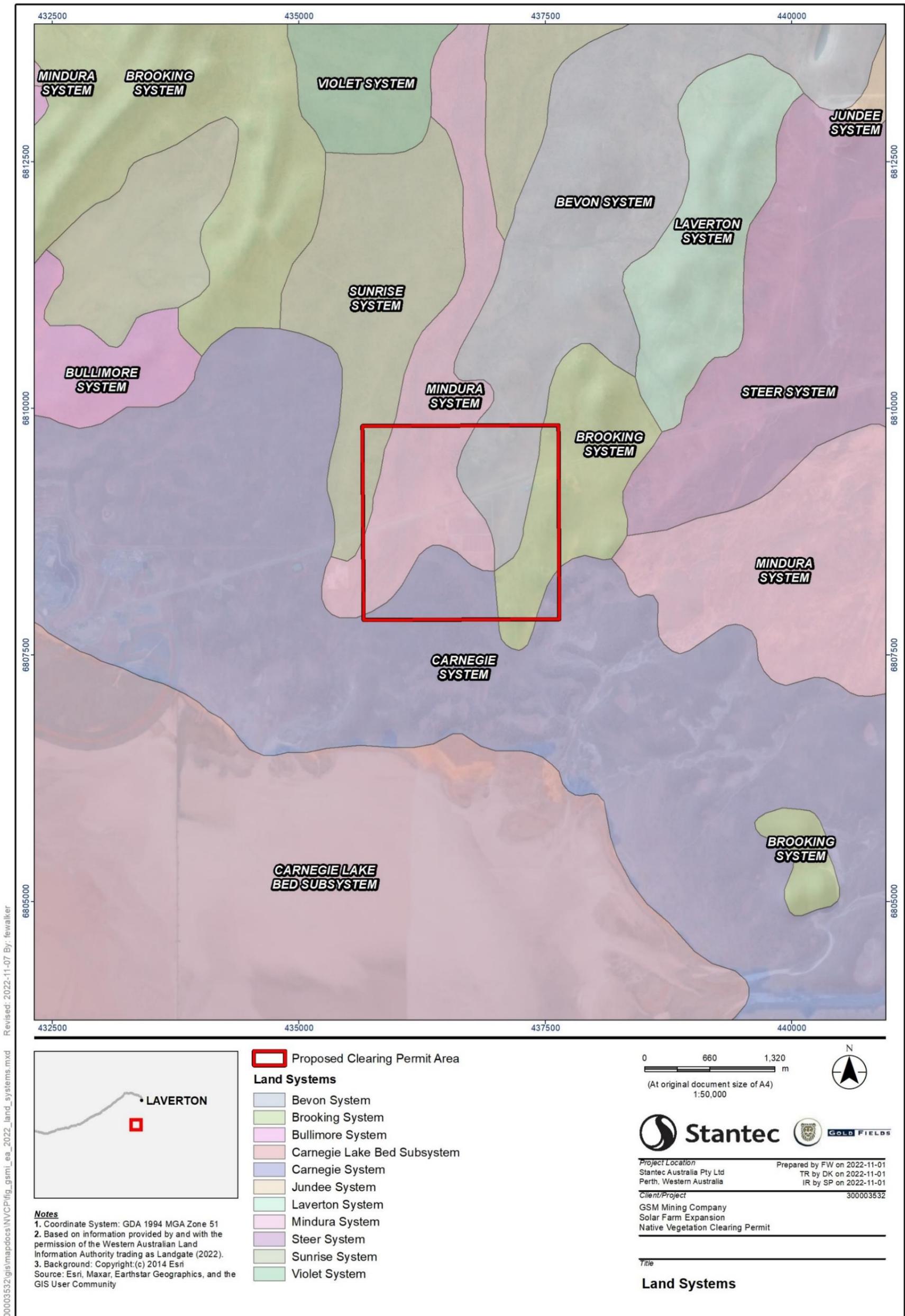
Figure 3-2: Pre-European vegetation of the Proposed Clearing Permit Area.

3.5 Land Systems & Topography

Land systems are defined as an area or group of areas throughout which there is a recurring pattern of topography, soils and vegetation (Tille 2006). An assessment of land systems provides an indication of the occurrence and distribution of fauna habitats and vegetation within and surrounding the Proposed Clearing Permit Area (Pringle *et al.* 1994). Land systems across the Murchison bioregion have been mapped by the Natural Resources Assessment Group of the Department of Primary Industries and Regional Development (DPIRD) (formerly the Department of Agriculture). This mapping provides a comprehensive description of biophysical resources within the area (Pringle *et al.* 1994). The Proposed Clearing Permit Area occurs within the Mindura System (39.0%), the Bevon System (20.3 %) the Carnegie System (18.5%), the Brooking System (17.8%), and the Sunrise system (4.4%) (Table 3-2; Figure 3-3). The natural topography of the region, and in the vicinity of the Proposed Clearing Permit Area, is flat to gently undulating and is closely related to underlying geology. The greatest topographical relief in the area is provided by waste landforms associated with mining operations adjacent to Lake Carey.

Table 3-2: Extent of land systems underlying and surrounding the Proposed Clearing Permit Area.

Land System	Description	Extent within the Proposed Clearing Permit Area	
		Extent (ha)	Proportion (%)
Carnegie System	Salt lakes with fringing saline alluvial plains, kopi dunes and sandy banks, supporting halophytic shrublands and acacia tall shrublands.	72.3	18.5
Sunrise System	Stony plains supporting Mulga shrublands.	17.4	4.4
Mindura System	Low hills, ridges and outcrops of granite, gneiss and quartz above convex, quartz-strewn interfluves and lower plains supporting sparse acacia shrublands becoming denser in drainage floors.	152.3	39
Bevon System	Irregular low ironstone hills with stony lower slopes supporting Mulga shrublands.	79.1	20.3
Brooking System	Prominent ridges of banded iron formation supporting Mulga shrublands and occasional minor halophytic communities.	69.6	17.8
Total		390.7	100



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Figure 3-3: Land systems underlying and surrounding the Proposed Clearing Permit Area.



3.6 Geology

The Proposed Clearing Permit Area lies within the Laverton Achaean granite-greenstone belt in the central north-south portion of the Eastern Goldfields Province of the Yilgarn Block within the Western Shield. The Achaean geology of the region is subdivided by two volcanics dominated by basalts, high magnesian basalts, interflow sediments, and basal ultramafics. Feldspathic conglomerates and siliciclastic overlay the Upper Association lithologies (Dames and Moore 2000).

Three north-south litho-structural terranes control the distribution of these rock associations; the Western terrane (dominated by mafic volcanics of the Base Association), the central terrane (comprised of calc-alkaline volcanics and siliciclastic of the Upper Association), and the eastern terrane (characterised by mafic volcanics of the Base Association). The Mt Weld carbonatite intrudes the central eastern terrane boundary and is approximately 13 km from the GSGM. Elongate basins of conglomerate are localised along the flanks of the terranes, while intrusions of the late syntectonic granites and granodiorite porphyry have occurred at the Granny Smith deposit (Dames and Moore 2000).

The local surface geology in the Proposed Clearing Permit Area can be broadly described as colluvial clay, silt, sand, and gravel with pockets of metamorphosed sandstone and or siltstone (**Figure 3-4**). Alluvial clay, silt, sand, and gravel can be found in and near the creek channels (**Figure 3-4**). The local geology beneath the Proposed Clearing Permit Area comprises both granite and granodiorite. The layers and zones of silcrete and ferricrete cementation within the palaeovalley show considerable lateral and vertical variation (GSM Mining Company Pty Ltd 2015b). The superficial and palaeochannel deposits are thought to vary laterally and vertically with distance away from the Proposed Clearing Permit Area, with the thickness of valley-fill deposits progressively increasing further downstream beneath Windich Creek (GSM Mining Company Pty Ltd 2015b). The Proposed Clearing Permit Area intersects with two regional geological units; unit 74322 comprising sedimentary rocks (120.6 ha) and unit 38491 comprising colluvium (270.0 ha) (**Table 3-3; Figure 3-4**) (Australian Government 2012a).

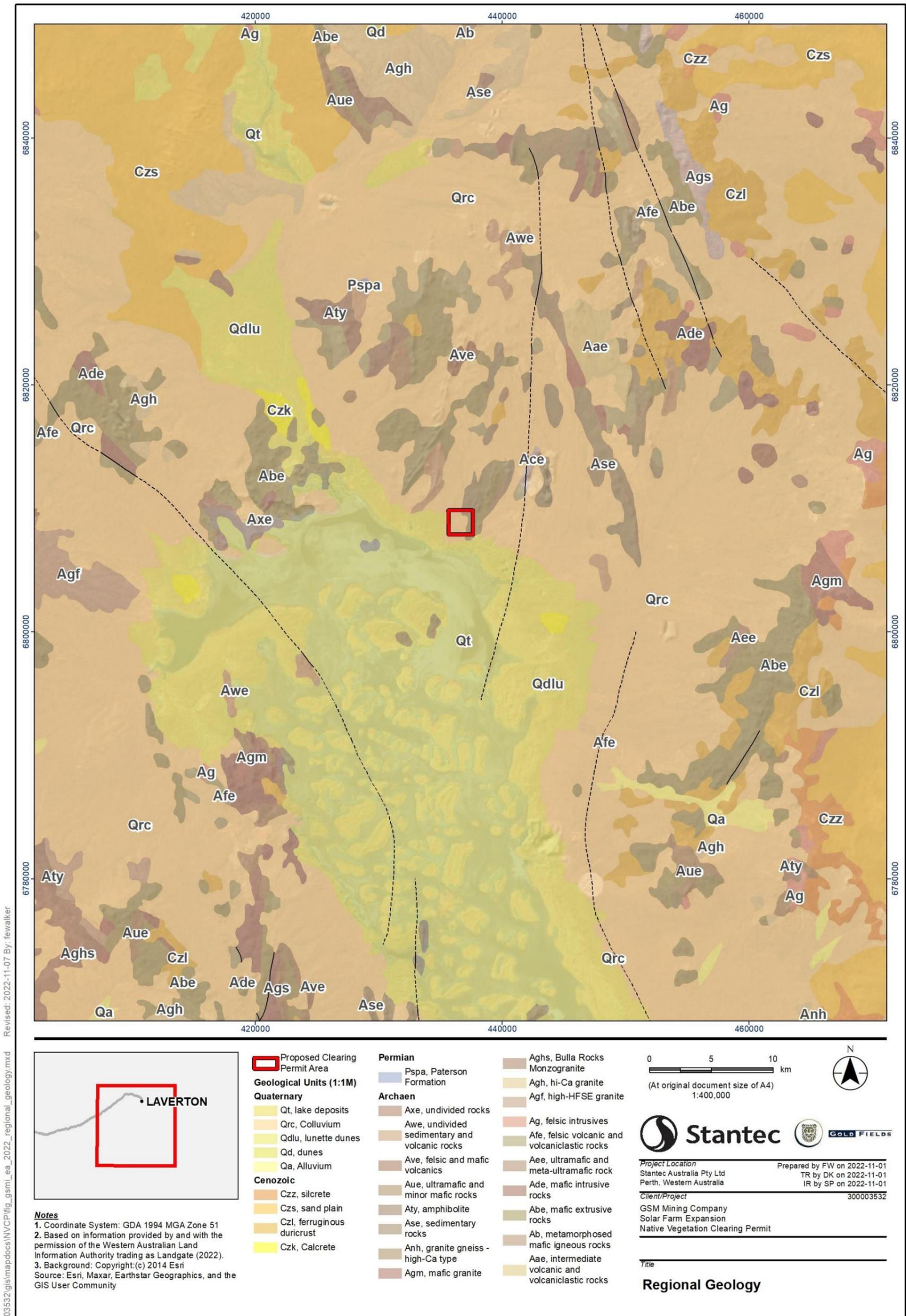
Table 3-3: Geological features within the Proposed Clearing Permit Area.

Geological unit	Description	Proposed Clearing Permit Area (ha)
Ase: sedimentary rocks 74322	Phyllitic schist, siltstone, sandstone, greywacke, pelite, conglomerate, quartzite, phyllite, shale, slate, claystone, chert, minor felsic volcanic and volcanoclastic rocks; arkose, para- and orthoamphibolites; rare banded iron formation.	120.6
Qrc: colluvium 38491	Colluvium and/or residual deposits, sheetwash, talus, scree; boulder, gravel, sand; may include minor alluvial or sand plain deposits, local calcrete, and reworked laterite	270.0
Total		390.7

3.7 Soils

The Murchison bioregion is defined by gently undulating soils with occasional ranges of low hills, and extensive sand plains in the eastern half. The area is characterised by shallow earthy loams overlying a red-brown hardpan, shallow stony loams on hills and red earthy sands on sand plains (Cowan 2001; Department of the Environment and the Arts 2000). The Proposed Clearing Permit Area is located within the Salinaland Plains soil-landscape zone of the Murchison Province. This zone consists of sandplains (with hardpan wash plains and some mesas, stony plains, and salt lakes) on granitic rocks (and some greenstone) of the Yilgarn Craton. Soils include red sandy earths, red deep sands, red shallow loams and red loamy earths with some red-brown hardpan shallow loams, salt lake soils and red shallow sandy duplexes.

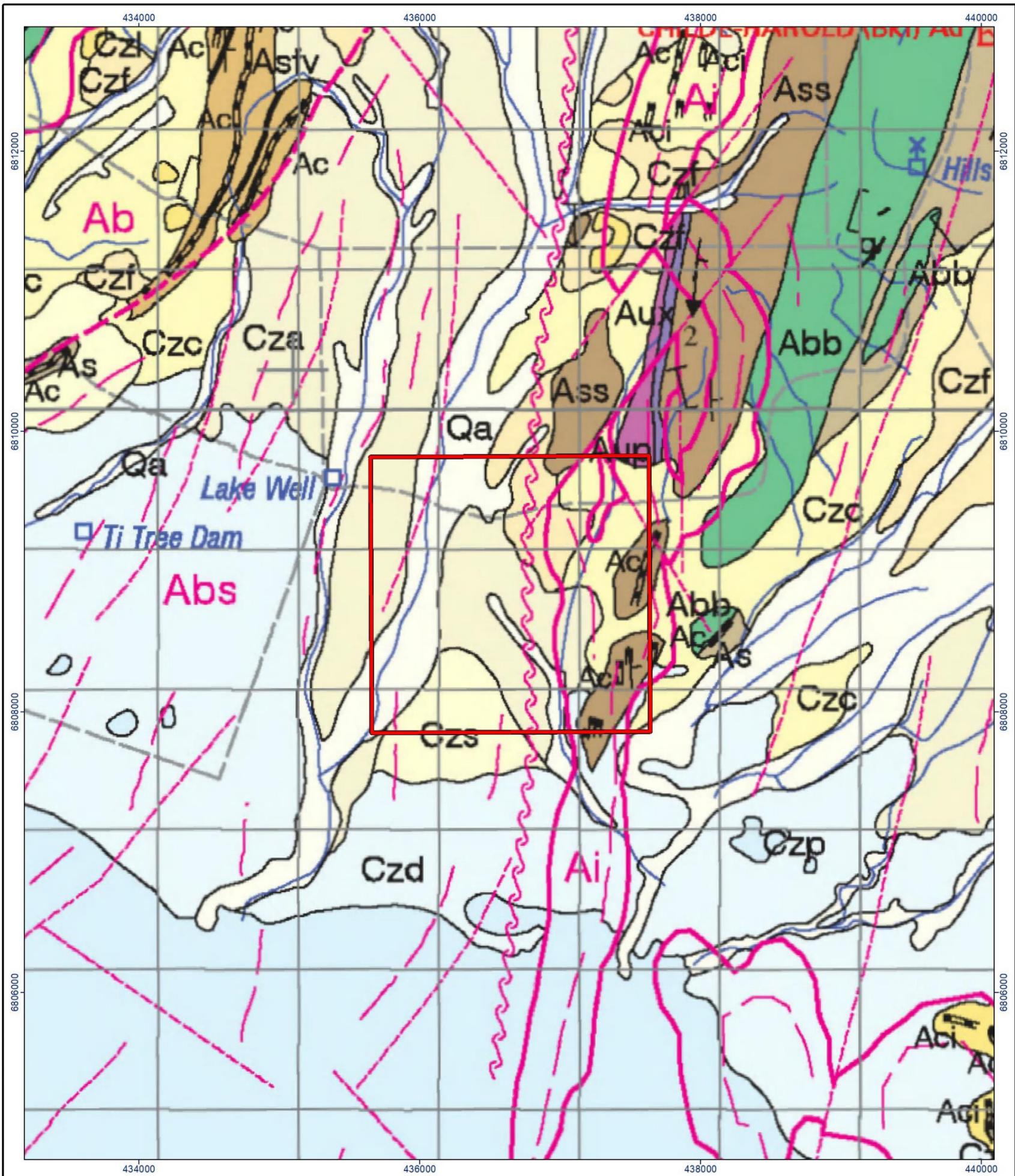
Land degradation includes any alteration to land capability, soil erosion, salinity, nutrient export, acidification, waterlogging and flooding that affects the present or future use of land. A review of the grade of soil erosion for the Yilgarn Plateau Province of Australia (Geoscience Australia 2021) indicated the Proposed Clearing Permit Area lies within an area classified as 'Poor', attributed to the province being vulnerable to wind erosion due to low ground cover and erodible soils. Poor soil erosion grading of the province is likely attributed to agriculture and grazing activities that dominate the region. Further, the Proposed Clearing Permit Area is already subject to degradation as a result of construction of the existing HPS and proximity to existing infrastructure and access/haul roads. The Proposed Clearing Permit Area does not occur within a known acid sulphate soils risk area.



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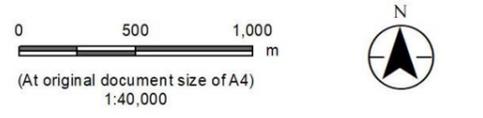
Figure 3-4: Regional geology of the Proposed Clearing Permit Area.





Notes
 1. Coordinate System: GDA 1994 MGA Zone 51
 2. Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2022).
 3. Background: Copyright(c) 2014 Esri

- Proposed Clearing Permit Area**
- Surface Geology (1:100K)**
- Quaternary**
- Qa: Clay, silt, sand and gravel in and near active stream channels; alluvial
- Cenozoic**
- Cza: Clay, silt and sand; pebbly in places; colluvial, distal
 - Czc: Gravel, talus, sand; colluvial, proximal
 - Czd: Quartz and gypsum dunes with minor silt and clay adjacent to playas (dunes dominant)
 - Czf: Pebbly colluvium and alluvium derived from laterite
 - Czl: Lateritic duricrust, massive and rubbly
- Archean**
- Ac: Chert
 - Aci: Banded Iron Formation
 - As: Metasedimentary rock, undivided
 - Asfv: Oligomictic conglomerate with dominantly felsic igneous clasts
 - Ass: Sandstone and/or siltstone, metamorphosed
 - Abb: Metabasalt +/- metadolerite
 - Aup: Peridotite
 - Aux: Pyroxenite
- Other units:**
- Czp: Evaporites, sand and clay in playas



Project Location
 Stantec Australia Pty Ltd
 Perth, Western Australia

Prepared by FW on 2022-11-01
 TR by DK on 2022-11-01
 IR by SP on 2022-11-01

Client/Project
 GSM Mining Company
 Solar Farm Expansion
 Native Vegetation Clearing Permit

300003532

Title
 Local Geology

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Figure 3-5: Surface geology of the Proposed Clearing Permit Area.

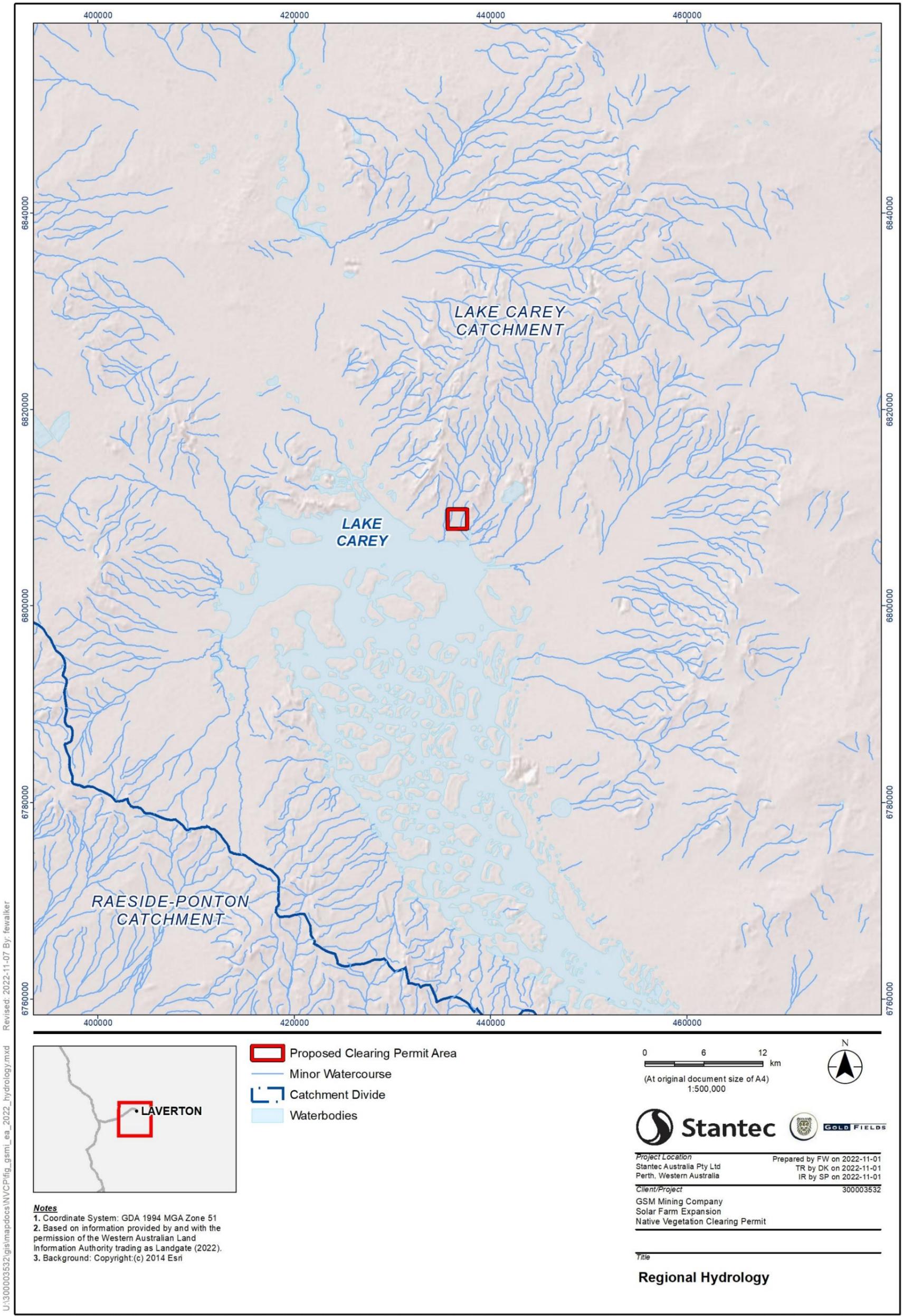


3.8 Surface Hydrology & Hydrogeology

The Proposed Clearing Permit Area is located within the Lake Carey Catchment, which drains into Lake Carey (Figure 3-6) (AECOM 2018). Lake Carey, situated approximately 1.5 km to the south of the Proposed Clearing Permit Area, is part of a chain of salt lakes located in the eastern portion of the Yilgarn Craton, and these lakes are the surface expression of the Carey Palaeoriver, an ancient drainage channel (Timms 1992). Drainage is internal and occurs in a south-easterly direction during surface sheet flow. Major flood events are rare, and the lake only fills after intense winter rains or cyclonic events (Timms *et al.* 2006), with surface water draining from the surrounding catchments via several key tributaries. The areas around Lake Carey are dominated by calcrete and gypsiferous dunes, salt pans, and sheet wash deposits (Gray and Britt 2005). Several minor ephemeral waterways are located within, or adjacent to, the Proposed Clearing Permit Area and may present a potential flood risk (AECOM 2018). However, surface water flow is ephemeral in the local area, occurring only after substantial rainfall events, with sub-catchments discharging to the north-eastern shore of Lake Carey, predominately via shallow, low velocity sheet flow (AECOM 2018).

The closest groundwater resource of significance to the Proposed Clearing Permit Area is the Mt Weld Carbonatite aquifer which is used by both GSM and Lynas Corporation for mine water supply, including potable water production (GSM Mining Company Pty Ltd 2015b). The closest Mt Weld Carbonatite aquifer bore is located more than 15 km from the Proposed Clearing Permit Area. The closest Public Drinking Water Source Area (PDWSA) is the Priority 1 Laverton PDWSA, located approximately 30 km from the Proposed Clearing Permit Area.

Groundwater salinity in the region ranges from fresh (<3,000 mg/L total dissolved solids; TDS) to mesosaline (20,000 mg/L TDS – 50,000 mg/L TDS) closer to the margins of Lake Carey (Allen 1996); however, local groundwater salinity ranges from saline to hypersaline (GSM Mining Company Pty Ltd 2015a). Groundwater salinity in the vicinity of the Goanna and Granny pits ranges from 14,000 mg/L TDS to 116,000 mg/L TDS, and between 1,890 mg/L TDS and 17,000 mg/L TDS adjacent to the Jubilee Pit (GSM Mining Company Pty Ltd 2015a). Seepage of hypersaline groundwater from disused pits adjacent to the Granny Pit has resulted in a groundwater salinity of 104,000 mg/L TDS; however no significant impact has been observed as a result of this increasing groundwater salinity.



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Figure 3-6: Regional hydrology of the Proposed Clearing Permit Area.



3.9 Climate

The climate of the Murchison bioregion is characterised as arid with a bimodal rainfall distribution and an annual rainfall approximately 200 mm (Gilligan 1994); however, rainfall in the area is unreliable. During summer, weather in the region is influenced by anticyclonic systems in the southeast, which result in clear skies and easterly winds (Gilligan 1994). The region borders the southern end of the Intertropic Convergence Zone and, consequently, thunderstorm activity and summer rainfall are generated (Gilligan 1994). Although summer rainfall is a feature of the bioregion, a dry period lasting four to six months in not uncommon most years; typically beginning in October (Gilligan 1994). During winter, weather is directly influenced by anticyclonic systems, which generate westerly winds and rain-bearing frontal systems (Gilligan 1994). Winter rains are typically heaviest in late May through to August and subside during September and October as the anticyclonic conditions stabilise (Gilligan 1994).

The closest Bureau of Meteorology station to the GSGM is Laverton Aero (station number 012305). Monthly mean maximum temperatures range from 18.6°C in winter (June, July) to 35.6°C in summer (January) (Figure 3-7) (Bureau of Meteorology 2023). Mean monthly rainfall ranges from 6.8 mm in September to 53.4 mm in February (Figure 3-7) (Bureau of Meteorology 2023). Average annual rainfall recorded at Laverton Aero is 275.9 mm (Bureau of Meteorology 2023).

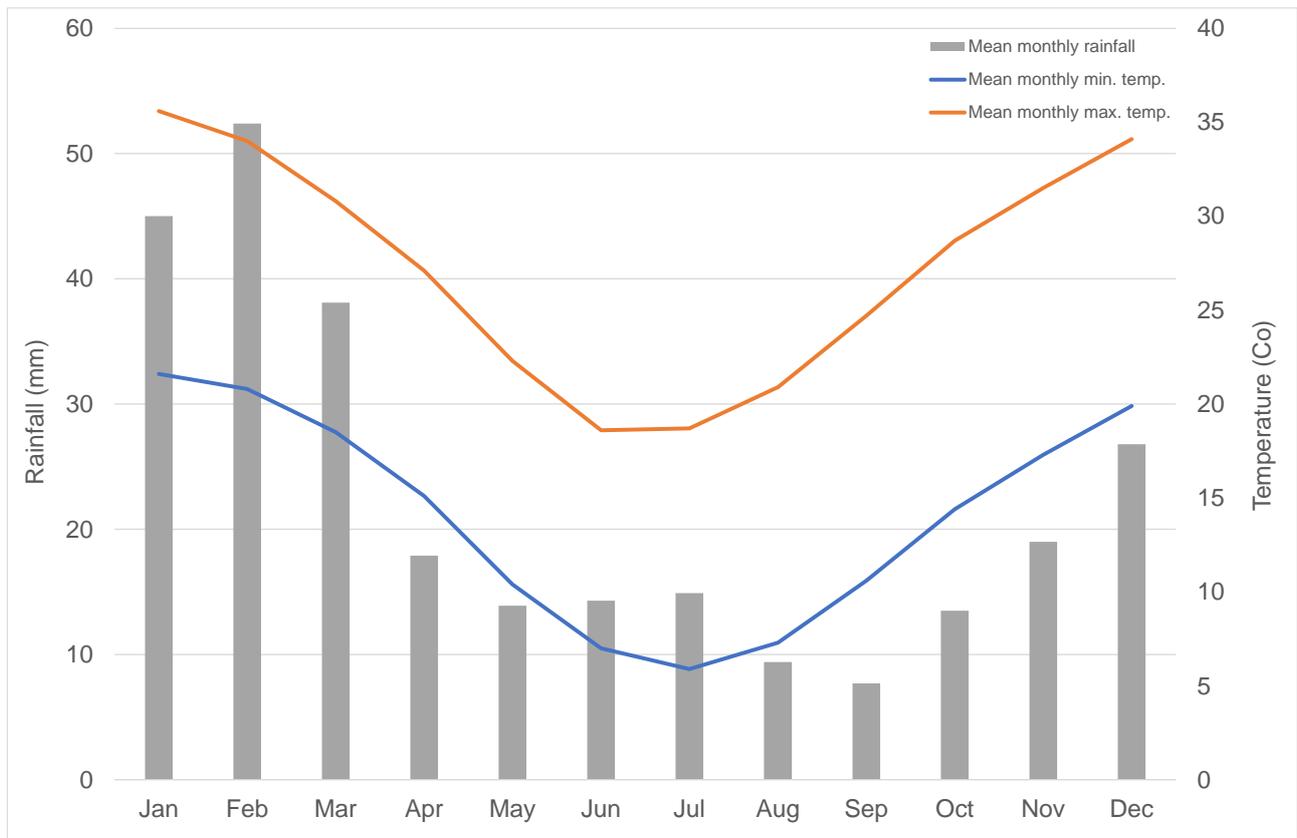


Figure 3-7: Mean monthly rainfall (mm) and temperature (°C) data recorded at the Laverton Aero weather station (012305).

4 Flora & Vegetation Assessment

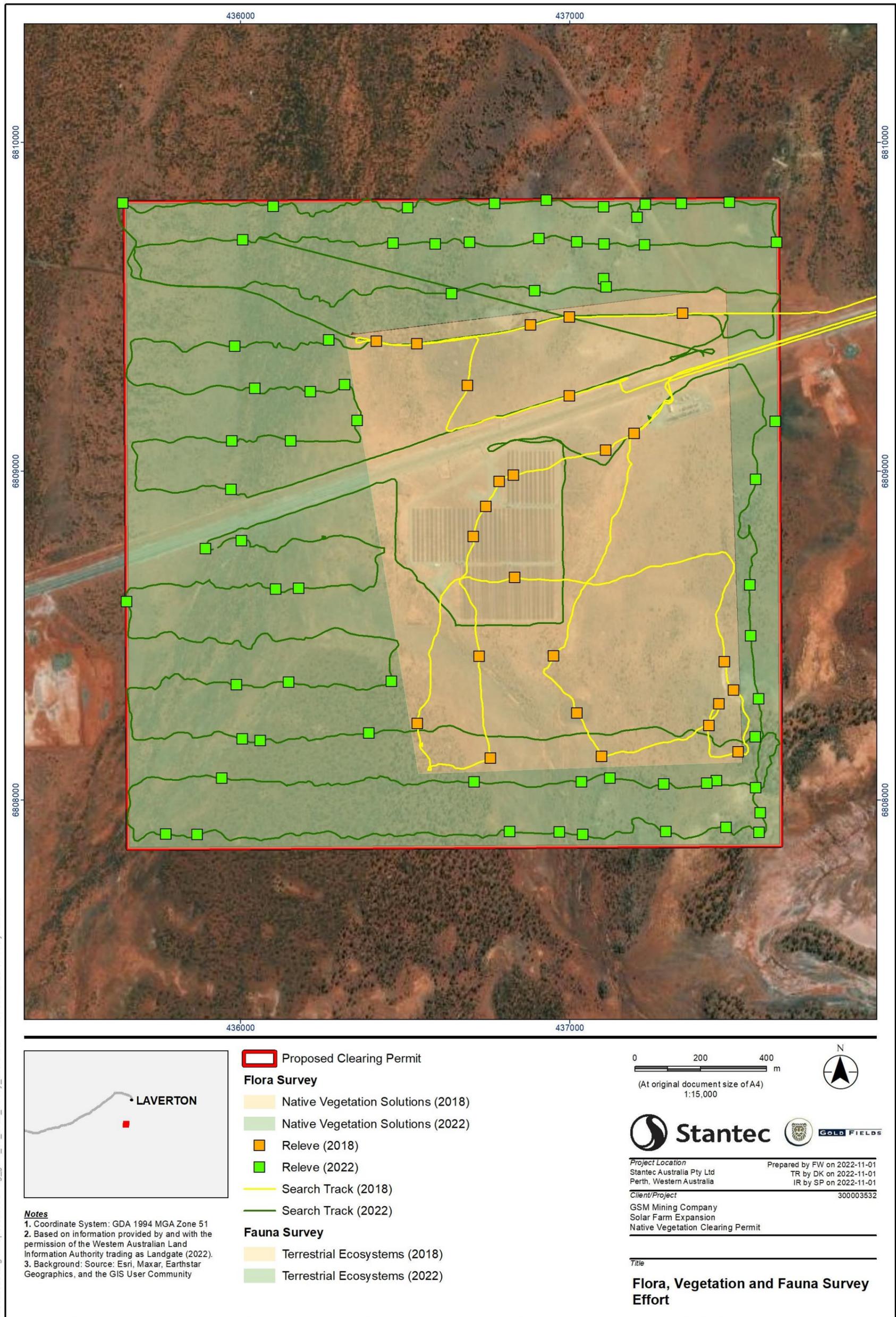
4.1 Flora Assemblage

A total of 66 flora taxa (including subspecies and variants) from 20 families were recorded within the Native Vegetation Solutions (2018) study area in the central portion of the Proposed Clearing Permit Area. The most diverse families were Chenopodiaceae (14 taxa) and Fabaceae (11 taxa). A total of 89 flora taxa from 19 families were recorded within the Native Vegetation Solutions (2022) study area in the central portion of the Proposed Clearing Permit Area. Consistent with the Native Vegetation Solutions (2018) study, the most diverse families were Chenopodiaceae (20 taxa) and Fabaceae (21 taxa). The findings from both surveys were consistent with what would be expected to occur within the Murchison bioregion, considering the landforms present, the field survey season, and the sampling intensity.

4.1.1 Threatened, Priority & Introduced Flora

The database searches undertaken by Native Vegetation Solutions (2022) indicated that six taxa of significance occur to within 20 km of the Proposed Clearing Permit Area, comprising one P1 taxa and five P3 taxa; *Tecticornia* sp. Lake Way (P. Armstrong 05/961) (P1), *Calytrix praecipua* (P3), *Goodenia lyrata* (P3), *Olearia mucronata* (P3), *Lysiandra baeckeoides* (P3), and *Tecticornia cymbiformis* (P3). *Gunniopsis propinqua* was reported as a P3 species; however, this species is not currently listed, and *Phyllanthus baeckeoides* is currently known as *Lysiandra baeckeoides* (P3) (Native Vegetation Solutions 2022; Western Australian Herbarium 2023a;b). Neither of the Native Vegetation Solutions (2018;2022) surveys recorded Threatened or Priority flora taxa within the Proposed Clearing Permit Area.

One species of introduced flora, **Cenchrus ciliaris* (Buffel Grass), was recorded at three locations within the Proposed Clearing Permit Area (**Figure 4-2**); however, this species is not listed as a Declared Pest under the *Biosecurity and Agriculture Management Act 2007* (BAM Act), in accordance with the Western Australian Organism List maintained by the Department of Primary Industries and Regional Development (2021), nor is it a Weed of National Significance (WoNS) (Australian Government 2012b).



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Figure 4-1: Flora, vegetation and fauna survey effort within the Proposed Clearing Permit Area.





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Figure 4-2: Location of introduced flora identified within the Proposed Clearing Permit Area.



4.2 Vegetation

4.2.1 Vegetation Types

Eight broad vegetation types were identified within the Proposed Clearing Permit Area (Table 4-1) (Native Vegetation Solutions 2022), none of which were considered analogous to any Priority ecological community (PEC) or Threatened ecological community (TEC) listed under the BC Act or *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). No unique or restricted vegetation communities were identified. All vegetation types were considered to be common or widespread within the East Murchison subregion.

Table 4-1: Vegetation descriptions recorded within the Proposed Clearing Permit Area.

Vegetation Descriptions	Dominant Flora Species	Proposed Clearing Permit Area Proportion	
		ha	%
Mulga creekline vegetation	Not provided	62.32	15.94
Open Mulga woodland over chenopod shrubland	<i>Acacia aneura</i> , <i>Acacia mulganeura</i> , <i>Acacia masliniana</i> , <i>Hakea preissii</i> , <i>Eremophila glabra</i> subsp. <i>glabra</i> , <i>Atriplex bunburyana</i> , <i>Maireana pyramidata</i>	33.50	8.57
Mulga over <i>Maireana</i> and sclerophyll shrubland	Not provided	71.23	19.73
Open Mulga woodland	Not provided	41.39	10.59
Mulga woodland over sandy plains	<i>Acacia ayersiana</i> , <i>Acacia pteraneura</i> , <i>Maireana pyramidata</i> , <i>Rhagodia drummondii</i> , <i>Aristida contorta</i> , <i>Eragrostis eriopoda</i> , <i>Solanum lasiophyllum</i> , <i>Enchylaena tomentosa</i> var. <i>tomentosa</i>	45.05	11.52
Open chenopod shrubland	<i>Maireana pyramidata</i> , <i>Cratystylis subspinescens</i> , <i>Hakea preissii</i> , <i>Lawrenzia squamata</i>	79.08	20.23
Mulga shrubland over banded iron formation rocky outcrops	<i>Acacia mulganeura</i> , <i>Acacia aneura</i> , <i>Acacia ayersiana</i> , <i>Philotheca brucei</i> subsp. <i>brucei</i> , <i>Eremophila latrobei</i> subsp. <i>latrobei</i> , <i>Dodonaea viscosa</i> , subsp. <i>angustissima</i> , <i>Acacia tetragonophylla</i>	11.27	2.88
<i>Tecticornia</i> shrubland	<i>Tecticornia disarticulata</i> , <i>Frankenia pauciflora</i>	1.64	0.42
Existing disturbance	Nil	45.20	11.56
Not mapped	Nil	0.30	0.07
Total		390.96	100

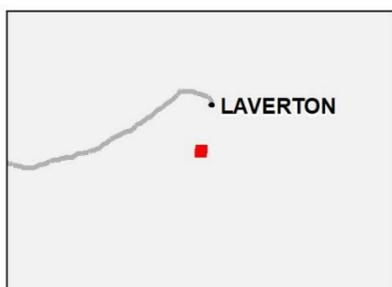
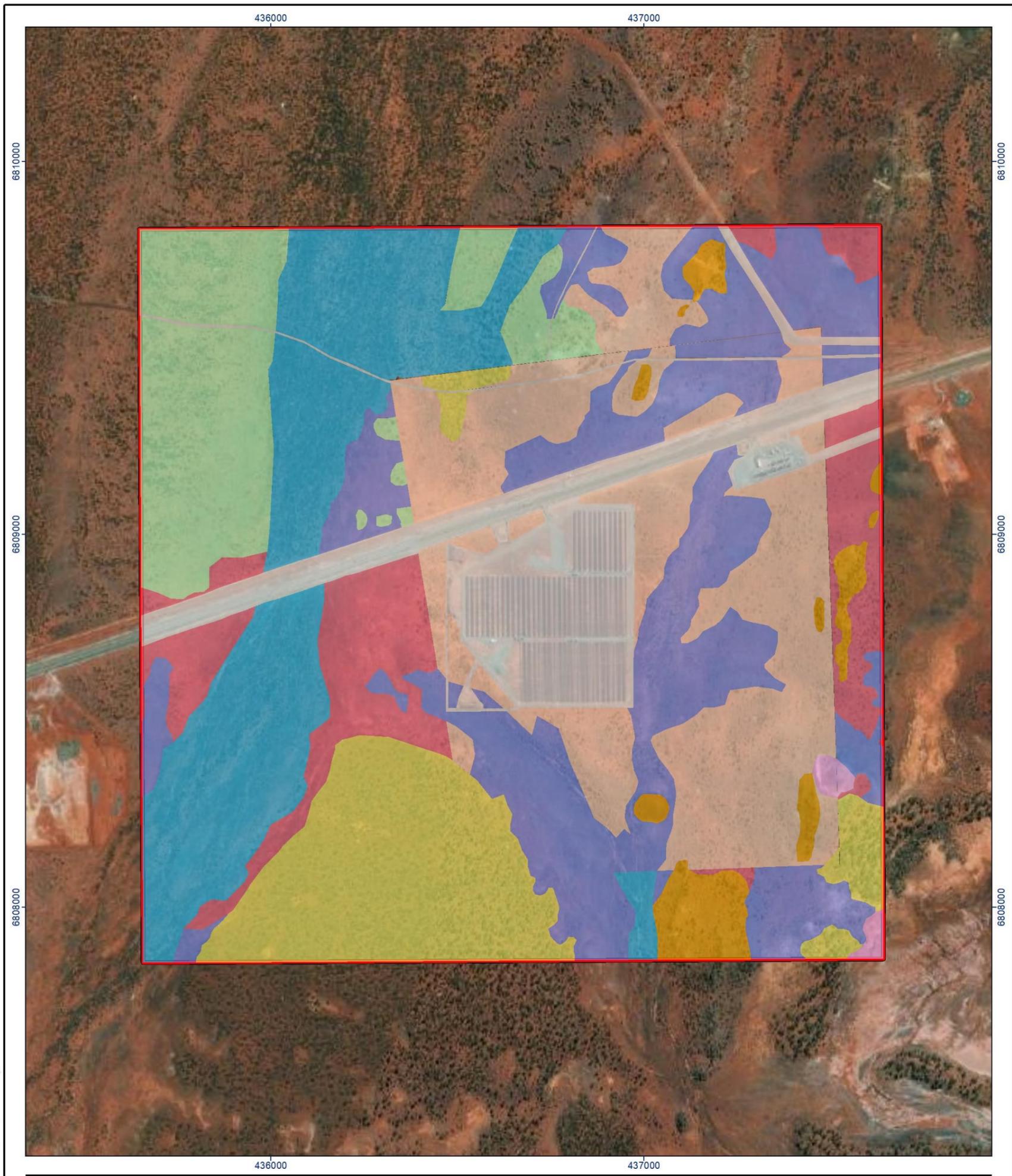
4.2.2 Vegetation Condition

The vegetation condition of the Proposed Clearing Permit Area ranged from 'Completely Degraded' to 'Very Good' (Table 4-2; Figure 4-4) (Keighery 1994; Native Vegetation Solutions 2018;2022). As *Phytophthora cinnamomi* has not been documented from the Murchison bioregion (Department of Biodiversity 2022), there is no risk of the introduction or spread of dieback.

Table 4-2: Vegetation condition in the Proposed Clearing Permit Area.

Condition Rating	Proposed Clearing Permit Area Proportion	
	ha	%
Very Good	73.44	18.79
Good	269.19	74.63
Degraded	2.56	0.65
Completely degraded	45.19	11.56
Not Mapped	0.29	0.07
Total	390.68	100





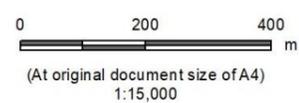
Notes

1. Coordinate System: GDA 1994 MGA Zone 51
2. Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2022).
3. Background: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Proposed Clearing Permit Area

Vegetation Type

- Mulga Creekline Vegetation
- Mulga over *Maireana sedifolia* and sclerophyll shrubland
- Mulga shrubland over BIF rocky outcrops
- Mulga woodland over *Eremophila forrestii* over tussock grassland on sandy plains
- Open Chenopodiaceae Shrubland
- Open Mulga Woodland
- Open Mulga woodland over *Acacia kalgoorliensis* and Chenopod shrublands
- Tecticornia shrubland
- Existing Disturbance



Project Location: Stantec Australia Pty Ltd, Perth, Western Australia
 Prepared by FW on 2022-11-01, TR by DK on 2022-11-01, IR by SP on 2022-11-01

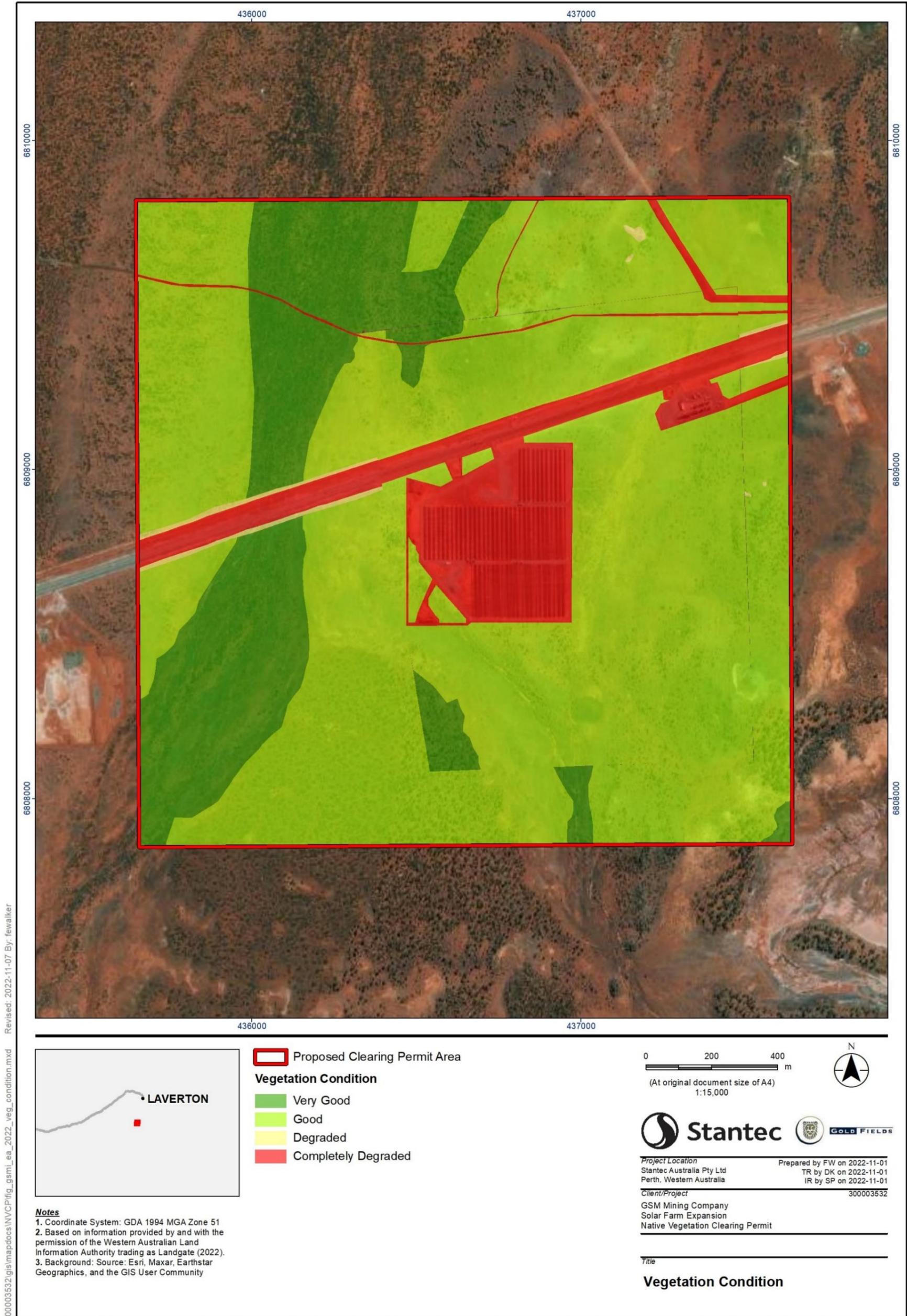
Client/Project: GSM Mining Company, Solar Farm Expansion, Native Vegetation Clearing Permit, 300003532

Title: **Vegetation Mapping**

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Figure 4-3: Vegetation descriptions recorded from within the Proposed Clearing Permit Area.





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Figure 4-4: Vegetation condition within the Proposed Clearing Permit Area.



5 Terrestrial Fauna Assessment

5.1 Fauna Assemblage

A Detailed (formerly Level 2) vertebrate fauna survey was undertaken by in 2011 by Terrestrial Ecosystems, approximately 3 km to the north of the Proposed Clearing Permit Area and included a trapping program and an avifauna survey. The 2011 survey area supported similar fauna habitat to that in the Proposed Clearing Permit Area. The 2011 survey was also used to inform on the likelihood of occurrence of significant fauna, due to the close proximity to the Proposed Clearing Permit Area and the similarity of fauna habitat present (Terrestrial Ecosystems 2022). Terrestrial fauna survey effort within the Proposed Clearing Permit Area is shown in **Figure 4-1**.

The trapping program recorded a reptile, mammal, and amphibian assemblage comparable to that recorded in other areas of open Mulga woodland in the East Murchison subregion. The exception was the capture of three Long-tailed Dunnart (P4) individuals, which was unexpected given the previous nearest known record at the time was 200 km southeast of the Proposed Clearing Permit Area. Subsequently, the Long-tailed Dunnart (P4) has been recorded at several banded iron formations in the East Murchison subregion (Terrestrial Ecosystems 2022).

The avifauna survey recorded 820 individuals from 60 species across 70 survey sites and an additional 495 opportunistic observations. A proportion of these species, primarily the waterbird species, are rarely observed in the north-eastern Goldfields; however, substantial rainfall resulted in increased observations of these bird during the survey period. No Malleefowl nests or tracks were observed.

Four species of bat were recorded during the 2011 survey, comprising Gould's Wattled Bat (*Chalinolobus gouldii*), the Inland Free-tailed Bat (*Ozimops petersi* / *Mormopterus* sp. 3), the Inland Broad-nosed Bat (*Scotorepens balstoni*), and Finlayson's Cave Bat (*Vespadelus finlaysoni*) (Terrestrial Ecosystems 2022). These species are commonly recorded throughout the Murchison bioregion.

5.1.1 Fauna of Significance

Terrestrial Ecosystems (2022) identified 13 significant species with the potential to occur within, or adjacent to, the Proposed Clearing Permit Area. Of these species, only one was considered Likely to occur in the Proposed Clearing Permit Area; Long-tailed Dunnart (*Sminthopsis longicaudata*) (P4). The Long-tailed Dunnart (P4) is widely distributed throughout the arid zone of Australia, specifically the Gibson Desert, West MacDonnell National Park, Murchison, Carnarvon Basin and the Pilbara. Its preferred habitat is rugged rocky landscapes that support a low open woodland or shrubland of *Acacia* spp., particularly Mulga, with an understorey of spinifex hummocks, perennial grasses and *Senna* spp.. The species has been caught in the Murchison bioregion at Mt Ida and Bottle Creek, although these specimens were approximately 200 km to the west of the GSGM. Three adult Long-tailed Dunnarts were caught in small rocky outcrops within approximately 3 km of the Proposed Clearing Permit Area (Terrestrial Ecosystems 2022) and a single individual was caught during a subsequent targeted survey. Suitable habitat for this species within Proposed Clearing Permit Area consists of 11.2 ha of small rocky outcrops of banded iron formation vegetated with open Mulga woodland. This species is considered Likely to occur in the Proposed Clearing Permit Area. Clearing of the 11.2 ha of small rocky outcrops of banded iron formation is unlikely to have a significant impact on this species, given its presence elsewhere in the Goldfields (Terrestrial Ecosystems 2022).

5.2 Fauna Habitat

The fauna habitat types recorded during the 2018 and 2022 surveys differed slightly in their descriptions; therefore, they were amalgamated to allow continuity in habitat mapping across the Proposed Clearing Permit Area (**Table 5-1**). A total of six broad fauna habitats were identified by Terrestrial Ecosystems (2022) (**Table 5-2; Figure 5-1**). Chenopod shrubland was the most widespread habitat type, occupying 36.7% (143.5 ha) of the Terrestrial Ecosystems (2022) survey area, followed by open Mulga woodland over scattered low shrubs and grasses with 29.1% (113.6 ha), Mulga and chenopod shrubland with 19.4% (75.9 ha), disturbed areas with 11.6% (45.2 ha), open Mulga woodland over scattered low shrubs and grasses on banded iron formation with 2.9% (11.2 ha), and samphire shrubland with 0.3% (1.0 ha).

The fauna habitat in the Proposed Clearing Permit Area is predominantly characterised by Mulga, varying in density across the area and typically sparse (Terrestrial Ecosystems 2022), with ephemeral waterways supporting denser vegetation. The fauna habitat condition within the Proposed Clearing Permit Area varied from Degraded to Good with the more degraded areas resulting from existing infrastructure development, historical exploration activity, and cattle grazing. Extensive evidence of rabbits and other feral fauna were recorded (Terrestrial Ecosystems 2022).

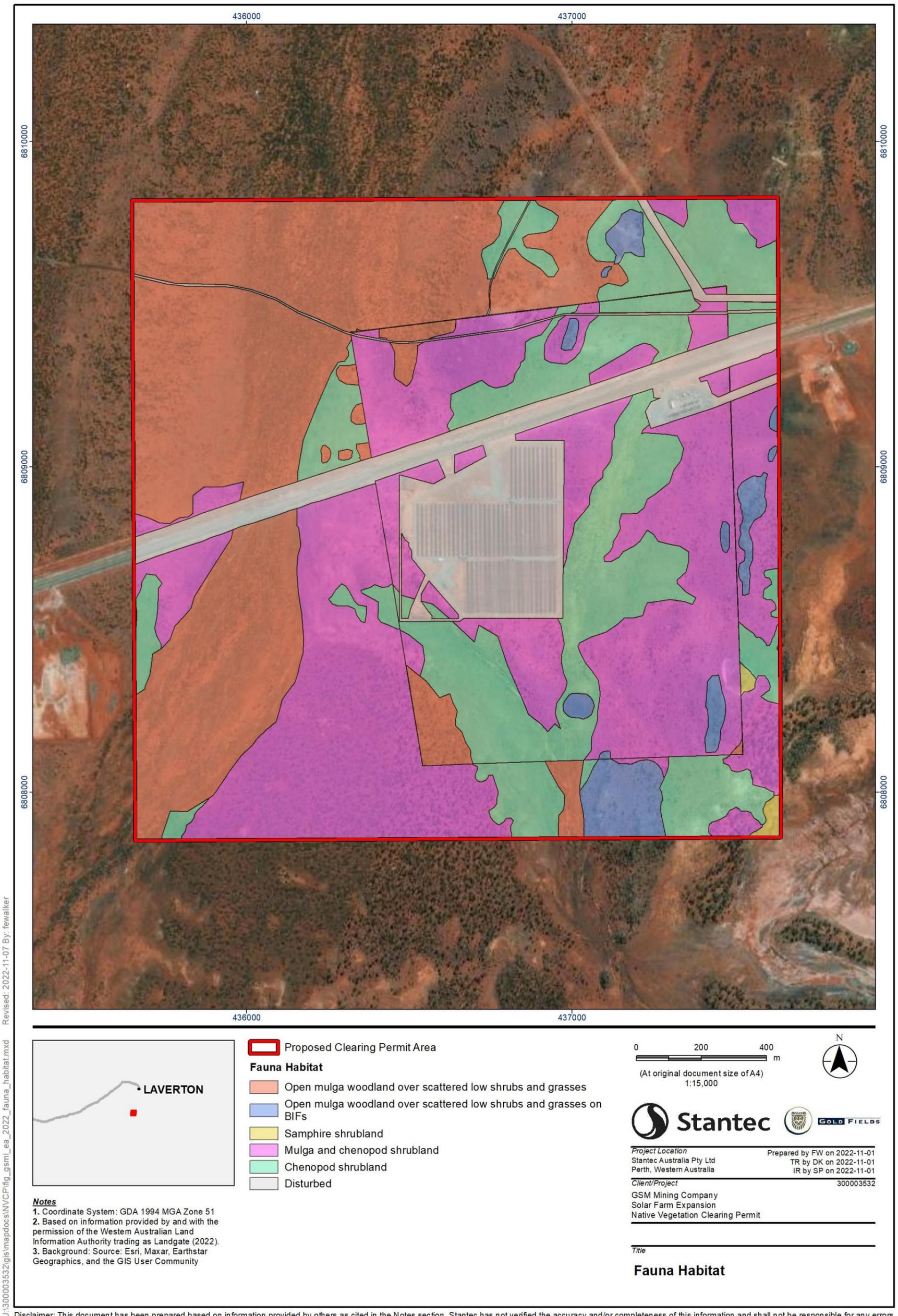
Table 5-1: Amalgamated fauna habitat descriptions within the Proposed Clearing Permit Area, 2018 and 2022.

Amalgamated Fauna Habitat Types	
Original Terrestrial Ecosystems (2018) Fauna Habitat Type Description	Amalgamated with Terrestrial Ecosystems (2022) Fauna Habitat Type Description
Samphire shrubland	Samphire shrubland
Chenopod and Mulga shrubland over scattered grasses of varying densities on a stony sandy-clay or sandy-clay substrate	Mulga and chenopod shrubland
Open Mulga woodland over scattered low shrubs and grasses of varying densities on a stony sandy-clay or sandy-clay substrate	Open Mulga woodland over scattered low shrubs and grasses
Open chenopod shrubland over grasses of varying densities on a stony sandy-clay or sandy-clay substrate	Chenopod shrubland
Banded iron formation rocky ridgeline with scattered Mulga and shrubs	Open Mulga woodland over scattered low shrubs and grasses on banded iron formation

Table 5-2: Fauna habitats recorded within the Proposed Clearing Permit Area.

Habitat Type	Proposed Clearing Permit Area Proportion		Value to Fauna
	ha	%	
Samphire shrubland	1	0.3	Widespread and well represented across the East Murchison subregion, and abundant in adjacent areas. Has been heavily grazed and is of limited significance to fauna.
Mulga and chenopod shrubland	75.9	19.4	
Open Mulga woodland over scattered low shrubs and grasses	113.6 *	29.1	
Chenopod shrubland	143.5	36.7	
Open Mulga woodland over scattered low shrubs and grasses on a banded iron formation	11.2	2.9	Not well represented across the East Murchison subregion, but abundant in adjacent areas. Likely habitat for the Long-tailed Dunnart (<i>Sminthopsis longicaudata</i>) (P4).
Disturbed areas	45.2	11.6	Cleared areas largely comprising bare open ground (e.g. tracks, roads) and existing solar farm infrastructure. Minimal vegetation and debris. This habitat lacks shelter and complexity and would provide minimal value to fauna.
Not mapped	0.3	0.1	Undetermined
Total	391.0 **	100	

Note: * indicates figure is exclusive of 6.6 ha "Open mulga woodland over scattered low shrubs and grasses" that overlapped with "Mulga and chenopod shrubland"; ** indicates figure is inclusive of 0.3 ha not mapped due to amalgamation of vegetation types.



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Notes
 1. Coordinate System: GDA 1994 MGA Zone 51
 2. Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2022).
 3. Background: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

- Proposed Clearing Permit Area
- Fauna Habitat**
- Open mulga woodland over scattered low shrubs and grasses
- Open mulga woodland over scattered low shrubs and grasses on BIFs
- Samphire shrubland
- Mulga and chenopod shrubland
- Chenopod shrubland
- Disturbed

0 200 400 m
 (At original document size of A4)
 1:15,000

Stantec

Project Location
 Stantec Australia Pty Ltd
 Perth, Western Australia

Prepared by FW on 2022-11-01
 TR by DK on 2022-11-01
 IR by SP on 2022-11-01

Client/Project
 GSM Mining Company
 Solar Farm Expansion
 Native Vegetation Clearing Permit

300003532

Title
Fauna Habitat

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

Figure 5-1: Fauna habitats within the Proposed Clearing Permit Area.



6 Environmental Management & Rehabilitation

GSM has considered the EPA's mitigation hierarchy (Environmental Protection Authority 2021) which is founded on a series of controls focussed on reducing adverse impacts to the surrounding environment and to the EPA's key environmental factors; avoid, minimise, rehabilitate, and offset. The key environmental factors include Flora and Vegetation, Terrestrial Fauna, and Social Surroundings. Mitigation approaches are detailed in subsequent sections; it is not anticipated that environmental offset will be required as part of the Solar Farm Expansion.

6.1 Avoid

The following mitigation approaches will be implemented to avoid impact to native vegetation as a result of clearing:

- Procedure for Granny Smith Surface Disturbance (GRA-ENV-PRD011) will be implemented to ensure all clearing works are compliant with regulatory requirements and are within the approved boundary.
- The area to be cleared shall be clearly demarcated and machinery operators made aware of the operational boundary, following confirmation with the relevant manager.

6.2 Minimise

The following mitigation approaches will be implemented to minimise impact to native vegetation as a result of clearing.

6.2.1 Land Clearing & Flora Management

- Adhere to relevant construction and/or operational environmental management plans with respect to clearing native vegetation.
- Clearing awareness training undertaken by all personnel involved in clearing activities.
- Vegetation clearing shall be kept to the minimum amount required, as far as practicable.

6.2.2 Weed Management

- Site Disturbance Permit and Land Clearing Procedure will be implemented to ensure all clearing works are compliant with regulatory requirements and are within approved boundary.
- Weed Management Plan (GRA-ENV-PL024) will be implemented to control access and movement of vehicles and construction personnel to prevent the introduction and spread of weeds into the Proposed Clearing Permit Area, weed-free areas, and between work areas.
- Vehicles with ground engaging equipment are to be cleaned, inspected, and issued with a Weed Hygiene Certificate prior to entry to site or moving between areas on-site.
- Vehicles and equipment shall be restricted to designated roads and tracks.
- Weed awareness and weed hygiene training shall be delivered to all personnel as part of the induction process.
- Regular inspection and maintenance of vehicles and equipment shall be undertaken.
- Restrict movement of topsoil at known weed locations.
- Ensure timely response for the management of any declared weed occurrences or other weed infestations occurs.
- Seasonal weed control programs shall be implemented, including herbicide spraying or physical removal.

6.2.3 Fauna

- Clearing awareness training is to be undertaken by all personnel involved in clearing activities, including specific information on significant flora within the Proposed Clearing Permit Area, the requirements for clearing, and the Site Disturbance Permit and Land Clearing Procedure processes.
- Vegetation clearing shall be kept to the minimum amount required, as far as practicable.
- Clearing extents and approved ground disturbance areas shall be pegged by qualified surveyors in the field prior to ground disturbance commencing.
- In unpegged areas, the use of GPS-guided machinery shall be used, provided the appropriate Site Disturbance Permit and Land Clearing Procedure processes have been followed.
- Vehicles and equipment shall be restricted to designated roads and tracks.
- Machinery and vehicle movements should be restricted during construction to minimise the potential for vehicle strikes, where practicable.

- Machinery and vehicle movements that must be undertaken between dusk and dawn should be limited to low speeds on access tracks.

6.2.4 Dust Deposition on Vegetation

- Dust Control Management Plan (GRA-ENV-PL017) will be implemented during land clearing activities to reduce impacts to surrounding fauna and vegetation from dust.
- Vehicles and equipment shall be restricted to designated roads and tracks.
- Dust suppression shall be implemented to manage dust emissions on cleared areas.
- Speed limits shall apply on site.
- Ground clearing (including topsoil stripping) shall not be undertaken during periods of high wind.

6.2.5 Water Management

- Where possible, clearing will be undertaken in the dry season to prevent contamination of surface water.
- Where possible, progressive land clearing will be undertaken to limit land exposure and reduce erosion.
- Correct placement of containment bunds on the downstream side of topsoil stockpiles will ensure that sediment runoff from these areas does not significantly increase for the duration of operations, and that any topsoil eroded during rainfall events is not lost in runoff.
- Suitable drainage features will be incorporated into the design to manage surface water runoff.
- Management of hydrocarbons and spills is detailed in Section 6.2.6.

6.2.6 Hydrocarbon Management

- Hydrocarbons will be managed in accordance with legislation, regulations, guidance materials, and licences.
- Disposal of hydrocarbons will be undertaken in accordance with existing systems, including waste oil separation and storage facilities in maintenance workshops.
- Storage and handling of hydrocarbons and wastes will comply with all relevant local and state regulations, including the Dangerous Goods Safety (Storage and Handling of Non-explosives) Regulations 2007, the Environmental Protection (Controlled Waste) Regulations 2004, and AS 1940:2017: The storage and handling of flammable and combustible liquids.
- Procedure for Hydrocarbon and Chemical Management at Granny Smith (GRA-ENV-PRD018) will be implemented to manage spills or leaks of hydrocarbons, including secondary containment.
- Hazardous Substances Management Plan GSM (GRA-OHS-PL012) will be implemented to manage chemicals, including containment in bunding, storage in double skinned tanks, and maintenance of spill protection equipment.
- Procedure for Hydrocarbon and Chemical Management at Granny Smith (GRA-ENV-PRD018) will be implemented to manage hydrocarbon spills, including immediate bunding to prevent spread, and removal of hydrocarbon contaminated material for processing at the bioremediation facility.

6.3 Rehabilitate

The following mitigation approaches will be implemented to rehabilitate any impact to native vegetation as a result of clearing:

- Adhere to *Mine Closure Plan: December 2022 – Granny Smith Gold Mine S0002288* (GSM Mining Company Pty Ltd 2015a) which states that, at closure, existing infrastructure will be decommissioned and disturbed areas will be revegetated.
- Salvage and stockpile soil and/or habitat features (e.g. vegetation, stumps, logs, boulders) during clearing for use in rehabilitation programs.
- De-energise, dismantle, and remove all infrastructure including all solar array panels.
- Sell, or transport off-site, switchgear and battery storage.
- Remove all powerlines and cut power poles to ground level, roll wiring, and transport all components off site.
- Disturbed ground shall be contour ripped, spread with topsoil (minimum of 100 mm deep), and revegetated with indigenous flora species to reflect the floristics of the local vegetation type.
- Develop and implement an appropriate rehabilitation plan (including components such as surface treatments; seed selection, collection, storage and management).



- Undertake progressive rehabilitation as far as practicable.
- Commence rehabilitation activities soon as practicable following closure.

7 Environmental Assessment

7.1 Assessment Against the 10 Clearing Principles

An assessment against *Schedule 5 Principles for clearing native vegetation* of the EP Act (10 clearing principles) was undertaken and a precautionary approach was applied, which assumed that all habitats within the Proposed Clearing Permit Area have an equal likelihood of being cleared. Based on this assumption, the proposed Solar Farm Expansion is not at variance to clearing principles (a), (b), (c), (d), (e), (f), (g), (h), (i) and (j). The assessment was made using information obtained from existing surveys and reports completed by Native Vegetation Solutions (2018;2022) and Terrestrial Ecosystems (2018;2022).

Table 7-1: Assessment of proposed clearing of native vegetation within the Proposed Clearing Permit Area against the 10 clearing principles.

Clearing Principle	Assessment	Mitigation Approach	Outcome
<p>Principle (a) Native vegetation should not be cleared if it comprises a high level of biological diversity.</p>	<p>Flora and Vegetation:</p> <ul style="list-style-type: none"> A total of 66 flora taxa from 20 families were recorded within the Native Vegetation Solutions (2018) study area, and 89 flora taxa from 19 families were recorded within the Native Vegetation Solutions (2022) study area, both located within the central portion of the Proposed Clearing Permit Area. The findings from both surveys were consistent with what would be expected to occur within the Murchison bioregion, considering the landforms present, the field survey season, and the sampling intensity. No Declared Pests or WoNS were recorded from the Proposed Clearing Permit Area. Eight broad vegetation types were identified within the Proposed Clearing Permit Area (Native Vegetation Solutions 2022), none of which were considered analogous to any Priority ecological community (PEC) or Threatened ecological community (TEC) listed under the BC Act or EPBC Act. No unique or restricted vegetation communities were identified. All vegetation types were considered to be common or widespread within the East Murchison subregion. The database searches undertaken by Native Vegetation Solutions (2022) indicated that six taxa of significance occur to within 20 km of the Proposed Clearing Permit Area, comprising one P1 taxa and five P3 taxa; however, neither of the Native Vegetation Solutions (2018;2022) surveys recorded Threatened or Priority flora taxa within the Proposed Clearing Permit Area. While the flora of the local area is relatively diversity, the Proposed Clearing Permit Area is not considered to have a high level of biological diversity. <p>Terrestrial Fauna:</p> <ul style="list-style-type: none"> The 2011 survey summarised in Terrestrial Ecosystems (2022) documented a terrestrial fauna assemblage comparable to that recorded in other areas of open Mulga woodland in the East Murchison subregion. Terrestrial Ecosystems (2022) also identified 13 significant species with the potential to occur within, or adjacent to, the Proposed Clearing Permit Area; however, the majority were considered Unlikely to occur. The avifauna survey recorded 820 individuals from 60 species across 70 survey sites and an additional 495 opportunistic observations. No Malleefowl nests or tracks were observed. Four species of bat were recorded during the 2011 survey; Gould's Wattled Bat, Inland Free-tailed Bat, Inland Broad-nosed Bat, and Finlayson's Cave Bat, all commonly recorded throughout the Murchison bioregion. The capture of three Long-tailed Dunnart (P4) individuals was unexpected given the previous nearest known record at the time was 200 km southeast of the Proposed Clearing Permit Area. Subsequently, the Long-tailed Dunnart (P4) has been recorded at several banded iron formations in the East Murchison subregion (Terrestrial Ecosystems 2022), as well as adjacent to the Proposed Clearing Permit Area during a subsequent targeted survey (Terrestrial Ecosystems 2022). As a result, it was considered Likely that the Long-tailed Dunnart (P4) could occur within the Proposed Clearing Permit Area. It is unlikely that clearing of vegetation will have significant impact on the Long-tailed Dunnart (P4) when considered in a bioregional context, due to the availability of similar open Mulga woodland and banded iron formation habitat throughout the Murchison bioregion (Terrestrial Ecosystems 2022). Further, the Long-tailed Dunnart (P4) has been caught in the Murchison bioregion at Mt Ida and Bottle Creek, although these specimens were approximately 200 km to the west of the GSGM. While the fauna of the local area is moderately diversity, the Proposed Clearing Permit Area is not considered to have a high level of biological diversity. 	<p>Avoid:</p> <ul style="list-style-type: none"> Procedure for Granny Smith Surface Disturbance (GRA-ENV-PRD011) will be implemented to ensure all clearing works are compliant with regulatory requirements and are within the approved boundary. The area to be cleared shall be clearly demarcated and machinery operators made aware of the operational boundary, following confirmation with the relevant manager. <p>Minimise:</p> <ul style="list-style-type: none"> Adhere to relevant construction and/or operational environmental management plans with respect to clearing native vegetation. Clearing awareness training undertaken by all personnel involved in clearing activities. Vegetation clearing shall be kept to the minimum amount required, as far as practicable. Site Disturbance Permit and Land Clearing Procedure will be implemented to ensure all clearing works are compliant with regulatory requirements and are within approved boundary. Weed Management Plan (GRA-ENV-PL024) will be implemented to control access and movement of vehicles and construction personnel to prevent the introduction and spread of weeds into the Proposed Clearing Permit Area, weed-free areas, and between work areas. Vehicles with ground engaging equipment are to be cleaned, inspected, and issued with a Weed Hygiene Certificate prior to entry to site or moving between areas on-site. Vehicles and equipment shall be restricted to designated roads and tracks. Weed awareness and weed hygiene training shall be delivered to all personnel as part of the induction process. Ensure timely response for the management of any declared weed occurrences or other weed infestations occurs. Seasonal weed control programs shall be implemented, including herbicide spraying or physical removal. Clearing awareness training is to be undertaken by all personnel involved in clearing activities, including specific information on significant flora within the Proposed Clearing Permit Area, the requirements for clearing, and the Site Disturbance Permit and Land Clearing Procedure processes. Clearing extents and approved ground disturbance areas shall be pegged by qualified surveyors in the field prior to ground disturbance commencing. In unpegged areas, the use of GPS guided machinery shall be used, provided the appropriate Site Disturbance Permit and Land Clearing Procedure processes have been followed. Dust Control Management Plan (GRA-ENV-PL017) will be implemented during land clearing activities to reduce impacts to surrounding fauna and vegetation from dust. Dust suppression shall be implemented to manage dust emissions on cleared areas. Ground clearing (including topsoil stripping) shall not be undertaken during periods of high wind. <p>Rehabilitate:</p> <ul style="list-style-type: none"> Adherence with Mine Closure Plan: December 2022 - Granny Smith Gold Mine S0002288 (GSM Mining Company Pty Ltd 2015a) which states that, at closure, existing infrastructure will be decommissioned and disturbed areas will be revegetated. Salvage and stockpile soil and/or habitat features (e.g. vegetation, stumps, logs, boulders) during clearing for use in rehabilitation programs. Disturbed ground shall be contour ripped, spread with topsoil (minimum of 100 mm deep), and revegetated with indigenous flora species to reflect the floristics of the local vegetation type. Develop and implement an appropriate rehabilitation plan (including components such as surface treatments; seed selection, collection, storage and management). Undertake progressive rehabilitation as far as practicable. Commence rehabilitation activities soon as practicable following closure. 	<p>The proposed clearing is not at variance with this principle.</p>

Clearing Principle	Assessment	Mitigation Approach	Outcome
<p>Principle (b) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna.</p>	<ul style="list-style-type: none"> Eight broad vegetation types were identified within the Proposed Clearing Permit Area (Native Vegetation Solutions 2022), none of which were considered analogous to any Priority ecological community (PEC) or Threatened ecological community (TEC) listed under the BC Act or EPBC Act. No unique or restricted vegetation communities were identified. All vegetation types were considered to be common or widespread within the East Murchison subregion. The 2011 survey summarised in Terrestrial Ecosystems (2022) documented a terrestrial fauna assemblage comparable to that recorded in other areas of open Mulga woodland in the East Murchison subregion. Terrestrial Ecosystems (2022) also identified 13 significant species with the potential to occur within, or adjacent to, the Proposed Clearing Permit Area; however, the majority were considered Unlikely to occur. The capture of three Long-tailed Dunnart (P4) individuals was unexpected given the previous nearest known record at the time was 200 km southeast of the Proposed Clearing Permit Area. Subsequently, the Long-tailed Dunnart (P4) has been recorded at several banded iron formations in the East Murchison subregion (Terrestrial Ecosystems 2022), as well as adjacent to the Proposed Clearing Permit Area during a subsequent targeted survey (Terrestrial Ecosystems 2022). As a result, it was considered Likely that the Long-tailed Dunnart (P4) could occur within the Proposed Clearing Permit Area. It is unlikely that clearing of vegetation will have significant impact on the Long-tailed Dunnart (P4) due to the availability of similar open Mulga woodland and banded iron formation habitat throughout the Murchison bioregion (Terrestrial Ecosystems 2022). It is unlikely that clearing of vegetation will fragment, restrict or isolate potential populations of the Long-tailed Dunnart (P4) within the Proposed Clearing Permit Area. 	<p>Avoid:</p> <ul style="list-style-type: none"> Procedure for Granny Smith Surface Disturbance (GRA-ENV-PRD011) will be implemented to ensure all clearing works are compliant with regulatory requirements and are within the approved boundary. The area to be cleared shall be clearly demarcated and machinery operators made aware of the operational boundary, following confirmation with the relevant manager. <p>Minimise:</p> <ul style="list-style-type: none"> Adhere to relevant construction and/or operational environmental management plans with respect to clearing native vegetation. Clearing awareness training undertaken by all personnel involved in clearing activities. Vegetation clearing shall be kept to the minimum amount required, as far as practicable. Site Disturbance Permit and Land Clearing Procedure will be implemented to ensure all clearing works are compliant with regulatory requirements and are within approved boundary. Clearing extents and approved ground disturbance areas shall be pegged by qualified surveyors in the field prior to ground disturbance commencing. In unpegged areas, the use of GPS guided machinery shall be used, provided the appropriate Site Disturbance Permit and Land Clearing Procedure processes have been followed. Vehicles and equipment shall be restricted to designated roads and tracks. <p>Rehabilitate:</p> <ul style="list-style-type: none"> Adherence with Mine Closure Plan: December 2022 - Granny Smith Gold Mine S0002288 (GSM Mining Company Pty Ltd 2015a) which states that, at closure, existing infrastructure will be decommissioned and disturbed areas will be revegetated. Salvage and stockpile soil and/or habitat features (e.g. vegetation, stumps, logs, boulders) during clearing for use in rehabilitation programs. Disturbed ground shall be contour ripped, spread with topsoil (minimum of 100 mm deep), and revegetated with indigenous flora species to reflect the floristics of the local vegetation type. Develop and implement an appropriate rehabilitation plan (including components such as surface treatments; seed selection, collection, storage and management). Undertake progressive rehabilitation as far as practicable. Commence rehabilitation activities soon as practicable following closure. 	<p>The proposed clearing is not at variance with this principle.</p>
<p>Principle (c) Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, threatened flora.</p>	<ul style="list-style-type: none"> The database searches undertaken by Native Vegetation Solutions (2022) indicated that six taxa of significance occur to within 20 km of the Proposed Clearing Permit Area, comprising one P1 taxa and five P3 taxa; however, neither of the Native Vegetation Solutions (2018;2022) surveys recorded Threatened or Priority flora taxa within the Proposed Clearing Permit Area. 	<p>Based on the assessment no mitigation approaches are proposed.</p>	<p>The proposed clearing is not at variance with this principle.</p>
<p>Principle (d) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a threatened ecological community.</p>	<ul style="list-style-type: none"> Eight broad vegetation types were identified within the Proposed Clearing Permit Area (Native Vegetation Solutions 2022), none of which were considered analogous to any PEC or TEC listed under the BC Act or EPBC Act. No unique or restricted vegetation communities were identified. All vegetation types were considered to be common or widespread within the East Murchison subregion. 	<p>Based on the assessment no mitigation approaches are proposed.</p>	<p>The proposed clearing is not at variance with this principle.</p>
<p>Principle (e) Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.</p>	<ul style="list-style-type: none"> One vegetation association intersects the Proposed Clearing Permit Area; the Laverton vegetation association, and the current remaining extent of the Laverton vegetation association exceeds 99%, substantially above the 30% threshold for protection of species diversity at an ecosystem level. 	<p>Avoid:</p> <ul style="list-style-type: none"> Procedure for Granny Smith Surface Disturbance (GRA-ENV-PRD011) will be implemented to ensure all clearing works are compliant with regulatory requirements and are within the approved boundary. The area to be cleared shall be clearly demarcated and machinery operators made aware of the operational boundary, following confirmation with the relevant manager. <p>Minimise:</p> <ul style="list-style-type: none"> Adhere to relevant construction and/or operational environmental management plans with respect to clearing native vegetation. Clearing awareness training undertaken by all personnel involved in clearing activities. Vegetation clearing shall be kept to the minimum amount required, as far as practicable. 	<p>The proposed clearing is not at variance with this principle.</p>

Clearing Principle	Assessment	Mitigation Approach	Outcome
		Rehabilitate <ul style="list-style-type: none"> Adhere to Mine Closure Plan: December–2022 - Granny Smith Gold Mine S0002288 (GSM Mining Company Pty Ltd 2015a). Salvage and stockpile soil and/or habitat features (e.g. vegetation, stumps, logs, boulders) during clearing for use in rehabilitation programs. Disturbed ground shall be contour ripped, spread with topsoil (minimum of 100 mm deep), and revegetated with indigenous flora species to reflect the floristics of the local vegetation type. Develop and implement an appropriate rehabilitation plan (including components such as surface treatments; seed selection, collection, storage and management). Commence rehabilitation activities soon as practicable following closure. 	
Principle (f) Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.	<ul style="list-style-type: none"> Several minor waterways are located within, or adjacent to, the Proposed Clearing Permit Area; however, surface water flow is ephemeral in the local area, occurring only after substantial rainfall events, and associated vegetation is not considered to be riparian. The closest waterbody to the Proposed Clearing Permit Area is Lake Carey, an ephemeral salt lake, located approximately 2 km to the southwest of the Proposed Clearing Permit Area. No semi-permanent or permanent surface water (waterway or wetland) or associated riparian vegetation occurs within the Proposed Clearing Permit Area. 	Minimise: <ul style="list-style-type: none"> Where possible, clearing will be undertaken in the dry season to prevent contamination of surface water. Where possible, progressive land clearing will be undertaken to limit land exposure and reduce erosion. Correct placement of containment bunds on the downstream side of topsoil stockpiles will ensure that sediment runoff from these areas does not significantly increase for the duration of operations, and that any topsoil eroded during rainfall events is not lost in runoff. Suitable drainage features will be incorporated into the design to manage surface water runoff. Rehabilitate: <ul style="list-style-type: none"> Adhere to Mine Closure Plan: December–2022 - Granny Smith Gold Mine S0002288 (GSM Mining Company Pty Ltd 2015a). Undertake progressive rehabilitation as far as practicable. Commence rehabilitation activities soon as practicable following closure. 	The proposed clearing is not at variance with this principle.
Principle (g) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.	<ul style="list-style-type: none"> The Proposed Clearing Permit Area lies within an area classified as 'Poor', attributed to the Yilgarn Plateau Province being vulnerable to wind erosion due to low ground cover and erodible soils (Geoscience Australia 2021). Poor soil erosion grading of the province is likely attributed to agriculture and grazing activities that dominate the region. The Proposed Clearing Permit Area is already subject to degradation as a result of construction of the existing HPS and proximity to existing infrastructure and access/haul roads. The Proposed Clearing Permit Area does not occur within a known acid sulphate soils risk area. 	Avoid: <ul style="list-style-type: none"> Procedure for Granny Smith Surface Disturbance (GRA-ENV-PRD011) will be implemented to ensure all clearing works are compliant with regulatory requirements and are within the approved boundary. The area to be cleared shall be clearly demarcated and machinery operators made aware of the operational boundary, following confirmation with the relevant manager. Minimise: <ul style="list-style-type: none"> Adhere to relevant construction and/or operational environmental management plans with respect to clearing native vegetation. Clearing awareness training undertaken by all personnel involved in clearing activities. Vegetation clearing shall be kept to the minimum amount required, as far as practicable. Where possible, progressive land clearing will be undertaken to limit land exposure and reduce erosion. Correct placement of containment bunds on the downstream side of topsoil stockpiles will ensure that sediment runoff from these areas does not significantly increase for the duration of operations, and that any topsoil eroded during rainfall events is not lost in runoff. Suitable drainage features will be incorporated into the design to manage surface water runoff. Rehabilitate: <ul style="list-style-type: none"> Adhere to Mine Closure Plan: December–2022 - Granny Smith Gold Mine S0002288 (GSM Mining Company Pty Ltd 2015a). Disturbed ground shall be contour ripped, spread with topsoil (minimum of 100 mm deep), and revegetated with indigenous flora species to reflect the floristics of the local vegetation type. Undertake progressive rehabilitation as far as practicable. Commence rehabilitation activities soon as practicable following closure. 	The proposed clearing is not at variance with this principle.

Clearing Principle	Assessment	Mitigation Approach	Outcome
<p>Principle (h) Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.</p>	<ul style="list-style-type: none"> The Proposed Clearing Permit Area does not intersect with an ESA or any conservation reserve and there is no connectivity between the Proposed Clearing Permit Area and any areas of high conservation value. 	<p>Based on the assessment no mitigation approaches are proposed.</p>	<p>The proposed clearing is not at variance with this principle.</p>
<p>Principle (i) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.</p>	<ul style="list-style-type: none"> Several minor waterways are located within, or adjacent to, the Proposed Clearing Permit Area; however, surface water flow is ephemeral in the local area, occurring only after substantial rainfall events, predominately via shallow, low velocity sheet flow (AECOM 2018). Therefore, it is unlikely that surface water quality will be affected as a result of clearing of vegetation. The closest waterbody to the Proposed Clearing Permit Area is Lake Carey, an ephemeral salt lake, located approximately 2 km to the southwest of the Proposed Clearing Permit Area. The closest PDWSA is the Priority 1 Laverton PDWSA, located approximately 30 km from the Proposed Clearing Permit Area. The closest groundwater resource to the Proposed Clearing Permit Area is the Mt Weld Carbonatite aquifer. Clearing of vegetation is unlikely to interact with local aquifers. 	<p>Avoid:</p> <ul style="list-style-type: none"> Procedure for Granny Smith Surface Disturbance (GRA-ENV-PRD011) will be implemented to ensure all clearing works are compliant with regulatory requirements and are within the approved boundary. The area to be cleared shall be clearly demarcated and machinery operators made aware of the operational boundary, following confirmation with the relevant manager. <p>Minimise:</p> <ul style="list-style-type: none"> Adhere to relevant construction and/or operational environmental management plans with respect to clearing native vegetation. Clearing awareness training undertaken by all personnel involved in clearing activities. Vegetation clearing shall be kept to the minimum amount required, as far as practicable. Where possible, clearing will be undertaken in the dry season to prevent contamination of surface water. Where possible, progressive land clearing will be undertaken to limit land exposure and reduce erosion. Correct placement of containment bunds on the downstream side of topsoil stockpiles will ensure that sediment runoff from these areas does not significantly increase for the duration of operations, and that any topsoil eroded during rainfall events is not lost in runoff. Suitable drainage features will be incorporated into the design to manage surface water runoff. <p>Rehabilitate:</p> <ul style="list-style-type: none"> Adhere to Mine Closure Plan: December–2022 - Granny Smith Gold Mine S0002288 (GSM Mining Company Pty Ltd 2015a). Undertake progressive rehabilitation as far as practicable. Commence rehabilitation activities soon as practicable following closure. 	<p>The proposed clearing is not at variance with this principle.</p>
<p>Principle (j) Native vegetation should not be cleared if the clearing the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding.</p>	<ul style="list-style-type: none"> Several minor waterways are located within, or adjacent to, the Proposed Clearing Permit Area; however, surface water flow is ephemeral in the local area, occurring only after substantial rainfall events, predominately via shallow, low velocity sheet flow (AECOM 2018). The closest waterbody to the Proposed Clearing Permit Area is Lake Carey, an ephemeral salt lake, located approximately 2 km to the southwest of the Proposed Clearing Permit Area. The natural topography of the region, and in the vicinity of the Proposed Clearing Permit Area, is flat to gently undulating. Clearing of vegetation has the potential to cause/exacerbate the incidence/intensity of flooding by removing resistance of the landscape to sheet flow; however, the ephemeral nature of surface water flow in the local area means that changes in the hydrological regime are likely to be infrequent. 	<p>Avoid:</p> <ul style="list-style-type: none"> Procedure for Granny Smith Surface Disturbance (GRA-ENV-PRD011) will be implemented to ensure all clearing works are compliant with regulatory requirements and are within the approved boundary. The area to be cleared shall be clearly demarcated and machinery operators made aware of the operational boundary, following confirmation with the relevant manager. <p>Minimise:</p> <ul style="list-style-type: none"> Adhere to relevant construction and/or operational environmental management plans with respect to clearing native vegetation. Vegetation clearing shall be kept to the minimum amount required, as far as practicable. Where possible, clearing will be undertaken in the dry season to prevent contamination of surface water. Where possible, progressive land clearing will be undertaken to limit land exposure and reduce erosion. Suitable drainage features will be incorporated into the design to manage surface water runoff. <p>Rehabilitate:</p> <ul style="list-style-type: none"> Adhere to Mine Closure Plan: December–2022 - Granny Smith Gold Mine S0002288 (GSM Mining Company Pty Ltd 2015a). Undertake progressive rehabilitation as far as practicable. Commence rehabilitation activities soon as practicable following closure. 	<p>The proposed clearing is not at variance with this principle.</p>

8 Stakeholder Consultation

GSM is committed to ongoing stakeholder communication, engagement and consultation through the planning and environmental approvals phases, as well as the construction and operation phases of the Solar Farm Expansion. Key stakeholders have been outlined in **Table 8-1**. As part of GSM's continual inclusion of indigenous communities in the planning process, Traditional Owners from the Nyalpa Pirniku Group were consulted, and participated in the anthropology and ethnographic heritage surveys.

Table 8-1: Project stakeholders.

Group	Stakeholder
State Government Agencies	Environmental Protection Authority (EPA)
Native Title Groups	Wongatha People of the Nyalpa Pirniku Group

9 References

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Appendices

We design with community in mind



Appendix A Native Vegetation Solutions (2018)





Reconnaissance
Flora and Vegetation Survey of the
Proposed GSM Solar Farm- October
2018
(L38/88, L38/326, M38/397, M38/691 &
M38/849)

Prepared for



GOLD FIELDS

GSM Mining Company Pty Ltd

FINAL V2.0
January 2019

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1 INTRODUCTION

Gold Fields Limited, via its subsidiary GSM Mining Company Pty Ltd (GSM), are proposing to construct a Solar Farm at the Granny Smith Mine, just south of the Wallaby Haul Road. The Solar Farm will produce electricity to supplement existing power supplies to the mine site.

A survey area was provided by GSM to Native Vegetation Solutions (NVS) and is located approximately 24km south of Laverton in the Murchison Bioregion of Western Australia (Figure 1). The total survey area received from GSM covers approximately 150.05 ha, and lies south of the Wallaby Haul Road, 6.5km southwest of the Granny Smith Mill, and adjacent to the existing gas power station. This report describes the results of a reconnaissance flora and vegetation survey conducted within the survey area, which will be utilised for future mining proposals and clearing permit applications.

The survey area is shown in Figures 1 & 2 and Appendix 4.



Figure 1: Regional map of survey location

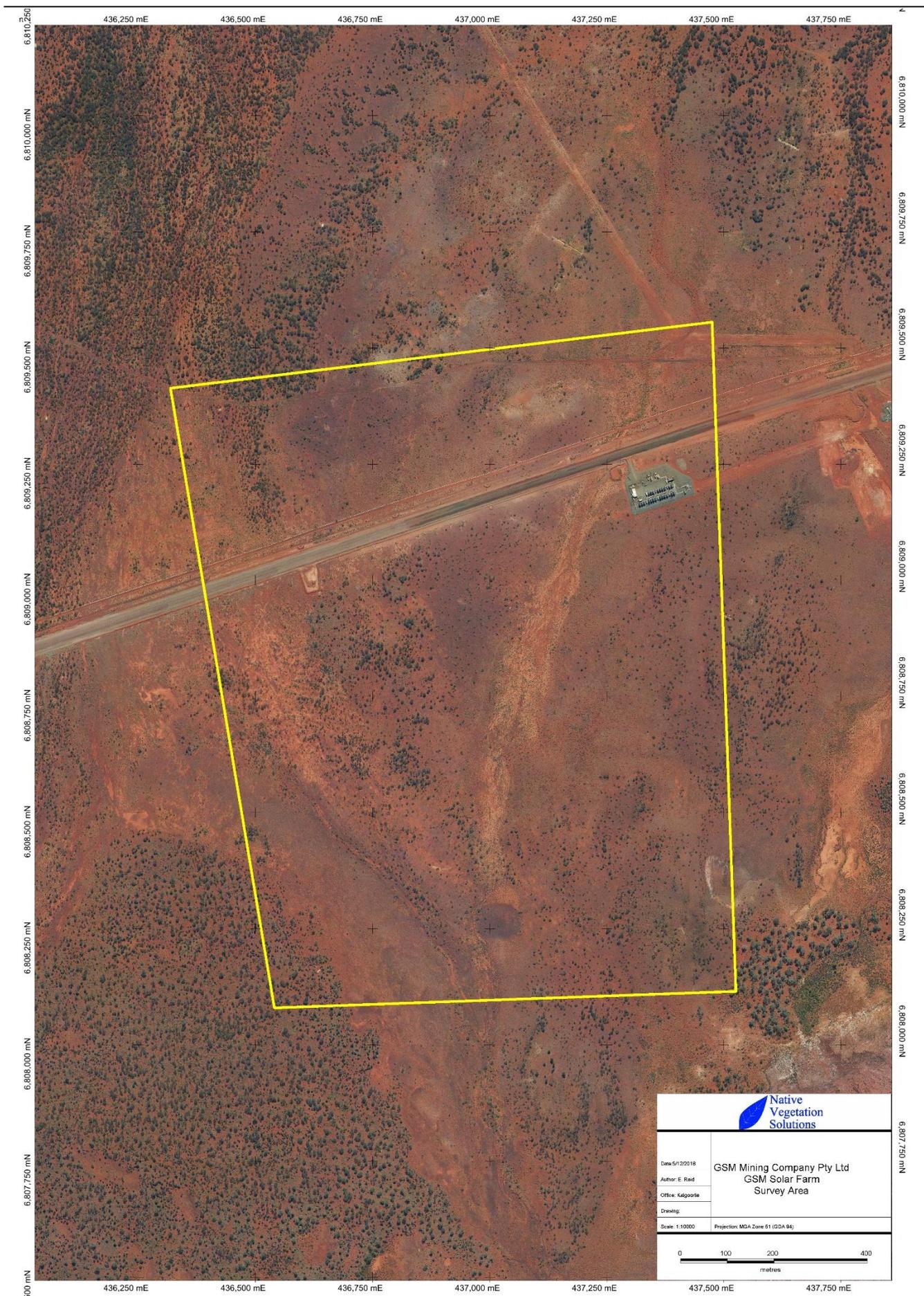


Figure 2: Survey Area

1.1 Objectives

The objective of this report is to document the results of the flora and vegetation component of a reconnaissance assessment conducted in accordance with:

- *Environmental Factor Guideline- Flora and Vegetation* (EPA, 2016); and
- *Technical Guidance- Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA, 2016a).

A reconnaissance assessment has two components:

- 1). Desktop study which includes a literature review and a search of the relevant databases;
- 2). Reconnaissance survey of the survey area to verify the desktop survey, to define vegetation groups present in the area, search for species of conservation significance and to determine potential sensitivity to impact.

As part of the reporting for the reconnaissance assessment, NVS has conducted a Flora and Vegetation Survey which includes broad-scale vegetation mapping and vegetation condition mapping of the survey area.

The scope of work for the Reconnaissance flora and vegetation survey was:

- conduct a desktop study that includes a literature review and search of the relevant databases;
- describe the vegetation associations in the survey area;
- prepare an inventory of species occurring in the survey area;
- identify any vegetation communities or flora species of conservation significance;
- Map broad-scale vegetation groups found within the survey area, including vegetation condition; and
- provide recommendations, including the management of perceived impacts to flora and vegetation within the survey area.

1.2 Geology and Vegetation

According to the Interim Biogeographic Regionalisation of Australia (IBRA, 2018), the survey area lies in the Murchison (MUR) bioregion within the Eastern Murchison (MUR01) subregion which totals over 7.8 million hectares (CALM, 2002). The MUR01 subregion is characterised by its internal drainage, and extensive areas of elevated red desert sandplains with minimal dune development. Salt lake systems are associated with the occluded Paleodrainage system and broad plains of red-brown soils and breakaway complexes as well as red sandplains are also common. Vegetation is dominated by Mulga Woodlands often rich in ephemerals; hummock grasslands, saltbush shrublands and *Tecticornia* shrublands. (CALM, 2002).

1.3 Climate

The subregional climate is Arid with mainly winter rainfall of 200mm annually (CALM, 2002).

The nearest official meteorological weather station with the most complete and up to date information is Laverton Aero weather station, which is located approximately 26 km north-northeast of the survey area. Recordings of the local climatic conditions commenced at Laverton Aero in 1991 (BOM, 2018) and data collected at this station 012305 was used for this report.

1.3.1 Temperature

Mean annual minimum temperature at Laverton is 13.9°C and mean annual maximum temperature is 27.1°C. The coldest temperatures occur in July (mean minimum temperature 5.9°C), the hottest is January (mean maximum temperature 35.5°C) and diurnal temperature variations are relatively consistent throughout the year (Figure 3).

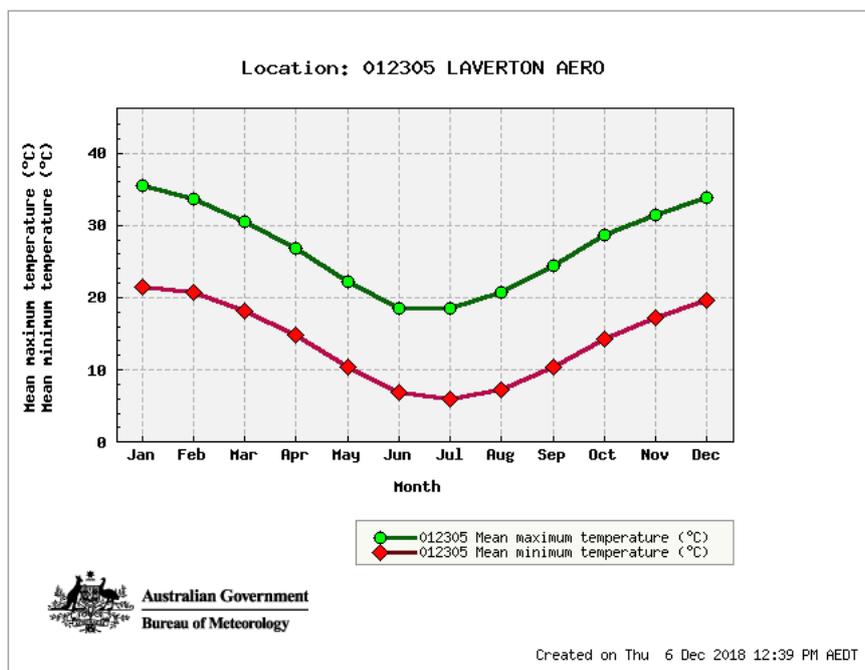
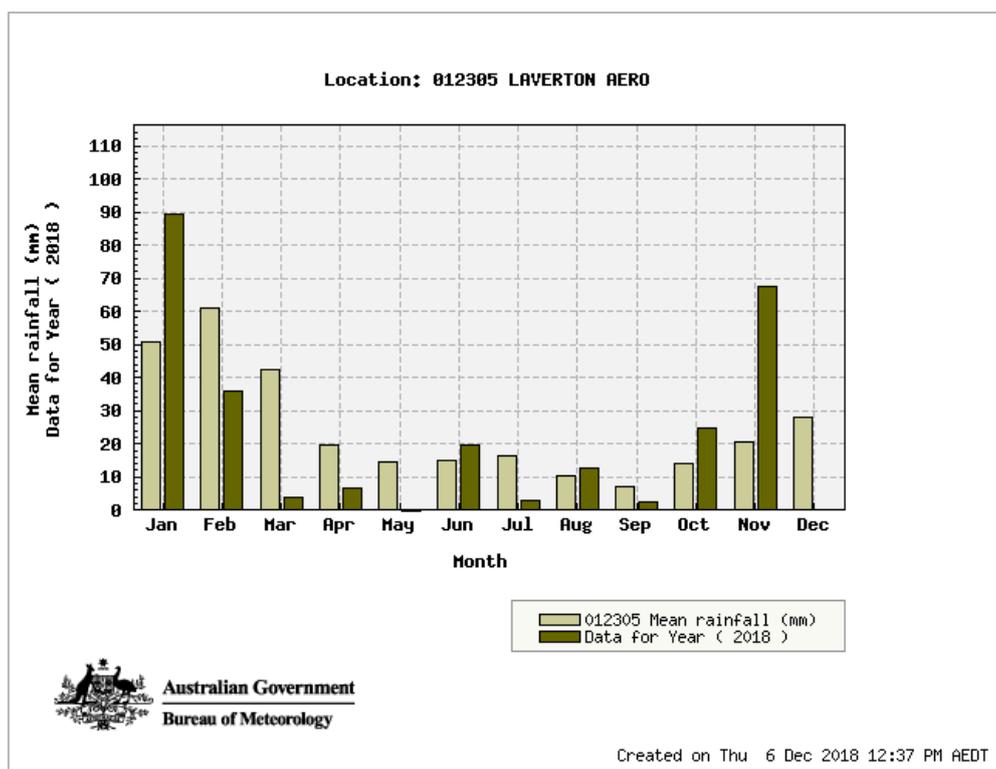


Figure 3: Mean temperature ranges for Laverton Aero weather station

1.3.2 Rainfall

The annual average rainfall at Laverton Aero is 301.2mm over an average 36.6 rain days (BOM, 2018). Average rainfall varies across the months, with slightly larger rainfall events falling between November and March (Figure 4), and the least average rainfall received in September. Rainfall in 2018 almost doubled the mean monthly rainfall in January and more than tripled November's monthly average. June, August and October also received above average rainfall, however monthly rainfall was lower than mean monthly rainfall for the remaining months, (excluding incomplete data for December) as depicted in Figure 4 below (BOM, 2018).



2. ASSESSMENT METHODOLOGY

2.1 Personnel and Reporting

The following personnel were involved in the Level 1 flora and vegetation survey:

- Mr Eren Reid (*BSc- Biological Science*), Principal Botanist, Native Vegetation Solutions, undertook the survey, vegetation mapping, data collation, field identification of flora, preparation and review of the report.
- Mr Frank Obbens (*BSc*), Consultant Botanist, Bushtech Consultancy, undertook identification of unknown plant taxa collected in the field.

2.2 Preliminary Desktop Study

A preliminary assessment of the survey area and its potential constraints was undertaken by reviewing relevant government agency managed databases (Sections 2.2.1 to 2.2.6, and Appendices 1 & 2) and consulting with government agencies where necessary. The following sections provide a summary of desktop searches undertaken for the project.

2.2.1 *Environment Protection and Biodiversity Conservation Act Protected Matters*

The *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)* Protected Matters Search tool was utilised to provide results for matters of National Environmental Significance within the survey area with a 1km buffer (DOTEE, 2018).

(<http://www.environment.gov.au/arcgis-framework/apps/pmst/pmst-coordinate.jsf>)

2.2.2 Threatened Flora and Communities

The Species and Communities Branch of the Department of Biodiversity, Conservation and Attractions (DBCA) was contacted for a search of their databases containing known populations of threatened flora within a 40km radial area of GPS coordinates GDA94 51J 422500mE 6812300mN (Reference: 19-0316FL). Threatened flora include Declared Rare Flora (DRF-extant, now redefined as 'Threatened') and Priority Flora.

The presence of Threatened and Priority Ecological Communities (TECs & PECs) was determined by examining Geographic Information System (GIS) data supplied by the DBCA upon request within a 40km radial area of GPS coordinates GDA94 51J 422500mE 6812300mN (Reference: 04-0416EC).

2.2.3 Environmentally Sensitive Areas (ESAs) and Conservation Reserves

The Department of Water and Environmental Regulation (DWER, 2018) Clearing Permit System Map Viewer was used to determine the location of any ESAs and Conservation Reserves (<https://cps.der.wa.gov.au/main.html>).

2.2.4 Vegetation Type, Extent and Status

Vegetation extent and status data was sourced from the Department of Agriculture and Food (DAFWA) report "Land-Use and Vegetation in Western Australia- National Land and Water Resources Audit Report" and its associated GIS file (Shepherd *et al*, 2002). This data comprises Beard's Pre-European vegetation groups.

DBCA's Statewide Vegetation Statistics (DBCA, 2018) was also referenced for the current extent of Beard's Vegetation Groups.

2.2.5 Wetlands

The potential of wetlands within the project area was determined by examining DWER's Clearing Permit System Map Viewer (DWER, 2018).

2.2.6 Dieback

Dieback is only considered a potential issue for the project if both the mean annual rainfall of the area is >400mm, and if the project area resides south of the 26th parallel.

2.3 Site Investigation

A site visit was carried out by Botanist Eren Reid from Native Vegetation Solutions, accompanied by Scott Thompson from Terrestrial Ecosystems on the 22nd October 2018 to examine the flora and vegetation groups contained within the survey area. A total of 8 hours was spent on site traversing the survey area, by four-wheel-drive vehicle and on foot.

The survey was conducted in accordance with relevant EPA's Statements and Guidelines (Section 1.1).

The EPA uses the Interim Biogeographic Regionalisation of Australia (IBRA) as the largest unit for Environmental Impact Assessment decision making in relation to the conservation of biodiversity. Given the scale and nature of the proposed disturbance as well as the existing disturbance, and that the survey area is located within the Murchison IBRA region, a reconnaissance flora and vegetation survey was deemed adequate.

2.3.1 Licenses

Field work was conducted under Scientific License SL012445, held by Mr ER Reid with expiry 18/09/2019.

2.3.2 Field Methods

Prior to the field work, the aerial photography was examined and representative sample sites for relevés were chosen to provide coverage over all viable vegetation types.

In the field, these sites were visited and non-permanent 20 x 20m relevé sites were established in appropriate locations, considering representativeness of the site to surrounding vegetation and vegetation boundaries. Relevé sites are represented in Appendix 4.

Each relevé site was captured on a TwoNav Aventura GPS at ±4m accuracy, using Universal Transverse Mercator location on GDA94 datum. Digital photographs were taken of each representative vegetation group present in the survey area.

Data collected at each relevé included:

- Photograph of representative vegetation group;
- GPS Location;
- Species Present;
- Population Count/Estimate of Conservation Significant Flora (if present);
- Disturbance Level; and
- Vegetation Condition

Specimens of taxa not recognised by the Botanists were collected and pressed along with specimens of taxa recognised as, or thought to be, conservation-significant species.

The condition of each relevé was assessed using the method developed by Keighery (1994). Definitions of the condition scale are presented in Appendix 3.

Vegetation groups were mapped (section 2.3.4 below).

Opportunistic sampling of plant taxa and vegetation group mapping was also utilised in the survey area between relevé sampling points, via wandering traverses. Smaller singular relevé

sites were also utilised as opportunistic sample sites to collect flora specimens and assist in mapping vegetation groups.

All sample sites, relevés and GPS tracks are included in Appendix 4.

2.3.3 Post-Field Methods

Unknown specimens collected in the field were identified post field work by Eren Reid with reference to published keys, NVS' reference herbarium and information published on Florabase (WAHERB, 2018). Further unknown specimens were identified by Consultant Botanist, Frank Obbens from Bushtech Consultancy, at the WAHERB Reference Library.

Species information was transferred into Microsoft Excel® worksheets representing presence/absence of species per vegetation group.

2.3.4 Mapping

Vegetation mapping was produced via GPS recorded information in the field, cross-referenced with vegetation descriptions made in the field, overlaid on aerial imagery of the survey area. The GPS utilized (TwoNav Aventura GPS) displayed aerial imagery, hence real-time mapping of vegetation groups was available during field work.

Vegetation Health Condition was assessed in the field with reference to Keighery (1994).

GPS tracks and waypoints recorded during field work are presented in Appendix 4.

2.3.5 IBSA Data Package

The Environmental Protection Authority (EPA), Department of Water and Environmental Regulation (DWER) and Department of Mines, Industry Regulation and Safety (DMIRS) require Index of Biodiversity Surveys for Assessments (IBSA) Data Packages to be submitted to support assessment and compliance under the *Environmental Protection Act 1986*.

An IBSA data package is a single file in .zip format, containing:

- one **Metadata and Licensing Statement** in .pdf format;
- one **survey report** in .pdf format;
- one **plain-text survey report** in .txt format; and
- a set of electronic data files, comprising:
 - one **survey details** spatial dataset in shapefile (.shp, etc.) or Mapinfo (.tab, etc.) format; and
 - one or more **survey data** spatial datasets, as required, in shapefile (.shp, etc.) or Mapinfo (.tab, etc.) format.

2.4 Limitations

Table 1 lists potential limitations that may have affected the survey. As shown, this survey was not limited by any factors listed below.

Table 1: List of potential survey limitations

Potential Limitations	Constraint (Y/N)	Comment
Competency and experience of the consultants undertaking the survey	N	Mr Eren Reid is an experienced botanist who has conducted many flora and vegetation surveys in the Goldfields, Pilbara and South-west regions of WA.
Proportion of flora identified during survey	N	As the survey was planned to target species of conservation significance and flora within a small survey area a complete census of the species present was attempted (Approx. 95%). Sufficient identifications were made to allow vegetation descriptions to be made.
Sources of information	N	Threatened and Priority Flora GIS information was available from DBCA.
Proportion of the task achieved	N	All tasks completed
Timing/Season	N	The survey was conducted in Spring 2018. Due to the above average rainfall in January, June, August and October, some species were still in flower, and some emergent annuals were also present.
Disturbance in survey area	N	Disturbance was present with some minor access tracks present.
Intensity of survey effort	N	Transects were walked through the survey area with all parts visited
Resources	N	Adequate resources were available
Access problems	N	No problems with access
Availability of contextual information on the region	N	Information on the Murchison Bioregion is readily available.

3. RESULTS

3.1 Preliminary Desktop Assessment

3.1.1 EPBC Protected Matters

The EPBC Protected Matters search tool revealed that the survey area could possibly be suitable habitat for non-native plant species *Carrichtera annua* (Ward's Weed) and *Cenchrus ciliaris* (Buffel-grass).

C. annua was introduced into Australia from the eastern Mediterranean, and is now widespread throughout South Australia, the Interior, and Western Australia (Lamp & Collet, 1999). This species is not listed as a declared plant by DPIRD (2018), however according to the EPBC search tool this invasive weed species is considered a threat to the rangeland biodiversity within the Southern Australian Sheep and Cattle Grazing Land Management Zone (DOTEE, 2018).

Buffel-grass is not listed as a declared plant by DPIRD (2018), however according to the EPBC search tool it can impact directly on biodiversity values, for example through competition, and indirectly through increasing the frequency and intensity of fires. Buffel-grass is a high-biomass tussock grass that is generally long-lived, deep-rooted and able to out-compete native vegetation. It can flower and fruit rapidly following rainfall for prolonged periods and produce a large amount of seed which disperses easily. Buffel-grass is tolerant to drought, fire and grazing and can naturalise on a wide range of soil types and landscapes. Hotter fires attributed to buffel-grass can affect groundcover vegetation (including bush foods important to Indigenous communities) and carry into the canopy of keystone arid zone trees such as river red gums (*Eucalyptus camaldulensis*), corkwoods (*Hakea* species) and beefwoods (*Grevillea striata*) with flow-on effects to other plants and animals. They can also increase the risk of damage to infrastructure and cultural sites (DOTEE, 2018).

The EPBC Protected Matters report indicated no TEC's or Commonwealth Reserves within a 1km buffer region of the survey area area.

The results of the EPBC Protected Matters search are included in Appendix 1

3.1.2 Threatened Flora and Communities

The DBCA database searches revealed that 1 Threatened and 41 Priority Flora species occur within a 40km radius of the search area (DBCA, 2016a). These taxa are considered to have the potential to occur within the survey area, based on their proximity and similar habitat. None of these known locations occur within the survey area, while the closest location occurs approximately 9.3km northeast of the survey area (DBCA, 2016a).

Results of the threatened flora database search are included in Appendix 2.

The PEC/TEC search (DBCA, 2016) revealed that there are no TECs or PECs within the survey area.

3.1.3 Environmentally Sensitive Areas and Conservation Reserves

No ESA's are located within the survey area (DWER, 2018).

No Conservation Reserves were identified within the survey area (DOTEE, 2018).

3.1.4 Vegetation Type, Extent and Status

Information relating to known vegetation within the survey area has been summarised in Table 2 below. This information has been compiled through both desktop assessments and the site visit.

Table 2: Summary of information regarding Pre-European and current vegetation extent of Vegetation Association 18 within the survey area

Factor	Value				
Beard Vegetation Association*	18				
Vegetation Association Description*	Low woodland; mulga (<i>Acacia aneura</i>)				
Pre-European Extent (ha)	Scale				
	By Association (WA)	By Association (WA)	By IBRA Region (MUR)	By IBRA Sub-region (MUR01)	By Shire (Shire of Laverton)
	22,029,557*	19,892,306**	12,403,172**	10,269,896**	2,878,673**
% Pre-European Extent Remaining	100.00%*	99.76%**	99.68%**	99.66%**	99.61%**
Surrounding Land Use***	Mining, Exploration, Pastoral Lease				
Weed prevalence***	Low				

* Source: Shepherd *et al.* (2002) Appendix 2

**Source: DBCA, (2018)

***Source: Field Assessment

3.1.5 Wetlands

No wetlands which are recorded on the DWER Clearing Permit System Map Viewer occur within the survey area (DWER, 2018).

3.1.6 Dieback

The survey area lies south of the 26th parallel, however receives average annual rainfall of 301.2 mm, below the 400mm threshold mark. There is no record of *Phytophthora cinnamomi* establishing in natural ecosystems in regions receiving <400mm rainfall per annum (CALM, 2003). Therefore, Dieback is not considered an issue for this survey area, however all measures should be taken to prevent any possible soil contamination (seeds of non-native species *etc.*) which poses a risk in the survey area during seasonally favourable conditions.

3.2 Field Assessment

3.2.1 Threatened Flora

No flora located in the survey area, are gazetted as Threatened pursuant to Section 5(1) of the *Biodiversity Conservation Act 2016*. No plant taxa listed as Threatened pursuant to Schedule 1 of the *Environment Protection and Biodiversity Conservation Act 1999* were located within the survey area.

No Priority flora species were located or recorded in the survey area.

3.2.2 Vegetation Type, Extent and Status

A total of 20 Families, 37 Genera and 66 Species were recorded within the survey area. Five major vegetation groups were recorded in the survey area, and are in “Good” to “Very Good” condition (using the scale of Keighery 1994, see Appendix 3). Disturbance occurring in the survey area included historic access tracks, haul roads and powerline corridors. The summary of Vegetation groups contained within the survey area is summarised in Table 3 below. Maps of the survey area can be seen in Appendix 4.

Table 3: Vegetation Group Summary

Vegetation Groups	Family	Genus	Species	Area (ha)	Percentage of Survey Area (%)
Chenopod Shrubland- Drainage Line	8	17	34	43.99	29.32%
Open Mulga woodland over Chenopod shrubland	8	11	18	89.63	59.73%
Mulga over Ironstone outcrops	18	27	42	2.35	1.57%
Mulga woodland over sandy plains	10	18	23	6.27	4.18%
<i>Tecticornia</i> shrubland	2	2	2	0.61	0.41%
Existing Disturbance	N/A	N/A	N/A	7.2	4.80%
Total	20*	37*	66*	150.05#	100.00%#

Note: * Within total survey area (not sum of column)
Sum of column

The vegetation groups are described in more detail below.

3.2.2.1 Chenopod shrubland- Drainage Line

This vegetation group consisted of 8 Families, 17 Genera and 34 Species. The vegetation group was approximately 43.99 ha which makes up 29.32% of the survey area.

Dominant species were *Maireana pyramidata*, *Cratystylis subspinescens*, *Hakea preissii* and *Lawrencia squamata*.



Figure 5: Chenopod shrubland- Drainage Line within the survey area

3.2.2.2 Open Mulga woodland over Chenopod shrubland

This vegetation group consisted of 8 Families, 11 Genera and 18 Species. The vegetation group was approximately 89.63 ha which makes up 59.73% of the survey area.

Dominant species were *Acacia aneura*, *Acacia mulganeura*, *Acacia masliniana*, *Hakea preissii*, *Eremophila glabra* subsp. *glabra*, *Atriplex bunburyana* and *Maireana pyramidata*.



Figure 6: Open Mulga woodland over Chenopod shrubland within the survey area

3.2.2.3 Mulga over ironstone outcrops

This vegetation group consisted of 18 Families, 27 Genera and 42 Species. The vegetation group was approximately 2.35 ha which makes up 1.57% of the survey area.

Dominant species were *Acacia mulganeura*, *Acacia aneura*, *Acacia ayersiana*, *Philotheca breucei* subsp. *brucei*, *Eremophila latrobei* subsp. *latrobei*, *Dodnaea viscosa*, subsp. *angustissima* and *Acacia tetragonophylla*.



Figure 7: Mulga over ironstone outcrops within the survey area

3.2.2.4 Mulga woodland over sandy plains

This vegetation group consisted of 10 Families, 18 Genera and 23 Species. The vegetation group was approximately 6.27 ha which makes up 4.18% of the survey area.

Dominant species were *Acacia ayersiana*, *Acacia pteraneura*, *Maireana pyramidata*, *Rhagodia drummondii*, *Aristida contorta*, *Eragrostis eriopoda*, *Solanum lasiophyllum* and *Enchylaena tomentosa* var. *tomentosa*.



Figure 8: Mulga woodland over sandy plains within the survey area

3.2.2.5 *Tecticornia* shrubland

This vegetation group consisted of 2 Families, 2 Genera and 2 Species. The vegetation group was approximately 0.61 ha which makes up 0.41% of the survey area.

Dominant species were *Tecticornia disarticulata* and *Frankenia pauciflora*.



Figure 9: *Tecticornia* shrubland within the survey area

3.2.2.6 Existing Disturbance

Existing disturbance consisted of historic clearing for mining purposes including a power station, haul road, powerline corridor and access tracks. Disturbance was approximately 7.2 ha which makes up 4.8% of the survey area.

3.2.3 Weeds

One Weed species was recorded in the survey area, *Cenchrus ciliaris* (Buffel-grass). This species was located at three locations within the survey area. Details are included in Table 4 below.

Table 4: Non-native weed species recorded in the survey area

Species	Approximate Number	GDA94 51 Easting (m)	GDA94 51 Northing (m)
<i>Cenchrus ciliaris</i>	50	437196	6809114
<i>Cenchrus ciliaris</i>	50	437423	6808226
<i>Cenchrus ciliaris</i>	50	437512	6808145

3.2.4 Vegetation Condition

Overall, the condition of the vegetation was determined to be “Good” to “Very Good”. No areas of vegetation were assessed to be in “Pristine” condition.

A map of the vegetation condition is included in Appendix 4.

4. DISCUSSION

A total of 20 Families, 37 Genera and 66 Species were recorded within the survey area. Five major vegetation groups were recorded in the survey area

The field assessment established that the condition of the vegetation in the proposed disturbance area is overall “Good” to “Very Good”. No areas of vegetation were assessed to be in “Pristine” condition.

No Threatened Flora, TECs or PECs were recorded in the survey area. No Priority Flora Species were recorded within the survey area.

One weed species, *Cenchrus ciliaris* (Buffel-grass) was recorded at three locations within the survey area.

Any proposed disturbance/clearing of vegetation will result in a loss of species from the survey area. However, given the size of the area and the extent of the Beard (1990) vegetation associations elsewhere, the impact on the vegetation and its component flora will not affect the conservation values of either, or create fragmentation or patches of remnant vegetation.

The following recommendations arise from the Reconnaissance flora and vegetation survey:

- Where possible, clearing be aligned to existing roads, tracks and other barriers or follow the boundaries of broad-scale intact native vegetation; and
- Weed control measures to be implemented during and following clearing

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6. GLOSSARY

Acronyms:

BOM	Bureau of Meteorology, Australian Government
BSc	Bachelor of Science
CALM	Department of Conservation and Land Management (now DBCA)
CPS	Clearing Permit System (DWER)
DBCA	Department of Biodiversity, Conservation and Attractions, Western Australia
DMIRS	Department of Mines, Industry Regulation and Safety, Western Australia
DOTEE	Department of the Environment and Energy, Australian Government
DPAW	Department of Parks and Wildlife, Western Australia (now DBCA)
DPIRD	Department of Primary Industries and Regional Development, Western Australia
DRF	Declared Rare Flora
DWER	Department of Water and Environmental Regulation, Western Australia
EPA	Environmental Protection Authority, Western Australia
EP Act	<i>Environmental Protection Act 1986</i> , Western Australia
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i> (Commonwealth Act)
ESA	Environmentally Sensitive Area
GIS	Geographical Information System
ha	Hectare (10,000 square metres)
IBRA	Interim Biogeographic Regionalisation for Australia, DOTEE
IUCN	International Union for the Conservation of Nature and Natural Resources – commonly known as the World Conservation Union
km	Kilometres
m	Metres
MUR	Murchison Bioregion, IBRA
MUR01	Eastern Murchison Subregion, IBRA
NVS	Native Vegetation Solutions
PEC	Priority Ecological Community, Western Australia
Ramsar	A wetland site designated of international importance under the Ramsar Convention (UNESCO)
TEC	Threatened Ecological Community
UNESCO	United Nations Educational, Scientific and Cultural Organization
WA	Western Australia
WAHERB	Western Australian Herbarium, DBCA

Definitions:

{DPAW (2017) Conservation Codes for Western Australian Flora and Fauna. Department of Parks and Wildlife, Western Australia, May 2017}: -

T Threatened species:

Published as Specially Protected under the *Wildlife Conservation Act 1950*, listed under Schedules 1 to 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora (which may also be referred to as Declared Rare Flora).

Threatened fauna is that subset of ‘Specially Protected Fauna’ declared to be ‘likely to become extinct’ pursuant to section 14(4) of the Wildlife Conservation Act.

Threatened flora is flora that has been declared to be ‘likely to become extinct or is rare, or otherwise in need of special protection’, pursuant to section 23F(2) of the Wildlife Conservation Act. 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.

CR Critically endangered species

Threatened species considered to be facing an extremely high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.

EN Endangered species

Threatened species considered to be facing a very high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.

VU Vulnerable species

Threatened species considered to be facing a high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.

EX Presumed extinct species

Species which have been adequately searched for and there is no reasonable doubt that the last individual has died. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Presumed Extinct Fauna and Wildlife Conservation (Rare Flora) Notice for Presumed Extinct Flora.

IA Migratory birds protected under an international agreement

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 the Bonn Convention, relating to the protection of migratory birds. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice.

CD Conservation dependent fauna

Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 6 of the Wildlife Conservation (Specially Protected Fauna) Notice.

OS Other specially protected fauna

Fauna otherwise in need of special protection to ensure their conservation. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 7 of the Wildlife Conservation (Specially Protected Fauna) Notice.

P Priority species

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 flora or fauna. Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring. Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.

P1 Priority One - Poorly-known species:

Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.

P2 Priority Two - Poorly-known species:

Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.

P3 Priority Three - Poorly-known species:

Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.

P4 Priority Four - Rare, Near Threatened and other species in need of monitoring:

(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands.

(b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for Vulnerable, but are not listed as Conservation Dependent.

(c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

Appendix 1

Relevant Government Database Search Results



EPBC Act Protected Matters Report

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

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

Information is available about [Environment Assessments](#) and the EPBC Act including significance guidelines, forms and application process details.

Report created: 06/12/18 13:28:19

[Summary](#)

[Details](#)

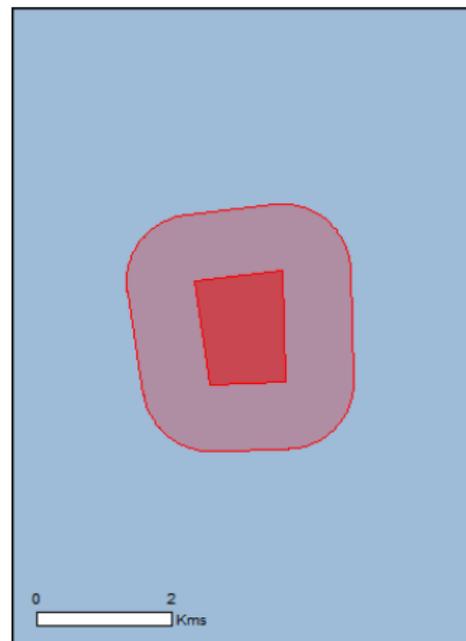
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

[Acknowledgements](#)



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Buffer: 1.0Km



Summary

Matters of National Environmental Significance

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

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

Other Matters Protected by the EPBC Act

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

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

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

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	11
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

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

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	10
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area
Polytelis alexandrae Princess Parrot, Alexandra's Parrot [758]	Vulnerable	Species or species habitat likely to occur within area
Listed Migratory Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species [[Resource Information](#)]

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

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat likely to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat may occur within area

Extra Information

Invasive Species

[[Resource Information](#)]

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

Name	Status	Type of Presence
Birds		
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Mammals		
Camelus dromedarius Dromedary, Camel [7]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Equus asinus Donkey, Ass [4]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Carrichtera annua Ward's Weed [9511]		Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area

Caveat

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

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

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

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

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

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

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

- migratory and
- marine

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

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

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

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

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

Coordinates

-28.841377 122.347185,-28.840148 122.359047,-28.853153 122.35949,-28.853422 122.349387,-28.841377 122.347185

Acknowledgements

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

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

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

Please feel free to provide feedback via the [Contact Us](#) page.

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- Localities
- Points of Interest
- Clearing Regulations - Instruments
 - Clearing Regulations - Environmentally S...
 - Local Government Authority

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DWER's Clearing Permit System Map Viewer showing no ESA's (dark green shaded areas) within the survey area (DWER, 2018)

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 - Waterbodies - Small
 - Waterbodies - Medium
 - Waterbodies - Large
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DWER Clearing Permit System Map Viewer showing no wetland areas within the survey area (DWER, 2018).

Appendix 2

Threatened Flora Databases Search Results

Taxon	Status	Distribution	Flowering Period
<i>Acacia eremophila</i> numerous-nerved variant (A.S. George 11924)	3	Norseman, Neale Junction, Great Victoria Desert, Balladonia, Plumridge Lakes	Sep,Jul
<i>Acacia websteri</i>	1		
<i>Angianthus prostratus</i>	3	Glenorn Stn, Baladjie Lake NR, Quairading, Lake Barlee, Bulga Downs Stn, Kalgoorlie	Jul-Sept
<i>Beyeria lapidicola</i>	1	Bulga Downs, Weld Range, Lake Way Stn.	Jul
<i>Bossiaea eremaea</i>	3	Merolia Stn, Sandstone, White Cliffs Stn	Jul-Sep
<i>Caesia talingka</i>	2	Plumridge Lakes N.R.	
<i>Calytrix hislopii</i>	3	Black Range Stn., Lake Mason Stn., White Cliffs Stn.	Sep
<i>Calytrix praecipua</i>	3	Melita Station, Laverton, Youno Downs, Wanjarri, Marymia, Erong Hmstd, Niagara Dam	Jun-Nov
<i>Cratystylis centralis</i>	3	Barwidgee Stn, Leonora	Aug-Nov
<i>Dicrastylis cundeeleensis</i>	4	Cundeelee, Plumridge Lakes, Rawlinna	Apr, Oct-Dec
<i>Eremophila annosocaulis</i>	3	Mt Morgans Mine (South of Leonora-Laverton Rd), Von Treuer Tableland	
<i>Eremophila arachnoides</i> subsp. <i>tenera</i>	1	Kambalda, Laverton	Sep,Dec
<i>Eremophila dendritica</i>	2	Rawlinna, Plumridge Lakes	Sep-Oct
<i>Eremophila eversa</i>	1	Yerilla	Oct
<i>Eremophila mirabilis</i>	2	Niagara, Morapoi, Kookynie, Woolgorong, Menzies	Aug-Sep
<i>Eremophila simulans</i> subsp. <i>megacalyx</i>	3	Mt Narryer, Boolardy Stn, Leonora	Aug-Sep
<i>Goodenia lyrata</i>	3	Laverton, Newman	
<i>Gunniopsis propinqua</i>	3	Laverton, Mt Margaret, Lake Carnegie, Windidda, Mt Eureka, Mt James, Menzies	Aug-Sep
<i>Hemigenia exilis</i>	4	Lake Darlot, Yakabindie, Leinster, Leonora, Mt Keith	Apr,May,Aug
<i>Homalocalyx echinulatus</i>	3	Carnegie Stn, Wiluna, Doolgunna Stn, Weld Range, Mount Hale, Windidda, Wongawal Stn	Dec
<i>Hybanthus floribundus</i> subsp. <i>chloroxanthus</i>	3	Leonora, Laverton	Aug-Oct
<i>Lechenaultia aphylla</i>	1	Cosmo Newbey - Laverton, SA	
<i>Lechenaultia divaricata</i>	1	Plumridge Lakes	Oct
<i>Micromyrtus placoides</i>	3	Cue, Weld Range, Mt Narryer, Tallering Peak	Aug,Sep
<i>Micromyrtus serrulata</i>	3	Karonie, Coonana, Melita, Jeedamya, Niagara Dam NR, Cardunia Rocks, Queen Victoria Spring NR	Mar,Jun,Nov
<i>Mirbelia stipitata</i>	3	Nth Sandstone, Nth Laverton	-
<i>Olearia arida</i>	4	Neale Junction, Plumridge Lakes, Great Victoria Desert	Jul
<i>Olearia mucronata</i>	3		
<i>Persoonia leucopogon</i>	1	Between Coolgardie & Laverton, Comet Vale (Menzies)	-
<i>Philothea linearis</i>	1	White Cliffs Stn, Central Australia	Jul
<i>Philothea tubiflora</i>	1	E of Laverton	Jun,Aug,Oct
<i>Phyllanthus baeckeoides</i>	3	Laverton, Merolia Stn, White Cliffs Stn, Windimurra Station, Cashmere Downs Stn, Leinster, Banjawarn Stn	Jul-Sep
<i>Prostanthera petrophila</i>	3	Cue, Mt Barloweerie, Woolgorong, Weld Range,	Jul-Aug
<i>Ptilotus blackii</i>	3	Plumridge Lakes N.R., Zanthus, Queen Victoria Springs N.R., S.A. N.T.	May-Sep
<i>Ptilotus tetrandrus</i>	1	Glenorn Station, Little Sandy Desert	Oct
<i>Tecticornia cymbiformis</i>	3		
<i>Tecticornia mellaria</i>	1		
<i>Tecticornia</i> sp. Lake Way (P. Armstrong 05/961)	1		
<i>Thryptomene nealensis</i>	3	Leinster, White Cliffs Stn, Neale Junction, Gt Victoria Desert	Oct
<i>Thryptomene wittweri</i>	T	Hamersley Range, Mt Augustus, Carnarvon Range, White Cliffs Stn, NT	Aug-Oct
<i>Vittadinia cervicularis</i> var. <i>oldfieldii</i>	1	Merredin, Laverton	
<i>Vittadinia pustulata</i>	3	Plumridge Lakes N.R., Morgan Range	

Appendix 3

Vegetation Condition Scale (Keighery, 1994)

Pristine (1). Pristine or nearly so, no obvious signs of disturbance.

Excellent (2). Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.

Very Good (3). Vegetation structure altered, obvious signs of disturbance.
For example, disturbance to vegetation structure caused by repeating fires, the presence of some more aggressive weeds, dieback, logging and grazing.

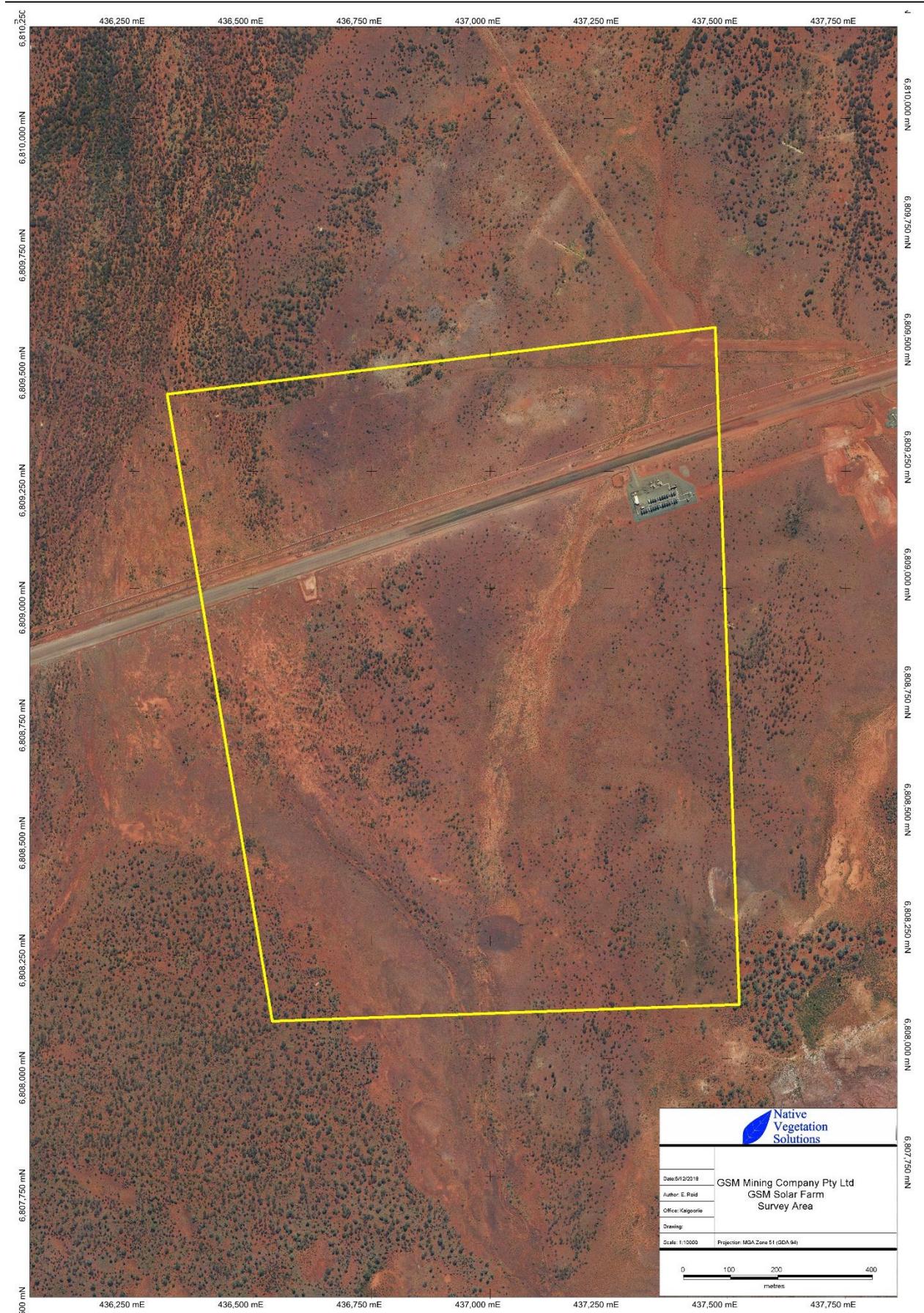
Good (4). Vegetation structure significantly altered by very obvious signs of multiple disturbance.
Retains basic vegetation structure or ability to regenerate it.
For example, disturbance to vegetation structure caused by frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.

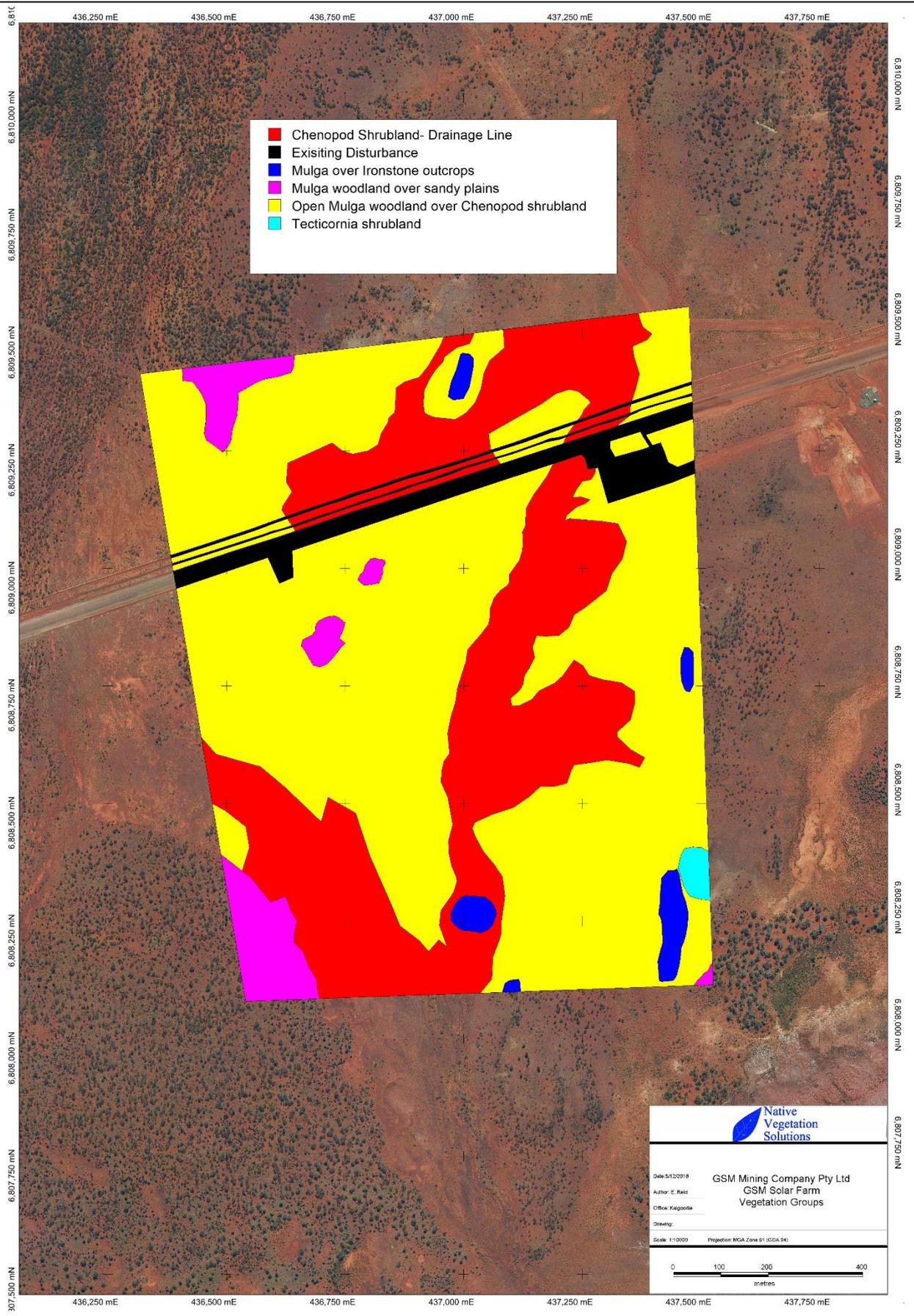
Degraded (5). Basic vegetation structure severely impacted by disturbance.
Scope for regeneration but not to a state approaching good condition without intensive management.
For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.

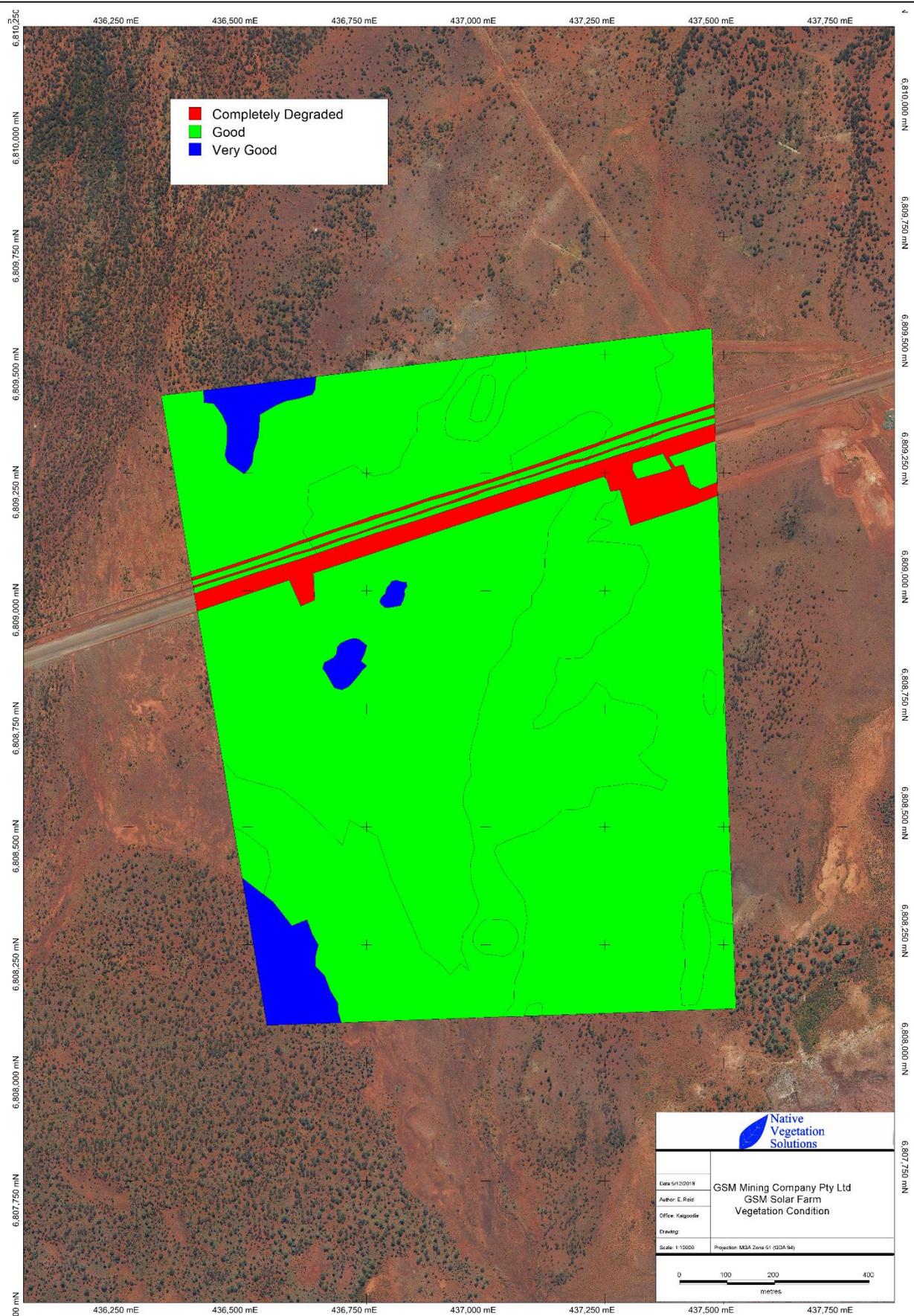
Completely Degraded (6). The structure of the vegetation is no longer intact and the area is completely or almost completely without native species.
These areas are often described as 'parkland cleared' with the flora compromising weed or crop species with isolated trees or shrubs.

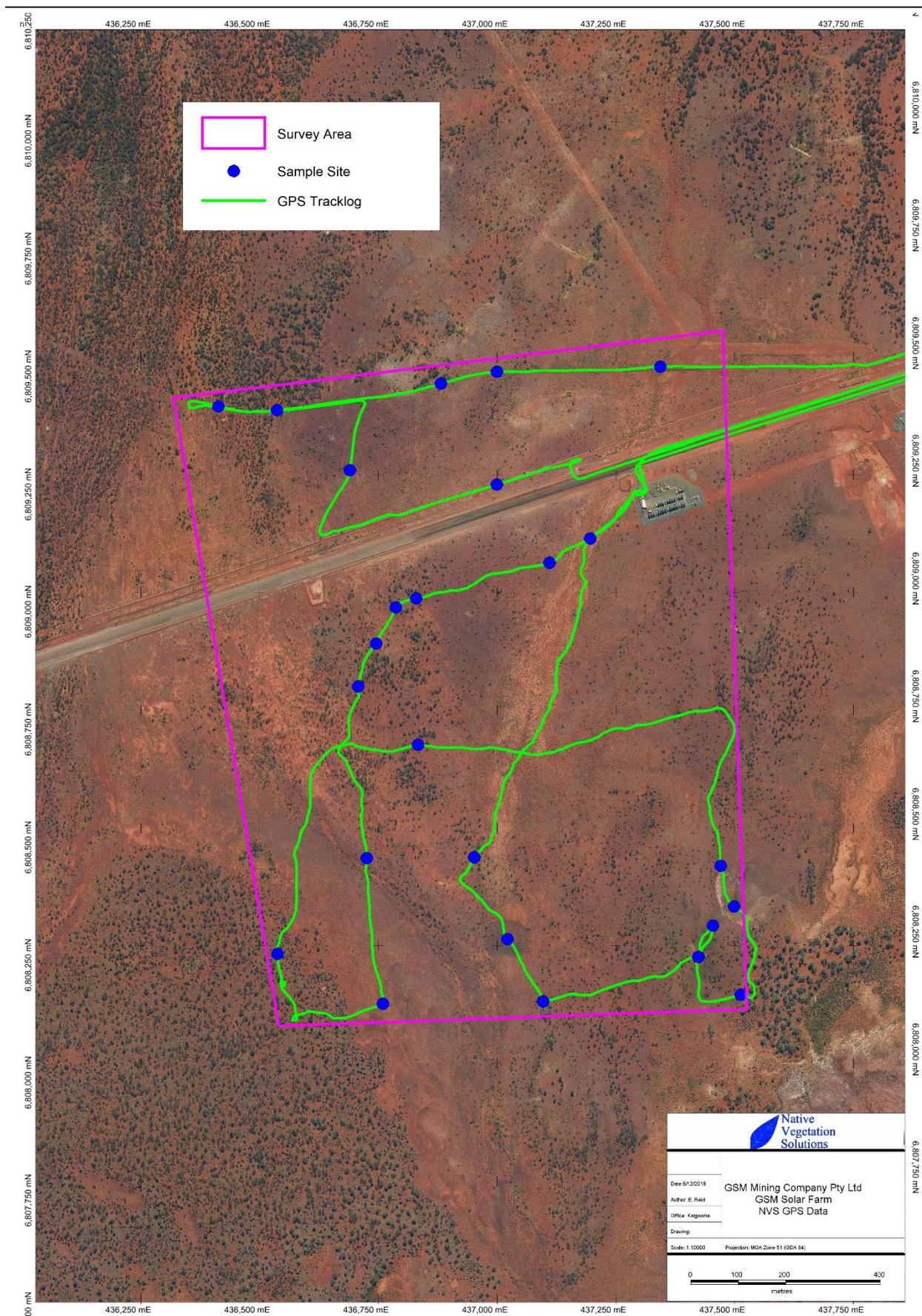
Appendix 4

Vegetation Mapping









Appendix 5

Species List

Family	Genus	Species	A, P or NN	Chenopod Shrubland- Drainage Line	Open Mulga woodland over Chenopod shrubland	Mulga over Ironstone outcrops	Mulga woodland over sandy plains	<i>Tecticornia</i> shrubland
Aizoaceae	<i>Gunnioopsis</i>	<i>quadrifida</i>	P				*	
Amaranthaceae	<i>Ptilotus</i>	<i>obovatus</i>	P		*	*	*	
Amaranthaceae	<i>Ptilotus</i>	<i>schwartzii</i>	P		*	*		
Apocynaceae	<i>Marsdenia</i>	<i>australis</i>	P		*	*		
Campanulaceae	<i>Isotoma</i>	<i>petraea</i>	A			*		
Casuarinaceae	<i>Casuarina</i>	<i>pauper</i>	P			*		
Chenopodiaceae	<i>Atriplex</i>	<i>bunburyana</i>	P	*	*	*	*	
Chenopodiaceae	<i>Atriplex</i>	<i>codonocarpa</i>	A	*				
Chenopodiaceae	<i>Atriplex</i>	<i>stipitata</i>	P	*				
Chenopodiaceae	<i>Atriplex</i>	<i>vesicaria</i>	P	*				
Chenopodiaceae	<i>Cratystylis</i>	<i>subspinescens</i>	P	*	*	*		
Chenopodiaceae	<i>Enchylaena</i>	<i>tomentosa</i> var. <i>tomentosa</i>	P	*			*	
Chenopodiaceae	<i>Maireana</i>	<i>brevifolia</i>	P	*				
Chenopodiaceae	<i>Maireana</i>	<i>georgei</i>	P	*	*	*		
Chenopodiaceae	<i>Maireana</i>	<i>glomerifolia</i>	P	*		*		
Chenopodiaceae	<i>Maireana</i>	<i>pyramidata</i>	P	*	*	*	*	
Chenopodiaceae	<i>Maireana</i>	<i>tomentosa</i>	P	*		*		
Chenopodiaceae	<i>Maireana</i>	<i>triptera</i>	P	*	*	*	*	
Chenopodiaceae	<i>Rhagodia</i>	<i>drummondii</i>	P			*	*	
Chenopodiaceae	<i>Tecticornia</i>	<i>disarticulata</i>	P					*
Fabaceae	<i>Acacia</i>	<i>aneura</i>	P		*	*		
Fabaceae	<i>Acacia</i>	<i>ayersiana</i>	P			*	*	
Fabaceae	<i>Acacia</i>	<i>craspedocarpa</i>	P		*			
Fabaceae	<i>Acacia</i>	<i>masliniana</i>	P	*	*	*		
Fabaceae	<i>Acacia</i>	<i>mulganeura</i>	P		*	*		
Fabaceae	<i>Acacia</i>	<i>pteraneura</i>	P	*	*	*	*	
Fabaceae	<i>Acacia</i>	<i>tetragonophylla</i>	P	*		*		
Fabaceae	<i>Senna</i>	<i>artemisioides</i> subsp. <i>artemisioides</i>	P	*				
Fabaceae	<i>Senna</i>	<i>artemisioides</i> subsp. <i>filifolia</i>	P	*			*	
Fabaceae	<i>Senna</i>	<i>artemisioides</i> subsp. <i>helmsii</i>	P			*		
Fabaceae	<i>Senna</i>	<i>glutinosa</i> subsp. <i>chatelainiana</i>	P	*				
Frankeniaceae	<i>Frankenia</i>	<i>interioris</i>	P			*		
Frankeniaceae	<i>Frankenia</i>	<i>pauciflora</i>	P	*		*		*
Goodeniaceae	<i>Scaevola</i>	<i>spinescens</i>	P			*		
Lamiaceae	<i>Teucrium</i>	<i>teucriflorum</i>	P			*		
Malvaceae	<i>Lawrencia</i>	<i>squamata</i>	P	*		*		
Malvaceae	<i>Sida</i>	<i>calyxhymania</i>	P	*	*			
Malvaceae	<i>Sida</i>	sp. dark green fruits	P	*		*		
Malvaceae	<i>Sida</i>	sp. Golden calyces glabrous	P			*		
Poaceae	<i>Aristida</i>	<i>contorta</i>	A	*			*	
Poaceae	<i>Austrostipa</i>	<i>elegantissima</i>	P	*	*			
Poaceae	<i>Cenchrus</i>	<i>ciliaris</i>	P, NN	*		*	*	
Poaceae	<i>Cymbopogon</i>	<i>obtectus</i>	P				*	
Poaceae	<i>Enteropogon</i>	<i>ramosus</i>	P	*	*	*		

Family	Genus	Species	A, P or NN	Chenopod Shrubland- Drainage Line	Open Mulga woodland over Chenopod shrubland	Mulga over Ironstone outcrops	Mulga woodland over sandy plains	<i>Tecticornia</i> shrubland
Poaceae	<i>Eragrostis</i>	<i>eriopoda</i>	P				*	
Poaceae	<i>Eriachne</i>	<i>pulchella</i> subsp. <i>pulchella</i>	A	*				
Poaceae	<i>Monachather</i>	<i>paradoxus</i>	P			*		
Proteaceae	<i>Grevillea</i>	<i>berryana</i>	P				*	
Proteaceae	<i>Hakea</i>	<i>preissii</i>	P	*	*	*		
Pteridaceae	<i>Cheilanthes</i>	<i>sieberi</i> subsp. <i>sieberi</i>	P			*		
Rubiaceae	<i>Psyrax</i>	<i>rigidula</i>	P			*	*	
Rutaceae	<i>Philothea</i>	<i>brucei</i> subsp. <i>brucei</i>	P			*		
Santalaceae	<i>Exocarpos</i>	<i>aphyllus</i>	P			*	*	
Santalaceae	<i>Santalum</i>	<i>lanceolatum</i>	P			*		
Sapindaceae	<i>Dodonaea</i>	<i>viscosa</i> subsp. <i>angustissima</i>	P			*		
Scrophulariaceae	<i>Eremophila</i>	<i>decipiens</i> subsp. <i>decipiens</i>	P	*				
Scrophulariaceae	<i>Eremophila</i>	<i>forrestii</i> subsp. <i>forrestii</i>	P				*	
Scrophulariaceae	<i>Eremophila</i>	<i>glabra</i> subsp. <i>glabra</i>	P	*	*		*	
Scrophulariaceae	<i>Eremophila</i>	<i>latrobei</i> subsp. <i>latrobei</i>	P	*		*		
Scrophulariaceae	<i>Eremophila</i>	<i>metallicorum</i>	P	*		*		
Scrophulariaceae	<i>Eremophila</i>	<i>oppositifolia</i> subsp. <i>angustifolia</i>	P			*		
Scrophulariaceae	<i>Eremophila</i>	<i>scoparia</i>	P	*				
Solanaceae	<i>Duboisia</i>	<i>hopwoodii</i>	P				*	
Solanaceae	<i>Solanum</i>	<i>ferocissimum</i>	P			*	*	
Solanaceae	<i>Solanum</i>	<i>lasiophyllum</i>	P	*		*	*	
Solanaceae	<i>Solanum</i>	<i>nummularium</i>	P				*	

Note:

A= Annual

P= Perennial

NN= Non Native

Appendix B Native Vegetation Solutions (2022)





Reconnaissance
Flora and Vegetation Survey of the
GSM Solar Farm Expansion Area-
May 2022

Prepared for



GOLD FIELDS

GSM Mining Company Pty Ltd

FINAL V2.0
October 2022

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1 INTRODUCTION

Gold Fields Limited, via its subsidiary GSM Mining Company Pty Ltd (GSM), are proposing to Expand the Solar Farm at the Granny Smith Mine, just south of the Wallaby Haul Road. The Solar Farm produces electricity to supplement existing power supplies to the mine site.

Native Vegetation Solutions (NVS) was supplied with a survey area located approximately 24 km South of Laverton, in the Murchison Region (MUR) of Western Australia (Figure 1). The total survey area received from GSM covers approximately 241.4 ha.

The survey area lies within Mining Tenements M 38/0849, M 38/1289, M 38/0397, M 38/0691 and M 38/1280, Miscellaneous tenements L 38/0326, L 39/0227, L 38/0144, L 38/0088 and L 38/0077, and Prospecting tenement P 38/4407.

Actual disturbance footprints are not yet defined; however, clearing required within the boundary of the survey area is anticipated to be less than the total survey area.

This report will encompass results of the reconnaissance flora and vegetation survey within the GSM Solar Farm Expansion survey area.



Figure 1: Regional map of survey location

1.1 Objectives

The objective of this report is to document the results of the flora and vegetation component of a reconnaissance assessment conducted in accordance with:

- *Environmental Factor Guideline- Flora and Vegetation* (EPA, 2016); and
- *Technical Guidance- Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA, 2016a).

A reconnaissance assessment has two components:

- 1). Desktop study which includes a literature review and a search of the relevant databases
- 2). Reconnaissance survey of the survey area to verify the desktop survey, to define vegetation units present in the area, search for species of conservation significance and to determine potential sensitivity to impact.

As part of the reporting for the reconnaissance assessment, NVS has conducted a Flora and Vegetation Survey which includes broad-scale vegetation mapping and vegetation condition mapping of the survey area.

The scope of work for the reconnaissance flora and vegetation survey was to:

- conduct a desktop study that includes a literature review and search of the relevant databases
- describe the vegetation associations in the survey area
- prepare an inventory of species occurring in the survey area
- identify any vegetation communities or flora species of conservation significance
- Map broad-scale vegetation groups found within the survey area, including vegetation condition; and
- provide recommendations, including the management of perceived impacts to flora and vegetation within the survey area.

1.2 Geology and Vegetation

The survey area lies in the Murchison (MUR) bioregion, more specifically the Eastern Murchison (MUR01) subregion. The Eastern Murchison subregion covers over 7 million hectares and contains the northern parts of the 'Southern Cross' and 'Eastern Goldfields' Terrains of the Yilgarn Craton. The landscape is characterised by extensive areas of elevated red desert sandplains with minimal dune development and internal drainage. The occluded Paleodrainage system generates Salt Lake systems. Other features include broad plains of red-brown soils, breakaway complexes, and red sandplains. Mulga woodlands often rich in ephemerals; hummock grasslands, saltbush shrublands and *Tecticornia* shrublands dominate the vegetation (CALM, 2002)

1.3 Climate

The climate is classified as Arid with 200-300 mm of rainfall, sometimes in summer but usually in winter (CALM, 2002). The nearest official meteorological weather station with the most complete and up to date temperature information is Laverton Aero (station number 012305), which is located approximately 26 km north-northeast of the survey area.

1.3.1 Temperature

Mean annual minimum temperature at Laverton Aero is 14.1°C and mean annual maximum temperature is 27.2°C (BOM, 2022). The coldest temperatures are attained in July (mean minimum temperature 5.9°C), the hottest is January (mean maximum temperature 35.6°C) and diurnal temperature variations are relatively consistent throughout the year (Figure 2).

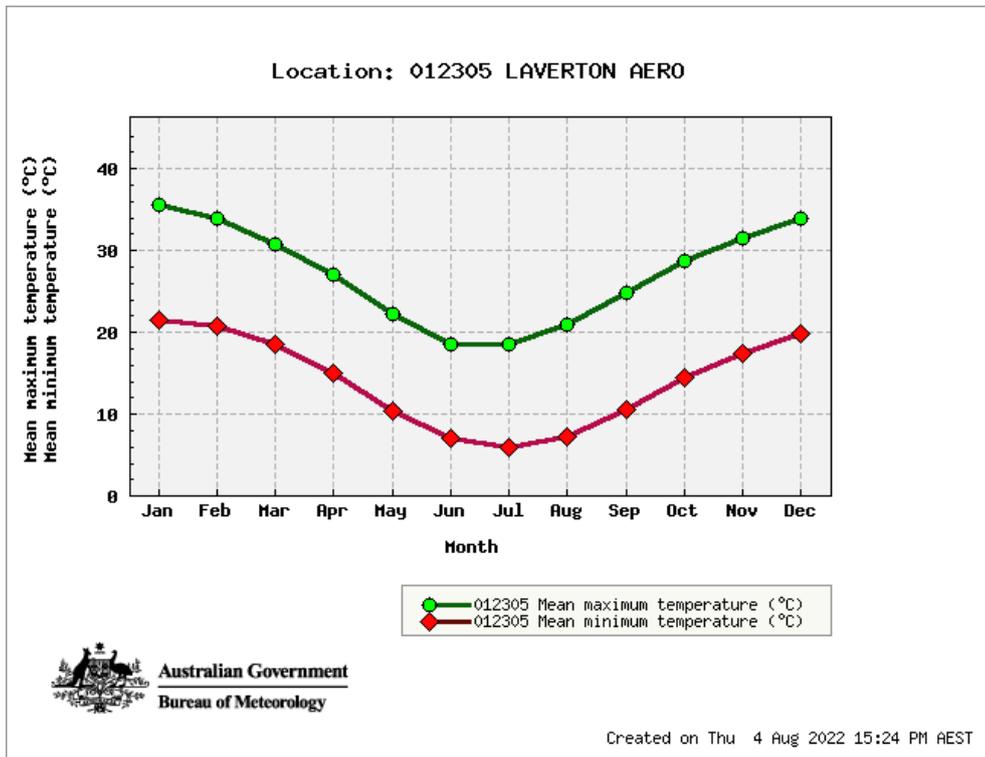


Figure 2: Mean temperature ranges for Laverton Aero weather station

1.3.2 Rainfall

The annual average rainfall at Laverton Aero is 275.5 mm, which falls (>1 mm) on an average of 34 rain-days (BOM, 2022). Larger rainfall events occur from December to March (Figure 3). Prior to the survey in 2022, rainfall in March exceeded monthly averages while rainfall for all other months remained below monthly averages (BOM, 2022).

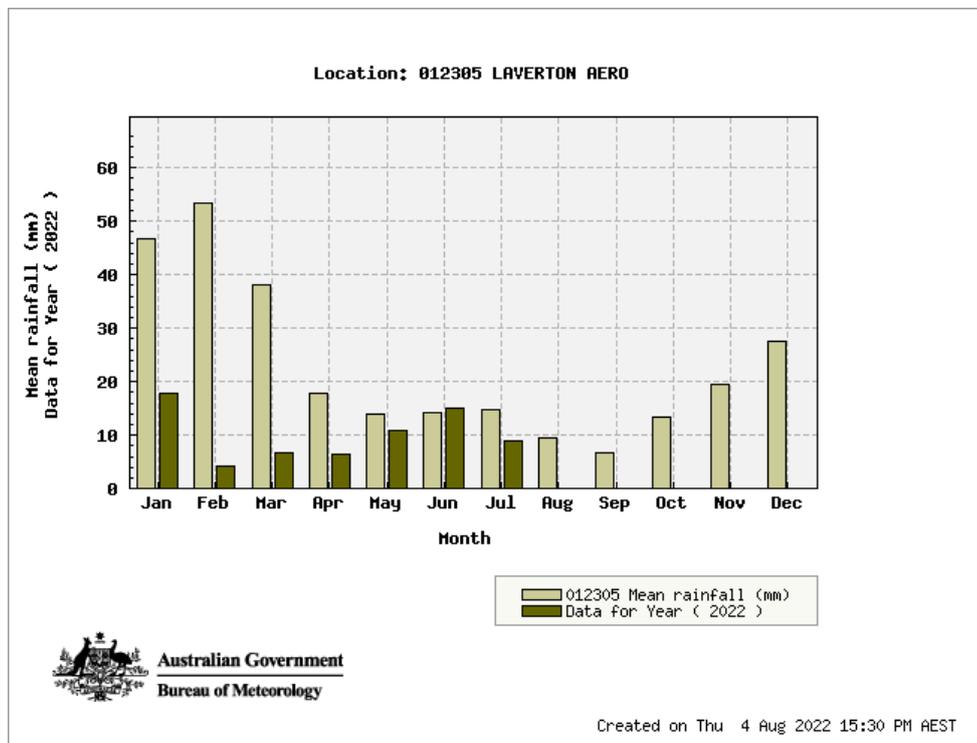


Figure 3: Monthly and mean rainfall for Laverton Aero weather station

2. ASSESSMENT METHODOLOGY

2.1 Personnel and Reporting

The following personnel were involved in the Reconnaissance flora and vegetation survey:

- Mr Eren Reid (*BSc- Biological Science*), Principal Botanist, Native Vegetation Solutions, undertook the survey, vegetation mapping, data collation, field identification of flora, preparation and review of the report. Mr Eren Reid has over 18 years' experience in botanical surveys throughout the Murchison Region and over a variety of environments across Western Australia.
- Ms Adele Thomasz (*BSc- Conservation and Wildlife Biology*), Native Vegetation Solutions, data collation and preparation of the report. Adele Thomasz has over 5 years' experience working in the conservation sector and one year specifically working on botanical survey reporting; and
- Mr Frank Obbens (*BSc*), Consultant Botanist, Bushtech Consultancy, undertook identification of unknown samples collected in the field. Mr Frank Obbens has over 22 years' experience offering botanical identification and conducting taxonomic investigations to consultancies and industry.

2.2 Preliminary Desktop Study

A preliminary assessment of the survey area and its potential constraints was undertaken by reviewing relevant government agency managed databases (Sections 2.2.1 to 2.2.6, and Appendices 1 & 2) and consulting with government agencies where necessary. The following sections provide a summary of desktop searches undertaken for the project.

2.2.1 Known Previous Flora and Vegetation Surveys

A Reconnaissance flora and vegetation survey was completed by NVS in the GSM Solar Farm project area in 2018 (NVS, 2018). The current survey area surrounds the previous survey area. Vegetation mapping from the 2018 report was used as a reference for vegetation mapping descriptions, and locations of known Priority and Threatened Flora within the current survey area.

2.2.2 *Environment Protection and Biodiversity Conservation Act* Protected Matters

The *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)* Protected Matters Search tool was utilised to provide results for matters of National Environmental Significance within the survey area using the survey area as the search criteria with a 3 km buffer (DAWE, 2022).

2.2.3 Threatened Flora and Communities

The Threatened and Priority Flora Database managed by the Department of Biodiversity, Conservation and Attractions (DBCA) was searched for threatened and priority flora within a 20 km radial area of the survey area (DBCA, 2016a).

The Threatened and Priority Ecological Communities (TECs and PECs) database was searched to determine the presence of PECs or TECs (DBCA, 2016), with Geographic Information System (GIS) data supplied for assessment, within a 20 km radial area of the survey area.

2.2.4 Environmentally Sensitive Areas (ESAs) and Conservation Reserves

The Department of Water and Environmental Regulation (DWER, 2022) Clearing Permit System Map Viewer was used to determine the location of any ESAs and Conservation Reserves.

2.2.5 Vegetation Type, Extent and Status

Vegetation extent and status data was sourced from the Department of Agriculture and Food (DAFWA) report and its associated GIS file (Shepherd *et al*, 2002). This data comprises Beard's Pre-European vegetation groups.

DBCA's Statewide Vegetation Statistics (DBCA, 2019) was also referenced for the current extent of Beard's Vegetation Groups. The purpose of examining this information is to determine if the survey area lies within any vegetation groups defined by Beard that may have been subjected to widescale clearing for European settlement. The national objectives and targets for biodiversity conservation recognise that the retention of 30% or more of the pre-clearing extent of a Beard vegetation association is necessary if Australia's biological diversity is to be protected.

2.2.6 Wetlands

The potential of wetlands within the project area was determined by examining DWER's Clearing Permit System Map Viewer (DWER, 2022).

2.2.7 Dieback

Dieback is only considered a potential issue for any project if both of the below factors are relevant for the project (CALM, 2003):

- the project area lies within the Southwest Land Division; and
- the mean annual rainfall of the area is greater than 400 mm.

2.3 Site Investigation

A site visit of the GSM Solar Farm Expansion area was carried out by Botanist Eren Reid from Native Vegetation Solutions on the 16th and 17th of May 2022 to examine the flora and vegetation groups contained within the survey area. A total of 9 hours was spent on site traversing the survey area, by Yamaha Viking and on foot.

The survey was conducted in accordance with relevant Environmental Protection Authority's (EPA's) Statements and Technical Guidance (Section 1.1).

The EPA uses the Interim Biogeographic Regionalisation of Australia (IBRA) as the largest unit for Environmental Impact Assessment (EIA) decision making in relation to the conservation of biodiversity. Given the scale and nature of the proposed disturbance as well as the existing disturbance, and that the survey area is located within the Murchison (MUR) IBRA region, a reconnaissance flora and vegetation survey was deemed adequate.

2.3.1 Licenses

Field work was conducted under Scientific License FB62000171, held by Mr Eren Reid with expiry 08/10/2022.

2.3.2 Field Methods

Prior to the field work, the aerial photography was examined and representative sample sites for relevés were chosen to provide coverage over all viable vegetation types.

In the field, 20m x 20m relevé sites were established at these sites, taking into account representation of surrounding vegetation and vegetation boundaries. Relevé sites are represented in Appendix 4.

Each relevé site was captured on a TwoNav Aventura GPS at ±4m accuracy, using Universal Transverse Mercator location on GDA94 datum. Digital photographs were taken of each representative vegetation group present in the survey area.

Data collected at each relevé included:

- Photograph of representative vegetation group
- GPS Location
- Species Present
- Population Count/Estimate of Conservation Significant Flora (if present)
- Disturbance Level; and
- Vegetation Condition

Specimens of taxa not recognised by the Botanists were collected and pressed along with specimens of taxa recognised as, or thought to be, conservation-significant species.

The vegetation structure was assessed using the method developed by Muir (1977). Definitions of the vegetation structure are presented in Appendix 3.

The condition of each relevé was assessed using the method developed by Keighery (1994). Definitions of the condition scale are presented in Appendix 3.

Vegetation groups were mapped using the methods listed in section 2.3.4. below.

Opportunistic sampling of plant taxa and vegetation group mapping was also utilised in the survey area between relevé sampling points, via wandering traverses. Smaller singular relevé sites were also utilised as opportunistic sample sites to collect flora specimens and assist in mapping vegetation groups.

All sample sites and GPS tracks are included in Appendix 4.

2.3.3 Post-Field Methods

Unknown specimens collected in the field were identified post field work by Frank Obbens (Bushtech Consultancy) and Eren Reid (NVS) with reference to published keys, WAHERB reference herbarium and information published on Florabase (WAHERB, 2022). Threatened flora range extensions and new locations were submitted to the Western Australian Herbarium (WAHERB) as per the EPA Technical Guidelines (EPA 2016a).

Species information was transferred into Microsoft Excel® worksheets representing presence/absence of species per vegetation group.

2.3.4 Mapping

Vegetation mapping was produced via GPS recorded information in the field, cross-referenced with vegetation descriptions made in the field, overlaid on aerial imagery of the survey area. The GPS utilised (TwoNav Aventura GPS) displayed aerial imagery, hence real-time mapping of vegetation groups was available during field work.

Vegetation Health Condition was assessed in the field with reference to Keighery (1994).

GPS tracks and waypoints recorded during field work are presented in Appendix 4.

2.3.5 IBSA Data Package

The Environmental Protection Authority (EPA), Department of Water and Environmental Regulation (DWER) and Department of Mines, Industry Regulation and Safety (DMIRS) require Index of Biodiversity Surveys for Assessments (IBSA) Data Packages to be submitted to support assessment and compliance under the *Environmental Protection Act 1986*.

An IBSA data package is a single file in .zip format, containing:

- one Metadata and Licensing Statement in .pdf format
- one survey report in .pdf format
- one plain-text survey report in .txt format; and
- a set of electronic data files, comprising:
 - one survey details spatial dataset in shapefile (.shp, etc.) or MapInfo (.tab, etc.) format; and
 - one or more survey data spatial datasets, as required, in shapefile (.shp, etc.) or MapInfo (.tab, etc.) format.
 -

The IBSA Data package for this survey has been submitted via the DWER IBSA Submission Portal.

2.4 Nomenclature And Taxonomy

Nomenclature follows that used by the WAHERB.

The WAHERB has updated its sequence and arrangement of collections to conform to the systematic sequence of the Angiosperm Phylogeny Group (APGIII), with the result that many Families and Genera have been moved or renamed. This report attempts to follow those changes in relation to species recorded during this survey. Definitions of Threatened Flora are also included in Section 6 below.

2.5 Limitations

Table 1 lists potential limitations that may have affected the survey.

Table 1: List of potential survey limitations

Potential Limitations	Constraint (Y/N)	Comment
Competency and experience of the consultants undertaking the survey	N	Experienced and competent personnel conducted the survey. Eren Reid has over 18 years' experience in botanical surveys throughout the Murchison Region and over a variety of environments across Western Australia.
Scope	N	The Scope of work was adequately defined. Vascular flora species were the focus of the survey and were thoroughly sampled.
Proportion of flora identified during survey	N	As the survey was planned to target species of conservation significance and flora within a defined survey area, a complete census of the species present was attempted (Approx. 95%). Sufficient identifications were made to allow vegetation descriptions to be made.
Sources of information	N	Threatened and Priority Flora GIS information was available from DBCA.
Proportion of the task achieved	N	All tasks completed.
Timing/Season	N	The reconnaissance flora and vegetation survey was conducted in Autumn 2022. Flowering annual species were present within the survey area, suggesting recent rainfall was sufficient for the period of survey.
Disturbance in survey area	N	Minimal disturbance (Roads and historical exploration) was observed within the survey area, however, did not compromise the results of the survey as these areas were avoided whilst collecting data.
Intensity of survey effort	N	The survey intensity is considered to have been sufficient for a reconnaissance survey according to EPA (2016) guidelines. Areas most likely to contain threatened and priority species were targeted. Vegetation mapping sites were selected to provide adequate coverage of the survey area.
Resources	N	Resources, in terms of time, equipment, support and personnel were adequate to undertake and complete the reconnaissance survey.
Access problems	N	All the areas in need of survey were easily accessible from existing tracks, or by foot.
Availability of contextual information on the region	N	Contextual information regarding vegetation and flora of the Murchison bioregion is readily available. Adequate information was able to be accessed from available databases.

3. RESULTS

3.1 Preliminary Desktop Assessment

3.1.1 EPBC Act Protected Matters

Results of the EPBC Protected Matters search tool are included in Appendix 1. The results revealed that the survey area could possibly contain suitable habitat for the weed species *Carrichtera annua* (Ward's Weed) and *Cenchrus ciliaris* (Buffel grass) (DAWE, 2022a).

Carrichtera annua was introduced into Australia from the eastern Mediterranean, and is now widespread throughout South Australia, the Interior, and Western Australia (Lamp & Collet, 1989). This species is not listed as a declared plant by DPIRD (2022), however according to the EPBC search tool this invasive weed species is considered a threat to the rangeland biodiversity within the Southern Australian Sheep and Cattle Grazing Land Management Zone (DAWE, 2022a).

Cenchrus ciliaris is native to Africa and India, was widely planted in Western Australian pastoral regions as a pasture grass, and has become a widespread weed of roadsides, creeklines, river edges and most vegetation types from Geraldton to the Pilbara, Kimberley and adjacent desert (Hussey, 2007). In the Murchison region it often colonises roadside table drains, excluding native everlastings. It seriously alters the fire characteristics of invaded plant cover by generating highly flammable fuel that is prone to more frequent fires.

The EPBC Protected Matters report indicated no TECs or Commonwealth Reserves within the requested survey area.

3.1.2 Threatened Flora and Communities

The DBCA database searches revealed a potential for no Threatened and 7 Priority Flora species to occur within a 20 km radius of the survey area (DBCA, 2016a). None of these known locations occur within the survey area, while the closest location occurs approximately 8.96 km northeast of the survey area (DBCA, 2016a).

Results of the threatened flora database search are included in Appendix 2, which includes the likelihood of each species to occur within the survey area.

The PEC/TEC search (DBCA, 2016) revealed that no PECs or TECs fall within the survey area. Two PECs are found within 20 km of the survey area, with the closest occurring approximately 0.8 km to the northwest (DBCA, 2016).

3.1.3 Environmentally Sensitive Areas and Conservation Reserves

No ESA's or Conservation reserves are located within the survey area (DWER, 2022).

3.1.4 Land Systems

As part of the Rangeland resource surveys, the Department of Agriculture mapped the Land Systems of Western Australia (DPIRD, 2017). The Land Systems occurring within the survey area are listed in Table 2 below and displayed in Appendix 4.

Table 2: Land Systems occurring within the survey area (DPIRD, 2017)

Land System	Description	Extent of Survey Area (ha)	% Of Survey Area (%)
Carnegie System	Salt lakes with fringing saline alluvial plains, kopi dunes and sandy banks, supporting halophytic shrublands and acacia tall shrublands.	54.91	22.74
Sunrise System	Stony plains supporting mulga shrublands.	17.50	7.25
Monitor System	Distributary alluvial fans and wash plains supporting mulga - chenopod shrublands.	111.75	46.29
Bevon System	Irregular low ironstone hills with stony lower slopes supporting mulga shrublands.	24.06	9.97
Brooking System	Prominent ridges of banded iron formation supporting mulga shrublands and occasional minor halophytic communities.	33.21	13.76

3.1.5 Vegetation Type, Extent and Status

Two vegetation units defined by Beard (1990) were identified as part of the desktop assessment. The vegetation units identify the Pre-European extent of vegetation, as mapped by Beard (1990). The national objectives and targets for biodiversity conservation recognise that the retention of 30% or more of the pre-clearing extent of Beard's vegetation associations is necessary if Australia's biological diversity is to be protected.

Information relating to known Beard (1990) vegetation units within the survey area has been summarised in Table 3, Table 4 and Table 5 below. This information has been compiled through both desktop assessments and the site visit.

The extent of the three Beard vegetation units within the survey area at all scales is less than 1% of the total area at each scale (Table 3). All scales are above the 30% threshold at a State, bioregional and subregional level (Table 4 and Table 5).

Table 3: Extent of Beard Associations within the survey area

Beard Vegetation Association	Extent within survey area (ha)	% of survey area (%)	By Association WA	By Association WA	By IBRA Region (MUR)	By IBRA Sub-region (MUR01)	By Shire (Shire of Laverton)
18	241.371	99.97	<1%	<1%	<1%	<1%	<1%
389	0.067	0.03	<1%	<1%	<1%	<1%	<1%

Table 4: Summary of information regarding Pre-European and current vegetation extent of Vegetation Association 18 within the survey area

Factor	Value				
Beard Vegetation Association*	18				
Vegetation Association Description*	Low woodland; mulga (<i>Acacia aneura</i>)				
Pre-European Extent (ha)	Scale				
	By Association (WA)	By Association (WA)	By IBRA Region (MUR)	By IBRA Sub-region (MUR01)	By Shire (Shire of Laverton)
	22,029,557*	19,892,306.46**	12,403,172.30**	10,269,896.44**	2,878,673.28**
% Pre-European Extent Remaining	100.00%*	99.75%**	99.68%**	99.66%**	99.61%**
Surrounding Land Use***	Mining, Exploration, Pastoral Lease				
Weed prevalence***	Low				

* Source: Shepherd *et al.* (2002) Appendix 2

**Source: DBCA, (2019)

***Source: Field Assessment

Table 5: Summary of information regarding Pre-European and current vegetation extent of Vegetation Association 389 within the survey area

Factor	Value				
Beard Vegetation Association*	389				
Vegetation Association Description*	Succulent steppe with open low woodland; mulga over saltbush				
Pre-European Extent (ha)	Scale				
	By Association (WA)	By Association (WA)	By IBRA Region (MUR)	By IBRA Sub-region (MUR01)	By Shire (Shire of Laverton)
	646,554*	442,356.85**	493,977.54**	493,977.54**	48,520.52**
% Pre-European Extent Remaining	100.00%*	99.71%**	99.62%**	99.62%**	97.61%**
Surrounding Land Use***	Mining, Exploration, Pastoral Lease				
Weed prevalence***	Low				

* Source: Shepherd *et al.* (2002) Appendix 2

**Source: DBCA, (2019)

***Source: Field Assessment

3.1.6 Wetlands

The DWER Clearing Permit System Map Viewer revealed no waterbodies occur within the survey area (DWER, 2022). The closest waterbody lies 0.2 km to the south of the survey area.

3.1.7 Dieback

The survey area lies south of the 26th parallel, however receives average annual rainfall of 275.5 mm. There is no record of *Phytophthora cinnamomi* establishing in natural ecosystems in regions receiving less than 400mm rainfall per annum (CALM, 2003). Therefore, Dieback is not

considered an issue for this survey area, however all measures should be taken to prevent any possible soil contamination (seeds of non-native species *etc.*) which poses a risk in the survey area during seasonally favourable conditions.

3.2 Field Assessment

3.2.1 Threatened Flora

No Threatened or Priority Flora were recorded in the survey area.

3.2.2 Vegetation Type, Extent and Status

A total of 19 Families, 34 Genera and 89 Species were recorded within the survey area. Eight major vegetation groups were recorded in the survey area and range from Good to Very Good (using the scale of Keighery 1994, see Appendix 3). Existing disturbance occurring in the survey area ranged from Completely degraded to degraded and included historic access tracks, haul roads and powerline corridors.

No unique or restricted vegetation communities were identified, and all vegetation types/communities are common, widespread and well represented in the Eastern Murchison subregion.

The summary of vegetation groups contained within the survey area is summarised in Table 6 below. Maps of the survey area can be seen in Appendix 4.

Table 6: Vegetation Group Summary

Vegetation Group	Veg Group Code	Families	Genera	Species	Area (ha)	Percentage of survey area (%)
Open Mulga woodland over <i>Acacia kalgoorliensis</i> and Chenopod shrublands	A	10	15	32	34.40	14.25
Mulga Creekline Vegetation	B	12	21	41	62.98	26.09
Mulga woodland over <i>Eremophila forrestii</i> over tussock grassland on sandy plains	C	8	14	23	39.78	16.48
Open Chenopodiaceae Shrubland	D	10	13	23	38.76	16.05
Mulga shrubland over BIF rocky outcrops	E	9	11	21	8.92	3.69
<i>Tecticornia</i> shrubland	F	3	5	7	1.03	0.43
Open Mulga Woodland	G	9	13	27	41.71	17.28
Mulga over <i>Maireana sedifolia</i> and sclerophyll shrubland	H	10	11	22	6.60	2.73
Existing Disturbance	N/A	N/A	N/A	N/A	7.25	3.00
Total		19*	34*	89*	241.4#	100%#

Note: * Within total survey area (not sum of column)
Sum of column

The GSM Solar Farm Expansion vegetation groups are described in more detail below

3.2.2.1 Open Mulga woodland over *Acacia kalgoorliensis* and Chenopod shrublands (A)

This Scrub (Muir, 1977) consisted of 10 Families, 15 Genera and 32 Species. The vegetation group was approximately 34.40 ha which makes up 14.25% of the survey area.



Figure 4: Vegetation Group A within the survey area

3.2.2.2 Mulga Creekline Vegetation (B)

This Thicket (Muir, 1977) consisted of 12 Families, 21 Genera and 41 Species. The vegetation group was approximately 62.98 ha which makes up 26.09% of the survey area.



Figure 5: Vegetation Group B within the survey area

3.2.2.3 Mulga woodland over *Eremophila forrestii* over tussock grassland on sandy plains (C)

This Scrub (Muir, 1977) consisted of 8 Families, 14 Genera and 23 Species. The vegetation group was approximately 39.78 ha which makes up 16.48% of the survey area.



Figure 6: Vegetation Group C within the survey area

3.2.2.4 Open Chenopodiaceae Shrubland (D)

This Low Scrub B (Muir, 1977) consisted of 10 Families, 13 Genera and 23 Species. The vegetation group was approximately 38.76 ha which makes up 16.05% of the survey area.



Figure 7: Vegetation Group D within the survey area

3.2.2.5 Mulga shrubland over BIF rocky outcrops (E)

This Scrub (Muir, 1977) consisted of 9 Families, 11 Genera and 21 Species. The vegetation group was approximately 8.92 ha which makes up 3.69% of the survey area.



Figure 8: Vegetation Group E within the survey area

3.2.2.6 *Tecticornia* shrubland (F)

This Low Heath D (Muir, 1977) consisted of 3 Families, 5 Genera and 7 Species. The vegetation group was approximately 1.03 ha which makes up 0.43% of the survey area.



Figure 9: Vegetation Group F within the survey area

3.2.2.7 Open Mulga shrubland (G)

This Open Scrub (Muir, 1977) consisted of 9 Families, 13 Genera and 27 Species. The vegetation group was approximately 41.71 ha which makes up 17.28% of the survey area.



Figure 10: Vegetation Group G within the survey area

3.2.2.8 Mulga over *Maireana sedifolia* and sclerophyll shrubland (H)

This Scrub (Muir, 1977) consisted of 10 Families, 11 Genera and 22 Species. The vegetation group was approximately 6.60 ha which makes up 2.73% of the survey area.



Figure 11: Vegetation Group H within the survey area

3.2.2.9 Existing Disturbance

Existing disturbance within the survey area consisted of historic access tracks, haul roads and powerline corridors and was approximately 7.25 ha which makes up 3.00% of the survey area.

No picture available for the existing disturbance.

3.2.3 Weeds

No weed species were recorded within the survey area.

3.2.4 Vegetation Condition

Evidence of historic exploration was observed during the field assessment. A number of access roads, gazetted roads and powerline corridors also run through the survey area.

Overall, the condition of the vegetation was determined to range from “Completely Degraded” to “Very Good” with most of the area falling into the “Good” Category. Areas which were affected by historic exploration were deemed in “Degraded” condition. A map of the vegetation condition within the survey is depicted in Appendix 4.

4. DISCUSSION

The field assessment established that the condition of the vegetation in the proposed disturbance area ranged from “Good” to “Very Good” with most of the area falling into the “Good” Category. Areas which were disturbed by roads and powerline corridors were categorised as “Completely Degraded” or “Degraded” and areas affected by historic exploration were deemed in “Degraded” condition. No areas of vegetation were assessed to be in “Pristine” condition.

No weed species were recorded within the survey area.

No Priority or Threatened Flora were recorded in the survey area, (DBCA, 2016a).

No TECs or PECs were recorded in the survey area.

No unique or restricted vegetation communities were identified, and all vegetation types/communities are common, widespread and well represented in the Eastern Murchison subregion.

Any proposed disturbance/clearing of vegetation will result in a loss of species. However, given the size of the area and the extent of the Beard (1990) vegetation association elsewhere, the impact on the vegetation and its component flora will not affect the conservation values of either, or create fragmentation or patches of remnant vegetation.

The following recommendations arise from the reconnaissance flora survey:

- Weed control measures should be implemented during and following earthworks; and
- Dust control measures should be implemented during earthworks.

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6. GLOSSARY

Acronyms:

BOM	Bureau of Meteorology, Australian Government
BSc	Bachelor of Science
CALM	Department of Conservation and Land Management (now DBCA)
CPS	Clearing Permit System (DWER)
DBCA	Department of Biodiversity, Conservation and Attractions, Western Australia
DMIRS	Department of Mines, Industry Regulation and Safety, Western Australia
DOTEE	Department of the Environment and Energy, Australian Government
DPAW	Department of Parks and Wildlife, Western Australia (now DBCA)
DPIRD	Department of Primary Industries and Regional Development, Western Australia
DRF	Declared Rare Flora (now classed as Threatened Flora)
DWER	Department of Water and Environmental Regulation, Western Australia
EPA	Environmental Protection Authority, Western Australia
EP Act	<i>Environmental Protection Act 1986</i> , Western Australia
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i> (Commonwealth Act)
ESA	Environmentally Sensitive Area
GIS	Geographical Information System
ha	Hectare (10,000 square metres)
IBRA	Interim Biogeographic Regionalisation for Australia, DOTEE
IUCN	International Union for the Conservation of Nature and Natural Resources – commonly known as the World Conservation Union
km	Kilometres
m	Metres
MUR	Murchison Bioregion (IBRA)
MUR01	Eastern Murchison Subregion (IBRA)
NVS	Native Vegetation Solutions
PEC	Priority Ecological Community, Western Australia
Ramsar	A wetland site designated of international importance under the Ramsar Convention (UNESCO)
TEC	Threatened Ecological Community
UNESCO	United Nations Educational, Scientific and Cultural Organization
WA	Western Australia
WAHERB	Western Australian Herbarium (DBCA)

Definitions:

{DBCA (2019) Conservation Codes for Western Australian Flora and Fauna. Department of Biodiversity, Conservation and Attractions, Western Australia, January 2019}: -

T Threatened species:

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.

CR Critically endangered species

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.

EN Endangered species

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.

VU Vulnerable species

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.

EX Extinct species

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.

EW Extinct in the wild species

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.

MI Migratory species

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*.

CD Species of special conservation interest (conservation dependent fauna)

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*.

OS Other specially protected species

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*.

P Priority Species

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

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

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

Priority 1: Poorly-known species

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

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

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

(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 1

Relevant Government Database Search Results



EPBC Act Protected Matters Report

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

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

Information is available about [Environment Assessments](#) and the EPBC Act including significance guidelines, forms and application process details.

Report created: 04/08/22 16:39:44

[Summary](#)

[Details](#)

[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

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[Buffer: 3.0Km](#)

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Summary

Matters of National Environmental Significance

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

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	4
Listed Migratory Species:	8

Other Matters Protected by the EPBC Act

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

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

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

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	10
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

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

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	10
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat may occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area
Polytelis alexandrae Princess Parrot, Alexandra's Parrot [758]	Vulnerable	Species or species habitat likely to occur within area
Mammals		
Sminthopsis psammophila Sandhill Dunnart [291]	Endangered	Species or species habitat may occur within area
Listed Migratory Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat likely to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat may occur within area

Extra Information

Invasive Species

[\[Resource Information \]](#)

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

Name	Status	Type of Presence
Birds		
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Mammals		
Camelus dromedarius Dromedary, Camel [7]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Equus asinus Donkey, Ass [4]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Carrichtera annua Ward's Weed [9511]		Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within

Name	Status	Type of Presence area
------	--------	--------------------------

Caveat

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

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

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

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

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

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

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

- migratory and
- marine

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

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

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

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

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

Coordinates

-28.83697 122.34092,-28.83705 122.36049,-28.84909 122.36049,-28.85475 122.34084,-28.83697 122.34092

Acknowledgements

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

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

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

Please feel free to provide feedback via the [Contact Us](#) page.

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Survey area

LAVERTON, SHIRE OF

SLIP

1 km

mapworks

122° 20.175' E 28° 51.397667' S

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DWER's Clearing Permit System Map Viewer showing no ESA's (dark green shaded areas) within the survey area (DWER, 2022)

← → ↻ cps.dwer.wa.gov.au/main.html#%5B%7B%22xclass%3A%22%3A%22app.map.Main%22%3A%22%7B%22xclass%3A%22%3A%22app.Content%22%7D%5D

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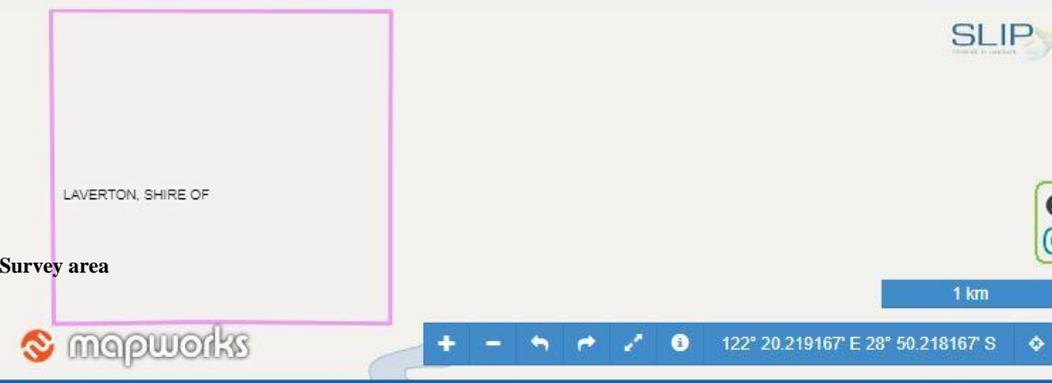
Search:

Map Layers Tools Draw Info Fullscreen

Add Remove Group

- Waterbodies - Very Small ✓
- Waterbodies - Small ✓
- Waterbodies - Medium ✓
- Waterbodies - Large ✓

Survey area



mapworks

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DWER Clearing Permit System Map Viewer showing waterbodies within the survey area (DWER, 2022)

Appendix 2

Threatened Flora Databases Search Results

GIS information provided in the Search results (Reference: 19_1316FL) listed the following species within a 20 km radius of the survey area (DBCA, 2016a):

Taxon	Conservation Code	Comment (Post field work)
<i>Calytrix praecipua</i>	P3	Not Likely- No suitable habitat
<i>Goodenia lyrata</i>	P3	Not Likely- Possible suitable habitat, extensively searched
<i>Gunniopsis propinqua</i>	P3	Not Likely- Possible suitable habitat, extensively searched
<i>Olearia mucronata</i>	P3	Not Likely- Possible suitable habitat, extensively searched
<i>Tecticornia cymbiformis</i>	P3	Not Likely- Possible limited suitable habitat, extensively searched
<i>Tecticornia</i> sp. Lake Way (P. Armstrong 05/961)	P1	Not Likely- Possible limited suitable habitat, extensively searched
<i>Phyllanthus baeckeoides</i>	P3	Not Likely- Possible suitable habitat, extensively searched

Appendix 3

Vegetation Definitions

Vegetation Condition Definitions (Keighery, 1994)

Pristine (1). Pristine or nearly so, no obvious signs of disturbance.

Excellent (2). Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.

Very Good (3). Vegetation structure altered, obvious signs of disturbance.
For example, disturbance to vegetation structure caused by repeating fires, the presence of some more aggressive weeds, dieback, logging and grazing.

Good (4). Vegetation structure significantly altered by very obvious signs of multiple disturbance.

Retains basic vegetation structure or ability to regenerate it.

For example, disturbance to vegetation structure caused by frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.

Degraded (5). Basic vegetation structure severely impacted by disturbance.

Scope for regeneration but not to a state approaching good condition without intensive management.

For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.

Completely Degraded (6). The structure of the vegetation is no longer intact and the area is completely or almost completely without native species.

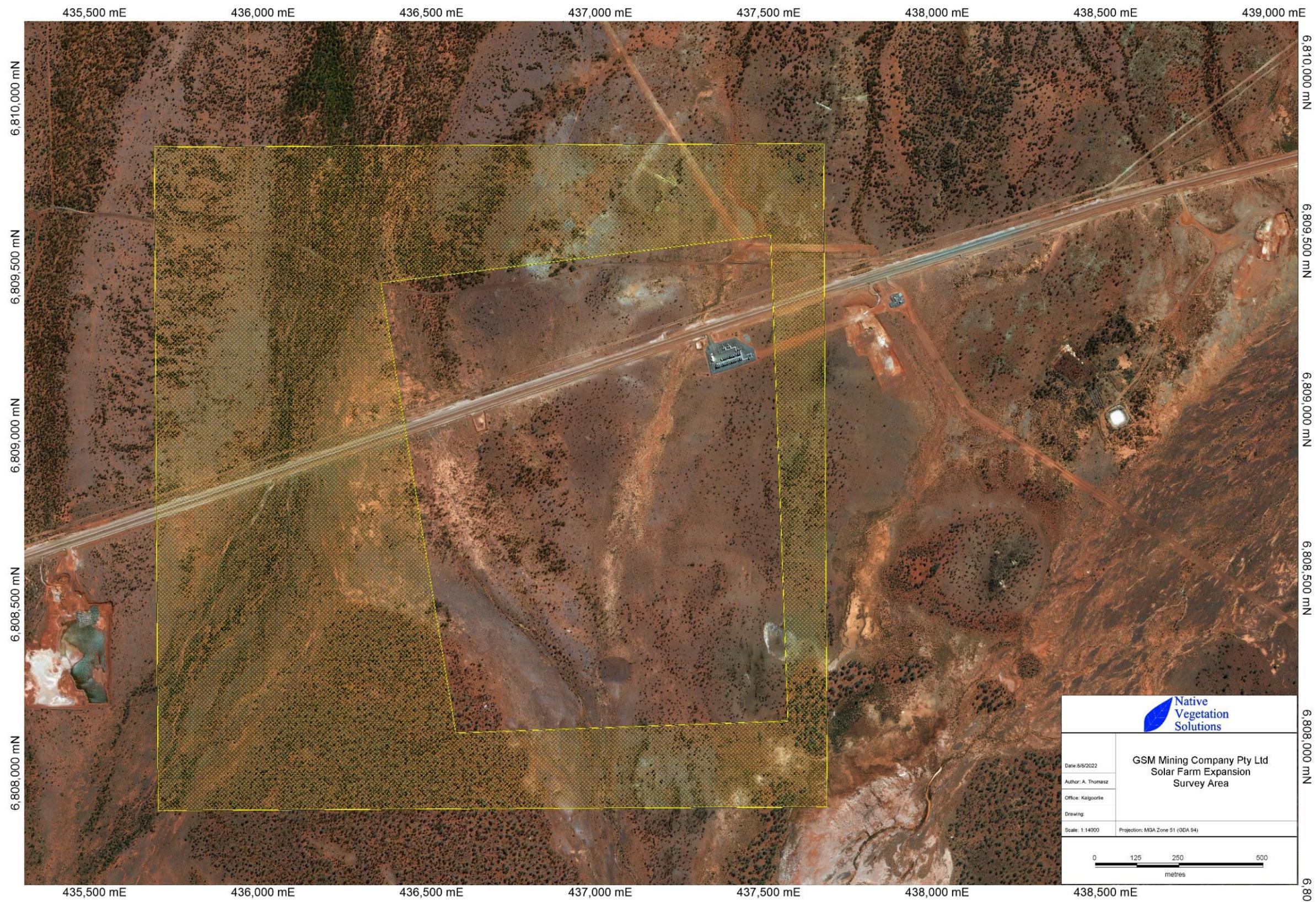
These areas are often described as 'parkland cleared' with the flora compromising weed or crop species with isolated trees or shrubs.

Vegetation Structure Definitions (Muir, 1977)

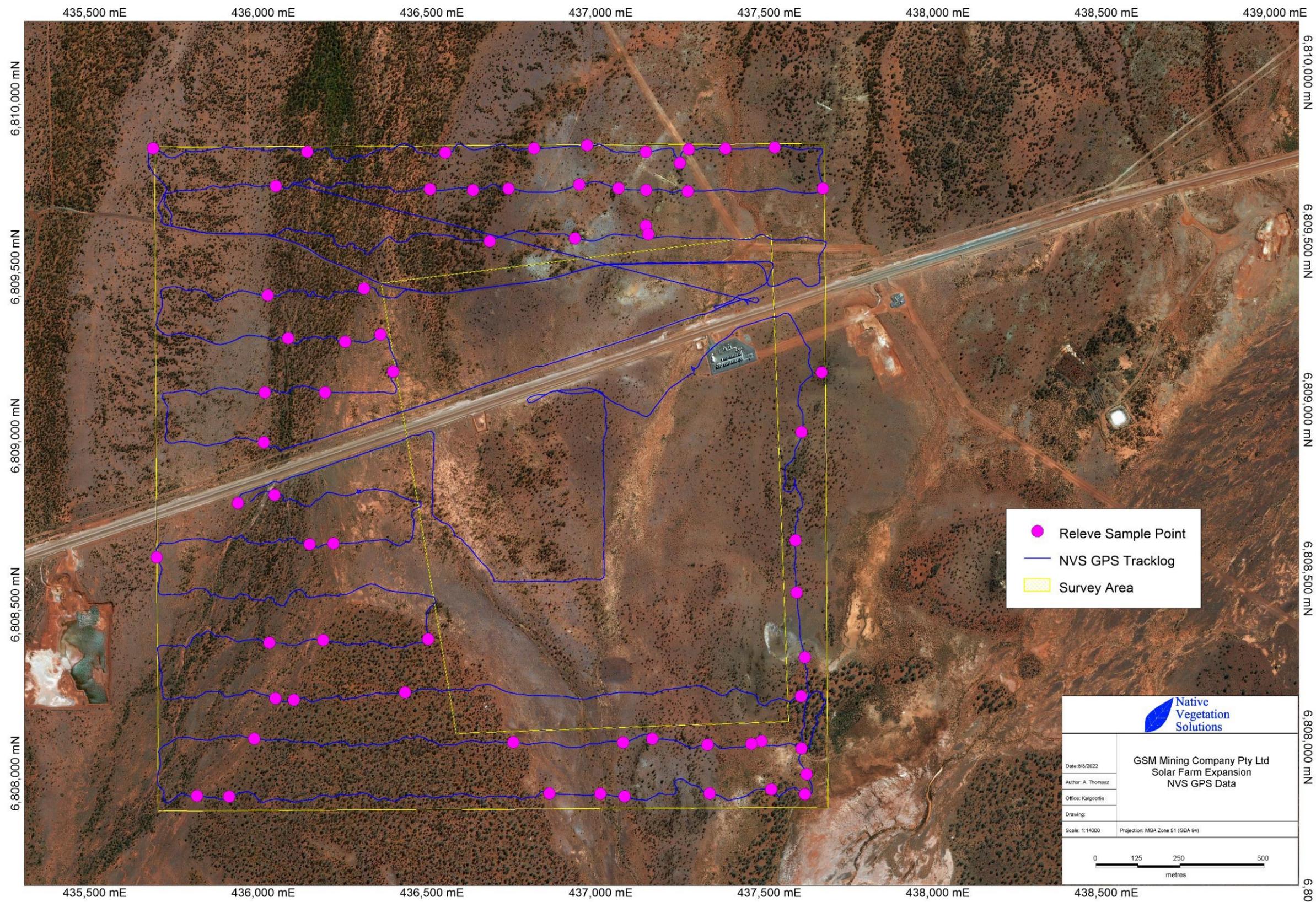
Life Form/Height Class	Canopy Cover			
	Dense 70-100% d	Mid-Dense 30-70% c	Sparse 10-30% i	Very Sparse 2-10% r
T Trees>30m	Dense Tall Forest	Tall Forest	Tall Woodland	Open Tall Woodland
M Trees 15-30m	Dense Forest	Forest	Woodland	Open Woodland
LA Trees 5-15m	Dense Low Forest A	Low Forest A	Low Woodland A	Open Low Woodland A
LB Trees<5m	Dense Low Forest B	Low Forest B	Low Woodland B	Open Low Woodland B
KT Mallee tree form	Dense Tree Mallee	Tree Mallee	Open Tree Mallee	Very Open Tree Mallee
KS Mallee shrub form	Dense Shrub Mallee	Shrub Mallee	Open Shrub Mallee	Very Open Shrub Mallee
S Shrubs>2m	Dense Thicket	Thicket	Scrub	Open Scrub
SA Shrubs 1.5-2.0m	Dense Heath A	Heath A	Low Scrub A	Open Low Scrub A
SB Shrubs 1.0-1.5m	Dense Heath B	Heath B	Low Scrub B	Open Low Scrub B
SC Shrubs 0.5-1.0m	Dense Low Heath C	Low Heath C	Dwarf Scrub C	Open Dwarf Scrub C
SD Shrubs 0.0-0.5m	Dense Low Heath D	Low Heath D	Dwarf Scrub D	Open Dwarf Scrub D
P Mat plants	Dense Mat Plants	Mat Plants	Open Mat Plants	Very Open Mat Plants
H Hummock Grass	Dense Hummock Grass	Mid-Dense Hummock Grass	Hummock Grass	Open Hummock Grass
GT Bunch grass >0.5m	Dense Tall Grass	Tall Grass	Open Tall Grass	Very Open Tall Grass
GL Bunch grass <0.5m	Dense Low Grass	Low Grass	Open Low Grass	Very Open Low Grass
J Herbaceous spp.	Dense Herbs	Herbs	Open Herbs	Very Open Herbs
VT Sedges >0.5m	Dense Tall Sedges	Tall Sedges	Open Tall Sedges	Very Open Tall Sedges
VL Sedges <0.5m	Dense Low Sedges	Low Sedges	Open Low Sedges	Very Open Low Sedges
X Ferns	Dense Ferns	Ferns	Open Ferns	Very Open Ferns
Mosses, liverwort	Dense Mosses	Mosses	Open Mosses	Very Open Mosses

Appendix 4

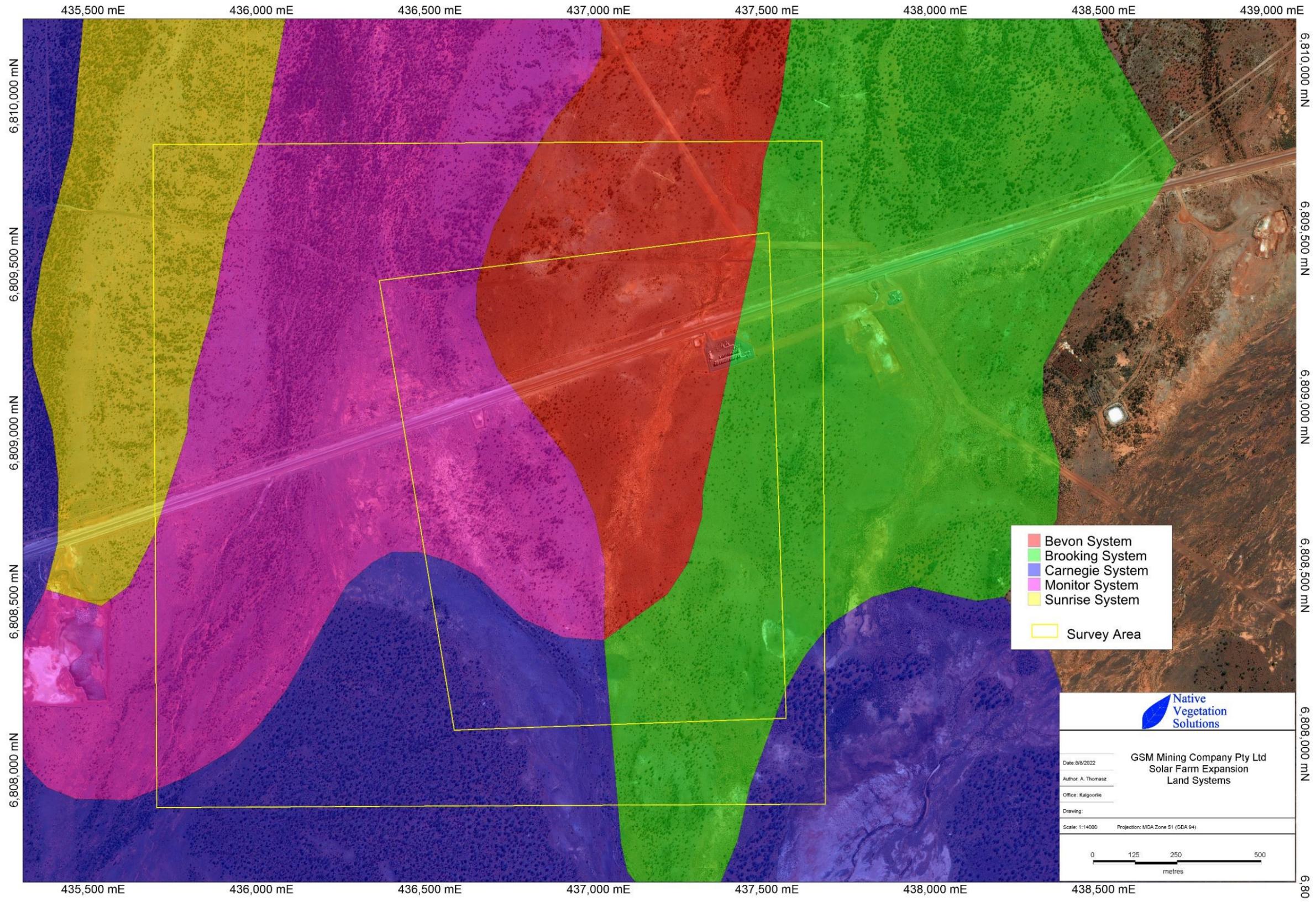
Vegetation Mapping



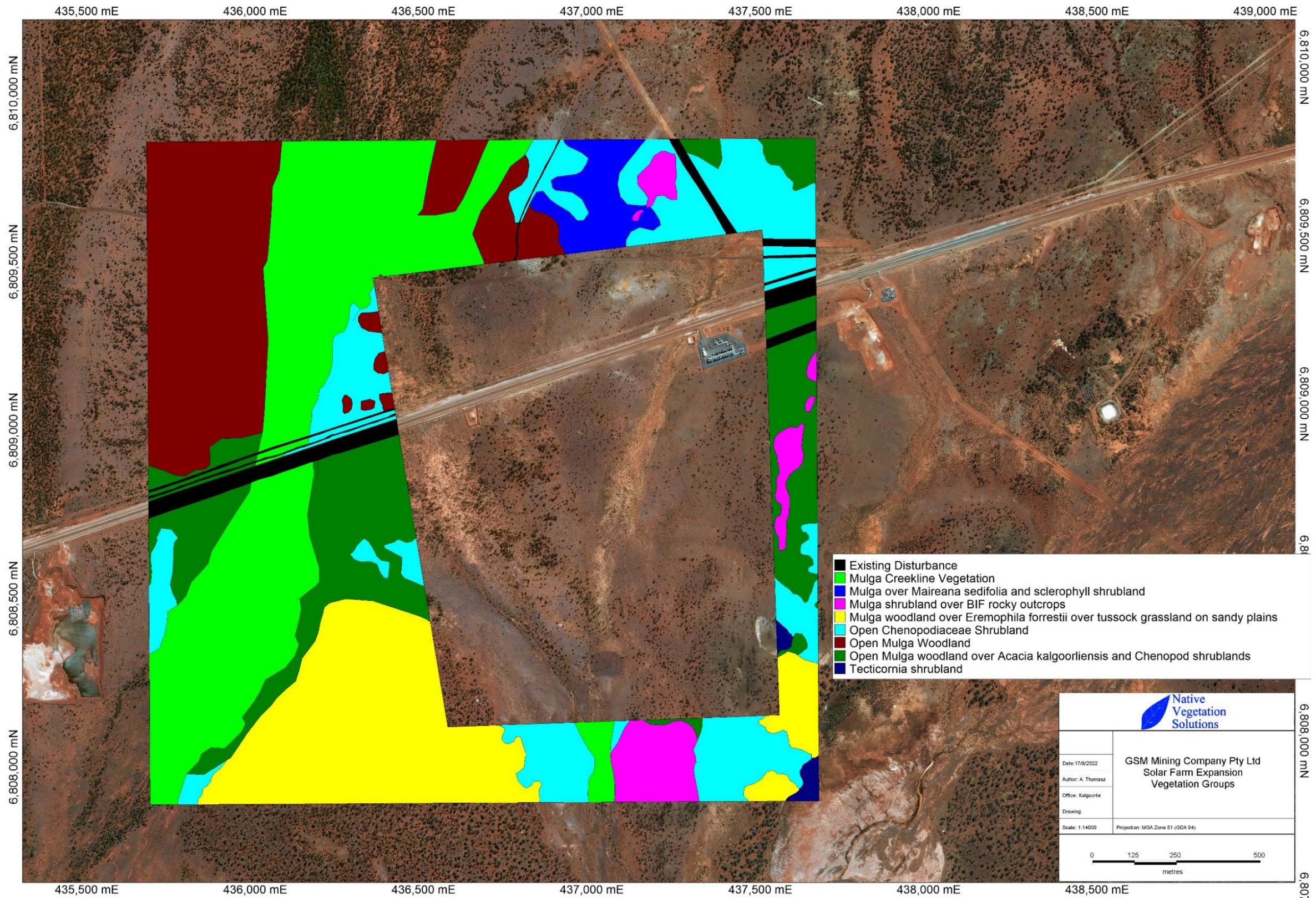
Map 1: GSM Solar Farm Expansion survey area



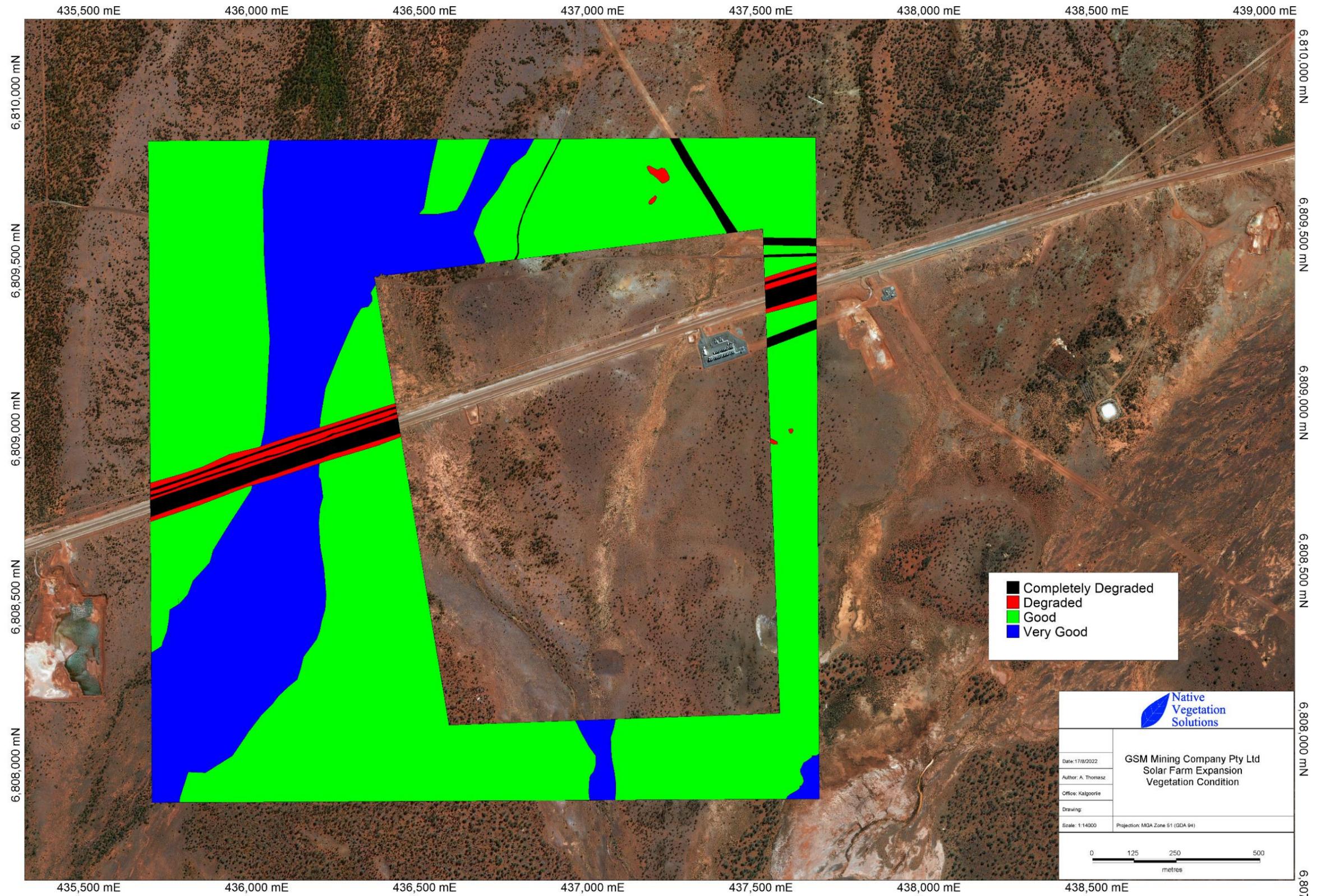
Map 2: NVS GPS Data for the GSM Solar Farm Expansion Area



Map 3: Land Systems for the GSM Solar Farm Expansion Area



Map 4: Vegetation Groups for the GSM Solar Farm Expansion Area



Map 5: Vegetation Condition for the GSM Solar Farm Expansion Area

Appendix 5

Species List

Species List per Vegetation Group

Family	Genus	Species	A	B	C	D	E	F	G	H
Amaranthaceae	<i>Ptilotus</i>	<i>Ptilotus divaricatus</i>	*	*	*	*	*		*	*
Amaranthaceae	<i>Ptilotus</i>	<i>Ptilotus obovatus</i>		*	*					
Amaranthaceae	<i>Ptilotus</i>	<i>Ptilotus schwartzii</i>	*	*						
Apocynaceae	<i>Leichhardtia</i>	<i>Leichhardtia australis</i>		*	*				*	*
Asteraceae	<i>Cratystylis</i>	<i>Cratystylis subspinescens</i>					*			
Asteraceae	<i>Rhodanthe</i>	<i>Rhodanthe charsleyae</i>		*	*				*	
Asteraceae	<i>Rhodanthe</i>	<i>Rhodanthe floribunda</i>	*				*			
Chenopodiaceae	<i>Atriplex</i>	<i>Atriplex bunburyana</i>								*
Chenopodiaceae	<i>Atriplex</i>	<i>Atriplex codonocarpa</i>			*					
Chenopodiaceae	<i>Atriplex</i>	<i>Atriplex nummularia</i> subsp. <i>spathulata</i>	*	*	*		*		*	
Chenopodiaceae	<i>Atriplex</i>	<i>Atriplex stipitata</i>	*							
Chenopodiaceae	<i>Enchylaena</i>	<i>Enchylaena tomentosa</i> var. <i>tomentosa</i>		*						
Chenopodiaceae	<i>Maireana</i>	<i>Maireana brevifolia</i>	*						*	*
Chenopodiaceae	<i>Maireana</i>	<i>Maireana georgei</i>	*	*			*		*	*
Chenopodiaceae	<i>Maireana</i>	<i>Maireana glomerifolia</i>			*					
Chenopodiaceae	<i>Maireana</i>	<i>Maireana planifolia</i>		*						
Chenopodiaceae	<i>Maireana</i>	<i>Maireana pyramidata</i>	*	*	*					
Chenopodiaceae	<i>Maireana</i>	<i>Maireana sedifolia</i>	*	*	*	*	*	*	*	
Chenopodiaceae	<i>Maireana</i>	<i>Maireana trichoptera</i>	*	*						
Chenopodiaceae	<i>Maireana</i>	<i>Maireana triptera</i>	*							
Chenopodiaceae	<i>Rhagodia</i>	<i>Rhagodia drummondii</i>		*		*			*	
Chenopodiaceae	<i>Sclerolaena</i>	<i>Sclerolaena densiflora</i>	*			*				
Chenopodiaceae	<i>Sclerolaena</i>	<i>Sclerolaena diacantha</i>					*			
Chenopodiaceae	<i>Sclerolaena</i>	<i>Sclerolaena patenticuspis</i>					*			
Chenopodiaceae	<i>Tecticornia</i>	<i>Tecticornia ?undulata</i>		*		*				
Chenopodiaceae	<i>Tecticornia</i>	<i>Tecticornia indica</i>		*	*					
Chenopodiaceae	<i>Tecticornia</i>	<i>Tecticornia undulata</i>								*
Fabaceae	<i>Acacia</i>	<i>Acacia aneura</i>	*	*					*	
Fabaceae	<i>Acacia</i>	<i>Acacia ayersiana</i>		*	*					
Fabaceae	<i>Acacia</i>	<i>Acacia burkittii</i>		*						
Fabaceae	<i>Acacia</i>	<i>Acacia craspedocarpa</i>		*	*					
Fabaceae	<i>Acacia</i>	<i>Acacia grasbyi</i>	*	*	*				*	
Fabaceae	<i>Acacia</i>	<i>Acacia incurvaneura</i>			*					
Fabaceae	<i>Acacia</i>	<i>Acacia kalgoorliensis</i>		*	*					
Fabaceae	<i>Acacia</i>	<i>Acacia kempeana</i>	*							
Fabaceae	<i>Acacia</i>	<i>Acacia ligulata</i>	*							
Fabaceae	<i>Acacia</i>	<i>Acacia mulganeura</i>		*						
Fabaceae	<i>Acacia</i>	<i>Acacia oswaldii</i>	*							
Fabaceae	<i>Acacia</i>	<i>Acacia pteraneura</i>				*	*		*	
Fabaceae	<i>Acacia</i>	<i>Acacia ramulosa</i> var. <i>ramulosa</i>		*		*				
Fabaceae	<i>Acacia</i>	<i>Acacia tetragonophylla</i>	*	*			*		*	
Fabaceae	<i>Acacia</i>	<i>Acacia victoriae</i>				*				
Fabaceae	<i>Daviesia</i>	<i>Daviesia aphylla</i>		*						*
Fabaceae	<i>Senna</i>	<i>Senna artemisioides</i> subsp. <i>xartemisioides</i>				*				*
Fabaceae	<i>Senna</i>	<i>Senna artemisioides</i> subsp. <i>xsturtii</i>	*							
Fabaceae	<i>Senna</i>	<i>Senna artemisioides</i> subsp. <i>filifolia</i>							*	

Family	Genus	Species	A	B	C	D	E	F	G	H
Fabaceae	<i>Senna</i>	<i>Senna artemisioides</i> subsp. <i>helmsii</i>	*							
Fabaceae	<i>Senna</i>	<i>Senna glutinosa</i> subsp. <i>chatelainiana</i>						*		
Frankeniaceae	<i>Frankenia</i>	<i>Frankenia ?pauciflora</i>				*				
Frankeniaceae	<i>Frankenia</i>	<i>Frankenia interioris</i>			*					
Frankeniaceae	<i>Frankenia</i>	<i>Frankenia setosa</i>	*			*	*			*
Goodeniaceae	<i>Scaevola</i>	<i>Scaevola spinescens</i>				*	*	*		
Lamiaceae	<i>Teucrium</i>	<i>Teucrium teucriiflorum</i>								*
Loranthaceae	<i>Amyema</i>	<i>Amyema preissii</i>				*				
Malvaceae	<i>Lawrenzia</i>	<i>Lawrenzia squamata</i>	*			*	*		*	
Malvaceae	<i>Sida</i>	<i>Sida ectogama</i>	*			*	*			
Poaceae	<i>Aristida</i>	<i>Aristida contorta</i>							*	
Poaceae	<i>Austrostipa</i>	<i>Austrostipa elegantissima</i>		*		*				*
Poaceae	<i>Enneapogon</i>	<i>Enneapogon caeruleescens</i>				*				*
Poaceae	<i>Enteropogon</i>	<i>Enteropogon ramosus</i>								*
Poaceae	<i>Eragrostis</i>	<i>Eragrostis eriopoda</i>	*	*		*	*		*	*
Poaceae	<i>Triodia</i>	<i>Triodia scariosa</i>					*			
Proteaceae	<i>Grevillea</i>	<i>Grevillea sarissa</i>			*					
Proteaceae	<i>Hakea</i>	<i>Hakea preissii</i>			*					
Pteridaceae	<i>Cheilanthes</i>	<i>Cheilanthes lasiophylla</i>		*						
Pteridaceae	<i>Cheilanthes</i>	<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>	*	*	*	*	*		*	*
Rubiaceae	<i>Psyrax</i>	<i>Psyrax rigidula</i>					*		*	*
Rubiaceae	<i>Psyrax</i>	<i>Psyrax suaveolens</i>			*					
Rutaceae	<i>Philotheca</i>	<i>Philotheca brucei</i> subsp. <i>brucei</i>		*						
Santalaceae	<i>Santalum</i>	<i>Santalum lanceolatum</i>		*						
Santalaceae	<i>Santalum</i>	<i>Santalum spicatum</i>	*							*
Sapindaceae	<i>Dodonaea</i>	<i>Dodonaea rigida</i>		*					*	
Scrophulariaceae	<i>Eremophila</i>	<i>Eremophila compacta</i>	*	*	*		*		*	*
Scrophulariaceae	<i>Eremophila</i>	<i>Eremophila falcata</i>							*	
Scrophulariaceae	<i>Eremophila</i>	<i>Eremophila forrestii</i> subsp. <i>forrestii</i>	*	*		*		*	*	
Scrophulariaceae	<i>Eremophila</i>	<i>Eremophila georgei</i>	*	*					*	
Scrophulariaceae	<i>Eremophila</i>	<i>Eremophila glabra</i> subsp. <i>glabra</i>		*					*	*
Scrophulariaceae	<i>Eremophila</i>	<i>Eremophila latrobei</i>	*	*		*	*			
Scrophulariaceae	<i>Eremophila</i>	<i>Eremophila latrobei</i> subsp. <i>filiformis</i>		*	*					*
Scrophulariaceae	<i>Eremophila</i>	<i>Eremophila latrobei</i> subsp. <i>latrobei</i>	*			*	*			
Scrophulariaceae	<i>Eremophila</i>	<i>Eremophila longifolia</i>								*
Scrophulariaceae	<i>Eremophila</i>	<i>Eremophila metallicorum</i>		*					*	
Scrophulariaceae	<i>Eremophila</i>	<i>Eremophila miniata</i>		*		*			*	*
Scrophulariaceae	<i>Eremophila</i>	<i>Eremophila oldfieldii</i> subsp. <i>angustifolia</i>	*							
Scrophulariaceae	<i>Eremophila</i>	<i>Eremophila pantonii</i>						*		
Scrophulariaceae	<i>Eremophila</i>	<i>Eremophila scoparia</i>						*		
Scrophulariaceae	<i>Eremophila</i>	<i>Eremophila youngii</i>						*		
Solanaceae	<i>Solanum</i>	<i>Solanum lasiophyllum</i>		*					*	
Solanaceae	<i>Solanum</i>	<i>Solanum nummularium</i>			*					

Appendix C Terrestrial Ecosystems (2018)



Vertebrate Fauna Risk Assessment for the Granny Smith Solar Power Farm Project



Version 1. November 2018

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Front Cover: Fauna habitat in the project area

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EXECUTIVE SUMMARY

Granny Smith Mining Company Pty Ltd (GSM) requested a vertebrate fauna risk assessment to support the preparation of environmental approval applications (mining proposal and clearing permit) for the proposed Solar Power Farm project (i.e. project area). The project is located adjacent to the existing Wallaby to Granny Smith haul road.

The total assessed area was approximately 150ha but only about 30ha of this area will be disturbed. There are four broad fauna habitats in the project area:

- Open mulga woodland over scattered low shrubs and grasses of varying densities on a stony sandy-clay or sandy-clay substrate;
- Open chenopod shrubland over grasses of varying densities on a stony sandy-clay or sandy-clay substrate;
- Chenopod and mulga shrubland over scattered grasses of varying densities on a stony sandy-clay or sandy-clay substrate; and
- Banded ironstone rocky ridgeline with scattered Mulga and shrubs.

The density of trees and shrubs in the relatively undisturbed areas varied across the project area but was mostly sparse. The fauna habitat varies from degraded to good; the more degraded areas are due to historical and recent exploration activity and cattle grazing. There are a few access tracks in the area, but these are narrow and mostly only wheel tracks on a stony red sand-clay substrate.

The area has been grazed by cattle with many areas showing obvious degradation (i.e. cattle tracks, chewed bushes and shrubs, etc). There was extensive evidence of rabbits and other feral fauna in the area.

The banded ironstone formation habitat type is significant for Long-tailed Dunnarts in the region. Therefore this habitat type should be avoided where practical and linkage corridors between this habitat type maintained, to facilitate the movement of these dunnarts between rocky outcrops. Clearing native vegetation in other habitat types is likely to result in the loss of small vertebrate fauna on-site that are unable to move away during the clearing process. The few larger animals, such as kangaroos and large goannas and snakes, and most of the birds will move into adjacent areas once clearing commences. Construction of a solar farm will have a minimal impact on the fauna in areas adjacent to those that will be cleared. There will be an on-going loss of small native fauna to vehicle strikes on access tracks but this will be very low. Migrants increase competition for resources, which may result in the subsequent loss of migrants or local individuals. Individuals shifted out of their established activity areas are also vulnerable to predation until they have become established in their new areas.

Impacts on vertebrate fauna associated with clearing vegetation in the project area in a landscape or bioregional context are likely to be low as there are vast tracts of similar habitat in adjacent areas.

The proposed project is unlikely to significantly impact on a conservation significant species, so a referral under the *EPBC Act* is not required.

It is recommended that:

- an induction program that includes a component on managing fauna is a mandatory component of working on the Petra project;
- the impact of dust on adjacent vegetation and fauna habitat is managed and monitored against appropriate KPIs;
- any development avoids impacting on the banded ironstone habitat and linkage between these habitat type (i.e. rocky hills) are maintained;
- if the banded ironstone habitat or linkages between the rocky areas will be impacted an assessment on the regional abundance and distribution of the Long-tailed Dunnart should be undertaken to provide a context for the potential impacts;
- implement a feral cat control program; and
- investigate options for management of rabbits in the area.

1 INTRODUCTION

1.1 Background

Granny Smith Mining Company Pty Ltd (Granny Smith) is an Australian mineral exploration and gold producing company with major tenements in the eastern Goldfields of Western Australia.

Granny Smith requested a vertebrate fauna risk assessment to support the preparation of environmental approvals (mining proposal and clearing permit) for the proposed Solar Power Farm project (i.e. project area). The assessed area was approximately 150ha; however, the anticipated disturbance footprint is only approximately 30ha.

1.2 Project objectives and scope of works

Terrestrial Ecosystems was commissioned by Granny Smith to undertake a Level 1 vertebrate fauna risk assessment development of the solar farm project. The purpose of this Level 1 fauna risk assessment was to provide information to the Department of Mines, Industry Regulation and Safety (DMIRS) regarding the potential impacts on the vertebrate fauna assemblage in the project area to enable the proposed development to be adequately assessed. The methodology broadly follows that described in the Environmental Protection Authority (EPA; 2016) *Technical Guidance Terrestrial Fauna Surveys*.

A typical Level 1 fauna risk assessment involves undertaking a desktop review and site visit. The objectives of this fauna risk assessment were to:

- provide an indication of the vertebrate fauna assemblage (reptiles, amphibians, mammals and birds) on and near the project area, so that potential impacts on the fauna and fauna assemblage might be adequately assessed;
- identify the presence and/or potential risk of impacts on species of conservation significance that are present or likely to be present in the project area;
- assess the impact and environmental risks associated with the proposed development on the fauna assemblage;
- determine if any additional surveys are required to assess the potential impact on fauna assemblages in the project area including impacts on species of conservation significance; and
- make recommendations that avoid, mitigate or minimise potential impacts on resident fauna.

To achieve these objectives, Terrestrial Ecosystems:

- reviewed Terrestrial Ecosystems' database [includes Atlas of Living Australia and Department of Biodiversity, Conservation and Attractions (DBCA) records in NatureMap] to identify potential vertebrate fauna within the area;
- searched the DBCA's NatureMap for Threatened and Priority Species;
- searched the Commonwealth Governments database of fauna of national environmental significance to identify species potentially occurring within the area that are protected under the *Environment Protection and Biodiversity Conservation (EPBC) Act 1999* or international migratory bird agreements (JAMBA/CAMBA);
- undertook a site reconnaissance survey;
- reviewed previous fauna surveys conducted near the project area;
- undertook an assessment of the potential risks to the fauna associated with clearing additional areas of native vegetation;
- discussed the likelihood of *EPBC Act 1999* and *Wildlife Conservation Act 1950* listed species being present in the project area; and
- provided management recommendations to avoid, mitigate and minimise potential impacts on the fauna in the project area.

2 EXISTING ENVIRONMENT

2.1 Location of project area

The project area is in the Murchison 1 (MUR1 – East Murchison subregion) IBRA bioregion. Cowan (2003) described the subregion as mostly dominated by mulga woodlands that are often rich in ephemerals; hummock grasslands, salt bush shrub lands and halosarcia shrub lands. Cowan (2003) recorded no threatened ecological communities in the vicinity of the project areas. Threatening process for conservation significant fauna were listed by Cowan (2003) as foxes and cats.

2.2 Land use history

The dominant land uses for the bioregion are native pasture to support grazing and crown land reserves, and to a lesser extent mining. The area surrounding the Granny Smith project area has been extensively explored for minerals and there are many operational and non-operational mining projects.

Mt Weld Station continues to graze cattle near the project area. An active haul road runs through the project area from east to west (Figure 2).

2.3 Climate

The project area is characterised as semi-arid. Laverton, 23km to the north, has an annual rainfall of approximately 235mm, although this varies considerably from year-to-year. The highest mean maximum and minimum temperatures in Laverton are in January with an average of 35.8°C and 20.5°C, respectively (Bureau of Meteorology, 2017). The lowest mean daily maximum and minimum temperatures occur in July (Chart 1). Average monthly rainfall is heaviest in January - March.

Summer rain is unpredictable and often results from thunderstorms coming from the north and the west or decaying cyclonic activity as low-pressure cells move from the Pilbara through the Goldfields.

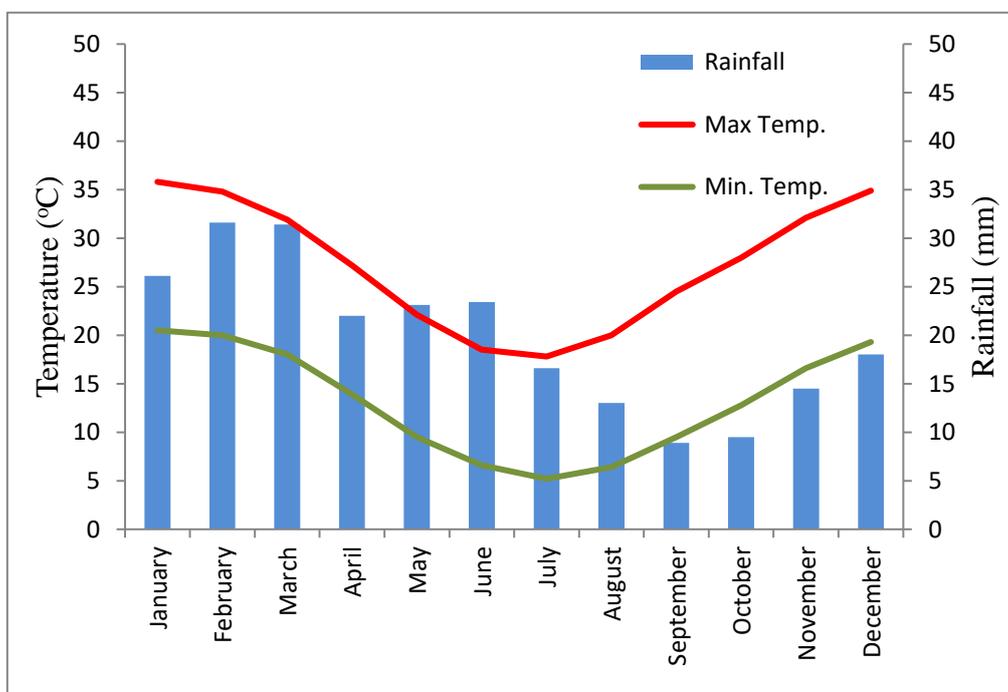


Chart 1. Climate averages for Laverton
(downloaded in May 2017)

2.4 Regional biological fauna context of project area

Numerous fauna surveys and assessments have been undertaken near the project area and in similar habitats in the region. These include:

- Bamford Consulting Ecologists (2007) *Fauna Assessment and Targeted Mulgara Search of the Fish Deposit*, Laverton Gold Project.
- Bell, D. T., Bell, R. C. and Loneragan, W. A. (2007) Winter bird assemblages across an arid gradient in south-west Western Australia. *Journal of the Royal Society of Western Australia* 90, 219-227.
- Biota Environmental Sciences (2004) *Cosmos Nickel Mine Extension Fauna Survey*. Unpublished report for Sir Samuel Mines NL and URS, Perth.
- Biota Environmental Sciences (2007) *Bannockburn Fauna Habitat and Assemblage Survey*. Unpublished report for Jubilee Mines NL, Perth.
- Coffey Environments (2007) *Level 1 Fauna Assessment, Leinster Nickel Operations*, Perth.
- Coffey Environments (2008c) *Level 2 Fauna Assessment for Moolart Well, Dogbolter and Erlistoun*. Unpublished report for Regis Resources, Ltd, Perth.
- Craig, M. D. and Chapman, A. (2003) Effects of short-term drought on the avifauna of Wanjarri Nature Reserve: What do they tell us about drought refugia. *Journal of the Royal Society of Western Australia* 86: 133-137.
- Dell, J. and How, R. A. (1988) Vertebrate fauna. In: The biological survey of the Eastern Goldfields of Western Australia, Part 5, Edjudina - Menzies Study Area. *Records of the Western Australian Museum*, Supplement No 31, 38-77.
- Dell, J., How, R. A. and Milewski, A. V. (1992) The biological survey of the Eastern Goldfields, Part 6, Youanmi-Leonora Study Area. *Records of the Western Australian Museum*, Supplement No 40, 131.
- Donarto Environmental Services (2005) *Leinster Nickel Operations Tailing Storage Facility and Water Storage Areas: Wildlife Interactions and Assessment of Risks*, Perth.
- Dunlop, J. N. (1990) The small vertebrate ground fauna of Mulga habitats near Wiluna, Western Australia. *Mulga Research Centre Journal*, 10, 19-27.
- ENV Australia (2008) *Agnew Prospects Fauna Assessment*. Unpublished report for Agnew Gold Mining Company Pty Limited, Perth.
- Halpern Glick Maunsell, (1998) *Rosemont Gold Project Biological Assessment Survey*, Perth.
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- Hall, N.J, McKenzie, N.L. and Keighery, B.J. (1994) The Biological Survey of the Eastern Goldfields of Western Australia Part 10. Sandstone-Sir Samuel and Laverton-Leonara Study Areas. *Records of the Western Australian Museum*. Supplement No. 47.
- Harewood, G (2011) *Terrestrial Fauna Survey (Level 1) of the West Laverton Area (P38/3717, P38/3718, P38/3491, P38/3492, P38/3314, P38/3490, P38/3315, M38/0046, M38/0049, M38/0040, M38/0358, M38/0048, M38/0101, M38/0364, M38/0342, M38/0345, L38/0179, L38/0177, L38/0178, L38/0153, L38/0092, E38/1930, E38/2347, E38/2084 & E38/1966)*. Unpublished report for Crescent Gold Limited.
- Hart, Simpson and Associates (2000) *Anaconda Nickel Ltd, Cawse Expansion Project, Fauna Survey*. Unpublished report for Anaconda Nickel Ltd, Perth.
- How, R. A. and Dell, J. (1992) Vertebrate fauna. In: The Biological Survey of the Eastern Goldfields of Western Australia Part 7. Duketon - Sir Samuel Study Area. *Records of the Western Australian Museum*; Supplement 40, 90-109.
- McKenzie, N. L., Rolfe, J. K. and Youngson, W. K. (1992) Vertebrate fauna. In: The Biological Survey of the Eastern Goldfields of Western Australia; Part 8; Kurnalpi - Kalgoorlie Study Area. *Records of the Western Australian Museum*, Supplement No 41, 37-65.
- McKenzie, N. L., Rolfe, J. K. and Youngson, W. K. (1994) Vertebrate fauna. In: The Biological Survey of the Eastern Goldfields of Western Australia Part 10, Sandstone-Sir Samuel and Laverton-Leonora Study Areas. *Records of the Western Australian Museum*, Supplement No 47, pp. 51-85.
- MBS Environmental (2004) *Vegetation and Habitat Assessment of the Euro, Sickle and Admiral Hill Project Areas, Laverton*. Unpublished report for Crescent Gold Limited.
- Moriarty, T. K. (1972) Birds of Wanjarri; WA (27°; 25'S; 120° 40'E) *The Emu*, 72, 1-7.
- Murphy, D. (1994) *Vertebrate fauna species of the North-eastern Goldfields*. Report to Western Mining's Leinster Nickel and Mount Keith Operations, Perth.
- Ninnox Wildlife Consulting (1998) *A Vertebrate Fauna Survey of the Murrin Expansion Project*. Unpublished report for Anaconda Nickel Ltd, Perth.

- Ninnox Wildlife Consulting (2005) *Vertebrate Fauna Habitat Assessment of the Proposed Expansions to the Cosmos Nickel Mine, near Leinster, Western Australia*. Unpublished report for URS Australia Pty Ltd, Perth.
- Onus, M. L., Rolfe, J.K., and Algar, D. (2011) Assessment of feral cat abundance and control options at Barrick, Granny Smith. Perth.
- Terrestrial Ecosystems (2010b) *Level 2 Fauna Risk Assessment for the Garden Well Project Area*. Unpublished report for Regis Resources Ltd, Perth.
- Terrestrial Ecosystems (2011a) Investigation of Short-Range Endemic Invertebrates for the Granny Deeps Project Area. Perth.
- Terrestrial Ecosystems (2011b) *Level 2 Fauna Risk Assessment for Granny Deeps Project Area*. Unpublished report for Barrick Gold Corporation, Perth.
- Terrestrial Ecosystems (2011c) Targeted Survey for Long-tailed Dunnarts for the Granny Deeps Project Area. Perth.
- Terrestrial Ecosystems (2012a) *Level 1 Fauna Risk Assessment for the Anchor Project*. Unpublished report for Regis Resources Ltd, Perth.
- Terrestrial Ecosystems (2012b) *Level 1 Fauna Risk Assessment for the Moolart Well to Garden Well Access Road on M38/354, M38/302, M38/303 and L38/216*. Perth.
- Terrestrial Ecosystems (2012c) *Level 1 Fauna Risk Assessment for the Petra Project*. Unpublished report for Regis Resources Ltd, Perth.
- Terrestrial Ecosystems (2012d) *Level 1 Fauna Risk Assessment for the Reichelt Project*. Unpublished report for Regis Resources Ltd, Perth.
- Terrestrial Ecosystems (2012e) *Level 1 Fauna Risk Assessment for the Rosemont Project Area*. Unpublished report for Regis Resources Ltd, Perth.
- Terrestrial Ecosystems (2012f) *Level 1 Fauna Risk Assessment for the Russell Find Project*. Unpublished report for Regis Resources Ltd, Perth.
- Terrestrial Ecosystems (2012g) *Level 1 Vertebrate Fauna Risk Assessment for the Proposed Exploration Areas around the Granny Open Pit Project Area*. Perth.
- Terrestrial Ecosystems (2012h) *Level 1 Vertebrate Fauna Risk Assessment for the Proposed Mining Areas around the Granny Open Pit Project Area*. Perth.
- Terrestrial Ecosystems (2013) *Level 1 Fauna Risk Assessment for Two Waste Dumps either side of the proposed Rosemont Project Area (G38/29, G38/30, G38/31, G38/32) and a Slurry Pipeline from the Rosemont mine to the Garden Well processing plant (L38/219)*. Unpublished report for Regis Resources Ltd, Perth.
- Terrestrial Ecosystems (2015b) *Level 1 Fauna Risk Assessment for the Gloster Project and haul road*. Unpublished report for Regis Resources Ltd, Perth.
- Terrestrial Ecosystems (2016a) *Level 1 Fauna Risk Assessment for the Anchor Project Area*. Unpublished report for Regis Resources Ltd, Perth.
- Terrestrial Ecosystems (2016b) *Level 1 Fauna Risk Assessment for the Baneygo Project*. Unpublished report for Regis Resources Ltd, Perth.
- Terrestrial Ecosystems (2016c) *Level 1 Fauna Risk Assessment for the Dogbolter-Coopers Project Area*. Unpublished report for Regis Resources Ltd, Perth.
- Terrestrial Ecosystems (2016c) *Level 1 Fauna Risk Assessment for the Petra Project Area*. Unpublished report for Regis Resources Ltd, Perth.
- Terrestrial Ecosystems (2016d) *Level 1 Fauna Risk Assessment for the Tooheys Project Area*. Unpublished report for Regis Resources Ltd, Perth.
- Terrestrial Ecosystems (2017b) *Level 1 Fauna Risk Assessment for the proposal Haul Road to the Baneygo Project Area*. Unpublished report for Regis Resources Ltd, Perth.
- Terrestrial Ecosystems (2017c) *Level 1 Fauna Risk Assessment for the proposal Haul Road to the proposed Petra Mining area*. Unpublished report for Regis Resources Ltd, Perth.
- Terrestrial Ecosystems (2018a) *Level 1 Fauna Risk Assessment for the proposal Haul Road to the proposed Petra Mining area*. Unpublished report for Regis Resources Ltd, Perth.
- Terrestrial Ecosystems (2018b) *Vertebrate Fauna Risk Assessment for the Petra Mining Project*, Perth.
- Volschenk, E. S. (2011) *Granny Deeps Scorpion Identification Report*. Perth.
- Whisson, C. and Slack-Smith, S. (2011) *Land Snails from the area of Laverton, Western Australia (Granny Deeps Project)*, Perth.

In addition, there are individual records for fauna contained in the Atlas of Living Australia, Western Australian Museum collection and in NatureMap's records that have also been accessed.

The most relevant and useful data are those from the two Terrestrial Ecosystems' (2011b, c) surveys in the area. These two surveys were undertaken in 2011 and were undertaken in similar habitat and in areas adjacent to the project areas. These surveys included pit trapping, funnel traps, echolocation bat detection surveys, avifauna surveys and short-range invertebrate surveys. One of Terrestrial Ecosystems surveys was a Level 2 fauna assessment and the other was an extensive targeted trapping program for Long-tailed Dunnarts (*Sminthopsis longicaudata*). Terrestrial Ecosystems has also complete multiple Level 1 fauna risk assessments in adjacent areas for Granny Smith (Terrestrial Ecosystems 2014, 2015a, 2017a).

Western Australian Museum (WAM) regional eastern goldfields biological surveys were undertaken in the Duketon-Sir Samuel, Sandstone-Sir Samuel and Laverton areas (How et al. 1992, McKenzie et al. 1994). These surveys were to the north of the project area. HGM (1999) undertook a terrestrial fauna assessment for the Rosemont Gold Project, which is also located to the north of the project area. A survey was undertaken by Terrestrial Ecosystems staff for the Moolart Well area (Coffey Environments 2008a) in the summer of 2007/08 and Terrestrial Ecosystems (2010b) surveyed the Garden Well mine; both of these surveys included habitat similar to the project area. The WAM bioregional surveys of the Edjudina – Menzies and the Kurnalpi - Kalgoorlie areas (Dell et al. 1988, McKenzie and Hall 1992) and Terrestrial Ecosystems unpublished data for around Ora Banda are for areas to the south of the project area. The Murrin Murrin Expansion project fauna survey is for an area to the west of the project area (Ninox Wildlife Consulting 1998).

These fauna surveys, when considered together, provide a near complete list of the vertebrate species likely to be found in the project area. The composition of vertebrate fauna assemblages varies from habitat-to-habitat and site-to-site within the bioregion, but the survey data contained in the attached appendices provide a good indication of the vertebrate fauna assemblage that is likely to be found in the project area. These data therefore provide a good regional context and indicate the extent of fauna assemblage variation that might be anticipated from site-to-site and temporally.

2.4.1 Fauna species at risk

Cowan (2003) reported the fauna species at risk in the East Murchison subregion as Bilby (*Macrotis lagotis*), Marsupial Mole (*Notoryctes typhlops*), Mulgara (*Dasyercus cristicauda / blythi*), Malleefowl (*Leipoa ocellata*), Princess Parrot (*Polytelis alexandrae*), Slender-billed Thornbill (*Acanthiza iredalei iredalei*), Giant Desert Skink (*Liopholis kintorei*) and Peregrine Falcon (*Falco peregrinus*). This report assesses the potential for these species to be found in the project area and the potential impact that the proposed development might have on these species, and other conservation significant fauna.

3 METHODOLOGY

3.1 Database searches

A review of the *EPBC* list of protected species was undertaken to identify species of conservation interest to the Commonwealth Government. The search circle had a radius of 50km around a centre point coordinate of -28.85252°S and 122.35785°E (Appendix A). In addition, a desktop search of the Terrestrial Ecosystems' fauna survey database was used to develop an appreciation of the vertebrate fauna assemblages in relevant sections of the bioregion near the project area. The DBCA threatened and priority species database was searched via the records in NatureMap.

Other more general texts were also used to provide supplementary information on vertebrates in the bioregion, including Tyler *et al.* (2000) for frogs; Storr *et al.* (1983, 1990, 1999a, 2002) and Thompson and Thompson (2010) for reptiles; Johnstone and Storr (1998, 2004) for birds; and Van Dyck and Strahan (2008) for mammals.

Collectively these sources of information were used to create lists of species expected to utilise the project area and broader bioregion. It should be noted that these lists will include species that have been recorded in the general region but are possibly vagrants and they will not generally be found in the project area due to a lack of suitable habitat (e.g. water and shore birds). Vagrants can be recorded almost anywhere. Many of the records are historical and the species is no longer present in the area (e.g. Malleefowl, Bilby). Many of the bird, mammal, reptile and amphibian species have specific habitat requirements that may be present in the general area but not in the project area. Also, the ecology of many of these species is often not well understood and it can sometimes be difficult to indicate those species whose specific habitat requirements are not present in the project area. Therefore, many species will be included in the lists produced from database searches but will not be present in the actual project area.

There are errors in most databases, including NatureMap, Atlas of Living Australia and the WAM collection. These errors occur because of a misidentification of individuals, taxonomic name changes and incorrect coordinates being entered into the database. Terrestrial Ecosystems was unable to verify the primary records, so it has used the information provided. Readers should therefore appreciate that species lists and fauna surveys reported in the appendices may include these errors.

3.2 Site Inspection and fauna habitat assessment

A site visit was undertaken on 22 October 2018 to assess fauna habitat types and condition in the project area. This fauna habitat assessment methodology required the assessor to stop at multiple locations within the project area and to assess a suite of data about the fauna habitat and its condition. This information included a description of the habitat structure, habitat condition, landform, soils and vegetation and time since last fire.

The fauna habitat assessment was undertaken for the majority of the project area. A small area could not be accessed due to heritage constraints. This field assessment had two foci:

- assessing fauna habitat types and their condition; and
- assessing the possible presence of and recording evidence of conservation significant fauna so that mitigation and management strategies might be implemented to reduce potential impacts.

Dr Scott Thompson, who undertook the site assessment, stopped at multiple locations within the project area and recorded a suite of data about the fauna habitat and its condition. This information included a description of the habitat structure, habitat condition, landform, soils and vegetation and time since last fire. The following data were recorded at each location as part of the habitat assessment:

Observer's name

Coordinates of the location as UTM (WGS 84)

Fire history – options

> 5 years

1-5 years

< 1 year

Landform – options

Beach

Clay plain

Cliff

Lake / lake edge

Lower slope

Mid slope

Creek line	Ridge
Dam	River
Drainage line	Rocky outcrop / breakaway
Dune crest	Salt lake
Dune slope	Sand dune
Dune swale	Sand plain
Escarpment	Stony plain
Flat	Swamp
Gorge	Undulating
Gully	Upper slope
Intertidal / mangrove	Wetland
	Water hole

Habitat quality – options

- *High quality fauna habitat* – These areas closely approximate the vegetation mix and quality that would have been in the area prior to any disturbance. The habitat has connectivity with other habitats and is likely to contain the most natural vertebrate fauna assemblage.
- *Very good fauna habitat* - These areas show minimal signs of disturbance (e.g. grazing, clearing, fragmentation, weeds) and generally retain many of the characteristics of the habitat if it had not been disturbed. The habitat has connectivity with other habitats and fauna assemblages in these areas are likely to be minimally effected by disturbance.
- *Good fauna habitat* – These areas showed signs of disturbance (e.g. grazing, clearing, fragmentation, weeds) but generally retain many of the characteristics of the habitat if it had not been disturbed. The habitat has connectivity with other habitats and fauna assemblages in these areas are likely to be affected by disturbance.
- *Disturbed fauna habitat*– These areas showed signs of significant disturbance. Many of the trees, shrubs and undergrowth are cleared. These areas may be in the early succession and regeneration stages. Areas may show signs of significant grazing, containing weeds or have been damaged by vehicle or machinery. Habitats are fragmented or have limited connectivity with other fauna habitats. Fauna assemblages in these areas are likely to differ significantly from what might be expected in the area had the disturbance not occurred.
- *Highly degraded fauna habitat* – These areas often have a significant loss of vegetation, an abundance of weeds, and a large number of vehicle tracks or are completely cleared. Limited or no fauna habitat connectivity. Fauna assemblages in these areas are likely to be significantly different to what might have been in the area pre-disturbance.

Habitat structure - options

Upper stratum

Tall open woodland	Scattered tall trees
Tall woodland	Scattered trees
Open woodland	Scattered low trees
Woodland	Low closed forest
Open forest	Low open forest
Closed forest	Low woodland
Tall closed forest	Low open woodland
Tall open forest	

Middle stratum

Shrubland	Open heath
Tall shrubland	Low closed heath
Tall open shrubland	Low open heath
Low shrubland	Tall closed scrub
Scattered low shrubs	Tall open scrub
Low open shrubland	Scattered tall shrubs
Scattered tall shrubs	Open shrubland
Closed heath	Scattered shrubs

Lower stratum

Closed hummock grassland	Closed tussock grassland / sedgeland / herbland
Mid-dense hummock grassland	Tussock grass land / sedgeland / herbland
Hummock grassland	Open tussock grassland / sedgeland / herbland
Open hummock grassland	Scattered tussock / grasses / sedges / herbs
Scattered hummock grassland	Very open tussock grassland / herbland

<i>Soil Type</i> – options	
Sand	Clay loam
Loamy sand	Silty clay loam
Clayey sand	Clay
Sandy loam	Rock
Loam	Peat / organic
Silty loam	Stony
Sandy clay loam	
<i>Soil Colour</i> –options	
Black	Red
Brown	White
Grey	Yellow
Orange	
<i>Surface stones</i> - options	
None	Boulders (>250mm)
Pebbles (0-50mm)	Rocks
Cobbles (51-250mm)	
Potential for conservation significant species to be found in the area	
Yes	
No	
Impact of clearing on conservation significant species – options	
Low	Moderate - high
Low - moderate	High
Moderate	Extreme

3.3 Survey and reporting staff

Dr Scott Thompson undertook the site investigation and fauna habitat assessment and searched the site for Malleefowl and their mounds. The field work was completed with the assistance of Eren Reid from Native Vegetation Solutions. Dr Scott Thompson prepared this report and Dr Graham Thompson reviewed the report before it was sent to the client. Both senior scientists have appropriate relevant post-graduate qualifications, extensive experience in conducting fauna assessments in the Goldfields, have published research articles on biodiversity, fauna assemblages, conservation significant species, trapping techniques and temporal variations in trapped fauna assemblages based on Goldfields surveys and are therefore appropriately trained and experienced for the task of preparing this assessment. Both Scott and Graham have undertaken multiple assessments at Granny Smith and are familiar with the site and habitat in the project area.

3.4 Taxonomy and nomenclature

Taxonomy and nomenclature for fauna species used in this report are generally based on the WA Museum species list except for bats, which follow (Churchill 2008) and birds which follow Christidis and Boles (2008). Terrestrial Ecosystems has presumed that the identifications referred to in the appendices or in reports used to provide local and regional comparative data were correct and we have only corrected obvious records where the nomenclature was known to be incorrect.

3.5 Limitations

This Level 1 fauna risk assessment is based on information contained in the Commonwealth Government database and other published and unpublished fauna survey data for the bioregion and a site visit. It is acknowledged that multiple surveys conducted in different seasons, repeated over several years are necessary to fully appreciate the fauna assemblage in the project area.

The EPA (2016) *Technical Guidance Terrestrial Fauna Surveys* suggested that fauna surveys may be limited by many variables. Limitations associated with each of these variables are assessed in Table 1.

Table 1. Fauna survey limitations and constraints

Possible limitations	Constraint (yes/no); significant, moderate or negligible	Comment
Competency and experience of the consultant carrying out this assessment	No	The environmental scientists that undertook the site assessment, drafted and reviewed this report are familiar with the vertebrate fauna of this bioregion.
Scope	No	All aspects of the scope of works have been addressed.
Proportion of fauna identified, recorded and/or collected	No	Not applicable.
Accuracy of previous survey work	Yes, negligible	Terrestrial Ecosystems has reported fauna survey data recorded by various authors but is not able to vouch for the accuracy of this information. It is acknowledged that the taxonomy of Western Australian vertebrates is continually being revised and the nomenclature of some of the species listed in the appendices may have changed since publication by the authors.
Sources of information	Yes, negligible	Vertebrate fauna information was available from an on-line database and unpublished and published reports of surveys conducted in the bioregion in a variety of habitat types. Many of these surveys employed a low level of trapping effort which significantly impacts on the capacity of these data to represent the fauna assemblages in the areas surveyed.
Proportion of the task achieved	No	All tasks completed.
Timing/weather/season/ cycle	N/A	Weather was fine during the site visit.
Disturbances which affected results of the survey	No	Minor disturbances in the project area have been factored into this assessment.
Intensity of survey effort	N/A	
Completeness	No	All aspects of this assessment have been completed.
Resources	No	Adequate resources were available.
Remoteness and/or access problems	Yes, negligible	A small section of the project area could not be accessed due to aboriginal heritage constraints; however, this did not impact on the ability to assess the habitat types.
Availability of contextual information on the region	No	Fauna survey data are available for the general area and specifically fauna habitats accessed in the project area.

4 RESULTS

4.1 Fauna habitat

There are four broad fauna habitats in the project area:

- Open mulga woodland over scattered low shrubs and grasses of varying densities on a stony sandy-clay or sandy-clay substrate (Plates 1-2);
- Open chenopod shrubland over grasses of varying densities on a stony sandy-clay or sandy-clay substrate (Plates 3-4);
- Chenopod and mulga shrubland over scattered grasses of varying densities on a stony sandy-clay or sandy-clay substrate (Plates 5-6); and
- Banded ironstone rocky ridgeline with scattered Mulga and shrubs (Plates 7-8).

The density of trees and shrubs in the relatively undisturbed areas varied across the project area but was mostly sparse. The fauna habitat varies from degraded to good; the more degraded areas are due to historical and recent exploration activity and cattle grazing. There are a few access tracks in the area, but these are narrow and mostly only wheel tracks of a stony red sand-clay substrate.

The area has been grazed by cattle with many areas showing obvious degradation (i.e. cattle tracks, chewed bushes and shrubs, etc). There was extensive evidence of rabbits and other feral fauna in the area.



Plate 1. Open mulga woodland over scattered low shrubs and grasses



Plate 2. Open mulga woodland over scattered low shrubs and grasses



Plate 3. Open chenopod shrubland over grasses



Plate 4. Open chenopod shrubland over grasses



Plate 5. Chenopod and mulga shrubland over scattered grasses



Plate 6. Chenopod and mulga shrubland over scattered grasses

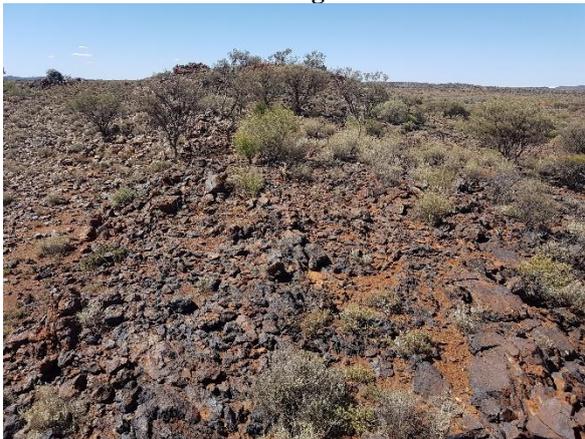


Plate 7. Banded ironstone rocky ridgeline with scattered Mulga and shrubs



Plate 8. Banded ironstone rocky ridgeline with scattered Mulga and shrubs

4.2 Fauna assemblage

In 2011, Terrestrial Ecosystems (2011b) undertook a Level 2 vertebrate fauna survey for adjacent areas at Granny Smith. This survey area supported one broad fauna habitat type – open mulga woodland and the density of trees and shrubs and understorey varied across the project area. Thirteen survey sites were trapped between 6-12 January 2011, which was optimal for reptiles and suitable for mammals. All pit-traps and drift fences were dug in prior to the field assessment and closed until the start of the trapping program. Each survey site contained four trap lines. Each trap line contained three 20L PVC buckets, three 150mm by 500mm deep PVC pipes as pit-traps and three pair of funnel traps evenly spaced along a 30m fly-wire drift fence. Trap lines were arranged approximately 50m apart. The trapping effort was 1,092 bucket pit-trap nights, 1,092 pipe pit-trap nights and 2,184 funnel trap nights.

An avian survey was undertaken concurrently with the trapping program. The avian surveys were conducted from sunrise for approximately four hours and again each afternoon for approximately four hours. The search protocol was for a 20-minute active walking transect search of approximately 3ha before moving to another area. Seventy sites were surveyed, which equated to approximately 1,400 minutes of survey effort. All birds were identified by their call or direct observation. Birds were also recorded opportunistically during the survey period by all field survey staff.

Bat echolocation calls were recorded using an Anabat system. Two Anabat recorders were left standing vertically all night (10-12 hours) on three occasions (8, 9 and 11 January 2011), and included representative habitat types and other locations likely to attract bats.

Table 2 indicates the small mammals, reptiles and amphibians caught during the 2011 survey. The reptile, mammal and amphibian assemblage recorded is like that recorded in other patches of open mulga woodland in this part of the Goldfields, except for the capture of three Long-tailed Dunnarts. As indicated in the follow up targeted survey

report for Long-tailed Dunnarts (Terrestrial Ecosystems 2011c), it was unexpected to record Long-tailed Dunnarts in this area and this record was more than 200km south-easterly of the previous known records.

Four species of bats were recorded during the 2011 survey (*Chalinolobus gouldii* - Gould's Wattled bat; *Mormopterus* sp. (sp. 3) - Inland free-tailed bat; *Scotorepens balstoni* - Inland broad-nosed bat; and *Vespadelus finlaysoni* - Finlayson's cave bat). All these species are commonly recorded throughout the Goldfields.

Table 2. Mammals, reptiles and amphibians caught at various trapping sites at Granny Smith (Terrestrial Ecosystems 2011b)

Taxa	Family	Species	Sites													
			1	2	3	4	5	6	7	8	9	10	11	12	13	
Mammal	Dasyuridae	<i>Antechinomys laniger</i>	2	1			3	3	3	2		2			1	
		<i>Sminthopsis dolichura</i>	1	1	3	7	5	4	13	3	5	3		1	1	
		<i>Sminthopsis hirtipes</i>				1										
		<i>Sminthopsis longicaudata</i>					1	1							1	
		<i>Sminthopsis macroura</i>	2	3		2	1	1	1	1	1	5	5	3	2	
	Muridae	<i>Notomys alexis</i>	3													
		<i>Pseudomys hermannsburgensis</i>	1	1	1	3					1	2	2	5	6	
		<i>Mus musculus</i>						1					5			
Amphibian	Hylidae	<i>Cyclorana maini</i>		1							11	5	1			
		<i>Cyclorana platycephala</i>		1	1						5	2		1	1	
	Limnodynastidae	<i>Neobatrachus kunapalari</i>									1					
		<i>Neobatrachus sutor</i>	8	2	5	3	1			1	13	2		1		
Reptile	Agamidae	<i>Diporiphora amphiboluroides</i>				2	1	1								
		<i>Tympanocryptis cephalus</i>				2	3	1								
	Elapidae	<i>Parasuta monachus</i>						1		1						
	Gekkonidae	<i>Diplodactylus granariensis</i>										1				
		<i>Diplodactylus pulcher</i>	2			1	4	3	1			2	1		1	
			<i>Gehyra variegata</i>		3	2	4		1		3		2	1	2	
			<i>Heteronotia binoei</i>	2				1				1	2	1	5	
			<i>Rhynchoedura ornata</i>	3					2			1				
			<i>Strophurus wellingtonae</i>	4	2										1	
	Scincidae	<i>Ctenotus leonhardii</i>	2	2						1		5	9	7	16	27
		<i>Egernia depressa</i>		1	1	2	2	3	9	6		1				
		<i>Eremiascincus richardsonii</i>				2									1	
		<i>Lerista desertorum</i>													2	
		<i>Lerista distinguenda</i>													1	
		<i>Menetia greyii</i>												1		
<i>Morethia butleri</i>			1		1		2				6	1		3		
Typhlopidae	<i>Tiliqua multifasciata</i>	1														
	<i>Anilius australis</i>								1	1						
Varanidae	<i>Anilius bicolor</i>			1												
	<i>Varanus caudolineatus</i>		2		1	3	1	1			1			2		
		<i>Varanus panoptes</i>	4		7		3	2	2			4	2	6		

The bird surveys recorded 820 individuals from 60 species across 70 survey sites and an additional 495 birds were opportunistically observed (Table 3). A proportion of these species are seldom seen in the north-eastern Goldfields. These are mostly the 'water birds' in the list (e.g. Musk Duck, Australian Wood Duck, Pink-eared Duck, Pacific Black Duck, Hardhead, stilts and White-faced Heron). Some of these birds will occasionally be seen in water contained in disused mining pits during the non-rainy period, however, it was the presence of the heavy rain that resulted in their presence in the area. No Malleefowl nests or tracks were observed in the project area.

Table 3. Birds detected at Granny Smith (Terrestrial Ecosystems 2011b)

Family	Species	Common Name	No
Accipitridae	<i>Aquila audax</i>	Wedge-tailed Eagle	3
Anatidae	<i>Biziura lobata</i>	Musk Duck	2
	<i>Chenonetta jubata</i>	Australian Wood Duck	81
	<i>Malacorhynchus membranaceus</i>	Pink-eared Duck	5
	<i>Anas gracilis</i>	Grey Teal	74
	<i>Anas superciliosa</i>	Pacific Black Duck	13
	<i>Aythya australis</i>	Hardhead	2
Casuariidae	<i>Dromaius novaehollandiae</i>	Emu	4
Charadriidae	<i>Elseornis melanops</i>	Black-fronted Dotterel	4
Recurvirostridae	<i>Himantopus himantopus</i>	Black-winged Stilt	5
	<i>Cladorhynchus leucocephalus</i>	Banded Stilt	14
Ardeidae	<i>Egretta novaehollandiae</i>	White-faced Heron	2
Columbidae	<i>Phaps chalcoptera</i>	Common Bronzewing	6
	<i>Ocyphaps lophotes</i>	Crested Pigeon	21
Alcedinidae	<i>Todiramphus pyrrhopygius</i>	Red-backed Kingfisher	1
Cuculidae	<i>Heteroscenes pallidus</i>	Pallid Cuckoo	3
Falconidae	<i>Falco cenchroides</i>	Nankeen Kestrel	2
	<i>Falco berigora</i>	Brown Falcon	2
Rallidae	<i>Fulica atra</i>	Eurasian Coot	21
Acanthizidae	<i>Acanthiza robustirostris</i>	Slaty-backed Thornbill	68
	<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill	1
	<i>Acanthiza apicalis</i>	Inland Thornbill	12
	<i>Aphelocephala leucopsis</i>	Southern Whiteface	13
Artamidae	<i>Artamus personatus</i>	Masked Woodswallow	27
	<i>Artamus cinereus</i>	Black-faced Woodswallow	6
	<i>Artamus minor</i>	Little Woodswallow	2
	<i>Cracticus torquatus</i>	Grey Butcherbird	9
	<i>Cracticus nigrogularis</i>	Pied Butcherbird	5
	<i>Gymnorhina tibicen</i>	Australian Magpie	1
Campephagidae	<i>Coracina maxima</i>	Ground Cuckoo-Shrike	7
	<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-Shrike	7
	<i>Lalage tricolor</i>	White-winged Triller	4
Corvidae	<i>Corvus bennetti</i>	Little Crow	5
	<i>Corvus orru</i>	Torresian Crow	2
Estrildidae	<i>Taeniopygia guttata</i>	Zebra Finch	2
Hirundinidae	<i>Cheramoeca leucosterna</i>	White-backed Swallow	6
	<i>Hirundo neoxena</i>	Welcome Swallow	6
	<i>Petrochelidon nigricans</i>	Tree Martin	10
Maluridae	<i>Malurus splendens</i>	Splendid Fairy-wren	12
	<i>Malurus leucopterus</i>	White-winged Fairy-wren	4
Meliphagidae	<i>Certhionyx variegatus</i>	Pied Honeyeater	2
	<i>Gavicalis virescens</i>	Singing Honeyeater	40
	<i>Manorina flavigula</i>	Yellow-throated Miner	41
	<i>Acanthagenys rufogularis</i>	Spiny-cheeked Honeyeater	44
	<i>Epthianura tricolor</i>	Crimson Chat	4
Monarchidae	<i>Grallina cyanoleuca</i>	Magpie-Lark	17
Motacilidae	<i>Anthus novaeseelandiae</i>	Australasian Pipit	8
Nectariniidae	<i>Dicaeum hirundinaceum</i>	Mistletoebird	4
Pachycephalidae	<i>Pachycephala rufiventris</i>	Rufous Whistler	22
	<i>Colluricincla harmonica</i>	Grey Shrike-thrush	3
	<i>Oreoica gutturalis</i>	Crested Bellbird	46
Pardalotidae	<i>Pardalotus striatus</i>	Striated Pardalote	1
Petroicidae	<i>Petroica goodenovii</i>	Red-capped Robin	10
	<i>Melanodryas cucullata</i>	Hooded Robin	7
Pomatostomidae	<i>Pomatostomus superciliosus</i>	White-browed Babbler	14
Ptilonorhynchidae	<i>Ptilonorhynchus guttatus</i>	Western Bowerbird	7
Rhipiduridae	<i>Rhipidura leucophrys</i>	Willie Wagtail	10
Podicipedidae	<i>Poliocephalus poliocephalus</i>	Hoary-headed Grebe	30
Psittacidae	<i>Barnardius zonarius</i>	Australian Ringneck	6
	<i>Psephotus varius</i>	Mulga Parrot	20
		Total Individuals	810
		Total Species	60

4.3 Bioregional vertebrate fauna

Appendix B provides a summary of the fauna survey data that are available near the project area. There are appreciable differences in the recorded fauna assemblages within and among fauna surveys shown in Appendix B. These differences are partially due to the low survey effort deployed by some of the surveys and they also reflect variations in soils and vegetation as well as temporal variations in the fauna assemblages.

Tables 4-7 provide a list of vertebrate species potentially found near the project area that have been compiled based on the fauna survey report results shown in Appendix B.

Table 4. Birds potentially found near the project area

Family	Species	Common Name	Family	Species	Common Name
Casuariidae	<i>Dromaius novaehollandiae</i>	Emu		<i>Heteroscenes pallidus</i>	Pallid Cuckoo
Anatidae	<i>Biziura lobata</i>	Musk Duck	Halcyonidae	<i>Todiramphus pyrrhopygius</i>	Red-backed Kingfisher
	<i>Tadorna tadornoides</i>	Australian Shelduck	Meropidae	<i>Merops ornatus</i>	Rainbow Bee-eater
	<i>Chenonetta jubata</i>	Australian Wood Duck	Climacteridae	<i>Climacteris affinis</i>	White-browed Treecreeper
	<i>Malacorhynchus membranceus</i>	Pink-eared Duck		<i>Climacteris rufa</i>	Rufous Treecreeper
	<i>Anas gracilis</i>	Grey Teal	Ptilonorhynchidae	<i>Ptilonorhynchus maculatus</i>	Spotted Bowerbird
	<i>Anas superciliosa</i>	Pacific Black Duck		<i>Ptilonorhynchus guttatus</i>	Western Bowerbird
	<i>Aythya australis</i>	Hardhead	Maluridae	<i>Malurus splendens</i>	Splendid Fairy-wren
Podicipedidae	<i>Poliiocephalus poliocephalus</i>	Hoary-headed Grebe		<i>Malurus leucopterus</i>	White-winged Fairy-wren
Columbidae	<i>Phaps chalcoptera</i>	Common Bronzewing		<i>Malurus lamberti</i>	Variegated Fairy-wren
	<i>Phaps histrionica</i>	Flock Bronzewing	Acanthizidae	<i>Calamanthus fuliginosus</i>	Striated Fieldwren
	<i>Ocyphaps lophotes</i>	Crested Pigeon		<i>Pyrrholaemus brunneus</i>	Redthroat
	<i>Geopelia placida</i>	Diamond Dove		<i>Smicromis brevirostris</i>	Weebill
Podargidae	<i>Podargus strigoides</i>	Tawny Frogmouth		<i>Gerygone fusca</i>	Western Gerygone
Caprimulgidae	<i>Eurostopodus argus</i>	Spotted Nightjar		<i>Acanthiza robustirostris</i>	Slaty-backed Thornbill
Aegothelidae	<i>Aegothales cristatus</i>	Australian Owlet-nightjar		<i>Acanthiza chrysorhoa</i>	Yellow-rumped Thornbill
Apodidae	<i>Apus pacificus</i>	Fork-tailed Swift		<i>Acanthiza uropygialis</i>	Chestnut-rumped Thornbill
Otididae	<i>Ardeotis australis</i>	Australian Bustard		<i>Acanthiza apicalis</i>	Inland Thornbill
Phalacrocoracidae	<i>Microcarbo melanoleucos</i>	Little Pied Cormorant		<i>Aphelocephala leucopsis</i>	Southern Whiteface
Ardeidae	<i>Ardea pacifica</i>	White-necked Heron	Pardalotidae	<i>Pardalotus striatus</i>	Striated Pardalote
	<i>Egretta novaehollandiae</i>	White-faced Heron	Meliphagidae	<i>Certhionyx variegatus</i>	Pied Honeyeater
Accipitridae	<i>Haliastur sphenurus</i>	Whistling Kite		<i>Gavicalis virescens</i>	Singing Honeyeater
	<i>Accipiter fasciatus</i>	Brown Goshawk		<i>Lichenostomus ornatus</i>	Yellow-plumed Honeyeater
	<i>Accipiter cirrocephalus</i>	Collared Sparrowhawk		<i>Lichenostomus plumulus</i>	Grey-fronted Honeyeater
	<i>Circus assimilis</i>	Spotted Harrier		<i>Purnella albifrons</i>	White-fronted Honeyeater
	<i>Aquila audax</i>	Wedge-tailed Eagle		<i>Manorina flavigula</i>	Yellow-throated Miner
	<i>Hieraetus morphnoides</i>	Little Eagle		<i>Acanthagenys rufogularis</i>	Spiny-cheeked Honeyeater
Falconidae	<i>Falco cenchroides</i>	Nankeen Kestrel		<i>Epthianura tricolor</i>	Crimson Chat
Falconidae	<i>Falco berigora</i>	Brown Falcon		<i>Epthianura aurifrons</i>	Orange Chat
	<i>Falco longipennis</i>	Australian Hobby		<i>Sugomel niger</i>	Black Honeyeater
	<i>Falco peregrinus</i>	Peregrine Falcon		<i>Lichmera indistincta</i>	Brown Honeyeater
Rallidae	<i>Tribonx ventralis</i>	Black-tailed Native-hen	Pomatostomidae	<i>Pomatostomus superciliosus</i>	White-browed Babbler
	<i>Fulica atra</i>	Eurasian Coot	Psophodidae	<i>Cinclosoma castaneothorax</i>	Chestnut-breasted Quail-thrush
Recurvirostridae	<i>Himantopus leucocephalus</i>	Pied Stilt	Neositidae	<i>Daphoenositta chrysoptera</i>	Varied Sittella
Recurvirostridae	<i>Cladorhynchus leucocephalus</i>	Banded Stilt	Campephagidae	<i>Coracina maxima</i>	Ground Cuckoo-shrike
Charadriidae	<i>Charadrius ruficapillus</i>	Red-capped Plover		<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike
	<i>Elsayornis melanops</i>	Black-fronted Dotterel		<i>Lalage tricolor</i>	White-winged Triller
	<i>Vanellus tricolor</i>	Banded Lapwing	Pachycephalidae	<i>Pachycephala rufiventris</i>	Rufous Whistler
Scolopacidae	<i>Actitis hypoleucos</i>	Common Sandpiper		<i>Colluricincla harmonica</i>	Grey Shrike-thrush
Turnicidae	<i>Turnix velox</i>	Little Button-quail		<i>Oreoica gutturalis</i>	Crested Bellbird
Cacatuidae	<i>Eolophus roseicapillus</i>	Galah	Artamidae	<i>Artamus personatus</i>	Masked Woodswallow
	<i>Nymphicus hollandicus</i>	Cockatiel		<i>Artamus cinereus</i>	Black-faced Woodswallow
Psittacidae	<i>Barnardius zonarius</i>	Australian Ringneck		<i>Artamus minor</i>	Little Woodswallow
	<i>Psephotus varius</i>	Mulga Parrot		<i>Cracticus torquatus</i>	Grey Butcherbird
	<i>Melopsittacus undulatus</i>	Budgerigar		<i>Cracticus nigrogularis</i>	Pied Butcherbird
	<i>Neopsephotus bourkii</i>	Bourke's Parrot		<i>Gymnorhina tibicen</i>	Australian Magpie
	<i>Neophema splendida</i>	Scarlet-chested Parrot		<i>Strepera versicolor</i>	Grey Currawong
Cuculidae	<i>Chalcites basalis</i>	Horsfield's Bronze-cuckoo	Rhipiduridae	<i>Rhipidura albiscapa</i>	Grey Fantail
	<i>Chalcites osculans</i>	Black-eared Cuckoo		<i>Rhipidura leucophrys</i>	Willie Wagtail

Family	Species	Common Name
Corvidae	<i>Corvus coronoides</i>	Australian Raven
	<i>Corvus bennetti</i>	Little Crow
	<i>Corvus orru</i>	Torresian Crow
Monarchidae	<i>Grallina cyanoleuca</i>	Magpie-lark
Petroicidae	<i>Microeca fascians</i>	Jacky Winter
	<i>Petroica goodenovii</i>	Red-capped Robin
	<i>Melanodryas cucullata</i>	Hooded Robin
Megaluridae	<i>Cincloramphus mathewsi</i>	Rufous Songlark

Family	Species	Common Name
	<i>Cincloramphus cruralis</i>	Brown Songlark
Hirundinidae	<i>Cheramoeca leucosterna</i>	White-backed Swallow
	<i>Hirundo neoxena</i>	Welcome Swallow
	<i>Petrochelidon ariel</i>	Fairy Martin
	<i>Petrochelidon nigricans</i>	Tree Martin
Nectariniidae	<i>Dicaeum hirundinaceum</i>	Mistletoebird
Motacillidae	<i>Anthus novaeseelandiae</i>	Australasian Pipit

Table 5. Amphibians potentially found near the project area

Family	Species	Common Name
Hylidae	<i>Cyclorana maini</i>	Sheep Frog
	<i>Cyclorana platycephala</i>	Water-holding Frog
Limnodynastidae	<i>Neobatrachus aqulonius</i>	Northern Burrowing Frog
	<i>Neobatrachus kunapalari</i>	Kunapalari Frog

Family	Species	Common Name
	<i>Neobatrachus sudelli</i>	Sudell's Frog
	<i>Neobatrachus sutor</i>	Shoemaker Frog
	<i>Neobatrachus wilsmorei</i>	Goldfields Bullfrog
	<i>Platyplectrum spenceri</i>	Spencer's Burrowing Frog

Table 6. Mammals potentially found near the project area

Family	Species	Common Name
Bovidae	<i>Bos taurus</i>	Cow
	<i>Capra hircus</i>	Goat
	<i>Ovis aries</i>	Sheep
Camelidae	<i>Camelus dromedarius</i>	Dromedary
Canidae	<i>Canis lupus</i>	Dingo/dog
	<i>Vulpes vulpes</i>	Red Fox
Felidae	<i>Felis catus</i>	House Cat
Emballonuridae	<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail Bat
Molossidae	<i>Austronomus australis</i>	White-striped Free-tail Bat
	<i>Mormopterus planiceps</i>	Southern Free-tail Bat
Pteropodidae	<i>Syconycteris australis</i>	Common Blossom-bat
Vespertilionidae	<i>Chalinolobus gouldii</i>	Gould's Wattled Bat
	<i>Chalinolobus morio</i>	Chocolate Wattled Bat
	<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat
	<i>Scotorepens balstoni</i>	Inland Broad-nosed Bat
	<i>Scotorepens greyii</i>	Little Broad-nosed Bat
	<i>Vespadelus regulus</i>	Southern Forest Bat
Dasyuridae	<i>Antechinomys laniger</i>	Kultarr

Family	Species	Common Name
	<i>Dasyercus cristicauda/blythi</i>	Mulgara
	<i>Ningau ridei</i>	Wongai Ningau
	<i>Sminthopsis crassicaudata</i>	Fat-tailed Dunnart
	<i>Sminthopsis dolichura</i>	Little Long-tailed Dunnart
	<i>Sminthopsis hirtipes</i>	Hairy-footed Dunnart
	<i>Sminthopsis longicaudata</i>	Long-tailed Dunnart
	<i>Sminthopsis macroura</i>	Stripe-faced Dunnart
	<i>Sminthopsis ooldea</i>	Ooldea Dunnart
Macropodidae	<i>Osphranter robustus</i>	Euro
	<i>Osphranter rufus</i>	Red Kangaroo
Leporidae	<i>Oryctolagus cuniculus</i>	European Rabbit
Tachyglossidae	<i>Tachyglossus aculeatus</i>	Short-beaked Echidna
	<i>Equus caballus</i>	Domestic Horse
Equidae	<i>Mus musculus</i>	House Mouse
Muridae	<i>Notomys alexis</i>	Spinifex Hopping Mouse
	<i>Pseudomys desertor</i>	Desert Mouse
	<i>Pseudomys hermannsburgensis</i>	Sandy Inland Mouse

Table 7. Reptiles potentially found near the project area

Family	Species	Common Name	Family	Species	Common Name
Agamidae	<i>Ctenophorus caudicinctus</i>	Ring-tailed Dragon	Scincidae	<i>Lialis burtonis</i>	Burton's Snake-lizard
	<i>Ctenophorus fordi</i>	Mallee Dragon		<i>Pygopus nigriceps</i>	Western Hooded Scaly-foot
	<i>Ctenophorus inermis</i>	Military Dragon		<i>Cryptoblepharus australis</i>	Inland Snake-eyed Skink
	<i>Ctenophorus isolepis</i>	Crested Dragon		<i>Cryptoblepharus buchananii</i>	Buchanan's Snake-eyed Skink
	<i>Ctenophorus maculatus</i>	Spotted Dragon		<i>Ctenotus ariadnae</i>	Ariadna's Ctenotus
	<i>Ctenophorus nuchalis</i>	Central Netted Dragon		<i>Ctenotus atlas</i>	Southern Mallee Ctenotus
	<i>Ctenophorus reticulatus</i>	Western Netted Dragon		<i>Ctenotus dux</i>	Fine Side-lined Ctenotus
	<i>Ctenophorus salinarum</i>	Saltpan Dragon		<i>Ctenotus grandis</i>	Grand Ctenotus
	<i>Ctenophorus scutulatus</i>	Lozenge-marked Dragon		<i>Ctenotus greeri</i>	Spotted-necked Ctenotus
	<i>Diporiphora amphiboluroides</i>	Mulga Dragon		<i>Ctenotus hanloni</i>	Nimbel Ctenotus
	<i>Moloch horridus</i>	Thorny Devil		<i>Ctenotus helenae</i>	Clay-soil Ctenotus
	<i>Pogona minor</i>	Western Bearded Dragon		<i>Ctenotus leonhardii</i>	Leonhardi's Ctenotus
	<i>Tympanocryptis cephalus</i>	Pebble Dragon		<i>Ctenotus pantherinus</i>	Leopard Skink
	Boidae	<i>Antaresia stimsoni</i>		Stimson's Python	<i>Ctenotus piankai</i>
Carphodactylidae	<i>Nephurus levis</i>	Three-lined Knob-tail	<i>Ctenotus quattuordecimlineatus</i>	Fourteen-lined Ctenotus	
	<i>Nephurus vertebralis</i>	Midline Knob-tail	<i>Ctenotus schomburgkii</i>	Schomburgk's Ctenotus	
	<i>Nephurus wheeleri</i>	Banded Knob-tail	<i>Ctenotus severus</i>	Stern Ctenotus	
	<i>Underwoodisaurus milii</i>	Barking Gecko	<i>Ctenotus uber</i>	Spotted Ctenotus	
Diplodactylidae	<i>Diplodactylus conspicillatus</i>	Fat-tailed Diplodactylus	<i>Egernia depressa</i>	Pygmy Spiny-tailed Skink	
	<i>Diplodactylus granariensis</i>	Wheat-belt Stone Gecko	<i>Egernia formosa</i>	Goldfields Crevice-skink	
	<i>Diplodactylus pulcher</i>	Fine-faced Gecko	<i>Eremiascincus richardsonii</i>	Broad-banded Sand Swimmer	
	<i>Lucasium damaeum</i>	Beaded Gecko	<i>Lerista bipes</i>	North-western Sandslider	
	<i>Lucasium squarrosum</i>	Mottled Ground Gecko	<i>Lerista desertorum</i>	Central Desert Robust Slider	
	<i>Strophurus assimilis</i>	Goldfields Spiny-tailed Gecko	<i>Lerista distinguenda</i>	South-western Orange-tailed Slider	
	<i>Strophurus elderi</i>	Jewelled Gecko	<i>Lerista kingi</i>	King's Slider	
	<i>Strophurus strophurus</i>	Western Spiny-tailed Gecko	<i>Lerista timida</i>	Timid Slider	
	<i>Strophurus wellingtonae</i>	Spiny-tailed Gecko	<i>Liopholis inornata</i>	Desert Skink	
	<i>Strophurus wellingtonae</i>	Spiny-tailed Gecko	<i>Liopholis striata</i>	Nocturnal Desert Skink	
Elapidae	<i>Brachyurophis fasciolata</i>	Narrow-banded Burrowing Snake	<i>Menetia greyii</i>	Common Dwarf Skink	
	<i>Brachyurophis semifasciata</i>	Half-girdlerd Snake	<i>Morethia butleri</i>	Woodland Morethia Skink	
	<i>Furina ornata</i>	Orange-naped Snake	<i>Tiliqua multifasciata</i>	Centralian Blue-tongued Lizard	
	<i>Parasuta monachus</i>	Monk Snake	<i>Tiliqua occipitalis</i>	Western Blue-tongued Lizard	
	<i>Pseudechis australis</i>	Mulga Snake	Typhlopidae	<i>Anilius australis</i>	Austral Blind Snake
	<i>Pseudechis butleri</i>	Spotted Mulga Snake		<i>Anilius bicolor</i>	Dark-spined Blind Snake
	<i>Pseudonaja mengdeni</i>	Gwardar		<i>Anilius endoterus</i>	Interior Blind Snake
	<i>Pseudonaja modesta</i>	Ringed Brown Snake		<i>Anilius hamatus</i>	Pale-headed Blind Snake
	<i>Simoselaps bertholdi</i>	Jan's Banded Snake	<i>Anilius waitii</i>	Waite's Blind Snake	
	<i>Suta fasciata</i>	Rosen's Snake	Varanidae	<i>Varanus breviceauda</i>	Short-tailed Pygmy Monitor
	Gekkonidae	<i>Gehyra purpurascens</i>		Purplish Dtella	<i>Varanus caudolineatus</i>
<i>Gehyra variegata</i>		Tree Dtella		<i>Varanus eremius</i>	Pygmy Desert Monitor
<i>Gehyra xenopus</i>		Crocodile-faced Dtella		<i>Varanus giganteus</i>	Perentie
<i>Heteronotia binoei</i>		Bynoe's Prickly Gecko		<i>Varanus gouldii</i>	Gould's Goanna
<i>Rhynchoedura ornata</i>		Western Beaked Gecko		<i>Varanus panoptes</i>	Yellow-spotted Monitor
Pygopodidae	<i>Aprasia picturata</i>	Black-headed Worm-lizard	<i>Varanus tristis</i>	Black-headed Monitor	
	<i>Delma butleri</i>	Unbanded Delma	Cheluidae	<i>Chelodina steindachneri</i>	Steindachner's Snake-necked Turtle
	<i>Delma nasuta</i>	Sharp-snouted Delma			

4.4 Conservation significant fauna

Conservation significant fauna are protected by the Commonwealth *Environment Protection and Biodiversity Conservation (EPBC) Act 1999*, and this list includes species covered by international treaties such as the Japan-Australia Migratory Bird Agreement (JAMBA) and China-Australia Migratory Bird Agreement (CAMBA) and the Western Australia (WA) *Wildlife Conservation Act 1950*. The WA *Wildlife Conservation Act 1950* provides for the publishing of the *Wildlife Conservation (Specially Protected Fauna) Notice* that lists species under multiple categories. In addition, the DBCA maintains a list of fauna that require monitoring under four priorities based on the current knowledge of their distribution, abundance and threatening processes. The *EPBC Act 1999* and *Wildlife Conservation Act 1950* imply legislative requirements for the management of anthropogenic impacts to minimise the effects of disturbances on species and their habitats. Priority species have no statutory protection, other than the DBCA wishes to monitor potential impacts on these species. Environmental consultants and proponents of developments are encouraged to avoid and minimise impacts on these species. Definitions of the significant fauna under the *WA Wildlife Conservation Act* are provided in Appendix C.

Six threatened species of fauna and four migratory/marine species of birds identified under the *EPBC Act 1999* potentially occur in the project area. Shore birds and waders have been excluded from this list due to a lack of suitable habitat near the project area (e.g. *Actitis hypoleucos*, *Calidris acuminata*, *Calidris acuminata* and *Tringa nebularia*). There are 10 Schedule species listed under the *WA Wildlife Conservation Act 1950* and three species listed on the DBCA's Priority Fauna List that potentially occur in the project area. The following is an assessment of the likelihood of each of the species listed in Table 8 being found in the project area.

Table 8. Assessment of the potential impact on conservation significant fauna that could occur in the bioregion

Species	DBCA Schedule / Priority	Status under Commonwealth <i>EPBC Act</i>	Comment
Night Parrot (<i>Pezoporus occidentalis</i>)	Critically Endangered	Endangered	Unlikely to be in the project area, due to a lack of suitable habitat. The potential for impacting on this species is therefore low.
Sandhill Dunnart (<i>Sminthopsis psammophila</i>)	Endangered	Endangered	Highly unlikely to be in the project area due to a lack of suitable habitat. The potential for impacting on this species is therefore low.
Malleefowl (<i>Leipoa ocellata</i>)	Vulnerable	Vulnerable	Unlikely to be in the project area due to a lack of suitable habitat and high density of feral fauna. The potential for impacting on this species is therefore low.
Giant Desert Skink (<i>Liopholis kintorei</i>)	Vulnerable	Vulnerable	Highly unlikely to be in the project area due to a lack of suitable habitat. The potential for impacting on this species is therefore low.
Princess Parrot (<i>Polytelis alexandrae</i>)	Priority 4	Vulnerable	May infrequently be seen in the area, however, clearing vegetation is unlikely to impact on this species.
Mulgara (<i>Dasycercus blythi</i>)	Priority 4		Unlikely to be in the project area due to a lack of suitable habitat. The potential for impacting on this species is therefore low.
Oriental Plover (<i>Charadrius veredus</i>)	IA	Migratory	Unlikely to be in the project area due to a lack of suitable habitat. The potential for impacting on this species is therefore low.
Fork-tailed Swift (<i>Apus pacificus</i>)	IA	Migratory	May very infrequently be seen in the area, however, clearing vegetation is unlikely to impact on this aerial species.
Grey Wagtail (<i>Motacilla cinerea</i>)	IA	Migratory	Highly unlikely to be present in the project area. The potential for impacting on this species is therefore low.
Yellow Wagtail (<i>Motacilla flava</i>)	IA	Migratory	Highly unlikely to be present in the project area. The potential for impacting on this species is therefore low.
Peregrine Falcon (<i>Falco peregrinus</i>)	OS		May infrequently be seen in the area, however, clearing vegetation is unlikely to impact on this species.
<i>Branchinella apophysata</i>	Priority 1		Unlikely to be in the project area, so the potential for impact on this species is low.
Long-tailed Dunnart (<i>Sminthopsis longicaudata</i>)	Priority 4		Caught in the Granny Smith area and has potential to be recorded in the rocky areas. Clearing or fragmenting the banded ironstone rock habitat would impact on this species.

IA Migratory birds protected under international agreements; OS Other specially protected fauna

Night Parrot (*Pezoporus occidentalis*) – Critically Endangered under the *WA Wildlife Conservation Act 1950*; Endangered under the *EPBC Act 1999*

The Night Parrot was probably originally distributed over much of the semi-arid and arid Australia (Garnett et al. 2011, Threatened Species Scientific Committee 2016). Sightings in north-west Queensland in the early 1990s were in a broad cross section of the habitats available (Garnett et al. 1993). There have been recent sightings in the Pilbara in 1980, 2005 and 2017, central WA in 1979, north-eastern South Australia in 1979, western Queensland (including Pullen-Pullen-Mt Windsor-Diamantina population) in 1980, 1990, 1993, 2006 and 2013-17 (Davis and Metcalf 2008, Garnett et al. 2011, Palaszczuk and Miles 2017), Pilbara in 2017 (Jones 2017) and near Lake Eyre in 2017 (McCarthy 2017). Garnett et al. (2011) suggested that there were between 50-250 mature individuals in less than 5% of its previous range.

Wilson's (1937) summary of observations provided information on the early records of Night Parrots' preferred habitat and breeding sites. Recent information indicates its preferred habitat appears to be in *Triodia* grasslands, chenopod shrublands, shrubby samphire and floristically diverse habitats dominated by large-seeded species (Threatened Species Scientific Committee 2016, McCarthy 2017, Murphy et al. 2017b). It nests under *Triodia* and has a runway and a tunnel entrance with an apron of dead *Triodia* sp. leaves. It has clutches of two to four sub-elliptical, white eggs with a lustrous appearance (Murphy et al. 2017a). Breeding followed significant rains in March for the observations in Pullen-Pullen Reserve, but it is thought that breeding generally occurs between April and October (Murphy et al. 2017a).

The Night Parrot has not been recorded near the project area, and the habitat in the project area is not suitable for nesting and roosting sites, so there is a very low probability that it is in the project area. It is therefore unlikely to be impacted by the proposed development.

Sandhill Dunnart (*Sminthopsis psammophila*) – Critically Endangered under the *WA Wildlife Conservation Act 1950*; Endangered under the *EPBC Act 1999*

The Sandhill Dunnart is a small (30-45g) arid adapted dasyurid that is found in the eastern part of the Western Australian section of the Great Victoria Desert and the western and southern parts of South Australia. Recent surveys undertaken for the Great Victoria Desert Trust have increased their geographic range in the Great Victoria Desert. The habitat in the project area is not suitable for this Dunnart and there are no records of the Sandhill Dunnart near the project area in the Atlas of Living Australia, so it is highly unlikely that they are present in the project area.

Malleefowl (*Leipoa ocellata*) – Schedule 3 species under the *WA Wildlife Conservation Act 1950*; Vulnerable under the *EPBC Act 1999*

Malleefowl have been found in mallee regions of southern Australia from approximately the 26th parallel of latitude southwards. Malleefowl are now only found throughout these regions in fragmented patches due to clearing of habitat for agriculture, increased fire frequency, competition with exotic herbivores (sheep, rabbits, cattle, goats) and kangaroos, predation by foxes and cats, inbreeding as a result of fragmentation and possibly hunting for food. DBCA records show the only recorded observation was near Leonora in 1998.

Some very old disused Malleefowl mounds were recorded in other regional surveys, however, the vegetation in the project area is generally too sparse to support Malleefowl. Terrestrial Ecosystems' assessment is that the Malleefowl is unlikely to occur in the project area.

Giant Desert Skink (*Liopholis kintorei*) - Vulnerable under the *EPBC Act 1999* and Schedule 3 species under the *WA Wildlife Conservation Act 1950*

Liopholis kintorei is a large skink found in the sandy desert regions of Western Australia, Northern Territory and South Australia. It is found on sand-flats and clay-based or loamy soils vegetated with spinifex. It lives in a multi-entranced communal burrow system and uses shared defecation sites. Storr *et al.* (1999b) recorded them as being in the Wanjarri area of the Great Victoria Desert, and the DBCA Threatened species database records them in Laverton in 1967. The Giant Desert Skink prefers sandy soils vegetated with spinifex. This habitat is not present in the project area. Terrestrial Ecosystems' assessment is that *Liopholis kintorei* is very unlikely to be found in the project area due to a lack of suitable habitat.

Princess Parrot (*Polytelis alexandrae*) - Vulnerable species under the *EPBC Act 1999*; and as a Priority 4 species with DBCA

Very little is known about the Princess Parrot; even the exact extent of its geographical distribution. It is thought to be nomadic within the central desert regions of Australia, occupying arid shrub lands, particularly those dominated by Mulga, Desert Oak and spinifex. Due to the paucity of information on the species, accurate estimates of its conservation significance are difficult to make, however, this species is probably threatened by habitat loss to agricultural practices and changes in fire regimes.

Dr S. Thompson sighted this parrot in a survey near the Wanjarri Nature Reserve in 2006 and Moriarty (1972) also reported it in the same area, so it may occasionally be seen in the general area. The proposed vegetation clearing is unlikely to significantly impact on this species as it will move away to other areas if it is disturbed.

Brush-tailed Mulgara (*Dasyercus blythi*) - Priority 4 with the DBCA

Woolley (2005) recognises two species of 'Mulgara'; *Dasyercus blythi* and *D. cristicauda*. *Dasyercus blythi* has a non-crested tail, two upper premolars and six nipples; *D. cristicauda* has a crested tail, three upper premolars and eight nipples. Both species potentially have overlapping distributions in arid Australia, but it is thought that *D. cristicauda* does not currently exist in Western Australia, although there are old records indicating its presence. Woolley (2005) suggested the common names for these two species be Brush-tailed Mulgara for *D. blythi* and Crest-tailed Mulgara for *D. cristicauda*. These two species can be sympatric in places, but probably utilise different parts of the habitat on a local scale when they are recorded in the same area. Currently, there are insufficient data to separate the spatial ecology, burrows and reproductive biology of these two species. Information that follows is based on what is known for 'Mulgara' without distinguishing between the species.

The reported distribution of Mulgara includes much of the inland spinifex covered sandy desert and spinifex vegetated areas in the Pilbara and northern goldfields. Within these areas their distribution is patchy and it is most frequently confined to mature spinifex dominated habitat (Gibson and Cole 1992, Masters 2003, Masters et al. 2003, Thompson and Thompson 2008). In some areas, their relative abundance is positively associated with rainfall in the previous 12 to 24 months (Gibson and Cole 1992, Masters 1998, Dickman et al. 2001, Letnic and Dickman 2005) and recent burning of the spinifex does not seem to be sufficient to shift Mulgara out of an area (Thompson and Thompson 2007). Mulgara are generally sedentary in contrast with some other small dasyurids and have high site fidelity and a low propensity for dispersal once a home range has been established (Masters 1998, Dickman et al. 2001).

Fauna habitat in the project area is not suitable for Mulgara. It is therefore Terrestrial Ecosystems' view that they are unlikely of be found in the project area.

Oriental Plover (*Charadrius veredus*) - Migratory species under the *EPBC Act 1999* and Schedule 5 species under the *WA Wildlife Conservation Act 1950*

A migrant species with patchy distribution in Australia, the Oriental Plover is sparsely distributed across arid and semi-arid Australia, but avoids truly desert regions. Its preferred habitat is dry plains. It was not recorded in other fauna surveys undertaken near the project area. The species is under threat because of habitat reduction due to agriculture and changing fire regimes. This plover has not been recorded in the general area in any of the other regional surveys.

Terrestrial Ecosystems' assessment is that the Oriental Plover is unlikely to be seen in the project area.

Fork-tailed Swift (*Apus pacificus*) - Migratory species under the *EPBC Act 1999* and Schedule 5 species under the *WA Wildlife Conservation Act 1950*

This species breeds in the northeast and mid-east Asia and winters in Australia and southern New Guinea. It is a visitor to most parts of Western Australia, beginning to arrive in the Kimberley in late September, in the Pilbara in November and in the southwest land division in mid-December, and leaving by late April. The Fork-tailed swift is an almost exclusively an aerial species, foraging and sleeping on the wing. It rarely comes to earth, usually only for breeding. It is common in the Kimberley, uncommon to moderately common near northwest, west and southeast coasts and rare to scarce elsewhere. It is rarely seen in the Goldfields.

Terrestrial Ecosystems' assessment is that the Fork-tailed Swift may infrequently be seen in the project area. However, the proposed vegetation clearing is unlikely to significantly impact on this species as it will move away to other areas if it is disturbed.

Grey Wagtail (*Motacilla cinerea*) - Migratory under the *EPBC Act 1999* under the *Wildlife Conservation Act 1950*

The Grey Wagtail is a small yellow breasted bird with a grey back and head. Johnstone and Storr (2004) reported this migratory species as breeding in Palearctic from western Europe and north-west Africa to eastern Asia and wintering in Africa, south-east Asia, Indonesia, the Philippines, New Guinea and Australia. Its preferred habitat in Australia is banks and rocks in fast-running fresh water including rivers, streams and creeks where it feeds on insects.

The Atlas of Living Australia records two sightings on the south-coast of Western Australia and none around the project area. It is highly unlikely to be seen in the project area due to a lack of suitable habitat.

Yellow Wagtail (*Motacilla flava*) - Migratory under the *EPBC Act 1999* under the *Wildlife Conservation Act 1950*

The Yellow Wagtail is found in the millions in the northern hemisphere and the Atlas of Living Australia records multiple records of this bird in Australia in the coastal areas. There are no records for this species in inland Western Australia near the project area, therefore it is highly unlikely to be impacted by the proposed development.

Peregrine Falcon (*Falco peregrinus*) – Schedule 7 species under the *WA Wildlife Conservation Act 1950*

The Peregrine Falcon is uncommon, although widespread throughout much of Australia excluding the extremely dry areas and has a wide and patchy distribution. It shows habitat preference for areas near cliffs along coastlines, rivers and ranges and within woodlands along watercourses and around lakes. Nesting sites include ledges along cliffs, granite outcrops and quarries, hollow trees near wetlands and old nests of other large bird species. There is no evidence to suggest any change in status in the last 50 years. The Peregrine Falcon has been seen in the Wanjarri Nature Reserve (Moriarty 1972, Ninnox Wildlife Consulting 1994), at Honeymoon Well (Ninnox Wildlife Consulting 1994) and Mileura (Tingay 1977), so they could infrequently be seen in the general area.

Terrestrial Ecosystems' assessment is that the Peregrine Falcon may infrequently be seen in the project area. However, the proposed developments are unlikely to significantly impact on this species as it will move away to other areas if it is disturbed.

Branchinella apophysata – Priority 1 species with DBCA

Notes from DBCA indicate that this fairy shrimp is known from a single location near Mt Magnet, but nothing is known of its habits or ecological requirements. As there are no salt lakes near the project area, it is Terrestrial Ecosystems' assessment that *B. apophysata* is unlikely to be impacted by the proposed development.

Long-tailed Dunnart (*Sminthopsis longicaudata*) – Priority 4 species with DEC.

Burbidge et al. (2008) summarised the Long-tailed Dunnart distribution as widely scattered in arid zone where it inhabits rugged rocky areas. They went on to suggest that its striated foot-pads, long tail and behaviour in captivity indicated that it was an active and capable climber. Specimens have been recorded in several rocky ranges in the Gibson Desert, West MacDonnell National Park, Murchison, Carnarvon Basin and the Pilbara. All previous capture sites for Long-tailed Dunnarts are within rugged rocky landscapes that support a low open woodland or shrubland of Acacias (especially mulga) with an understorey of spinifex hummocks, and (occasionally) also perennial grasses and cassias.

Three adult Long-tailed Dunnarts were caught in the Granny Smith Level 2 fauna survey (Terrestrial Ecosystems 2011b) and a single individual was caught in the follow up targeted survey (Terrestrial Ecosystems 2011c). Subsequently, Long-tailed Dunnarts have been caught at Mt Ida and Bottle Creek, which are about 200km to the west of Granny Smith mine. This Dunnart is likely to be recorded in the Banded Ironstone rocky habitats that are present in the project area. Clearing or fragmenting this habitat could impact on the Long-tailed Dunnart.

5 DISCUSSION

5.1 Adequacy of the fauna survey data for fauna habitats represented in the project area

The EPA's (2016) *Technical Guidance on Terrestrial Fauna* indicated that a Level 2 fauna assessment is required for a disturbance area of in excess of 75ha in this bioregion. The project area is greater than 75ha, so the disturbance exceeds one of the criterion to require a Level 2 survey in the Murchison 1 IBRA bioregion, however, in this instance, the earlier surveys of the Granny Smith area (Terrestrial Ecosystems 2011a, c, b, 2012g) in particular the Level 2 survey in similar habitat by Terrestrial Ecosystems (2011b) provide information on the fauna assemblages potentially in the project area. It is unlikely that a Level 2 vertebrate fauna survey in the project area will provide new species not previously identified for this area that would alter the assessment of potential impacts. However, as with all surveys, until it is completed the outcome is unknown.

Terrestrial Ecosystems undertook a Level 2 vertebrate fauna assessment in January 2011. A single survey was deemed adequate as there was already substantial fauna survey data for open mulga woodlands for this part of the eastern Goldfields. These fauna trapping sites, the avian surveys and Long-tailed Dunnart survey sites are near the project area. The single survey was used to confirm the vertebrate fauna assemblage was as would be predicted based on the available survey data. The 2011 survey provided two notable observations, namely the presence of Long-tailed Dunnarts and the abundance of Kultarr. Long-tailed Dunnarts were not expected as the habitat was not as indicated in the available texts and this population is about 200km further south east of other reported populations. Subsequent surveys of other areas have recorded Long-tailed Dunnarts 200km to the west at Mt Ida and Bottle Creek in rocky terrain which is more typical of their preferred habitat. Other similar surveys in the eastern Goldfields would often record one or two Kultarr. Terrestrial Ecosystems' capture of 17 in the 2011 survey indicated an unusually high abundance. It is unknown whether the trapped number of Kultarr accurately reflects their abundance, or whether they are particularly trap shy or jump out of pit-traps and are not subsequently recorded.

The fauna habitat in the 2011 survey was predominantly open mulga woodland over mixed scattered shrubs. The density of trees and shrubs varied considerably across the site. The Terrestrial Ecosystems (2011b, c) surveys of the area provide an adequate representation of the trappable vertebrate fauna in the open mulga woodlands in the vicinity of the Solar Farm project.

5.1.1 Amphibians

Frogs are normally only detected immediately after rainfall or around semi-permanent pools. It is likely that *Cyclorana maini*, *Pseudophryne occidentalis*, *Neobatrachus kunapalari* and *Neobatrachus wilsmorei* would be found in the general area. These species, other than *P. occidentalis*, burrow into the ground and aestivate between rainfall events. *Pseudophryne occidentalis* find shelter under rocks and in crevices during the dry periods and enter temporary ponds to breed after major rainfall events. All four species have a wide-spread distribution and are abundant. Clearing vegetation is likely to result in a loss of individuals within the disturbed area, however, is unlikely to have a significant impact on these species when assessed in a regional context.

5.1.2 Reptiles

Typically, between 25 and 35 species of reptiles are caught in open mulga woodland (Coffey Environments 2008b, Terrestrial Ecosystems 2010b, 2011b, 2012i). None of the species likely to be in the project area, are of conservation significance. There were no characteristics of the reptile assemblage surveyed in 2011 that indicated the fauna habitat present in the project area was of conservation significance or different to that in the neighbouring areas, and given that there were large expanses of similar habitat in adjacent areas, clearing of the vegetation is unlikely to have significant impact on reptiles when assessed in a regional context.

Terrestrial Ecosystems' view is that the proposed clearing of the project area is unlikely to significantly impact on the reptile fauna of the bioregion.

5.1.3 Birds

The number of birds and bird species in the northern Goldfields fluctuates based on seasons and recent rainfall. Semi-arid and arid areas of inland Australia support a diverse range of transient and nomadic species that move through large areas in search of available resources. Heavy rain that is followed by flowering and seeding of many plant species is often sufficient to draw a large number of these nomadic species to the general area. These species move on to other areas once the resource is depleted or better resources are available in adjacent areas.

The project area is likely to support a similar assemblage to that present in the adjacent areas. Birds of conservation significance potentially found in the area include the Peregrine Falcon and Princess Parrot. The Princess Parrot is nomadic and moves around the arid interior often in search of water and resources and the Peregrine Falcon will normally have a very large home range and clearing a small section of vegetation in the project area, particularly when similar habitat exists in the adjacent areas, is unlikely to significantly impact on this species. All birds will readily shift to other areas when there is a disturbance.

Terrestrial Ecosystems' view is that the proposed clearing for the access road is unlikely to significantly impact on the avian fauna of the bioregion.

5.1.4 Mammals

The diversity of small terrestrial mammals potentially caught in the project area would be low due the sparsely vegetated and degraded habitat. The capture of Long-tailed Dunnarts (Terrestrial Ecosystems 2011c, b) was unexpected as they are rarely caught, not normally caught this far south and not normally caught in open, flat, mulga woodland with no spinifex, low shrubs and little ground cover. It is highly probable that if Long-tailed Dunnarts are present in the project area they will be inhabiting the banded ironstone rocky ridges. Avoiding impacts to this habitat or fragmenting the ridges from each other will significantly reduce any potential impacts on the Long-tailed Dunnart.

Other than the Long-tailed Dunnart, there are no other mammals of conservation significance likely to be in the project area.

5.2 Biodiversity value

From a fauna perspective, the project area has been heavily grazed resulting in degradation to the mulga and shrublands. The habitat types identified in the project area are also abundant in adjacent areas, indicating that any localised impacts will not be significant in a regional context.

5.2.1 Ecological functional value at the ecosystem level

Vertebrate species potentially in the project area are wide-ranging and have been recorded in various other fauna surveys in the bioregion (Appendix B). There is likely to be a relatively low abundance of reptiles and mammals caught in the project area because of the sparseness of the vegetation, lack of leaf litter on the ground in many areas and degradation by cattle and feral fauna.

The development of the Solar Farm Project will increase the existing impact in the area. Except for the banded ironstone ridges, the habitat types in the project area are well represented across the bioregion. Assuming that the banded ironstone habitat is not impacted and these habitat areas are not fragmented from each other, the project area does not have high ecological value, nor does it support conservation significant fauna or a conservation significant ecosystem.

5.2.2 Maintenance of threatened ecological communities

No threatened ecological fauna communities were identified in the project area.

5.2.3 Condition of fauna habitat

Some of the project area has been disturbed due to historical development activity (i.e. tracks, water pipeline and fences). There is also extensive evidence of disturbance by cattle and the presence of rabbits and cats. The uncleared fauna habitat present in the project area is similar to many square kilometres of adjacent habitat; the clearing of vegetation is therefore unlikely to have a significant impact on the vertebrate fauna when considered in a bioregional context.

5.2.4 Ecological linkages

The project area does not provide an important ecological linkage or fauna movement corridors; however it does contain a banded ironstone ridge habitat type which is significant for Long-tailed Dunnarts. Maintaining a native vegetation and undisturbed corridor between the ridges is important for maintaining Long-tailed Dunnarts in the project area and broader Granny Smith mine.

5.2.5 Size and scale of the proposed disturbance

The project area is a very small proportion of similar habitat found in the adjacent area and region. Given the available fauna survey data for these habitat types, no additional surveys are warranted.

5.2.6 Abundance and distribution of similar habitat in the adjacent areas

Fauna habitats present in the project area are abundant in adjacent areas. It is therefore likely that the fauna assemblage in the project area is similar to the many square kilometres of similar habitat in adjacent areas and the bioregion.

5.2.7 Potential impacts on ecosystem function

Clearing native vegetation is likely to result in the loss of small vertebrate fauna on site that are unable to move away during the clearing process. The few larger animals, such as kangaroos and large goannas, and most of the birds will move into adjacent areas once clearing commences. Shifting animals into adjacent areas will increase the pressure on resources in those areas and it is likely that there will be some disruption to the ecosystems in these areas for a period until a balance is restored.

Impacts associated with clearing vegetation in the project area in a landscape or bioregional context on the vertebrate fauna are likely to be low as the proposed disturbance area is very small relative to the quantity of similar habitat in the bioregion.

5.3 Potential environmental impacts

Clearing of vegetation will potentially affect vertebrate fauna in numerous ways, including death/injury of fauna during clearing, grading and impacts with vehicles and the loss of habitat.

Although there are anticipated short term impacts on fauna, they are not considered to result in significant impacts on fauna habitat and fauna assemblages in the long term. The overall impact on fauna species and species of conservation significance will be minimal provided the recommended management procedures are implemented and adhered to.

5.3.1 Direct impacts

Clearing vegetation and activities associated with the development will result in the loss of small fauna that retreat to burrows, such as reptiles and mammals. Nocturnal species are unlikely to be active when most of the land clearing and construction work is taking place which may result in these individuals being adversely impacted when they attempt to escape. This loss of vegetation is unlikely to have a significant impact when considered in a bioregional context.

Clearing linear corridors and other large areas increases fauna habitat edges. Small mammals can respond both positively and negatively to edges depending on their ecological traits (Laurance 1991, 1994, Goosem and Marsh 1997, Goosem 2000). Edge and disturbance effects can lead to altered and most often higher levels of predation, restricting or increasing fauna movements and altering assemblage structure (Oxley et al. 1974, Paton 1994, Baker et al. 1998, Temple 1998, Luck et al. 1999, Goosem et al. 2001). Goldingay and Whelan (1997) and Clarke and Oldland (2007) reported that edge effects can extend up to 150-200m from the edge for some species, meaning the impact area on vertebrate fauna is likely to be larger than the cleared footprint.

Edge effects can lead to the disruption of ecological processes such as predation and dispersal, animal movements and can change assemblage structure. The consequence is that the impact area will always be much larger than the cleared area.

5.3.2 Secondary impacts

Increased human activity is often associated with an altered fire regime, increased dust or fauna deaths on access tracks, which lead to a degradation of natural ecosystems. Fire has been identified as one of the threatening processes for some conservation significant species as a number of small mammal and bird species rely on long unburnt vegetation. Fires are unlikely to be a significant threat to native fauna species near the project area due to the sparseness of the vegetation.

Introduced plant species can successfully and rapidly invade areas of cleared native vegetation or otherwise disturbed by humans. Introduced plant species may replace native species that provide shelter or foraging areas for native fauna. Major changes to the structure of vegetation will alter the fauna habitat and consequently may influence fauna species composition. Preparing and implementing a weed management plan will largely reduce their threat to native fauna species.

5.3.3 Anthropogenic activity

Unnatural noises, vibrations, artificial light sources, and vehicle and human movement in an area may be sufficient to force individuals or fauna species to move from adjacent areas or alter their activity periods. This form of disturbance is likely to occur during the vegetation clearing and when development activity commences. The overall impact is likely to be confined to a relatively small proportion of very similar habitat elsewhere in the bioregion.

5.3.4 Rehabilitation of cleared areas

To minimise the long-term potential impacts, rehabilitation programs should be progressively implemented and evaluated. An emphasis should be placed on the establishment of near-natural, self-sustaining, functional ecosystems in rehabilitation planning, and this should be one of the focal criteria for assessing the success of rehabilitation programs.

5.3.5 Dust

Dust generated from shifting top soil and spoil and vehicle traffic can potentially degrade surrounding vegetation, reducing its ability to absorb sunlight and influencing photosynthetic rates. Degradation of these areas may potentially render habitat unsuitable for fauna. As there is unlikely to be significant vehicle traffic once the solar farm is developed this is likely to only be an issue during construction. Dust suppression and management programs are an essential component of minimising impacts on fauna in areas adjacent to the haul road. An effective dust management and monitoring program is required.

5.4 Risk assessment

Fauna surveys to support Environmental Impact Assessments (EIA) are part of the environmental risk assessment undertaken to consider what potential impacts a development might have on the biodiversity on a particular area and region. Potential impacts on fauna from the proposed development are identified and briefly described above. Tables 9, 10 and 11 provide a summary of the risk assessment associated with this project.

Table 9. Fauna impact risk assessment descriptors

Any risk assessment is a product of the likelihood of an impact occurring and the consequences of that impact. Likelihood and consequences are categorised and described below. The assessed risk level (likelihood x consequences) is then calculated as the overall risk for the development. This is followed by an assessment of the acceptability of the risk associated with each of the impacts. Disturbances and vegetation clearing have an impact on the fauna at multiple scales – site, local, landscape and regional. Each of these is considered in the risk assessment. This assessment should be considered in the context of the summary in Table 9.

Likelihood		
Level	Description	Criteria
A	Rare	The environmental event may occur, or one or more conservation significant species may be present in exceptional circumstances.
B	Unlikely	The environmental event could occur, or one or more conservation significant species could be present at some time.
C	Moderate	The environmental event should occur, or one or more conservation significant species should be present at some time.
D	Likely	The environmental event will probably occur, or one or more conservation significant species will be present in most circumstances.
E	Almost certain	The environmental event is expected to occur, or one or more conservation significant species is expected to be present in most circumstances.
Consequences		
Level	Description	Criteria
1	Insignificant	Insignificant impact on fauna of conservation significance or regional biodiversity, and the loss of individuals will be insignificant in the context of the availability of similar fauna or fauna assemblages in the area.
2	Minor	Impact on fauna localised and no significant impact on species of conservation significance in the project area. Loss of species at the local scale.
3	Moderate	An appreciable loss of fauna in a regional context or a limited impact on species of conservation significance in the project area.
4	Major	Significant impact on conservation significant fauna or their habitat in the project area and/or regional biodiversity and/or a significant loss in the biodiversity at the landscape scale.
5	Catastrophic	Loss of species at the regional scale and/or a significant loss of species categorised as 'vulnerable' or 'endangered' under the <i>EPBC Act (1999)</i> at a regional scale.
Acceptability of Risk		
Level of risk	Management Action Required	
Low	No action required.	
Moderate	Avoid if possible, routine management with internal audit and review of monitoring results annually.	
High	Externally approved management plan to reduce risks, monitor major risks annually with external audit and review of management plan outcomes annually. May a referral to the Commonwealth under the <i>EPBC Act 1999</i> .	
Extreme	Unacceptable, project should be redesigned or not proceed.	

Table 10. Levels of acceptable risk

		Likelihood				
		Rare or very low (A)	Unlikely or low (B)	Moderate (C)	Likely (D)	Almost certain (E)
Consequences	Insignificant (1)	Low	Low	Low	Low	Low
	Minor (2)	Low	Low	Low	Moderate	Moderate
	Moderate (3)	Low	Moderate	Moderate	High	High
	Major (4)	Moderate	Moderate	High	High	Extreme
	Catastrophic (5)	Moderate	High	High	Extreme	Extreme

Table 11. A risk assessment of the impact of ground disturbance activity on fauna

			Before Management			With Management			
Factor	Potential Impact		Inherent Risk			Risk Controls / Management	Residual Risk		
			Likelihood	Consequence	Significance		Likelihood	Consequence	Significance
Fauna survey data	Inadequate survey data to adequately assess the risks	Unknown loss of fauna, fauna of conservation significance, and fauna assemblages, and an incomplete fauna assessment.	B	2	Low				
	Inadequacy of comparative data	Limits on the availability of comparative data reduced the capacity to assess the uniqueness of the fauna assemblages in the project area.	B	2	Low				
Clearing vegetation	Loss of fauna habitat – local scale	Loss of terrestrial fauna in the project area.	E	2	Mod.				
	Loss of fauna habitat – landscape scale	Loss of some fauna during vegetation clearing.	B	1	Low				
	Loss of fauna habitat – regional scale	Small loss of some fauna from the region.	B	1	Low				
	Loss of a threatened ecological fauna community	Loss of an undetected threatened ecological fauna community.	A	3	Low				
	Habitat fragmentation	Fauna movement restricted resulting in the death of fauna and a loss of biodiversity.	A	2	Low				
	Loss of a unique terrestrial fauna ecosystem	Loss of an ecosystem containing fauna with high species richness, high abundance and numerous top of the food chain predators.	A	2	Low				
Death or loss of conservation significant fauna	Malleefowl (<i>Leipoa ocellata</i>)	Death or the reduced viability of Malleefowl.	A	3	Low				
	Peregrine Falcon (<i>Falco peregrinus</i>)	Death or the reduced viability of the Peregrine Falcon.	A	2	Low				
	Fork-tailed Swift (<i>Apus pacificus</i>)	Death or the reduced viability of Fork-tailed Swift.	A	2	Low				
	Long-tailed Dunnart (<i>Sminthopsis longicaudata</i>)	Death or the reduced viability of the Long-tailed Dunnart	C	3	Mod.	Don't impact banded iron formation or fragment this habitat linkage	A	3	Low
Human impacts	Spread of weeds	Changed vegetation and a resulting loss of fauna habitat.	E	2	Mod.	Implementation of a weed management plan.	D	2	Low
	Road kills	Animals being killed as they cross roads by vehicles	E	1	Low	Limiting speeds	E	1	Low
	Increase in feral mammals, specifically the dog and cat	Increased predation on the native fauna	C	2	Low	Management of waste and not-feeding feral animals.	B	2	Low

5.5 Native vegetation clearing principles as they pertain to vertebrate fauna

The *Environmental Protection Act (1986)* outlines 10 principles that are to be used in the assessment of native vegetation clearing permit applications which are also applicable for other assessments and approvals (Table 12). Where possible, native vegetation should not be cleared if any of the following principles are comprised.

Table 12. Assessment of impact using the native vegetation clearing principles

Principle	Response
It comprises a high level of biological diversity.	Clearing vegetation will not comprise a high level of biodiversity.
It comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.	Clearing the vegetation will not result in the loss of significant habitat for indigenous fauna.
It includes, or is necessary for the continued existence or, rare flora.	N/A
It comprises the whole or a part of, or is necessary for the maintenance of, a threatened ecological community.	The area does not contain a threatened ecological fauna community.
It is significant as a remnant of native vegetation in an area that has been extensively cleared.	The area is not a remnant.
It is growing in, or in association with, an environment associated with a watercourses or wetland.	The area does not contain a wetland.
The clearing of the vegetation is likely to cause appreciable land degradation.	N/A
The clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.	Clearing of vegetation is unlikely to impact on the environmental values of the bioregion.
The clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.	N/A
The clearing of the vegetation is likely to cause, or exacerbate the incidence of flooding.	N/A

5.6 Referral under the EPBC Act

The proposed project is unlikely to significantly impact on a conservation significant vertebrate fauna species, so a referral under the *EPBC Act* is not required.

6 SUMMARY

The total assessed area is 150ha but the development area is likely to be only 30ha. There are four broad fauna habitats in the project area:

- Open mulga woodland over scattered low shrubs and grasses of varying densities on a stony sandy-clay or sandy-clay substrate;
- Open chenopod shrubland over grasses of varying densities on a stony sandy-clay or sandy-clay substrate;
- Chenopod and mulga shrubland over scattered grasses of varying densities on a stony sandy-clay or sandy-clay substrate; and
- Banded Ironstone rocky ridgeline with scattered Mulga and shrubs.

The density of trees and shrubs in the relatively undisturbed areas varied across the project area but was mostly sparse. The fauna habitat varies from degraded to good; the more degraded areas are due to historical and recent exploration activity and cattle grazing. There are a few access tracks in the area, but these are narrow and mostly only wheel tracks of a stony red sand-clay substrate.

The area has been grazed by cattle with many areas showing obvious degradation (i.e. cattle tracks, chewed bushes and shrubs, etc). There was extensive evidence of rabbits and other feral fauna in the area.

The banded ironstone formation habitat type is significant for Long-tailed Dunnarts in the region. This habitat type should be avoided and linkage corridors between these habitat areas maintained. Clearing native vegetation in other habitat types is likely to result in the loss of small vertebrate fauna on-site that are unable to move away during the clearing process. The few larger animals, such as kangaroos and large goannas and snakes, and most of the birds will move into adjacent areas once clearing commences.

Construction of a solar farm will have a minimal impact on the fauna in areas adjacent to those that will be cleared. There will be a small loss of native fauna to vehicle strikes on access tracks, but this will be very low. Migrants increase competition for resources, which may result in the subsequent loss of migrants or local individuals. Individuals shifted out of their established activity areas are also vulnerable to predation until they have become established in their new areas.

Impacts associated with clearing vegetation in the project area in a landscape or bioregional context on the vertebrate fauna are likely to be low as there are vast tracts of similar habitat in adjacent areas.

The proposed project is unlikely to significantly impact on a conservation significant species, so a referral under the *EPBC Act* is not required.

7 MANAGEMENT STRATEGIES

7.1 Induction and awareness

All contractors and people involved in construction of solar farm should be made aware of the possible presence and issues associated with terrestrial fauna in the area through the induction process.

Recommendation 1: An induction program that includes a component on managing fauna is a mandatory component of working on the solar farm project.

7.2 Dust

Dust generated from the construction of the solar farm could potentially degrade surrounding vegetation, reducing its ability to absorb sunlight and influencing photosynthetic rates. Degradation of these areas will potentially render habitat unsuitable for fauna. Dust suppression and management programs are an essential component of minimising mining impacts on fauna during the construction program.

Recommendation 2: The impact of dust on adjacent vegetation and fauna habitat is managed and monitored against appropriate KPIs.

7.3 Long-tailed Dunnarts

Long-tailed Dunnarts were recorded during the 2011 Level 2 fauna trapping surveys in adjacent areas. They are therefore potentially present in the banded ironstone formations in the eastern portions of the project area. To reduce the potential impacts on the Long-tailed Dunnart this habitat type should not be impacted and linkage habitat between the rocky ridges maintained.

If the banded ironstone habitat and habitat linkages cannot be retained an assessment of the regional abundance of this dunnart in surrounding areas should be undertaken to demonstrate the consequential impact on this species of a vegetation clearing program. This survey should include all other available rocky hill habitats.

Recommendation 3: Avoid impacting on the banded ironstone habitat and linkage habitats between the rocky hills.

Recommendation 4: If the banded ironstone habitat or linkages between the rocky areas will be impacted, an assessment on the regional abundance and distribution of the Long-tailed Dunnart is undertaken to demonstrate the consequential impact on this species of a vegetation clearing program.

7.4 Feral fauna

Based on feral cat tracks and scats recorded in the project area, the success of an earlier feral cat trapping program (Onus et al. 2011) and the lack of any subsequent follow up program, it is highly probable that the Granny Smith mining area currently supports a significant population of feral cats. Rabbits were also present in the project area. Reducing the impacts of feral cats and rabbits will reduce the stress on fauna and fauna assemblages in the area.

Recommendation 5: Implement a feral cat control program.

Recommendation 6: Investigate options for management of rabbits in the area.

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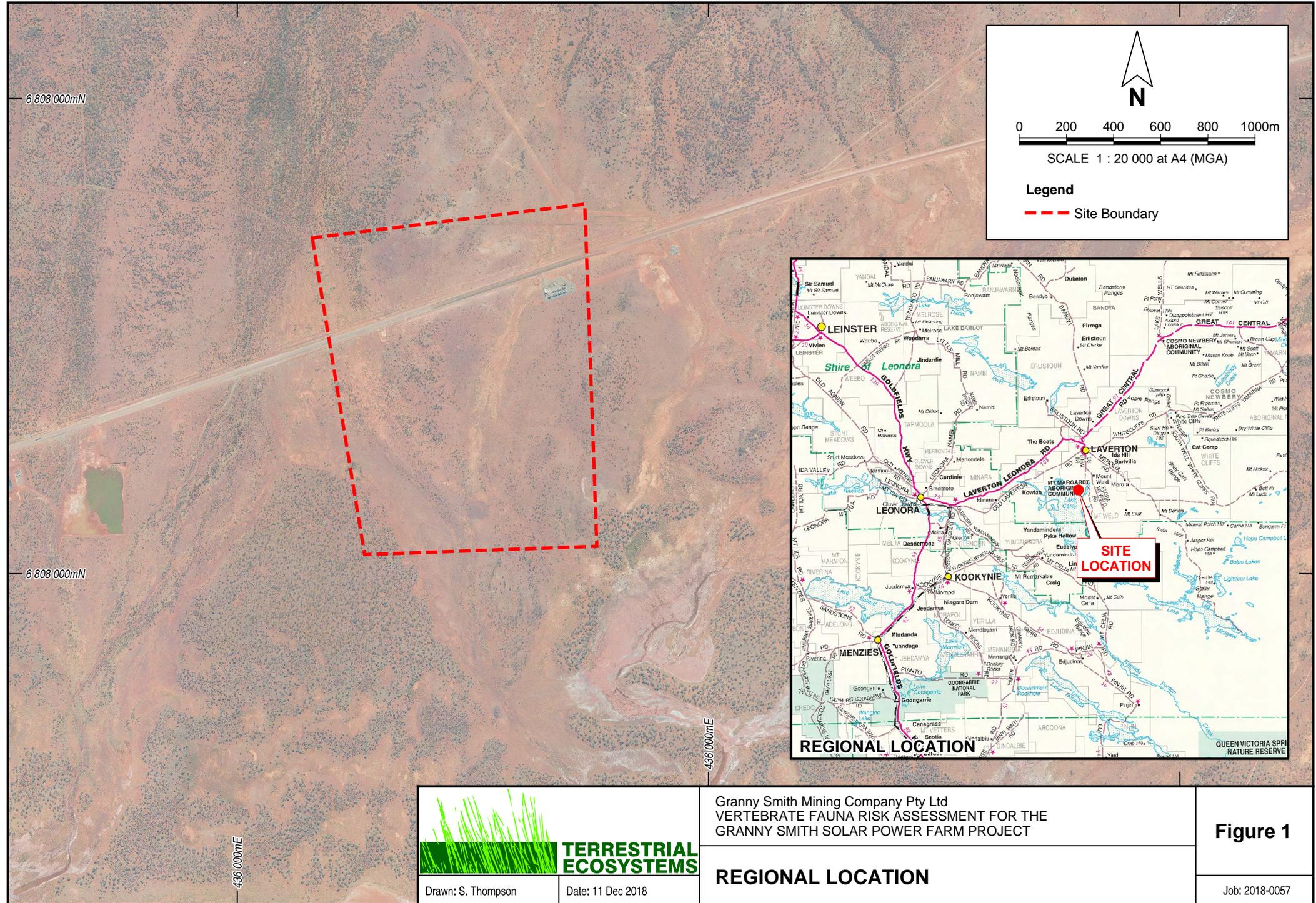
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Figures

Vertebrate Fauna Assessment – Granny Smith Solar Power Farm Project



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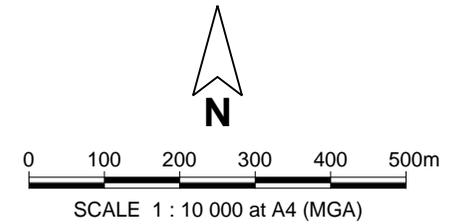
Drawn: S. Thompson Date: 11 Dec 2018

Granny Smith Mining Company Pty Ltd
 VERTEBRATE FAUNA RISK ASSESSMENT FOR THE
 GRANNY SMITH SOLAR POWER FARM PROJECT

REGIONAL LOCATION

Figure 1

Job: 2018-0057



Legend
- - - Site Boundary

Habitat Types

- Open mulga woodland over scattered low shrubs and grasses of varying densities on a stony sandy-clay or sandy-clay substrate
- Open chenopod shrubland over grasses of varying densities on a stony sandy-clay or sandy-clay substrate
- Chenopod and mulga shrubland over scattered grasses of varying densities on a stony sandy-clay or sandy-clay substrate
- Banded ironstone rocky ridgeline with scattered Mulga and shrubs
- Existing disturbance

TERRESTRIAL ECOSYSTEMS

Drawn: S. Thompson Date: 11 Dec 2018

Granny Smith Mining Company Pty Ltd
 VERTEBRATE FAUNA RISK ASSESSMENT FOR THE
 GRANNY SMITH SOLAR POWER FARM PROJECT

HABITAT TYPES

Figure 2

Job: 2018-0057

Appendix A
Results of the *EPBC Act* Protected
Matters Search

Vertebrate Fauna Assessment – Granny Smith Solar Power Farm Project



EPBC Act Protected Matters Report

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

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

Information is available about [Environment Assessments](#) and the EPBC Act including significance guidelines, forms and application process details.

Report created: 29/10/18 15:40:59

[Summary](#)

[Details](#)

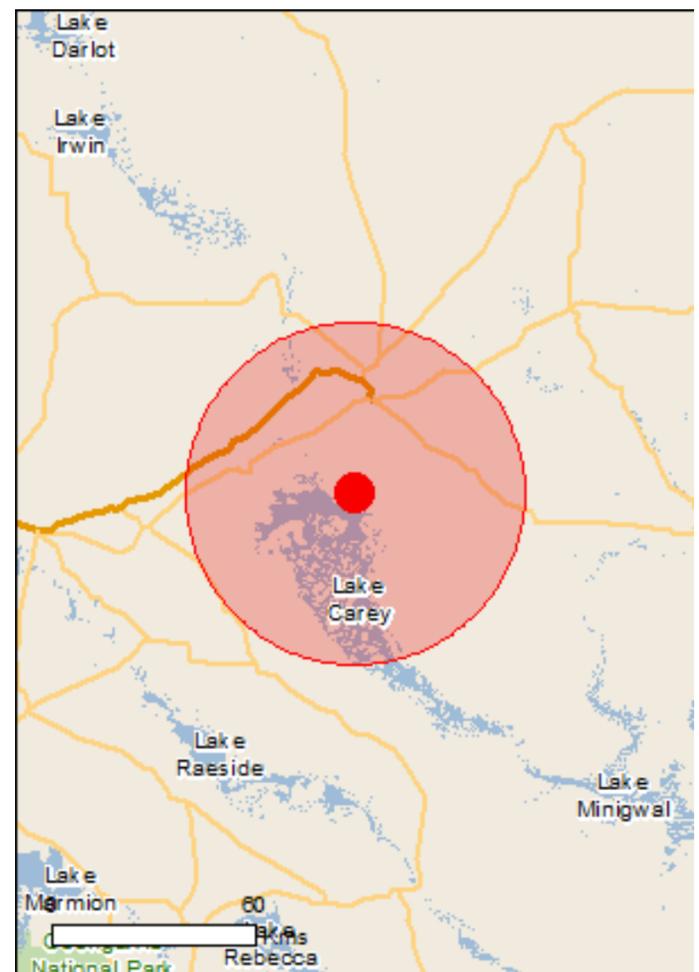
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

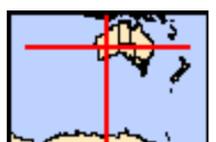
[Acknowledgements](#)



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

[Coordinates](#)

Buffer: 50.0Km



Summary

Matters of National Environmental Significance

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

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	4
Listed Migratory Species:	8

Other Matters Protected by the EPBC Act

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

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

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

Commonwealth Land:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	11
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

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

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	13
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Species [\[Resource Information \]](#)

Name	Status	Type of Presence
Birds		
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat known to occur within area
Pezoporus occidentalis Night Parrot [59350]	Endangered	Species or species habitat may occur within area
Polytelis alexandrae Princess Parrot, Alexandra's Parrot [758]	Vulnerable	Species or species habitat known to occur within area

Mammals

Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat may occur within area
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Listed Migratory Species [\[Resource Information \]](#)

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

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area

Migratory Terrestrial Species

Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area

Migratory Wetlands Species

Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [\[Resource Information \]](#)

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

Name
Commonwealth Land -

Listed Marine Species [\[Resource Information \]](#)

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

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat known to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within

Name	Threatened	Type of Presence area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Extra Information

Invasive Species [\[Resource Information \]](#)

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

Name	Status	Type of Presence
Birds		
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Mammals		
Camelus dromedarius Dromedary, Camel [7]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Equus asinus Donkey, Ass [4]		Species or species habitat likely to occur within area
Equus caballus Horse [5]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species

Name	Status	Type of Presence
Plants		
Carrichtera annua Ward's Weed [9511]		habitat likely to occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area

Caveat

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

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

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

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

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

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

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

- migratory and
- marine

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

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

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

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

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

Coordinates

-28.84252 122.3578

Acknowledgements

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

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

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

Please feel free to provide feedback via the [Contact Us](#) page.

Appendix B
Vertebrate Fauna Recorded in Biological
Surveys in the Region

Vertebrate Fauna Assessment – Granny Smith Solar Power Farm Project

Family	Species	Common Name	Surveys																	A										B									
			Site 1E	Site 1W	Site SS18	Site SS21	Site SS1	Site 1W08	Site LL4	Site LL5	Site SS19	Site SS20	Site LL3	Site LL6	Site SS22	Site LL1	Site LL2	Site SS23	Site 2	Site 3	Site 6	Site 7	Site 8	Site 1	Site 4	Site 5	Pundin	Wells	Site 2	Site 10	Site 21	Site 18	Site 21a	Site 9	Weebo	Site 17	Opportunistic		
	<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat	5	13														1	1	1						2	8												
	<i>Scotorepens balstoni</i>	Inland Broad-nosed Bat	6	21			1											1	1	1																			
	<i>Scotorepens greyii</i>	Little Broad-nosed Bat																								1	0												
	<i>Vespadelus finlaysoni</i>	Finlayson's Cave Bat		3			1												1	1																			
	<i>Vespadelus regulus</i>	Southern Forest Bat																								2													
Dasyuridae	<i>Antechinomys laniger</i>	Kultarr		2	6	3				2	3																									1			
	<i>Ningauai ridei</i>	Wongai Ningauai		1	2	3	1		5	1	1		1	7														7	2	8	2	4							
	<i>Pseudantechinus woolleyae</i>	Woolley's False Antechinus					1																																
	<i>Sminthopsis crassicaudata</i>	Fat-tailed Dunnart										1			4	7												3											
	<i>Sminthopsis dolichura</i>	Little Long-tailed Dunnart																										1			1								
	<i>Sminthopsis hirtipes</i>	Hairy-footed Dunnart										2	8			1												1			1								
	<i>Sminthopsis macroura</i>	Stripe-faced Dunnart			10				3	7	10	2				1												2				1							
	<i>Sminthopsis ooldea</i>	Ooldea Dunnart				2	2		2		2	1			1													1		2									
Macropodidae	<i>Osphranter robustus</i>	Euro	3	12	1		7			1	1			1												1	1			1	1		1						
	<i>Osphranter rufus</i>	Red Kangaroo	3	8	24	4			1	1	1	2		1	4											1	1			1	1		1	1	1				
Leporidae	<i>Oryctolagus cuniculus</i>	European Rabbit	3												1													1											
Tachyglossidae	<i>Tachyglossus aculeatus</i>	Short-beaked Echidna	1				1																																
Equidae	<i>Equus caballus</i>	Domestic Horse								1																													
Muridae	<i>Mus musculus</i>	House Mouse						2	3		1	3			3	8												2	3					2					
	<i>Notomys alexis</i>	Spinifex Hopping Mouse				1		1		3			1	9			2													1	1								
	<i>Pseudomys hermannsburgensis</i>	Sandy Inland Mouse	1	1	5	6	2		8	1	14	9	6	1	2	1													7	3		3					7		

A McKenzie, N. L., J. K. Rolfe, and K. Youngson. 1994. Vertebrate fauna In: The Biological Survey of the Eastern Goldfields of Western Australia Part 10, Sandstone-Sir Samuel and Laverton-Leonara Study Areas. *Records of the Western Australian Museum* Supplement No. 47:51-85.

B How, R. A. and Dell, J. (1992) Vertebrate fauna. In: The Biological Survey of the Eastern Goldfields of Western Australia Part 7. Duketon - Sir Samuel Study Area. *Records of the Western Australian Museum*; Supplement 40, 90-109.

Family	Species	Common Name	Surveys																																		
			A									B									C																
			MME1	MME2	MME3	MME4	MME5	MME6	MME7	MME8	MME9	Opportunistic	Site 11	Site 11a	Site 14	Site 14a	Site 14b	Site 17a	Site 19	Site 1a	Site 20a	Site 21	Site 21a	Site 5a	Site 8	Site 9	Site 9a	CM001	CM002	CM003	CM004	CM005	Opportunistic				
	<i>Ctenotus quattuordecimlineatus</i>	Fourteen-lined Ctenotus																	11																		
	<i>Ctenotus schomburgkii</i>	Schomburgk's Ctenotus	1								2	1	3						11		2	3			15	1											
	<i>Ctenotus severus</i>	Stern Ctenotus																6	1																		
	<i>Ctenotus uber</i>	Spotted Ctenotus														3	2				6	1	1														
	<i>Egernia depressa</i>	Pygmy Spiny-tailed Skink						1													4	2															
	<i>Egernia formosa</i>	Goldfields Crevice-skink																						3													
	<i>Eremiascincus richardsonii</i>	Broad-banded Sand Swimmer														1		1													1	1					
	<i>Lerista desertorum</i>	Central Desert Robust Slider						1			1	1						6	6		2											5					
	<i>Lerista macropisthopus</i>	Unpatterned Robust Slider																						2													
	<i>Lerista muelleri</i>	Wood Mulch-slider																														1	2				
	<i>Lerista picturata</i>	Southern Robust Slider																						2													
	<i>Lerista sp.</i>							2			1	1						9	1			1		5													
	<i>Liopholis inornata</i>	Desert Skink																				1	1														
	<i>Liopholis striata</i>	Nocturnal Desert Skink																			2																
	<i>Menetia greyii</i>	Common Dwarf Skink	4								1	1										1		4		1						2					
	<i>Morethia butleri</i>	Woodland Morethia Skink		2		4	2	3	1	1	1	1			2			6					2	4													
Typhlopidae	<i>Anilius hamatus</i>	Pale-headed Blind Snake														1									1												
	<i>Anilius margaretae</i>	Buff-snouted Blind Snake																																			
	<i>Anilius waitii</i>	Waite's Blind Snake														2									1												
Varanidae	<i>Varanus caudolineatus</i>	Stripe-tailed Monitor		1				1								1					6		2		1			1									
	<i>Varanus giganteus</i>	Perentie																					1														
	<i>Varanus gouldii</i>	Gould's Goanna																1				2	2	1		1	1										
	<i>Varanus panoptes</i>	Yellow-spotted Monitor						1			1	1	1			2					1									1	4	2					
Birds																																					
Casuariidae	<i>Dromaius novaehollandiae</i>	Emu	1	1				1		1	1	1	2		1	5		2					1	2		1					1						
Megapodiidae	<i>Leipoa ocellata</i>	Malleefowl										1																									
Phasianidae	<i>Coturnix pectoralis</i>	Stubble Quail														1																					
Anatidae	<i>Cygnus atratus</i>	Black Swan																																			
	<i>Tadorna tadornoides</i>	Australian Shelduck										1																									
	<i>Malacorhynchus membranaceus</i>	Pink-eared Duck										1																									
	<i>Anas gracilis</i>	Grey Teal										1																									
	<i>Anas superciliosa</i>	Pacific Black Duck										1																									
Columbidae	<i>Phaps chalcoptera</i>	Common Bronzewing										1											1		1												
	<i>Ocyphaps lophotes</i>	Crested Pigeon	2					2			3	1		1	5	2	11			7			6	9	6				2		1						
Podargidae	<i>Podargus strigoides</i>	Tawny Frogmouth									2											1															
Caprimulgidae	<i>Eurostopodus argus</i>	Spotted Nightjar																		2				2													
Aegothelidae	<i>Aegotheles cristatus</i>	Australian Owlet-nightjar													3	3	2									1											
Otididae	<i>Ardeotis australis</i>	Australian Bustard												1		4																					
Ardeidae	<i>Ardea pacifica</i>	White-necked Heron										1																									
	<i>Egretta novaehollandiae</i>	White-faced Heron										1																									
Accipitridae	<i>Haliaeetus albicilla</i>	White-bellied Sea-eagle	1		2	1	1	1		1	1	1																									
	<i>Accipiter fasciatus</i>	Brown Goshawk																	3																		
	<i>Circus assimilis</i>	Spotted Harrier															1					1															
	<i>Aquila audax</i>	Wedge-tailed Eagle													6	2	2														2						

Family	Species	Common Name	Surveys													B		C																			
			Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11	Site 12	Site 13	Opportunistic	Granny Deeps birds	Agnew Gold	BKBO1	BKBO4	BKBO5	BKBO7	BKBO9	BKBS04	BKBO2	BKBO3	BKBO12	BKBO8	BKBO6	BKBO10	BKBO11	BKBS01	BKBHarp01	BKBS03			
Motacillidae	<i>Anthus novaeseelandiae</i>	Australasian Pipit														6	2	1																			
Mammals																																					
Bovidae	<i>Capra hircus</i>	Goat																																			
Molossidae	<i>Ozimops planiceps</i>	Southern Free-tail Bat																																			
Vespertilionidae	<i>Chalinolobus gouldii</i>	Gould's Wattled Bat																																			
	<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat																																			
	<i>Scotorepens balstoni</i>	Inland Broad-nosed Bat																																			
	<i>Vespadelus baverstocki</i>	Inland Forest Bat																																			
	<i>Vespadelus finlaysoni</i>	Finlayson's Cave Bat																																			
Dasyuridae	<i>Antechinomys laniger</i>	Kultarr	2	1			3	3	3	2					2																						
	<i>Sminthopsis dolichura</i>	Little Long-tailed Dunnart	1	1	3	7	5	4	13	3	5	3		1	1																						
	<i>Sminthopsis hirtipes</i>	Hairy-footed Dunnart				1																															
	<i>Sminthopsis longicaudata</i>	Long-tailed Dunnart					1	1								1																					
	<i>Sminthopsis macroura</i>	Stripe-faced Dunnart	2	3		2	1	1	1	1	1	5	5	3	2												1	1	2	7							
	<i>Sminthopsis ooldea</i>	Ooldea Dunnart																		1																	
Macropodidae	<i>Macropus fuliginosus</i>	Western Grey Kangaroo																1																			
	<i>Osphranter robustus</i>	Euro																1																			1
	<i>Osphranter rufus</i>	Red Kangaroo																1	4	2		4	1		2												
Leporidae	<i>Oryctolagus cuniculus</i>	European Rabbit																1																			
Tachyglossidae	<i>Tachyglossus aculeatus</i>	Short-beaked Echidna																1																			1
Muridae	<i>Mus musculus</i>	House Mouse																																			
	<i>Notomys alexis</i>	Spinifex Hopping Mouse	3										5																								
	<i>Pseudomys desertor</i>	Desert Mouse																																			
	<i>Pseudomys hermannsburgensis</i>	Sandy Inland Mouse	1	1	1	3																															

A Terrestrial Ecosystems (2010a) *Level 2 Fauna Risk Assessment for Granny Deeps Project Area*. Unpublished report for Barrick Gold Corporation, Perth.

B ENV Australia (2008) *Agnew Prospects Fauna Assessment*. Unpublished report for Agnew Gold Mining Company Pty Limited, Perth.

C Biota Environmental Sciences (2007) *Bannockburn Fauna Habitat and Assemblage Survey*. Unpublished report for Jubilee Mines NL, Perth.

Family	Species	Common Name	Surveys		A								B														
			Site 1	Site 2	Site 7	Site 5	Site 6	Site 3	Site 4	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11	Site 12	Site 13	Site 14	Site 15	Opportunistic	Birds		
Motacillidae	<i>Anthus novaeseelandiae</i>	Australasian Pipit		1				1																		1	
Mammals																											
Bovidae	<i>Bos taurus</i>	Cow	1	1	1	1	1	1	1																		
	<i>Capra hircus</i>	Goat	1	1																							
Canidae	<i>Canis lupus</i>	Dingo	1																								
	<i>Vulpes vulpes</i>	Red Fox	1																								
Felidae	<i>Felis catus</i>	House Cat	1	1																							
Vespertilionidae	<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat																								4	
Dasyuridae	<i>Sminthopsis crassicaudata</i>	Fat-tailed Dunnart		1																							
	<i>Sminthopsis dolichura</i>	Little Long-tailed Dunnart							1	5		1	4	4	2		1		1	1	3	2					
	<i>Sminthopsis macroura</i>	Stripe-faced Dunnart				1				1	1			1	3	1	1										
Macropodidae	<i>Osphranter robustus</i>	Euro			1																						
	<i>Osphranter rufus</i>	Red Kangaroo	1	1				1																			
Leporidae	<i>Oryctolagus cuniculus</i>	European Rabbit	1			1																					
Tachyglossidae	<i>Tachyglossus aculeatus</i>	Short-beaked Echidna			1																						
Equidae	<i>Equus caballus</i>	Domestic Horse		1				1																			
Muridae	<i>Mus musculus</i>	House Mouse	1	1		1		1	1																		

A Halpern Glick Maunsell (1999) *Rosemont Gold Project Biological Assessment Survey - Phases 1 & 2*. Unpublished report for Johnson's Well Mining NL. Perth.

B Terrestrial Ecosystems (2010) *Level 2 Fauna Risk Assessment for the Garden Well Project Area*. Unpublished report for Regis Resources, Perth.

Family	Species	Common Name	Survey											
			TMI	JS2	WM2	WS2	WM1	WS1	JS3	JS1	JS4	HBI		
	<i>Cracticus nigrogularis</i>	Pied Butcherbird												
	<i>Gymnorhina tibicen</i>	Australian Magpie												
	<i>Strepera versicolor</i>	Grey Currawong												
Rhipiduridae	<i>Rhipidura leucophrys</i>	Willie Wagtail												
Corvidae	<i>Corvus bennetti</i>	Little Crow												
	<i>Corvus orru</i>	Torresian Crow												
Monarchidae	<i>Grallina cyanoleuca</i>	Magpie-lark												
Petroicidae	<i>Microeca fascinans</i>	Jacky Winter												
	<i>Petroica goodenovii</i>	Red-capped Robin												
	<i>Melanodryas cucullata</i>	Hooded Robin												
Megaluridae	<i>Cincloramphus mathewsi</i>	Rufous Songlark												
	<i>Cincloramphus cruralis</i>	Brown Songlark												
Hirundinidae	<i>Cheramoeca leucosterna</i>	White-backed Swallow												
	<i>Petrochelidon ariel</i>	Fairy Martin												
Nectariniidae	<i>Dicaeum hirundinaceum</i>	Mistletoebird												
Estrildidae	<i>Taeniopygia guttata</i>	Zebra Finch												
Motacillidae	<i>Anthus novaeseelandiae</i>	Australasian Pipit												
Mammals														
Bovidae	<i>Capra hircus</i>	Goat												
	<i>Ovis aries</i>	Sheep												
Camelidae	<i>Camelus dromedarius</i>	Dromedary												
	<i>Canis familiaris</i>	Dog												
	<i>Vulpes vulpes</i>	Red Fox												
Felidae	<i>Felis catus</i>	House Cat												
Molossidae	<i>Austronomus australis</i>	White-striped Free-tail Bat												
	<i>Ozimops planiceps</i>	Southern Free-tail Bat												
Vespertilionidae	<i>Chalinolobus gouldii</i>	Gould's Wattled Bat												
	<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat												
	<i>Scotorepens balstoni</i>	Inland Broad-nosed Bat												
Dasyuridae	<i>Ningaii ridei</i>	Wongai Ningaii								1				
	<i>Sminthopsis crassicaudata</i>	Fat-tailed Dunnart												
	<i>Sminthopsis dolichura</i>	Little Long-tailed Dunnart												
	<i>Sminthopsis macroura</i>	Stripe-faced Dunnart												
Macropodidae	<i>Macropus fuliginosus</i>	Western Grey Kangaroo												
	<i>Osphranter robustus</i>	Euro												
	<i>Osphranter rufus</i>	Red Kangaroo												
Leporidae	<i>Oryctolagus cuniculus</i>	European Rabbit												
Tachyglossidae	<i>Tachyglossus aculeatus</i>	Short-beaked Echidna												
Muridae	<i>Mus musculus</i>	House Mouse												
	<i>Notomys alexis</i>	Spinifex Hopping Mouse								1				
	<i>Notomys mitchellii</i>	Mitchell's Hopping Mouse												
	<i>Pseudomys bolami</i>	Bolam's Mouse												
	<i>Pseudomys hermannsburgensis</i>	Sandy Inland Mouse												

A Dunlop, J.N. and Payne, W. (1999) *A vertebrate fauna survey of the North Lake Carey region*, Unpublished report for Placer (Granny Smith) and Homestake.

Appendix C
Definitions of Significant Fauna under the
WA Wildlife Conservation Act 1950 and
Priority Species

Vertebrate Fauna Assessment – Granny Smith Solar Power Farm Project

APPENDIX C
DEFINITIONS OF SIGNIFICANT FAUNA UNDER THE EPBC ACT AND THE WESTERN AUSTRALIAN WILDLIFE CONSERVATION ACT 1950

Published as Specially Protected under the *Wildlife Conservation Act 1950*, and listed under Schedules 1 to 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora (which may also be referred to as Declared Rare Flora).

Threatened fauna is that subset of ‘Specially Protected Fauna’ declared to be ‘likely to become extinct’ pursuant to section 14(4) of the Wildlife Conservation Act.

Threatened flora is flora that has been declared to be ‘likely to become extinct or is rare, or otherwise in need of special protection’, pursuant to section 23F(2) of the Wildlife Conservation Act.

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.

CR Critically endangered species

Threatened species considered to be facing an extremely high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in **Schedule 1** of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.

EN Endangered species

Threatened species considered to be facing a very high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in **Schedule 2** of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.

VU Vulnerable species

Threatened species considered to be facing a high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in **Schedule 3** of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.

EX Presumed extinct species

Species which have been adequately searched for and there is no reasonable doubt that the last individual has died. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in **Schedule 4** of the Wildlife Conservation (Specially Protected Fauna) Notice for Presumed Extinct Fauna and Wildlife Conservation (Rare Flora) Notice for Presumed Extinct Flora.

IA Migratory birds protected under an international agreement

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 the Bonn Convention, relating to the protection of migratory birds. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in **Schedule 5** of the Wildlife Conservation (Specially Protected Fauna) Notice.

CD Conservation dependent fauna

Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 6 of the Wildlife Conservation (Specially Protected Fauna) Notice.

OS Other specially protected fauna

Fauna otherwise in need of special protection to ensure their conservation. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in **Schedule 7** of the Wildlife Conservation (Specially Protected Fauna) Notice.

Priority species

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 flora or fauna.

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

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

P1 Priority 1: Poorly-known species

Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.

P2 Priority 2: Poorly-known species

Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.

P3 Priority 3: Poorly-known species

Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.

P4 Priority 4: Rare, Near Threatened and other species in need of monitoring

- (a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands.
- (b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for Vulnerable, but are not listed as Conservation Dependent.
- (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

Appendix D Terrestrial Ecosystems (2022)



Desktop Vertebrate Fauna Assessment

Expansion of the Solar Power Farm Project Area

Prepared for: Granny Smith Mining Company

Version 1. October, 2022



RECORD OF DISTRIBUTION

No. of copies	Report File Name	Report Status	Date	Prepared for:	Initials
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EXECUTIVE SUMMARY

The Granny Smith Mining Company is proposing to expand the area for its solar power farm. The project area is approximately 240ha, and surrounds an area approximately 150ha that was the subject of an earlier fauna assessment (Terrestrial Ecosystems 2018b).

Based on a desktop analysis and information provided from the botanical assessment of the project area, there are six broad fauna habitats in the project area:

- Open Mulga woodland over scattered low shrubs and grasses;
- Mulga and chenopod shrubland;
- Open Mulga woodland over scattered low shrubs and grasses on a banded ironstone formation;
- Samphire shrubland;
- Chenopod shrubland; and
- Disturbed areas.

The density of Mulga trees and shrubs varies across the project area, being more-dense around the ephemeral creek line.

Clearing native vegetation is likely to result in the loss of very few small vertebrate fauna that are unable to move away during the clearing process. The few larger animals, such as kangaroos and large goannas and snakes, and most of the birds will move into adjacent areas once clearing commences. There will be a small loss of native fauna to vehicle strikes on access tracks, but this will be very low. There are a few low banded ironstone formations (BIFs) in the project area, with a low possibility that they support a very low density of Long-tailed Dunnarts, a priority 4 species with the Department of Biodiversity, Conservation and Attractions (DBCA). The proposed vegetation clearing is not considered to be a significant impact on this species when considered in a bioregional context, as they are present on other BIFs in the Goldfields.

Impacts associated with clearing vegetation in the project area in a local, landscape and bioregional context on the vertebrate fauna are likely to be low as it is a very small amount of clearing and there are vast tracts of similar habitat in adjacent areas.

The proposed project is unlikely to significantly impact on a conservation significant species, so a referral under the *EPBC Act* is not required.

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1. INTRODUCTION

1.1 BACKGROUND

Gold Fields is an Australian mineral exploration and gold producing company with major tenements in the eastern Goldfields of Western Australia. The Granny Smith Mining Company, a subsidiary of Gold Fields, requested a desktop vertebrate fauna risk assessment to support the preparation of documentation seeking environmental approvals for the expansion of the area for its solar power farm (i.e. project area) in the eastern Goldfields (Figure 1). Terrestrial Ecosystems undertook the vertebrate fauna assessment for the original area (i.e. ~ 150ha; Terrestrial Ecosystems 2018b) and the Granny Smith Mining Company is now proposing to enlarge that area to approximately 390ha, of which approximately 240ha is assessed in this report.

1.1 PROJECT OBJECTIVES AND SCOPE OF WORKS

Terrestrial Ecosystems was commissioned to undertake a Basic vertebrate fauna risk assessment development of the expansion of solar farm project. The purpose of this Basic fauna risk assessment was to provide information to the Department of Mines, Industry Regulation and Safety (DMIRS) regarding the potential impacts on the vertebrate fauna assemblage in the project area to enable the proposed development to be adequately assessed. The methodology broadly follows that described in the Environmental Protection Authority (2020) Technical Guidance Terrestrial Fauna Surveys.

A typical Basic fauna risk assessment involves undertaking a desktop review and site visit. The objectives of this fauna risk assessment were to:

- provide an indication of the vertebrate fauna assemblage (reptiles, amphibians, mammals and birds) on and near the project area, so that potential impacts on the fauna and fauna assemblage might be adequately assessed;
- identify the presence and/or potential risk of impacts on species of conservation significance that are present or likely to be present in the project area;
- assess the impact and environmental risks associated with the proposed development on the fauna assemblage;
- determine if any additional surveys are required to assess the potential impact on fauna assemblages in the project area including impacts on species of conservation significance; and
- make recommendations that avoid, mitigate or minimise potential impacts on resident fauna.

To achieve these objectives, Terrestrial Ecosystems:

- reviewed Terrestrial Ecosystems' database [includes Atlas of Living Australia and Department of Biodiversity, Conservation and Attractions (DBCA) records in NatureMap] to identify potential vertebrate fauna within the area;
- searched the DBCA's NatureMap for Threatened and Priority Species;
- searched the Commonwealth Governments database of fauna of national environmental significance to identify species potentially occurring within the area that are protected under the *Environment Protection and Biodiversity Conservation (EPBC) Act 1999* or international migratory bird agreements (JAMBA/CAMBA);
- used information provided by Native Vegetation Solutions who undertook the botanical assessment of the project area for fauna habitats and their condition;
- reviewed previous fauna surveys conducted near the project area;
- undertook an assessment of the potential risks to the fauna associated with clearing additional areas of native vegetation;

- discussed the likelihood of *EPBC Act 1999* and *Biodiversity Conservation Act 2016* listed species being present in the project area; and
- provided management recommendations to avoid, mitigate and minimise potential impacts on the fauna in the project area.

2 EXISTING ENVIRONMENT

2.1 LOCATION OF PROJECT AREA

The project area is in the Murchison 1 (MUR1 – East Murchison subregion) IBRA bioregion. Cowan (2003) described the subregion as mostly dominated by mulga woodlands that are often rich in ephemerals; hummock grasslands, salt bush shrub lands and haloscarcia shrub lands. Cowan (2003) recorded no threatened ecological communities in the vicinity of the project areas. Threatening process for conservation significant fauna were listed by Cowan (2003) as foxes and cats.

2.2 LAND USE HISTORY

The dominant land uses for the bioregion are native pasture to support grazing and crown land reserves, and to a lesser extent mining. The area surrounding the Granny Smith project area has been extensively explored for minerals and there are many operational and non-operational mining projects.

The project area is on Mt Weld Station which continues to graze cattle near the project area. An active haul road runs through the project area from east to west (Figure 2).

2.3 CLIMATE

The project area is characterised as semi-arid. Laverton, 25km to the north, has an annual rainfall of approximately 235mm, although this varies considerably from year-to-year. The highest mean maximum and minimum temperatures in Laverton are in January with an average of 35.8°C and 20.5°C, respectively (Bureau of Meteorology, 2022). The lowest mean daily maximum and minimum temperatures occur in July (Chart 1). Average monthly rainfall is heaviest in January - March.

Summer rain is unpredictable and often results from thunderstorms coming from the north and the west or decaying cyclonic activity as low-pressure cells move from the Pilbara through the Goldfields.

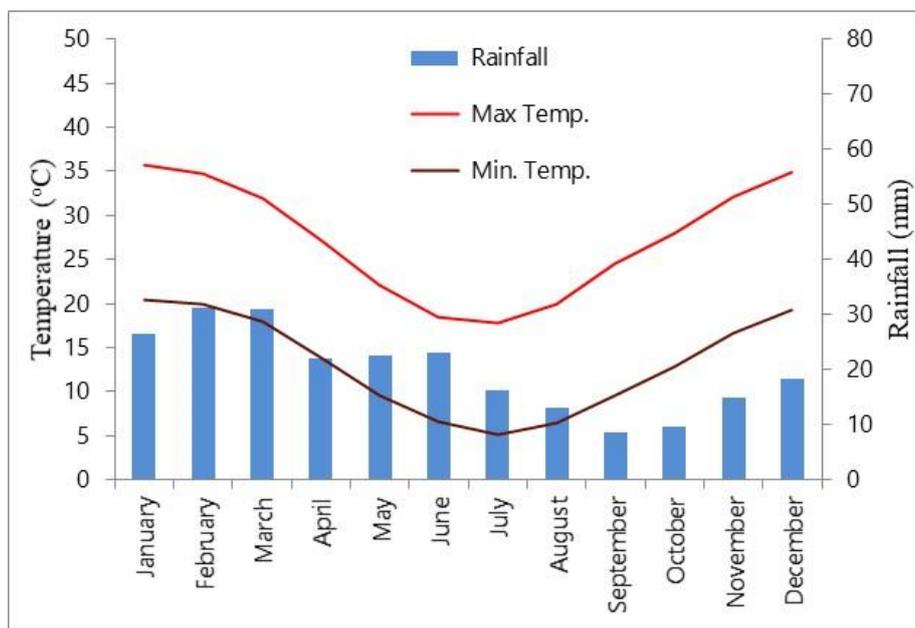


Chart 1. Climatic averages for Laverton

2.4 REGIONAL BIOLOGICAL FAUNA CONTEXT OF PROJECT AREA

Numerous fauna surveys and assessments have been undertaken near the project area and in similar habitats in the region. These include:

- Bamford Consulting Ecologists (2007) *Fauna Assessment and Targeted Mulgara Search of the Fish Deposit*, Laverton Gold Project.
- Bell, D. T., Bell, R. C. and Loneragan, W. A. (2007) Winter bird assemblages across an arid gradient in south-west Western Australia. *Journal of the Royal Society of Western Australia* 90, 219-227.
- Biota Environmental Sciences (2004) *Cosmos Nickel Mine Extension Fauna Survey*. Unpublished report for Sir Samuel Mines NL and URS, Perth.
- Biota Environmental Sciences (2007) *Bannockburn Fauna Habitat and Assemblage Survey*. Unpublished report for Jubilee Mines NL, Perth.
- Coffey Environments (2007) *Level 1 Fauna Assessment, Leinster Nickel Operations*, Perth.
- Coffey Environments (2008c) *Level 2 Fauna Assessment for Moolart Well, Dogbolter and Erlistoun*. Unpublished report for Regis Resources, Ltd, Perth.
- Craig, M. D. and Chapman, A. (2003) Effects of short-term drought on the avifauna of Wanjarri Nature Reserve: What do they tell us about drought refugia. *Journal of the Royal Society of Western Australia* 86: 133-137.
- Dell, J. and How, R. A. (1988) Vertebrate fauna. In: The biological survey of the Eastern Goldfields of Western Australia, Part 5, Edjudina - Menzies Study Area. *Records of the Western Australian Museum*, Supplement No 31, 38-77.
- Dell, J., How, R. A. and Milewski, A. V. (1992) The biological survey of the Eastern Goldfields, Part 6, Youanmi-Leonora Study Area. *Records of the Western Australian Museum*, Supplement No 40, 131.
- Donarto Environmental Services (2005) *Leinster Nickel Operations Tailing Storage Facility and Water Storage Areas: Wildlife Interactions and Assessment of Risks*, Perth.
- Dunlop, J. N. (1990) The small vertebrate ground fauna of Mulga habitats near Wiluna, Western Australia. *Mulga Research Centre Journal*, 10, 19-27.
- ENV Australia (2008) *Agnew Prospects Fauna Assessment*. Unpublished report for Agnew Gold Mining Company Pty Limited, Perth.
- Halpern Glick Maunsell, (1999) *Rosemont Gold Project Biological Assessment Survey - Phases 1 & 2*. Unpublished report for Johnson's Well Mining NL, Perth.
- Hall, N.J, McKenzie, N.L. and Keighery, B.J. (1994) The Biological Survey of the Eastern Goldfields of Western Australia Part 10. Sandstone-Sir Samuel and Laverton-Leonora Study Areas. *Records of the Western Australian Museum*. Supplement No. 47.
- Harewood, G (2011) *Terrestrial Fauna Survey (Level 1) of the West Laverton Area (P38/3717, P38/3718, P38/3491, P38/3492, P38/3314, P38/3490, P38/3315, M38/0046, M38/0049, M38/0040, M38/0358, M38/0048, M38/0101, M38/0364, M38/0342, M38/0345, L38/0179, L38/0177, L38/0178, L38/0153, L38/0092, E38/1930, E38/2347, E38/2084 & E38/1966)*. Unpublished report for Crescent Gold Limited.
- Hart, Simpson and Associates (2000) *Anaconda Nickel Ltd, Cawse Expansion Project, Fauna Survey*. Unpublished report for Anaconda Nickel Ltd, Perth.
- How, R. A. and Dell, J. (1992) Vertebrate fauna. In: The Biological Survey of the Eastern Goldfields of Western Australia Part 7. Duketon - Sir Samuel Study Area. *Records of the Western Australian Museum*; Supplement 40, 90-109.
- McKenzie, N. L., Rolfe, J. K. and Youngson, W. K. (1992) Vertebrate fauna. In: The Biological Survey of the Eastern Goldfields of Western Australia; Part 8; Kurnalpi - Kalgoorlie Study Area. *Records of the Western Australian Museum*, Supplement No 41, 37-65.
- McKenzie, N. L., Rolfe, J. K. and Youngson, W. K. (1994) Vertebrate fauna. In: The Biological Survey of the Eastern Goldfields of Western Australia Part 10, Sandstone-Sir Samuel and Laverton-Leonora Study Areas. *Records of the Western Australian Museum*, Supplement No 47, pp. 51-85.
- MBS Environmental (2004) *Vegetation and Habitat Assessment of the Euro, Sickle and Admiral Hill Project Areas, Laverton*. Unpublished report for Crescent Gold Limited.

- Moriarty, T. K. (1972) Birds of Wanjarri; WA (27°; 25'S; 120° 40'E) *The Emu*, 72, 1-7.
- Murphy, D. (1994) *Vertebrate fauna species of the North-eastern Goldfields*. Report to Western Mining's Leinster Nickel and Mount Keith Operations, Perth.
- Ninnox Wildlife Consulting (1998) *A Vertebrate Fauna Survey of the Murrin Expansion Project*. Unpublished report for Anaconda Nickel Ltd, Perth.
- Ninnox Wildlife Consulting (2005) *Vertebrate Fauna Habitat Assessment of the Proposed Expansions to the Cosmos Nickel Mine, near Leinster, Western Australia*. Unpublished report for URS Australia Pty Ltd, Perth.
- Onus, M. L., Rolfe, J.K., and Algar, D. (2011) Assessment of feral cat abundance and control options at Barrick, Granny Smith. Perth.
- Terrestrial Ecosystems (2010) *Level 2 Fauna Risk Assessment for the Garden Well Project Area*. Unpublished report for Regis Resources Ltd, Perth.
- Terrestrial Ecosystems (2011a) Investigation of Short-Range Endemic Invertebrates for the Granny Deeps Project Area. Perth.
- Terrestrial Ecosystems (2011b) *Level 2 Fauna Risk Assessment for Granny Deeps Project Area*. Unpublished report for Barrick Gold Corporation, Perth.
- Terrestrial Ecosystems (2011c) *Targeted Survey for Long-tailed Dunnarts for the Granny Deeps Project Area*. Perth.
- Terrestrial Ecosystems (2012a) *Level 1 Fauna Risk Assessment for the Anchor Project*. Unpublished report for Regis Resources Ltd, Perth.
- Terrestrial Ecosystems (2012b) *Level 1 Fauna Risk Assessment for the Moolart Well to Garden Well Access Road on M38/354, M38/302, M38/303 and L38/216*. Perth.
- Terrestrial Ecosystems (2012c) *Level 1 Fauna Risk Assessment for the Petra Project*. Unpublished report for Regis Resources Ltd, Perth.
- Terrestrial Ecosystems (2012d) *Level 1 Fauna Risk Assessment for the Reichelt Project*. Unpublished report for Regis Resources Ltd, Perth.
- Terrestrial Ecosystems (2012e) *Level 1 Fauna Risk Assessment for the Rosemont Project Area*. Unpublished report for Regis Resources Ltd, Perth.
- Terrestrial Ecosystems (2012f) *Level 1 Fauna Risk Assessment for the Russell Find Project*. Unpublished report for Regis Resources Ltd, Perth.
- Terrestrial Ecosystems (2012g) *Level 1 Vertebrate Fauna Risk Assessment for the Proposed Exploration Areas around the Granny Open Pit Project Area*. Perth.
- Terrestrial Ecosystems (2012h) *Level 1 Vertebrate Fauna Risk Assessment for the Proposed Mining Areas around the Granny Open Pit Project Area*. Perth.
- Terrestrial Ecosystems (2013) *Level 1 Fauna Risk Assessment for Two Waste Dumps either side of the proposed Rosemont Project Area (G38/29, G38/30, G38/31, G38/32) and a Slurry Pipeline from the Rosemont mine to the Garden Well processing plant (L38/219)*. Unpublished report for Regis Resources Ltd, Perth.
- Terrestrial Ecosystems (2015b) *Level 1 Fauna Risk Assessment for the Gloster Project and haul road*. Unpublished report for Regis Resources Ltd, Perth.
- Terrestrial Ecosystems (2016a) *Level 1 Fauna Risk Assessment for the Anchor Project Area*. Unpublished report for Regis Resources Ltd, Perth.
- Terrestrial Ecosystems (2016b) *Level 1 Fauna Risk Assessment for the Baneygo Project*. Unpublished report for Regis Resources Ltd, Perth.
- Terrestrial Ecosystems (2016c) *Level 1 Fauna Risk Assessment for the Dogbolter-Coopers Project Area*. Unpublished report for Regis Resources Ltd, Perth.
- Terrestrial Ecosystems (2016c) *Level 1 Fauna Risk Assessment for the Petra Project Area*. Unpublished report for Regis Resources Ltd, Perth.
- Terrestrial Ecosystems (2016d) *Level 1 Fauna Risk Assessment for the Tooheys Project Area*. Unpublished report for Regis Resources Ltd, Perth.
- Terrestrial Ecosystems (2017b) *Level 1 Fauna Risk Assessment for the proposal Haul Road to the Baneygo Project Area*. Unpublished report for Regis Resources Ltd, Perth.

- Terrestrial Ecosystems (2017c) *Level 1 Fauna Risk Assessment for the proposal Haul Road to the proposed Petra Mining area*. Unpublished report for Regis Resources Ltd, Perth.
- Terrestrial Ecosystems (2018a) *Level 1 Fauna Risk Assessment for the proposal Haul Road to the proposed Petra Mining area*. Unpublished report for Regis Resources Ltd, Perth.
- Terrestrial Ecosystems (2018c) *Vertebrate Fauna Risk Assessment for the Petra Mining Project*, Perth.
- Terrestrial Ecosystems (2020) *Vertebrate fauna risk assessment for the Granny Smith Tailing Storage Facility Expansion*. Unpublished letter report for Granny Smith Gold Mine, Perth.
- Terrestrial Ecosystems (2021) *Potential impact on Long-tailed Dunnarts by the proposed vegetation clearing and construction of a new TSF west of Cell 3 at Granny Smith Mine*. Unpublished letter report for Granny Smith Gold Mine, Perth.

In addition, there are individual records for fauna contained in the Atlas of Living Australia, Western Australian Museum collection and in NatureMap's records that have also been accessed.

The most relevant and useful data are those from the two Terrestrial Ecosystems' (2011b, c) surveys in the area. These two surveys were undertaken in 2011 and were undertaken in similar habitat and in areas adjacent to the project areas. These surveys included pit trapping, funnel traps, echolocation bat detection surveys, avifauna surveys and short-range invertebrate surveys. One of Terrestrial Ecosystems surveys was a Level 2 fauna assessment, and the other was an extensive targeted trapping program for Long-tailed Dunnarts (*Sminthopsis longicaudata*). Terrestrial Ecosystems has also completed multiple Level 1 fauna risk assessments in adjacent areas for Granny Smith mining area (Terrestrial Ecosystems 2014, 2015a, 2017a, 2020, 2021).

Western Australian Museum (WAM) regional eastern goldfields biological surveys were undertaken in the Duketon-Sir Samuel, Sandstone-Sir Samuel and Laverton areas (How et al. 1992, McKenzie et al. 1994). These surveys were to the north of the project area. HGM (1999) undertook a terrestrial fauna assessment for the Rosemont Gold Project, which is also located to the north of the project area. A survey was undertaken by Terrestrial Ecosystems staff for the Moolart Well area (Coffey Environments 2008a) in the summer of 2007/08 and Terrestrial Ecosystems (2010) surveyed the Garden Well mine; both of these surveys included habitat similar to the project area. The WAM bioregional surveys of the Edjudina – Menzies and the Kurnalpi - Kalgoorlie areas (Dell et al. 1988, McKenzie and Hall 1992) and Terrestrial Ecosystems unpublished data for around Ora Banda are for areas to the south of the project area. The Murrin Murrin Expansion project fauna survey is for an area to the west of the project area (Ninox Wildlife Consulting 1998).

These fauna surveys, when considered together, provide a near complete list of the vertebrate species likely to be found in the project area. The composition of vertebrate fauna assemblages varies from habitat-to-habitat and site-to-site within the bioregion, but the survey data contained in the attached appendices provide a good indication of the vertebrate fauna assemblage that is likely to be found in the project area. These data therefore provide a good regional context and indicate the extent of fauna assemblage variation that might be anticipated from site-to-site and temporally.

2.4.1 Fauna species at risk

Cowan (2003) reported the fauna species at risk in the East Murchison subregion as Bilby (*Macrotis lagotis*), Marsupial Mole (*Notoryctes typhlops*), Mulgara (*Dasyercus cristicauda / blythi*), Malleefowl (*Leipoa ocellata*), Princess Parrot (*Polytelis alexandrae*), Slender-billed Thornbill (*Acanthiza iredalei iredalei*), Giant Desert Skink (*Liopholis kintorei*) and Peregrine Falcon (*Falco peregrinus*). Since then, the Night Parrot (*Pezoporus occidentalis*) has been added to the Commonwealth and State threatened species lists for the project area. This report assesses the potential for these species to be found in the project area and the potential impact that the proposed development might have on these species, and other conservation significant fauna.

3 METHODOLOGY

3.1 DATABASE SEARCHES

A review of the EPBC list of protected species was undertaken to identify species of conservation interest to the Commonwealth Government by searching the Matters of National Environmental Significance (MNES) online database (Appendix A). In addition, a desktop search of the Terrestrial Ecosystems' fauna survey database was used to develop an appreciation of the vertebrate fauna assemblages in relevant sections of the bioregion near the project area.

Other more general texts were also used to provide supplementary information on vertebrates in the bioregion, including Tyler et al. (2000) for frogs; Storr et al. (1983, 1990, 1999a, 2002) and Thompson and Thompson (2010) for reptiles; Johnstone and Storr (1998a, 2004) for birds; and Van Dyck and Strahan (2008) for mammals.

Collectively these sources of information were used to create lists of species expected to utilise the project area and broader bioregion. It should be noted that these lists will include species that have been recorded in the general region but are possibly vagrants and they will not generally be found in the project area due to a lack of suitable habitat (e.g. water and shore birds). Vagrants can be recorded almost anywhere. Many of the records are historical and the species is no longer present in the area (e.g. Malleefowl, Bilby). Many of the bird, mammal, reptile and amphibian species have specific habitat requirements that may be present in the general area but not in the project area. Also, the ecology of many of these species is often not well understood and it can sometimes be difficult to indicate those species whose specific habitat requirements are not present in the project area. Therefore, many species will be included in the lists produced from database searches but will not be present in the actual project area.

There are errors in most databases, including NatureMap, Atlas of Living Australia and the WAM collection. These errors occur because of a misidentification of individuals, taxonomic name changes and incorrect coordinates being entered into the database. Terrestrial Ecosystems was unable to verify the primary records, so it has used the information provided. Readers should therefore appreciate that species lists, and fauna surveys reported in the appendices may include these errors.

1.2 SITE INSPECTION AND FAUNA HABITAT ASSESSMENT

A site visit was undertaken on 22 October 2018 for the central part of the project area (~150ha) to assess fauna habitat types and condition in the project area (Terrestrial Ecosystems 2018b). This fauna habitat assessment methodology required the assessor to stop at multiple locations within the project area and to assess a suite of data about the fauna habitat and its condition. This information included a description of the habitat structure, habitat condition, landform, soils and vegetation and time since last fire was provided in the earlier report (Terrestrial Ecosystems 2018b).

3.2 REPORTING STAFF

Dr Graham Thompson prepared this report, and it was reviewed by Dr Scott Thompson before it was sent to the client. Both senior scientists have appropriate relevant post-graduate qualifications, extensive experience in conducting fauna assessments in the Goldfields, have published research articles on biodiversity, fauna assemblages, conservation significant species, trapping techniques and temporal variations in trapped fauna assemblages based on Goldfields surveys and are therefore appropriately trained and experienced for the task of preparing this assessment. Both Scott and Graham have undertaken multiple assessments at Granny Smith and are familiar with the site and habitat in the project area.

3.3 TAXONOMY AND NOMENCLATURE

Taxonomy and nomenclature for fauna species used in this report are generally based on the WA Museum species lists. Terrestrial Ecosystems has presumed that the identifications referred to in the appendices or in reports used to provide local and regional comparative data were correct and we have only corrected obvious records where the nomenclature was known to be incorrect.

3.4 LIMITATIONS

This desktop vertebrate fauna risk assessment is based on information contained in the Commonwealth Government database, other published and unpublished fauna survey data for the bioregion and site and habitat information provided by Native Vegetation Solutions gathered during a botanical survey site visit. It is acknowledged that multiple surveys conducted in different seasons, repeated over several years are necessary to fully appreciate the fauna assemblage in the project area.

The EPA's (2020) *Technical Guidance - Terrestrial vertebrate fauna surveys for environmental impact assessment* suggested that fauna surveys may be limited by many variables. Limitations associated with each of these variables are assessed in Table 1.

Table 1. Fauna survey limitations and constraints

Possible limitations	Constraint (yes/no); significant, moderate or negligible	Comment
Availability of data and information	No	There is a substantial quantity of vertebrate fauna survey data available for similar habitats near the project area.
Competency/experience of the survey team, including experience in the bioregion surveyed	No	The authors of this report have appropriate post-graduate qualifications, undertaken multiple surveys and assessments in the Goldfields, have published a book and multiple refereed journal articles based on fauna surveys in the region and are familiar with the vertebrate fauna in this bioregion.
Scope of the survey, e.g. where faunal groups were excluded from the survey	N/A	
Timing, weather and season	N/A	
Disturbance that may have affected results, e.g. fire, flood	No	Disturbances in the project area have been factored into this assessment.
The proportion of fauna identified, recorded or collected	N/A	
Adequacy of the survey intensity and proportion of survey achieved, e.g. the extent to which the area was surveyed	N/A	
Access problems	N/A	
Problems with data and analysis, including sampling biases	N/A	

2. RESULTS

2.1 FAUNA HABITAT

Based on a desktop analysis and information provided by Native Vegetation Solutions gathered during a botanical assessment of the project area, there are six broad fauna habitats in the project area (Figure 2):

- Samphire shrubland (Plates 1-2);
- Mulga and chenopod shrubland (Plates 3-6);
- Open Mulga woodland over scattered low shrubs and grasses (Plates 7–8);
- Chenopod shrubland (Plate 9); Open Mulga woodland over scattered low shrubs and grasses on a banded ironstone formation (BIF; Plates 10–12); and
- Disturbed areas.

The density of Mulga trees and shrubs varies across the project area, being more-dense around the ephemeral creek line that runs north-south through the western side of the project area.

The fauna habitat condition varies from degraded to good; the more degraded areas are due to infrastructure, historical exploration activity and cattle grazing. There was extensive evidence of rabbits and other feral fauna in the area.



Plate 1. Samphire shrubland



Plate 2. Samphire shrubland



Plate 3. Mulga and chenopod shrubland



Plate 4. Mulga and chenopod shrubland



Plate 5. Mulga and chenopod shrubland



Plate 6. Mulga and chenopod shrubland



Plate 7. Open Mulga woodland over scattered low shrubs and grasses



Plate 8. Open Mulga woodland over scattered low shrubs and grasses



Plate 9. Chenopod shrubland



Plate 10. Open Mulga woodland on BIF



Plate 11. Open Mulga woodland on BIF



Plate 12. Open Mulga woodland on BIF

2.2 FAUNA ASSEMBLAGE

In 2011, Terrestrial Ecosystems (2011b) undertook a Level 2 vertebrate fauna survey for nearby areas at Granny Smith. This survey area supported fauna habitat similar to that in the project area. Thirteen survey sites were trapped between 6-12 January 2011, which was optimal for reptiles and suitable for mammals. All pit-traps and drift fences were dug in prior to the field assessment and closed until the start of the trapping program. Each survey site contained four trap lines. Each trap line contained three 20L PVC buckets, three 150mm by 500mm deep PVC pipes as pit-traps and three pair of funnel traps evenly spaced along a 30m fly-wire drift fence. Trap lines were arranged approximately 50m apart. The trapping effort was 1,092 bucket pit-trap nights, 1,092 pipe pit-trap nights and 2,184 funnel trap nights.

An avian survey was undertaken concurrently with the trapping program. The avian surveys were conducted from sunrise for approximately four hours and again each afternoon for approximately four hours. The search protocol was for a 20-minute active walking transect search of approximately 3ha before moving to another area. Seventy sites were surveyed, which equated to approximately 1,400 minutes of survey effort. All birds were identified by their call or direct observation. Birds were also recorded opportunistically during the survey period by all field survey staff.

Bat echolocation calls were recorded using an Anabat system. Two Anabat recorders were left standing vertically all night (10-12 hours) on three occasions (8, 9 and 11 January 2011), and included representative habitat types and other locations likely to attract bats.

Table 2 indicates the small mammals, reptiles and amphibians caught during the 2011 survey. The reptile, mammal and amphibian assemblage recorded is like that recorded in other patches of open mulga woodland in this part of the Goldfields, except for the capture of three Long-tailed Dunnarts. As indicated in the follow up targeted survey report for Long-tailed Dunnarts (Terrestrial Ecosystems 2011c), it was unexpected to record Long-tailed Dunnarts in this area and this record at the time was more than 200km south-easterly of the previous known records. However, since then the Long-tailed Dunnart has been recorded at a number of banded ironstone formations in the general area.

Four species of bats were recorded during the 2011 survey (*Chalinolobus gouldii* - Gould's Wattled bat; *Mormopterus* sp. (sp. 3) - Inland free-tailed bat; *Scotorepens balstoni* - Inland broad-nosed bat; and *Vespadelus finlaysoni* - Finlayson's cave bat). All these species are commonly recorded throughout the Goldfields.

Table 2. Granny Smith terrestrial fauna survey results

Taxa	Family	Species	Sites												
			1	2	3	4	5	6	7	8	9	10	11	12	13
Mammals	Dasyuridae	<i>Antechinomys laniger</i>	2	1			3	3	3	2		2			1
		<i>Sminthopsis dolichura</i>	1	1	3	7	5	4	13	3	5	3		1	1
		<i>Sminthopsis hirtipes</i>				1									
		<i>Sminthopsis longicaudata</i>					1	1							1
		<i>Sminthopsis macroura</i>	2	3		2	1	1	1	1	1	5	5	3	2
	Muridae	<i>Notomys alexis</i>	3												
		<i>Pseudomys hermannsburgensis</i>	1	1	1	3					1	2	2	5	6
		<i>Mus musculus</i>						1					5		
Amphibians	Hylidae	<i>Cyclorana maini</i>		1							11	5	1		
		<i>Cyclorana platycephala</i>		1	1						5	2		1	1
	Limnodynastidae	<i>Neobatrachus kunapalari</i>									1				
		<i>Neobatrachus sutor</i>	8	2	5	3	1			1	13	2		1	
Reptiles	Agamidae	<i>Diporiphora amphiboluroides</i>				2	1	1							
		<i>Tympanocryptis cephalus</i>				2	3	1		1					
	Elapidae	<i>Parasuta monachus</i>						1		1					
	Gekkonidae	<i>Diplodactylus granariensis</i>										1			
		<i>Diplodactylus pulcher</i>	2			1	4	3	1			2	1		1
		<i>Gehyra variegata</i>		3	2	4		1		3		2	1	2	
		<i>Heteronotia binoei</i>	2				1					1	2	1	5
		<i>Rhynchoedura ornata</i>	3					2			1				
		<i>Strophurus wellingtonae</i>	4	2											1
	Scincidae	<i>Ctenotus leonhardii</i>	2	2					1		5	9	7	16	27
		<i>Egernia depressa</i>		1	1	2	2	3	9	6		1			
		<i>Eremiascincus richardsonii</i>				2									1
		<i>Lerista desertorum</i>													2
		<i>Lerista distinguenda</i>													1
		<i>Menetia greyii</i>											1		
		<i>Morethia butleri</i>		1		1		2			6	1		3	
		<i>Tiliqua multifasciata</i>	1												

		Sites															
	Typhlopidae	<i>Anilius australis</i>										1	1				
		<i>Anilius bicolor</i>			1												
	Varanus	<i>Varanus caudolineatus</i>		2		1	3	1	1				1		2		
		<i>Varanus panoptes</i>	4		7		3	2	2				4	2			6

The bird surveys recorded 820 individuals from 60 species across 70 survey sites and an additional 495 birds were opportunistically observed (Table 3). A proportion of these species are seldom seen in the north-eastern Goldfields. These are mostly the 'water birds' in the list (e.g. Musk Duck, Australian Wood Duck, Pink-eared Duck, Pacific Black Duck, Hardhead, stilts and White-faced Heron). Some of these birds will occasionally be seen in water contained in disused mining pits during the non-rainy period, however, it was the presence of the heavy rain that resulted in their presence in the area. No Malleefowl nests or tracks were observed in the project area.

Table 3. Bird survey results for Granny Smith mining area

Family	Species	Common Name	No
Accipitridae	<i>Aquila audax</i>	Wedge-tailed Eagle	3
Anatidae	<i>Biziura lobata</i>	Musk Duck	2
	<i>Chenonetta jubata</i>	Australian Wood Duck	81
	<i>Malacorhynchus membranaceus</i>	Pink-eared Duck	5
	<i>Anas gracilis</i>	Grey Teal	74
	<i>Anas superciliosa</i>	Pacific Black Duck	13
	<i>Aythya australis</i>	Hardhead	2
Casuariidae	<i>Dromaius novaehollandiae</i>	Emu	4
Charadriidae	<i>Euseyornis melanops</i>	Black-fronted Dotterel	4
Recurvirostridae	<i>Himantopus himantopus</i>	Black-winged Stilt	5
	<i>Cladorhynchus leucocephalus</i>	Banded Stilt	14
Ardeidae	<i>Egretta novaehollandiae</i>	White-faced Heron	2
Columbidae	<i>Phaps chalcoptera</i>	Common Bronzewing	6
	<i>Ocyphaps lophotes</i>	Crested Pigeon	21
Alcedinidae	<i>Todiramphus pyrrohopygius</i>	Red-backed Kingfisher	1
Cuculidae	<i>Heteroscenes pallidus</i>	Pallid Cuckoo	3
Falconidae	<i>Falco cenchroides</i>	Nankeen Kestrel	2
	<i>Falco berigora</i>	Brown Falcon	2
Rallidae	<i>Fulica atra</i>	Eurasian Coot	21
Acanthizidae	<i>Acanthiza robustirostris</i>	Slaty-backed Thornbill	68
	<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill	1

Family	Species	Common Name	No
	<i>Acanthiza apicalis</i>	Inland Thornbill	12
	<i>Aphelocephala leucopsis</i>	Southern Whiteface	13
Artamidae	<i>Artamus personatus</i>	Masked Woodswallow	27
	<i>Artamus cinereus</i>	Black-faced Woodswallow	6
	<i>Artamus minor</i>	Little Woodswallow	2
	<i>Cracticus torquatus</i>	Grey Butcherbird	9
	<i>Cracticus nigrogularis</i>	Pied Butcherbird	5
	<i>Gymnorhina tibicen</i>	Australian Magpie	1
Campephagidae	<i>Coracina maxima</i>	Ground Cuckoo-Shrike	7
	<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-Shrike	7
	<i>Lalage tricolor</i>	White-winged Triller	4
Corvidae	<i>Corvus bennetti</i>	Little Crow	5
	<i>Corvus orru</i>	Torresian Crow	2
Estrildidae	<i>Taeniopygia guttata</i>	Zebra Finch	2
Hirundinidae	<i>Cheramoeca leucosterna</i>	White-backed Swallow	6
	<i>Hirundo neoxena</i>	Welcome Swallow	6
	<i>Petrochelidon nigricans</i>	Tree Martin	10
Maluridae	<i>Malurus splendens</i>	Splendid Fairy-wren	12
	<i>Malurus leucopterus</i>	White-winged Fairy-wren	4
Meliphagidae	<i>Certhionyx variegatus</i>	Pied Honeyeater	2
	<i>Gavicalis virescens</i>	Singing Honeyeater	40
	<i>Manorina flavigula</i>	Yellow-throated Miner	41
	<i>Acanthagenys rufogularis</i>	Spiny-cheeked Honeyeater	44
	<i>Epthianura tricolor</i>	Crimson Chat	4
Monarchidae	<i>Grallina cyanoleuca</i>	Magpie-Lark	17
Motacilidae	<i>Anthus novaeseelandiae</i>	Australasian Pipit	8
Nectariniidae	<i>Dicaeum hirundinaceum</i>	Mistletoebird	4
Pachycephalidae	<i>Pachycephala rufiventris</i>	Rufous Whistler	22
	<i>Colluricincla harmonica</i>	Grey Shrike-thrush	3
	<i>Oreoica gutturalis</i>	Crested Bellbird	46
Pardalotidae	<i>Pardalotus striatus</i>	Striated Pardalote	1
Petroicidae	<i>Petroica goodenovii</i>	Red-capped Robin	10
	<i>Melanodryas cucullata</i>	Hooded Robin	7

Family	Species	Common Name	No
Pomatostomidae	<i>Pomatostomus superciliosus</i>	White-browed Babbler	14
Ptilonorhynchidae	<i>Ptilonorhynchus guttatus</i>	Western Bowerbird	7
Rhipiduridae	<i>Rhipidura leucophrys</i>	Willie Wagtail	10
Podicipedidae	<i>Poliiocephalus poliocephalus</i>	Hoary-headed Grebe	30
Psittacidae	<i>Barnardius zonarius</i>	Australian Ringneck	6
	<i>Psephotus varius</i>	Mulga Parrot	20
		Total Individuals	810
		Total Species	60

2.3 BIOREGIONAL VERTEBRATE FAUNA

Appendix B provides a summary of the fauna survey data that are available near the project area. There are appreciable differences in the recorded fauna assemblages within and among fauna surveys shown in Appendix B. These differences are partially due to the low survey effort deployed by some of the surveys and they also reflect variations in soils and vegetation as well as temporal variations in the fauna assemblages.

Tables 5-8 provide a list of vertebrate species potentially found near the project area that have been compiled based on the fauna survey report results shown in Appendix B.

Table 4. Birds potentially found near the project area

Family	Species	Common Name	Family	Species	Common Name
Casuariidae	<i>Dromaius novaehollandiae</i>	Emu		<i>Ocyphaps lophotes</i>	Crested Pigeon
Anatidae	<i>Biziura lobata</i>	Musk Duck		<i>Geopelia placida</i>	Diamond Dove
	<i>Tadorna tadornoides</i>	Australian Shelduck	Podargidae	<i>Podargus strigoides</i>	Tawny Frogmouth
	<i>Chenonetta jubata</i>	Australian Wood Duck	Caprimulgidae	<i>Eurostopodus argus</i>	Spotted Nightjar
	<i>Malacorhynchus membranaceus</i>	Pink-eared Duck	Aegothelidae	<i>Aegotheles cristatus</i>	Australian Owlet-nightjar
	<i>Anas gracilis</i>	Grey Teal	Apodidae	<i>Apus pacificus</i>	Fork-tailed Swift
	<i>Anas superciliosa</i>	Pacific Black Duck	Otididae	<i>Ardeotis australis</i>	Australian Bustard
	<i>Aythya australis</i>	Hardhead	Phalacrocoracidae	<i>Microcarbo melanoleucos</i>	Little Pied Cormorant
Podicipedidae	<i>Poliiocephalus poliocephalus</i>	Hoary-headed Grebe	Ardeidae	<i>Ardea pacifica</i>	White-necked Heron
Columbidae	<i>Phaps chalcoptera</i>	Common Bronzewing		<i>Egretta novaehollandiae</i>	White-faced Heron
	<i>Phaps histrionica</i>	Flock Bronzewing	Accipitridae	<i>Haliastur sphenurus</i>	Whistling Kite
				<i>Accipiter fasciatus</i>	Brown Goshawk

Family	Species	Common Name
	<i>Accipiter cirrocephalus</i>	Collared Sparrowhawk
	<i>Circus assimilis</i>	Spotted Harrier
	<i>Aquila audax</i>	Wedge-tailed Eagle
	<i>Hieraaetus morphnoides</i>	Little Eagle
Falconidae	<i>Falco cenchroides</i>	Nankeen Kestrel
Falconidae	<i>Falco berigora</i>	Brown Falcon
	<i>Falco longipennis</i>	Australian Hobby
	<i>Falco peregrinus</i>	Peregrine Falcon
Rallidae	<i>Tribonyx ventralis</i>	Black-tailed Native-hen
	<i>Fulica atra</i>	Eurasian Coot
Recurvirostridae	<i>Himantopus leucocephalus</i>	Pied Stilt
Recurvirostridae	<i>Cladorhynchus leucocephalus</i>	Banded Stilt
Charadriidae	<i>Charadrius ruficapillus</i>	Red-capped Plover
	<i>Elsayornis melanops</i>	Black-fronted Dotterel
	<i>Vanellus tricolor</i>	Banded Lapwing
Scolopacidae	<i>Actitis hypoleucos</i>	Common Sandpiper
Turnicidae	<i>Turnix velox</i>	Little Button-quail
Cacatuidae	<i>Eolophus roseicapillus</i>	Galah
	<i>Nymphicus hollandicus</i>	Cockatiel
Psittacidae	<i>Barnardius zonarius</i>	Australian Ringneck
	<i>Psephotus varius</i>	Mulga Parrot
	<i>Melopsittacus undulatus</i>	Budgerigar
	<i>Neopsephotus bourkii</i>	Bourke's Parrot

Family	Species	Common Name
	<i>Neophema splendida</i>	Scarlet-chested Parrot
Cuculidae	<i>Chalcites basalís</i>	Horsfield's Bronze-cuckoo
	<i>Chalcites osculans</i>	Black-eared Cuckoo
	<i>Heteroscenes pallidus</i>	Pallid Cuckoo
Halcyonidae	<i>Todiramphus pyrrhopygius</i>	Red-backed Kingfisher
Meropidae	<i>Merops ornatus</i>	Rainbow Bee-eater
Climacteridae	<i>Climacteris affinis</i>	White-browed Treecreeper
	<i>Climacteris rufa</i>	Rufous Treecreeper
Ptilonorhynchidae	<i>Ptilonorhynchus maculatus</i>	Spotted Bowerbird
	<i>Ptilonorhynchus guttatus</i>	Western Bowerbird
Maluridae	<i>Malurus splendens</i>	Splendid Fairy-wren
	<i>Malurus leucopterus</i>	White-winged Fairy-wren
	<i>Malurus lamberti</i>	Variiegated Fairy-wren
Acanthizidae	<i>Calamanthus fuliginosus</i>	Striated Fieldwren
	<i>Pyrrholaemus brunneus</i>	Redthroat
	<i>Smicromis brevirostris</i>	Weebill
	<i>Gerygone fusca</i>	Western Gerygone
	<i>Acanthiza robustirostris</i>	Slaty-backed Thornbill
	<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill
	<i>Acanthiza uropygialis</i>	Chestnut-rumped Thornbill
	<i>Acanthiza apicalis</i>	Inland Thornbill

Family	Species	Common Name
	<i>Aphelocephala leucopsis</i>	Southern Whiteface
Pardalotidae	<i>Pardalotus striatus</i>	Striated Pardalote
Meliphagidae	<i>Certhionyx variegatus</i>	Pied Honeyeater
	<i>Gavicalis virescens</i>	Singing Honeyeater
	<i>Lichenostomus ornatus</i>	Yellow-plumed Honeyeater
	<i>Lichenostomus plumulus</i>	Grey-fronted Honeyeater
	<i>Purnella albifrons</i>	White-fronted Honeyeater
	<i>Manorina flavigula</i>	Yellow-throated Miner
	<i>Acanthagenys rufogularis</i>	Spiny-cheeked Honeyeater
	<i>Epthianura tricolor</i>	Crimson Chat
	<i>Epthianura aurifrons</i>	Orange Chat
	<i>Sugomel niger</i>	Black Honeyeater
	<i>Lichmera indistincta</i>	Brown Honeyeater
Pomatostomidae	<i>Pomatostomus superciliosus</i>	White-browed Babbler
Psophodidae	<i>Cinclosoma castaneothorax</i>	Chestnut-breasted Quail-thrush
Neosittidae	<i>Daphoenositta chrysoptera</i>	Varied Sittella
Campephagidae	<i>Coracina maxima</i>	Ground Cuckoo-shrike
	<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike
	<i>Lalage tricolor</i>	White-winged Triller
Pachycephalidae	<i>Pachycephala rufiventris</i>	Rufous Whistler
	<i>Colluricincla harmonica</i>	Grey Shrike-thrush
	<i>Oreoica gutturalis</i>	Crested Bellbird

Family	Species	Common Name
Artamidae	<i>Artamus personatus</i>	Masked Woodswallow
	<i>Artamus cinereus</i>	Black-faced Woodswallow
	<i>Artamus minor</i>	Little Woodswallow
	<i>Cracticus torquatus</i>	Grey Butcherbird
	<i>Cracticus nigrogularis</i>	Pied Butcherbird
	<i>Gymnorhina tibicen</i>	Australian Magpie
	<i>Strepera versicolor</i>	Grey Currawong
Rhipiduridae	<i>Rhipidura albiscapa</i>	Grey Fantail
	<i>Rhipidura leucophrys</i>	Willie Wagtail
Corvidae	<i>Corvus coronoides</i>	Australian Raven
	<i>Corvus bennetti</i>	Little Crow
	<i>Corvus orru</i>	Torresian Crow
Monarchidae	<i>Grallina cyanoleuca</i>	Magpie-lark
Petroicidae	<i>Microeca fascians</i>	Jacky Winter
	<i>Petroica goodenovii</i>	Red-capped Robin
	<i>Melanodryas cucullata</i>	Hooded Robin
Megaluridae	<i>Cincloramphus mathewsi</i>	Rufous Songlark
	<i>Cincloramphus cruralis</i>	Brown Songlark
Hirundinidae	<i>Cheramoeca leucosterna</i>	White-backed Swallow
	<i>Hirundo neoxena</i>	Welcome Swallow
	<i>Petrochelidon ariel</i>	Fairy Martin
	<i>Petrochelidon nigricans</i>	Tree Martin
Nectariniidae	<i>Dicaeum hirundinaceum</i>	Mistletoebird
Motacillidae	<i>Anthus novaeseelandiae</i>	Australasian Pipit

Table 5. Amphibians potentially found near the project area

Family	Species	Common Name	Family	Species	Common Name
Hylidae	<i>Cyclorana maini</i>	Sheep Frog		<i>Neobatrachus sutor</i>	Shoemaker Frog
	<i>Cyclorana platycephala</i>	Water-holding Frog		<i>Neobatrachus wilsmorei</i>	Goldfields Bullfrog
Limnodynastidae	<i>Neobatrachus aquilonius</i>	Northern Burrowing Frog		<i>Platyplectrum spenceri</i>	Spencer's Burrowing Frog
	<i>Neobatrachus kunapalari</i>	Kunapalari Frog	Hylidae	<i>Cyclorana maini</i>	Sheep Frog
	<i>Neobatrachus sudelli</i>	Sudell's Frog		<i>Cyclorana platycephala</i>	Water-holding Frog

Table 6. Mammals potentially found near the project area

Family	Species	Common Name	Family	Species	Common Name
Bovidae	<i>Bos taurus</i>	Cow		<i>Vespadelus regulus</i>	Southern Forest Bat
	<i>Capra hircus</i>	Goat	Dasyuridae	<i>Antechinomys laniger</i>	Kultarr
	<i>Ovis aries</i>	Sheep		<i>Dasyercus cristicauda/blythi</i>	Mulgara
Camelidae	<i>Camelus dromedarius</i>	Dromedary		<i>Ningauai ridei</i>	Wongai Ningauai
Canidae	<i>Canis lupus</i>	Dingo/dog		<i>Sminthopsis crassicaudata</i>	Fat-tailed Dunnart
	<i>Vulpes vulpes</i>	Red Fox		<i>Sminthopsis dolichura</i>	Little Long-tailed Dunnart
Felidae	<i>Felis catus</i>	Feral Cat		<i>Sminthopsis hirtipes</i>	Hairy-footed Dunnart
Emballonuridae	<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail Bat		<i>Sminthopsis longicaudata</i>	Long-tailed Dunnart
Molossidae	<i>Austronomus australis</i>	White-striped Free-tail Bat		<i>Sminthopsis macroura</i>	Stripe-faced Dunnart
	<i>Mormopterus planiceps</i>	Southern Free-tail Bat		<i>Sminthopsis ooldea</i>	Ooldea Dunnart
Pteropodidae	<i>Syconycteris australis</i>	Common Blossom-bat	Macropodidae	<i>Osphranter robustus</i>	Euro
Vespertilionidae	<i>Chalinolobus gouldii</i>	Gould's Wattled Bat		<i>Osphranter rufus</i>	Red Kangaroo
	<i>Chalinolobus morio</i>	Chocolate Wattled Bat	Leporidae	<i>Oryctolagus cuniculus</i>	European Rabbit
	<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat	Tachyglossidae	<i>Tachyglossus aculeatus</i>	Short-beaked Echidna
	<i>Scotorepens balstoni</i>	Inland Broad-nosed Bat		<i>Equus caballus</i>	Domestic Horse
	<i>Scotorepens greyii</i>	Little Broad-nosed Bat	Equidae	<i>Mus musculus</i>	House Mouse

Family	Species	Common Name
Muridae	<i>Notomys alexis</i>	Spinifex Hopping Mouse

Family	Species	Common Name
	<i>Pseudomys desertor</i>	Desert Mouse

Table 7. Reptiles potentially found in the project area

Family	Species	Common Name
Agamidae	<i>Ctenophorus caudicinctus</i>	Ring-tailed Dragon
	<i>Ctenophorus fordi</i>	Mallee Dragon
	<i>Ctenophorus inermis</i>	Military Dragon
	<i>Ctenophorus isolepis</i>	Crested Dragon
	<i>Ctenophorus maculatus</i>	Spotted Dragon
	<i>Ctenophorus nuchalis</i>	Central Netted Dragon
	<i>Ctenophorus reticulatus</i>	Western Netted Dragon
	<i>Ctenophorus salinarum</i>	Saltpan Dragon
	<i>Ctenophorus scutulatus</i>	Lozenge-marked Dragon
	<i>Diporiphora amphiboluroides</i>	Mulga Dragon
	<i>Moloch horridus</i>	Thorny Devil
	<i>Pogona minor</i>	Western Bearded Dragon
	<i>Tympanocryptis cephalus</i>	Pebble Dragon
Boidae	<i>Antaresia stimsoni</i>	Stimson's Python
Carphodactylidae	<i>Nephrurus levis</i>	Three-lined Knob-tail
	<i>Nephrurus vertebralis</i>	Midline Knob-tail
	<i>Nephrurus wheeleri</i>	Banded Knob-tail
	<i>Underwoodisaurus milii</i>	Barking Gecko
Diplodactylidae	<i>Diplodactylus conspicillatus</i>	Fat-tailed Diplodactylus
	<i>Diplodactylus granariensis</i>	Wheat-belt Stone Gecko
	<i>Diplodactylus pulcher</i>	Fine-faced Gecko

Family	Species	Common Name
	<i>Lucasium damaeum</i>	Beaded Gecko
	<i>Lucasium squarrosum</i>	Mottled Ground Gecko
	<i>Strophurus assimilis</i>	Goldfields Spiny-tailed Gecko
	<i>Strophurus elderi</i>	Jewelled Gecko
	<i>Strophurus strophurus</i>	Western Spiny-tailed Gecko
	<i>Strophurus wellingtonae</i>	Spiny-tailed Gecko
Elapidae	<i>Brachyuropis fasciolata</i>	Narrow-banded Burrowing Snake
	<i>Brachyuropis semifasciata</i>	Half-girdled Snake
	<i>Furina ornata</i>	Orange-naped Snake
	<i>Parasuta monachus</i>	Monk Snake
	<i>Pseudechis australis</i>	Mulga Snake
	<i>Pseudechis butleri</i>	Spotted Mulga Snake
	<i>Pseudonaja mengdeni</i>	Gwardar
	<i>Pseudonaja modesta</i>	Ringed Brown Snake
	<i>Simoselaps bertholdi</i>	Jan's Banded Snake
	<i>Suta fasciata</i>	Rosen's Snake
Gekkonidae	<i>Gehyra purpurascens</i>	Purplish Dtella
	<i>Gehyra variegata</i>	Tree Dtella
	<i>Gehyra xenopus</i>	Crocodile-faced Dtella
	<i>Heteronotia binoei</i>	Bynoe's Prickly Gecko

Family	Species	Common Name
	<i>Rhynchoedura ornata</i>	Western Beaked Gecko
Pygopodidae	<i>Aprasia picturata</i>	Black-headed Worm-lizard
	<i>Delma butleri</i>	Unbanded Delma
	<i>Delma nasuta</i>	Sharp-snouted Delma
	<i>Lialis burtonis</i>	Burton's Snake-lizard
	<i>Pygopus nigriceps</i>	Western Hooded Scaly-foot
Scincidae	<i>Cryptoblepharus australis</i>	Inland Snake-eyed Skink
	<i>Cryptoblepharus buechananii</i>	Buchanan's Snake-eyed Skink
	<i>Ctenotus ariadnae</i>	Ariadna's Ctenotus
	<i>Ctenotus atlas</i>	Southern Mallee Ctenotus
	<i>Ctenotus dux</i>	Fine Side-lined Ctenotus
	<i>Ctenotus grandis</i>	Grand Ctenotus
	<i>Ctenotus greeri</i>	Spotted-necked Ctenotus
	<i>Ctenotus hanloni</i>	Nimbel Ctenotus
	<i>Ctenotus helenae</i>	Clay-soil Ctenotus
	<i>Ctenotus leonhardii</i>	Leonhardi's Ctenotus
	<i>Ctenotus pantherinus</i>	Leopard Skink
	<i>Ctenotus piankai</i>	Coarse Sands Ctenotus
	<i>Ctenotus quattuordecimlineatus</i>	Fourteen-lined Ctenotus
	<i>Ctenotus schomburgkii</i>	Schomburgk's Ctenotus
	<i>Ctenotus severus</i>	Stern Ctenotus
	<i>Ctenotus uber</i>	Spotted Ctenotus

Family	Species	Common Name
	<i>Egernia depressa</i>	Pygmy Spiny-tailed Skink
	<i>Egernia formosa</i>	Goldfields Crevice-skink
	<i>Eremiascincus richardsonii</i>	Broad-banded Sand Swimmer
	<i>Lerista bipes</i>	North-western Sandslider
	<i>Lerista desertorum</i>	Central Desert Robust Slider
	<i>Lerista distinguenda</i>	South-western Orange-tailed Slider
	<i>Lerista kingi</i>	King's Slider
	<i>Lerista timida</i>	Timid Slider
	<i>Liopholis inornata</i>	Desert Skink
	<i>Liopholis striata</i>	Nocturnal Desert Skink
	<i>Menetia greyii</i>	Common Dwarf Skink
	<i>Morethia butleri</i>	Woodland Morethia Skink
	<i>Tiliqua multifasciata</i>	Centralian Blue-tongued Lizard
	<i>Tiliqua occipitalis</i>	Western Blue-tongued Lizard
Typhlopidae	<i>Anilius australis</i>	Austral Blind Snake
	<i>Anilius bicolor</i>	Dark-spined Blind Snake
	<i>Anilius endoterus</i>	Interior Blind Snake
	<i>Anilius hamatus</i>	Pale-headed Blind Snake
	<i>Anilius waitii</i>	Waite's Blind Snake
Varanidae	<i>Varanus brevicauda</i>	Short-tailed Pygmy Monitor
	<i>Varanus caudolineatus</i>	Stripe-tailed

Family	Species	Common Name
		Monitor
	<i>Varanus eremius</i>	Pygmy Desert Monitor
	<i>Varanus giganteus</i>	Perentie
	<i>Varanus gouldii</i>	Gould's Goanna
	<i>Varanus panoptes</i>	Yellow-spotted Monitor
	<i>Varanus tristis</i>	Black-headed Monitor
Cheluidae	<i>Chelodina steindachneri</i>	Steindachner's Snake-necked Turtle

2.4 CONSERVATION SIGNIFICANT FAUNA

Conservation significant fauna are protected by the Commonwealth *Environment Protection and Biodiversity Conservation (EPBC) Act 1999*, and this list includes species covered by international treaties such as the Japan-Australia Migratory Bird Agreement (JAMBA) and China-Australia Migratory Bird Agreement (CAMBA) and the Western Australia (WA) *Biodiversity Conservation Act 2016*. The WA *Biodiversity Conservation Act 2016* provides for the publishing of the *Wildlife Conservation (Specially Protected Fauna) Notice* that lists species under multiple categories. In addition, the DBCA maintains a list of fauna that require monitoring under four priorities based on the current knowledge of their distribution, abundance, and threatening processes. The *EPBC Act 1999* and *Biodiversity Conservation Act 2016* imply legislative requirements for the management of anthropogenic impacts to minimise the effects of disturbances on species and their habitats. Priority species have no statutory protection, other than the DBCA wishes to monitor potential impacts on these species. Environmental consultants and proponents of developments are encouraged to avoid and minimise impacts on these species. Definitions of the significant fauna under the *WA Biodiversity Conservation Act* are provided in Appendix C.

There were no threatened or migratory/marine species of birds identified under the *EPBC Act 1999* that were likely to frequent the project area. Shore birds and waders (e.g. *Actitis hypoleucos*, *Calidris acuminata*, *Calidris melanotos*, and *Tringa nebularia*) have been excluded from this list due to a lack of suitable habitat in the project area, although it is acknowledged that some of these species would be attracted to Lake Carey when it contained water. There is one listed under the *WA Biodiversity Conservation Act 2016* and one species listed on the DBCA's Priority Fauna List that potentially occur in the project area. The following is an assessment of the likelihood of each of the species listed in Table 8 being found in the project area.

Table 8. Potential conservation significant species found around the project area

Species	DBCA Schedule / Priority	Status under Commonwealth EPBC Act	Comment
Night Parrot (<i>Pezoporus occidentalis</i>)	Critically Endangered	Endangered	Highly unlikely to be in the project area, due to a lack of suitable habitat. The potential for impacting on this species is therefore very low.
Sandhill Dunnart (<i>Sminthopsis psammophila</i>)	Endangered	Endangered	Highly unlikely to be in the project area due to a lack of suitable habitat. The potential for impacting on this species is therefore very low.
Malleefowl (<i>Leipoa ocellata</i>)	Vulnerable	Vulnerable	Unlikely to be in the project area due to a lack of suitable habitat and an abundance of feral fauna. The potential for impacting on this species is therefore low.
Giant Desert Skink (<i>Liopholis kintorei</i>)	Vulnerable	Vulnerable	Highly unlikely to be in the project area due to a lack of suitable habitat. The potential for impacting on this species is therefore very low.
Chuditch (<i>Dasyurus geoffroii</i>)	Vulnerable	Vulnerable	Highly unlikely to be in the project area due to a lack of suitable habitat. The potential for impacting on this species is therefore low.
Princess Parrot (<i>Polytelis alexandrae</i>)	Priority 4	Vulnerable	May infrequently be seen in the area, however, clearing vegetation is unlikely to impact on this species.
Mulgara (<i>Dasycercus blythi</i>)	Priority 4		Highly unlikely to be in the project area due to a lack of suitable habitat. The potential for impacting on this species is therefore low.
Oriental Plover (<i>Charadrius veredus</i>)	IA	Migratory	Unlikely to be in the project area due to a lack of suitable habitat. The potential for impacting on this species is therefore low.

Species	DBCA Schedule / Priority	Status under Commonwealth EPBC Act	Comment
Fork-tailed Swift (<i>Apus pacificus</i>)	IA	Migratory	May very infrequently be seen in the area, however, clearing vegetation is unlikely to impact on this aerial species.
Grey Wagtail (<i>Motacilla cinerea</i>)	IA	Migratory	Highly unlikely to be present in the project area. The potential for impacting on this species is therefore low.
Yellow Wagtail (<i>Motacilla flava</i>)	IA	Migratory	Highly unlikely to be present in the project area. The potential for impacting on this species is therefore low.
Peregrine Falcon (<i>Falco peregrinus</i>)	OS		May infrequently be seen in the area, however, clearing vegetation is unlikely to impact on this species.
<i>Branchinella apophysata</i>	Priority 1		Unlikely to be in the project area, so the potential for impact on this species is low.
Long-tailed Dunnart (<i>Sminthopsis longicaudata</i>)	Priority 4		Caught in the Granny Smith area and has potential to be recorded in the rocky areas. The BIF areas are unlikely to be impacted, so the potential impact on this species is low.

IA Migratory birds protected under international agreements; OS Other specially protected fauna

Night Parrot (*Pezoporus occidentalis*) – Critically Endangered under the *BC Act 2016* and Endangered under the *EPBC Act 1999*

The Night Parrot is a small, arid-adapted, nocturnal, ground-feeding parrot (Johnstone and Storr 1998b, Threatened Species Scientific Committee 2016). Its length is 22-25cm with a body mass of approximately 104g (Threatened Species Scientific Committee 2016), although it was suggested that they were semi-nomadic, the Night Parrots in south-western Queensland appear to be sedentary (Murphy 2015).

The Night Parrot was probably originally distributed over much of the semi-arid and arid Australia (Garnett *et al.* 2011, Threatened Species Scientific Committee 2016). Recordings in north-west and western Queensland in the early 1990-2000s were in a broad cross section of the habitats available (Cupitt and Cupitt 2008, Garnett *et al.* 2011, Boles *et al.* 2016). There have been recent sightings in the Pilbara in 1980, 2005 and 2017, central WA in 1979, north-eastern South Australia in 1979, western Queensland (including Pullen-Pullen-Mt Windsor-Diamantina population) in 1980, 1990, 1993, 2006 and 2013-17 (Davis and Metcalf 2008, Garnett *et al.* 2011, Charalambous 2016, Pickrell 2016, AG staff 2017, Palaszczuk and Miles 2017, Rykers 2017, AG staff 2018), Pilbara in 2017 (Jones 2017), and the northern Goldfields (Jackett *et al.* 2017). Garnett *et al.* (2011) suggested that there were between 50-250 mature individuals in less than 5% of its previous range.

Wilson's (1937) summary of observations provided information on the early records of Night Parrots' preferred habitat and breeding sites. Recent information indicates its preferred habitat appears to be in Triodia grasslands, chenopod shrublands, shrubby samphire and floristically diverse habitats dominated by large-seeded species (Threatened Species Scientific Committee 2016, McCarthy 2017, Murphy *et al.* 2017b). At Pullen Pullen Reserve it nests in large, more or less ring-shaped Triodia, and the nest consists of a tunnel (25-30° and 0° to the ground; 20-33cm long) through an apron of dead spinifex leaves that leads to a chamber under a live hummock, with a shallow depression (3-4cm) excavated into the gravelly/sandy soil (Murphy *et al.* 2017a). In the northern Goldfields the nest was again in a spinifex hummock; it was circular, with an excavated depression (~1.5-2.0cm) in sandy substrate (Hamilton *et al.* 2017, Jackett *et al.* 2017). The entrance tunnel was 62cm long, and was downward sloping (27°) with the entrance 28cm above the ground (Hamilton *et al.* 2017). It has clutches of two to four sub-elliptical, white eggs with a lustrous appearance (Murphy *et al.* 2017a). Breeding followed significant rains in March for the observations in Pullen-Pullen Reserve and in April in the northern Goldfields (Hamilton *et al.* 2017, Murphy *et al.* 2017a), but it is thought that breeding generally occurs between April and October (Murphy *et al.* 2017a).

The Night Parrot has not been recorded near the project area, and the habitat in the project area is not suitable for nesting and roosting sites (i.e. mature, long-unburnt, ring-forming spinifex) so there is a very low probability that it is in the project area. It is therefore unlikely to be impacted by the proposed development.

Sandhill Dunnart (*Sminthopsis psammophila*) – Critically Endangered under the *BC Act 2016* and Endangered under the *EPBC Act 1999*

The Sandhill Dunnart is a small (30-45g) arid adapted dasyurid that is found in the eastern part of the Western Australian section of the Great Victoria Desert, eastern Goldfields and the western and southern parts of South Australia. Recent surveys undertaken for the Great Victoria Desert Trust have increased their geographic range in the Great Victoria Desert. The habitat in the project area is not suitable for this Dunnart and there are no records of the Sandhill Dunnart near the project area in the Atlas of Living Australia, so it is highly unlikely that they are present in the project area.

Malleefowl (*Leipoa ocellata*) – Vulnerable under the *BC Act 2016* and *EPBC Act 1999*

Malleefowl have been found in mallee regions of southern Australia from approximately the 26th parallel of latitude southwards. Malleefowl are now only found throughout these regions in fragmented patches due to clearing of habitat for agriculture, increased fire frequency, competition with exotic herbivores (sheep, rabbits, cattle, goats) and kangaroos, predation by foxes and cats, inbreeding as a result of fragmentation and possibly hunting for food.

Some very old disused Malleefowl mounds were recorded in other regional surveys, however, based on desktop analysis and the site investigation by Native Vegetation Solutions, the vegetation in the project area appears too sparse to support Malleefowl and the presence of feral species ensures that they are unable to survive in this area. Terrestrial Ecosystems' assessment is that the Malleefowl is unlikely to occur in the project area.

Giant Desert Skink (*Liopholis kintorei*) - Vulnerable under the *EPBC Act 1999* and *BC Act 2016*

Liopholis kintorei is a large skink found in the sandy desert regions of Western Australia, Northern Territory and South Australia. It is found on sand-flats and clay-based or loamy soils vegetated with spinifex. It lives in a multi-entranced communal burrow system and uses shared defecation sites. Storr *et al.* (1999b) recorded them as being in the Wanjarri area of the Great Victoria Desert, and the DBCA Threatened species database records them in Laverton in 1967. The Giant Desert Skink prefers sandy soils vegetated with spinifex. This habitat is not present in the project area. Terrestrial Ecosystems' assessment is that *Liopholis kintorei* is very unlikely be found in the project area due to a lack of suitable habitat.

Chuditch (*Dasyurus geoffroii*) - Vulnerable under the *EPBC Act 1999* and *BC Act 2016*

The Chuditch is the largest extant carnivorous marsupial in WA. It is usually active from dusk to dawn. Formally known from over 70% of Australia, the Chuditch now has a patchy distribution throughout the Jarrah forest and mixed Karri/Marri/Jarrah forest of south-west WA and other isolated areas. Chuditch are solitary animals for most of their life and den in hollow logs, burrows, culverts, etc. and have also been recorded in tree hollows and rock cavities. Chuditch are opportunistic feeders, and forage primarily on the ground at night. Their diet can include other mammals, birds, lizards, bird and reptile eggs but the majority is a mixture of large invertebrates (e.g. spiders, scorpions and crickets).

How *et al.* (1988) reported Chuditch being found near the Norseman-Lake King Road and near Mount Holland. DBCA records show that one specimen was recorded in 1974 in Kambalda East. There are records south of Southern Cross and Marvel Loch and there have been other old sightings east of Kambalda and near Norseman, but none recently. As the project area is outside of its current known geographic distribution it is highly unlikely that the Chuditch would be found in the project area. Consequently, Terrestrial Ecosystems'

assessment is that vegetation clearing in the project area is unlikely to have any significant impact on this species.

Princess Parrot (*Polytelis alexandrae*) - Vulnerable under the *EPBC Act 1999* and Priority 4 species with DBCA

Very little is known about the Princess Parrot; even the exact extent of its geographical distribution. It is thought to be nomadic within the central desert regions of Australia, occupying arid shrub lands, particularly those dominated by Mulga, Desert Oak and spinifex. Due to the paucity of information on the species, accurate estimates of its conservation significance are difficult to make, however, this species is probably threatened by habitat loss to agricultural practices and changes in fire regimes.

Dr S. Thompson sighted this parrot in a survey near the Wanjarri Nature Reserve in 2006 and Moriarty (1972) also reported it in the same area, so it may very infrequently be seen in the general area. The proposed vegetation clearing is unlikely to significantly impact on this species as it will move away to other areas if it is disturbed.

Brush-tailed Mulgara (*Dasyercus blythi*) - Priority 4 with the DBCA

Woolley (2005) recognises two species of 'Mulgara'; *Dasyercus blythi* and *D. cristicauda*. *Dasyercus blythi* has a non-crested tail, two upper premolars and six nipples; *D. cristicauda* has a crested tail, three upper premolars and eight nipples. Both species potentially have overlapping distributions in arid Australia, but it is thought that *D. cristicauda* does not currently exist in Western Australia, although there are old records indicating its presence. Woolley (2005) suggested the common names for these two species be Brush-tailed Mulgara for *D. blythi* and Crest-tailed Mulgara for *D. cristicauda*. These two species can be sympatric in places, but probably utilise different parts of the habitat on a local scale when they are recorded in the same area. Currently, there are insufficient data to separate the spatial ecology, burrows and reproductive biology of these two species. Information that follows is based on what is known for 'Mulgara' without distinguishing between the species.

The reported distribution of Mulgara includes much of the inland spinifex covered sandy desert and spinifex vegetated areas in the Pilbara and northern goldfields. Within these areas their distribution is patchy and it is most frequently confined to mature spinifex dominated habitat (Gibson and Cole 1992, Masters 2003, Masters et al. 2003, Thompson and Thompson 2008). In some areas, their relative abundance is positively associated with rainfall in the previous 12 to 24 months (Gibson and Cole 1992, Masters 1998, Dickman et al. 2001, Letnic and Dickman 2005) and recent burning of the spinifex does not seem to be sufficient to shift Mulgara out of an area (Thompson and Thompson 2007). Mulgara are generally sedentary in contrast with some other small dasyurids and have high site fidelity and a low propensity for dispersal once a home range has been established (Masters 1998, Dickman et al. 2001).

Fauna habitat in the project area is not suitable for Mulgara. It is therefore unlikely to be found in the project area.

Oriental Plover (*Charadrius veredus*) - Migratory species under the *EPBC Act 1999* and *BC Act 2016*

A migrant species with patchy distribution in Australia, the Oriental Plover is sparsely distributed across arid and semi-arid Australia, but avoids truly desert regions. Its preferred habitat is dry plains. It was not recorded in other fauna surveys undertaken near the project area. The species is under threat because of habitat reduction due to agriculture and changing fire regimes. This plover has not been recorded in the general area in any of the other regional surveys.

Terrestrial Ecosystems' assessment is that the Oriental Plover is unlikely to be seen in the project area.

Fork-tailed Swift (*Apus pacificus*) - Migratory species under the *EPBC Act 1999* and *BC Act 2016*

This species breeds in the northeast and mid-east Asia, northern Australia and winters in Australia and southern New Guinea. It is a visitor to most parts of Western Australia, beginning to arrive in the Kimberley in late September, in the Pilbara in October and November and in the southwest land division in mid-December, and leaving by late April. The Fork-tailed Swift is an almost exclusively an aerial species, foraging and sleeping on the wing. It rarely comes to earth, usually only for breeding. It is common in the Kimberley, uncommon to moderately common near northwest, west and southeast coasts and rare to scarce elsewhere. It is rarely seen in the Goldfields.

Terrestrial Ecosystems' assessment is that the Fork-tailed Swift may infrequently be seen in the project area. However, the proposed vegetation clearing is unlikely to significantly impact on this species as it will move away to other areas if it is disturbed.

Grey Wagtail (*Motacilla cinerea*) - Migratory species under the *EPBC Act 1999* and *BC Act 2016*

The Grey Wagtail is a small yellow breasted bird with a grey back and head. Johnstone and Storr (2004) reported this migratory species as breeding in Palearctic from western Europe and north-west Africa to eastern Asia and wintering in Africa, south-east Asia, Indonesia, the Philippines, New Guinea and Australia. Its preferred habitat in Australia is banks and rocks in fast-running fresh water including rivers, streams and creeks where it feeds on insects.

The Atlas of Living Australia records two sightings on the south-coast of Western Australia and none around the project area. It is highly unlikely to be seen in the project area due to a lack of suitable habitat.

Yellow Wagtail (*Motacilla flava*) - Migratory species under the *EPBC Act 1999* and *BC Act 2016*

The Yellow Wagtail is found in the millions in the northern hemisphere and the Atlas of Living Australia records multiple records of this bird in Australia in the coastal areas. There are no records for this species in inland Western Australia near the project area, therefore it is highly unlikely to be impacted by the proposed development.

Peregrine Falcon (*Falco peregrinus*) – Other specially protected fauna under the *BC Act 2016*

The Peregrine Falcon is uncommon, although widespread throughout much of Australia excluding the extremely dry areas and has a wide and patchy distribution. It shows habitat preference for areas near cliffs along coastlines, rivers and ranges and within woodlands along watercourses and around lakes. Nesting sites include ledges along cliffs, granite outcrops and quarries, hollow trees near wetlands and old nests of other large bird species. There is no evidence to suggest any change in status in the last 50 years. The Peregrine Falcon has been seen in the Wanjarri Nature Reserve (Moriarty 1972, Ninnox Wildlife Consulting 1994), at Honeymoon Well (Ninnox Wildlife Consulting 1994) and Mileura (Tingay 1977), so they could infrequently be seen in the general area.

Terrestrial Ecosystems' assessment is that the Peregrine Falcon may infrequently be seen in the project area. However, the proposed developments are unlikely to significantly impact on this species as it will move away to other areas if it is disturbed.

Branchinella apophysata – Priority 1 species with DBCA

Notes on this species provided by DBCA indicate that this fairy shrimp is known from a single location near Mt Magnet, but nothing is known of its habits or ecological requirements. As there are no salt lakes in the project area, it is Terrestrial Ecosystems' assessment that *B. apophysata* is unlikely to be impacted by the proposed development.

Long-tailed Dunnart (*Sminthopsis longicaudata*) – Priority 4 species with DBCA.

Burbidge et al. (2008) summarised the Long-tailed Dunnart distribution as widely scattered in arid zone where it inhabits rugged rocky areas. They went on to suggest that its striated foot-pads, long tail and behaviour in captivity indicated that it was an active and capable climber. Specimens have been recorded in several rocky ranges in the Gibson Desert, West MacDonnell National Park, Murchison, Carnarvon Basin and the Pilbara. All previous capture sites for Long-tailed Dunnarts are within rugged rocky landscapes that support a low open woodland or shrubland of Acacias (especially mulga) with an understorey of spinifex hummocks, and (occasionally) also perennial grasses and cassias.

Three adult Long-tailed Dunnarts were caught in the Granny Smith Level 2 fauna survey (Terrestrial Ecosystems 2011b) and a single individual was caught in the follow up targeted survey (Terrestrial Ecosystems 2011c). Subsequently, Long-tailed Dunnarts have been caught at other projects in the region including at Mt Ida and Bottle Creek, which are about 200km to the west of Granny Smith mine.

There are a few small rocky outcrops (e.g. BIFs) vegetated with open Mulga woodland in the project area, which are habitat for Long-tailed Dunnarts. Long-tailed Dunnarts were previously recorded in the Banded Ironstone rocky habitats in project area in very low numbers. These BIF areas are small (i.e. 9.5ha) so clearing of this habitat is unlikely to have a significant impact on this species, given its presence elsewhere in the Goldfields.

3. DISCUSSION

3.1 ADEQUACY OF THE FAUNA SURVEY DATA FOR FAUNA HABITATS REPRESENTED IN THE PROJECT AREA

The EPA's (2020) Technical Guidance on terrestrial fauna surveys indicated that the type of survey should be determined based on:

- level of existing regional knowledge;
- type and comprehensiveness of recent local surveys;
- degree of existing disturbance or fragmentation at the regional scale;
- extent, distribution and significance of habitats;
- significance of species likely to be present;
- sensitivity of the environment to the proposed activities; and
- scale and nature of impact.

The two-season survey by Terrestrial Ecosystems (2011b) was undertaken in similar fauna habitat to the project area approximately 3km to the north. In addition, there are multiple other surveys (1992, McKenzie et al. 1992, Ninnox Wildlife Consulting 1998, 1999, 2008b, 2010) undertaken in mulga woodland habitat in the eastern Goldfields, so the vertebrate fauna assemblages in this habitat type are well known, and an additional survey is unlikely to provide new information that will alter the regulators assessment.

Previous Long-tailed Dunnart surveys and investigations in the adjacent areas (Terrestrial Ecosystems 2011b, c) provide sufficient information to provide an adequate assessment of potential impacts on this species.

3.1.1 Amphibians

Frogs are normally only detected immediately after rainfall or around semi-permanent pools. It is likely that *Cyclorana maini*, *Pseudophryne occidentalis*, *Neobatrachus kunapalari* and *Neobatrachus wilsmorei* would be found in the general area. These species, other than *P. occidentalis*, burrow into the ground and aestivate between rainfall events. *Pseudophryne occidentalis* find shelter under rocks and in crevices during the dry periods and enter temporary ponds to breed after major rainfall events. All four species have a wide-spread distribution and are abundant, and because of the ephemeral creekline in the project area, some or all of these species could be present. Clearing vegetation is likely to result in a loss of individuals within the disturbed area, however, is unlikely to have a significant impact on these species when assessed in a regional context.

3.1.2 Reptiles

Typically, between 25 and 35 species of reptiles are caught in open mulga woodland (Coffey Environments 2008b, Terrestrial Ecosystems 2010, 2011b, 2012i). None of the species likely to be in the project area are of conservation significance. There were no characteristics of the reptile assemblage surveyed in 2011 that indicated the fauna habitat present in the project area are of conservation significance or different to that in the neighbouring areas, and given that there were large expanses of similar habitat in adjacent areas, clearing of the vegetation is unlikely to have significant impact on reptiles when assessed in a regional context.

Terrestrial Ecosystems' view is that the proposed clearing of the project area is unlikely to significantly impact on the reptile fauna of the bioregion.

3.1.3 Birds

The number of birds and bird species in the northern Goldfields fluctuates based on seasons and recent rainfall (Craig and Chapman 2003). Semi-arid and arid areas of inland Australia support a diverse range of transient and nomadic species (e.g. Princess Parrot) that move through large areas in search of available resources. Heavy rain that is followed by flowering and seeding of many plant species is often sufficient to draw a large number of these nomadic species to the general area. These species move on to other areas once the resource is depleted or better resources are available in adjacent areas.

The project area is likely to support a similar assemblage to that present in the adjacent areas. Birds of conservation significance potentially found in the general area include the Peregrine Falcon and Princess Parrot. The Princess Parrot is nomadic and moves around the arid interior often in search of water and resources and the Peregrine Falcon will normally have a very large home range and clearing a small section of vegetation in the project area, particularly when similar habitat exists in the adjacent areas, is unlikely to significantly impact on this species. All birds will readily shift to other areas when there is a disturbance.

Terrestrial Ecosystems' view is that the proposed clearing for the access road is unlikely to significantly impact on the avian fauna of the bioregion.

3.1.4 Mammals

The diversity of small terrestrial mammals potentially caught in the project area would be low due the sparsely vegetated and degraded habitat. The capture of Long-tailed Dunnarts (Terrestrial Ecosystems 2011c, b) in the Granny Smith mining area was unexpected as they are rarely caught, not normally caught this far south and not normally caught in open, flat, mulga woodland with no spinifex, low shrubs and little ground cover. However, since those individuals were caught, this species has been recorded in other banded ironstone formation in the eastern Goldfields. It is possible that the Long-tailed Dunnart is present in the project area given the BIFs that are present.

There are no other mammals of conservation significance likely to be in the project area.

3.2 BIODIVERSITY VALUE

From a fauna perspective, the project area has been grazed resulting in degradation to the mulga and shrublands. The habitat types identified in the project area are also abundant in adjacent areas, indicating that any localised impacts will not be significant in a regional context.

3.2.1 Ecological functional value at the ecosystem level

Vertebrate species potentially in the project area are wide-ranging and have been recorded in various other fauna surveys in the bioregion (Appendix B). There is likely to be a relatively low abundance of reptiles and mammals caught in the project area because of the sparseness of the vegetation, lack of leaf litter on the ground in many areas and degradation by cattle and feral fauna.

The development of the Solar Farm Project will increase the existing impact in the area. Except for the BIFs, the habitat types in the project area are well represented across the bioregion. There are numerous BIFs in the Goldfields region and it is highly likely that the larger ones support Long-tailed Dunnarts.

3.2.2 Maintenance of threatened ecological communities

No threatened ecological fauna communities were identified in the project area.

3.2.3 Ecological linkages

The project area does not provide an important ecological linkage or fauna movement corridors.

3.2.4 Condition of fauna habitat

Some of the project area has been disturbed due to historical development activity (i.e. haul road, tracks etc). There is also extensive evidence of disturbance by cattle and the presence of rabbits and cats. The uncleared fauna habitat present in the project area is like many square kilometres of adjacent habitat; the clearing of vegetation is therefore unlikely to have a significant impact on the vertebrate fauna when considered in a bioregional context.

3.2.5 Size and scale of the proposed disturbance

The assessed project area is approximately 240ha and surrounds an area of approximately 150ha that had previously been assessed.

3.2.6 Abundance and distribution of similar habitat in the adjacent areas

Fauna habitats present in the project area are abundant in adjacent areas. It is therefore likely that the fauna assemblage in the project area is like the many square kilometres of similar habitat in adjacent areas and the bioregion.

3.2.7 Potential impacts on ecosystem function

The proposed disturbance is small (~240ha). Clearing native vegetation is likely to result in the loss of very few small vertebrate fauna that are unable to move away during the clearing process. The few larger animals, such as kangaroos and large goannas and snakes, and most of the birds will move into adjacent areas once clearing commences. There will be a small loss of native fauna to vehicle strikes on access tracks, but this will be very low. Shifting animals into adjacent areas may increase the pressure on resources in those areas and there may be some disruption to the ecosystems for a short period until a balance is restored.

Impacts associated with clearing vegetation in the project area in a local, landscape and bioregional context on the vertebrate fauna are likely to be low as it is a very small amount of clearing and there are vast tracts of similar habitat in adjacent areas.

3.3 RISK ASSESSMENT

Fauna surveys to support Environmental Impact Assessments (EIA) are part of the environmental risk assessment undertaken to consider what potential impacts a development might have on the biodiversity on a particular area and region. Potential impacts on fauna from the proposed development are identified and briefly described above. Tables 9 10 and 11 provide a summary of the risk assessment associated with this project.

Any risk assessment is a product of the likelihood of an impact occurring and the consequences of that impact. Likelihood and consequences are categorised and described below. The assessed risk level (likelihood x consequences) is then calculated as the overall risk for the development. This is followed by an assessment of the acceptability of the risk associated with each of the impacts. Disturbances and vegetation clearing have an impact on the fauna at multiple scales – site, local, landscape and regional. Each of these is considered in the risk assessment. This assessment should be considered in the context of the summary in Table 11.

Table 9. Fauna impact risk assessment descriptors

Likelihood		
Level	Description	Criteria
A	Rare	The environmental event may occur, or one or more conservation significant species may be present in exceptional circumstances.
B	Unlikely	The environmental event could occur, or one or more conservation significant species could be present at some time.
C	Moderate	The environmental event should occur, or one or more conservation significant species should be present at some time.
D	Likely	The environmental event will probably occur, or one or more conservation significant species will be present in most circumstances.
E	Almost certain	The environmental event is expected to occur, or one or more conservation significant species is expected to be present in most circumstances.
Consequences		
Level	Description	Criteria
1	Insignificant	Insignificant impact on fauna of conservation significance or regional biodiversity, and the loss of individuals will be insignificant in the context of the availability of similar fauna or fauna assemblages in the area.
2	Minor	Impact on fauna localised and no significant impact on species of conservation significance in the project area. Loss of species at the local scale.
3	Moderate	An appreciable loss of fauna in a regional context or a limited impact on species of conservation significance in the project area.
4	Major	Significant impact on conservation significant fauna or their habitat in the project area and/or regional biodiversity and/or a significant loss in the biodiversity at the landscape scale.
5	Catastrophic	Loss of species at the regional scale and/or a significant loss of species categorised as 'vulnerable' or 'endangered' under the EPBC Act (1999) at a regional scale.
Acceptability of risk		
Level of risk	Management Action Required	
Low	No action required.	
Moderate	Avoid if possible, routine management with internal audit and review of monitoring results annually.	
High	Externally approved management plan to reduce risks, monitor major risks annually with external audit and review of management plan outcomes annually. May a referral to the Commonwealth under the EPBC Act 1999.	
Extreme	Unacceptable, project should be redesigned or not proceed.	

Table 10. Risk assessment matrix

		Likelihood				
		Rare or very low (A)	Unlikely or low (B)	Moderate (C)	Likely (D)	Almost certain (E)
Consequences	Insignificant (1)	Low	Low	Low	Low	Low
	Minor (2)	Low	Low	Low	Moderate	Moderate
	Moderate (3)	Low	Moderate	Moderate	High	High
	Major (4)	Moderate	Moderate	High	High	Extreme
	Catastrophic (5)	Moderate	High	High	Extreme	Extreme

Table 11. Assessed risk of potential impacts on the vertebrate fauna assemblage

			Before management			Management	With management		
			Inherent risk				Residual risk		
Factors	Potential impacts		Likelihood	Consequence	Significance		Likelihood	Consequence	Significance
Fauna survey data	Inadequate survey data to adequately assess the risks	Unknown loss of fauna, fauna of conservation significance, and fauna assemblages, and an incomplete fauna assessment.	B	2	Low				
	Inadequacy of comparative data	Limits on the availability of comparative data reduced the capacity to assess the uniqueness of the fauna assemblages in the project area.	B	2	Low				
Clearing vegetation	Loss of fauna habitat – local scale	Loss of terrestrial fauna in the project area.	E	2	Mod				
	Loss of fauna habitat – landscape scale	Loss of some fauna during vegetation clearing.	B	1	Low				
	Loss of fauna habitat – regional scale	Small loss of some fauna from the region.	B	1	Low				
	Loss of a threatened ecological fauna community	Loss of an undetected threatened ecological fauna community.	A	3	Low				
	Habitat fragmentation	Fauna movement restricted resulting in the death of fauna and a loss of biodiversity.	A	2	Low				
	Loss of a unique terrestrial fauna ecosystem	Loss of an ecosystem containing fauna with high species richness, high abundance and numerous top of the food chain predators.	A	2	Low				
Death or loss of conservation significant fauna	Malleefowl (<i>Leipoa ocellata</i>)	Death or the reduced viability of Malleefowl.	A	3	Low				

			Before management			Management	With management		
	Peregrine Falcon <i>(Falco peregrinus)</i>	Death or the reduced viability of the Peregrine Falcon.	A	2	Low				
	Fork-tailed Swift <i>(Apus pacificus)</i>	Death or the reduced viability of the Fork-tailed Swift.	A	2	Low				
	Long-tailed Dunnart <i>(Sminthopsis longicaudata)</i>	Death or the reduced viability of the Long-tailed Dunnart.	A	2	Low				
Human impacts	Spread of weeds	Changed vegetation and a resulting loss of fauna habitat.	E	2	Mod	Implementation of a weed management plan.	D	2	Low
	Road kills	Animals being killed as they crossroads by vehicles	E	1	Low	Limiting speeds	E	1	Low
	Increase in feral mammals, specifically the dog and cat	Increased predation on the native fauna	A	2	Low				

3.4 NATIVE VEGETATION CLEARING PRINCIPLES AS THEY PERTAIN TO VERTEBRATE FAUNA

The *Environmental Protection Act (1986)* outlines 10 principles that are to be used in the assessment of native vegetation clearing permit applications which are also applicable for other assessments and approvals (Table 12). Where possible, native vegetation should not be cleared if any of the following principles are comprised.

Table 12. Assessment of impact using the native vegetation clearing principles

Principle	Response
It comprises a high level of biological diversity.	Clearing vegetation will not comprise a high level of biodiversity. There is a very low possibility that the BIFs support a small population of Long-tailed Dunnarts, a Priority 4 species with DBCA. It is unlikely that clearing the vegetation and earth works would have a significant impact on this species when considered in a bioregional context, as there are other BIFs in the Goldfields that would support this species.
It comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.	Clearing the vegetation will not result in the loss of significant habitat for indigenous fauna.
It includes, or is necessary for the continued existence or, rare flora.	N/A
It comprises the whole or a part of, or is necessary for the maintenance of, a threatened ecological community.	The area does not contain a threatened ecological fauna community.
It is significant as a remnant of native vegetation in an area that has been extensively cleared.	The area is not a remnant.
It is growing in, or in association with, an environment associated with a watercourses or wetland.	The area does not contain a wetland.
The clearing of the vegetation is likely to cause appreciable land degradation.	N/A
The clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.	Clearing of vegetation is unlikely to impact on the environmental values of the bioregion.
The clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.	N/A
The clearing of the vegetation is likely to cause, or exacerbate the incidence of flooding.	N/A

3.5 REFERRAL UNDER THE EPBC ACT

The proposed project is unlikely to significantly impact on a conservation significant vertebrate fauna species, so a referral under the *EPBC Act* is not required.

4. SUMMARY

Granny Smith Mining is proposing to increase the area of its solar farm. The assessed area for this project was approximately 240ha and surrounds an area of approximately 150ha that had been previously assessed (Terrestrial Ecosystems 2018b).

Based on a desktop analysis and information provided by Native Vegetation Solutions gathered during the botanical assessment for the project area, there are six broad fauna habitats in the project area:

- Open Mulga woodland over scattered low shrubs and grasses;
- Mulga and chenopod shrubland;
- Open Mulga woodland over scattered low shrubs and grasses on a banded ironstone formation;
- Samphire shrubland;
- Chenopod shrubland; and
- Disturbed areas.

The density of trees and shrubs in the relatively undisturbed areas varied across the project area but was mostly sparse. The fauna habitat varies from degraded to good; the more degraded areas are due to a haul road that runs east-west through the project area, gravel tracks in the north-eastern corner, historical exploration activity and cattle grazing.

The BIFs are the preferred habitat of the Long-tailed Dunnart, a Priority 4 species with DBCA. This habitat type represents only a small percentage of the project area, and clearing it is unlikely to have a significant impact on Long-tailed Dunnarts, when viewed in a bioregional context. Clearing native vegetation in other habitat types is likely to result in the loss of small vertebrate fauna on-site that are unable to move away during the clearing process. The few larger animals, such as kangaroos and large goannas and snakes, and most of the birds will move into adjacent areas once clearing commences.

Impacts associated with clearing vegetation in the project area in a landscape or bioregional context on the vertebrate fauna are likely to be low as there are vast tracts of similar habitat in adjacent areas.

The proposed project is unlikely to significantly impact on a conservation significant species, so a referral under the *EPBC Act* is not required.

5. MANAGEMENT STRATEGIES

5.1 INDUCTION AND AWARENESS

All contractors and people involved in construction of solar farm should be made aware of the possible presence and issues associated with terrestrial fauna in the area through the induction process.

Recommendation 1: An induction program that includes a component on managing fauna is a mandatory component of working on the solar farm project.

5.2 DUST

Dust generated from vegetation clearing and the construction of the solar farm could potentially degrade surrounding vegetation, reducing its ability to absorb sunlight and influencing photosynthetic rates. Degradation of these areas will potentially render habitat unsuitable for fauna. Dust suppression and management programs are an essential component of minimising mining impacts on fauna during the construction program.

Recommendation 2: The impact of dust on adjacent vegetation and fauna habitat is managed and monitored against appropriate KPIs.

5.3 LONG-TAILED DUNNARTS

Long-tailed Dunnarts were recorded during the 2011 Level 2 fauna trapping surveys in adjacent areas. They are therefore potentially present in the banded ironstone formations in the project area. These dunnarts have now been recorded on multiple other BIFs in the Goldfields, so clearing of BIFs in the project area is unlikely to have a significant impact of this species.

If it is practical to avoid clearing the BIFs, then this would be highly desirable.

Recommendation 3: If practical, avoid impacting on the banded ironstone habitat.

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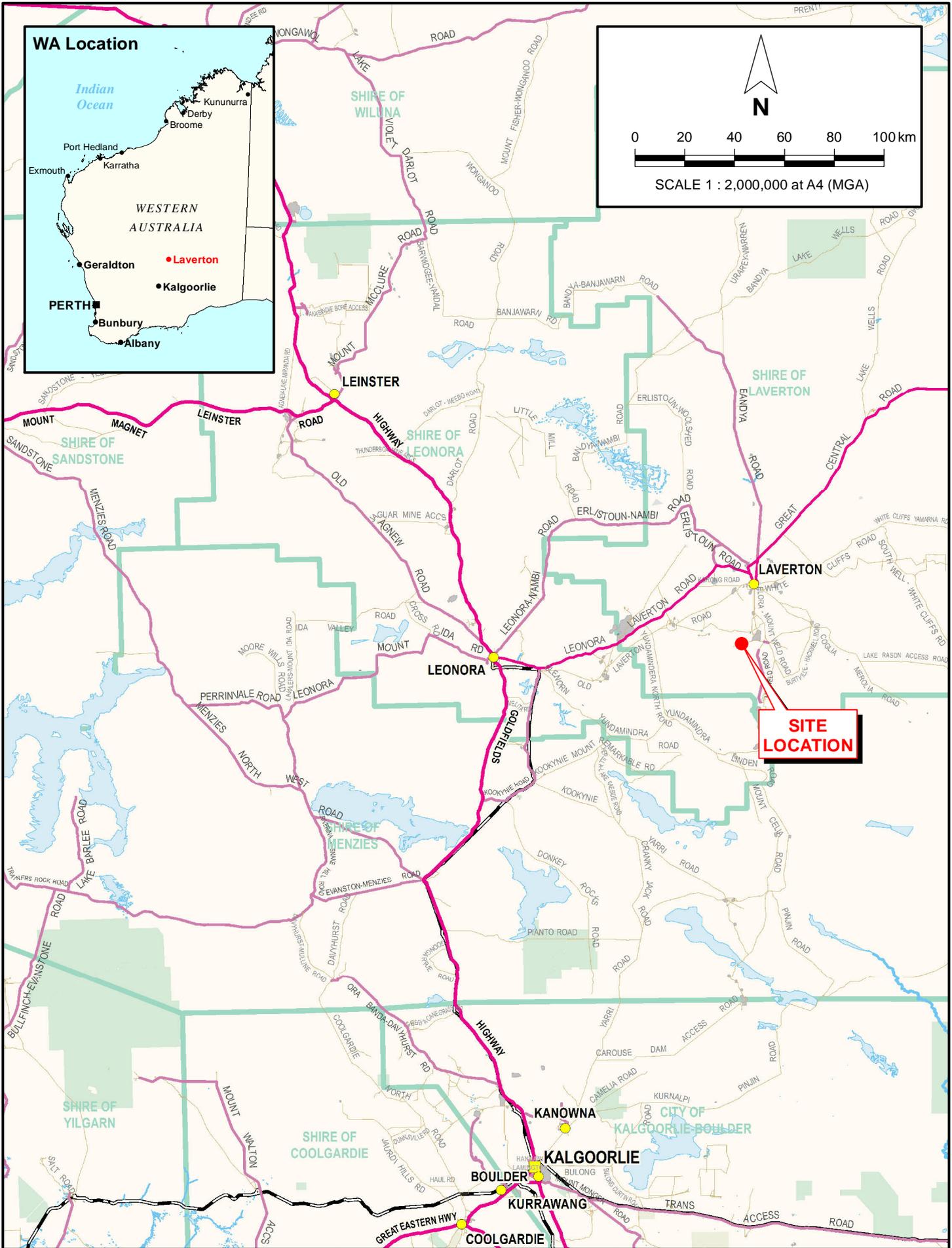
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Figures

**Desktop Vertebrate Fauna Assessment
Expansion of the Solar Power Farm Project Area**





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TERRESTRIAL ECOSYSTEMS

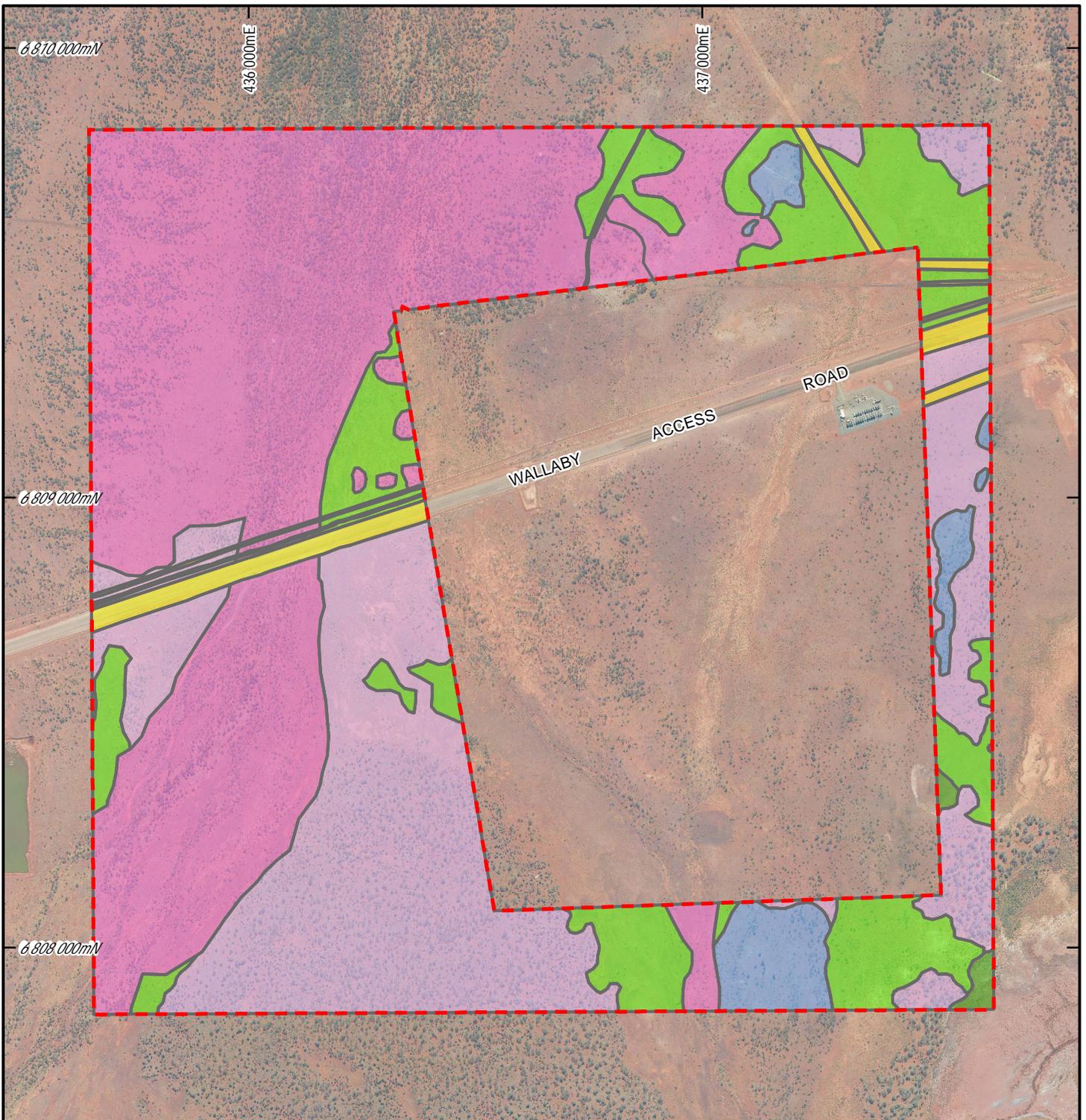
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GSM Mining Company Pty Ltd
 DESKTOP VERTEBRATE FAUNA ASSESSMENT
 EXPANSION OF THE SOLAR POWER FARM PROJECT AREA

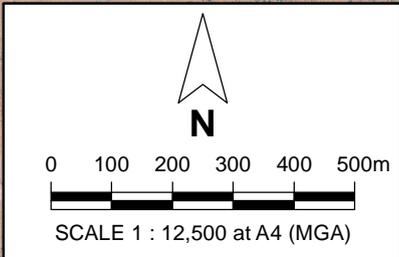
REGIONAL LOCATION

Figure 1

Job: 2022-0035



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Legend	
	Site Boundary
Fauna Habitats	
	Chenopod shrubland
	Disturbed
	Mulga and chenopod shrubland
	Open mulga woodland over scattered low shrubs and grasses
	Open mulga woodland over scattered low shrubs and grasses on BIFs
	Samphire shrubland

TERRESTRIAL ECOSYSTEMS

Drawn: S. Thompson Date: 31 May 2022

GSM Mining Company Pty Ltd
 DESKTOP VERTEBRATE FAUNA ASSESSMENT
 EXPANSION OF THE SOLAR POWER FARM PROJECT AREA

**PROJECT AREA AND SURROUNDS
 SHOWING FAUNA HABITATS**

Figure 2

Job: 2022-0035

Appendix A.

Results of the EPBC Act Protected Matters Search

Desktop Vertebrate Fauna Assessment
Expansion of the Solar Power Farm Project Area





EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 26-May-2022

[Summary](#)

[Details](#)

[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

[Acknowledgements](#)

Summary

Matters of National Environment Significance

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

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance (Ramsar)	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	9
Listed Migratory Species:	9

Other Matters Protected by the EPBC Act

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

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

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

Commonwealth Lands:	5
Commonwealth Heritage Places:	None
Listed Marine Species:	12
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

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

State and Territory Reserves:	None
Regional Forest Agreements:	None
Nationally Important Wetlands:	1
EPBC Act Referrals:	4
Key Ecological Features (Marine):	None
Biologically Important Areas:	None
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

Listed Threatened Species

[\[Resource Information \]](#)

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

Scientific Name

Threatened Category

Presence Text

BIRD

[Calidris ferruginea](#)

Curlew Sandpiper [856]

Critically Endangered

Species or species habitat may occur within area

[Falco hypoleucos](#)

Grey Falcon [929]

Vulnerable

Species or species habitat may occur within area

[Leipoa ocellata](#)

Malleefowl [934]

Vulnerable

Species or species habitat known to occur within area

[Pezoporus occidentalis](#)

Night Parrot [59350]

Endangered

Species or species habitat may occur within area

[Polytelis alexandrae](#)

Princess Parrot, Alexandra's Parrot [758]

Vulnerable

Species or species habitat known to occur within area

MAMMAL

[Dasyurus geoffroii](#)

Chuditch, Western Quoll [330]

Vulnerable

Species or species habitat may occur within area

[Sminthopsis psammophila](#)

Sandhill Dunnart [291]

Endangered

Species or species habitat likely to occur within area

PLANT

Scientific Name	Threatened Category	Presence Text
Hibbertia crispula Ooldea Guinea-flower [15222]	Vulnerable	Species or species habitat may occur within area
REPTILE		
Liopholis kintorei Great Desert Skink, Tjakura, Warrarna, Mulyamiji [83160]	Vulnerable	Species or species habitat may occur within area
Listed Migratory Species [Resource Information]		
Scientific Name	Threatened Category	Presence Text
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Lands [\[Resource Information \]](#)

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

Commonwealth Land Name	State
Defence	
Defence - JINDALEE STATION [50257]	WA
Defence - JINDALEE STATION [50256]	WA

Unknown	
Commonwealth Land - [51827]	WA
Commonwealth Land - [51829]	WA
Commonwealth Land - [51828]	WA

Listed Marine Species [\[Resource Information \]](#)

Scientific Name	Threatened Category	Presence Text
Bird		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area overfly marine area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area overfly marine area
Chalcites osculans as Chrysococcyx osculans Black-eared Cuckoo [83425]		Species or species habitat known to occur within area overfly marine area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area overfly marine area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area overfly marine area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area overfly marine area
Thinornis cucullatus as Thinornis rubricollis Hooded Dotterel, Hooded Plover [87735]		Species or species habitat may occur within area overfly marine area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area overfly marine area

Extra Information

Nationally Important Wetlands [\[Resource Information \]](#)

Wetland Name	State
Lake Marmion	WA

EPBC Act Referrals [\[Resource Information \]](#)

Title of referral	Reference	Referral Outcome	Assessment Status
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Not controlled action

Eastern Goldfields Gas Pipeline Construction, WA	2014/7284	Not Controlled Action	Completed
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Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed
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Murrin Murrin East Nickel and Cobalt Mine Expansion	2008/4140	Not Controlled Action	Completed
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Re-establish and Recommencement of Mount Windarra Nickel Mine	2008/4016	Not Controlled Action	Completed
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Caveat

1 PURPOSE

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

The report contains the mapped locations of:

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

2 DISCLAIMER

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

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

3 DATA SOURCES

Threatened ecological communities

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

Threatened, migratory and marine species

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

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

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

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

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

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

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

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

Acknowledgements

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

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

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

Please feel free to provide feedback via the [Contact Us](#) page.

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Appendix B.

Vertebrate Fauna Recorded in Biological Surveys in the Region

Desktop Vertebrate Fauna Assessment
Expansion of the Solar Power Farm Project Area



B.1 [APPENDIX HEADING TITLE]

Family	Species	Common Name	Surveys																																		
			A															B																			
			Site 1E	Site 1W	Site SS18	Site SS21	Site SS1	Site 1W08	Site LL4	Site LL5	Site SS19	Site SS20	Site LL3	Site LL6	Site SS22	Site LL1	Site LL2	Site SS23	Site 2	Site 3	Site 6	Site 7	Site 8	Site 1	Site 4	Site 5	Pundin	Wells	Site 2	Site 10	Site 21	Site 18	Site 21a	Site 9	Weebo	Site 17	Opportunistic
Frogs																																					
Hylidae	<i>Cyclorana maini</i>	Sheep Frog	4	1	2	1																						1	2	4	1	2					
Limnodynastidae	<i>Neobatrachus kunapalari</i>	Kunapalari Frog	6	5	7		1	2	1	2	1	4																						1			
	<i>Neobatrachus wilsmorei</i>	Goldfields Bullfrog																												1	8	5	2				
	<i>Platyplectrum spenceri</i>	Spencer's Burrowing Frog																										3		6							
Reptiles																																					
Agamidae	<i>Ctenophorus caudicinctus</i>	Ring-tailed Dragon		2			3																					8									
	<i>Ctenophorus fordi</i>	Mallee Dragon	5																											14				19			
	<i>Ctenophorus inermis</i>	Military Dragon	2	6		1					1	1	1															5	1	2			2		1		
	<i>Ctenophorus isolepis</i>	Crested Dragon	7	2		3		1	4					1	3																	4				1	
	<i>Ctenophorus reticulatus</i>	Western Netted Dragon	2	2							2																										
	<i>Ctenophorus salinarum</i>	Saltpan Dragon	3	1												1	5										1								6		
	<i>Ctenophorus scutulatus</i>	Lozenge-marked Dragon	1										1																								
	<i>Diporiphora amphiboluroides</i>	Mulga Dragon		1			1																														
	<i>Moloch horridus</i>	Thorny Devil	3												1															1	1	2	1				
	<i>Pogona minor</i>	Dwarf Bearded Dragon	2	2					2	1			1																2	1							
Carphodactylidae	<i>Nephrurus vertebralis</i>	Midline Knob-tail																										1									
	<i>Underwoodisaurus milii</i>	Barking Gecko	1																																		
Diplodactylidae	<i>Diplodactylus pulcher</i>	Fine-faced Gecko			1	2																						2									

Family	Species	Common Name	Surveys																																			
			A												B																							
			Site 1E	Site 1W	Site SS18	Site SS21	Site SS1	Site 1W08	Site LL4	Site LL5	Site SS19	Site SS20	Site LL3	Site LL6	Site SS22	Site LL1	Site LL2	Site SS23	Site 2	Site 3	Site 6	Site 7	Site 8	Site 1	Site 4	Site 5	Pundin	Wells	Site 2	Site 10	Site 21	Site 18	Site 21a	Site 9	Weebo	Site 17	Opportunistic	
	<i>Lucasium squarrosus</i>	Mottled Ground Gecko	1													1																		18				
	<i>Strophurus elderi</i>	Jewelled Gecko											1																		1	10						
	<i>Strophurus strophurus</i>	Western Spiny-tailed Gecko	1					1																														
	<i>Strophurus wellingtonae</i>	Shield Spiny-tailed Gecko	1	1	1	1	1																															
Elapidae	<i>Brachyuropis semifasciata</i>	Half-girdlerd Snake																										1		1								
	<i>Furina ornata</i>	Orange-naped Snake	2																																			
	<i>Pseudechis australis</i>	Mulga Snake	1																																			
	<i>Pseudonaja mengdeni</i>	Gwardar		1																										1								
	<i>Pseudonaja modesta</i>	Ringed Brown Snake																														1						
	<i>Simoselaps bertholdi</i>	Jan's Banded Snake	1																																			
Gekkonidae	<i>Gehyra purpurascens</i>	Purplish Dtella	1						1																			10							3			
	<i>Gehyra variegata</i>	Tree Dtella	25	2		1	8		1				1		1												5	7	3		3	2	1	3		1		
	<i>Heteronotia binoei</i>	Bynoe's Prickly Gecko	5	2		2																						3	1		1							
	<i>Rhynchoedura ornata</i>	Western Beaked Gecko	2	1		4																						2	2	6	3					1		
Pygopodidae	<i>Delma butleri</i>	Unbanded Delma			1			1																							1	1						
	<i>Delma nasuta</i>	Sharp-snouted Delma						1					1	3	1			1																				
	<i>Lialis burtonis</i>	Burton's Snake-lizard	1																											1	2	1			1			
	<i>Pygopus nigriceps</i>	Western Hooded Scaly-foot																													1							
Scincidae	<i>Cryptoblepharus buchanani</i>	Buchanan's Snake-eyed Skink	3													1																						
	<i>Ctenotus ariadnae</i>	Ariadna's Ctenotus				4																																

Family	Species	Common Name	Surveys																								Opportunistic											
			A												B																							
			Site 1E	Site 1W	Site SS18	Site SS21	Site SS1	Site 1W08	Site LL4	Site LL5	Site SS19	Site SS20	Site LL3	Site LL6	Site SS22	Site LL1	Site LL2	Site SS23	Site 2	Site 3	Site 6	Site 7	Site 8	Site 1	Site 4	Site 5	Pundin	Wells	Site 2	Site 10	Site 21	Site 18	Site 21a	Site 9	Weebo	Site 17		
	<i>Morethia butleri</i>	Woodland Morethia Skink	2	3	1	3																														1		
	<i>Tiliqua multifasciata</i>	Centralian Blue-tongued Lizard		2																																		
	<i>Tiliqua occipitalis</i>	Western Blue-tongued Lizard	2			1																																
Typhlopidae	<i>Anilius hamatus</i>	Pale-headed Blind Snake					1						1																									
	<i>Anilius waitii</i>	Waite's Blind Snake																																				
Varanidae	<i>Varanus brevicauda</i>	Short-tailed Pygmy Monitor							1								1																					
	<i>Varanus caudolineatus</i>	Stripe-tailed Monitor	1		2					1		3																					2		1			
	<i>Varanus eremius</i>	Pygmy Desert Monitor																																4				
	<i>Varanus giganteus</i>	Perentie																									1											
	<i>Varanus gouldii</i>	Gould's Goanna	1																														1	1				
	<i>Varanus panoptes</i>	Yellow-spotted Monitor					1																					1										
	<i>Varanus tristis</i>	Black-headed Monitor																										1										
Cheluidae	<i>Chelodina steindachneri</i>	Steindachner's Turtle																										1										
Birds																																						
Casuariidae	<i>Dromaius novaehollandiae</i>	Emu				1							2			1																						1
Anatidae	<i>Tadorna tadornoides</i>	Australian Shelduck	1	1																									1	1					7			
	<i>Chenonetta jubata</i>	Australian Wood Duck	1																										37									
	<i>Malacorhynchus membranaceus</i>	Pink-eared Duck	1																																			
	<i>Anas gracilis</i>	Grey Teal	1	1																									41									
	<i>Anas superciliosa</i>	Pacific Black Duck	1																																			

Family	Species	Common Name	Surveys																																		
			A														B																				
			Site 1E	Site 1W	Site SS18	Site SS21	Site SS1	Site 1W08	Site LL4	Site LL5	Site SS19	Site SS20	Site LL3	Site LL6	Site SS22	Site LL1	Site LL2	Site SS23	Site 2	Site 3	Site 6	Site 7	Site 8	Site 1	Site 4	Site 5	Pundin	Wells	Site 2	Site 10	Site 21	Site 18	Site 21a	Site 9	Weebo	Site 17	Opportunistic
Podicipedidae	<i>Poliiocephalus poliocephalus</i>	Hoary-headed Grebe	1																										2								
Columbidae	<i>Phaps chalcoptera</i>	Common Bronzewing				3			4																						4					54	
	<i>Phaps histrionica</i>	Flock Bronzewing																										22	38	21					33	1	
	<i>Ocyphaps lophotes</i>	Crested Pigeon		11	5	17		5	4	2					2																						
	<i>Geopelia cuneata</i>	Diamond Dove							8																												
Podargidae	<i>Podargus strigoides</i>	Tawny Frogmouth	1																											2							
Caprimulgidae	<i>Eurostopodus argus</i>	Spotted Nightjar																										1	2								
Aegothelidae	<i>Aegotheles cristatus</i>	Australian Owlet-nightjar	1							1																			7	2				1	1		
Otididae	<i>Ardeotis australis</i>	Australian Bustard	1																																		
Phalacrocoracidae	<i>Microcarbo melanoleucos</i>	Little Pied Cormorant	1																																		
Ardeidae	<i>Ardea pacifica</i>	White-necked Heron	1	1																																1	
	<i>Egretta novaehollandiae</i>	White-faced Heron	1																									1								1	
Accipitridae	<i>Haliastur sphenurus</i>	Whistling Kite																										6	1								
	<i>Accipiter cirrocephalus</i>	Collared Sparrowhawk				2																						5									
	<i>Circus assimilis</i>	Spotted Harrier	1																																		
	<i>Aquila audax</i>	Wedge-tailed Eagle				2						4		8	3													1		1						1	
	<i>Hieraaetus morphnoides</i>	Little Eagle	1																								3										
Falconidae	<i>Falco cenchroides</i>	Nankeen Kestrel				3	3		1	1	2			1	2													1			1			1			
	<i>Falco berigora</i>	Brown Falcon			4	2			3		1																				1						
	<i>Falco longipennis</i>	Australian Hobby	1																									2									
	<i>Falco peregrinus</i>	Peregrine Falcon																										1									

Family	Species	Common Name	Surveys																																			
			A													B																						
			Site 1E	Site 1W	Site SS18	Site SS21	Site SS1	Site 1W08	Site LL4	Site LL5	Site SS19	Site SS20	Site LL3	Site LL6	Site SS22	Site LL1	Site LL2	Site SS23	Site 2	Site 3	Site 6	Site 7	Site 8	Site 1	Site 4	Site 5	Pundin	Wells	Site 2	Site 10	Site 21	Site 18	Site 21a	Site 9	Weebo	Site 17	Opportunistic	
Rallidae	<i>Tribonyx ventralis</i>	Black-tailed Native-hen	1																																			
	<i>Fulica atra</i>	Eurasian Coot	1																																			
Burhinidae	<i>Burhinus grallarius</i>	Bush Stone-curlew		1																																		
Recurvirostridae	<i>Himantopus himantopus</i>	Black-winged Stilt	1																																			
Charadriidae	<i>Charadrius ruficapillus</i>	Red-capped Plover	1																																			
	<i>Eseyornis melanops</i>	Black-fronted Dotterel	1																																			
	<i>Vanellus tricolor</i>	Banded Lapwing	1				2																						1								1	
Scolopacidae	<i>Actitis hypoleucos</i>	Common Sandpiper	1																																			
Turnicidae	<i>Turnix velox</i>	Little Button-quail																														1	1					
Cacatuidae	<i>Eolophus roseicapillus</i>	Galah					124	26	4	19						10													1	1		9			1	1		
	<i>Nymphicus hollandicus</i>	Cockatiel				21	4	15	12							20													9	1	1	1	1	1				1
Psittacidae	<i>Barnardius zonarius</i>	Australian Ringneck			2	5	3	4	2	2	3				2														115	7	13					1	1	
	<i>Psephotus varius</i>	Mulga Parrot				4		9																													1	
	<i>Melopsittacus undulatus</i>	Budgerigar			16	18	5	6	9	5	29	6			5	8													1	1	1	1	1	1			1	1
	<i>Neopsephotus bourkii</i>	Bourke's Parrot			2	3		6																						9							1	
Cuculidae	<i>Chalcites basalis</i>	Horsfield's Bronze-cuckoo			2	3	1		1																				1	5		1		5			1	
	<i>Cacomantis pallidus</i>	Pallid Cuckoo	1			1					1																		1		3						2	
Halcyonidae	<i>Todiramphus pyrrhopygius</i>	Red-backed Kingfisher	1			1																															1	
Climacteridae	<i>Climacteris affinis</i>	White-browed Treecreeper	1		9																										3	13					2	
Ptilonorhynchidae	<i>Ptilonorhynchus maculatus</i>	Spotted Bowerbird					2																							4						4	1	
Maluridae	<i>Malurus leucopterus</i>	White-winged Fairy-wren										2	69			57														143			142				1	

Family	Species	Common Name	Surveys																																		
			A												B																						
			Site 1E	Site 1W	Site SS18	Site SS21	Site SS1	Site 1W08	Site LL4	Site LL5	Site SS19	Site SS20	Site LL3	Site LL6	Site SS22	Site LL1	Site LL2	Site SS23	Site 2	Site 3	Site 6	Site 7	Site 8	Site 1	Site 4	Site 5	Pundin	Wells	Site 2	Site 10	Site 21	Site 18	Site 21a	Site 9	Weebo	Site 17	Opportunistic
	<i>Malurus lamberti</i>	Variiegated Fairy-wren								2																											
Acanthizidae	<i>Smicronis brevirostris</i>	Weebill				10		8	6																			350		5					71		
	<i>Gerygone fusca</i>	Western Gerygone																										17							1		
	<i>Acanthiza robustirostris</i>	Slaty-backed Thornbill				10																															
	<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill			11	1		3																				30	2	1						1	
	<i>Acanthiza uropygialis</i>	Chestnut-rumped Thornbill		1	40	22	19	3	20	8		3																	37					2	1		
	<i>Acanthiza apicalis</i>	Inland Thornbill						8																					2								
	<i>Aphelocephala leucopsis</i>	Southern Whiteface			17	2		9	12																												
Pardalotidae	<i>Pardalotus striatus</i>	Striated Pardalote		1												2												188		1					4		
Meliphagidae	<i>Certhionyx variegatus</i>	Pied Honeyeater			1	3		2	4	1	1																		23	7					20	1	
	<i>Lichenostomus virescens</i>	Singing Honeyeater			4	4	3		20	1	13	1																1	1	2					6	1	
	<i>Lichenostomus penicillatus</i>	White-plumed Honeyeater		1																																	
	<i>Purnella albifrons</i>	White-fronted Honeyeater			2	8	2	33	17		6	40			81	99													1	3	3				2		
	<i>Manorina flavigula</i>	Yellow-throated Miner																										216	9	17					32	1	
	<i>Acanthagenys rufogularis</i>	Spiny-cheeked Honeyeater			34	1	11	5	32	2	1	12																1	24	8					23		
	<i>Epthianura tricolor</i>	Crimson Chat				3		11	28	55	43				20													1	47	4		44		1	1		
	<i>Epthianura aurifrons</i>	Orange Chat																										8			14						
	<i>Sugomel niger</i>	Black Honeyeater	1																																		
	<i>Lichmera indistincta</i>	Brown Honeyeater		1				1																													
Pomatostomidae	<i>Pomatostomus superciliosus</i>	White-browed Babbler				34		22		2																			4								
Psophodidae	<i>Cinclosoma cinnamomeum</i>	Cinnamon Quail-thrush				1				2																											

Family	Species	Common Name	Surveys																																		
			A															B																			
			Site 1E	Site 1W	Site SS18	Site SS21	Site SS1	Site 1W08	Site LL4	Site LL5	Site SS19	Site SS20	Site LL3	Site LL6	Site SS22	Site LL1	Site LL2	Site SS23	Site 2	Site 3	Site 6	Site 7	Site 8	Site 1	Site 4	Site 5	Pundin	Wells	Site 2	Site 10	Site 21	Site 18	Site 21a	Site 9	Weebo	Site 17	Opportunistic
Neosittidae	<i>Daphoenositta chrysoptera</i>	Varied Sittella				12																															
Campephagidae	<i>Coracina maxima</i>	Ground Cuckoo-shrike															3																				1
	<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike			1	1							1			2	2												20	12	1					9	1
	<i>Lalage sueurii</i>	White-winged Triller			2	7				1	1	7	11																								
Pachycephalidae	<i>Pachycephala rufiventris</i>	Rufous Whistler			7	11	1		1	18																		7	12	2	2					6	
	<i>Colluricincla harmonica</i>	Grey Shrike-thrush				1	4		1		1																										
	<i>Oreoica gutturalis</i>	Crested Bellbird			3	8	6		2	18	7	1	17																	15	6					7	
Artamidae	<i>Artamus personatus</i>	Masked Woodswallow			99	21	43			1		119																	1	2			20		10		
	<i>Artamus superciliosus</i>	White-browed Woodswallow		1																																	
	<i>Artamus cinereus</i>	Black-faced Woodswallow			3	5			1	1	16	9	23			43	1											1	8	37	27		5		18	1	
	<i>Cracticus torquatus</i>	Grey Butcherbird							1																			2		1	6		2		1	1	
	<i>Cracticus nigrogularis</i>	Pied Butcherbird			1		5		1	3			15			5	2											55	1		2		3		28	1	
	<i>Cracticus tibicen</i>	Australian Magpie	1																									31								1	
	<i>Strepera versicolor</i>	Grey Currawong	1				1																														
Rhipiduridae	<i>Rhipidura leucophrys</i>	Willie Wagtail			1	7	4		1	7	2	1	3			2														5	2	2			2	1	
Corvidae	<i>Corvus bennetti</i>	Little Crow			7		2									10												231	15	48	14		34		46	1	
	<i>Corvus orru</i>	Torresian Crow																										1		1		1					
Monarchidae	<i>Grallina cyanoleuca</i>	Magpie-lark	1																									17								1	
Petroicidae	<i>Microeca fascinans</i>	Jacky Winter							3			1																									
	<i>Petroica goodenovii</i>	Red-capped Robin			18	8	11		33	2		12																4	4	22	7		1		4		
	<i>Melanodryas cucullata</i>	Hooded Robin			3	4	3		5	9	6	3																1	7						4		

Family	Species	Common Name	Surveys																																		
			A														B																				
			Site 1E	Site 1W	Site SS18	Site SS21	Site SS1	Site 1W08	Site LL4	Site LL5	Site SS19	Site SS20	Site LL3	Site LL6	Site SS22	Site LL1	Site LL2	Site SS23	Site 2	Site 3	Site 6	Site 7	Site 8	Site 1	Site 4	Site 5	Pundin	Wells	Site 2	Site 10	Site 21	Site 18	Site 21a	Site 9	Weebo	Site 17	Opportunistic
Megaluridae	<i>Cincloramphus mathewsi</i>	Rufous Songlark	1									1																									
	<i>Cincloramphus cruralis</i>	Brown Songlark	1									1																23				18			1		
Hirundinidae	<i>Cheramoeca leucosterna</i>	White-backed Swallow	1																																		
	<i>Hirundo nigricans</i>	Tree Martin	1																																	1	
Nectariniidae	<i>Dicaeum hirundinaceum</i>	Mistletoebird				3	1		4	7																	1		1	4					1		
Estrildidae	<i>Taeniopygia guttata</i>	Zebra Finch			12	99			22	2	4																27	16	8		8		6	1			
Motacillidae	<i>Anthus novaeseelandiae</i>	Australasian Pipit			1				2	1	7	5					4										9					43			1		
Mammals																																					
Bovidae	<i>Bos taurus</i>	Cow		4																							1							1			
	<i>Capra hircus</i>	Goat																								1	1	1	1	1	1	1	1				
	<i>Ovis aries</i>	Sheep		10																						1	1	1	1	1	1	1	1		1		
Camelidae	<i>Camelus dromedarius</i>	Dromedary	1	1						1						1																					
Felidae	<i>Felis catus</i>	House Cat	2																																		
Molossidae	<i>Austronomus australis</i>	White-striped Free-tail Bat																		1	1	1	1	1													
	<i>Ozimops planiceps</i>	Southern Free-tail Bat	2	3																1		1	1		1												
Pteropodidae	<i>Syconycteris australis</i>	Common Blossom-bat	2	9																																	
Vespertilionidae	<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	5	14		1				1										1	1	1		1	1	1	1	2		5				1			
	<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat	5	13					4											1	1	1		1	1		28		4								
	<i>Scotorepens balstoni</i>	Inland Broad-nosed Bat	6	21		1														1	1	1		1	1	1	1										
	<i>Scotorepens greyii</i>	Little Broad-nosed Bat																									10										
	<i>Vespadelus finlaysoni</i>	Finlayson's Cave Bat		3		1															1	1															

Family	Species	Common Name	Surveys																																		
			A															B																			
			Site 1E	Site 1W	Site SS18	Site SS21	Site SS1	Site 1W08	Site LL4	Site LL5	Site SS19	Site SS20	Site LL3	Site LL6	Site SS22	Site LL1	Site LL2	Site SS23	Site 2	Site 3	Site 6	Site 7	Site 8	Site 1	Site 4	Site 5	Pundin	Wells	Site 2	Site 10	Site 21	Site 18	Site 21a	Site 9	Weebo	Site 17	Opportunistic
	<i>Vespadelus regulus</i>	Southern Forest Bat																									2										
Dasyuridae	<i>Antechinomys laniger</i>	Kultarr		2	6	3					2	3																								1	
	<i>Ningaiu ridei</i>	Wongai Ningai		1	2	3	1		5		1	1		1	7															7	2	8	2	4			
	<i>Pseudantechinus woolleyae</i>	Woolley's False Antechinus					1																														
	<i>Sminthopsis crassicaudata</i>	Fat-tailed Dunnart											1		4	7														3							
	<i>Sminthopsis dolichura</i>	Little Long-tailed Dunnart																											1		1						
	<i>Sminthopsis hirtipes</i>	Hairy-footed Dunnart												2	8			1												1		1					
	<i>Sminthopsis macroura</i>	Stripe-faced Dunnart			10				3	7	10	2				1															2		1				
	<i>Sminthopsis ooldea</i>	Ooldea Dunnart				2	2		2			1			1														1		2						
Macropodidae	<i>Osphranter robustus</i>	Euro	3	12	1		7				1	1			1												1	1		1	1		1				
	<i>Osphranter rufus</i>	Red Kangaroo	38	24	4				1	1	1	2		1	4												1	1		1	1		1	1	1		
Leporidae	<i>Oryctolagus cuniculus</i>	European Rabbit	3													1													1								
Tachyglossidae	<i>Tachyglossus aculeatus</i>	Short-beaked Echidna	1				1																														
Equidae	<i>Equus caballus</i>	Domestic Horse									1																										
Muridae	<i>Mus musculus</i>	House Mouse							2	3		1	3		3	8													2	3				2			
	<i>Notomys alexis</i>	Spinifex Hopping Mouse				1	1			3			1	9			2														1	1					
	<i>Pseudomys hermannsburgensis</i>	Sandy Inland Mouse	1	1	5	6	2		8	1	14	9	6	1	2	1													7	3		3			7		

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- B How, R. A. and Dell, J. (1992) Vertebrate fauna. In: The Biological Survey of the Eastern Goldfields of Western Australia Part 7. Duketon - Sir Samuel Study Area. *Records of the Western Australian Museum*; Supplement 40, 90-109.

Family	Species	Common Name	A									B									C																
			MME1	MME2	MME3	MME4	MME5	MME6	MME7	MME8	MME9	Opportunistic	Site 11	Site 11a	Site 14	Site 14a	Site 14b	Site 17a	Site 19	Site 1a	Site 20a	Site 21	Site 21a	Site 5a	Site 8	Site 9	Site 9a	CM001	CM002	CM003	CM004	CM005	Opportunistic				
	<i>Diplodactylus pulcher</i>	Fine-faced Gecko						1							4	3	1						3						2	1	1						
	<i>Lucasium maini</i>	Main's Ground Gecko																			1																
	<i>Lucasium squarrosom</i>	Mottled Ground Gecko									1	3		1		3				2								6	3		2						
	<i>Strophurus assimilis</i>	Goldfields Spiny-tailed Gecko																										1			1						
	<i>Strophurus ciliaris</i>	Spiny-tailed Gecko												2		1			1			2															
	<i>Strophurus strophurus</i>	Western Spiny-tailed Gecko																				7										4					
	<i>Strophurus wellingtonae</i>	Western Shield Spiny-tailed Gecko		1																											1						
Elapidae	<i>Brachyuropis fasciolata</i>	Narrow-banded Burrowing Snake																		1																	
	<i>Parasuta monachus</i>	Monk Snake									1			1		3													1		1						
	<i>Pseudechis butleri</i>	Spotted Mulga Snake									1																										
	<i>Simoselaps bertholdi</i>	Jan's Banded Snake																	1																		
	<i>Suta fasciata</i>	Rosen's Snake																				2															
Gekkonidae	<i>Gehyra variegata</i>	Tree Dtella	3	9	3	16	3	9	2		3	1				15	1	1	1		2	15	1				1		5	2							
	<i>Heteronotia binoei</i>	Bynoe's Prickly Gecko		3		1						1				34					2	7									1	1					
	<i>Rhynchoedura ornata</i>	Western Beaked Gecko																			1		2	1							1						
Pygopodidae	<i>Pygopus nigriceps</i>	Western Hooded Scaly-foot														1			1	1																	
Scincidae	<i>Cryptoblepharus buchananii</i>	Buchanan's Snake-eyed Skink		2								1			1							1	1														
	<i>Ctenotus calurus</i>	Blue-tailed Finesnout Ctenotus																		1																	
	<i>Ctenotus greeri</i>	Spotted-necked Ctenotus																																			

Family	Species	Common Name	A										B										C												
			MME1	MME2	MME3	MME4	MME5	MME6	MME7	MME8	MME9	Opportunistic	Site 11	Site 11a	Site 14	Site 14a	Site 14b	Site 17a	Site 19	Site 1a	Site 20a	Site 21	Site 21a	Site 5a	Site 8	Site 9	Site 9a	CM001	CM002	CM003	CM004	CM005	Opportunistic		
	<i>Purnella albifrons</i>	White-fronted Honeyeater	80	100	12	40	8	1	10	6	6	1		1	3		1	4		7	6		2	16											
	<i>Manorina flavigula</i>	Yellow-throated Miner	10	5	7		2	10		2	2	1			10	15	98	1	13		41	3		21	109				1	12		6			
	<i>Acanthagenys rufogularis</i>	Spiny-cheeked Honeyeater	25	20		1	6	2	1	1	2	1			11	2	2	5	8		10	6	4	2	9	7			1	2					
	<i>Anthochaera carunculata</i>	Red Wattlebird											3					2		3				1											
	<i>Conopophila whitei</i>	Grey Honeyeater														18					17			1											
	<i>Epthianura tricolor</i>	Crimson Chat												18	154	24		6		29				75											
	<i>Epthianura aurifrons</i>	Orange Chat												5																					
Pomatostomidae	<i>Pomatostomus temporalis</i>	Grey-crowned Babbler																															12		
	<i>Pomatostomus superciliosus</i>	White-browed Babbler										1				3					3	2													
Psophodidae	<i>Cinclosoma castaneothorax</i>	Chestnut-breasted Quail-thrush												2						3												1			
Neosittidae	<i>Daphoenositta chrysoptera</i>	Varied Sittella														2	6																		
Campephagidae	<i>Coracina maxima</i>	Ground Cuckoo-shrike												4		31	2	3																	
	<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike		2		1							1		4	5	6	1	9		10			7	3			1							
	<i>Lalage sueurii</i>	White-winged Triller														3	9			34	6		39	2											
Pachycephalidae	<i>Pachycephala rufiventris</i>	Rufous Whistler					1	1	1	1		1						8				1													
	<i>Colluricincla harmonica</i>	Grey Shrike-thrush						1	2			1						5				1													
	<i>Oreoica gutturalis</i>	Crested Bellbird	1	3	1	2	1	1	2			1		3	14	5	1	15	2	10		2		6	2			4							
Artamidae	<i>Artamus personatus</i>	Masked Woodswallow												2	2		31	2		72															
	<i>Artamus superciliosus</i>	White-browed Woodswallow			4		1	1				1								3															
	<i>Artamus cinereus</i>	Black-faced Woodswallow												7	55	25	6	11		1		1		12				9	2				6		
	<i>Cracticus torquatus</i>	Grey Butcherbird	1	1	1		2	1	1		2	1			2	4	7	8		8				4	1			1	1	3					

Family	Species	Common Name	A									B									C													
			MME1	MME2	MME3	MME4	MME5	MME6	MME7	MME8	MME9	Opportunistic	Site 11	Site 11a	Site 14	Site 14a	Site 14b	Site 17a	Site 19	Site 1a	Site 20a	Site 21	Site 21a	Site 5a	Site 8	Site 9	Site 9a	CM001	CM002	CM003	CM004	CM005	Opportunistic	
	<i>Cracticus nigrogularis</i>	Pied Butcherbird	2	1	1						1	1		6	23	1	4	1			2	4	13	14					2	2				
	<i>Cracticus tibicen</i>	Australian Magpie	3							3	1			3	9			1						5			1	5	2					
	<i>Strepera versicolor</i>	Grey Currawong			1									2	3	2				1			4											
Rhipiduridae	<i>Rhipidura albiscapa</i>	Grey Fantail							1																									
	<i>Rhipidura leucophrys</i>	Willie Wagtail	1								1			2	2	1							12	1			1					1		
Corvidae	<i>Corvus bennetti</i>	Little Crow		2		6	1			1		11	29	50	21	12	24		6			7	36	149				7	4					
	<i>Corvus orru</i>	Torresian Crow		1	2		1	1	2		1	2			2														2					
Monarchidae	<i>Grallina cyanoleuca</i>	Magpie-lark		1	2			2		2	1			12	7	2																		
Petroicidae	<i>Microeca fascians</i>	Jacky Winter												1		22		1																
	<i>Petroica goodenovii</i>	Red-capped Robin	1	2		1	2	6			1		1	5	3	1	29	3	47		4	3	3	4							1			
	<i>Melanodryas cucullata</i>	Hooded Robin			3						1	1	2	1					1		1		2					2						
Megaluridae	<i>Cincloramphus mathewsi</i>	Rufous Songlark													3							2												
	<i>Cincloramphus cruralis</i>	Brown Songlark										7	7	3	7	8		1																
Hirundinidae	<i>Cheramoeca leucosterna</i>	White-backed Swallow			2						1				2																			
	<i>Hirundo rustica</i>	Barn Swallow					5																											
	<i>Petrochelidon ariel</i>	Fairy Martin																										6						
Nectariniidae	<i>Dicaeum hirundinaceum</i>	Mistletoebird													4				1															
Estrildidae	<i>Taeniopygia guttata</i>	Zebra Finch									1	9	12		4	5														6				
Motacillidae	<i>Anthus novaeseelandiae</i>	Australasian Pipit			4						1	7	18		16	1	36							2				4	1					
Mammals																																		
Bovidae	<i>Capra hircus</i>	Goat									1		1	1			1																	

Family	Species	Common Name	A										B										C																	
			MME1	MME2	MME3	MME4	MME5	MME6	MME7	MME8	MME9	Opportunistic	Site 11	Site 11a	Site 14	Site 14a	Site 14b	Site 17a	Site 19	Site 1a	Site 20a	Site 21	Site 21a	Site 5a	Site 8	Site 9	Site 9a	CM001	CM002	CM003	CM004	CM005	Opportunistic							
	<i>Ovis aries</i>	Sheep												1			1		1	1					1	1														
Camelidae	<i>Camelus dromedarius</i>	Dromedary										1																												
Canidae	<i>Canis familiaris</i>	Dog										1																												
	<i>Canis lupus</i>	Dingo										1																												
	<i>Vulpes vulpes</i>	Red Fox										1						1	1		1	1																		
Felidae	<i>Felis catus</i>	House Cat										1																												
Molossidae	<i>Austronomus australis</i>	White-striped Free-tail Bat																						1																
	<i>Ozimops planiceps</i>	Southern Free-tail Bat																						1																
Vespertilionidae	<i>Chalinolobus gouldii</i>	Gould's Wattled Bat												1										3																
	<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat												4	9									3																
	<i>Scotorepens balstoni</i>	Inland Broad-nosed Bat												6										1																
Dasyuridae	<i>Ningai ridei</i>	Wongai Ningai																5																						
	<i>Sminthopsis crassicaudata</i>	Fat-tailed Dunnart	1		1							5								7		1				1														
	<i>Sminthopsis fuliginosus</i>	Grey-bellied Dunnart																																						
	<i>Sminthopsis dolichura</i>	Little Long-tailed Dunnart										1		2		1	1	1					1	2																
	<i>Sminthopsis macroura</i>	Stripe-faced Dunnart																											2		2									
Macropodidae	<i>Macropus fuliginosus</i>	Western Grey Kangaroo										1											1	1																
	<i>Osphranter robustus</i>	Euro				1						1				1	1		1	1		1	1																	
	<i>Osphranter robustus erubescens</i>	Euro																																	1			3		
	<i>Osphranter rufus</i>	Red Kangaroo			5						6	1	1	1	1	1			1		1		1	1																
Leporidae	<i>Oryctolagus cuniculus</i>	European Rabbit				1						1	1																									1		

Family	Species	Common Name	Surveys													B	C																				
			Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11	Site 12	Site 13	Opportunistic	Granny Deeps birds	Agnew Gold	BKBO1	BKBO4	BKBO5	BKBO7	BKBO9	BKBS04	BKBO2	BKBO3	BKBO12	BKBO8	BKBO6	BKBO10	BKBO11	BKBS01	BKBHarp01	BKBS03			
	<i>Lerista distinguenda</i>	Orange-tailed Slider												1																							
	<i>Lerista sp.</i>																							2	1	1	1										
	<i>Menetia greyii</i>	Common Dwarf Skink											1											1													
	<i>Morethia butleri</i>	Woodland Morethia Skink		1		1		2				6	1		3																						
	<i>Tiliqua multifasciata</i>	Centralian Blue-tongued Lizard	1																																		
Typhlopidae	<i>Anilius australis</i>	Austral Blind Snake								1	1																										
	<i>Anilius bicolor</i>	Dark-spined Blind Snake			1																																
	<i>Anilius waitii</i>	Waite's Blind Snake																														1					
Varanidae	<i>Varanus caudolineatus</i>	Stripe-tailed Monitor		2		1	3	1	1			1	2							1	3	1		1					1	3							
	<i>Varanus gouldii</i>	Gould's Goanna														1																					
	<i>Varanus panoptes</i>	Yellow-spotted Monitor	4		7		3	2	2			4	2		6						2							2		1							
Birds																																					
Casuariidae	<i>Dromaius novaehollandiae</i>	Emu														3	1				1																
Anatidae	<i>Biziura lobata</i>	Musk Duck														2																					
	<i>Tadorna tadornoides</i>	Australian Shelduck															1																				
	<i>Chenonetta jubata</i>	Australian Wood Duck																																			
	<i>Malacorhynchus membranaceus</i>	Pink-eared Duck																																			
	<i>Anas gracilis</i>	Grey Teal																																			

Family	Species	Common Name	Surveys													Opportunistic	B																			
			A														C																			
			Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11	Site 12	Site 13	Granny Deeps birds	Agnew Gold	BKBO1	BKBO4	BKBO5	BKBO7	BKBO9	BKBS04	BKBO2	BKBO3	BKBO12	BKBO8	BKBO6	BKBO10	BKBO11	BKBS01	BKBHarp01	BKBS03			
	<i>Anas superciliosa</i>	Pacific Black Duck														13	1																			
	<i>Aythya australis</i>	Hardhead														2																				
Podicipedidae	<i>Tachybaptus novaehollandiae</i>	Australasian Grebe															1																			
	<i>Poliiocephalus poliocephalus</i>	Hoary-headed Grebe														30	1																			
Columbidae	<i>Phaps chalcoptera</i>	Common Bronzewing															1																			
Columbidae	<i>Ocyphaps lophotes</i>	Crested Pigeon															1	6			2								9							
Caprimulgidae	<i>Eurostopodus argus</i>	Spotted Nightjar															1																			
Ardeidae	<i>Egretta novaehollandiae</i>	White-faced Heron														2																				
Accipitridae	<i>Elanus axillaris</i>	Black-shouldered Kite															1																			
	<i>Haliastur sphenurus</i>	Whistling Kite																							1											
	<i>Accipiter fasciatus</i>	Brown Goshawk															1																			
	<i>Aquila audax</i>	Wedge-tailed Eagle														2	1					3														
Falconidae	<i>Falco cenchroides</i>	Nankeen Kestrel														2	1					1								1						
	<i>Falco berigora</i>	Brown Falcon														1																				
Rallidae	<i>Fulica atra</i>	Eurasian Coot														21																				
Recurvirostridae	<i>Himantopus himantopus</i>	Black-winged Stilt														5																				
	<i>Cladorhynchus leucocephalus</i>	Banded Stilt														14																				
Charadriidae	<i>Elsayornis melanops</i>	Black-fronted Dotterel														1	1																			



C Biota Environmental Sciences (2007) *Bannockburn Fauna Habitat and Assemblage Survey*. Unpublished report for Jubilee Mines NL, Perth.

Family	Species	Common Name	Survey																													
			A																													
			REG Open spinifex 1	REG Open spinifex 2	REG Open spinifex 3	REG Open spinifex 4	REG Shrubs over spinifex 1	REG Shrubs over spinifex 2	REG Shrubs over spinifex 3	REG Shrubs over spinifex 4	REG Dogbolter 2	REG Mulga woodland 1	REG Mulga woodland 4	REG Eucalypt over spinifex 2	REG Eucalypt over spinifex 4	REG Eucalypt over spinifex 1	REG Dogbolter 1	REG Dogbolter 3	REG Dogbolter 4	REG Eucalypt over spinifex 3	REG Mulga woodland 2	REG Mulga woodland 3	REG Opportunistic	REG Open spinifex	REG Mulga woodland	REG Eucalypt over spinifex	REG Shrubs over spinifex	REG Mulga thicket 2	REG Turkeys	REG Mulga thicket 1	REG Dogbolter	
	<i>Parasuta monachus</i>	Monk Snake				1			1		2		1		1								1									
	<i>Pseudechis australis</i>	Mulga Snake														2																
	<i>Pseudonaja mengdeni</i>	Gwardar		2																												
	<i>Pseudonaja modesta</i>	Ringed Brown Snake																	1													
	<i>Simoselaps bertholdi</i>	Jan's Banded Snake							1																							
Gekkonidae	<i>Gehyra purpurascens</i>	Purplish Dtella		1							2				1																	
	<i>Gehyra variegata</i>	Tree Dtella	2			1			1	2					1	1	2		1	3	1	10										
	<i>Heteronotia binoei</i>	Bynoe's Prickly Gecko						2							1	1					1	3										
	<i>Rhynchoedura ornata</i>	Western Beaked Gecko											1	1			7	4														
Pygopodidae	<i>Delma butleri</i>	Unbanded Delma	1	2	2	1	2	1	3	1		1									1											
	<i>Lialis burtonis</i>	Burton's Snake-lizard												1	2																	
	<i>Pygopus nigriceps</i>	Western Hooded Scaly-foot					1	1							1	3																
Scincidae	<i>Ctenotus ariadnae</i>	Ariadna's Ctenotus	1		4	3	7	4	6	8					2						4											
	<i>Ctenotus dux</i>	Fine Side-lined Ctenotus		2	2		6	2	13	2				4	14						4											
	<i>Ctenotus grandis grandis</i>	Grand Ctenotus	6	8	9	14	1	3	3	4				4	1																	
	<i>Ctenotus greeri</i>	Spotted-necked Ctenotus												9	7	8					6											
	<i>Ctenotus helenae</i>	Clay-soil Ctenotus	1	2			20	23	13	10				20	14	15					26											

Family	Species	Common Name	Survey																														
			A																														
			REG Open spinifex 1	REG Open spinifex 2	REG Open spinifex 3	REG Open spinifex 4	REG Shrubs over spinifex 1	REG Shrubs over spinifex 2	REG Shrubs over spinifex 3	REG Shrubs over spinifex 4	REG Dogbolter 2	REG Mulga woodland 1	REG Mulga woodland 4	REG Eucalypt over spinifex 2	REG Eucalypt over spinifex 4	REG Eucalypt over spinifex 1	REG Dogbolter 1	REG Dogbolter 3	REG Dogbolter 4	REG Eucalypt over spinifex 3	REG Mulga woodland 2	REG Mulga woodland 3	REG Opportunistic	REG Open spinifex	REG Mulga woodland	REG Eucalypt over spinifex	REG Shrubs over spinifex	REG Mulga thicket 2	REG Turkeys	REG Mulga thicket 1	REG Dogbolter		
	<i>Ctenotus leonhardii</i>	Leonhardi's Ctenotus	1	4	6						11	6	7	37	16	15	11	20	16	25	6	2											
	<i>Ctenotus pantherinus</i>	Leopard Skink	9		6	3	12	11	1	1				9	3	1					13												
	<i>Ctenotus piankai</i>	Coarse Sands Ctenotus	1	4	3	2		1	1	1																							
	<i>Ctenotus quattuordecimlineatus</i>	Fourteen-lined Ctenotus	4	12	3	2	19	16	9	5	4			2	3		1		1	9													
	<i>Ctenotus schomburgkii</i>	Schomburgk's Ctenotus				1					7		3				8	16			1												
	<i>Ctenotus uber</i>	Spotted Ctenotus									2	7	18				1	10	7		8												
	<i>Egernia depressa</i>	Southern Pygmy Spiny-tailed Skink											1	1					1		4	1											
	<i>Egernia formosa</i>	Goldfields Crevice-skink											1	1		1	1					2											
	<i>Eremiascincus richardsonii</i>	Broad-banded Sand Swimmer												2	1							1											
	<i>Lerista bipes</i>	North-western Sandslider	35	37	10	17	5	11	48	56																							
	<i>Lerista desertorum</i>	Central Desert Robust Slider	1	2		1		1		1	1	1	1	3	1						3												
	<i>Lerista muelleri</i>	Wood Mulch-slider										2		1		1		1			1												
	<i>Liopholis inornata</i>	Desert Skink					2	10	14	5																							
	<i>Liopholis striata</i>	Nocturnal Desert Skink	2	2	5	4																											
	<i>Menetia greyii</i>	Common Dwarf Skink	2	4	12	8						2				1		1			2	1											
	<i>Morethia butleri</i>	Woodland Morethia Skink												1							1		1										
	<i>Tiliqua multifasciata</i>	Centralian Blue-tongued Lizard	1	1	1		4																										

Family	Species	Common Name	Survey																																
			A																																
			REG Open spinifex 1	REG Open spinifex 2	REG Open spinifex 3	REG Open spinifex 4	REG Shrubs over spinifex 1	REG Shrubs over spinifex 2	REG Shrubs over spinifex 3	REG Shrubs over spinifex 4	REG Dogbolter 2	REG Mulga woodland 1	REG Mulga woodland 4	REG Eucalypt over spinifex 2	REG Eucalypt over spinifex 4	REG Eucalypt over spinifex 1	REG Dogbolter 1	REG Dogbolter 3	REG Dogbolter 4	REG Eucalypt over spinifex 3	REG Mulga woodland 2	REG Mulga woodland 3	REG Opportunistic	REG Open spinifex	REG Mulga woodland	REG Eucalypt over spinifex	REG Shrubs over spinifex	REG Mulga thicket 2	REG Turkeys	REG Mulga thicket 1	REG Dogbolter				
	<i>Aphelocephala leucopsis</i>	Southern Whiteface																								3			2	1	2	2			
Meliphagidae	<i>Lichenostomus virescens</i>	Singing Honeyeater																							1	2	3	5	1	2	2	2	1		
	<i>Manorina flavigula</i>	Yellow-throated Miner																							3	12	5	5	8	7	3	7			
Pomatostomidae	<i>Pomatostomus superciliosus</i>	White-browed Babbler																							3					2					
Psophodidae	<i>Cinclosoma castaneothorax</i>	Chestnut-breasted Quail-thrush																											1		1				
Campephagidae	<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike																								2		3		2					
Pachycephalidae	<i>Pachycephala rufiventris</i>	Rufous Whistler																									4	3		3		3	2		
	<i>Pachycephala rufiventris</i>	Rufous Whistler																																	
	<i>Colluricincla harmonica</i>	Grey Shrike-thrush																											1	1					
	<i>Oreoica gutturalis</i>	Crested Bellbird																									3	3	5	4	1	1	1	3	
Artamidae	<i>Artamus cinereus</i>	Black-faced Woodswallow																							3										
	<i>Cracticus torquatus</i>	Grey Butcherbird																								3	3	1	2	2	2		2		
	<i>Cracticus nigrogularis</i>	Pied Butcherbird																								2	4	2	2	4	1		1	2	
	<i>Cracticus tibicen</i>	Australian Magpie																								2	3	2							
	<i>Strepera versicolor</i>	Grey Currawong																											1	2					
Rhipiduridae	<i>Rhipidura albiscapa</i>	Grey Fantail																															1		
	<i>Rhipidura leucophrys</i>	Willie Wagtail																									3		4						

Family	Species	Common Name	Survey																														
			A																														
			REG Open spinifex 1	REG Open spinifex 2	REG Open spinifex 3	REG Open spinifex 4	REG Shrubs over spinifex 1	REG Shrubs over spinifex 2	REG Shrubs over spinifex 3	REG Shrubs over spinifex 4	REG Dogbolter 2	REG Mulga woodland 1	REG Mulga woodland 4	REG Eucalypt over spinifex 2	REG Eucalypt over spinifex 4	REG Eucalypt over spinifex 1	REG Dogbolter 1	REG Dogbolter 3	REG Dogbolter 4	REG Eucalypt over spinifex 3	REG Mulga woodland 2	REG Mulga woodland 3	REG Opportunistic	REG Open spinifex	REG Mulga woodland	REG Eucalypt over spinifex	REG Shrubs over spinifex	REG Mulga thicket 2	REG Turkeys	REG Mulga thicket 1	REG Dogbolter		
	<i>Notomys alexis</i>	Spinifex Hopping Mouse		1			1		4					1																			
	<i>Pseudomys desertor</i>	Desert Mouse	1				1	3		1								1	1	1													
	<i>Pseudomys hermannsburgensis</i>	Sandy Inland Mouse	1		2						1				2							2											

A Coffey Environments (2008) *Level 2 Fauna Assessment for the Duketon Gold Project*. Unpublished report for Regis Resources, Perth.

Family	Species	Common Name	Surveys															Opportunistic Birds								
			A							B																
			Site 1	Site 2	Site 7	Site 5	Site 6	Site 3	Site 4	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11	Site 12	Site 13	Site 14	Site 15		
Reptiles																										
Agamidae	<i>Ctenophorus reticulatus</i>	Western Netted Dragon	1																							
	<i>Diporiphora amphiboluroides</i>	Mulga Dragon									1	2				1	1						1	1		
	<i>Pogona minor</i>	Dwarf Bearded Dragon		1																1						
	<i>Tympanocryptis cephalus</i>	Pebble Dragon								2		2	1													
Boidae	<i>Antaresia stimsoni</i>	Stimson's Python			1																					
Carphodactylidae	<i>Underwoodisaurus milii</i>	Barking Gecko		1											1											
Diplodactylidae	<i>Diplodactylus pulcher</i>	Fine-faced Gecko				1				1	1	3				5	3	2	3	7	4	6	3	3		
	<i>Strophurus assimilis</i>	Goldfields Spiny-tailed Gecko	1																							
	<i>Strophurus wellingtonae</i>	Western Shield Spiny-tailed Gecko								1	2	3	1				3	4	5	1		2	4	1		
Elapidae	<i>Parasuta monachus</i>	Monk Snake																		1						
Gekkonidae	<i>Heteronotia binoei</i>	Bynoe's Prickly Gecko	1			1				1		1	7	1	1	1	3	7			7	1	1			
Pygopodidae	<i>Pygopus nigriceps</i>	Western Hooded Scaly-foot								1																
Scincidae	<i>Cryptoblepharus buchanani</i>	Buchanan's Snake-eyed Skink	1																							
	<i>Cryptoblepharus plagiocephalus</i>	Peron's Snake-eyed Skink																3				3				
	<i>Ctenotus schomburgkii</i>	Schomburgk's Ctenotus									1															
	<i>Ctenotus uber</i>	Spotted Ctenotus				1				3	1	8	4		2					1		1	2	2		
	<i>Egernia depressa</i>	Pygmy Spiny-tailed Skink			1		1	1	1			1					1				1	1		3		
	<i>Egernia formosa</i>	Goldfields Crevice-skink			1					1	1	1					2	2	4				1			

Family	Species	Common Name	Surveys															Opportunistic Birds								
			A							B																
			Site 1	Site 2	Site 7	Site 5	Site 6	Site 3	Site 4	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11	Site 12	Site 13	Site 14	Site 15		
	<i>Eremiascincus richardsonii</i>	Broad-banded Sand Swimmer	1	1							2				1								1			
	<i>Lerista desertorum</i>	Central Desert Robust Slider		1											1		6	2	5		1	2				
	<i>Lerista muelleri</i>	Wood Mulch-slider								2					5				1	1		5	4			
	<i>Lerista sp.</i>					1	1		1																	
	<i>Liopholis striata</i>	Nocturnal Desert Skink					1																			
	<i>Menetia greyii</i>	Common Dwarf Skink	1	1		1									1								1			
	<i>Morethia butleri</i>	Woodland Morethia Skink								1							2	2		2	1	1	1	1		
Typhlopidae	<i>Anilius australis</i>	Austral Blind Snake																						1		
Varanidae	<i>Varanus caudolineatus</i>	Stripe-tailed Monitor		1						4	3		3				2		1	1			1			
	<i>Varanus panoptes</i>	Yellow-spotted Monitor												1		1							1			
	<i>Varanus panoptes rubidus</i>	Yellow-spotted Monitor	1	1	1	1	1	1	1																	
Cheluidae	<i>Chelodina steindachneri</i>	Steindachner's Turtle	1																							
Birds																										
Casuariidae	<i>Dromaius novaehollandiae</i>	Emu	1	1	1	1	1	1	1																1	
Columbidae	<i>Phaps chalcoptera</i>	Common Bronzewing	1	1		1	1		1																1	3
Columbidae	<i>Ocyphaps lophotes</i>	Crested Pigeon	1	1	1	1	1	1																	1	14
Caprimulgidae	<i>Eurostopodus argus</i>	Spotted Nightjar																								1
Aegothelidae	<i>Aegotheles cristatus</i>	Australian Owlet-nightjar						1																		
Otididae	<i>Ardeotis australis</i>	Australian Bustard		1																						
Accipitridae	<i>Accipiter fasciatus</i>	Brown Goshawk	1																							
	<i>Aquila audax</i>	Wedge-tailed Eagle					1																			

Family	Species	Common Name	Surveys																							
			A								B															
			Site 1	Site 2	Site 7	Site 5	Site 6	Site 3	Site 4	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11	Site 12	Site 13	Site 14	Site 15	Opportunistic	Birds
	<i>Hieraaetus morphnoides</i>	Little Eagle		1																						
Falconidae	<i>Falco cenchroides</i>	Nankeen Kestrel		1	1	1		1	1																	1
	<i>Falco berigora</i>	Brown Falcon	1	1			1																			
Charadriidae	<i>Elseyornis melanops</i>	Black-fronted Dotterel	1																							
Charadriidae	<i>Vanellus tricolor</i>	Banded Lapwing					1																			
Turnicidae	<i>Turnix velox</i>	Little Button-quail							1																	
Cacatuidae	<i>Eolophus roseicapillus</i>	Galah	1	1	1	1	1	1																	1	1
Psittacidae	<i>Barnardius zonarius</i>	Australian Ringneck	1			1	1	1																		12
	<i>Psephotus varius</i>	Mulga Parrot	1			1	1																		1	3
	<i>Melopsittacus undulatus</i>	Budgerigar	1	1		1	1	1	1																	
	<i>Neopsephotus bourkii</i>	Bourke's Parrot				1	1																			
Cuculidae	<i>Chalcites basalis</i>	Horsfield's Bronze-cuckoo	1	1			1		1																	
	<i>Chalcites osculans</i>	Black-eared Cuckoo		1			1																			
	<i>Cacomantis pallidus</i>	Pallid Cuckoo	1					1	1																	
Halcyonidae	<i>Todiramphus pyrrhopygius</i>	Red-backed Kingfisher		1				1	1																	
Meropidae	<i>Merops ornatus</i>	Rainbow Bee-eater	1					1																		
Climacteridae	<i>Climacteris affinis</i>	White-browed Treecreeper				1	1	1	1																1	1
Ptilonorhynchidae	<i>Ptilonorhynchus maculatus</i>	Spotted Bowerbird	1					1																		
	<i>Ptilonorhynchus guttatus</i>	Western Bowerbird																							1	3
Maluridae	<i>Malurus splendens</i>	Splendid Fairy-wren	1	1			1																			19
	<i>Malurus leucopterus</i>	White-winged Fairy-wren		1				1																		3

Family	Species	Common Name	Surveys															Opportunistic	Birds								
			A							B																	
			Site 1	Site 2	Site 7	Site 5	Site 6	Site 3	Site 4	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11	Site 12	Site 13	Site 14	Site 15			
	<i>Malurus lamberti</i>	Variagated Fairy-wren	1	1			1																				
Acanthizidae	<i>Pyrrholaemus brunneus</i>	Redthroat		1																							
	<i>Smicromnis brevirostris</i>	Weebill		1																							3
	<i>Gerygone fusca</i>	Western Gerygone	1	1																							
	<i>Acanthiza robustirostris</i>	Slaty-backed Thornbill	1		1	1	1	1	1																		34
	<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill	1		1	1	1	1	1																		1
	<i>Acanthiza uropygialis</i>	Chestnut-rumped Thornbill	1		1	1	1	1	1																		8
	<i>Acanthiza apicalis</i>	Inland Thornbill	1	1	1			1	1																		30
	<i>Aphelocephala leucopsis</i>	Southern Whiteface	1	1	1	1	1	1																			7
Meliphagidae	<i>Certhionyx variegatus</i>	Pied Honeyeater	1	1		1			1																		
	<i>Lichenostomus virescens</i>	Singing Honeyeater	1	1	1	1	1	1	1																		24
	<i>Purnella albifrons</i>	White-fronted Honeyeater	1	1					1																		
	<i>Manorina flavigula</i>	Yellow-throated Miner	1	1	1	1	1	1	1																	1	10
	<i>Acanthagenys rufogularis</i>	Spiny-cheeked Honeyeater	1	1		1	1	1	1																		13
	<i>Epthianura tricolor</i>	Crimson Chat		1		1	1	1	1																		
	<i>Sugomel niger</i>	Black Honeyeater							1																		
	<i>Lichmera indistincta</i>	Brown Honeyeater		1																							
Pomatostomidae	<i>Pomatostomus superciliosus</i>	White-browed Babbler	1				1																			1	8
Psophodidae	<i>Cinclosoma castaneothorax</i>	Chestnut-breasted Quail-thrush				1	1	1	1																		
Neosittidae	<i>Daphoenositta chrysoptera</i>	Varied Sittella			1																						

Family	Species	Common Name	Surveys															Opportunistic Birds							
			A							B															
			Site 1	Site 2	Site 7	Site 5	Site 6	Site 3	Site 4	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11	Site 12	Site 13	Site 14	Site 15	
Campephagidae	<i>Coracina maxima</i>	Ground Cuckoo-shrike	1	1				1																	
	<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike	1	1		1		1	1																2
	<i>Lalage sueurii</i>	White-winged Triller		1			1																		
Pachycephalidae	<i>Pachycephala rufiventris</i>	Rufous Whistler	1	1	1	1	1	1	1																22
	<i>Colluricincla harmonica</i>	Grey Shrike-thrush	1	1	1	1	1	1	1																13
	<i>Oreoica gutturalis</i>	Crested Bellbird	1	1	1	1	1	1	1																40
Artamidae	<i>Artamus cinereus</i>	Black-faced Woodswallow	1	1		1		1	1																2 3
	<i>Cracticus torquatus</i>	Grey Butcherbird	1	1	1	1	1	1	1																
	<i>Cracticus nigrogularis</i>	Pied Butcherbird	1	1	1	1	1	1	1																1 2
	<i>Cracticus tibicen</i>	Australian Magpie	1		1		1																		
	<i>Strepera versicolor</i>	Grey Currawong	1																						
Rhipiduridae	<i>Rhipidura leucophrys</i>	Willie Wagtail	1	1			1		1																
Corvidae	<i>Corvus bennetti</i>	Little Crow			1	1	1		1																14
	<i>Corvus orru</i>	Torresian Crow	1	1	1		1	1	1																1
Monarchidae	<i>Grallina cyanoleuca</i>	Magpie-lark	1	1																					1
Petroicidae	<i>Petroica goodenovii</i>	Red-capped Robin	1	1	1	1	1	1	1																14
	<i>Melanodryas cucullata</i>	Hooded Robin	1	1	1		1	1	1																3
Megaluridae	<i>Cincloramphus mathewsi</i>	Rufous Songlark		1				1																	
Hirundinidae	<i>Hirundo neoxena</i>	Welcome Swallow	1				1	1	1																
	<i>Petrochelidon ariel</i>	Fairy Martin							1																
	<i>Hirundo nigricans</i>	Tree Martin						1	1																

Family	Species	Common Name	Surveys															Opportunistic Birds									
			A							B																	
			Site 1	Site 2	Site 7	Site 5	Site 6	Site 3	Site 4	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11	Site 12	Site 13	Site 14	Site 15			
Estrildidae	<i>Taeniopygia guttata</i>	Zebra Finch	1	1	1	1		1	1																		
Motacillidae	<i>Anthus novaeseelandiae</i>	Australasian Pipit		1				1																		1	
Mammals																											
Bovidae	<i>Bos taurus</i>	Cow	1	1	1	1	1	1	1																		
	<i>Capra hircus</i>	Goat	1	1																							
Canidae	<i>Canis lupus</i>	Dingo	1																								
	<i>Vulpes vulpes</i>	Red Fox	1																								
Felidae	<i>Felis catus</i>	House Cat	1	1																							
Vespertilionidae	<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat																									4
Dasyuridae	<i>Sminthopsis crassicaudata</i>	Fat-tailed Dunnart		1																							
	<i>Sminthopsis dolichura</i>	Little Long-tailed Dunnart								1	5		1	4	4	2		1		1	1	1	3	2			
	<i>Sminthopsis macroura</i>	Stripe-faced Dunnart				1				1	1			1	3	1	1										
Macropodidae	<i>Osphranter robustus</i>	Euro			1																						
	<i>Osphranter rufus</i>	Red Kangaroo	1	1				1																			
Leporidae	<i>Oryctolagus cuniculus</i>	European Rabbit	1			1																					
Tachyglossidae	<i>Tachyglossus aculeatus</i>	Short-beaked Echidna			1																						
Equidae	<i>Equus caballus</i>	Domestic Horse		1				1																			
Muridae	<i>Mus musculus</i>	House Mouse	1	1		1		1	1																		

A Halpern Glick Maunsell (1999) *Rosemont Gold Project Biological Assessment Survey - Phases 1 & 2*. Unpublished report for Johnson's Well Mining NL. Perth.

B Terrestrial Ecosystems (2010) *Level 2 Fauna Risk Assessment for the Garden Well Project Area*. Unpublished report for Regis Resources, Perth.

Family	Species	Common Name	Survey									
			A									
			TM1	JS2	WM2	WS2	WM1	WS1	JS3	JS1	JS4	HB1
Frogs												
Limnodynastidae	<i>Neobatrachus sutor</i>	Shoemaker Frog										
	<i>Neobatrachus wilsmorei</i>	Goldfields Bullfrog	3	1								
	<i>Platyplectrum spenceri</i>	Spencer's Burrowing Frog										
Myobatrachidae	<i>Pseudophryne occidentalis</i>	Orange-crowned Toadlet										
Reptiles												
Agamidae	<i>Ctenophorus caudicinctus</i>	Ring-tailed Dragon										
	<i>Ctenophorus fordi</i>	Mallee Dragon										
	<i>Ctenophorus inermis</i>	Military Dragon			1							
	<i>Ctenophorus maculatus</i>	Spotted Dragon				2						
	<i>Ctenophorus reticulatus</i>	Western Netted Dragon					1					
	<i>Ctenophorus salinarum</i>	Saltpan Dragon				2		1				
	<i>Ctenophorus vadrappa</i>	Red-barred Dragon										
	<i>Moloch horridus</i>	Thorny Devil										
	<i>Pogona minor</i>	Dwarf Bearded Dragon	1		2				2	1	1	
	<i>Tympanocryptis cephalus</i>	Pebble Dragon										
Carphodactylidae	<i>Nephrurus vertebralis</i>	Midline Knob-tail					1		1			
	<i>Underwoodisaurus milii</i>	Barking Gecko										
Diplodactylidae	<i>Diplodactylus granariensis</i>	Wheat-belt Stone Gecko										
	<i>Diplodactylus pulcher</i>	Fine-faced Gecko										
	<i>Lucasium maini</i>	Main's Ground Gecko										
	<i>Lucasium squarrosum</i>	Mottled Ground Gecko	2	1	5	2	1					2

Family	Species	Common Name	Survey									
			A									
			TM1	JS2	WM2	WS2	WM1	WS1	JS3	JS1	JS4	HB1
	<i>Strophurus assimilis</i>	Goldfields Spiny-tailed Gecko										
	<i>Strophurus ciliaris</i>	Spiny-tailed Gecko										
	<i>Strophurus elderi</i>	Jewelled Gecko		1					1	2		
	<i>Strophurus strophurus</i>	Western Spiny-tailed Gecko										
	<i>Strophurus wellingtonae</i>	Western Shield Spiny-tailed Gecko										
Elapidae	<i>Brachyuropsis fasciolata</i>	Narrow-banded Burrowing Snake										
	<i>Parasuta monachus</i>	Monk Snake										
	<i>Simoselaps bertholdi</i>	Jan's Banded Snake	1									
	<i>Suta fasciata</i>	Rosen's Snake										
Gekkonidae	<i>Gehyra variegata</i>	Tree Dtella										
	<i>Gehyra xenopus</i>	Crocodile-faced Dtella		1			1			1	1	
	<i>Heteronotia binoei</i>	Bynoe's Prickly Gecko	1				2				2	3
	<i>Rhynchoedura ornata</i>	Western Beaked Gecko										
Pygopodidae	<i>Delma nasuta</i>	Sharp-snouted Delma									1	
	<i>Pygopus nigriceps</i>	Western Hooded Scaly-foot									1	
Scincidae	<i>Cryptoblepharus buchanani</i>	Buchanan's Snake-eyed Skink										
	<i>Ctenotus calurus</i>	Blue-tailed Finesnout Ctenotus										
	<i>Ctenotus greeri</i>	Spotted-necked Ctenotus										
	<i>Ctenotus helenae</i>	Clay-soil Ctenotus		2					2	1		
	<i>Ctenotus leonhardii</i>	Leonhardi's Ctenotus	6	3	3	6	7				2	4
	<i>Ctenotus pantherinus</i>	Leopard Skink										
	<i>Ctenotus quattuordecimlineatus</i>	Fourteen-lined Ctenotus										

Family	Species	Common Name	Survey									
			A									
			TM1	JS2	WM2	WS2	WM1	WS1	JS3	JS1	JS4	HB1
	<i>Ctenotus schomburgkii</i>	Schomburgk's Ctenotus										
	<i>Ctenotus severus</i>	Stern Ctenotus										
	<i>Ctenotus uber</i>	Spotted Ctenotus										
	<i>Egernia depressa</i>	Pygmy Spiny-tailed Skink										
	<i>Egernia formosa</i>	Goldfields Crevice-skink										
	<i>Eremiascincus richardsonii</i>	Broad-banded Sand Swimmer										
	<i>Lerista desertorum</i>	Central Desert Robust Slider	4	1	1				1	2	1	
	<i>Lerista kingi</i>	King's Slider					1					
	<i>Lerista macropisthopus</i>	Unpatterned Robust Slider										
	<i>Lerista muelleri</i>	Wood Mulch-slider										
	<i>Lerista picturata</i>	Southern Robust Slider										
	<i>Lerista sp.</i>											
	<i>Liopholis inornata</i>	Desert Skink										
	<i>Liopholis striata</i>	Nocturnal Desert Skink										
	<i>Menetia greyii</i>	Common Dwarf Skink				1	1					
	<i>Morethia butleri</i>	Woodland Morethia Skink										
Typhlopidae	<i>Anilius hamatus</i>	Pale-headed Blind Snake					1				1	
	<i>Anilius waitii</i>	Waite's Blind Snake										
Varanidae	<i>Varanus caudolineatus</i>	Stripe-tailed Monitor			1							
	<i>Varanus giganteus</i>	Perentie										
	<i>Varanus gouldii</i>	Gould's Goanna					1		1			
	<i>Varanus panoptes</i>	Yellow-spotted Monitor										
	<i>Varanus tristis</i>	Black-headed Monitor										

Family	Species	Common Name	Survey										
			A										
			TM1	JS2	WM2	WS2	WM1	WS1	JS3	JS1	JS4	HB1	
Birds													
Casuariidae	<i>Dromaius novaehollandiae</i>	Emu											
Phasianidae	<i>Coturnix pectoralis</i>	Stubble Quail											
Columbidae	<i>Phaps chalcoptera</i>	Common Bronzewing											
	<i>Ocyphaps lophotes</i>	Crested Pigeon											
	<i>Geopelia cuneata</i>	Diamond Dove											
Podargidae	<i>Podargus strigoides</i>	Tawny Frogmouth											
Caprimulgidae	<i>Eurostopodus argus</i>	Spotted Nightjar											
Aegothelidae	<i>Aegotheles cristatus</i>	Australian Owlet-nightjar											
Otididae	<i>Ardeotis australis</i>	Australian Bustard											
Accipitridae	<i>Accipiter fasciatus</i>	Brown Goshawk											
	<i>Circus assimilis</i>	Spotted Harrier											
	<i>Aquila audax</i>	Wedge-tailed Eagle											
	<i>Hieraaetus morphnoides</i>	Little Eagle											
Falconidae	<i>Falco cenchroides</i>	Nankeen Kestrel											
	<i>Falco berigora</i>	Brown Falcon											
	<i>Falco longipennis</i>	Australian Hobby											
Charadriidae	<i>Vanellus tricolor</i>	Banded Lapwing											
Turnicidae	<i>Turnix velox</i>	Little Button-quail											
Cacatuidae	<i>Eolophus roseicapillus</i>	Galah											
	<i>Nymphicus hollandicus</i>	Cockatiel											
Psittacidae	<i>Barnardius zonarius</i>	Australian Ringneck											
	<i>Psephotus varius</i>	Mulga Parrot											

Family	Species	Common Name	Survey										
			A										
			TM1	JS2	WM2	WS2	WM1	WS1	JS3	JS1	JS4	HB1	
	<i>Melopsittacus undulatus</i>	Budgerigar											
	<i>Neopsephotus bourkii</i>	Bourke's Parrot											
Cuculidae	<i>Chalcites basalis</i>	Horsfield's Bronze-cuckoo											
	<i>Chalcites osculans</i>	Black-eared Cuckoo											
	<i>Cacomantis pallidus</i>	Pallid Cuckoo											
Halcyonidae	<i>Todiramphus pyrrhopygius</i>	Red-backed Kingfisher											
Meropidae	<i>Merops ornatus</i>	Rainbow Bee-eater											
Climacteridae	<i>Climacteris affinis</i>	White-browed Treecreeper											
Maluridae	<i>Malurus leucopterus</i>	White-winged Fairy-wren											
Acanthizidae	<i>Pyrrholaemus brunneus</i>	Redthroat											
	<i>Smicromnis brevirostris</i>	Weebill											
	<i>Acanthiza robustirostris</i>	Slaty-backed Thornbill											
	<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill											
	<i>Acanthiza uropygialis</i>	Chestnut-rumped Thornbill											
	<i>Acanthiza apicalis</i>	Inland Thornbill											
	<i>Aphelocephala leucopsis</i>	Southern Whiteface											
Pardalotidae	<i>Pardalotus striatus</i>	Striated Pardalote											
Meliphagidae	<i>Certhionyx variegatus</i>	Pied Honeyeater											
	<i>Lichenostomus virescens</i>	Singing Honeyeater											
	<i>Lichenostomus plumulus</i>	Grey-fronted Honeyeater											
	<i>Purnella albifrons</i>	White-fronted Honeyeater											
	<i>Manorina flavigula</i>	Yellow-throated Miner											
	<i>Acanthagenys rufogularis</i>	Spiny-cheeked Honeyeater											

Family	Species	Common Name	Survey										
			A										
			TM1	JS2	WM2	WS2	WM1	WS1	JS3	JS1	JS4	HB1	
	<i>Anthochaera carunculata</i>	Red Wattlebird											
	<i>Conopophila whitei</i>	Grey Honeyeater											
	<i>Epthianura tricolor</i>	Crimson Chat											
	<i>Epthianura aurifrons</i>	Orange Chat											
Pomatostomidae	<i>Pomatostomus temporalis</i>	Grey-crowned Babbler											
	<i>Pomatostomus superciliosus</i>	White-browed Babbler											
Psophodidae	<i>Cinclosoma castaneothorax</i>	Chestnut-breasted Quail-thrush											
Neosittidae	<i>Daphoenositta chrysoptera</i>	Varied Sittella											
Campephagidae	<i>Coracina maxima</i>	Ground Cuckoo-shrike											
	<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike											
	<i>Lalage sueurii</i>	White-winged Triller											
Pachycephalidae	<i>Pachycephala rufiventris</i>	Rufous Whistler											
	<i>Colluricincla harmonica</i>	Grey Shrike-thrush											
	<i>Oreoica gutturalis</i>	Crested Bellbird											
Artamidae	<i>Artamus personatus</i>	Masked Woodswallow											
	<i>Artamus superciliosus</i>	White-browed Woodswallow											
	<i>Artamus cinereus</i>	Black-faced Woodswallow											
	<i>Cracticus torquatus</i>	Grey Butcherbird											
	<i>Cracticus nigrogularis</i>	Pied Butcherbird											
	<i>Cracticus tibicen</i>	Australian Magpie											
	<i>Strepera versicolor</i>	Grey Currawong											
Rhipiduridae	<i>Rhipidura leucophrys</i>	Willie Wagtail											
Corvidae	<i>Corvus bennetti</i>	Little Crow											

Family	Species	Common Name	Survey										
			A										
			TM1	JS2	WM2	WS2	WM1	WS1	JS3	JS1	JS4	HB1	
	<i>Corvus orru</i>	Torresian Crow											
Monarchidae	<i>Grallina cyanoleuca</i>	Magpie-lark											
Petroicidae	<i>Microeca fascinans</i>	Jacky Winter											
	<i>Petroica goodenovii</i>	Red-capped Robin											
	<i>Melanodryas cucullata</i>	Hooded Robin											
Megaluridae	<i>Cincloramphus mathewsi</i>	Rufous Songlark											
	<i>Cincloramphus cruralis</i>	Brown Songlark											
Hirundinidae	<i>Cheramoeca leucosterna</i>	White-backed Swallow											
	<i>Petrochelidon ariel</i>	Fairy Martin											
Nectariniidae	<i>Dicaeum hirundinaceum</i>	Mistletoebird											
Estrildidae	<i>Taeniopygia guttata</i>	Zebra Finch											
Motacillidae	<i>Anthus novaeseelandiae</i>	Australasian Pipit											
Mammals													
Bovidae	<i>Capra hircus</i>	Goat											
	<i>Ovis aries</i>	Sheep											
Camelidae	<i>Camelus dromedarius</i>	Dromedary											
	<i>Canis familiaris</i>	Dog											
	<i>Vulpes vulpes</i>	Red Fox											
Felidae	<i>Felis catus</i>	House Cat											
Molossidae	<i>Austronomus australis</i>	White-striped Free-tail Bat											
	<i>Ozimops planiceps</i>	Southern Free-tail Bat											
Vespertilionidae	<i>Chalinolobus gouldii</i>	Gould's Wattled Bat											
	<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat											

Family	Species	Common Name	Survey									
			A									
			TM1	JS2	WM2	WS2	WM1	WS1	JS3	JS1	JS4	HB1
	<i>Scotorepens balstoni</i>	Inland Broad-nosed Bat										
Dasyuridae	<i>Ningai ridei</i>	Wongai Ningai							1			
	<i>Sminthopsis crassicaudata</i>	Fat-tailed Dunnart										
	<i>Sminthopsis dolichura</i>	Little Long-tailed Dunnart										
	<i>Sminthopsis macroura</i>	Stripe-faced Dunnart										
Macropodidae	<i>Macropus fuliginosus</i>	Western Grey Kangaroo										
	<i>Osphranter robustus</i>	Euro										
	<i>Osphranter rufus</i>	Red Kangaroo										
Leporidae	<i>Oryctolagus cuniculus</i>	European Rabbit										
Tachyglossidae	<i>Tachyglossus aculeatus</i>	Short-beaked Echidna										
Muridae	<i>Mus musculus</i>	House Mouse										
	<i>Notomys alexis</i>	Spinifex Hopping Mouse							1			
	<i>Notomys mitchellii</i>	Mitchell's Hopping Mouse										
	<i>Pseudomys bolami</i>	Bolam's Mouse										
	<i>Pseudomys hermannsburgensis</i>	Sandy Inland Mouse										

A Dunlop, J.N. and Payne, W. (1999) *A vertebrate fauna survey of the North Lake Carey region*, Unpublished report for Placer (Granny Smith) and Homestake.

Appendix C.

Definitions of Significant Fauna under the *WA Biodiversity Conservation Act 2016* and Priority Species

**Desktop Vertebrate Fauna Assessment
Expansion of the Solar Power Farm Project Area**



C.1 DEFINITIONS OF SIGNIFICANT FAUNA UNDER THE WA BIODIVERSITY CONSERVATION ACT 2016

Threatened Extinct and Specially Protected fauna or flora¹ are species² which have been adequately searched for and are deemed to be, in the wild, threatened, extinct or in need of special protection, and have been gazetted as such. The *Wildlife Conservation (Specially Protected Fauna) Notice 2018* and the *Wildlife Conservation (Rare Flora) Notice 2018* have been transitioned under regulations 170, 171 and 172 of the *Biodiversity Conservation Regulations 2018* to be the lists of Threatened, Extinct and Specially Protected species under Part 2 of the *Biodiversity Conservation Act 2016*. Categories of Threatened, Extinct and Specially Protected fauna and flora are:

T Threatened Species

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.

CR Critically endangered species

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.

¹ The definition of flora includes algae, fungi and lichens

² Species includes all taxa (plural of taxon - a classificatory group of any taxonomic rank, e.g. a family, genus, species or any infraspecific category i.e. subspecies or variety, or a distinct population).

EN Endangered species

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.

VU Vulnerable species

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.

EX Extinct species

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.

EW Extinct in the wild species

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.

MI Migratory birds protected under an international agreement

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*.

CD Species of special conservation interest (conservation dependant fauna)

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*.

OS Other specially protected species

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*.

P Priority species

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

P1 Priority 1: Poorly-known species

Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.

P2 Priority 2: Poorly-known species

Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.

P3 Priority 3: Poorly-known species

Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.

P4 Priority 4: Rare, Near Threatened and other species in need of monitoring

(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands.

(b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as Conservation Dependent.

(c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.



DESIGN WITH COMMUNITY IN MIND

Communities are fundamental. Whether around the corner or across the globe, they provide a foundation, a sense of place and of belonging. That's why at Stantec, we always design with community in mind.

We care about the communities we serve—because they're our communities too. This allows us to assess what's needed and connect our expertise, to appreciate nuances and envision what's never been considered, to bring together diverse perspectives so we can collaborate toward a shared success.

We're designers, engineers, scientists, and project managers, innovating together at the intersection of community, creativity, and client relationships. Balancing these priorities results in projects that advance the quality of life in communities across the globe.

Stantec trades on the TSX and the NYSE under the symbol STN.
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