

BHP

Amendment Application for CPS 9178/2 Jimblebar West Solar Project NVCP

**Native Vegetation Clearing Permit Amendment
Application Supporting Document**

March 2023



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1 INTRODUCTION

BHP Iron Ore Pty Ltd (BHP) currently operates a number of Iron Ore mines and associated rail and port infrastructure within the Pilbara region of Western Australia (WA). Current mining operations include the:

- Newman Operations consisting of:
 - The Mount Whaleback hub (including Orebodies 29, 30 and 35) located approximately two kilometres (km) west of Newman Township; and
 - The Eastern Ridge hub (Consisting of Orebodies 23, 24, 25 25 West and 32) located approximately 5 km east of Newman Township;
- Mining Area C located approximately 90 km north west of Newman Township;
- Orebodies 18 and Wheelarra Hill (Jimblebar) Mine located approximately 35 km east of Newman Township; and
- Yandi Mine located approximately 100 km north west of Newman Township.

Ore from the above mining operations is transported to Port Hedland via the BHP Newman to Port Hedland Mainline (and associated spur lines) and is then shipped out through Port Hedland at the BHP facilities at Nelson Point and Finucane Island.

BHP currently holds Native Vegetation Clearing Permit (NVCP) CPS 9178/12 for the construction of solar array to the west of the existing Jimblebar Mining Operations (**Figure 1**). The solar array will be approximately 50 MW and is part of the company's commitment to a 30% emission reduction by 2030, and net zero emissions by 2050. As designs have progressed BHP has identified that up to an additional 20 hectares (ha) of disturbance will be required to enable construction of the solar array and the associated infrastructure. This is predominately due to supply issues resulting in the installation of slightly larger panels.

In accordance with Part V Division 2 of the *Environmental Protection Act, 1986* (EP Act), BHP hereby refers the application to amend NVCP CPS 9178/2 by increasing the disturbance allocation to 130 ha to the Department of Mines, Industry Regulation and Safety (DMIRS).

This supporting document describes the proposal to clear up to 130 ha of native vegetation within a 429.55 ha Amendment Application Area for the purposes of a solar array, geotechnical investigations, and associated activities;

The proponent for this NVCP amendment application is "BHP Iron Ore Pty Ltd". The following information is provided in this document to support this NVCP amendment application:

- a description of the works to be carried out;
- other associated approvals required;
- information on vegetation, flora and fauna;
- an assessment against the ten clearing principles; and
- management strategies for indigenous heritage.

1.1 LOCATION

The Amendment Application Area is located west of the Jimblebar Mining Operations Hub and approximately 27 km east of the Town of Newman (**Figure 1**).

1.2 TENURE

The Amendment Application Area is located on Mining Lease M266S and Miscellaneous Licence 52/109.

1.3 LOCAL GOVERNMENT JURISDICTION

The Amendment Application Area is located within the Shire of East Pilbara.

1.4 PROPONENT

The Amendment Application Area is managed and operated by BHP on behalf of the owners of:

- Mining Lease M266SA: BHP Iron Ore (Jimblebar) Pty Ltd; and

The key contact for this proposal is:

Mr Chris Hopkins
Principal Environmental Approvals
BHP
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PERTH WA 6000
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1.5 PROJECT DESCRIPTION

The proposed works will involve the construction and maintenance of a solar array, geotechnical investigations and any associated activities.

1.6 PROJECT CHARACTERISTICS AND COMMITMENTS

BHP commits to undertake the Project in accordance with the details set out in **Table 1**.

Table 1: Project Characteristics and Commitments

Permit Characteristics		
Authorising Agency:	DMIRS.	
Permit Title:	Jimblebar West Solar Project NVCP	
Permit Number	CPS 9178/1	
Area to be cleared:	10 hectares.	
Amendment Application Area:	429.55 hectares.	
Purpose of the permit:	Clearing for the purpose of a solar array, geotechnical investigations, and associated activities.	
Tenure:	Mining Lease M266SA. Miscellaneous Licence 52/109	
Clearing Duration:	Until 30 November 2030	
Permit Duration:	Until 30 November 2037	
Proposed Annual Reporting Date:	01 October for the previous Financial Year	
Proposed Final Reporting Date:	30 November 2037	
Application Boundary:	Map Reference: <ul style="list-style-type: none"> • Figure 1: PWR_005NVCP_001_RevA_0 • Figure 2: PWR_005NVCP_002_RevA_0 • Figure 3: PWR_005NVCP_003_RevA_0 BHP Shapefile 1 Doc Reference:	
Application Commitments		Section
Control of established weed populations will be carried out according to BHP's standard Weed Control and Management Procedures.		3.4.3 6.7.4
In the event that active Mulgara burrows are identified they will be avoided where practicable.		3.4.4 6.2
In the event that active mounds of the Western Pebble-mound Mouse will be avoided using a 10 m buffer, where practicable.		3.4.4 6.2
The Project Environmental Aboriginal Heritage Review Procedure will be used to manage any potential environmental impacts of the proposal.		4

1.7 NVCP RECORDS

BHP reports on each NVCP in accordance with the permit reporting conditions. For a majority of NVCP's this is incorporated into BHP Iron Ore's Annual Environmental Report which is submitted to government prior to the 01 October each year.

Clearing for geotechnical investigations commenced on 29 October 2021 with a total of 4.90 ha cleared to 30 June 2023 (BHP, 2022). No rehabilitation has been undertaken as the locations cleared are still required for the purpose for which they were cleared.

Clearing has been minimised by restricting track widths and drill pad size to the minimal width required for safety and equipment access. BHP's PEHR process has been used to ensure that known populations of priority flora have been avoided.

No significant fauna have been recorded in the NVCP area therefore no specific actions beyond minimisation of clearing have been taken with respect to fauna management.

No environmental offsets are required for this NVCP.

2 ASSOCIATED APPROVALS

Any other additional approvals will be sought as required.

3 EXISTING ENVIRONMENT

3.1 CLIMATE

Newman Aero meteorological site (007176) is the closest Bureau of Meteorology (BoM) station to the Amendment Application Area. Average annual rainfall at Newman Aero is 323.8 mm (BOM, 2023a). This is mainly derived from tropical storms and cyclones during summer, producing sporadic, heavy rains over the area. Mean monthly rainfall varies from 4.7 mm in September to 72.3 mm in February (BoM, 2023a). Daily rainfall is highly variable; the highest maximum daily rainfall ranges from 34.8 mm in October, to 305.6 mm in February (BoM, 2023a). The mean maximum temperature in summer months (October to March) is 35.1°C to 39.3°C, and mean maximum temperature in winter (April to September) is between 23.1°C and 32.2°C (BoM, 2023a).

Wittenoom meteorological site (005026) is the closest station to the Amendment Application Area that records daily evaporation. Wittenoom is located approximately 200 km north west of the Amendment Application Area. Mean daily evaporation at Wittenoom throughout the year is 8.6 mm/day (BoM, 2023b), which equates to 3.1 metres per year. Evaporation greatly exceeds rainfall in the region throughout the year and on a month-by-month basis (BoM, 2023b).

3.2 BIOREGION, LANDFORMS AND LAND SYSTEMS

The proposed Amendment Application Area is located in the Hamersley subregion of the Pilbara biogeographic region and the Augustus subregion of the Gascoyne biogeographic region.

The Hamersley subregion is described as: “the southern section of the Pilbara Craton. Mountainous area of Proterozoic sedimentary ranges and plateaux, dissected by gorges (basalt, shale and dolerite). Mulga low woodland over bunch grasses on fine textured soils in valley floors, and *Eucalyptus leucophloia* over *Triodia brizoides* on skeletal soils of the ranges. Drainage into either the Fortescue (to the north), the Ashburton to the south, or the Robe to the west.” (Kendrick, 2001).

The Augustus subregion is described as: “Rugged low Proterozoic sedimentary and granite ranges divided by broad flat valleys. Also includes the Narryera Complex and Bryah Basin of the Proterozoic Capricorn Orogen (on northern margin of the Yilgarn Craton), as well as the Archaean Marymia and Sylvania Inliers. Although the Gascoyne River System provides the main drainage of this subregion, it is also the headwaters of the Ashburton and Fortescue Rivers. There are extensive areas of alluvial valley-fill deposits. Mulga woodland with *Triodia* occur on shallow stony loams on rises, while the shallow earthy loams over hardpan on the plains are covered by Mulga parkland. A desert climate with bimodal rainfall.”

It is also located in the following land systems, as mapped by van Vreeswyk *et al.* (2004).

Divide: “Level to gently undulating sandplains and occasional small dunes.”

Jamindie: “Level to gently undulating hardpan wash plains with mantles of ironstone grit and pebbles, minor stonyplains, low rises and occasional low ridges with relief up to 30 m.”

McKay: “Hills, ridges, plateaux remnants and minor breakaways of sedimentary and meta sedimentary rocks, relief up to 100 m.”

3.3 GEOLOGY AND SOILS

Soils of the Pilbara region have been defined and mapped at a scale of 1:2,000,000 by Bettenay *et al.* (1967). The following soil unit occurs within the Amendment Application Area, based on mapping by Bettenay *et al.* (1967):

BE6: “Extensive flat and gently sloping plains, which sometimes have a surface cover of gravels and on which redbrown hardpan frequently outcrops: chief soils are shallow earthy loams (Um5.3), with associated (Gn) soils of units My5O and Mz23 of Sheet 6. As mapped, there are inclusions of units Oc47 and BB9.”

Oc64: “Low stony hills and dissected pediments on granite with occasional basic dykes: chief soils are hard, alkaline red soils (Dr2.33) having shallow stony A horizons. Associated are shallow stony (Uc5.11) soils on steep slopes; (Uc1.22) soils along creek lines; and (Um5.11) soils on patches of calcrete (kunkar).”

3.4 FLORA, VEGETATION AND FAUNA

The most recent vegetation, flora and fauna surveys conducted across the Amendment Application Area are:

- *Dynasty and West Jiblebar Flora and Vegetation Survey* (Onshore Environmental, 2015) (**Appendix 1**);
- *West Jiblebar and Noddy Bore Single Season Targeted Flora Survey* (Biologic, 2020a) (**Appendix 2**); and
- *Jiblebar Greenhouse Gas Abatement Study Basic Vertebrate Fauna Survey* (Biologic, 2020b) (**Appendix 3**).

The Amendment Application Area is within the Interim Biogeographic Regionalisation for Australia (IBRA) Pilbara and Gascoyne Bioregions (Department of Environment and Heritage, 2005).

The vegetation within the Amendment Application Area is classified as the following vegetation association, as mapped by Beard (1975):

29	Sparse low woodland; mulga, discontinuous in scattered groups
82	Hummock grasslands, low tree steppe; snappy gum over <i>Triodia wiseana</i>
216	Low woodland; mulga (with spinifex) on rises

There is more than 99% of the pre-European vegetation remaining of these vegetation association (**Table 2**). The Amendment Application Area is not part of any significant remnant vegetation in the wider regional area.

Table 2: Extent of pre-European and current vegetation in the Pilbara bioregion and vegetation associations represented in the Amendment Application Area (Government of Western Australia, 2013)

	Pre-European Extent (ha)	Current Extent (ha)	Remaining (%)	Pre-European % in IUCN Class I-IV Reserves
Pilbara IBRA Bioregion	17,808,657	17,733,583	99.58	6.34
Gascoyne IBRA Bioregion	18,075,219.48	18,067,441.43	99.96	1.93
Vegetation association 29 within Western Australia	7,903,991.47	7,900,200.44	99.95	0.29
Vegetation association 29 within the Pilbara Bioregion	1,133,219.76	1,132,939.20	99.98	1.19
Vegetation association 29 within the Gascoyne Bioregion	3,802,459.63	3,799,635.88	99.93	0.03
Vegetation association 82 within Western Australia	2,565,901	2,553,217	99.51	10.25
Vegetation association 82 within the Pilbara Bioregion	2,563,583	2,550,898	99.51	10.26
Vegetation association 82 within the Gascoyne Bioregion	2,318.05	2,318.05	100.00	0.00
Vegetation association 216 within Western Australia	280,759.40	279,237.06	99.46	0.00
Vegetation association 216 within the Pilbara Bioregion	26,669.89	26,372.58	98.89	0.00
Vegetation association 216 within the Gascoyne Bioregion	254,089.51	252,864.49	99.52	0.00

3.4.1 Flora

No species listed under the *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act) or gazetted as Threatened Flora species under the *Biodiversity Conservation Act, 2016* (BC Act) were identified within the Amendment Application Area (Biologic, 2020a).

One Priority flora (*Goodenia nuda*) has been identified within the Amendment Application Area. This species is no longer listed as Priority flora.

3.4.2 Vegetation Communities

Onshore Environmental (2015) mapped a total of seven broad floristic communities with 15 vegetation associations within the Amendment Application Area (**Table 3; Figure 2**).

Table 3: Vegetation associations of the Amendment Application Area (Onshore Environmental, 2015)

Broad Floristic Community	Vegetation Association	
Acacia High Shrubland	4a	High Shrubland of <i>Acacia rhodophloia</i> , <i>Acacia tetragonophylla</i> and <i>Acacia synchronicia</i> with Low Open Woodland of <i>Acacia aptaneura</i> and <i>Acacia pruinocarpa</i> with Open Shrubland of <i>Eremophila forrestii</i> subsp. <i>forrestii</i> , <i>Senna artemisioides</i> subsp. <i>helmsii</i> and <i>Eremophila cuneifolia</i> on orange loam on rises and stony plains.
	4b	High Shrubland of <i>Acacia ancistrocarpa</i> over Open Hummock Grassland of <i>Triodia pungens</i> over Open Tussock Grassland of <i>Eragrostis eriopoda</i> on red sand on plains.
Acacia Low Woodland	2b	Low Woodland of <i>Acacia aptaneura</i> and <i>Acacia ayersiana</i> over Open Shrubland of <i>Senna artemisioides</i> subsp. <i>helmsii</i> and Very Open Tussock Grassland of <i>Aristida inaequiglumis</i> , <i>Cymbopogon obtectus</i> and <i>Aristida contorta</i> on orange brown silty clay loam on plains.
	2c	Low Woodland of <i>Acacia catenulata</i> subsp. <i>occidentalis</i> , <i>Acacia aptaneura</i> and <i>Acacia paraneura</i> over Open Tussock Grassland of <i>Aristida inaequiglumis</i> and <i>Digitaria ammophila</i> with Low Open Shrubland of <i>Eremophila forrestii</i> subsp. <i>forrestii</i> , <i>Isotropis forrestii</i> and <i>Senna glaucifolia</i> on brown clay loam on plains.
Acacia Open Shrubland	7	Open Shrubland of <i>Acacia aptaneura</i> , <i>Acacia tetragonophylla</i> and <i>Senna artemisioides</i> subsp. <i>helmsii</i> over Very Open Tussock Grassland of <i>Aristida inaequiglumis</i> , <i>Tripogon loliformis</i> and <i>Eragrostis eriopoda</i> with Scattered Low Trees of <i>Acacia aptaneura</i> on brown loamy sand on plains.
Eremophila High Open Shrubland	5	High Open Shrubland of <i>Eremophila fraseri</i> and <i>Acacia synchronicia</i> over Low Open Shrubland of <i>Senna artemisioides</i> subsp. <i>helmsii</i> and <i>Eremophila fraseri</i> with Scattered Low Trees of <i>Acacia pruinocarpa</i> , <i>Hakea lorea</i> subsp. <i>lorea</i> and <i>Acacia aptaneura</i> on orange loamy sand on sand plain.
Eremophila Low Shrubland	8b	Low Shrubland of <i>Eremophila cuneifolia</i> , <i>Senna artemisioides</i> subsp. <i>helmsii</i> and <i>Senna</i> sp. Meekatharra (E. Bailey 1-26) with High Open Shrubland of <i>Hakea preissii</i> , <i>Acacia tetragonophylla</i> and <i>Acacia synchronicia</i> and Very Open Tussock Grassland of <i>Eragrostis eriopoda</i> , <i>Enteropogon ramosus</i> and <i>Eragrostis xerophila</i> on brown loam on stony plains.
Mosaic of Gilgai and stony plains	M	Mosaic of Vegetation associations 8b and 11. Veg Association 11: Tussock Grassland of <i>Eriachne benthamii</i> , <i>Eragrostis xerophila</i> and <i>Eragrostis setifolia</i> with High Open Shrubland of <i>Acacia tetragonophylla</i> and Scattered Low Trees of <i>Acacia aptaneura</i> on light brown heavy clay on gilgai drainage zones.
Triodia Hummock Grassland	10b	Hummock Grassland of <i>Triodia</i> sp. Shovelanna Hill (S. van Leeuwen 3835) and <i>Triodia pungens</i> with High Open Shrubland of <i>Senna glutinosa</i> subsp. <i>x luerssenii</i> , <i>Acacia tetragonophylla</i> and <i>Acacia trudgeniana</i> and Scattered Low Trees of <i>Acacia aptaneura</i> and <i>Acacia pruinocarpa</i> on orange sandy loam on hillslopes.
	10d	Hummock Grassland of <i>Triodia basedowii</i> and/or <i>Triodia schinzii</i> with High Open Shrubland of <i>Acacia pachyacra</i> and <i>Acacia ancistrocarpa</i> and Scattered Low Trees of <i>Hakea lorea</i> subsp. <i>lorea</i> , <i>Acacia aptaneura</i> and <i>Corymbia hamersleyana</i> on red brown sandy loam on plains.
	10f	Hummock Grassland of <i>Triodia pungens</i> and <i>Triodia</i> sp. Shovelanna Hill (S. van Leeuwen 3835) with Low Open Woodland of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> , <i>Acacia rhodophloia</i> and <i>Acacia bivenosa</i> (wispy form) and High Open Shrubland of <i>Acacia maitlandii</i> , <i>Acacia rhodophloia</i> and <i>Senna glutinosa</i> subsp. <i>x luerssenii</i> on brown sandy loam on hillcrests and slopes.
	10g	Hummock Grassland of <i>Triodia pungens</i> with High Open Shrubland of <i>Grevillea wickhamii</i> subsp. <i>hispidula</i> and <i>Acacia maitlandii</i> and Low Open Shrubland of <i>Eremophila exilifolia</i> , <i>Acacia hillianana</i> and <i>Senna artemisioides</i> subsp. <i>helmsii</i> on red brown loamy sand on dolerite hillslopes.
	10h	Hummock Grassland of <i>Triodia pungens</i> and <i>Triodia basedowii</i> with Open Mallee of <i>Eucalyptus gamophylla</i> and High Shrubland of <i>Acacia kempeana</i> and <i>Acacia sclerosperma</i> subsp. <i>sclerosperma</i> on red loamy sand on drainage zones
	10j	Hummock Grassland of <i>Triodia</i> sp. Shovelanna Hill (S. van Leeuwen 3835) and <i>Triodia brizoides</i> with High Open Shrubland of <i>Acacia pruinocarpa</i> , <i>Hakea chordophylla</i> and <i>Grevillea berryana</i> and Open Shrubland of <i>Senna glutinosa</i> subsp. <i>pruinosa</i> and <i>Ptilotus rotundifolius</i> on brown sandy loam on hillcrests.
	10k	Hummock Grassland of <i>Triodia pungens</i> with Low Open Shrubland of <i>Eremophila fraseri</i> and <i>Acacia synchronicia</i> and Scattered Low Trees of <i>Hakea lorea</i> subsp. <i>lorea</i> and <i>Grevillea striata</i> on skeletal brown loam on dolerite hillcrests and slopes.

None of these vegetation associations are representative of a Threatened Ecological Community (TEC) (Onshore Environmental, 2015).

Vegetation condition within the Amendment Application Area ranges from Excellent to Very good (Onshore Environmental, 2015). Vegetation adjacent to the Amendment Application Area is in similar condition to the vegetation of the Amendment Application Area.

3.4.3 Weeds

Three introduced flora species (weeds) were recorded within the Application Area (**Table 4**). Control of established weed populations will be carried out according to BHP's standard *Weed Control and Management Procedures*.

Table 4: Introduced Flora of the Amendment Application Area

Species	Common Name	DPAW Rating (DPAW, 2016)	Declared Pest ¹
* <i>Bidens bipinnata</i>	Bipinnate Beggartick	Unknown and Rapid	No
* <i>Cenchrus ciliaris</i>	Buffel Grass	High and Rapid	No
* <i>Malvastrum Americanum</i>	Spiked Malvastrum	Unknown and Rapid	No

3.4.4 Fauna

Biologic (2020b) undertook a basic (formerly Level 1) vertebrate fauna assessment and identified the following four fauna habitat types occur within the Amendment Application Area (**Figure 3**):

- **Mulga Woodland:** Mulga Woodland habitat within the Study Area is variable in density, often associated with low lying drainage areas subject to occasional sheet flow following rainfall. Vegetation dominated by open mulga (*Acacia aneura*) with sparse to no understory of mixed small shrubs, tussock and hummock grasses.
- **Hardpan Plain:** Hardpan Plain is characterised as lower lying plain often sparsely vegetated with open or sparsely scattered Mulga over a sparse mixed herb and small to medium shrub (predominantly *Acacia* and *Eremophila* species) understory on heavy clay substrates, often with a stony or gravelly surface. Large open areas often void of vegetation. Often subject to sheet flow following rainfall, occasionally pooling in lower lying areas; however, presence of water often temporary and persisting for only short periods following rainfall.
- **Sand Plain:** Sand Plain habitat is characterised by sandy soils, often supporting *Triodia* hummock grassland and open *Acacia* shrubland vegetation. Vegetation is often dominated by *Triodia* hummocks of varying density and life stages, with scattered *Acacia* shrubs on sandy to sandy loam substrates.
- **Stony Plain:** Stony Plain habitat comprises flat to low undulating areas and low hills. Vegetation structure and density is variable, often occurring within scattered patches amount larger sparsely vegetated areas. Vegetation is often dominated by *Triodia* hummock grasses and/or scattered mixed small to medium shrub species on gravelly clay loam substrates.

No fauna species of conservation significance have been recorded from within the Amendment Application Area.

Based on the occurrence of the habitat types and conservation significant fauna species previously recorded in the vicinity, eight species are considered to potentially occur within the Amendment Application Area (i.e. those considered 'likely' or 'possible' to occur within the Amendment Application Area):

- Brush-tailed mulgara (*Dasymercus blythi*) (DBCAs Priority 4);
- Fork-tailed Swift (*Apus pacificus*) (Migratory, EPBC Act; Schedule 5, BC Act);
- Ghost bat (*Macroderma gigas*) (Vulnerable, EPBC Act; Vulnerable, BC Act);
- Greater bilby (*Macrotis lagotis*) (Vulnerable, EPBC Act; Vulnerable, BC Act);
- Grey falcon (*Falco hypoleucos*) (Vulnerable, EPBC Act; Vulnerable, BC Act);
- Peregrine falcon (*Falco peregrinus*) (Specially Protected, BC Act);
- Spotted ctenotus (*Ctenotus uber* subsp. *johnstonei*) (DBCAs Priority 2); and
- Western pebble-mound mouse (*Pseudomys chapmani*) (DBCAs Priority 4);

¹ Biosecurity and Agriculture Management Act, 2007 (BAM Act) s22

An assessment of the potential impact of the proposed clearing on the species of conservation significant fauna that may occur in the application amendment area is provided in **Table 5**.

Table 5: Conservation Significant Fauna Potentially Occurring within the Amendment Application Area (biologic, 2020b)

Conservation Significant Species	Conservation Status	Distribution and Ecology	Habitat Relevance	Likelihood	Potential Impact on Species
Birds					
Fork-tailed Swift (<i>Apus pacificus</i>)	Migratory (EPBC Act) Schedule 5 (BC Act)	The Fork-tailed Swift breeds in north-east and east Asia, wintering in Australia and southern New Guinea (Johnstone and Storr, 1998). Fork-tailed Swifts are entirely aerial within the Pilbara and may forage sporadically over the Amendment Application Area in the summer months, associated with thunderstorms and cyclonic systems (Johnstone and Storr, 1998).	The Fork-tailed Swift is largely an aerial species and has a broad distribution across much of Western Australia. It is viewed as a nomadic species and may fly over the Amendment Application Area.	Possible	Negligible As this species is entirely aerial and not reliant on terrestrial habitats, the impact to this species is considered to be negligible.
Grey Falcon (<i>Falco hypoleucos</i>)	Vulnerable (EPBC Act) Vulnerable (BC Act)	This species appears to have a distribution centred on ephemeral or permanent drainage lines (Garnett and Crowley, 2000) with numerous records from the Fortescue Marsh region. Grey Falcons prefer sparsely-treed, open plains and drainage lines for hunting (Slater et al., 2009). They typically nest in the abandoned nest of a raptor or corvid (Slater et al. 2009) in trees or man-made structures, most notably repeater towers.	The Amendment Application Area does not contain suitable nesting habitat for this species. It may forage over the Amendment Application Area.	Possible	Low This species is highly mobile with large home ranges and therefore able to easily move away from disturbance. This species may forage within the Amendment Application Area, however, no suitable nesting habitats were recorded, so impacts on breeding activity to these species are negligible. In addition, there are large amounts of suitable foraging and nesting habitat for this species outside of the Amendment Application Area.
Peregrine Falcon (<i>Falco peregrine</i>)	Specially Protected (BC Act)	The Peregrine Falcon is uncommon but wide ranging across Australia. They occur mainly along coastal cliffs, rivers and ranges as well as wooded watercourses and lakes. The Peregrine Falcon nests primarily on cliffs, granite outcrops and quarries, and feed mostly on birds (Johnstone and Storr 1998).	The Amendment Application Area does not contain suitable nesting habitat for this species. It may forage over the Amendment Application Area.	Possible	Low This species is highly mobile with large home ranges and therefore able to easily move away from disturbance. This species may forage within the Amendment Application Area, however, no suitable nesting habitats were recorded, so impacts on breeding activity to these species are negligible. In addition, there are large amounts of suitable foraging and nesting habitat for this species outside of the Amendment Application Area.

Conservation Significant Species	Conservation Status	Distribution and Ecology	Habitat Relevance	Likelihood	Potential Impact on Species
Mammals					
Brush-tailed Mulgara (<i>Dasymercus blythi</i>)	Priority 4 (DBCA) (only Brush-tailed Mulgara)	Brush-tailed mulgaras occur in a range of vegetation types, however, the principal habitat is mature hummock grasslands of spinifex, especially <i>Triodia basedowii</i> and <i>T. pungens</i> (Masters <i>et al.</i> , 2003). Note: Woolley, <i>et. al.</i> (2013) noted that the Crest-tailed Mulgara (<i>Dasymercus cristicauda</i>) is unlikely to occur within the Pilbara.	Sandplain habitats of the Amendment Application Area represent suitable habitat for this species. Sandplains are present within and adjacent to the Amendment Application Area. There are multiple records of the Brush-tailed Mulgara in the broader area (Biologic, 2020b).	Likely	Low No Mulgara have been recorded from the Amendment Application Area. An area of preferred habitat (sandplain) occurs within the Amendment Application Area. Installation of the solar array is most likely to occur in the north of the Amendment Application Area outside of the Sand Plain habitat. In addition large areas of Sandplain habitat occur outside of the Amendment Application Area and in the broader region (Biologic, 2020b). In the event that active Mulgara burrows are identified they will be avoided where practicable.
Ghost Bat (<i>Macroderma gigas</i>)	Vulnerable (EPBC Act) Vulnerable (BC Act)	Ghost Bats are patchily distributed across most of northern Australia, however the recent contraction in the distribution in central Australia has left the Pilbara population of ghost bats isolated by extensive sandy deserts (Worthington-Wilmer <i>et al.</i> 1994). They are generally associated with Gorge / Gully or drainage line habitats, requiring an undisturbed cave, deep fissure or disused mine shaft in which to roost. The Ghost Bat forages in areas of open woodland (Churchill, 2008).	There are no suitable caves within the Amendment Application Area however it is likely that Ghost Bats will forage over the Amendment Application Area.	Likely	Low This species is likely to forage across the Amendment Application Area and its surrounds. No suitable roosting habitat has been identified within the Amendment Application Area and therefore the Ghost Bat is unlikely to be dependant on the habitats present within the Amendment Application Area.
Greater Bilby (<i>Macrotis lagotis</i>)	Vulnerable (EPBC Act) Vulnerable (BC Act)	Three major vegetation types associated with the Greater Bilby are listed by Southgate (1990) including: open tussock grassland on uplands and hills, Mulga woodland/shrubland on ridges and rises, and hummock grassland in plains and alluvial areas. Other habitats used by the species include stony downs, cracking clays, desert sandplains and dune fields, spinifex grassland and <i>Acacia</i> species shrublands on red earths (Johnson, 2008).	The habitats of the Amendment Application Area are considered potentially suitable habitats for the Greater Bilby. Such habitat is widespread in broader region (Biologic, 2020b). Greater Bilbys have not been recorded within the Amendment Application Area.	Possible	Low There is likely to be a low impact on this species given that: <ul style="list-style-type: none"> the Sand Plain habitat within the Amendment Application Area is widespread throughout the Pilbara; and Installation of the solar array is most likely to occur in the north of the Amendment Application Area outside of the Sand Plain habitat.

Conservation Significant Species	Conservation Status	Distribution and Ecology	Habitat Relevance	Likelihood	Potential Impact on Species
Western Pebble-mound mouse (<i>Pseudomys chapmani</i>)	Priority 4 (DBCA)	<p>The Western Pebble-mouse is restricted to the Pilbara region, where it is recognized as an endemic species. Abandoned mounds to the east of its current range indicate a decline in distribution (Menkhorst and Knight, 2004). Abandoned mounds in disturbed areas suggest that the species is under threat by grazing and mining activities. The construction of extensive pebble mounds, built from small stones, which typically cover areas from 0.5-9.0 square metres, is characteristic of this species. Mounds are restricted to suitable class stones, and are usually found on gentle slopes and spurs (van Dyck and Strahan, 2008).</p>	<p>The Stony Plain habitat of the Amendment Application Area is suitable for this species. This species has not been recorded within the Amendment Application Area, but is common in the broader region.</p> <p>In the event that active mounds of the Western Pebble-mound Mouse will be avoided using a 10 m buffer, where practicable.</p>	Possible	<p>Low</p> <p>This species has not been recorded within the Amendment Application Area. There are large areas of suitable habitat adjacent to the Amendment Application Area.</p> <p>In the event that active mounds of the Western Pebble-mound Mouse will be avoided using a 10 m buffer, where practicable.</p>
Reptiles					
Spotted ctenotus (<i>Ctenotus uber</i> subsp. <i>johnstonei</i>)	Priority 2 (DBCA)	<p>Little is known of this species and its taxonomic status is uncertain. <i>Ctenotus uber johnstonei</i> has been found on chenopod shrubland at a base of a sandstone hill (Wilson and Swan, 2008).</p> <p>Within the Pilbara, the taxon is known from <i>Triodia</i> on hillslopes, <i>Acacia xiphophylla</i> over chenopods, and <i>Acacia xiphophylla</i> scattered tall shrubs to high open shrubland (Cogger, 2014).</p>	This species has been recorded in the broader area and is likely to be a resident in the Amendment Application Area.	Possible	<p>Low</p> <p>The habitats of the Amendment Application Area are common adjacent to the Amendment Application Area and in the broader region. It is unlikely this species would rely on the habitat of the Amendment Application Area and there is more suitable habitat outside the Amendment Application Area.</p>

3.5 GROUNDWATER

The Amendment Application Area is located in the Pilbara Groundwater Area, proclaimed under the RIWI Act (DoW, 2009a).

There is one main aquifer within the Amendment Application Area, the Hamersley – Fractured Rock Aquifer which is described as: “The Precambrian rocks of the Hamersley Basin are principally volcanics, shales and iron formations. Groundwater is contained within fractures within these rocks. The groundwater level may be deep below the surface, and is generally fresh. The main use of this aquifer is for mining and mine dewatering from iron ore mines. Bores have also been drilled for road and railway construction. There will be increasing dewatering from the fractured rocks around iron ore mines as the pits become deeper (DoW, 2015)”.

3.6 SURFACE WATER

The Amendment Application Area is located in the Pilbara Surface Water Area, proclaimed under the RIWI Act (DoW, 2009b).

The northern end of the Amendment Application Area contains one unnamed non-perennial minor drainage line.

Where practicable, existing cleared tracks will be used to cross the unnamed non-perennial minor drainage line. If it is necessary for new crossings to be installed, clearing will be kept to a bare minimum and will be constructed flat level to the surface (i.e. a simple clearing with no bunds) to maintain the natural surface flow.

4 ENVIRONMENTAL MANAGEMENT

4.1 CORPORATE LEVEL PLANS AND PROCEDURES

The management of the environmental aspects of BHP's operations for the Prescribed Premises are managed under the company's AS/NZS ISO 14001:2016 certified Environmental Management System (EMS). The EMS describes the organisational structure, responsibilities, practices, processes and resources for implementing and maintaining environmental objectives at all BHP sites.

Additionally, operational controls for environmental management for the Prescribed Premises are guided by BHP's Charter values. The Charter Values outline a commitment to develop, implement and maintain management systems for sustainable development that drive continual improvement and set and achieve targets that promote efficient use of resources. In order to give effect to the Charter Values, a series of "Our Requirements" documents have been developed.

BHP has also developed a Sustainable Development Policy for its Iron Ore operations. The Sustainable Development Policy outlines a commitment to setting objective and targets to achieve sustainable outcomes and to continually improve our performance.

To support these documents BHP has an internal Project Environmental and Aboriginal Heritage Review (PEAHR) system for its Iron Ore operations. The purpose of the system is to manage implementation of environmental, Aboriginal heritage, land tenure and legal commitments prior to and during land disturbance. All ground disturbance activities will meet the requirements of the PEAHR system.

5 PROJECT COMPLIANCE WITH THE TEN CLEARING PRINCIPLES

BHP consider that the clearing within the Amendment Application Area will not result in any significant environmental or social impacts, and complies with the Ten Clearing Principles, as defined in Schedule 5 of the EP Act. **Section 6** provides an assessment of project compliance with the Ten Clearing Principles.

6 ASSESSMENT AGAINST THE TEN CLEARING PRINCIPLES

The information used to assess the application against the Ten Clearing Principles has been based on the findings of multiple baseline surveys (**Section 3**).

6.1 PRINCIPLE A

Native vegetation should not be cleared if it comprises a high level of biological diversity

This proposal is not likely to be at variance to this Principle.

Similar habitat to the Amendment Application Area is located outside the Amendment Application Area. These other areas of similar vegetation type are therefore expected to have a similar biological diversity and conservation value than that of the Amendment Application Area.

The proposed clearing is therefore unlikely to have any significant impact on the biodiversity of the region.

Table 6 provides an assessment of the proposed clearing activities within the Amendment Application Area against the components of clearing Principle A.

Table 6: Assessment against Principle A components

Principle	Criteria	Assessment	Outcome
<p>a) Native vegetation should not be cleared if it comprises a high level of biological diversity.</p>	<p>a1) Native vegetation should not be cleared if it is representative of an area of outstanding biodiversity in the Bioregion.</p>	<p>The native vegetation within the Amendment Application Area is represented in the same condition within the broader region and is not considered to be of outstanding biodiversity in the Bioregion.</p>	<p>Not at variance with clearing principle.</p>
	<p>a2) Native vegetation should not be cleared if it has higher diversity of indigenous aquatic or terrestrial plant or fauna species than native vegetation of that ecological community in good or better condition in the Bioregion.</p>	<p>The native vegetation within the Amendment Application Area is in the same condition as other areas of similar vegetation type within the broader region.</p>	<p>Not at variance with clearing principle.</p>
	<p>a3) Native vegetation should not be cleared if it has higher diversity of indigenous aquatic or terrestrial plant or fauna species than the remaining vegetation of that ecological community in the local area.</p>	<p>The native vegetation within the Amendment Application Area is not considered to have higher biodiversity and conservation value than that of the surrounding vegetation within the local area.</p>	<p>Not at variance with clearing principle.</p>
	<p>a4) Native vegetation should not be cleared if it has higher ecosystem diversity than other native vegetation of that local area.</p>	<p>The native vegetation within the Amendment Application Area is not considered to have a higher ecosystem diversity than other native vegetation of that local area.</p>	<p>Not at variance with clearing principle.</p>
	<p>a5) Native vegetation should not be cleared if it has higher genetic diversity than the remaining native vegetation of that ecological community.</p>	<p>The native vegetation within the Amendment Application Area is not considered to have a higher genetic diversity than the remaining native vegetation of that ecological community as the vegetation is contiguous with adjacent native vegetation and has no special features.</p>	<p>Not at variance with clearing principle.</p>
	<p>A6) Native vegetation should not be cleared if it is necessary for the continued <i>in situ</i> existence of significant habitat for priority flora species published by the Department of Parks and Wildlife.</p>	<p>No priority flora species have been recorded in the Amendment Application Area (Onshore, 2015). The previously identified species <i>Goodenia nuda</i> is no longer listed as a Priority flora species.</p>	<p>Not at variance with clearing principle.</p>

6.2 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 indigenous to Western Australia

This proposal is not likely to be at variance to this Principle.

There are four broad fauna habitat types within the Amendment Application Area (**Figure 3**).

The vegetation and habitat found within the Amendment Application Area are considered to be well represented in the Pilbara bioregions.

No fauna species of conservation significance have been recorded from within the Amendment Application Area with eight species are considered to potentially occur within the Amendment Application Area (**Table 5**). As described in **Section 3.4.4** and **Table 5** clearing of the Amendment Application Area is expected to have a low impact on these species.

Table 7 provides an assessment of the proposed clearing activities within the Amendment Application Area against the components of clearing Principle B.

Table 7: Assessment against Principle B components

Principle	Criteria	Assessment	Outcome
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 indigenous to Western Australia.	b1) Native vegetation should not be cleared if it is or is likely to be habitat for fauna that is declared Specially Protected under the BC Act.	Five BC Act protected species are considered 'possible' or 'likely' to occur within the Amendment Application Area. These BC Act protected species are unlikely to be significantly impacted by this proposal as: <ul style="list-style-type: none"> All species are wide-ranging and found throughout the broader region; All species are likely to be transitory within the Amendment Application Area and will be able to move away from disturbance; Installation of the solar array is most likely to occur in the north of the Amendment Application Area outside of the key habitats for these species.. The impact to the BC Act protected species recorded within the Amendment Application Area and those considered 'possible' or 'likely' to occur will be low (Table 5).	Not likely to be at variance with clearing principle.
	b2) Native vegetation should not be cleared if it is or is likely to be habitat for Priority Listed Fauna.	Three priority fauna species have the potential to occur within the Amendment Application Area. As detailed in Table 5 these species are unlikely to be impacted for the following reasons: <ul style="list-style-type: none"> It are unlikely be reliant solely on habitat within the Amendment Application Area; In the event that active Mulgara burrows are identified they will be avoided where practicable; In the event that active mounds of the Western Pebble-mound Mouse will be avoided using a 10 m buffer, where practicable; and Suitable breeding and foraging habitat in the same or better condition is widespread in the Amendment Application Area surrounds. 	Not likely to be at variance with clearing principle.
	b3) Native vegetation should not be cleared if it is or is likely to be habitat for fauna that is otherwise significant.	Habitat found within the Amendment Application Area may be suitable for use by conservation significant fauna, however similar habitat in the same or better condition is widespread in the Amendment Application Area surrounds	Not at variance with clearing principle.
	b4) Native vegetation should not be cleared if it provides significant habitat for fauna species in the local area.	Habitat within the Amendment Application Area is not considered significant habitat for fauna species within the local area. Similar habitat to that proposed to be cleared is located to the area surrounding of the Amendment Application Area.	Not at variance with clearing principle.
	b5) Native vegetation should not be cleared if it maintains ecological functions and processes that protect significant habitat for fauna.	The clearing of native vegetation is not considered to alter ecological functions and processes that protect significant habitat for fauna.	Not at variance with clearing principle.
	b6) Native vegetation should not be cleared if it forms, or is part of, an ecological linkage that is necessary for the maintenance of fauna.	No ecological linkages run through the Amendment Application Area that are necessary for the maintenance of fauna.	Not at variance with clearing principle.

Principle	Criteria	Assessment	Outcome
	b7) Native vegetation should not be cleared if it provides significant habitat for fauna communities (assemblages) and meta-populations.	The Amendment Application Area is not considered to contain significant habitat for faunal assemblages that are not also present in other areas within the vicinity. The Amendment Application Area is not considered likely to contain geographically isolated fauna populations.	Not at variance with clearing principle.

6.3 PRINCIPLE C

Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora

This proposal is not likely to be at variance to this Principle.

No species listed under the EPBC Act, gazetted as Threatened Flora under the BC Act were recorded in the Amendment Application Area (Biologic, 2020a).

Table 8 provides an assessment of the proposed clearing activities within the Amendment Application Area against the components of clearing Principle C.

Table 8: Assessment against Principle C components

Principle	Criteria	Assessment	Outcome
c) Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.	c1) Native vegetation should not be cleared if it is necessary for the continued <i>in situ</i> existence of populations of Threatened Flora under the <i>BC Act 2016</i> .	No Threatened Flora were recorded in the Amendment Application Area.	Not at variance with clearing principle.
	c2) Native vegetation should not be cleared if it is necessary for the continued <i>in situ</i> existence of other significant flora.	No species listed under the EPBC Act or other significant flora species were recorded in the Amendment Application Area.	Not at variance with clearing principle.

6.4 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

This proposal is not likely to be at variance to this Principle.

No TECs, Environmentally Sensitive Areas or PECs are located in the Amendment Application Area (Onshore, 2015).

Table 9 provides an assessment of the proposed clearing activities within the Amendment Application Area against the components of clearing Principle D.

Table 9: Assessment against Principle D components

Principle	Criteria	Assessment	Outcome
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.	d1) Native vegetation should not be cleared if threatened ecological communities listed under the Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i> are present.	No EPBC Act TECs are present in the Amendment Application Area.	Not at variance with clearing principle.
	d2) Native vegetation should not be cleared if it is necessary for the maintenance of Threatened Ecological Communities listed under the Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i> .	No EPBC Act TECs or associated native vegetation will be impacted by the proposed works.	Not at variance with clearing principle.
	d3) Native vegetation should not be cleared if other significant ecological communities are present.	No other significant ecological communities are known to occur or are likely to occur within the Amendment Application Area.	Not at variance with clearing principle.
	d4) Native vegetation should not be cleared if it is necessary for the maintenance of other significant ecological communities.	No DBCA listed TECs or associated native vegetation will be impacted by the proposed works.	Not at variance with clearing principle.
	d5) Native vegetation should not be cleared if it is necessary for the continued <i>in situ</i> existence of significant examples of priority threatened ecological communities published by the Department of Environment and Conservation.	No DBCA listed PECs or associated native vegetation will be impacted by the proposed works.	Not at variance with clearing principle.

6.5 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

This proposal is not likely to be at variance to this Principle.

The habitat and vegetation within the Amendment Application Area is well represented in the Land Systems of the region (**Table 2**). It therefore is unlikely that individual species would be restricted to a particular habitat and vegetation occurring in the Amendment Application Area.

Table 10 provides an assessment of the proposed clearing activities within the Amendment Application Area against the components of clearing Principle E.

Table 10: Assessment against Principle E components

Principle	Criteria	Assessment	Outcome
<p>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>	<p>e1) Native vegetation should not be cleared if the remaining native vegetation represents less than 30%, or the clearing would reduce the representation of remaining native vegetation to less than 30% in the Bioregion (or subregion where applicable).</p>	<p>Clearing native vegetation within the Amendment Application Area will not reduce the extent of native vegetation below 30% in the bioregion or subregion.</p>	<p>Not at variance with clearing principle.</p>
	<p>e2) Native vegetation should not be cleared if an ecological community represents less than 30% of its original extent or clearing would reduce the representation of any ecological community to less than 30% of its original extent in the Bioregion (or subregion where applicable).</p>	<p>Clearing native vegetation within the Amendment Application Area will not significantly reduce the known extent of the ecological community from pre-European extents. Current extents of this vegetation community in the bioregion are almost 100% of pre-European extents.</p>	<p>Not at variance with clearing principle.</p>
	<p>e3) Native vegetation should not be cleared if clearing would reduce an ecological community to less than 1% of the Bioregion (or subregion where applicable)</p>	<p>Clearing native vegetation within the Amendment Application Area will not significantly reduce the known extent of the vegetation community in the bioregion.</p>	<p>Not at variance with clearing principle.</p>
	<p>e4) Native vegetation should not be cleared if the remaining native vegetation represents less than 30% or the clearing would reduce the representation of remaining native vegetation to less than 30% in the Local Area.</p>	<p>Clearing native vegetation within the Amendment Application Area will not reduce the representation of remaining native vegetation to less than 30% in the local area.</p>	<p>Not at variance with clearing principle.</p>
	<p>e5) Native vegetation should not be cleared if an ecological community represents less than 30% of its original extent or clearing will reduce the representation of any ecological community to less than 30% of its original extent in the Local Area.</p>	<p>Clearing native vegetation within the Amendment Application Area will not reduce the representation of any ecological community to less than 30% of its original extent in the local area.</p>	<p>Not at variance with clearing principle.</p>
	<p>e6) Native vegetation should not be cleared if clearing would reduce any ecological community to less than 1% of the Local Area.</p>	<p>Clearing native vegetation within the Amendment Application Area will not significantly reduce the known extent of the vegetation community in the local area.</p>	<p>Not at variance with clearing principle.</p>

6.6 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

This proposal is not likely to be at variance to this Principle.

The Amendment Application Area contains one unnamed non-perennial minor drainage line.

Where practicable, existing cleared tracks will be used to cross the unnamed non-perennial minor drainage line. If it is necessary for new crossings to be installed, clearing will be kept to a bare minimum and will be constructed flat level to the surface (i.e. a simple clearing with no bunds) to maintain the natural surface flow.

An assessment of the proposed clearing activities within the Amendment Application Area against the components of clearing Principle F is provided in **Table 11**.

Table 11: Assessment against Principle F components

Principle	Criteria	Assessment	Outcome
f) Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.	f1) Native vegetation should not be cleared if it is growing in a watercourse or wetland that has been identified as having significant environmental values.	No watercourses of significant environmental value occur within the Amendment Application Area	Not at variance with clearing principle.
	f2) Native vegetation should not be cleared if it provides a buffer area for watercourses and wetlands identified in criteria (f1) and (f2).	No native vegetation occurs within the Amendment Application Area that provides a buffer to watercourses or wetlands that have been identified as having significant environmental values.	Not at variance with clearing principle.
	f3) Native vegetation should not be cleared if water tables are likely to change and adversely affect ecological communities that are wetland or groundwater dependent.	Due to the purpose of the clearing this project is not considered likely to adversely alter water tables, and as such will not impact on any ecological communities that are wetland or groundwater dependent.	Not at variance with clearing principle.
	f4) Native vegetation should not be cleared if it is growing in other watercourses or wetlands.	Where practicable, existing cleared tracks will be used to cross the unnamed non-perennial minor drainage line. If it is necessary for new crossings to be installed, clearing will be kept to a bare minimum and will be constructed flat level to the surface (i.e. a simple clearing with no bunds) to maintain the natural surface flow.	Unlikely to be at variance with clearing principle.

6.7 PRINCIPLE G

Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation

This proposal is not likely to be at variance to this Principle.

Land degradation may include impacts such as erosion, changes to pH, water logging, salinisation or spread of weeds. These potential impacts are assessed in the sections below. **Table 12** provides an assessment of the proposed clearing activities within the Amendment Application Area against the components of clearing Principle G.

Given the proposed management strategies for weed species and the low susceptibility of the soils to erosion, it is considered that the project will not be at variance to Principle G.

6.7.1 Erosion

It is not anticipated that the removal of vegetation will contribute to increased amounts of wind or water erosion in the Amendment Application Area or adjacent areas.

6.7.2 Changes to pH

The Amendment Application Area is not in an area at risk of acid sulphate soils and there are no recorded acid sulphate soils within the Amendment Application Area. It is not expected that the proposed clearing will result in changes to soil pH.

6.7.3 Water logging and salinisation

No water logging or increased salinisation is expected to occur as a result of the proposed clearing.

6.7.4 Weeds

Three introduced flora species have been recorded in the amendment application area (**Table 4**). None are listed as a Declared Pest under the BAM Act. These are typical introduced species commonly recorded in the Pilbara region.

Control of established weed populations will be carried out according to the *BHP Weed Control and Management Procedure* (BHP, 2010).

Table 12: Assessment against Principle G components

Principle	Criteria	Assessment	Outcome
g) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.	g1) Native vegetation should not be cleared if wind or water erosion of soil is likely to be increased (on or off site).	Soil erosion is not anticipated to occur as any areas cleared that are no longer required will be re-vegetated, where practicable.	Not at variance with clearing principle.
	g2) Native vegetation on land with soils with high or low pH should not be cleared.	The Amendment Application Area is not considered to contain soils at risk of having acid sulphate soils present. No vegetation on soils with significantly low (or high) pH will be impacted by the proposed works.	Not at variance with clearing principle.
	g3) Native vegetation should not be cleared if water logging is likely to be increased (on or off site).	It is not expected the proposal will result in significant water logging within or adjacent to the Amendment Application Area by the clearing of native vegetation within the Amendment Application Area.	Not at variance with clearing principle.
	g4) Native vegetation should not be cleared if land salinisation is likely to be increased (on or off site).	Soil salinity is not considered to be increased in the Amendment Application Area (on or off site) by the clearing of native vegetation.	Not at variance with clearing principle.

6.8 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

This proposal is not likely to be at variance to this Principle.

The Amendment Application Area is not within any conservation areas as listed by the DBCA or those protected under the EPBC Act. The closest conservation area is Karijini National Park which is more than 140 km west of the Amendment Application Area.

The Amendment Application Area is not considered to form an ecological linkage to any conservation areas.

An assessment of the proposed clearing activities within the Amendment Application Area against the components of clearing Principle H is provided in **Table 13** below.

Table 13: Assessment against Principle H components

Principle	Criteria	Assessment	Outcome
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.	h1) Native vegetation should not be cleared if it contributes significantly to the environmental values of a conservation area.	The vegetation of the Amendment Application Area does not contribute significantly to the environmental values of a conservation area.	Not at variance with clearing principle.
	h2) Native vegetation should not be cleared if that vegetation provides a buffer to a conservation area.	There are no conservation areas within the vicinity of the Amendment Application Area.	Not at variance with clearing principle.
	h3) Native vegetation should not be cleared if the land contributes to an ecological linkage to a conservation area.	The Amendment Application Area is not an ecological linkage to a conservation area.	Not at variance with clearing principle.
	h4) Native vegetation should not be cleared if it provides habitats not well represented on conservation land.	There are no habitats within the Amendment Application Area that are not well represented on conservation land.	Not at variance with clearing principle.

6.9 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

This proposal is not likely to be at variance to this Principle.

The Amendment Application Area is located in the Pilbara Groundwater Area and the East Murchison Groundwater Area, proclaimed under the (RIWI Act) (DoW, 2009a),

There is one main aquifer within the Amendment Application Area: Hamersley – Fractured Rock.

The small amount of clearing is unlikely to cause deterioration in the quality of any surface or underground water.

Where practicable, existing cleared tracks will be used to cross the unnamed non-perennial minor drainage line. If it is necessary for new crossings to be installed, clearing will be kept to a bare minimum and will be constructed flat level to the surface (i.e. a simple clearing with no bunds) to maintain the natural surface flow.

Table 14 provides an assessment of the proposed clearing activities within the Amendment Application Area against the components of clearing Principle I.

Table 14: Assessment against Principle I components

Principle	Criteria	Assessment	Outcome
<p>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>	<p>i1) Native vegetation should not be cleared if clearing the vegetation will reduce the quality of surface or underground water in proclaimed, gazetted or declared areas or catchments.</p>	<p>The clearing of native vegetation is not considered likely to alter the quality of surface or groundwater within the Amendment Application Area due to the:</p> <ul style="list-style-type: none"> • small amount of clearing; and • the lack of permanent waterbodies in the vicinity. 	<p>Not at variance with clearing principle.</p>
	<p>i2) Native vegetation should not be cleared if sedimentation, erosion, turbidity or eutrophication of water bodies on or off site is likely to be caused or increased.</p>	<p>Localised erosion will not impact any waterbodies as no permanent waterbodies are present within the vicinity of the Amendment Application Area.</p>	<p>Not at variance with clearing principle.</p>
	<p>i3) Native vegetation should not be cleared if water tables are likely to change significantly altering salinity or pH.</p>	<p>The clearing of native vegetation is not considered likely to alter the quality of surface or ground water within the Amendment Application Area due to the:</p> <ul style="list-style-type: none"> • small amount of clearing; and • the lack of permanent waterbodies in the vicinity. 	<p>Not at variance with clearing principle.</p>
	<p>i4) Native vegetation should not be cleared if the clearing is likely to alter the water regimes of groundwater-dependent ecosystems on or off site, causing degradation to the biological communities associated with these systems.</p>	<p>The clearing of native vegetation is not considered likely to alter the regimes of surface or groundwater dependent vegetation within the vicinity of the Amendment Application Area.</p>	<p>Not at variance with clearing principle.</p>

6.10 PRINCIPLE J

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

This proposal is not likely to be at variance to this Principle.

In the Pilbara massive surface water runoff and localised flooding occurs following intense rainfall events. However, the incidence or intensity of flooding is not likely to be significantly influenced by either the proposed the small amount of vegetation clearing. It is highly improbable that surface runoff generated from the cleared area could create sufficient concentrated water volumes to cause even a localised flood event.

Table 15 provides an assessment of the proposed clearing activities within the Amendment Application Area against the components of clearing Principle J.

Table 14: Assessment against Principle J components

Principle	Criteria	Assessment	Outcome
j) Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence of flooding.	j1) Native vegetation should not be cleared if it is likely to lead to an incremental increase in peak flood height.	The clearing of native vegetation is not considered likely to cause any alteration to peak flood height.	Not at variance with clearing principle.
	j2) Native vegetation should not be cleared if it is likely to lead to an incremental increase in duration of flood peak.	The clearing of native vegetation is not considered likely to cause any impact on duration of flood peak.	Not at variance with clearing principle.

7 HERITAGE

The Land Access Unit is the internal group within BHP that manages Aboriginal heritage matters. The Land Access Unit is responsible for ensuring that BHP complies with the *Aboriginal Cultural Heritage Act 2022*, and all other state and federal heritage legislation. All land disturbance activities are subject to ethnographic and archaeological surveys as part of an internal PEHR. The PEHR process ensures that all heritage sites in the vicinity of the Amendment Application Area are identified and avoided where practicable.

The Proposal is situated within the Nyiyaparli People Native Title Claim (WC2005/006). Ethnographic and archaeological surveys of the Amendment Application Area have been conducted in consultation with the Nyiyaparli People. There are a number of heritage sites that have been identified within the Amendment Application Area. The location of these sites have not been provided out of respect to the Traditional Owners, however the Project has been designed to avoid and prevent impacts to these sites.

In the event that a heritage site is identified and cannot practicably be avoided, BHP Iron Ore would consult the relevant traditional owners and seek approval under the *Aboriginal Heritage Act 1972* before the site is disturbed.

8 CONCLUSION

The proposed clearing of up to 130 ha of native vegetation within the 429.55.14 ha Amendment Application Area is unlikely to be at variance to any of the Ten Clearing Principles and is therefore unlikely to have any significant negative impacts on biodiversity and environmental values in the area.

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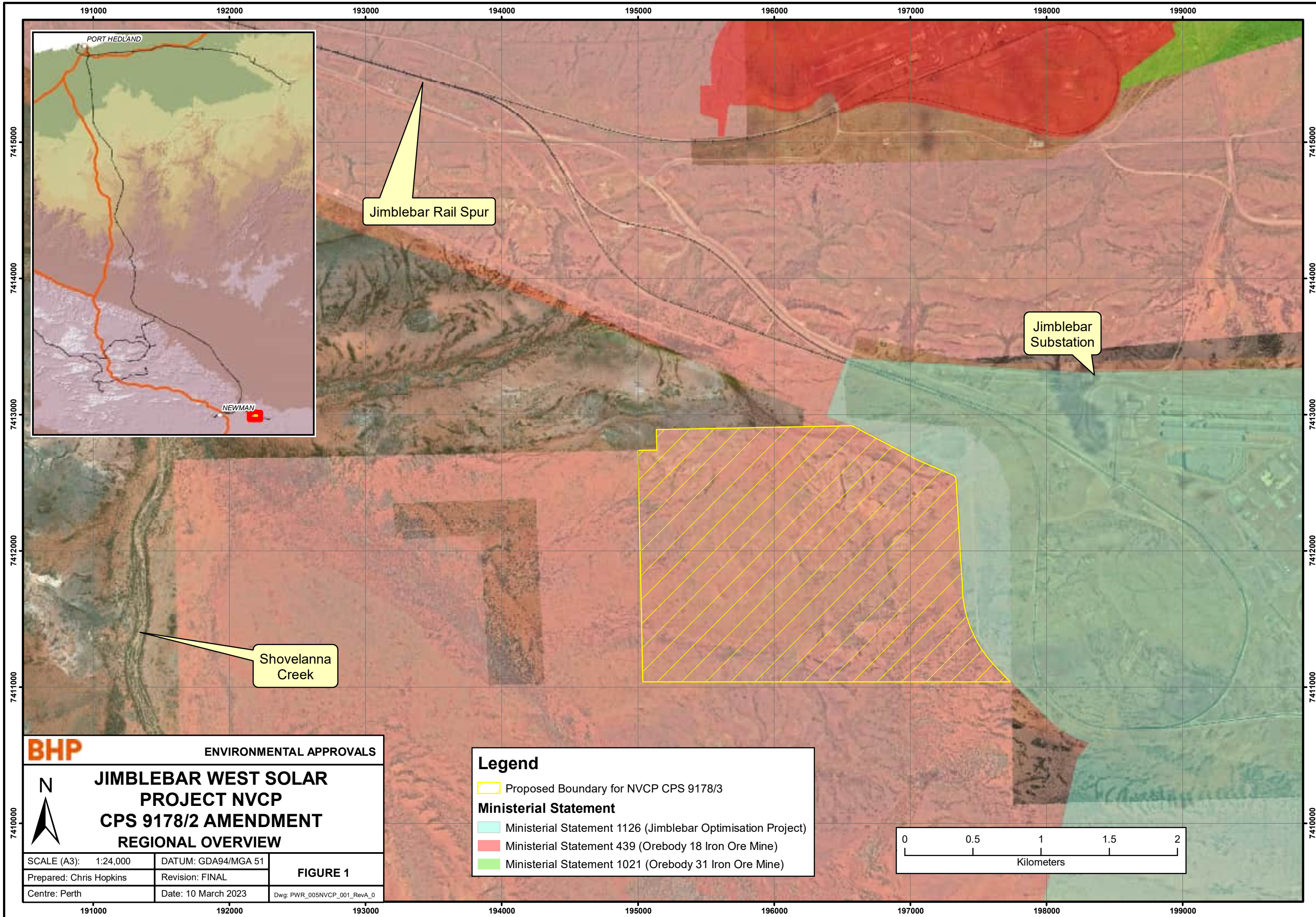
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Figures



BHP

ENVIRONMENTAL APPROVALS

**JIMBLEBAR WEST SOLAR
PROJECT NVCP
CPS 9178/2 AMENDMENT
REGIONAL OVERVIEW**

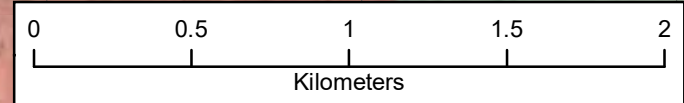


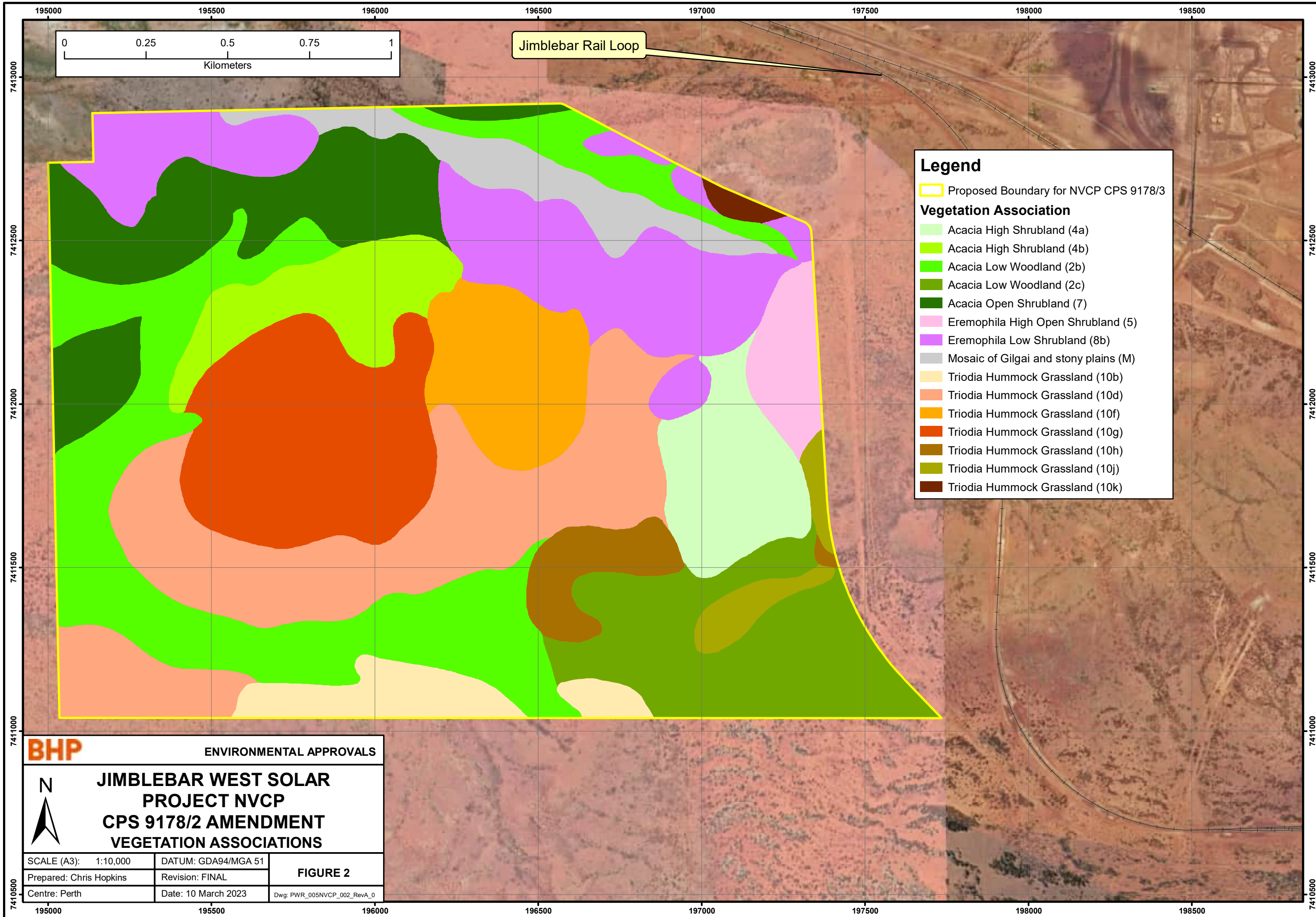
SCALE (A3): 1:24,000	DATUM: GDA94/MGA 51	FIGURE 1
Prepared: Chris Hopkins	Revision: FINAL	
Centre: Perth	Date: 10 March 2023	

Dwg: PWR_005NVCP_001_RevA_0

Legend

- Proposed Boundary for NVCP CPS 9178/3
- Ministerial Statement**
- Ministerial Statement 1126 (Jimblebar Optimisation Project)
- Ministerial Statement 439 (Orebody 18 Iron Ore Mine)
- Ministerial Statement 1021 (Orebody 31 Iron Ore Mine)





Jiblebar Rail Loop

Legend

Proposed Boundary for NVCP CPS 9178/3

Vegetation Association

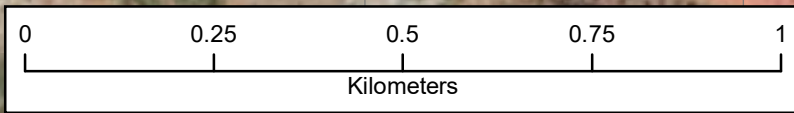
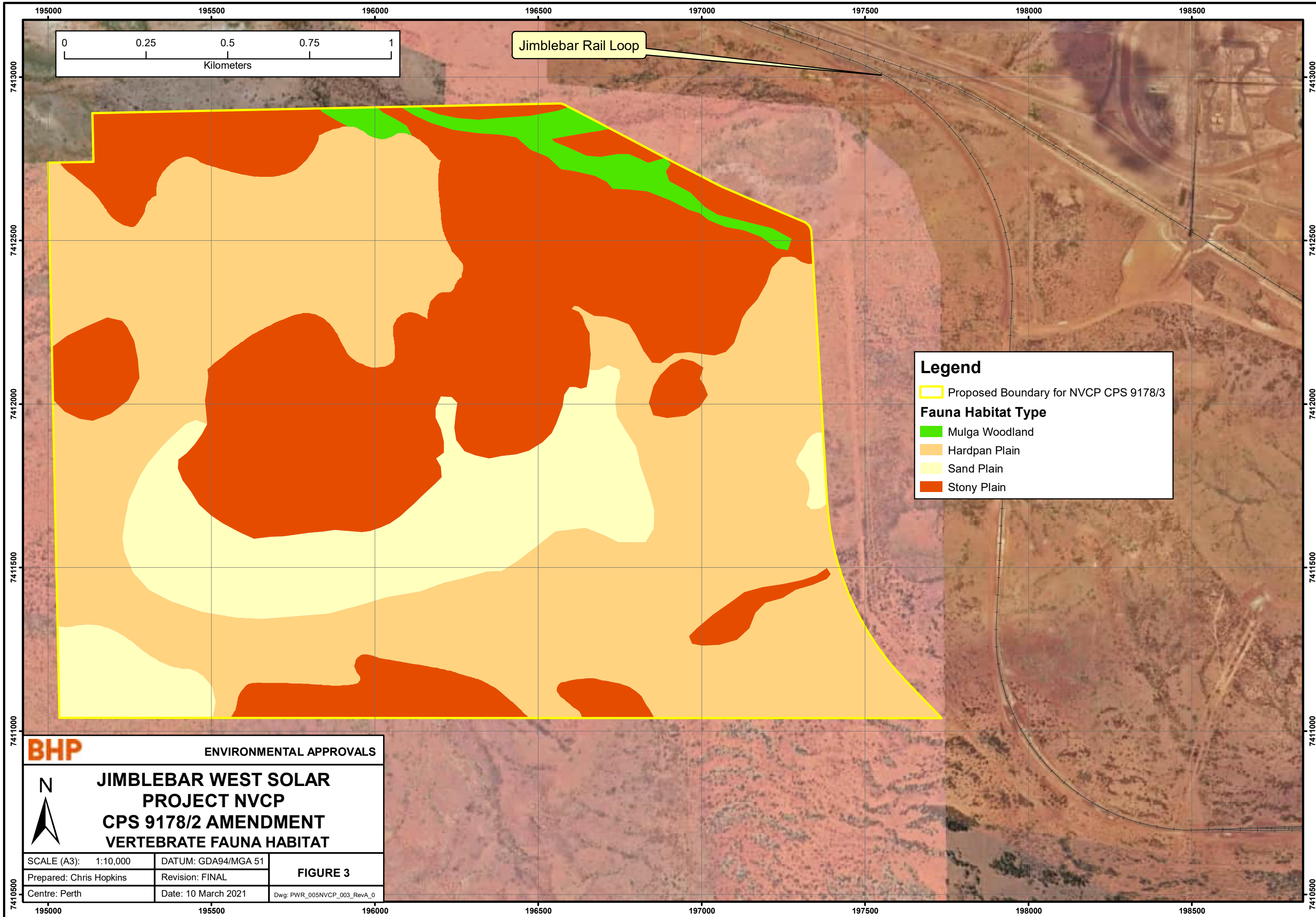
- Acacia High Shrubland (4a)
- Acacia High Shrubland (4b)
- Acacia Low Woodland (2b)
- Acacia Low Woodland (2c)
- Acacia Open Shrubland (7)
- Eremophila High Open Shrubland (5)
- Eremophila Low Shrubland (8b)
- Mosaic of Gilgai and stony plains (M)
- Triodia Hummock Grassland (10b)
- Triodia Hummock Grassland (10d)
- Triodia Hummock Grassland (10f)
- Triodia Hummock Grassland (10g)
- Triodia Hummock Grassland (10h)
- Triodia Hummock Grassland (10j)
- Triodia Hummock Grassland (10k)

BHP ENVIRONMENTAL APPROVALS

JIMBLEBAR WEST SOLAR PROJECT NVCP CPS 9178/2 AMENDMENT VEGETATION ASSOCIATIONS

SCALE (A3): 1:10,000	DATUM: GDA94/MGA 51	FIGURE 2
Prepared: Chris Hopkins	Revision: FINAL	
Centre: Perth	Date: 10 March 2023	

Dwg: PWR_005NVCP_002_RevA_0



Jimblebar Rail Loop

Legend

- Proposed Boundary for NVCP CPS 9178/3

Fauna Habitat Type

- Mulga Woodland
- Hardpan Plain
- Sand Plain
- Stony Plain

BHP		ENVIRONMENTAL APPROVALS
<p>JIMBLEBAR WEST SOLAR PROJECT NVCP CPS 9178/2 AMENDMENT VERTEBRATE FAUNA HABITAT</p>		
SCALE (A3): 1:10,000	DATUM: GDA94/MGA 51	FIGURE 3
Prepared: Chris Hopkins	Revision: FINAL	
Centre: Perth	Date: 10 March 2021	
		Dwg: PWR_005NVCP_003_RevA_0

Appendices

Appendix 1: Dynasty and West Jimblebar Flora and Vegetation Survey (Onshore Environmental, 2015)



Dynasty and West Jimblebar Level 2 Flora and Vegetation Survey

**Prepared for BHP Billiton Iron Ore Pty Ltd
June 2015**



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EXECUTIVE SUMMARY

BHP Billiton Iron Ore Pty Ltd (BHP Billiton Iron Ore) commissioned Onshore Environmental Consultants Pty Ltd (Onshore Environmental) to undertake a Level 2 flora and vegetation survey of approximately 3,385 ha encompassing the Dynasty and West Jimblebar tenements, herein referred to as the study area. The study area is located in the south-east Pilbara region of Western Australia, approximately 25 km east of Newman and directly west of BHP Billiton Iron Ore's Wheelarra Hill (Jimblebar) Mine.

There has been a large survey effort completed at surrounding BHP Billiton Iron Ore tenements over previous years, providing an extensive local database. In early 2014 Onshore Environmental completed a desktop flora and vegetation review covering the Dynasty tenement in the western half of the study area (Onshore Environmental 2014a). There have been one previous baseline survey encompassing the West Jimblebar tenement situated across the eastern sector the study area (ENV Australia 2007a). Additionally, six baseline flora and vegetation surveys have been undertaken adjacent to the study area and at least 30 surveys have been completed within a 25 km radius of the study area.

The Level 2 flora and vegetation survey was completed by two botanists from Onshore Environmental working over a seven day period between the 23rd February and 1st March 2015. A total of 29 quadrats and 142 relevé plots were sampled as part of the field assessment. A total number of 263 plant taxa (including varieties and subspecies) from 36 families and 106 genera were recorded from the study area, with species representation greatest amongst the Fabaceae (49 taxa), Poaceae (45 taxa), Malvaceae (33 taxa), Chenopodiaceae (18 taxa) and Amaranthaceae (15 taxa) families. The most speciose genera were *Acacia* (25 taxa), *Sida* (13 taxa), *Senna* (12 taxa), *Eremophila* (9 taxa) and *Ptilotus* (9 taxa).

There was no plant taxon gazetted as Threatened Flora (T) pursuant to subsection (2) of Section 23F of the WC Act or listed under the EPBC Act recorded from the study area.

There were three DPaW listed Priority flora taxon recorded from the study area; *Ipomoea racemigera* (Priority 2), *Goodenia nuda* (Priority 4) and *Goodenia berringbinensis* (Priority 4). *Ipomoea racemigera* is a creeping annual herb recorded from two releve sites (approximately 20 plants at each site) occurring along the major drainage channel of Shovelanna Creek. It has previously been recorded from Newman, Millstream Chichester National Park and Kununurra. *Goodenia nuda* is an erect herb recorded as approximately 150 plants from nine spot locations within the south-western and central eastern sectors of the study area. *Goodenia nuda* has been recorded extensively from over 80 formally documented locations throughout the Pilbara, including Karijini National Park, up to 200 km south east of Newman, Port Hedland and south of Onslow. An isolated record also occurs to the east of the Karlamilyi (Rudall River) National Park. *Goodenia berringbinensis* is an ascending annual herb restricted to a localised drainage foci (approximately 0.5 ha in area) within the south west sector of the study area. An estimated 50 plants occurred on moist light brown clay (gilgai) soils. *Goodenia berringbinensis* has been recorded predominantly within the Murchison with one location represented in the western Gascoyne and western Pilbara.

There were five plant taxa recorded from within the study area that were regarded as range extensions; *Eragrostis speciosa* (150 km south-east), *Hibiscus verdcourtii* (200 km east), *Goodenia berringbinensis* (250 km north), *Eleocharis pallens* (350 km south-east) and *Tribulus* cf. *eichlerianus* (950 km west). This reflects the location of the study area which lies on the south-eastern fringe of the Pilbara bioregion and bordering the Gascoyne bioregion to the south and Little Sandy Desert bioregion to the east.

A total of four introduced (weed) species were recorded from the study area; **Aerva javanica* (Kapok Bush), **Bidens bipinnata* (Bipinnate Beggartick), **Cenchrus ciliaris* (Buffel Grass) and

**Malvastrum americanum* (Spiked Malvastrum). None of these taxa are listed as a Declared Pest under the BAM Act.

A total of 26 vegetation associations were mapped and described within the study area. The vegetation associations were classified into eleven broad floristic formations on the basis of the dominant vegetation stratum. No TECs were recorded from within or adjacent to the study area. None of the vegetation associations described and mapped from the study area were found to have affiliations with any PECs documented within the Pilbara.

The study area is dominated by the Shovelanna Creek system and surrounding plains which are actively grazed by cattle. Grazing of native vegetation by domestic stock and associated introduction of weeds are the primary factors that have reduced vegetation condition across the larger study area to the status of *very good*. Other disturbances recorded were pastoral and exploration tracks, and edge effects from adjacent mining infrastructure in the north-east sector of the study area. Three vegetation associations supported vegetation condition rated as *excellent*; 10f, 10g and 10i. These areas are associated with hill crests and hill slopes situated in the eastern sector of the study area and supporting vegetation that is less palatable to domestic stock and hence largely unimpacted by grazing.

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1.0 INTRODUCTION

1.1 Preamble

Onshore Environmental was commissioned by BHP Billiton Iron Ore to undertake a Level 2 flora and vegetation survey of the Dynasty and West Jimblebar exploration leases, herein referred to as the study area. The study area is located in the south-east Pilbara region of Western Australia, fringing the northern boundary of the Gascoyne region. It is situated approximately 25 km east of Newman and directly west of the existing Wheelarra Hill (Jimblebar) Mine (Figure 1).

1.2 Previous Surveys

There has been one previous flora and vegetation surveys completed within the boundary of the study area:

- ENV Australia (2007a) *West Jimblebar Exploration Lease Flora and Vegetation Assessment*.

Additionally, six baseline surveys have been completed adjacent to the study area:

- ENV Australia (2009a) *Ammonium Nitrate Storage Facility Flora and Vegetation Assessment*;
- ENV Australia (2009b) *Construction Water Supply Pipeline and Ammonium Nitrate Storage Facility Flora and Vegetation Assessment*;
- ENV Australia (2010a) *RGP6 Jimblebar Hub (Water Pipeline) Flora and Vegetation Assessment*;
- Astron (2012) *Eastern Mines Weed Survey, Jimblebar*;
- Onshore Environmental (2014b) *Tenement E52/2238 Level 1 Flora and Vegetation and Level 1 Vertebrate Fauna Survey*; and
- Syrinx (2014) *South West Jimblebar Flora and Vegetation Survey*.

There are a further 30 baseline surveys completed within a 25 km radius of the study area. These surveys are listed and described in more detail in Section 3.1.1.

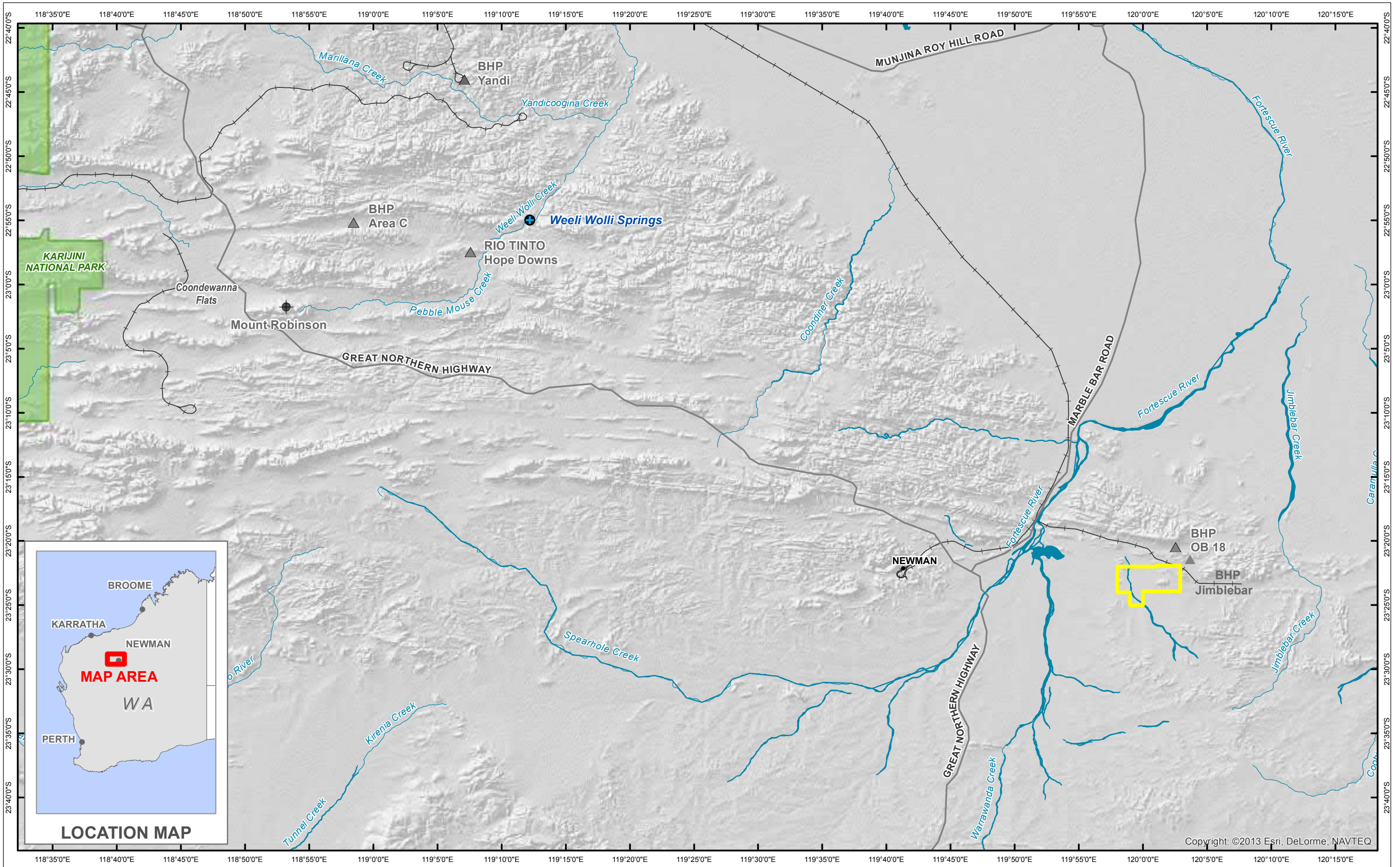
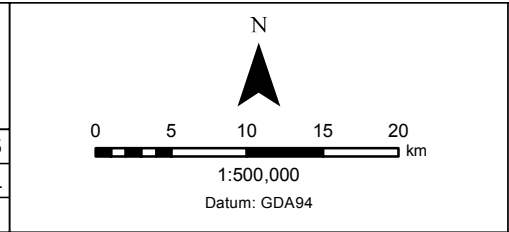


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BHPBIO
DYNASTY - WEST JIMBLEBAR
REGIONAL LOCATION
Figure 1

Legend	
	Study Area - Dynasty - West Jimblebar
	Watercourse Areas
	Nature Conservation Reserve
	Roads
	Railways
	Watercourses

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1.3 Climate

The climate of the south-east Pilbara is arid-tropical with hot summers extending from October to April and mild winters from May to September. The climate is dry and rainfall is variable and unreliable. Rainfall occurs in both summer and winter months with the major falls received during summer. Cyclones that develop over the Indian Ocean bring heavy summer rainfall, especially from January to March. Winter rainfall is generally lighter and typically associated with cold fronts extending from southern parts into the Pilbara region. Annual average rainfall for the Pilbara ranges from 180 millimeters (mm) to over 400 mm (Beard 1975) with a long-term average of 326 mm for the town of Newman (Bureau of Meteorology 2014).

Average maximum summer temperatures are typically between 35°C to 40°C, and winter maximum temperatures are between 22°C and 30°C. Summer temperatures can reach 49°C with frosts occurring occasionally during winter months. The prevailing wind direction for Newman is east south-east between May and August, with stronger west north-west winds dominant between September and March (Bureau of Meteorology 2014).

Rainfall for 2014 was above average with the annual total of 363.0 mm exceeding the long term annual average of 326.8 mm. However, this was due primarily to cyclonic rainfall in January 2014 contributing to a very high monthly total of 220.2 mm. The other months during 2014 with above average falls were July and November (Figure 2).

The monthly total for January 2015 was 5.4 mm with a further 25.6 mm received in February 2015. Seasonal conditions for the field survey completed between the 23rd February and 1st March 2015 were rated as good, noting that much of the new plant growth was in the early stages of development.

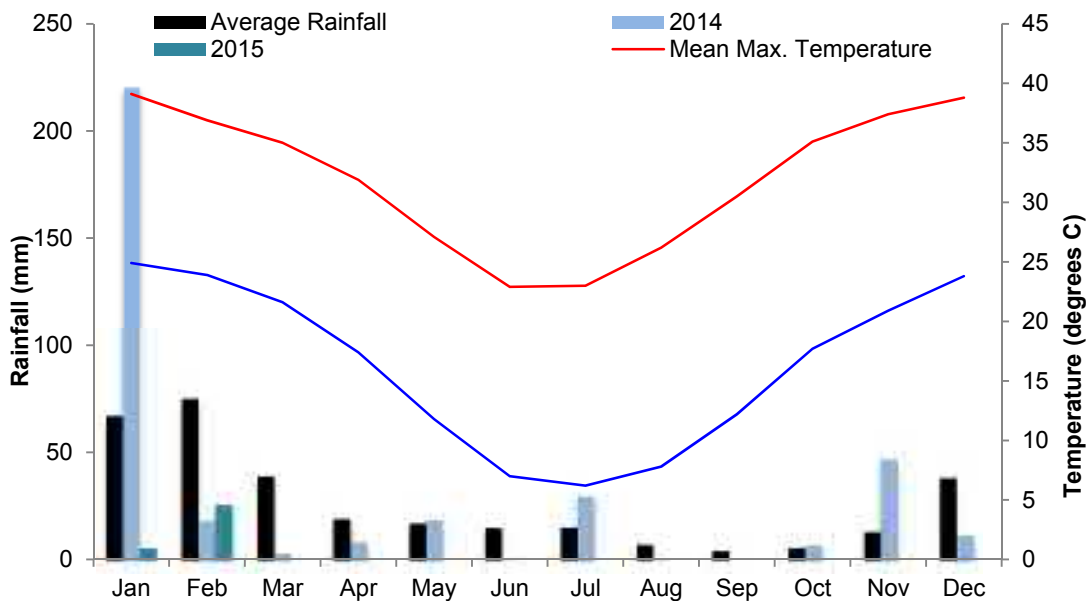


Figure 2 Climate and rainfall data for Newman during 2014 and January to February 2015. Long-term temperature averages are from 1996 to 2013, while long-term rainfall data are calculated from 1971 to 2013 (Bureau of Meteorology 2015).

1.4 Biogeographic Regions

The Interim Biogeographic Regionalisation for Australia (IBRA) describes a system of 85 'biogeographic regions' (bioregions) and 403 subregions covering the entire Australian continent (Thackway and Cresswell 1995). Bioregions are defined on the basis of climate, geology, landforms, vegetation and fauna. The study area is located in close proximity to the border between the Pilbara and Gascoyne Bioregions (Thackway and Cresswell 1995). The subregions in the area are the Hamersley subregion (PIL3) of the Pilbara bioregion and the Augustus subregion (GAS03) of the Gascoyne Bioregion.

The Hamersley subregion is located in the southern section of the Pilbara Craton with a subregion area of 6,215,095 ha. It is described as:

"Mountainous area of Proterozoic sedimentary ranges and plateaux dissected by gorges (basalt, shale and dolerite). Mulga low woodland over bunch grasses on fine textured soils in valley floors, and *Eucalyptus leucophloia* over *Triodia brizoides* on skeletal soils of the ranges. The climate is semi-desert tropical, average 300 mm rainfall, usually in summer cyclonic or thunderstorm events. Winter rain is not uncommon. Drainage into either the Fortescue (to the north), the Ashburton to the south, or the Robe to the west."

The Hamersley subregion (PIL3) is characterised by mountain ranges of Proterozoic sedimentary rock, dissected by gorges (Kendrick 2001; Australian Natural Resource Atlas [ANRA] 2008). Beard (1975) described the Hamersley subregion as "rounded hills and ranges, mainly of jaspilite and dolomite with some shale, siltstone and volcanics". This plateau supports mulga (*Acacia aneura*) low woodland over bunch grasses on fine textured soils and snappy gum (*Eucalyptus leucophloia*) over hummock grass (*Triodia brizoides*) on skeletal sandy soils of the ranges.

The Augustus subregion has an area of 10,687,739ha. It is described as low rugged ranges of Proterozoic sedimentary and granite ranges interspersed by broad flat valleys. The subregion includes the Narryera Complex and Bryah Basin of the Proterozoic Capricorn Orogen (on northern margin of the Yilgarn Craton), as well as the Archaean Marymia and Sylvania Inliers. The main drainage in the subregion is to the Gascoyne River System however the area also contains the headwaters of the Ashburton and Fortescue Rivers. Extensive areas of alluvial valley-fill deposits occur within this subregion. The vegetation on rises consists of Mulga woodland and *Triodia* on shallow stony loams. The hardpan plains of the subregion are dominated by Mulga parkland with shallow earthy loams (Desmond *et al* 2001).

1.5 Existing Land Use

Land tenure in the Pilbara consists of Aboriginal and leasehold reserves, national parks and reserves and Crown land which fall under a range of pastoral and mining leases. The current use of lands surrounding the study area is predominantly for mineral exploration, iron ore mining and dry land agriculture, specifically pastoralism, cattle grazing and rangelands. The study area is located on Sylvania Station within the Shire of East Pilbara, and directly west of the existing Wheelarra Hill (Jimblebar) Mine (Figure 1).

Conservation lands amount to less than ten percent of the total area of the Pilbara Bioregion, with the major reserves being Karijini and Millstream-Chichester National Parks. These Parks are supplemented by lesser conservation estates such as Cane River and Meentheena Conservation Parks. Wetlands of National significance include the permanent pools of Millstream and Karijini National Parks and the Fortescue Marsh. The study area is not within or adjacent to any gazetted conservation reserves. The Collier Range National Park is the nearest reserve, situated approximately 125 km to the south. Karijini National Park is located approximately 150 km west north-west of the study area.

1.6 Landforms

The study area lies on plains situated south of the Ophthalmia Range and east of Ophthalmia Dam. The Ophthalmia Range is characterised by long strike ridges rising from valley floors reaching elevations up to 300 m. The flat valley floors consist of Cainozoic sediments. The study area is dissected by Shovelanna Creek which flows into the Fortescue River.

The landforms of the nearby Wheelarra Hill (Jimblebar) Iron Ore Project area were described by Outback Ecology (2010) as:

- Flats;
- Floodplains;
- Major creeklines
- Minor drainage lines
- Ridges and hillcrests;
- Rocky scree slopes;
- Sandy plains and;
- Stony plains.

1.7 Soils

The soils of the Pilbara have been defined and mapped at a scale of 1:2,000,000 by Bettanay *et al.* (1967). Soils of the Jimblebar area have been described as loamy with weak pedologic development. Tille (2006) collated the most recent and detailed mapping of Western Australia's Rangelands and Arid interior into a hierarchy of soil-landscape mapping units. The study area falls within the Fortescue Province, an area that occupies approximately 160,050 km² (6.3 percent of Western Australia) and includes the towns of Port Hedland, Karratha, Dampier, Roebourne, Newman, Tom Price, Paraburdoo, Pannawonica, Marble Bar, Nullagine and Jigalong.

Soils and landforms of the Fortescue Province are described as "Hills and ranges (with stony plains and some alluvial plains and sandplains) on the volcanic, granitic and sedimentary rocks of the Pilbara Craton. Stony soils with red loamy earths and red shallow loams (and some red/brown non-cracking clays, red deep sandy duplexes and red deep sands)" (Tille 2006). The Fortescue Province is divided into ten soil-landscape zones:

- Nullagine Hills Zone;
- De Grey-Roebourne Lowlands Zone;
- Chichester Ranges Zone;
- Abydos Plains and Hills Zone;
- Fortescue Valley Zone;
- Hamersley Plateaux Zone;
- Karratha Coast Zone;
- Warrawagine Hills Zone;
- Jigalong Plains Zone; and
- Harding Hills and Plains Zone.

The study area occurs at the junction between the Hamersley Plateaux Zone and the Fortescue Valley Zone. The dominant landform features within the Hamersley Plateaux Zone are rocky ranges, hills and stony plains and some hard pan wash plains (Tille 2006). Rugged hills, ridges, dissected plateaux and mountains occur on the basalt, banded iron formation and sandstone of the Hamersley Basin, the most notable examples being the Chichester and Hamersley Range. The study area occurs to the south of the Ophthalmia Range, which together with the Hamersley Range comprise the majority of the Hamersley Plateau. The soils here are generally stony with red shallow loams, red/brown non-cracking clays, and red loamy earths (Tille 2006).

The study area lies in close proximity to the north of the Ashburton Province, which covers a total area of 188,375 km². It is described as “Hills and ranges (with stony plains and hardpan wash plains) on the sedimentary and granitic rocks of the Capricorn Orogen”. The Ashburton Province is comprised predominantly of a mosaic of hills and stony plains. It is divided into eight soil landscape zones:

- Bulloo Plains and Hills Zone;
- South Bangemall Hills Zone;
- Frere uplands Zone;
- Paroo Uplands Zone;
- Yaragner Hills and Plains Zone;
- Gascoyne Valley Zone;
- Stuart Plains and Hills Zone; and
- Ashburton Valley Zone.

The study area lies closest to the Bulloo Plains and Hills Zone, which covers 29,325 km². Landforms within this zone include plains, stony plains, hills and ranges with some sand plains. Soils in the area are red shallow loams (often with hardpans), red loamy earths, stony soils and red deep sands with some red shallow sands. The vegetation is described predominantly as Mulga shrublands with some spinifex grasslands.

1.8 Geology

The ancient continental Western Shield dominates the geology of Western Australia. The Pilbara region makes up a portion of the Western Shield and consists of pre-Cambrian, Proterozoic and Archaean rocks. The area contains some of the earth's oldest rock formations, thought to be around 3.5 billion years old (Australian Natural Resource Atlas [ANRA] 2008). Important mineral reserves, including iron ore, which is prevalent in the Pilbara, are associated with these rock formations. The study area is situated in the southern edge of the Pilbara Craton in close proximity to the sedimentary basins that separate the Yilgarn and Pilbara Cratons. These consist of the sandstone and shales of the Collier and Bresnahan Basins and granites of the Sylvania Inlier (Tille 2006).

The Pilbara Craton lies beneath the Proterozoic rocks of the Hamersley and Bangemall Basins. The Hamersley Basin covers the majority of the southern part of the Pilbara Craton and is separated into three stratigraphic groups; the Fortescue, Hamersley and Turee Creek rock groups.

The Fortescue Group consists mainly of basalt with beds of siltstone, mudstone, shale, dolomite and jaspilite. These rocks form the Chichester Plateau, which lies beneath the Hamersley Plateau. The Turee Creek Group consists of interbedded mudstone, siltstone, sandstone, conglomerate and carbonate. These rocks are the youngest of the three groups and are exposed mainly in the Ashburton Valley. The Hamersley Group is the most relevant to the study area as it contains both the Brockman Iron Formation and the Marra Mamba Iron Formation, which together provide most of the major iron ore deposits in the Pilbara (O'Brien and Associates 1992). This group forms the Hamersley Range and Plateau and consists of jaspilite and dolomite. The jaspilite produces deposits of haematite and limonite, which are mined for iron ore.

The surface geology of the nearby Jimblebar Lease is dominated by the Brockman Iron Formation, Marra Mamba Iron Formation, interbedded chert, Wittenoorn dolomite and alluvium (Williams and Tyler, 1991 as cited in Outback Ecology 2010).

1.9 Flora and Vegetation

Historical systematic flora surveys of the Pilbara are limited to work completed by Burbridge (1959) and Beard (1975), and further refining of the original Beard mapping by Shepherd *et al.* (2002). Beard (1975) mapped vegetation of the Pilbara at a scale of 1:1,000,000. Vegetation within the local area was defined broadly as Mulga low woodlands (continuous) and Mulga (trees in groves and patches).

The original vegetation mapping undertaken by Beard (1975) was refined by Shepherd *et al.* (2002). There were four vegetation associations present within the study area, with 'Kumarina Hills 29' covering the majority of the study area (Figure 3). While the Pre-European extent for each vegetation association is 100 percent, less than ten percent of each association occurs within formal or informal reserves, excluding the 'Fortescue Valley 82' sub-association (Table 1).

Table 1 Pre-European extent of vegetation associations occurring within the study area (Shepherd *et al.* 2002).

Vegetation Sub-Association	Description	Pre-Euro. Extent Remaining	% remaining IUCN Class I-IV Reserves	% remaining Other Reserves	% remaining DPaW Managed PL
Kumarina Hills 29	Sparse low woodland; mulga, discontinuous in scattered groups	100.0	0.3	0.0	2.4
Kumarina Hills 216	Low woodland; mulga (with spinifex) on rises	100.0	0.0	0.0	0.0
Fortescue Valley 82	Hummock grasslands, low tree steppe; snappy gum over <i>Triodia wiseana</i>	100.0	8.9	0.2	1.0
Fortescue Valley 216	Low woodland; mulga (with spinifex) on rises	100.0	0.0	0.0	0.0

The resources boom in the Pilbara over the past decade has resulted in a significant number of site-specific biological surveys being completed as part of the formal environmental approvals process. Since 1991 there have been at least 37 flora and vegetation surveys completed within a 25 km radius of the study area; these are described in more detail in Section 3.1.1.

1.10 Land Systems

The Department of Agriculture has conducted inventory and condition surveys of the Pilbara (van Vreeswyk *et al.* 2004) using an integrated survey method involving the land system approach to rangeland description evaluation. The primary objective of the surveys was to provide comprehensive descriptions and mapping of the biophysical resources of the region as well as an evaluation on the condition of soils and vegetation. The mapping is based on patterns in topography, soils and vegetation.

A total of 102 land systems were defined in the Pilbara at scale of 1:250,000 (van Vreeswyk *et al.* 2004), with seven land systems occurring within the study area (Table 2, Figure 4). The dominant land system represented was the Sylvania and Divide Land Systems consisting of plains and low rises. All the land systems occurring within the study area are common throughout the Pilbara.

Table 2 Land Systems occurring within the study area (descriptions from van Vreeswyk *et al.* 2004).

Land System	Land System	Representation in the Pilbara	Description	Distribution
RGECAD	Cadgie	495 km ² or 0.3%	Hardpan plains with thin sand cover and sandy banks supporting mulga shrublands with soft and hard spinifex.	South-east, common
RGEDIV	Divide	5,293 km ² or 2.9%	Sandplains and occasional dunes supporting shrubby hard spinifex grasslands	Mainly south-east, common
RGEJAM	Jamindie	2,074 km ² or 1.1%	Stony hardpan plains and rises supporting groved mulga shrublands, occasionally with spinifex understorey.	East, common
RGEMCK	McKay	4,202 km ² or 2.3%	Hills, ridges, plateaux remnants and breakaways of meta sedimentary and sedimentary rocks supporting hard spinifex grasslands.	Wide, common
RGENEW	Newman	14,580 km ² or 8.0%	Rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands.	Southern half, very common
RGESYL	Sylvania	1,077 km ² or 0.6%	Gritty surfaced plains and low rises on granite supporting acacia-eremophila-cassia shrublands.	South-east, common
RGEWSP	Washplain	917 km ² or 0.5%	Hardpan plains supporting groved mulga shrublands	South-east, common

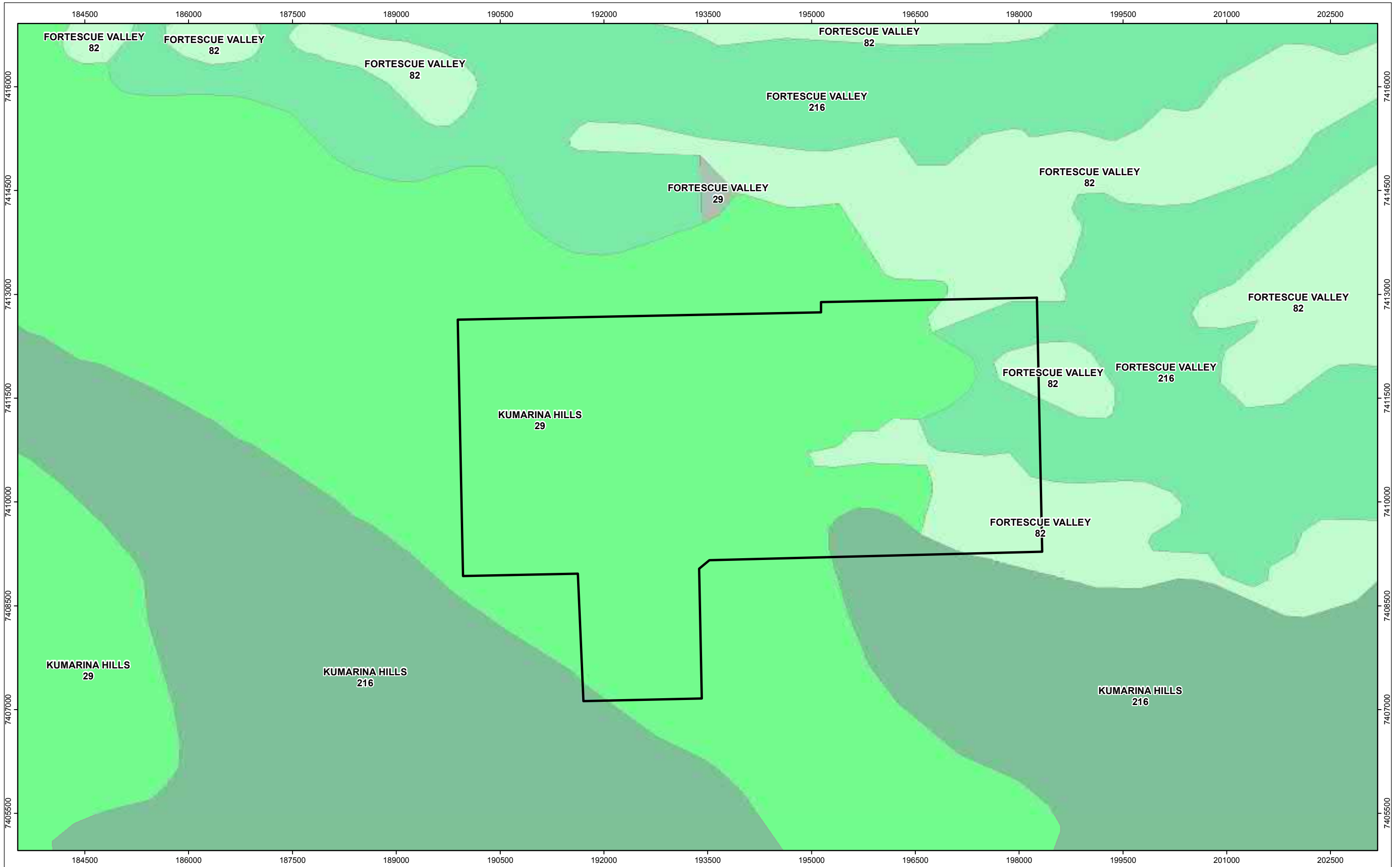
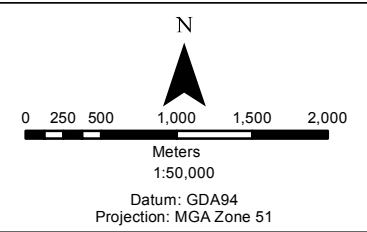


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**BHPBIO
DYNASTY - WEST JIMBLEBAR**
Vegetation of the study area, as
mapped by Beard (1975)
Figure 3

	Study Area - Dynasty-West Jimblebar		FORTESCUE VALLEY, 29
Pre- European Vegetation			FORTESCUE VALLEY, 82
SYSTEM / VEGETATION ASSOCIATION			KUMARINA HILLS, 216
	FORTESCUE VALLEY, 216		KUMARINA HILLS, 29

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2.0 METHODOLOGY

2.1 Desktop Searches

Desktop searches of three databases were completed for information relating to rare flora, TECs and PECs previously collected or described within, or in close proximity to, the study area. For this report a database search covering the entire study area was completed. The search was extended beyond the immediate survey limits to place flora values into a local and regional context. The search co-ordinate used was a 50 km radius around the central point of the study area; 730000 mE 7452500 mN (50K GDA94). The State database search investigated three DPaW databases (DPaW 2013a):

1. The DPaW Threatened (Declared Rare) Flora Database;
2. The DPaW Declared Rare and Priority Flora List (Appendix 1); and
3. The Western Australian Herbarium Specimen Database for priority species opportunistically collected in the area of interest.

A search of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Protected Matters database was undertaken (DoE 2014, Appendix 2), as well as a search of the International Union for Conservation of Nature (IUCN) database (IUCN 2014).

2.2 Literature Review

A total of 37 flora and vegetation surveys previously completed within a 25 km radius of the study area were reviewed to investigate significant flora and vegetation values of the local area. Background survey information was collated including location of survey area relative to the study area, and timing of field assessment. Other data collated included the presence of conservation significant flora and introduced weed species. The current status of flora taxa recorded was checked against Florabase (WAH 2015) to ensure any change in nomenclature or conservation code was identified.

2.3 Field Methodology

2.3.1 Timing and Personnel

The Level 2 flora and vegetation survey was completed by Principal Botanist Dr Jerome Bull and Field Botanist Ms Jessica Waters working over a seven day period between the 23rd February and 1st March 2015.

2.3.2 Sampling of Study Sites

The field survey involved systematic sampling using quadrats (referred to as study sites). Relevé vegetation descriptions were made to increase the accuracy of vegetation mapping and targeted searches were completed in areas supporting significant plant taxa, or within habitats where it was anticipated significant flora may occur.

Quadrats were generally 50 m by 50 m. However along narrow associations such as minor drainage lines an equivalent area (2,500 m²) was surveyed. The area sampled for each quadrat is standard for the Pilbara bioregion. The number of study sites sampled was determined by the size and heterogeneity of the study area, with a minimum density of one quadrat per square kilometre. For the study area a total of 29 quadrats were formally assessed. An additional 142 relevé plots were assessed. The locations of all quadrats and relevé plots sampled are provided in Figure 5.

The sampling sites were assessed to provide a list of the total flora occurring within the study area and a description of the vegetation structure. Data collected covered a range of environmental parameters including:

- Landform and habitat;
- Aspect;
- Soil colour and soil type;
- Rock type;
- Slope (angle);
- Percentage of bare ground, logs, twigs and leaves;
- Vegetation condition;
- Disturbance (caused by fire, clearing, grazing etc.);
- Age since fire;
- Broad floristic formation;
- Vegetation association description; and
- Height and percentage ground cover provided by individual plant taxa.

Other parameters recorded for each study site were:

- Study site number and date of assessment;
- Names of the botanists undertaking the assessment;
- Location description a waypoint – GPS coordinate (GDA94) using a handheld GPS; and
- Photograph number.

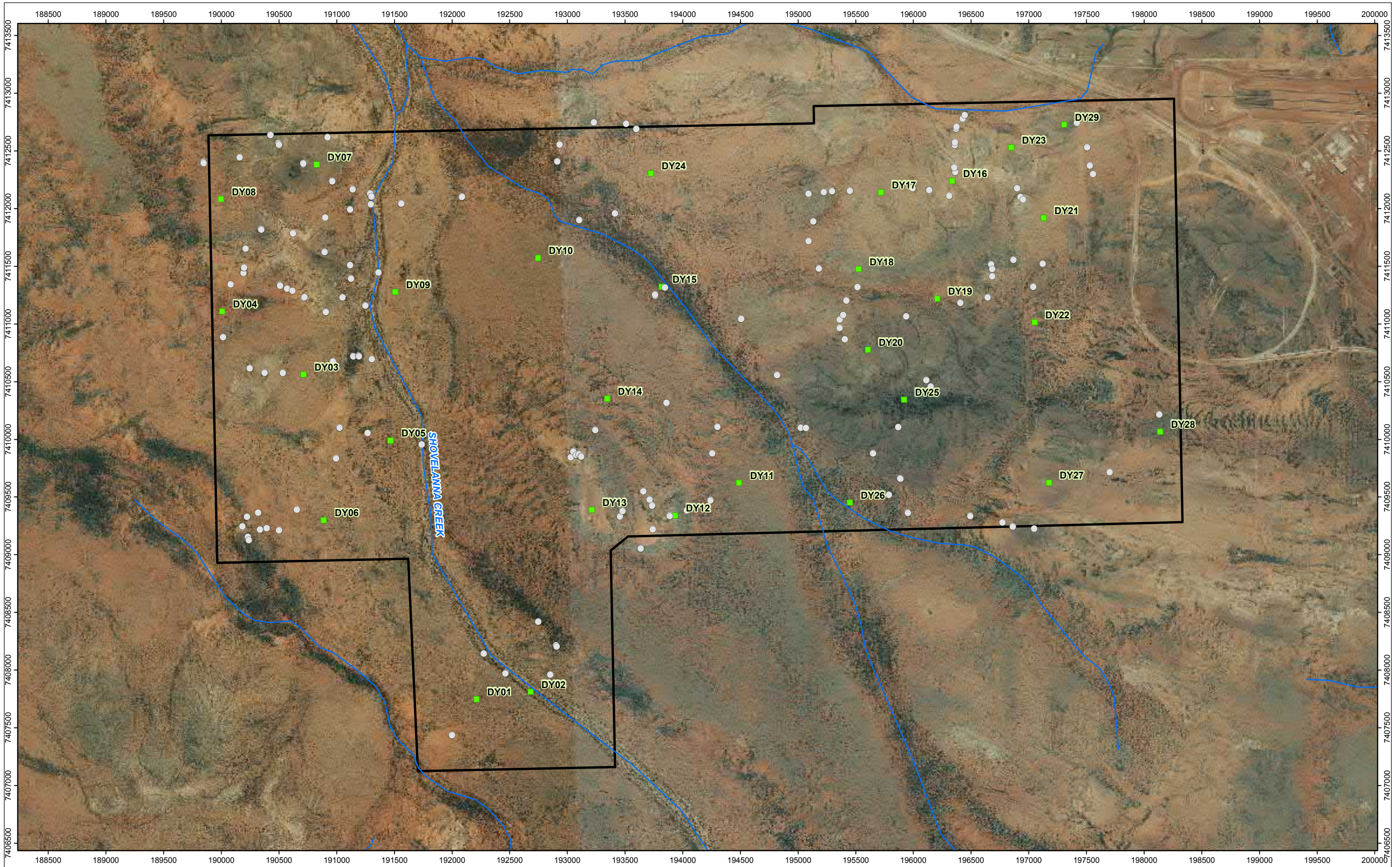
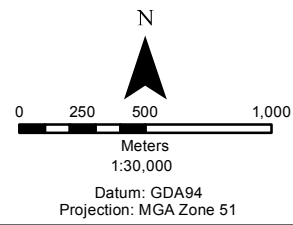


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**BHPBIO
DYNASTY - WEST JIMBLEBAR**

**Study area (quadrat) and
releve plot locations
Figure 5**

Legend

- Study Area - Dynasty-West Jimblebar
- Vegetation Sample Location
- Relleve Location

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2.3.3 Targeted Surveys for Conservation Significant Species

The entire study area was ground truthed at approximately 1 km intervals during field assessment and vegetation mapping. This ground coverage provided the opportunity to record opportunistic locations for Threatened and Priority listed flora, and also undertake closer examination of specific landforms where conservation significant flora may be expected to occur.

2.3.4 Weed Survey and Mapping

Introduced weed species were recorded from the 29 formal quadrats and 142 relevé plots assessed within the study area. Opportunistic collections were also made while moving through the study area and targeted weed searches were completed in high moisture habitats including larger drainage lines and floodplains.

2.3.5 Vegetation Association Mapping

The vegetation mapping utilised high-resolution aerial photography of the entire study area at a scale of 1:15,000, with definition of vegetation polygons based on contrasting shading patterns. Ground-truthing of the study area was completed during the survey with vegetation descriptions made within selected vegetation polygons to confirm dominant structural layers and associated plant taxa.

The location of 29 quadrats (50 m x 50 m or 2,500 m² in equivalent area) and 142 relevé plots was overlaid on the aerial photography, and associated flora and vegetation data was used to provide vegetation association descriptions for individual polygons defined. Description of vegetation structure follows the height, life form and density classes of Specht (1970) as modified by Alpin (1979) and Trudgen (2009) (see Appendix 3). This is largely a structural classification suitable for broader scale mapping, but taking all ecologically significant strata into account. Vegetation condition for each of the sampling sites was determined using a recognised rating scale (based on Keighery 1994, see Appendix 4).

2.3.6 Vouchering

At least one voucher specimen was taken for each species collected to verify identification. Taxonomy was completed by Dr Jerome Bull at the Western Australian Herbarium (WAH), with selected voucher specimens provided to the BHP Billiton Iron Ore sponsored botanist, Mr Steve Dillon. Use was made of the WAH for confirmation of species identification. Nomenclature follows the WAH.

2.3.7 Field Survey Constraints

The EPA Guidance Statement for Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia (EPA 2004) list twelve potential constraints that field surveys may encounter. These constraints are addressed in Table 3.

Table 3 Relevance of constraints, as identified by EPA (2004), to the flora and vegetation survey.

Constraint	Relevance
Scope	The scope was established by BHP Billiton Iron Ore in compliance with relevant EPA Guidance Statements.
Proportion of flora collected and identified	It is likely that a large proportion of the flora occurring within the study area has been collected, given the intensity of the February 2015 survey effort by Onshore Environmental and good seasonal conditions.
Sources of information	Onshore Environmental has recently completed a comprehensive level 2 flora and vegetation survey of the nearby OB31 tenement held by BHP Billiton Iron Ore. There has been additional high intensity sampling from neighboring BHP Billiton Iron Ore tenements (within a 25km radius around the study area), providing an extensive local database (at least 37 baseline survey reports). This is confirmed by the intensity of records for the area on Florabase.
The proportion of the task achieved and further work which might be needed	All allocated tasks were achieved during the survey and no further work is required at this site.
Timing / weather / season / cycle	The survey was completed in late February 2015 following earlier summer rainfall. It is noted that much of the new plant growth was in the early stages of development with the previous year's annual growth largely senescent. However, for the majority of plant taxa this did not prevent accurate species level identification.
Disturbances, e.g. fire, flood	Disturbances within the study area include introduced species, grazing of vegetation and damage to the creekline by domestic stock (cattle), historical access tracks and exploration activities, and adjacent mining operations. None of the disturbances prevented the survey from being accurately completed.
Intensity	A total of 29 quadrats and 142 relevé plots were assessed within the study area by Onshore Environmental at February 2015. This represents a high intensity sampling effort.
Completeness	Given the intensity of sampling, it is considered the area has been adequately surveyed. It is noted that the western half of the study area has only been covered by a single season survey.
Resources	Appropriate resources have been applied to surveying the study area.
Access problems	The entire study area could be accessed by vehicle and on foot, noting that vegetation mapping was facilitated by high-resolution aerial photography. Heavy rainfall restricted vehicular access to the south-east corner of the study area during latter stages of the survey. A ground truthing transect was completed within the area, which has previously been surveyed by ENV Australia (2007a).
Availability of contextual information	At least 37 flora and vegetation surveys have been undertaken within a 25 km radius of the study area, providing an extensive local database.
Experience levels	The Principal Botanist working on the survey has over 15 years Pilbara experience, and the accompanying Field Botanist has in excess of three years Pilbara experience. Both botanists have completed numerous surveys in close proximity to the study area over recent years.

2.4 Vegetation Association Mapping

Desktop vegetation mapping of the western half of the study area was completed by Onshore Environmental in early 2014 as part of a desktop review of the Dynasty tenement (Onshore Environmental 2014a). The eastern half of the study area was recently mapped as part of the West Jimblebar flora and vegetation survey (ENV Australia 2007a). Both of these datasets were used to inform vegetation mapping of the study area during the field survey.

The vegetation mapping utilised high-resolution aerial photography of the entire study area at a scale of 1:15,000, with definition of vegetation polygons based on contrasting shading patterns. The location of 29 quadrats (50 m x 50 m or 2,500 m² in equivalent area) was overlaid on the aerial photography, and associated flora and vegetation data was used to provide vegetation association descriptions for individual polygons defined. Ground-truthing of the study area was completed during the survey and 142 relevé vegetation descriptions were made within selected vegetation polygons to confirm dominant structural layers and associated plant taxa.

Description of vegetation structure follows the height, life form and density classes of Specht (1970) as modified by Alpin (1979) and Trudgen (2009) (see Appendix 3). This is largely a structural classification suitable for broader scale mapping, but taking all ecologically significant strata into account. Vegetation condition for each of the sampling sites was determined using a recognised rating scale (based on Keighery 1994, see Appendix 4).

2.5 Assessment of Conservation Significance

The conservation significance of flora and ecological communities are classified on a Commonwealth, State and Local level on the basis of various Acts and Agreements (EPA Guidance Statement No. 51, EPA 2004), including:

Commonwealth Level:

- EPBC Act: The Department of Environment (DoE) lists Threatened Flora and Ecological Communities, which are determined by the Western Australian Threatened Species Scientific Committee according to criteria set out in the Act. The Act lists flora that are considered to be of conservation significance under one of six categories (Appendix 2).

State Level:

- WC Act: At a State level native flora species are protected under the WC Act – Wildlife Conservation (Rare Flora) Notice. A number of plant species are assigned an additional level of conservation significance based on a limited number of known populations and the perceived threats to these locations. Species of the highest conservation significance are gazetted Threatened Flora (T) under subsection 2 of section 23F of the Act. It is an offence to take or damage Threatened flora without Ministerial approval. Section 23F of the Act defines 'to take' as "to gather, pick, cut, pull up, destroy, dig up, remove or injure the flora or to cause or permit the same to be done by any means".
- DPaW Priority list: DPaW produces a list of Priority species and ecological communities (PECs) that have not been assigned statutory protection under the WC Act. Priority Flora are under consideration for declaration as 'Rare Flora', classified as in urgent need of further survey (Priority One to Three), require monitoring every 5-10 years (Priority Four) or require a specific conservation program to prevent the taxon becoming threatened within five years (Priority 5), see Appendix 1. The list of PECs identifies those that need further investigation before nomination for TEC status.

Local Level:

- Species may be considered of local conservation significance because of their patterns of distribution and abundance. Although not formally protected by legislation, such species are acknowledged to be in decline as a result of threatening processes, primarily habitat loss through land clearing.

3.0 RESULTS

3.1 Desktop Review

3.1.1 Previous Flora and Vegetation Surveys

A total of 37 previous surveys occurring within a 25 km radius of the study area were reviewed to provide local context and inform of flora and vegetation values that may occur within the area of interest. Table 4 summarises the review findings including previous records for conservation significant flora and introduced weed species.

One baseline flora and vegetation survey has previously been completed across the eastern sector of the study area:

- ENV Australia (2007a) *West Jimblebar Exploration Lease Flora and Vegetation Assessment*.

Another six baseline surveys have been completed adjacent to the study area:

- ENV Australia (2009a) *Ammonium Nitrate Storage Facility Flora and Vegetation Assessment*;
- ENV Australia (2009b) *Construction Water Supply Pipeline and Ammonium Nitrate Storage Facility Flora and Vegetation Assessment*;
- ENV Australia (2010a) *RGP6 Jimblebar Hub (Water Pipeline) Flora and Vegetation Assessment*;
- Astron (2012) *Eastern Mines Weed Survey, Jimblebar*;
- Onshore Environmental (2014b) *Tenement E52/2238 Level 1 Flora and Vegetation and Level 1 Vertebrate Fauna Survey*; and
- Syrinx (2014) *South West Jimblebar Flora and Vegetation Survey*.

There are a further 30 baseline surveys completed within a 25 km radius of the study area:

- Dames and Moore (1993) *Ecological Observations Jimblebar Railway Line*;
- BHP IO (1994) *Jimblebar Mine Site Biological Survey*;
- Ecologia Environmental (1996) *Jimblebar Rail Spur Biological Assessment Survey*;
- Ecologia Environmental (2004a) *OB 18 Flora and Fauna Review*;
- Ecologia Environmental (2004a) *Jimblebar-Wheelarra Hill Expansion Biological Study*;
- Biota (2004) *Jimblebar – Wheelarra Hill 3 Flora and Fauna Assessment*;
- Ecologia Environmental (2005) *Jimblebar East Exploration Project Biological Survey*;
- Ecologia Environmental (2006) *Jimblebar Marra Mamba Exploration Biological Survey*;
- ENV Australia (2007b) *RGP4 Jimblebar Rail Loop Flora and Vegetation Assessment*;
- ENV Australia (2007c) *Jimblebar Stage 2, Levee Banks and Communications Tower Redevelopment Flora and Vegetation Assessments*;
- ENV Australia (2007d) *OB 18 Flora and Vegetation Assessment Phase II*;
- ENV Australia (2007e) *Jimblebar Wye Rail Junction (Borrow Areas) Flora and Vegetation Assessment*;
- ENV Australia (2008a) *Rapid Growth Project 5: Repeater 9 Access Road Flora and Vegetation Assessment*;
- ENV Australia (2008b) *Jimblebar Access Road Flora and Vegetation Assessment*;
- GHD (2008a) *Mesa Gap Biological Survey*;
- Pilbara Flora (2008) *OB17 Flora and Vegetation Survey*;

- GHD (2008b) *Wheelarra Hill (Jimblebar Mine Site) Priority Species Verification – Goodenia hartiana Species Verification*;
- Outback Ecology (2009a) *Eastern Pilbara Accommodation Camp Flora and Fauna Assessment*;
- Outback Ecology (2009b) *Jimblebar Linear Development Flora and Vegetation Assessment*;
- Outback Ecology (2009c) *Wheelarra Hill Iron Ore Mine Modification Flora and Fauna Assessment*;
- ENV Australia (2009c) *Jimblebar Spur 2 Flora and Vegetation Assessment*;
- ENV Australia (2010b) *Jimblebar Wye Targeted Declared Rare Flora and Priority Listed Flora Assessment*;
- Outback Ecology (2010) *Jimblebar Iron Ore Project Flora and Vegetation Assessment*;
- Syrinx (2011) *OB 31 Flora and Vegetation Assessment*;
- Syrinx (2012) *Wheelarra Hill North Level 2 Flora and Vegetation Assessment*;
- Eco Logical (2012) *Level 1 flora and fauna surveys along the Great Northern Highway for Jimblebar mine module transport*; and
- Onshore Environmental (2013) *Orebody 17/18 Derived Vegetation Association Mapping Report*;
- Onshore Environmental (2014c) *Orebody 31 / Wheelarra Hill North Targeted Flora Survey*;
- Onshore Environmental (2014d) *Orebody 31 Level 2 Flora and Vegetation Survey*; and
- Onshore Environmental (2014e) *Orebody 18 to Orebody 31 Proposed Infrastructure Corridor Targeted Flora Survey*.

Table 4 Summary of results from previous flora and vegetation surveys completed within a 25 km radius of the study area.

Survey Area	Company	Proximity to Study Area	Survey Timing	Introduced (Weed) Taxa	Conservation Significant Flora
Situated within the study area					
West Jimblebar Exploration Lease Flora and Vegetation Assessment - Management Recommendations	ENV Australia (2007)	Covers the eastern portion of the study area	14-18 May 2007	* <i>Cenchrus ciliaris</i> , * <i>Malvastrum americanum</i> , * <i>Bidens bipinnata</i>	<i>Goodenia nuda</i> (P4) Range extension: <i>Thyridolepis xerophila</i>
Situated adjacent to the study area					
South West Jimblebar Flora and Vegetation Survey	Syrinx (2014)	Adjacent to the study area to the south east	14-8 March 2011 27 August - 4 September 2013	* <i>Bidens bipinnata</i> , * <i>Cenchrus ciliaris</i> , * <i>Cenchrus setiger</i> , * <i>Cucumis melo</i> , * <i>Malvastrum americanum</i> , * <i>Taraxacum officinale</i> , * <i>Vachellia farnesiana</i>	<i>Aristida jerichoensis</i> var. <i>subspinulifera</i> (P3), <i>Vittadinia</i> sp. Coondewanna Flats (S. van Leeuwen 4684) (P1), <i>Euphorbia inappendiculata</i> var. <i>inappendiculata</i> (P2) Range extensions: <i>Abutilon malvifolium</i> , <i>Brachyscome ciliaris</i> var. <i>ciliaris</i> , <i>Euphorbia porcata</i> , <i>Leptochloa fusca</i> subsp. <i>muelleri</i> , <i>Tephrosia sphaerospora</i>
Eastern Mines Weed Survey, Jimblebar	Astron (2012)	Adjacent to the study area to the east	22-30 May 2012	* <i>Acetosa vesicaria</i> , * <i>Aerva javanica</i> , * <i>Bidens bipinnata</i> , * <i>Cenchrus ciliaris</i> , * <i>Chloris barbata</i> , * <i>Chloris virgata</i> , * <i>Citrullus colocynthis</i> , * <i>Cynodon dactylon</i> , * <i>Malvastrum americanum</i> , * <i>Solanum nigrum</i> , * <i>Sochus asper</i> , * <i>Vachellia farnesiana</i>	None

Survey Area	Company	Proximity to Study Area	Survey Timing	Introduced (Weed) Taxa	Conservation Significant Flora
RGP6 Jimblebar Hub (Water Pipeline) Flora and Vegetation Assessment	ENV Australia (2010)	Adjacent to the study area	November 2009	* <i>Cenchrus ciliaris</i> , * <i>Malvastrum americanum</i>	None
Ammonium Nitrate Storage Facility Flora and Vegetation Assessment	ENV Australia (2009a)	Adjacent to the study area	17 September 2009	* <i>Cenchrus ciliaris</i>	None
Construction Water Supply Pipeline and Ammonium Storage Facility Flora and Vegetation Assessment	ENV Australia (2009b)	Adjacent to the study area	17 September and 4-6 November 2009	* <i>Cenchrus ciliaris</i> , * <i>Malvastrum americanum</i>	<i>Goodenia nuda</i> (P4)
RGP4 Jimblebar Rail Loop Flora and Vegetation Assessment	ENV Australia (2007a)	Adjacent to the study area to the east	27 November – 1 December 2006	* <i>Bidens bipinnata</i> , * <i>Cenchrus ciliaris</i>	None
Jimblebar Stage 2, Levee Banks and Communications Tower Redevelopment Flora and Vegetation Assessments	ENV Australia (2007b)	Adjacent to the study area to the east	April – June 2007	* <i>Cenchrus ciliaris</i> , * <i>Cenchrus setiger</i> , * <i>Citrullus lanatus</i> , * <i>Bidens bipinnata</i> , * <i>Cynodon dactylon</i>	None
Jimblebar Marra Mamba Exploration Biological Survey	Ecologia Environmental (2006)	Adjacent to the study area to the east	22-28 May 2006	* <i>Acetosa vesicaria</i> , * <i>Cenchrus ciliaris</i>	<i>Goodenia nuda</i> (P4)
Wheellarra Hill Iron Ore Mine Modification Flora and Fauna Assessment	Outback Ecology (2009)	Adjacent to the study area to the east	October and November 2008 and January 2009	* <i>Cenchrus ciliaris</i>	<i>Goodenia nuda</i> (P4)

Survey Area	Company	Proximity to Study Area	Survey Timing	Introduced (Weed) Taxa	Conservation Significant Flora
Draft Report for Wheelarra Hill (Jimblebar Mine Site) Priority Species Verification – <i>Goodenia hartiana</i> Species Verification	GHD (2008b)	Jimblebar Mine Site adjacent to the study area to the east	25-26 September 2007	None	None
Situated within a 25 km radius of the study area					
Orebody 31 / Wheelarra Hill North Targeted Flora Survey	Onshore Environmental (2014b)	5km north-east of the study area	24-30 April 2014 Targeted flora survey	Not recorded	<i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794) (P3), <i>Triodia</i> sp. Mt Ella (M.E. Trudgen 12739) (P3), <i>Goodenia nuda</i> (P4), <i>Acacia</i> sp. East Fortescue (J. Bull & D. Roberts ONS A 27.01) (P1), <i>Acacia clelandii</i> (range extension)
Orebody 31 Level 2 Flora and Vegetation Survey	Onshore Environmental (2014c)	5km north-east of the study area	1-14 October 2013 Baseline flora survey	* <i>Cenchrus ciliaris</i> , * <i>Malvastrum americanum</i>	<i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794) (P3), <i>Triodia</i> sp. Mt Ella (M.E. Trudgen 12739) (P3), <i>Acacia</i> sp. East Fortescue (J. Bull & D. Roberts ONS A 27.01) (P1)
Orebody 18 to Orebody 31 Proposed Infrastructure Corridor Targeted Flora Survey	Onshore Environmental (2014d)	5km north-east of the study area	13 September 2014 Targeted flora survey	* <i>Cenchrus ciliaris</i>	<i>Triodia</i> sp. Mt Ella (M.E. Trudgen 12739) (P3), <i>Goodenia nuda</i> (P4)
Orebody 17/18 Derived Vegetation Association Mapping Report	Onshore Environmental (2013)	Located to the north of the study area	Desktop review	None	None

Survey Area	Company	Proximity to Study Area	Survey Timing	Introduced (Weed) Taxa	Conservation Significant Flora
Wheellarra Hill North Level 2 Flora and Vegetation Assessment	Syrinx (2012)	It is approx. 10 km to the northwest of the study area.	17-29 May 2011, 4-12 October 2011	* <i>Bidens bipinnata</i> , * <i>Cenchrus ciliaris</i> , * <i>Malvastrum americanum</i>	<i>Aristida ?jerichoensis</i> var. <i>subspinulifera</i> (P3), Range extensions: <i>Sclerolaena minuta</i> , <i>Eragrostis olida</i> , <i>Oldenlandia galioides</i> , <i>Evolvulus alsinoides</i> var. <i>decumbens</i> , <i>Phyllanthus erwinii</i> , <i>Phyllanthus maderaspatensis</i> , <i>Santalum spicatum</i> , <i>Cyperus ixiocarpus</i> , <i>Abutilon cunninghamii</i> Possible range extensions: <i>Tephrosia</i> aff. <i>sphaerospora</i> , <i>Hibiscus</i> aff. <i>apodus</i> .
Level 1 flora and fauna surveys along the Great Northern Highway for Jimblebar mine module transport	Eco Logical (2012)	To the west of the study area along the Great Northern Highway	18-19 August 2011	* <i>Cenchrus ciliaris</i>	None
OB 31 Flora and Vegetation Assessment	Syrinx (2011)	5km north-east of the study area	10-15 February 2011, and 9-13 March 2011	* <i>Bidens bipinnata</i> , * <i>Cenchrus ciliaris</i> , * <i>Malvastrum americanum</i>	None
Jimblebar Wye Targeted Declared Rare Flora and Priority Listed Flora Assessment	ENV Australia (2010)	5km north-west of the study area	3-5 March 2010 8-11 June 2010	None	<i>Gymnanthera cunninghamii</i> (P3)
Jimblebar Iron Ore Project Flora and Vegetation Assessment	Outback Ecology (2010)	To the east and north of the study area	July and September 2008, January and March 2009	* <i>Acetosa vesicaria</i> , * <i>Bidens bipinnata</i> , * <i>Cenchrus ciliaris</i> , * <i>Cucumis melo</i> , * <i>Cucumis myricarpus</i> , * <i>Malvastrum americanum</i>	<i>Josephinia</i> sp. Marandoo (P1), <i>Goodenia nuda</i> (P4)
Eastern Pilbara Accommodation Camp Flora and Fauna Assessment	Outback Ecology (2009a)	Approx. 4 km to the northwest of the study area	30 October – 4 November 2008	None	None

Survey Area	Company	Proximity to Study Area	Survey Timing	Introduced (Weed) Taxa	Conservation Significant Flora
Jimblebar Linear Development Flora and Vegetation Assessment	Outback Ecology (2009b)	To the north of the study area	October 2008, March 2009	* <i>Aerva javanica</i> , * <i>Bidens bipinnata</i> , * <i>Cenchrus ciliaris</i> , * <i>Cenchrus setiger</i> , * <i>Cucumis melo</i> subsp. <i>agrestis</i> , * <i>Cynodon dactylon</i> , * <i>Echinochloa colona</i> , * <i>Malvastrum americanum</i> , * <i>Setaria verticillata</i> , * <i>Tribulus terrestris</i> , * <i>Vachellia farnesiana</i>	<i>Aristida jerichoensis</i> var. <i>subspinulifera</i> (P3)
Jimblebar Spur 2 Flora and Vegetation Assessment	ENV Australia (2009)	To the north of the study area	14-18 September 2009	* <i>Cenchrus ciliaris</i> , * <i>Malvastrum americanum</i>	None
Rapid Growth Project 5: Repeater 9 Access Road Flora and Vegetation Assessment	ENV Australia (2008)	10 km north-west of the study area	12-13 June 2008	* <i>Acetosa vesicaria</i> , * <i>Aerva javanica</i> , * <i>Brassica tournefortii</i> , * <i>Cenchrus ciliaris</i> , * <i>Citrullus lanatus</i> , * <i>Cucumis melo</i> subsp. <i>agrestis</i> , * <i>Cynodon dactylon</i> , * <i>Datura leichhardtii</i> , * <i>Malvastrum americanum</i> , * <i>Setaria verticillata</i> , * <i>Sonchus asper</i> , * <i>Sonchus oleraceus</i> , * <i>Vachellia farnesiana</i>	<i>Rostellularia adscendens</i> var. <i>latifolia</i> (P3)
Jimblebar Access Road Flora and Vegetation Assessment	ENV Australia (2008)	Approximately 4 km north of the study area	20-23 May 2007	* <i>Cenchrus ciliaris</i> , * <i>Aerva javanica</i> , * <i>Citrullus lanatus</i>	None

Survey Area	Company	Proximity to Study Area	Survey Timing	Introduced (Weed) Taxa	Conservation Significant Flora
Mesa Gap Biological Survey	GHD (2008a)	Situated between OB 18 and Wheelarra Hill mine sites, north of the study area	October 2007	None	None
OB17 Flora and Vegetation Survey	Pilbara Flora (2008)	North-east of the study area	October 2008	None	None
OB 18 Flora and Vegetation Assessment Phase II	ENV Australia (2007a)	Located 4 km north-east of the study area	July and August 2006	* <i>Acetosa vesicaria</i> , * <i>Cenchrus ciliaris</i>	None
Jimblebar Wye Rail Junction (Borrow Areas) Flora and Vegetation Assessment	ENV Australia (2007b)	Approximately 5 km north-west of the study area	21-24 August 2007	* <i>Cynodon dactylon</i> , * <i>Cenchrus ciliaris</i> , * <i>Vachellia farnesiana</i>	None
Hashimoto Exploration Project Biological Survey: Flora and Vegetation	Ecologia Environment (2007)	Approximately 15 km south-east of the study area	August/September 2005 and February 2006	* <i>Cenchrus ciliaris</i> , * <i>Bidens bipinnata</i> , * <i>Sonchus oleraceus</i>	<i>Goodenia nuda</i> (P4)
Jimblebar East Exploration Project Biological Survey	Ecologia Environmental (2005)	Approximately 20 km south-east of the study area	8-14 February 2005	* <i>Cenchrus ciliaris</i>	None
OB 18 Flora and Fauna Review	Ecologia Environmental (2004a)	Approximately 4 km north-east of the study area	July 2004	* <i>Cenchrus ciliaris</i>	<i>Rhodanthe frenchii</i> (P2)
Jimblebar-Wheelarra Hill Expansion Biological Study	Ecologia Environmental (2004b)	Adjacent to the east of the study area	9 February – 4 March 2004	* <i>Cenchrus ciliaris</i>	None
Jimblebar – Wheelarra Hill 3 Flora and Fauna Assessment	Biota (2004)	Adjacent east of the study area	August 2003	* <i>Acetosa vesicaria</i>	None

Survey Area	Company	Proximity to Study Area	Survey Timing	Introduced (Weed) Taxa	Conservation Significant Flora
Jimblebar Rail Spur Biological Assessment Survey	Ecologia Environmental (1996)	Located to the north of the study area	6-8 June 1995	* <i>Cenchrus ciliaris</i> , * <i>Acetosa vesicarius</i> , * <i>Malvastrum americanum</i> , * <i>Sonchus oleraceus</i>	None
Jimblebar Mine Site Biological Survey	BHP IO (1994)	Adjacent east of the study area	11-22 June 1994	* <i>Acetosa vesicaria</i>	None
Ecological Observations Jimblebar Railway Line	Dames and Moore (1993)	Runs to the north of the study area	19 - 22 November 1992	None	None

3.1.2 Threatened Flora listed under the EPBC Act

A search of the EPBC Act Protected Matters database was undertaken within a 50 km radius of the study area (DoE 2014). The database search listed one Threatened Flora species or their habitat as potentially occurring within the study area; *Pityrodia augustensis* (Mt Augustus Foxglove). No TECs were identified from the search.

3.1.3 Threatened Flora listed under the IUCN Red List database

A search of the IUCN database produced no records of threatened flora likely to occur within the study area (IUCN 2014).

3.1.4 Threatened Flora listed under the WA Wildlife Conservation (Rare Flora) Notice

The State database search identified one Threatened Flora taxon occurring within a 50 km radius of the study area; *Lepidium catapycnon* (DPaW 2014a).

3.1.5 Priority Flora recognised by the DPaW

The State database search identified 87 Priority flora taxa from a 50 km search radius around the study area (DPaW 2014a, see Table 5). The likelihood of these taxa occurring within the study area has been determined on the basis of proximity of previous records and presence of appropriate habitat.

There are eight taxa considered 'likely' to occur within the study area:

- *Aristida jerichoensis* var. *subspinulifera* (Priority 3);
- *Euphorbia inappendiculata* var. *inappendiculata* (Priority 2);
- *Gymnanthera cunninghamii* (Priority 3);
- *Goodenia nuda* (Priority 4);
- *Josephinia* sp. Marandoo (M.E. Trudgen 1554) (Priority 1);
- *Rhodanthe frenchii* (Priority 2);
- *Rostellularia adscendens* var. *latifolia* (Priority 3); and
- *Vittadinia* sp. Coondewanna Flats (S. van Leeuwen 4684) (Priority 1).

These species have been recorded from surrounding survey areas and the habitats supporting these species are present within the study area (Table 5).

A further 26 significant plant taxa are listed as 'possibly' occurring within the study area. The appropriate habitat type occurs within the study area but no previous records are known from a 10 km radius (Table 5). The remaining taxa are considered 'unlikely' to occur within the study area due to a lack of suitable habitat or absence of previous records from the surrounding area (Table 5).

Table 5 Significant flora previously recorded from a 50 km radius around the study area and likelihood of occurrence within the study area.
 SCC State Conservation Code (WC Act) and DPaW (2014); FCC Federal Conservation Code (EPBC Act)

Species	SCC	FCC	Habitat Description	Habitat Present	Nearest known record	Potential to occur within study area
<i>Acacia bromilowiana</i>	4		Red skeletal stony loam, orange-brown pebbly, gravelly loam, laterite, banded ironstone, basalt. Rocky hills, breakaways, scree slopes, gorges, creek beds	No	Not recorded from previous surveys in close proximity	Unlikely
<i>Acacia dawweana</i>	3		Stony red loamy soils. Low rocky rises, along drainage lines	No	Not recorded from previous surveys in close proximity	Unlikely
<i>Acacia effusa</i>	3		Scree slopes of low ranges	No	Not recorded from previous surveys in close proximity	Unlikely
<i>Acacia subtiliformis</i>	3		Rocky calcrete plateau	No	Not recorded from previous surveys in close proximity	Unlikely
<i>Adiantum capillus-veneris</i>	2		Moist, sheltered sites in gorges and on cliff walls	No	Not recorded from previous surveys in close proximity	Unlikely
<i>Amaranthus centralis</i>	3		Alluvial plain	Yes	Has not been recorded from surrounding study areas. Nearest record close to the Fortescue River approximately 40 km north	Possible
<i>Aristida jerichoensis</i> var. <i>subspinulifera</i>	3		Hardpan plains	Yes	Recorded from Southwest Jimblebar (adjacent to the east) but species unconfirmed. Also recorded from other previous surveys in close proximity	Likely
<i>Astrebla lappacea</i>	3		Plains and floodplains	Yes	Not recorded from previous surveys in close proximity	Possible
<i>Atriplex flabelliformis</i>	3		Saline flats or marshes	No	Not recorded from previous surveys in close proximity	Unlikely
<i>Atriplex lindleyi</i> subsp. <i>conduplicata</i>	3		Crabhole plains	Yes	Not recorded from previous surveys in close proximity	Possible

Species	SCC	FCC	Habitat Description	Habitat Present	Nearest known record	Potential to occur within study area
<i>Barbula ehrenbergii</i>	1		Iron rich weathered conglomerate on gorge walls	No	Not recorded from previous surveys in close proximity	Unlikely
<i>Bothriochloa decipiens</i> var. <i>cloncurrans</i>	1		Plains	Yes	Not recorded from previous surveys in close proximity	Possible
<i>Brachyscome</i> sp. Wanna Munna Flats (S. van Leeuwen 4662)	1		Sump, low in landscape, flat terrain, red-brown loamy soil with some stone, ironstone hardpan outcropping occasionally	Yes	Recorded approximately 15 km east of the study area	Possible
<i>Calotis latiuscula</i>	3		Rocky hillsides, floodplains, rocky creeks or river beds	Yes	Not recorded from previous surveys in close proximity	Possible
<i>Calotis squamigera</i>	1		Pebbly loam	Yes	Not recorded from previous surveys in close proximity	Possible
<i>Cochlospermum macnamarae</i>	1		Upper slopes of a low hill in shallow, stony soil (Hislop <i>et. al.</i> 2013)	Yes	Not recorded from previous surveys in close proximity	Possible
<i>Crotalaria smithiana</i>	3		Regeneration site on floodplain	Yes	Not recorded from previous surveys in close proximity	Possible
<i>Dampiera anonyma</i>	3		Skeletal red-brown to brown gravelly soil over banded ironstone, basalt, shale and jaspilite. Hill summits, upper slopes (above 1000m)	No	Not recorded from previous surveys in close proximity	Unlikely
<i>Dampiera metallorum</i>	3		Skeletal red-brown gravelly soil over banded ironstone. Steep slopes, summits of hills	No	Not recorded from previous surveys in close proximity	Unlikely
<i>Dicladantha glabra</i>	2		Along watercourses, near rock pools	Yes	Not recorded from previous surveys in close proximity	Possible
<i>Eragrostis</i> sp. Mt Robinson (S. van Leeuwen 4109)	1		Red-brown skeletal soils, ironstone. Steep slopes, summits	No	Not recorded from previous surveys in close proximity	Unlikely
<i>Eremophila appressa</i>	1		Ridge slopes	No	Not recorded from previous surveys in close proximity	Unlikely

Species	SCC	FCC	Habitat Description	Habitat Present	Nearest known record	Potential to occur within study area
<i>Eremophila forrestii</i> subsp. Pingandy (M.E. Trudgen 2662)	2		Flat plain with thin soil underlain by partly consolidated colluvium	Yes	Not recorded from previous surveys in close proximity	Possible
<i>Eremophila magnifica</i> subsp. <i>magnifica</i>	4		Skeletal soils over ironstone on rocky hill slopes	No	Not recorded from previous surveys in close proximity	Unlikely
<i>Eremophila magnifica</i> subsp. <i>velutina</i>	3		Skeletal soils over ironstone on summits and rocky hill slopes	No	Not recorded from previous surveys in close proximity	Unlikely
<i>Eremophila pilosa</i>	1		Red brown clay loams on sandy plains	Yes	Approximately 20km north of the study area (ALA 2014)	Possible
<i>Eremophila rigida</i>	3		Hardpan plains, stony clay depressions	Yes	Not recorded from previous surveys in close proximity	Possible
<i>Eremophila</i> sp. Hamersley Range (K. Walker KW 136) PN	1		High ironstone hill slopes	No	Not recorded from previous surveys in close proximity	Unlikely
<i>Eremophila</i> sp. Rudall River (P.G. Wilson 10512) PN	2		Low rises with dense quartz (gibber) scree	No	Not recorded from previous surveys in close proximity	Unlikely
<i>Eremophila</i> sp. Snowy Mountain (S. van Leeuwen 3737)	1		Rocky hills and slopes, ironstone	No	Not recorded from previous surveys in close proximity	Unlikely
<i>Eremophila</i> sp. West Angelas (S. van Leeuwen 4068)	1		High in landscape, summit of hill, gently undulating to steep terrain, skeletal red gritty soil over massive banded iron of the Brockman Iron Formation.	No	Not recorded from previous surveys in close proximity	Unlikely
<i>Eucalyptus lucens</i>	1		Ironstone. Rocky slopes and mountain tops, high in the landscape	No	Not recorded from previous surveys in close proximity	Unlikely
<i>Eucalyptus rowleyi</i>	3		Hard red soil	Yes	Not recorded from previous surveys in close proximity	Possible

Species	SCC	FCC	Habitat Description	Habitat Present	Nearest known record	Potential to occur within study area
<i>Euphorbia parvicaruncula</i>	1		Hard crusty duplex soils, brown gibber soils, shaded positions	Yes	Not recorded from previous surveys in close proximity	Possible
<i>Fimbristylis sieberiana</i>	3		Mud, skeletal soil pockets. Pool edges, sandstone cliffs	No	Not recorded from previous surveys in close proximity	Unlikely
<i>Geijera salicifolia</i>	3		Skeletal soils, stony soils. Massive rock scree, gorges	No	Not recorded from previous surveys in close proximity	Unlikely
Genus sp. Hamersley Range hilltops (S. van Leeuwen 4345)	1		Skeletal, brown gritty soil over ironstone. Hill summit	No	Not recorded from previous surveys in close proximity	Unlikely
<i>Glycine falcata</i>	3		Along drainage depressions in crabhole plains on river floodplains	Yes	Not recorded from previous surveys in close proximity	Possible
<i>Goodenia hartiana</i>	2		Sand dune swales, sand hills	No	Not recorded from previous surveys in close proximity	Unlikely
<i>Goodenia lyrata</i>	3		Red sandy loam. Near claypan	Yes	Not recorded from previous surveys in close proximity	Possible
<i>Goodenia nuda</i>	4		Plains and floodplains	Yes	Recorded within the study area (ENV 2007)	Likely
<i>Goodenia</i> sp. East Pilbara (A.A. Mitchell PRP 727)	3		Red-brown clay soil, calcrete pebbles. Low undulating plain, swampy plains	No	Not recorded from previous surveys in close proximity	Unlikely
<i>Grevillea</i> sp. Turee (J. Bull & G. Hopkinson ONS JJ 01.01) PN	1		Steep mulga breakaways and scree slopes	No	Not recorded from previous surveys in close proximity	Unlikely
<i>Gymnanthera cunninghamii</i>	3		Sandy soils along river banks	Yes	Recorded approx. 5 km north-west of the study area	Likely
<i>Hibiscus</i> sp. Gurinbidy Range (M.E. Trudgen MET 15708)	2		Rocky ridges and hill slopes	Yes	Not recorded from previous surveys in close proximity	Possible
<i>Hibiscus</i> sp. Mt Brockman (E. Thoma ET 1354) PN	1		Rocky ridges and hill slopes	Yes	Not recorded from previous surveys in close proximity	Possible

Species	SCC	FCC	Habitat Description	Habitat Present	Nearest known record	Potential to occur within study area
<i>Indigofera</i> sp. Bungaroo Creek (S. van Leeuwen 4301)	3		Rocky creek gullies and hill slopes	No	Not recorded from previous surveys in close proximity	Unlikely
<i>Indigofera</i> sp. Gilesii (M.E. Trudgen 15869) PN	3		Pebbly loam amongst boulders & outcrops. Hills	No	Not recorded from previous surveys in close proximity	Unlikely
<i>Iotasperma sessilifolium</i>	3		Cracking clay, black loam. Edges of waterholes, plains	Yes	Not recorded from previous surveys in close proximity	Possible
<i>Ipomoea racemigera</i>	1		Major drainage lines and flood plains	Yes	Not recorded from previous surveys in close proximity	Possible
<i>Isotropis parviflora</i>	2		Valley slope of ironstone plateau	No	Not recorded from previous surveys in close proximity	Unlikely
<i>Josephinia</i> sp. Marandoo (M.E. Trudgen 1554)	1		Gritty soil, granite. Plains, mixed shrubland of <i>Senna</i> and <i>Acacia</i>	Yes	Recorded approximately 4km east of the study area	Likely
<i>Lepidium catapycnon</i>	T	V	Skeletal soils. Hillsides	No	Previously recorded from Mt Whaleback and other locations around Newman	Unlikely
<i>Maireana prosthocochaeta</i>	3		Laterite, gibber plains, hills, salty places	No	Not recorded from previous surveys in close proximity	Unlikely
<i>Myriocephalus scalpellus</i>	1		Depressions on flood plains	Yes	Not recorded from previous surveys in close proximity	Possible
<i>Nicotiana heterantha</i>	1		Seasonally wet flats	Yes	Not recorded from previous surveys in close proximity	Possible
<i>Nicotiana umbratica</i>	3		Shallow soils. Rocky outcrops	No	Not recorded from previous surveys in close proximity	Unlikely
<i>Oldenlandia</i> sp. Hamersley Station (A.A. Mitchell PRP 1479)	3		Cracking clay, basalt. Gently undulating plain with large surface rocks, flat crabholed plain	Yes	Not recorded from previous surveys in close proximity	Possible
<i>Olearia mucronata</i>	3		Schistose hills, along drainage channels	No	Not recorded from previous surveys in close proximity	Unlikely

Species	SCC	FCC	Habitat Description	Habitat Present	Nearest known record	Potential to occur within study area
<i>Oxalis</i> sp. Pilbara (M.E. Trudgen 12725)	2		Shaded gully on the lower slopes of a large hill, in the flowline in the gully. Soil: pebbly/gravelly red-brown loam amongst boulders	No	Not recorded from previous surveys in close proximity	Unlikely
<i>Pentalepis trichodesmoides</i> subsp. <i>hispida</i>	2		Summits and slopes of low hills, on basaltic soils amongst <i>Triodia</i> Hummock Grassland (Orchard and Cross 2012)	No	Not recorded from previous surveys in close proximity	Unlikely
<i>Peplidium</i> sp. <i>fortescue</i> marsh (S. van Leeuwen 4865)	1		Saline marshes and flats	No	Not recorded from previous surveys in close proximity	Unlikely
<i>Pilbara trudgenii</i>	2		Skeletal, red stony soil over ironstone. Hill summits, steep slopes, screes, cliff faces	No	Not recorded from previous surveys in close proximity	Unlikely
<i>Polymeria distigma</i>	3		Sandy soils	Yes	Not recorded from previous surveys in close proximity	Possible
<i>Ptilotus subspinescens</i>	3		Gentle rocky slopes, screes and the bases of screes	No	Not recorded from previous surveys in close proximity	Unlikely
<i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794)	3		Floodplains, hardpan plains	Yes	Not recorded from previous surveys in close proximity	Possible
<i>Rhodanthe frenchii</i>	2		Stony hills, rocky river banks and outcrops	Yes	Recorded approx. 4 km to the north east	Likely
<i>Rhynchosia bungarensis</i>	4		Pebbly, shingly coarse sand amongst boulders. Banks of flow line in the mouth of a gully in a valley wall	No	Not recorded from previous surveys in close proximity	Unlikely
<i>Rostellularia adscendens</i> var. <i>latifolia</i>	3		Ironstone soils. Near creeks, rocky hills	Yes	Recorded approx. 10 km northwest	Likely
<i>Scaevola</i> sp. Hamersley Range basalts (S. van Leeuwen 3675)	2		Skeletal, brown gritty soil over basalt. Summits of hills, steep hills	No	Not recorded from previous surveys in close proximity	Unlikely

Species	SCC	FCC	Habitat Description	Habitat Present	Nearest known record	Potential to occur within study area
<i>Sida</i> sp. Barlee Range (S. van Leeuwen 1642)	3		Skeletal red soils pockets. Steep slope	No	Not recorded from previous surveys in close proximity	Unlikely
<i>Sida</i> sp. Hamersley Range (K. Newbey 10692)	1		Rocky ridges and hill slopes	Yes	Not recorded from previous surveys in close proximity	Possible
<i>Solanum albostellatum</i>	3		Cracking clay soils on open floodplains (Davis and Hurter 2012)	Yes	Not recorded from previous surveys in close proximity	Possible
<i>Solanum kentrocaule</i>	3		High altitude (700-1250m) hilltops and hillslopes and occasionally creekbeds (Bean 2013)	No	Not recorded from previous surveys in close proximity	Unlikely
<i>Spartothamnella puberula</i>	2		Rocky loam, sandy or skeletal soils, clay. Sandplains, hills	Yes	Not recorded from previous surveys in close proximity	Possible
<i>Stemodia</i> sp. Battle Hill (A.L. Payne 1006)	1		Floodplain	Yes	Not recorded from previous surveys in close proximity	Possible
<i>Swainsona thompsoniana</i>	3		Open floodplains on heavy clay soils (Davis and Hurter 2013)	Yes	Not recorded from previous surveys in close proximity	Possible
<i>Tecticornia medusa</i>	3		Red-brown gritty clay on a saline alluvial plain (Shepherd and van Leeuwen 2011)	No	Not recorded from previous surveys in close proximity	Unlikely
<i>Tecticornia</i> sp. Christmas Creek (K.A. Shepherd & T. Colmer et al. KS 1063)	1		Salt flats and marshes	No	Not recorded from previous surveys in close proximity	Unlikely
<i>Tetradlea fordiana</i>	1		Shale pocket amongst ironstone	No	Not recorded from previous surveys in close proximity	Unlikely
<i>Teucrium pilbaranum</i>	1		Crab hole plain in a river floodplain, margin of calcrete table	Yes	Not recorded from previous surveys in close proximity	Possible
<i>Themeda</i> sp. Hamersley Station (M.E. Trudgen 11431)	3		Red clay. Clay pan, grass plain	Yes	Recorded approx. 40 km west northwest	Possible

Species	SCC	FCC	Habitat Description	Habitat Present	Nearest known record	Potential to occur within study area
<i>Thryptomene wittweri</i>	T	V	Skeletal red stony soils. Breakaways, stony creek beds. Light orange-brown, pebbly loam. Amongst rocks & outcrops, gully slopes	No	Not recorded from previous surveys in close proximity	Unlikely
<i>Triodia</i> sp. Karijini (S. van Leeuwen 4111) PN	1		High hill crests and slopes	No	Not recorded from previous surveys in close proximity	Unlikely
<i>Triodia</i> sp. Mt Ella (M.E. Trudgen 12739)	3		Light orange-brown, pebbly loam. Amongst rocks & outcrops, gully slopes	No	Not recorded from previous surveys in close proximity	Unlikely
<i>Triodia</i> sp. Robe River (M.E. Trudgen et al. MET 12367)	3		Slopes or peaks of mesas	No	Not recorded from previous surveys in close proximity	Unlikely
<i>Triodia triticoides</i>	1		Rocky sandstone and limestone hillslopes	No	Recorded approx. 30 km west north west of the study area	Unlikely
<i>Vittadinia</i> sp. Coondewanna Flats (S. van Leeuwen 4684)	1		Floodplains, hardpan plains	Yes	Not recorded from previous surveys in close proximity	Possible
<i>Whiteochloa capillipes</i>	3		Drainage lines and levee banks	No	Not recorded from previous surveys in close proximity	Unlikely

3.1.6 TECs listed under State and Federal Legislation

A search of the EPBC Act Protected Matters database (DoE 2014) confirmed there were no Federal listed TECs previously recorded within or adjacent to the study area.

Similarly, a search of the State database by DPaW (2013b) confirmed there were no State listed TEC records for the immediate study area. The Ethel Gorge Aquifer Stygobiont Community (Table 6) is associated with a narrow section of the Fortescue River situated approximately 12 km west of the study area (Figure 6). However the significant characteristics of this community relate to the stygofauna community and are unrelated to flora and vegetation, and hence will not be discussed further.

3.1.7 PECs recognised by DPaW

A search of the State database by DPaW confirmed that no PECs occur within, or in close proximity to, the study area (Figure 6). There are two PEC records known from a 90 km radius around the study area; Vegetation of sand dunes of the Hamersley Range/Fortescue Valley (previously Fortescue Valley Sand Dunes) situated approximately 45 km to the north-east, and the Weeli Wolli Spring Community situated approximately 90 km to the east north-east (Table 6, Figure 6).

Table 6 TECs and PECs known to occur within a 90 km radius of the study area.

Threatened or Priority Ecological Community	Priority
<p>Ethel Gorge Aquifer Stygobiont Community A diverse stygofaunal community situated on the Ophthalmia Floodplain. The aquifer extends 20 km north and 14 km south of Ophthalmia Dam (Environmental Protection Authority 2010).</p>	EN B) ii)
<p>Weeli Wolli Spring Community Fringing forest or tall woodland of Silver Cadjeput (<i>Melaleuca argentea</i>) and River Red Gum (<i>Eucalyptus camaldulensis</i>) over trees of Coolibah (<i>Eucalyptus victrix</i>) and a dense shrub layer dominated by wattles, in particular Pilbara Jam (<i>Acacia citrinoviridis</i>). Threats: dewatering and re-watering altering patterns of inundation, weed invasion.</p>	Priority 1
<p>Vegetation of sand dunes of the Hamersley Range/Fortescue Valley (previously Fortescue Valley Sand Dunes) This community consists of red linear sand dunes of the Divide Land system. They lie at the junction between the Hamersley Range and Fortescue Valley, between Weeli Wolli Creek and the low hills to the west. A small number are vegetated with <i>Acacia dictyophleba</i> scattered tall shrubs over <i>Crotalaria cunninghamii</i>, <i>Trichodesma zeylanicum</i> var. <i>grandiflorum</i> open shrubland. They are regionally rare, small and fragile and highly susceptible to threatening processes including weed invasion especially Buffel Grass, and erosion.</p>	Priority 3(iii)

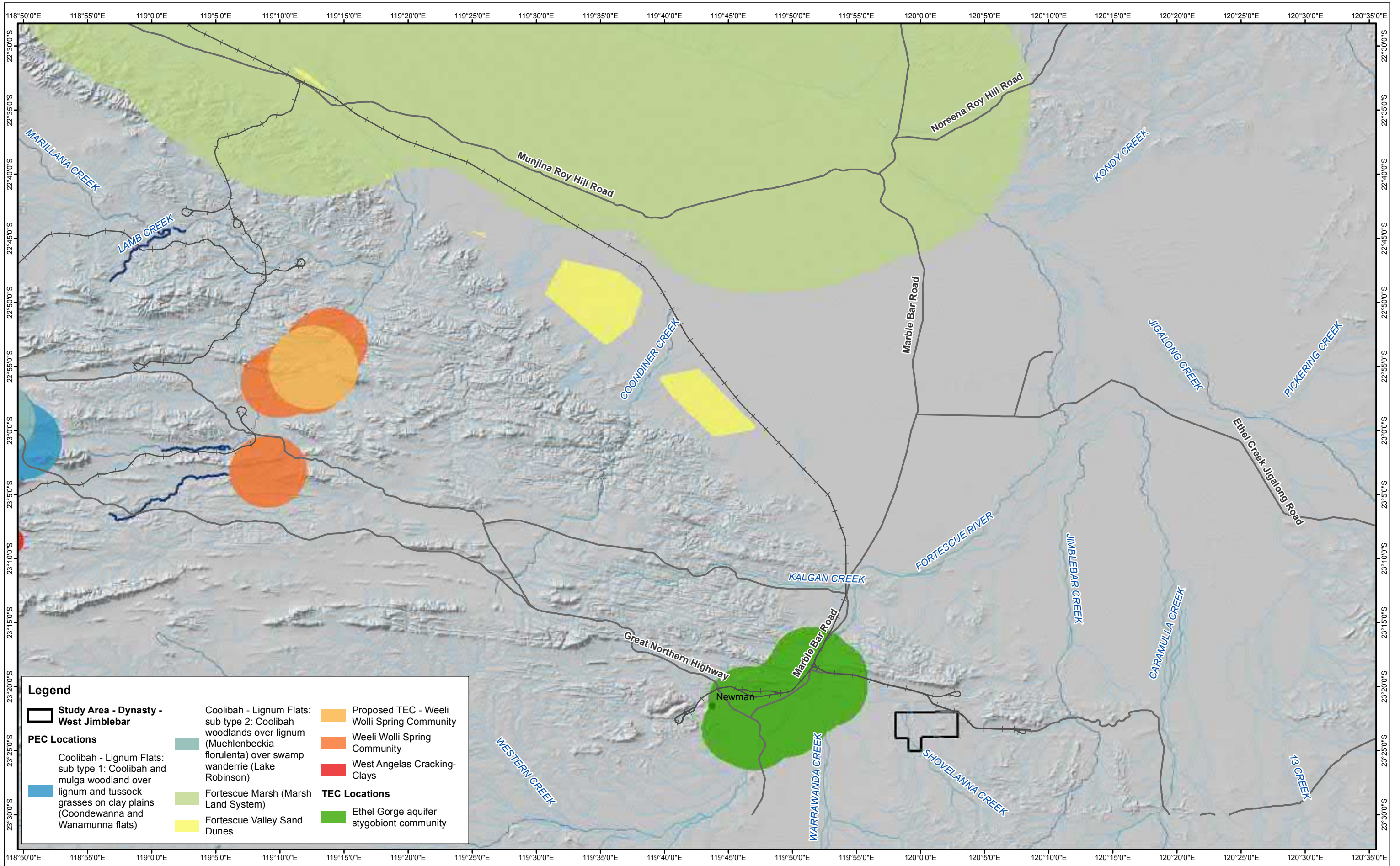
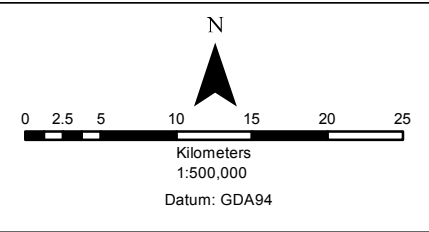
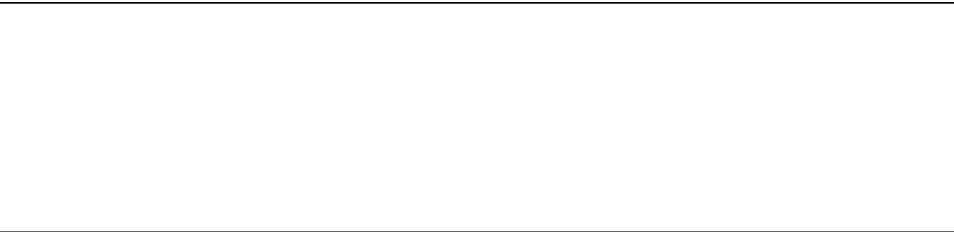


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Location of PECs/TEC near the study area, as mapped by the DPaW
Figure 6



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3.2 Flora Species

A total number of 263 plant taxa (including varieties and subspecies) from 36 families and 106 genera were recorded from the study area (Table 7, Appendix 5). Species representation was greatest among the Fabaceae (49 taxa), Poaceae (45 taxa), Malvaceae (33 taxa), Chenopodiaceae (18 taxa) and Amaranthaceae (15 taxa) families, which is typical for the Pilbara Bioregion. The most speciose genus was *Acacia* (25 taxa), followed by *Sida* (13 taxa), *Senna* (12 taxa), *Eremophila* (9 taxa) and *Ptilotus* (9 taxa).

Table 7 Statistics for total flora recorded from the study area.

Overview	No. Taxa
Families	36
Genera	106
Taxa (species, subspecies, varieties)	263
Native Taxa	259
Introduced Taxa	4
Threatened Flora	0
Priority Flora	3
Range Extensions	5
Speciose Families	No. Taxa
Fabaceae	49
Poaceae	45
Malvaceae	33
Chenopodiaceae	18
Amaranthaceae	15
Cyperaceae	10
Goodeniaceae	9
Scrophulariaceae	9
Convolvulaceae	9
Asteraceae	8
Myrtaceae	8
Speciose Genera	No. Taxa
<i>Acacia</i>	25
<i>Sida</i>	13
<i>Senna</i>	12
<i>Eremophila</i>	9
<i>Ptilotus</i>	9
<i>Maireana</i>	7
<i>Sclerolaena</i>	7
<i>Eriachne</i>	7
<i>Corchorus</i>	6
<i>Goodenia</i>	6
<i>Triodia</i>	6
<i>Cyperus</i>	5
<i>Hibiscus</i>	5
<i>Ipomoea</i>	5
<i>Abutilon</i>	4
<i>Eragrostis</i>	4

3.3 Conservation Significant Flora Species

3.3.1 Threatened Flora listed under the WC Act and EPBC Act

There was no plant taxon gazetted as Threatened Flora (T) pursuant to subsection (2) of Section 23F of the WC Act or listed under the EPBC Act recorded from the study area.

3.3.2 Significant Flora

There were three DPaW listed Priority flora taxon recorded from the study area; *Ipomoea racemigera* (Priority 2), *Goodenia berringbinensis* (Priority 4) and *Goodenia nuda* (Priority 4). The location of these taxa within the study area is presented in Figure 7 and listed in Appendix 6.

Ipomoea racemigera is a creeping annual herb or climber with white flowers (Plate 1). It has previously been recorded from Newman, Millstream Chichester National Park and Kununurra. Within the study area it was recorded from two releve sites (approximately 20 plants at each site) occurring along the major drainage channel of Shovellana Creek. Vegetation was described as 'Open Woodland of *Eucalyptus victrix* over Low Open Woodland of *Eucalyptus victrix*, *Acacia coriacea* subsp. *pendens* and *Hakea lorea* subsp. *lorea* over High Shrubland of *Acacia pyrifolia* var. *pyrifolia* and Low Open Shrubland of *Tephrosia rosea* var. *Fortescue* creeks (M.I.H. Brooker 2186)' (Figure 7).

Goodenia berringbinensis is an ascending annual herb occurring to between 0.1 m and 0.3 m in height and flowering yellow (Plate 2). It is typically found on red sandy loam along watercourses. Within the study area plants were restricted to a localised drainage foci approximately 0.5 ha in area in the south-west sector of the study area (Figure 7). An estimated 50 plants occurred on moist light brown clay (gilgai) soils. Vegetation was described as 'Tussock Grassland of *Eriachne benthamii*, *Leptochloa fusca* subsp. *muelleri* and *Echinochloa colona* with High Open Shrubland of *Acacia tetragonophylla* and *Acacia synchronicia*, Open Sedges of *Schoenoplectis laevis*, *Cyperus difformis* and *Elytrophorus spicatus* and Open Herbs of *Marsilea hirsuta* and *Goodenia berringbinensis*'. *Goodenia berringbinensis* has been recorded predominantly within the Murchison with one location represented in the western Gascoyne and western Pilbara.

Goodenia nuda occurs on drainage levees, flood plains and sand plains as an erect annual or biennial herb to 0.3 m in height (Plate 3). It is widespread throughout the Pilbara, with records also from the northern Carnarvon and eastern Gascoyne bioregions. This species is typically recorded from relatively mesic habitats, such as floodplains and drainage areas. *Goodenia nuda* was recorded from nine spot locations; seven occurring in the south-west corner of the study area, and two in the central eastern sector of the study area (Figure 7). The south-western population occurred as approximately 100 plants on red brown light clay soils on clay flats supporting 'Low Woodland of *Acacia aptaneura* over High Shrubland of *Acacia tetragonophylla* and *Hakea preissii* over Open Shrubland of *Eremophila margarethae*, *Senna artemisoides* subsp. *helmsii* and *Senna artemisoides* subsp. *oligophylla* over Open Tussock Grassland of *Aristida inaequiglumis*, *Eragrostis xerophila* and *Enteropogon ramosus*'. The central eastern population occurred as less than 50 plants on brown loam soils on flood plains supporting 'Low Open Woodland of *Acacia aptaneura* over Open Shrubland of *Acacia aptaneura* over Very Open Hummock Grassland of *Triodia pungens*, *Triodia basedowii* and *Triodia* sp. Shovelanna Hill (s. Van Leeuwen 3835)'. *Goodenia nuda* has been recorded extensively from over 80 formally documented locations throughout the Pilbara, including Karijini National Park, 200 km to the south east of Newman, Port Hedland and south of Onslow. An isolated record also occurs to the east of the Karlamilyi (Rudall River) National Park.



Plate 1 *Ipomoea racemigera* (Priority 2)



Plate 2 *Goodenia berringbinensis* (Priority 4)



Plate 3 ***Goodenia nuda* (Priority 4)**

3.3.3 Range Extensions

Five plant taxa recorded from within the study area were regarded as range extensions; *Eragrostis speciosa* (150 km south-east), *Hibiscus verdcourtii* (200 km east), *Goodenia berringbinensis* (250 km north), *Eleocharis pallens* (350 km south-east) and *Tribulus* cf.¹ *eichlerianus* (950 km west). The range extensions likely reflect the location of the study area which lies on the south-eastern fringe of the Pilbara bioregion and bordering the Gascoyne bioregion to the south and Little Sandy Desert bioregion to the east. This transitional zone supports an overlap of plant taxa from the three bioregions, noting that a larger body of contextual information is available for the Pilbara bioregion.

¹ Closest identification based on published descriptions and keys. The only previous record is from near the Central Ranges close to the Western Australian Border. A portion of the collection has been forwarded on to R. Barker for a second opinion.

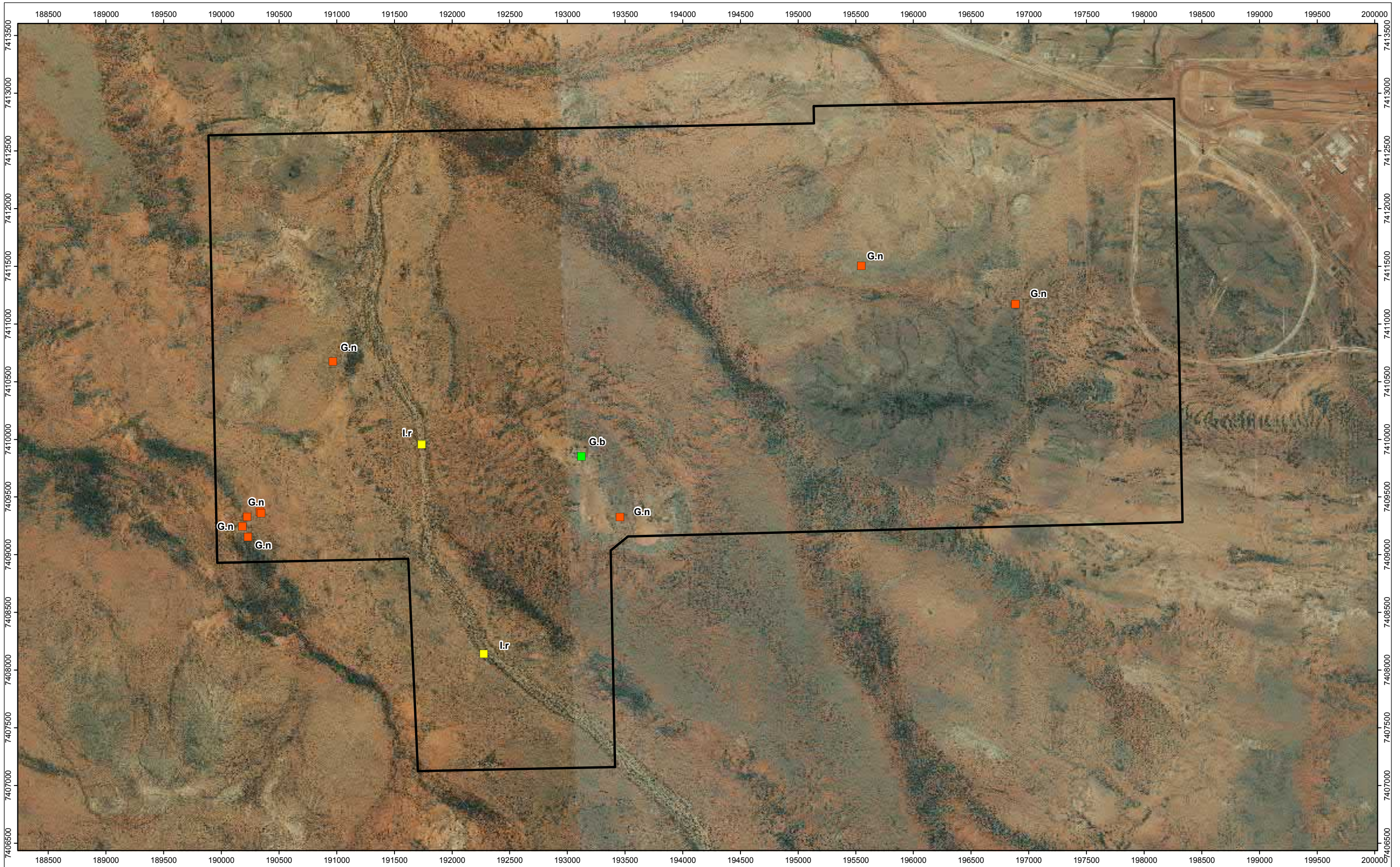
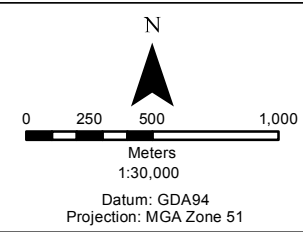


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**FIGURE 7
Significant Flora Locations**

Legend
 Study Area - Dynasty-West Jimblebar

- Significant Flora**
- Goodenia berringbinensis* (G.b)
 - Goodenia nuda* (G.n)
 - Ipomoea racemigera* (I.r)

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3.4 Introduced Flora



A total of four introduced (weed) species were recorded from the study area (Table 8, Figure 8, Appendix 7):

- **Aerva javanica* (Kapok Bush);
- **Bidens bipinnata* (Bipinnate Beggartick);
- **Cenchrus ciliaris* (Buffel Grass); and
- **Malvastrum americanum* (Spiked Malvastrum).

None of these taxa are listed as a Declared Pest under the BAM Act.

Table 8 Introduced weed species recorded from the study area.

Taxon (Common Name)	Photograph	Description	Occurrence within the Study Area
<p>*<i>Aerva javanica</i> (Kapok Bush)</p>		<p>An erect branched perennial herb that grows to between 0.4 m and 1.6 m in height, flowering (white) between January and October. This species prefers sandy soils and is commonly found along drainage lines. Kapok Bush is native to northern Africa and south-west Asia but is found across northern Western Australia, Queensland, South Australia and the Northern Territory (Hussey <i>et al.</i> 1997).</p>	<p>Recorded from one location in the north-west sector of the study area occurring on a sandy floodplain adjacent to Shovelanna Creek (Figure 8).</p> <p>Plants were recorded as scattered individuals providing less than two percent ground cover.</p>
<p>*<i>Bidens bipinnata</i> (Bipinnate Beggars Tick)</p>		<p>Erect annual herb that grows up to 1m in height. This species is widespread in the northern parts of Western Australia from Shark Bay up to the Northern Territory border. It has three pronged barbs on its seeds so it is easily spread by livestock and other animals. In the Pilbara it is common in moist habitats such as drainage lines, flood plains and gorges, and responds vigorously following rainfall.</p>	<p>Recorded from nine spot locations along Shovelanna Creek and the surrounding flood plains, scattered across the majority of the study area (Figure 8).</p> <p>Ground coverage typically represented as scattered plants providing less than two percent cover, with localised denser clusters with cover up to 10 percent.</p>

Taxon (Common Name)	Photograph	Description	Occurrence within the Study Area
<p>*<i>Cenchrus ciliaris</i> (Buffel Grass)</p>		<p>Tufted perennial grass originating from the Middle East as a fodder species by pastoralists. It grows in dense tussocks up to 1 m tall and typically occurs in monospecific stands on loamy plains and creekline levee banks. It is an aggressive colonising species that has become well established throughout the Pilbara, Gascoyne and Murchison regions of Western Australia, and is continuing to spread in the south west (Hussey <i>et al.</i> 1997).</p>	<p>Recorded from 28 locations scattered across the entire study area (Figure 8). Most prolific populations associated with levee banks of Shovelanna Creek and adjacent flood plains frequented by cattle.</p> <p>Provided ground coverage up to 30 percent.</p>
<p>*<i>Malvastrum americanum</i> (Spiked Malvastrum)</p>		<p>Erect perennial herb or shrub, ranging from 0.5 m to 1.3 m in height. It grows in a variety of soil types on stony ridges and hill sides, flood plains and along drainage lines.</p>	<p>Recorded from three locations in the southwest sector of the study area associated with Mulga on flood plains and drainage flats (Figure 8).</p> <p>Generally represented as scattered plants (ground cover less than two percent) or localised denser clusters with cover up to 10 percent.</p>

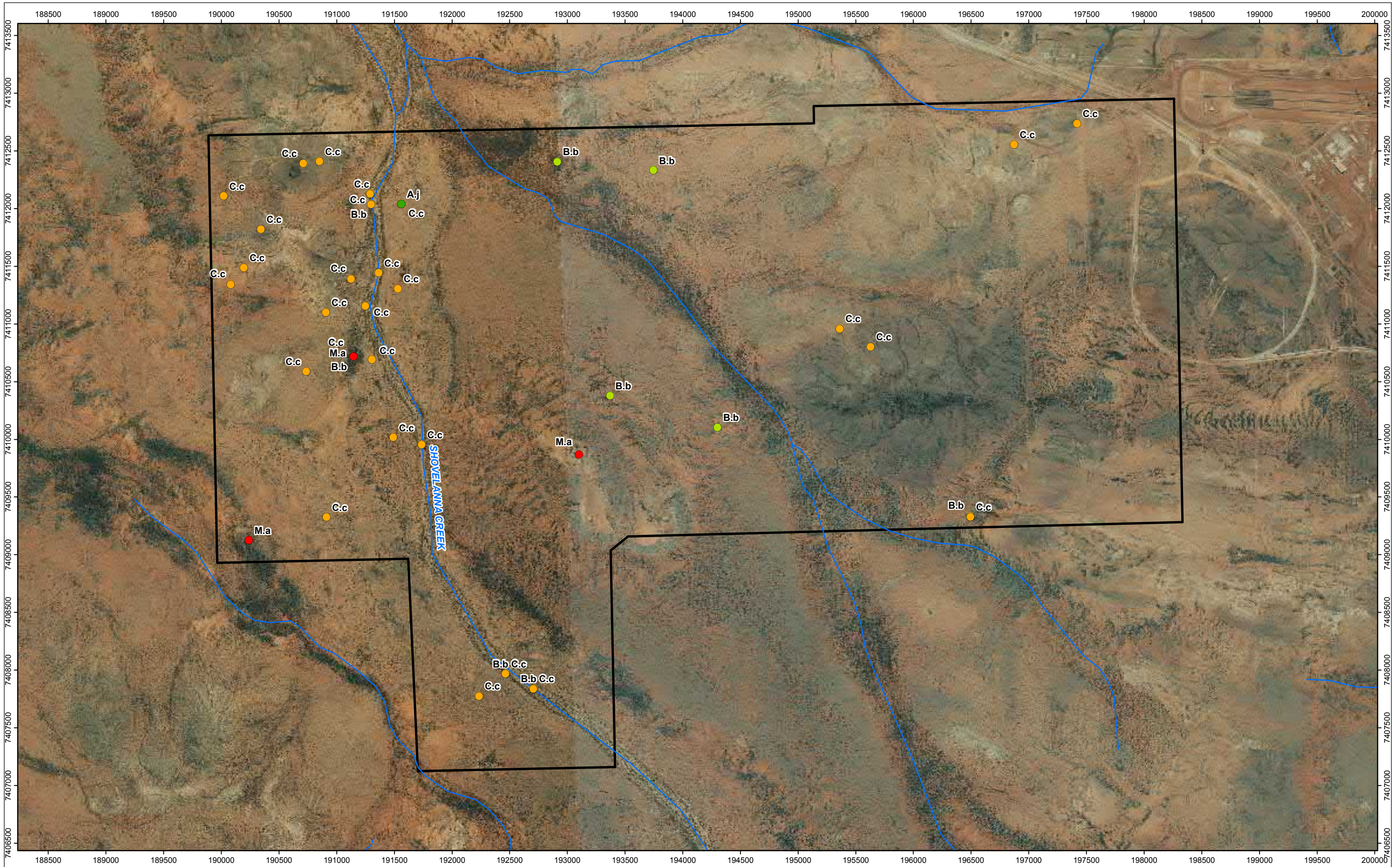
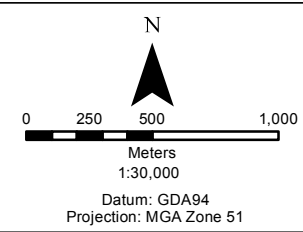







	
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**Introduced Flora Locations
Figure 8**

Legend
 Study Area - Dynasty-West Jimblebar

- Significant Flora**
-  *Aerva javanica* (A.j)
 -  *Bidens bipinnata* (B.b)
 -  *Cenchrus ciliaris* (C.c)
 -  *Malvastrum americanum* (M.a)



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3.5 Threatened Ecological Communities

No TECs were recorded from within or adjacent to the study area. The nearest known TEC is the endangered Ethel Gorge aquifer stygobiont community located approximately 40 km west of the study area. This community is characterised by the stygofauna component and is unrelated to flora and vegetation.

3.6 Priority Ecological Communities

None of the vegetation associations described and mapped from the study area were found to have affiliations with any PECs documented within the Pilbara.

3.7 Vegetation

A total of 26 vegetation associations were mapped and described within the study area (Figure 9). These vegetation associations have been classified into eleven broad floristic formations on the basis of the dominant vegetation stratum (Table 9). Raw data for the 29 quadrats formally assessed is provided as Appendix 8.

The study area is dissected by two branches of Shovelanna Creek and is surrounded by a mosaic of low lying flood plains, stony plains, sand plains and gilgai drainage depressions. A series of low hills occur in the eastern and western sectors of the study area dispersing surface run-off onto the plains and drainage lines.

Table 9 Summary for the 26 vegetation associations described and mapped from the study area.

Map Code	Broad Floristic Formation	Vegetation Association
1	Acacia Low Open Forest	Low Open Forest of <i>Acacia aptaneura</i> and <i>Corymbia aspera</i> over Open Shrubland of <i>Eremophila fraseri</i> over Very Open Tussocks of <i>Aristida inaequiglumis</i> , <i>Aristida contorta</i> and <i>Themeda triandra</i> on orange light clay on plains
2a	Acacia Low Woodland	Low Woodland of <i>Acacia aptaneura</i> , <i>Acacia macraneura</i> and <i>Hakea lorea</i> subsp. <i>lorea</i> over Low Shrubland of <i>Eremophila forrestii</i> subsp. <i>forrestii</i> , <i>Senna artemisioides</i> subsp. <i>helmsii</i> and <i>Eremophila fraseri</i> over Open Tussock Grassland of <i>Aristida inaequiglumis</i> with brown sandy loam on plains
2b	Acacia Low Woodland	Low Woodland of <i>Acacia aptaneura</i> and <i>Acacia ayersiana</i> over Open Shrubland of <i>Senna artemisioides</i> subsp. <i>helmsii</i> and Very Open Tussock Grassland of <i>Aristida inaequiglumis</i> , <i>Cymbopogon obtectus</i> and <i>Aristida contorta</i> on orange brown silty clay loam on plains
2c	Acacia Low Woodland	Low Woodland of <i>Acacia catenulata</i> subsp. <i>occidentalis</i> , <i>Acacia aptaneura</i> and <i>Acacia paraneura</i> over Open Tussock Grassland of <i>Aristida inaequiglumis</i> and <i>Digitaria ammophila</i> with Low Open Shrubland of <i>Eremophila forrestii</i> subsp. <i>forrestii</i> , <i>Isotropis forrestii</i> and <i>Senna glaucifolia</i> on brown clay loam on plains
3	<i>Eucalyptus</i> Low Woodland	Low Woodland of <i>Eucalyptus victrix</i> and <i>Acacia coriacea</i> subsp. <i>pendens</i> over Open Tussock Grassland of <i>Eulalia aurea</i> and * <i>Cenchrus ciliaris</i> with High Open Shrubland of <i>Acacia pyrifolia</i> var. <i>pyrifolia</i> and <i>Melaleuca glomerata</i> on brown sand in major drainage line
4a	Acacia High Shrubland	High Shrubland of <i>Acacia rhodophloia</i> , <i>Acacia tetragonophylla</i> and <i>Acacia synchronicia</i> with Low Open Woodland of <i>Acacia aptaneura</i> and <i>Acacia pruinocarpa</i> with Open Shrubland of <i>Eremophila forrestii</i> subsp. <i>forrestii</i> , <i>Senna artemisioides</i> subsp. <i>helmsii</i> and <i>Eremophila cuneifolia</i> on orange loam on rises and stony plains
4b	Acacia High Shrubland	High Shrubland of <i>Acacia ancistrocarpa</i> over Open Hummock Grassland of <i>Triodia pungens</i> over Open Tussock Grassland of <i>Eragrostis eriopoda</i> on red sand on plains
5	<i>Eremophila</i> High Open Shrubland	High Open Shrubland of <i>Eremophila fraseri</i> and <i>Acacia synchronicia</i> over Low Open Shrubland of <i>Senna artemisioides</i> subsp. <i>helmsii</i> and <i>Eremophila fraseri</i> with Scattered Low Trees of <i>Acacia pruinocarpa</i> , <i>Hakea lorea</i> subsp. <i>lorea</i> and <i>Acacia aptaneura</i> on orange loamy sand on sand plains
6	<i>Senna</i> Shrubland	Shrubland of <i>Senna artemisioides</i> subsp. <i>oligophylla</i> , <i>Senna artemisioides</i> subsp. <i>helmsii</i> and <i>Senna</i> sp. Meekatharra (E. Bailey 1-26) over Open Tussock Grassland of <i>Eragrostis eriopoda</i> with Scattered Low Trees of <i>Acacia aptaneura</i> , <i>Acacia pruinocarpa</i> and <i>Hakea lorea</i> subsp. <i>lorea</i> on brown loam on plains
7	Acacia Open Shrubland	Open Shrubland of <i>Acacia aptaneura</i> , <i>Acacia tetragonophylla</i> and <i>Senna artemisioides</i> subsp. <i>helmsii</i> over Very Open Tussock Grassland of <i>Aristida inaequiglumis</i> , <i>Tripogon loliformis</i> and <i>Eragrostis eriopoda</i> with Scattered Low Trees of <i>Acacia aptaneura</i> on brown loamy sand on plains

Map Code	Broad Floristic Formation	Vegetation Association
8a	<i>Eremophila</i> Low Shrubland	Low Shrubland of <i>Eremophila margarethae</i> and <i>Senna artemisioides</i> subsp. <i>helmsii</i> with Open Tussock Grassland of <i>Aristida contorta</i> , <i>Aristida holathera</i> var. <i>holathera</i> and <i>Aristida inaequiglumis</i> on orange brown sandy loam on plains and floodplains
8b	<i>Eremophila</i> Low Shrubland	Low Shrubland of <i>Eremophila cuneifolia</i> , <i>Senna artemisioides</i> subsp. <i>helmsii</i> and <i>Senna</i> sp. Meekatharra (E. Bailey 1-26) with High Open Shrubland of <i>Hakea preissii</i> , <i>Acacia tetragonophylla</i> and <i>Acacia synchronicia</i> and Very Open Tussock Grassland of <i>Eragrostis eriopoda</i> , <i>Enteropogon ramosus</i> and <i>Eragrostis xerophila</i> on brown loam on stony plains
8c	<i>Eremophila</i> Low Shrubland	Low Shrubland of <i>Eremophila cuneifolia</i> , <i>Eremophila exilifolia</i> and <i>Senna stricta</i> with Low Open Woodland of <i>Acacia aptaneura</i> over Open Tussock Grassland of <i>Eriachne mucronata</i> on skeletal brown loam on hillcrests and steep slopes
9	<i>Frankenia</i> Low Shrubland	Low Shrubland of <i>Frankenia setosa</i> with Scattered Tall Shrubs of <i>Hakea preissii</i> and <i>Acacia synchronicia</i> over Very Open Bunch Grasses of <i>Aristida contorta</i> and <i>Enteropogon ramosus</i> on orange brown loamy sand on eroded plains
10a	<i>Triodia</i> Hummock Grassland	Hummock Grassland of <i>Triodia schinzii</i> and <i>Triodia basedowii</i> with Low Shrubland of <i>Eremophila forrestii</i> subsp. <i>forrestii</i> and <i>Senna artemisioides</i> subsp. <i>helmsii</i> with Low Open Woodland of <i>Acacia pruinocarpa</i> , <i>Acacia aptaneura</i> and <i>Acacia paraneura</i> on red sandy loam on plains
10b	<i>Triodia</i> Hummock Grassland	Hummock Grassland of <i>Triodia</i> sp. Shovelanna Hill (S. van Leeuwen 3835) and <i>Triodia pungens</i> with High Open Shrubland of <i>Senna glutinosa</i> subsp. <i>x luerssenii</i> , <i>Acacia tetragonophylla</i> and <i>Acacia trudgeniana</i> and Scattered Low Trees of <i>Acacia aptaneura</i> and <i>Acacia pruinocarpa</i> on orange sandy loam on hillslopes
10c	<i>Triodia</i> Hummock Grassland	Hummock Grassland of <i>Triodia angusta</i> with Low Shrubland of <i>Eremophila cuneifolia</i> , <i>Senna artemisioides</i> subsp. <i>helmsii</i> and <i>Acacia bivenosa</i> and High Open Shrubland of <i>Acacia synchronicia</i> and <i>Acacia bivenosa</i> (wispy form) on brown loam on hillslopes and footslopes
10d	<i>Triodia</i> Hummock Grassland	Hummock Grassland of <i>Triodia basedowii</i> and/or <i>Triodia schinzii</i> with High Open Shrubland of <i>Acacia pachyacra</i> and <i>Acacia ancistrocarpa</i> and Scattered Low Trees of <i>Hakea lorea</i> subsp. <i>lorea</i> , <i>Acacia aptaneura</i> and <i>Corymbia hamersleyana</i> on red brown sandy loam on plains
10e	<i>Triodia</i> Hummock Grassland	Hummock Grassland of <i>Triodia pungens</i> with High Open Shrubland of <i>Hakea lorea</i> subsp. <i>lorea</i> , <i>Acacia synchronicia</i> and <i>Acacia pachyacra</i> and Low Open Shrubland of <i>Senna artemisioides</i> subsp. <i>oligophylla</i> , <i>Eremophila fraseri</i> and <i>Indigofera monophylla</i> on brown sandy loam on calcrete plains and hillslopes
10f	<i>Triodia</i> Hummock Grassland	Hummock Grassland of <i>Triodia pungens</i> and <i>Triodia</i> sp. Shovelanna Hill (S. van Leeuwen 3835) with Low Open Woodland of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> , <i>Acacia rhodophloia</i> and <i>Acacia bivenosa</i> (wispy form) and High Open Shrubland of <i>Acacia maitlandii</i> , <i>Acacia rhodophloia</i> and <i>Senna glutinosa</i> subsp. <i>x luerssenii</i> on brown sandy loam on hillcrests and slopes

Map Code	Broad Floristic Formation	Vegetation Association
10g	<i>Triodia</i> Hummock Grassland	Hummock Grassland of <i>Triodia pungens</i> with High Open Shrubland of <i>Grevillea wickhamii</i> subsp. <i>hispidula</i> and <i>Acacia maitlandii</i> and Low Open Shrubland of <i>Eremophila exilifolia</i> , <i>Acacia hilliana</i> and <i>Senna artemisioides</i> subsp. <i>helmsii</i> on red brown loamy sand on dolerite hillslopes
10h	<i>Triodia</i> Hummock Grassland	Hummock Grassland of <i>Triodia pungens</i> and <i>Triodia basedowii</i> with Open Mallee of <i>Eucalyptus gamophylla</i> and High Shrubland of <i>Acacia kempeana</i> and <i>Acacia sclerosperma</i> subsp. <i>sclerosperma</i> on red loamy sand on drainage zones
10i	<i>Triodia</i> Hummock Grassland	Hummock Grassland of <i>Triodia</i> sp. Shovelanna Hill Hill (S. van Leeuwen 3835) and <i>Triodia pungens</i> with Low Woodland of <i>Acacia aptaneura</i> , <i>Acacia pruinocarpa</i> and <i>Acacia catenulata</i> subsp. <i>occidentalis</i> and High Open Shrubland of <i>Acacia tetragonophylla</i> and <i>Senna glutinosa</i> subsp. <i>x luerssenii</i> on skeletal brown sandy loam on hillslopes
10j	<i>Triodia</i> Hummock Grassland	Hummock Grassland of <i>Triodia</i> sp. Shovelanna Hill (S. van Leeuwen 3835) and <i>Triodia brizoides</i> with High Open Shrubland of <i>Acacia pruinocarpa</i> , <i>Hakea chordophylla</i> and <i>Grevillea berryana</i> and Open Shrubland of <i>Senna glutinosa</i> subsp. <i>pruinosa</i> and <i>Ptilotus rotundifolius</i> on brown sandy loam on hillcrests
10k	<i>Triodia</i> Hummock Grassland	Hummock Grassland of <i>Triodia pungens</i> with Low Open Shrubland of <i>Eremophila fraseri</i> and <i>Acacia synchronicia</i> and Scattered Low Trees of <i>Hakea lorea</i> subsp. <i>lorea</i> and <i>Grevillea striata</i> on skeletal brown loam on dolerite hillcrests and slopes
11	<i>Eriachne</i> Tussock Grassland	Tussock Grassland of <i>Eriachne benthamii</i> , <i>Eragrostis xerophila</i> and <i>Eragrostis setifolia</i> with High Open Shrubland of <i>Acacia tetragonophylla</i> and Scattered Low Trees of <i>Acacia aptaneura</i> on light brown heavy clay on gilgai drainage zones
M	Mosaic of gilgai and stony plains	Mosaic of Vegetation associations 8b and 11

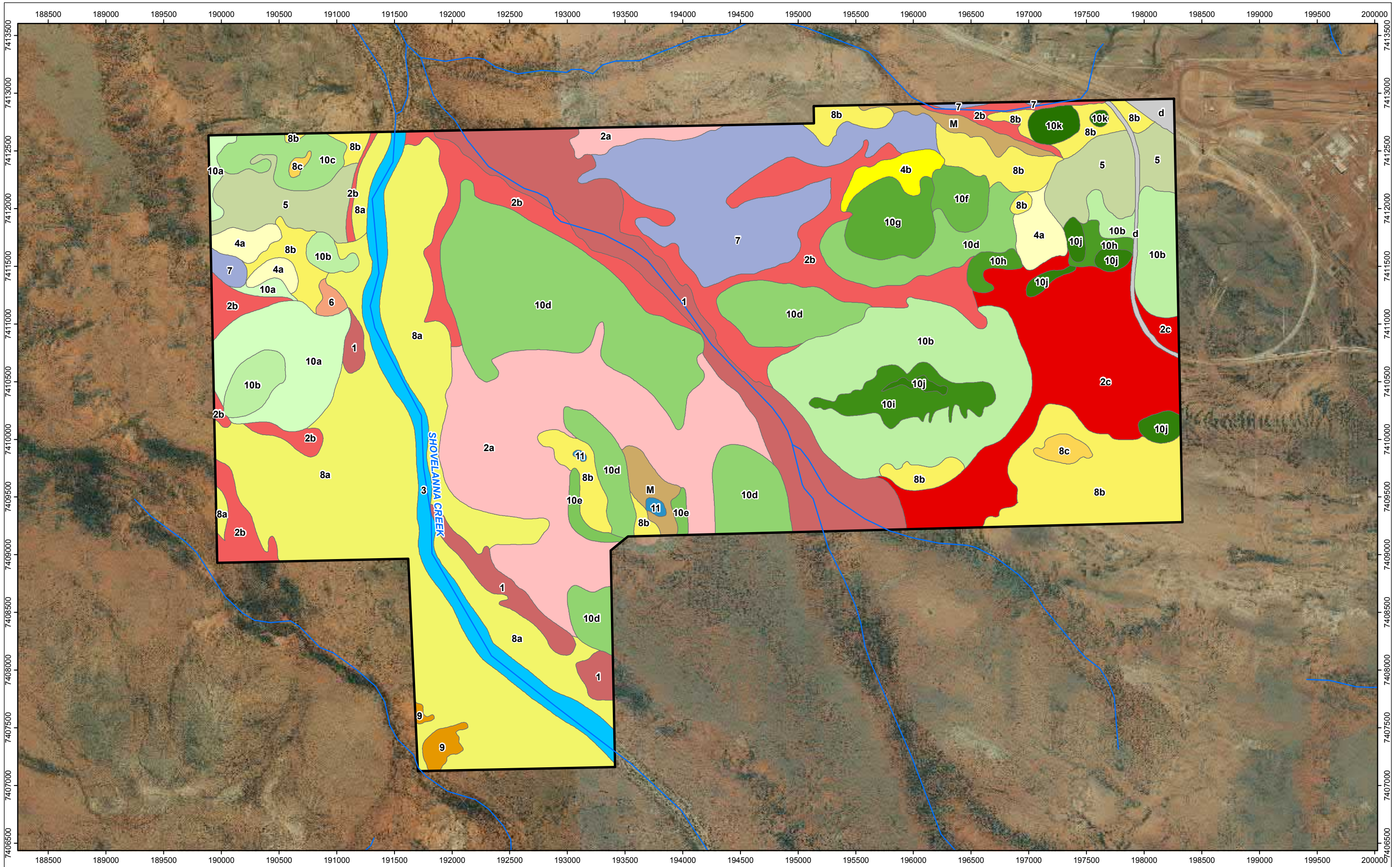




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**BHPBIO
DYNASTY - WEST JIMBLEBAR**

**FIGURE 9
Vegetation Association Map**

Legend

 Study Area - Dynasty-West Jimblebar




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Legend


 Study Area - Dynasty and West Jimblebar


Vegetation Types

Acacia Low Open Forest

 1 Low Open Forest of *Acacia aptaneura* and *Corymbia aspera* over Open Shrubland of *Eremophila fraseri* over Very Open Tussocks of *Aristida inaequiglumis*, *Aristida contorta* and *Themeda triandra* on orange light clay on plains


Acacia Low Woodland

 2a Low Woodland of *Acacia aptaneura*, *Acacia macraneura* and *Hakea lorea* subsp. *lorea* over Low Shrubland of *Eremophila forrestii* subsp. *forrestii*, *Senna artemisioides* subsp. *helmsii* and *Eremophila fraseri* over Open Tussock Grassland of *Aristida inaequiglumis* with brown sandy loam on plains

 2b Low Woodland of *Acacia aptaneura* and *Acacia ayersiana* over Open Shrubland of *Senna artemisioides* subsp. *helmsii* and Very Open Tussock Grassland of *Aristida inaequiglumis*, *Cymbopogon oblectus* and *Aristida contorta* on orange brown silty clay loam on plains


 2c Low Woodland of *Acacia catenulata* subsp. *occidentalis*, *Acacia aptaneura* and *Acacia paraneura* over Open Tussock Grassland of *Aristida inaequiglumis* and *Digitaria ammophila* with Low Open Shrubland of *Eremophila forrestii* subsp. *forrestii*, *Isotropis forrestii* and *Senna glaucifolia* on brown clay loam on plains

Eucalyptus Low Woodland


 3 Low Woodland of *Eucalyptus victrix* and *Acacia coriacea* subsp. *pendens* over Open Tussock Grassland of *Eulalia aurea* and *Cenchrus ciliaris* with High Open Shrubland of *Acacia pyrifolia* var. *pyrifolia* and *Melaleuca glomerata* on brown sand on major drainage line

Acacia High Shrubland


 4a High Shrubland of *Acacia rhodophloia*, *Acacia tetragonophylla* and *Acacia synchronicia* with Low Open Woodland of *Acacia aptaneura* and *Acacia pruinocarpa* with Open Shrubland of *Eremophila forrestii* subsp. *forrestii*, *Senna artemisioides* subsp. *helmsii* and *Eremophila cuneifolia* on orange loam on low rises and stony plains

 4b High Shrubland of *Acacia ancistrocarpa* over Open Hummock Grassland of *Triodia pungens* over Open Tussock Grassland of *Eragrostis eriopoda* on red sand on plains


Eremophila High Open Shrubland

 5 High Open Shrubland of *Eremophila fraseri* and *Acacia synchronicia* over Low Open Shrubland of *Senna artemisioides* subsp. *helmsii* and *Eremophila fraseri* with Scattered Low Trees of *Acacia pruinocarpa*, *Hakea lorea* subsp. *lorea* and *Acacia aptaneura* on orange loamy sand on sand plains


Senna Shrubland


 6 Shrubland of *Senna artemisioides* subsp. *oligophylla*, *Senna artemisioides* subsp. *helmsii* and *Senna* sp. Meekatharra (E. Bailey 1-26) over Open Tussock Grassland of *Eragrostis eriopoda* with Scattered Low Trees of *Acacia aptaneura*, *Acacia pruinocarpa* and *Hakea lorea* subsp. *lorea* on brown loam on plains

Acacia Open Shrubland

 7 Open Shrubland of *Acacia aptaneura*, *Acacia tetragonophylla* and *Senna artemisioides* subsp. *helmsii* over Very Open Tussock Grassland of *Aristida inaequiglumis*, *Tripogon loliiformis* and *Eragrostis eriopoda* with Scattered Low Trees of *Acacia aptaneura* on brown loamy sand on plains


Eremophila Low Shrubland

 8a Low Shrubland of *Eremophila margarethae* and *Senna artemisioides* subsp. *helmsii* with Open Tussock Grassland of *Aristida contorta*, *Aristida holathera* var. *holathera* and *Aristida inaequiglumis* on orange brown sandy loam on plains and floodplains


 8b Low Shrubland of *Eremophila cuneifolia*, *Senna artemisioides* subsp. *helmsii* and *Senna* sp. Meekatharra (E. Bailey 1-26) with High Open Shrubland of *Hakea preissii*, *Acacia tetragonophylla* and *Acacia synchronicia* and Very Open Tussock Grassland of *Eragrostis eriopoda*, *Enteropogon ramosus* and *Eragrostis xerophila* on brown loam on stony plains


 8c Low Shrubland of *Eremophila cuneifolia*, *Eremophila exilifolia* and *Senna stricta* with Low Open Woodland of *Acacia aptaneura* over Open Tussock Grassland of *Eriachne mucronata* on skeletal brown loam on hillcrests and steep hillslopes


Frankenia Low Shrubland


 9 Low Shrubland of *Frankenia setosa* with Scattered Tall Shrubs of *Hakea preissii* and *Acacia synchronicia* over Very Open Bunch Grasses of *Aristida contorta* and *Enteropogon ramosus* on orange brown loamy sand on eroded plains


Triodia Hummock Grassland


 10a Hummock Grassland of *Triodia schinzii* and *Triodia basedowii* with Low Shrubland of *Eremophila forrestii* subsp. *forrestii* and *Senna artemisioides* subsp. *helmsii* with Low Open Woodland of *Acacia pruinocarpa*, *Acacia aptaneura* and *Acacia paraneura* on red sandy loam on plains


 10b Hummock Grassland of *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835) and *Triodia pungens* with High Open Shrubland of *Senna glutinosa* subsp. *x luerssenii*, *Acacia tetragonophylla* and *Acacia trudgeniana* and Scattered Low Trees of *Acacia aptaneura* and *Acacia pruinocarpa* on orange sandy loam on hillslopes


 10c Hummock Grassland of *Triodia angusta* with Low Shrubland of *Eremophila cuneifolia*, *Senna artemisioides* subsp. *helmsii* and *Acacia bivenosa* and High Open Shrubland of *Acacia synchronicia* and *Acacia bivenosa* (wispy form) on brown loam on hillslopes and footslopes


 10d Hummock Grassland of *Triodia basedowii* and/or *Triodia schinzii* with High Open Shrubland of *Acacia pachyacra* and *Acacia ancistrocarpa* and Scattered Low Trees of *Hakea lorea* subsp. *lorea*, *Acacia aptaneura* and *Corymbia hamersleyana* on red brown sandy loam on plains


 10e Hummock Grassland of *Triodia pungens* with High Open Shrubland of *Hakea lorea* subsp. *lorea*, *Acacia synchronicia* and *Acacia pachyacra* and Low Open Shrubland of *Senna artemisioides* subsp. *oligophylla*, *Eremophila fraseri* and *Indigofera monophylla* on brown sandy loam on calcrete plains and hillslopes


 10f Hummock Grassland of *Triodia pungens* and *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835) with Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia*, *Acacia rhodophloia* and *Acacia bivenosa* (wispy form) and High Open Shrubland of *Acacia maitlandii*, *Acacia rhodophloia* and *Senna glutinosa* subsp. *x luerssenii* on brown sandy loam on hillcrests and hillslopes

 10g Hummock Grassland of *Triodia pungens* with High Open Shrubland of *Grevillea wickhamii* subsp. *hispidula* and *Acacia maitlandii* and Low Open Shrubland of *Eremophila exilifolia*, *Acacia hilliana* and *Senna artemisioides* subsp. *helmsii* on red brown loamy sand on dolerite hillslopes


 10h Hummock Grassland of *Triodia pungens* and *Triodia basedowii* with Open Mallee of *Eucalyptus gamophylla* and High Shrubland of *Acacia kempeana* and *Acacia sclerosperma* subsp. *sclerosperma* on red loamy sand on drainage zones

 10i Hummock Grassland of *Triodia* sp. Shovelanna Hill and *Triodia pungens* with Low Woodland of *Acacia aptaneura*, *Acacia pruinocarpa* and *Acacia catenulata* subsp. *occidentalis* and High Open Shrubland of *Acacia tetragonophylla* and *Senna glutinosa* subsp. *x luerssenii* on skeletal brown sandy loam on hillslopes


 10j Hummock Grassland of *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835) and *Triodia brizoides* with High Open Shrubland of *Acacia pruinocarpa*, *Hakea chordophylla* and *Grevillea berryana* and Open Shrubland of *Senna glutinosa* subsp. *pruinosa* and *Ptilotus rotundifolius* on brown sandy loam on hillcrests

 10k Hummock Grassland of *Triodia pungens* with Low Open Shrubland of *Eremophila fraseri* and *Acacia synchronicia* and Scattered Low Trees of *Hakea lorea* subsp. *lorea* and *Grevillea striata* on skeletal brown loam on dolerite hillcrests and hillslopes

Eriachne Tussock Grassland


 11 Tussock Grassland of *Eriachne benthamii*, *Eragrostis xerophila* and *Eragrostis setifolia* with High Open Shrubland of *Acacia tetragonophylla* and Scattered Low Trees of *Acacia aptaneura* on light brown clay on gilgai drainage zones

Mosaic of 8b (stony plains) and 11 (gilgai)

 Mosaic Mosaic of 8b Low Shrubland of *Eremophila cuneifolia*, *Senna artemisioides* subsp. *helmsii* and *Senna* sp. Meekatharra (E. Bailey 1-26) with High Open Shrubland of *Hakea preissii*, *Acacia tetragonophylla* and *Acacia synchronicia* and Very Open Tussock Grassland of *Eragrostis eriopoda*, *Enteropogon ramosus* and *Eragrostis xerophila* on brown loam on stony plains; and 11 ussock Grassland of *Eriachne benthamii*, *Eragrostis xerophila* and *Eragrostis setifolia* with High Open Shrubland of *Acacia tetragonophylla* and Scattered Low Trees of *Acacia aptaneura* on light brown heavy clay on gilgai drainage zones

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**BHPBIO
DYNASTY - WEST JIMBLEBAR
Figure 9
Vegetation Association Legend**

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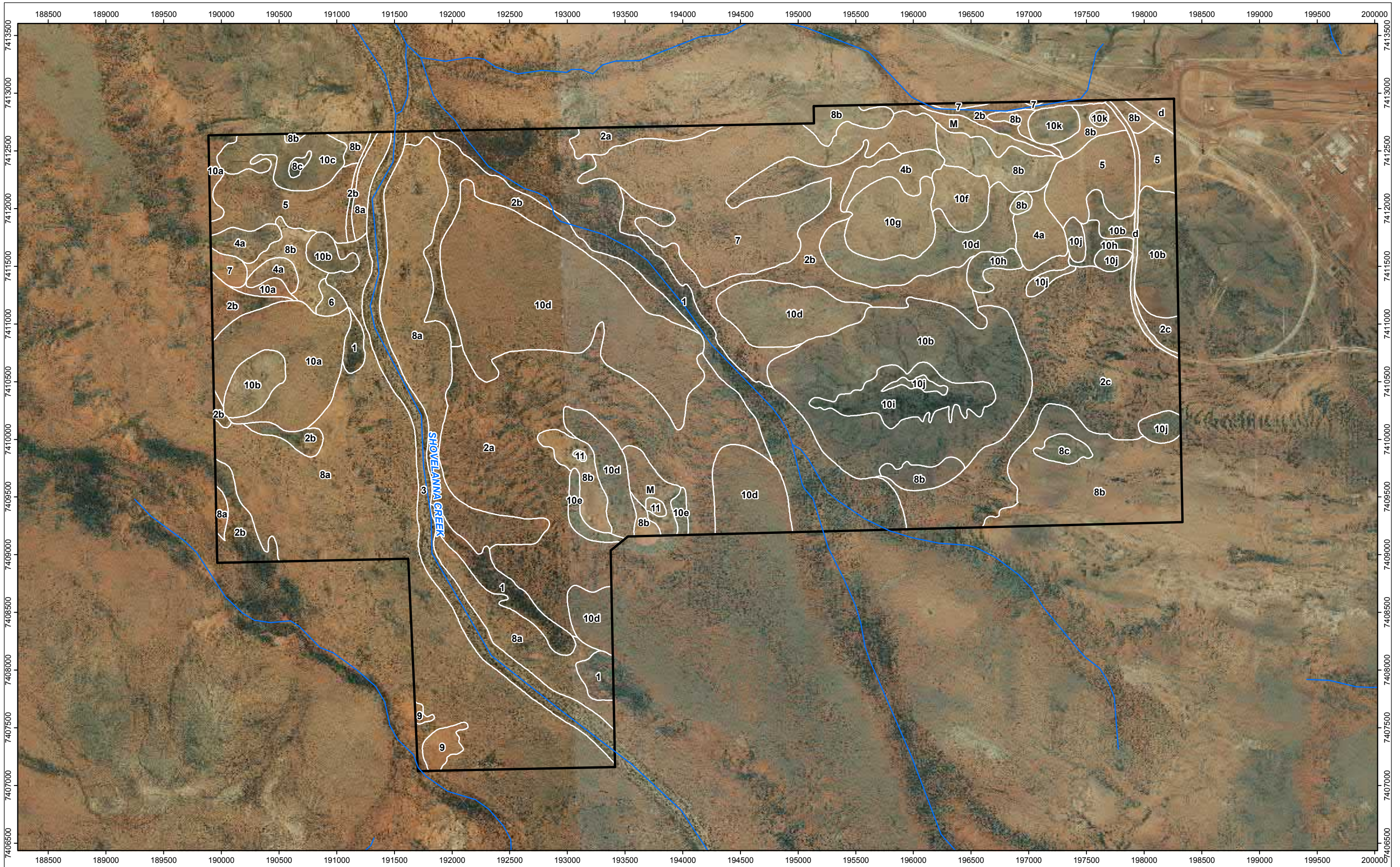
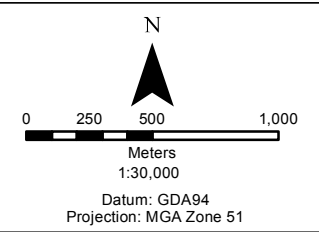


	
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BHPBIO
DYNASTY - WEST JIMBLEBAR
FIGURE 9
Vegetation Association Map

Legend
 Study Area - Dynasty-West Jimblebar


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Broad Floristic Formation	1 <i>Acacia</i> Low Open Forest
Vegetation Association	Low Open Forest of <i>Acacia aptaneura</i> and <i>Corymbia aspera</i> over Open Shrubland of <i>Eremophila fraseri</i> over Very Open Tussock Grassland of <i>Aristida inaequiglumis</i> , <i>Aristida contorta</i> and <i>Themeda triandra</i> on red brown clay loam on floodplains



Area Mapped	234.82 ha
Quadrats Sampled	DY15, DY26, RD04, RD08, RD09, RD61
Location	Eastern tributary of Shovelanna Creek dissecting the central sector of the study area
Leaf Litter Cover (%)	5
Bare Ground (%)	15
Soils and Geology	Orange light clay
Land System	Washplain
Land Form	Floodplain (Mulga drainage flats)
Priority Ecological Community	None
Rare Flora	None
Introduced (Weed) Species	* <i>Bidens bipinnata</i> , * <i>Cenchrus ciliaris</i>
Vegetation Condition	Very Good
Disturbances	Livestock, weeds
Average Fire Age	Very Old (10+ years)
Characteristics	Dense mulga stands on plains with occasional trees of <i>Corymbia aspera</i> . Understorey generally very open.
Vegetation Structure & Floristics	
Trees <10m	<i>Acacia aptaneura</i> , <i>Corymbia aspera</i> , <i>Eucalyptus xerothermica</i> , <i>Hakea lorea</i> subsp. <i>lorea</i>
Tall Shrubs 1-2m	<i>Eremophila fraseri</i> , <i>Eremophila forrestii</i> subsp. <i>forrestii</i> , <i>Sida ectogama</i>
Shrubs <1m	<i>Isotropis forrestii</i> , <i>Ptilotus obovatus</i> , <i>Senna artemisioides</i> subsp. <i>helmsii</i>
Tussock Grasses	<i>Aristida inaequiglumis</i> , <i>Aristida contorta</i> , <i>Themeda triandra</i> , <i>Digitaria brownii</i> , <i>Chrysopogon fallax</i>

Broad Floristic Formation 2a *Acacia* Low Woodland
Vegetation Association Low Woodland of *Acacia aptaneura*, *Acacia macraneura* and *Hakea lorea* subsp. *lorea* over Low Shrubland of *Eremophila forrestii* subsp. *forrestii*, *Senna artemisioides* subsp. *helmsii* and *Eremophila fraseri* over Open Tussock Grassland of *Acacia inaequilatera* brown sandy loam on plains



Area Mapped	322.41 ha
Quadrats Sampled	DY14, RD62, RD117
Location	Central southern sector of the study area
Leaf Litter Cover (%)	<2
Bare Ground (%)	70
Soils and Geology	Brown sandy loam, hard loam crust, scattered quartz and ironstone pebbles
Land System	Cadgie
Land Form	Plains (mulga grove intergrove)
Priority Ecological Community	None
Rare Flora	None
Introduced (Weed) Species	* <i>Bidens bipinnata</i>
Vegetation Condition	Very Good
Disturbances	Livestock
Average Fire Age	Old (5-10 years)
Characteristics	Mulga forming grove / intergrove formation
Vegetation Structure & Floristics	
Trees <10m	<i>Acacia aptaneura</i> , <i>Acacia macraneura</i> , <i>Hakea lorea</i> subsp. <i>lorea</i> , <i>Acacia paraneura</i> , <i>Grevillea striata</i>
Tall Shrubs >2m	<i>Acacia tetragonophylla</i>
Shrubs <1m	<i>Eremophila fraseri</i> , <i>Sida ectogamma</i> , <i>Senna artemisioides</i> subsp. <i>helmsii</i> , <i>Eremophila forrestii</i> subsp. <i>forrestii</i>
Tussock Grasses	<i>Aristida inaequiglumis</i>

Broad Floristic Formation	2b <i>Acacia</i> Low Woodland
Vegetation Association	Low Woodland of <i>Acacia aptaneura</i> and <i>Acacia ayersiana</i> over Open Shrubland of <i>Senna artemisioides</i> subsp. <i>helmsii</i> and Very Open Tussock Grassland of <i>Aristida inaequiglumis</i> , <i>Cymbopogon obtectus</i> and <i>Aristida contorta</i> on orange brown silty clay loam on plains



Area Mapped	251.43 ha
Quadrats Sampled	DY04, RD82, DY19
Location	Western half and north-eastern sectors of the study area
Leaf Litter Cover (%)	1
Bare Ground (%)	60
Soils and Geology	Orange brown silty clay loam, scattered ironstone and quartz pebbles
Land System	Divide, Sylvania, Washplain
Land Form	Plains
Priority Ecological Community	None
Rare Flora	None
Introduced (Weed) Species	* <i>Cenchrus ciliaris</i> , * <i>Malvastrum americanum</i>
Vegetation Condition	Very Good
Disturbances	Fire, livestock
Average Fire Age	Old (5-10 years)
Characteristics	Mulga woodland over Tussocks, <i>Sida platycalyx</i> was distinctive within this unit
Vegetation Structure & Floristics	
Trees <10m	<i>Acacia aptaneura</i> , <i>Acacia ayersiana</i>
Tall Shrubs >2m	<i>Acacia tetragonophylla</i>
Shrubs 1-2m	<i>Senna artemisioides</i> subsp. <i>helmsii</i> , <i>Eremophila forrestii</i> subsp. <i>forrestii</i>
Tussock Grasses	<i>Aristida inaequiglumis</i> , <i>Cymbopogon obtectus</i> , <i>Aristida contorta</i>
Hummock Grasses	<i>Triodia pungens</i> , <i>Triodia basedowii</i> , <i>Triodia</i> sp. Shovelanna Hill

Broad Floristic Formation	2c <i>Acacia</i> Low Woodland
Vegetation Association	Low Woodland of <i>Acacia catenulata</i> subsp. <i>occidentalis</i> , <i>Acacia aptaneura</i> and <i>Acacia paraneura</i> over Open Tussock Grassland of <i>Acacia inaequilatera</i> and <i>Digitaria ammophila</i> with Low Open Shrubland of <i>Eremophila forrestii</i> subsp. <i>forrestii</i> , <i>Isotropis forrestii</i> and <i>Senna glaucifolia</i> on brown clay loam on plains



Area Mapped	222.25 ha
Quadrats Sampled	DY22
Location	South-eastern sector of the study area
Leaf Litter Cover (%)	4
Bare Ground (%)	65
Soils and Geology	Stony brown clay loam, scattered ironstone and quartz pebbles
Land System	Jaminda
Land Form	Plain
Priority Ecological Community	None
Rare Flora	None
Introduced (Weed) Species	* <i>Bidens bipinnata</i> , * <i>Cenchrus ciliaris</i>
Vegetation Condition	Very Good
Disturbances	Livestock
Average Fire Age	Old (5-10 years)
Characteristics	Dominance of <i>Acacia catenulata</i> subsp. <i>occidentalis</i> within the groving association
Vegetation Structure & Floristics	
Trees <10m	<i>Acacia catenulata</i> subsp. <i>occidentalis</i> , <i>Acacia aptaneura</i> , <i>Acacia paraneura</i>
Shrubs <1m	<i>Eremophila forrestii</i> subsp. <i>forrestii</i> , <i>Isotropis forrestii</i> , <i>Senna glaucifolia</i>
Tussock Grasses	<i>Acacia inaequiglumis</i> , <i>Digitaria ammophila</i>

Broad Floristic Formation 3. *Eucalyptus* Low Woodland
Vegetation Association Low Woodland of *Eucalyptus victrix* and *Acacia coriacea* subsp. *pendens* over Open Tussock Grassland of *Eulalia aurea*, *Eragrostis speciosa* and **Cenchrus ciliaris* with High Open Shrubland of *Acacia pyrifolia* var. *pyrifolia* and *Melaleuca glomerata* on brown sand on major drainage line



Area Mapped	91.85 ha
Quadrats Sampled	DY02, RD02, RD06, RD22
Location	Main drainage channel of Shovelanna Creek dissecting the western sector of the study area
Leaf Litter Cover (%)	5
Bare Ground (%)	55
Soils and Geology	Brown sand with alluvial gravels, hard pavement exposed in places
Land System	Sylvania
Land Form	Major drainage line
Priority Ecological Community	None
Rare Flora	None
Introduced (Weed) Species	* <i>Bidens bipinnata</i> , * <i>Cenchrus ciliaris</i>
Vegetation Condition	Very Good
Disturbances	Livestock, weeds
Average Fire Age	Old (5-10 years)
Characteristics	Major drainage line supporting <i>Eucalyptus victrix</i>
Vegetation Structure & Floristics	
Trees >10m	<i>Eucalyptus victrix</i>
Trees <10m	<i>Eucalyptus victrix</i> , <i>Acacia coriacea</i> subsp. <i>pendens</i> , <i>Hakea lorea</i> subsp. <i>lorea</i> , <i>Acacia aptaneura</i> (on banks)
Tall Shrubs >2m	<i>Melaleuca glomerata</i> , <i>Acacia pyrifolia</i> var. <i>pyrifolia</i>
Shrubs <1m	<i>Tephrosia rosea</i> var. <i>Fortescue creeks</i> (M.I.H. Brooker 2186)
Sedges	<i>Cyperus ixiocarpus</i>
Tussock Grasses	<i>Eulalia aurea</i> , <i>Eragrostis speciosa</i> , * <i>Cenchrus ciliaris</i>

Broad Floristic Formation 4a *Acacia* High Shrubland
Vegetation Association High Shrubland of *Acacia rhodophloia*, *Acacia tetragonophylla* and *Acacia synchronicia* with Low Open Woodland of *Acacia aptaneura* and *Acacia pruinocarpa* with Open Shrubland of *Eremophila forrestii* subsp. *forrestii*, *Senna artemisioides* subsp. *helmsii* and *Eremophila cuneifolia* on orange loam on rises and stony plains



Area Mapped	41.34 ha
Quadrats Sampled	RD15, RD46
Location	Localised areas in the north-west and north-east sectors of the study area
Leaf Litter Cover (%)	<1
Bare Ground (%)	70
Soils and Geology	Orange loam with ironstone and quartz pebbles
Land System	Divide, Sylvania
Land Form	Stony rises and plains, footslopes (bare patches)
Priority Ecological Community	None
Rare Flora	None
Introduced (Weed) Species	None
Vegetation Condition	Very Good
Disturbances	Livestock
Average Fire Age	Old (5-10 years)
Characteristics	<i>Acacia rhodophloia</i> on stony rises or plains
Vegetation Structure & Floristics	
Trees <10m	<i>Acacia aptaneura</i> , <i>Acacia pruinocarpa</i>
Tall Shrubs >2m	<i>Acacia rhodophloia</i> , <i>Acacia tetragonophylla</i> , <i>Acacia synchronicia</i>
Shrubs 1-2m	<i>Eremophila forrestii</i> subsp. <i>forrestii</i> , <i>Senna artemisioides</i> subsp. <i>helmsii</i> , <i>Eremophila cuneifolia</i> , <i>Senna glutinosa</i> subsp. <i>x luerssenii</i>
Tussock Grasses	<i>Eragrostis eriopoda</i> , <i>Aristida inaequiglumis</i>

Broad Floristic Formation	4b <i>Acacia</i> High Shrubland
Vegetation Association	High Shrubland of <i>Acacia ancistrocarpa</i> over Open Hummock Grassland of <i>Triodia pungens</i> over Open Tussock Grassland of <i>Eragrostis eriopoda</i> on red sand on plains



Area Mapped	19.17 ha
Quadrats Sampled	RD91
Location	Localised areas in the north-west and north-east sectors of the study area
Leaf Litter Cover (%)	<2
Bare Ground (%)	40
Soils and Geology	Red sandy soils
Land System	Divide
Land Form	Plains (run-on zones)
Priority Ecological Community	None
Rare Flora	None
Introduced (Weed) Species	None
Vegetation Condition	Very Good
Disturbances	Livestock
Average Fire Age	Old (5-10 years)
Characteristics	High Shrubland of <i>Acacia ancistrocarpa</i> is characterisitc
Vegetation Structure & Floristics	
Trees <10m	<i>Acacia aptaneura</i> , <i>Hakea lorea</i> subsp. <i>lorea</i>
Tall Shrubs >2m	<i>Acacia ancistrocarpa</i>
Hummock Grasses	<i>Triodia pungens</i>
Tussock Grasses	<i>Eragrostis eriopoda</i>

Broad Floristic Formation 5 *Eremophila* High Open Shrubland
High Open Shrubland of *Eremophila fraseri* and *Acacia synchronicia* over Low Open Shrubland of *Senna artemisioides* subsp. *helmsii*, *Eremophila fraseri* with Scattered Low Trees of *Acacia pruinocarpa*, *Hakea lorea* subsp. *lorea* and *Acacia pruinocarpa* on orange loamy sand on sand plains

Vegetation Association



Area Mapped	114.63 ha
Quadrats Sampled	DY08, RD140
Location	Localised areas in the north-west and north-east sectors of the study area
Leaf Litter Cover (%)	1
Bare Ground (%)	50
Soils and Geology	Orange loamy sand, scattered ironstone and quartz cobbles
Land System	Divide, Sylvania
Land Form	Sand plains
Priority Ecological Community	None
Rare Flora	None
Introduced (Weed) Species	* <i>Cenchrus ciliaris</i>
Vegetation Condition	Very Good
Disturbances	Livestock
Average Fire Age	Old (5-10 years)
Characteristics	Open sand plains with <i>Eremophila fraseri</i> and various other shrub species
Vegetation Structure & Floristics	
Trees <10m	<i>Acacia pruinocarpa</i> , <i>Hakea lorea</i> subsp. <i>lorea</i> , <i>Acacia aptaneura</i>
Tall Shrubs >2m	<i>Eremophila fraseri</i> , <i>Acacia synchronicia</i>
Shrubs <1m	<i>Senna artemisioides</i> subsp. <i>helmsii</i> , <i>Eremophila fraseri</i>
Hummock Grasses	<i>Triodia pungens</i>
Tussock Grasses	<i>Aristida contorta</i> , <i>Enneapogon polyphyllus</i> , <i>Aristida inaequiglumis</i> , <i>Tripogon lolliformis</i>

Broad Floristic Formation	6 <i>Senna</i> Shrubland
Vegetation Association	Shrubland of <i>Senna artemisioides</i> subsp. <i>oligophylla</i> , <i>Senna artemisioides</i> subsp. <i>helmsii</i> and <i>Senna</i> sp. Meekatharra (E. Bailey 1-26) over Open Tussock Grassland of <i>Eragrostis eriopoda</i> with Scattered Low Trees of <i>Acacia aptanerua</i> , <i>Acacia pruinocarpa</i> and <i>Hakea lorea</i> subsp. <i>lorea</i> on brown loam on plains



Area Mapped	5.28 ha
Quadrats Sampled	RD19, RD59
Location	One localised area in the north-west sector of the study area fringing Shovelanna Creek
Leaf Litter Cover (%)	2
Bare Ground (%)	70
Soils and Geology	Brown loam with quartz pebbles
Land System	Sylvania
Land Form	Plain
Priority Ecological Community	None
Rare Flora	None
Introduced (Weed) Species	* <i>Cenchrus ciliaris</i>
Vegetation Condition	Very Good
Disturbances	Weeds, livestock
Average Fire Age	Old (5-10 years)
Characteristics	<i>Eragrostis eriopoda</i> dominated plains with <i>Senna</i> spp.
Vegetation Structure & Floristics	
Trees <10m	<i>Acacia aptanerua</i> , <i>Acacia pruinocarpa</i> , <i>Hakea lorea</i> subsp. <i>lorea</i>
Tall Shrubs >2m	<i>Acacia synchronicia</i>
Shrubs 1-2m	<i>Senna artemisioides</i> subsp. <i>oligophylla</i> , <i>Senna artemisioides</i> subsp. <i>helmsii</i> , <i>Senna</i> sp. Meekatharra (E. Bailey 1-26)
Tussock Grasses	<i>Eragrostis eriopoda</i>

Broad Floristic Formation	7 <i>Acacia</i> Open Shrubland
Vegetation Association	Open Shrubland of <i>Acacia aptaneura</i> , <i>Acacia tetragonophylla</i> and <i>Senna artemisioides</i> subsp. <i>helmsii</i> over Very Open Tussock Grassland of <i>Aristida inaequiglumis</i> , <i>Tripogon lolliformis</i> and <i>Eragrostis eriopoda</i> with Scattered Low Trees of <i>Acacia aptaneura</i> on brown loamy sand on plains



Area Mapped	206.40 ha
Quadrats Sampled	DY24
Location	Occurring extensively across the northern one third of the study area
Leaf Litter Cover (%)	4
Bare Ground (%)	60
Soils and Geology	Brown sandy loam
Land System	Sylvania, Divide, McKay
Land Form	Plain
Priority Ecological Community	None
Rare Flora	None
Introduced (Weed) Species	* <i>Bidens bipinnata</i> , * <i>Cenchrus ciliaris</i>
Vegetation Condition	Very Good
Disturbances	Livestock, weeds
Average Fire Age	Old (5-10 years)
Characteristics	Open Mulga with large bare areas often covered with <i>Sida platycalyx</i> seeds
Vegetation Structure & Floristics	
Trees <10m	<i>Acacia aptaneura</i>
Shrubs 1-2m	<i>Acacia aptaneura</i> , <i>Senna artemisiodies</i> subsp. <i>helmsii</i>
Shrubs <1m	<i>Sida platycalyx</i>
Tussock Grasses	<i>Aristida inaequiglumis</i> , <i>Tripogon lolliformis</i> , <i>Eragrostis eriopoda</i> , <i>Aristida holathera</i> var. <i>holathera</i>

Broad Floristic Formation	8a. <i>Eremophila</i> Low Shrubland
Vegetation Association	Low Shrubland of <i>Eremophila margarethae</i> and <i>Senna artemisioides</i> subsp. <i>helmsii</i> with Open Tussock Grassland of <i>Aristida contorta</i> , <i>Aristida holathera</i> var. <i>holathera</i> and <i>Acacia inaequiglumis</i> on orange brown sandy loam on plains and floodplains



Area Mapped	550.95 ha
Quadrats Sampled	DY01, DY05, DY06, DY09, RD03, RD07, RD34, RD35
Location	Extensive floodplains in western sector of the study area, fringing Shovelanna Creek
Leaf Litter Cover (%)	5
Bare Ground (%)	40
Soils and Geology	Orange brown sandy loam
Land System	Sylvania
Land Form	Floodplain
Priority Ecological Community	None
Rare Flora	None
Introduced (Weed) Species	* <i>Aerva javanica</i> , * <i>Cenchrus ciliaris</i>
Vegetation Condition	Very Good
Disturbances	Livestock, weeds
Average Fire Age	Old (5-10 years)
Characteristics	Sandy plains/floodplains with <i>Eremophila margarethae</i>
Vegetation Structure & Floristics	
Trees <10m	<i>Acacia pruinocarpa</i> , <i>Hakea lorea</i> subsp. <i>lorea</i> , <i>Acacia aptaneura</i> , <i>Acacia paraneura</i> , <i>Acacia macraneura</i>
Tall Shrubs >2m	<i>Acacia pachyneura</i> , <i>Acacia synchronicia</i> , <i>Acacia sclerosperma</i> subsp. <i>sclerosperma</i> , <i>Acacia pachyacra</i>
Shrubs <1m	<i>Eremophila margarethae</i> , <i>Senna artemisioides</i> subsp. <i>helmsii</i> , <i>Solanum lasiophyllum</i>
Hummock Grasses	<i>Triodia basedowii</i>
Tussock Grasses	<i>Aristida contorta</i> , <i>Aristida holathera</i> var. <i>holathera</i> , <i>Aristida inaequiglumis</i> , <i>Eragrostis eriopoda</i> , * <i>Cenchrus ciliaris</i>

Broad Floristic Formation	8b <i>Eremophila</i> Low Shrubland
Vegetation Association	Low Shrubland of <i>Eremophila cuneifolia</i> , <i>Senna artemisioides</i> subsp. <i>helmsii</i> and <i>Senna</i> sp. Meekatharra (E. Bailey 1-26) with High Open Shrubland of <i>Hakea preissii</i> , <i>Acacia tetragoophylla</i> and <i>Acacia synchronicia</i> and Very Open Tussock Grassland of <i>Eragrostis eriopoda</i> , <i>Enteropogon ramosus</i> and <i>Eragrostis xerophila</i> on brown loam on stony plains



Area Mapped	246.27 ha
Quadrats Sampled	RD18, RD19, RD40, DY13, RD69, RD86, DY27, RD47,
Location	Scattered across entire study area
Leaf Litter Cover (%)	<1
Bare Ground (%)	80
Soils and Geology	Brown loam/clay loam with quartz pebbles
Land System	Cadgie, McKay, Jaminda, Newman
Land Form	Stony plains
Priority Ecological Community	None
Rare Flora	None
Introduced (Weed) Species	* <i>Cenchrus ciliaris</i>
Vegetation Condition	Very Good
Disturbances	Livestock
Average Fire Age	Old (5-10 years)
Characteristics	Low Shrubland of <i>Eremophila</i> and <i>Senna</i> spp. with chenopods on open plains
Vegetation Structure & Floristics	
Trees <10m	<i>Acacia paraneura</i> , <i>Hakea lorea</i> subsp. <i>lorea</i> , <i>Acacia aptaneura</i>
Tall Shrubs >2m	<i>Hakea preissii</i> , <i>Acacia tetragonophylla</i> , <i>Acacia synchronicia</i>
Shrubs 1-2m	<i>Eremophila fraseri</i> , <i>Acacia tetragonophylla</i>
Shrubs <1m	<i>Eremophila cuneifolia</i> , <i>Senna artemisioides</i> subsp. <i>helmsii</i> , <i>Senna</i> sp. Meekatharra (E. Bailey 1-26), <i>Eremophila forrestii</i> subsp. <i>forrestii</i> , <i>Sclerolaena cornishiana</i> , <i>Sclerolaena cuneata</i> , <i>Maireana triptera</i>
Tussock Grasses	<i>Eragrostis eriopoda</i> , <i>Enteropogon ramosus</i> , <i>Eragrostis xerophila</i>

Broad Floristic Formation	8c <i>Eremophila</i> Low Shrubland
Vegetation Association	Low Shrubland of <i>Eremophila cuneifolia</i> , <i>Eremophila exilifolia</i> and <i>Senna stricta</i> with Low Open Woodland of <i>Acacia aptaneura</i> over Open Tussock Grassland of <i>Eriachne mucronata</i> on skeletal brown loam on hillcrests and steep slopes



Area Mapped	10.78 ha
Quadrats Sampled	RD41, WP440
Location	North-west and south-eastern sectors of the study area
Leaf Litter Cover (%)	<2
Bare Ground (%)	40
Soils and Geology	Skeletal brown loam, ironstone
Land System	McKay, Jaminda
Land Form	Hillcrests and steep slopes or cliff lines
Priority Ecological Community	None
Rare Flora	None
Introduced (Weed) Species	* <i>Cenchrus ciliaris</i>
Vegetation Condition	Very Good
Disturbances	Livestock
Average Fire Age	Old (5-10 years)
Characteristics	Steep hillslopes and crests with <i>Eremophila</i> and <i>Senna</i> spp.
Vegetation Structure & Floristics	
Trees <10m	<i>Acacia aptaneura</i>
Tall Shrubs 1-2	<i>Senna stricta</i> , <i>Senna glutinosa</i> subsp. x <i>luerssenii</i>
Shrubs <1m	<i>Eremophila cuneifolia</i> , <i>Eremophila exilifolia</i> , <i>Ptilotus obovatus</i> , <i>Dodonaea viscosa</i> subsp. <i>mucronata</i> , <i>Tribulus suberosus</i> , <i>Senna stricta</i>
Hummock Grasses	<i>Triodia angusta</i> , <i>Triodia pungens</i> , <i>Triodia</i> sp. Shovelanna Hill
Tussock Grasses	<i>Eriachne mucronata</i> , <i>Enneapogon polyphyllus</i>

Broad Floristic Formation 9. *Frankenia* Low Shrubland
Vegetation Association Low Shrubland of *Frankenia setosa* with Scattered Tall Shrubs of *Hakea preissii* and *Acacia synchronicia* over Very Open Bunch Grasses of *Aristida contorta* and *Enteropogon ramosus* on orange brown loamy sand on eroded plains



Area Mapped	11.12 ha
Quadrats Sampled	RD01
Location	Restricted to a localised area in the south-west corner
Leaf Litter Cover (%)	<1
Bare Ground (%)	90
Soils and Geology	Light orange brown loamy sand
Land System	Sylvania
Land Form	Eroded plain (crusty)
Priority Ecological Community	None
Rare Flora	None
Introduced (Weed) Species	None (likely to be present following good seasonal rainfall)
Vegetation Condition	Very Good
Disturbances	Livestock, weeds
Average Fire Age	Old (5-10 years)
Characteristics	Bare eroded plains with <i>Frankenia setosa</i>
Vegetation Structure & Floristics	
Tall Shrubs >2m	<i>Hakea preissii</i> , <i>Acacia synchronicia</i>
Shrubs <1m	<i>Frankenia setosa</i>
Tussock Grasses	<i>Aristida contorta</i> , <i>Enteropogon ramosus</i>

Broad Floristic Formation	10a <i>Triodia</i> Hummock Grassland
Vegetation Association	Hummock Grassland of <i>Triodia schinzii</i> and <i>Triodia basedowii</i> with Low Shrubland of <i>Eremophila forrestii</i> subsp. <i>forrestii</i> and <i>Senna artemisioides</i> subsp. <i>helmsii</i> with Low Open Woodland of <i>Acacia pruinocarpa</i> , <i>Acacia aptaneura</i> and <i>Acacia paraneura</i> on red sandy loam on plains



Area Mapped	95.53 ha
Quadrats Sampled	DY03, RD10
Location	North-west and central western fringes of the study area
Leaf Litter Cover (%)	5
Bare Ground (%)	45
Soils and Geology	Red sandy loam (hard loam undercrust)
Land System	Sylvania
Land Form	Plains
Priority Ecological Community	None
Rare Flora	None
Introduced (Weed) Species	* <i>Cenchrus ciliaris</i>
Vegetation Condition	Very Good
Disturbances	Livestock
Average Fire Age	Old (5-10 years)
Characteristics	<i>Triodia schinzii</i> on sandy plains with a Mulga-dominant overstorey
Vegetation Structure & Floristics	
Trees <10m	<i>Acacia pruinocarpa</i> , <i>Acacia aptaneura</i> , <i>Acacia paraneura</i>
Tall Shrubs >2m	<i>Acacia tetragonophylla</i>
Shrubs <1m	<i>Eremophila forrestii</i> subsp. <i>forrestii</i> , <i>Senna artemisioides</i> subsp. <i>helmsii</i>
Hummock Grasses	<i>Triodia schinzii</i> , <i>Triodia basedowii</i>
Tussock Grasses	<i>Aristida inaequiglumis</i> , <i>Eragrostis eriopoda</i>

Broad Floristic Formation	10b <i>Triodia</i> Hummock Grassland
Vegetation Association	Hummock Grassland of <i>Triodia</i> sp. Shovelanna Hill (S. van Leeuwen 3835) and <i>Triodia pungens</i> with High Open Shrubland of <i>Senna glutinosa</i> subsp. x <i>luerssenii</i> , <i>Acacia tetragonophylla</i> and <i>Acacia trudgeniana</i> and Scattered Low Trees of <i>Acacia aptaneura</i> and <i>Acacia pruinocarpa</i> on orange sandy loam on hillslopes



Area Mapped	279.49 ha
Quadrats Sampled	DY20, RD11, RD12, RD13, RD52, RD57, RD105, RD126, RD129
Location	Hill slopes in the eastern and western sectors of the study area
Leaf Litter Cover (%)	1
Bare Ground (%)	47
Soils and Geology	Quartz/quartzite cobbles and pebbles with orange sandy loam
Land System	Sylvania, McKay, Newman
Land Form	Hillslopes
Priority Ecological Community	None
Rare Flora	None
Introduced (Weed) Species	* <i>Cenchrus ciliaris</i>
Vegetation Condition	Very Good
Disturbances	Livestock, weeds
Average Fire Age	Old (5-10 years)
Characteristics	Low quartz hillslopes
Vegetation Structure & Floristics	
Trees <10m	<i>Acacia aptaneura</i>
Shrubs 1-2m	<i>Acacia ancistrocarpa</i> , <i>Eremophila fraseri</i> , <i>Senna glutinosa</i> subsp. x <i>luerssenii</i> , <i>Acacia tetragonophylla</i> , <i>Acacia trudgeniana</i> , <i>Senna artemisioides</i> subsp. <i>helmsii</i> , <i>Senna glutinosa</i> subsp. <i>pruinosa</i>
Shrubs <1m	<i>Eremophila exilifolia</i>
Hummock Grasses	<i>Triodia pungens</i> , <i>Triodia</i> sp. Shovelanna Hill
Tussock Grasses	<i>Aristida contorta</i> , <i>Eragrostis eriopoda</i> , <i>Paraneurachne muelleri</i>

Broad Floristic Formation	10c <i>Triodia</i> Hummock Grassland
Vegetation Association	Hummock Grassland of <i>Triodia angusta</i> with Low Shrubland of <i>Eremophila cuneifolia</i> , <i>Senna artemisioides</i> subsp. <i>helmsii</i> and <i>Acacia bivenosa</i> and High Open Shrubland of <i>Acacia synchronicia</i> and <i>Acacia bivenosa</i> (wispy form) on brown loam on hillslopes and footslopes



Area Mapped	35.94 ha
Quadrats Sampled	DY07, RD42, RD43, RD44
Location	One localised area in north-west sector of the study area
Leaf Litter Cover (%)	<1
Bare Ground (%)	35
Soils and Geology	Brown loam, ironstone and quartz cobbles and pebbles, pink and white shales and slates
Land System	McKay
Land Form	Hillslopes and footslopes
Priority Ecological Community	None
Rare Flora	None
Introduced (Weed) Species	* <i>Cenchrus ciliaris</i>
Vegetation Condition	Very Good
Disturbances	Livestock, weeds
Average Fire Age	Old (5-10 years)
Characteristics	Hillslopes with <i>Triodia angusta</i> and some <i>Triodia</i> sp. Shovelanna Hill on lowerslopes
Vegetation Structure & Floristics	
Trees <10m	<i>Acacia macraneura</i> , <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i>
Tall Shrubs >2m	<i>Acacia synchronicia</i> , <i>Acacia bivenosa</i> (wispy form), <i>Acacia tetragonophylla</i>
Shrubs <1m	<i>Eremophila cuneifolia</i> , <i>Senna artemisioides</i> subsp. <i>helmsii</i> , <i>Acacia bivenosa</i> , <i>Senna</i> sp. Meekatharra (E. Bailey 1-26), <i>Senna glutinosa</i> subsp. <i>x luerssenii</i>
Hummock Grasses	<i>Triodia angusta</i>

Broad Floristic Formation	10d <i>Triodia</i> Hummock Grassland
Vegetation Association	Hummock Grassland of <i>Triodia basedowii</i> and/or <i>Triodia schinzii</i> with High Open Shrubland of <i>Acacia pachyacra</i> and <i>Acacia ancistrocarpa</i> and Scattered Low Trees of <i>Hakea lorea</i> subsp. <i>lorea</i> , <i>Acacia aptaneura</i> and <i>Corymbia hamersleyana</i> on red brown sandy loam on plains



Area Mapped	414.83 ha
Quadrats Sampled	DY10, DY11, RD70
Location	Extensively north-south through the central sector of the study area
Leaf Litter Cover (%)	<5
Bare Ground (%)	30
Soils and Geology	Red brown loamy sand with hard loam crust, scattered quartz and cherts
Land System	Cadgie, Divide
Land Form	Plains
Priority Ecological Community	None
Rare Flora	None
Introduced (Weed) Species	None recorded (likely to be present following good seasonal rainfall)
Vegetation Condition	Very Good
Disturbances	Livestock
Average Fire Age	Old (5-10 years)
Characteristics	Extensive sand plains with <i>Triodia basedowii</i> and <i>Triodia schinzii</i>
Vegetation Structure & Floristics	
Trees <10m	<i>Hakea lorea</i> subsp. <i>lorea</i> , <i>Acacia aptaneura</i> , <i>Corymbia hamersleyana</i> , <i>Acacia paraneura</i> , <i>Corymbia deserticola</i> , <i>Hakea lorea</i> subsp. <i>lorea</i>
Tall Shrubs >2m	<i>Acacia pachyacra</i> , <i>Acacia ancistrocarpa</i> , <i>Acacia tetragonophylla</i>
Shrubs <1m	<i>Androcalva loxophylla</i> , <i>Bonamia erecta</i> , <i>Scaevola parvifolia</i>
Hummock Grasses	<i>Triodia basedowii</i> , <i>Triodia schinzii</i>

Broad Floristic Formation	10e <i>Triodia</i> Hummock Grassland
Vegetation Association	Hummock Grassland of <i>Triodia pungens</i> with High Open Shrubland of <i>Hakea lorea</i> subsp. <i>lorea</i> , <i>Acacia synchronicia</i> and <i>Acacia pachyacra</i> and Low Open Shrubland of <i>Senna artemisioides</i> subsp. <i>oligophylla</i> , <i>Eremophila fraseri</i> and <i>Indigofera monophylla</i> on brown sandy loam on calcrete plains and hillslopes



Area Mapped	12.30 ha
Quadrats Sampled	DY12, RD72
Location	Localised area in central southern sector of study area
Leaf Litter Cover (%)	2
Bare Ground (%)	20
Soils and Geology	Brown sandy loam, chert, quartz with calcrete
Land System	Cadgie
Land Form	Low stony rises
Priority Ecological Community	None
Rare Flora	None
Introduced (Weed) Species	None
Vegetation Condition	Very Good
Disturbances	Livestock
Average Fire Age	Old (5-10 yrs)
Characteristics	Dominant hummock grassland stratum and absence of trees (bordering on being closed)
Vegetation Structure & Floristics	
Tall Shrubs >2m	<i>Hakea lorea</i> subsp. <i>lorea</i> , <i>Acacia synchronicia</i> , <i>Acacia pachyacra</i> , <i>Acacia trudgeniana</i>
Shrubs <1m	<i>Senna artemisioides</i> subsp. <i>oligophylla</i> , <i>Eremophila fraseri</i> , <i>Indigofera monophylla</i>
Tussock Grasses	<i>Triodia pungens</i>

Broad Floristic Formation 10f *Triodia* Hummock Grassland
Hummock Grassland of *Triodia pungens* and *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835) with Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia*, *Acacia rhodophloia* and *Acacia bivenosa* (wispy form) and High Open Shrubland of *Acacia maitlandii*, *Acacia rhodophloia* and *Senna glutinosa* subsp. *x luerssenii* on brown sandy loam on hillcrests and slopes

Vegetation Association



Area Mapped	22.20 ha
Quadrats Sampled	DY16, RD88, RD101
Location	North-east sector of the study area
Leaf Litter Cover (%)	1
Bare Ground (%)	55
Soils and Geology	Brown sandy loam, quartz pebbles, cobbles and outcrops
Land System	McKay
Land Form	Hill crests and slopes
Priority Ecological Community	None
Rare Flora	None
Introduced (Weed) Species	None
Vegetation Condition	Excellent
Disturbances	Livestock
Average Fire Age	Old (5-10 years)
Characteristics	<i>Acacia rhodophloia</i> over <i>Eremophila exilifolia</i>
Vegetation Structure & Floristics	
Trees <10m	<i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> , <i>Acacia rhodophloia</i>
Tall Shrubs >2m	<i>Acacia maitlandii</i> , <i>Acacia rhodophloia</i> , <i>Senna glutinosa</i> subsp. <i>x luerssenii</i> , <i>Acacia bivenosa</i>
Shrubs <1m	<i>Eremophila exilifolia</i> , <i>Eremophila cuneifolia</i> , <i>Senna stricta</i>
Tussock Grasses	<i>Triodia pungens</i> , <i>Triodia</i> sp. Shovelanna Hill (occurring on lower slopes)

Broad Floristic Formation	10g <i>Triodia</i> Hummock Grassland
Vegetation Association	Hummock Grassland of <i>Triodia pungens</i> with High Open Shrubland of <i>Grevillea wickhamii</i> subsp. <i>hispidula</i> and <i>Acacia maitlandii</i> and Low Open Shrubland of <i>Eremophila exilifolia</i> , <i>Acacia hilliana</i> and <i>Senna artemisioides</i> subsp. <i>helmsii</i> on red brown loamy sand on dolerite hillslopes



Area Mapped	44.81 ha
Quadrats Sampled	DY17
Location	North-east sector of the study area
Leaf Litter Cover (%)	<1
Bare Ground (%)	40
Soils and Geology	Dolerite and quartz outcropping with red brown loamy sand
Land System	McKay
Land Form	Dolerite hillslopes
Priority Ecological Community	None
Rare Flora	None
Introduced (Weed) Species	None
Vegetation Condition	Excellent
Disturbances	Livestock
Average Fire Age	Old (5-10 years)
Characteristics	Open shrub strata over hummock grassland
Vegetation Structure & Floristics	
Shrubs 1-2m	<i>Grevillea wickhamii</i> subsp. <i>hispidula</i> , <i>Acacia maitlandii</i>
Shrubs <1m	<i>Eremophila exilifolia</i> , <i>Acacia hilliana</i> , <i>Senna artemisioides</i> subsp. <i>helmsii</i>
Tussock Grasses	<i>Triodia pungens</i>

Broad Floristic Formation	10h <i>Triodia</i> Hummock Grassland
Vegetation Association	Hummock Grassland of <i>Triodia pungens</i> and <i>Triodia basedowii</i> with Open Mallee of <i>Eucalyptus gamophylla</i> and High Shrubland of <i>Acacia kempeana</i> and <i>Acacia sclerosperma</i> subsp. <i>sclerosperma</i> on red loamy sand on drainage zones



Area Mapped	17.96 ha
Quadrats Sampled	RD109
Location	North-east sector of the study area
Leaf Litter Cover (%)	5
Bare Ground (%)	30
Soils and Geology	Red loamy sand
Land System	Divide
Land Form	Sandy drainage zones
Priority Ecological Community	None
Rare Flora	None
Introduced (Weed) Species	None
Vegetation Condition	Very Good
Disturbances	Livestock
Average Fire Age	Very Good
Characteristics	<i>Eucalyptus gamophylla</i> on sandy drainage lines
Vegetation Structure & Floristics	
Trees <10m	<i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> , <i>Acacia aptaneura</i> , <i>Hakea lorea</i> subsp. <i>lorea</i>
Mallee	<i>Eucalyptus gamophylla</i>
Tall Shrubs >2m	<i>Acacia kempeana</i> , <i>Acacia sclerosperma</i> subsp. <i>sclerosperma</i>
Shrubs <1m	<i>Kennedia prorepens</i>
Hummock Grasses	<i>Triodia pungens</i> , <i>Triodia basedowii</i>
Tussock Grasses	<i>Eragrostis eriopoda</i>

Broad Floristic Formation 10i *Triodia* Hummock Grassland
Hummock Grassland of *Triodia* sp. Shovelanna Hill and *Triodia pungens* with Low Woodland of *Acacia aptaneura*, *Acacia pruinocarpa* and *Acacia catenulata* subsp. *occidentalis* and High Open Shrubland of *Acacia tetragonophylla* and *Senna glutinosa* subsp. *x luerssenii* on skeletal brown sandy loam on hillslopes

Vegetation Association



Area Mapped	42.10 ha
Quadrats Sampled	DY25
Location	South-east sector of study area
Leaf Litter Cover (%)	5
Bare Ground (%)	35
Soils and Geology	Skeletal brown sandy loam, ironstone cobbles, pebbles and outcropping
Land System	Newman
Land Form	Hillslopes
Priority Ecological Community	None
Rare Flora	None
Introduced (Weed) Species	None
Vegetation Condition	Excellent
Disturbances	Historical drilling activity
Average Fire Age	Old (5-10 years)
Characteristics	Mulga species growing on hillslopes
Vegetation Structure & Floristics	
Trees <10m	<i>Acacia aptaneura</i> , <i>Acacia pruinocarpa</i> , <i>Acacia catenulata</i> subsp. <i>occidentalis</i> , <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i>
Tall Shrubs >2m	<i>Acacia tetragonophylla</i> , <i>Senna glutinosa</i> subsp. <i>x luerssenii</i>
Shrubs 1-2m	<i>Eremophila latrobei</i> subsp. <i>latrobei</i>
Hummock Grasses	<i>Triodia</i> sp. Shovelanna Hill, <i>Triodia pungens</i> , <i>Triodia brizoides</i> ²

² Unsure of ID due to absence of fruits at time of survey

Broad Floristic Formation	10j <i>Triodia</i> Hummock Grassland
Vegetation Association	Hummock Grassland of <i>Triodia</i> sp. Shovelanna Hill and <i>Triodia brizoides</i> ³ with High Open Shrubland of <i>Acacia pruinocarpa</i> , <i>Hakea chordophylla</i> and <i>Grevillea berryana</i> and Open Shrubland of <i>Senna glutinosa</i> subsp. <i>pruinosa</i> and <i>Ptilotus rotundifolius</i> on brown sandy loam on hillcrests



Area Mapped	26.51 ha
Quadrats Sampled	DY28, RD128
Location	Hills and hillcrests in the central east of the study area
Leaf Litter Cover (%)	<1
Bare Ground (%)	20
Soils and Geology	Brown sandy loam with ironstone cobbles and pebbles
Land System	Newman, Jamindie
Land Form	Hillcrests
Priority Ecological Community	None
Rare Flora	None
Introduced (Weed) Species	None
Vegetation Condition	Very Good
Disturbances	Historical drilling activities
Average Fire Age	Old (5-10 years)
Characteristics	<i>Triodia</i> sp. Shovelanna Hill on hill crests
Vegetation Structure & Floristics	
Tall Shrubs >2m	<i>Acacia pruinocarpa</i> , <i>Hakea chordophylla</i> , <i>Grevillea berryana</i>
Shrubs 1-2m	<i>Senna glutinosa</i> subsp. <i>pruinosa</i> , <i>Ptilotus rotundifolius</i>
Low Shrubs <1m	<i>Acacia hilliana</i> , <i>Halgania solanacea</i> var. Mt Doreen (G.M. Chippendale 4206)
Hummock Grasses	<i>Triodia</i> sp. Shovelanna Hill (S. van Leeuwen 3835)
Tussock Grasses	<i>Amphipogon sericeus</i>

³ Unsure of identification due to absence of fruiting material at the time of survey

Broad Floristic Formation	10k <i>Triodia</i> Hummock Grassland
Vegetation Association	Hummock Grassland of <i>Triodia pungens</i> with Low Open Shrubland of <i>Eremophila fraseri</i> and <i>Acacia synchronicia</i> and Scattered Low Trees of <i>Hakea lorea</i> subsp. <i>lorea</i> and <i>Grevillea striata</i> on skeletal brown loam on dolerite hillcrests and slopes



Area Mapped	13.97 ha
Quadrats Sampled	DY29
Location	North-eastern fringe of study area
Leaf Litter Cover (%)	<1
Bare Ground (%)	25
Soils and Geology	Dolerite with skeletal brown loam, outcropping
Land System	McKay
Land Form	Dolerite hill crests and slopes
Priority Ecological Community	None
Rare Flora	None
Introduced (Weed) Species	None
Vegetation Condition	Very Good
Disturbances	Tracks, rail line and powerlines nearby
Average Fire Age	Old (5-10 years)
Characteristics	Dolerite hill crests and slopes
Vegetation Structure & Floristics	
Trees <10m	<i>Hakea lorea</i> subsp. <i>lorea</i> , <i>Grevillea striata</i>
Shrubs <1m	<i>Eremophila fraseri</i> , <i>Acacia synchronicia</i>
Hummock Grasses	<i>Triodia pungens</i>

Broad Floristic Formation 11 *Eriachne* Tussock Grassland
Vegetation Association Tussock Grassland of *Eriachne benthamii*, *Eragrostis xerophila* and *Eragrostis setifolia* with High Open Shrubland of *Acacia tetragonophylla* and Scattered Low Trees of *Acacia aptaneura* on light brown heavy clay on gilgai drainage zones

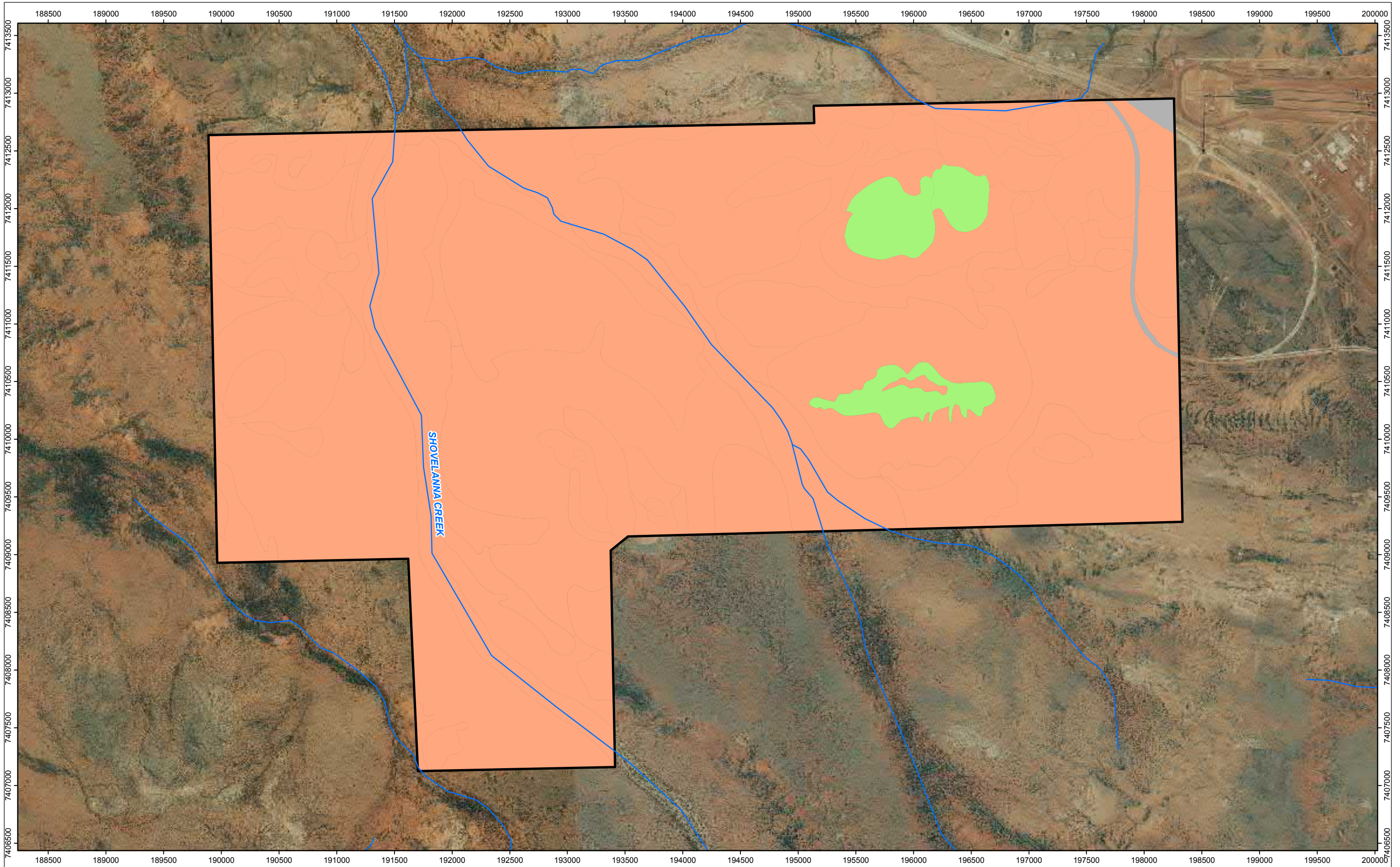


Area Mapped	2.89 ha
Quadrats Sampled	RD66, RD67, RD84
Location	Two localised areas in the south-eastern sector of the study area
Leaf Litter Cover (%)	5
Bare Ground (%)	80
Soils and Geology	Cracking light brown clay or clay loam, gilgai
Land System	Cadgie
Land Form	Gilgai drainage zones, open stony plains
Priority Ecological Community	None
Rare Flora	None
Introduced (Weed) Species	None at time of sampling
Vegetation Condition	Very Good
Disturbances	Livestock
Average Fire Age	Old (5-10 years)
Characteristics	This unit included two small areas clay drainage depressions dominated by <i>Eriachne benthamii</i>
Vegetation Structure & Floristics	
Tall Shrubs >2m	<i>Acacia aptaneura</i> , <i>Acacia tetragonophylla</i> , <i>Acacia synchronicia</i>
Low Shrubs <1m	<i>Senna artemisioides</i> subsp. <i>oligophylla</i> , <i>Eremophila forrestii</i> subsp. <i>forrestii</i> , <i>Eremophila cuneifolia</i> , <i>Senna</i> sp. <i>Meekatharra</i>
Tussock Grasses	<i>Eriachne benthamii</i> , <i>Eragrostis xerophila</i> , <i>Eragrostis setifolia</i>
Herbs	<i>Marsilea hirsuta</i> , <i>Ptilotus gomphrenoides</i> subsp. <i>gomphrenoides</i> , <i>Minuria integerrima</i> , <i>Neptunia dimorphantha</i> , <i>Aeschymene indica</i> , <i>Strepoglossa adscendens</i>

3.8 Vegetation Condition

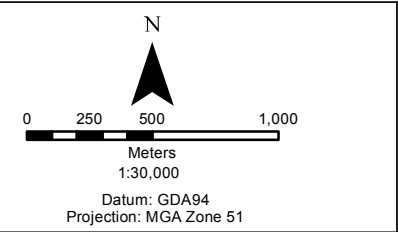
The study area is situated south of the Ophthalmia Range and is dominated by the Shovelanna Creek system and surrounding plains which are actively grazed by cattle. Grazing of native vegetation by domestic stock and associated introduction of weeds are the primary factors that have reduced vegetation condition across the larger study area to the status of *very good* (Appendix 4, Figure 10). Other disturbances recorded were pastoral and exploration tracks, and edge effects from adjacent mining infrastructure in the north-east sector of the study area.

Three vegetation associations supported vegetation condition rated as *excellent*; 10f, 10g and 10i (Figure 10). These areas are associated with hill crests and hill slopes situated in the eastern sector of the study area and supporting vegetation that is less palatable to domestic stock and hence largely unimpacted by grazing.



SHOVELANNA CREEK




			
Figure:	10	Date:	29 Apr 2015
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GSM	DB	Dynasty_Jimblebar_Vegetation_cond	



**BHPBIO
DYNASTY - WEST JIMBLEBAR**

**FIGURE 10
Vegetation Condition Map**

Legend
 Study Area - Dynasty-West Jimblebar

- Vegetation Condition**
-  Degraded
 -  Very Good
 -  Excellent



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4.0 SUMMARY

A total number of 263 plant taxa (including varieties and subspecies) from 36 families and 106 genera were recorded from the study area, with species representation greatest amongst the Fabaceae (49 taxa), Poaceae (45 taxa), Malvaceae (33 taxa), Chenopodiaceae (18 taxa) and Amaranthaceae (15 taxa) families. The most speciose genera were *Acacia* (25 taxa), *Sida* (13 taxa), *Senna* (12 taxa), *Eremophila* (9 taxa) and *Ptilotus* (9 taxa). There was no plant taxon gazetted as Threatened Flora (T) pursuant to subsection (2) of Section 23F of the WC Act or listed under the EPBC Act recorded from the study area.

There were three DPaW listed Priority flora taxon recorded from the study area; *Ipomoea racemigera* (Priority 2), *Goodenia berringbinensis* (Priority 4) and *Goodenia nuda* (Priority 4). *Ipomoea racemigera* is a creeping annual herb recorded from two releve sites (approximately 20 plants at each site) occurring along the major drainage channel of Shovellana Creek. *Goodenia berringbinensis* is an ascending annual herb restricted to a localised drainage foci approximately 0.5 ha in area in the south-west sector of the study area. An estimated 50 plants occurred on moist light brown clay (gilgai) soils. *Goodenia nuda* is an erect herb recorded as approximately 150 plants from nine spot locations within the south-western and central eastern sectors of the study area.

Five plant taxa recorded from within the study area were regarded as range extensions; *Eragrostis speciosa* (150 km south-east), *Hibiscus verdcourtii* (200 km east), *Goodenia berringbinensis* (250 km north), *Eleocharis pallens* (350 km south-east) and *Tribulus cf. eichlerianus* (950 km west).

A total of four introduced (weed) species were recorded from the study area; **Aerva javanica* (Kapok Bush), **Bidens bipinnata* (Bipinnate Beggartick), **Cenchrus ciliaris* (Buffel Grass) and **Malvastrum americanum* (Spiked Malvastrum). None of these taxa are listed as a Declared Pest under the BAM Act.

A total of 26 vegetation associations were mapped and described within the study area. The vegetation associations were classified into eleven broad floristic formations on the basis of the dominant vegetation stratum. No TECs were recorded from within or adjacent to the study area. None of the vegetation associations described and mapped from the study area were found to have affiliations with any PECs documented within the Pilbara.

The study area is dominated by the Shovelanna Creek system and surrounding plains which are actively grazed by cattle. Grazing of native vegetation by domestic stock and associated introduction of weeds are the primary factors that have reduced vegetation condition across the larger study area to the status of *very good*. Other disturbances recorded were pastoral and exploration tracks, and edge effects from adjacent mining infrastructure in the north-east sector of the study area. Three vegetation associations supported vegetation condition rated as *excellent*; 10f, 10g and 10i. These areas are associated with hill crests and hill slopes situated in the eastern sector of the study area and supporting vegetation that is less palatable to domestic stock and hence largely unimpacted by grazing.

⁴ Closest identification based on published descriptions and keys. The only previous record is from near the Central Ranges close to the Western Australian Border. A portion of the collection has been forwarded on to R. Barker for a second opinion.

5.0 STUDY TEAM

The Level 2 flora and vegetation survey was planned, co-ordinated and executed by the following personnel:

Onshore Environmental Consultants P/L
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Project Staff

Dr Darren Brearley	PhD	Project Manager
Dr Jerome Bull	PhD	Principal Botanist
Ms Jessica Waters	BSc	Botanist
Mr Todd Griffin		GIS and Mapping Specialist

Licences

The field survey was conducted under the authorisation of the following licences issued by the Department of Parks and Wildlife:

- Jerome Bull, Onshore Environmental Consultants 'Licence to take flora for scientific & other prescribed purposes' Licence No. SL009579
- Jessica Waters, Onshore Environmental Consultants 'Licence to take flora for scientific & other prescribed purposes' Licence No. SL009563

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APPENDIX 1

Conservation Codes for Western Australian Flora.

T: Threatened (Declared Rare) Flora - Extant Taxa

Taxa which have been adequately searched for, and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such.

1: Priority One - Poorly Known Taxa

Taxa that are known from one or a few collections or sight records (generally less than five), all on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, Shire, Westrail and Main Roads WA road, gravel and soil reserves, and active mineral leases and under threat of habitat destruction or degradation. Taxa may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes.

2: Priority Two - Poorly Known Taxa

Taxa that are known from one or a few collections or sight records, some of which are on lands not under imminent threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. Taxa may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes.

3: Priority Three - Poorly Known Taxa

Taxa that are known from collections or sight records from several localities not under imminent threat, or from few but widespread localities with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Taxa may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them.

4: Priority Four - Rare, Near Threatened and other taxa in need of monitoring

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

5: Priority Five - Conservation Dependent taxa

Taxa that are not threatened but are subject to a specific conservation program, the cessation of which would result in the taxa becoming threatened within five years.

APPENDIX 2

Conservation categories for flora described
under the EPBC Act.

Category	Description
Extinct	A species is extinct if there is no reasonable doubt that the last member of the species has died.
Extinct in the Wild	A species is categorised as extinct in the wild if it is only known to survive in cultivations, in captivity, or as a naturalised population well outside its past range; or if it has not been recorded in its known/expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
Critically Endangered	The species is facing an extremely high risk of extinction in the wild and in the immediate future.
Endangered	The species is likely to become extinct unless the circumstances and factors threatening its abundance, survival, or evolutionary development cease to operate; or its numbers have been reduced to such a critical level, or its habitats have been so drastically reduced, that it is in immediate danger of extinction.
Vulnerable	Within the next 25 years, the species is likely to become endangered unless the circumstances and factors threatening its abundance, survival or evolutionary development cease to operate.
Conservation Dependent	The species is the focus of a specific conservation program, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within a period of 5 years.

APPENDIX 3

Vegetation Classifications for the Pilbara based on Specht (1970), as modified by Aplin (1979) and Trudgen (2009).

Height Class	Canopy Cover				
	100 - 70%	70 - 30%	30 - 10%	10 - 2%	< 2%
Trees > 30 m	High Closed Forest	High Open Forest	High Woodland	High Open Woodland	Scattered Tall Trees
Trees 10-30 m	Closed Forest	Open Forest	Woodland	Open Woodland	Scattered Trees
Trees < 10 m	Low Closed Woodland	Low Open Forest	Low Woodland	Low Open Woodland	Scattered Low Trees
Mallee	Closed Mallee	Mallee	Open Mallee	Very Open Mallee	Scattered Mallees
Shrubs > 2 m	Closed Scrub	Open Scrub	High Shrubland	High Open Shrubland	Scattered Tall Shrubs
Shrubs 1-2 m	Closed Heath	Open Heath	Shrubland	Open Shrubland	Scattered Shrubs
Shrubs < 1 m	Low Closed Heath	Low Open Heath	Low Shrubland	Low Open Shrubland	Low Scattered Shrubs
Hummock Grass	Closed Hummock Grassland	Hummock Grassland	Open Hummock Grassland	Very Open Hummock Grassland	Scattered Hummock Grass
Tussock Grass	Closed Tussock Grassland	Tussock Grassland	Open Tussock Grassland	Very Open Tussock Grassland	Scattered Tussock Grass
Bunch Grass	Closed Bunch Grassland	Bunch Grassland	Open Bunch Grassland	Very Open Bunch Grassland	Scattered Bunch Grass
Sedges	Closed Sedges	Sedges	Open Sedges	Very Open Sedges	Scattered Sedges
Herbs	Closed Herbs	Herbs	Open Herbs	Very Open Herbs	Scattered Herbs

Source: S. Van Leeuwen (DPaW)

APPENDIX 4

Vegetation condition scale
(as developed by Keighery 1994)

Condition	Code	Description
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.
Good	4	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it.
Degraded	5	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching Very Good condition without intensive management.
Completely Degraded	6	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species.

APPENDIX 5

Total flora list from the study area

Family	Genus	Species	Inf_Rank	Inf_Name
Aizoaceae	<i>Trianthera</i>	<i>pilosum</i>		
Aizoaceae	<i>Trianthera</i>	<i>triquetrum</i>		
Amaranthaceae	<i>Aerva</i>	<i>javanica</i>		
Amaranthaceae	<i>Alternanthera</i>	<i>nana</i>		
Amaranthaceae	<i>Alternanthera</i>	<i>nodiflora</i>		
Amaranthaceae	<i>Alternanthera</i>		sp.	indet.
Amaranthaceae	<i>Gomphrena</i>	<i>kanisii</i>		
Amaranthaceae	<i>Gomphrena</i>	<i>lanata</i>		
Amaranthaceae	<i>Ptilotus</i>	<i>aervoides</i>		
Amaranthaceae	<i>Ptilotus</i>	<i>astrolasius</i>		
Amaranthaceae	<i>Ptilotus</i>	<i>calostachyus</i>		
Amaranthaceae	<i>Ptilotus</i>	<i>gomphrenoides</i>	subsp.	<i>gomphrenoides</i>
Amaranthaceae	<i>Ptilotus</i>	<i>nobilis</i>		
Amaranthaceae	<i>Ptilotus</i>	<i>obovatus</i>		
Amaranthaceae	<i>Ptilotus</i>	<i>schwartzii</i>		
Amaranthaceae	<i>Ptilotus</i>		cf.	<i>clementii</i>
Amaranthaceae	<i>Ptilotus</i>		sp.	indet.
Apocynaceae	<i>Cynanchum</i>	<i>floribundum</i>		
Apocynaceae	<i>Rhyncharrhena</i>	<i>linearis</i>		
Apocynaceae	<i>Sarcostemma</i>	<i>australe</i>		
Asteraceae	<i>Bidens</i>	<i>bipinnata</i>		
Asteraceae	<i>Chrysocephalum</i>	<i>apiculatum</i>		
Asteraceae	<i>Chrysocephalum</i>	<i>pterochaetum</i>		
Asteraceae	<i>Minuria</i>	<i>integerrima</i>		
Asteraceae	<i>Pluchea</i>	<i>dentex</i>		
Asteraceae	<i>Pterocaulon</i>	<i>sphaeranthoides</i>		
Asteraceae	<i>Rutidosia</i>	<i>helichrysoides</i>		
Asteraceae	<i>Streptoglossa</i>	<i>adscendens</i>		
Boraginaceae	<i>Halgania</i>	<i>solanacea</i>	var.	Mt Doreen (G.M. Chippendale 4206)
Boraginaceae	<i>Heliotropium</i>		sp.	indet.
Brassicaceae	<i>Lepidium</i>	<i>platypetalum</i>		
Brassicaceae	<i>Stenopetalum</i>	<i>decipiens</i>		
Chenopodiaceae	<i>Maireana</i>	<i>georgei</i>		
Chenopodiaceae	<i>Maireana</i>	<i>melanocoma</i>		
Chenopodiaceae	<i>Maireana</i>	<i>planifolia</i>		
Chenopodiaceae	<i>Maireana</i>	<i>tomentosa</i>		
Chenopodiaceae	<i>Maireana</i>	<i>triptera</i>		
Chenopodiaceae	<i>Maireana</i>	<i>villosa</i>		
Chenopodiaceae	<i>Maireana</i>		sp.	indet.
Chenopodiaceae	<i>Rhagodia</i>	<i>eremaea</i>		
Chenopodiaceae	<i>Rhagodia</i>	<i>eremophila</i>		
Chenopodiaceae	<i>Salsola</i>	<i>australis</i>		
Chenopodiaceae	<i>Sclerolaena</i>	<i>convexula</i>		
Chenopodiaceae	<i>Sclerolaena</i>	<i>cornishiana</i>		
Chenopodiaceae	<i>Sclerolaena</i>	<i>costata</i>		
Chenopodiaceae	<i>Sclerolaena</i>	<i>cuneata</i>		
Chenopodiaceae	<i>Sclerolaena</i>	<i>eriacantha</i>		
Chenopodiaceae	<i>Sclerolaena</i>		cf.	<i>convexula</i>
Chenopodiaceae	<i>Sclerolaena</i>		sp.	indet.
Chenopodiaceae	<i>Tecticornia</i>	<i>disarticulata</i>		
Cleomaceae	<i>Cleome</i>	<i>viscosa</i>		
Convolvulaceae	<i>Bonamia</i>	<i>erecta</i>		
Convolvulaceae	<i>Duperreya</i>	<i>commixta</i>		
Convolvulaceae	<i>Evolvulus</i>	<i>alsinoides</i>	var.	<i>villosicalyx</i>

Family	Genus	Species	Inf_Rank	Inf_Name
Convolvulaceae	<i>Ipomoea</i>	<i>calobra</i>		
Convolvulaceae	<i>Ipomoea</i>	<i>coptica</i>		
Convolvulaceae	<i>Ipomoea</i>	<i>muelleri</i>		
Convolvulaceae	<i>Ipomoea</i>	<i>polymorpha</i>		
Convolvulaceae	<i>Ipomoea</i>	<i>racemigera</i>		
Convolvulaceae	<i>Isotropis</i>	<i>forrestii</i>		
Cucurbitaceae	<i>Cucumis</i>	<i>variabilis</i>		
Cyperaceae	<i>Bulbostylis</i>	<i>barbata</i>		
Cyperaceae	<i>Cyperus</i>	<i>bulbosus</i>		
Cyperaceae	<i>Cyperus</i>	<i>difformis</i>		
Cyperaceae	<i>Cyperus</i>	<i>iria</i>		
Cyperaceae	<i>Cyperus</i>	<i>ixiocarpus</i>		
Cyperaceae	<i>Cyperus</i>	<i>squarrosus</i>		
Cyperaceae	<i>Eleocharis</i>	<i>pallens</i>		
Cyperaceae	<i>Fimbristylis</i>	<i>dichotoma</i>		
Cyperaceae	<i>Fimbristylis</i>		sp.	indet.
Cyperaceae	<i>Schoenoplectis</i>	<i>laevis</i>		
Euphorbiaceae	<i>Euphorbia</i>	<i>trigonosperma</i>		
Euphorbiaceae	<i>Euphorbia</i>		cf.	<i>tannensis</i> subsp. <i>eremophila</i>
Fabaceae	<i>Acacia</i>	<i>ancistrocarpa</i>		
Fabaceae	<i>Acacia</i>	<i>aneura</i>		
Fabaceae	<i>Acacia</i>	<i>aptaneura</i>		
Fabaceae	<i>Acacia</i>	<i>aptaneura</i> hybrid		
Fabaceae	<i>Acacia</i>	<i>ayersiana</i>		
Fabaceae	<i>Acacia</i>	<i>catenulata</i>	subsp.	<i>occidentalis</i>
Fabaceae	<i>Acacia</i>	<i>coriacea</i>	subsp.	<i>pendens</i>
Fabaceae	<i>Acacia</i>	<i>hilliana</i>		
Fabaceae	<i>Acacia</i>	<i>kempeana</i>		
Fabaceae	<i>Acacia</i>	<i>macraneura</i>		
Fabaceae	<i>Acacia</i>	<i>maitlandii</i>		
Fabaceae	<i>Acacia</i>	<i>marramamba</i>		
Fabaceae	<i>Acacia</i>	<i>melleodora</i>		
Fabaceae	<i>Acacia</i>	<i>pachyacra</i>		
Fabaceae	<i>Acacia</i>	<i>paraneura</i>		
Fabaceae	<i>Acacia</i>	<i>pruinocarpa</i>		
Fabaceae	<i>Acacia</i>	<i>pteraneura</i>		
Fabaceae	<i>Acacia</i>	<i>pyrifolia</i>		
Fabaceae	<i>Acacia</i>	<i>rhodophloia</i>		
Fabaceae	<i>Acacia</i>	<i>sclerosperma</i>	subsp.	<i>sclerosperma</i>
Fabaceae	<i>Acacia</i>	<i>synchronicia</i>		
Fabaceae	<i>Acacia</i>	<i>tenuissima</i>		
Fabaceae	<i>Acacia</i>	<i>tetragonophylla</i>		
Fabaceae	<i>Acacia</i>	<i>trudgeniana</i>		
Fabaceae	<i>Acacia</i>		cf.	<i>sibirica</i>
Fabaceae	<i>Aeschymene</i>	<i>indica</i>		
Fabaceae	<i>Glycine</i>	<i>canescens</i>		
Fabaceae	<i>Indigofera</i>	<i>georgei</i>		
Fabaceae	<i>Indigofera</i>	<i>linnaei</i>		
Fabaceae	<i>Indigofera</i>	<i>monophylla</i>		
Fabaceae	<i>Kennedia</i>	<i>prorepens</i>		
Fabaceae	<i>Neptunia</i>	<i>dimorphantha</i>		
Fabaceae	<i>Senna</i>	<i>artemisioides</i>	subsp.	<i>helmsii</i>
Fabaceae	<i>Senna</i>	<i>artemisioides</i>	subsp.	<i>helmsii</i> x <i>oligophylla</i>
Fabaceae	<i>Senna</i>	<i>artemisioides</i>	subsp.	<i>oligophylla</i>

Family	Genus	Species	Inf_Rank	Inf_Name
Fabaceae	<i>Senna</i>	<i>artemisioides</i>	subsp.	<i>oligophylla</i> x Meekatharra
Fabaceae	<i>Senna</i>	<i>glaucifolia</i>		
Fabaceae	<i>Senna</i>	<i>glaucifolia</i> × sp. Meekatharra (E. Bailey 1-26)		
Fabaceae	<i>Senna</i>	<i>glutinosa</i>	subsp.	<i>glutinosa</i>
Fabaceae	<i>Senna</i>	<i>glutinosa</i>	subsp.	<i>pruinosa</i>
Fabaceae	<i>Senna</i>	<i>glutinosa</i>	subsp.	x <i>luerssenii</i>
Fabaceae	<i>Senna</i>	<i>pleurocarpa</i>	var.	<i>angustifolia</i>
Fabaceae	<i>Senna</i>	<i>stricta</i>		
Fabaceae	<i>Senna</i>		sp.	Meekatharra (E. Bailey 1-26)
Fabaceae	<i>Sesbania</i>	<i>cannabina</i>		
Fabaceae	<i>Tephrosia</i>	<i>rosea</i>	var.	Fortescue Creeks (M.I.H. Brooker 2186)
Fabaceae	<i>Tephrosia</i>	<i>supina</i>		
Fabaceae	<i>Tephrosia</i>		sp.	clay soils (S. van Leeuwen et al. PBS 0273)
Fabaceae	<i>Tephrosia</i>		sp.	Newman (A.A. Mitchell PRP 29)
Frankeniaceae	<i>Frankenia</i>	<i>setosa</i>		
Goodeniaceae	<i>Goodenia</i>	? <i>berringbinensis</i>		
Goodeniaceae	<i>Goodenia</i>	<i>lamprosperma</i>		
Goodeniaceae	<i>Goodenia</i>	<i>nuda</i>		
Goodeniaceae	<i>Goodenia</i>	<i>stobbsiana</i>		
Goodeniaceae	<i>Goodenia</i>	<i>triodiophila</i>		
Goodeniaceae	<i>Goodenia</i>		sp.	indet.
Goodeniaceae	<i>Scaevola</i>	<i>parvifolia</i>	subsp.	<i>pilbarae</i>
Goodeniaceae	<i>Scaevola</i>	<i>parvifolia</i>		
Goodeniaceae	<i>Scaevola</i>	<i>spinescens</i>		
Lamiaceae	<i>Dicrasyllis</i>	<i>cordifolia</i>		
Lauraceae	<i>Cassytha</i>	<i>filiformis</i>		
Loranthaceae	<i>Amyema</i>	<i>fitzgeraldii</i>		
Loranthaceae	<i>Amyema</i>	<i>hilliana</i>		
Malvaceae	<i>Abutilon</i>	<i>cryptopetalum</i>		
Malvaceae	<i>Abutilon</i>	<i>lepidum</i>		
Malvaceae	<i>Abutilon</i>	<i>oxycarpum</i>	subsp.	Prostrate (A.A. Mitchell PRP 1266)
Malvaceae	<i>Abutilon</i>		cf.	<i>leucopetalum</i>
Malvaceae	<i>Androcalva</i>	<i>loxophylla</i>		
Malvaceae	<i>Androclava</i>	<i>luteiflora</i>		
Malvaceae	<i>Corchorus</i>	<i>crozophorifolius</i>		
Malvaceae	<i>Corchorus</i>	<i>lasiocarpus</i>	subsp.	<i>parvus</i>
Malvaceae	<i>Corchorus</i>	<i>lasiocarpus</i>		
Malvaceae	<i>Corchorus</i>	<i>sidoides</i>	subsp.	<i>sidoides</i>
Malvaceae	<i>Corchorus</i>	<i>tridens</i>		
Malvaceae	<i>Corchorus</i>	<i>walcottii</i>		
Malvaceae	<i>Gossypium</i>	<i>australe</i>		
Malvaceae	<i>Hibiscus</i>	<i>burtonii</i>		
Malvaceae	<i>Hibiscus</i>		sp.	Gardneri (A.L. Payne PRP 1435)
Malvaceae	<i>Hibiscus</i>	<i>sturtii</i>	var.	<i>platychlamys</i>
Malvaceae	<i>Hibiscus</i>	<i>sturtii</i>	var.	<i>truncatus</i>
Malvaceae	<i>Hibiscus</i>	<i>verdcourtii</i>		
Malvaceae	<i>Malvastrum</i>	<i>americanum</i>		
Malvaceae	<i>Sida</i>	<i>cardiophylla</i>		

Family	Genus	Species	Inf_Rank	Inf_Name
Malvaceae	<i>Sida</i>	<i>echinocarpa</i>		
Malvaceae	<i>Sida</i>	<i>ectogama</i>		
Malvaceae	<i>Sida</i>	<i>fibulifera</i>		
Malvaceae	<i>Sida</i>	<i>platycalyx</i>		
Malvaceae	<i>Sida</i>		cf.	<i>echinocarpa</i>
Malvaceae	<i>Sida</i>		cf.	<i>fibulifera</i>
Malvaceae	<i>Sida</i>		cf.	sp. Pilbara
Malvaceae	<i>Sida</i>		cf.	verrucose glands (F.H. Mollemans 2423)
Malvaceae	<i>Sida</i>		sp.	Golden calyces glabrous (H.N. Foote 32)
Malvaceae	<i>Sida</i>		sp.	indet.
Malvaceae	<i>Sida</i>		sp.	Pilbara (A.A. Mitchell PRP 1543)
Malvaceae	<i>Sida</i>		sp.	verrucose glands (F.H. Mollemans 2423)
Malvaceae	<i>Waltheria</i>	<i>indica</i>		
Marsileaceae	<i>Marsilea</i>	<i>hirsuta</i>		
Marsileaceae	<i>Marsilea</i>		sp.	indet.
Molluginaceae	<i>Mollugo</i>	<i>molluginea</i>		
Myrtaceae	<i>Calytrix</i>	<i>carinata</i>		
Myrtaceae	<i>Corymbia</i>	<i>aspera</i>		
Myrtaceae	<i>Corymbia</i>	<i>deserticola</i>		
Myrtaceae	<i>Corymbia</i>	<i>hamersleyana</i>		
Myrtaceae	<i>Eucalyptus</i>	<i>leucophloia</i>	subsp.	<i>leucophloia</i>
Myrtaceae	<i>Eucalyptus</i>	<i>victrix</i>		
Myrtaceae	<i>Eucalyptus</i>	<i>xerothermica</i>		
Myrtaceae	<i>Melaleuca</i>	<i>glomerata</i>		
Nyctaginaceae	<i>Boerhavia</i>	<i>coccinea</i>		
Nyctaginaceae	<i>Boerhavia</i>	<i>repleta</i>		
Phrymaceae	<i>Peplidium</i>	<i>aitchocheilum</i>		
Phyllanthaceae	<i>Phyllanthus</i>	<i>erwinii</i>		
Phyllanthaceae	<i>Phyllanthus</i>	<i>maderaspatensis</i>		
Poaceae	<i>Amphipogon</i>	<i>sericeus</i>		
Poaceae	<i>Aristida</i>	<i>contorta</i>		
Poaceae	<i>Aristida</i>	<i>holathera</i>	var.	<i>holathera</i>
Poaceae	<i>Aristida</i>	<i>inaequiglumis</i>		
Poaceae	<i>Bothriochloa</i>	<i>ewartiana</i>		
Poaceae	<i>Bothriochloa</i>		sp.	indet.
Poaceae	<i>Brachyachne</i>	<i>prostrata</i>		
Poaceae	<i>Cenchrus</i>	<i>ciliaris</i>		
Poaceae	<i>Chrysopogon</i>	<i>fallax</i>		
Poaceae	<i>Cymbopogon</i>	<i>obtectus</i>		
Poaceae	<i>Digitaria</i>	<i>ammophila</i>		
Poaceae	<i>Digitaria</i>	<i>brownii</i>		
Poaceae	<i>Echinochloa</i>	<i>colona</i>		
Poaceae	<i>Elytrophorus</i>	<i>spicatus</i>		
Poaceae	<i>Enneapogon</i>	<i>caerulescens</i>		
Poaceae	<i>Enneapogon</i>	<i>polyphyllus</i>		
Poaceae	<i>Enteropogon</i>	<i>ramosus</i>		
Poaceae	<i>Eragrostis</i>	<i>cumingii</i>		
Poaceae	<i>Eragrostis</i>	<i>eriopoda</i>		
Poaceae	<i>Eragrostis</i>	<i>speciosa</i>		
Poaceae	<i>Eragrostis</i>	<i>xerophila</i>		

Family	Genus	Species	Inf_Rank	Inf_Name
Poaceae	<i>Eriachne</i>	<i>aristidea</i>		
Poaceae	<i>Eriachne</i>	<i>benthamii</i>		
Poaceae	<i>Eriachne</i>	<i>flaccida</i>		
Poaceae	<i>Eriachne</i>	<i>helmsii</i>		
Poaceae	<i>Eriachne</i>	<i>mucronata</i>		
Poaceae	<i>Eriachne</i>	<i>obtusa</i>		
Poaceae	<i>Eriachne</i>	<i>pulchella</i>	subsp.	<i>dominii</i>
Poaceae	<i>Eulalia</i>	<i>aurea</i>		
Poaceae	Grass		sp.	indet.
Poaceae	<i>Leptochloa</i>	<i>fusca</i>	subsp.	<i>muelleri</i>
Poaceae	<i>Monachather</i>	<i>paradoxus</i>		
Poaceae	<i>Panicum</i>	<i>decompositum</i>		
Poaceae	<i>Panicum</i>	<i>effusum</i>		
Poaceae	<i>Paraneurachne</i>	<i>muelleri</i>		
Poaceae	<i>Paspalidium</i>	<i>basicladum</i>		
Poaceae	<i>Themeda</i>	<i>avenacea</i>		
Poaceae	<i>Themeda</i>	<i>triandra</i>		
Poaceae	<i>Triodia</i>	<i>angusta</i>		
Poaceae	<i>Triodia</i>	<i>basedowii</i>		
Poaceae	<i>Triodia</i>	<i>brizoides</i>		
Poaceae	<i>Triodia</i>	<i>pungens</i>		
Poaceae	<i>Triodia</i>	<i>schinzii</i>		
Poaceae	<i>Triodia</i>		sp.	Shovelanna Hill (S. van Leeuwen 3835)
Poaceae	<i>Tripogon</i>	<i>lolliformis</i>		
Portulacaceae	<i>Portulaca</i>	<i>filifolia</i>		
Portulacaceae	<i>Portulaca</i>	<i>oleracea</i>		
Portulacaceae	<i>Portulaca</i>	<i>pilosa</i>		
Proteaceae	<i>Grevillea</i>	<i>berryana</i>		
Proteaceae	<i>Grevillea</i>	<i>striata</i>		
Proteaceae	<i>Grevillea</i>	<i>wickhamii</i>	subsp.	<i>hispidula</i>
Proteaceae	<i>Hakea</i>	<i>chordophylla</i>		
Proteaceae	<i>Hakea</i>	<i>lorea</i>	subsp.	<i>lorea</i>
Proteaceae	<i>Hakea</i>	<i>preissii</i>		
Pteridaceae	<i>Cheilanthes</i>	<i>brownii</i>		
Pteridaceae	<i>Cheilanthes</i>	<i>sieberi</i>	subsp.	<i>sieberi</i>
Pteridaceae	<i>Cheilanthes</i>	<i>sieberi</i>		
Rubiaceae	<i>Psydrax</i>	<i>latifolia</i>		
Rubiaceae	<i>Psydrax</i>	<i>suaveolens</i>		
Rubiaceae	<i>Synaptantha</i>	<i>tillaeacea</i>		
Santalaceae	<i>Anthobolus</i>	<i>brownii</i>		
Santalaceae	<i>Anthobolus</i>	<i>leptomerioides</i>		
Sapindaceae	<i>Dodonaea</i>	<i>pachyneura</i>		
Sapindaceae	<i>Dodonaea</i>		cf.	<i>petiolaris</i>
Scrophulariaceae	<i>Eremophila</i>	<i>cuneifolia</i>		
Scrophulariaceae	<i>Eremophila</i>	<i>exilifolia</i>		
Scrophulariaceae	<i>Eremophila</i>	<i>forrestii</i>		
Scrophulariaceae	<i>Eremophila</i>	<i>fraseri</i>		
Scrophulariaceae	<i>Eremophila</i>	<i>lachnocalyx</i>		
Scrophulariaceae	<i>Eremophila</i>	<i>latrobei</i>	subsp.	<i>filiformis</i>
Scrophulariaceae	<i>Eremophila</i>	<i>latrobei</i>	subsp.	<i>latrobei</i>
Scrophulariaceae	<i>Eremophila</i>	<i>longifolia</i>		
Scrophulariaceae	<i>Eremophila</i>	<i>margarethae</i>		
Solanaceae	<i>Solanum</i>	<i>cleistogamum</i>		
Solanaceae	<i>Solanum</i>	<i>lasiophyllum</i>		

Family	Genus	Species	Inf_Rank	Inf_Name
Violaceae	<i>Hybanthus</i>	<i>aurantiacus</i>		
Zygophyllaceae	<i>Tribulus</i>		cf.	<i>eichlerianus</i>
Zygophyllaceae	<i>Tribulus</i>	<i>suberosus</i>		

APPENDIX 6

Records of conservation significant flora
from the study area

Waypoint	Date	Genus	Species	% Cover	Easting GDA	Northing GDA
RD27	23/02/2015	<i>Goodenia</i>	<i>nuda</i>	11 to 30	197199	7409651
RD28	23/02/2015	<i>Goodenia</i>	<i>nuda</i>	<2	198163	7410094
RD30	23/02/2015	<i>Goodenia</i>	<i>nuda</i>	<2	803495.8	7409285
RD31	23/02/2015	<i>Goodenia</i>	<i>nuda</i>	2 to 10	803449.9	7409378
RD32	23/02/2015	<i>Goodenia</i>	<i>nuda</i>	2 to 10	803496.0	7409461
DY19	27/02/2015	<i>Goodenia</i>	<i>nuda</i>	<2	196231.0	7411247
GN1	24/02/2015	<i>Goodenia</i>	<i>nuda</i>	<2	810226.6	7411025
RD10	24/02/2015	<i>Goodenia</i>	<i>nuda</i>	<2	804293.9	7410774
RD71	26/02/2015	<i>Goodenia</i>	<i>nuda</i>	2 to 10	193456.0	7409326
RD06	23/02/2015	<i>Ipomoea</i>	<i>racemigera</i>	<2	805495.5	7408187
RD22	24/02/2015	<i>Ipomoea</i>	<i>racemigera</i>	<2	805033.9	7410022
RD74	26/02/2015	<i>Goodenia</i>	<i>berringbinensis</i>	<2	806411.9	7409862

APPENDIX 7

Records for introduced weed species recorded
from the study area

Waypoint	Date	Genus	Species	% Cover	Easting GDA	Northing GDA
RD35	25/02/2015	<i>Aerva</i>	<i>javanica</i>	<2	804939.0	7412114
DY02	23/02/2015	<i>Bidens</i>	<i>bipinnata</i>	<2	805913.0	7407868
DY14	26/02/2015	<i>Bidens</i>	<i>bipinnata</i>	<2	193369.0	7410380
DY22	27/02/2015	<i>Bidens</i>	<i>bipinnata</i>	<2	197075.0	7411042
RD02	23/02/2015	<i>Bidens</i>	<i>bipinnata</i>	<2	805675.9	7408008
RD09	24/02/2015	<i>Bidens</i>	<i>bipinnata</i>	2 to 10	804473.7	7410810
RD121	28/02/2015	<i>Bidens</i>	<i>bipinnata</i>	2 to 10	806309.9	7412423
RD133	28/02/2015	<i>Bidens</i>	<i>bipinnata</i>	2 to 10	196494.8	7409329
RD36	25/02/2015	<i>Bidens</i>	<i>bipinnata</i>	<2	804688.1	7412187
RD62	26/02/2015	<i>Bidens</i>	<i>bipinnata</i>	2 to 10	194302.8	7410104
DY01	23/02/2015	<i>Cenchrus</i>	<i>ciliaris</i>	<2	805441.0	7407823
DY02	23/02/2015	<i>Cenchrus</i>	<i>ciliaris</i>	<2	805913.0	7407868
DY03	24/02/2015	<i>Cenchrus</i>	<i>ciliaris</i>	<2	804060.0	7410698
DY05	24/02/2015	<i>Cenchrus</i>	<i>ciliaris</i>	<2	804790.0	7410094
DY06	24/02/2015	<i>Cenchrus</i>	<i>ciliaris</i>	<2	804182.0	7409428
DY07	25/02/2015	<i>Cenchrus</i>	<i>ciliaris</i>	<2	804250.0	7412511
DY08	25/02/2015	<i>Cenchrus</i>	<i>ciliaris</i>	<2	803408.0	7412246
DY09	25/02/2015	<i>Cenchrus</i>	<i>ciliaris</i>	2 to 10	804884.0	7411380
DY20	27/02/2015	<i>Cenchrus</i>	<i>ciliaris</i>	<2	195629.0	7410804
DY23	27/02/2015	<i>Cenchrus</i>	<i>ciliaris</i>	<2	196872.0	7412558
RD02	23/02/2015	<i>Cenchrus</i>	<i>ciliaris</i>	<2	805675.9	7408008
RD07	24/02/2015	<i>Cenchrus</i>	<i>ciliaris</i>	2 to 10	804631.6	7410777
RD09	24/02/2015	<i>Cenchrus</i>	<i>ciliaris</i>	2 to 10	804473.7	7410810
RD102	27/02/2015	<i>Cenchrus</i>	<i>ciliaris</i>	<2	195361.2	7410960
RD133	28/02/2015	<i>Cenchrus</i>	<i>ciliaris</i>	<2	196494.8	7409329
RD142	28/02/2015	<i>Cenchrus</i>	<i>ciliaris</i>	2 to 10	197419.0	7412739
RD19	24/02/2015	<i>Cenchrus</i>	<i>ciliaris</i>	<2	804251.6	7411202
RD22	24/02/2015	<i>Cenchrus</i>	<i>ciliaris</i>	2 to 10	805033.9	7410022
RD35	25/02/2015	<i>Cenchrus</i>	<i>ciliaris</i>	2 to 10	804939.0	7412114
RD36	25/02/2015	<i>Cenchrus</i>	<i>ciliaris</i>	2 to 10	804688.1	7412187
RD41	25/02/2015	<i>Cenchrus</i>	<i>ciliaris</i>	<2	804109.3	7412493
RD47	25/02/2015	<i>Cenchrus</i>	<i>ciliaris</i>	<2	803557.4	7411617
RD48	25/02/2015	<i>Cenchrus</i>	<i>ciliaris</i>	2 to 10	803436.9	7411478
RD50	25/02/2015	<i>Cenchrus</i>	<i>ciliaris</i>	11 to 30	803717.7	7411945
RD55	25/02/2015	<i>Cenchrus</i>	<i>ciliaris</i>	11 to 30	804681.6	7412121
RD56	25/02/2015	<i>Cenchrus</i>	<i>ciliaris</i>	2 to 10	804722.1	7411525
RD58	25/02/2015	<i>Cenchrus</i>	<i>ciliaris</i>	<2	804480.8	7411482
RD60	25/02/2015	<i>Cenchrus</i>	<i>ciliaris</i>	2 to 10	804595.2	7411245
RD09	24/02/2015	<i>Malvastrum</i>	<i>americanum</i>	2 to 10	804473.7	7410810
RD29	23/02/2015	<i>Malvastrum</i>	<i>americanum</i>	<2	803502.0	7409255
RD75	26/02/2015	<i>Malvastrum</i>	<i>americanum</i>	<2	806391.8	7409879

APPENDIX 8

Site sheets summarising raw data for quadrats
within the study area

Site	Dynasty - Site DY01
Date	23/10/2014
Recorder	JB/JW
Photo	120-196/197
Shape/Size	50m x 50m
Datum	GDA 94
Zone	50K
Easting	805441
Northing	7407823
Habitat	Plain (PLA)
Aspect	South West
Slope	Low
Soil	Low Sandy Loam – Red/ Brown
Rock Type	
% Leaves:Logs	2 to 10: <2
% Bare Ground	40
Vegetation Condition	Very Good
Disturbance Type	Livestock; Weeds
Fire Age	Old (6+ yrs)
Vegetation	High Shrubland of <i>Acacia pachyacra</i> over Low Shrubland of <i>Eremophila margarethae</i> , <i>Senna artemisioides</i> subsp. <i>helmsii</i> over Open Tussock Grassland of <i>Aristida holathera</i> var. <i>holathera</i> , <i>Aristida inaequiglumis</i> , <i>Eragrostis eriopoda</i> with Low Open Woodland of <i>Acacia pruinocarpa</i> , <i>Hakea lorea</i> subsp. <i>lorea</i>

Genus	Species	subsp. / var.	% Cover	Height
<i>Cenchrus</i>	<i>ciliaris</i>		<2	0.2
<i>Acacia</i>	<i>aptaneura</i>		<2	2
<i>Acacia</i>	<i>melleodora</i>		<2	1-2
<i>Acacia</i>	<i>pachyacra</i>		11 to 30	2-3
<i>Acacia</i>	<i>pruinocarpa</i>		2 to 10	3-8
<i>Acacia</i>	<i>rhodophloia</i>		<2	1-2
<i>Acacia</i>	<i>sclerosperma</i>	subsp. <i>sclerosperma</i>	<2	2
<i>Acacia</i>	<i>synchronicia</i>		<2	1-2
<i>Acacia</i>	<i>tetragonophylla</i>		<2	1-2
<i>Anthobolus</i>	<i>leptomerioides</i>		<2	2
<i>Aristida</i>	<i>contorta</i>		2 to 10	0.2
<i>Aristida</i>	<i>holathera</i>	var. <i>holathera</i>	2 to 10	0.2
<i>Aristida</i>	<i>inaequiglumis</i>		2 to 10	1
<i>Bothriochloa</i>	<i>ewartiana</i>		<2	0.8
<i>Cymbopogon</i>	<i>obtectus</i>		<2	1
<i>Digitaria</i>	<i>brownii</i>		<2	0.5
<i>Duperreya</i>	<i>commixta</i>		<2	Cl
<i>Enneapogon</i>	<i>polyphyllus</i>		<2	0.2
<i>Enteropogon</i>	<i>ramosus</i>		<2	1.5
<i>Eragrostis</i>	<i>eriopoda</i>		2 to 10	0.35
<i>Eremophila</i>	<i>margarethae</i>		2 to 10	0.6
<i>Evolvulus</i>	<i>alsinoides</i>	var. <i>villosicalyx</i>	<2	0.2
<i>Gomphrena</i>	<i>kanisii</i>		<2	0.25
<i>Hakea</i>	<i>lorea</i>	subsp. <i>lorea</i>	2 to 10	6

Genus	Species	subsp. / var.	% Cover	Height
<i>Hakea</i>	<i>preissii</i>		<2	1.5
<i>Hibiscus</i>	<i>burtonii</i>		<2	0.3
<i>Maireana</i>	<i>planifolia</i>		<2	0.7
<i>Maireana</i>	<i>villosa</i>		<2	0.5
<i>Rhagodia</i>	<i>eremaea</i>		<2	1.5
<i>Sclerolaena</i>	<i>cornishiana</i>		<2	0.25
<i>Senna</i>	<i>artemisioides</i>	subsp. <i>helmsii</i>	2 to 10	1.5
<i>Senna</i>	<i>artemisioides</i>	subsp. <i>oligophylla</i>	<2	1
<i>Sida</i>	<i>fibulifera</i>		<2	0.2
<i>Sida</i>	<i>platycalyx</i>		<2	
<i>Sida</i>		sp. indet	<2	0.15
<i>Solanum</i>	<i>lasiophyllum</i>		<2	0.6
<i>Tephrosia</i>		sp. Newman (A.A. Mitchell 929)	<2	0.2
<i>Triodia</i>	<i>basedowii</i>		2 to 10	0.6

Site	Dynasty - Site DY02
Date	23/02/2015
Recorder	JB/JW
Photo	120-198/199
Shape/Size	50m x 50m
Datum	GDA 94
Zone	50K
Easting	805913
Northing	7407868
Habitat	Drainage depression (DDE)
Aspect	North West
Slope	Low
Soil	Sand – Orange/ Brown
Rock Type	Alluvial gravel (pebbles)
% Leaves:Logs	2 to 10: <2
% Bare Ground	
Vegetation Condition	Very Good
Disturbance Type	Livestock; Weeds
Fire Age	Very Old (>10 yrs)
Vegetation	Low Woodland of <i>Eucalyptus victrix</i> , <i>Acacia coriacea</i> subsp. <i>pendens</i> over Open Tussock Grassland of <i>Eulalia aurea</i> , * <i>Cenchrus ciliaris</i> , <i>Eragrostis speciosa</i> with High Open Shrubland of <i>Melaleuca glomerata</i> , <i>Acacia pyrifolia</i> over Very Open Sedges of <i>Cyperus ixiocarpus</i>

Genus	Species	subsp. / var.	% Cover	Height
<i>Bidens</i>	<i>bipinnata</i>		<2	0.1
<i>Cenchrus</i>	<i>ciliaris</i>		<2	0.6
<i>Abutilon</i>		cf. <i>leucopetalum</i>	<2	0.6
<i>Acacia</i>	<i>coriacea</i>	subsp. <i>pendens</i>	2 to 10	3-8
<i>Acacia</i>	<i>pyrifolia</i>	var. <i>pyrifolia</i>	2 to 10	2-4
<i>Alternanthera</i>	<i>nodiflora</i>		<2	0.1
<i>Androcalva</i>	<i>luteiflora</i>		<2	0.5
<i>Aristida</i>	<i>holathera</i>	var. <i>holathera</i>	<2	0.35
<i>Bulbostylis</i>	<i>barbata</i>		<2	0.1
<i>Cheilanthes</i>	<i>sieberi</i>		<2	0.1
<i>Cleome</i>	<i>viscosa</i>		<2	0.05
<i>Ipomoea</i>	<i>coptica</i>		<2	Cl
<i>Corchorus</i>	<i>tridens</i>		<2	0.1
<i>Cucumis</i>	<i>maderspatanus</i>		<2	Cl
<i>Cynanchum</i>	<i>floribundum</i>		<2	Cl
<i>Cyperus</i>	<i>iria</i>		<2	0.2
<i>Cyperus</i>	<i>ixiocarpus</i>		<2	0.8
<i>Cyperus</i>	<i>squarrosus</i>		<2	0.1
<i>Digitaria</i>	<i>brownii</i>		<2	0.4
<i>Duperreya</i>	<i>commixta</i>		<2	Cl
<i>Enteropogon</i>	<i>ramosus</i>		<2	1
<i>Eragrostis</i>	<i>cumingii</i>		<2	0.1
<i>Eragrostis</i>	<i>speciosa</i>		<2	1
<i>Eremophila</i>	<i>fraseri</i>		<2	1.3
<i>Eucalyptus</i>	<i>victrix</i>		11 to 30	5-10
<i>Eulalia</i>	<i>aurea</i>		2 to 10	1.2

Genus	Species	subsp. / var.	% Cover	Height
<i>Euphorbia</i>	<i>trigonosperma</i>		<2	0.2
<i>Evolvulus</i>	<i>alsinoides</i>	var. <i>villosicalyx</i>	<2	0.1
<i>Glycine</i>	<i>canescens</i>		<2	Cl
<i>Goodenia</i>	<i>lamprosperma</i>		<2	0.3
<i>Hakea</i>	<i>lorea</i>	subsp. <i>lorea</i>	<2	6
<i>Indigofera</i>	<i>linnaei</i>		<2	0.2
<i>Ipomoea</i>	<i>muelleri</i>		<2	Cr
<i>Maireana</i>	<i>villosa</i>		<2	0.5
<i>Melaleuca</i>	<i>glomerata</i>		2 to 10	2-8
<i>Panicum</i>	<i>decompositum</i>		<2	0.5
<i>Paspalidium</i>	<i>basicladum</i>		<2	0.4
<i>Phyllanthus</i>	<i>erwinii</i>		<2	0.1
<i>Phyllanthus</i>	<i>maderaspatensis</i>		<2	0.3
<i>Pluchea</i>	<i>dentex</i>		<2	0.2
<i>Portulaca</i>	<i>oleracea</i>		<2	0.05
<i>Sesbania</i>	<i>cannabina</i>		<2	0.2
<i>Sida</i>		sp. indet.	<2	1.5
<i>Synaptantha</i>	<i>tillaeacea</i>		<2	0.05
<i>Tephrosia</i>	<i>rosea</i>	var. Fortescue Creeks (M.I.H. Brooker 2186)	<2	0.5
<i>Themeda</i>	<i>avenacea</i>		<2	1
<i>Themeda</i>	<i>triandra</i>		<2	1

Site	Dynasty - Site DY03
Date	24/02/2015
Recorder	JB/JW
Photo	120-225; DSC949
Shape/Size	50m x 50m
Datum	GDA 94
Zone	50K
Easting	804060
Northing	7410698
Habitat	Plain (PLA)
Aspect	North
Slope	Low
Soil	Sandy Loam – Orange/ Brown
Rock Type	Quartz/ Chert (scattered)
% Leaves:Logs	2 to 10: <2
% Bare Ground	45
Vegetation Condition	Very Good
Disturbance Type	Livestock; Weeds
Fire Age	Very Old (>10 yrs)
Vegetation	Open Hummock Grassland of <i>Triodia schinzii</i> with Shrubland of <i>Senna artemisioides</i> subsp. <i>helmsii</i> , <i>Eremophila forrestii</i> with Low Open Woodland of <i>Acacia pruinocarpa</i>

Genus	Species	subsp. / var.	% Cover	Height
<i>Cenchrus</i>	<i>ciliaris</i>		<2	0.3
<i>Acacia</i>	<i>aptaneura</i>		<2	3
<i>Acacia</i>	<i>pruinocarpa</i>		2 to 10	2-4-6
<i>Acacia</i>	<i>tetragonophylla</i>		2 to 10	1.5
<i>Amyema</i>	<i>hilliana</i>		<2	Mt
<i>Anthobolus</i>	<i>leptomerioides</i>		<2	2
<i>Aristida</i>	<i>contorta</i>		<2	0.25
<i>Aristida</i>	<i>holathera</i>	var. <i>holathera</i>	<2	0.4
<i>Aristida</i>	<i>inaequiglumis</i>		<2	0.8
<i>Boerhavia</i>	<i>coccinea</i>		<2	0.1
<i>Bonamia</i>	<i>erecta</i>		<2	0.2
<i>Cleome</i>	<i>viscosa</i>		<2	0.3
<i>Cymbopogon</i>	<i>obtectus</i>		<2	0.7
<i>Digitaria</i>	<i>brownii</i>		<2	0.4
<i>Enneapogon</i>	<i>polyphyllus</i>		<2	0.2
<i>Eragrostis</i>	<i>eriopoda</i>		2 to 10	0.5
<i>Eremophila</i>	<i>forrestii</i>	subsp. <i>forrestii</i>	2 to 10	1-2
<i>Eulalia</i>	<i>aurea</i>		<2	0.5
<i>Evolvulus</i>	<i>alsinoides</i>	var. <i>villosicalyx</i>	<2	0.1
<i>Gomphrena</i>	<i>kanisii</i>		<2	0.2
<i>Goodenia</i>		sp. indet	<2	0.4
<i>Grevillea</i>	<i>striata</i>		<2	7
<i>Hakea</i>	<i>lorea</i>	subsp. <i>lorea</i>	<2	2.5
<i>Hibiscus</i>	<i>burtonii</i>		<2	0.3
<i>Indigofera</i>	<i>linnaei</i>		<2	0.1
<i>Maireana</i>	<i>villosa</i>		<2	0.2
<i>Paraneurachne</i>	<i>muelleri</i>		<2	0.3

Genus	Species	subsp. / var.	% Cover	Height
<i>Sclerolaena</i>	<i>cornishiana</i>		<2	0.3
<i>Sclerolaena</i>	<i>convexula</i>		<2	0.1
<i>Senna</i>	<i>artemisioides</i>	subsp. <i>helmsii</i>	11 to 30	1.5
<i>Senna</i>	<i>artemisioides</i>	subsp. <i>helmsii</i> x <i>oligophylla</i>	<2	1
<i>Sida</i>	<i>platycalyx</i>		<2	Dead
<i>Sida</i>	<i>echinocarpa</i>		<2	0.5
<i>Solanum</i>	<i>lasiophyllum</i>		<2	0.5
<i>Solanum</i>	<i>cleistogamum</i>		<2	0.1
<i>Tephrosia</i>		sp. Newman (A.A. Mitchell PRP 29)	<2	0.2
<i>Triodia</i>	<i>schinzii</i>		11 to 30	0.71.3
<i>Tripogon</i>	<i>loliiformis</i>		<2	0.1

Site	Dynasty - Site DY04
Date	24/02/2015
Recorder	JB/JW
Photo	120-242; DSC950
Shape/Size	50m x 50m
Datum	GDA 94
Zone	50K
Easting	803378
Northing	7411273
Habitat	Plain (PLA)
Aspect	
Slope	Flat
Soil	Silty Clay Loam – Orange/ Brown
Rock Type	
% Leaves:Logs	<2: <2
% Bare Ground	67
Vegetation Condition	Very Good
Disturbance Type	Livestock
Fire Age	Very Old (>10 yrs)
Vegetation	Low Open Woodland of <i>Acacia aptaneura</i> over Low Open Shrubland of <i>Senna artemisioides</i> subsp. <i>helmsii</i> , <i>Eremophila forrestii</i> subsp. <i>forrestii</i> over Very Open Tussock Grassland of <i>Aristida inaequiglumis</i> , <i>Aristida contorta</i> , <i>Cymbopogon obtectus</i>

Genus	Species	subsp. / var.	% Cover	Height
<i>Acacia</i>	<i>aptaneura</i>		2 to 10	4-6
<i>Acacia</i>	<i>ayersiana</i>		<2	5
<i>Acacia</i>	<i>melleodora</i>		<2	1-2
<i>Acacia</i>	<i>tetragonophylla</i>		<2	1-2
<i>Alternanthera</i>	<i>nana</i>			
<i>Anthobolus</i>	<i>leptomerioides</i>		<2	0.5
<i>Aristida</i>	<i>contorta</i>		<2	0.2
<i>Aristida</i>	<i>inaequiglumis</i>		2 to 10	1
<i>Cymbopogon</i>	<i>obtectus</i>		<2	0.5
<i>Digitaria</i>	<i>ammophila</i>		<2	0.2
<i>Digitaria</i>	<i>brownii</i>		<2	0.6
<i>Enneapogon</i>	<i>polyphyllus</i>		<2	0.1
<i>Eragrostis</i>	<i>eripoda</i>		<2	0.3
<i>Eremophila</i>	<i>forrestii</i>	subsp. <i>forrestii</i>	<2	1
<i>Eriachne</i>	<i>mucronata</i>		<2	0.3
<i>Evolvulus</i>	<i>alsinoides</i>	var. <i>villosicalyx</i>	<2	0.2
<i>Gomphrena</i>	<i>kanisii</i>		<2	0.2
<i>Hakea</i>	<i>lorea</i>	subsp. <i>lorea</i>	<2	0.5
<i>Hibiscus</i>	<i>burtonii</i>		<2	0.4
<i>Maireana</i>	<i>villosa</i>		<2	0.3
<i>Paraneurachne</i>	<i>muelleri</i>		<2	0.3
<i>Psyrax</i>	<i>latifolia</i>		<2	2
<i>Ptilotus</i>	<i>astrolasius</i>		<2	0.3
<i>Rhyncharrhena</i>	<i>linearis</i>		<2	Cl
<i>Sclerolaena</i>	<i>cornishiana</i>		<2	0.2
<i>Senna</i>	<i>artemisioides</i>	subsp. <i>helmsii</i>	<2	0.5-1.3

Genus	Species	subsp. / var.	% Cover	Height
<i>Senna</i>	<i>glutinosa</i>	subsp. x <i>luerssenii</i>	<2	1.5
<i>Senna</i>		sp. Meekatharra (E. Bailey 1-26)	<2	1
<i>Sida</i>		sp. verrucose glands (F.H. Mollemans 2423)	<2	0.2
<i>Sida</i>	<i>platycalyx</i>		<2	Dead
<i>Sida</i>		cf. sp. <i>Pilbara</i> (A.A. Mitchell PRP 1543)	<2	0.4
<i>Solanum</i>	<i>lasiophyllum</i>		<2	0.4
<i>Tephrosia</i>		sp. Newman (A.A. Mitchell PRP 29)		
<i>Monachather</i>	<i>paradoxus</i>		<2	0.4

Site	Dynasty - Site DY05
Date	24/02/2015
Recorder	JB/JW
Photo	120-249; DSC952
Shape/Size	50m x 50m
Datum	GDA 94
Zone	50K
Easting	804790
Northing	7410094
Habitat	Plain (PLA)
Aspect	North
Slope	Low
Soil	Clayey Sand - Red
Rock Type	
% Leaves:Logs	2 to 10: <2
% Bare Ground	40
Vegetation Condition	Very Good
Disturbance Type	Livestock
Fire Age	Very Old (>10 yrs)
Vegetation	Low Woodland of <i>Acacia pruinocarpa</i> , <i>Hakea lorea</i> subsp. <i>lorea</i> , <i>Acacia paraneura</i> over Open Tussock Grassland of <i>Aristida inaequiglumis</i> , <i>Eragrostis eriopoda</i> , <i>Aristida contorta</i> with Low Open Shrubland of <i>Eremophila margarethae</i> , <i>Senna artemisioides</i> subsp. <i>helmsii</i> over Very Open TussockHummock Grassland of <i>Triodia basedowii</i>

Genus	Species	subsp. / var.	% Cover	Height
* <i>Cenchrus</i>	<i>ciliaris</i>		<2	0.2
<i>Acacia</i>	<i>aptaneura</i>		2 to 10	3
<i>Acacia</i>	<i>coriacea</i>	subsp. <i>pendens</i>	<2	2
<i>Acacia</i>	<i>kempeana</i>		<2	1.5
<i>Acacia</i>	<i>melleodora</i>		<2	2
<i>Acacia</i>	<i>pachyacra</i>		<2	1-2
<i>Acacia</i>	<i>paraneura</i>		2 to 10	4
<i>Acacia</i>	<i>pruinocarpa</i>		2 to 10	4-8
<i>Acacia</i>	<i>tetragonophylla</i>		<2	0.5-2
<i>Anthobolus</i>	<i>leptomerioides</i>		<2	1.3
<i>Aristida</i>	<i>contorta</i>		2 to 10	0.2
<i>Aristida</i>	<i>holathera</i>	var. <i>holathera</i>	<2	0.3
<i>Aristida</i>	<i>inaequiglumis</i>		2 to 10	1
<i>Chrysopogon</i>	<i>fallax</i>		<2	1.5
<i>Corchorus</i>	<i>crozophorifolius</i>		<2	0.5
<i>Cymbopogon</i>	<i>obtectus</i>		<2	0.5
<i>Digitaria</i>	<i>brownii</i>		<2	0.4
<i>Duperreya</i>	<i>commixta</i>		<2	Cl
<i>Enneapogon</i>	<i>polyphyllus</i>		<2	0.3
<i>Eragrostis</i>	<i>eriopoda</i>		<2	0.5
<i>Eremophila</i>	<i>margarethae</i>		<2	0.5
<i>Euphorbia</i>		cf. <i>tannensis</i> subsp. <i>eremophila</i>	<2	0.2
<i>Evolvulus</i>	<i>alsinoides</i>	var. <i>villosicalyx</i>	<2	0.1
<i>Gomphrena</i>	<i>kanisii</i>		<2	0.2

Genus	Species	subsp. / var.	% Cover	Height
<i>Grevillea</i>	<i>berryana</i>		<2	
<i>Hakea</i>	<i>lorea</i>	subsp. <i>lorea</i>	2 to 10	3
<i>Heliotropium</i>		sp. indet	<2	0.2
<i>Hibiscus</i>	<i>burtonii</i>		<2	0.1
<i>Hibiscus</i>	<i>sturtii</i>	var. <i>platyklamys</i>	<2	0.3
<i>Maireana</i>	<i>villosa</i>		<2	0.2
<i>Maireana</i>	<i>planifolia</i>		<2	0.2
<i>Mollugo</i>	<i>molluginea</i>		<2	0.1
<i>Ptilotus</i>	<i>astrolasius</i>		<2	0.2
<i>Tripogon</i>	<i>loliiformis</i>		<2	0.1
<i>Rhagodia</i>	<i>eremaea</i>		<2	1.5
<i>Waltheria</i>	<i>indica</i>		<2	0.4
<i>Sclerolaena</i>	<i>costata</i>		<2	0.2
<i>Senna</i>	<i>artemisioides</i>	subsp. <i>helmsii</i>	2 to 10	1-1.5
<i>Sida</i>	<i>cardiophylla</i>		<2	0.4
<i>Sida</i>		sp. indet.	<2	0.15
<i>Sida</i>	<i>platycalyx</i>		<2	
<i>Solanum</i>	<i>lasiophyllum</i>		<2	0.5
<i>Tephrosia</i>		sp. Newman (A.A. Mitchell PRP 29)	<2	0.1
<i>Themeda</i>	<i>triandra</i>		<2	1
<i>Triodia</i>	<i>basedowii</i>		2 to 10	1

Site	Dynasty - Site DY06
Date	24/10/2015
Recorder	JB/JW
Photo	120-252;DSC953
Shape/Size	50m x 50m
Datum	GDA 94
Zone	50K
Easting	804182
Northing	7409428
Habitat	Plain (PLA)
Aspect	North
Slope	Low
Soil	Sandy Loam – Orange/ Brown
Rock Type	
% Leaves:Logs	2 to 10: <2
% Bare Ground	40
Vegetation Condition	Very Good
Disturbance Type	Livestock
Fire Age	Very Old (>10 yrs)
Vegetation	Shrubland of <i>Senna artemisioides</i> subsp. <i>helmsii</i> with Low Open Woodland of <i>Hakea lorea</i> subsp. <i>lorea</i> , <i>Acacia macraneura</i> , <i>Acacia synchronicia</i> over High Open Shrubland of <i>Eremophila margarethae</i> , <i>Sclerolaena cornishiana</i> over Very Open Tussock Grassland of <i>Acacia inaequiglumis</i> , <i>Chrysopogon fallax</i> , <i>Cymbopogon obtectus</i>

Genus	Species	subsp. / var.	% Cover	Height
<i>Cenchrus</i>	<i>ciliaris</i>		<2	0.4
<i>Acacia</i>	<i>macraneura</i>		2 to 10	3
<i>Acacia</i>	<i>pruinocarpa</i>		<2	4
<i>Acacia</i>	<i>synchronicia</i>		<2	4
<i>Acacia</i>	<i>tetragonophylla</i>		2 to 10	2.5
<i>Aristida</i>	<i>contorta</i>		<2	0.2
<i>Aristida</i>	<i>inaequiglumis</i>		2 to 10	1
<i>Bothriochloa</i>	<i>ewartiana</i>		<2	1
<i>Chrysopogon</i>	<i>fallax</i>		<2	1
<i>Cleome</i>	<i>viscosa</i>		<2	0.3
<i>Cucumis</i>	<i>maderspatanus</i>		<2	Cl
<i>Cymbopogon</i>	<i>obtectus</i>		<2	1
<i>Digitaria</i>	<i>ammophila</i>		<2	0.5
<i>Enneapogon</i>	<i>polyphyllus</i>		2 to 10	0.1
<i>Enteropogon</i>	<i>ramosus</i>		<2	0.3
<i>Eragrostis</i>	<i>eriopoda</i>		<2	0.4
<i>Eremophila</i>	<i>margarethae</i>		2 to 10	1
<i>Evolvulus</i>	<i>alsinoides</i>	var. <i>villosicalyx</i>	<2	0.1
<i>Gomphrena</i>	<i>kanisii</i>		<2	0.2
<i>Grevillea</i>	<i>berryana</i>		<2	2.5
<i>Hakea</i>	<i>lorea</i>	subsp. <i>lorea</i>	2 to 10	4
<i>Heliotropium</i>		sp. indet.	<2	0.2
<i>Hybanthus</i>	<i>aurantiacus</i>		<2	0.1
<i>Portulaca</i>	<i>filifolia</i>		<2	0.2
<i>Tripogon</i>	<i>loliiformis</i>		<2	0.1

Genus	Species	subsp. / var.	% Cover	Height
<i>Rhagodia</i>	<i>eremaea</i>		<2	1
<i>Sclerolaena</i>	<i>cornishiana</i>		<2	0.3
<i>Sclerolaena</i>	<i>cornishiana</i>		<2	0.3
<i>Senna</i>	<i>artemisioides</i>	subsp. <i>helmsii</i>	11 to 30	1.5
<i>Senna</i>		sp. Meekatharra (E. Bailey 1-26)	<2	0.6
<i>Sida</i>	<i>platycalyx</i>		<2	
<i>Solanum</i>	<i>lasiophyllum</i>		<2	0.3
<i>Tephrosia</i>		sp. Newman (A.A. Mitchell PRP 29)	<2	0.1
<i>Triodia</i>	<i>basedowii</i>		2 to 10	1
<i>Triodia</i>	<i>schinzii</i>		2 to 10	1

Site	Dynasty - Site DY07
Date	25/02/2015
Recorder	JB/JW
Photo	120-280; DSC954
Shape/Size	50m x 50m
Datum	GDA 94
Zone	50K
Easting	804250
Northing	7412511
Habitat	Hillslope (HSL)
Aspect	East
Slope	Low
Soil	Loam - Brown
Rock Type	BIF (pebbles, cobbles)
% Leaves:Logs	<2: <2
% Bare Ground	40
Vegetation Condition	Very Good
Disturbance Type	Livestock: Weeds
Fire Age	Old (6+ yrs)
Vegetation	Open Hummock Grassland of <i>Triodia angusta</i> with Low Shrubland of <i>Eremophila cuneifolia</i> with High Open Shrubland of <i>Acacia synchronicia</i> , <i>Acacia tetragonophylla</i>

Genus	Species	subsp. / var.	% Cover	Height
<i>Cenchrus</i>	<i>ciliaris</i>		<2	0.3
<i>Acacia</i>	<i>macraneura</i>		<2	4
<i>Acacia</i>	<i>rhodophloia</i>		<2	2
<i>Acacia</i>	<i>synchronicia</i>		<2	1-4
<i>Acacia</i>	<i>tetragonophylla</i>		<2	1.5
<i>Aristida</i>	<i>contorta</i>		<2	0.2
<i>Aristida</i>	<i>inaequiglumis</i>		<2	0.3
<i>Boerhavia</i>	<i>coccinea</i>		<2	0.1
<i>Cheilanthes</i>	<i>sieberi</i>	subsp. <i>sieberi</i>	<2	0.1
<i>Corchorus</i>	<i>lasiocarpus</i>	subsp. <i>parvus</i>	<2	0.4
<i>Cymbopogon</i>	<i>obtectus</i>		<2	0.5
<i>Digitaria</i>	<i>brownii</i>		<2	0.6
<i>Duperreya</i>	<i>commixta</i>		<2	Cl
<i>Enneapogon</i>	<i>caerulescens</i>		<2	0.3
<i>Enneapogon</i>	<i>polyphyllus</i>		<2	0.2
<i>Eremophila</i>	<i>cuneifolia</i>		2 to 10	1
<i>Eremophila</i>	<i>forrestii</i>	subsp. <i>forrestii</i>	<2	0.3
<i>Evolvulus</i>	<i>alsinoides</i>	var.	<2	0.2
<i>Gomphrena</i>	<i>kanisii</i>		<2	0.2
<i>Hakea</i>	<i>lorea</i>	subsp. <i>lorea</i>	<2	0.4-6
<i>Maireana</i>	<i>melanocoma</i>		<2	0.8
<i>Maireana</i>	<i>georgei</i>		<2	0.2
<i>Maireana</i>	<i>planifolia</i>		<2	0.6
<i>Maireana</i>	<i>villosa</i>		<2	0.5
<i>Paraneurachne</i>	<i>muelleri</i>		<2	0.4
<i>Ptilotus</i>	<i>nobilis</i>		<2	0.1
<i>Tripogon</i>	<i>loliiformis</i>		<2	0.1

Genus	Species	subsp. / var.	% Cover	Height
<i>Rhagodia</i>	<i>eremaea</i>		<2	0.6
<i>Sclerolaena</i>	<i>cuneata</i>		<2	0.2
<i>Sclerolaena</i>		cf. <i>convullexa</i>	<2	0.1
<i>Sclerolaena</i>	<i>ericantha</i>		<2	0.1
<i>Senna</i>	<i>artemisioides</i>	subsp. <i>helmsii</i>	<2	1
<i>Senna</i>	<i>glutinosa</i>	subsp. <i>x luerssenii</i>	<2	1.5
<i>Senna</i>	<i>glutinosa</i>	subsp. <i>pruinosa</i>	<2	0.5-2
<i>Senna</i>	<i>stricta</i>		<2	0.8
<i>Senna</i>		sp. Meekatharra (E. Bailey 1-26)	<2	0.5
<i>Sida</i>	<i>echinocarpa</i>		<2	0.3
<i>Sida</i>	<i>fibulifera</i>		<2	0.2
<i>Solanum</i>	<i>lasiophyllum</i>		<2	0.5
<i>Solanum</i>	<i>cleistogamum</i>		<2	0.2
<i>Tribulus</i>	<i>suberosus</i>		<2	0.5
<i>Triodia</i>	<i>angusta</i>		11 to 30	1
<i>Triodia</i>	<i>pungens</i>		<2	1
<i>Triodia</i>		sp. Shovelanna Hill (S. van Leeuwen 3835)	<2	0.4

Site	Dynasty - Site DY08
Date	25/02/2015
Recorder	JB/JW
Photo	120-298;DSC955
Shape/Size	50m x 50m
Datum	GDA 94
Zone	50K
Easting	803408
Northing	7412246
Habitat	Plain (PLA)
Aspect	West/ South West
Slope	Low
Soil	Loamy Sand - Orange
Rock Type	BIF (Scattered cobbles)
% Leaves:Logs	<2: <2
% Bare Ground	47
Vegetation Condition	Very Good
Disturbance Type	Livestock
Fire Age	Very Old (>10 yrs)
Vegetation	Shrubland of <i>Senna artemisioides</i> subsp. <i>helmsii</i> , <i>Eremophila fraseri</i> with Low Open Woodland of <i>Acacia pruinocarpa</i> , <i>Hakea lorea</i> subsp. <i>lorea</i> , <i>Acacia aptaneura</i> over High Open Shrubland of <i>Acacia synchronicia</i> , <i>Eremophila fraseri</i> over Scattered Hummock Grasses of <i>Triodia pungens</i> over Scattered Tussock Grasses of <i>Aristida contorta</i> , <i>Enneapogon polyphyllus</i>

Genus	Species	subsp. / var.	% Cover	Height
<i>Cenchrus</i>	<i>ciliaris</i>			
<i>Acacia</i>	<i>aptaneura</i>			
<i>Acacia</i>	<i>paraneura</i>			
<i>Acacia</i>	<i>pruinocarpa</i>			
<i>Acacia</i>	<i>synchronicia</i>			
<i>Acacia</i>	<i>tetragonophylla</i>			
<i>Anthobolus</i>	<i>leptomerioides</i>			
<i>Aristida</i>	<i>contorta</i>			
<i>Aristida</i>	<i>inaequiglumis</i>			
<i>Boerhavia</i>	<i>coccinea</i>			
<i>Brachyachne</i>	<i>prostrata</i>			
<i>Cymbopogon</i>	<i>obtectus</i>			
<i>Digitaria</i>	<i>brownii</i>			
<i>Enneapogon</i>	<i>polyphyllus</i>			
<i>Eragrostis</i>	<i>xerophila</i>			
<i>Eremophila</i>	<i>forrestii</i>	subsp. <i>forrestii</i>		
<i>Eremophila</i>	<i>fraseri</i>			
<i>Evolvulus</i>	<i>alsinoides</i>	var. <i>villosicalyx</i>		
<i>Gomphrena</i>	<i>kanisii</i>			
<i>Hakea</i>	<i>lorea</i>	subsp. <i>lorea</i>		
<i>Indigofera</i>	<i>linnaei</i>			
<i>Maireana</i>	<i>villosa</i>			
<i>Paraneurachne</i>	<i>muelleri</i>			
<i>Ptilotus</i>	<i>obovatus</i>			
<i>Tripogon</i>	<i>loliiformis</i>			

Genus	Species	subsp. / var.	% Cover	Height
<i>Rhagodia</i>	<i>eremaea</i>			
<i>Salsola</i>	<i>australis</i>			
<i>Sclerolaena</i>	<i>cornishiana</i>			
<i>Sclerolaena</i>		<i>cf. convexula</i>		
<i>Senna</i>	<i>artemisioides</i>	subsp. <i>helmsii</i>		
<i>Senna</i>	<i>artemisioides</i>	subsp. <i>oligophylla</i>		
<i>Senna</i>	<i>artemisioides</i>	subsp. <i>oligophylla</i> x <i>Meekatharra</i>		
<i>Sida</i>	<i>fibulifera</i>			
<i>Sida</i>	<i>platycalyx</i>			
<i>Solanum</i>	<i>lasiophyllum</i>			
<i>Tephrosia</i>		sp. Newman (A.A. Mitchell PRP 29)		
<i>Trianthema</i>	<i>triquetrum</i>			
<i>Triodia</i>	<i>pungens</i>			
<i>Triodia</i>	<i>schinzii</i>			

Site	Dynasty - Site DY09
Date	25/02/2015
Recorder	JB/JW
Photo	120-312;DSC956
Shape/Size	50m x 50m
Datum	GDA 94
Zone	50K
Easting	804884
Northing	7411380
Habitat	Plain (PLA)
Aspect	North
Slope	Low
Soil	Loamy Sand - Orange
Rock Type	
% Leaves:Logs	2 to 10: <2
% Bare Ground	45
Vegetation Condition	Very Good
Disturbance Type	Livestock: Weeds
Fire Age	Very Old (>10 yrs)
Vegetation	Low Shrubland of <i>Eremophila margarethae</i> with Low Open Woodland of <i>Hakea lorea</i> subsp. <i>lorea</i> , <i>Acacia macraneura</i> , <i>Acacia aptaneura</i> over Very Open Tussock Grassland of * <i>Cenchrus ciliaris</i> , <i>Aristida inaequiglumis</i> , <i>Aristida contorta</i> over Very Open Hummock Grassland of <i>Triodia basedowii</i>

Genus	Species	subsp. / var.	% Cover	Height
<i>Cenchrus</i>	<i>ciliaris</i>		2 to 10	0.5
<i>Acacia</i>	<i>aptaneura</i>		<2	4
<i>Acacia</i>	<i>macraneura</i>		<2	4
<i>Acacia</i>	<i>tetragonophylla</i>		<2	1.5-2
<i>Amyema</i>	<i>fitzgeraldii</i>		<2	Mt
<i>Aristida</i>	<i>contorta</i>		<2	0.1
<i>Aristida</i>	<i>inaequiglumis</i>		<2	0.8
<i>Chrysopogon</i>	<i>fallax</i>		<2	1
<i>Cymbopogon</i>	<i>obtectus</i>		<2	0.5
<i>Duperreya</i>	<i>commixta</i>		<2	Cl
<i>Enneapogon</i>	<i>polyphyllus</i>		<2	0.1
<i>Eragrostis</i>	<i>eriopoda</i>		<2	0.2
<i>Eremophila</i>	<i>margarethae</i>		2 to 10	1
<i>Evolvulus</i>	<i>alsinoides</i>	var. <i>villosicalyx</i>	<2	0.1
<i>Fimbristylis</i>	<i>dichotoma</i>		<2	0.1
<i>Gomphrena</i>	<i>kanisii</i>		<2	0.1
<i>Hakea</i>	<i>lorea</i>	subsp. <i>lorea</i>	2 to 10	2-4
<i>Portulaca</i>	<i>filifolia</i>		<2	0.2
<i>Psydrax</i>	<i>latifolia</i>		<2	0.4
<i>Tripogon</i>	<i>loliiformis</i>		<2	0.1
<i>Rhagodia</i>	<i>eremaea</i>		<2	0.3
<i>Salsola</i>	<i>australis</i>		<2	0.1
<i>Sclerolaena</i>	<i>cornishiana</i>		<2	0.2
<i>Sclerolaena</i>	<i>convexula</i>		<2	0.1
<i>Senna</i>	<i>artemisioides</i>	subsp. <i>helmsii</i>	2 to 10	1
<i>Senna</i>	<i>glaucifolia</i>		<2	0.4

Genus	Species	subsp. / var.	% Cover	Height
<i>Senna</i>		sp. Meekatharra (E. Bailey 1-26)	<2	1
<i>Sida</i>	<i>platycalyx</i>		<2	
<i>Sida</i>		sp. indet	<2	0.2
<i>Solanum</i>	<i>lasiophyllum</i>		<2	0.5
<i>Tribulus</i>		cf. <i>eichlerianus</i>	<2	0.2
<i>Triodia</i>	<i>basedowii</i>		<2	1

Site	Dynasty - Site DY10
Date	25/02/2015
Recorder	JB/JW
Photo	120-314;DSC957
Shape/Size	50m x 50m
Datum	GDA 94
Zone	50K
Easting	806133
Northing	7411622
Habitat	Plain (PLA)
Aspect	North
Slope	Low
Soil	Sandy Loam - Red
% Leaves:Logs	2 to 10: <2
% Bare Ground	35
Vegetation Condition	Excellent
Disturbance Type	Livestock
Fire Age	Very Old (>10 yrs)
Vegetation	Hummock Grassland of <i>Triodia basedowii</i> with High Open Shrubland of <i>Acacia pachyacra</i> with Scattered Low Trees of <i>Hakea lorea</i> subsp. <i>lorea</i> , <i>Acacia aptaneura</i> , (<i>Corymbia hamersleyana</i>)

Genus	Species	subsp. / var.	% Cover	Height
<i>Acacia</i>	<i>ancistrocarpa</i>		<2	3
<i>Acacia</i>	<i>aptaneura</i>		<2	2
<i>Acacia</i>	<i>melleodora</i>		<2	1.5
<i>Acacia</i>	<i>pachyacra</i>		2 to 10	2
<i>Androcalva</i>	<i>loxophylla</i>		<2	0.4
<i>Anthobolus</i>	<i>leptomerioides</i>		<2	0.5
<i>Aristida</i>	<i>contorta</i>		<2	0.2
<i>Aristida</i>	<i>holathera</i>	var. <i>holathera</i>	<2	0.3
<i>Aristida</i>	<i>inaequiglumis</i>		<2	1.5
<i>Bonamia</i>	<i>erecta</i>		<2	0.5
<i>Cymbopogon</i>	<i>obtectus</i>		<2	1
<i>Dicrastylis</i>	<i>cordifolia</i>		<2	0.5
<i>Duperreya</i>	<i>commixta</i>		<2	Cl
<i>Eragrostis</i>	<i>eriopoda</i>		<2	0.5
<i>Eremophila</i>	<i>forrestii</i>	subsp. <i>forrestii</i>	<2	0.5-1
<i>Eremophila</i>	<i>margarethae</i>		<2	0.5
<i>Eriachne</i>	<i>aristidea</i>		<2	0.3
<i>Hakea</i>	<i>lorea</i>	subsp. <i>lorea</i>	<2	2
<i>Paraneurachne</i>	<i>muelleri</i>		<2	0.3
<i>Ptilotus</i>	<i>obovatus</i>		<2	0.4
<i>Scaevola</i>	<i>parvifolia</i>	subsp. <i>pilbarae</i>	<2	0.4
<i>Senna</i>	<i>artemisioides</i>	subsp. <i>helmsii</i>	<2	0.5
<i>Senna</i>	<i>pleurocarpa</i>	var. <i>angustifolia</i>	<2	0.4
<i>Senna</i>		sp. <i>Meekatharra</i> (E. Bailey 1-26)	<2	0.5
<i>Sida</i>	<i>cardiophylla</i>		<2	0.5
<i>Solanum</i>	<i>lasiophyllum</i>		<2	0.5
<i>Triodia</i>	<i>basedowii</i>		31 to 70	1

Site	Dynasty - Site DY11
Date	26/02/2015
Recorder	JB/JW
Photo	120-315; DSC958
Shape/Size	50m x 50m
Datum	GDA 94
Zone	50K
Easting	194512
Northing	7409650
Habitat	Plain (PLA)
Aspect	North
Slope	Low
Soil	Sandy Loam - Red
Rock Type	BIF (scattered)
% Leaves:Logs	<2: 2 to 10
% Bare Ground	35
Vegetation Condition	Very Good
Disturbance Type	Livestock
Fire Age	Moderate (3-5yrs)
Vegetation	Hummock Grassland of <i>Triodia basedowii</i> with Low Open Woodland of <i>Acacia paraneura</i> , <i>Acacia aptaneura</i> , <i>Corymbia deserticola</i> , <i>Hakea lorea</i> subsp. <i>lorea</i> over High Open Shrubland of <i>Acacia pachyacra</i>

Genus	Species	subsp. / var.	% Cover	Height
<i>Abutilon</i>	<i>cryptopetalum</i>		<2	1
<i>Acacia</i>	<i>aptaneura</i>		<2	1.5
<i>Acacia</i>	<i>pachyacra</i>		2 to 10	3
<i>Acacia</i>	<i>paraneura</i>		2 to 10	3
<i>Acacia</i>	<i>pruinocarpa</i>		<2	0.72
<i>Acacia</i>	<i>tetragonophylla</i>		<2	1.2
<i>Aristida</i>	<i>contorta</i>		<2	0.2
<i>Aristida</i>	<i>inaequiglumis</i>		2 to 10	1
<i>Chrysopogon</i>	<i>fallax</i>		<2	1
<i>Cleome</i>	<i>viscosa</i>		<2	0.3
<i>Corymbia</i>	<i>deserticola</i>		<2	1-3
<i>Cymbopogon</i>	<i>obtectus</i>		<2	0.6
<i>Eragrostis</i>	<i>eriopoda</i>		<2	0.4
<i>Eremophila</i>	<i>forrestii</i>	subsp. <i>forrestii</i>	<2	1
<i>Eremophila</i>	<i>fraseri</i>		<2	1.5
<i>Eremophila</i>	<i>latrobei</i>	subsp. <i>latrobei</i>	<2	1.5
<i>Hakea</i>	<i>lorea</i>	subsp. <i>lorea</i>	<2	2.5
<i>Paraneurachne</i>	<i>muelleri</i>		<2	0.3
<i>Sclerolaena</i>		sp. indet	<2	0.1
<i>Senna</i>	<i>artemisioides</i>	subsp. <i>helmsii</i>	<2	1.5
<i>Senna</i>	<i>artemisioides</i>	subsp. <i>oligophylla</i>	<2	1.5
<i>Senna</i>	<i>glaucifolia</i>		<2	1.7
<i>Senna</i>	<i>glutinosa</i>	subsp. <i>pruinosa</i>	<2	1.5
<i>Sida</i>	<i>cardiophylla</i>		<2	0.3
<i>Solanum</i>	<i>lasiophyllum</i>		<2	0.5
<i>Tribulus</i>	<i>suberosus</i>		<2	0.7
<i>Triodia</i>	<i>basedowii</i>		31 to 70	1

Site	Dynasty - Site DY12
Date	26/02/2015
Recorder	JB/JW
Photo	120-318; DSC959
Shape/Size	50m x 50m
Datum	GDA 94
Zone	50K
Easting	193958
Northing	7409367
Habitat	Hillslope (HSL)
Aspect	East South East
Slope	Low
Soil	Sandy Loam - Brown
Rock Type	BIF (blue/ white quartz)
% Leaves:Logs	<2: 2 to 10
% Bare Ground	20
Vegetation Condition	Very Good
Disturbance Type	Livestock
Fire Age	Old (6+ yrs)
Vegetation	Closed Hummock Grassland of <i>Triodia pungens</i> with High Open Shrubland of <i>Hakea lorea</i> subsp. <i>lorea</i> , <i>Acacia trudgeniana</i> over Low Open Shrubland of <i>Senna artemisioides</i> subsp. <i>oligophylla</i> , <i>Eremophila fraseri</i> , <i>Indigofera monophylla</i>

Genus	Species	subsp. / var.	% Cover	Height
<i>Acacia</i>	<i>melleodora</i>		<2	1
<i>Acacia</i>	<i>pachyacra</i>		<2	1-2
<i>Acacia</i>	<i>synchronicia</i>		2 to 10	1.5-2.5
<i>Acacia</i>	<i>tetragonophylla</i>		<2	2.5
<i>Acacia</i>	<i>trudgeniana</i>		<2	2-4
<i>Anthobolus</i>	<i>leptomerioides</i>		<2	1-2
<i>Aristida</i>	<i>holathera</i>	var. <i>holathera</i>	<2	0.4
<i>Cassytha</i>	<i>filiformis</i>		<2	Cl
<i>Corchorus</i>	<i>sidoides</i>	subsp. <i>sidoides</i>	<2	0.3
<i>Cymbopogon</i>	<i>obtectus</i>		<2	1
<i>Eragrostis</i>	<i>eriopoda</i>		<2	0.3
<i>Eremophila</i>	<i>fraseri</i>		<2	1-2
<i>Grevillea</i>	<i>wickhamii</i>	subsp. <i>hispidula</i>	<2	2.5
<i>Hakea</i>	<i>chordophylla</i>		<2	2.5
<i>Hakea</i>	<i>lorea</i>	subsp. <i>lorea</i>	<2	5-6
<i>Indigofera</i>	<i>monophylla</i>		<2	0.6
<i>Panicum</i>	<i>effusum</i>		<2	0.4
<i>Paraneurachne</i>	<i>muelleri</i>		<2	0.35
<i>Pterocaulon</i>	<i>sphaeranthoides</i>		<2	0.5
<i>Ptilotus</i>	<i>astrolasius</i>		<2	0.4
<i>Ptilotus</i>	<i>obovatus</i>		<2	0.6
<i>Ptilotus</i>		cf. <i>clementii</i>	<2	0.4
<i>Senna</i>	<i>artemisioides</i>	subsp. <i>helmsii</i>	<2	0.5-1
<i>Senna</i>	<i>artemisioides</i>	subsp. <i>oligophylla</i>	<2	1.5
<i>Solanum</i>	<i>lasiophyllum</i>		<2	0.5

Genus	Species	subsp. / var.	% Cover	Height
<i>Triodia</i>	<i>pungens</i>		71 to 100	1
<i>Triodia</i>		sp. Shovelanna Hill (S. van Leeuwen 3835)	<2	0.5

Site	Dynasty - Site DY13
Date	26/10/2015
Recorder	JB/JW
Photo	120-339;DSC960
Shape/Size	50m x 50m
Datum	GDA 94
Zone	50K
Easting	806507
Northing	7409421
Habitat	Plain (PLA)
Aspect	
Slope	Flat
Soil	Sandy Loam - Brown
Rock Type	BIF (pebbles, cobbles)
% Leaves:Logs	<2: <2
% Bare Ground	85
Vegetation Condition	Very Good
Disturbance Type	Livestock
Fire Age	Very Old (>10 yrs)
Vegetation	Low Open Shrubland of <i>Sclerolaena cuneata</i> , <i>Eremophila cuneifolia</i> with Scattered Tall Shrubs of <i>Hakea preissii</i> , <i>Acacia synchronicia</i> over Scattered Tussock Grasses of <i>Aristida contorta</i> , <i>Enneapogon ramosus</i>

Genus	Species	subsp. / var.	% Cover	Height
<i>Acacia</i>	<i>synchronicia</i>		<2	1
<i>Aristida</i>	<i>contorta</i>		<2	0.1
<i>Aristida</i>	<i>inaequiglumis</i>		<2	1
<i>Brachyachne</i>	<i>prostrata</i>		<2	0.1
<i>Enneapogon</i>	<i>polyphyllus</i>		<2	0.2
<i>Enteropogon</i>	<i>ramosus</i>		<2	0.3
<i>Eragrostis</i>	<i>xerophila</i>		<2	0.3
<i>Eremophila</i>	<i>cuneifolia</i>		2 to 10	0.5
<i>Eremophila</i>	<i>margarethae</i>		<2	0.5
<i>Hakea</i>	<i>preissii</i>		<2	1.5
<i>Maireana</i>	<i>melanocoma</i>		<2	0.4
<i>Maireana</i>	<i>tomentosa</i>		<2	0.2
<i>Maireana</i>	<i>triptera</i>		<2	0.1
<i>Maireana</i>		sp. indet	<2	0.3
<i>Ptilotus</i>	<i>obovatus</i>		<2	0.6
<i>Sclerolaena</i>	<i>cornishiana</i>		<2	0.25
<i>Sclerolaena</i>	<i>cuneata</i>		2 to 10	0.1
<i>Senna</i>	<i>artemisioides</i>	subsp. <i>helmsii</i>	<2	0.2
<i>Senna</i>	<i>glutinosa</i>	subsp. <i>x luerssenii</i>	<2	1.5
<i>Senna</i>		sp. Meekatharra (E. Bailey 1-26)	<2	0.5
<i>Solanum</i>	<i>lasiophyllum</i>		<2	0.2
<i>Solanum</i>	<i>cleistogamum</i>		<2	0.7

Site	Dynasty - Site DY14
Date	26/02/2015
Recorder	JB/JW
Photo	120-364;DSC961
Shape/Size	50m x 50m
Datum	GDA 94
Zone	50K
Easting	193369
Northing	7410380
Habitat	Plain (PLA)
Aspect	
Slope	Flat
Soil	Sandy Loam - Brown
Rock Type	BIF (scattered): Ironstone (pebbles)
% Leaves:Logs	2 to 10: <2
% Bare Ground	70
Vegetation Condition	Very Good
Disturbance Type	Livestock
Fire Age	Very Old (>10 yrs)
Vegetation	Low Woodland of <i>Acacia aptaneura</i> over Open Shrubland of <i>Eremophila fraseri</i> , <i>Sida ectogama</i> , <i>Senna artemisioides</i> subsp. <i>helmsii</i> over Low Open Shrubland of <i>Eremophila fraseri</i> , <i>Senna artemisioides</i> subsp. <i>helmsii</i> over Very Open Tussock Grassland of <i>Aristida inaequiglumis</i> , <i>Aristida contorta</i> , <i>Digitaria brownii</i>

Genus	Species	subsp. / var.	% Cover	Height
<i>Bidens</i>	<i>bipinnata</i>		<2	0.2
<i>Acacia</i>	<i>aptaneura</i>		2 to 10	4-10
<i>Acacia</i>	<i>pachyacra</i>		<2	2
<i>Acacia</i>	<i>paraneura</i>		<2	6
<i>Acacia</i>	<i>pruinocarpa</i>		<2	4
<i>Acacia</i>	<i>rhodophloia</i>		<2	3
<i>Acacia</i>	<i>tenuissima</i>		<2	1-2
<i>Acacia</i>	<i>tetragonophylla</i>		<2	1-2
<i>Anthobolus</i>	<i>brownii</i>		<2	1
<i>Aristida</i>	<i>contorta</i>		<2	0.2
<i>Aristida</i>	<i>holathera</i>	var. <i>holathera</i>	<2	0.4
<i>Aristida</i>	<i>inaequiglumis</i>		<2	0.8
<i>Cheilanthes</i>	<i>sieberi</i>		<2	0.2
<i>Cleome</i>	<i>viscosa</i>		<2	0.5
<i>Cymbopogon</i>	<i>obtectus</i>		<2	1
<i>Digitaria</i>	<i>ammophila</i>		<2	0.2
<i>Digitaria</i>	<i>brownii</i>		<2	0.5
<i>Duperreya</i>	<i>commixta</i>		<2	Cl
<i>Enneapogon</i>	<i>polyphyllus</i>		<2	0.2
<i>Eragrostis</i>	<i>eriopoda</i>		<2	0.5
<i>Eremophila</i>	<i>forrestii</i>	subsp. <i>forrestii</i>	<2	1
<i>Eremophila</i>	<i>fraseri</i>		2 to 10	1-2.5
<i>Eremophila</i>	<i>margarethae</i>		<2	0.6
<i>Eriachne</i>	<i>mucronata</i>		<2	0.4
<i>Eriachne</i>	<i>obtusa</i>		<2	0.5

Genus	Species	subsp. / var.	% Cover	Height
<i>Eriachne</i>	<i>pulchella</i>	subsp. <i>pulchella</i>	<2	0.1
<i>Eulalia</i>	<i>aurea</i>		<2	0.7
<i>Gomphrena</i>	<i>kanisii</i>		<2	0.2
<i>Hakea</i>	<i>lorea</i>	subsp. <i>lorea</i>	<2	0.5-3
<i>Hibiscus</i>	<i>burtonii</i>		<2	0.5
<i>Maireana</i>	<i>villosa</i>		<2	0.5
<i>Paraneurachne</i>	<i>muelleri</i>		<2	0.4
<i>Psydrax</i>	<i>latifolia</i>		<2	0.5-1
<i>Ptilotus</i>	<i>aervoides</i>		<2	0.05
<i>Ptilotus</i>	<i>obovatus</i>		<2	0.5
<i>Sclerolaena</i>	<i>cornishiana</i>		<2	0.3
<i>Senna</i>	<i>artemisioides</i>	subsp. <i>helmsii</i>	2 to 10	1
<i>Sida</i>	<i>ectogama</i>		2 to 10	1-1.5
<i>Sida</i>	<i>platycalyx</i>		<2	
<i>Solanum</i>	<i>lasiophyllum</i>		<2	0.4
<i>Triodia</i>	<i>basedowii</i>		2 to 10	0.5-1

Site	Dynasty - Site DY15
Date	26/02/2015
Recorder	JB/JW
Photo	120-372
Shape/Size	50m x 50m
Datum	GDA 94
Zone	50K
Easting	193841
Northing	7411350
Habitat	Drainage depression (DDE)
Aspect	
Slope	Flat
Soil	Clay Loam - Red
Rock Type	
% Leaves:Logs	2 to 10: 2 to 10
% Bare Ground	15
Vegetation Condition	Very Good
Disturbance Type	Livestock: Weeds
Fire Age	Very Old (>10yrs)
Vegetation	Low Closed Forest of <i>Acacia aptaneura</i> , <i>Corymbia aspera</i> , <i>Eucalyptus xerothermica</i> , <i>Hakea lorea</i> subsp. <i>lorea</i> over Very Open Tussock Grassland of <i>Chrysopogon fallax</i> , <i>Aristida inaequiglumis</i> , <i>Eragrostis xerophila</i> with Scattered Low Shrubs of <i>Isotropis forrestii</i>

Genus	Species	subsp. / var.	% Cover	Height
<i>Acacia</i>	<i>aptaneura</i>		71 to 100	4-8
<i>Aristida</i>	<i>contorta</i>		<2	0.2
<i>Aristida</i>	<i>inaequiglumis</i>		2 to 10	0.5-1
<i>Chrysopogon</i>	<i>fallax</i>		2 to 10	1
<i>Corymbia</i>	<i>aspera</i>		<2	6
<i>Digitaria</i>	<i>ammophila</i>		<2	0.3
<i>Eragrostis</i>	<i>xerophila</i>		<2	0.35
<i>Eriachne</i>	<i>mucronata</i>		<2	0.4
<i>Eucalyptus</i>	<i>xerothermica</i>		<2	7
<i>Evolvulus</i>	<i>alsinoides</i>	var. <i>villosicalyx</i>	<2	0.1
<i>Hakea</i>	<i>lorea</i>	subsp. <i>lorea</i>	<2	6
<i>Indigofera</i>	<i>georgei</i>		<2	0.6
<i>Ipomoea</i>	<i>calobra</i>		<2	Cr
<i>Isotropis</i>	<i>forrestii</i>		<2	0.5
<i>Maireana</i>	<i>villosa</i>		<2	0.2
<i>Psyrax</i>	<i>latifolia</i>		<2	2
<i>Ptilotus</i>	<i>obovatus</i>		<2	0.5
<i>Senna</i>	<i>glaucifolia</i>		<2	0.6-2
<i>Sida</i>	<i>ectogama</i>		<2	1
<i>Solanum</i>	<i>lasiophyllum</i>		<2	0.2
<i>Themeda</i>	<i>triandra</i>		<2	1
<i>Triodia</i>	<i>pungens</i>		<2	1

Site	Dynasty - Site DY16
Date	27/02/2015
Recorder	JB/JW
Photo	120-410/411; DSC962
Shape/Size	50m x 50m
Datum	GDA 94
Zone	50K
Easting	196359
Northing	7411267
Habitat	Hillslope (HSL)
Aspect	North
Slope	Low
Soil	Sandy Loam - Brown
Rock Type	BIF (pebbles, cobbles, outcrop)
% Leaves:Logs	<2: <2
% Bare Ground	55
Vegetation Condition	Excellent
Disturbance Type	Livestock
Fire Age	Old (6+ yrs)
Vegetation	Hummock Grassland of <i>Triodia pungens</i> , <i>Triodia</i> sp. <i>Shovelanna Hill</i> (<i>S. van Leeuwen</i> 3835) with Low Open Woodland of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> , <i>Acacia rhodophloia</i> over High Open Shrubland of <i>Acacia maitlandii</i> , <i>Acacia rhodophloia</i> over Low Open Shrubland of <i>Eremophila exilifolia</i>

Genus	Species	subsp. / var.	% Cover	Height
<i>Acacia</i>		<i>cf. sibirica</i>	<2	0.5-1
<i>Acacia</i>	<i>maitlandii</i>		<2	1.5
<i>Acacia</i>	<i>marramamba</i>			
<i>Acacia</i>	<i>rhodophloia</i>		2 to 10	3
<i>Acacia</i>	<i>synchronicia</i>		<2	0.4
<i>Acacia</i>	<i>tetragonophylla</i>		<2	1.5
<i>Aristida</i>	<i>contorta</i>		<2	0.2
<i>Aristida</i>	<i>holathera</i>	<i>var. holathera</i>	<2	0.3
<i>Aristida</i>	<i>inaequiglumis</i>		<2	1
<i>Bonamia</i>	<i>erecta</i>		<2	0.3
<i>Calytrix</i>	<i>carinata</i>		<2	0.5
<i>Cheilanthes</i>	<i>brownii</i>			
<i>Corchorus</i>	<i>lasiocarpus</i>	<i>subsp. parvus</i>	<2	0.3
<i>Corchorus</i>	<i>walcottii</i>		<2	0.2
<i>Cymbopogon</i>	<i>obtectus</i>		<2	0.7
<i>Eragrostis</i>	<i>eriopoda</i>		<2	0.3
<i>Eremophila</i>	<i>cuneifolia</i>			
<i>Eremophila</i>	<i>exilifolia</i>		2 to 10	0.5-1
<i>Eremophila</i>	<i>latrobei</i>	<i>subsp. latrobei</i>	<2	1-2
<i>Eriachne</i>	<i>mucronata</i>		<2	0.3
<i>Eucalyptus</i>	<i>leucophloia</i>	<i>subsp. leucophloia</i>	<2	4
<i>Gomphrena</i>	<i>kanisii</i>		<2	0.3
<i>Goodenia</i>	<i>stobbsiana</i>		<2	0.2
<i>Goodenia</i>	<i>triodiophila</i>		<2	0.3
<i>Goodenia</i>		<i>sp. indet</i>	<2	0.2

Genus	Species	subsp. / var.	% Cover	Height
<i>Grevillea</i>	<i>berryana</i>		<2	4
<i>Hibiscus</i>	<i>sturtii</i>	var. <i>truncatus</i>	<2	0.15
<i>Hybanthus</i>	<i>aurantiacus</i>		<2	0.25
<i>Paraneurachne</i>	<i>muelleri</i>		<2	0.3
<i>Sarcostemma</i>	<i>australe</i>			
<i>Scaevola</i>	<i>spinescens</i>			
<i>Senna</i>	<i>artemisioides</i>	subsp. <i>helmsii</i>	<2	0.5-1
<i>Senna</i>	<i>artemisioides</i>	subsp. <i>helmsii</i> x <i>oligophylla</i>	<2	1.-1.5
<i>Senna</i>	<i>glutinosa</i>	subsp. <i>glutinosa</i>	<2	1-2
<i>Senna</i>	<i>glutinosa</i>	subsp. x <i>luerssenii</i>	<2	0.5-1.5
<i>Senna</i>	<i>stricta</i>			
<i>Solanum</i>	<i>lasiophyllum</i>		<2	0.5
<i>Triodia</i>	<i>pungens</i>		31 to 70	1
<i>Triodia</i>		sp. Shovelanna Hill (S. van Leeuwen 3835)	2 to 10	0.8
<i>Tripogon</i>	<i>loliiformis</i>		<2	0.2

Site	Dynasty - Site DY17
Date	27/02/2015
Recorder	JB/JW
Photo	120-413; DSC963
Shape/Size	50m x 50m
Datum	GDA 94
Zone	50K
Easting	195742
Northing	7412168
Habitat	Hillslope (HSL)
Aspect	North
Slope	Low
Soil	Loamy Sand - Red
Rock Type	BIF (outcrops, pebbles, cobbles)
% Leaves:Logs	<2: <2
% Bare Ground	40
Vegetation Condition	Excellent
Disturbance Type	
Fire Age	Old (6+ yrs)
Vegetation	Hummock Grassland of <i>Triodia pungens</i> with Open Shrubland of <i>Grevillea wickhamii</i> subsp. <i>hispidula</i> over Low Open Shrubland of <i>Acacia hilliana</i> , <i>Eremophila exilifolia</i> , <i>Senna artemisioides</i> subsp. <i>helmsii</i>

Genus	Species	subsp. / var.	% Cover	Height
<i>Abutilon</i>	<i>lepidum</i>		<2	0.3
<i>Acacia</i>	<i>hilliana</i>		2 to 10	0.4
<i>Acacia</i>		cf. <i>sibirica</i>	<2	1
<i>Acacia</i>	<i>maitlandii</i>		<2	0.5
<i>Acacia</i>	<i>tetragonophylla</i>		<2	2
<i>Aristida</i>	<i>contorta</i>		<2	0.2
<i>Aristida</i>	<i>holathera</i>	var. <i>holathera</i>	<2	0.3
<i>Corchorus</i>	<i>walcottii</i>		<2	0.35
<i>Cymbopogon</i>	<i>obtectus</i>		<2	0.6
<i>Digitaria</i>	<i>brownii</i>		<2	0.35
<i>Enneapogon</i>	<i>polyphyllus</i>		<2	0.2
<i>Eragrostis</i>	<i>eriopoda</i>		<2	0.3
<i>Eremophila</i>	<i>exilifolia</i>		2 to 10	0.6
<i>Evolvulus</i>	<i>alsinoides</i>	var. <i>villosicalyx</i>	<2	0.2
<i>Fimbristylis</i>	<i>dichotoma</i>		<2	0.2
<i>Gomphrena</i>	<i>kanisii</i>		<2	0.3
<i>Goodenia</i>	<i>triodiophila</i>		<2	0.35
<i>Gossypium</i>	<i>australe</i>		<2	0.5-1
<i>Grevillea</i>	<i>wickhamii</i>	subsp. <i>hispidula</i>	2 to 10	1.2-3
<i>Hibiscus</i>	<i>sturtii</i>	var. <i>truncatus</i>	<2	0.3
<i>Hybanthus</i>	<i>aurantiacus</i>		<2	0.3
<i>Indigofera</i>	<i>monophylla</i>		<2	0.4
<i>Pluchea</i>	<i>dentex</i>		<2	0.5
<i>Ptilotus</i>	<i>obovatus</i>		<2	0.2
<i>Sclerolaena</i>	<i>cornishiana</i>		<2	0.3
<i>Sclerolaena</i>	<i>cuneata</i>		<2	0.2
<i>Senna</i>	<i>artemisioides</i>	subsp. <i>helmsii</i>	2 to 10	1.2

Genus	Species	subsp. / var.	% Cover	Height
<i>Solanum</i>	<i>lasiophyllum</i>		<2	0.35
<i>Solanum</i>	<i>cleistogamum</i>		<2	0.2
<i>Tephrosia</i>		sp. Newman (A.A. Mitchell PRP 29)	<2	0.1
<i>Tribulus</i>	<i>suberosus</i>		<2	1
<i>Triodia</i>	<i>pungens</i>		31 to 70	0.5-1
<i>Tripogon</i>	<i>loliiformis</i>		2 to 10	0.2

Site	Dynasty - Site DY18
Date	27/02/2015
Recorder	JB/JW
Photo	120-425; DSC694
Shape/Size	50m x 50m
Datum	GDA 94
Zone	50K
Easting	195549
Northing	7411504
Habitat	Plain (PLA)
Aspect	North
Slope	Low
Soil	Sandy Clay Loam – Red/ Brown
Rock Type	BIF (scattered pebbles)
% Leaves:Logs	<2: <2
% Bare Ground	25
Vegetation Condition	Excellent
Disturbance Type	
Fire Age	Old (6+ yrs)
Vegetation	Closed Hummock Grassland of <i>Triodia schinzii</i> with High Open Shrubland of <i>Acacia aptaneura</i> , <i>Hakea lorea</i> subsp. <i>lorea</i> over Open Shrubland of <i>Acacia pachyacra</i> , <i>Acacia ancistrocarpa</i> , <i>Acacia tetragonophylla</i> , <i>Acacia aptaneura</i>

Genus	Species	subsp. / var.	% Cover	Height
<i>Acacia</i>	<i>ancistrocarpa</i>		<2	2
<i>Acacia</i>	<i>aptaneura</i>		2 to 10	2.5
<i>Acacia</i>	<i>melleodora</i>		<2	2
<i>Acacia</i>	<i>pachyacra</i>		<2	1.5
<i>Acacia</i>	<i>pruinocarpa</i>		<2	0.5
<i>Acacia</i>	<i>rhodophloia</i>		<2	2
<i>Acacia</i>	<i>tetragonophylla</i>		<2	1.5
<i>Bonamia</i>	<i>erecta</i>		<2	0.4
<i>Chrysocephalum</i>	<i>pterochaetum</i>			
<i>Cymbopogon</i>	<i>obtectus</i>		<2	1
<i>Dicrastylis</i>	<i>cordifolia</i>		<2	0.5
<i>Duperreya</i>	<i>commixta</i>		<2	Cl
<i>Eragrostis</i>	<i>eriopoda</i>		<2	0.4
<i>Eremophila</i>	<i>forrestii</i>	subsp. <i>forrestii</i>	<2	1
<i>Euphorbia</i>		cf. <i>tannensis</i> subsp. <i>eremophila</i>	<2	0.3
<i>Hakea</i>	<i>lorea</i>	subsp. <i>lorea</i>	<2	2
<i>Kennedia</i>	<i>prorepens</i>			
<i>Senna</i>	<i>artemisioides</i>	subsp. <i>helmsii</i>	<2	0.4
<i>Senna</i>	<i>artemisioides</i>	subsp. <i>oligophylla</i>	<2	1
<i>Sida</i>	<i>cardiophylla</i>		<2	0.3
<i>Triodia</i>	<i>schinzii</i>		71 to 100	1.5

Site	Dynasty - Site DY19
Date	27/02/2015
Recorder	JB/JW
Photo	120-432; DSC965
Shape/Size	50m x 50m
Datum	GDA 94
Zone	50K
Easting	196231
Northing	7411247
Habitat	Drainage depression (DDE)
Aspect	
Slope	Flat
Soil	Loam - Brown
Rock Type	BIF (scattered pebbles)
% Leaves:Logs	2 to 10: <2
% Bare Ground	50
Vegetation Condition	Very Good
Disturbance Type	Fire: Livestock
Fire Age	Moderate (3-5 yrs)
Vegetation	Low Open Woodland of <i>Acacia aptaneura</i> over Open Shrubland of <i>Acacia aptaneura</i> over Very Open Hummock Grassland of <i>Triodia pungens</i> , <i>Triodia basedowii</i> , <i>Triodia</i> sp. <i>Shovelanna Hill</i> (s. Van Leeuwen 3835)

Genus	Species	subsp. / var.	% Cover	Height
<i>Goodenia</i>	<i>nuda</i>		<2	0.2
<i>Acacia</i>	<i>ancistrocarpa</i>		<2	2
<i>Acacia</i>	<i>aptaneura</i>		11 to 30	2-5
<i>Acacia</i>	<i>kempeana</i>		<2	0.5
<i>Acacia</i>	<i>macraneura</i>		<2	4
<i>Acacia</i>	<i>tetragonophylla</i>		<2	1
<i>Anthobolus</i>	<i>leptomerioides</i>		<2	2
<i>Aristida</i>	<i>contorta</i>		<2	0.1
<i>Aristida</i>	<i>holathera</i>	var. <i>holathera</i>	<2	0.1
<i>Aristida</i>	<i>inaequiglumis</i>		<2	1
<i>Chrysocephalum</i>	<i>pterochaetum</i>		<2	0.3
<i>Corymbia</i>	<i>hamersleyana</i>		<2	4
<i>Cymbopogon</i>	<i>obtectus</i>		<2	0.7
<i>Digitaria</i>	<i>brownii</i>		<2	0.4
<i>Duperreya</i>	<i>commixta</i>		<2	Cl
<i>Eragrostis</i>	<i>eriopoda</i>		<2	0.3
<i>Eremophila</i>	<i>exilifolia</i>		<2	1
<i>Eremophila</i>	<i>forrestii</i>	subsp. <i>forrestii</i>	<2	1
<i>Eremophila</i>	<i>fraseri</i>		<2	1.2
<i>Eremophila</i>	<i>latrobei</i>	subsp. <i>latrobei</i>	<2	1.5
<i>Eucalyptus</i>	<i>leucophloia</i>	subsp. <i>leucophloia</i>	<2	4
<i>Evolvulus</i>	<i>alsinoides</i>	var. <i>villosicalyx</i>	<2	0.1
<i>Gomphrena</i>	<i>kanisii</i>		<2	0.1
<i>Grevillea</i>	<i>wickhamii</i>	subsp. <i>hispidula</i>	<2	3
<i>Hakea</i>	<i>lorea</i>	subsp. <i>lorea</i>	<2	3
<i>Indigofera</i>	<i>monophylla</i>		<2	0.3
<i>Maireana</i>	<i>villosa</i>		<2	0.2

Genus	Species	subsp. / var.	% Cover	Height
<i>Paraneurachne</i>	<i>muelleri</i>		<2	0.3
<i>Rhagodia</i>	<i>eremaea</i>		<2	1
<i>Scaevola</i>	<i>parvifolia</i>	subsp. <i>pilbarae</i>	<2	0.2
<i>Sclerolaena</i>	<i>cornishiana</i>		<2	0.2
<i>Senna</i>	<i>artemisioides</i>	subsp. <i>helmsii</i>	<2	1
<i>Senna</i>	<i>artemisioides</i>	subsp. <i>oligophylla</i>	<2	1.7
<i>Senna</i>	<i>glutinosa</i>	subsp. <i>x luerssenii</i>	<2	1.5
<i>Sida</i>	<i>fibulifera</i>		<2	0.1
<i>Sida</i>	<i>platycalyx</i>		<2	
<i>Sida</i>		cf. <i>echinocarpa</i>	<2	0.3
<i>Solanum</i>	<i>lasiophyllum</i>		<2	0.5
<i>Tephrosia</i>		sp. Newman (A.A. Mitchell PRP 29).	<2	0.2
<i>Triodia</i>	<i>basedowii</i>		<2	1
<i>Triodia</i>	<i>pungens</i>		2 to 10	1
<i>Triodia</i>		sp. Shovelanna Hill (S. van Leeuwen 3835)	<2	0.5
<i>Tripogon</i>	<i>loliiformis</i>		<2	0.1

Site	Dynasty - Site DY20
Date	27/02/2015
Recorder	JB/JW
Photo	120-431
Shape/Size	50m x 50m
Datum	GDA 94
Zone	50K
Easting	195629
Northing	7410804
Habitat	Footslope (FOO)
Aspect	North West
Slope	Low
Soil	Sandy Loam - Brown
Rock Type	BIF (cobbles)
% Leaves:Logs	<2: <2
% Bare Ground	47
Vegetation Condition	Excellent
Disturbance Type	Weeds
Fire Age	Moderate (3-5 yrs)
Vegetation	Open Hummock Grassland of <i>Triodia</i> sp. <i>Shovelanna Hill</i> (S. Van Leeuwen 3835), <i>Triodia pungens</i> with High Open Shrubland of <i>Acacia ancistrocarpa</i> over Open Shrubland of <i>Senna glutinosa</i> subsp. <i>luerssenii</i> , <i>Senna artemisioides</i> subsp. <i>helmsii</i> over Low Open Shrubland of <i>Senna artemisioides</i> subsp. <i>helmsii</i> over Very Open Tussock Grassland of <i>Aristida contorta</i> , <i>Eragrostis eriopoda</i> , <i>Paraneurachne muelleri</i>

Genus	Species	subsp. / var.	% Cover	Height
<i>Cenchrus</i>	<i>ciliaris</i>		<2	0.5
<i>Acacia</i>	<i>ancistrocarpa</i>		2 to 10	2-3
<i>Acacia</i>	<i>aptaneura</i>		<2	2-6
<i>Acacia</i>	<i>maitlandii</i>		<2	2
<i>Acacia</i>	<i>melleodora</i>		<2	1
<i>Acacia</i>	<i>pachyacra</i>		<2	1-2
<i>Acacia</i>	<i>pruinocarpa</i>		<2	4
<i>Acacia</i>	<i>tetragonophylla</i>		<2	1-2
<i>Amphipogon</i>	<i>sericeus</i>		<2	0.3
<i>Aristida</i>	<i>contorta</i>		2 to 10	0.2
<i>Aristida</i>	<i>holathera</i>	var. <i>holathera</i>	<2	0.4
<i>Aristida</i>	<i>inaequiglumis</i>		<2	1
<i>Corchorus</i>	<i>lasiocarpus</i>	subsp. <i>parvus</i>	<2	0.5
<i>Cymbopogon</i>	<i>obtectus</i>		<2	1
<i>Digitaria</i>	<i>brownii</i>		<2	0.45
<i>Duperreya</i>	<i>commixta</i>		<2	Cl
<i>Enneapogon</i>	<i>polyphyllus</i>		<2	0.2
<i>Eragrostis</i>	<i>eriopoda</i>		2 to 10	0.3
<i>Eremophila</i>	<i>cuneifolia</i>		<2	0.5
<i>Eremophila</i>	<i>latrobei</i>	subsp. <i>latrobei</i>	<2	1.2
<i>Eremophila</i>	<i>longifolia</i>		<2	1
<i>Eriachne</i>	<i>mucronata</i>		<2	0.4
<i>Evolvulus</i>	<i>alsinoides</i>	var. <i>villosicalyx</i>	<2	0.2
<i>Gomphrena</i>	<i>kanisii</i>		<2	0.3

Genus	Species	subsp. / var.	% Cover	Height
<i>Grevillea</i>	<i>wickhamii</i>	subsp. <i>hispidula</i>	<2	2-3
<i>Hakea</i>	<i>chordophylla</i>		<2	0.5
<i>Hakea</i>	<i>lorea</i>	subsp. <i>lorea</i>	<2	2-3
<i>Hibiscus</i>	<i>sturtii</i>	var. <i>truncatus</i>	<2	0.3
<i>Hybanthus</i>	<i>aurantiacus</i>		<2	0.5
<i>Indigofera</i>	<i>monophylla</i>		<2	0.3
<i>Maireana</i>	<i>planifolia</i>		<2	0.5
<i>Paraneurachne</i>	<i>muelleri</i>		<2	0.4
<i>Ptilotus</i>	<i>astrolasius</i>		<2	0.4
<i>Ptilotus</i>	<i>calostachyus</i>		<2	1
<i>Ptilotus</i>	<i>nobilis</i>		<2	0.2
<i>Ptilotus</i>	<i>obovatus</i>		<2	0.4
<i>Ptilotus</i>		sp. <i>indet</i>	<2	0.4
<i>Rhagodia</i>	<i>eremaea</i>		<2	1
<i>Salsola</i>	<i>australis</i>		<2	
<i>Senna</i>	<i>artemisioides</i>	subsp. <i>helmsii</i>	2 to 10	1
<i>Senna</i>	<i>artemisioides</i>	subsp. <i>oligophylla</i>	<2	0.5
<i>Senna</i>	<i>glutinosa</i>	subsp. <i>x luerssenii</i>	2 to 10	1-2
<i>Senna</i>	<i>glutinosa</i>	subsp. <i>pruinosa</i>	<2	1
<i>Sida</i>		sp. Pilbara (A. A. Mitchell PRP 1543)	<2	0.6
<i>Solanum</i>	<i>lasiophyllum</i>		<2	0.6
<i>Solanum</i>	<i>cleistogamum</i>		<2	0.2
<i>Themeda</i>	<i>triandra</i>		<2	1
<i>Tribulus</i>	<i>suberosus</i>		<2	0.5
<i>Triodia</i>	<i>pungens</i>		2 to 10	0.8-1.2
<i>Triodia</i>		sp. Shovelanna Hill (S. van Leeuwen 3835)	11 to 30	0.6

Site	Dynasty - Site DY21
Date	27/10/2015
Recorder	JB/JW
Photo	120-451;DSC966
Shape/Size	50m x 50m
Datum	GDA 94
Zone	50K
Easting	197153
Northing	7411947
Habitat	Hillcrest (HCR)
Aspect	East
Slope	Low
Soil	Sandy Loam - Orange
Rock Type	BIF (pebbles. Cobbles)
% Leaves:Logs	<2: <2
% Bare Ground	60
Vegetation Condition	Very Good
Disturbance Type	Livestock
Fire Age	Moderate (3-5 yrs)
Vegetation	Shrubland of <i>Senna artemisioides</i> subsp. <i>helmsii</i> , <i>Eremophila fraseri</i> with High Open Shrubland of <i>Acacia rhodophloia</i> over Very Open Tussock Grassland of <i>Aristida contorta</i> , <i>Digitaria brownii</i> , <i>Tripogon lolliformis</i>

Genus	Species	subsp. / var.	% Cover	Height
<i>Acacia</i>	<i>aptaneura</i>		<2	1.5
<i>Acacia</i>	<i>maitlandii</i>		<2	1
<i>Acacia</i>	<i>rhodophloia</i>		2 to 10	1
<i>Acacia</i>	<i>tetragonophylla</i>		<2	1
<i>Aristida</i>	<i>contorta</i>		2 to 10	0.2
<i>Aristida</i>	<i>holathera</i>	var. <i>holathera</i>	<2	0.2
<i>Aristida</i>	<i>inaequiglumis</i>		<2	0.4
<i>Chrysocephalum</i>	<i>pterochaetum</i>		<2	0.3
<i>Cymbopogon</i>	<i>obtectus</i>		<2	1
<i>Digitaria</i>	<i>brownii</i>		<2	0.5
<i>Enneapogon</i>	<i>polyphyllus</i>		<2	0.1
<i>Eragrostis</i>	<i>eriopoda</i>		<2	0.3
<i>Eremophila</i>	<i>exilifolia</i>		<2	1
<i>Eremophila</i>	<i>forrestii</i>	subsp. <i>forrestii</i>	<2	1
<i>Eremophila</i>	<i>fraseri</i>		<2	1
<i>Evolvulus</i>	<i>alsinoides</i>	var. <i>villosicalyx</i>	<2	0.1
<i>Gomphrena</i>	<i>kanisii</i>		<2	0.1
<i>Goodenia</i>		sp. indet.	<2	0.2
<i>Hibiscus</i>	<i>burtonii</i>		<2	0.3
<i>Hibiscus</i>	<i>sturtii</i>	var. <i>truncatus</i>	<2	0.3
<i>Indigofera</i>	<i>monophylla</i>		<2	0.2
<i>Paraneurachne</i>	<i>muelleri</i>		<2	0.3
<i>Sclerolaena</i>	<i>cornishiana</i>		<2	0.3
<i>Senna</i>	<i>artemisioides</i>	subsp. <i>helmsii</i>	2 to 10	1.5
<i>Senna</i>	<i>glutinosa</i>	subsp. <i>x luerssenii</i>	<2	1
<i>Sida</i>	<i>fibulifera</i>		<2	0.2
<i>Sida</i>	<i>platycalyx</i>		<2	

Genus	Species	subsp. / var.	% Cover	Height
<i>Solanum</i>	<i>lasiophyllum</i>		<2	0.5
<i>Solanum</i>	<i>cleistogamum</i>		<2	0.2
<i>Tephrosia</i>		sp. Newman (A.A. Mitchell PRP 29)..	<2	0.3
<i>Triodia</i>	<i>pungens</i>		<2	1
<i>Tripogon</i>	<i>loliiformis</i>		<2	0.1

Site	Dynasty - Site DY22
Date	27/02/2015
Recorder	JB/JW
Photo	120-450
Shape/Size	50m x 50m
Datum	GDA 94
Zone	50K
Easting	197075
Northing	7411042
Habitat	Plain (PLA)
Aspect	
Slope	Flat
Soil	Clay Loam - Brown
Rock Type	BIF (scattered pebbles)
% Leaves:Logs	2 to 10: 2 to 10
% Bare Ground	65
Vegetation Condition	Very Good
Disturbance Type	Livestock
Fire Age	Very Old (>10 yrs)
Vegetation	Low Woodland of <i>Acacia catenulata</i> subsp. <i>occidentalis</i> , <i>Acacia aptaneura</i> , <i>Acacia paraneura</i> over Open Tussock Grassland of <i>Aristida inaequiglumis</i> , <i>Digitaria ammophila</i> with Low Open Shrubland of <i>Eremophila forrestii</i> subsp. <i>forrestii</i> , <i>Isotropis forrestii</i> , <i>Senna glaucifolia</i>

Genus	Species	subsp. / var.	% Cover	Height
<i>Bidens</i>	<i>bipinnata</i>		<2	0.1
<i>Acacia</i>	<i>aptaneura</i>		2 to 10	4-10
<i>Acacia</i>	<i>catenulata</i>	subsp. <i>occidentalis</i>	2 to 10	4-8
<i>Acacia</i>	<i>paraneura</i>		<2	6
<i>Acacia</i>	<i>pruinocarpa</i>		<2	4
<i>Acacia</i>	<i>pteraneura</i>		2 to 10	2-4
<i>Acacia</i>	<i>tetragonophylla</i>		<2	1-2
<i>Alternanthera</i>		sp. indet	<2	0.3
<i>Aristida</i>	<i>contorta</i>		<2	0.25
<i>Aristida</i>	<i>inaequiglumis</i>		11 to 30	1
<i>Cheilanthes</i>	<i>sieberi</i>	subsp. <i>sieberi</i>	<2	0.15
<i>Digitaria</i>	<i>ammophila</i>		2 to 10	0.3
<i>Enneapogon</i>	<i>polyphyllus</i>		<2	0.2
<i>Eremophila</i>	<i>forrestii</i>	subsp. <i>forrestii</i>	<2	1
<i>Eremophila</i>	<i>fraseri</i>		<2	0.5-1.5
<i>Eremophila</i>	<i>latrobei</i>	subsp. <i>latrobei</i>	<2	1-2
<i>Eriachne</i>	<i>helmsii</i>		<2	0.4
<i>Eucalyptus</i>	<i>leucophloia</i>	subsp. <i>leucophloia</i>	<2	4-8
<i>Eulalia</i>	<i>aurea</i>		<2	0.5-1
<i>Evolvulus</i>	<i>alsinoides</i>	var. <i>villosicalyx</i>	<2	0.3
<i>Gomphrena</i>	<i>kanisii</i>		<2	0.3
<i>Ipomoea</i>	<i>calobra</i>		<2	Cl
<i>Isotropis</i>	<i>forrestii</i>		2 to 10	1
<i>Maireana</i>	<i>villosa</i>		<2	0.5
<i>Psyrax</i>	<i>latifolia</i>		<2	0.5
<i>Psyrax</i>	<i>suaveolens</i>		<2	2

Genus	Species	subsp. / var.	% Cover	Height
<i>Ptilotus</i>	<i>aeroides</i>		<2	0.05
<i>Ptilotus</i>	<i>obovatus</i>		<2	0.8
<i>Ptilotus</i>	<i>schwartzii</i>		<2	0.4
<i>Rhagodia</i>	<i>eremaea</i>		<2	1-2
<i>Senna</i>	<i>glaucifolia</i>		<2	1-2
<i>Sida</i>	<i>ectogama</i>		<2	1-2
<i>Sida</i>	<i>fibulifera</i>		<2	0.2
<i>Solanum</i>	<i>lasiophyllum</i>		<2	0.5

Site	Dynasty - Site DY23
Date	27/02/2015
Recorder	JB/JW
Photo	120-464
Shape/Size	50m x 50m
Datum	GDA 94
Zone	50K
Easting	196872
Northing	7412558
Habitat	Plain (PLA)
Aspect	North
Slope	Low
Soil	Sandy Clay Loam – Brown
Rock Type	BIF (mixed pebbles)
% Leaves:Logs	<2; <2
% Bare Ground	70
Vegetation Condition	Very Good
Disturbance Type	Access track; Livestock; Weeds
Fire Age	Moderate (3-5 yrs)
Vegetation	Open Shrubland of <i>Acacia synchronicia</i> over Low Open Shrubland of <i>Eremophila cuneifolia</i> , <i>Senna</i> sp. <i>Meekatharra</i> (<i>E. Bailey 1-26</i>), <i>Maireana triptera</i> over Very Open Tussock Grassland of <i>Eragrostis xerophila</i> , <i>Aristida contorta</i> , <i>Enteropogon ramosus</i>

Genus	Species	subsp. / var.	% Cover	Height
<i>Cenchrus</i>	<i>ciliaris</i>		<2	0.2
<i>Acacia</i>	<i>aptaneura</i>		<2	1-2
<i>Acacia</i>	<i>synchronicia</i>		2 to 10	1.5-3
<i>Acacia</i>	<i>tetragonophylla</i>		<2	1-2
<i>Aristida</i>	<i>contorta</i>		<2	0.2
<i>Aristida</i>	<i>inaequiglumis</i>		<2	1
<i>Enneapogon</i>	<i>polyphyllus</i>		<2	0.2
<i>Enteropogon</i>	<i>ramosus</i>		<2	0.4
<i>Eragrostis</i>	<i>xerophila</i>		<2	0.25
<i>Eremophila</i>	<i>cuneifolia</i>		2 to 10	0.6
<i>Eremophila</i>	<i>forrestii</i>	subsp. <i>forrestii</i>	<2	0.4
<i>Eremophila</i>	<i>longifolia</i>		<2	1.2
<i>Gomphrena</i>	<i>kanisii</i>		<2	0.2
<i>Hakea</i>	<i>preissii</i>		<2	2-4
<i>Hibiscus</i>	<i>burtonii</i>		<2	0.3
<i>Lepidium</i>	<i>platypetalum</i>		<2	0.3
<i>Maireana</i>	<i>georgei</i>		<2	0.15
<i>Maireana</i>	<i>tomentosa</i>		<2	0.2
<i>Maireana</i>	<i>triptera</i>		<2	0.25
<i>Portulaca</i>	<i>filifolia</i>		<2	0.2
<i>Ptilotus</i>	<i>obovatus</i>		<2	0.5
<i>Rhagodia</i>	<i>eremaea</i>		<2	0.6
<i>Sclerolaena</i>	<i>cuneata</i>		<2	0.2
<i>Sclerolaena</i>		sp. indet	<2	0.15
<i>Senna</i>	<i>artemisioides</i>	subsp. <i>helmsii</i>	<2	1
<i>Senna</i>	<i>artemisioides</i>	subsp. <i>oligophylla</i>	<2	1

Genus	Species	subsp. / var.	% Cover	Height
<i>Senna</i>	<i>glutinosa</i>	subsp. <i>x luerssenii</i>	<2	0.5
<i>Senna</i>		sp. Meekatharra (E. Bailey 1-26).	<2	0.5-1
<i>Sida</i>	<i>echinocarpa</i>		<2	0.5
<i>Sida</i>		cf. <i>fibulifera</i>	<2	0.2
<i>Solanum</i>	<i>lasiophyllum</i>		<2	0.35
<i>Triodia</i>	<i>pungens</i>		<2	1

Site	Dynasty - Site DY24
Date	28/02/2015
Recorder	JB/JW
Photo	120-465; DSC968
Shape/Size	50m x 50m
Datum	GDA 94
Zone	50K
Easting	193747
Northing	7412333
Habitat	Plain (PLA)
Aspect	West
Slope	Low
Soil	Sandy Loam - Brown
Rock Type	BIF (scattered cobbles, pebbles)
% Leaves:Logs	<2: 2 to 10
% Bare Ground	60
Vegetation Condition	Very Good
Disturbance Type	Livestock
Fire Age	Very Old (>10 yrs)
Vegetation	Open Shrubland of <i>Senna artemisioides</i> subsp. <i>helmsii</i> , <i>Acacia aptaneura</i> over Very Open Tussock Grassland of <i>Aristida inaequiglumis</i> , <i>Tripogon lolliiformis</i> , <i>Eragrostis eriopoda</i> , <i>Aristida holathera</i> var. <i>holathera</i> with Scattered Low Trees of <i>Acacia aptaneura</i>

Genus	Species	subsp. / var.	% Cover	Height
<i>Acacia</i>	<i>aptaneura</i>		2 to 10	1-4
<i>Acacia</i>	<i>tetragonophylla</i>		<2	1
<i>Aristida</i>	<i>contorta</i>		<2	0.2
<i>Aristida</i>	<i>holathera</i>	var. <i>holathera</i>	<2	0.2
<i>Aristida</i>	<i>inaequiglumis</i>		<2	1
<i>Boerhavia</i>	<i>coccinea</i>		<2	0.2
<i>Cleome</i>	<i>viscosa</i>		<2	0.4
<i>Cymbopogon</i>	<i>obtectus</i>		<2	0.5
<i>Digitaria</i>	<i>brownii</i>		<2	0.4
<i>Enneapogon</i>	<i>polyphyllus</i>		<2	0.1
<i>Eragrostis</i>	<i>eriopoda</i>		<2	0.3
<i>Eremophila</i>	<i>forrestii</i>	subsp. <i>forrestii</i>	<2	1.2
<i>Euphorbia</i>		cf. <i>tannensis</i> subsp. <i>eremophila</i>	<2	0.3
<i>Evolvulus</i>	<i>alsinoides</i>	var. <i>villosicalyx</i>	<2	0.1
<i>Fimbristylis</i>	<i>dichotoma</i>		<2	0.2
<i>Gomphrena</i>	<i>kanisii</i>		<2	0.2
<i>Goodenia</i>		sp. indet	<2	0.1
<i>Hakea</i>	<i>lorea</i>	subsp. <i>lorea</i>	<2	0.5
<i>Hibiscus</i>	<i>burtonii</i>		<2	0.3
<i>Indigofera</i>	<i>georgei</i>		<2	0.4
<i>Maireana</i>	<i>villosa</i>		<2	0.4
<i>Paraneurachne</i>	<i>muelleri</i>		<2	0.4
<i>Portulaca</i>	<i>filifolia</i>		<2	0.2
<i>Ptilotus</i>	<i>obovatus</i>		<2	0.3
<i>Rhagodia</i>	<i>eremaea</i>		<2	0.5

Genus	Species	subsp. / var.	% Cover	Height
<i>Sclerolaena</i>	<i>cornishiana</i>		<2	0.3
<i>Senna</i>	<i>artemisioides</i>	subsp. <i>helmsii</i>	2 to 10	1
<i>Senna</i>	<i>artemisioides</i>	subsp. <i>oligophylla</i>	<2	0.4
<i>Sida</i>	<i>fibulifera</i>		<2	0.2
<i>Sida</i>	<i>platycalyx</i>		<2	0.25
<i>Solanum</i>	<i>lasiophyllum</i>		<2	0.5
<i>Solanum</i>	<i>cleistogamum</i>		<2	0.3
<i>Tephrosia</i>		sp. Newman (A.A. Mitchell PRP 29)..	<2	0.2
<i>Triodia</i>	<i>schinzii</i>		<2	1.2
<i>Tripogon</i>	<i>loliiformis</i>		<2	0.1

Site	Dynasty - Site DY25
Date	28/02/2015
Recorder	JB/JW
Photo	120-483/484;DSC969
Shape/Size	50m x 50m
Datum	GDA 94
Zone	50K
Easting	195943
Northing	7410371
Habitat	Hillslope (HSL)
Aspect	South
Slope	Moderate
Soil	Sandy Loam - Brown
Rock Type	BIF (cobbles, pebbles, outcropping)
% Leaves:Logs	2 to 10: 2 to 10
% Bare Ground	
Vegetation Condition	Excellent
Disturbance Type	Drill pads & tracks nearby
Fire Age	Very Old (>10 yrs)
Vegetation	Hummock Grassland of <i>Triodia</i> sp. <i>Shovelanna Hill</i> (S. Van Leeuwen 3835), <i>Triodia pungens</i> with Low Woodland of <i>Acacia aptaneura</i> , <i>Acacia catenulata</i> subsp. <i>occidentalis</i> , <i>Acacia pruinocarpa</i> , <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> over Scattered Shrubs of <i>Eremophila latrobei</i> subsp. <i>latrobei</i>

Genus	Species	subsp. / var.	% Cover	Height
<i>Acacia</i>	<i>aptaneura</i>		2 to 10	4
<i>Acacia</i>	<i>ayersiana</i>		<2	1
<i>Acacia</i>	<i>catenulata</i>	subsp. <i>occidentalis</i>	2 to 10	4
<i>Acacia</i>	<i>maitlandii</i>		<2	1-2-3
<i>Acacia</i>	<i>pruinocarpa</i>		2 to 10	4
<i>Acacia</i>	<i>tetragonophylla</i>		<2	2
<i>Anthobolus</i>	<i>leptomerioides</i>		<2	3
<i>Cymbopogon</i>	<i>obtectus</i>		<2	1
<i>Digitaria</i>	<i>brownii</i>		<2	0.3
<i>Dodonaea</i>	<i>pachyneura</i>		<2	1
<i>Duperreya</i>	<i>commixta</i>		<2	Cl
<i>Eragrostis</i>	<i>eriopoda</i>		<2	0.4
<i>Eremophila</i>	<i>latrobei</i>	subsp. <i>latrobei</i>	<2	2
<i>Eriachne</i>	<i>mucronata</i>		<2	0.4
<i>Eucalyptus</i>	<i>leucophloia</i>	subsp. <i>leucophloia</i>	2 to 10	4
<i>Grevillea</i>	<i>berryana</i>		<2	2-5
<i>Hibiscus</i>		sp. Gardneri (A.L. Payne PRP 1435)	<2	0.2-1
<i>Psyrax</i>	<i>suaveolens</i>		<2	0.5-1
<i>Ptilotus</i>	<i>calostachyus</i>		<2	0.4
<i>Ptilotus</i>	<i>obovatus</i>		<2	0.5
<i>Senna</i>	<i>glutinosa</i>	subsp. <i>x luerssenii</i>	<2	2
<i>Sida</i>		sp. indet	<2	0.6
<i>Sida</i>		sp. Golden calyces glabrous (H.N. Foote 32)	<2	0.3

Genus	Species	subsp. / var.	% Cover	Height
<i>Solanum</i>	<i>cleistogamum</i>		<2	0.4
<i>Triodia</i>	<i>brizoides</i>		<2	
<i>Triodia</i>	<i>pungens</i>		2 to 10	1
<i>Triodia</i>		sp. Shovelanna Hill (S. van Leeuwen 3835)	31 to 70	1

Site	Dynasty - Site DY26
Date	28/02/2015
Recorder	JB/JW
Photo	120-493;DSC970
Shape/Size	50m x 50m
Datum	GDA 94
Zone	50K
Easting	195473
Northing	7409479
Habitat	Plain (PLA)
Aspect	
Slope	Flat
Soil	Clay Loam - Brown
Rock Type	
% Leaves:Logs	2 to 10: 2 to 10
% Bare Ground	60
Vegetation Condition	Very Good
Disturbance Type	Livestock; Track nearby
Fire Age	Old (6+ yrs)
Vegetation	Low Woodland of <i>Acacia aptaneura</i> , (<i>Corymbia aspera</i> , <i>Hakea lorea</i> subsp. <i>lorea</i>) over Open Tussock Grassland of <i>Aristida inaequiglumis</i> , <i>Digitaria brownii</i> with Open Shrubland of <i>Eremophila forrestii</i> subsp. <i>forrestii</i> , <i>Isotropis forrestii</i> , <i>Sida ectogama</i>

Genus	Species	subsp. / var.	% Cover	Height
<i>Acacia</i>	<i>aptaneura</i>		11 to 30	5-8
<i>Acacia</i>	<i>tetragonophylla</i>		<2	2
<i>Amyema</i>	<i>fitzgeraldii</i>		<2	
<i>Aristida</i>	<i>contorta</i>		<2	0.25
<i>Aristida</i>	<i>inaequiglumis</i>		2 to 10	1
<i>Cheilanthes</i>	<i>sieberi</i>	subsp. <i>sieberi</i>	<2	0.3
<i>Corymbia</i>	<i>aspera</i>		<2	7
<i>Digitaria</i>	<i>ammophila</i>		<2	0.3
<i>Digitaria</i>	<i>brownii</i>		<2	0.4
<i>Enneapogon</i>	<i>polyphyllus</i>		<2	0.2
<i>Eremophila</i>	<i>forrestii</i>	subsp. <i>forrestii</i>	<2	0.5
<i>Eremophila</i>	<i>fraseri</i>		<2	1-2
<i>Evolvulus</i>	<i>alsinoides</i>	var. <i>villosicalyx</i>	<2	0.2
<i>Gomphrena</i>	<i>kanisii</i>		<2	0.2
<i>Grevillea</i>	<i>berryana</i>		<2	1-2
<i>Hakea</i>	<i>lorea</i>	subsp. <i>lorea</i>	<2	4-6
<i>Hibiscus</i>	<i>burtonii</i>		<2	0.3
<i>Hibiscus</i>	<i>sturtii</i>	var.	<2	0.2
<i>Ipomoea</i>	<i>calobra</i>		<2	Cl
<i>Isotropis</i>	<i>forrestii</i>		<2	0.5-1
<i>Maireana</i>	<i>villosa</i>		<2	0.4
<i>Psyrax</i>	<i>latifolia</i>		<2	2
<i>Ptilotus</i>	<i>obovatus</i>		<2	0.4
<i>Senna</i>	<i>artemisioides</i>	subsp. <i>helmsii</i>	<2	1
<i>Sida</i>	<i>ectogama</i>		11 to 30	1-2
<i>Sida</i>	<i>fibulifera</i>		<2	0.3

Genus	Species	subsp. / var.	% Cover	Height
<i>Sida</i>	<i>platycalyx</i>		<2	
<i>Solanum</i>	<i>lasiophyllum</i>		<2	0.3
<i>Tripogon</i>	<i>loliiformis</i>		<2	0.1

Site	Dynasty - Site DY27
Date	28/02/2015
Recorder	JB/JW
Photo	120-509; DSC971
Shape/Size	50m x 50m
Datum	GDA 94
Zone	50K
Easting	197199
Northing	7409651
Habitat	Plain (PLA)
Aspect	
Slope	Flat
Soil	Clay Loam - Brown
Rock Type	BIF (pebbles)
% Leaves:Logs	<2: <2
% Bare Ground	80
Vegetation Condition	Very Good
Disturbance Type	Livestock
Fire Age	Old (6+ yrs)
Vegetation	Open Tussock Grassland of <i>Aristida contorta</i> , <i>Eragrostis xerophila</i> with Open Shrubland of <i>Senna artemisioides</i> subsp. <i>helmsii</i> , <i>Senna glutinosa</i> subsp. <i>luerssenii</i> , <i>Eremophila cuneifolia</i> with Scattered Tall Shrubs of <i>Acacia tetragonophylla</i>

Genus	Species	subsp. / var.	% Cover	Height
<i>Acacia</i>	<i>kempeana</i>		<2	0.5
<i>Acacia</i>	<i>synchronicia</i>		<2	0.2
<i>Acacia</i>	<i>tetragonophylla</i>		<2	3.5
<i>Aristida</i>	<i>contorta</i>		2 to 10	0.3
<i>Aristida</i>	<i>holathera</i>	var. <i>holathera</i>	<2	0.2
<i>Aristida</i>	<i>inaequiglumis</i>		<2	0.5
<i>Boerhavia</i>	<i>coccinea</i>		<2	0.1
<i>Cymbopogon</i>	<i>obtectus</i>		<2	0.4
<i>Eragrostis</i>	<i>xerophila</i>		<2	0.35
<i>Eremophila</i>	<i>cuneifolia</i>		<2	0.3
<i>Eriachne</i>	<i>mucronata</i>		<2	0.4
<i>Evolvulus</i>	<i>alsinoides</i>	var. <i>villosicalyx</i>	<2	0.1
<i>Gomphrena</i>	<i>kanisii</i>		<2	0.1
<i>Hibiscus</i>	<i>burtonii</i>		<2	0.3
<i>Maireana</i>	<i>triptera</i>		<2	0.3
<i>Maireana</i>	<i>villosa</i>		<2	0.1
<i>Portulaca</i>	<i>oleracea</i>		<2	0.15
<i>Rhagodia</i>	<i>eremaea</i>		<2	0.2
<i>Salsola</i>	<i>australis</i>		<2	0.3
<i>Sclerolaena</i>	<i>cornishiana</i>		<2	0.2
<i>Sclerolaena</i>	<i>cuneata</i>		<2	0.25
<i>Sclerolaena</i>	<i>ericantha</i>		<2	0.3
<i>Senna</i>	<i>artemisioides</i>	subsp. <i>helmsii</i>	2 to 10	0.5
<i>Senna</i>	<i>glaucifolia</i>		<2	0.5
<i>Senna</i>	<i>glutinosa</i>	subsp. <i>x luerssenii</i>	<2	0.5-1.5

Genus	Species	subsp. / var.	% Cover	Height
<i>Sida</i>		cf. verrucose glands (F.H. Mollemans 2423)	<2	0.2
<i>Solanum</i>	<i>lasiophyllum</i>		<2	0.6
<i>Solanum</i>	<i>cleistogamum</i>		<2	0.2
<i>Tripogon</i>	<i>loliiformis</i>		<2	0.1

Site	Dynasty - Site DY28
Date	28/02/2015
Recorder	JB/JW
Photo	120-511: DSC 972
Shape/Size	50m x 50m
Datum	GDA 94
Zone	50K
Easting	198163
Northing	7410094
Habitat	Hillcrest (HCR)
Aspect	East
Slope	Flat
Soil	Loam - Brown
Rock Type	BIF (cobbles, pebbles, outcropping)
% Leaves:Logs	<2: <2
% Bare Ground	20
Vegetation Condition	Very Good
Disturbance Type	Tracks nearby; Livestock
Fire Age	Old (6+ yrs)
Vegetation	Hummock Grassland of <i>Triodia</i> sp. <i>Shovelanna Hill</i> (S. Van Leeuwen 3835) with Low Open Woodland of <i>Acacia pruinocarpa</i> , <i>Grevillea berryana</i> over Low Open Shrubland of <i>Halgania solanacea</i> var. <i>Mt Doreen</i> (G.M. Chippendale 4206), <i>Acacia hilliana</i>

Genus	Species	subsp. / var.	% Cover	Height
<i>Acacia</i>	<i>aneura</i>		<2	6
<i>Acacia</i>	<i>catenulata</i>	subsp. <i>occidentalis</i>	<2	2-4
<i>Acacia</i>	<i>hilliana</i>		<2	0.5
<i>Acacia</i>	<i>paraneura</i>		<2	6
<i>Acacia</i>	<i>pruinocarpa</i>		2 to 10	5
<i>Acacia</i>	<i>tetragonophylla</i>		<2	2
<i>Anthobolus</i>	<i>leptomerioides</i>		<2	1-2
<i>Cymbopogon</i>	<i>obtectus</i>		<2	1
<i>Digitaria</i>	<i>ammophila</i>		<2	0.2
<i>Duperreya</i>	<i>commixta</i>		<2	Cl
<i>Eragrostis</i>	<i>eriopoda</i>		<2	0.3
<i>Eremophila</i>	<i>forrestii</i>	subsp. <i>forrestii</i>	<2	1
<i>Eremophila</i>	<i>latrobei</i>	subsp. <i>filiformis</i>	<2	1
<i>Grevillea</i>	<i>berryana</i>		2 to 10	4
<i>Halgania</i>	<i>solanacea</i>	var. <i>Mt Doreen</i> (G.M. Chippendale 4206)	<2	0.35
<i>Hibiscus</i>	<i>burtonii</i>		<2	0.3
<i>Hibiscus</i>	<i>sturtii</i>	var. <i>truncatus</i>	<2	0.3
<i>Maireana</i>	<i>georgei</i>		<2	0.3
<i>Maireana</i>	<i>villosa</i>		<2	0.5
<i>Ptilotus</i>	<i>calostachyus</i>		<2	0.4
<i>Ptilotus</i>	<i>obovatus</i>		<2	0.5
<i>Scaevola</i>	<i>spinescens</i>		<2	0.5
<i>Senna</i>	<i>artemisioides</i>	subsp. <i>helmsii</i> x	<2	1
<i>Senna</i>	<i>glutinosa</i>	subsp. x <i>luerssenii</i>	<2	2

Genus	Species	subsp. / var.	% Cover	Height
<i>Solanum</i>	<i>lasiophyllum</i>		<2	0.5
<i>Triodia</i>		sp. Shovelanna Hill (S. van leeuwen 3835)	31 to 70	1

Site	Dynasty - Site DY29
Date	28/02/2015
Recorder	JB/JW
Photo	120-520; DSC974
Shape/Size	50m x 50m
Datum	GDA 94
Zone	50K
Easting	197331
Northing	7412756
Habitat	Hillcrest (HCR)
Aspect	South East
Slope	Moderate
Soil	Sandy Loam - Brown
Rock Type	BIF (outcrops, cobbles, pebbles)
% Leaves:Logs	<2: <2
% Bare Ground	25
Vegetation Condition	Very Good
Disturbance Type	Tracks, rail and powerline nearby
Fire Age	Old (6+ yrs)
Vegetation	Hummock Grassland of <i>Triodia pungens</i> with Open Shrubland of <i>Eremophila fraseri</i> , <i>Acacia synchronicia</i> with Scattered Low Trees of <i>Hakea lorea</i> subsp. <i>lorea</i> , <i>Grevillea striata</i>

Genus	Species	subsp. / var.	% Cover	Height
<i>Acacia</i>	<i>synchronicia</i>		31 to 70	1
<i>Acacia</i>	<i>tetragonophylla</i>		2 to 10	2
<i>Corchorus</i>	<i>walcottii</i>		<2	1.2
<i>Eragrostis</i>	<i>eriopoda</i>		<2	0.3
<i>Eremophila</i>	<i>lachnocalyx</i>		<2	0.3
<i>Eremophila</i>	<i>fraseri</i>			
<i>Eriachne</i>	<i>mucronata</i>		2 to 10	1
<i>Grevillea</i>	<i>striata</i>		<2	0.35
<i>Hakea</i>	<i>lorea</i>	subsp. <i>lorea</i>	<2	2
<i>Indigofera</i>	<i>monophylla</i>		<2	2
<i>Ptilotus</i>	<i>obovatus</i>		<2	0.3
<i>Senna</i>	<i>artemisioides</i>	subsp. <i>helmsii</i>	<2	0.5
<i>Senna</i>	<i>artemisioides</i>	subsp. <i>oligophylla</i>	<2	0.5
<i>Senna</i>	<i>glaucifolia</i>		<2	0.3
<i>Senna</i>	<i>glutinosa</i>	subsp. <i>x luerssenii</i>	<2	0.5
<i>Senna</i>	<i>glutinosa</i>	subsp. <i>pruinosa</i>	<2	1-2
<i>Sida</i>		sp. indet	<2	0.5-1
<i>Themeda</i>	<i>triandra</i>		<2	0.1
<i>Tribulus</i>	<i>suberosus</i>		<2	1
<i>Triodia</i>	<i>pungens</i>		<2	

**Appendix 2: West Jimblebar and Noddy Bore Single Season Targeted Flora Survey
(Biologic, 2020a)**



West Jimblebar and Noddy Bore Single Season Targeted Flora Survey

Biologic Environmental Survey

Report to BHP Western Australia Iron Ore

November 2020



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EXECUTIVE SUMMARY

BHP Western Australian Iron Ore commissioned Biologic Environmental Survey Pty Ltd to conduct a single season targeted flora survey covering West Jimblebar and Noddy Bore. The Study Area is located 30 km east of Newman and covers an area of approximately 2400 hectares encompassing Exploration, Miscellaneous and Mining tenure (see Section 2.3).

The targeted flora survey was undertaken across six days from the 7th to the 12th of May 2020. The survey was undertaken by traversing the Study Area in systematic and targeted searches. Any areas then considered to contain habitat that could support conservation significant flora were infilled with more intensive searches. Locations of previously recorded conservation significant flora species were also revisited to verify presence/abundance and current status of the individuals/population.

The desktop assessment identified 31 conservation significant taxa which had varying likelihoods of occurring within the Study Area. Three taxa had previously been recorded from the Study Area, three taxa were considered highly likely to occur and two were considered to possibly occur. The remainder were considered unlikely or highly unlikely to occur within the Study Area.

Two conservation significant flora taxa were recorded by this survey in the Study Area:

- *Ipomoea racemigera* (P2) – 63 individuals from 38 point locations; and
- *Goodenia nuda* (P4) – 352 individuals from 102 point locations.

An additional 22 individuals from 15 point locations of *Ipomoea racemigera* (P2) and 17 individuals from three point locations of *Goodenia nuda* (P4) were recorded outside of the Study Area along the western boundary. The two conservation significant flora taxa observed in this current survey have previously been recorded from the Study Area. The remaining taxon, *Goodenia berringbinensis* (P4), previously recorded in the Study Area was not located by this survey. No taxa listed as Threatened flora (under the EPBC Act or BC Act) were recorded by this survey.

One flora of “other” significance was recorded by this survey in the Study Area, representing a range extension of approximately 55 km to the south east:

- *Brunonia* sp. Long hairs (D.E. Symon 2440) – one individual from one point location.

Seven introduced flora taxa, **Aerva javanica*, **Bidens bipinnata*, **Cenchrus ciliaris*, **Citrullus amarus*, **Malvastrum americanum*, **Rumex vesicarius* and **Setaria verticillata* were recorded from the Study Area by this survey. These taxa are not listed as Weeds of National Significance or Declared Plant Pests listed under the *Biosecurity and Agriculture Management Act 2007*. These taxa have been previously recorded within and/or surrounding the Study Area and are common in the Pilbara.

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1 INTRODUCTION

1.1 Background

BHP Western Australian Iron Ore (BHP WAIO) commissioned Biologic Environmental Survey Pty Ltd (Biologic) to conduct a single season targeted flora survey covering West Jimblebar and Noddy Bore (hereafter referred to as the Study Area). The Study Area is located 30 km east of Newman and covers an area of approximately 2400 hectares (ha) (Figure 1.1) encompassing Exploration, Miscellaneous and Mining tenure (see Section 2.3).

1.2 Scope of Works

The overarching objective of the single season targeted flora survey (hereafter referred to as the Survey) was to identify the flora (conservation significant, introduced and “other”) values that would need to be considered during any future environmental approvals across the Study Area. The overarching objective was achieved via the following scope of works:

- The completion of a desktop assessment, including the review of previous biological surveys and government and non-government databases;
- The completion of a single season targeted flora survey across the Study Area; and
- A review of the results of the flora survey to determine if there are any significant environmental values within the Study Area.

1.3 Background to Protection of Flora

Within Western Australia, all native flora is protected under the *Biodiversity Conservation Act 2016* (BC Act) and any action that has the potential to impact on native flora needs to be approved by relevant State and/ or Federal departments as dictated by the Western Australian *Environmental Protection Act 1986* (EP Act) and the Federal *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Flora taxa that are determined to be at risk of extinction or in decline are afforded extra protection under these Acts. For the purposes of this report, these are called conservation significant flora taxa. A summary of applicable legislation and status codes is provided in (Table 1.1). Additional information on conservation status codes is provided in Appendix A.

The EPBC Act identifies Threatened Ecological Communities (TECs) as ecological communities at risk of extinction. The BC Act provides for the statutory listing of TECs by the WA Minister for Environment. The WA Minister for Environment has endorsed 69 ecological communities as threatened under critically endangered (20 communities), endangered (17 communities), vulnerable (28 communities) and presumed totally destroyed (four communities).

For some flora taxa and ecological communities, there is insufficient information to determine their status. These taxa are generally considered by the Environmental Protection Authority (EPA)/ Department of Biodiversity, Conservation and Attractions (DBCA) as ‘conservation significant’ for all development related approvals and are listed on a ‘Priority List’. The Priority List is regularly reviewed and maintained

by DBCA. Potential TECs that do not meet the criteria for statutory listing by the Minister for Environment are added to DBCA's 'Priority Ecological Communities' (PECs) lists under Priorities 1, 2, 3 (near threatened) or 4 (conservation dependent).

Table 1.1 Conservation significance assessment guidelines

Agreement, Act or List	Status Codes
FEDERAL	
<p><i>Environment Protection and Biodiversity Conservation Act 1999</i> DoEE lists threatened flora, which are determined by the Threatened Species Scientific Committee (TSSC) according to criteria set out in the Act. The Act lists flora that are considered to be of conservation significance under one of eight categories (listed under 'Status Codes').</p>	<ul style="list-style-type: none"> • Extinct (EX) • Extinct in the Wild (EW) • Critically Endangered (CE) • Endangered (EN) • Vulnerable (VU) • Conservation Dependent (CD)
<p>Threatened Ecological Communities (TECs) are those that are at risk of extinction.</p>	<ul style="list-style-type: none"> • Critically Endangered (CE) • Endangered (EN) • Vulnerable (VU)
Agreement, Act or List	Status Codes
STATE	
<p><i>Biodiversity Conservation Act 2016</i> The <i>Biodiversity Conservation Act 2016</i> provides for the listing of threatened native flora and Threatened Ecological Communities that need protection as critically endangered, endangered or vulnerable species or ecological communities because they are under identifiable threat of extinction (species) or collapse (ecological communities).</p>	<ul style="list-style-type: none"> • Schedule 1 (Critically Endangered) (S1 or CR) • Schedule 2 (Endangered) (S2 or EN) • Schedule 3 (Vulnerable) (S3 or VU) • Schedule 4 (Extinct) (S4 or EX)
<p>DBCA Priority list (DBCA) DBCA produces a list of Priority species and ecological communities (e.g. Priority Ecological Communities) that have not been assigned statutory protection under the <i>Biodiversity Conservation Act 2016</i>. This system gives a ranking from Priority 1 to Priority 4.</p>	<ul style="list-style-type: none"> • Priority 1 (P1) • Priority 2 (P2) • Priority 3 (P3) • Priority 4 (P4)

Figure 1.1: Study Area and regional location

2 ENVIRONMENT

2.1 Biogeographical Regionalisation of Australia

The Study Area is located at the juncture between the Pilbara bioregion and the Gascoyne bioregion (Figure 1.1), as defined by the Interim Biogeographic Regionalisation of Australia (IBRA) (Thackway & Cresswell, 1995). The majority of the Study Area is located within the Gascoyne bioregion, while the remaining small portion in the east of the Study Area is located within the Pilbara bioregion. The Gascoyne bioregion is characterised by rugged low Proterozoic sedimentary and granite ranges divided by broad flat valleys (Thackway & Cresswell, 1995), with vegetation dominated by open mulga low woodlands (Bastin, 2008). The Pilbara bioregion is characterised by vast coastal plains and inland mountain ranges with cliffs and deep gorges (Thackway & Cresswell, 1995), with vegetation predominantly consisting of mulga low woodlands or snappy gum over bunch and hummock grasses (Bastin, 2008).

The Gascoyne bioregion is characterised by three separate subregions; Ashburton (GAS01), Carnegie (GAS02) and Augustus (GAS03), of which the Study Area is partially located within the Augustus (GAS03) subregion (Figure 1.1). The Augustus subregion is located on the northern margin of Yilgarn Craton (Desmond *et al.*, 2001). The Gascoyne River System provides the main drainage of the subregion; however, the headwaters of the Ashburton and Fortescue Rivers also occur in the subregion (Desmond *et al.*, 2001). There are extensive areas of alluvial valley-fill deposits. Mulga (*Acacia aneura* and close relatives) woodland with *Triodia* spp. occur on shallow stony loams on rises, while the shallow earthy loams over hardpan on the plains are covered by Mulga parkland (Desmond *et al.*, 2001).

The Pilbara bioregion is characterised by four separate subregions, Chichester (PIL01), Fortescue (PIL02), Hamersley (PIL03) and Roebourne (PIL04). The Study Area is located within the Hamersley (PIL03) subregion (Figure 1.1). The Hamersley subregion is characterised by mountainous area of sedimentary ranges and plateaus, dissected by gorges (Kendrick, 2001). The Hamersley contains extensive open snappy gum woodland and hummock grassland communities on ranges and plateaus, with low mulga woodlands over bunch grasses on fine textured soils in lower areas and valley floors (Kendrick, 2001). The significant and dominant feature of this subregion is the Hamersley Range. This prominent range feature, 450 kilometres (km) long, is a mountainous plateau which receives significantly higher rainfall than the surrounding subregion giving rise to deeply incised gorges, up to 100 metres (m) deep, containing extensive permanent spring-fed streams and pools (Kendrick, 2001). The Hamersley and Chichester Ranges drain to give rise to the Fortescue Marsh and Fortescue River system (McKenzie *et al.*, 2002).

2.2 Climate

The Gascoyne and Pilbara bioregions have a semi-desert to tropical climate, with rainfall occurring sporadically throughout the year, although heavier falls occur mostly during summer (Thackway & Cresswell, 1995). Summer rainfall is usually the result of tropical storms in the north or tropical cyclones that impact upon the coast and move inland (Leighton, 2004). The winter rainfall is generally lighter and

is the result of cold fronts moving north easterly across the state (Leighton, 2004). The average annual rainfall ranges from 200- 350 mm, although there are significant fluctuations between years (BoM, 2020), with up to 1200 mm falling in some locations in some years (McKenzie *et al.*, 2002).

Long-term climatic data is not available for the Study Area itself; however, long term climatic data is available from the Bureau of Meteorology (BoM) weather station at Newman Airport (Station 7176), approximately 18 km west of the Study Area (BoM, 2020). The Newman Airport is expected to provide the most accurate long-term average (LTA) dataset for climatic conditions experienced within the Study Area (Figure 2.1).

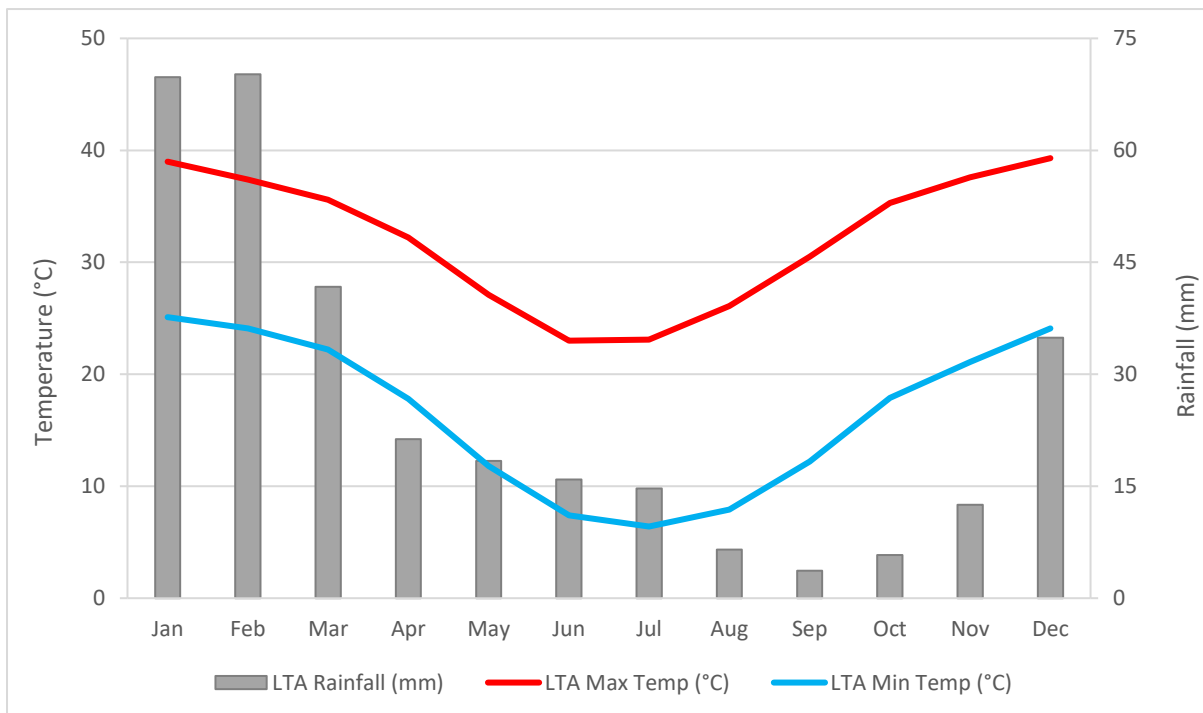


Figure 2.1: Long-term climatic averages (LTA) of monthly rainfall and temperature from Newman Airport Station 7176 (BoM, 2020)

2.3 Existing Land Use

The Study Area is comprised of mining lease M266SA (held by BHP Iron Ore (Jimblebar) Pty Ltd, a subsidiary of the BHP Group), exploration licence E52/259-I (held by BHP Iron Ore (Jimblebar) Pty Ltd), and the miscellaneous licences L52/108 and L52/109 (held by BHP Billiton Minerals Pty Ltd, Itochu Minerals & Energy Of Australia Pty Ltd and Mitsui-Itochu Iron Pty Ltd). The Study Area is located within the Sylvania pastoral lease, which is actively utilised for the grazing of cattle. Limited pastoral infrastructure occurs within the Study Area, with mainly informal tracks present.

The Study Area is wholly located within the Shire of East Pilbara local government authority (LGA) (Figure 2.2). The boundary between the Shire of East Pilbara and the Shire of Meekatharra is located approximately 5 km south of the Study Area.

Figure 2.2: Study Area and BHP WAIO tenure

2.4 Soils and Landforms

The Atlas of Australian Soils (Northcote *et al.*, 1960-1968) was compiled by Commonwealth Scientific and Industrial Research Organisation (CSIRO) in the 1960s to provide a consistent national description of Australia's soils. It comprises of a series of ten maps and associated explanatory notes and is published at a scale of 1:2,000,000, but the original compilation was at scales from 1:250,000 to 1:500,000.

The broad soil landscape units that have been mapped across the Study Area comprises Oc64, BE6 and Fa13 (Northcote *et al.*, 1960-1968) (Table 2.1 and Figure 2.3). The majority of the Study Area is mapped as BE6, followed by Oc64, with a small portion (in the northwest corner) mapped as Fa13 (Table 2.1).

Table 2.1 Soil-landscape units of the Study Area

Code & Description	Study Area	
	ha	%
<p>Oc64: Low stony hills and dissected pediments on granite with occasional basic dykes: chief soils are hard alkaline red soils having shallow stony horizons. Associated are shallow stony soils on steep slopes, soils along creek lines, and soils on patches of calcrete.</p> <p>Soils with predominantly physical limitations; hard-setting soils with dispersible clay subsoils.</p>	634.3	26
<p>BE6: Extensive flat and gently sloping plains that sometimes have a surface cover of gravels and on which red-brown hardpan frequently outcrops: chief soils are shallow earthy loams.</p> <p>Soils with predominantly physical limitations; shallow soils.</p>	1,781.9	73
<p>Fa13: Ranges of banded jaspilite and chert along with shales, dolomites, and iron ore formations; some areas of ferruginous duricrust as well as occasional narrow winding valley plains and steeply dissected pediments. This unit is largely associated with the Hamersley and Ophthalmia Ranges. The soils are frequently stony and shallow and there are extensive areas without soil cover: chief soils are shallow stony earthy loams along with some soils on the steeper slopes.</p> <p>Soils with predominantly physical limitations; shallow soils.</p>	22.2	1
Total	2,438.4	100

NB: values have been rounded to the nearest whole number

The Study Area is broadly composed of erosional surfaces, resulting from the higher relief, associated with the stony hills, ridges and plains (van Vreeswyk *et al.*, 2004). The dominant broad landforms in the Study Area are low stony hills and extensive flat and gently sloping plains (Northcote *et al.*, 1960-1968). The eastern portion of the Study Area broadly coincided with undulating low stony hills, the northern and western portions coincided with flat and gently sloping sandy plains, the central portion coincided with ironstone hills/ low ranges and the remaining intersect portions coincided with flowlines and floodplains (van Vreeswyk *et al.*, 2004).

Figure 2.3: Soil-landscape units of the Study Area

2.5 Geology

According to the Australian Geological Provinces database, the Study Area is located within the Warakurna Large Igneous Province (Wingate *et al.*, 2004). The spatial data has been captured largely at the 1:1 million scale. The Warakurna Large Igneous Province consists of layered mafic-ultramafic intrusions, mafic to felsic volcanic rocks and dykes, extensive mafic sills and swarms of mafic dykes (Wingate *et al.*, 2004). The bulk of the magmatic products emplaced between 1,078 and 1,070 million years ago, along an east-west swath approximately 800 km wide and 2,400 km long (Wingate *et al.*, 2004).

At a finer scale (1:500,000) using GSWA (2016) the Study Area is mapped as:

- Sylvania Inlier granitic unit (A-g-PYV). This is granite to granodiorite which is metamorphosed and variably foliated. Occurs through the central and south western portion across 49% (1,184.4ha) of the Study Area (Figure 2.3);
- Marra Mamba Iron Formation (A-Ham-cib). This is a mix of Chert, banded iron-formation, mudstone, siltstone and metamorphosed minor carbonate. Occurs in the east across 9% (214.3ha) of the Study Area;
- Wittenoom Formation (A-Had-kd). This is thinly bedded dolomite and dolomitic shale, with minor black chert, shale, banded iron formation and sandstone. A small portion occurs along the eastern boundary across 5% (123.2ha) of the Study Area; and
- Jeerinah Formation (A-FOj-xs-b). This is a mix of siliciclastic sedimentary rocks, mafic volcanic rocks and minor felsic volcanic rocks; local carbonate rocks, chert, and dolerite sills. Occurs along the northern boundary, centrally and in the southeast across 38% (916.4ha) of the Study Area.

Figure 2.4: Geological units of the Study Area

2.6 Land Systems

Work undertaken by a joint team from the former Department of Agriculture (now Department of Primary Industries and Regional Development) and the former Department of Lands Administration (now Department of Planning, Lands and Heritage) classified the pastoral areas of Western Australia (Payne *et al.*, 1988; van Vreeswyk *et al.*, 2004). The purpose of the surveys was to provide a comprehensive description and mapping of the biophysical resources of the pastoral areas, together with an evaluation of the pastoral potential and the condition of the soils and vegetation (Payne *et al.*, 1988; van Vreeswyk *et al.*, 2004).

Seven land systems have been mapped as occurring across the Study Area, Cadgie, Divide, Jamindie, McKay, Newman, Sylvania and Washplain (Payne *et al.*, 1988; van Vreeswyk *et al.*, 2004) (Table 2.2 and Figure 2.5). The dominant land system is the Divide land system, which covers approximately 31% of the Study Area (Table 2.2). The land type for the Divide land system is described as sandplains and occasional dunes supporting shrubby hard spinifex grasslands (Table 2.2).

Table 2.2 Land Systems of the Study Area

Land System	Land Type	Description	Study Area	
			ha	%
Cadgie	Wash plains and sandy banks on hardpan, with mulga shrublands and wanderrie grasses or spinifex	Hardpan plains with thin sand cover and sandy banks supporting mulga shrublands with soft and hard spinifex.	334.1	14
Divide	Sandplains and occasional dunes with spinifex grasslands	Sandplains and occasional dunes supporting shrubby hard spinifex grasslands.	765.2	31
Jamindie	Wash plains on hardpan with mulga shrublands	Stony hardpan plains and rises supporting groved mulga shrublands, occasionally with spinifex understorey.	396.8	16
McKay	Hills and ranges with spinifex grasslands	Hills, ridges, plateaux remnants and breakaways of meta sedimentary and sedimentary rocks supporting hard spinifex grasslands.	193.2	8
Newman	Hills and ranges with spinifex grasslands	Rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands.	288.9	12
Sylvania	Stony plains with acacia shrublands	Gritty surfaced plains and low rises on granite supporting acacia-eremophila-cassia shrublands.	114.1	5
Washplain	Wash plains on hardpan with mulga shrublands	Hardpan plains supporting groved mulga shrublands.	346.1	14
Total			2,438.4	100

NB: hectare values have been rounded to the nearest whole number

Figure 2.5: Land systems of the Study Area

2.7 Hydrology

The surface and groundwater hydrology of the Pilbara is highly variable as a result of a dynamic climate with severe droughts and major flooding (DoW, 2010). Streamflows are usually a direct response to rainfall and are therefore highly seasonal and variable. Most runoff occurs from January to March as a result of episodic cyclonic activities (DoW, 2010).

The Study Area is located within the Fortescue River basin, which extends from the Upper Fortescue River, along the Fortescue Marsh and through the Lower Fortescue River. At a finer scale, the Study Area is located within the Upper Fortescue River Catchment and the Fortescue Marsh sub-catchment (Figure 2.6). Shovelanna Creek traverses through the southwest corner of the Study Area before flowing into the Fortescue River, approximately 15 km northwest of the Study Area.

Groundwater originates from direct infiltration by rainfall and from surface water flows and occurs throughout the Pilbara; however, it is most easily located and accessed in close proximity to surface water drainage lines (alluvial channels). The most significant aquifers can be grouped into three types; alluvial aquifers that are either unconsolidated sedimentary aquifers or chemically deposited aquifers, consolidated sedimentary (or sedimentary rock) aquifers and fractured rock aquifers. Broadly, the groundwater associated with the Study Area is located within fractured and weathered rock aquifers.

2.8 Flora and Vegetation Background

Vegetation Associations

The Study Area is located in the Fortescue Botanical District, which is a part of the Eremaean Province (Beard, 1990). The Fortescue Botanical District is essentially a tree- and shrub-steppe with *Eucalyptus* spp. trees, *Acacia* shrubs, *Triodia pungens* and *Triodia wiseana* (Beard, 1990). Some mulga (*Acacia aneura* and close relatives) occurs in valleys and there are short-grass plains on alluvia (Beard, 1990). The vegetation associations of the Study Area were mapped by Beard (1975), in which he classified the following three vegetation associations (Figure 2.7):

- 29: Sparse low woodland; mulga (*Acacia aneura* and close relatives), discontinuous in scattered groups;
- 82: Hummock grasslands, low tree steppe; snappy gum (*Eucalyptus leucophloia*) over *Triodia wiseana*; and
- 216: Low woodland; mulga (*Acacia aneura* and close relatives) (with spinifex) on rises.

The majority of the Study Area was mapped as vegetation association 29, while the eastern portion of the Study Area was mapped as both vegetation associations 82 and 216 (Figure 2.7).

Figure 2.6: Surface hydrology of the Study Area

Figure 2.7: Vegetation system associations occurring within the Study Area

Shepherd *et al.* (2002) reinterpreted and updated the vegetation association mapping to reflect the National Vegetation Information System (NVIS Technical Working Group) standards (ESCAVI, 2003). The update also accounts for extensive clearing since Beard's 1975 mapping. Shepherd *et al.* (2002) created a series of 'systems' to assist in removing mosaic vegetation associations originally mapped by Beard (1975); however, some mosaics still occur. The Study Area is located within the Fortescue Valley and Kumarina Hills, and under Shepherd *et al.* (2002) comprises:

- 29: *Acacia* isolated clumps of shrubs;
- 82: *Eucalyptus* isolated trees/*Triodia* open hummock grassland; and
- 216: *Acacia* woodland/*Triodia* sparse hummock grassland.

The remaining extent of the vegetation system associations present in the Study Area exceeds 94% across the four regional scales: State, bioregion (Pilbara and Gascoyne), subregion (Hamersley and Augustus) and Local Government Authority (Shire of East Pilbara) (Government of Western Australia, 2019) (Table 2.3 and Table 2.4). Currently only one vegetation system association (29) is represented within the National Reserve System, having less than 2% of current state, Pilbara bioregional and Hamersley subregional extent within reserves (Government of Western Australia, 2019) (Table 2.3).

Table 2.3: Regional and local extent of Fortescue Valley System Associations within the Study Areas

Code	Study Area (ha / %)	Scale	Pre-European extent (ha)	Current extent remaining (ha / %)	Current extent remaining within reserves (ha / %)
29	1,736.8 / 71	State	878,058	877,889 / 99.98	2,329 / 0.27
		Pilbara	877,822	877,653 / 99.98	2,329 / 0.27
		Gascoyne	83	83 / 100.00	0 / 0
		Hamersley	1,256	1,256 / 100.00	25 / 1.98
		Augustus	83	83 / 100.00	0 / 0
		LGA	697,400	697,230 / 99.98	0 / 0
82	367.5 / 15	State	30,467	30,271 / 99.36	0 / 0
		Pilbara	30,240	30,044 / 99.35	0 / 0
		Gascoyne	227	227 / 100.00	0 / 0
		Hamersley	15,047	14,851 / 98.70	0 / 0
		Augustus	227	227 / 100.00	0 / 0
		LGA	29,989	29,793 / 99.35	0 / 0
216	334.1 / 14	State	26,399	26,102 / 99.87	0 / 0
		Pilbara	26,388	26,091 / 98.87	0 / 0
		Gascoyne	11	11 / 100.00	0 / 0
		Hamersley	7,457	7,160 / 96.01	0 / 0
		Augustus	11	11 / 100.00	0 / 0
		LGA	26,399	26,102 / 98.87	0 / 0

NB: LGA (Local Government Authority): Shire of East Pilbara

Reserves - International Union of Nature Conservation (IUCN) Class I-IV reserves (i.e. National Parks, Strict Nature Reserves)

Source: Government of Western Australia (2019); NB: area values have been rounded to the nearest whole number.

Table 2.4: Regional and local extent of Kumarina Hills System Associations within the Study Area

Code	Study Area (ha / %)	Scale	Pre-European extent (ha)	Current extent remaining (ha / %)	Current extent remaining within reserves (ha / %)
29	1,736.8 / 71	State	784,575	784,364 / 99.97	0 / 0
		Pilbara	2,706	2,689 / 99.37	0 / 0
		Gascoyne	780,622	780,429 / 99.98	0 / 0
		Hamersley	2,389	2,372 / 99.29	0 / 0
		Augustus	780,337	780,144 / 99.98	0 / 0
		LGA	42,853	42,645 / 99.51	0 / 0
82	367.5 / 15	State	276	276 / 100.00	0 / 0
		Pilbara	276	276 / 100.00	0 / 0
		Gascoyne	0.04	0.04 / 100.00	0 / 0
		Hamersley	276	276 / 100.00	0 / 0
		Augustus	0.04	0.04 / 100.00	0 / 0
		LGA	0	0 / 0	0 / 0
216	334.1 / 14	State	254,360	253,153 / 99.52	0 / 0
		Pilbara	282	282 / 100.00	0 / 0
		Gascoyne	254,078	252,853 / 99.52	0 / 0
		Hamersley	146	146 / 100.00	0 / 0
		Augustus	254,078	252,853 / 99.52	0 / 0
		LGA	18,669	17,710 / 94.86	0 / 0

NB: LGA (Local Government Authority): Shire of East Pilbara

Reserves - International Union of Nature Conservation (IUCN) Class I-IV reserves (i.e. National Parks, Strict Nature Reserves)

Source: Government of Western Australia (2019); NB: area values have been rounded to the nearest whole number.

Introduced flora taxa

Weeds of National Significance (WoNS)

The Commonwealth of Australia, in collaboration with the states and territories, has identified 32 WoNS based on an assessment process that prioritises these weeds according to their invasiveness, potential for spread as well as their environmental, social and economic impacts. A list of 20 WoNS was endorsed in 1999 and a further 12 were added in 2012.

Landowners and land managers at all levels are responsible for managing WoNS. State and territory governments are responsible for legislation, regulation and administration of weeds. The WoNS were selected as they require coordination among all levels of government, organisations, and individuals with weed management responsibilities.

Declared Plant Pests (DPP)

To protect Western Australian agriculture the Department of Primary Industries and Regional Development (DPIRD) (formerly the Department of Agriculture and Food Western Australia, DAFWA) regulates harmful plants under the *Biosecurity and Agriculture Management Act 2007* (BAM Act). Plants that are prevented entry into the state or have control or keeping requirements within the state are

known as declared pests. The main purposes of the BAM Act and its regulations related to DPP are to prevent new plant pests from entering Western Australia, manage the impact and spread of those pests already present in the state and safely manage the use of agricultural chemicals.

The BAM Act has categorised the weeds of Western Australia into four main classifications:

- Declared Pests (under Section 22 of the Act);
- Permitted (under Section 11 of the Act);
- Prohibited (under Section 12 of the Act); and
- Permitted requiring a permit (Section 73, BAM Regulations 2013).

Under the BAM Act all declared plant pests are placed in one of three categories:

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

Weed Prioritisation

In 2008 Parks and Wildlife developed and implemented an integrated approach to weed management on Parks and Wildlife-managed lands in WA, the Weed Prioritisation Process. It was updated in 2013 and further revised in 2016. Parks and Wildlife prioritised weeds in each region, based on their:

- invasiveness;
- ecological impact;
- potential and current distribution; and
- feasibility of control.

The resulting priorities focus on weeds considered to be high impact, rapidly invasive and still at a population size that can feasibly be eradicated or contained to a manageable size. This means that weed taxa that are already widespread may not be ranked as a high priority. The weed prioritisation for the Gascoyne and Pilbara bioregions has recently been revised by Parks and Wildlife. The key priorities are now centred on 'Priority Alert' weeds and weeds that receive a rating for 'ecological impact' and 'invasiveness'.

3 METHODOLOGY

3.1 Compliance

The survey was carried out in a manner consistent with the Western Australian EPA, DBCA and BHP WAIO guidelines for the environmental surveying and reporting of flora and vegetation. The following guidelines, procedures and documents were used prior to, during and after completion of the field survey:

- EPA (2018) Statement of Environmental Principles, Factors and Objectives;
- EPA (2016a) Environmental Factor Guideline: Flora and Vegetation;
- EPA (2016b) Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment;
- BHP WAIO’s Biological Survey Spatial Data Requirements (SPR-IEN-EMS-015) (BHP, 2020); and
- BHP WAIO’s Vegetation and Flora Survey Procedure (0124627) (BHP, 2018).

3.2 Desktop Assessment

Literature Review

Background information on the Study Area and surrounds was compiled prior to, during and after the field survey. Historic vegetation mapping conducted by Beard (1975) and Shepherd *et al.* (2002), land systems mapping (van Vreeswyk *et al.*, 2004), and the IBRA classification system (Desmond *et al.*, 2001) were consulted to provide broad contextual knowledge of the vegetation types likely to be encountered within the Study Area. The literature review also considered 24 field surveys and desktop assessments reports of relevance to the Study Area (**Table 3.1**). The previous surveys and assessments that were considered were provided by BHP WAIO and The Index of Biological Surveys for Assessments (IBSA). All are located within a radius of 20 km from the Study Area.

Table 3.1: Literature sources used for review

Survey Title	Reference	Survey Type	Distance from Study Area (km)
Dynasty and West Jimblebar Level 2 Flora and Vegetation Survey	Onshore (2015b)	Level 2 Flora and Vegetation Survey	Overlaps Study Area
Mesa Gap Biological Survey	GHD (2008)	Biological Survey	Partially overlaps Study Area
Eastern Mines Weed Survey, Jimblebar	Astron (2012)	Targeted Weed Survey	Partially overlaps Study Area
Dynasty Tenement E52/2591 Flora and Vegetation Desktop Assessment	Onshore (2014c)	Desktop Assessment	Partially overlaps Study Area
Jimblebar - Wheelarra Hill 3 Flora and Fauna Assessment	Biota (2004)	Biological Survey	Adjacent east
Jimblebar Marra Mamba Exploration Biological Survey	Ecologia (2006)	Level 2 Flora and Vegetation Survey	Adjacent east

Survey Title	Reference	Survey Type	Distance from Study Area (km)
Jimblebar Iron Ore Project Flora and Vegetation Assessment	Outback Ecology (2010)	Two-phase Level 2 Flora and Vegetation Survey	Adjacent east
South West Jimblebar Level 2 Flora and Vegetation Survey	Syrinx (2014)	Level 2 Flora and Vegetation Survey	Adjacent south
Jumbuck Reconnaissance Flora and Vegetation Assessment	Biologic (2020)	Reconnaissance Flora and Vegetation Survey	1.8 km south
Orebody 18 to OB31 Infrastructure Corridor Targeted Flora Survey	Onshore (2014a)	Targeted Flora Survey	2.2 km north
Jimblebar Access Road Flora and Vegetation Assessment	ENV (2008)	Level 2 Flora and Vegetation Survey	3.2 km northwest
Targeted Flora Survey Acacia sp. East Fortescue	Onshore (2015a)	Targeted Flora Survey	3.4 km east
OB18 Flora and Vegetation Assessment Phase II	ENV (2007b)	Level 2 Flora and Vegetation Survey	3.5 km north
Orebody 31 Targeted Significant Flora Survey	Onshore (2014b)	Targeted Flora Survey	3.5 km east
West Jimblebar Exploration Lease Flora and Vegetation Assessment	ENV (2007c)	Biological Survey	4.2 km west
Orebody 31 Level 2 Flora and Vegetation Survey	Onshore (2014d)	Level 2 Flora and Vegetation Survey	5.3 km northeast
Shearers West Detailed Flora and Vegetation Survey	Onshore (2018)	Detailed Flora and Vegetation Survey	5.5 km east
Hashimoto Exploration Project Biological Survey: Flora and Vegetation	Ecologia (2007)	Biological Survey	12.5 km east
Jimblebar Wye Targeted Declared Rare Flora and Priority Listed Flora Assessment	ENV (2010)	Targeted Flora Survey	13.0 km northwest
Jimblebar Stage 2, Levee Banks and Communications Tower Redevelopment Flora and Vegetation Assessments	ENV (2007a)	Level 1 Flora and Vegetation	14.0 km east
Newman-Roy Hill Transmission Line Survey	Ecoscape (2012)	Level 2 Flora and Vegetation Survey	14.2 km northwest
Shearers East Reconnaissance Flora and Vegetation Assessment	Biologic (2019)	Reconnaissance Flora and Vegetation Survey	15.0 km east
Level 2 Riparian & Aquatic Flora & Vegetation Survey Jimblebar Creek and Innawally Pool	Onshore (2016)	Level 2 Flora and Vegetation Survey	15.1 km east
Level 1 Flora and Fauna surveys along the Great Northern Highway for Jimblebar Mine Module Transport	Eco Logical (2012)	Level 1 Flora and Vegetation	20.0 km west

Database Searches

Database searches were undertaken to generate a list of conservation significant vascular flora taxa previously recorded within, and near, the Study Area. Conservation codes for flora of conservation

significance are provided in Appendix A. Four database searches were conducted around a central coordinate (23°23'02.00"S; 120°00'58.00"E), with varying buffers as deemed appropriate (Table 3.2).

Table 3.2: Details of databases searches

Provider	Reference	Database	Parameters
Department of Biodiversity, Conservation and Attractions	DBCA (2020a)	NatureMap	Circle of radius 40 km centred on the coordinates: 23°23'02.00"S; 120°00'58.00"E
Department of Biodiversity, Conservation and Attractions	DBCA (2020b)	Threatened and Priority Flora	Circle of radius 50 km centred on the coordinates: 23°23'02.00"S; 120°00'58.00"E
Department of Agriculture, Water and the Environment	DAWE (2020)	Protected Matters Search (MNES)	Circle of radius 40 km centred on the coordinates: 23°23'02.00"S; 120°00'58.00"E
Atlas of Living Australia	ALA (2020)	Occurrence search	Circle of radius 40 km centred on the coordinates: 23°23'02.00"S; 120°00'58.00"E
Department of Primary Industry and Regional Development (DPIRD)	DPIRD (2020)	Declared Plants Database (WAOL)	Search of the entire Shire of East Pilbara

NB: MNES – Matters of National Environment Significance

NB: WAOL – Western Australian Organism List

The conservation significant flora species identified from the database searches were assessed and ranked on the likelihood of occurring within the Study Area (Appendix B). The rankings were assigned using the following matrix (Table 3.3):

Table 3.3: Flora likelihood of occurrence decision matrix

Occurrence categories	Habitat categories (within the Study Area)			
	Core/ critical habitat present	Suitable habitat present/ within known distribution	Marginal habitat present/ adjacent to known distribution	No suitable habitat present/ outside of known distribution
Recorded in the Study Area	Confirmed	Confirmed	Confirmed	Confirmed
Recorded within <5 km	Highly Likely	Likely	Possible	Possible
Recorded within 5-15 km	Likely	Possible	Possible	Unlikely
Recorded within 15-50 km	Possible	Possible	Unlikely	Unlikely
Recorded >50 km	Possible	Unlikely	Unlikely	Highly Unlikely
Species considered locally/ regionally extinct	Unlikely	Unlikely	Highly Unlikely	Highly Unlikely

3.3 Field Survey

Targeted Searching

The field survey was undertaken with due consideration given to:

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

Prior to the field survey, the desktop assessment was completed and a list of conservation significant flora was compiled that are known, highly likely, likely or possible to occur within the Study Area. Field personnel familiarised themselves with photographs, reference samples and descriptions of these taxa before conducting the survey. Once on the ground, the survey was undertaken by traversing the Study Area in systematic searches from east to west along gridlines ranging from approximately 100 to 300 m apart (Figure 3.1). Any areas then considered to contain habitat that could support conservation significant flora were infilled with more intensive searches. Locations of previously recorded conservation significant flora species were also revisited to verify presence/abundance and current status of the individuals/population.

Where conservation significant flora taxa were located in the field, a GPS coordinate of the individual was taken, or, if the species existed within a small population, a central coordinate with an approximate 20 m radius was used. Generalised information was collected for each occurrence, including an estimate of the number of individuals, reproductive status, condition and broad vegetation community and condition.

Threatened and Priority Flora Report Forms (TPRFs) will be provided to the Parks and Wildlife Division (Parks and Wildlife) of DBCA, as required under the flora collecting permits. Conservation significant flora specimens will be vouchered with the Western Australian Herbarium (WAH), where required and appropriate (see Section 4.2).

Timing and Weather

The day time weather conditions during the field survey (moderate temperatures and clear skies, BoM (2020) were adequate to complete the survey on foot and with minimal constraints and limitations.

The field survey was undertaken following a winter, spring, and summer season of large fluctuations from the long-term average. Late 2019 received well below-average rainfall, with the period from September–December receiving only 8.4 mm compared to the LTA of 56.9 mm (Figure 3.1). Above average rainfall was recorded in January 2020 (198.2 mm compared to an LTA of 69.8 mm), but declined during February, March, and April (Figure 3.2) with March in particular receiving negligible amounts. No rain was recorded during, or in the week prior to, the survey.

Figure 3.1: Sampling intensity and track data

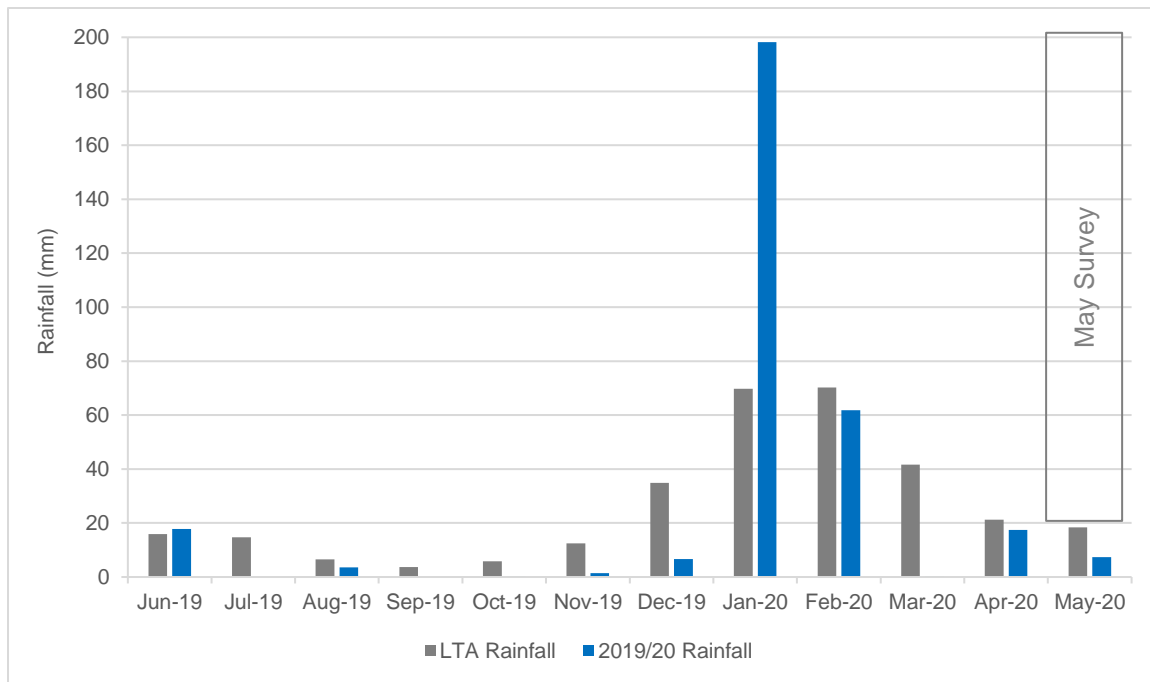


Figure 3.2: Long-term average (LTA) rainfall and 2019-2020 rainfall for Newman Airport (BoM, 2020)

Survey Team and Licensing

The field survey was led by Mr Sam Coultas, a Botanist with over 6 years' experience. Sam meets the minimum requirements (5+ years' experience in the bioregion) to lead and manage a flora survey in the Pilbara bioregion, as prescribed by the EPA (2016b). Sam was supported by Biologic's botanist Emily Eakin-Busher, who has over 2 years' experience completing flora surveys in Western Australia. The collection of flora specimens was taken under flora collecting permits (FB62000017; FB2000160) pursuant to the BC Act (Regulation 61). Sam and Emily also hold a *Permit to Take Declared Rare Flora* for identification purposes (TFL 60-1819 and 53-1920 respectively), issued under the BC Act, Section 40.

Identification of Flora Specimens

Plant taxa that could not be identified during the field survey were collected, assigned a unique number for tracking purposes, and pressed for subsequent identification. Identifications were carried out by Biologic botanists Samuel Coultas and Emily Eakin-Busher utilising Western Australian Herbariums (WAH) reference collection, taxonomic keys and reference material. All taxa were checked against Florabase© (version 2.9.31; WAH, 1998-) to ensure their currency and validity. Any conservation significant flora taxa, range extensions and potential new taxa have been verified and vouchered (if appropriate) at the WAH.

Limitations and Constraints

There are a number of possible constraints and limitations that can impinge on the adequacy of vegetation and flora surveys (EPA, 2016b). The limitations of the current assessment are presented in accordance with the Technical Guidance (EPA, 2016b) (Table 3.4).

The survey was undertaken during a time considered to be optimal for the Gascoyne and Pilbara bioregions (optimal timing is considered to be between March and June, EPA, 2016b). However, despite above average rainfall occurring during January 2020, the dry months preceding the survey (particularly March) resulted in dry on-ground survey conditions. There were limited annual and ephemeral taxa present, and many perennial species were lacking flowering and fruiting material. Although the survey was undertaken in dry conditions, the survey outcomes were only marginally constrained and/or limited by the conditions.

Table 3.4: Survey limitations and constraints

Limitation	Constraint	Comment
Availability of contextual information at a regional and local scale	No	Sufficient contextual information was available for the Study Area, including broad information on land systems and vegetation associations. The Study Area is located immediately west of the Jimblebar (Wheelarra Hill) mine operated by BHP. An extensive amount of biological survey work has occurred across Jimblebar, the data and reports of which were all available for this assessment.
Competency/experience of the team carrying out the survey, including experience in the bioregion surveyed	No	The survey was led by a Senior Botanist with over 6 years' experience. The lead botanist met the minimum requirements to manage a flora and vegetation field survey in the Pilbara bioregion (EPA, 2016b).
Proportion of flora recorded and/or collected, any identification issues	Yes (Minor)	The survey intensity (targeted) is designed to capture significant flora species in both specific habitat and while covering as much area as possible within Study Area. The seasonal conditions prior to the survey may have been adequate, however, there were many taxa observed lacking flowering and/or fruiting material. Various taxa previously confirmed or considered Highly Likely, Likely or Possible to occur (see Section 4.2) were not located or found within the Study Area, likely due to preceding seasonal conditions.
Was the appropriate area fully surveyed (effort and extent)?	No	The Study Area was traversed and surveyed on foot with prospective habitat visited. The survey was undertaken by traversing east to west along gridlines ranging from approximately 100 to 300 m apart (Figure 3.1). Any areas then considered to contain habitat that could support conservation significant flora were infilled with more intensive searches. The Study Area is more than 2,400 ha in size and it was not feasible to traverse the entire Study Area. The area could benefit from further infill survey effort, however, the survey intensity and coverage match that of which is required for a targeted survey and is not considered to be a constraint.

Limitation	Constraint	Comment
Access restrictions within the survey area	No	The Study Area was accessed via mining, exploration, and pastoral tracks in good condition. Tracks were limited in the Study Area. As a result, the survey was mostly completed on foot. Walking traverses were generally limited to 2 km from the vehicle.
Survey timing, rainfall, season of survey	Yes (Minor)	The survey was undertaken during a period which is considered to be optimal, between March and June for the region (EPA, 2016b). Rainfall in the four months before the survey was well above average, however the majority of this fell in one month (January). Hot daytime temperatures and dry conditions occurred in the three months prior to the survey. This may have limited the capacity of the rainfall to infiltrate the soil, and soil moisture was likely to have been quickly lost. Several taxa were observed lacking flowering and/or fruiting material. Various taxa previously confirmed or considered Highly Likely, Likely or Possible to occur (see Section 4.2) were not located or found within the Study Area, likely due to preceding seasonal conditions. It is therefore considered to be a minor constraint due to the season of the survey.
Disturbance that may have affected the results of the survey such as fire, flood or clearing	No	The Study Area is located within an active pastoral lease and multiple current mining leases. The vegetation was noted as being altered, however, not to a point that limited the results of the flora and vegetation survey. Disturbances recorded during the survey included fire, grazing, dust, mining and exploration related disturbances and weeds. Disturbances were highest within areas that have high cattle visitation (i.e. drainage lines and Mulga flats/floodplains). Vegetation towards the eastern boundary of the Study Area was observed as being dusty, likely due to the proximity to active mining, processing and active rail. A small portion in the northeast of the Study Area had been burnt within the last 5 years prior to the survey.

4 RESULTS AND DISCUSSION

4.1 Desktop Assessment

Literature Review

The results and outcomes of the review of 24 flora and vegetation reports identified from the literature review are presented in Appendix C. The literature review identified three conservation significant flora taxa confirmed within the Study Area (*Ipomoea racemigera* (P2), *Goodenia berringbinensis* (P4), and *Goodenia nuda* (P4)), while an additional eleven conservation significant flora taxa have been previously recorded in close proximity to the Study Area (*Acacia corusca* (P1), *Aristida jerichoensis* var. *subspinulifera* (P3), *Eremophila pilosa* (P1), *Eremophila youngii* subsp. *lepidota* (P4), *Euphorbia inappendiculata* var. *inappendiculata* (P2), *Goodenia hartiana* (P2), *Gymnanthera cunninghamii* (P3), *Rhagodia* sp. Hamersley (M. Trudgen 17794) (P3), *Themeda* sp. Hamersley Station (M.E. Trudgen 11431) (P3), *Triodia* sp. Mt Ella (M.E. Trudgen 12739) (P3), and *Vittadinia* sp. Coondewanna Flats (S. van Leeuwen 4684) (P1)).

Database Search Results

Flora of conservation significance

A total of 31 conservation significant flora taxa (those listed under the EPBC Act, WC Act, or DBCA's Priority List) were identified from the database searches (Appendix D). All conservation significant flora identified by the literature review (see above) were also identified from the database searches.

Of the 31 conservation significant flora taxa, one taxon (*Pityrodia augustensis*) is listed as Threatened (Vulnerable) under the EPBC Act and BC Act (Appendix D). However, this taxon is only known to occur on highly restricted sandstone rocky hillslopes within Mount Augustus National Park (WAH, 1998-), none of which occur in the Study Area. It is therefore considered highly unlikely to occur in the Study Area. Of the remaining 30 Priority listed flora taxa, seven are Priority 1, five are Priority 2, 13 are Priority 3 and five are Priority 4 (Appendix D).

Flora taxa of conservation significance identified by the desktop assessment were assessed and ranked on the likelihood of occurring within the Study Area pre-survey (Appendix B). Three taxa have previously been recorded from the Study Area, three taxa were considered highly likely to occur and two were considered to possibly occur within the Study Area (**Table 4.1**). The remaining 23 were considered unlikely (19) or highly unlikely (four) to occur within the Study Area (Appendix B).

Figure 4.1: Conservation significant flora desktop assessment results

Table 4.1: Conservation significant flora taxa occurrences within or near the Study Area based on the desktop assessment

Taxon	Description (WAH, 1998-)	Location
Confirmed		
<i>Ipomoea racemigera</i> (P2)	Creeping annual, herb or climber. Fl. white.	Within
<i>Goodenia berringbinensis</i> (P4)	Ascending annual, herb, 0.1-0.3 m high. Fl. yellow, Oct. Red sandy loam. Along watercourses.	Within
<i>Goodenia nuda</i> (P4)	Erect to ascending herb, to 0.5 m high. Fl. yellow, Apr to Aug.	Within
Highly Likely		
<i>Aristida jerichoensis</i> var. <i>subspinulifera</i> (P3)	Compactly tufted perennial, grass-like or herb, 0.3-0.8 m high, lemma groove muricate. Hardpan plains.	~ 0.5 km east
<i>Euphorbia inappendiculata</i> var. <i>inappendiculata</i> (P2)	Prostrate annual herb, to 0.1 m high. Red brown clay loam. Flat plain, cracking clay floodplain, gentle slopes.	~ 1.1 km east
<i>Vittadinia</i> sp. Coondewanna Flats (S. van Leeuwen 4684) (P1)	Erect annual herb, 0.3-1 m high. Fl. cream. Red-brown sandy loam. Drainage areas, floodplains, flat and/or stony plains.	~ 1.8 km south
Possible		
<i>Eremophila capricornica</i> (P1)	Compact shrub, 0.2-0.5(-0.75) m high. Fl. blue-purple. Red brown loam soil. Hardpan plain over granite.	~ 9.7 km northeast
<i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794) (P3)	Tall spindly shrub, 1.5-4 m high. Fl. yellow. Red brown sandy loam or clay, ironstone plain. Undulating plains, floodplain.	~ 9.7 km northeast

Introduced flora

The NatureMap (DBCA, 2020a), Protected Matters (DAWE, 2020), ALA (ALA, 2020) and WAOL (DPIRD, 2020) database searches identified a list of 71 introduced taxa that may potentially occur within the Study Area. The list of introduced taxa known to occur or potentially occur within the Study Area (Appendix E) was reviewed to identify Weeds of National Significance (WoNS) and Declared Plant Pests (DPP).

Weeds of National Significance (WoNS)

Of the list of introduced taxa identified during the desktop assessment as potentially occurring in or near the Study Area, 30 are listed as WoNS (Appendix E). The 30 WoNS were identified from the WAOL database search for the entire Shire of East Pilbara and occur or may potentially occur within the shire boundaries. No other database search or literature review identified any WoNS. The 30 taxa include numerous *Opuntia* and *Cylindropuntia* species that are grouped together in the WoNS listing.

Declared Plant Pests (DPP)

The desktop assessment identified 48 DPPs (including numerous cacti species that are all listed as DPPs, (Appendix E) previously recorded or potentially located within the Shire of East Pilbara. The desktop assessment did not identify any DPPs as occurring within the Study Area but identified *Cylindropuntia* spp., *Jatropha gossypifolia* and *Lantana camara* as occurring immediately adjacent to the Study Area.

Weed Prioritisation

Twenty-one introduced taxa have been identified by Parks and Wildlife as 'Priority Alerts' for the Pilbara and Midwest regions, comprising *Azadirachta indica*, *Calotropis procera*, *Chloris gayana*, *Chrysanthemoides monilifera* subsp. *monilifera*, *Clitoria ternatea*, *Cryptostegia grandiflora*, *Cylindropuntia* spp., *Eichhornia crassipes*, *Euphorbia tirucalli*, *Jatropha gossypifolia*, *Lantana camara*, *Moringa oleifera*, *Parkinsonia aculeata*, *Ricinus communis*, *Rubus anglocandicans*, *Salvinia molesta*, *Schinus molle* var. *areira*, *Vachellia nilotica*, *Washingtonia robusta*, *Xanthium strumarium* and *Zantedeschia* spp.

No Priority Alert weeds have been recorded from within the Study Area. *Cylindropuntia* spp. and *Jatropha gossypifolia* have previously been recorded near the Study Area. The remaining Priority Alert weeds have not previously been recorded from within or near the Study Area. None of these introduced 'Priority Alerts' taxa are expected to occur in the Study Area.

4.2 Field Survey

Flora of Conservation Significance

Two conservation significant flora taxa were recorded by this survey in the Study Area (Figure 4.2):

- *Ipomoea racemigera* (P2) – 63 individuals from 38 point locations; and
- *Goodenia nuda* (P4) – 352 individuals from 102 point locations (Appendix F).

An additional 22 individuals from 15 point locations of *Ipomoea racemigera* (P2) and 17 individuals from three point locations of *Goodenia nuda* (P4) were recorded outside of the Study Area along the western boundary (Figure 4.2). Both observed conservation significant flora taxa have previously been recorded from the Study Area, as determined by Onshore (2015a) (see Section 0). TPRFs completed for both taxa are presented in Appendix G. Submissions of specimens are to occur following report delivery. The remaining taxon previously recorded in the Study Area by Onshore (2015a), *Goodenia berringbinensis* (P4), was not located by this survey (discussed further below).

No threatened flora taxa were recorded by this survey.

Ipomoea racemigera (P2)

Ipomoea racemigera (P2) is described as a pilose, creeping annual herb or climber with twining stems (Plate 4.1) (WAH, 1998-). The leaves are ovate to ovate-elliptical, entire and bluntly acute (Plate 4.1)

(WAH, 1998-). *I. racemigera* has a cymose inflorescence bearing 1-2, funnel-shaped white flowers (Plate 4.1) produced throughout the year (pending favourable conditions), predominantly from March to August (WAH, 1998-). It superficially closely resembles the unlisted taxon *Ipomoea plebeia*, differing only in having glabrous to very sparsely hairy upper surfaces and moderately pilose lower surfaces (Plate 4.1) compared to evenly pilose upper and lower surfaces of *I. plebeia* (Keybase, 2020). *I. racemigera* is mostly recorded from sandy soils along medium and major watercourses in the Pilbara region of Western Australia from Newman to Kununurra, as well as in the Northern Territory, South Australia and Queensland (ALA, 2020; WAH, 1998-).

This survey recorded 63 individuals from 38 point locations of *Ipomoea racemigera* (P2) within the Study Area (Appendix F), all located in the southeast corner of the Study Area occurring along the medium/major drainage channel of Shovelanna Creek (Figure 4.2) amongst an open mid to low woodland of *Eucalyptus victrix* and *Acacia coriacea* subsp. *pendens* over an open tall *Acacia pyrifolia* var. *pyrifolia* shrubland over tall tussock grassland of **Cenchrus ciliaris* and *Eulalia aurea* (Plate 4.2). The majority of the individuals were located on or near the channel banks/edges, trailing along the ground or climbing on nearby shrubs or trees (Plate 4.2). Previously, Onshore (2015a) recorded 20 individuals from one location within the Study Area in the same stretch of Shovelanna Creek, with an additional record of the same number of plants approximately 2 km upstream (south). It is therefore likely that a greater number of individuals continue up and downstream outside of the Study Area. There are very few current records known of this taxon, with only seven WA Herbarium (WAHerb) and six Nature Map records (NatureMap, 2013; WAH, 1998-). Additionally, information on the size of known populations is limited. The size of the population within the Study Area is relatively large, particularly if plants continue outside of the Study Area.



Plate 4.1: Close-up photos of *Ipomoea racemigera* (P2) showing its creeping habit, twining stems and funnel-shaped white flowers (left) and its pilose stem, pilose lower leaf surfaces and glabrous to very sparsely hairy upper leaf surfaces (right) (Biologic photos)



Plate 4.2: Shovelanna Creek showing core habitat for *Ipomoea racemigera* (P2) (left) and a specimen of *Ipomoea racemigera* (P2) observed trailing along the sandy channel of Shovelanna Creek (right) (Biologic photos)

Goodenia nuda (P4)

Goodenia nuda (P4) is described as a prostrate or erect to ascending annual herb which grows up to 0.5 m high. This species is pale green to glaucous in colour and is glabrous, or with very few simple and glandular hairs. Basal leaves are prominently 3-veined towards the base, are an oblanceolate to narrowly elliptic shape, and are generally entire or have few narrow teeth. Flowers are yellow with a maroon centre, generally appearing between April and August (WAH, 1998-) (Plate 4.3). *Goodenia nuda* is mostly recorded from seasonally inundated clay soils, floodplains and drainage lines, often in

mulga, and has also been recorded from sand in scoured riverbeds and from hillslopes (WAH, 1998-). It is a relatively common and well-documented (105 WAHerb and 126 Nature Map records (NatureMap, 2013; WAH, 1998-) Western Australian endemic species with a range of approximately 700 km that mostly occurs in the Pilbara region from Newman to Port Hedland, though some records exist from the Carnarvon and eastern Gascoyne bioregions (WAH, 1998-).

This survey recorded 352 individuals from 102 locations of *Goodenia nuda* (P4) (Appendix F), mostly from Mulga woodlands associated with drainage lines, floodplains and hardpan plains (Figure 4.2). However, plants were recorded in a variety of other habitats including, but not limited to, sandy plains with *Triodia basedowii* hummock grasses, low ironstone rocky rises with *Triodia vanleeuwenii* hummock grasses, undulating low saline quartz hills with *Acacia synchronicia* and sandy medium/major drainage lines with *Eucalyptus victrix* (Shovelanna Creek) (Figure 4.2). Previously, Onshore (2015a) recorded approximately 50 individuals from three populations within the Study Area in similar locations to this survey, with an additional record (approximately 100 individuals from two populations). It is therefore likely that a greater number of individuals occur both within and outside of the Study Area.



Plate 4.3: Close up photos of *Goodenia nuda* (P4) showing its often upright and glabrous habit (left) and its yellow flowers with maroon centres (right) (Biologic photos)

Figure 4.2: Conservation significant flora locations

Review of conservation significant flora likelihood of occurrence

Given the occurrence of priority listed taxa during the field survey, *Ipomoea racemigera* (P2) and *Goodenia nuda* (P4) remain as confirmed. *Goodenia berringbinensis* (P4) was changed from confirmed to highly likely as no individuals were located by this survey.

Previously, Onshore (2015a) recorded approximately 50 individuals from one location of *Goodenia berringbinensis* (P4) within the Study Area, restricted to an ephemeral claypan/ depression in the southwest corner of the Study Area (Plate 4.4 and Plate 4.5). Review of the Onshore (2015a) survey revealed the depression was in suitable condition for the persistence of this annual herb during the time of survey, containing surface water with dense fringing tussock grasses and herbs. The specific point and area was revisited during the current survey, however, conditions were observed as being completely dry with limited tussock grass cover and little to no herbaceous cover (Plate 4.5). Grazing and trampling pressures were also noted as having a significant impact on presence and cover of grasses and herbs in the area (Plate 4.5). It is therefore considered, that during favourable conditions, individuals of *G. berringbinensis* would persist at this location in the Study Area. Review of the likelihood of occurrence post-survey for this taxon has been changed from confirmed to highly likely as no individuals were located by this survey.



Plate 4.4: Aerial image of drainage foci area (red) in the southwest of the Study Area (black) where Onshore (2015a) previously recorded *Goodenia berringbinensis* (P4) (Google Earth, 2020)



Plate 4.5: Close-up aerial image (with surface water present) of drainage foci area previously containing *Goodenia berringbinensis* (P4) (Google Earth, 2020) (left) and on-ground photo taken during this survey of drainage foci area displaying poor current conditions not conducive for the presence *Goodenia berringbinensis* (P4) (right) (Biologic photo). Note the absence of herbs and surface water and the presence of grazed tussock grasses and surface trampling

Following the survey, three taxa which were previously considered highly likely to occur in the Study Area, *Vittadinia* sp. Coondewanna Flats (S. van Leeuwen 4684) (P1), *Euphorbia inappendiculata* var. *inappendiculata* (P2) and *Aristida jerichoensis* var. *subspinulifera* (P3) are now considered possible (Appendix B). *V.* sp. Coondewanna Flats (S. van Leeuwen 4684) and *E. inappendiculata* var. *inappendiculata* are both small herbs that are inconspicuous in the landscape and require good seasonal conditions for persistence. *A. jerichoensis* var. *subspinulifera* is described as low and relatively inconspicuous perennial tussock grass, which may also have been unidentifiable at the time due to preceding seasonal conditions. Known locations outside of the Study Area (all within 1.8 km) were visited during this survey, however no individuals of any of the three taxa were found at these locations. However, as systematic searches in the Study Area were relatively broad and suitable habitat for all three taxa was observed in the Study Area, it is possible that individuals of these taxa could have been missed by this survey.

Following the survey, two taxa which were previously considered possible to occur in the Study Area, *Eremophila capricornica* (P1) and *Rhagodia* sp. Hamersley (M. Trudgen 17794) (P3) are now considered unlikely (Appendix B). The Study Area lacked habitat for *Eremophila capricornica* (P1), while all *Rhagodia* species observed in the Study Area were in-field identified as *Rhagodia eremaea*. The remaining 23 taxa considered unlikely or highly unlikely prior to survey have either remained as such or have been downgraded to highly unlikely due to the lack of habitat present and their distance from the Study Area (Appendix B).

Flora of other significance

The EPA (2004) advises that flora species, subspecies, varieties, hybrids and ecotypes may be considered significant for reasons other than listing as a Threatened or Priority Flora taxa. This may include, but is not limited to, range extensions, keystone species, relic status, local endemism and

anomalous features. Based on these features, one taxon recorded from the Study Area by this survey, *Brunonia* sp. Long hairs (D.E. Symon 2440), is considered to be flora taxon of “other” significance as it represents a range extension.

Brunonia sp. Long hairs (D.E. Symon 2440) is an erect herb, to 0.1 m high, with long spreading hairs on the leaves and flower spikes, with blue/ purple inflorescence, to 0.3 m high (Plate 4.6) (WAH, 1998-). It superficially resembles that of the unlisted taxon *Brunonia australis*, differing in having long spreading hairs on the leaves (WAH, 1998-). Known records (eight WAH and seven Nature Map records) and information on habitat preference is limited, however this taxon has been recorded from undulating stony plains, rocky hill slopes, rocky flats, sandy flats and floodplains (NatureMap, 2013; WAH, 1998-). It has a current range of approximately 190 km from 35 km west of Newman in the southeast to Solomon Airport in the northwest, with an additional presumably erroneous disjunct record 960 km east near the Northern Territory border in the Great Sandy Desert (Plate 4.7) (NatureMap, 2013; WAH, 1998-).

This survey recorded one individual from one point location of *Brunonia* sp. Long hairs (D.E. Symon 2440) in the east of the Study Area on a sandy plain with *Triodia basedowii* hummock grasses (Figure 4.3). However, additional plants (approximately 10) were observed but not recorded in various locations across the Study Area. It is therefore likely that a greater number of individuals occur both within and outside of the Study Area. This record represents a range extension of approximately 55 km south east, assuming that the disjunct record in the Great Sandy Desert is erroneous.



Plate 4.6: Close up photos of *Brunonia* sp. Long hairs (D.E. Symon 2440) showing its blue/purple inflorescence (left) and its basal leaves with long spreading hairs (right) (Biologic photos)

Figure 4.3: Flora of “other” significance locations

Brunonia sp. Long hairs (D.E. Symon 2440)

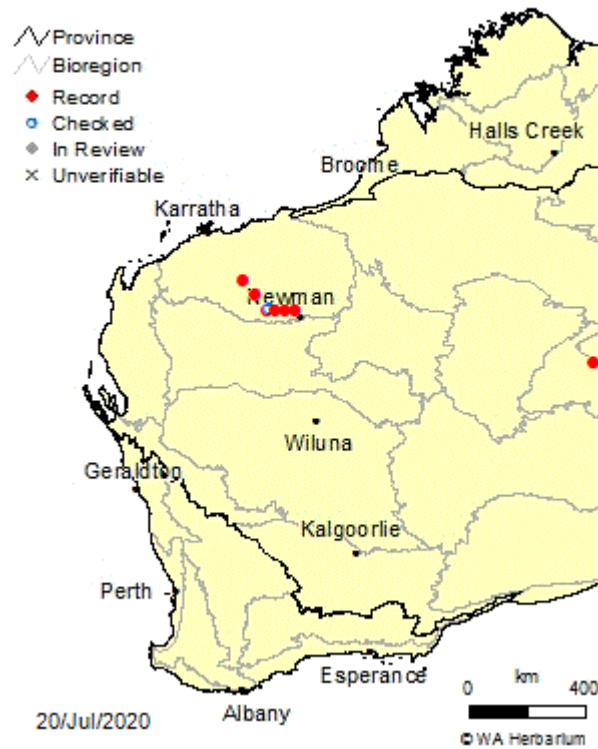


Plate 4.7: Distribution of WAH records of *Brunonia* sp. Long hairs (D.E. Symon 2440) (WAH, 1998-)

Introduced Flora Taxa

Six introduced flora taxa, **Bidens bipinnata*, **Cenchrus ciliaris*, **Citrullus amarus*, **Malvastrum americanum*, **Rumex vesicarius* and **Setaria verticillata*, were recorded from the Study Area by this survey (Figure 4.4, Appendix H). **Aerva javanica* was recorded just outside the western boundary of the Study Area. The introduced taxa are not listed as WoNS, DPPs under the BAM Act or 'Priority Alert' weeds by Parks and Wildlife.

The most frequently observed introduced flora taxon was **Bidens bipinnata* (1220 individuals from 19 point locations), which was mostly observed in dense Mulga woodlands on floodplains and flowlines, particularly at the bases of Mulga trees (Plate 4.8). **Cenchrus ciliaris* and **Citrullus amarus* were recorded from six and ten locations totalling 188 and 38 individuals respectively (one additional location of each taxa was recorded just outside of the Study Area). **C. ciliaris* was generally recorded in patches within Mulga flowlines and drainage lines, while **C. amarus* was recorded sporadically as individuals or clusters of plants predominantly on floodplains and hardpan plains. The remaining introduced taxa were only observed in two or fewer locations, with very low numbers (<15) of individuals. However, these species may occur more frequently in the Study Area following suitable rainfall.



Plate 4.8: A patch of *Bidens bipinnata* showing under a mulga tree (left) and a close-up photo showing its “pronged” heads (right) (Biologic photos)

Figure 4.4: Introduced flora locations

5 CONCLUSION

A single season targeted flora survey was completed over six days between the 7th and 12th of May 2020 across the Study Area, with systematic gridding and targeted habitat searching completed. The survey recorded.

Two conservation significant flora taxa were recorded by this survey in the Study Area:

- *Ipomoea racemigera* (P2) – 63 individuals from 38 point locations; and
- *Goodenia nuda* (P4) – 352 individuals from 102 point locations.

An additional 22 individuals from 15 point locations of *Ipomoea racemigera* (P2) and 17 individuals from three point locations of *Goodenia nuda* (P4) were recorded outside of the Study Area along the western boundary. The two conservation significant flora taxa observed in this current survey have previously been recorded from the Study Area. The size of the population within the Study Area of *Ipomoea racemigera* (P2) is relatively large, as plants are considered to continue outside of the Study Area. The remaining taxon previously recorded in the Study Area, *Goodenia berringbinensis* (P4), was not located by this survey. No threatened flora taxa were recorded by this survey.

One flora of “other” significance was recorded by this survey in the Study Area, representing a range extension of approximately 55 km to the south east:

- *Brunonia* sp. Long hairs (D.E. Symon 2440) – one individual from one point location.

Six introduced flora taxa, **Bidens bipinnata*, **Cenchrus ciliaris*, **Citrullus amarus*, **Malvastrum americanum*, **Rumex vesicarius* and **Setaria verticillata* were recorded from the Study Area during this survey, with **Aerva javanica* recorded just outside of the Study Area. These taxa are not listed as Weeds of National Significance or Declared Plant Pests listed under the *Biosecurity and Agriculture Management Act 2007*. These taxa have been previously recorded within and/or surrounding the Study Area and are common in the Pilbara.

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7 APPENDICES

Appendix A: State and Federal Conservation Codes

Category	Definition
Extinct (EX)	A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.
Extinct in the Wild (EW)	A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.
Critically Endangered (CR)	A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered (see Section V), and it is therefore considered to be facing an extremely high risk of extinction in the wild.
Endangered (EN)	A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered (see Section V), and it is therefore considered to be facing a very high risk of extinction in the wild.
Vulnerable (VU)	A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable (see Section V), and it is therefore considered to be facing a high risk of extinction in the wild.
Near Threatened (NT)	A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.
Least Concern (LTC)	A taxon is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.
Data Deficient (DD)	A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and a threatened status. If the range of a taxon is suspected to be relatively circumscribed, and a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.
Not Evaluated (NE)	A taxon is Not Evaluated when it has not yet been evaluated against the criteria.

Environment Protection and Biodiversity Conservation Act 1999

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

Category	Definition
	(iv) cessation of the plan of management would adversely affect the conservation status of the species.
Threatened Ecological Communities	
Critically Endangered	An ecological community is eligible to be included in the critically endangered category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
Endangered	An ecological community is eligible to be included in the endangered category at a particular time if, at that time: <ul style="list-style-type: none"> (a) it is not critically endangered; and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
Vulnerable	An ecological community is eligible to be included in the vulnerable category at a particular time if, at that time: <ul style="list-style-type: none"> (a) it is not critically endangered nor endangered; and (b) it is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.

Biodiversity Conservation Act 2016

Category	Definition
Threatened Flora Species	
Critically Endangered (CR)	Threatened species considered to be “facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines”. Published under schedule 1 of the <i>Wildlife Conservation (Rare Flora) Notice 2018</i> for critically endangered flora.
Endangered (EN)	Threatened species considered to be “facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines”. Published under schedule 2 of the <i>Wildlife Conservation (Rare Flora) Notice 2018</i> for endangered flora.
Vulnerable (VU)	Threatened species considered to be “facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines”. Published under schedule 3 of the <i>Wildlife Conservation (Rare Flora) Notice 2018</i> for vulnerable flora.
Extinct (EX)	Species where “there is no reasonable doubt that the last member of the species has died”, and listing is otherwise in accordance with the ministerial guidelines (section 24 of the BC Act). Published as presumed extinct under schedule 4 of the <i>Wildlife Conservation (Rare Flora) Notice 2018</i> for extinct flora.

Category	Definition
Extinct in the Wild (EW)	Species that “is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; and it has not been recorded in its known habitat or expected habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its life cycle and form”, and listing is otherwise in accordance with the ministerial guidelines (section 25 of the BC Act). Currently there are no threatened flora species listed as extinct in the wild.
Threatened Ecological Communities	
Critically Endangered (CR)	<p>An ecological community is eligible for listing in the category of critically endangered ecological community at a particular time if, at that time —</p> <p>(a) it is facing an extremely high risk of becoming eligible for listing as a collapsed ecological community in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines; and</p> <p>(b) listing in that category is otherwise in accordance with the ministerial guidelines.</p>
Endangered (EN)	<p>An ecological community is eligible for listing in the category of endangered ecological community at a particular time if, at that time —</p> <p>(a) it is not a critically endangered ecological community; and</p> <p>(b) it is facing a very high risk of becoming eligible for listing as a collapsed ecological community in the near future, as determined in accordance with criteria set out in the ministerial guidelines; and</p> <p>(c) listing in that category is otherwise in accordance with the ministerial guidelines.</p>
Vulnerable (VU)	<p>An ecological community is eligible for listing in the category of vulnerable ecological community at a particular time if, at that time —</p> <p>(a) it is not a critically endangered ecological community or an endangered ecological community; and</p> <p>(b) it is facing a high risk of becoming eligible for listing as a collapsed ecological community in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines; and</p> <p>(c) listing in that category is otherwise in accordance with the ministerial guidelines.</p>
Collapsed	<p>An ecological community is eligible for listing as a collapsed ecological community at a particular time if, at that time —</p> <p>(a) there is no reasonable doubt that the last occurrence of the ecological community has collapsed; or</p> <p>(b) the ecological community has been so extensively modified throughout its range that no occurrence of it is likely to recover —</p> <p style="padding-left: 40px;">(i) its species composition or structure; or</p> <p style="padding-left: 40px;">(ii) its species composition and structure.</p>

Department of Biodiversity, Conservation and Attractions Priority Definitions

Category	Definition
Threatened Flora Species	
Priority 1 (P1)	<p>Poorly-known Species</p> <p>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.</p>
Priority 2 (P2)	<p>Poorly-known Species</p> <p>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.</p>
Priority 3 (P3)	<p>Poorly-known Species</p> <p>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.</p>
Priority 4 (P4)	<p>Rare, Near Threatened and other species in need of monitoring</p> <p>(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.</p> <p>(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.</p> <p>(c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.</p>

Category	Definition
Threatened Ecological Communities	
Priority 1 (P1)	<p>Poorly-known ecological communities</p> <p>Ecological communities that are known from very few occurrences with a very restricted distribution (generally ≤ 5 occurrences or a total area of ≤ 100ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.</p>
Priority 2 (P2)	<p>Poorly-known Ecological Communities</p> <p>Communities that are known from few occurrences with a restricted distribution (generally ≤ 10 occurrences or a total area of ≤ 200ha). At least some occurrences are not believed to be under immediate threat (within approximately 10 years) of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.</p>
Priority 3 (P3)	<p>Poorly-known Ecological Communities</p> <p>(i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or:</p> <p>(ii) communities known from a few widespread occurrences, which are either large or with significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat (within approximately 10 years), or;</p> <p>(iii) communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, inappropriate fire regimes, clearing, hydrological change etc.</p> <p>Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.</p>

Category	Definition
<p>Priority 4 (P4)</p>	<p>Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring.</p> <p>(i) Rare. Ecological communities known from few occurrences 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 communities are usually represented on conservation lands.</p> <p>(ii) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for a higher threat category.</p> <p>(iii) Ecological communities that have been removed from the list of threatened communities during the past five years.</p>
<p>Priority 5 (P5)</p>	<p>Conservation Dependent Ecological Communities</p> <p>Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.</p>

Appendix B: Likelihood Assessment

Taxon	Conservation Status			Habit and Habitat	Habitat Within Study Area	Within Known Distribution	Distance to Nearest Record	Likelihood of Occurrence	Likelihood Post-Survey
	DBCA	BC Act	EPBC Act						
<i>Ipomoea racemigera</i>	P2			Creeping annual, herb or climber. Fl. white.	Yes	Yes	Within	Confirmed	Confirmed
<i>Goodenia berringbinensis</i>	P4			Ascending annual, herb, 0.1-0.3 m high. Fl. yellow, Oct. Red sandy loam. Along watercourses.	Yes	Yes	Within	Confirmed	Highly Likely
<i>Goodenia nuda</i>	P4			Erect to ascending herb, to 0.5 m high. Fl. yellow, Apr to Aug.	Yes	Yes	Within	Confirmed	Confirmed
<i>Vittadinia</i> sp. Coondewanna Flats (S. van Leeuwen 4684)	P1			Erect annual herb, 0.3-1 m high. Fl. cream. Red-brown sandy loam. Drainage areas, floodplains, flat and/or stony plains.	Yes	Yes	1.8 km S	Highly Likely	Possible
<i>Euphorbia inappendiculata</i> var. <i>inappendiculata</i>	P2			Prostrate annual herb, to 0.1 m high. Red brown clay loam. Flat plain, cracking clay floodplain, gentle slopes.	Yes	Yes	1.1 km E	Highly Likely	Possible
<i>Aristida jerichoensis</i> var. <i>subspinulifera</i>	P3			Compactly tufted perennial, grass-like or herb, 0.3-0.8 m high, lemma groove muricate. Hardpan plains.	Yes	Yes	0.5 km E	Highly Likely	Possible
<i>Eremophila capricornica</i>	P1			Compact shrub, 0.2-0.5(-0.75) m high. Fl. blue-purple. Red brown loam soil. Hardpan plain over granite.	Possible	Yes	9.7 km NE	Possible	Unlikely
<i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794)	P3			Tall spindly shrub, 1.5-4 m high. Fl. yellow. Red brown sandy loam or clay, ironstone plain. Undulating plains, floodplain.	Possible	Yes	9.7 km NE	Possible	Unlikely
<i>Amaranthus centralis</i>	P3			Annual herb, decumbent or erect to 0.6 m high. Grows in red sand in ephemeral watercourses, sandy to clayey loam on river banks and edges of permanent pools in eucalypt lined channels, or acacia shrubland	No	Yes	31.1 km N	Unlikely	Unlikely
<i>Crotalaria smithiana</i>	P3			Annual, herb, to 0.4 m high. Fl. yellow, Jun. Regeneration site on floodplain.	No	Yes	19.7 km NNW	Unlikely	Unlikely
<i>Goodenia</i> sp. East Pilbara (A.A. Mitchell PRP 727)	P3			Open, erect annual or biennial, herb, to 0.2 m high. Fl. yellow. Red-brown clay soil, calcrete pebbles. Low undulating plain, swampy plains.	Possible	Yes	16.2 km W	Unlikely	Unlikely

Taxon	Conservation Status			Habit and Habitat	Habitat Within Study Area	Within Known Distribution	Distance to Nearest Record	Likelihood of Occurrence	Likelihood Post-Survey
	DBCA	BC Act	EPBC Act						
<i>Gymnanthera cunninghamii</i>	P3			Erect shrub, 1-2 m high. Fl. cream-yellow-green, Jan to Dec. Sandy soils.	No	Yes	14.1 km NW	Unlikely	Unlikely
<i>Themeda</i> sp. Hamersley Station (M.E. Trudgen 11431)	P3			Tussocky perennial, grass-like or herb, 0.9-1.8 m high. Fl. Aug. Red clay. Clay pan, grass plain.	No	No	24.5 km NNW	Unlikely	Unlikely
<i>Acacia corusca</i>	P1			Shrub, 1.5-5(-7) m high. Red brown sandy loam soils. Hill slopes, hillcrests, drainage lines.	No	No	8.2 km NNE	Unlikely	Highly Unlikely
<i>Eremophila pilosa</i>	P1			Shrub, ca 0.8 m high. Fl. purple, Sep.	Yes	No	49 km ESE	Unlikely	Highly Unlikely
<i>Eremophila rhegos</i>	P1			Erect shrub, ca 1 m high. Fl. blue-purple-white, Sep. Skeletal stony loam over granite.	Possible	No	45.4 km SW	Unlikely	Highly Unlikely
<i>Hibiscus</i> sp. Gurinbiddy Range (M.E. Trudgen 15708)	P2			Erect slender shrub, 1-3 m high. Fl. pale purple. Loamy skeletal soils. Gorge with ironstone outcropping, gullies, drainage line.	Possible	No	21.4 km WNW	Unlikely	Highly Unlikely
<i>Isotropis parviflora</i>	P2			Shrub, 0.1 m high. Fl. white/pink, Mar. Valley slope of ironstone plateau.	Possible	Yes	4.5 km N	Unlikely	Highly Unlikely
<i>Eremophila magnifica</i> subsp. <i>velutina</i>	P3			Shrub, 0.5-1.5 m high. Fl. blue-purple, Aug to Sep. Skeletal soils over ironstone. Summits.	Possible	No	35 km SW	Unlikely	Highly Unlikely
<i>Eremophila rigida</i>	P3			Bushy shrub, 0.3-4 m high. Fl. cream, Sep. Red sand alluvium. Hardpan plains, stony clay depressions.	Possible	No	26.4 km SW	Unlikely	Highly Unlikely
<i>Eremophila</i> sp. Hamersley Range (K. Walker KW 136)	P3			Erect shrub, 1-3 m high. Fl. White/pale blue. Red brown sandy clay loam. Upper slopes, gullies, gorges.	Possible	No	21.7 km NW	Unlikely	Highly Unlikely
<i>Indigofera gilesii</i>	P3			Shrub, to 1.5 m high. Fl. purple-pink, May or Aug. Pebbly loam. Amongst boulders & outcrops, hills.	Possible	No	36.7 km NW	Unlikely	Highly Unlikely
<i>Swainsona thompsoniana</i>	P3			Prostrate annual herb, to 0.2m high, Fl. blue. higher altitude floodplains, top of hilltops and cracking clays on red-brown clay	Possible	No	27.1 km W	Unlikely	Highly Unlikely
<i>Triodia</i> sp. Mt Ella (M.E. Trudgen 12739)	P3			Perennial, grass-like or herb, 0.4 m high. Light orange-brown, pebbly	Possible	Yes	4.1 km N	Unlikely	Highly Unlikely

Taxon	Conservation Status			Habit and Habitat	Habitat Within Study Area	Within Known Distribution	Distance to Nearest Record	Likelihood of Occurrence	Likelihood Post-Survey
	DBCA	BC Act	EPBC Act						
				loam. Amongst rocks & outcrops, gully slopes.					
<i>Eremophila magnifica</i> subsp. <i>magnifica</i>	P4			Shrub, 0.5-1.5 m high. Fl. blue, Aug to Nov. Skeletal soils over ironstone. Rocky screes.	No	No	29.5 km W	Unlikely	Highly Unlikely
<i>Eremophila youngii</i> subsp. <i>lepidota</i>	P4			Dense, spreading shrub, (0.2-)1-3 m high. Fl. purple-red-pink, Jan or Mar or Jun or Aug to Sep. Stony red sandy loam. Flats plains, floodplains, sometimes semi-saline, clay flats.	No	Yes	15.8 km NNW	Unlikely	Highly Unlikely
<i>Lepidium catapycnon</i>	P4			Open, woody perennial, herb or shrub, 0.2-0.3 m high, stems zigzag. Fl. white, Oct. Skeletal soils. Hillsides.	Possible	No	33.5 km W	Unlikely	Highly Unlikely
<i>Hibiscus campanulatus</i>	P1			Erect bushy shrub, 1-3.5 m high. Fl. White/pale pink. Brown loamy to skeletal soils. Rocky gullies, ironstone range.	No	No	177.3 km WSW	Highly Unlikely	Highly Unlikely
<i>Triodia pascoeana</i> ¹	P1			Dense, tussock-forming perennial, grass-like or herb, 1-3 m high, non-resinous, panicle long-linear, extremely scabrous, lemma 3-lobed, awnless. Fl. Jan to Apr. Limestone. Limestone ranges & gorges, floodplains.	No	No	28.4 km W	Highly Unlikely	Highly Unlikely
<i>Goodenia hartiana</i> ²	P2			Erect to spreading, multistemmed perennial, herb or shrub (sub-shrub). Fl. blue-purple. Sand. Sand dune swales, sandhills.	Yes	Yes	3 km E	Highly Unlikely	Highly Unlikely
<i>Pityrodia augustensis</i>	T	VUL	VUL	Bushy shrub, ca 1 m high. Fl. purple/purple-red, Aug to Sep. Amongst rocks on slopes or in drainage lines.	No	No	329.8 km WSW	Highly Unlikely	Highly Unlikely

¹ Records of this taxon in close proximity to the Study Area are likely erroneous. This taxon is only known from the Kimberley.

² Records of this taxon in close proximity to the Study Area are likely erroneous. These records are considered to be that of *Goodenia* sp. Sandy Creek (R.D. Royce 1653)

Appendix C: Key Findings from the Literature Review

Study details	Methods	Results	Significant findings	Limitations
Onshore (2015a) Client: BHP Billiton Iron Ore Type: Level 2 Flora and Vegetation Survey Location: Dynasty and West Jimblebar Tenements Timing: February/March 2015	<ul style="list-style-type: none"> 29 detailed floristic sites (quadrats) 142 relevé plots Targeted searching 	<ul style="list-style-type: none"> 263 plant taxa from 106 genera and 36 families 26 vegetation associations 11 broad floristic formations Four introduced weed species 	<ul style="list-style-type: none"> Three priority listed flora: <ul style="list-style-type: none"> <i>Ipomoea racemigera</i> (P2) <i>Goodenia nuda</i> (P4) <i>Goodenia berringbinensis</i> (P4) Five range extensions: <ul style="list-style-type: none"> <i>Eragrostis speciosa</i> (150 km southeast) <i>Hibiscus verdcourtii</i> (200 km east) <i>Goodenia berringbinensis</i> (250 km north) <i>Eleocharis pallens</i> (350 km southeast) <i>Tribulus cf. eichlerianus</i> (950 km west) 	<ul style="list-style-type: none"> No significant limitations
GHD (2008) Client: BHP Billiton Iron Ore Type: Biological Survey Location: Mesa Gap Exploration Area Timing: October 2007	<ul style="list-style-type: none"> Desktop Assessment Detailed floristic sites (quadrats) Transects Targeted searching 	<ul style="list-style-type: none"> 133 plant taxa from 32 families Five vegetation associations and eight vegetation types No introduced weed species 	<ul style="list-style-type: none"> No significant findings 	<ul style="list-style-type: none"> No significant limitations
Astron (2012) Client: BHP Billiton Iron Ore Type: Weed Survey Location: Jimblebar Timing: May 2012	<ul style="list-style-type: none"> Weed mapping survey using Project and Reference sites 	<ul style="list-style-type: none"> 631 weed record points within monitoring cells 141 weed record points opportunistically sampled 13 introduced weed species 	<ul style="list-style-type: none"> No Weeds of National Significance or Declared Plant Pests 	<ul style="list-style-type: none"> Poor access to some sites

Study details	Methods	Results	Significant findings	Limitations
Onshore (2014a) Client: BHP Billiton Iron Ore Type: Flora and Vegetation Desktop Assessment Location: Dynasty Tenement E52/2591 Timing: February 2014	<ul style="list-style-type: none"> Desktop Assessment 	<ul style="list-style-type: none"> Nine vegetation associations Six broad floristic formations 	<ul style="list-style-type: none"> Conservation significant flora identified as likely to occur in the study area: <ul style="list-style-type: none"> <i>Aristida jerichoensis</i> var. <i>subspinulifera</i> (P1)³ <i>Euphorbia inappendiculata</i> var. <i>inappendiculata</i> (P2) <i>Gymnanthera cunninghamii</i> (P3) <i>Goodenia nuda</i> (P4) <i>Josephinia</i> sp. Marandoo (M.E. Trudgen 1554) (P1)⁴ <i>Rhodanthe frenchii</i> (P2) <i>Rostellularia adscendens</i> var. <i>latifolia</i> (P3) <i>Vittadinia</i> sp. Coondewanna Flats (S. van Leeuwen 4684) (P1) 	<ul style="list-style-type: none"> No significant limitations
Biota (2004) Client: BHP Billiton Iron Ore Type: Biological Survey Location: Jimblebar – Wheelarra Hill Timing: August 2003	<ul style="list-style-type: none"> Two detailed floristic sites (quadrats) Targeted searching 	<ul style="list-style-type: none"> 227 plant taxa from 99 genera and 42 families Six vegetation types One introduced weed species 	<ul style="list-style-type: none"> One priority listed taxon: <ul style="list-style-type: none"> <i>Eriachne</i> sp. Hamersley Range hilltops (S van Leeuwen 4199) (P1)⁵ 	<ul style="list-style-type: none"> Timing of survey (poor season) Poor access

³ *Aristida jerichoensis* var. *subspinulifera* is no longer listed as Priority 1. It is now listed as Priority 3.

⁴ *Josephinia* sp. Marandoo (M.E. Trudgen 1554) is not current and is more recently known as *Josephinia eugeniae*, which is not listed as a Priority flora species

⁵ *Eriachne* sp. Hamersley Range hilltops (S. van Leeuwen 4199) is not current and is more recently known as *Eriachne lanata*, which is not listed as a Priority flora species.

Study details	Methods	Results	Significant findings	Limitations
Ecologia (2006) Client: BHP Billiton Iron Ore Type: Level 2 Flora and Vegetation Survey Location: Jimblebar Marra Mamba Timing: May 2006	<ul style="list-style-type: none"> 105 detailed floristic sites (quadrats) Targeted searching 	<ul style="list-style-type: none"> 267 plant taxa from 119 genera and 45 families Four vegetation types Four introduced weed species 	<ul style="list-style-type: none"> Two priority listed taxa: <ul style="list-style-type: none"> <i>Goodenia nuda</i> (P3)⁶ <i>Triumfetta leptacantha</i> (P3)⁷ 	<ul style="list-style-type: none"> No significant limitations
Outback Ecology (2010) Client: BHP Billiton Iron Ore Type: Two-phase Level 2 Flora and Vegetation Survey Location: Jimblebar Iron Ore Project Timing: July & September 2008, and January & March 2009	<ul style="list-style-type: none"> 128 detailed floristic sites (quadrats) Targeted Searching 	<ul style="list-style-type: none"> 326 plant taxa from 111 genera and 42 families 21 vegetation associations 12 broad floristic formations Six introduced weed species 	<ul style="list-style-type: none"> Three priority listed taxa: <ul style="list-style-type: none"> <i>Josephinia</i> sp. Marandoo (M.E. Trudgen 1554) (P1)⁸ <i>Acacia balsamea</i> (P4)⁹ <i>Goodenia nuda</i> (P3)¹⁰ 	<ul style="list-style-type: none"> No significant limitations

⁶ *Goodenia nuda* is no longer listed as Priority 3. It is now listed as Priority 4.

⁷ *Triumfetta leptacantha* is no longer listed as a Priority flora species

⁸ *Josephinia* sp. Marandoo (M.E. Trudgen 1554) is not current and is more recently known as *Josephinia eugeniae*, which is not listed as a Priority flora species

⁹ *Acacia balsamea* is no longer listed as a Priority flora species.

¹⁰ *Goodenia nuda* is no longer listed as Priority 3. It is now listed as Priority 4.

Study details	Methods	Results	Significant findings	Limitations
<p>Syrinx (2014) Client: BHP Billiton Iron Ore Type: Level 2 Flora and Vegetation Survey Location: Jimblebar Lease AML7000266 Timing: March 2011 and August/September 2013</p>	<ul style="list-style-type: none"> 38 detailed floristic sites (quadrats) 10 relevé plots Targeted searches 	<ul style="list-style-type: none"> 330 plant taxa from 137 genera and 44 families Seven introduced weed species 13 vegetation associations Nine broad floristic formations 	<ul style="list-style-type: none"> Three priority listed taxon: <ul style="list-style-type: none"> <i>Aristida jerichoensis</i> var. <i>subspinulifera</i> (P1)¹¹ <i>Vittadinia</i> sp. Coondewanna Flats (S. van Leeuwen 4684) (P1) <i>Euphorbia inappendiculata</i> var. <i>inappendiculata</i> (P2) Five range extensions: <ul style="list-style-type: none"> <i>Abutilon malvifolium</i> (150-200 km east) <i>Brachyscome ciliaris</i> var. <i>ciliaris</i> (400 km northwest) <i>Euphorbia porcata</i> (400 km west) <i>Leptochloa fusca</i> subsp. <i>muelleri</i> (200 km west) <i>Tephrosia sphaerospora</i> (37 km north to northwest) 	<ul style="list-style-type: none"> No significant limitations
<p>Biologic (2019a) Client: BHP Billiton Iron Ore Type: Reconnaissance Flora and Vegetation Assessment Location: Jumbuck (Tenement E52/3628) Timing: October 2018</p>	<ul style="list-style-type: none"> 83 relevé plots 	<ul style="list-style-type: none"> 124 plant taxa from 48 genera and 25 families 18 vegetation associations Four broad floristic formations Two introduced weed species 	<ul style="list-style-type: none"> No significant findings 	<ul style="list-style-type: none"> No significant limitations
<p>Onshore (2014b) Client: BHP Billiton Iron Ore Type: Targeted Flora Survey Location: Orebody 18 to OB31 Infrastructure Corridor Timing: September 2014</p>	<ul style="list-style-type: none"> Targeted searching 	<ul style="list-style-type: none"> One introduced weed species 	<ul style="list-style-type: none"> Two priority listed flora: <ul style="list-style-type: none"> <i>Goodenia nuda</i> (P4) <i>Triodia</i> sp. Mt Ella (M.E. Trudgen 12739) (P3) 	<ul style="list-style-type: none"> No significant limitations

¹¹ *Aristida jerichoensis* var. *subspinulifera* is no longer listed as Priority 1. It is now listed as Priority 3.

Study details	Methods	Results	Significant findings	Limitations
ENV (2008) Client: BHP Billiton Iron Ore Type: Level 2 Flora and Vegetation Survey Location: Jimblebar Access Road Timing: November 2007	<ul style="list-style-type: none"> 22 detailed floristic sites (quadrats) Targeted searching 	<ul style="list-style-type: none"> 112 plant taxa from 58 genera and 28 families 10 vegetation communities Three introduced weed species 	<ul style="list-style-type: none"> No significant findings 	<ul style="list-style-type: none"> Timing of survey (poor season)
Onshore (2015b) Client: BHP Billiton Iron Ore Type: Targeted Flora Survey Location: Orebody 31 Timing: March 2015	<ul style="list-style-type: none"> Targeted survey for <i>Acacia</i> sp. East Fortescue (J. Bull & D. Roberts ONS A 27.01)¹² 	<ul style="list-style-type: none"> 567 plants from three populations recorded 	<ul style="list-style-type: none"> Restricted in occurrence 	<ul style="list-style-type: none"> No significant limitations
ENV (2007c) Client: BHP Billiton Iron Ore Type: Level 2 Flora and Vegetation Survey Location: Orebody 18 Project Area Timing: July and August 2006	<ul style="list-style-type: none"> 71 detailed floristic sites (quadrats) and relevés Targeted Searching 	<ul style="list-style-type: none"> 276 plant taxa from 110 genera and 46 families Six broad vegetation types Two introduced weed species 	<ul style="list-style-type: none"> No significant findings 	<ul style="list-style-type: none"> No significant limitations

¹² *Acacia* sp. East Fortescue (J. Bull & D. Roberts ONS A 27.01) is not current and is more recently known as *Acacia corusca*, a Priority 1 species.

Study details	Methods	Results	Significant findings	Limitations
Onshore (2014d) Client: BHP Billiton Iron Ore Type: Targeted Flora Survey Location: Orebody 31 Timing: April 2014	<ul style="list-style-type: none"> Targeted searches 	<ul style="list-style-type: none"> No introduced weed species 	<ul style="list-style-type: none"> Three priority listed taxon: <ul style="list-style-type: none"> <i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794) (P3) <i>Triodia</i> sp. Mt Ella (M.E. Trudgen 12739) (P3) <i>Goodenia nuda</i> (P4) One plant taxa of interest: <ul style="list-style-type: none"> <i>Acacia</i> sp. nov (reticulate/anastomosing)¹³ One range extension: <ul style="list-style-type: none"> <i>Acacia clelandii</i> (400 km north range extension) 	<ul style="list-style-type: none"> No significant limitations
ENV (2007a) Client: BHP Billiton Iron Ore Type: Biological Survey Location: West Jimblebar Exploration Lease Timing: May 2007	<ul style="list-style-type: none"> 29 detailed floristic sites (quadrats) 33 relevé plots Targeted Searching 	<ul style="list-style-type: none"> 318 plant taxa from 113 genera and 44 families 11 vegetation types Three introduced weed species 	<ul style="list-style-type: none"> One priority listed taxon: <ul style="list-style-type: none"> <i>Goodenia nuda</i> (P3)¹⁴ 	<ul style="list-style-type: none"> No significant limitations
Onshore (2014c) Client: BHP Billiton Iron Ore Type: Second Season Level 2 Flora and Vegetation Survey Location: Orebody 31 Timing: October 2013	<ul style="list-style-type: none"> 45 detailed floristic sites (quadrats) 146 relevé plots Targeted searches 	<ul style="list-style-type: none"> 280 plant taxa from 110 genera and 35 families Two introduced weed species 35 vegetation associations 15 broad floristic formations 	<ul style="list-style-type: none"> One priority listed taxon: <ul style="list-style-type: none"> <i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794) (P3) Two plant taxa of interest: <ul style="list-style-type: none"> <i>Acacia</i> sp. nov (reticulate/anastomosing)¹⁵ <i>Triodia</i> ? sp. Mt Ella (M.E. Trudgen 12739) Two range extensions: <ul style="list-style-type: none"> <i>Acacia clelandii</i> (400 km north) <i>Eremophila demissa</i> (150 km east) 	<ul style="list-style-type: none"> No significant limitations

¹³ *Acacia* sp. nov (reticulate/anastomosing) is not current and is more recently known as *Acacia corusca*, a Priority 1 species.

¹⁴ *Goodenia nuda* is no longer listed as Priority 3. It is now listed as Priority 4.

¹⁵ *Acacia* sp. nov (reticulate/anastomosing) is not current and is more recently known as *Acacia corusca*, a Priority 1 species.

Study details	Methods	Results	Significant findings	Limitations
<p>Onshore (2018)</p> <p>Client: BHP Billiton Iron Ore</p> <p>Type: Detailed Flora and Vegetation Survey</p> <p>Location: Shearers West</p> <p>Timing: May 2018</p>	<ul style="list-style-type: none"> 49 detailed floristic sites (quadrats) Relevé plots Targeted searching 	<ul style="list-style-type: none"> 264 plant taxa from 110 genera and 38 families 18 vegetation associations Nine broad floristic formations Six introduced weed species 	<ul style="list-style-type: none"> Two range extensions: <ul style="list-style-type: none"> <i>Euphorbia multifaria</i> (150 km southeast) <i>Ipomoea coptica</i> (100 km south) 	<ul style="list-style-type: none"> Timing of survey (poor season)
<p>Ecologia (2007)</p> <p>Client: BHP Billiton Iron Ore</p> <p>Type: Biological Survey</p> <p>Location: Hashimoto Project Area</p> <p>Timing: August/September 2005 and February 2006</p>	<ul style="list-style-type: none"> 44 detailed floristic sites (quadrats) Targeted Searching 	<ul style="list-style-type: none"> 372 plant taxa from 129 genera and 43 families Nine vegetation types Four introduced weed species 	<ul style="list-style-type: none"> Two priority listed taxa: <ul style="list-style-type: none"> <i>Goodenia</i> sp. Rudall River (R.P. Hart 972) (P2)¹⁶ <i>Goodenia nuda</i> (P3)¹⁷ 	<ul style="list-style-type: none"> Timing of survey (poor season)
<p>ENV (2010)</p> <p>Client: BHP Billiton Iron Ore</p> <p>Type: Targeted Flora Survey</p> <p>Location: Jimblebar Wye Project Area</p> <p>Timing: March and June 2010</p>	<ul style="list-style-type: none"> Targeted searching 	<ul style="list-style-type: none"> No introduced weed species 	<ul style="list-style-type: none"> One priority listed taxon: <ul style="list-style-type: none"> <i>Gymnanthera cunninghamii</i> (P3) 	<ul style="list-style-type: none"> No significant limitations

¹⁶ *Goodenia* sp. Rudall River (R.P. Hart 972) is not current and is more recently known as *Goodenia hartiana*, a Priority 2 species.

¹⁷ *Goodenia nuda* is no longer listed as Priority 3. It is now listed as Priority 4.

Study details	Methods	Results	Significant findings	Limitations
ENV (2007b) Client: BHP Billiton Iron Ore Type: Level 1 Flora and Vegetation Survey Location: Levee Banks and Communications Tower areas Timing: April and June 2006	<ul style="list-style-type: none"> Detailed floristic sites (quadrats) Relevé plots Transects Targeted Searching 	<ul style="list-style-type: none"> 103 plant taxa from 24 families Six vegetation associations Five introduced weed species 	<ul style="list-style-type: none"> No significant findings 	<ul style="list-style-type: none"> No significant limitations
Ecoscape (2013) Client: Alinta Energy Type: Level 2 Flora and Vegetation Survey Location: Newman – Roy Hill Transmission Line Timing: August 2012	<ul style="list-style-type: none"> 15 detailed floristic sites (quadrats) 54 relevé plots Targeted searching Opportunistic observations 	<ul style="list-style-type: none"> 292 plant taxa from 110 genera and 38 families 13 vegetation types Eight introduced weed species 	<ul style="list-style-type: none"> Five priority listed taxa: <ul style="list-style-type: none"> <i>Eremophila pilosa</i> (P1) <i>Eremophila youngii</i> subsp. <i>lepidota</i> (P4) <i>Goodenia ?nuda</i> (P4) <i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794) (P3) <i>Themeda</i> sp. Hamersley Station (M.E. Trudgen 11431) (P3) 	<ul style="list-style-type: none"> No significant limitations
Biologic (2019b) Client: BHP Billiton Iron Ore Type: Reconnaissance Flora and Vegetation Assessment Location: Shearers East Timing: October 2018	<ul style="list-style-type: none"> 50 relevé plots 	<ul style="list-style-type: none"> 112 plant taxa from 51 genera and 25 families 17 vegetation associations Seven broad floristic formations Two introduced weed species 	<ul style="list-style-type: none"> No significant findings 	<ul style="list-style-type: none"> No significant limitations
Onshore (2016) Client: BHP Billiton Iron Ore Type: Level 2 Flora and Vegetation Survey Location: Jimblebar Creek Timing: May 2016	<ul style="list-style-type: none"> 15 detailed floristic sites (quadrats) 75 relevé plots Targeted searching 	<ul style="list-style-type: none"> 242 plant taxa from 117 genera and 42 families 11 vegetation associations Five broad floristic formations Five introduced weed species 	<ul style="list-style-type: none"> Two priority listed flora: <ul style="list-style-type: none"> <i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794) (P3) <i>Goodenia nuda</i> (P4) 	<ul style="list-style-type: none"> No significant limitations

Study details	Methods	Results	Significant findings	Limitations
<p>Eco Logical (2012)</p> <p>Client: BHP Billiton Iron Ore</p> <p>Type: Level 1 Flora and Vegetation Survey</p> <p>Location: Great Northern Highway</p> <p>Timing: August 2011</p>	<ul style="list-style-type: none"> Detailed floristic sites (quadrats) Targeted searching 	<ul style="list-style-type: none"> 52 plant taxa from 26 genera and 14 families Seven vegetation associations One introduced weed species 	<ul style="list-style-type: none"> No significant findings 	<ul style="list-style-type: none"> No significant limitations

Appendix D: **Database Search Results**

Parks and Wildlife Service (DBCA, 2020b)
EPBC Act Protected Matters Search (DAWE, 2020)
NatureMap (DBCA, 2020a)
Atlas of Living Australia (ALA, 2020)
Western Australian Organism List (DPIRD, 2020)

Family	Taxon	Source						Conservation Status			Introduced
		NatureMap	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
Acanthaceae	<i>Dicladantha forrestii</i>	•	•								
	<i>Dipteracanthus australasicus</i>	•	•								
	<i>Dipteracanthus australasicus</i> subsp. <i>australasicus</i>	•									
Acarosporaceae	<i>Acarospora citrina</i>	•									
Aizoaceae	<i>Trianthema glossostigmum</i>	•	•								
	<i>Trianthema pilosum</i>	•	•								
	<i>Trianthema triquetrum</i>	•	•								
Alismataceae	<i>Sagittaria platyphylla</i>						•				Y
Amaranthaceae	<i>Aerva javanica</i>	•	•								Y
	<i>Alternanthera angustifolia</i>	•	•								
	<i>Alternanthera nana</i>	•	•								
	<i>Alternanthera nodiflora</i>	•	•								
	<i>Alternanthera pungens</i>	•	•								Y
	<i>Amaranthus centralis</i>	•		•	•			P3			
	<i>Amaranthus cuspidifolius</i>	•	•								
	<i>Amaranthus mitchellii</i>	•	•								
	<i>Amaranthus undulatus</i>	•	•								
	<i>Gomphrena canescens</i>	•	•								
	<i>Gomphrena cunninghamii</i>	•	•								
	<i>Gomphrena kanisii</i>	•	•								
	<i>Gomphrena lanata</i>	•	•								
<i>Gomphrena sordida</i>	•	•									

Family	Taxon	Source						Conservation Status			Introduced
		NatureMap	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	<i>Ptilotus aevroides</i>	•	•								
	<i>Ptilotus aphyllus</i>	•	•								
	<i>Ptilotus astrolasius</i>	•	•								
	<i>Ptilotus auriculifolius</i>	•	•								
	<i>Ptilotus axillaris</i>	•	•								
	<i>Ptilotus calostachyus</i>	•	•								
	<i>Ptilotus carinatus</i>	•	•								
	<i>Ptilotus clementii</i>	•	•								
	<i>Ptilotus exaltatus</i>	•									
	<i>Ptilotus fusiformis</i>		•								
	<i>Ptilotus gaudichaudii</i>	•	•								
	<i>Ptilotus gomphrenoides</i>	•	•								
	<i>Ptilotus helipteroides</i>	•	•								
	<i>Ptilotus incanus</i>	•	•								
	<i>Ptilotus nobilis</i>		•								
	<i>Ptilotus obovatus</i>	•	•								
	<i>Ptilotus polystachyus</i>	•	•								
	<i>Ptilotus roei</i>	•	•								
	<i>Ptilotus rotundifolius</i>	•	•								
	<i>Ptilotus schwartzii</i>	•	•								
	<i>Ptilotus xerophilus</i>		•								
Apocynaceae	<i>Calotropis procera</i>						•				Y

Family	Taxon	Source						Conservation Status			Introduced
		NatureMap	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	<i>Cryptostegia madagascariensis</i>						•				Y
	<i>Cynanchum floribundum</i>	•	•								
	<i>Gymnanthera cunninghamii</i>	•	•	•	•			P3			
Araceae	<i>Pistia stratiotes</i>						•				Y
	<i>Zantedeschia aethiopica</i>						•				Y
Araliaceae	<i>Astrotricha hamptonii</i>	•	•								
	<i>Hydrocotyle ranunculoides</i>						•				Y
	<i>Trachymene bialata</i>	•	•								
	<i>Trachymene glaucifolia</i>		•								
	<i>Trachymene oleracea</i>	•	•								
	<i>Trachymene oleracea</i> subsp. <i>oleracea</i>	•									
Asparagaceae	<i>Asparagus asparagoides</i>						•				Y
Asteraceae	<i>Bidens bipinnata</i>	•	•								Y
	<i>Bidens subalternans</i>		•								Y
	<i>Bidens subalternans</i> var. <i>araneosa</i>	•									Y
	<i>Calocephalus beardii</i>	•	•								
	<i>Calocephalus pilbarensis</i>	•	•								
	<i>Calotis hispidula</i>	•	•								
	<i>Calotis latiuscula</i>	•	•								
	<i>Calotis multicaulis</i>	•	•								
	<i>Calotis plumulifera</i>		•								
	<i>Centipeda minima</i>		•								

Family	Taxon	Source						Conservation Status			Introduced
		NatureMap	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	<i>Centipeda minima</i> subsp. <i>macrocephala</i>	•									
	<i>Centipeda thespidioides</i>	•	•								
	<i>Chondrilla juncea</i>						•				Y
	<i>Chrysocephalum apiculatum</i>	•	•								
	<i>Chrysocephalum apiculatum</i> subsp. <i>pilbarensis</i>	•									
	<i>Chrysocephalum gilesii</i>	•	•								
	<i>Chrysocephalum pterochaetum</i>	•	•								
	<i>Flaveria trinervia</i>	•	•								Y
	<i>Gnephosis arachnoidea</i>	•	•								
	<i>Ixiochlamys cuneifolia</i>		•								
	<i>Lactuca saligna</i>	•	•								Y
	<i>Leiocarpa semicalva</i>		•								
	<i>Leiocarpa semicalva</i> subsp. <i>semicalva</i>	•									
	<i>Minuria integerrima</i>	•	•								
	<i>Olearia stuartii</i>	•	•								
	<i>Onopordum acaulon</i>						•				Y
	<i>Peripleura arida</i>	•									
	<i>Pluchea dentex</i>	•	•								
	<i>Pluchea dunlopii</i>	•	•								
	<i>Pluchea ferdinandi-muelleri</i>	•	•								
	<i>Pluchea rubelliflora</i>	•	•								
	<i>Podolepis capillaris</i>	•	•								

Family	Taxon	Source						Conservation Status			Introduced
		NatureMap	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	<i>Podolepis eremaea</i>	•	•								
	<i>Pseudognaphalium luteoalbum</i>	•	•								
	<i>Pterocaulon sphacelatum</i>	•	•								
	<i>Pterocaulon sphaeranthoides</i>	•	•								
	<i>Rhodanthe charsleyae</i>	•	•								
	<i>Rhodanthe floribunda</i>	•	•								
	<i>Rhodanthe margarethae</i>	•	•								
	<i>Rhodanthe polakii</i>	•	•								
	<i>Rhodanthe sterilecens</i>	•	•								
	<i>Rhodanthe stricta</i>	•	•								
	<i>Roebuckiella similis</i>	•	•								
	<i>Rutidosia helichrysoidea</i>	•	•								
	<i>Rutidosia helichrysoidea</i> subsp. <i>helichrysoidea</i>	•									
	<i>Schoenia cassiniana</i>	•	•								
	<i>Silybum marianum</i>						•				Y
	<i>Sonchus oleraceus</i>	•	•								Y
	<i>Streptoglossa cylindriceps</i>	•	•								
	<i>Streptoglossa decurrens</i>	•	•								
	<i>Streptoglossa liatroides</i>	•	•								
	<i>Streptoglossa macrocephala</i>	•	•								
	<i>Streptoglossa odora</i>	•	•								
	<i>Symphotrichum squamatum</i>	•	•								Y

Family	Taxon	Source						Conservation Status			Introduced
		NatureMap	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	<i>Vittadinia arida</i>		•								
	<i>Vittadinia eremaea</i>		•								
	<i>Vittadinia</i> sp. Coondewanna Flats (S. van Leeuwen 4684)	•	•	•				P1			
	<i>Xanthium spinosum</i>						•				Y
	<i>Xanthium strumarium</i>						•				Y
Boraginaceae	<i>Echium plantagineum</i>						•				Y
	<i>Halgania erecta</i>	•	•								
	<i>Halgania solanacea</i>		•								
	<i>Halgania solanacea</i> var. Mt Doreen (G.M. Chippendale 4206)	•									
	<i>Heliotropium cunninghamii</i>	•	•								
	<i>Heliotropium heteranthum</i>	•	•								
	<i>Heliotropium inexplicitum</i>	•	•								
	<i>Heliotropium pachyphyllum</i>	•	•								
	<i>Heliotropium tanythrix</i>	•	•								
	<i>Heliotropium tenuifolium</i>	•	•								
	<i>Trichodesma zeylanicum</i>	•	•								
	<i>Trichodesma zeylanicum</i> var. <i>zeylanicum</i>	•									
Brassicaceae	<i>Lepidium catapycnon</i>	•	•	•	•			P4			
	<i>Lepidium echinatum</i>	•	•								
	<i>Lepidium muelleri-ferdinandii</i>	•	•								
	<i>Lepidium oxytrichum</i>	•	•								
	<i>Lepidium pedicellosum</i>	•	•								

Family	Taxon	Source						Conservation Status			Introduced
		NatureMap	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	<i>Lepidium phlebopetalum</i>	•	•								
	<i>Lepidium pholidogynum</i>	•	•								
	<i>Lepidium platypetalum</i>	•	•								
	<i>Stenopetalum anfractum</i>	•	•								
	<i>Stenopetalum decipiens</i>	•	•								
	<i>Stenopetalum nutans</i>		•								
	<i>Stenopetalum velutinum</i>	•	•								
Cactaceae	<i>Austrocylindropuntia cylindrica</i>						•				Y
	<i>Austrocylindropuntia subulata</i>						•				Y
	<i>Cylindropuntia fulgida</i>						•				Y
	<i>Cylindropuntia imbricata</i>						•				Y
	<i>Cylindropuntia kleiniae</i>						•				Y
	<i>Cylindropuntia pallida</i>						•				Y
	<i>Cylindropuntia tunicata</i>						•				Y
	<i>Opuntia elata</i>						•				Y
	<i>Opuntia elatior</i>						•				Y
	<i>Opuntia engelmannii</i>						•				Y
	<i>Opuntia ficus-indica</i>						•				Y
	<i>Opuntia microdasys</i>						•				Y
	<i>Opuntia monacantha</i>						•				Y
	<i>Opuntia polyacantha</i>						•				Y
	<i>Opuntia puberula</i>						•				Y

Family	Taxon	Source						Conservation Status			Introduced
		NatureMap	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	<i>Opuntia stricta</i>						•				Y
	<i>Opuntia tomentosa</i>						•				Y
Campanulaceae	<i>Wahlenbergia tumidifructa</i>	•	•								
Capparaceae	<i>Capparis lasiantha</i>	•	•								
	<i>Capparis spinosa</i>	•	•								
	<i>Capparis umbonata</i>		•								
Caryophyllaceae	<i>Polycarpaea corymbosa</i>	•	•								
	<i>Polycarpaea corymbosa</i> var. <i>corymbosa</i>	•									
	<i>Polycarpaea holtzei</i>	•	•								
	<i>Polycarpaea involucrata</i>	•	•								
	<i>Polycarpaea longiflora</i>	•	•								
Celastraceae	<i>Stackhousia intermedia</i>	•	•								
	<i>Stackhousia</i> sp. Swollen gynophore (W.R. Barker 2041)	•									
Chenopodiaceae	<i>Atriplex codonocarpa</i>	•	•								
	<i>Atriplex lindleyi</i>		•								
	<i>Atriplex semilunaris</i>	•	•								
	<i>Atriplex vesicaria</i>		•								
	<i>Dysphania kalpari</i>	•	•								
	<i>Dysphania melanocarpa</i>	•	•								
	<i>Dysphania rhadinostachya</i>		•								
	<i>Dysphania rhadinostachya</i> subsp. <i>inflata</i>	•									

Family	Taxon	Source						Conservation Status			Introduced
		NatureMap	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	<i>Dysphania rhadinostachya</i> subsp. <i>rhadinostachya</i>	•									
	<i>Enchylaena tomentosa</i>		•								
	<i>Enchylaena tomentosa</i> var. <i>tomentosa</i>	•									
	<i>Maireana carnosae</i>	•	•								
	<i>Maireana georgei</i>	•	•								
	<i>Maireana melanocoma</i>	•	•								
	<i>Maireana planifolia</i>	•	•								
	<i>Maireana pyramidata</i>	•	•								
	<i>Maireana thesioides</i>	•	•								
	<i>Maireana triptera</i>	•	•								
	<i>Maireana villosa</i>	•	•								
	<i>Rhagodia eremaea</i>		•								
	<i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794)	•	•	•				P3			
	<i>Salsola australis</i>	•	•								
	<i>Sclerolaena convexula</i>	•	•								
	<i>Sclerolaena cornishiana</i>	•	•								
	<i>Sclerolaena costata</i>	•	•								
	<i>Sclerolaena densiflora</i>	•	•								
	<i>Sclerolaena diacantha</i>	•	•								
	<i>Sclerolaena eriacantha</i>	•	•								
	<i>Sclerolaena lanicuspis</i>	•	•								
	<i>Sclerolaena minuta</i>	•	•								

Family	Taxon	Source						Conservation Status			Introduced
		NatureMap	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	<i>Tecticornia disarticulata</i>	•	•								
Cleomaceae	<i>Cleome oxalidea</i>	•	•								
	<i>Cleome viscosa</i>	•	•								
Colchicaceae	<i>Wurmbea deserticola</i>	•	•								
Convolvulaceae	<i>Bonamia erecta</i>	•	•								
	<i>Bonamia pilbarensis</i>	•	•								
	<i>Bonamia rosea</i>	•	•								
	<i>Convolvulus clementii</i>	•	•								
	<i>Duperreya commixta</i>	•	•								
	<i>Evolvulus alsinoides</i>		•								
	<i>Evolvulus alsinoides</i> var. <i>decumbens</i>	•									
	<i>Evolvulus alsinoides</i> var. <i>villosicalyx</i>	•									
	<i>Ipomoea costata</i>	•	•								
	<i>Ipomoea muelleri</i>	•	•								
	<i>Ipomoea pes-caprae</i>		•								
	<i>Ipomoea pes-caprae</i> subsp. <i>brasiliensis</i>	•									
	<i>Ipomoea plebeia</i>	•	•								
	<i>Ipomoea racemigera</i>	•	•	•					P2		
	<i>Operculina aequisejala</i>	•	•								
<i>Polymeria ambigua</i>		•									
<i>Polymeria calycina</i>	•	•									
<i>Polymeria</i> sp.	•										

Family	Taxon	Source						Conservation Status			Introduced
		NatureMap	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
Cucurbitaceae	<i>Austrobryonia pilbarensis</i>		•								
	<i>Citrullus amarus</i>	•	•								Y
Cyperaceae	<i>Bulbostylis barbata</i>	•	•								
	<i>Bulbostylis turbinata</i>	•	•								
	<i>Cyperus betchei</i>		•								
	<i>Cyperus betchei</i> subsp. <i>commiscens</i>	•									
	<i>Cyperus bifax</i>	•	•								
	<i>Cyperus cunninghamii</i>	•	•								
	<i>Cyperus dactyloides</i>		•								
	<i>Cyperus difformis</i>	•	•								
	<i>Cyperus iria</i>	•	•								
	<i>Cyperus ixiocarpus</i>	•	•								
	<i>Cyperus pulchellus</i>	•	•								
	<i>Cyperus squarrosus</i>	•	•								
	<i>Cyperus tenuiflorus</i>	•	•								Y
	<i>Cyperus vaginatus</i>	•	•								
	<i>Eleocharis pallens</i>	•	•								
	<i>Fimbristylis dichotoma</i>	•	•								
<i>Fimbristylis elegans</i>	•	•									
<i>Fimbristylis eremophila</i>	•	•									
<i>Fimbristylis microcarya</i>	•	•									
<i>Fimbristylis simulans</i>	•	•									

Family	Taxon	Source						Conservation Status			Introduced
		NatureMap	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	<i>Lipocarpha microcephala</i>	•	•								
	<i>Schoenoplectiella laevis</i>	•	•								
Ditrichaceae	<i>Eccremidium arcuatum</i>	•	•								
Droseraceae	<i>Drosera finlaysoniana</i>	•	•								
	<i>Drosera indica</i>		•								
Euphorbiaceae	<i>Euphorbia australis</i>		•								
	<i>Euphorbia australis</i> var. <i>subtomentosa</i>	•									
	<i>Euphorbia biconvexa</i>	•	•								
	<i>Euphorbia boophthona</i>	•	•								
	<i>Euphorbia careyi</i>	•	•								
	<i>Euphorbia coghlanii</i>	•	•								
	<i>Euphorbia inappendiculata</i>		•								
	<i>Euphorbia inappendiculata</i> var. <i>inappendiculata</i>	•		•				P2			
	<i>Euphorbia porcata</i>	•	•								
	<i>Euphorbia tannensis</i>		•								
	<i>Euphorbia tannensis</i> subsp. <i>eremophila</i>	•									
	<i>Jatropha gossypifolia</i>						•				Y
Fabaceae	<i>Acacia acradenia</i>	•	•								
	<i>Acacia adoxa</i>		•								
	<i>Acacia adoxa</i> var. <i>adoxa</i>	•									
	<i>Acacia adsurgens</i>	•	•								
	<i>Acacia ampliceps</i>	•	•								

Family	Taxon	Source						Conservation Status			Introduced
		NatureMap	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	<i>Acacia ancistrocarpa</i>	•	•								
	<i>Acacia aneura</i>		•								
	<i>Acacia aptaneura</i>	•	•								
	<i>Acacia arida</i>	•	•								
	<i>Acacia atkinsiana</i>	•	•								
	<i>Acacia ayersiana</i>	•	•								
	<i>Acacia balsamea</i>	•	•								
	<i>Acacia bivenosa</i>	•	•								
	<i>Acacia bivenosa x sclerosperma</i> subsp. <i>sclerosperma</i>	•									
	<i>Acacia catenulata</i>		•								
	<i>Acacia catenulata</i> subsp. <i>occidentalis</i>	•									
	<i>Acacia citrinoviridis</i>	•	•								
	<i>Acacia clelandii</i>	•	•								
	<i>Acacia coolgardiensis</i>		•								
	<i>Acacia coriacea</i>	•	•								
	<i>Acacia coriacea</i> subsp. <i>pendens</i>	•									
	<i>Acacia corusca</i>	•	•	•				P1			
	<i>Acacia cuspidifolia</i>	•	•								
	<i>Acacia dictyophleba</i>	•	•								
	<i>Acacia elachantha</i>	•	•								
	<i>Acacia eriopoda</i>	•	•								
	<i>Acacia fuscaneura</i>		•								

Family	Taxon	Source						Conservation Status			Introduced
		NatureMap	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	<i>Acacia gregorii</i>		•								
	<i>Acacia hamersleyensis</i>	•	•								
	<i>Acacia hilliana</i>	•	•								
	<i>Acacia inaequilatera</i>	•	•								
	<i>Acacia kempeana</i>	•	•								
	<i>Acacia ligulata</i>	•	•								
	<i>Acacia macraneura</i>	•	•								
	<i>Acacia maitlandii</i>	•	•								
	<i>Acacia marramamba</i>	•	•								
	<i>Acacia melleodora</i>	•	•								
	<i>Acacia monticola</i>	•	•								
	<i>Acacia mulganeura</i>	•	•								
	<i>Acacia orthocarpa</i>	•	•								
	<i>Acacia pachyacra</i>	•	•								
	<i>Acacia pachycarpa</i>	•	•								
	<i>Acacia paraneura</i>	•	•								
	<i>Acacia pruinocarpa</i>	•	•								
	<i>Acacia pteraneura</i>	•	•								
	<i>Acacia ptychophylla</i>	•	•								
	<i>Acacia pyrifolia</i>		•								
	<i>Acacia pyrifolia</i> var. <i>morrisonii</i>	•									
	<i>Acacia pyrifolia</i> var. <i>pyrifolia</i>	•									

Family	Taxon	Source						Conservation Status			Introduced
		NatureMap	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	<i>Acacia rhodophloia</i>	•	•								
	<i>Acacia sclerosperma</i>	•	•								
	<i>Acacia sclerosperma</i> subsp. <i>sclerosperma</i>	•									
	<i>Acacia sericophylla</i>	•	•								
	<i>Acacia sibirica</i>	•	•								
	<i>Acacia</i> sp. Jimblebar (S. van Leeuwen 1342)	•	•								
	<i>Acacia spondylophylla</i>	•	•								
	<i>Acacia subcontorta</i>	•	•								
	<i>Acacia synchronicia</i>	•	•								
	<i>Acacia tenuissima</i>	•	•								
	<i>Acacia tetragonophylla</i>	•	•								
	<i>Acacia trudgeniana</i>	•	•								
	<i>Acacia tumida</i>		•								
	<i>Acacia tumida</i> var. <i>pilbarensis</i>	•									
	<i>Acacia victoriae</i>	•	•								
	<i>Acacia wanyu</i>	•	•								
	<i>Acacia xiphophylla</i>		•								
	<i>Aenictophyton reconditum</i>		•								
	<i>Aenictophyton reconditum</i> subsp. <i>macrophyllum</i>	•									
	<i>Alhagi maurorum</i>						•				Y
	<i>Cajanus marmoratus</i>	•	•								
	<i>Crotalaria cunninghamii</i>		•								

Family	Taxon	Source						Conservation Status			Introduced
		NatureMap	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	<i>Crotalaria smithiana</i>	•	•	•				P3			
	<i>Cullen cinereum</i>	•	•								
	<i>Cullen lachnostachys</i>	•	•								
	<i>Cullen leucanthum</i>	•	•								
	<i>Cullen leucochaites</i>	•	•								
	<i>Cullen pogonocarpum</i>	•	•								
	<i>Desmanthus virgatus</i>	•	•								Y
	<i>Desmodium campylocaulon</i>		•								
	<i>Glycine canescens</i>	•	•								
	<i>Gompholobium oreophilum</i>	•	•								
	<i>Gompholobium polyzygum</i>		•								
	<i>Indigofera colutea</i>	•	•								
	<i>Indigofera georgei</i>	•	•								
	<i>Indigofera gilesii</i>			•				P3			
	<i>Indigofera monophylla</i>	•	•								
	<i>Isotropis atropurpurea</i>	•	•								
	<i>Isotropis parviflora</i>	•	•	•				P2			
	<i>Isotropis</i> sp. Arid zone (G. Byrne 2775)	•	•								
	<i>Jacksonia aculeata</i>	•	•								
	<i>Kennedia prorepens</i>	•	•								
	<i>Lotus cruentus</i>	•	•								
	<i>Mirbelia ramulosa</i>	•									

Family	Taxon	Source						Conservation Status			Introduced
		NatureMap	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	<i>Mirbelia viminalis</i>	•	•								
	<i>Muelleranthus trifoliolatus</i>	•	•								
	<i>Neptunia dimorphantha</i>	•	•								
	<i>Parkinsonia aculeata</i>						•				Y
	<i>Petalostylis cassioides</i>	•	•								
	<i>Petalostylis labicheoides</i>	•	•								
	<i>Prosopis glandulosa</i> x <i>velutina</i>						•				Y
	<i>Rhynchosia minima</i>		•								
	<i>Senna alata</i>						•				Y
	<i>Senna artemisioides</i>	•	•								
	<i>Senna artemisioides</i> subsp. <i>filifolia</i>	•									
	<i>Senna artemisioides</i> subsp. <i>helmsii</i>	•									
	<i>Senna artemisioides</i> subsp. <i>oligophylla</i>	•									
	<i>Senna glutinosa</i>	•	•								
	<i>Senna glutinosa</i> subsp. <i>glutinosa</i>	•									
	<i>Senna glutinosa</i> subsp. <i>pruinosa</i>	•									
	<i>Senna glutinosa</i> subsp. x <i>luerssenii</i>	•									
	<i>Senna hamersleyensis</i>	•	•								
	<i>Senna notabilis</i>	•	•								
	<i>Senna obtusifolia</i>						•				Y
	<i>Senna occidentalis</i>	•	•								Y
	<i>Senna</i> sp. Billabong (J.D. Alonzo 721)	•	•								

Family	Taxon	Source						Conservation Status			Introduced
		NatureMap	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	<i>Senna symonii</i>	•	•								
	<i>Senna venusta</i>	•	•								
	<i>Senna</i> sp. Meekatharra (E. Bailey 1-26)	•	•								
	<i>Swainsona decurrens</i>	•	•								
	<i>Swainsona formosa</i>		•								
	<i>Swainsona leeana</i>		•								
	<i>Swainsona thompsoniana</i>		•	•				P3			
	<i>Tephrosia densa</i>	•	•								
	<i>Tephrosia oxalidea</i>	•	•								
	<i>Tephrosia rosea</i>		•								
	<i>Tephrosia rosea</i> var. Fortescue creeks (M.I.H. Brooker 2186)	•									
	<i>Tephrosia</i> sp. clay soils (S. van Leeuwen et al. PBS 0273)	•	•								
	<i>Tephrosia</i> sp. deserts (J.R. Maconochie 1403)	•	•								
	<i>Tephrosia</i> sp. Newman (A.A. Mitchell PRP 29)	•	•								
	<i>Tephrosia</i> sp. Willowra (G.M. Chippendale 4809)	•	•								
	<i>Tephrosia</i> sp. NW Eremaean (S. van Leeuwen et al. PBS 0356)	•	•								
	<i>Ulex europaeus</i>						•				Y
	<i>Vigna lanceolata</i>		•								
	<i>Vigna lanceolata</i> var. <i>lanceolata</i>	•									
	<i>Vigna</i> sp. Hamersley Clay (A.A. Mitchell PRP 113)	•	•								
Frankeniaceae	<i>Frankenia setosa</i>	•	•								

Family	Taxon	Source						Conservation Status			Introduced
		NatureMap	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
Geraniaceae	<i>Erodium cygnorum</i>	•	•								
Goodeniaceae	<i>Brunonia australis</i>	•	•								
	<i>Dampiera candidans</i>	•	•								
	<i>Dampiera cinerea</i>	•	•								
	<i>Goodenia armitiana</i>	•	•								
	<i>Goodenia azurea</i>		•								
	<i>Goodenia azurea</i> subsp. <i>hesperia</i>	•									
	<i>Goodenia berringbinensis</i>	•	•	•				P4			
	<i>Goodenia hartiana</i>	•	•	•	•			P2			
	<i>Goodenia lamprosperma</i>	•	•								
	<i>Goodenia microptera</i>	•	•								
	<i>Goodenia mimuloides</i>		•								
	<i>Goodenia muelleriana</i>	•	•								
	<i>Goodenia nuda</i>	•	•	•				P4			
	<i>Goodenia pascua</i>		•								
	<i>Goodenia prostrata</i>	•	•								
	<i>Goodenia ramelii</i>	•	•								
	<i>Goodenia</i> sp. East Pilbara (A.A. Mitchell PRP 727)	•		•				P3			
<i>Goodenia</i> sp. Sandy Creek (R.D. Royce 1653)	•	•									
<i>Goodenia stobbsiana</i>	•	•									
<i>Goodenia tenuiloba</i>	•	•									
<i>Goodenia triodiophila</i>	•	•									

Family	Taxon	Source						Conservation Status			Introduced
		NatureMap	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	<i>Goodenia vilmoriniae</i>	•	•								
	<i>Scaevola acacioides</i>	•	•								
	<i>Scaevola browniana</i>	•	•								
	<i>Scaevola browniana</i> subsp. <i>browniana</i>	•									
	<i>Scaevola parvifolia</i>		•								
	<i>Scaevola parvifolia</i> subsp. <i>pilbarae</i>	•									
	<i>Scaevola</i> sp. Mt Nameless (P.A.S. Wurm 1443)	•	•								
	<i>Scaevola spinescens</i>	•	•								
	<i>Velleia connata</i>	•	•								
	<i>Velleia glabrata</i>	•	•								
Gyrostemonaceae	<i>Codonocarpus cotinifolius</i>	•	•								
Haloragaceae	<i>Gonocarpus ephemerus</i>	•	•								
	<i>Haloragis gossei</i>	•	•								
	<i>Haloragis gossei</i> var. <i>gossei</i>	•									
	<i>Haloragis maierae</i>	•	•								
Iridaceae	<i>Moraea flaccida</i>						•				Y
	<i>Moraea miniata</i>						•				Y
Lamiaceae	<i>Clerodendrum floribundum</i>		•								
	<i>Clerodendrum floribundum</i> var. <i>angustifolium</i>	•									
	<i>Dicrastylis cordifolia</i>	•	•								
	<i>Dicrastylis kumarinensis</i>	•	•								
	<i>Newcastelia cephalantha</i>	•	•								

Family	Taxon	Source						Conservation Status			Introduced
		NatureMap	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	<i>Newcastelia hexarrhena</i>	•	•								
	<i>Pityrodia augustensis</i>					•		T	VU	VU	
Lauraceae	<i>Cassytha capillaris</i>	•	•								
Linderniaceae	<i>Buchnera linearis</i>		•								
	<i>Striga squamigera</i>	•	•								
Loganiaceae	<i>Mitrasacme connata</i>	•	•								
Loranthaceae	<i>Amyema bifurcata</i>	•	•								
	<i>Amyema fitzgeraldii</i>	•	•								
	<i>Amyema gibberula</i>		•								
	<i>Amyema gibberula</i> var. <i>gibberula</i>	•									
	<i>Amyema preissii</i>	•	•								
	<i>Lysiana casuarinae</i>	•	•								
Lythraceae	<i>Lysiana murrayi</i>		•								
	<i>Ammannia multiflora</i>	•	•								
Malvaceae	<i>Rotala diandra</i>	•	•								
	<i>Abutilon amplum</i>	•	•								
	<i>Abutilon cunninghamii</i>	•	•								
	<i>Abutilon fraseri</i>	•	•								
	<i>Abutilon lepidum</i>	•	•								
	<i>Abutilon macrum</i>	•	•								
	<i>Abutilon malvifolium</i>	•	•								
<i>Abutilon oxycarpum</i>		•									

Family	Taxon	Source						Conservation Status			Introduced
		NatureMap	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	<i>Abutilon oxycarpum</i> subsp. Prostrate (A.A. Mitchell PRP 1266)	•									
	<i>Abutilon</i> sp. Dioicum (A.A. Mitchell PRP 1618)	•	•								
	<i>Abutilon</i> sp. Pilbara (W.R. Barker 2025)	•	•								
	<i>Androcalva luteiflora</i>	•	•								
	<i>Corchorus crozophorifolius</i>	•	•								
	<i>Corchorus elachocarpus</i>	•									
	<i>Corchorus lasiocarpus</i>	•	•								
	<i>Corchorus lasiocarpus</i> subsp. <i>lasiocarpus</i>	•									
	<i>Corchorus lasiocarpus</i> subsp. <i>parvus</i>	•									
	<i>Corchorus sidoides</i>	•	•								
	<i>Corchorus sidoides</i> subsp. <i>sidoides</i>	•									
	<i>Corchorus</i> sp. Hamersley Range hilltops (S. van Leeuwen 3826)	•	•								
	<i>Corchorus tridens</i>	•	•								
	<i>Corchorus walcottii</i>		•								
	<i>Gossypium hirsutum</i>	•	•								Y
	<i>Gossypium sturtianum</i>		•								
	<i>Gossypium sturtianum</i> var. <i>sturtianum</i>	•									
	<i>Hibiscus arenicola</i>	•	•								
	<i>Hibiscus austrinus</i>		•								
	<i>Hibiscus austrinus</i> var. <i>austrinus</i>	•									
	<i>Hibiscus burtonii</i>	•	•								

Family	Taxon	Source						Conservation Status			Introduced
		NatureMap	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	<i>Hibiscus campanulatus</i>	•						P1			
	<i>Hibiscus coatesii</i>	•	•								
	<i>Hibiscus haynaldii</i>	•	•								
	<i>Hibiscus sturtii</i>	•	•								
	<i>Hibiscus sturtii</i> var. <i>grandiflorus</i>	•									
	<i>Hibiscus sturtii</i> var. <i>truncatus</i>	•									
	<i>Hibiscus verdcourtii</i>	•	•								
	<i>Hibiscus</i> sp. Gurinbiddy Range (M.E. Trudgen MET 15708)		•	•				P2			
	<i>Malvastrum americanum</i>	•	•								Y
	<i>Seringia elliptica</i>	•	•								
	<i>Seringia nephrosperma</i>	•	•								
	<i>Sida arsiniata</i>	•	•								
	<i>Sida brownii</i>	•	•								
	<i>Sida calyxhymenia</i>	•	•								
	<i>Sida cardiophylla</i>	•	•								
	<i>Sida corrugata</i>		•								
	<i>Sida echinocarpa</i>	•	•								
	<i>Sida ectogama</i>	•	•								
	<i>Sida fibulifera</i>	•	•								
	<i>Sida kingii</i>	•	•								
	<i>Sida</i> sp. dark green fruits (S. van Leeuwen 2260)	•									
	<i>Sida</i> sp. <i>Excedentifolia</i> (J.L. Egan 1925)	•	•								

Family	Taxon	Source						Conservation Status			Introduced
		NatureMap	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	<i>Sida</i> sp. L (A.M. Ashby 4202)	•	•								
	<i>Sida</i> sp. Rabbit Flat (B.J. Carter 626)	•	•								
	<i>Sida</i> sp. Shovelanna Hill (S. van Leeuwen 3842)	•	•								
	<i>Sida</i> sp. tiny glabrous fruit (A.A. Mitchell PRP1152)	•									
	<i>Sida</i> trichopoda	•	•								
	<i>Sida</i> sp. Pilbara (A.A. Mitchell PRP 1543)	•	•								
	<i>Sida</i> sp. spiciform panicles (E. Leyland s.n. 14/8/90)	•	•								
	<i>Triumfetta leptacantha</i>	•	•								
	<i>Triumfetta maconochieana</i>	•	•								
	<i>Waltheria virgata</i>	•	•								
Marsileaceae	<i>Marsilea exarata</i>	•	•								
	<i>Marsilea hirsuta</i>	•	•								
Molluginaceae	<i>Glinus lotoides</i>		•								
	<i>Hypertelis cerviana</i>	•	•								
	<i>Trigastrotheca molluginea</i>	•	•								
Montiaceae	<i>Calandrinia balonensis</i>	•									
Myrtaceae	<i>Calytrix carinata</i>	•	•								
	<i>Corymbia aspera</i>	•	•								
	<i>Corymbia candida</i>	•	•								
	<i>Corymbia candida</i> subsp. <i>dipsodes</i>	•									
	<i>Corymbia deserticola</i>		•								

Family	Taxon	Source						Conservation Status			Introduced
		NatureMap	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	<i>Corymbia deserticola</i> subsp. <i>deserticola</i>	•									
	<i>Corymbia ferritcola</i>	•	•								
	<i>Corymbia hamersleyana</i>	•	•								
	<i>Corymbia lenziana</i>		•								
	<i>Corymbia opaca</i>	•	•								
	<i>Corymbia terminalis</i>		•								
	<i>Eucalyptus camaldulensis</i>		•								
	<i>Eucalyptus camaldulensis</i> subsp. <i>obtusa</i>	•									
	<i>Eucalyptus gamophylla</i>	•	•								
	<i>Eucalyptus kingsmillii</i>	•	•								
	<i>Eucalyptus leucophloia</i>	•	•								
	<i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i>	•									
	<i>Eucalyptus lucasii</i>	•	•								
	<i>Eucalyptus patellaris</i>		•								
	<i>Eucalyptus pilbarensis</i>		•								
	<i>Eucalyptus socialis</i>	•	•								
	<i>Eucalyptus socialis</i> subsp. <i>eucentrica</i>	•									
	<i>Eucalyptus trivalva</i>	•	•								
	<i>Eucalyptus victrix</i>	•	•								
	<i>Eucalyptus xerothermica</i>	•	•								
	<i>Lamarchea sulcata</i>	•	•								
	<i>Melaleuca eleuterostachya</i>		•								

Family	Taxon	Source						Conservation Status			Introduced
		NatureMap	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	<i>Melaleuca fulgens</i>		•								
	<i>Melaleuca glomerata</i>	•	•								
Nyctaginaceae	<i>Boerhavia coccinea</i>	•	•								
	<i>Boerhavia repleta</i>	•	•								
Orobanchaceae	<i>Buchnera linearis</i>	•									
Phrymaceae	<i>Mimulus gracilis</i>	•	•								
	<i>Peplidium maritimum</i>	•	•								
Phyllanthaceae	<i>Phyllanthus erwinii</i>	•	•								
	<i>Phyllanthus maderaspatensis</i>	•	•								
	<i>Phyllanthus virgatus</i>	•	•								
	<i>Synostemon rhytidospermus</i>	•	•								
Plantaginaceae	<i>Stemodia viscosa</i>	•	•								
Plumbaginaceae	<i>Plumbago zeylanica</i>	•	•								
Poaceae	<i>Acrachne racemosa</i>	•	•								
	<i>Alloteropsis cimicina</i>	•	•								
	<i>Amphipogon caricinus</i>	•	•								
	<i>Amphipogon sericeus</i>	•	•								
	<i>Aristida A (aff. ingrata)</i>		•								
	<i>Aristida contorta</i>	•	•								
	<i>Aristida holathera</i>	•	•								
	<i>Aristida inaequiglumis</i>	•	•								
	<i>Aristida jerichoensis</i>		•								

Family	Taxon	Source						Conservation Status			Introduced
		NatureMap	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	<i>Aristida jerichoensis</i> var. <i>subspinulifera</i>	•		•				P3			
	<i>Aristida latifolia</i>	•	•								
	<i>Aristida</i> sp.	•									
	<i>Brachyachne prostrata</i>		•								
	<i>Cenchrus ciliaris</i>	•	•			•					Y
	<i>Cenchrus setiger</i>	•	•								Y
	<i>Chloris pectinata</i>	•	•								
	<i>Chloris pumilio</i>	•	•								
	<i>Chloris</i> sp.	•									
	<i>Chrysopogon fallax</i>	•	•								
	<i>Cymbopogon ambiguus</i>	•	•								
	<i>Cymbopogon oblectus</i>	•	•								
	<i>Cynodon convergens</i>	•	•								
	<i>Cynodon dactylon</i>	•	•								Y
	<i>Cynodon prostratus</i>	•	•								
	<i>Dactyloctenium radulans</i>	•	•								
	<i>Dichanthium fecundum</i>	•	•								
	<i>Dichanthium sericeum</i>		•								
	<i>Dichanthium sericeum</i> subsp. <i>sericeum</i>	•									
	<i>Digitaria brownii</i>	•	•								
	<i>Digitaria ctenantha</i>	•	•								
	<i>Digitaria longiflora</i>	•	•								

Family	Taxon	Source						Conservation Status			Introduced
		NatureMap	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	<i>Diplachne fusca</i>		•								
	<i>Diplachne fusca</i> subsp. <i>muelleri</i>	•									
	<i>Echinochloa colona</i>	•	•								Y
	<i>Enneapogon caerulescens</i>	•	•								
	<i>Enneapogon lindleyanus</i>	•	•								
	<i>Enneapogon robustissimus</i>	•	•								
	<i>Eragrostis cumingii</i>	•	•								
	<i>Eragrostis dielsii</i>	•	•								
	<i>Eragrostis elongata</i>	•	•								
	<i>Eragrostis eriopoda</i>	•	•								
	<i>Eragrostis lanipes</i>	•	•								
	<i>Eragrostis leptocarpa</i>	•	•								
	<i>Eragrostis olida</i>	•	•								
	<i>Eragrostis pergracilis</i>	•	•								
	<i>Eragrostis setifolia</i>	•	•								
	<i>Eragrostis speciosa</i>	•	•								
	<i>Eragrostis tenellula</i>	•	•								
	<i>Eragrostis xerophila</i>		•								
	<i>Eriachne aristidea</i>	•	•								
	<i>Eriachne lanata</i>	•	•								
	<i>Eriachne mucronata</i>	•	•								
	<i>Eriachne obtusa</i>	•	•								

Family	Taxon	Source						Conservation Status			Introduced
		NatureMap	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	<i>Eriachne pulchella</i>		•								
	<i>Eriachne pulchella</i> subsp. <i>dominii</i>	•									
	<i>Eriachne pulchella</i> subsp. <i>pulchella</i>	•									
	<i>Eriachne tenuiculmis</i>	•	•								
	<i>Eriochloa pseudoacrotricha</i>	•	•								
	<i>Eulalia aurea</i>	•	•								
	<i>Iseilema dolichotrichum</i>	•	•								
	<i>Iseilema eremaeum</i>	•	•								
	<i>Iseilema membranaceum</i>	•	•								
	<i>Iseilema vaginiflorum</i>	•	•								
	<i>Leptochloa digitata</i>	•	•								
	<i>Monachather paradoxus</i>	•	•								
	<i>Panicum decompositum</i>	•	•								
	<i>Panicum effusum</i>	•	•								
	<i>Paraneurachne muelleri</i>	•	•								
	<i>Paspalidium clementii</i>	•	•								
	<i>Paspalidium constrictum</i>	•	•								
	<i>Paspalidium rarum</i>	•	•								
	<i>Perotis rara</i>	•	•								
	<i>Schizachyrium fragile</i>	•	•								
	<i>Setaria dielsii</i>	•	•								
	<i>Setaria surgens</i>	•	•								

Family	Taxon	Source						Conservation Status			Introduced
		NatureMap	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	<i>Setaria verticillata</i>	•	•								Y
	<i>Sporobolus actinocladius</i>	•	•								
	<i>Sporobolus australasicus</i>	•	•								
	<i>Themeda</i> sp. Hamersley Station (M.E. Trudgen 11431)	•	•	•				P3			
	<i>Themeda triandra</i>	•	•								
	<i>Thyridolepis xerophila</i>	•	•								
	<i>Tragus australianus</i>	•	•								
	<i>Triodia angusta</i>	•	•								
	<i>Triodia basedowii</i>	•	•								
	<i>Triodia bitextura</i>		•								
	<i>Triodia brizoides</i>	•	•								
	<i>Triodia longiceps</i>	•	•								
	<i>Triodia melvillei</i>	•									
	<i>Triodia pascoeana</i>		•					P1			
	<i>Triodia pungens</i>	•	•								
	<i>Triodia schinzii</i>	•	•								
	<i>Triodia</i> sp. Mt Ella (M.E. Trudgen 12739)	•	•	•				P3			
	<i>Triodia vanleeuwenii</i>	•	•								
	<i>Triodia wiseana</i>	•	•								
	<i>Tripogonella loliiformis</i>	•	•								
	<i>Urochloa piligera</i>	•	•								
	<i>Urochloa subquadripara</i>		•								

Family	Taxon	Source						Conservation Status			Introduced
		NatureMap	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	<i>Xerochloa imberbis</i>	•	•								
	<i>Yakirra australiensis</i>		•								
	<i>Yakirra australiensis</i> var. <i>australiensis</i>	•									
Polygalaceae	<i>Polygala glaucifolia</i>	•	•								
	<i>Polygala isingii</i>	•	•								
Polygonaceae	<i>Rumex vesicarius</i>	•	•								Y
Portulacaceae	<i>Calandrinia balonensis</i>		•								
	<i>Calandrinia ptychosperma</i>	•	•								
	<i>Calandrinia quadrivalvis</i>		•								
	<i>Calandrinia schistorhiza</i>	•	•								
	<i>Calandrinia stagnensis</i>	•	•								
	<i>Calandrinia tepperiana</i>	•									
	<i>Portulaca cyclophylla</i>	•	•								
	<i>Portulaca decipiens</i>	•	•								
	<i>Portulaca filifolia</i>	•	•								
	<i>Portulaca intraterranea</i>	•	•								
	<i>Portulaca oleracea</i>	•	•								
	<i>Portulaca pilosa</i>	•									Y
Proteaceae	<i>Grevillea berryana</i>		•								
	<i>Grevillea juncifolia</i>		•								
	<i>Grevillea juncifolia</i> subsp. <i>juncifolia</i>	•									
	<i>Grevillea pyramidalis</i>	•	•								

Family	Taxon	Source						Conservation Status			Introduced
		NatureMap	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	<i>Grevillea stenobotrya</i>	•									
	<i>Grevillea striata</i>	•	•								
	<i>Grevillea wickhamii</i>		•								
	<i>Grevillea wickhamii</i> subsp. <i>aprica</i>	•									
	<i>Grevillea wickhamii</i> subsp. <i>hispidula</i>	•									
	<i>Hakea chordophylla</i>		•								
	<i>Hakea lorea</i>		•								
	<i>Hakea lorea</i> subsp. <i>lorea</i>	•									
	<i>Hakea preissii</i>	•	•								
Pteridaceae	<i>Cheilanthes austrotenuifolia</i>	•	•								
	<i>Cheilanthes brownii</i>	•	•								
	<i>Cheilanthes lasiophylla</i>	•	•								
	<i>Cheilanthes sieberi</i>		•								
	<i>Cheilanthes sieberi</i> subsp. <i>pseudovellea</i>	•									
	<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>	•									
	<i>Cheilanthes tenuifolia</i>	•									
Rhamnaceae	<i>Cryptandra monticola</i>	•	•								
	<i>Ventilago viminalis</i>	•	•								
	<i>Ziziphus mauritiana</i>						•				Y
Ricciaceae	<i>Riccia crinita</i>	•	•								
Rosaceae	<i>Rubus anglocandicans</i>						•				Y
	<i>Rubus laudatus</i>						•				Y

Family	Taxon	Source						Conservation Status			Introduced
		NatureMap	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	<i>Rubus rugosus</i>						•				Y
	<i>Rubus ulmifolius</i>						•				Y
Rubiaceae	<i>Oldenlandia crouchiana</i>	•	•								
	<i>Oldenlandia galioides</i>	•	•								
	<i>Psydrax latifolia</i>		•								
	<i>Psydrax suaveolens</i>	•	•								
Ruppiaceae	<i>Ruppia polycarpa</i>	•	•								
Santalaceae	<i>Anthobolus leptomerioides</i>	•	•								
	<i>Santalum lanceolatum</i>	•	•								
	<i>Santalum spicatum</i>	•	•								
Sapindaceae	<i>Diplopeltis stuartii</i>		•								
	<i>Diplopeltis stuartii</i> var. <i>stuartii</i>	•									
	<i>Dodonaea coriacea</i>	•	•								
	<i>Dodonaea pachyneura</i>	•	•								
Scrophulariaceae	<i>Eremophila canaliculata</i>	•	•								
	<i>Eremophila capricornica</i>	•	•	•				P1			
	<i>Eremophila clarkei</i>	•	•								
	<i>Eremophila cuneifolia</i>	•	•								
	<i>Eremophila exilifolia</i>	•	•								
	<i>Eremophila forrestii</i>		•								
	<i>Eremophila forrestii</i> subsp. <i>forrestii</i>	•									
<i>Eremophila fraseri</i>		•									

Family	Taxon	Source						Conservation Status			Introduced
		NatureMap	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	<i>Eremophila fraseri</i> subsp. <i>fraseri</i>	•									
	<i>Eremophila lachnocalyx</i>	•	•								
	<i>Eremophila lanceolata</i>	•	•								
	<i>Eremophila latrobei</i>		•								
	<i>Eremophila latrobei</i> subsp. <i>latrobei</i>	•									
	<i>Eremophila longifolia</i>	•	•								
	<i>Eremophila maculata</i>		•								
	<i>Eremophila maculata</i> subsp. <i>brevifolia</i>	•									
	<i>Eremophila maculata</i> subsp. <i>maculata</i>	•									
	<i>Eremophila magnifica</i>		•								
	<i>Eremophila magnifica</i> subsp. <i>magnifica</i>	•		•				P4			
	<i>Eremophila magnifica</i> subsp. <i>velutina</i>	•		•				P3			
	<i>Eremophila margarethae</i>	•	•								
	<i>Eremophila oppositifolia</i>		•								
	<i>Eremophila oppositifolia</i> subsp. <i>angustifolia</i>	•									
	<i>Eremophila pilosa</i>				•			P1			
	<i>Eremophila platycalyx</i>		•								
	<i>Eremophila platycalyx</i> subsp. Neds Creek (N.H. Speck 1228)	•									
	<i>Eremophila rhegos</i>			•				P1			
	<i>Eremophila rigida</i>	•	•	•				P3			
	<i>Eremophila</i> sp.		•								
	<i>Eremophila</i> sp. Hamersley Range (K. Walker KW 136)	•		•				P3			

Family	Taxon	Source						Conservation Status			Introduced
		NatureMap	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	<i>Eremophila tietkensis</i>		•								
	<i>Eremophila youngii</i>		•								
	<i>Eremophila youngii</i> subsp. <i>lepidota</i>	•		•				P4			
	<i>Myoporum montanum</i>		•								
Solanaceae	<i>Nicotiana benthamiana</i>	•	•								
	<i>Nicotiana occidentalis</i>	•	•								
	<i>Nicotiana occidentalis</i> subsp. <i>obliqua</i>	•									
	<i>Nicotiana simulans</i>		•								
	<i>Solanum austropiceum</i>	•	•								
	<i>Solanum centrale</i>	•	•								
	<i>Solanum cleistogamum</i>	•	•								
	<i>Solanum diversiflorum</i>		•								
	<i>Solanum elaeagnifolium</i>						•				Y
	<i>Solanum elatius</i>	•	•								
	<i>Solanum lasiophyllum</i>	•	•								
	<i>Solanum linnaeanum</i>						•				Y
	<i>Solanum morrisonii</i>	•	•								
	<i>Solanum piceum</i>	•	•								
<i>Solanum sturtianum</i>		•									
Stylidiaceae	<i>Stylidium desertorum</i>		•								
Tamaricaceae	<i>Tamarix aphylla</i>						•				Y
Ustilaginaceae	<i>Anthracoystis tumefaciens</i>	•									

Family	Taxon	Source						Conservation Status			Introduced
		NatureMap	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
Verbenaceae	<i>Lantana camara</i>						•				Y
Violaceae	<i>Hybanthus aurantiacus</i>	•	•								
Zygophyllaceae	<i>Roepera iodocarpa</i>		•								
	<i>Roepera similis</i>		•								
	<i>Tribulus astrocarpus</i>		•								
	<i>Tribulus eichlerianus</i>	•									
	<i>Tribulus hirsutus</i>	•	•								
	<i>Tribulus hystrix</i>		•								
	<i>Tribulus macrocarpus</i>	•	•								
	<i>Tribulus suberosus</i>		•								
	<i>Tribulus terrestris</i>	•	•								Y

Appendix E: Introduced Flora Database Results

EPBC Act Protected Matters Search (DAWE, 2020)
NatureMap (DBCA, 2020a)
Atlas of Living Australia (ALA, 2020)
Western Australian Organism List (DPIRD, 2020)

Family	Taxon	Source				Declared Plant Pest	Weeds of National Significance	Ecological Impact	Invasiveness
		NatureMap	ALA	EPBC	WAOL				
Alismataceae	<i>Sagittaria platyphylla</i>				•	Yes	Yes	Not assessed	Not assessed
Amaranthaceae	<i>Aerva javanica</i>	•	•			No	No	High	Rapid
	<i>Alternanthera pungens</i>	•	•			No	No	Low	Slow
Apocynaceae	<i>Calotropis procera</i>				•	Yes	No	Not assessed	Not assessed
	<i>Cryptostegia madagascariensis</i>				•	Yes	No	Not assessed	Not assessed
Araceae	<i>Pistia stratiotes</i>				•	Yes	No	Not assessed	Not assessed
	<i>Zantedeschia aethiopica</i>				•	Yes	No	Not assessed	Not assessed
Araliaceae	<i>Hydrocotyle ranunculoides</i>				•	Yes	No	Not assessed	Not assessed
Asparagaceae	<i>Asparagus asparagoides</i>				•	Yes	Yes	Not assessed	Not assessed
Asteraceae	<i>Bidens bipinnata</i>	•	•			No	No	Unknown	Rapid
	<i>Bidens subalternans</i>		•			No	No	Not assessed	Not assessed
	<i>Bidens subalternans</i> var. <i>araneosa</i>	•				No	No	Not assessed	Not assessed
	<i>Chondrilla juncea</i>				•	Yes	No	Not assessed	Not assessed
	<i>Flaveria trinervia</i>	•	•			No	No	Not assessed	Not assessed
	<i>Lactuca saligna</i>	•	•			No	No	Not assessed	Not assessed
	<i>Onopordum acaulon</i>				•	Yes	No	Not assessed	Not assessed
	<i>Silybum marianum</i>				•	Yes	No	Not assessed	Not assessed
	<i>Sonchus oleraceus</i>	•	•			No	No	Low	Rapid
	<i>Symphotrichum squamatum</i>	•	•			No	No	Not assessed	Not assessed
	<i>Xanthium spinosum</i>				•	Yes	No	Not assessed	Not assessed
	<i>Xanthium strumarium</i>				•	Yes	No	Not assessed	Not assessed
Boraginaceae	<i>Echium plantagineum</i>				•	Yes	No	Not assessed	Not assessed
Cactaceae	<i>Austrocyllindropuntia cylindrica</i>				•	Yes	Yes	Not assessed	Not assessed
	<i>Austrocyllindropuntia subulata</i>				•	Yes	Yes	Not assessed	Not assessed
	<i>Cylindropuntia fulgida</i>				•	Yes	Yes	High	Slow
	<i>Cylindropuntia imbricata</i>				•	Yes	Yes	Not assessed	Not assessed
	<i>Cylindropuntia kleiniae</i>				•	Yes	Yes	Not assessed	Not assessed

Family	Taxon	Source				Declared Plant Pest	Weeds of National Significance	Ecological Impact	Invasiveness
		NatureMap	ALA	EPBC	WAOL				
	<i>Cylindropuntia pallida</i>				•	Yes	Yes	Not assessed	Not assessed
	<i>Cylindropuntia tunicata</i>				•	Yes	Yes	Not assessed	Not assessed
	<i>Opuntia elata</i>				•	Yes	Yes	Not assessed	Not assessed
	<i>Opuntia elatior</i>				•	Yes	Yes	Not assessed	Not assessed
	<i>Opuntia engelmannii</i>				•	Yes	Yes	Not assessed	Not assessed
	<i>Opuntia ficus-indica</i>				•	Yes	Yes	Not assessed	Not assessed
	<i>Opuntia microdasys</i>				•	Yes	Yes	Not assessed	Not assessed
	<i>Opuntia monacantha</i>				•	Yes	Yes	Not assessed	Not assessed
	<i>Opuntia polyacantha</i>				•	Yes	Yes	Not assessed	Not assessed
	<i>Opuntia puberula</i>				•	Yes	Yes	Not assessed	Not assessed
	<i>Opuntia stricta</i>				•	Yes	Yes	High	Rapid
	<i>Opuntia tomentosa</i>				•	Yes	Yes	Not assessed	Not assessed
Cucurbitaceae	<i>Citrullus amarus</i>	•	•			No	No	Not assessed	Not assessed
Cyperaceae	<i>Cyperus tenuiflorus</i>	•	•			No	No	Not assessed	Not assessed
Euphorbiaceae	<i>Jatropha gossypifolia</i>				•	Yes	Yes	Not assessed	Not assessed
Fabaceae	<i>Alhagi maurorum</i>				•	Yes	No	Not assessed	Not assessed
	<i>Desmanthus virgatus</i>	•	•			No	No	Not assessed	Not assessed
	<i>Parkinsonia aculeata</i>				•	Yes	Yes	High	Rapid
	<i>Prosopis glandulosa x velutina</i>				•	Yes	Yes	Not assessed	Not assessed
	<i>Senna alata</i>				•	Yes	No	Not assessed	Not assessed
	<i>Senna obtusifolia</i>				•	Yes	No	Not assessed	Not assessed
	<i>Senna occidentalis</i>	•	•			No	No	Not assessed	Not assessed
	<i>Ulex europaeus</i>				•	Yes	Yes	Not assessed	Not assessed
Iridaceae	<i>Moraea flaccida</i>				•	Yes	No	Not assessed	Not assessed
	<i>Moraea miniata</i>				•	Yes	No	Not assessed	Not assessed
Malvaceae	<i>Gossypium hirsutum</i>	•	•			No	No	Not assessed	Not assessed
	<i>Malvastrum americanum</i>	•	•			No	No	High	Rapid

Family	Taxon	Source				Declared Plant Pest	Weeds of National Significance	Ecological Impact	Invasiveness
		NatureMap	ALA	EPBC	WAOL				
Poaceae	<i>Cenchrus ciliaris</i>	•	•	•		No	No	High	Rapid
	<i>Cenchrus setiger</i>	•	•			No	No	High	Rapid
	<i>Cynodon dactylon</i>	•	•			No	No	High	Rapid
	<i>Echinochloa colona</i>	•	•			No	No	High	Rapid
	<i>Setaria verticillata</i>	•	•			No	No	High	Rapid
Polygonaceae	<i>Rumex vesicarius</i>	•	•			No	No	Not assessed	Not assessed
Portulacaceae	<i>Portulaca pilosa</i>	•				No	No	Not assessed	Not assessed
Rhamnaceae	<i>Ziziphus mauritiana</i>				•	Yes	No	Not assessed	Not assessed
Rosaceae	<i>Rubus anglocandicans</i>				•	Yes	Yes	Not assessed	Not assessed
	<i>Rubus laudatus</i>				•	Yes	Yes	Not assessed	Not assessed
	<i>Rubus rugosus</i>				•	Yes	Yes	Not assessed	Not assessed
	<i>Rubus ulmifolius</i>				•	Yes	Yes	Not assessed	Not assessed
Solanaceae	<i>Solanum elaeagnifolium</i>				•	Yes	Yes	Not assessed	Not assessed
	<i>Solanum linnaeanum</i>				•	Yes	No	Not assessed	Not assessed
Tamaricaceae	<i>Tamarix aphylla</i>				•	Yes	Yes	High	Rapid
Verbenaceae	<i>Lantana camara</i>				•	Yes	Yes	Not assessed	Not assessed
Zygophyllaceae	<i>Tribulus terrestris</i>	•	•			No	No	Unknown	Moderate

Appendix F: Conservation Significant Flora Locations

*Recorded outside of the Study Area

Species	Latitude	Longitude	Date	No. of Individuals
<i>Goodenia nuda</i> (P4)	-23.3681	120.0151	2020-05-11	4
<i>Goodenia nuda</i> (P4)	-23.3700	119.9911	2020-05-09	2
<i>Goodenia nuda</i> (P4)	-23.3779	120.0038	2020-05-12	1
<i>Goodenia nuda</i> (P4)	-23.3892	119.9836	2020-05-11	6
<i>Goodenia nuda</i> (P4)	-23.3869	119.9833	2020-05-11	3*
<i>Goodenia nuda</i> (P4)	-23.3729	120.0193	2020-05-10	1
<i>Goodenia nuda</i> (P4)	-23.3902	119.9838	2020-05-11	1
<i>Goodenia nuda</i> (P4)	-23.3696	119.9905	2020-05-09	1
<i>Goodenia nuda</i> (P4)	-23.3789	120.0049	2020-05-09	2
<i>Goodenia nuda</i> (P4)	-23.3732	120.0318	2020-05-10	1
<i>Goodenia nuda</i> (P4)	-23.3755	120.0160	2020-05-11	5
<i>Goodenia nuda</i> (P4)	-23.3973	119.9849	2020-05-11	4
<i>Goodenia nuda</i> (P4)	-23.3703	119.9919	2020-05-12	6
<i>Goodenia nuda</i> (P4)	-23.3690	120.0262	2020-05-11	4
<i>Goodenia nuda</i> (P4)	-23.3896	119.9837	2020-05-11	10
<i>Goodenia nuda</i> (P4)	-23.3745	120.0343	2020-05-10	3
<i>Goodenia nuda</i> (P4)	-23.3800	120.0056	2020-05-12	3
<i>Goodenia nuda</i> (P4)	-23.3783	120.0040	2020-05-12	8
<i>Goodenia nuda</i> (P4)	-23.3778	120.0035	2020-05-12	6
<i>Goodenia nuda</i> (P4)	-23.3777	120.0036	2020-05-12	2
<i>Goodenia nuda</i> (P4)	-23.3782	120.0043	2020-05-12	2
<i>Goodenia nuda</i> (P4)	-23.3704	119.9921	2020-05-12	1
<i>Goodenia nuda</i> (P4)	-23.3740	120.0344	2020-05-10	3
<i>Goodenia nuda</i> (P4)	-23.3746	120.0347	2020-05-11	1
<i>Goodenia nuda</i> (P4)	-23.3744	120.0344	2020-05-10	5
<i>Goodenia nuda</i> (P4)	-23.3674	119.9874	2020-05-09	2
<i>Goodenia nuda</i> (P4)	-23.3739	120.0225	2020-05-11	2
<i>Goodenia nuda</i> (P4)	-23.3961	119.9846	2020-05-11	5
<i>Goodenia nuda</i> (P4)	-23.3976	119.9850	2020-05-11	30
<i>Goodenia nuda</i> (P4)	-23.3687	120.0188	2020-05-11	2
<i>Goodenia nuda</i> (P4)	-23.3728	120.0151	2020-05-11	5
<i>Goodenia nuda</i> (P4)	-23.3927	119.9840	2020-05-11	1
<i>Goodenia nuda</i> (P4)	-23.3786	120.0275	2020-05-10	1
<i>Goodenia nuda</i> (P4)	-23.3970	119.9841	2020-05-11	2
<i>Goodenia nuda</i> (P4)	-23.3702	120.0208	2020-05-10	2
<i>Goodenia nuda</i> (P4)	-23.3815	120.0069	2020-05-12	2
<i>Goodenia nuda</i> (P4)	-23.3969	119.9849	2020-05-11	3

Species	Latitude	Longitude	Date	No. of Individuals
<i>Goodenia nuda</i> (P4)	-23.3994	119.9880	2020-05-08	3
<i>Goodenia nuda</i> (P4)	-23.3712	120.0150	2020-05-11	2
<i>Goodenia nuda</i> (P4)	-23.3727	120.0194	2020-05-10	2
<i>Goodenia nuda</i> (P4)	-23.3890	119.9836	2020-05-11	5
<i>Goodenia nuda</i> (P4)	-23.3689	120.0137	2020-05-11	1
<i>Goodenia nuda</i> (P4)	-23.3914	119.9839	2020-05-11	1
<i>Goodenia nuda</i> (P4)	-23.3794	120.0052	2020-05-09	1
<i>Goodenia nuda</i> (P4)	-23.3847	119.9821	2020-05-11	6*
<i>Goodenia nuda</i> (P4)	-23.3750	120.0344	2020-05-11	1
<i>Goodenia nuda</i> (P4)	-23.3742	120.0224	2020-05-11	3
<i>Goodenia nuda</i> (P4)	-23.3927	119.9846	2020-05-11	1
<i>Goodenia nuda</i> (P4)	-23.3698	119.9907	2020-05-09	3
<i>Goodenia nuda</i> (P4)	-23.3890	119.9844	2020-05-11	1
<i>Goodenia nuda</i> (P4)	-23.3864	119.9830	2020-05-11	8*
<i>Goodenia nuda</i> (P4)	-23.3675	120.0138	2020-05-11	2
<i>Goodenia nuda</i> (P4)	-23.3797	120.0054	2020-05-12	8
<i>Goodenia nuda</i> (P4)	-23.3723	119.9963	2020-05-12	2
<i>Goodenia nuda</i> (P4)	-23.3939	119.9847	2020-05-11	1
<i>Goodenia nuda</i> (P4)	-23.3748	120.0345	2020-05-11	1
<i>Goodenia nuda</i> (P4)	-23.3785	119.9850	2020-05-09	1
<i>Goodenia nuda</i> (P4)	-23.3987	119.9867	2020-05-08	3
<i>Goodenia nuda</i> (P4)	-23.3879	119.9838	2020-05-11	5
<i>Goodenia nuda</i> (P4)	-23.3702	119.9916	2020-05-12	3
<i>Goodenia nuda</i> (P4)	-23.3930	120.0334	2020-05-08	14
<i>Goodenia nuda</i> (P4)	-23.3728	120.0152	2020-05-11	3
<i>Goodenia nuda</i> (P4)	-23.3703	119.9921	2020-05-12	8
<i>Goodenia nuda</i> (P4)	-23.3728	120.0150	2020-05-11	6
<i>Goodenia nuda</i> (P4)	-23.3716	119.9958	2020-05-12	1
<i>Goodenia nuda</i> (P4)	-23.3811	120.0209	2020-05-10	2
<i>Goodenia nuda</i> (P4)	-23.3725	120.0150	2020-05-11	3
<i>Goodenia nuda</i> (P4)	-23.3706	119.9927	2020-05-12	1
<i>Goodenia nuda</i> (P4)	-23.3977	119.9842	2020-05-11	1
<i>Goodenia nuda</i> (P4)	-23.3757	120.0211	2020-05-10	1
<i>Goodenia nuda</i> (P4)	-23.3870	119.9834	2020-05-11	4
<i>Goodenia nuda</i> (P4)	-23.3874	119.9836	2020-05-11	20
<i>Goodenia nuda</i> (P4)	-23.3746	120.0388	2020-05-11	1
<i>Goodenia nuda</i> (P4)	-23.3688	120.0191	2020-05-11	6

Species	Latitude	Longitude	Date	No. of Individuals
<i>Goodenia nuda</i> (P4)	-23.3794	120.0049	2020-05-09	1
<i>Goodenia nuda</i> (P4)	-23.3737	120.0195	2020-05-10	6
<i>Goodenia nuda</i> (P4)	-23.3776	120.0034	2020-05-12	1
<i>Goodenia nuda</i> (P4)	-23.3806	120.0064	2020-05-12	2
<i>Goodenia nuda</i> (P4)	-23.3700	119.9912	2020-05-09	2
<i>Goodenia nuda</i> (P4)	-23.3777	120.0034	2020-05-12	3
<i>Goodenia nuda</i> (P4)	-23.3981	120.0144	2020-05-08	1
<i>Goodenia nuda</i> (P4)	-23.3732	119.9980	2020-05-12	1
<i>Goodenia nuda</i> (P4)	-23.3735	119.9978	2020-05-12	2
<i>Goodenia nuda</i> (P4)	-23.3747	120.0344	2020-05-10	6
<i>Goodenia nuda</i> (P4)	-23.3960	119.9839	2020-05-11	2
<i>Goodenia nuda</i> (P4)	-23.3701	119.9914	2020-05-09	4
<i>Goodenia nuda</i> (P4)	-23.3704	119.9919	2020-05-12	2
<i>Goodenia nuda</i> (P4)	-23.3880	119.9837	2020-05-09	1
<i>Goodenia nuda</i> (P4)	-23.3742	120.0187	2020-05-10	2
<i>Goodenia nuda</i> (P4)	-23.3885	119.9833	2020-05-11	7
<i>Goodenia nuda</i> (P4)	-23.3763	120.0020	2020-05-12	2
<i>Goodenia nuda</i> (P4)	-23.3966	119.9848	2020-05-11	2
<i>Goodenia nuda</i> (P4)	-23.3931	119.9846	2020-05-11	1
<i>Goodenia nuda</i> (P4)	-23.3887	119.9835	2020-05-11	5
<i>Goodenia nuda</i> (P4)	-23.3795	120.0054	2020-05-09	2
<i>Goodenia nuda</i> (P4)	-23.3893	119.9837	2020-05-11	1
<i>Goodenia nuda</i> (P4)	-23.3975	119.9850	2020-05-11	10
<i>Goodenia nuda</i> (P4)	-23.3993	119.9877	2020-05-08	5
<i>Goodenia nuda</i> (P4)	-23.3724	119.9966	2020-05-12	7
<i>Goodenia nuda</i> (P4)	-23.3938	119.9847	2020-05-11	1
<i>Goodenia nuda</i> (P4)	-23.3755	120.0147	2020-05-11	3
<i>Goodenia nuda</i> (P4)	-23.3841	120.0346	2020-05-10	1
<i>Goodenia nuda</i> (P4)	-23.3729	120.0206	2020-05-10	5
<i>Goodenia nuda</i> (P4)	-23.3945	119.9913	2020-05-08	5
<i>Goodenia nuda</i> (P4)	-23.3687	119.9888	2020-05-09	3
<i>Ipomoea racemigera</i> (P2)	-23.3967	119.9840	2020-05-08	1
<i>Ipomoea racemigera</i> (P2)	-23.3868	119.9832	2020-05-11	2*
<i>Ipomoea racemigera</i> (P2)	-23.3861	119.9829	2020-05-11	1*
<i>Ipomoea racemigera</i> (P2)	-23.3880	119.9838	2020-05-11	2
<i>Ipomoea racemigera</i> (P2)	-23.3861	119.9828	2020-05-11	1*
<i>Ipomoea racemigera</i> (P2)	-23.3882	119.9840	2020-05-11	2

Species	Latitude	Longitude	Date	No. of Individuals
<i>Ipomoea racemigera</i> (P2)	-23.3856	119.9825	2020-05-11	1*
<i>Ipomoea racemigera</i> (P2)	-23.3856	119.9825	2020-05-11	1*
<i>Ipomoea racemigera</i> (P2)	-23.3956	119.9845	2020-05-11	2
<i>Ipomoea racemigera</i> (P2)	-23.3990	119.9841	2020-05-11	2
<i>Ipomoea racemigera</i> (P2)	-23.3963	119.9840	2020-05-11	1
<i>Ipomoea racemigera</i> (P2)	-23.3910	119.9844	2020-05-11	2
<i>Ipomoea racemigera</i> (P2)	-23.3933	119.9846	2020-05-11	1
<i>Ipomoea racemigera</i> (P2)	-23.3990	119.9841	2020-05-11	5
<i>Ipomoea racemigera</i> (P2)	-23.3867	119.9830	2020-05-11	2*
<i>Ipomoea racemigera</i> (P2)	-23.3976	119.9842	2020-05-11	1
<i>Ipomoea racemigera</i> (P2)	-23.3867	119.9830	2020-05-11	1*
<i>Ipomoea racemigera</i> (P2)	-23.3908	119.9844	2020-05-11	1
<i>Ipomoea racemigera</i> (P2)	-23.3875	119.9835	2020-05-11	1
<i>Ipomoea racemigera</i> (P2)	-23.3929	119.9845	2020-05-09	2
<i>Ipomoea racemigera</i> (P2)	-23.3877	119.9837	2020-05-11	3
<i>Ipomoea racemigera</i> (P2)	-23.3895	119.9838	2020-05-11	1
<i>Ipomoea racemigera</i> (P2)	-23.3877	119.9837	2020-05-11	1
<i>Ipomoea racemigera</i> (P2)	-23.3965	119.9845	2020-05-11	1
<i>Ipomoea racemigera</i> (P2)	-23.3854	119.9824	2020-05-11	1*
<i>Ipomoea racemigera</i> (P2)	-23.3981	119.9843	2020-05-11	1
<i>Ipomoea racemigera</i> (P2)	-23.3908	119.9839	2020-05-11	1
<i>Ipomoea racemigera</i> (P2)	-23.3862	119.9828	2020-05-11	2*
<i>Ipomoea racemigera</i> (P2)	-23.3848	119.9821	2020-05-11	1*
<i>Ipomoea racemigera</i> (P2)	-23.3877	119.9837	2020-05-11	3
<i>Ipomoea racemigera</i> (P2)	-23.3987	119.9849	2020-05-11	1
<i>Ipomoea racemigera</i> (P2)	-23.3980	119.9842	2020-05-11	1
<i>Ipomoea racemigera</i> (P2)	-23.3965	119.9839	2020-05-11	1
<i>Ipomoea racemigera</i> (P2)	-23.3910	119.9843	2020-05-11	1
<i>Ipomoea racemigera</i> (P2)	-23.3860	119.9827	2020-05-11	1*
<i>Ipomoea racemigera</i> (P2)	-23.3963	119.9839	2020-05-11	3
<i>Ipomoea racemigera</i> (P2)	-23.3854	119.9823	2020-05-11	1*
<i>Ipomoea racemigera</i> (P2)	-23.3911	119.9844	2020-05-11	3
<i>Ipomoea racemigera</i> (P2)	-23.3882	119.9833	2020-05-11	2
<i>Ipomoea racemigera</i> (P2)	-23.3889	119.9837	2020-05-11	1
<i>Ipomoea racemigera</i> (P2)	-23.3893	119.9838	2020-05-11	1
<i>Ipomoea racemigera</i> (P2)	-23.3985	119.9843	2020-05-11	1
<i>Ipomoea racemigera</i> (P2)	-23.3911	119.9839	2020-05-11	3

Species	Latitude	Longitude	Date	No. of Individuals
<i>Ipomoea racemigera</i> (P2)	-23.3865	119.9831	2020-05-11	5*
<i>Ipomoea racemigera</i> (P2)	-23.3848	119.9820	2020-05-11	1*
<i>Ipomoea racemigera</i> (P2)	-23.3995	119.9849	2020-05-11	1
<i>Ipomoea racemigera</i> (P2)	-23.3887	119.9842	2020-05-11	4
<i>Ipomoea racemigera</i> (P2)	-23.3862	119.9829	2020-05-11	1*
<i>Ipomoea racemigera</i> (P2)	-23.3877	119.9837	2020-05-11	2
<i>Ipomoea racemigera</i> (P2)	-23.3885	119.9836	2020-05-11	1
<i>Ipomoea racemigera</i> (P2)	-23.3874	119.9836	2020-05-11	2
<i>Ipomoea racemigera</i> (P2)	-23.3872	119.9834	2020-05-11	1
<i>Ipomoea racemigera</i> (P2)	-23.3884	119.9835	2020-05-11	2

Appendix G: Threatened and Priority Flora Report Forms

Appendix H: Introduced Flora Locations

Species	Latitude	Longitude	Date	No. of Individuals
* <i>Aerva javanica</i>	-23.37303472	119.9827971	2020-05-11	2*
* <i>Bidens bipinnata</i>	-23.36865663	119.9898284	2020-05-09	30
* <i>Bidens bipinnata</i>	-23.3983602	120.0294417	2020-05-08	50
* <i>Bidens bipinnata</i>	-23.3741134	119.997622	2020-05-09	100
* <i>Bidens bipinnata</i>	-23.3984786	120.02611	2020-05-08	30
* <i>Bidens bipinnata</i>	-23.3961125	120.0273049	2020-05-08	50
* <i>Bidens bipinnata</i>	-23.3704684	120.0005092	2020-05-09	50
* <i>Bidens bipinnata</i>	-23.3870016	120.0405615	2020-05-10	50
* <i>Bidens bipinnata</i>	-23.3962053	120.0327406	2020-05-08	50
* <i>Bidens bipinnata</i>	-23.3672623	119.9941187	2020-05-09	100
* <i>Bidens bipinnata</i>	-23.3949212	120.0191166	2020-05-08	50
* <i>Bidens bipinnata</i>	-23.3672303	120.0061386	2020-05-11	60
* <i>Bidens bipinnata</i>	-23.3961707	120.0306258	2020-05-08	100
* <i>Bidens bipinnata</i>	-23.3931209	120.0333014	2020-05-08	30
* <i>Bidens bipinnata</i>	-23.3933945	120.0326754	2020-05-08	50
* <i>Bidens bipinnata</i>	-23.3981624	120.0169365	2020-05-08	70
* <i>Bidens bipinnata</i>	-23.3979597	120.0199938	2020-05-08	50
* <i>Bidens bipinnata</i>	-23.39763109	120.0310842	2020-05-08	50
* <i>Bidens bipinnata</i>	-23.3984866	120.0313767	2020-05-08	50
* <i>Bidens bipinnata</i>	-23.3673412	119.9901722	2020-05-09	200
* <i>Cenchrus ciliaris</i>	-23.3865362	119.9829282	2020-05-11	100*
* <i>Cenchrus ciliaris</i>	-23.3978995	119.9843653	2020-05-08	50
* <i>Cenchrus ciliaris</i>	-23.39712726	120.0033408	2020-05-08	50
* <i>Cenchrus ciliaris</i>	-23.3994804	119.9841727	2020-05-08	30
* <i>Cenchrus ciliaris</i>	-23.3672597	119.9940956	2020-05-09	40
* <i>Cenchrus ciliaris</i>	-23.3966311	120.0460978	2020-05-08	8
* <i>Cenchrus ciliaris</i>	-23.3986547	120.0412924	2020-05-08	10
* <i>Citrullus amarus</i>	-23.386533	119.9837732	2020-05-09	5
* <i>Citrullus amarus</i>	-23.3991934	119.987432	2020-05-08	1
* <i>Citrullus amarus</i>	-23.3794187	120.0049931	2020-05-09	2
* <i>Citrullus amarus</i>	-23.367286	119.9901638	2020-05-09	5
* <i>Citrullus amarus</i>	-23.3699729	119.992856	2020-05-09	1
* <i>Citrullus amarus</i>	-23.3865464	119.9829271	2020-05-11	1*
* <i>Citrullus amarus</i>	-23.3979089	119.9843413	2020-05-08	5
* <i>Citrullus amarus</i>	-23.3728472	120.0147637	2020-05-11	1
* <i>Citrullus amarus</i>	-23.3672873	119.9949351	2020-05-09	1
* <i>Citrullus amarus</i>	-23.3673117	119.994059	2020-05-09	2

Species	Latitude	Longitude	Date	No. of Individuals
* <i>Citrullus amarus</i>	-23.3990986	119.9857274	2020-05-08	15
* <i>Malvastrum americanum</i>	-23.3957867	119.9840415	2020-05-08	10
* <i>Rumex vesicarius</i>	-23.3671968	119.9939412	2020-05-09	10
* <i>Setaria verticillata</i>	-23.3965387	120.0462148	2020-05-08	10
* <i>Setaria verticillata</i>	-23.3984019	120.0261638	2020-05-08	10

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Appendix 3: Jimblebar Greenhouse Gas Abatement Study Basic Vertebrate Fauna Survey (Biologic, 2020b).



Jimblebar Greenhouse Gas
Abatement Study
Basic Vertebrate Fauna Survey

Biologic Environmental Survey

Report to BHP Western Australian Iron Ore

December 2020



Document Status				
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			Name	Date
1	B. Downing; R. Ellis; A. Hide; C. Proctor; A. Hutchison;	C. Knuckey	S. Constantaras H. Gupta	18/08/2020
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3	B. Downing	C. Knuckey	S. Constantaras H. Gupta	22/10/2020
4	C. Knuckey	C. Knuckey	-	03/12/2020
Final	C. Knuckey	C. Knuckey	-	07/12/2020

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EXECUTIVE SUMMARY

BHP Western Australia Iron Ore (BHP WAIO) commissioned Biologic Environmental Survey Pty Ltd (Biologic) to undertake a basic (formerly Level 1) vertebrate fauna assessment for the Jimblebar Greenhouse Gas Abatement Study Area (hereafter referred to as the Study Area). The Study Area is located approximately 30 kilometres (km) east of Newman in the Pilbara region, and is approximately 2,438 hectares (ha) in size. The overarching objective of this assessment was to identify the occurrence of terrestrial vertebrate fauna species and their supporting habitats within the Study Area, with a focus on species of conservation significance (i.e. species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), *Biodiversity Conservation Act 2016* (BC Act) and/or by the Department of Biodiversity, Conservation and Attractions (DBCA) as a Priority species). Specifically, the key objectives of the assessment were to:

- conduct a comprehensive desktop assessment (database searches and literature review) to identify vertebrate fauna species potentially occurring within the Study Area;
- conduct a basic (formerly Level 1) survey to identify vertebrate fauna species and fauna habitats occurring in the Study Area;
- define and delineate broad fauna habitats occurring within the Study Area, and describe their significance to vertebrate fauna, particularly species of conservation significance; and
- assess the likelihood and distribution of conservation significant vertebrate fauna species occurring within the Study Area.

The desktop assessment was conducted prior to the field survey to identify all fauna species which have the potential to occur in the Study Area. A single-season basic vertebrate fauna survey was undertaken over six days between 7th and 12th May 2020.

A total of six broad fauna habitat types were recorded and mapped within the Study Area, comprising, in descending extent of occurrence, Hardpan Plain (47.37%, 1,155.08 ha), Stony Plain (18.77%, 457.77 ha), Sand Plain (16.63%, 405.39 ha), Mulga Woodland (13.52%, 329.65 ha), Hillcrest/ Hillslope (2.02%, 49.29 ha) and Major Drainage Line (0.69%, 16.89 ha). The remaining 0.99% (24.22 ha) of the Study Area comprised Cleared/ Disturbed areas, which are associated with the Jimblebar Iron Ore Mine. All fauna habitats mapped within the Study Area are broadly distributed and well represented in the vicinity of the Study Area and across the Pilbara region, and therefore support fauna assemblages which are generally common and widespread.

Of the six broad fauna habitats occurring within the Study Area, all have the potential to support species of conservation significance at varying capacities, though the provision of primary and/or secondary (supporting) breeding, denning, nesting/roosting, foraging and/or dispersal habitat. Sand Plain habitat provides primary breeding, foraging and dispersal habitat for greater bilby, brush-tailed mulgara, spectacled hare-wallaby, night parrot and spotted ctenotus, in addition to foraging and dispersal habitat for ghost bat and peregrine falcon. Hillcrest/ Hillslope habitat provides breeding, foraging and dispersal habitat for long-tailed dunnart, western pebble-mound mouse and the Pilbara flat-headed blind-snake. Furthermore, suitable foraging and dispersal habitat is also provided for northern quoll, Pilbara leaf-nosed bat and peregrine falcon. Suitable breeding, foraging and dispersal habitat is provided for brush-

tailed mulgara, western pebble-mound mouse, night parrot and spotted ctenotus in Stony Plain habitat, with foraging and dispersal habitat provided for long-tailed dunnart, ghost bat and peregrine falcon. Hardpan Plain habitat provides suitable breeding, foraging and dispersal habitat for brush-tailed mulgara and spotted ctenotus, and foraging/ dispersal habitat for peregrine falcon. Mulga Woodland habitat provides breeding and foraging habitat for greater bilby and the Pilbara flat-headed blind-snake and additional foraging habitat for ghost bat. Furthermore, Major Drainage Line habitat provides suitable foraging and dispersal habitat for northern quoll, ghost bat, Pilbara leaf-nosed bat, peregrine falcon and Pilbara olive python. No important habitat features (caves or water features) were recorded within the Study Area during the current survey.

Temporary waterbodies may occur throughout parts of the Study Area where pooling or flowing water may be present following significant rainfall events, primarily within Major Drainage Line habitat, and to a lesser extent Hardpan Plain.

The desktop assessment identified a total of 355 vertebrate fauna species that have previously been recorded within or have the potential to occur in the Study Area, comprising 47 mammals (38 native and nine introduced), 198 birds (197 native and one introduced), 101 reptiles, and nine amphibians. During the current survey, a total of 76 vertebrate fauna species, comprising 14 mammal species (11 native and three introduced), 57 bird species and five reptile species were recorded from the Study Area. All 76 species recorded during the current survey, were previously identified in the desktop assessment. Of the 355 species identified by the desktop assessment, 40 are species listed as conservation significance, comprising nine mammals, 28 birds and three reptiles. No species of conservation significance were recorded within the Study Area during the current survey. However, the following have previously been recorded within the Study Area:

- brush-tailed mulgara (*Dasyercus blythi*; Priority 4 – DBCA);
- western pebble-mound mouse (*Pseudomys chapmani*; Priority 4 – DBCA); and
- spotted ctenotus (*Ctenotus uber* subsp. *johnstonei*; Priority 2 – DBCA).

Based on the habitats present within the Study Area, species distributions, habitat preferences and general ecology, four species identified in the desktop assessment were considered Likely to occur within the Study Area, the:

- ghost bat (*Macroderma gigas*; Vulnerable - EPBC/BC Act);
- long-tailed dunnart (*Sminthopsis longicaudata*; Priority 4 – DBCA);
- grey falcon (*Falco hypoleucos*; Vulnerable - EPBC/BC Act); and
- peregrine falcon (*Falco peregrinus*; Specially Protected – BC Act).

Given the habitats present within the Study Area and locations of nearby records identified during the desktop assessment, the occurrence of a further seven species of conservation significance within the Study Area is considered Possible:

- Pilbara leaf-nosed bat (*Rhinonictis aurantia* Pilbara form; Vulnerable – EPBC/BC Act);
- greater bilby (*Macrotis lagotis*; Vulnerable – EPBC/BC Act);
- northern quoll (*Dasyurus hallucatus*; Endangered – EPBC/BC Act);

- Pilbara olive python (*Liasis olivaceus barroni*; Vulnerable – EPBC/BC Act);
- spectacled hare-wallaby (*Lagorchestes conspicillatus* subsp. *leichardti*; Priority 4 – DBCA);
- fork-tailed swift (*Apus pacificus*; Migratory – EPBC/BC Act); and
- Pilbara flat-headed blind-snake (*Anilius ganei*; Priority 1 – DBCA).

The remaining 26 species were considered Unlikely or Highly Unlikely to occur within the Study Area due to the absence of suitable habitat or habitat features to support the species and/or the Study Area occurring outside their current known distribution.

All broad fauna habitats mapped, and species assemblages recorded or likely to occur within the Study Area are typical of the Pilbara region, and are not considered significant at a local or regional scale. No vertebrate fauna values occur within the Study Area that are not represented more broadly in the vicinity of the Study Area and across the Pilbara region.

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1 INTRODUCTION

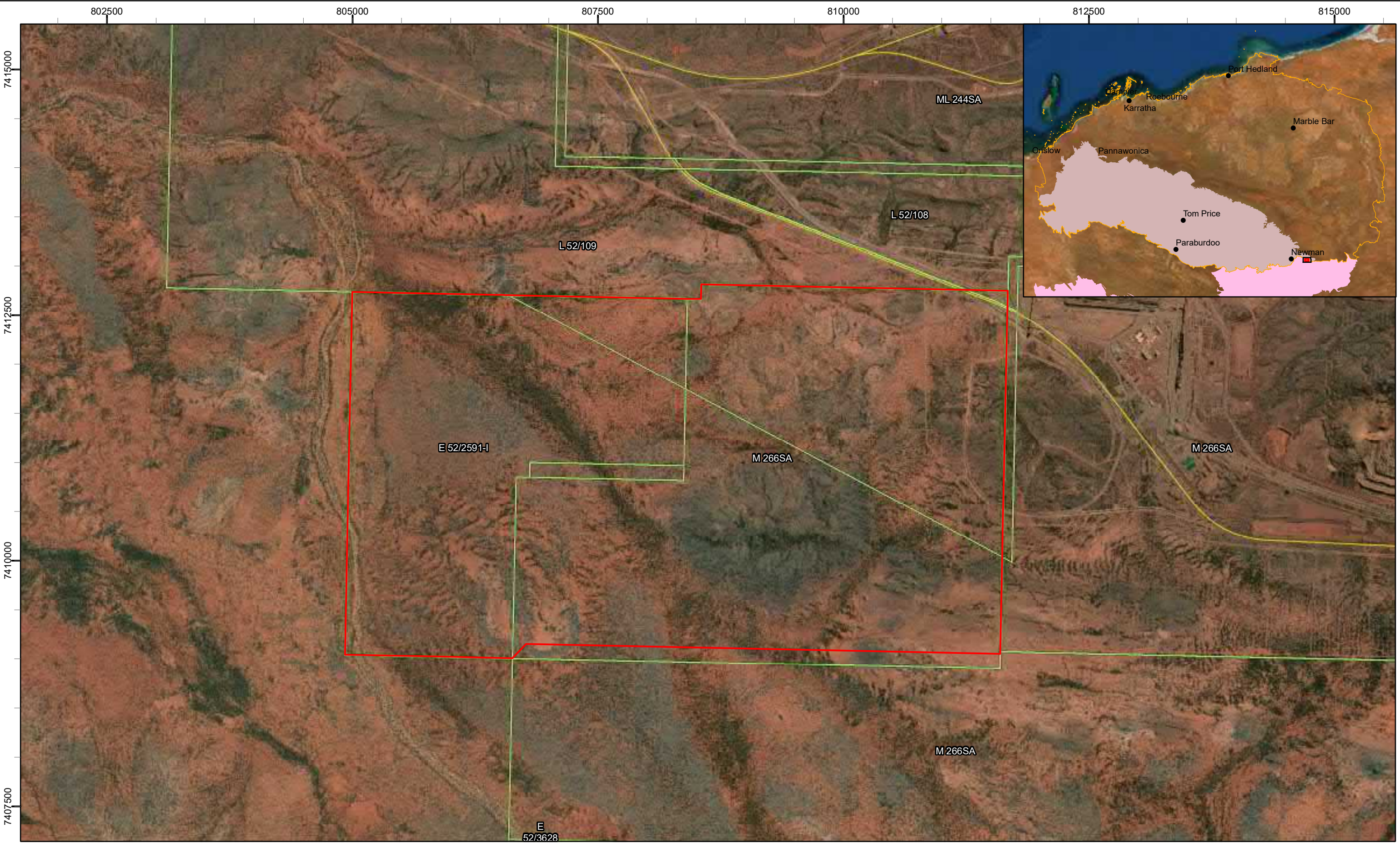
1.1 Background

BHP Western Australian Iron Ore (BHP WAIO) is investigating the biological values relating to the Jimblebar Greenhouse Gas Abatement Study area (hereafter referred to as the Study Area). The Study Area is located approximately 30 kilometres (km) east of Newman in the Pilbara region, and is approximately 2,438 hectares (ha) in size. Four live tenements held by BHP WAIO overlap the Study Area, including one exploration license (E522591-I), one mining lease (M266SA) and two miscellaneous licenses (I52/108 and L52/109) (Figure 1.1). To support this survey, BHP WAIO commissioned Biologic Environmental Survey Pty Ltd (Biologic) to undertake a basic (formerly Level 1) vertebrate fauna survey of the Study Area. This report documents the findings of this survey, which comprised a desktop assessment and a basic field survey.

1.2 Survey Objectives

The overarching objective of this assessment was to identify the occurrence of terrestrial vertebrate fauna species and their supporting habitats within the Study Area, with a focus on species of conservation significance. Specifically, the key objectives of the assessment were to:

- conduct a comprehensive desktop assessment (database searches and literature review) to identify vertebrate fauna species potentially occurring within the Study Area;
- conduct a basic (formerly Level 1) survey to identify vertebrate fauna species and fauna habitats occurring in the Study Area;
- define and delineate broad fauna habitats occurring within the Study Area, and describe their significance to vertebrate fauna, particularly species of conservation significance; and
- assess the likelihood and distribution of conservation significant vertebrate fauna species occurring within the Study Area.



- Legend**
- Study Area
 - BHP Tenements
 - Road
 - Railroad
 - Pilbara Bioregion
 - IBRA Subregions**
 - Augustus
 - Hamersley

Scale: 1:35,000

0 0.275 0.55 1.1 1.65 2.2 km

BHP Western Australian Iron Ore
Jimblebar Basic Vertebrate Fauna Survey
Figure 1.1: Study Area location and adjacent BHP tenure

Coordinate System: GDA 1994 MGA Zone 50
 Projection: Transverse Mercator
 Datum: GDA 1994

Size A3. Created 27/07/2020

1.3 Background to the Protection of Fauna

Terrestrial fauna may be significant for a range of reasons (EPA, 2016a), including:

- being identified as a threatened or priority species;
- being a species with restricted distribution;
- enduring a degree of historical impact from threatening processes; or
- providing an important function required to maintain the ecological integrity of a significant ecosystem.

Native fauna in Western Australia are protected at a state level under BC Act and the *Environmental Protection Act 1986* (EP Act). Any action that has the potential to impact native fauna needs to be approved by relevant state and/or federal departments in accordance with the WA *Environmental Protection Act 1986* (EP Act) and the federal *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act).

While all native fauna is protected under these acts, some species are afforded extra protection. These include: species that are considered Threatened under the BC Act and EPBC Act; migratory bird species that are protected under international agreements and subsequently listed as Migratory under the BC Act or EPBC Act; and species that may be threatened but for which there is not enough information available to allocate a threatened status, and which are subsequently listed as Priority species by the Western Australian Department of Biodiversity, Conservation and Attractions (DBCA) (Table 1.1).

For the purposes of this assessment, species considered to be of conservation significance are those that are afforded protection under the EPBC Act, BC Act and/or listed as Priority by DBCA (Table 1.1). A summary of applicable legislation and status codes is provided in Table 1.1.

Table 1.1: Definitions and terms for fauna of conservation significance

Act, Agreement or List	Status Codes ¹
Federal	
<p>Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)</p> <p>In Australia, native fauna are protected under the EPBC Act. This Act makes provisions for an independent committee (the Threatened Species Scientific Committee [TSSC]), which is charged with maintaining a list of threatened species. Threatened species are listed under one of six categories, depending on their specific conservation status.</p> <p>Migratory bird species are those listed under international agreements and protected under the EPBC Act as a Matter of National Environmental Significance (MNES). Relevant international agreements include the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), China-Australia Migratory Bird Agreement (CAMBA), Japan-Australia Migratory Bird Agreement (JAMBA), and Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA).</p>	<p><i>Extinct:</i></p> <ul style="list-style-type: none"> • EX – Extinct • EW – Extinct in the Wild <p><i>Threatened:</i></p> <ul style="list-style-type: none"> • CR – Critically Endangered • EN – Endangered • VU – Vulnerable • CD – Conservation Dependent <p><i>Other:</i></p> <ul style="list-style-type: none"> • MI – Migratory
State	
<p>Biodiversity Conservation Act 2016 (BC Act)</p> <p>In WA, native fauna are protected under the BC Act. Species in special need of protection are listed as being Extinct, Threatened or Specially Protected. Within these groups, species are listed under one of eight categories, depending on their specific conservation status. Migratory bird species are those listed under the Bonn Convention and/or CAMBA, JAMBA and ROKAMBA agreements.</p>	<p><i>Extinct:</i></p> <ul style="list-style-type: none"> • EX – Extinct <p><i>Threatened:</i></p> <ul style="list-style-type: none"> • CR – Critically Endangered • EN – Endangered • VU – Vulnerable <p><i>Specially Protected:</i></p> <ul style="list-style-type: none"> • MI – Migratory • CD – Conservation Dependent • OS – Other specially protected fauna
<p>DBCA Priority List</p> <p>The DBCA maintains a list of Priority species that are considered to be possibly threatened but have not been assigned statutory protection under the BC Act, as not enough information is available for an accurate determination of conservation status. These species are generally in urgent need of survey to determine their distribution and abundance.</p>	<p><i>Poorly Known:</i></p> <ul style="list-style-type: none"> • P1 – Priority 1 • P2 – Priority 2 • P3 – Priority 3 <p><i>Rare, Near Threatened and other</i></p> <ul style="list-style-type: none"> • P4 – Priority

¹See Appendix A for definitions of status codes

2 EXISTING ENVIRONMENT

2.1 Biogeography

As defined by the Interim Biogeographic Regionalisation of Australia (Thackway & Cresswell, 1995), the Study Area is located along the boundary of the Gascoyne and Pilbara bioregions, and occurs primarily within the Augustus (74.8%) and partly within the Hamersley (25.2%) subregions of the bioregions respectively (Table 2.1; Figure 1.1).

Table 2.1: IBRA bioregion and subregion of the Study Area

Bioregion	Subregion	Extent in Study Area	
		Area (ha)	%
Gascoyne Characterised by low, rugged ranges and broad, flat valleys. Vegetation is dominated by open mulga low woodlands (Bastin, 2008).	Augustus (GAS03) Comprises rugged low Proterozoic and granite ranges divided by broad flat valleys. Also includes the Narryera Complex and Bryah Basin of the Proterozoic Capricorn Orogen (on northern margins of the Yilgarn Craton), as well as the Archaean Marymia and Sylvania Inliers. Extensive areas of alluvial valley-filled deposits. Mulga woodland with <i>Triodia</i> on shallow stony loams on rises, while the shallow earthy loams over hardpan on the plains are covered by mulga parkland (Desmond <i>et al.</i> , 2001).	1,824.80	74.8%
Pilbara Characterised by vast coastal plains and inland mountain ranges with cliffs and deep gorges. Vegetation is predominantly mulga low woodlands or snappy gum over bunch and hummock grasses. (Bastin, 2008).	Hamersley (PIL03) Comprises the southern section of the Pilbara Craton. Mountainous area of Proterozoic sedimentary ranges and plateau, dissected by gorges (basalt, shale and dolerite). Mulga low woodland over bunch grasses on fine textured soils in valley floors, and <i>Eucalyptus leucophloia</i> over <i>Triodia brizoides</i> on skeletal soils of the ranges (Kendrick, 2001).	613.48	25.2%
Total		2,438.28	100%

2.2 Climate

The eastern Gascoyne and Pilbara bioregions have an arid climate with rainfall occurring primarily during summer months (Bastin, 2008). Summer rainfall in both bioregions is usually the result of tropical cyclones that occur to the north and northwest that impacts the coast and move inland, while sporadic winter rainfall is generally the result of cold fronts moving north-easterly across the regions (Leighton, 2004). Average annual in both regions is highly variable, with average rainfall ranging between 200 and 350 millimetres (mm) (Bastin, 2008), although there are significant fluctuations between years with up to 1,200 mm recorded at some locations in the Pilbara some years (BoM, 2020; McKenzie *et al.*, 2009).

Long-term climatic data is not available for the Study Area itself; however, long term climatic data is available from the Bureau of Meteorology (BoM) weather station at Newman Airport (station 7176), approximately 30 km west of the Study Area (BoM, 2020). This weather station is expected to provide the most accurate dataset for historic and current climatic conditions experienced within the Study Area (Figure 2.1). Temperatures vary significantly throughout the year with the highest temperatures recorded between November and March, when mean minimum and maximum temperatures are 22.2°C

and 39.3°C, respectively (Figure 2.1). The lowest temperatures are recorded between June and August, when mean minimum and maximum temperatures are 6.4°C and 26.1°C, respectively (Figure 2.1).

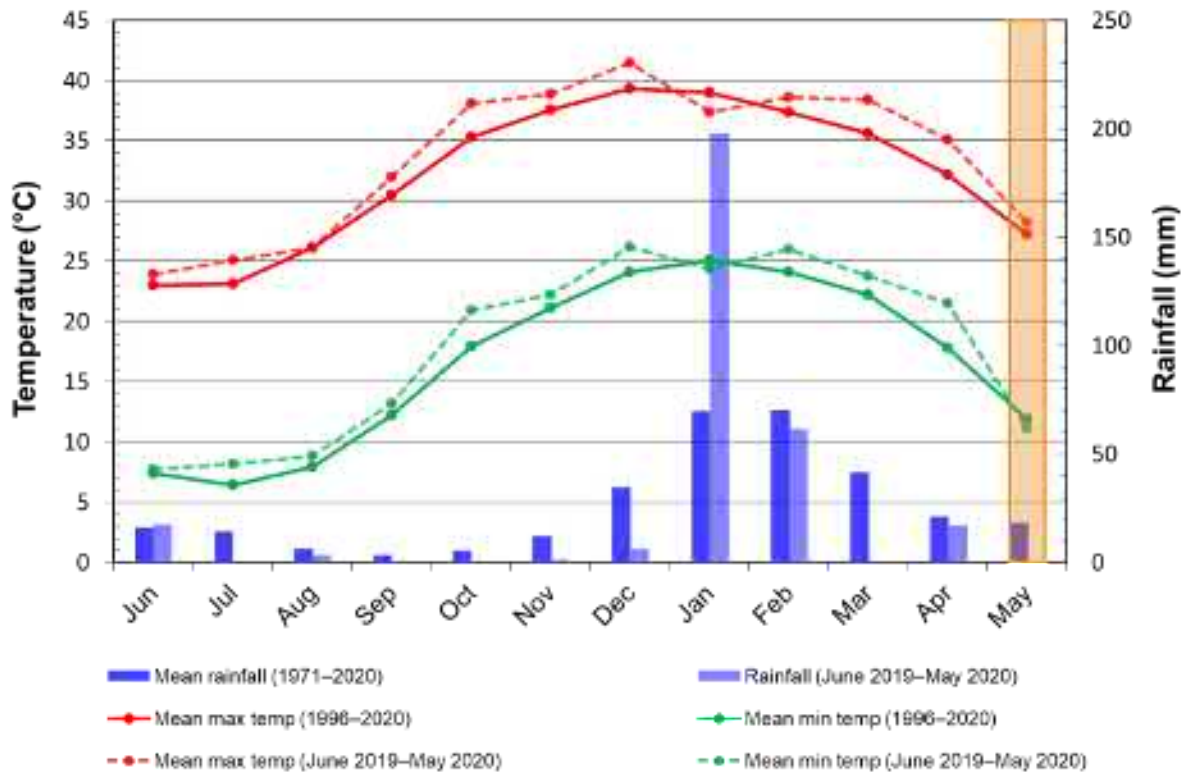


Figure 2.1: Long term average and pre-survey climate data for Newman Airport (Station # 007176) (BoM, 2020) with approximate survey timing shown in shaded boxes

2.3 Land Systems

Van Vreeswyk *et al.* (2004) classified and mapped the land systems of the Pilbara according to similarities in landform, soil, vegetation, geology and geomorphology. An assessment of land systems provides an indication of the diversity and distribution of fauna habitats present within the Study Area.

The Study Area intercepts seven land systems, comprising Cadgie, Divide, Jamindie, McKay, Newman, Sylvania and Washplain (DPIRD, 2020; Payne *et al.*, 1988; van Vreeswyk *et al.*, 2004) (Figure 2.2; Table 2.2). The dominant land system is the Divide land system, covering approximately 31.4% (765.21 ha) of the Study Area (Figure 2.2; Table 2.2). The Divide land system is defined as “gently undulating sandplains with minor dunes, supporting hard spinifex hummock grasslands with numerous shrubs” (DPIRD, 2020; van Vreeswyk *et al.*, 2004). The second most dominant is the Jamindie land system, covering approximately 16.3% (396.83 ha) of the Study Area (Figure 2.2; Table 2.2). The five remaining land systems (Washplain, Newman Cadgie, McKay and Sylvania) each occupy less than 15% of the Study Area each (Figure 2.2; Table 2.2).

Of the seven land systems occurring within the Study Area, the Divide, Newman and McKay land system generally contain the most significant habitats for many Matters of National Environmental Significance (MNES) species occurring in the Pilbara. This occurs as sandplains and dunes with

spinifex grasslands associated with the Divide land system which can support greater bilby and as the rocky ridges and mountains associated with Newman and McKay land systems, which can support important refugia and foraging habitats for Pilbara leaf-nosed bat, ghost bat, northern quoll and Pilbara olive python (DBCA, 2020a). None of the land systems occurring within the Study Area are limited in extent or protected as Priority Ecological Communities (DBCA, 2020b) (Figure 2.2; Table 2.2).

Table 2.2: Land systems occurring within the Study Area

Land System	Land Type	Description	Extent in Study Area	
			Area (ha)	%
Divide	Sandplains and occasional dunes with spinifex grasslands	Gently undulating sandplains with minor dunes, supporting hard spinifex hummock grasslands with numerous shrubs	765.20	31.4%
Jamindie	Wash plains on hardpan with mulga shrublands	Stony hardpan plains and rises supporting groved mulga shrublands, occasionally with spinifex understorey	396.82	16.3%
Washplain	Wash plains on hardpan with mulga shrublands	Hardpan plains supporting groved mulga shrublands	346.05	14.2%
Newman	Hills and ranges with spinifex grasslands	Rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands	288.89	11.8%
Cadgie	Wash plains and sandy banks on hardpan, with mulga shrublands and wanderrie grasses or spinifex	Hardpan plains with thin sand cover and sandy banks supporting mulga shrublands with soft and hard spinifex	334.08	13.7%
McKay	Hills and ranges with spinifex grasslands	Hills, ridges, plateaux remnants and breakaways of meta sedimentary and sedimentary rocks supporting hard spinifex grasslands with acacias and occasional eucalypts	193.19	7.9%
Sylvania	Stony plains with acacia shrublands	Gritty surfaced plains and low rises on granite supporting acacia-eremophila-cassia shrublands	114.05	4.7%
Total			2,438.28	100%

805000

807500

810000

812500

7412500

7410000



Legend

Study Area

Land systems

Cadgie Land System

Divide Land System

Jamindie Land System

McKay Land System

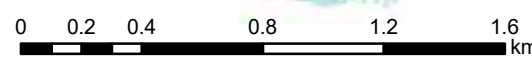
Newman Land System

Sylvania Land System

Washplain Land System



1:25,000



BHP Western Australian Iron Ore
Jimblebar Basic Vertebrate Fauna Survey
Figure 2.2: Land systems of the Study Area

Coordinate System: GDA 1994 MGA Zone 50
 Projection: Transverse Mercator
 Datum: GDA 1994

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2.4 Geology

The Study Area occurs across four broad (1:500,000) geological units (GSWA, 2016) (Table 2.3; Figure 2.3). The dominant geological unit occurring within the Study Area is the Sylvania Inlier granitic unit, occupying approximately 48.6%, followed by the Jeerinah Formation (37.6%), Marra Mamba Iron Formation (8.8%) and Wittenoom Formation (5.1%) (Table 2.3; Figure 2.3).

Table 2.3: Geological units occurring within the Study Area

Unit code	Unit name	Description	Extent in Study Area	
			Area (ha)	%
A-g-PYV	Sylvania Inlier Granitic Unit	Granite to granodiorite; metamorphosed and variably foliated	1,184.44	48.6%
A-FOj-xs-b	Jeerinah Formation	Siliciclastic sedimentary rocks, mafic volcanic rocks and minor felsic volcanic rocks; local carbonate rocks, chert, and dolerite sills	916.3	37.6%
A-HAm-cib	Marra Mamba Iron Formation	Chert, banded iron-formation, mudstone, and siltstone; minor carbonate; metamorphosed	214.31	8.8%
A-HAd-kd	Wittenoom Formation	Thinly bedded dolomite and dolomitic shale, with minor black chert, shale, banded iron formation and sandstone	123.23	5.1%
Total			2,438.28	100%

2.5 Soils

The National Committee on Soil and Terrain (2009) Atlas of Australian Soils described and mapped the soils of Australia following Bettany *et al.* (1967). The Study Area occurs across three soil units, BE6, Oc64 and Fa13 and (Table 2.4; Figure 2.4). The dominant soil unit is Fa13, which covers approximately 73% (1781.83 ha) of the Study Area (Table 2.4; Figure 2.4) and comprises ranges of banded jaspilite and chert along with shales, dolomites, and iron ore formations; some areas of ferruginous duricrust as well as occasional narrow winding valley plains and steeply dissected pediments. The soils are frequently stony and shallow and there are extensive areas without soil cover: chief soils are shallow stony earthy loams (Um5.51) along with some (Uc5.11) soils on the steeper slopes.

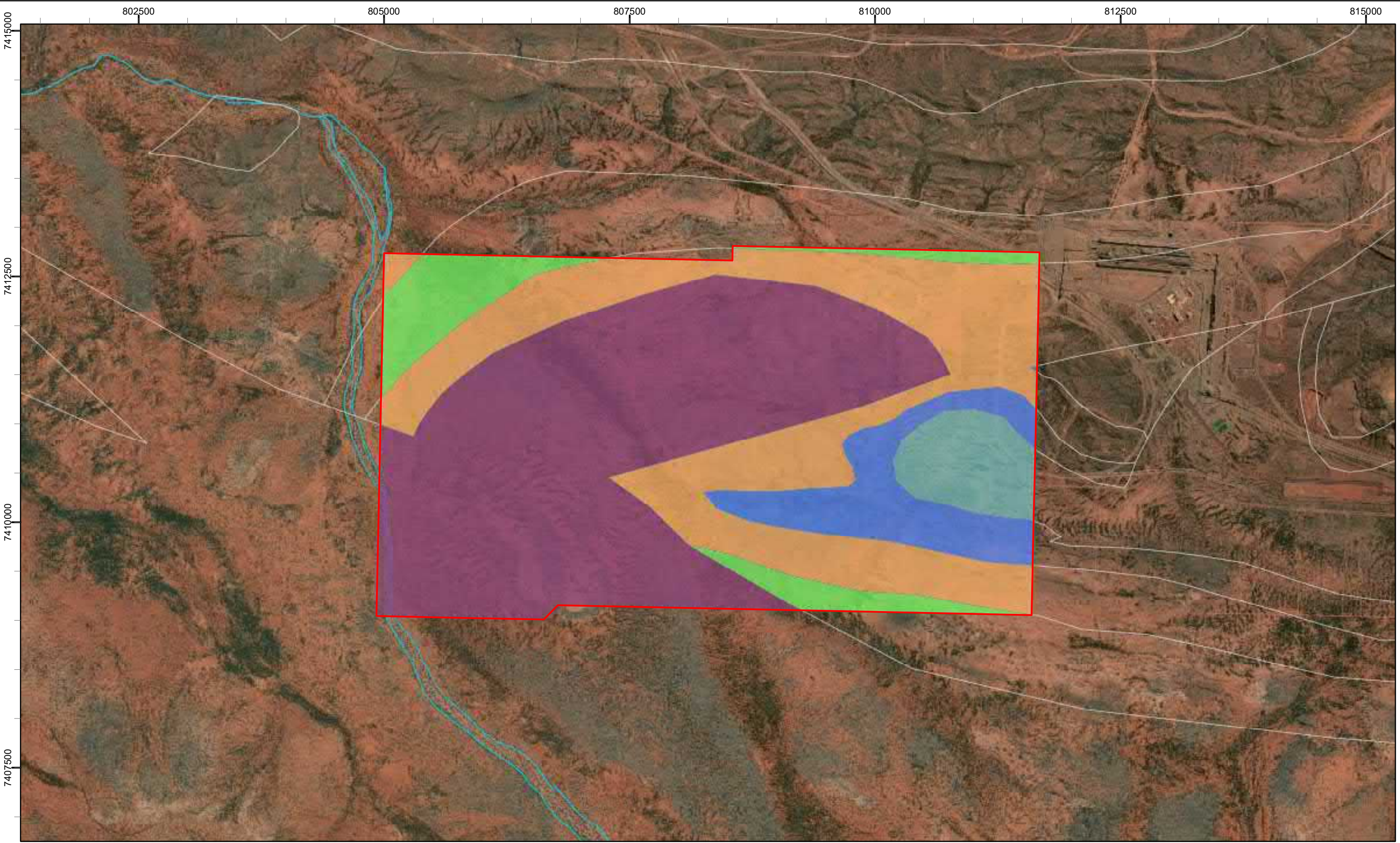
The second soil unit, covering approximately 26% (634.21 ha) of the Study Area, is Oc64 (Table 2.4; Figure 2.4). This soil unit comprises low stony hills and dissected pediments on granite with occasional basic dykes. The chief soils are hard alkaline red soils (Dr2.33) having shallow stony horizons. Associated are shallow stony (Uc5.11) soils on steep slopes, (Uc1.22) soils along creek lines, and (Um5.11) soils on patches of calcrete (kunkar). The remaining soil unit, BE6, covers only 0.9% (22.24 ha) of the Study Area and comprises extensive flat and gently sloping plains that sometimes have a surface cover of gravels and on which red-brown hardpan frequently outcrops. The chief soils are shallow earthy loams (Um5.3), with associated (Gn) soils of broad plains (My5O) and extensive flat and gently sloping plains (Mz23).







Table 2.4: Soil units within the Study Area


Soil unit	Description	Extent in Study Area	
		Area (ha)	%
BE6	Extensive flat and gently sloping plains that sometimes have a surface cover of gravels and on which red-brown hardpan frequently outcrops.	22.24	0.9%
Oc64	Low stony hills and dissected pediments on granite with occasional basic dykes.	634.21	26.0%
Fa13	Ranges of banded jaspilite and chert along with shales, dolomites, and iron ore formations; some areas of ferruginous duricrust as well as occasional narrow winding valley plains and steeply dissected pediments.	1,781.83	73.1%
Total		2,438.28	100%

2.6 Hydrology and Surface Drainage

The Study Area contains one major watercourse (Shovelanna Creek) which intersects the south-western corner of the Study Area (Figure 2.3). Other minor watercourses and drainage lines may occur throughout the Study Area; however, these are likely to be ephemeral and temporary only during or following large rainfall events.



Legend	
	Study Area
	Waterway
Geological units	
	A-FOj-bbo-HAS
	A-g-PSY
	A-FOj-xs-b-HAS
	A-HAd-kd-HAS
	A-HAm-cib-HAS



N
1:35,000
0 0.275 0.55 1.1 1.65 2.2 km

BHP Western Australian Iron Ore
Jimblebar Basic Vertebrate Fauna Survey
Figure 2.3: Broad geology and hydrology of the Study Area

Coordinate System: GDA 1994 MGA Zone 50
 Projection: Transverse Mercator
 Datum: GDA 1994

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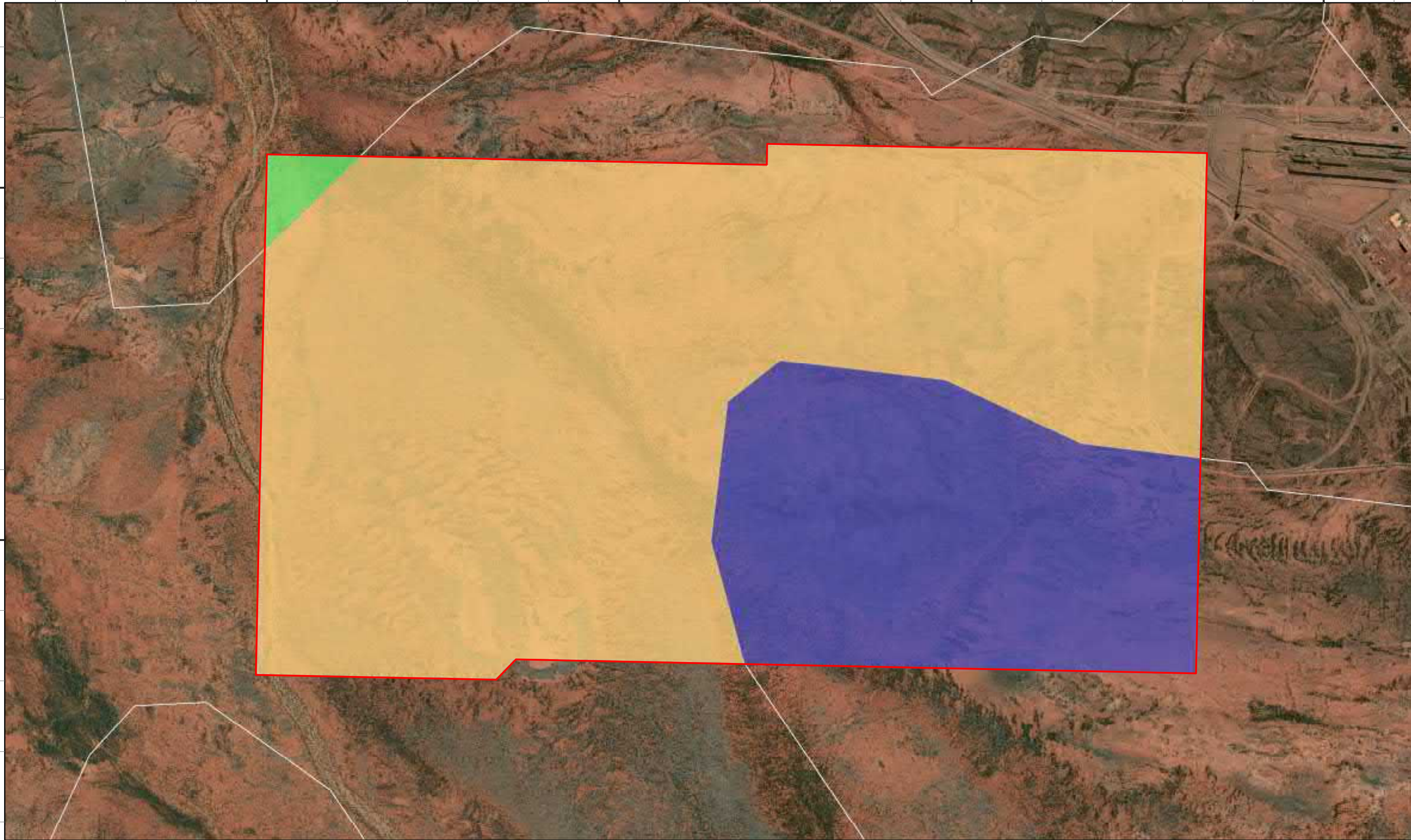
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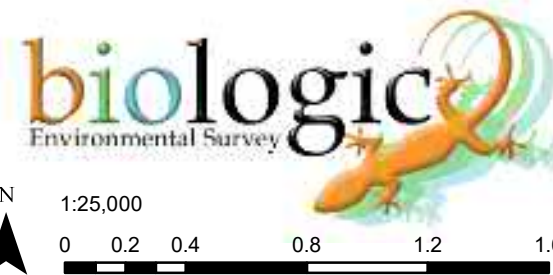
 Study Area

Soil units

 BE6

 Fa13

 Oc64



BHP Western Australian Iron Ore
Jimblebar Basic Vertebrate Fauna Survey
Figure 2.4: Soil units of the Study Area

Coordinate System: GDA 1994 MGA Zone 50
 Projection: Transverse Mercator
 Datum: GDA 1994

Size A3. Created 04/08/2020

2.7 Pre-European Vegetation

Beard (1975) broadly (1:1,000,000) mapped the major structural vegetation types of Western Australia. Shepherd *et al.* (2002) reinterpreted and updated the vegetation association mapping to reflect the National Vegetation Information System (NVIS) standards (ESCAVI, 2003). This update also accounts for extensive clearing since Beard (1975) mapping. Some of Beard’s vegetation associations have been separated to remove mosaic vegetation associations; however, some mosaics still occur.

The Study Area is located in the Fortescue Botanical District, within the Eremaean Province (Beard, 1990). The Fortescue Botanical District is essentially a tree and shrub-steppe with *Eucalyptus* spp. trees, *Acacia* shrubs, *Triodia pungens* and *T. wiseana* (Beard, 1990). Some mulga (*A. aneura* and close relatives) occurs in valleys and there are short-grass plains on alluvia (Beard, 1990).

Three vegetation associations occur within the Study Area (Table 2.5; Figure 2.5) (Shepherd *et al.*, 2002). The dominant vegetation association is association 29, which is defined as “sparse low woodland; mulga, discontinuous in scattered groups” (Shepherd *et al.*, 2002) and covers approximately 71.2% (1,736.78 ha) of the Study Area. The remaining vegetation associations, 82 and 216, cover approximately 15.1% (367.47 ha) and 13.7% (334.03 ha) of the Study Area respectively (Table 2.5; Figure 2.5).

Table 2.5 Vegetation system associations occurring within the Study Area

Vegetation Association	Description (Shepherd <i>et al.</i> , 2002)	Extent in Study Area	
		Area (ha)	%
29	Sparse low woodland; mulga, discontinuous in scattered groups	1,736.78	71.2%
82	Hummock grasslands, low tree steppe; snappy gum over <i>Triodia wiseana</i>	367.47	15.1%
216	Low woodland; mulga (with spinifex) on rises	334.03	13.7%
Total		2,438.28	100%

805000

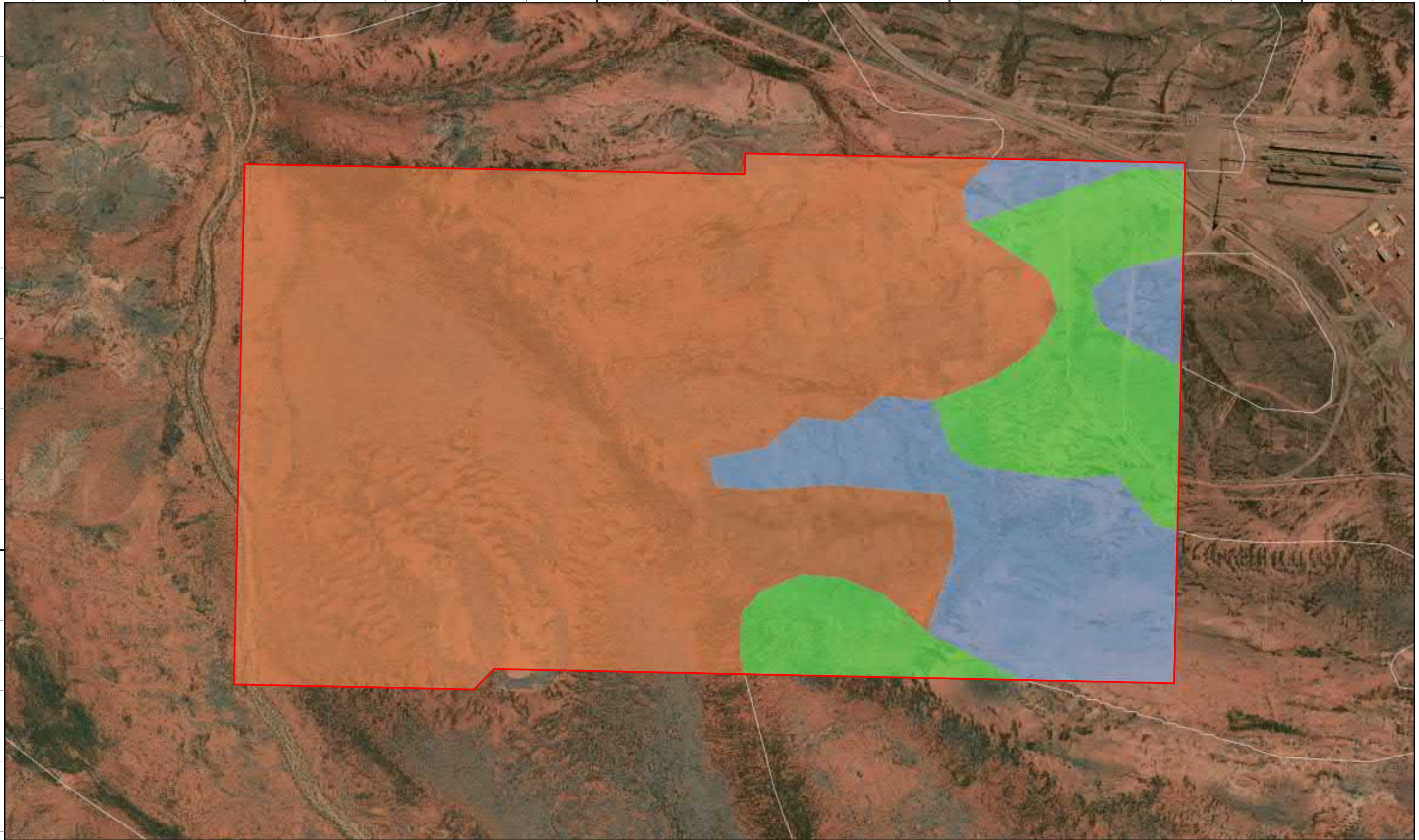
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Legend

Study Area

Vegetation Association

- 29: Sparse low woodland; mulga, discontinuous in scattered groups
- 82: Hummock grasslands, low tree steppe; snappy gum over *Triodia wiseana*
- 216: Low woodland; mulga (with spinifex) on rises

1:25,000

BHP Western Australian Iron Ore
Jimblebar Basic Vertebrate Fauna Survey
Figure 2.5: Pre-European vegetation associations of the Study Area

Coordinate System: GDA 1994 MGA Zone 50
 Projection: Transverse Mercator
 Datum: GDA 1994

Size A3. Created 04/08/2020

2.8 Threatened and Priority Ecological Communities

No Threatened Ecological Communities (TECs) or Priority Ecological Communities (PECs) occur within the Study Area (Figure 2.6). One TEC (Ethel Gorge Aquifer Stygobiont Community) and one PEC (Fortescue Valley Sand Dunes) occur within 50 km of the Study Area (Figure 2.6; Table 2.6); however, neither have conservation values related to terrestrial vertebrate fauna.

Table 2.6: Threatened and Priority Ecological Communities within 50 km of the Study Area

Name	Status	Description (DBCA, 2020b)	Distance from Study Area	Applied Buffer
TEC				
Ethel Gorge Aquifer Stygobiont Community	Endangered	Stygofauna communities of the Ethel Gorge Aquifer	45.3 NW	5 km
PEC				
Fortescue Valley Sand Dunes	Priority 3	Vegetation of sand dunes of the Hamersley Range/Fortescue Valley	6.5 km W	500 m

2.9 Land Use and Tenure

The Study Area is located within the northern portion of the Sylvania pastoral lease, which is actively utilised for the grazing of cattle (Figure 1.1). Dominant land use within the Study Area is native pasture to date, with some mining related infrastructure (road and rail) occurring in the north-eastern corner of the Study Area.

Tenure within the Study Area comprises four live tenements which overlap parts of the Study Area, including one exploration license (E522591-I), one mining lease (M266SA) and two miscellaneous licenses (I52/108 and L52/109) (Figure 1.1).

765000 780000 795000 810000 825000 840000 855000

7455000
7440000
7425000
7410000



Legend

- Study Area
- TEC**
- Ethel Gorge Aquifer Stygobiont Community
- PEC**
- Fortescue Valley Sand Dunes

biologic
Environmental Survey

N
1:275,000
0 2 4 8 12 16 km

BHP Western Australian Iron Ore
Basic Vertebrate Fauna Survey
Figure 2.6: Threatened and Priority Ecological Communities occurring within 50km of the Study Area

Coordinate System: GDA 1994 MGA Zone 50
 Projection: Transverse Mercator
 Datum: GDA 1994

Size A3. Created 04/08/2020

3 DESKTOP ASSESSMENT

3.1 Methods

3.1.1 Database Searches

Five fauna databases were searched, three to obtain information on all species previously recorded in the search area (NatureMap, Birddata and BHP WAIO Fauna Records Database), one to identify locations of species of conservation significance previously recorded (DBCA Threatened Fauna Database), and one to identify species of conservation significance known or likely to occur within the region based on habitat modelling (Protected Matters Search Tool) (Table 3.1).

Table 3.1: Details of database searches conducted

Database	Data Access/Receival Date	Search Area
DBCA (2020a) NatureMap	12/05/2020	Study Area with a 40 km buffer
DBCA (2020c) Threatened and Priority Fauna Database	15/05/2020	
Birdlife Australia (2020) Birdata	12/05/2020	
Department of Environment and Energy (DoEE, 2020) Protected Matters Search Tool	12/05/2020	
BHP (2020) BHP WAIO Fauna Records Database	01/09/2020	Study Area with 40 km buffer. Includes any biological surveys completed for BHP WAIO within search area.

3.1.2 Literature Review

A review of available literature relevant to the Study Area was undertaken to compile a list of fauna habitats and vertebrate fauna species with the potential to occur within the Study Area. A total of ten assessments were reviewed, comprising four single-season and three two-season detailed (formerly Level 2) surveys, two basic (formerly Level 1) surveys and one desktop assessments (Table 3.2).

Table 3.2: Literature sources used for the review

Survey	Reference	Survey Type	Distance from Study Area (km)
Biologic (2013) South West Jimblebar Vertebrate Fauna Assessment	A	Single-season detailed	Directly adjacent (south) of Study Area
Biologic (2014a) Dynasty Tenement - Desktop Review of Vertebrate Fauna and Habitats	B	Desktop	Within part (western portion) of Study Area
Biologic (2016a) Dynasty Level 1 Vertebrate Fauna Survey	C	Basic	Within part (western portion) of Study Area
Biologic (2016b) Dynasty Level 2 Vertebrate Fauna Survey	D	Single-season detailed	Within part (western portion) of Study Area
Biologic (2018b) Dynasty Vertebrate Fauna Monitoring 2018	E	Single-season detailed	Within part (western portion) of Study Area
ENV (2007) West Jimblebar Lease Fauna Assessment	F	Single-season detailed	Within part (central portion) of Study Area
ENV (2009) Newman to Jimblebar Transmission Line and Newman Town Substation Terrestrial Fauna Assessment	G	Basic	~4 km north-west
Outback Ecology (2009a) Jimblebar Iron Ore Project: Terrestrial vertebrate fauna assessment	H	Duel-season detailed	Within part (eastern portion) of Study Area
Outback Ecology (2009b) Jimblebar Linear Development Terrestrial Vertebrate Assessment	I	Duel-season detailed	~4 km north-west
Outback Ecology (2009c) Wheelarra Hill Iron Ore Mine Modification. Flora and Fauna Assessment	J	Duel-season detailed	~5 km E

3.2 Results

The desktop assessment identified a total of 355 vertebrate fauna species that have been previously recorded in the vicinity of or have the potential to occur, in the Study Area. This comprised 47 mammals (38 native and nine introduced), 198 birds (197 native and one introduced), 101 reptiles, and nine amphibians (Table 3.3; Appendix C). Due to the size of the desktop assessment search area, and likelihood of encompassing habitats which may not occur within the Study Area. Additionally, many species tend to be patchily distributed even where appropriate habitats are present, and many species of birds can occur as regular migrants, occasional visitors or vagrants. Thus, results of the desktop assessment represent an overly conservative list of species for the area, and thus many may not actually occur within the Study Area.

Table 3.3: Species richness recorded by previous surveys and database searches

Source	Mammals (native)	Mammals (introduced)	Birds (native)	Birds (introduced)	Reptiles	Amphibians	Total
Literature Source							
A (Biologic, 2013)	15	6	55		38	2	116
B (Biologic, 2014a)							
C (Biologic, 2016a)	9	4	27		2		42
D (Biologic, 2016b)	15	1	39		32	2	89
E (Biologic, 2018b)	16	2	25		15	4	62
F (ENV, 2007)	4	5	72		27		108
G (ENV, 2009)	7	2	57		12	1	79
H (Outback Ecology, 2009a)	11	6	46		26	2	91
I (Outback Ecology, 2009b)	15	2	80		45	4	146
J (Outback Ecology, 2009c)	10	4	26		20		60
Database searches							
NatureMap (DBCA, 2020a)	33	6	170		92	9	310
Protected Matters (DoEE, 2020)	4	8	1	1	1		30
Birdata (Birdlife Australia, 2020)			162				162
Threatened and Priority Fauna (DBCA, 2020c)	7		3		3		24
BHP WAIO Fauna Records (BHP, 2020)	36	8	178		103	9	334
Total number of species	38	9	197	1	101	9	355
Total number of species of conservation significance	9		28		3		40

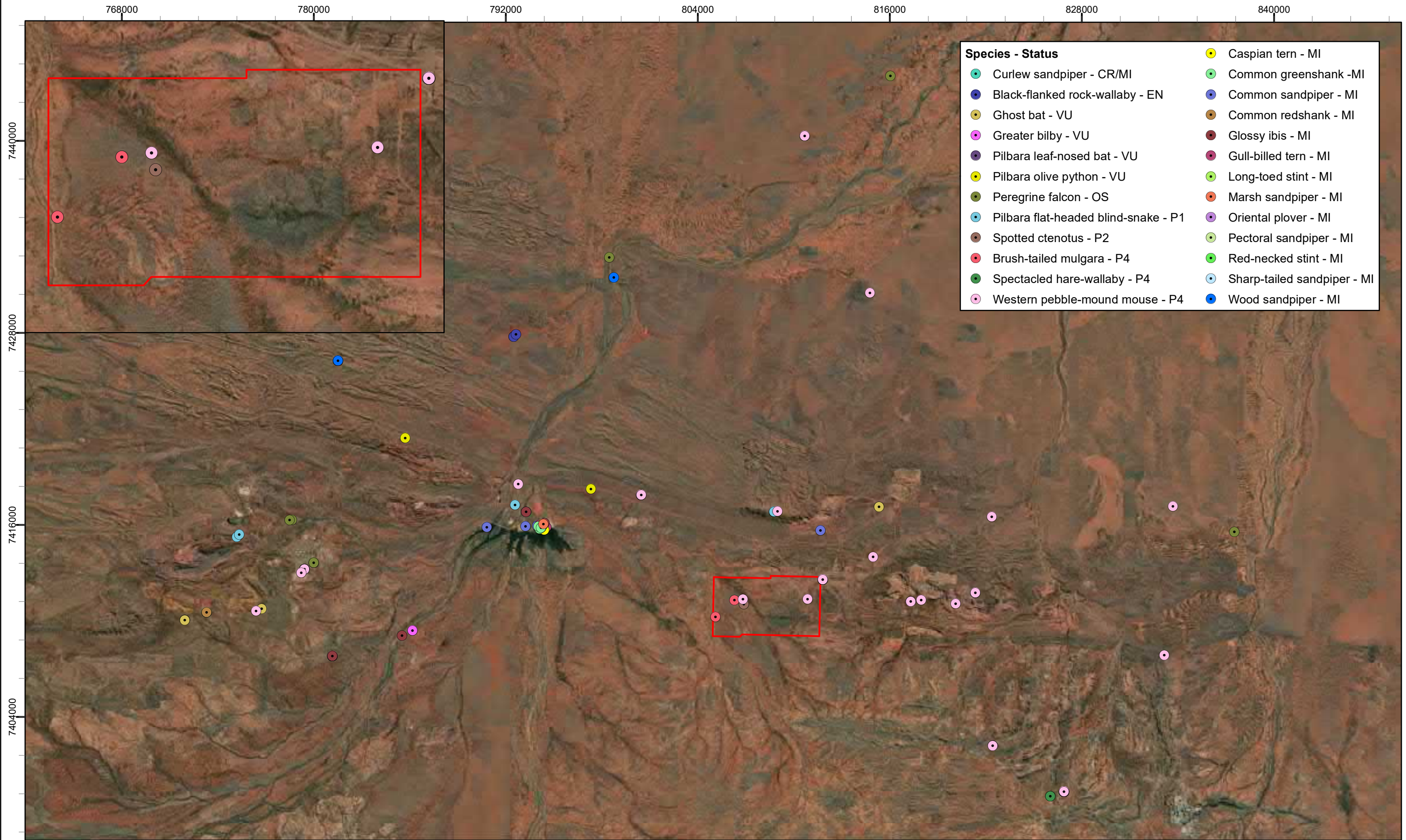
Of the 355 species identified by the desktop assessment, 40 are species listed as conservation significance, comprising nine mammals, 28 birds and three reptiles (Table 3.4; Figure 3.1; Figure 3.2). Of these, the brush-tailed mulgara (*Dasyercus blythi* – Priority 4 DBCA), western pebble-mound mouse (*Pseudomys chapmani* – Priority 4 DBCA) and spotted ctenotus (*Ctenotus uber* subsp. *johnstonei* – Priority 2 DBCA) have previously been recorded within the Study Area (BHP, 2020; Biologic, 2016a, 2016b, 2018b; DBCA, 2020c) (Figure 3.1; Figure 3.2).

Due to the historic nature or record type (i.e. secondary evidence of historic occurrence), some records represent historic occupation of species which have suffered significant declines and are now considered regionally extinct in the vicinity of the Study Area. This includes lesser stick-nest rat (*Leporillus apicalis*), for which is considered extinct in the Pilbara region and records are primarily associated with secondary evidence of past occurrence (i.e. stick-nests) (Burbidge, 2004; Menkhorst & Knight, 2014). The species is considered Highly Unlikely to occur within the Study Area and is not discussed further in this report.

Table 3.4: Species of conservation significance identified by the desktop assessment

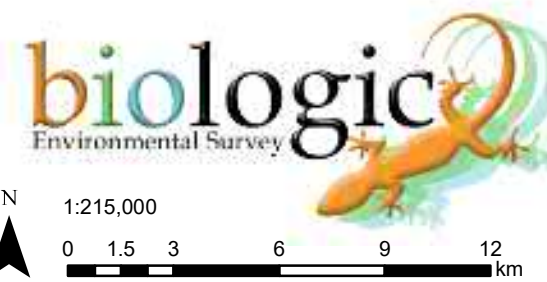
Genus and Species	Common Name	Conservation Status			
		EPBC Act	BC Act	DBCA	IUCN
MAMMALS					
DASYURIDAE					
<i>Dasyercus blythi</i>	Brush-tailed mulgara			P4	
<i>Dasyurus hallucatus</i>	Northern quoll	EN	EN		EN
<i>Sminthopsis longicaudata</i>	Long-tailed dunnart			P4	
HIPPOSIDERIDAE					
<i>Rhinonicteris aurantia</i> Pilbara form	Pilbara leaf-nosed bat	VU	VU		
MACROPODIDAE					
<i>Lagorchestes conspicillatus</i> subsp. <i>leichardti</i>	Spectacled hare-wallaby			P4	
<i>Petrogale lateralis</i> subsp. <i>lateralis</i>	Black-flanked rock-wallaby	EN	EN		NT
MEGADERMATIDAE					
<i>Macroderma gigas</i>	Ghost bat	VU	VU		VU
MURIDAE					
<i>Leporillus apicalis</i>	Lesser stick-nest rat	EX	EX		
<i>Pseudomys chapmani</i>	Western pebble-mound mouse			P4	
THYLACOMYIDAE					
<i>Macrotis lagotis</i>	Greater bilby	VU	VU		VU
AVES					
ANATIDAE					
<i>Anas querquedula</i>	Garganey	MI	MI		
APODIDAE					
<i>Apus pacificus</i>	Fork-tailed swift	MI	MI		
CHARADRIIDAE					
<i>Charadrius dubius</i>	Little ringed plover	MI	MI		
<i>Charadrius veredus</i>	Oriental plover	MI	MI		
CICONIIDAE					
<i>Ephippiorhynchus asiaticus</i>	Black-necked stork				NT
FALCONIDAE					
<i>Falco hypoleucos</i>	Grey falcon	VU	VU		VU
<i>Falco peregrinus</i>	Peregrine falcon		OS		
HIRUNDINIDAE					
<i>Hirundo rustica</i>	Barn swallow	MI	MI		
LARIDAE					
<i>Sterna caspia</i>	Caspian tern	MI	MI		
<i>Gelocheidon nilotica</i>	Gull-billed tern	MI	MI		

Genus and Species	Common Name	Conservation Status			
		EPBC Act	BC Act	DBCA	IUCN
MOTACILLIDAE					
<i>Motacilla cinerea</i>	Grey wagtail	MI	MI		
<i>Motacilla flava</i>	Yellow wagtail	MI	MI		
PSITTACIDAE					
<i>Pezoporus occidentalis</i>	Night parrot	EN	CR		EN
<i>Polytelis alexandrae</i>	Princess parrot	VU		P4	NT
ROSTRATULIDAE					
<i>Rostratula benghalensis</i> subsp. <i>australis</i>	Australian painted snipe	EN	EN		EN
SCOLOPACIDAE					
<i>Calidris acuminata</i>	Sharp-tailed sandpiper	MI	MI		
<i>Calidris ferruginea</i>	Curlew sandpiper	CR/ MI	CR/ MI		NT
<i>Calidris melanotos</i>	Pectoral sandpiper	MI	MI		
<i>Calidris ruficollis</i>	Red-necked stint	MI	MI		NT
<i>Calidris subminuta</i>	Long-toed stint	MI	MI		
<i>Limosa limosa</i>	Black-tailed godwit	MI	MI		NT
<i>Philomachus pugnax</i>	Ruff	MI	MI		
<i>Tringa glareola</i>	Wood sandpiper	MI	MI		
<i>Tringa hypoleucos</i>	Common sandpiper	MI	MI		
<i>Tringa nebularia</i>	Common greenshank	MI	MI		
<i>Tringa stagnatilis</i>	Marsh sandpiper	MI	MI		
<i>Tringa totanus</i>	Common redshank	MI	MI		
THRESKIORNITHIDAE					
<i>Plegadis falcinellus</i>	Glossy ibis	MI	MI		
REPTILES					
BOIDAE					
<i>Liasis olivaceus</i> subsp. <i>barroni</i>	Pilbara olive python	VU	VU		
SCINCIDAE					
<i>Ctenotus uber</i> subsp. <i>johnstonei</i>	Spotted ctenotus			P2	
TYPHLOPIDAE					
<i>Anilius ganeii</i>	Pilbara flat-headed blind-snake			P1	



Legend

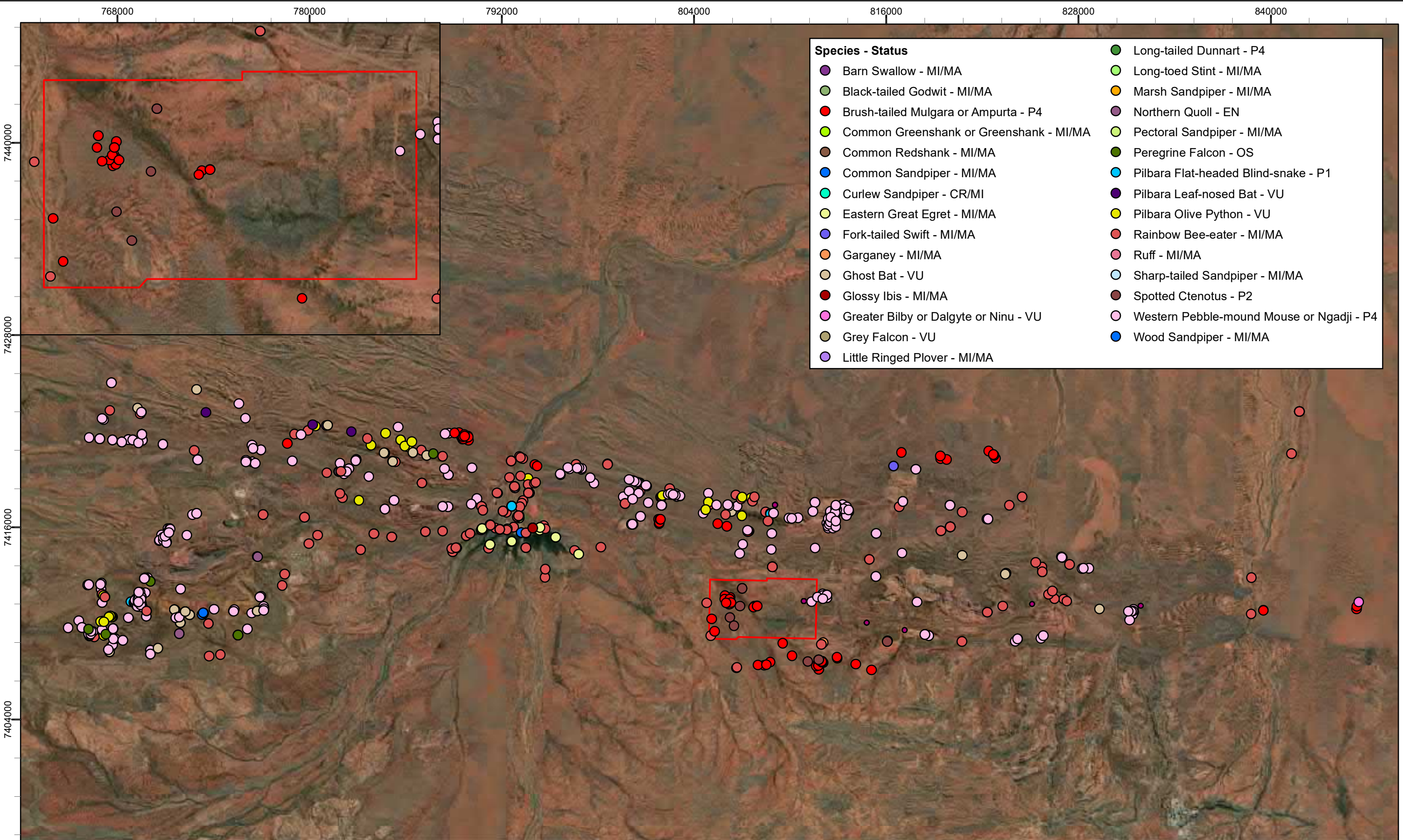
□ Study Area



BHP Western Australian Iron Ore
Jimblebar Basic Vertebrate Fauna Survey
 Figure 3.1: Vertebrate fauna species of conservation significance identified by BDCA in the desktop assessment

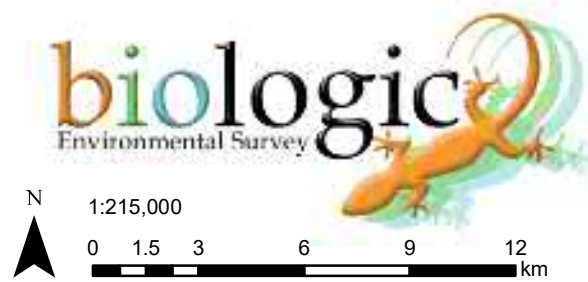
Coordinate System: GDA 1994 MGA Zone 50
 Projection: Transverse Mercator
 Datum: GDA 1994

Size A3. Created 04/08/2020



- Species - Status**
- Barn Swallow - MI/MA
 - Black-tailed Godwit - MI/MA
 - Brush-tailed Mulgara or Ampurta - P4
 - Common Greenshank or Greenshank - MI/MA
 - Common Redshank - MI/MA
 - Common Sandpiper - MI/MA
 - Curlew Sandpiper - CR/MI
 - Eastern Great Egret - MI/MA
 - Fork-tailed Swift - MI/MA
 - Garganey - MI/MA
 - Ghost Bat - VU
 - Glossy Ibis - MI/MA
 - Greater Bilby or Dalgyte or Ninu - VU
 - Grey Falcon - VU
 - Little Ringed Plover - MI/MA
 - Long-tailed Dunnart - P4
 - Long-toed Stint - MI/MA
 - Marsh Sandpiper - MI/MA
 - Northern Quoll - EN
 - Pectoral Sandpiper - MI/MA
 - Peregrine Falcon - OS
 - Pilbara Flat-headed Blind-snake - P1
 - Pilbara Leaf-nosed Bat - VU
 - Pilbara Olive Python - VU
 - Rainbow Bee-eater - MI/MA
 - Ruff - MI/MA
 - Sharp-tailed Sandpiper - MI/MA
 - Spotted Ctenotus - P2
 - Western Pebble-mound Mouse or Ngadji - P4
 - Wood Sandpiper - MI/MA

Legend
 □ Study Area



BHP Western Australian Iron Ore
Jimblebar Basic Vertebrate Fauna Survey
Figure 3.2: Vertebrate fauna species of conservation significance identified by BHP in the desktop assessment

Coordinate System: GDA 1994 MGA Zone 50
 Projection: Transverse Mercator
 Datum: GDA 1994
 Size A3. Created 20/10/2020

4 FIELD SURVEY METHODS

4.1 Conformance

This assessment was carried out in a manner consistent with the following guidelines and recommendations from the EPA, DBCA, the Department of Agriculture, Water and the Environment (DAWE; formerly DEHWA, DSEWPaC, DoE) and BHP WAIO:

- BHP (2017) Guidance for terrestrial vertebrate fauna surveys in the Pilbara. Procedure document number: SPR-IEN-EMS-012;
- DBCA (2017) Guidelines for surveys to detect the presence of bilbies, and assess the importance of habitat in Western Australia;
- DEWHA (2010a) Survey guidelines for Australia's threatened bats;
- DEWHA (2010b) Survey guidelines for Australia's threatened birds;
- DoE (2016) EPBC Act referral guideline for the endangered northern quoll (*Dasyurus hallucatus*);
- DPaW (2017) Interim guidelines for the preliminary surveys of night parrot (*Pezoporus occidentalis*) in Western Australia;
- DSEWPaC (2011a) Survey guidelines for Australia's threatened mammals;
- DSEWPaC (2011b) Survey guidelines for Australia's threatened reptiles;
- DoE (2013) Significant impact guidelines 1.1: Matters of national Environmental significance;
- EPA (2018) Statement of environmental principles, factors and objectives;
- EPA (2020) Technical guidance: Terrestrial vertebrate fauna surveys for environmental impact assessment.

As of July 2020, EPA (2016b) and EPA (2016c) been replaced with EPA (2020) *Technical guidance: terrestrial vertebrate fauna surveys for environmental impact assessment*. The current survey largely conforms with EPA (2020); however, as the timing of the field sampling component of the survey predates the revised guidance, some sampling effort differs (i.e. number recording nights for ultrasonic recorders). Although a

4.2 Timing and Weather

The field survey was undertaken over six days between the 7th and 12th May 2020. Observed temperatures during the survey were comparable to long-term minimum and maximum averages for May (11.1°C and 28.2°C respectively), with minimum temperatures ranging between 11.6–19.1°C (mean 15.8°C) and maximum temperatures ranging between 25.9–29.4°C (mean 28.2°C) (Table 4.1; Figure 2.1). No rainfall was recorded during the survey.

In the 12 months prior to the surveys, mean minimum and maximum temperatures recorded at Newman Airport were similar to or slightly higher than long-term averages for most months, with above average temperatures recorded throughout most of the year (Figure 2.1). Rainfall in the 12 months prior to the

surveys was variable, with below long-term averages recorded throughout most of the year (Figure 2.1). Well above average rainfall was recorded during January 2020, which occurred as a result of multiple cyclones occurring in the north-west and subsequent rainfall (Figure 2.1).

Table 4.1: Daily climate data recorded at Newman Airport during the field survey (BoM, 2020)

Date	Rainfall (mm)	Temperature (°C)	
		Min	Max
07/05/2020	0	15.5	29.2
08/05/2020	0	13.5	29.4
09/05/2020	0	17.9	26.0
10/05/2020	0	19.1	25.9
11/05/2020	0	17.1	29.6
12/05/2020	0	11.6	29.0
Total/Average	0	15.8	28.2

4.3 Survey Team and Licensing

The fauna sampling for this survey was conducted under a DBCA Regulation 27 “Fauna Taking (Biological Assessment) License” (BA27000247) issued to C. Knuckey. The assessment was undertaken by Aidan Williams, a Zoologist with extensive experience with fauna in the Pilbara.

4.4 Sampling and Survey Methods

The field survey was carried out in a manner consistent with the guidelines and recommendations listed in Section 4.1. Survey effort and sampling locations were selected based on a number of principles:

- Survey effort was focused in areas deemed most likely to record the target species based on the type and quality of habitat present;
- Survey effort was, where possible, spread across the Study Area to ensure adequate geographical coverage, though was constrained by access;
- Survey effort focussed on areas that had not had any prior sampling effort (Figure 4.1); and
- Sampling was often focussed at or near previous records of the target species, including within records from outside the Study Area, though within instances of the same habitat.

4.4.1 Habitat Assessments

Habitat assessments were undertaken in the field to characterise and define habitats and their significance to vertebrate fauna. A total of 95 vertebrate fauna habitat assessments were conducted within the Study Area (Figure 4.1; Appendix B; Appendix D). Habitat assessments were conducted and attributes assessed using attribute terminology prescribed by BHP, which have been modified from the *Australian Soil and Land Survey Field Handbook* (National Committee on Soil and Terrain, 2009). The characteristics recorded during the habitat assessments were:

- site information, photo and location;
- landform: slope, relative inclination of slope, morphological type and landform type;

- vegetation: leaf litter %, wood litter, hollow bearing trees, broad floristic formation, vegetation structure (tall, mid and low), and dominant species;
- land surface: micro relief, sheet erosion, rill erosion, gully erosion, gully depth, abundance and size of coarse fragments, rock outcropping, water bodies, comments on nests, burrows, roosts and diggings;
- soil: texture, colour;
- substrate: bare ground, rock size, rock type, rock outcropping; and
- disturbance: time since last fire, evidence of weeds, grazing, or human disturbances.

Additionally, a further four opportunistic short-range endemic (SRE) invertebrate fauna habitat assessments were conducted within the Study Area (Appendix E). No targeted sampling for SRE invertebrate fauna was undertaken during the field survey and no further analysis of SRE habitats is included in this report.

4.4.2 Targeted Searches

Targeted searches were undertaken throughout the Study Area within habitats considered likely to support species of conservation significance. Targeted searches comprised searching for occurrence of conservation significant species (i.e. direct observation and/or secondary evidence such as tracks, scats and nests) and habitats and/or habitat features of significance (i.e. dens, caves and water features) likely to be utilised by particular species.

Searches were undertaken at all sites within the Study Area where habitat was considered suitable for species of conservation significance, including northern quoll, Pilbara leaf-nosed bat and ghost (cave searches only), greater bilby, spectacled hare-wallaby, brush-tailed mulgara and Pilbara olive python (Figure 4.1; Appendix B). Additionally, more intensive sampling was completed for some conservation significant species where deemed suitable (i.e. targeted sampling for northern quoll, greater bilby, mulgara and night parrot), which are discussed further below.

4.4.3 Ultrasonic Bat Recorders

SongMeter (SM; Wildlife Acoustics Inc.) ultrasonic bat recorders were deployed at three locations within the Study Area (Table 4.2; Figure 4.1). At each location, recorders were placed in or in the vicinity of areas of prospective foraging and/or roosting habitats and features most likely to be utilised by bats, including ghost bat and Pilbara leaf-nosed bat. Recorders were deployed between two and eight nights at each location for a total of 12 recording nights (Table 4.2). The audio settings used for all the SM units followed the manufacturer's recommendations (Wildlife Acoustics, 2011, 2017) in conjunctions with those required to adequately record all species known to occur within the region (Gibson & McKenzie, 2009). Bat calls were analysed by Robert Bullen of Bat Call WA.

Table 4.2: Ultrasonic sampling locations within the Study Area

Site	Habitat	Latitude	Longitude	Sampling Nights
VJMW-001	Stony Plain	-23.3881	120.0188	8
VJMW-007	Hardpan Plain	-23.3669	119.9842	2
VJMW-069	Major Drainage Line	-23.3884	119.9837	2
Total				12

4.4.4 Targeted Sampling – Northern Quoll Camera Transect

Targeted sampling for northern quoll was undertaken by deploying a motion camera transect, which is the “recommended detection technique” of DoE (2016). One northern quoll motion camera transect was established within Hillcrest/ Hillslope habitat during the field survey (VJMW-001; Figure 4.1). The configuration and sampling duration of motion camera sites also followed sampling recommendations of DoE (2016), comprising ten motion cameras placed approximately 50–100 metres apart. Cameras were baited with universal bait (a mixture of oats, peanut butter, and sardines) within a non-reward receptacle and remained deployed for a total of 65 nights each, resulting in a total of 650 motion camera sample nights.

4.4.5 Targeted Sampling – Greater Bilby Plot Searches and Camera Transect

Greater bilby sampling within the Study Area comprised plot searches and deployment of a single motion camera transect (Table 4.3; Figure 4.1). Plot searches within the Study Area comprised 2 ha survey plots (bilby plots) distributed within areas of suitable Sand Plain and Hardpan Plain habitat across the Study Area, in accordance with DBCA survey guidelines for the species (DBCA, 2017) (Table 4.3; Figure 4.1). Each bilby plot was subjected to targeted searches for a minimum of 30 minutes and comprised searches for secondary evidence for the species (i.e. burrows, diggings, tracks and scats, as described by Southgate *et al.* (2019). Additionally, targeted searches for evidence of brush-tailed mulgara (i.e. burrows and tracks) were undertaken concurrently with targeted bilby searches within all bilby plots. Overall, a total of 13 bilby plots were sampled for greater bilby and brush-tailed mulgara during the field survey, with targeted searches for the species totalling 6.5 person hours (Table 4.3).

One motion camera transect comprising six cameras was established within suitable Sand Plain habitat for the species during the field survey (VJMW-008; Figure 4.1). The camera transect was deployed for a total of 65 nights, resulting in a total of 390 motion camera sample nights.

Table 4.3: Bilby plot sampling locations within the Study Area

Site	Habitat	Latitude	Longitude	Search Hours
VJMW-017	Hardpan Plain	-23.3935	119.9885	0.5
VJMW-019	Sand Plain	-23.3826	119.9887	0.5
VJMW-020	Sand Plain	-23.3746	119.9894	0.5
VJMW-021	Sand Plain	-23.3800	119.9939	0.5
VJMW-024	Sand Plain	-23.3925	120.0000	0.5
VJMW-026	Sand Plain	-23.3813	120.0136	0.5
VJMW-032	Hardpan Plain	-23.3753	120.0183	0.5
VJMW-034	Sand Plain	-23.3777	119.9887	0.5
VJMW-038	Hardpan Plain	-23.3842	120.0373	0.5
VJMW-040	Sand Plain	-23.3776	120.0237	0.5
VJMW-041	Sand Plain	-23.3768	120.0293	0.5
VJMW-050	Sand Plain	-23.3755	120.0395	0.5
VJMW-056	Sand Plain	-23.3786	119.9977	0.5
Total				6.5

4.4.6 Targeted Sampling – Night Parrot Acoustic Recorders

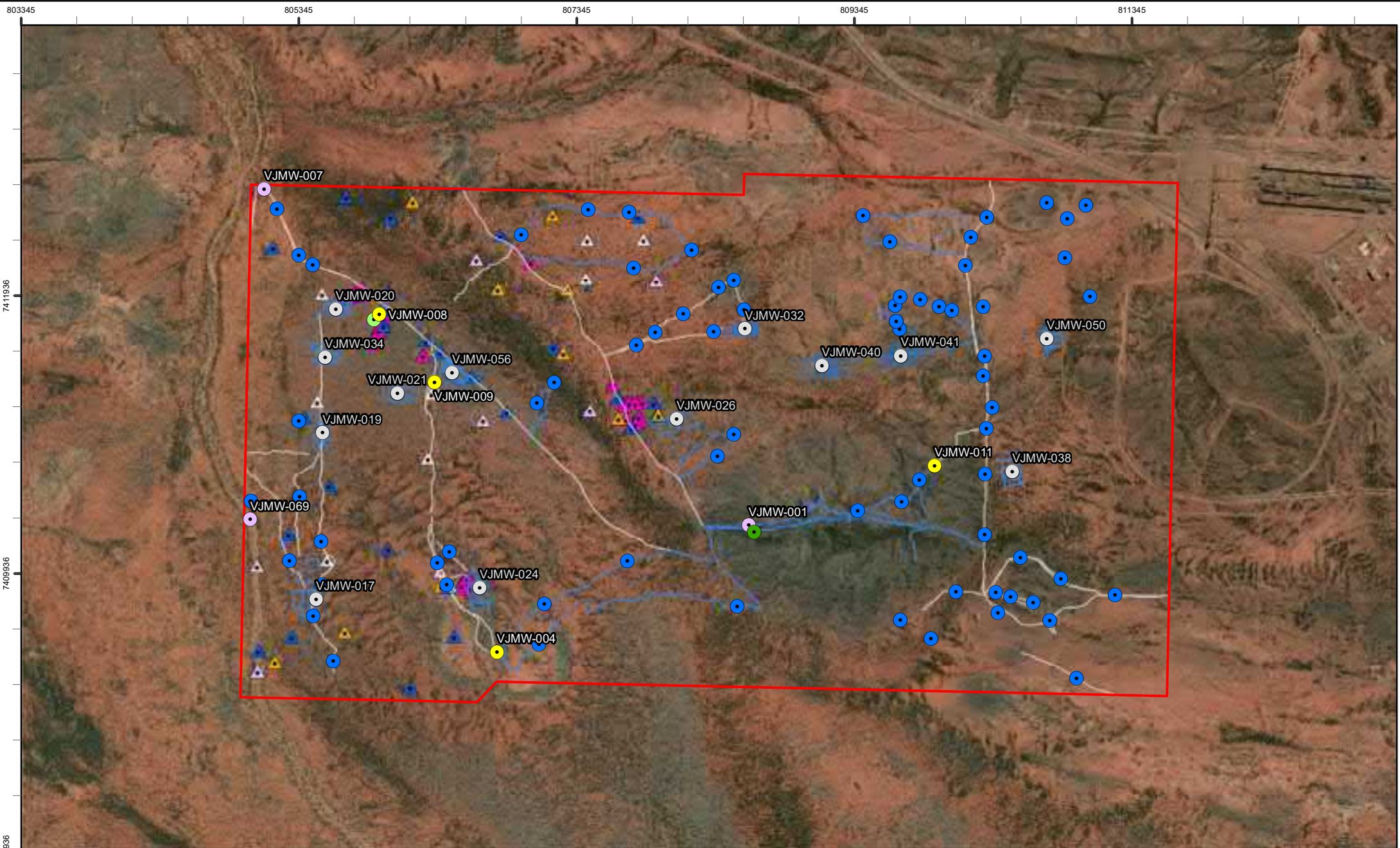
SongMeter (SM; Wildlife Acoustics Inc.) acoustic sound recorders were deployed at four locations within the Study Area (Figure 4.1). In an effort to target night parrot, the SM4 acoustic recorders were deployed in habitat most similar to that recommended within the *Interim Guideline for Preliminary Surveys of Night parrot (Pezoporus occidentalis) in Western Australia* (DPaW, 2017) – “stands of large, old clumps of spinifex (*Triodia*)... especially so if the identified area is part of a paleo-drainage system or contains healthy stands of samphire”. SongMeters were deployed for four consecutive nights at each location for a total of 16 recording nights (Table 4.4). Acoustic recordings were analysed for night parrot calls by ornithologist Nigel Jackett using publicly available calls and call information (Leseberg *et al.*, 2019; Night Parrot Recovery Team, 2017). All non-target species recorded at each recorder site was also compiled and incorporated into the results for each site.

Table 4.4: Acoustic sampling locations within the Study Area

Site	Habitat	Latitude	Longitude	Sampling Nights
VJMW-004	Sand Plain	-23.3967	120.0013	4
VJMW-008	Sand Plain	-23.3749	119.9925	4
VJMW-009	Sand Plain	-23.3792	119.9965	4
VJMW-011	Stony Plain	-23.3840	120.0318	4
Total				16

4.4.7 Opportunistic Sightings

At all times while surveying, all records pertaining to species not previously recorded during the survey, rare species, species of conservation significance or other fauna of interest were documented. These records include those from primary (i.e. direct observation of species) or secondary (e.g. burrows, scratching's, diggings and scats) evidence. Efforts were made to target likely microhabitats by turning rocks, logs and anthropogenic debris where present.



803345
7411936
7409836
7407936

807345

809345

811345

Legend

Study Area	Northern Quoll Motion Camera Transect	Previous Sampling	Trapping
Current Sampling	SongMeter (acoustic)	Habitat Assessment	
GPS Tracks	SongMeter (ultrasonic)	Motion camera	
Search Transects	Targeted search	SongMeter (ultrasonic)	
Greater Bilby Motion Camera Transect		Targeted Search	
Habitat Assessment			

biologic
Environmental Survey

N
1:35,000
0 0.4 0.8 1.6 km

**BHP Western Australian Iron Ore
Jimblebar Basic Vertebrate Fauna Survey**
Figure 4.1: Vertebrate fauna sampling within the Study Area

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994
Size A4. Created 7/01/2020

4.5 Fauna Habitat Mapping and Significance

Fauna habitat mapping was previously completed in the western portion of the Study Area as part of the Dynasty Level 2 Vertebrate Fauna Survey (Biologic, 2016b). During the current survey, fauna habitat mapping was completed using the vertebrate fauna habitat assessments conducted during the field survey, as well as high-resolution aerial imagery, vegetation, topographical, land system and drainage mapping. Habitats were delineated and mapped across the Study Area at a scale of approximately 1:20,000.

Habitats mapped within the Study Area were compiled and used to delineate critical habitat for all conservation significant species identified in the desktop assessment. For the purposes of this assessment, critical habitat followed that of DoE (2013), being areas necessary “for activities such as foraging, breeding, roosting, or dispersal”. Within these categories, habitat types were recognised as providing primary habitat (i.e. critical habitat as per the definition above), or secondary habitat (i.e. habitats not critical for foraging, breeding, roosting or dispersal, but may support such activities and/ or habitats of marginal suitability for such activities). Due to differing habitat preferences of conservation significant species (including habitat features and/or microhabitats), habitat significance was assessed on a species by species basis. Where specific habitat criteria are available for species, these defined categories are used (i.e. Pilbara leaf-nosed bat foraging habitat categories as defined by TSSC (2016)).

It should be noted that assessment of habitat significance applies only to habitat occurring within the Study Area, and therefore may not be representative of significance applied to the same habitat in other areas outside the Study Area. For example, a habitat within the Study Area may be deemed unsuitable due to the absence of certain habitat features which are required for the species persistence, despite the same habitat occurring outside the Study Area being considered of greater significance. The significance of a habitats within the Study Area may also be influenced by other habitats occurring within the Study Area and more broadly, including areas adjacent to the Study Area, particularly if representative of primary habitat.

4.6 Likelihood of Vertebrate Fauna Occurrence

The likelihood of occurrence within the Study Area was assessed for all conservation significant species identified in the desktop assessment using the decision matrix shown in Table 4.5. The occurrence assessment was based on known information relating to species’ distribution, habitat preferences (landforms, substrates and vegetation associations), locality records from database searches and previous studies within and/or in the vicinity of the Study Area and results of the current survey pertaining to species records and/or habitats occurring within the Study Area. The fauna assessments assigned each species to one of six ratings, ranging from Confirmed to Highly Unlikely.

Due to several factors influencing species occurrence (i.e. known distribution, habitat preferences, ecology and/or dispersal capabilities), interpretation of occurrence assessment criteria may vary between species (i.e. a small species with limited dispersal capabilities previously recorded close to the Study Area may not necessarily occur within the Study Area, whereas larger species with greater dispersal and/or foraging capabilities may have an increased likelihood of occurring).

Where a species determined likelihood of occurrence differs from the assessment criteria in Table 4.5, detailed justification for the determined assessment will be provided in the discussion of that species. For example, historic or presumed erroneous records which may not be representative of species' current known distribution (i.e. locally/regionally extinct species) or limited sampling within or in the vicinity of the Study Area resulting in lack of contextual records which may influence a higher or lower determined likelihood of occurrence to criteria.

Table 4.5: Species likelihood of occurrence decision matrix

Range/occurrence categories (<50 years only)	Habitat Categories (within Study Area)			
	Core/critical habitat present	Foraging/dispersal habitat present	Marginal/intermittent habitat present	No suitable habitat present
Recorded in Study Area	Confirmed	Confirmed	Confirmed	Confirmed
Recorded within 10 km	Highly Likely	Likely	Possible	Possible
Recorded within 10–50km	Likely	Possible	Possible	Unlikely
Recorded within 50–100 km	Possible	Possible	Unlikely	Unlikely
Recorded >100 km	Possible	Unlikely	Unlikely	Highly Unlikely
Species considered locally/regionally extinct	Unlikely	Unlikely	Highly Unlikely	Highly Unlikely

5 FIELD SURVEY RESULTS AND DISCUSSION

5.1 Fauna Habitats

A total of six broad fauna habitat types were recorded and mapped within the Study Area, comprising, in descending extent of occurrence, Hardpan Plain, Stony Plain, Sand Plain, Mulga Woodland, Hillcrest/ Hillslope and Major Drainage Line (Table 5.1; Figure 5.1). Hardpan Plain was the dominant broad fauna habitat within the Study Area, occupying approximately 47.37%, (1,155.08 ha) of the Study Area (Table 5.1; Figure 5.1). Following Hardpan Plain is Stony Plain (18.77%, 457.77 ha), Sand Plain (16.63%, 405.39 ha), and Mulga Woodland (13.52%, 329.65 ha) (Table 5.1; Figure 5.1). Two broad fauna habitats represented less than 5% of the Study Area each; Hillcrest/ Hillslope (2.02%, 49.29 ha) and Major Drainage Line (0.7%, 16.89 ha) (Table 5.1; Figure 5.1). The remaining 1.00% (24.22 ha) of the Study Area comprised Cleared/ Disturbed areas, which are associated with infrastructure (rail and haul road) for current operations areas for the Jimblebar Iron Ore Mine (Table 5.1; Figure 5.1). Data from on-site vertebrate fauna habitat assessments are presented in Appendix D and SRE invertebrate fauna assessments in Appendix E.



Of the six broad fauna habitats occurring within the Study Area, all have the potential to support species of conservation significance at varying capacities though the provision of primary or secondary (supporting) breeding, denning, nesting/roosting, foraging and/or dispersal habitat (Table 5.1).



Table 5.1: Summary of fauna habitats within the Study Area


Fauna Habitat Type	Area (ha)	Proportion of Study Area (%)
Hardpan Plain	1155.08	47.37%
Stony Plain	457.77	18.77%
Sand Plain	405.39	16.63%
Mulga Woodland	329.65	13.52%
Hillcrest/ Hillslope	49.29	2.02%
Cleared/ Disturbed	24.22	1.00%
Major Drainage Line	16.89	0.69%
Total	2,438.29	100%

Table 5.2: Broad fauna habitat types identified within the Study Area

Habitat	Distinguishing Habitat Characteristics	Habitat Extent	Conservation Significant Species	Representative Photo
<p>Hardpan Plain</p> <ul style="list-style-type: none"> • 1,155.08 ha • 47.37% 	<p>Hardpan Plain is characterised as lower lying plain often sparsely vegetated with open or sparsely scattered Mulga over a sparse mixed herb and small to medium shrub (predominantly <i>Acacia</i> and <i>Eremophila</i> species) understory on heavy clay substrates, often with a stony or gravelly surface. Large open areas often void of vegetation.</p> <p>Often subject to sheet flow following rainfall, occasionally pooling in lower lying areas; however, presence of water often temporary and persisting for only short periods following rainfall.</p>	<p>Hardpan Plain is the most widely distributed habitat within the Study Area, occurring throughout the area and often occurring as the intervening area between other habitats.</p> <p>The extent of the habitat within the Study Area forms part of a larger expanse that occurs more broadly in the vicinity of the Study Area and across the Pilbara regions.</p>	<ul style="list-style-type: none"> • Grey falcon – primary foraging and dispersal • Peregrine falcon – primary foraging and dispersal • Brush-tailed mulgara – secondary breeding, foraging and dispersal • Spotted ctenotus – primary breeding, foraging and dispersal 	

Habitat	Distinguishing Habitat Characteristics	Habitat Extent	Conservation Significant Species	Representative Photo
<p>Stony Plain</p> <ul style="list-style-type: none"> • 457.77 ha • 18.77% 	<p>Stony Plain habitat comprises flat to low undulating areas and low hills. Vegetation structure and density is variable, often occurring within scattered patches amount larger sparsely vegetated areas. Vegetation is often dominated by <i>Triodia</i> hummock grasses and/or scattered mixed small to medium shrub species on gravelly clay loam substrates.</p>	<p>The extent of Stony Plain habitat occurs primarily within the north-eastern and south-eastern portions of the Study Area, often in close association with Hardpan Plain and Mulga Woodland habitats.</p> <p>Stony Plain is one of the most common and widespread habitat types within the Pilbara region. The vegetation and substrate which make up this habitat type are characteristic features of the region.</p>	<ul style="list-style-type: none"> • Brush-tailed mulgara – secondary breeding, foraging and dispersal • Long-tailed dunnart – secondary foraging and dispersal • Western pebble-mound mouse – secondary breeding, foraging and dispersal • Ghost bat – secondary foraging and dispersal • Grey falcon – primary foraging and dispersal • Peregrine falcon – primary foraging and dispersal • Night parrot – secondary roosting and nesting • Spotted ctenotus – secondary breeding, foraging and dispersal 	
<p>Sand Plain</p> <ul style="list-style-type: none"> • 405.39 ha • 16.63% 	<p>Sand Plain habitat is characterised by sandy soils, often supporting <i>Triodia</i> hummock grassland and open <i>Acacia</i> shrubland vegetation.</p> <p>Vegetation is often dominated by <i>Triodia</i> hummocks of varying density and life stages, with scattered <i>Acacia</i> shrubs on sandy to sandy loam substrates.</p>	<p>Within the Study Area, Sand Plain occurs in scattered areas primarily in the west and north-eastern portions of the Study Area, often within larger areas of Hardpan Plain.</p> <p>The habitat extends beyond the Study Area, often occurring as relatively small and isolated patches. More broadly within the Pilbara region, the habitat can occur as large expanses or smaller isolated areas.</p>	<ul style="list-style-type: none"> • Greater bilby – primary breeding, foraging and dispersal • Brush-tailed mulgara – primary breeding, foraging and dispersal • Ghost bat – secondary foraging and dispersal • Spectacled hare-wallaby – primary breeding, foraging and dispersal • Peregrine falcon – primary foraging and dispersal • Grey falcon – primary foraging and dispersal • Night parrot – secondary roosting and nesting • Spotted ctenotus – primary breeding, foraging and dispersal 	

Habitat	Distinguishing Habitat Characteristics	Habitat Extent	Conservation Significant Species	Representative Photo
<p>Mulga Woodland</p> <ul style="list-style-type: none"> • 329.65 ha • 13.52% 	<p>Mulga Woodland habitat within the Study Area is variable in density, often associated with low lying drainage areas subject to occasional sheet flow following rainfall. Vegetation dominated by open mulga (<i>Acacia aneura</i>) with sparse to no understory of mixed small shrubs, tussock and hummock grasses.</p>	<p>Within the Study Area, a large area of Mulga Woodland bisects the Study Area in a northwest to southeast direction. It also occurs as smaller extents in the northeast of the Study Area. The occurrence of Mulga Woodland within the Study Area is often associated with Hardpan Plain, Sand Plain and/or Stony Plain habitats.</p> <p>Mulga Woodland within the Study Area forms part of larger occurrences of the habitat that extend well beyond the Study Area. The habitat is relatively common throughout the Pilbara bioregion, though can often be sparsely distributed and occur in isolated patches.</p>	<ul style="list-style-type: none"> • Ghost bat – primary foraging and dispersal • Greater bilby – secondary breeding and foraging • Pilbara flat-headed blind-snake – secondary breeding, foraging and dispersal 	
<p>Hillcrest/ Hillslope</p> <ul style="list-style-type: none"> • 49.29 ha • 2.02% 	<p>Hillcrest/ Hillslope habitat comprises hills and undulating stony plains of higher elevation, often supporting hard spinifex with a mantle of gravel and larger rocks. Scattered areas of minor outcropping and breakaway, particularly atop hillcrests.</p> <p>Often sparsely vegetated, with vegetation often dominated by hard <i>Triodia</i> hummock grasses with scattered mulga trees and other <i>Acacia</i> and/or <i>Grevillea</i> shrubs.</p>	<p>Hillcrest/ Hillslope habitat occurs primarily in the eastern portion of the Study Area, often within larger expanses of Hardpan Plain, Stony Plain and/or Sandy Plain habitats.</p> <p>Hillcrest/ Hillslope habitat is a characteristic habitat type of the Pilbara region. Its occurrence in the broader vicinity of the Study Area and throughout the region is widespread and common.</p>	<ul style="list-style-type: none"> • Northern quoll – secondary foraging and dispersal • Long-tailed dunnart – primary breeding, foraging and dispersal • Western pebble-mound mouse – primary breeding, foraging and dispersal • Pilbara leaf-nosed bat – secondary foraging (Priority 3) and dispersal • Peregrine falcon – secondary foraging and dispersal • Pilbara flat-headed blind-snake – secondary breeding, foraging and dispersal 	

Habitat	Distinguishing Habitat Characteristics	Habitat Extent	Conservation Significant Species	Representative Photo
<p>Cleared/ Disturbed</p> <ul style="list-style-type: none"> • 24.22 ha • 1.00% 	<p>Cleared/ Disturbed areas are characterised as currently or previously disturbed area, often void of vegetation as a result of previous clearing.</p> <p>Within the Study Area, Cleared/ Disturbed areas includes major tracks and larger clearings for mine operations areas. Minor tracks dissecting broad fauna habitats do not form part of this habitat.</p>	<p>Within the Study Area, Cleared/ Disturbed areas confined to the north-eastern portion of the Study Area, and are associated with current operations areas for the Jimblebar Iron Ore Mine.</p>	<p>N/A</p>	<p>No Photo Available</p>
<p>Major Drainage Line</p> <ul style="list-style-type: none"> • 16.89 ha • 0.69% 	<p>Within the Study Area, Major Drainage Line habitat is variable in structure and condition. Vegetation is often dominated by Eucalyptus species over a variable understory comprising mixed small to medium shrubs and tussock grasses.</p>	<p>Major Drainage Line is restricted to a small area in the southwest of the Study Area, where it forms part of a continuous extent of the habitat that extends beyond the Study Area.</p> <p>Major Drainage Line habitat is widespread throughout the Pilbara region, though its condition is often highly variable and susceptible to degradation from cattle grazing.</p>	<ul style="list-style-type: none"> • Northern quoll – secondary foraging and dispersal • Ghost bat – secondary foraging and dispersal • Pilbara leaf-nosed bat – primary foraging (Priority 4) and dispersal • Peregrine falcon – primary foraging and dispersal • Grey falcon – primary nesting, foraging and dispersal • Pilbara olive python – secondary foraging and dispersal (where proximal to primary breeding habitat) 	

805000

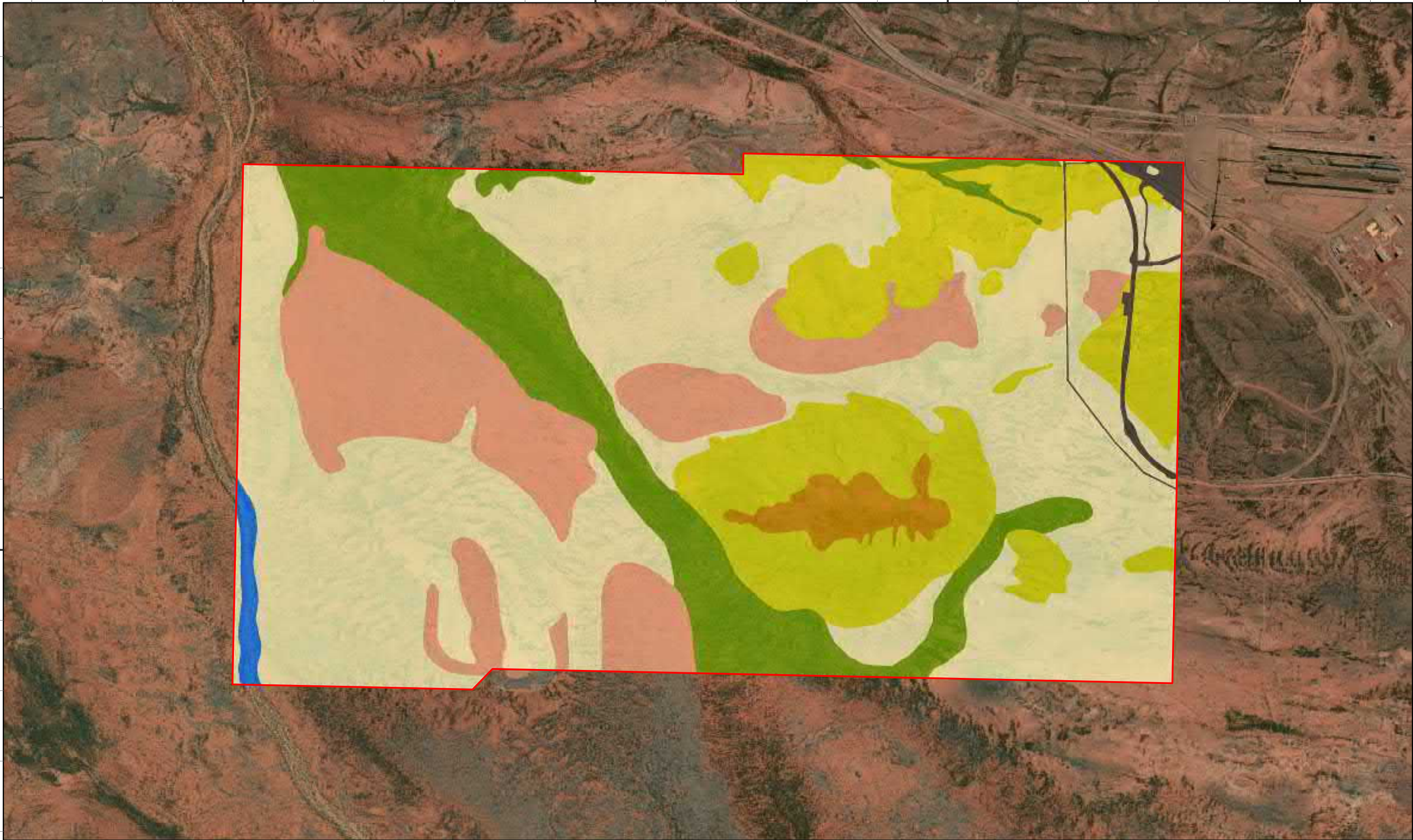
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Legend

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|----------------------|---------------------------|---------------------|
| Study Area | Fauna Habitat Type | Major Drainage Line |
| Cleared/ Disturbed | Mulga Woodland | |
| Hardpan Plain | Sand Plain | |
| Hillcrest/ Hillslope | Stony Plain | |

1:25,000

BHP Western Australian Iron Ore
Jimblebar Basic Vertebrate Fauna Survey
Figure 5.1: Broad fauna habitats occurring within the Study Area

Coordinate System: GDA 1994 MGA Zone 50
 Projection: Transverse Mercator
 Datum: GDA 1994

Size A3. Created 04/08/2020

5.2 Fauna Habitat Features

5.2.1 Caves


Caves can be particularly important features within a landscape, particularly in arid zone systems, often providing stable microclimates, shelter and protection (Medellin *et al.*, 2017). No caves were recorded within the Study Area. Numerous caves occur within the broader vicinity of the Study Area; however, contemporary records of conservation significant species which may utilise these caves (ghost bat and Pilbara leaf-nosed bat) are scarce (DBCA, 2020c), suggesting caves in the vicinity of the Study Area may not be regularly utilised by these species or records represent limited sampling for these species. This is particularly applicable to ghost bat, which prior to being listed as Vulnerable under the EPBC Act in 2016, was only listed as Priority 4, and was not subjected to the same sampling intensity it now is.

5.2.2 Water Features

Water sources are a limiting factor for many ecosystems (James *et al.*, 1995), particularly within arid-zone ecosystems such as the Pilbara (Burbidge *et al.*, 2010; Doughty *et al.*, 2011), often representing areas of comparatively high ecological productivity (Murray *et al.*, 2003). Mammals and birds have endothermic metabolisms and therefore require relatively continuous sources of food and moisture, while water for amphibians provides opportunities to forage (i.e. suitably wet periods) and breed (i.e. when water pools for long enough for them to complete the life cycle) (James *et al.*, 1995). These features are highlighted because they may provide important sources of food and water for species of conservation significance.

No semi-permanent or permanent natural waterbodies, natural or artificial, were recorded within the Study Area during the survey. One permanent artificial waterbody was recorded approximately 55 m north of the north-western corner Study Area (Table 5.3). It is likely that temporary waterbodies occur throughout parts of the Study Area where pooling or flowing water may be present following significant rainfall events, primarily within Major Drainage Line habitat, and to a lesser extent Hardpan Plain.

Table 5.3: Water features recorded during the survey

Water Feature ID	Latitude	Longitude	Comments	Photo
WJMW-01	-23.3662	119.9839	Artificial water feature – Noddy Bore	

5.3 Vertebrate Fauna Records

A total of 76 vertebrate fauna species, comprising 14 mammal species (11 native and three introduced), 57 bird species and five reptile species were recorded from the Study Area during the current survey (Table 5.4; Appendix F). All 76 species recorded during the current survey, were previously identified in the desktop assessment (Appendix C). None of the species recorded during the current survey were of conservation significance.

Table 5.4: Species richness recorded by previous surveys and the current survey

Source	Mammals (native)	Mammals (introduced)	Birds (native)	Birds (introduced)	Reptiles	Amphibians	Total
Literature Source							
A (Biologic, 2013)	15	6	55		38	2	116
B (Biologic, 2014a)							
C (Biologic, 2016a)	9	4	27		2		42
D (Biologic, 2016b)	15	1	39		32	2	89
E (Biologic, 2018b)	16	2	25		15	4	62
F (ENV, 2007)	4	5	72		27		108
G (ENV, 2009)	7	2	57		12	1	79
H (Outback Ecology, 2009a)	11	6	46		26	2	91
I (Outback Ecology, 2009b)	15	2	80		45	4	146
J (Outback Ecology, 2009c)	10	4	26		20		60
Current Survey	11	3	57		5	0	76

5.3.1 Occurrence of Vertebrate Fauna of Conservation Significance

The desktop assessment identified 36 species of conservation significance as potentially occurring in the Study Area (Table 3.4; Figure 3.1; Figure 3.2). Of these:

- three species (brush-tailed mulgara, western pebble-mound mouse and spotted ctenotus) have been recorded within the Study Area during previous surveys, though were not recorded during the current survey;
- four species were considered Likely to occur (ghost bat, long-tailed dunnart, grey falcon and peregrine falcon);
- seven species were considered Possible to occur (Pilbara leaf-nosed bat, Pilbara olive python, greater bilby, northern quoll, spectacled-hare wallaby, fork-tailed swift and Pilbara flat-headed bind-snake);
- 22 species were considered Unlikely to occur (night parrot, black-flanked rock-wallaby, garganey, little ringed plover, curlew sandpiper, oriental plover, black-necked stork, caspian tern, gull-billed tern, princess parrot, sharp-tailed sandpiper, pectoral sandpiper, red-necked

stint, long-toed stint, black-tailed godwit, ruff, wood sandpiper, common sandpiper, common greenshank, marsh sandpiper, common redshank and glossy ibis); and

- four species were considered Highly Unlikely to occur (barn swallow, Australian painted snipe, grey wagtail and yellow wagtail).

While a number of migratory shorebirds and waterbirds were identified in the desktop assessment as potentially occurring in the Study Area, these are generally considered Unlikely or Highly Unlikely to occur in the Study Area, owing to the lack of, or suboptimal, natural water bodies likely to support the species. Due to the proximity of optimal habitat likely to support these species occurring near the Study Area, it is unlikely the suboptimal habitat within the Study Area would be utilised. Optimal habitat in the vicinity of the Study Area includes Ophthalmia Dam (~9 km west of the Study Area) where numerous migratory shorebirds and waterbirds identified in the desktop assessment have previously been recorded.

Justification for the rating of the likelihood of these species occurring in the Study Area is outlined in Section 4.6. Those species recorded in the Study Area or considered to Likely occur, or to Possibly occur, in the Study Area are discussed further in Sections 5.3.2 to 5.3.6.

Table 5.5: Likelihood of vertebrate fauna species of conservation significance occurring in the Study Area

Species	Conservation Status				Preferred Broad Habitats	Nearest Record to the Study Area, date recorded and relevant source	Potential Critical Habitat Within the Study Area						Comments	Likelihood of Occurrence	Occurrence
	EPBC Act	BC Act	DBCA	IUCN			Hardpan Plain	Sand Plain	Hillcrest/ Hillslope	Mulga Woodland	Stony Plain	Major Drainage			
MAMMALIA															
DASYURIDAE															
Brush-tailed mulgara <i>(Dasycercus blythi)</i>			P4		Prefers spinifex <i>Triodia</i> spp. grasslands on sand plains and the swales between low dunes (Pavey <i>et al.</i> , 2012; Woolley, 2006). Mature spinifex hummocks appear to be important for protection from introduced predators (Körtner <i>et al.</i> , 2007).	Within Study Area (2016, 2018) (BHP, 2020; DBCA, 2020c)	•	•			•		Recorded 22 times during previous surveys within part of the Study Area, in Sand Plain and Hardpan Plain habitats. Likely to occur as a resident throughout Study Area where suitable sandy habitat and vegetation cover is present.	Confirmed (Biologic, 2016a, 2016b, 2018b)	Resident
Northern quoll <i>(Dasyurus hallucatus)</i>	EN	EN		EN	The species tends to inhabit rocky habitats which offer protection from predators and are generally more productive in terms of availability of resources (Braithwaite & Griffiths, 1994) (Oakwood, 2000). Other Microhabitat features important to the species include rock cover, proximity to permanent water and time-since last fire (Woinarski <i>et al.</i> , 2008).	~28km W (2007) (Onshore & Biologic, 2009), ~33 km W (2020) (Biologic, 2020b)					•	•	May occasionally occur within the Study Area during foraging and dispersal activities, primarily in Hillcrest/ Hillslope (where suitable outcropping occurs) and Major Drainage Line habitats. No suitable denning/shelter present within Study Area; however, suitable habitat occurs in the broader vicinity. Occurrence within the habitat likely to be subject to connectivity between suitable denning/shelter habitat to habitat within the Study Area.	Possible	Infrequent visitor (foraging/dispersal)
Long-tailed dunnart <i>(Sminthopsis longicaudata)</i>			P4		Typically occurs on plateaus near breakaways and scree slopes, and on rugged boulder-strewn scree slopes (Gibson & McKenzie, 2012). Once considered rare but now shown to be relatively common and widespread in rocky habitats (Burbidge <i>et al.</i> , 2008).	~34 km W (1998) (BHP, 2020)					•	•	May occur as a resident in Hillcrest/Hillslope habitat of the Study Area, particularly where suitable denning sites occur in rock formations. Foraging and dispersal may occur more broadly within Stony Plain habitat, where proximal to denning sites.	Likely	Resident
HIPPOSIDERIDAE															
Pilbara leaf-nosed bat <i>(Rhinioncteris aurantia</i> (Pilbara form))	VU	VU		VU	Species roosts within caves and abandoned Mines with high humidity (95%) and temperature (32°C) (Armstrong, 2001). Species forages in caves and along waterbodies with fringing vegetation (TSSC, 2016).	~24 km NW (2013) (Biologic, 2014b)					•	•	May occasionally occur within the Study Area to forage. Frequency of visitation dependent on proximity of primary roosting habitat outside of the Study Area. No suitable roosting habitat present within the Study Area.	Possible	Occasional visitor (foraging/dispersal)
MACROPODIDAE															
Spectacled hare-wallaby <i>(Lagorchestes conspicillatus leichardti)</i>			P4		Within the Pilbara the spectacled hare-wallaby is known to occur in tussock and hummock grasslands and <i>Acacia</i> shrublands (Burbidge & Johnson, 1995; Ingleby & Westoby, 1992).	~17.5 km SE (no date) (DBCA, 2020c)		•					May occur within the Study Area as a resident, primarily in Sand Plain habitat where suitable vegetation cover is present. May also forage and disperse more broadly within other habitats adjacent to Sand Plain.	Possible	Resident
Black-flanked rock-wallaby <i>(Petrogale lateralis</i> subsp. <i>lateralis)</i>	EN	EN		NT	Rocky habitats, including gorges and gullies or outcrops with sufficient shelter habitat. Often vegetated with <i>Acacia</i> thickets and open low eucalypt woodlands with an understory of grasses and low shrubs (Willers <i>et al.</i> , 2011)	~19 km NW (1975) (DBCA, 2020c)							Suitable habitat not present	Unlikely	N/A

Species	Conservation Status				Preferred Broad Habitats	Nearest Record to the Study Area, date recorded and relevant source	Potential Critical Habitat Within the Study Area						Comments	Likelihood of Occurrence	Occurrence			
	EPBC Act	BC Act	DBCA	IUCN			Hardpan Plain	Sand Plain	Hillcrest/ Hillslope	Mulga Woodland	Stony Plain	Major Drainage						
MEGADERMATIDAE																		
Ghost bat <i>(Macroderma gigas)</i>	VU	VU		VU	Ghost bats roost in deep, complex caves beneath bluffs of low, rounded hills, granite rock piles and abandoned Mines (Armstrong & Anstee, 2000). These features often occur within habitats including gorge/gully, hill crest/hill slope and low hills (Armstrong & Anstee, 2000).	~4 km N (2013) (BHP, 2020), ~5 km NE (1899) (DBCA, 2020c) and 9km NE (2019) (GHD, 2019b)							•	•	•	May occasionally occur within the Study Area to forage. Frequency of visitation dependent on proximity of primary roosting habitat outside of the Study Area. No suitable roosting habitat present within the Study Area	Likely	Regular visitor (foraging/dispersal)
MURIDAE																		
Western pebble-mound mouse <i>(Pseudomys chapmani)</i>				P4	This species occurs on the gentler slopes of rocky ranges where the ground is covered with a stony mantle and vegetated by hard spinifex, often with a sparse overstorey of eucalypts and scattered shrubs (Anstee, 1996; Start <i>et al.</i> , 2000).	Within Study Area (1994, 2008, 2009) (BHP, 2020; DBCA, 2020c)							•	•		Recorded three times during previous surveys within the Study Area, in Sand Plain, Hardpan Plain and Hillcrest/ Hillslope habitats. Likely to occur as a resident throughout Study Area where suitable stony habitat present, primarily within Hillcrest/ Hillslope and Stony Plain habitats.	Confirmed (BHP, 2020; DBCA, 2020c)	Resident
THYLACOMYIDAE																		
Greater bilby <i>(Macrotis lagotis)</i>	VU	VU		VU	Variety of habitats including spinifex hummock grassland and <i>Acacia</i> shrubland, on soft soils (Burrows <i>et al.</i> , 2012). In the Pilbara often associated with major drainage line sandy terraces (How <i>et al.</i> , 1991).	~19 km SW (1979) (DBCA, 2020c), ~34km E (2018) (Biologic, 2018a)							•	•		May occur within Sand Plain, and to a lesser extent Mulga Woodland, habitats of the Study Area, where suitable vegetation cover present. May occur as a resident or occasional visitor to forage or during dispersal. Occurrence within the Study Area also dependent on occurrence of suitable habitat in the vicinity of the Study Area due to relatively small and isolated nature of suitable habitat extend within the Study Area alone.	Possible	Resident
AVES																		
ANATIDAE																		
Garganey <i>(Anas querquedula)</i>	MI	MI			Garganey is small teal. This duck is a rare visitor to Australia recorded from lakes and inland waterbodies (Johnstone & Storr, 1998).	0.5 km SE (2013) (BHP, 2020)										Suitable habitat not present	Unlikely	N/A
APODIDAE																		
Fork-tailed swift <i>(Apus pacificus)</i>	MI	MI			Inhabits dry/open habitats, inclusive of riparian woodlands and tea-tree swamps, low scrub, heathland or saltmarsh, as well as treeless grassland and sandplains covered with spinifex, open farmland and inland and coastal sand-dunes (Johnstone & Storr, 1998). Almost exclusively aerial.	~9 km NE (2011, 2013) (BHP, 2020)										Likely to occasionally occur within the airspace above the Study Area to forage, unlikely to land or nest within Study Area.	Possible	Infrequent visitor (foraging/migration)
CHARADRIIDAE																		
Little ringed plover <i>(Charadrius dubius)</i>	MI	MI			Bare or sparsely vegetated sandy and pebbly shores of shallow standing freshwater pools, lakes or slow-flowing rivers. Also found in artificial habitats including gravel pits, sewage works, industrial wastelands and rubbish tips (Geering <i>et al.</i> , 2007).	~13 km W (2014) (BHP, 2020)										Suitable habitat not present	Unlikely	N/A

Species	Conservation Status				Preferred Broad Habitats	Nearest Record to the Study Area, date recorded and relevant source	Potential Critical Habitat Within the Study Area						Comments	Likelihood of Occurrence	Occurrence
	EPBC Act	BC Act	DBCA	IUCN			Hardpan Plain	Sand Plain	Hillcrest/ Hillslope	Mulga Woodland	Stony Plain	Major Drainage			
Oriental plover <i>(Charadrius veredus)</i>	MI	MI			A variety of habitats, including coastal habitats, such as estuarine mudflats and sandbanks, on sandy or rocky ocean beaches as well as open inland environments such as, semi-arid or arid grasslands, where the grass is short and sparse (Johnstone & Storr, 2004).	~24 km SW (1981) (DBCA, 2020c) ~97 km N (2017) (DBCA, 2020a)							Suitable habitat not present.	Unlikely	N/A
CICONIIDAE															
Black-necked stork <i>(Ephippiorhynchus asiaticus)</i>				NT	Found mainly on freshwater wetlands and associated grasslands in tropics and subtropics and also on tidal flats (Menkhorst, 2017).	~24 km SW (2003) (DBCA, 2020a)							Suitable habitat not present.	Unlikely	N/A
FALCONIDAE															
Grey falcon <i>(Falco hypoleucos)</i>	VU	VU		VU	Timbered lowlands, particularly <i>Acacia</i> shrubland and along inland drainage systems. Also frequent spinifex and tussock grassland (Burbidge <i>et al.</i> , 2010; Olsen & Olsen, 1986)	~10 km NW (2013) (BHP, 2020)	•	•			•	•	Likely to occur regularly within the Study Area to forage. Frequency of occurrence to forage dependent on nesting proximity to the Study Area. Nesting may occur within Major Drainage habitat where suitable tall trees occur.	Likely	Resident (nesting)/ frequent visitor (foraging)
Peregrine falcon <i>(Falco peregrinus)</i>		OS			In arid areas, it is most often encountered along cliffs above rivers, ranges and wooded watercourses where it hunts birds (Johnstone & Storr, 1998). It typically nests on rocky ledges occurring on tall, vertical cliff faces between 25 m and 50 m high (Olsen <i>et al.</i> , 2004; Olsen & Olsen, 1989).	~19km NW (2013) (Biologic, 2014b), ~25 km W (2011) (DBCA, 2020c)	•	•	•		•	•	Likely to occur regularly within the Study Area to forage. Frequency of occurrence to forage dependent on nesting location. Nesting unlikely to occur within the Study Area.	Likely	frequent visitor (foraging)
HIRUNDINIDAE															
Barn swallow <i>(Hirundo rustica)</i>	MI	MI			The barn swallow is a non-breeding summer visitor to the Pilbara, predominantly occurring in coastal areas. It occurs in a range of habitats, often favouring areas near water (Johnstone <i>et al.</i> , 2013).	~12 km W (2014) (BHP, 2020)							Suitable habitat not present. Study Area outside of species known range (coastal Pilbara).	Highly Unlikely	N/A
LARIDAE															
Caspian tern <i>(Sterna caspia)</i>	MI	MI			Mainly sheltered seas, estuaries and tidal creeks; occasionally near-coastal salt lakes (including saltwork ponds) and brackish pools in lower courses of rivers; rarely fresh water (Johnstone & Storr, 1998).	~12 km NW (2004, 2007, 2008)(DBCA, 2020a)							Suitable habitat not present.	Unlikely	N/A
Gull-billed tern <i>(Gelocheidon nilotica)</i>	MI	MI			Shallow sheltered seas close to land, estuaries, tidal creeks; and inundated samphire flats, flooded salt lakes, claypans and watercourses in the interior (Johnstone & Storr, 1998).	~11 km NW (2008) (DBCA, 2020c)							Suitable habitat not present.	Unlikely	N/A
MOTACILLIDAE															
Grey wagtail <i>(Motacilla cinerea)</i>	MI	MI			A rare vagrant to Western Australia where it has been recorded within various habitats with open waterbodies (Johnstone & Storr, 2004).	~153 km NW (2012)(DBCA, 2020a)							Suitable habitat not present.	Highly Unlikely	N/A

Species	Conservation Status				Preferred Broad Habitats	Nearest Record to the Study Area, date recorded and relevant source	Potential Critical Habitat Within the Study Area						Comments	Likelihood of Occurrence	Occurrence
	EPBC Act	BC Act	DBCA	IUCN			Hardpan Plain	Sand Plain	Hillcrest/ Hillslope	Mulga Woodland	Stony Plain	Major Drainage			
Yellow wagtail (<i>Motacilla flava</i>)	MI	MI			An uncommon but regular visitor to the Pilbara region (Johnstone <i>et al.</i> , 2013). Occupies a range of damp or wet habitats with low vegetation although favours edges of fresh water, especially sewage ponds (Johnstone & Storr, 2004).	~369 km N (1982)(DBCA, 2020a)							Suitable habitat not present. Outside of species known range (Kimberley).	Highly Unlikely	N/A
PSITTACIDAE															
Night parrot (<i>Pezoporus occidentalis</i>)	EN	CR		EN	The night parrot prefers sandy/stony plain habitat with old-growth spinifex for roosting and nesting in conjunction with native grasses and herbs for foraging (DPaW, 2017).	~119 km NE (1970) and ~149 km NW (2005)(DBCA, 2020a)		•				•	Although larger mature <i>Triodia</i> hummocks occur within Sand Plain and Stony Plain habitats of the Study Area, It should be noted that the occurrence of nesting habitat in proximity to primary foraging habitat (defined as low, treeless chenopod shrublands or herb lands with high abundance of annual grasses and herbs) is believed to be a key factor in the species occurrence. As no known suitable primary foraging habitat occurs within 10 km of the Study Area (furthest distance recorded for a foraging individual; Murphy <i>et al.</i> , 2017), the species occurrence is considered unlikely.	Unlikely	N/A
Princess parrot (<i>Polytelis alexandrae</i>)	VU		P4	NT	The princess parrot inhabits low open eucalypt woodlands and savannah shrublands in arid deserts, usually with <i>Casuarina</i> and <i>Allocasuarina</i> spp. Primarily breeds in Marble Gum hollows (Pavey <i>et al.</i> , 2014).	~50 km NW (2012)(DBCA, 2020a)							Suitable habitat not present.	Unlikely	N/A
ROSTRATULIDAE															
Australian painted snipe (<i>Rostratula benghalensis subsp. australis</i>)	EN	EN		EN	Generally, occupies shallow terrestrial freshwater wetlands (i.e. temporary and permanent lakes, swamps and claypans) with rank emergent tussocks of grass, sedges, rushes or reeds, or samphire (Johnstone & Storr, 1998).	~80 km NW (2012)(DBCA, 2020a)							Suitable habitat not present.	Highly Unlikely	N/A
SCOLOPACIDAE															
Sharp-tailed sandpiper (<i>Calidris acuminata</i>)	MI	MI			Favours flooded samphire flats and grasslands, mangrove creeks mudflats, beaches, river pools, saltwork ponds, sewage ponds and freshwater soaks (Johnstone <i>et al.</i> , 2013).	~11 km W (2001, 2009) (DBCA, 2020c), ~11 km W (2014) (BHP, 2020)							Suitable habitat not present.	Unlikely	N/A
Curlew sandpiper (<i>Calidris ferruginea</i>)	CR/MI	CR/MI		NT	Inhabits intertidal mudflats in sheltered coastal areas (i.e. estuaries, bays, inlets and lagoons) (Geering <i>et al.</i> , 2007). This rare species generally roosts on bare dry shingle, shell or sand beaches, sandspits and islets in or around coastal or near-coastal lagoons and other wetlands (Geering <i>et al.</i> , 2007).	~11 km W (2005) (DBCA, 2020c) , ~11 km W (2014) (BHP, 2020)							Suitable habitat not present.	Unlikely	N/A

Species	Conservation Status				Preferred Broad Habitats	Nearest Record to the Study Area, date recorded and relevant source	Potential Critical Habitat Within the Study Area						Comments	Likelihood of Occurrence	Occurrence
	EPBC Act	BC Act	DBCA	IUCN			Hardpan Plain	Sand Plain	Hillcrest/ Hillslope	Mulga Woodland	Stony Plain	Major Drainage			
Pectoral sandpiper <i>(Calidris melanotos)</i>	MI	MI			Coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands (Johnstone & Storr, 2004; Johnstone <i>et al.</i> , 2013). It prefers wetlands with open fringing mudflats and low, emergent or fringing vegetation (Geering <i>et al.</i> , 2007).	~13 km W (2014) (BHP, 2020)						Suitable habitat not present.	Unlikely	N/A	
Red-necked stint <i>(Calidris ruficollis)</i>	MI	MI			Lives in permanent or ephemeral wetlands of varying salinity, and also regularly at sewage farms and saltworks. They are recorded less often at reservoirs, waterholes, soaks, bore-drain swamps and flooded inland lakes. In Western Australia they prefer freshwater to marine environments. The species usually forages in shallow water at the edge of wetlands and roost or loaf on tidal mudflats, near low saltmarsh, and around inland swamps (Johnstone & Storr, 1998).	~11 km W (2005) (DBCA, 2020c)						Suitable habitat not present.	Unlikely	N/A	
Long-toed stint <i>(Calidris subminuta)</i>	MI	MI			They prefer shallow freshwater or brackish wetlands but are also fond of muddy shorelines, growths of short grasses, weeds, sedges, low or floating aquatic vegetation, reeds, rushes and occasionally stunted samphire. The Long-toed Stint also frequents permanent wetlands and forages on wet mud or in shallow water, often among short grass, weeds and other vegetation on islets or around the edges of wetlands. They roost or loaf in sparse vegetation at the edges of wetlands and on damp mud near shallow water. It also roosts in small depressions in the mud (Johnstone & Storr, 1998).	~11 km W (2001) (DBCA, 2020c), ~13 km W (2014) (BHP, 2020)						Suitable habitat not present.	Unlikely	N/A	
Black-tailed godwit <i>(Limosa limosa)</i>	MI	MI		NT	Found mainly in coastal habitats like estuaries, tidal mudflats, shallow river margins, sewage ponds, brackish or saline inland lakes, airfields and flooded pastures (Pizzey & Knight, 2007).	~11 km W (2014) (BHP, 2020)						Suitable habitat not present.	Unlikely	N/A	
Ruff <i>(Philomachus pugnax)</i>	MI	MI			Mainly fresh, brackish and saline wetlands with exposed mudflats. Found near lakes, swamps, pools, lagoons, tidal rivers and floodlands. Sometimes observed in sheltered coastal areas, including harbours and estuaries (DoEE, 2019)	~13 km W (2014) (BHP, 2020)						Suitable habitat not present.	Unlikely	N/A	
Wood sandpiper <i>(Tringa glareola)</i>	MI	MI			Species occurs as a non-breeding summer migrant which occurs throughout the region. Occurs mainly in river pools, sewage ponds, flooded claypans, freshwater lagoons and bore overflows (Johnstone <i>et al.</i> , 2013).	~11 km W (2007) (DBCA, 2020c), ~11 km W (2014) (BHP, 2020)						Suitable habitat not present.	Unlikely	N/A	
Common sandpiper <i>(Tringa hypoleucos)</i>	MI	MI			Estuaries and deltas of streams, as well as banks farther upstream; around lakes, pools, billabongs, reservoirs, dams and claypans (Geering <i>et al.</i> , 2007).	~11 km W (most recent 2013)(DBCA, 2020a), ~11 km W (2014) (BHP, 2020)						Suitable habitat not present.	Unlikely	N/A	

Species	Conservation Status				Preferred Broad Habitats	Nearest Record to the Study Area, date recorded and relevant source	Potential Critical Habitat Within the Study Area						Comments	Likelihood of Occurrence	Occurrence		
	EPBC Act	BC Act	DBCA	IUCN			Hardpan Plain	Sand Plain	Hillcrest/ Hillslope	Mulga Woodland	Stony Plain	Major Drainage					
Common greenshank <i>(Tringa nebularia)</i>	MI	MI			Species occurs as a non-breeding summer Migrant which occurs throughout the region. Occurs mainly in Tidal mudflats, mangrove creeks, flooded samphire flats, beaches, river pools, and saltwork and sewage ponds (Johnstone <i>et al.</i> , 2013).	~11 km W (2007, 2013, 2016) (DBCA, 2020c), ~10 km W (2014) (BHP, 2020)							Suitable habitat not present.	Unlikely	N/A		
Marsh sandpiper <i>(Tringa stagnatilis)</i>	MI	MI			Lives in permanent or ephemeral wetlands of varying salinity, and also regularly at sewage farms and saltworks. They are recorded less often at reservoirs, waterholes, soaks, bore-drain swamps and flooded inland lakes. In Western Australia they prefer freshwater to marine environments. The species usually forages in shallow water at the edge of wetlands and roost or loaf on tidal mudflats, near low saltmarsh, and around inland swamps (Johnstone & Storr, 1998).	~11 km W (2005) (DBCA, 2020c) ~11 km W (2014) (BHP, 2020)							Suitable habitat not present.	Unlikely	N/A		
Common redshank <i>(Tringa totanus)</i>	MI	MI			It is found at sheltered coastal wetlands with bare open flats and banks of mud or sand. They are also found around salt lakes, freshwater lagoons, artificial wetlands and saltworks and sewage farms. The species has been observed feeding in shallow water, on wet bare mud or sand, or on algal deposits and roosting on small elevated areas such as estuarine sandbars and muddy islets surrounded by water (Johnstone & Storr, 1998).	~32 km W (2012) (DBCA, 2020c)							Suitable habitat not present.	Unlikely	N/A		
THRESKIORNITHIDAE																	
Glossy ibis <i>(Plegadis falcinellus)</i>	MI	MI			Freshwater wetlands, irrigated areas, margins of dams, floodplains, brackish and saline wetlands, tidal mudflats, pastures, lawns and public gardens (Johnstone <i>et al.</i> , 2013).	~11 km W (most recent 2013) (DBCA, 2020c) ~10 km W (2014) (BHP, 2020)							Suitable habitat not present.	Unlikely	N/A		
REPTILIA																	
BOIDAE																	
Pilbara olive python <i>(Liasis olivaceus subsp. barroni)</i>	VU	VU			Associated with drainage systems, including areas with localized drainage and watercourses (Pearson, 1993). In the inland Pilbara the species is most often encountered near permanent waterholes in rocky ranges or among riverine vegetation (Pearson, 1993).	~4 km N (2013) (BHP, 2020)							•	•	May infrequently occur within Hillcrest/ Hillslope (particularly where suitable outcropping occurs) and Major Drainage Line habitats of the Study Area during foraging and dispersal. Unlikely to occur as a resident due to the absence of suitable rocky shelter habitat or water sources often utilised by the species.	Possible	Infrequent visitor (foraging/dispersal)

Species	Conservation Status				Preferred Broad Habitats	Nearest Record to the Study Area, date recorded and relevant source	Potential Critical Habitat Within the Study Area						Comments	Likelihood of Occurrence	Occurrence
	EPBC Act	BC Act	DBCA	IUCN			Hardpan Plain	Sand Plain	Hillcrest/ Hillslope	Mulga Woodland	Stony Plain	Major Drainage			
SCINCIDAE															
Spotted ctenotus <i>(Ctenotus uber subsp. johnstonei)</i>			P2		Within the Pilbara, the taxon is known from <i>Triodia</i> on hillslopes, <i>Acacia xiphophylla</i> over chenopods, and <i>Acacia xiphophylla</i> scattered tall shrubs to high open shrubland (Cogger, 2014).	Within Study Area (2016, 2018) (BHP, 2020; DBCA, 2020c)	•	•			•		Recorded five times during previous surveys in Sand Plain, Stony Plain and Hardpan Plain habitats. Likely to occur as a resident throughout the extent of these habitats within the Study Area.	Confirmed (Biologic, 2016b, 2018b)	Resident
TYPHLOPIDAE															
Pilbara flat-headed blind-snake <i>(Anilius ganei)</i>			P1		Little is known of the species' ecology, but this species is often associated with moist soils and leaf litter within gorges and gullies (Wilson & Swan, 2014), and potentially within a wide range of other stony habitats. The species has been recorded from numerous habitats but is most likely to be present in rocky terrain and along drainage lines (Wilson & Swan, 2014). Also presumed to occur within other mulga and stony habitats (Chapple <i>et al.</i> , 2019).	~4 km N (2006) (DBCA, 2020c), (2007, 2013) (BHP, 2020)			•	•			May occur as a resident within Hillcrest/ Hillslope and Mulga Woodland habitats of the Study Area, particularly in areas where leaf litter accumulates, and moisture is retained in leaf litter and substrates.	Possible	Resident

5.3.2 EPBC Matters of National Environmental Significance

The sections below provide summaries on the Program Matters identified in the approved Program for BHP's Strategic Assessment (northern quoll, greater bilby, ghost bat, Pilbara Leaf-nosed Bat, and Pilbara olive python) as well as the night parrot.

5.3.2.1 Northern Quoll (*Dasyurus hallucatus*) – Endangered (EPBC/BC Act)

The northern quoll tends to inhabit rocky habitats which offer protection from predators and are generally more productive in terms of availability of resources (Braithwaite & Griffiths, 1994; DoE, 2016; Oakwood, 2000). Other microhabitat features important to the species include: rock cover; proximity to permanent water and time-since last fire (Woinarski *et al.*, 2008).

Despite being relatively common in the northern and western Pilbara region (generally within 150 km of the coast), it is much less common in the south eastern Pilbara. No northern quoll or evidence of the species' occurrence has been recorded within the Study Area by previous surveys or during the current survey. Overall, records of the species in the vicinity of the Study Area are sparse. A 2007 record of a roadkill juvenile individual was reported from the main access bridge into Whaleback, located approximately 28 km west of the Study Area (Onshore & Biologic, 2009). Additionally, the species was recorded ~33km west of the Study Area within BHP's Western Ridge tenement (Biologic, 2020b). These records represent the south-eastern limit of the species occurrence in the Pilbara region (DBCA, 2020a).

The species is considered to possibly occur based on the presence of potential habitat (Gorge/ Gully) in areas 3.5 km north and 4.5 km east (adjacent to and coinciding with Wheelarra mine) of the Study Area (BHP, 2020). Northern quoll may occasionally occur within Hillcrest/ Hillslope habitat of the Study Area to forage or during dispersal movements, particularly in areas near suitable primary habitat outside of the Study Area. Due to the isolated nature of most Hillcrest/ Hillslope habitat within the Study Area, the species is not considered likely to utilise these habitats on a regular basis.

Due to the absence of any records of the species occurring within the Study Area and the scarcity of records in the vicinity, the species occurrence within the Study Area may also be limited to infrequent visitations by foraging and dispersing individuals. Except for Hillcrest/ Hillslope habitat, the remaining habitats mapped within the Study Area are unlikely to provide significant habitat for the species.

5.3.2.2 Greater Bilby (*Macrotis lagotis*) – Vulnerable (EPBC/BC Act)

Extant populations of the greater bilby occur in a variety of habitats, usually on landforms with level to low slope topography and light to medium soils (Southgate, 1990). Throughout its distribution, it occupies three major vegetation types: open tussock grassland on uplands and hills, hummock grassland in plains and alluvial areas and occasionally mulga woodland/shrubland growing on ridges and rises, and (Southgate, 1990). Within the Pilbara region the species is sparsely distributed, and often associated with spinifex sandplain habitat (Dziminski & Carpenter, 2016).

No records or evidence of occurrence of greater bilby has been recorded within the Study Area by previous surveys or during the current survey. The nearest record of the species is located

approximately 19 km south west of the Study Area (DBCA, 2020c); however, based on the date of the record (1979), it is considered to be a historic record and is unlikely to be an accurate representation of the species current occurrence within the Pilbara region. The nearest, more recent record (dated 2018) is located approximately 34 km east of the Study Area (Biologic, 2018a). An inactive burrow belonging to the species was recorded within Sand Plain habitat at BHP's Caramulla tenement. The burrow was old (likely >3 years), with no scats and no indication of current occupation (Biologic, 2018a).

The Sand Plain habitat represents primary breeding, foraging and dispersal habitat for the species, particularly where suitable vegetation cover is present. The species is considered to possibly occur as a resident or occasional visitor to forage or during dispersal. Occurrence within the Study Area is also dependent on the occurrence of suitable habitat in the vicinity of the Study Area due to the relatively small and isolated nature of suitable habitat within the Study Area. Patches of Sand Plain habitat extend outside the Study Area, the nearest of which is adjacent to and extend to the south of the Study Area.

The Mulga Woodland habitat represents secondary breeding and foraging habitat for the species. Although the species is known to utilise broad mulga habitats in other parts of its distribution, this habitat is rarely utilised by the species within the Pilbara region, likely due to the high amount of alluvial material making substrates less suitable for burrowing activity compared to sand-plain habitats (Cramer *et al.*, 2017). However, the likelihood of this habitats being utilised by the species may also increase when larger areas of suitable habitat (e.g. sandplain) are present adjacent to or in the vicinity (such as the north eastern portion of the Study Area).

5.3.2.3 Ghost Bat (*Macroderma gigas*) – Vulnerable (EPBC/BC Act)

In the Pilbara region, the species roosts in deep, complex caves beneath bluffs of low rounded hills, often composed of Marra Mamba Iron Formation or banded iron formation, granite rock piles and abandoned mines (Armstrong & Anstee, 2000). They roost either individually or in colonies (Churchill, 2008) and move between a number of caves, both seasonally and as dictated by weather changes (Armstrong & Anstee, 2000). The species will often forage more broadly across habitats, often utilising drainage lines and other habitats where prey species are likely to be most abundant (Richards *et al.*, 2008; Tidemann *et al.*, 1985). Recent studies of ghost bat home range and foraging behaviour in the Pilbara region have identified Drainage Area/ Floodplain, Gorge/ Gully, Major Drainage Line and Mulga Woodland as high suitability foraging habitats for the species, followed by Stony Plain as moderate suitability (Biologic, 2020a; unpublished data). This suitability, however, is variable depending on particular characteristics of the habitat, including the abundance of foraging structures (tree perches) and density of understory vegetation present. Where these habitat are present, their suitability for ghost bat is dependent on the abundance of foraging structures and an open understory (Biologic, 2020a; unpublished data).

No ghost bat or suitable roost caves likely to be used by the species were recorded within the Study Area during the current survey; however, detectability, particularly of foraging individuals is difficult due to their foraging behaviour (i.e. infrequent and highly variable calling during foraging) and capabilities of ultrasonic recording devices (i.e. limited detection zones). The nearest records of the species occurs approximately 4 km north (scats recorded in 2013; (BHP, 2020)), 5 km northeast (record is considered

historical - WAM vouched specimen from 1899 (DBCA, 2020c)). Scats and feeding evidence have been recently recorded at various locations between 9 and 12 km east of the Study Area (GHD, 2019a, 2019b). In 2006, a foraging individual was recorded 17 km east of the Study Area (Ecologia, 2006). Ultrasonic calls of the species has also been recorded approximately 19 km northwest of the Study Area within the Orebody 24 Area (BHP, 2020) and 28 km west of the Study Area in 2012 (DBCA, 2020c) as well as on multiple occasions within the Western Ridge Area, located approximately 32 km west of the Study Area (Biologic, 2020b).

The Major Drainage Line and Mulga Woodland habitats represent primary foraging and dispersal habitat for the species. Moreover, Stony Plain represents secondary foraging and dispersal (where proximal to primary roosting and breeding habitat) for the species. Due to the absence of any potential roosting habitat within the Study Area, occurrence of ghost bat within the Study Area is likely to be individuals originating from outside the Study Area, where known caves occur (one day roost (16 km east), three potential day roosts (~9–16 km east), two potential day/night roosts (~12 km east) and two potential night roosts (~7–12 km east) (Biologic, 2019; GHD, 2019a, 2019b)).

Tidemann *et al.* (1985) suggested ghost bat foraging areas averaged 60.83 (± 18.0) ha in size (range = 28.47 to 120.8 ha), with an average distance of 1.89 (± 0.45) km (range = 0.45 to 2.95 km) centred on diurnal roosts. The species has, however, been recorded moving larger distances of up to 15 km (Tidemann *et al.*, 1985). Therefore, with confirmed and potential day roosts within nightly flight of the Study Area, the species' likelihood of occurrence within the Study Area is considered likely. The species occurrence within the Study Area, however, is likely to be restricted to visitation to forage and/or during dispersal movements.

5.3.2.4 Pilbara Leaf-nosed Bat (*Rhinonictoris aurantia*) – Vulnerable (EPBC/BC Act)

This species' limited ability to conserve heat and water means it requires warm (28–32 °C) and very humid (85–100%) roost sites in caves (Armstrong, 2001; Churchill, 1991) and/or mine shafts as these enable the individuals to persist in arid climates by limiting water loss and energy expenditure (van Dyck & Strahan, 2008). Such caves are relatively uncommon in the Pilbara (Armstrong, 2001), which limits the availability of diurnal roosts for this species. The species forages within and in the vicinity of roost caves and more broadly along waterbodies with suitable fringing vegetation supporting prey species (TSSC, 2016). Pilbara leaf-nosed bats are predicted to travel up to 20 km from roost caves during nightly foraging (Cramer *et al.*, 2016); however, seasonal variation is known to occur, with foraging occurring up to 20 km in the dry season and up to 50 km during the wet season (Bullen, 2013). Long-distance movements by the species have also been recorded, with a single monitored individual recorded from two roost caves located 170 km distant approximately 12 months apart (Bullen & Reiffer, 2019), suggesting the species may forage and/or disperse over greater distances.

No Pilbara leaf-nosed bat were recorded within the Study Area during the current survey; however, the species has previously been recorded approximately 24 km northwest in 2013 (Biologic, 2014b) and 29 km northwest of the Study Area in 2013 (Figure 3.1) (DBCA, 2020c). The species' likelihood of occurrence within the Study Area is considered Possible; however, its occurrence is likely to be restricted to occasional visitation to forage and/or during dispersal movements. No suitable roosting

habitat occurs within the Study Area; however, suitable roosting habitat may occur in some caves within the broader area. The scarcity of records in the broader vicinity of the Study Area suggests the species is relatively uncommon in the area and its occurrence may be restricted to foraging events only. Within the Study Area, based on (TSSC, 2016) categories of foraging habitat for the species, limited instances where outcropping occurs within Hillcrest/ Hillslope may provide potential Priority 3 foraging habitat, while Major Drainage Line provides Priority 4 habitat and Mulga Woodland provides suitable Priority 5 foraging habitat.

5.3.2.5 Pilbara Olive Python (*Liasis olivaceus barroni*) – Vulnerable (EPBC/BC Act)

The Pilbara olive python is moderately common through the ranges of the Pilbara region and the Mt Augustus area in the Gascoyne region. The species is often associated with rocky habitats (i.e. Gorge/Gully, Breakaway/ Cliff and Hillcrest/Hillslope habitats) and drainage systems (i.e. Major Drainage Lines), particularly where occurring in proximity to permanent or semi-permanent waterbodies, including areas with localised drainage and watercourses (Pearson, 1993). In the inland Pilbara, the species is most often encountered near permanent waterholes in rocky ranges or among riverine vegetation (Pearson, 1993). Pilbara olive python are primarily nocturnal and tend to shelter in small caves or under vegetation during the day, although it is occasionally active during the day during warmer summer months (Pearson, 1993).

No Pilbara olive python were recorded during the current survey; however, the nearest records are located approximately 4km north, 5km north, and 6km northwest of the Study Area from 2013 (BHP, 2020) (Figure 3.1; Figure 3.2). Although no optimal habitat likely to support the species as a resident was recorded within the Study Area, the species may occasionally occur to forage or during dispersal movements from other areas of suitable habitat outside the Study Area. The species' likelihood of occurrence is considered Possible, particularly within Major Drainage Line and limited instances of outcropping within Hillcrest/ Hillslope habitats; however, the occurrence within the Study Area is likely to be dependent on habitat outside of the Study Area and the presence of connectivity with habitats of the Study Area.

5.3.2.6 Night Parrot (*Pezoporus occidentalis*) – Endangered (EPBC/BC Act)

This highly cryptic and nocturnal parrot inhabits arid and semi-arid areas that comprise dense, low vegetation. The habitat of the night parrot often comprises *Triodia* grasslands in stony or sandy environments (Jackett *et al.*, 2017; McGilp, 1931; Murphy *et al.*, 2017; North, 1898; Whitlock, 1924; Wilson, 1937), and of samphire and chenopod shrublands, including genera such as *Atriplex*, *Bassia* and *Maireana*, on floodplains and claypans, as well as on the margins of salt lakes, creeks or other sources of water (Jackett *et al.*, 2017; McGilp, 1931; Murphy *et al.*, 2017; Wilson, 1937). The current interim guidelines for preliminary surveys of night parrot in Western Australia suggest this species requires old-growth spinifex (*Triodia* spp.) (often more than 50 years' unburnt) for roosting and nesting (DPaW, 2017).

Foraging areas include highly productive and floristically diverse alluvial habitats, stony herb fields, sparse ironstone pavements, and quaternary sand drifts and ridges (Night Parrot Recovery Team,

2017). The occurrence of nesting habitat in proximity to primary foraging habitat, defined as low, treeless chenopod shrublands or herb lands with high abundance and diversity of annual grasses and herbs, is believed to be key to the species presence (Jackett *et al.*, 2017; Murphy *et al.*, 2017). Foraging habitat is likely to be more important if it is adjacent to or within about 10 km (furthest distance recorded for a foraging individual; Murphy *et al.*, 2017) of suitable roosting habitat (DPaW, 2017).

Records of night parrot within the Pilbara region are scarce, with the nearest contemporary record of the species located approximately 140 km northwest, from April 2005 (Davis & Metcalf, 2008; DBCA, 2020a). Three individuals were purportedly observed at Minga Well, a station bore and livestock watering point with large pools of water (Davis & Metcalf, 2008). The site is heavily degraded from cattle and lacks understory within a larger area; however, larger patches of old-growth *Triodia* grasslands occur in the vicinity along the peripherals of the Fortescue Marsh and chenopod shrublands occur throughout the marsh itself. Despite this observation, targeted surveys since have failed to record the species again.

No evidence of occurrence of night parrot was recorded within the Study Area during the current survey, including from targeted acoustic recorders deployed in areas of habitat considered possibly suitable for the species. Habitat within the Study Area was largely considered suboptimal for the species given to most areas of *Triodia* grasslands lacking large long-unburnt hummocks and the absence of any chenopod shrubland or other foraging habitat occurring. Although little is known about the species' habitat preferences and occurrence, the presence of nesting habitat in proximity to primary foraging habitat (defined as low, treeless chenopod shrublands and/or herb lands with a high abundance of annual grasses and herbs (Murphy *et al.*, 2017)) is believed to be a key factor in the species occurrence. As potential roosting or nesting habitat within the Study Area is considered suboptimal and no known suitable primary foraging habitat occurs within 10 km of the Study Area, the species occurrence is considered unlikely to occur within the Study Area, either as a resident or infrequent visitor during foraging and or dispersal/migration movements.

5.3.3 Species Confirmed in the Study Area

5.3.3.1 Brush-tailed Mulgara (*Dasyercus blythi*) – Priority 4 (DBCA)

The brush-tailed mulgara is often recorded from a range of sandy and stony plain habitats (Pavey *et al.*, 2012). No evidence of the species was recorded during the current survey; however, the species was recorded within the Study Area during three previous surveys in 2016 and 2018 (Biologic, 2016a, 2016b, 2018b) (Figure 3.1; Figure 3.2). Biologic (2016a) recorded the species on four occasions at four locations in Sand Plain and Hardpan Plain habitats, comprising three inactive burrows and a single individual recorded on a motion camera (Figure 3.1; Figure 3.2). Biologic (2016b) recorded the species on nine occasions from five locations, comprising five individuals captures (including one recapture), two active burrows and one direct observation of an active individual in Sand Plain and Hardpan Plain habitats (Figure 3.1; Figure 3.2). The species was recorded a further nine times from nine locations by Biologic (2018b), comprising six inactive (recently active) burrows, two active burrows and one trapped individual, with the majority of records from Sand Plain habitat (Figure 3.1; Figure 3.2). Therefore, the species is considered to occur as a resident in Sand Plain (regarded as primary breeding, foraging and

dispersal habitat), particularly where suitable vegetation cover and sandy or loamy substrates permitting burrowing are present. Additionally, Hardpan Plain and Stony Plain provide secondary breeding, foraging and dispersal habitat for the species.

5.3.3.2 Western Pebble-mound Mouse (*Pseudomys chapmani*) – Priority 4 (DBCA)

The western pebble-mound mouse has experienced a significant decline in their range through the Gascoyne and Murchison and is now considered endemic to the Pilbara (Start *et al.*, 2000). This species almost exclusively occurs on the gentler slopes of rocky ranges and low undulating hills where the ground is covered with a stony mantle and vegetated by hard spinifex, often with a sparse overstorey of eucalypts and scattered shrubs (Anstee & Armstrong, 2001).

The western pebble-mound mouse was recorded within the Study Area on one occasion in 1994 within Sand Plain habitat, on one occasion in 2008 within Hardpan Plain habitat (DBCA, 2020c), one occasion in 2008 within Stony Plain habitat (Outback Ecology, 2009c) and on one occasion in 2015 within Hillcrest/ Hillslope habitat (BHP, 2020) (Figure 3.1; Figure 3.2). This comprised two records from secondary evidence (pebble mounds). The species is considered to occur within the Study Area as a resident, whereby Stony Plain and Hillcrest/ Hillslope provide secondary breeding, foraging and dispersal habitat for the species.

5.3.3.3 Spotted *Ctenotus* (*Ctenotus uber* subsp. *johnstonei*) – Priority 2 (DBCA).

Habitat preferences of the spotted ctenotus are poorly known; however, previous records of the subspecies in the Pilbara region are associated with stony hillslope and plain habitats with variable vegetation cover, often dominated by open *Acacia* shrubland and *Triodia* hummock grassland (Cogger, 2014). No evidence of the spotted ctenotus was recorded during the current survey; however, the species was recorded within the Study Area during previous surveys in 2016 and 2018 (Biologic, 2016b, 2018b). A total of five individuals of the species were recorded from direct observation (trapped individuals and one opportunistic record) at three locations within Hardpan Plain habitat in 2016 (BHP, 2020; Biologic, 2016b) (Figure 3.1; Figure 3.2). The species was also recorded once from direct observation (trapped individual) within Sand Plain habitat in 2018 (BHP, 2020; Biologic, 2018b) (Figure 3.1; Figure 3.2). Hardpan Plain and Sand Plain habitats provide primary breeding, foraging and dispersal habitat for the species. It should be noted that there is currently some taxonomic uncertainty regarding the isolated Pilbara population of this subspecies, and the population may represent an undescribed taxon (P. Doughty, Western Australian Museum, *pers. comm.*).

5.3.4 Species Highly Likely to Occur in the Study Area

No species of conservation significance identified in the desktop assessment are considered Highly Likely to occur in the Study Area (Table 5.5).

5.3.5 Species Likely to Occur in the Study Area

In addition to the ghost bat discussed above (see Section 5.3.2), a further three species of conservation significance are considered Likely to occur in the Study Area.

5.3.5.1 Long-tailed Dunnart (*Sminthopsis longicaudata*) – Priority 4 (DBCA)

Despite the relatively widespread distribution of long-tailed dunnart, the species is often sparsely distributed and locally uncommon in the Pilbara region, where it often occurs in rugged rocky areas, scree slopes and stony plains and plateaus dominated by open shrubland and *Triodia* grassland vegetation (van Dyck *et al.*, 2013).

No evidence of the long-tailed dunnart was recorded within the Study Area during the current survey; however, based on the presence of potential habitat for the species, its likelihood of occurrence is considered Likely. The species has previously been recorded approximately 34 km west of the Study Area (1997), with a more contemporary record located approximately 47 km east of the Study Area (2006) (DBCA, 2020a). Within the Study Area, the species may occur as a resident, primarily within Hillcrest/ Hillslope habitat which provides primary breeding and foraging habitat. Hillcrest/ Hillslope and Stony Plain habitat provides primary and secondary foraging and dispersal habitat, respectively. The species may also move into adjacent habitats to forage and/or disperse, particularly when occurring in proximity to denning habitat.

5.3.5.2 Grey Falcon (*Falco hypoleucos*) – Vulnerable (EPBC Act/BC Act)

The grey falcon is sparsely distributed, inhabiting the arid and semi-arid zones of Australia (Schoenjahn *et al.*, 2019). The species commonly nests in timbered lowlands, particularly *Acacia* shrubland and along inland drainage systems (Garnett *et al.*, 2011), within artificial structures or remanent stick-nests of other species of bird (Schoenjahn *et al.*, 2019). It forages in open or more sparsely vegetated habitats (Garnett *et al.*, 2011) such as spinifex and tussock grassland (Burbidge *et al.*, 2010; Olsen & Olsen, 1986) and feeds predominantly on birds (Schoenjahn *et al.*, 2019).

No grey falcons were recorded within the Study Area during the current survey; however, the species has previously been recorded approximately 10 km northwest (2013) (BHP, 2020) (Table 5.5; Figure 3.1; Figure 3.2). Due to the large foraging range of the species, the species is considered likely to occur within the Study Area as a frequent visitor to forage, particularly within Sand Plain, Stony Plain, Hardpan Plain and Major Drainage habitats. Occurrence within the Study Area will be influenced by proximity of nesting to the Study Area. Nesting may occur within Major Drainage habitat where suitable tall trees are present.

5.3.5.3 Peregrine Falcon (*Falco peregrinus*) – Specially Protected (BC Act)

In arid areas of its distribution, the peregrine falcon is often recorded along cliffs above rivers, ranges and wooded watercourses where it hunts birds (Johnstone & Storr, 1998). It typically nests on rocky ledges occurring on tall, vertical cliff faces between 25 m and 50 m high (Olsen & Olsen, 1989). It also appears to prefer nesting on large ledges a reasonable distance (average of 13 m) from the top of the cliff (Olsen & Olsen, 1989), possibly to avoid ground dwelling predators. Nesting may also occasionally occur in tall trees along drainage lines, including use of abandoned nests of other large bird species (Olsen & Olsen, 1989).

No peregrine falcons were recorded within the Study Area during the current survey; however, the species has previously been recorded approximately 19 km northwest (2013) and 25 km west of the

Study Area (2011) (DBCA, 2020c) (Table 5.5; Figure 3.1; Figure 3.2). The species is considered likely to occur within the Study Area as a frequent visitor to forage, particularly if nesting occurs in the vicinity of the Study Area, and/or when dispersing. No suitable nesting habitat occurs within the Study Area and nesting is unlikely to occur.

5.3.6 Species Possibly Occurring in the Study Area

In addition to the Pilbara leaf-nosed bat, Pilbara olive python, greater bilby and northern quoll discussed above (see Section 5.3.2), a further three species of conservation significance are considered Possible to occur in the Study Area.

5.3.6.1 Spectacled-hare Wallaby (*Lagorchestes conspicillatus* subsp. *leichardti*) – Priority 4 (DBCA)

The spectacled hare-wallaby has declined across most of its Pilbara distribution and is now only known from sparsely distributed and infrequent records within the region (DBCA, 2020a) and thus, the current known range of the species is poorly defined. Within the Pilbara region the spectacled hare-wallaby is known to occur in tussock and hummock grasslands and *Acacia* shrublands, particularly in areas where large mature *Triodia* hummocks occur (Burbidge & Johnson, 1995; Ingleby & Westoby, 1992).

Records of the species are scarce in the vicinity of the Study Area; however, the species has previously been recorded approximately 17.5 km southeast of the Study Area (undated record) (DBCA, 2020c). Moreover, scats belonging to the species have been recorded ~74km north of the Study Area (APM, 2010). Based on habitats present within and in the vicinity of the Study Area and the above record, the species likelihood of occurrence within the Study Area is considered Possible. The species may occur as a resident within suitable vegetated areas of Sand Plain habitat within the Study Area. Foraging and dispersal may occur more broadly within other habitats proximal to Sand Plain habitat, including Hardpan Plain, Stony Plain and Mulga Woodland, where suitable vegetation cover is also present.

5.3.6.2 Fork-tailed Swift (*Apus pacificus*) – Migratory (EPBC/BC Act)

The fork-tailed swift is a wide ranging but sparsely distributed species that occurs in a wide range of habitats (Johnstone & Storr, 1998). The species does not breed in Australia, migrating from breeding grounds in the northern Hemisphere. During its occurrence in Australia, the species is almost exclusively aerial, feeding and possibly also roosting aerially (DoEE, 2019).

The fork-tailed swift was not recorded during the current survey and the nearest record of the species is located approximately 8.6 km northeast of the Study Area (BHP, 2020). The species is considered to possibly occur due to its wide-ranging and sporadic occurrence. The species is likely to occur as an infrequent visitor and may forage in the airspace above all habitats occurring within the Study Area, though the species is highly unlikely to land or nest.

5.3.6.3 Pilbara Flat-headed Blind-snake (*Anilius ganei*) – Priority 1 (DBCA)

Little is known about the Pilbara flat-headed blind-snake; however, it can be assumed that its ecology and behaviour are similar to other blind snake species (Cogger, 2014). Due to its fossorial nature, the species is rarely encountered, and little is known of the species habitat preferences. Records of the

species are often associated with moist gorges and gullies; however, the species is presumed to occur within other mulga and stony habitats (Chapple *et al.*, 2019; Wilson & Swan, 2014).

The Pilbara flat-headed blind-snake was not recorded during the current survey; however, based on the occurrence of habitats that are similar to those in which the species has previously been recorded or are considered to potentially occur, and the occurrence of a previous record of the species approximately 4 km north of the Study Area (2004, 2007, 2014) (BHP, 2020; DBCA, 2020c), its occurrence is considered Possible. The species may occur as a resident within Hillcrest/ Hillslope, Stony Plain and Mulga Woodland habitats, particularly in areas where leaf litter accumulates, and moisture is retained in leaf litter and substrates.

5.4 Potential Limitation and Constraints

The EPA (2020) outlines several potential limitations to fauna surveys. These aspects are assessed and discussed in Table 5.6 below. No major limitations or constraints were identified for the current survey.

Table 5.6: Survey limitations and constraints

Potential limitation or constraint	Limitation to current survey	Applicability to this survey
Experience of personnel	No	The field personnel involved in the survey and reporting are experienced in undertaking fauna surveys of similar nature, including for conservation significant species of interest to the survey.
Scope (faunal groups sampled and whether any constraints affect this)	No	The scope of the survey was a basic (formerly Level 1) survey with targeted survey effort focused on species of conservation significance (i.e. northern quoll, bilby, night parrot). The survey was conducted within this framework in accordance with relevant guidelines and recommendations. All sampling methods implemented were able to be undertaken as expected to sample all target fauna groups. Although the timing of the field survey predated recently revised guidance (EPA, 2020, released July 2020), not all ultrasonic recording sites confirmed with the recommended three nights of sampling (Table 4.2). The reduced sampling effort at some sites is not considered to have significantly influenced the results of the field survey and assessment of the likelihood of occurrence of conservation significant species.
Proportion of fauna identified	No	The majority of fauna recorded in the Study Area were identified at the point of capture or observation. Bat calls were identified after they were recorded by Mr. Robert Bullen, of Bat Call WA. Acoustic recordings were analysed following the survey by Nigel Jakkett. No fauna recorded during the survey were incompletely identified to relevant taxonomic levels.
Sources of information (recent or historic) and availability of contextual information	No	All contextual resources required to complete the scope were available (previous surveys, database searches, environmental information, climate data). This included information from ten biological surveys previously conducted within and in the vicinity of the Study Area, comprising a reasonable amount of previous survey effort. Also available were regional biodiversity surveys describing known assemblages of vertebrate fauna occurring in the Pilbara (McKenzie <i>et al.</i> , 2009).
Proportion of the task achieved	No	A comprehensive desktop assessment and basic field survey of the Study Area was completed as scoped for the survey.

Potential limitation or constraint	Limitation to current survey	Applicability to this survey
Timing / weather / season / cycle	No	Climactic conditions during and preceding the field survey were similar to or slightly above long-term averages. Above average temperatures and below average rainfall in the months preceding the field survey may have resulted in reduced activity of some vertebrate groups during the survey.
Disturbances (e.g. fire or flood)	No	No disturbance occurred during or immediately prior to the surveys that is likely to have significantly impacted survey outcomes.
Intensity of survey	No	A comprehensive desktop assessment and basic survey (with targeted components) was identified by BHP WAIO as the requirement for this survey. The survey methods and effort were assessed as sufficient to meet this level of survey for the size of the Study Area.
Completeness of survey	No	The survey achieved enough coverage of the Study Area and associated habitats through the sampling techniques employed and habitat assessments undertaken to complete all required aspects of the survey.
Resources (e.g. degree of expertise available)	No	All relevant resources and expertise required to complete the survey were available.
Remoteness or access issues	No	The Study Area was largely accessible either by vehicle or on foot and sampling within all broad fauna habitats mapped within the Study Area could be accessed, thus the sampling techniques used during this survey were unconstrained by accessibility or remoteness.
Availability of contextual information on the region	No	Fauna assemblages of the Pilbara region are well documented, particularly for vertebrate fauna groups. All contextual resources within the vicinity of the Study Area and the broader Pilbara region required to complete the survey were available (previous surveys, database searches, environmental information, climate data etc.)

6 CONCLUSION

Six broad fauna habitat types were recorded and mapped within the Study Area, comprising, in decreasing order of extent, Hardpan Plain (47.37%, 1,155.08 ha), Stony Plain (18.77%, 457.77 ha), Sand Plain (16.63%, 405.39 ha), Mulga Woodland (13.52%, 329.65 ha), Hillcrest/ Hillslope (2.02%, 49.29 ha) and Major Drainage Line (0.69%, 16.89 ha) (Table 5.1; Figure 5.1). The remaining 1.00% (24.22 ha) of the Study Area comprised Cleared areas and are not considered to provide suitable habitat for fauna.

All broad fauna habitats occurring within the Study Area are known to, or considered likely to, provide suitable habitat for species of conservation significance. The degree and extent of usage of these habitats by species of conservation significance is variable; however, none are considered to provide critical habitat for which any MNES species of conservation significance would be reliant upon. In instances where suitable habitat for conservation significant species occurs within the Study Area, it is often within widespread habitats and generally limited to supporting habitat (such as foraging and/or dispersal only) or occurs in relatively small and isolated areas which are less likely to be accessed or utilised by the species. All six broad habitats mapped within the Study Area are broadly distributed and well represented in the vicinity of the Study Area and across the Pilbara bioregion, and therefore support fauna assemblages which are generally common and widespread.

Of the six broad fauna habitats occurring within the Study Area, all have the potential to support species of conservation significance at varying capacities, though the provision of primary and/or secondary (supporting) breeding, denning, nesting/roosting, foraging and/or dispersal habitat. Sand Plain habitat provides primary breeding, foraging and dispersal habitat for greater bilby, brush-tailed mulgara, spectacled hare-wallaby, night parrot and spotted ctenotus, in addition to foraging and dispersal habitat for ghost bat and peregrine falcon. Hillcrest/ Hillslope habitat provides breeding, foraging and dispersal habitat for long-tailed dunnart, western pebble-mound mouse and the Pilbara flat-headed blind-snake. Furthermore, suitable foraging and dispersal habitat is also provided for northern quoll, Pilbara leaf-nosed bat and peregrine falcon. Suitable breeding, foraging and dispersal habitat is provided for brush-tailed mulgara, western pebble-mound mouse, night parrot and spotted ctenotus in Stony Plain habitat, with foraging and dispersal habitat provided for long-tailed dunnart, ghost bat and peregrine falcon. Hardpan Plain habitat provides suitable breeding, foraging and dispersal habitat for brush-tailed mulgara and spotted ctenotus, and foraging/ dispersal habitat for peregrine falcon. Mulga Woodland habitat provides breeding and foraging habitat for greater bilby and the Pilbara flat-headed blind-snake and additional foraging habitat for ghost bat. Furthermore, Major Drainage Line habitat provides suitable foraging and dispersal habitat for northern quoll, ghost bat, Pilbara leaf-nosed bat, peregrine falcon and Pilbara olive python. No important habitat features (caves or water features) were recorded within the Study Area during the current survey.

A total of 76 vertebrate fauna species, comprising 14 mammal species (11 native and three introduced), 57 bird species and five reptile species were recorded in the Study Area during the current survey, representing approximately 21.4% of species identified in the desktop assessment as potentially

occurring. No conservation significant species were recorded during the current survey; however, three species have been recorded within the Study Area during previous surveys (BHP, 2020; DBCA, 2020c):

- brush-tailed mulgara (Priority 4 – DBCA) – resident;
- western pebble-mound mouse (Priority 4 – DBCA) – resident; and
- spotted ctenotus (Priority 2 – DBCA) – resident.

Based on the habitats present within the Study Area, species distributions, habitat preferences and general ecology, three species identified in the desktop assessment were considered Likely to occur within the Study Area:

- ghost bat (Vulnerable - EPBC/BC Act) – regular visitor (foraging/dispersal only);
- long-tailed dunnart (Priority 4 – DBCA) – resident;
- grey falcon (Vulnerable - EPBC/BC Act) – potential resident (nesting)/ frequent visitor (foraging/dispersal); and
- peregrine falcon (Specially Protected – BC Act) – frequent visitor (foraging/dispersal only).

Given the habitats present within the Study Area and locations of nearby records identified during the desktop assessment, the occurrence of a further seven species of conservation significance within the Study Area is considered Possible:

- Pilbara leaf-nosed bat (Vulnerable – EPBC/BC Act) – occasional visitor (foraging/dispersal only);
- greater bilby (Vulnerable – EPBC/BC Act) – resident;
- northern quoll (Endangered – EPBC/BC Act) – infrequent visitor (foraging/dispersal only);
- Pilbara olive python (Vulnerable – EPBC/BC Act) – infrequent visitor (foraging/dispersal);
- spectacled hare-wallaby (Priority 4 – DBCA) – resident;
- fork-tailed swift (Migratory – EPBC/BC Act) – infrequent visitor (foraging/migration only); and
- Pilbara flat-headed blind-snake (Priority 1 – DBCA) – resident.

The remaining 26 species were considered Unlikely or Highly Unlikely to occur within the Study Area due to the absence of suitable habitat or habitat features to support the species and/or the Study Area occurring outside their current known distribution.

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8 APPENDICES

Appendix A – Conservation listings

International Union for Conservation of Nature

Category	Definition
Extinct (EX)	A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.
Extinct in the Wild (EW)	A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.
Critically Endangered (CE)	A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered (see Section V), and it is therefore considered to be facing an extremely high risk of extinction in the wild.
Endangered (EN)	A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered (see Section V), and it is therefore considered to be facing a very high risk of extinction in the wild.
Vulnerable (VU)	A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable (see Section V), and it is therefore considered to be facing a high risk of extinction in the wild.
Near Threatened (NT)	A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future
Data Deficient (DD)	A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases, great care should be exercised in choosing between DD and a threatened status. If the range of a taxon is suspected to be relatively circumscribed, and a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.

Environment Protection and Biodiversity Conservation Act 1999

Category	Definition
Threatened	
Extinct (EX)	Presumed extinct i.e. there is no reasonable doubt that the last member of the species has died.
Extinct in the Wild (EW)	Presumed extinct in the wild, only surviving in cultivation, captivity or as a naturalised population well outside its past range.
Critically Endangered (CR)	Taxa facing an extremely high risk of extinction in the wild in the immediate future (i.e. 50% chance of extinction in the immediate future).
Endangered (EN)	Taxa facing a very high risk of extinction in the wild in the near future i.e. 20% chance of extinction in the near future.
Vulnerable (VU)	Taxa facing a high risk of extinction in the wild in the medium-term future i.e. 10% chance of extinction in the medium-term future.
Conservation Dependent (CD)	Taxa which will become Vulnerable, Endangered or Critically Endangered if specific conservation efforts cease.
Other	
Migratory (MI)	Birds listed under international agreements relating to the protection of migratory birds i.e. Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), China-Australia Migratory Bird Agreement (CAMBA), Japan-Australia Migratory Bird Agreement (JAMBA) or Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA).

Biodiversity Conservation Act 2016

Category	Definition
Extinct	
Extinct (EX)	Presumed extinct i.e. there is no reasonable doubt that the last member of the species has died.
Extinct in the Wild (EW)	Presumed extinct in the wild i.e. species which have been adequately searched for and there is no reasonable doubt that the last wild individual has died.
Threatened	
Critically Endangered (CR)	Taxa facing an extremely high risk of extinction in the wild.
Endangered (EN)	Taxa facing a very high risk of extinction in the wild.
Vulnerable (VU)	Taxa facing a high risk of extinction in the wild.
Specially Protected	
Migratory (MI)	Birds listed under international agreements relating to the protection of migratory birds i.e. Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), China-Australia Migratory Bird Agreement (CAMBA), Japan-Australia Migratory Bird Agreement (JAMBA) or Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA).
Conservation Dependent (CD)	Species dependent on ongoing conservation intervention to prevent them becoming eligible for listing as threatened.
Other specially protected fauna (OS)	Species otherwise in need of special protection to ensure their conservation.

Department of Biodiversity, Conservation and Attractions Priority codes

Category	Definition
Poorly known	
Priority 1 (P1)	Species that are known from one or a few locations which are potentially at risk. Species whose occurrences are either small, on lands not managed for conservation or otherwise threatened with habitat destruction or degradation. Species that are well known from one or more locations but are under immediate threat from threatening processes. In urgent need of further survey.
Priority 2 (P2)	Species that are known from one or a few locations, some of which are on lands managed for conservation. Species that are well known from one or more locations but are under threat from threatening processes. In urgent need of further survey. In need of further survey.
Priority 3 (P3)	Species that are well known from several locations and are not are under imminent threat. Species known from few but widespread locations with either a large population size or with large areas of suitable habitat remaining, much of which is not under imminent threat. Species that are well known from one or more locations and threatening processes exist that could affect them.
Rare, Near Threatened and other species in need of monitoring	
Priority 4 (P4)	<p><i>Rare</i> – Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection but could be if present circumstances change.</p> <p><i>Near Threatened</i> – Species that are considered to have been adequately surveyed and that are close to qualifying for Vulnerable but are not listed as Conservation Dependent.</p> <p><i>In need of monitoring</i> - Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy</p>



Appendix B – Locations of vertebrate fauna sampling sites

Site	Start Date	End Date	Method	Habitat	Latitude	Longitude
VJMW-001	8/05/2020	8/05/2020	Habitat assessment	Stony Plain	-23.3881	120.0189
VJMW-001	8/05/2020	12/07/2020	Motion camera (ten)	Stony Plain	-23.3881	120.0189
VJMW-001	8/05/2020	12/05/2020	Ultrasonic recorder (two)	Stony Plain	-23.3881	120.0189
VJMW-002	8/05/2020	8/05/2020	Habitat assessment	Hillcrest/ Hillslope	-23.3870	120.0265
VJMW-003	8/05/2020	8/05/2020	Habitat assessment	Hardpan Plain	-23.3961	120.0043
VJMW-004	8/05/2020	8/05/2020	Habitat assessment	Sand Plain	-23.3967	120.0013
VJMW-004	8/05/2020	12/05/2020	Acoustic recorder	Sand Plain	-23.3967	120.0013
VJMW-005	8/05/2020	8/05/2020	Habitat assessment	Hardpan Plain	-23.3935	120.0046
VJMW-005	8/05/2020	8/05/2020	Targeted search	Hardpan Plain	-23.3935	120.0046
VJMW-006	8/05/2020	8/05/2020	Habitat assessment	Hardpan Plain	-23.3906	120.0104
VJMW-007	8/05/2020	8/05/2020	Habitat assessment	Hardpan Plain	-23.3669	119.9843
VJMW-007	8/05/2020	10/05/2020	Ultrasonic recorder	Hardpan Plain	-23.3669	119.9843
VJMW-008	8/05/2020	8/05/2020	Habitat assessment	Sand Plain	-23.3749	119.9926
VJMW-008	8/05/2020	12/07/2020	Motion camera (six)	Sand Plain	-23.3749	119.9926
VJMW-008	8/05/2020	12/05/2020	Acoustic recorder	Sand Plain	-23.3749	119.9926
VJMW-009	8/05/2020	8/05/2020	Habitat assessment	Sand Plain	-23.3793	119.9965
VJMW-009	8/05/2020	12/05/2020	Acoustic recorder	Sand Plain	-23.3793	119.9965
VJMW-010	8/05/2020	8/05/2020	Habitat assessment	Stony Plain	-23.371	120.0337
VJMW-011	8/05/2020	8/05/2020	Habitat assessment	Stony Plain	-23.3840	120.0319
VJMW-011	8/05/2020	12/05/2020	Acoustic recorder	Stony Plain	-23.3840	120.0319
VJMW-012	8/05/2020	8/05/2020	Habitat assessment	Hillcrest/ Hillslope	-23.3850	120.0308
VJMW-013	8/05/2020	8/05/2020	Habitat assessment	Hillcrest/ Hillslope	-23.3864	120.0296
VJMW-013	8/05/2020	8/05/2020	Targeted search	Hillcrest/ Hillslope	-23.3864	120.0296
VJMW-014	8/05/2020	8/05/2020	Habitat assessment	Sand Plain	-23.3823	120.0177
VJMW-015	8/05/2020	8/05/2020	Habitat assessment	Stony Plain	-23.3837	120.0166
VJMW-015	8/05/2020	8/05/2020	Targeted search	Stony Plain	-23.3837	120.0166
VJMW-016	9/05/2020	9/05/2020	Habitat assessment	Hardpan Plain	-23.3910	119.9866
VJMW-017	9/05/2020	9/05/2020	Habitat assessment	Hardpan Plain	-23.3935	119.9885
VJMW-017	9/05/2020	9/05/2020	Targeted search	Hardpan Plain	-23.3935	119.9885

Site	Start Date	End Date	Method	Habitat	Latitude	Longitude
VJMW-018	9/05/2020	9/05/2020	Habitat assessment	Hardpan Plain	-23.3869	119.9872
VJMW-019	9/05/2020	9/05/2020	Habitat assessment	Sand Plain	-23.3827	119.9887
VJMW-019	9/05/2020	9/05/2020	Targeted search	Sand Plain	-23.3827	119.9887
VJMW-020	9/05/2020	9/05/2020	Habitat assessment	Sand Plain	-23.3746	119.9895
VJMW-020	9/05/2020	9/05/2020	Targeted search	Sand Plain	-23.3746	119.9895
VJMW-021	9/05/2020	9/05/2020	Habitat assessment	Sand Plain	-23.3800	119.9940
VJMW-021	9/05/2020	9/05/2020	Targeted search	Sand Plain	-23.3800	119.9940
VJMW-022	9/05/2020	9/05/2020	Habitat assessment	Hardpan Plain	-23.3910	119.9970
VJMW-023	9/05/2020	9/05/2020	Habitat assessment	Hardpan Plain	-23.3924	119.9977
VJMW-024	9/05/2020	9/05/2020	Habitat assessment	Sand Plain	-23.3925	120.0000
VJMW-024	9/05/2020	9/05/2020	Targeted search	Sand Plain	-23.3925	120.0000
VJMW-025	9/05/2020	9/05/2020	Habitat assessment	Hardpan Plain	-23.3903	119.9978
VJMW-026	9/05/2020	9/05/2020	Habitat assessment	Sand Plain	-23.3813	120.0136
VJMW-026	9/05/2020	9/05/2020	Targeted search	Sand Plain	-23.3813	120.0136
VJMW-027	9/05/2020	9/05/2020	Habitat assessment	Hardpan Plain	-23.3766	120.0107
VJMW-028	9/05/2020	9/05/2020	Habitat assessment	Hardpan Plain	-23.3757	120.0120
VJMW-029	9/05/2020	9/05/2020	Habitat assessment	Hardpan Plain	-23.3745	120.0139
VJMW-030	9/05/2020	9/05/2020	Habitat assessment	Stony Plain	-23.3727	120.0164
VJMW-030	9/05/2020	9/05/2020	Targeted search	Stony Plain	-23.3727	120.0164
VJMW-031	9/05/2020	9/05/2020	Habitat assessment	Stony Plain	-23.3722	120.0175
VJMW-032	9/05/2020	9/05/2020	Habitat assessment	Hardpan Plain	-23.3754	120.0183
VJMW-032	9/05/2020	9/05/2020	Targeted search	Hardpan Plain	-23.3754	120.0183
VJMW-033	9/05/2020	9/05/2020	Habitat assessment	Hardpan Plain	-23.3756	120.0161
VJMW-033	9/05/2020	9/05/2020	Targeted search	Hardpan Plain	-23.3756	120.0161
VJMW-034	9/05/2020	9/05/2020	Habitat assessment	Sand Plain	-23.3778	119.9888
VJMW-034	9/05/2020	9/05/2020	Targeted search	Sand Plain	-23.3778	119.9888
VJMW-035	10/05/2020	10/05/2020	Habitat assessment	Stony Plain	-23.3899	120.0381
VJMW-036	10/05/2020	10/05/2020	Habitat assessment	Stony Plain	-23.3912	120.0409
VJMW-037	10/05/2020	10/05/2020	Habitat assessment	Hardpan Plain	-23.3922	120.0448

Site	Start Date	End Date	Method	Habitat	Latitude	Longitude
VJMW-038	10/05/2020	10/05/2020	Habitat assessment	Hardpan Plain	-23.3843	120.0373
VJMW-038	10/05/2020	10/05/2020	Targeted search	Hardpan Plain	-23.3843	120.0373
VJMW-039	10/05/2020	10/05/2020	Habitat assessment	Hardpan Plain	-23.3815	120.0354
VJMW-040	9/05/2020	9/05/2020	Habitat assessment	Sand Plain	-23.3776	120.0238
VJMW-040	9/05/2020	9/05/2020	Targeted search	Sand Plain	-23.3776	120.0238
VJMW-041	9/05/2020	9/05/2020	Habitat assessment	Sand Plain	-23.3769	120.0293
VJMW-041	9/05/2020	9/05/2020	Targeted search	Sand Plain	-23.3769	120.0293
VJMW-042	9/05/2020	9/05/2020	Habitat assessment	Sand Plain	-23.3752	120.0292
VJMW-043	10/05/2020	10/05/2020	Habitat assessment	Stony Plain	-23.3747	120.0290
VJMW-044	10/05/2020	10/05/2020	Habitat assessment	Stony Plain	-23.3747	120.0290
VJMW-045	10/05/2020	10/05/2020	Habitat assessment	Stony Plain	-23.3736	120.0289
VJMW-046	10/05/2020	10/05/2020	Habitat assessment	Stony Plain	-23.3731	120.0292
VJMW-046	10/05/2020	10/05/2020	Targeted search	Stony Plain	-23.3731	120.0292
VJMW-047	10/05/2020	10/05/2020	Habitat assessment	Stony Plain	-23.3732	120.0306
VJMW-048	10/05/2020	10/05/2020	Habitat assessment	Sand Plain	-23.3736	120.0319
VJMW-049	10/05/2020	10/05/2020	Habitat assessment	Sand Plain	-23.3739	120.0328
VJMW-050	10/05/2020	10/05/2020	Habitat assessment	Sand Plain	-23.3756	120.0396
VJMW-050	10/05/2020	10/05/2020	Targeted search	Sand Plain	-23.3756	120.0396
VJMW-051	10/05/2020	10/05/2020	Habitat assessment	Sand Plain	-23.3728	120.0425
VJMW-052	10/05/2020	10/05/2020	Habitat assessment	Hardpan Plain	-23.3703	120.0407
VJMW-053	10/05/2020	10/05/2020	Habitat assessment	Stony Plain	-23.3678	120.0408
VJMW-054	10/05/2020	10/05/2020	Habitat assessment	Stony Plain	-23.3669	120.0421
VJMW-055	10/05/2020	10/05/2020	Habitat assessment	Stony Plain	-23.3668	120.0394
VJMW-056	10/05/2020	10/05/2020	Habitat assessment	Sand Plain	-23.3786	119.9978
VJMW-056	10/05/2020	10/05/2020	Targeted search	Sand Plain	-23.3786	119.9978
VJMW-057	10/05/2020	10/05/2020	Habitat assessment	Hardpan Plain	-23.3922	120.0364
VJMW-058	10/05/2020	10/05/2020	Habitat assessment	Hardpan Plain	-23.3924	120.0374
VJMW-059	10/05/2020	10/05/2020	Habitat assessment	Stony Plain	-23.3928	120.0390
VJMW-060	10/05/2020	10/05/2020	Habitat assessment	Hardpan Plain	-23.3935	120.0365

Site	Start Date	End Date	Method	Habitat	Latitude	Longitude
VJMW-061	10/05/2020	10/05/2020	Habitat assessment	Hardpan Plain	-23.3939	120.0402
VJMW-062	10/05/2020	10/05/2020	Habitat assessment	Hardpan Plain	-23.3976	120.0422
VJMW-063	10/05/2020	10/05/2020	Habitat assessment	Mulga Woodland	-23.3952	120.0319
VJMW-064	10/05/2020	10/05/2020	Habitat assessment	Stony Plain	-23.3941	120.0297
VJMW-065	10/05/2020	10/05/2020	Habitat assessment	Mulga Woodland	-23.3922	120.0335
VJMW-066	10/05/2020	10/05/2020	Habitat assessment	Sand Plain	-23.3884	120.0355
VJMW-067	10/05/2020	10/05/2020	Habitat assessment	Hardpan Plain	-23.3845	120.0354
VJMW-068	10/05/2020	10/05/2020	Habitat assessment	Hillcrest/ Hillslope	-23.3802	120.0358
VJMW-069	10/05/2020	10/05/2020	Habitat assessment	Major Drainage Line	-23.3884	119.9838
VJMW-069	10/05/2020	12/05/2020	Ultrasonic recorder	Major Drainage Line	-23.3884	119.9838
VJMW-070	10/05/2020	10/05/2020	Habitat assessment	Hardpan Plain	-23.3872	119.9838
VJMW-071	10/05/2020	10/05/2020	Habitat assessment	Hardpan Plain	-23.3682	119.9852
VJMW-072	10/05/2020	10/05/2020	Habitat assessment	Hardpan Plain	-23.3712	119.9868
VJMW-073	10/05/2020	10/05/2020	Habitat assessment	Mulga Woodland	-23.3718	119.9878
VJMW-074	10/05/2020	10/05/2020	Habitat assessment	Hardpan Plain	-23.3975	119.9898
VJMW-075	10/05/2020	10/05/2020	Habitat assessment	Hardpan Plain	-23.3946	119.9883
VJMW-076	10/05/2020	10/05/2020	Habitat assessment	Hardpan Plain	-23.3926	119.9889
VJMW-077	10/05/2020	10/05/2020	Habitat assessment	Hardpan Plain	-23.3898	119.9888
VJMW-078	11/05/2020	11/05/2020	Habitat assessment	Hardpan Plain	-23.3820	119.9870
VJMW-078	11/05/2020	11/05/2020	Targeted search	Hardpan Plain	-23.3820	119.9870
VJMW-079	11/05/2020	11/05/2020	Habitat assessment	Hardpan Plain	-23.3696	120.0024
VJMW-080	11/05/2020	11/05/2020	Habitat assessment	Hardpan Plain	-23.3678	120.0071
VJMW-081	11/05/2020	11/05/2020	Habitat assessment	Hardpan Plain	-23.3680	120.0100
VJMW-082	11/05/2020	11/05/2020	Habitat assessment	Hardpan Plain	-23.3703	120.0144
VJMW-082	11/05/2020	11/05/2020	Targeted search	Hardpan Plain	-23.3703	120.0144
VJMW-083	11/05/2020	11/05/2020	Habitat assessment	Hardpan Plain	-23.3716	120.0104
VJMW-084	11/05/2020	11/05/2020	Habitat assessment	Hardpan Plain	-23.3781	120.0351
VJMW-085	11/05/2020	11/05/2020	Habitat assessment	Hillcrest/ Hillslope	-23.3768	120.0352
VJMW-085	8/05/2020	8/05/2020	Targeted search	Hillcrest/ Hillslope	-23.3768	120.0352

Site	Start Date	End Date	Method	Habitat	Latitude	Longitude
VJMW-085	11/05/2020	11/05/2020	VHF Tower	Hillcrest/ Hillslope	-23.3882	120.0209
VJMW-086	11/05/2020	11/05/2020	Habitat assessment	Stony Plain	-23.3882	120.0209
VJMW-087	11/05/2020	11/05/2020	Habitat assessment	Stony Plain	-23.3736	120.035
VJMW-088	11/05/2020	11/05/2020	Habitat assessment	Mulga Woodland	-23.3691	120.0341
VJMW-089	12/05/2020	12/05/2020	Habitat assessment	Mulga Woodland	-23.3678	120.0352
VJMW-089	12/05/2020	12/05/2020	Targeted search	Mulga Woodland	-23.3678	120.0352
VJMW-090	12/05/2020	12/05/2020	Habitat assessment	Mulga Woodland	-23.3805	120.0038
VJMW-091	12/05/2020	12/05/2020	Habitat assessment	Mulga Woodland	-23.3791	120.0050
VJMW-092	12/05/2020	12/05/2020	Habitat assessment	Hardpan Plain	-23.3934	120.0182
VJMW-092	12/05/2020	12/05/2020	Targeted search	Hardpan Plain	-23.3934	120.0182
VJMW-093	12/05/2020	12/05/2020	Habitat assessment	Hardpan Plain	-23.3695	120.0284
VJMW-094	9/05/2020	9/05/2020	Habitat assessment	Hardpan Plain	-23.3679	120.0264
VJMW-095	10/05/2020	10/05/2020	Habitat assessment	Hardpan Plain	-23.3741	120.0182



Appendix C – Vertebrate fauna identified in the desktop assessment

Genus and Species	Common Name	Conservation Status				Database Searches					Previous Surveys										
		EPBC Act	BC Act	DBCA	IUCN	NatureMap	EPBC Protected Matters	Birddata	DBCA Threatened and Priority Fauna	BHP WAIO Fauna Records	A	B	C	D	E	F	G	H	I	J	Current Survey
MAMMALS																					
BOVIDAE																					
<i>*Bos taurus</i>	cow					•				•	•	•	•	•			•		•	•	
CAMELIDAE																					
<i>*Camelus dromedarius</i>	camel					•	•			•	•	•	•	•							
CANIDAE																					
<i>*Canis familiaris subsp. dingo</i>	dog						•			•	•			•	•	•	•	•	•	•	
<i>*Vulpes vulpes</i>	fox						•														
DASYURIDAE																					
<i>Dasyercus blythi</i>	brush-tailed mulgara			P4		•			•	•	•	•	•								
<i>Dasykaluta rosamondae</i>	little red kaluta					•				•	•		•	•			•	•	•	•	
<i>Dasyurus hallucatus</i>	northern quoll	EN	EN		EN		•			•											
<i>Ningui timealeyi</i>	Pilbara ningui					•							•								
Planigale sp.	Undescribed Pilbara planigale									•											
<i>Pseudantechinus roryi</i>	Rory's pseudantechinus					•															
<i>Pseudantechinus woolleyae</i>	Woolley's pseudantechinus					•				•											
<i>Sminthopsis crassicaudata</i>	fat-tailed dunnart					•				•							•		•		
<i>Sminthopsis longicaudata</i>	long-tailed dunnart			P4		•				•											
<i>Sminthopsis macroura</i>	stripe-faced dunnart					•				•	•						•		•		
<i>Sminthopsis ooldea</i>	Ooldea dunnart					•				•											
<i>Sminthopsis youngsoni</i>	lesser hairy-footed dunnart					•				•	•		•				•	•	•		
EMBALLONURIDAE																					
<i>Saccolaimus flaviventris</i>	yellow-bellied sheathtail-bat					•				•	•	•	•	•				•		•	
<i>Taphozous georgianus</i>	common sheathtail-bat					•				•		•	•	•		•		•			
<i>Taphozous hilli</i>	Hill's sheathtail-bat					•				•			•	•							

Genus and Species	Common Name	Conservation Status				Database Searches					Previous Surveys										
		EPBC Act	BC Act	DBCA	IUCN	NatureMap	EPBC Protected Matters	Birddata	DBCA Threatened and Priority Fauna	BHP WAIO Fauna Records	A	B	C	D	E	F	G	H	I	J	Current Survey
EQUIDAE																					
* <i>Equus asinus</i>	donkey					•	•			•			•					•			
* <i>Equus caballus</i>	horse						•				•				•		•				
FELIDAE																					
* <i>Felis catus</i>	cat					•	•			•	•	•	•	•	•	•	•	•	•	•	•
HIPPOSIDERIDAE																					
<i>Rhinonicteris aurantia</i> (Pilbara form)	Pilbara leaf-nosed bat	VU	VU			•	•		•	•											
LEPORIDAE																					
* <i>Oryctolagus cuniculus</i>	rabbit					•	•			•											
MACROPODIDAE																					
<i>Lagorchestes conspicillatus</i> subsp. <i>leichardti</i>	spectacled hare-wallaby			P3*		•			•												
<i>Osphranter robustus</i> subsp. <i>erubescens</i>	euro, biggada					•				•				•	•	•	•	•	•	•	•
<i>Osphranter rufus</i>	red kangaroo, marlu					•				•	•	•	•	•	•	•	•	•	•	•	•
<i>Petrogale lateralis</i> subsp. <i>lateralis</i>	black-flanked rock-wallaby	EN	EN		NT	•			•												
<i>Petrogale rothschildi</i>	Rothschild's rock-wallaby					•				•								•			
MEGADERMATIDAE																					
<i>Macroderma gigas</i>	ghost bat	VU	VU		VU	•	•		•	•									•		
MOLOSSIDAE																					
<i>Austronomus australis</i>	white-striped freetail-bat									•						•	•				•
<i>Chaerophon jobensis</i> subsp. <i>colonicus</i>	northern freetail-bat					•				•	•	•	•	•							
<i>Ozimops lumsdenae</i>	northern free-tailed bat									•	•		•					•			•
MURIDAE																					
<i>Leporillus apicalis</i>	Lesser Stick-nest Rat	EX	EX																		•
* <i>Mus musculus</i>	house mouse					•	•			•	•				•		•	•	•		
<i>Notomys alexis</i>	spinifex hopping-mouse					•				•	•	•	•	•							•

Genus and Species	Common Name	Conservation Status				Database Searches					Previous Surveys									
		EPBC Act	BC Act	DBCA	IUCN	NatureMap	EPBC Protected Matters	Birddata	DBCA Threatened and Priority Fauna	BHP WAIO Fauna Records	A	B	C	D	E	F	G	H	I	J
<i>Pseudomys chapmani</i>	western pebble-mound mouse			P4		•			•	•						•	•		•	
<i>Pseudomys desertor</i>	desert mouse					•				•	•		•	•						
<i>Pseudomys hermannsburgensis</i>	sandy inland mouse					•				•	•		•	•			•		•	
<i>Zyzomys argurus</i>	common rock-rat					•				•					•		•	•		
TACHYGLOSSIDAE																				
<i>Tachyglossus aculeatus</i>	echidna					•				•						•	•	•		
THYLACOMYIDAE																				
<i>Macrotis lagotis</i>	bilby, dalgyte	VU	VU		VU	•	•		•	•										
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>Scotorepens greyii</i>	little broad-nosed bat					•				•	•	•	•	•		•		•		•
<i>Vespadelus finlaysoni</i>	Finlayson's Cave Bat					•				•	•	•	•	•	•	•		•	•	•
AVES																				
ACANTHIZIDAE																				
<i>Acanthiza apicalis</i>	inland thornbill					•				•					•		•	•	•	
<i>Acanthiza chrysorrhoa</i>	yellow-rumped thornbill					•		•		•		•		•			•		•	
<i>Acanthiza robustirostris</i>	slaty-backed thornbill					•		•		•				•	•					•
<i>Acanthiza uropygialis</i>	chestnut-rumped thornbill					•		•		•	•	•	•	•				•		•
<i>Aphelocephala leucopsis</i>	southern whiteface							•						•						•
<i>Aphelocephala nigricincta</i>	banded whiteface					•														
<i>Gerygone fusca</i>	western gerygone					•		•		•		•	•	•	•	•	•	•	•	•
<i>Pyrrholaemus brunneus</i>	redthroat					•		•		•				•						
<i>Smicromnis brevirostris</i>	weebill					•		•		•			•		•	•	•	•	•	

Genus and Species	Common Name	Conservation Status				Database Searches					Previous Surveys										
		EPBC Act	BC Act	DBCA	IUCN	NatureMap	EPBC Protected Matters	Birddata	DBCA Threatened and Priority Fauna	BHP WAIO Fauna Records	A	B	C	D	E	F	G	H	I	J	Current Survey
ACCIPITRIDAE																					
<i>Accipiter cirrocephalus</i>	collared sparrowhawk					•				•	•		•								
<i>Accipiter fasciatus</i>	brown goshawk					•		•		•	•		•		•	•		•			•
<i>Aquila audax</i>	wedge-tailed eagle					•		•		•	•		•			•	•	•	•		•
<i>Circus approximans</i>	swamp harrier					•		•													
<i>Circus assimilis</i>	spotted harrier					•		•		•											•
<i>Elanus caeruleus</i> subsp. <i>axillaris</i>	black-shouldered kite					•		•		•							•				
<i>Haliaeetus leucogaster</i>	white-bellied sea-eagle					•		•		•											
<i>Haliastur sphenurus</i>	whistling kite					•		•		•	•				•	•	•	•			•
<i>Hamirostra isura</i>	square-tailed kite					•		•		•											
<i>Hamirostra melanosternon</i>	black-breasted buzzard					•		•		•						•	•	•			
<i>Hieraaetus morphnoides</i>	little eagle					•		•		•					•	•	•				•
<i>Milvus migrans</i>	black kite					•		•		•							•				
ACROCEPHALIDAE																					
<i>Acrocephalus australis</i>	Australian reed-warbler					•		•		•							•		•		
AEGOTHELIDAE																					
<i>Aegotheles cristatus</i>	Australian owl-nightjar					•		•		•									•		•
ALAUDIDAE																					
<i>Mirafra javanica</i>	Horsfield's bushlark					•		•		•					•					•	
ALCEDINIDAE																					
<i>Dacelo leachii</i> subsp. <i>leachii</i>	blue-winged kookaburra					•		•		•							•		•		
<i>Todiramphus pyrrhopygius</i>	red-backed kingfisher					•		•		•					•	•	•	•			
<i>Todiramphus sanctus</i>	sacred kingfisher					•		•		•	•					•		•			•
ANATIDAE																					
<i>Anas gracilis</i>	grey teal					•		•		•											

Genus and Species	Common Name	Conservation Status				Database Searches					Previous Surveys										
		EPBC Act	BC Act	DBCA	IUCN	NatureMap	EPBC Protected Matters	Birddata	DBCA Threatened and Priority Fauna	BHP WAIO Fauna Records	A	B	C	D	E	F	G	H	I	J	Current Survey
<i>Anas querquedula</i>	garganey	MI	MI						•	•											
<i>Anas rhynchotis</i>	Australasian shoveler					•		•													
<i>Anas superciliosa</i>	Pacific black duck					•		•	•												
<i>Aythya australis</i>	hardhead					•		•	•												
<i>Biziura lobata</i>	musk duck					•		•													
<i>Chenonetta jubata</i>	Australian wood duck					•		•	•												•
<i>Cygnus atratus</i>	black swan					•		•	•												
<i>Dendrocygna arcuata</i>	wandering whistling duck					•		•	•										•		
<i>Dendrocygna eytoni</i>	plumed whistling-duck					•		•	•												
<i>Malacorhynchus membranaceus</i>	pink-eared duck					•		•	•												
<i>Stictonetta naevosa</i>	freckled duck					•		•	•												
<i>Tadorna tadornoides</i>	Australian shell duck					•		•	•												
ANHINGIDAE																					
<i>Anhinga novaehollandiae</i>	Australasian darter					•		•	•										•		•
ANSERANATIDAE																					
<i>Anseranas semipalmata</i>	magpie goose					•		•													
APODIDAE																					
<i>Apus pacificus</i>	fork-tailed swift	MI	MI					•		•											
ARDEIDAE																					
<i>Ardea garzetta</i>	little egret					•		•	•												
<i>Ardea ibis</i>	cattle egret					•	•	•													
<i>Ardea intermedia</i>	intermediate egret					•		•	•												
<i>Ardea modesta</i>	eastern great egret					•	•	•	•												
<i>Ardea novaehollandiae</i>	white-faced heron					•		•	•										•		•
<i>Ardea pacifica</i>	white-necked heron					•		•	•	•			•						•		

Genus and Species	Common Name	Conservation Status				Database Searches					Previous Surveys										
		EPBC Act	BC Act	DBCA	IUCN	NatureMap	EPBC Protected Matters	Birddata	DBCA Threatened and Priority Fauna	BHP WAIO Fauna Records	A	B	C	D	E	F	G	H	I	J	Current Survey
<i>Nycticorax caledonicus</i> subsp. <i>australasiae</i>	nankeen night-heron					•		•		•											
ARTAMIDAE																					
<i>Artamus cinereus</i>	black-faced woodswallow					•		•		•	•	•	•	•	•	•	•	•	•	•	•
<i>Artamus minor</i>	little woodswallow					•		•		•					•	•					•
<i>Artamus personatus</i>	masked woodswallow					•		•		•	•			•			•		•		
<i>Artamus superciliosus</i>	white-browed woodswallow					•		•		•											
<i>Cracticus nigrogularis</i>	piebald butcherbird					•				•	•		•	•	•	•	•	•	•	•	•
<i>Cracticus tibicen</i>	Australian magpie					•		•		•		•	•	•	•	•	•	•	•	•	•
<i>Cracticus torquatus</i>	grey butcherbird					•		•		•	•		•		•						•
BURHINIDAE																					
<i>Burhinus grallarius</i>	bush stone-curlew					•		•		•	•						•				•
CACATUIDAE																					
<i>Cacatua roseicapilla</i>	galah					•		•		•	•		•	•	•	•		•			•
<i>Cacatua sanguinea</i>	little corella					•		•		•			•	•		•	•	•			•
<i>Nymphicus hollandicus</i>	cockatiel					•		•		•	•	•	•		•	•		•			•
CAMPEPHAGIDAE																					
<i>Coracina maxima</i>	ground cuckoo-shrike					•		•		•	•										
<i>Coracina novaehollandiae</i> subsp. <i>subpallida</i>	black-faced cuckoo-shrike					•		•		•	•	•	•	•	•	•	•	•	•	•	•
<i>Lalage leucomela</i>	Varied Triller									•											
<i>Lalage tricolor</i>	white-winged triller					•		•		•	•	•		•	•	•		•			•
CAPRIMULGIDAE																					
<i>Eurostopodus argus</i>	spotted nightjar					•		•		•	•	•	•		•						
CASUARIIDAE																					
<i>Dromaius novaehollandiae</i>	emu					•		•		•					•	•		•			
CHARADRIIDAE																					

Genus and Species	Common Name	Conservation Status				Database Searches					Previous Surveys										
		EPBC Act	BC Act	DBCA	IUCN	NatureMap	EPBC Protected Matters	Birddata	DBCA Threatened and Priority Fauna	BHP WAIO Fauna Records	A	B	C	D	E	F	G	H	I	J	Current Survey
<i>Elseyornis melanops</i>	black-fronted dotterel					•		•		•	•								•		
<i>Charadrius dubius</i>	little ringed plover	MI	MI							•											
<i>Charadrius ruficapillus</i>	red-capped plover					•		•		•											
<i>Charadrius veredus</i>	oriental plover	MI	MI				•		•												
<i>Erythronyctes alpinus</i>	red-kneed dotterel							•													
<i>Vanellus tricolor</i>	banded lapwing					•															
CICONIDAE																					
<i>Ephippiorhynchus asiaticus</i>	black-necked stork				NT	•		•		•											
CLIMACTERIDAE																					
<i>Climacteris melanurus</i>	black-tailed treecreeper							•													
COLUMBIDAE																					
* <i>Columba livia</i>	domestic pigeon						•														
<i>Geopelia cuneata</i>	diamond dove					•		•		•	•			•	•			•		•	
<i>Geopelia humeralis</i>	bar-shouldered dove					•		•				•									
<i>Geopelia striata</i> subsp. <i>placida</i>	peaceful dove					•		•		•		•				•		•		•	
<i>Geophaps plumifera</i> subsp. <i>ferruginea</i>	spinifex pigeon					•		•		•	•						•	•	•	•	
<i>Ocyphaps lophotes</i>	crested pigeon					•		•		•	•	•	•	•	•	•	•	•	•	•	•
<i>Phaps chalcoptera</i>	common bronzewing					•		•		•	•	•	•	•	•			•		•	•
CORVIDAE																					
<i>Corvus bennetti</i>	little crow					•				•							•				
<i>Corvus orru</i> subsp. <i>cecilae</i>	torresian crow					•				•	•	•	•	•	•	•	•	•	•	•	•
CUCULIDAE																					
<i>Cacomantis pallidus</i>	pallid cuckoo					•		•		•		•		•				•		•	•
<i>Centropus phasianinus</i> subsp. <i>highami</i>	pheasant coucal									•									•		
<i>Chrysococcyx basalis</i>	Horsfield's bronze-cuckoo					•		•		•	•				•			•	•	•	•

Genus and Species	Common Name	Conservation Status				Database Searches					Previous Surveys										
		EPBC Act	BC Act	DBCA	IUCN	NatureMap	EPBC Protected Matters	Birddata	DBCA Threatened and Priority Fauna	BHP WAIO Fauna Records	A	B	C	D	E	F	G	H	I	J	Current Survey
<i>Chrysococcyx osculans</i>	black-eared cuckoo					•	•	•		•									•		•
DICAEIDAE																					
<i>Dicaeum hirundinaceum</i>	mistletoebird					•		•		•								•	•		
ESTRILDIDAE																					
<i>Emblema pictum</i>	painted finch					•		•		•					•	•			•		
<i>Neochmia ruficauda</i> subsp. <i>subclaescens</i>	star finch (western)					•		•		•						•			•		
<i>Taeniopygia guttata</i> subsp. <i>castanotis</i>	zebra finch					•		•		•	•		•	•	•	•	•	•	•	•	•
FALCONIDAE																					
<i>Falco berigora</i>	brown falcon					•		•		•	•		•	•	•	•	•	•	•	•	•
<i>Falco cenchroides</i>	nankeen kestrel					•		•		•	•			•	•	•	•	•			•
<i>Falco hypoleucos</i>	grey falcon	VU	VU		VU					•											
<i>Falco longipennis</i>	Australian hobby					•		•		•	•					•			•		•
<i>Falco peregrinus</i>	peregrine falcon		OS			•		•	•	•											
<i>Falco subniger</i>	black falcon									•											
GLAREOLIDAE																					
<i>Stiltia isabella</i>	Australian pratincole					•		•		•											
HIRUNDINIDAE																					
<i>Cheramoeca leucosterna</i>	white-backed swallow					•		•		•								•	•		
<i>Hirundo neoxena</i>	welcome swallow					•		•		•											
<i>Hirundo rustica</i>	barn swallow	MI	MI					•		•											
<i>Petrochelidon ariel</i>	fairy martin					•		•		•									•		•
<i>Petrochelidon nigricans</i>	tree martin					•		•		•			•			•			•		
LARIDAE																					
<i>Larus novaehollandiae</i>	silver gull					•		•		•											
<i>Sterna caspia</i>	caspian tern	MI	MI			•		•	•												

Genus and Species	Common Name	Conservation Status				Database Searches					Previous Surveys										
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<i>Sterna hybrida</i>	whiskered tern							•		•											
<i>Gelochelidon nilotica</i>	gull-billed tern	MI	MI			•		•	•												
<i>Cladorhynchus leucocephalus</i>	banded stilt					•		•													
LOCUSTELLIDAE																					
<i>Eremiornis carteri</i>	spinifexbird					•		•		•	•				•		•				
<i>Megalurus cruralis</i>	brown songlark							•		•	•			•	•						
<i>Megalurus gramineus</i>	little grassbird					•		•		•											
<i>Megalurus mathewsi</i>	rufous songlark							•		•	•		•	•			•	•		•	•
MALURIDAE																					
<i>Amytornis striatus</i> subsp. <i>whitei</i>	striated grasswren					•		•		•							•	•			
<i>Malurus lamberti</i> subsp. <i>assimilis</i>	variegated fairy-wren					•		•		•	•		•	•			•	•	•	•	•
<i>Malurus leucopterus</i> subsp. <i>leuconotus</i>	white-winged fairy-wren					•				•	•		•	•		•	•	•	•	•	•
<i>Malurus splendens</i>	splendid fairy-wren					•				•			•	•				•		•	•
<i>Stipiturus ruficeps</i>	rufous-crowned emu-wren					•		•		•											
MELIPHAGIDAE																					
<i>Acanthagenys rufogularis</i>	spiny-cheeked honeyeater					•		•		•	•		•	•			•	•		•	•
<i>Certhionyx variegatus</i>	piebald honeyeater					•		•		•				•							
<i>Epthianura aurifrons</i>	orange chat					•															
<i>Epthianura tricolor</i>	crimson chat					•		•		•	•		•	•				•		•	•
<i>Gavicalis virescens</i>	singing honeyeater					•		•		•	•		•	•		•	•	•	•	•	•
<i>Conopophila whitei</i>	grey honeyeater					•				•				•				•			
<i>Lichmera indistincta</i>	brown honeyeater					•		•		•				•	•			•			
<i>Manorina flavigula</i>	yellow-throated miner					•		•		•			•	•		•	•	•	•	•	•
<i>Melithreptus gularis</i> subsp. <i>latior</i>	black-chinned honeyeater					•				•								•			
<i>Ptilotula keartlandi</i>	grey-headed honeyeater					•		•		•				•	•		•	•			

Genus and Species	Common Name	Conservation Status				Database Searches					Previous Surveys										
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<i>Ptilotula penicillata</i>	white-plumed honeyeater							•		•	•				•	•	•	•	•		•
<i>Purnella albifrons</i>	white-fronted honeyeater					•		•		•					•						
<i>Sugomel niger</i>	black honeyeater							•		•					•	•			•		
MEROPIDAE																					
<i>Merops ornatus</i>	rainbow bee-eater					•	•	•		•	•		•	•	•	•	•	•	•	•	
MONARCHIDAE																					
<i>Grallina cyanoleuca</i>	magpie-lark					•		•		•	•	•	•	•	•	•	•	•	•	•	•
MOTACILLIDAE																					
<i>Anthus australis</i> subsp. <i>australis</i>	Australasian pipit					•		•		•			•		•	•	•	•			
<i>Motacilla cinerea</i>	grey wagtail	MI	MI				•														
<i>Motacilla flava</i>	yellow wagtail	MI	MI				•														
OTIDIDAE																					
<i>Ardeotis australis</i>	Australian bustard					•		•		•	•		•					•	•		•
PACHYCEPHALIDAE																					
<i>Colluricincla harmonica</i> subsp. <i>rufiventris</i>	grey shrike-thrush					•		•		•					•			•	•	•	
<i>Pachycephala rufiventris</i> subsp. <i>rufiventris</i>	rufous whistler					•		•		•	•	•	•		•	•	•	•	•		•
<i>Oreoica gutturalis</i>	crested bellbird					•		•		•	•		•	•	•	•			•	•	•
PARDALOTIDAE																					
<i>Pardalotus rubricatus</i>	red-browed pardalote					•		•		•										•	
<i>Pardalotus striatus</i> subsp. <i>murchisoni</i>	striated pardalote					•		•		•						•			•		
PELECANIDAE																					
<i>Pelecanus conspicillatus</i>	Australian pelican					•		•		•											
PETROICIDAE																					
<i>Melanodryas cucullata</i>	hooded robin					•		•		•	•				•				•		
<i>Petroica goodenovii</i>	red-capped robin					•		•		•	•		•	•	•	•			•	•	•

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PHAETHONTIDAE																				
<i>Phalacrocorax carbo</i>	black cormorant					•		•	•											
<i>Phalacrocorax melanoleucos</i>	little pied cormorant					•		•	•											
<i>Phalacrocorax sulcirostris</i>	little black cormorant					•		•	•										•	
<i>Phalacrocorax varius</i> subsp. <i>hypoleucos</i>	pied cormorant					•		•	•										•	
PHASIANIDAE																				
<i>Coturnix pectoralis</i>	stubble quail					•			•											
<i>Coturnix ypsilophora</i>	brown quail					•		•											•	
PODARGIDAE																				
<i>Podargus strigoides</i>	tawny frogmouth					•		•	•											
PODICIPEDIDAE																				
<i>Podiceps cristatus</i>	great crested grebe					•		•	•											
<i>Poliiocephalus poliocephalus</i>	hoary-headed grebe					•		•	•											
<i>Tachybaptus novaehollandiae</i>	Australasian grebe					•		•	•											
POMATOSTOMIDAE																				
<i>Pomatostomus superciliosus</i>	white-browed babbler					•		•	•					•	•					
<i>Pomatostomus temporalis</i> subsp. <i>rubeculus</i>	grey-crowned babbler					•		•	•	•		•	•	•	•	•	•	•	•	•
PSITTACIDAE																				
<i>Melopsittacus undulatus</i>	budgerigar					•		•	•	•	•			•	•	•	•	•	•	•
<i>Neopsephotus bourkii</i>	Bourke's parrot					•			•				•	•						•
<i>Pezoporus occidentalis</i>	night parrot	EN	CR		EN		•													
<i>Psephotus varius</i>	mulga parrot								•					•						
<i>Platycercus zonarius</i> subsp. <i>zonarius</i>	Port Lincoln parrot					•		•	•	•	•	•	•	•	•	•	•	•	•	•
<i>Polytelis alexandrae</i>	princess parrot	VU		P4	NT		•													

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PSOPHODIDAE																					
<i>Psophodes occidentalis</i>	chiming wedgebill					•		•													
<i>Cinclosoma castaneothorax</i>	chestnut-breasted quail-thrush					•				•	•										
PTILINORHYNCHIDAE																					
<i>Ptilinorhynchus maculatus</i> subsp. <i>guttatus</i>	western bowerbird					•		•		•	•		•		•	•					
RALLIDAE																					
<i>Fulica atra</i>	Eurasian coot					•		•		•											
<i>Gallirallus philippensis</i>	buff-banded rail					•		•													
<i>Porphyrio porphyrio</i>	purple swamphen					•		•		•											
<i>Porzana pusilla</i>	Baillon's crane					•		•													
<i>Porzana tabuensis</i>	spotless crane					•		•		•											
<i>Tribonyx ventralis</i>	black-tailed native-hen					•		•		•	•										
RECURVIROSTRIDAE																					
<i>Himantopus himantopus</i>	black-winged stilt					•		•		•											
<i>Recurvirostra novaehollandiae</i>	red-necked avocet					•		•													
RHIPIDURIDAE																					
<i>Rhipidura albiscapa</i>	grey fantail					•		•		•						•					
<i>Rhipidura leucophrys</i> subsp. <i>leucophrys</i>	willie wagtail					•		•		•	•		•	•	•	•	•	•	•	•	•
ROSTRATULIDAE																					
<i>Rostratula benghalensis</i> subsp. <i>australis</i>	Australian painted snipe	EN	EN		EN		•														
SCOLOPACIDAE																					
<i>Calidris acuminata</i>	sharp-tailed sandpiper	MI	MI			•	•	•	•	•											
<i>Calidris ferruginea</i>	curlew sandpiper	CR/MI	CR/MI		NT	•	•	•	•	•											
<i>Calidris melanotos</i>	pectoral sandpiper	MI	MI			•	•		•	•											
<i>Calidris ruficollis</i>	red-necked stint	MI	MI		NT	•		•	•												

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<i>Calidris subminuta</i>	long-toed stint	MI	MI			•		•	•	•											
<i>Limosa limosa</i>	black-tailed godwit	MI	MI		NT					•											
<i>Philomachus pugnax</i>	ruff	MI	MI							•											
<i>Tringa glareola</i>	wood sandpiper	MI	MI			•		•	•	•											
<i>Tringa hypoleucos</i>	common sandpiper	MI	MI			•	•	•	•	•											
<i>Tringa nebularia</i>	common greenshank	MI	MI			•		•	•	•											
<i>Tringa stagnatilis</i>	marsh sandpiper	MI	MI			•		•	•	•											
<i>Tringa totanus</i>	common redshank	MI	MI			•				•											
STRIGIDAE																					
<i>Ninox boobook</i>	boobook owl							•		•				•		•	•				
<i>Ninox connivens</i>	barking owl					•				•											
THRESKIORNITHIDAE																					
<i>Platalea flavipes</i>	yellow-billed spoonbill					•		•		•									•		
<i>Platalea regia</i>	royal spoonbill					•		•		•											
<i>Plegadis falcinellus</i>	glossy ibis	MI	MI			•		•	•	•											
<i>Threskiornis molucca</i>	Australian white ibis							•		•											
<i>Threskiornis spinicollis</i>	straw-necked ibis					•		•		•											
TURNICIDAE																					
<i>Turnix velox</i>	little button-quail					•		•		•	•			•	•						•
TYTONIDAE																					
<i>Tyto alba</i>	barn owl					•		•		•									•		
REPTILES																					
AGAMIDAE																					
<i>Ctenophorus caudicinctus</i>	ring-tailed dragon					•				•	•		•		•	•	•	•	•	•	•
<i>Ctenophorus isolepis</i> subsp. <i>isolepis</i>	military dragon or crested dragon					•				•	•	•	•	•		•	•	•	•	•	•

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<i>Ctenophorus nuchalis</i>	central netted dragon					•				•	•			•	•		•	•	•	
<i>Ctenophorus reticulatus</i>	western netted dragon					•				•	•		•							
<i>Diporiphora amphiboluroides</i>	mulga dragon					•				•	•			•						
<i>Diporiphora valens</i>	southern pilbara tree dragon					•														
<i>Amphibolurus longirostris</i>	long-nosed dragon					•				•	•		•	•	•	•		•		
<i>Moloch horridus</i>	thorny devil					•				•										
<i>Pogona minor</i> subsp. <i>minor</i>	dwarf bearded dragon					•				•	•		•	•	•					
BOIDAE																				
<i>Antaresia perthensis</i>	pygmy python					•				•	•								•	
<i>Antaresia stimsoni</i>	Stimson's python					•				•						•		•		
<i>Aspidites melanocephalus</i>	black-headed python					•				•										
<i>Liasis olivaceus</i> subsp. <i>barroni</i>	Pilbara olive python	VU	VU			•	•		•	•										
CARPHODACTYLIDAE																				
<i>Nephurus wheeleri</i> subsp. <i>cinctus</i>	banded knob-tailed gecko					•				•										
CHELUIDAE																				
<i>Chelodina steindachneri</i>	flat-shelled turtle					•			•	•									•	
DIPODACTYLIDAE																				
<i>Diplodactylus conspicillatus</i>	fat-tailed gecko					•				•	•							•	•	•
<i>Diplodactylus mitchelli</i>	gecko					•														
<i>Diplodactylus pulcher</i>	fine-faced gecko					•														
<i>Diplodactylus savagei</i>	southern pilbara beak-faced gecko					•				•									•	
<i>Lucasium stenodactylum</i>	gecko					•				•	•			•	•		•	•	•	
<i>Lucasium wombeyi</i>	gecko					•				•					•					
<i>Oedura fimbria</i>	western marbled velvet gecko					•				•					•	•		•		•
<i>Rhynchoedura ornata</i>	western beaked gecko					•				•	•		•					•		

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<i>Strophurus ciliaris subsp. aberrans</i>	Northern spiny-tailed gecko									•											
<i>Strophurus elderi</i>	jewelled gecko					•				•			•								
<i>Strophurus jeanae</i>	gecko					•					•										
<i>Strophurus wellingtonae</i>	gecko					•				•	•		•		•						
ELAPIDAE																					
<i>Acanthophis wellsi</i>	Pilbara death adder					•				•											
<i>Brachyuropis approximans</i>	north-western shovel-nosed snake					•				•	•			•					•		
<i>Demansia psammophis subsp. cupreiceps</i>	yellow-faced whipsnake					•				•					•				•		
<i>Demansia rufescens</i>	rufous whipsnake					•				•											
<i>Furina ornata</i>	moon snake					•									•						
<i>Pseudechis australis</i>	mulga snake					•				•							•	•			
<i>Pseudonaja mengdeni</i>	western brown snake					•				•	•		•					•		•	
<i>Pseudonaja modesta</i>	ringed brown snake					•				•	•										
<i>Suta fasciata</i>	Rosen's snake					•				•											
<i>Suta gaikhorstorum</i>	snake					•															
<i>Suta punctata</i>	little spotted snake					•				•	•			•							
<i>Vermicella snelli</i>	Pilbara bandy bandy					•				•									•		
GEKKONIDAE																					
<i>Gehyra montium</i>	gecko									•											
<i>Gehyra pilbara</i>	Pilbara dtella					•									•						
<i>Gehyra punctata</i>	spotted rock dtella					•				•	•		•		•	•	•	•	•		
<i>Gehyra variegata</i>	tree dtella					•				•	•		•		•	•	•	•	•	•	
<i>Heteronotia binoei</i>	Bynoe's gecko					•				•					•		•	•			
<i>Heteronotia spelea</i>	desert cave gecko					•				•											
PYGOPODIDAE																					

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<i>Delma butleri</i>	legless lizard					•				•	•			•							
<i>Delma elegans</i>	legless lizard					•				•											
<i>Delma haroldi</i>	Neck-barred delma									•											
<i>Delma nasuta</i>	long-nosed delma					•				•				•	•						
<i>Delma pax</i>	legless lizard					•				•				•		•		•	•	•	
<i>Delma tincta</i>	legless lizard					•												•			
<i>Lialis burtonis</i>	Burton's legless lizard					•				•	•			•		•		•			
<i>Pygopus nigriceps</i>	legless lizard					•				•									•	•	
<i>Delma haroldi</i>	neck-barred delma					•															
SCINCIDAE																					
<i>Carlia munda</i>	shaded-litter rainbow skink					•				•									•		
<i>Carlia triacantha</i>	desert rainbow skink					•				•	•			•		•		•	•		
<i>Cryptoblepharus buchananii</i>	Buchanan's snake-eyed skink					•				•				•	•						
<i>Cryptoblepharus ustulatus</i>	russet snake-eyed skink					•				•											
<i>Ctenotus ariadnae</i>	Ariadne's ctenotus					•				•	•			•							
<i>Ctenotus duricola</i>	skink					•				•	•							•	•	•	
<i>Ctenotus grandis</i> subsp. <i>titan</i>	grand ctenotus					•				•	•			•				•	•	•	
<i>Ctenotus inornatus</i>	skink					•				•				•		•	•	•	•	•	•
<i>Ctenotus leonhardii</i>	skink					•				•									•		
<i>Ctenotus pantherinus</i> subsp. <i>ocellifer</i>	leopard ctenotus					•				•	•			•	•		•	•	•	•	•
<i>Ctenotus rubicundus</i>	ruddy ctenotus					•				•											
<i>Ctenotus rutilans</i>	skink					•				•											
<i>Ctenotus schomburgkii</i>	skink					•				•											
<i>Ctenotus serventyi</i>	north-western sandy-loam ctenotus									•				•							
<i>Ctenotus uber</i>	spotted ctenotus					•				•								•	•	•	

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<i>Ctenotus uber</i> subsp. <i>johnstonei</i>	spotted ctenotus			P2		•			•	•	•			•	•						
<i>Cyclodomorphus melanops</i> subsp. <i>melanops</i>	slender blue-tongue					•				•				•					•		
<i>Egernia cygnitos</i>	pygmy spiny-tailed skink (western)					•				•											
<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>	Two-toed Skink					•				•					•				•		
<i>Lerista flammicauda</i>	Pilbara flame-tailed slider					•															
<i>Lerista muelleri</i>	skink					•				•					•		•	•	•		
<i>Lerista neander</i>	skink					•				•	•			•				•	•		
<i>Lerista timida</i>	dwarf three-toed slider					•				•	•			•							
<i>Lerista zietzi</i>	Pilbara blue-tailed slider					•				•									•		
<i>Menetia greyii</i>	common dwarf skink					•				•							•	•			
<i>Menetia surda</i> subsp. <i>surda</i>	skink					•				•					•						
<i>Morethia ruficauda</i> subsp. <i>exquisita</i>	fire-tailed skink					•				•					•	•			•		
<i>Tiliqua multifasciata</i>	central blue-tongue lizard					•				•	•			•	•			•	•	•	
TYPHLOPIDAE																					
<i>Anilius ammodytes</i>	blind snake									•					•				•		
<i>Anilius ganei</i>	Pilbara flat-headed blind-snake			P1		•				•									•		
<i>Anilius grypus</i>	blind snake									•									•		
<i>Anilius hamatus</i>	blind snake									•							•	•	•		
<i>Ramphotyphlops waitii</i>	blind snake									•											
VARANIDAE																					
<i>Varanus acanthurus</i>	spiny-tailed monitor					•				•	•				•		•	•			
<i>Varanus brevicauda</i>	short-tailed pygmy monitor					•				•	•										

Genus and Species	Common Name	Conservation Status				Database Searches					Previous Surveys										
		EPBC Act	BC Act	DBCA	IUCN	NatureMap	EPBC Protected Matters	Birddata	DBCA Threatened and Priority Fauna	BHP WAIO Fauna Records	A	B	C	D	E	F	G	H	I	J	Current Survey
<i>Varanus bushi</i>	Bush's monitor					•															
<i>Varanus caudolineatus</i>	stripe-tailed pygmy monitor					•				•	•		•		•		•	•	•		
<i>Varanus eremius</i>	pygmy desert monitor					•				•					•						
<i>Varanus giganteus</i>	perentie					•				•	•		•								
<i>Varanus gouldii</i>	Gould's monitor					•				•	•			•	•		•	•		•	
<i>Varanus hamersleyensis</i>	Southern pilbara rock goanna									•											
<i>Varanus panoptes</i>	yellow spotted monitor					•				•	•		•		•						
<i>Varanus pilbarensis</i>	Pilbara rock monitor					•				•											
<i>Varanus tristis</i> subsp. <i>tristis</i>	racehorse goanna					•				•			•				•	•	•		
AMPHIBIANS																					
PELODRYADIDAE																					
<i>Cyclorana maini</i>	sheep frog					•				•	•		•	•							
<i>Cyclorana occidentalis</i>	water-holding frog					•				•											
<i>Litoria rubella</i>	little red tree frog					•				•	•			•		•	•	•			
LIMNODYNASTIDAE																					
<i>Neobatrachus kunapalari</i>	kunapalari frog					•				•									•		
<i>Notaden nicholli</i>	desert spadefoot					•															
<i>Platyplectrum spenceri</i>	centralian burrowing frog					•				•			•	•							
MYOBATRACHIDAE																					
<i>Pseudophryne douglasi</i>	gorge toadlet					•				•									•		
<i>Uperoleia russelli</i>	Russell's toadlet					•				•				•			•	•			
<i>Uperoleia saxatilis</i>	Pilbara toadlet					•															

Appendix D – Vertebrate fauna habitat assessments

Appendix D: Vertebrate fauna habitat assessments

Site ID	Coord.	Date	Habitat Type	Landform	Aspect	Slope	Soil Type	Soil Avail.	Outcropping/ Rock Type	Rock Size	Veg. Litter	Dominant Veg. Type	Rocky Cracks / Crevices	Burrowing Suitability	Hollows	Water present	Disturbances	Last Fire	Notes
VJMW-001	-23.3881, 120.0189	8/05/2020	Stony Plain	Basalt Outcrops	North	Moderate	Clay Loam	Evenly Spread	Major Outcropping BIF	Small Rocks (11-20cm)	Few Large Patches	Acacia Shrubland	High	Low	0	None	Cattle Grazing	Old (6+ yr.)	
VJMW-002	-23.387, 120.0265	8/05/2020	Hillcrest/Hillslope	Hillcrest/ Upper Hillslope	North	Moderate	Clay Loam	Evenly Spread	Major Outcropping BIF	Large Rocks (21-60cm)	Few Small Patches	Acacia Shrubland	High	Nil	1	None	Mining Exploration	Old (6+ yr.)	
VJMW-003	-23.3961, 120.0043	8/05/2020	Hardpan Plain	Drainage Area/ Floodplain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Negligible	Scarce	Tussock Grassland	Nil	Moderate	0	None	Cattle Grazing	Old (6+ yr.)	
VJMW-004	-23.3967, 120.0013	8/05/2020	Sand Plain	Drainage Area/ Floodplain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Gravel (1-4cm)	Few Large Patches	Spinifex Hummock Grassland	Nil	Low	0	None	Cattle Grazing	Old (6+ yr.)	
VJMW-005	-23.3935, 120.0046	8/05/2020	Hardpan Plain	Drainage Area/ Floodplain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Negligible	Many Large Patches	Acacia Shrubland, Spinifex Hummock Grassland	Nil	Moderate	0	None	Cattle Grazing	Old (6+ yr.)	
VJMW-006	-23.3906, 120.0104	8/05/2020	Hardpan Plain	Hardpan Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Negligible	Scarce	Mulga Woodland	Nil	Moderate	0	None	Cattle Grazing	Old (6+ yr.)	
VJMW-007	-23.3669, 119.9843	8/05/2020	Hardpan Plain	Hardpan Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Negligible	Evenly Spread	Mulga Woodland	Nil	Moderate	0	Permanent	Cattle Grazing	Old (6+ yr.)	Noddy Bore
VJMW-008	-23.3749, 119.9926	8/05/2020	Sand Plain	Sand Plain	Flat	Flat	Sand	Evenly Spread	Negligible	Negligible	Few Large Patches	Spinifex Hummock Grassland	Nil	High	0	None	Cattle Grazing	Old (6+ yr.)	
VJMW-009	-23.3793, 119.9965	8/05/2020	Sand Plain	Sand Plain	Flat	Flat	Sand	Evenly Spread	Negligible	Negligible	Few Large Patches	Spinifex Hummock Grassland	Nil	High	0	None	Mining Exploration	Old (6+ yr.)	
VJMW-010	-23.371, 120.0337	8/05/2020	Stony Plain	Stony Plain	West	Low	Clay Loam	Evenly Spread	Negligible	Pebbles (5-10cm)	Scarce	Acacia Shrubland	Nil	Low	0	None	Road/ Access Track	Old (6+ yr.)	
VJMW-011	-23.384, 120.0319	8/05/2020	Stony Plain	Footslope	North	Low	Clay Loam	Evenly Spread	Negligible	Gravel (1-4cm)	Few Small Patches	Spinifex Hummock Grassland	Nil	Low	0	None	Non-Discernible	Old (6+ yr.)	
VJMW-012	-23.385, 120.0308	8/05/2020	Hillcrest/Hillslope	Breakaway	South/ West	Cliff	Clay Loam	Scarce	Major Outcropping Conglomerate	Boulders (>61cm)	Few Small Patches	Acacia Shrubland	Very High	Nil	0	None	Non-Discernible	Old (6+ yr.)	
VJMW-013	-23.3864, 120.0296	8/05/2020	Hillcrest/Hillslope	Hillslope	North	Low	Clay Loam	Evenly Spread	Negligible	Pebbles (5-10cm)	Few Large Patches	Acacia Shrubland	Nil	Low	0	None	Non-Discernible	Old (6+ yr.)	
VJMW-014	-23.3823, 120.0177	8/05/2020	Sand Plain	Sand Plain	Flat	Flat	Sand	Evenly Spread	Negligible	Negligible	Many Large Patches	Acacia Shrubland	Nil	High	0	None	Cattle Grazing	Old (6+ yr.)	
VJMW-015	-23.3837, 120.0166	8/05/2020	Stony Plain	Granite Outcrops/ Domes	North	Moderate	Clay Loam	Scarce	Major Outcropping Granite	Large Rocks (21-60cm)	Scarce	Acacia Shrubland	High	Nil	0	None	Non-Discernible	Old (6+ yr.)	
VJMW-016	-23.391, 119.9866	9/05/2020	Hardpan Plain	Hardpan Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Negligible	Many Large Patches	Acacia Shrubland	Nil	Moderate	0	None	Cattle Grazing	Old (6+ yr.)	
VJMW-017	-23.3935, 119.9885	9/05/2020	Hardpan Plain	Hardpan Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Negligible	Few Small Patches	Acacia Shrubland	Nil	Moderate	0	None	Cattle Grazing	Old (6+ yr.)	
VJMW-018	-23.3869, 119.9872	9/05/2020	Hardpan Plain	Hardpan Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Negligible	Few Large Patches	Mulga Woodland	Nil	Moderate	0	None	Cattle Grazing	Old (6+ yr.)	
VJMW-019	-23.3827, 119.9887	9/05/2020	Sand Plain	Sand Plain	Flat	Flat	Sand	Evenly Spread	Negligible	Negligible	Few Small Patches	Acacia Shrubland, Spinifex Hummock Grassland	Nil	High	0	None	Cattle Grazing	Old (6+ yr.)	
VJMW-020	-23.3746, 119.9895	9/05/2020	Sand Plain	Sand Plain	Flat	Flat	Sand	Evenly Spread	Negligible	Negligible	Many Small Patches	Acacia Shrubland, Spinifex Hummock Grassland	Nil	High	0	None	Cattle Grazing	Old (6+ yr.)	
VJMW-021	-23.38, 119.994	9/05/2020	Sand Plain	Sand Plain	Flat	Flat	Sand	Evenly Spread	Negligible	Negligible	Few Large Patches	Acacia Shrubland, Spinifex Hummock Grassland	Nil	High	0	None	Cattle Grazing	Old (6+ yr.)	
VJMW-022	-23.391, 119.997	9/05/2020	Hardpan Plain	Gilgai Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Gravel (1-4cm)	Scarce	Acacia Shrubland	Nil	Low	0	None	Cattle Grazing	Old (6+ yr.)	
VJMW-023	-23.3924, 119.9977	9/05/2020	Hardpan Plain	Claypan	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Negligible	Non-Discernible	Tussock Grassland	Nil	Low	0	Prone to Pooling	Cattle Grazing	Old (6+ yr.)	

Site ID	Coord.	Date	Habitat Type	Landform	Aspect	Slope	Soil Type	Soil Avail.	Outcropping/ Rock Type	Rock Size	Veg. Litter	Dominant Veg. Type	Rocky Cracks / Crevices	Burrowing Suitability	Hollows	Water present	Disturbances	Last Fire	Notes
VJMW-024	-23.3925, 120	9/05/2020	Sand Plain	Hardpan Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Negligible	Few Large Patches	Acacia Shrubland	Nil	Moderate	0	None	Cattle Grazing	Old (6+ yr.)	
VJMW-025	-23.3903, 119.9978	9/05/2020	Hardpan Plain	Hardpan Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Negligible	Few Large Patches	Mulga Woodland	Nil	Moderate	0	None	Cattle Grazing	Old (6+ yr.)	
VJMW-026	-23.3813, 120.0136	9/05/2020	Sand Plain	Sand Plain	Flat	Flat	Sand	Evenly Spread	Limited Outcropping Granite	Negligible	Evenly Spread	Acacia Shrubland, Spinifex Hummock Grassland	Nil	High	0	None	Cattle Grazing	Old (6+ yr.)	
VJMW-027	-23.3766, 120.0107	9/05/2020	Hardpan Plain	Hardpan Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Negligible	Few Large Patches	Mulga Woodland	Nil	Moderate	0	None	Cattle Grazing	Old (6+ yr.)	
VJMW-028	-23.3757, 120.012	9/05/2020	Hardpan Plain	Hardpan Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Negligible	Few Large Patches	Acacia Shrubland	Nil	Moderate	0	None	Cattle Grazing	Old (6+ yr.)	
VJMW-029	-23.3745, 120.0139	9/05/2020	Hardpan Plain	Hardpan Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Negligible	Evenly Spread	Acacia Shrubland	Nil	Moderate	0	None	Cattle Grazing	Old (6+ yr.)	
VJMW-030	-23.3727, 120.0164	9/05/2020	Stony Plain	Stony Plain	Flat	Flat	Clay Loam	Evenly Spread	Limited Outcropping Granite	Pebbles (5-10cm)	Evenly Spread	Acacia Shrubland	Nil	Moderate	0	None	Cattle Grazing	Old (6+ yr.)	
VJMW-031	-23.3722, 120.0175	9/05/2020	Stony Plain	Granite Outcrops/ Domes	West	Moderate	Clay Loam	Few Small Patches	Moderate Outcropping Granite	Large Rocks (21-60cm)	Few Large Patches	Acacia Shrubland, Spinifex Hummock Grassland	Very High	Nil	0	None	Non-Discernible	Old (6+ yr.)	
VJMW-032	-23.3754, 120.0183	9/05/2020	Hardpan Plain	Sand Plain	Flat	Flat	Sand	Evenly Spread	Negligible	Negligible	Many Small Patches	Acacia Shrubland	Nil	High	0	None	Non-Discernible	Old (6+ yr.)	
VJMW-033	-23.3756, 120.0161	9/05/2020	Hardpan Plain	Hardpan Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Negligible	Few Large Patches	Acacia Shrubland	Nil	Moderate	0	None	Cattle Grazing	Old (6+ yr.)	
VJMW-034	-23.3778, 119.9888	9/05/2020	Sand Plain	Sand Plain	Flat	Flat	Sand	Evenly Spread	Negligible	Negligible	Many Small Patches	Acacia Shrubland, Spinifex Hummock Grassland	Nil	High	0	None	Cattle Grazing	Old (6+ yr.)	
VJMW-035	-23.3899, 120.0381	10/05/2020	Stony Plain	Hillcrest/ Upper Hillslope	North	Low	Clay Loam	Evenly Spread	Negligible	Gravel (1-4cm)	Few Large Patches	Acacia Shrubland, Spinifex Hummock Grassland	Nil	Low	0	None	Road/ Access Track	Old (6+ yr.)	
VJMW-036	-23.3912, 120.0409	10/05/2020	Stony Plain	Hillcrest/ Upper Hillslope	North	Low	Clay Loam	Evenly Spread	Negligible	Gravel (1-4cm)	Few Large Patches	Acacia Shrubland, Spinifex Hummock Grassland	Nil	Low	0	None	Road/ Access Track	Old (6+ yr.)	
VJMW-037	-23.3922, 120.0448	10/05/2020	Hardpan Plain	Hardpan Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Gravel (1-4cm)	Scarce	Acacia Shrubland	Nil	Low	0	None	Road/ Access Track	Old (6+ yr.)	
VJMW-038	-23.3843, 120.0373	10/05/2020	Hardpan Plain	Hardpan Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Negligible	Few Large Patches	Mulga Woodland	Nil	Low	0	None	Cattle Grazing	Old (6+ yr.)	
VJMW-039	-23.3815, 120.0354	10/05/2020	Hardpan Plain	Hardpan Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Negligible	Few Large Patches	Mulga Woodland	Nil	Low	0	None	Cattle Grazing	Old (6+ yr.)	
VJMW-040	-23.3776, 120.0238	9/05/2020	Sand Plain	Sand Plain	Flat	Flat	Sand	Evenly Spread	Negligible	Negligible	Many Small Patches	Acacia Shrubland, Spinifex Hummock Grassland	Nil	High	0	None	Cattle Grazing	Old (6+ yr.)	
VJMW-041	-23.3769, 120.0293	9/05/2020	Sand Plain	Sand Plain	Flat	Flat	Sand	Evenly Spread	Negligible	Negligible	Many Small Patches	Acacia Shrubland, Spinifex Hummock Grassland	Nil	High	0	None	Cattle Grazing	Old (6+ yr.)	
VJMW-042	-23.3752, 120.0292	9/05/2020	Sand Plain	Sand Plain	Flat	Flat	Sand	Evenly Spread	Negligible	Negligible	Many Large Patches	Acacia Shrubland, Spinifex Hummock Grassland, Scattered Eucalypts	Nil	High	0	None	Cattle Grazing	Old (6+ yr.)	
VJMW-043	-23.3747, 120.029	10/05/2020	Stony Plain	Hillslope	South	Low	Clay Loam	Evenly Spread	Negligible	Negligible	Few Small Patches	Spinifex Hummock Grassland, Acacia Shrubland	Low	Low	0	None	Non-Discernible	Old (6+ yr.)	
VJMW-044	-23.3747, 120.029	10/05/2020	Stony Plain	Minor Drainage Line	South	Low	Clay Loam	Evenly Spread	Negligible	Negligible	Few Large Patches	Acacia Shrubland	Nil	Moderate	0	None	Non-Discernible	Old (6+ yr.)	
VJMW-045	-23.3736, 120.0289	10/05/2020	Stony Plain	Granite Outcrops/ Domes	South	Steep	Clay Loam	Scarce	Major Outcropping Granite	Large Rocks (21-60cm)	Few Small Patches	Acacia Shrubland	High	Nil	0	None	Non-Discernible	Old (6+ yr.)	
VJMW-046	-23.3731, 120.0292	10/05/2020	Stony Plain	Granite Outcrops/ Domes	South/ East	Moderate	Clay Loam	Few Large Patches	Major Outcropping Granite	Large Rocks (21-60cm)	Few Small Patches	Acacia Shrubland	High	Nil	0	None	Non-Discernible	Old (6+ yr.)	
VJMW-047	-23.3732, 120.0306	10/05/2020	Stony Plain	Hillslope	South/ East	Low	Clay Loam	Many Large Patches	Moderate Outcropping Granite	Small Rocks (11-20cm)	Few Small Patches	Acacia Shrubland, Spinifex Hummock Grassland	Low	Nil	0	None	Non-Discernible	Old (6+ yr.)	

Site ID	Coord.	Date	Habitat Type	Landform	Aspect	Slope	Soil Type	Soil Avail.	Outcropping/ Rock Type	Rock Size	Veg. Litter	Dominant Veg. Type	Rocky Cracks / Crevices	Burrowing Suitability	Hollows	Water present	Disturbances	Last Fire	Notes
VJMW-048	-23.3736, 120.0319	10/05/2020	Sand Plain	Hillslope	South/East	Low	Sand	Evenly Spread	Negligible	Gravel (1-4cm)	Many Small Patches	Acacia Shrubland, Spinifex Hummock Grassland	Nil	Low	0	None	Cattle Grazing	Old (6+ yr.)	
VJMW-049	-23.3739, 120.0328	10/05/2020	Sand Plain	Sand Plain	Flat	Flat	Sand	Evenly Spread	Negligible	Negligible	Few Large Patches	Acacia Shrubland, Spinifex Hummock Grassland	Nil	Moderate	0	None	Cattle Grazing	Old (6+ yr.)	
VJMW-050	-23.3756, 120.0396	10/05/2020	Sand Plain	Hardpan Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Negligible	Few Large Patches	Acacia Shrubland, Spinifex Hummock Grassland	Nil	Moderate	0	None	Non-Discernible	Old (6+ yr.)	
VJMW-051	-23.3728, 120.0425	10/05/2020	Sand Plain	Hardpan Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Negligible	Few Large Patches	Acacia Shrubland, Spinifex Hummock Grassland	Nil	Low	0	None	Non-Discernible	Old (6+ yr.)	
VJMW-052	-23.3703, 120.0407	10/05/2020	Hardpan Plain	Hardpan Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Negligible	Few Large Patches	Acacia Shrubland	Nil	Low	0	None	Non-Discernible	Old (6+ yr.)	
VJMW-053	-23.3678, 120.0408	10/05/2020	Stony Plain	Stony Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Gravel (1-4cm)	Scarce	Acacia Shrubland	Nil	Low	0	None	Non-Discernible	Old (6+ yr.)	
VJMW-054	-23.3669, 120.0421	10/05/2020	Stony Plain	Basalt Outcrops	South/West	Low	Clay Loam	Many Small Patches	Minor Outcropping BIF	Gravel (1-4cm)	Scarce	Acacia Shrubland	Low	Nil	0	None	Non-Discernible	Old (6+ yr.)	
VJMW-055	-23.3668, 120.0394	10/05/2020	Stony Plain	Granite Outcrops/Domes	North	Moderate	Clay Loam	Evenly Spread	Minor Outcropping Granite	Large Rocks (21-60cm)	Few Small Patches	Spinifex Hummock Grassland, Acacia Shrubland	Moderate	Nil	0	None	Non-Discernible	Old (6+ yr.)	
VJMW-056	-23.3786, 119.9978	10/05/2020	Sand Plain	Sand Plain	Flat	Flat	Sand	Evenly Spread	Negligible	Negligible	Few Large Patches	Acacia Shrubland, Spinifex Hummock Grassland	Nil	High	0	None	Cattle Grazing	Old (6+ yr.)	
VJMW-057	-23.3922, 120.0364	10/05/2020	Hardpan Plain	Stony Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Gravel (1-4cm)	Non-Discernible		Nil	Low	0	None	Road/ Access Track	Old (6+ yr.)	
VJMW-058	-23.3924, 120.0374	10/05/2020	Hardpan Plain	Stony Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Gravel (1-4cm)	Non-Discernible	Spinifex Hummock Grassland	Nil	Low	0	None	Non-Discernible	Old (6+ yr.)	
VJMW-059	-23.3928, 120.039	10/05/2020	Stony Plain	Granite Outcrops/Domes	West	Moderate	Clay Loam	Evenly Spread	Major Outcropping Granite	Pebbles (5-10cm)	Few Small Patches	Spinifex Hummock Grassland, Acacia Shrubland	Moderate	Nil	0	None	Non-Discernible	Old (6+ yr.)	
VJMW-060	-23.3935, 120.0365	10/05/2020	Hardpan Plain	Stony Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Gravel (1-4cm)	Non-Discernible	Acacia Shrubland	Nil	Low	0	None	Road/ Access Track	Old (6+ yr.)	
VJMW-061	-23.3939, 120.0402	10/05/2020	Hardpan Plain	Stony Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Gravel (1-4cm)	Non-Discernible	Acacia Shrubland	Nil	Low	0	None	Road/ Access Track	Old (6+ yr.)	
VJMW-062	-23.3976, 120.0422	10/05/2020	Hardpan Plain	Stony Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Gravel (1-4cm)	Non-Discernible	Acacia Shrubland	Nil	Low	0	None	Road/ Access Track	Old (6+ yr.)	
VJMW-063	-23.3952, 120.0319	10/05/2020	Mulga Woodland	Drainage Area/ Floodplain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Negligible	Few Small Patches	Mulga Woodland	Nil	Moderate	0	None	Road/ Access Track	Old (6+ yr.)	
VJMW-064	-23.3941, 120.0297	10/05/2020	Stony Plain	Stony Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Negligible	Few Small Patches	Acacia Shrubland	Nil	Moderate	0	None	Road/ Access Track	Old (6+ yr.)	
VJMW-065	-23.3922, 120.0335	10/05/2020	Mulga Woodland	Medium Drainage Line	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Negligible	Few Small Patches	Mulga Woodland	Nil	Moderate	0	None	Road/ Access Track	Old (6+ yr.)	
VJMW-066	-23.3884, 120.0355	10/05/2020	Sand Plain	Footslope	Flat	Flat	Sand	Evenly Spread	Negligible	Negligible	Few Small Patches	Acacia Shrubland, Spinifex Hummock Grassland	Nil	High	0	None	Road/ Access Track	Old (6+ yr.)	
VJMW-067	-23.3845, 120.0354	10/05/2020	Hardpan Plain	Footslope	Flat	Flat	Sand	Evenly Spread	Negligible	Negligible	Many Small Patches	Acacia Shrubland, Spinifex Hummock Grassland	Nil	High	0	None	Road/ Access Track	Old (6+ yr.)	
VJMW-068	-23.3802, 120.0358	10/05/2020	Hillcrest/Hillslope	Hillcrest/ Upper Hillslope	West	Low	Clay Loam	Evenly Spread	Negligible	Gravel (1-4cm)	Few Small Patches	Spinifex Hummock Grassland	Nil	Low	0	None	Mining Exploration	Old (6+ yr.)	
VJMW-069	-23.3884, 119.9838	10/05/2020	Major Drainage Line	Major Drainage Line	Flat	Flat	Sand	Evenly Spread	Negligible	Negligible	Few Small Patches	Scattered Eucalypts	Nil	High	0	None	Non-Discernible	Old (6+ yr.)	
VJMW-070	-23.3872, 119.9838	10/05/2020	Hardpan Plain	Hardpan Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Negligible	Many Small Patches	Acacia Shrubland	Nil	Low	0	None	Cattle Grazing	Old (6+ yr.)	
VJMW-071	-23.3682, 119.9852	10/05/2020	Hardpan Plain	Hardpan Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Negligible	Evenly Spread	Acacia Shrubland	Nil	Low	0	None	Cattle Grazing	Old (6+ yr.)	

Site ID	Coord.	Date	Habitat Type	Landform	Aspect	Slope	Soil Type	Soil Avail.	Outcropping/ Rock Type	Rock Size	Veg. Litter	Dominant Veg. Type	Rocky Cracks / Crevices	Burrowing Suitability	Hollows	Water present	Disturbances	Last Fire	Notes
VJMW-072	-23.3712, 119.9868	10/05/2020	Hardpan Plain	Hardpan Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Negligible	Evenly Spread	Acacia Shrubland	Nil	Low	0	None	Cattle Grazing	Old (6+ yr.)	
VJMW-073	-23.3718, 119.9878	10/05/2020	Mulga Woodland	Hardpan Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Negligible	Evenly Spread	Acacia Shrubland	Nil	Low	0	None	Cattle Grazing	Old (6+ yr.)	
VJMW-074	-23.3975, 119.9898	10/05/2020	Hardpan Plain	Hardpan Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Negligible	Few Large Patches	Acacia Shrubland, Spinifex Hummock Grassland	Nil	Low	0	None	Mining Exploration	Old (6+ yr.)	
VJMW-075	-23.3946, 119.9883	10/05/2020	Hardpan Plain	Hardpan Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Negligible	Scarce	Acacia Shrubland	Nil	Low	0	None	Mining Exploration	Old (6+ yr.)	
VJMW-076	-23.3926, 119.9889	10/05/2020	Hardpan Plain	Hardpan Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Negligible	Few Small Patches	Acacia Shrubland	Nil	Low	0	None	Mining Exploration	Old (6+ yr.)	
VJMW-077	-23.3898, 119.9888	10/05/2020	Hardpan Plain	Hardpan Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Negligible	Few Small Patches	Acacia Shrubland	Nil	Low	0	None	Mining Exploration	Old (6+ yr.)	
VJMW-078	-23.3696, 120.0024	11/05/2020	Hardpan Plain	Hardpan Plain	Flat	Flat	Loamy Sand	Evenly Spread	Negligible	Negligible	Few Large Patches	Mulga Woodland	Nil	Moderate	0	None	Cattle Grazing	Old (6+ yr.)	
VJMW-079	-23.3678, 120.0071	11/05/2020	Hardpan Plain	Hardpan Plain	Flat	Flat	Loamy Sand	Evenly Spread	Negligible	Negligible	Few Small Patches	Acacia Shrubland	Nil	Moderate	0	None	Cattle Grazing	Old (6+ yr.)	
VJMW-080	-23.368, 120.01	11/05/2020	Hardpan Plain	Hardpan Plain	Flat	Flat	Loamy Sand	Evenly Spread	Negligible	Negligible	Scarce	Acacia Shrubland	Nil	Moderate	0	None	Cattle Grazing	Old (6+ yr.)	
VJMW-081	-23.3703, 120.0144	11/05/2020	Hardpan Plain	Hardpan Plain	Flat	Flat	Loamy Sand	Evenly Spread	Negligible	Negligible	Evenly Spread	Acacia Shrubland	Nil	Moderate	0	None	Cattle Grazing	Old (6+ yr.)	
VJMW-082	-23.3716, 120.0104	11/05/2020	Hardpan Plain	Hardpan Plain	Flat	Flat	Loamy Sand	Evenly Spread	Negligible	Negligible	Few Large Patches	Acacia Shrubland	Nil	Moderate	0	None	Cattle Grazing	Old (6+ yr.)	
VJMW-083	-23.3781, 120.0351	11/05/2020	Hardpan Plain	Hardpan Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Pebbles (5-10cm)	Few Small Patches	Acacia Shrubland, Spinifex Hummock Grassland	Nil	Low	0	None	Cattle Grazing	Old (6+ yr.)	
VJMW-084	-23.3768, 120.0352	11/05/2020	Hardpan Plain	Stony Plain	South/West	Low	Clay Loam	Evenly Spread	Limited Outcropping Granite	Pebbles (5-10cm)	Few Small Patches	Spinifex Hummock Grassland	Low	Nil	0	None	Road/ Access Track	Old (6+ yr.)	
VJMW-085	-23.3882, 120.0209	11/05/2020	Hillcrest/ Hillslope	Hillcrest/ Upper Hillslope	South	Moderate	Clay Loam	Evenly Spread	Negligible	Gravel (1-4cm)	Few Small Patches	Spinifex Hummock Grassland, Acacia Shrubland	Low	Nil	0	None	Mining Exploration	Old (6+ yr.)	
VJMW-086	-23.3736, 120.035	11/05/2020	Stony Plain	Stony Plain	South/West	Low	Clay Loam	Evenly Spread	Negligible	Pebbles (5-10cm)	Few Small Patches	Acacia Shrubland	Nil	Nil	0	None	Cattle Grazing	Old (6+ yr.)	
VJMW-087	-23.3691, 120.0341	11/05/2020	Stony Plain	Stony Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Gravel (1-4cm)	Few Small Patches	Acacia Shrubland	Nil	Nil	0	None	Road/ Access Track	Old (6+ yr.)	
VJMW-088	-23.3678, 120.0352	11/05/2020	Mulga Woodland	Minor Drainage Line	Flat	Flat	Loamy Sand	Evenly Spread	Negligible	Negligible	Few Small Patches	Acacia Shrubland	Nil	Moderate	0	None	Road/ Access Track	Old (6+ yr.)	
VJMW-089	-23.3805, 120.0038	12/05/2020	Mulga Woodland	Medium Drainage Line	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Negligible	Evenly Spread	Acacia Shrubland	Nil	Low	0	None	Cattle Grazing	Old (6+ yr.)	
VJMW-090	-23.3791, 120.005	12/05/2020	Mulga Woodland	Medium Drainage Line	South/East	Flat	Clay Loam	Evenly Spread	Negligible	Negligible	Few Large Patches	Mulga Woodland	Nil	Low	0	None	Cattle Grazing	Old (6+ yr.)	
VJMW-091	-23.3934, 120.0182	12/05/2020	Mulga Woodland	Medium Drainage Line	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Negligible	Few Large Patches	Mulga Woodland	Nil	Low	0	None	Cattle Grazing	Old (6+ yr.)	
VJMW-092	-23.3695, 120.0284	12/05/2020	Hardpan Plain	Hardpan Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Negligible	Evenly Spread	Acacia Shrubland, Spinifex Hummock Grassland	Nil	Low	0	None	Cattle Grazing	Old (6+ yr.)	
VJMW-093	-23.3679, 120.0264	12/05/2020	Hardpan Plain	Hardpan Plain	Flat	Flat	Loamy Sand	Evenly Spread	Negligible	Negligible	Few Small Patches	Acacia Shrubland	Nil	Moderate	0	None	Cattle Grazing	Old (6+ yr.)	
VJMW-094	-23.3741, 120.0182	9/05/2020	Hardpan Plain	Sand Plain	Flat	Flat	Sand	Evenly Spread	Negligible	Negligible	Evenly Spread	Acacia Shrubland	Nil	High	0	None	Non-Discernible	Old (6+ yr.)	
VJMW-095	-23.382, 119.987	10/05/2020	Hardpan Plain	Minor Drainage Line	Flat	Flat	Loamy Sand	Evenly Spread	Negligible	Negligible	Few Large Patches	Acacia Shrubland	Nil	Moderate	0	None	Cattle Grazing	Old (6+ yr.)	

Appendix E – SRE invertebrate fauna habitat assessments

Site ID	Coord.	Date	Habitat Type	Drainage	Landform	Slope	Aspect	Rocky outcrop amount	Rocky outcrop type	Rock size	Vegetation type	Vegetation litter	Shade	Soil type	Soil availability	Last fire	Disturbance
SJMW-001	-23.3876, 120.0224	8/05/2020	Hillcrest/Hillslope	Gully	Gully	Moderate	North	Major Outcropping	BIF	Small Rocks (11-20cm)	Mulga Grove	Few Small Patches	Medium 40-60%	Clay Loam	Few Small Patches	Old (6+ yr.)	Mining Exploration
SJMW-002	-23.3897, 120.0133	8/05/2020	Mulga Woodland	Creek	Medium Drainage Line	Flat	Flat	Negligible	Non-Discernible	Negligible	Mulga Woodland	Evenly Spread	Medium 40-60%	Sandy Loam	Evenly Spread	Old (6+ yr.)	Cattle Grazing
SJMW-003	-23.374, 119.9977	11/05/2020	Mulga Woodland	Creek	Medium Drainage Line	Flat	West	Negligible	Non-Discernible	Negligible	Mulga Grove	Evenly Spread	Medium 40-60%	Clay Loam	Evenly Spread	Old (6+ yr.)	Cattle Grazing
SJMW-004	-23.3716, 120.0002	11/05/2020	Mulga Woodland	Creek	Medium Drainage Line	Flat	West	Negligible	Non-Discernible	Negligible	Mulga Grove	Evenly Spread	Medium 40-60%	Clay Loam	Evenly Spread	Old (6+ yr.)	Cattle Grazing

Appendix F – Fauna recorded during the current survey

Species	Common Name	Conservation Status			
		EPBC Act	BC Act	DBCA	IUCN
MAMMALIA					
BOVIDAE					
* <i>Bos taurus</i>	cow				
CANIDAE					
* <i>Canis familiaris subsp. dingo</i>	dog				
DASYURIDAE					
<i>Dasykaluta rosamondae</i>	little red kaluta				
EMBALLONURIDAE					
<i>Saccolaimus flaviventris</i>	yellow-bellied sheath-tail bat				
FELIDAE					
* <i>Felis catus</i>	cat				
MACROPODIDAE					
<i>Osphranter robustus subsp. erubescens</i>	euro				
<i>Osphranter rufus</i>	red kangaroo				
MOLOSSIDAE					
<i>Austronomus australis</i>	white-striped freetail-bat				
<i>Ozimops lumsdenae</i>	northern free-tailed bat				
MURIDAE					
<i>Notomys alexis</i>	spinifex hopping-mouse				
VESPERTILIONIDAE					
<i>Chalinolobus gouldii</i>	Gould's wattled bat				
<i>Nyctophilus geoffroyi</i>	lesser long-eared bat				
<i>Scotorepens greyii</i>	little broad-nosed bat				
<i>Vespadelus finlaysoni</i>	Finlayson's cave bat				
AVES					
ACANTHIZIDAE					
<i>Acanthiza robustirostris</i>	slaty-backed thornbill				
<i>Acanthiza uropygialis</i>	chestnut-rumped thornbill				
<i>Aphelocephala leucopsis</i>	southern whiteface				
<i>Gerygone fusca</i>	western gerygone				
ACCIPITRIDAE					
<i>Accipiter fasciatus</i>	brown goshawk				
<i>Aquila audax</i>	wedge-tailed eagle				
<i>Circus assimilis</i>	spotted harrier				
<i>Haliastur sphenurus</i>	whistling kite				
<i>Hieraaetus morphnoides</i>	little eagle				
AEGOTHELIDAE					
<i>Aegotheles cristatus</i>	Australian owl-nightjar				
ALCEDINIDAE					
<i>Todiramphus sanctus</i>	sacred kingfisher				
ANATIDAE					
<i>Chenonetta jubata</i>	Australian wood duck				
ARDEIDAE					
<i>Ardea novaehollandiae</i>	white-faced heron				
ARTAMIDAE					
<i>Artamus cinereus</i>	black-faced woodswallow				
<i>Artamus minor</i>	little woodswallow				
<i>Cracticus nigrogularis</i>	pied butcherbird				
<i>Cracticus tibicen</i>	Australian magpie				
<i>Cracticus torquatus</i>	grey butcherbird				
BURHINIDAE					
<i>Burhinus grallarius</i>	bush stone-curlew				

Species	Common Name	Conservation Status			
		EPBC Act	BC Act	DBCA	IUCN
CACATUIDAE					
<i>Cacatua roseicapilla</i>	galah				
<i>Cacatua sanguinea</i>	little corella				
<i>Nymphicus hollandicus</i>	cockatiel				
CAMPEPHAGIDAE					
<i>Coracina novaehollandiae</i> subsp. <i>subpallida</i>	black-faced cuckoo-shrike				
<i>Lalage tricolor</i>	white-winged triller				
COLUMBIDAE					
<i>Geopelia cuneata</i>	diamond dove				
<i>Ocyphaps lophotes</i>	crested pigeon				
<i>Phaps chalcoptera</i>	common bronzewing				
CORVIDAE					
<i>Corvus orru</i> subsp. <i>ceciliae</i>	torresian crow				
CUCULIDAE					
<i>Cacomantis pallidus</i>	pallid cuckoo				
<i>Chrysococcyx basalis</i>	Horsfield's bronze-cuckoo				
<i>Chrysococcyx osculans</i>	black-eared cuckoo				
ESTRILDIDAE					
<i>Taeniopygia guttata</i> subsp. <i>castanotis</i>	zebra finch				
FALCONIDAE					
<i>Falco berigora</i>	brown falcon				
<i>Falco cenchroides</i>	nankeen kestrel				
<i>Falco longipennis</i>	Australian hobby				
HIRUNDINIDAE					
<i>Petrochelidon ariel</i>	fairy martin				
LOCUSTELLIDAE					
<i>Megalurus mathewsi</i>	rufous songlark				
MALURIDAE					
<i>Malurus lamberti</i> subsp. <i>assimilis</i>	variegated fairy-wren				
<i>Malurus leucopterus</i> subsp. <i>leuconotus</i>	white-winged fairy-wren				
<i>Malurus splendens</i>	splendid fairywren				
MELIPHAGIDAE					
<i>Acanthagenys rufogularis</i>	spiny-cheeked honeyeater				
<i>Epthianura tricolor</i>	crimson chat				
<i>Gavicalis virescens</i>	singing honeyeater				
<i>Manorina flavigula</i>	yellow-throated miner				
<i>Ptilotula pencillata</i>	white-plumed honeyeater				
MONARCHIDAE					
<i>Grallina cyanoleuca</i>	magpie-lark				
OTIDIDAE					
<i>Ardeotis australis</i>	Australian bustard				
PACHYCEPHALIDAE					
<i>Pachycephala rufiventris</i> subsp. <i>rufiventris</i>	rufous whistler				
<i>Oreoica gutturalis</i>	crested bellbird				
PETROICIDAE					
<i>Melanodryas cucullata</i>	hooded robin				
<i>Petroica goodenovii</i>	red-capped robin				
POMATOSTOMIDAE					
<i>Pomatostomus temporalis</i> subsp. <i>rubeculus</i>	grey-crowned babbler				
PSITTACIDAE					
<i>Melopsittacus undulatus</i>	budgerigar				
<i>Neopsephotus bourkii</i>	Bourke's parrot				

Species	Common Name	Conservation Status			
		EPBC Act	BC Act	DBCA	IUCN
<i>Platycercus zonarius</i> subsp. <i>zonarius</i>	Port Lincoln parrot				
RHIPIDURIDAE					
<i>Rhipidura leucophrys</i> subsp. <i>leucophrys</i>	willie wagtail				
TURNICIDAE					
<i>Turnix velox</i>	little button-quail				
REPTILIA					
AGAMIDAE					
<i>Ctenophorus isolepis</i> subsp. <i>isolepis</i>	military dragon				
DIPLODACTYLIDAE					
<i>Oedura fimbria</i>	western marbled velvet gecko				
SCINCIDAE					
<i>Ctenotus inornatus</i>	skink				
<i>Ctenotus pantherinus</i> subsp. <i>ocellifer</i>	leopard ctenotus				
VARANIDAE					
<i>Varanus gouldii</i>	Gould's monitor				