Great Central Road Warburton & Warakurna Biological Survey

Prepared for

mainroads WESTERN AUSTRALIA

FINAL
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Prepared by

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Cover Photo: Great Central Road survey area vegetation (taken 1st November 2021)

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1 EXECUTIVE SUMMARY

Main Roads Western Australia (Main Roads) is proposing to reconstruct and upgrade two sections of Great Central Road near the communities of Warburton and Warakurna in the Shire of Ngaanyatjarraku. Works for the project include road widening on the Great Central Road, construction of material and borrow pits, and installation of water bores and turkey nests. The Warburton section is from SLK 539 – 559 and includes five potential water source locations (80 hectares (ha)), one gravel pit location (159 ha), and an area 10 metres (m) on either side of the current road alignment (37 ha). The Warakurna section is from SLK 762 – 800.05 and includes five potential water source locations (364 ha), one gravel pit location (30 ha), one borrow pit location (26 ha), and an area 10 m on either side of the current road alignment (20 ha).

Botanica Consulting Pty Ltd (Botanica) was commissioned by Main Roads to undertake the following assessments of the Great Central Road Warburton & Warakurna (referred to as the 'study area'):

- Desktop assessment within a 40-kilometre (km) radius of the Great Central Road Warburton & Warakurna survey area (referred to as the 'desktop study area');
- Basic fauna survey of the Great Central Road Warburton & Warakurna, covering an area of approximately 779 ha (referred to as the 'survey area'); and
- Targeted flora survey and detailed flora and vegetation survey of the Great Central Road Warburton & Warakurna, covering an area of approximately 779 ha (referred to as the 'survey area').

The survey was conducted from the 31st of October to 2nd November 2021. Thirty-eight quadrats (50 m X 50 m) were established during the survey.

Six vegetation types were identified within the survey area which were representative of two pre-European vegetation associations (association 8 and 230) of the Central Ranges and Gibson Desert System. These vegetation types were identified within three landform types and comprised of five major vegetation groups, which were represented by a total of 20 families, 43 genera and 82 taxa. One Threatened Flora taxon (*Seringia exastia*) listed as Critically Endangered under the Western Australian *Biodiversity Conservation (BC) Act 2016* and Commonwealth *Environment Protection and Biodiversity Conservation (EPBC) Act 1999* was identified within the survey area. This taxon is currently being nominated to be de-listed as a Threatened Flora taxon under the BC Act. No Threatened Ecological Communities as listed under the Western Australian BC Act or Commonwealth EPBC Act were identified within the survey area.

Based on the vegetation condition rating scale specified in the Environmental Protection Authority (EPA) *Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment – December 2016* (EPA, 2016a), vegetation ranged from 'good' to 'very good' with the majority of vegetation rated as 'good'. Disturbance in the area was a result of recent and/ or frequent fires and road siding of the Great Central Road. Three introduced flora taxa were identified within the survey area, none of which are listed as a Declared Pest or Weed of National Significance; *Cenchrus ciliaris* (Buffel Grass), *Cucumis myriocarpus* (Prickly Paddy Melon) and *Rumex vesicarius* (Ruby Dock).

No Priority Flora were listed on the Department of Biodiversity, Conservation and Attractions (DBCA) database as occurring within the survey area. The desktop assessment identified one Threatened Flora and nine[1] Priority Flora taxa as possibly occurring within the survey area based on their broad habitat descriptions/ soil types including sand, gravelly soils of sandplains and creeklines. Based on the field assessment, one Threatened Flora taxon was identified within the survey area. No Priority Flora taxa were identified within the survey area. Six of the nine Priority Flora identified as possible to occur from the desktop assessment were considered to be unlikely to occur within the survey area. The remaining three Priority Flora were identified as possible to occur within the survey area, however these taxa were not recorded during the field survey. No Priority Ecological Communities (as listed by DBCA) were identified within the survey area or the desktop study area.

Three fauna habitats were identified within the survey area. Results of the literature review identified 3 amphibians, 21 mammals, 99 bird and 55 reptile species as having been previously recorded in the desktop study area, some of which have the potential to occur within the survey area. A total of 62 fauna taxa were observed during the field survey.

Five significant fauna were identified as potentially occurring within the survey area based on their habitat preferences including hummock grassland, sandplains and creeklines:

1. Grey Falcon (*Falco hypoleucos*)-Threatened (Vulnerable EPBC Act and BC Act)
2. Princess Parrot (*Polytelis alexandrae*)-Threatened (Vulnerable EPBC Act) and Priority 4
3. Peregrine Falcon (*Falco peregrinus*)-Other specially protected species
4. Striated Grasswren (inland) (*Amytornis striatus* subsp*. striatus*)-Priority 4
5. Great Desert Skink (*Liopholis kintorei*)-Threatened (Vulnerable EPBC Act and BC Act)

No Threatened fauna or other specially protected species as listed under the Western Australian BC Act or the Commonwealth EPBC Act was identified within the survey area. No Priority fauna as listed by DBCA were recorded within the survey area.

There are no wetlands of international importance (Ramsar Wetlands) or national importance (Australian Nature Conservation Agency Wetlands) within the survey area nor proposed or gazetted conservation reserves within the survey area.

[1] Including one taxon without a habitat description which has been tentatively considered as ‘possible to occur’

2 INTRODUCTION

Botanica Consulting Pty Ltd (Botanica) was commissioned by Main Roads Western Australia (Main Roads) to undertake the following assessments of the Great Central Road Warburton & Warakurna (referred to as the 'study area'):

- Desktop assessment within a 40-kilometre (km) radius of the Great Central Road Warburton & Warakurna (referred to as the 'desktop study area');
- Basic fauna survey of the Great Central Road Warburton & Warakurna, covering an area of approximately 50 hectares (ha) (referred to as the 'survey area'); and
- Targeted flora survey and detailed flora and vegetation survey of the Great Central Road Warburton & Warakurna, covering an area of approximately 50 ha (referred to as the 'survey area').

Main Roads Western Australia (Main Roads) is proposing to reconstruct and upgrade two sections of Great Central Road near the communities of Warburton and Warakurna in the Shire of Ngaanyatjarraku. Works for the project include road widening on the Great Central Road, construction of material and borrow pits, and installation of water bores and turkey nests (Figure 2-1). The Warburton section is from SLK 539 – 559 and includes five potential water source locations (80 ha), one gravel pit location (159 ha), and an area 10 metres (m) on either side of the current road alignment (37 ha). The Warakurna section is from SLK 762 – 800.05 and includes five potential water source locations (364 ha), one gravel pit location (30 ha), one borrow pit location (26 ha), and an area 10 m on either side of the current road alignment (20 ha)

2.1 Objectives

The flora/vegetation assessment was conducted in accordance with the requirements of a detailed survey as defined in *Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment – December 2016* (EPA, 2016a). The objectives of the assessment were to:

1. Gather background information on flora and vegetation in the desktop study area (literature review, database and map-based searches);
2. Conduct a field survey to verify / ground truth the desktop assessment findings through reconnaissance survey;
3. Define and map vegetation communities of the survey area to a scale appropriate for the Bioregion and described according to the National Vegetation Information System (NVIS) classification (NVIS Level V – Association);
4. Record the species composition (abundance and diversity) of each vegetation community within the survey area and compile a species list for the survey area by vegetation type;
5. Provide quadrat-based data from plots representative of each vegetation type (minimum of three quadrats per vegetation type) according to Environmental Protection Authority (EPA) guidelines;
6. Assess the species composition of each quadrat;
7. Determine the local and regional significance of flora and vegetation within the desktop study area and survey area;
8. Identify and record the locations of any significant flora/vegetation within the survey area;
9. Identify and record the locations of any introduced flora species (including Declared Pests) within the survey area;
10. Provide a map showing the distribution of significant flora/vegetation within the survey area; and
11. Define and map the condition of vegetation within the survey area in accordance with the

vegetation condition rating scale specified in the Environmental Protection Authority (EPA) *Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment – December 2016* (EPA, 2016a).

The targeted flora survey was conducted in accordance with the requirements of a targeted survey as defined in *Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment – December 2016* (EPA, 2016a). The objectives of the assessment were to:

1. Gather background information on flora of significance in the local area (literature review, database and map-based searches);
2. Based on results of the desktop assessment, identify vegetation types within the survey area that have the potential to contain flora of significance;
3. Conduct a field survey to identify flora of significance within the survey area; and
4. Provide GPS records and spatial map showing the distribution of flora of significance within the survey area.

The fauna assessment was conducted in accordance with the requirements of a basic terrestrial fauna survey as defined in *Technical Guidance - Terrestrial Fauna Surveys for Environmental Impact Assessment – June 2020* (EPA, 2020). The objectives of the assessment were to:

1. Undertake a literature review, including map-based information searches of all current and relevant literature sources and databases relating to the survey area;
2. Undertake a desktop investigation to identify any previously recorded occurrences of or potentially occurring Threatened and Priority listed fauna within the survey area;
3. Undertake searches on available databases for details relating to any Threatened and Priority listed fauna previously identified as occurring or potentially occurring within the survey area;
4. Conduct fauna habitat mapping and identify habitat types which are suitable for each significant fauna considered likely or possible to occur, or fauna recorded in the survey area;
5. Compile an inventory of fauna species occurrences within the survey area;
6. Undertake opportunistic, low intensity sampling of fauna; and
7. Report on the conservation status of species present using the Western Australian Museum and *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) databases for presence of Threatened and Priority listed fauna species within the survey area.

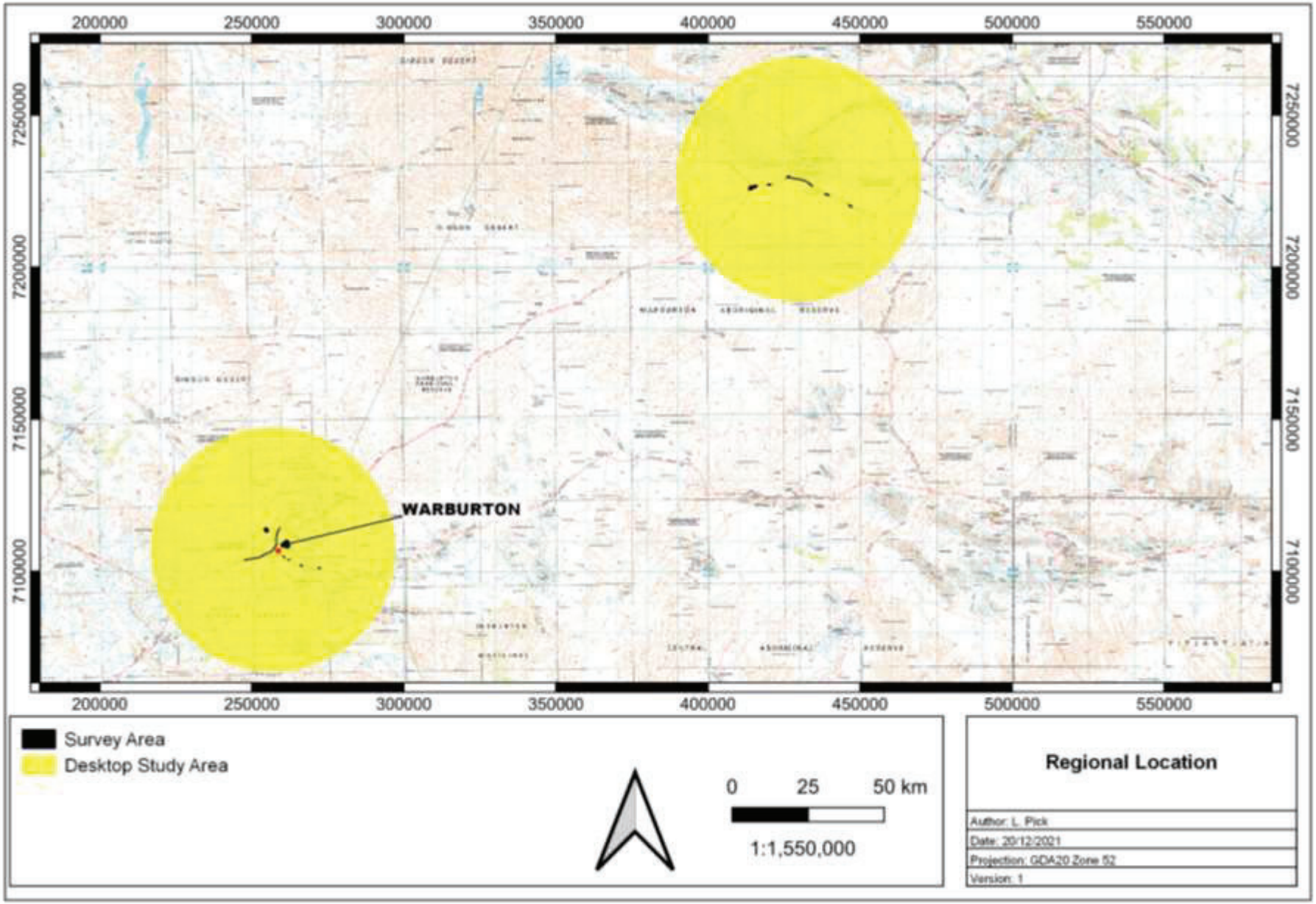


Figure 2-1: Regional map of the desktop study area/ survey area

3 REGIONAL BIOPHYSICAL ENVIRONMENT

3.1 Regional Environment

The study area lies within the Eremaean Province of WA. Based on the Interim Biogeographic Regionalisation of Australia (IBRA, Version 7) (DotEE, 2012) the study area is located within three Bioregions; Central Ranges, Gibson Desert and Great Victoria Desert. These Bioregions are further divided into subregions with the study area located within the Mann-Musgrave Block (CR1), Lateritic Plain (GD1) and Central (GVD2) subregions. The survey area is located predominately located within the Mann-Musgrave Block (CR1) subregion (Figure 3-1).

The Mann-Musgrave Block (CR1) subregion of the Central Ranges Bioregion contains a high proportion of Proterozoic ranges including both volcanic and quartzites and derived soil plains, interspersed with red Quaternary sandplains with some permian exposure. This subregion is described as the 'Giles Botanical District', comprising of sandplains supporting low open woodlands of either Desert Oak or Mulga over *Triodia basedowii* hummock grasslands. Low open woodlands of Ironwood (*Acacia estrophiolata*) and Corkwoods (*Hakea* spp.) over tussock and hummock grasses often fringe ranges. The ranges support mixed wattle scrub or *Callitris glaucophylla* woodlands over hummock and tussock grasslands. The climate is described as arid, with a mean rainfall of 200mm comprising summer and winter rain (Graham & Cowan, 2001).

The Lateritic Plain subregion of the Gibson Desert Bioregion is characterized as a monotonous, gently undulating plain with few sandstone mesas. It comprises of solitic gravelly sandplains and laterised upland on flat-lying Jurassic and Cretaceous sandstones of Canning (Gunbarrel) Basin. Vegetation of this subregion is described as 'Carnegie Botanical District', which includes mulga parkland over *Triodia basedowii* on lateritic "buckshot" plains. Mixed shrub steppe of Acacia, Hakea and Grevillea over *Triodia pungens* occur on red sand plains and dune fields. Lateritic uplands support shrub steppe in the north and mulga scrub in the south. Quaternary alluvia associated with palaeo-drainage features support Coolibah woodlands over bunch grasses. The climate is described as arid, with a mean annual rainfall of 200mm with mainly summer rainfall (Graham, Barton & Cowan, 2001).

The Central subregion of the Great Victoria Desert Bioregion consists of salt lakes and major valley floors with lake derived dunes. The subregion comprises sand plains with extensive seif dunes running east west, occasional outcropping (breakaways) and quartzite hills which provide minor relief. Vegetation is primarily a Tree steppe of *Eucalyptus gongylocarpa*, Mulga and *E. youngiana* over hummock grassland dominated by *Triodia basedowii* on the aeolian sands. Acacia dominates colluvial soils with *Eremophila* and *Santalum* spp. Halophytes are confined to edges of salt lakes and saline drainage systems. The climate is arid, with summer and winter rain averaging 150 – 180mm (Barton & Cowan, 2001).

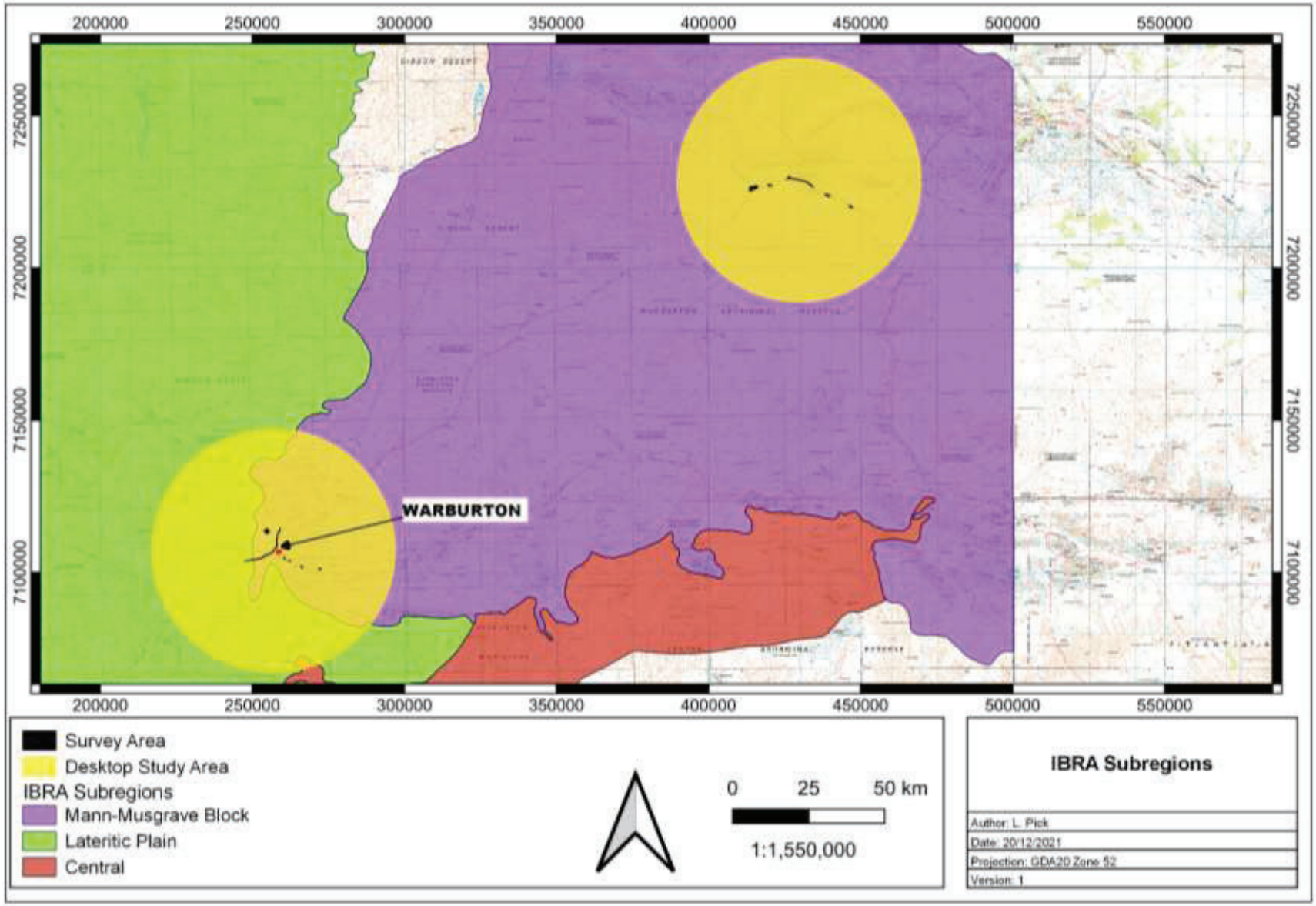


Figure 3-1: Map of IBRA subregions in relation to the desktop study area/ survey area

3.2 Soil Landscape Systems

Based on geographic information provided by Department of Primary Industries and Regional Development (DPIRD, 2018), the desktop study area is located within the Canning Province (11), Gunbarrel Province (12), Western Coastlands Province (19) and Western Desert Ranges Province (61). These Provinces are further divided into zones with the survey area located within the Kennedy Range Zone (192) of the Western Coastlands Province, Paterson Sandplain Zone (613) and Warburton Range Zone (619) of the Western Desert Ranges Province.

The Kennedy Range Zone (192) is characterised by dissected sandstone plateau with partial laterite cappings, covered by longitudinal dunes (Tille, 2006).

The Paterson Sandplain Zone (613) is characterised by sandplains and dunes with some wash plains on granitic and volcanic rocks of the Musgrave Complex. Soils include red sandy earths and red loamy earths with red deep sands. Vegetation comprises of spinifex grasslands with mulga (and other acacia) woodlands. This zone is located in the central-eastern Arid Interior between Giles Meteorological Station and the Blackstone and Warburton Ranges (and between Tomkinson Range and Baggaley Hill in the south) (Tille, 2006).

The Warburton Range Zone (619) is characterised by wash plains with associated hill and ranges on Musgrave Complex volcanic rocks, granite and gneiss. Soils include red loamy earths and red sandy earths with some red-brown hardpan shallow loams, calcareous shallow loams and stony soils. Vegetation comprises of Mulga woodlands with some spinifex grasslands. This zone is located in the central-eastern Arid Interior between Warburton and the Jamieson Range (Tille, 2006).

The soil landscape systems of the desktop study area/ survey area described in Table 3-1 and shown in Figure 3-2 (ASRIS, 2014).

Table 3-1: Soil landscape systems within the desktop study area/ survey area

Zone	Landscape System/ Mapping Unit	Description
112 (Great Sandy Desert Zone)	AB60	Plains with many dunes often relatively short and of irregular shape
	B40	Dune fields--longitudinal and ring dunes, some small clay pans
122 (Northwestern Great Victoria Desert Zone)	AB47	Plains and dunes--longitudinal and ring dunes with interdune corridors and plains; occasional salt pans
	AB48	Very gently undulating plain traversed by longitudinal dunes
	AY3	Broad undulating upland (tableland) elevated above the adjacent plains and dunes; scarps, pediments, mesas, and buttes are common
191 (North West Cape Ridges Zone)	AB47	Plains and dunes--longitudinal and ring dunes with interdune corridors and plains; occasional salt pans
	AY2	Dissected lateritic upland (tableland) of flat to hilly topography with shallow detrital valleys and pediment slopes
	B40	Dune fields--longitudinal and ring dunes, some small clay pans
192 (Kennedy Range Zone)	AB47	Plains and dunes--longitudinal and ring dunes with interdune corridors and plains; occasional salt pans
	AY2	Dissected lateritic upland (tableland) of flat to hilly topography with shallow detrital valleys and pediment slopes
	B40	Dune fields--longitudinal and ring dunes, some small clay pans
613 (Paterson Sandplain Zone)	BA21	Steep hills and ranges on sedimentary and some metamorphic, volcanic, and granitic rocks; bare rock outcrop is common; some gorges
	My109	Outwash plains and dissected fan and terrace formations flanking ranges of sedimentary and some metamorphic, volcanic, and granitic rocks

Zone	Landscape System/ Mapping Unit	Description
	My111	Extensive plains with a few low dunes; occasional low stony residuals
	My112	Extensive plains with numerous dunes which are often short and of irregular shape and orientation
616 (Rawlinson-Peterman Range Zone)	AB56	Plains extensively covered with longitudinal dunes; some hilly residuals with rock outcrops
	AB60	Plains with many dunes often relatively short and of irregular shape
	BA21	Steep hills and ranges on sedimentary and some metamorphic, volcanic, and granitic rocks; bare rock outcrop is common; some gorges
	My109	Outwash plains and dissected fan and terrace formations flanking ranges of sedimentary and some metamorphic, volcanic, and granitic rocks
	SV10	Shallow valleys with lakes, clay pans, salt pans, calcrete (kunkar) platforms, sand dunes, kopi dunes, and calcareous dunes
619 (Warburton Range Zone)	AB48	Very gently undulating plain traversed by longitudinal dunes
	BA21	Steep hills and ranges on sedimentary and some metamorphic, volcanic, and granitic rocks; bare rock outcrop is common; some gorges
	BA37	Ranges and hills mainly on granitic rocks; rock outcrop is extensive
	My109	Outwash plains and dissected fan and terrace formations flanking ranges of sedimentary and some metamorphic, volcanic, and granitic rocks
Note 1: Green shaded cells indicate soil landscape system boundaries within the survey area		

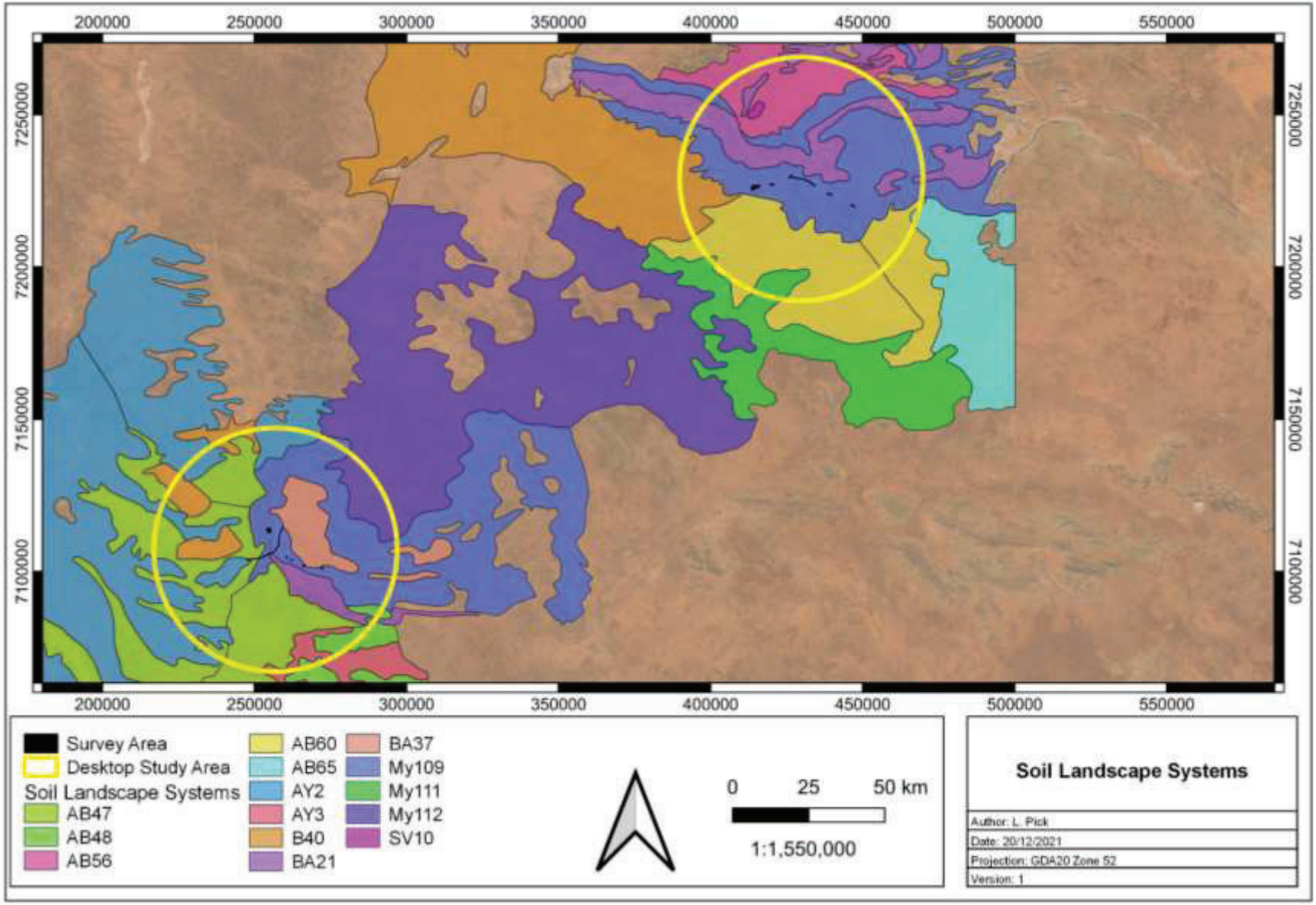


Figure 3-2: Map of soil landscape systems within the desktop study area/ survey area

3.3 Vegetation

The DPIRD GIS file (2018) indicates that the desktop study area and survey area is located within Pre-European Beard vegetation associations of the Central Ranges, Gibson Desert and Great Victoria Desert systems of the Mann-Musgrave Block, Lateritic Plain and Central subregions. The extent of these vegetation associations as specified in the *2018 Statewide Vegetation Statistics* (Government of Western Australia, 2019) is provided in Table 3-2 and shown in Figure 3-3.

Areas retaining less than 30% of their pre-European vegetation extent generally experience exponentially accelerated species loss, while areas with less than 10% are considered "endangered" (EPA, 2000).

Table 3-2: Beard vegetation associations within the desktop study area/ survey area

IBRA Subregion	Vegetation Association	Current extent (Ha)	Pre-European extent remaining (%)	% of current extent within DBCA managed lands	Vegetation Description (Beard, 1990)
Mann-Musgrave Block	Central Ranges 18^	1,074,955.07	99.93	0	Low woodland; mulga (*Acacia aneura*)
	Central Ranges 19	901,596.61	99.99	0	Low woodland; mulga between sandridges
	Central Ranges 39	404,689.10	100.00	0	Shrublands; mulga scrub
	Central Ranges 45	20,776.86	100.00	0	Shrublands; mallee scrub (Great Victoria Desert)
	Central Ranges 230^	1,179,612.88	100.00	0	Mosaic: Medium sparse woodland; desert oak between sand dunes / Hummock grasslands, grass steppe; hard spinifex, *Triodia basedowii*
	Central Ranges 233	118,009.47	100.00	0	Shrublands; *Acacia bivenosa*
	Central Ranges 234	4,479.00	100.00	0	Shrublands; *Acacia cyperophylla* scrub
Lateritic Plain	Gibson Desert 18^	47,901.58	100.00	0	Low woodland; mulga (*Acacia aneura*)
	Gibson Desert 96	694,323.83	100.00	2.51	Hummock grasslands, shrub steppe; acacia species (+ Grevillea) over *Triodia basedowii* often between sandridges
	Gibson Desert 139	6,992,391.68	100.00	16.14	Hummock grasslands, patchy shrub steppe; mulga over hard spinifex on laterite
Central	Great Victoria Desert 236	640,259.28	100.00	0	Hummock grasslands, shrub steppe; mulga and mallee (marble gum) over hard spinifex

Note 1: Green shaded cells indicate pre-European vegetation association boundaries within the survey area
Note 2: ^ indicates pre-European vegetation associations represented by vegetation types identified within the survey area

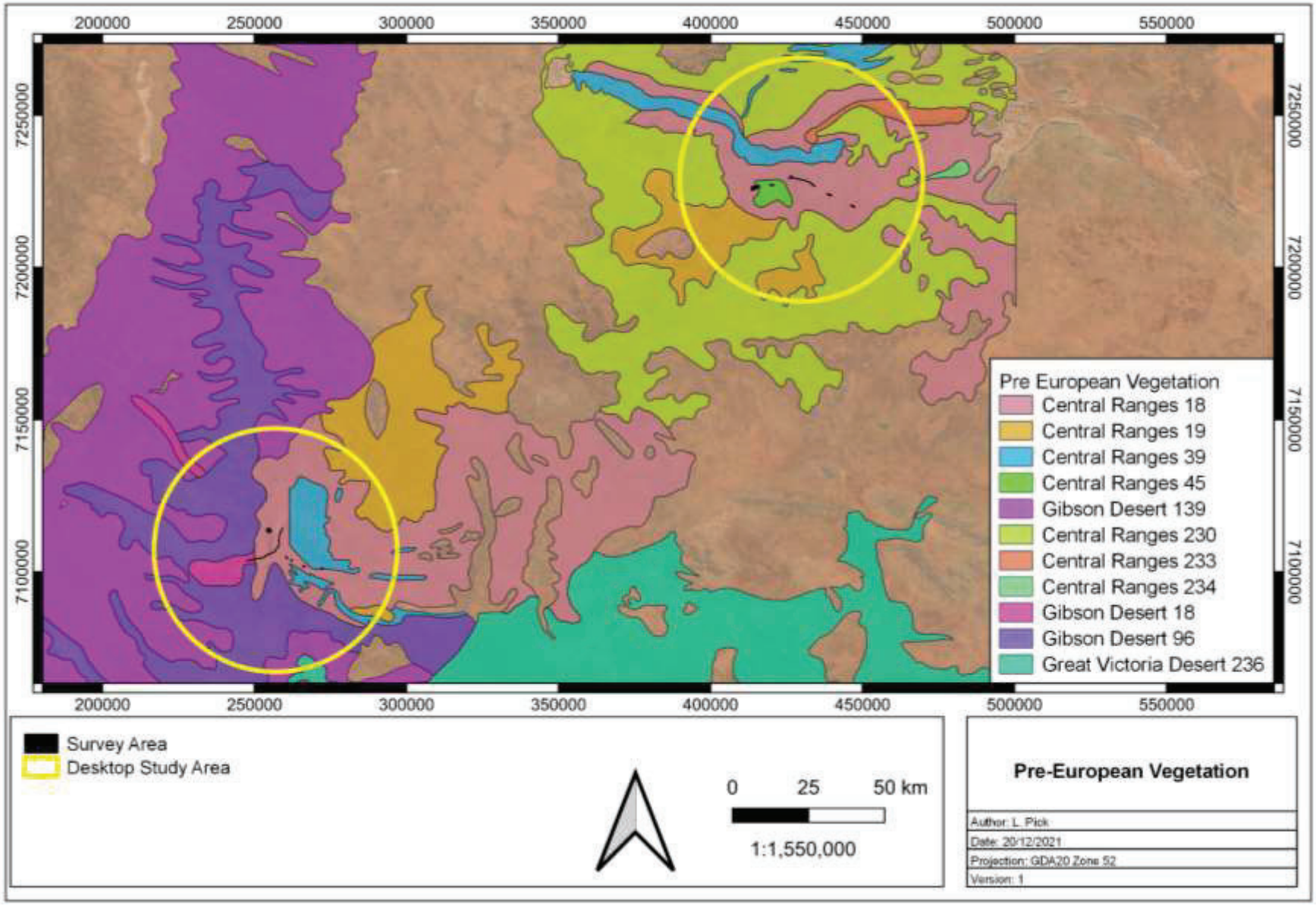
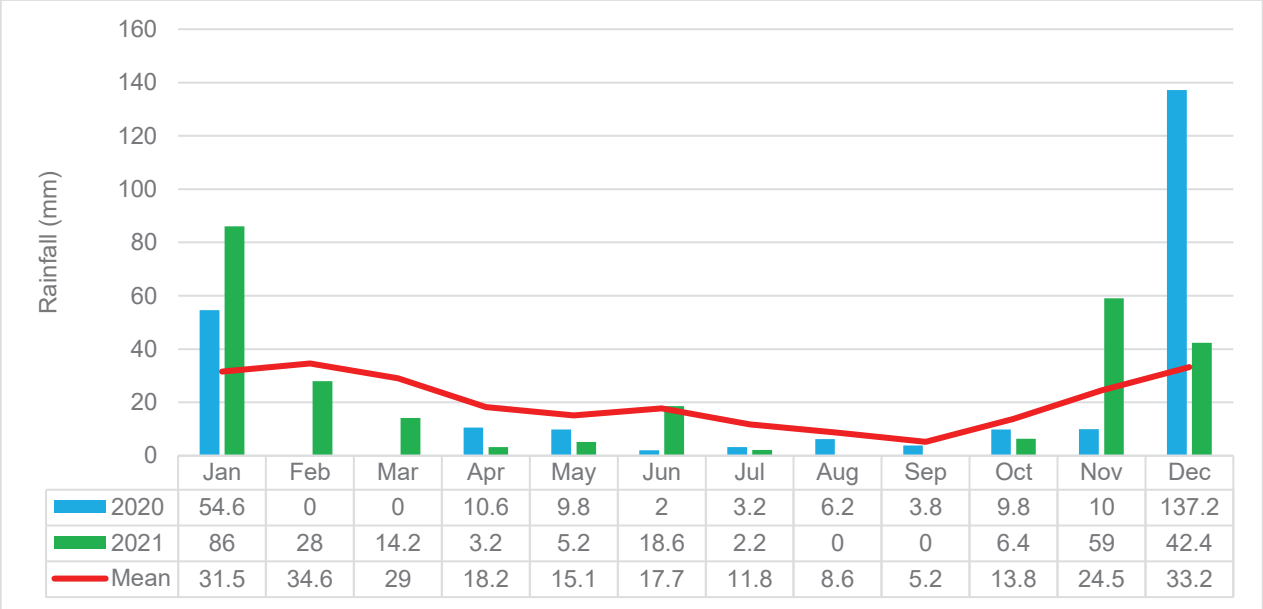


Figure 3-3: Pre-European vegetation associations within the desktop study area/ survey area

3.4 Climate

The climate of the Central Ranges, Gibson Desert and Great Victoria Desert Bioregions are characterised as arid with an annual rainfall of 200mm (Graham & Cowan, 2001; Graham, Barton & Cowan, 2001; Barton & Cowan, 2001). Rainfall data for the Warburton Airfield weather station (#13011) located adjacent to the Warburton section of the survey area is shown in Figure 3-4 (BoM, 2022). Rainfall received in the months preceding the survey was below average, however multiple annual species were present during the field survey.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2020	54.6	0	0	10.6	9.8	2	3.2	6.2	3.8	9.8	10	137.2
2021	86	28	14.2	3.2	5.2	18.6	2.2	0	0	6.4	59	42.4
Mean	31.5	34.6	29	18.2	15.1	17.7	11.8	8.6	5.2	13.8	24.5	33.2

Figure 3-4: Monthly rainfall (January 2020 to December 2021) for the Warburton Airfield weather station (#13011) (BoM, 2022)

3.5 Land Use

The dominant land uses of the Mann-Musgrave Block (CR1), Lateritic Plain (GD1) and Central (GVD2) subregions have been defined as Unallocated Crown Land (UCL) and Crown Reserves, Grazing, Conservation Reserves and Aboriginal Reserves (Graham & Cowan, 2001; Graham, Barton & Cowan, 2001; Barton & Cowan, 2001).

3.6 Hydrology

According to the Geoscience Australia database (2015) there are no inland waters that intersect the desktop study area or the survey area (Figure 3-5). There are numerous non-perennial/ intermittent drainage lines located within the desktop study area with multiple drainage lines intersecting the survey area, including Elder Creek (Figure 3-5).

The Baker Palaeochannel intersects though the desktop study area surrounding the Warburton survey area, covering an area of approximately 563,430ha (Figure 3-5).The Kadgo Palaeochannel intersects the southern section of the desktop study area surrounding the Warakurna survey area covering an area of approximately 1,140,843 ha (Figure 3-5). The van der Linden Palaeochannel intersects the eastern section of the desktop study area surrounding the Warburton survey area and western section of the desktop study area surrounding the Warakurna survey area. The van der Linden Palaeochannel covers an area of approximately 539,946 ha (Figure 3-5).

According to the Department of Water and Environmental Regulation (DWER) groundwater salinity database (DWER, 2018), groundwater salinities in majority of the desktop study area ranges from 1,000 mg/L to 3,000 mg/L with the Baker paleochannel recording a groundwater salinity >35,000 mg/L. Groundwater in the region is an intermediate and local flow systems in Palaeozoic rocks or Mesozoic intrusives. The survey area is located within the Canning Groundwater Province.

Groundwater Dependent Ecosystems (GDE) includes biological assemblages of species such as wetlands or woodlands that use groundwater either opportunistically or as their primary water source. For the purposes of this report, a GDE is defined as any vegetation community that derives part of its water budget from groundwater and must be assumed to have some degree of groundwater dependency. According to the BoM *Atlas of Groundwater Dependent Ecosystems* (BoM, 2021) database, there are no known aquatic or terrestrial GDEs located within the survey area; however, the GDE database (BoM, 2021) indicates the desktop study area has low potential to contain two terrestrial GDEs as listed in Table 3-3 and shown in Figure 3-5.

Table 3-3: Potential Terrestrial Groundwater Dependent Ecosystems within the survey area

Ecosystem Description	Potential Groundwater Dependence (BoM, 2021)
Shrublands; mulga scrub	Low Potential
Low woodland; mulga between sandridges	Low Potential

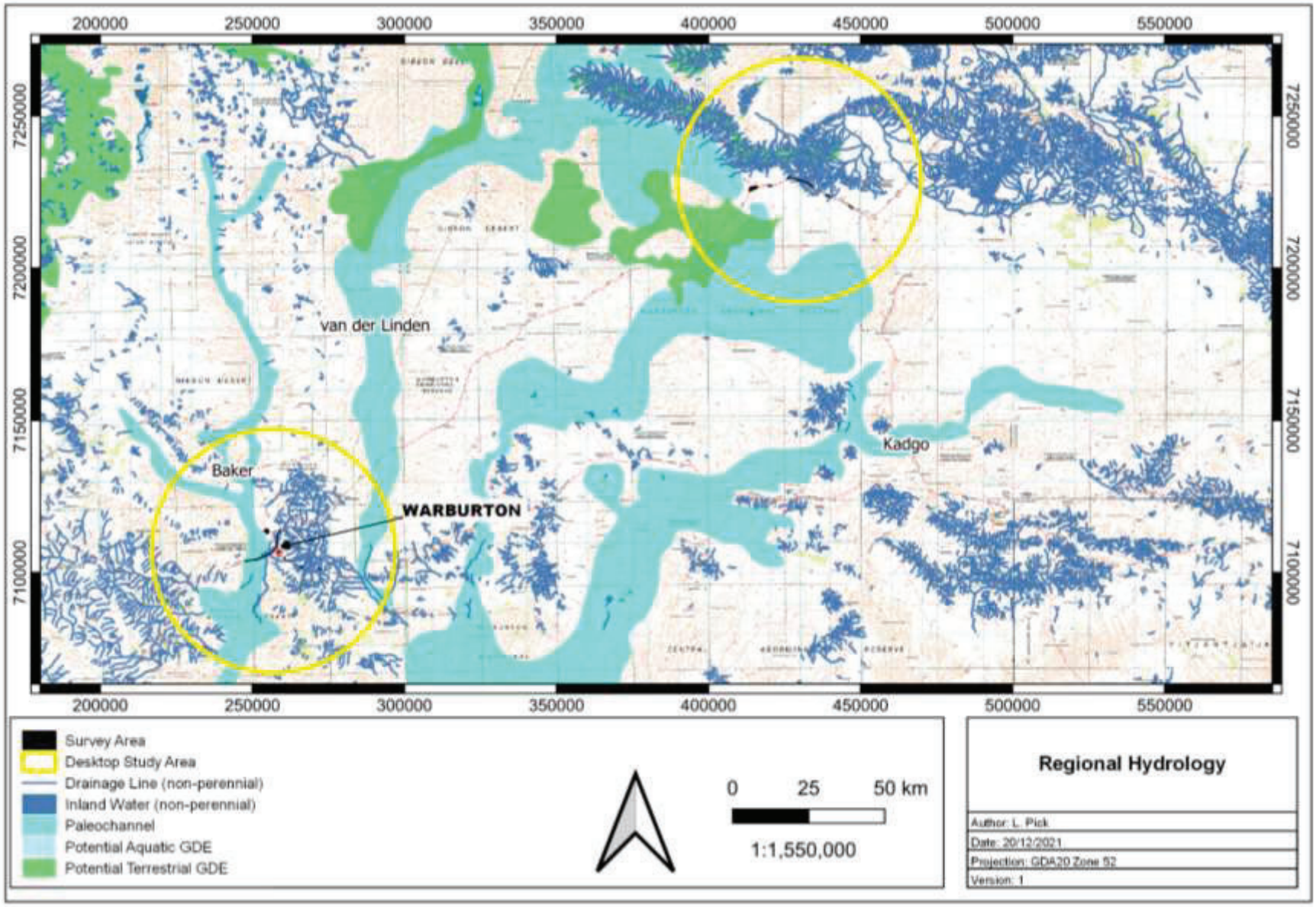


Figure 3-5: Regional hydrology of the desktop study area/ survey area

4 SURVEY METHODOLOGY

4.1 Desktop Assessment

Prior to the field assessment a literature review was undertaken of previous flora and fauna assessments conducted within the local region. Documents reviewed included:

- Botanica Consulting (2011). Level 1 Yamarna Proposed Haul Road Flora and Vegetation Survey.
- Botanica Consulting (2012). Level 2 Flora and Vegetation Survey, Yamarna Project.
- Botanica Consulting (2014a). Level 1 Flora and Vegetation Survey, Gruyere Project.
- Botanica Consulting (2014b). Level 1 Flora and Vegetation Survey, Murrin Murrin to Sunrise Dam Gold Mine Gas Pipeline.
- Botanica Consulting (2015). Level 2 Flora and Vegetation Survey of the Gruyere Project.
- Botanica Consulting (2017). Level 1 Flora & Fauna Survey Yamarna Gas Pipeline Project.
- Botanica Consulting (2020). Flora, Vegetation and Fauna Assessment of the Great Central Road Stage 1 Biological Survey. Prepared for Main Roads Western Australia.
- Harewood, G. (2011). Terrestrial Fauna Survey (Level 1) of Yamarna Gold Project (Central Bore, Attila, Alaric, Haul Road and Khan North). Unpublished report for Gold Road Resources. September 2011.
- Harewood G. (2014). Fauna Assessment (Level 1) Gruyere Project. Unpublished report for Gold Road Resources Ltd. July 2014.
- Keith Linbeck and Associates (2012). Fauna Assessment (Level 2) Yamarna Project. Unpublished report for Gold Road Resources. October 2012.

Searches of the following databases were undertaken to aid in the compilation of a list of flora, vegetation and fauna taxa within the survey area:

- Department of Biodiversity, Conservation and Attractions (DBCA) Priority/ Threatened Flora Database Search (DBCA, 2021a),
- DBCA Priority/ Threatened Fauna Database Search (DBCA, 2021b),
- DBCA Priority/ Threatened Ecological Communities Database Search (DBCA, 2021c)
- DBCA NatureMap Database (DBCA, 2021d); and
- Department of Agriculture, Water and Environment (DAWE) Protected Matters search tool (DAWE, 2021a).x

The NatureMap and Protected Matters Searches were conducted for an area encompassing a 40 km radius of the centre coordinates; -26.138 S 126.575 E (Warburton) and -25.054 S 128.299 E (Warakurna). It should be noted that these lists are based on observations from a broader area than the assessment area (40 km radius) and therefore may include taxa not present. The databases also often include very old records that may be incorrect or in some cases the taxa in question have become locally or regionally extinct.

Information from these sources should therefore be taken as indicative only and local knowledge and information also need to be taken into consideration when determining what actual species may be present within the specific area being investigated.

The significance of flora and fauna taxa was assessed using data from the following sources:

- *Environment Protection and Biodiversity Conservation* (EPBC) *Act 1999*. Administered by the Australian Government (DAWE);
- *Biodiversity Conservation* (BC) *Act 2016*. Administered by the WA Government (DBCA);
- Red List produced by the Species Survival Commission (SSC) of the World Conservation Union (also known as the IUCN Red List – the acronym derived from its former name of the

International Union for Conservation of Nature and Natural Resources). The Red List has no legislative power in Australia but is used as a framework for State and Commonwealth categories and criteria; and

- Priority Flora/ Fauna list. A non-legislative list maintained by DBCA for management purposes (fauna list released 10th April 2019; flora list released 5th December 2018).

The EPBC Act also requires the compilation of a list of migratory species that are recognised under international treaties including the:

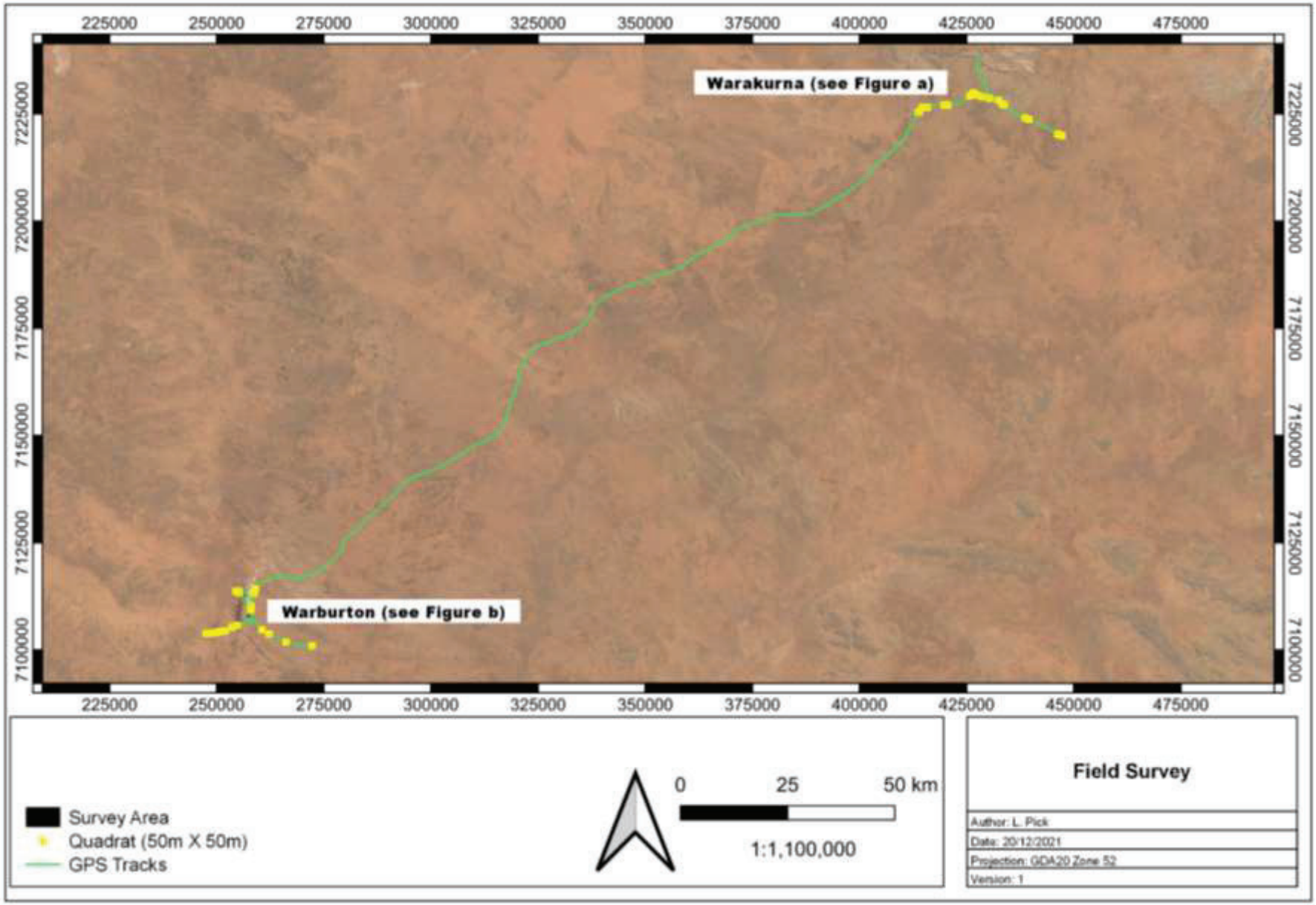
- Japan Australia Migratory Bird Agreement 1981 (JAMBA)[2];
- China Australia Migratory Bird Agreement 1998 (CAMBA);
- Republic of Korea-Australia Migratory Bird Agreement 2007 (ROKAMBA); and
- Bonn Convention 1979 (The Convention on the Conservation of Migratory Species of Wild Animals).

Most but not all migratory bird species listed in the annexes to these bilateral agreements are protected in Australia as Matters of National Environmental Significance (MNES) under the EPBC Act. Descriptions of significant species and communities are provided in Appendix A.

4.2 Flora and Vegetation Field Assessment

Botanica conducted a detailed flora and vegetation survey and targeted flora survey from the 31st of October to 2nd November 2021. The survey area was traversed by two people via 4WD, ATV and on foot (Figure 4-1).

[2] Most but not all species listed under JAMBA are also specially protected under Specially Protected Species of the BC Act.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Warakurna (see Figure a)
Warburton (see Figure b)
Survey Area
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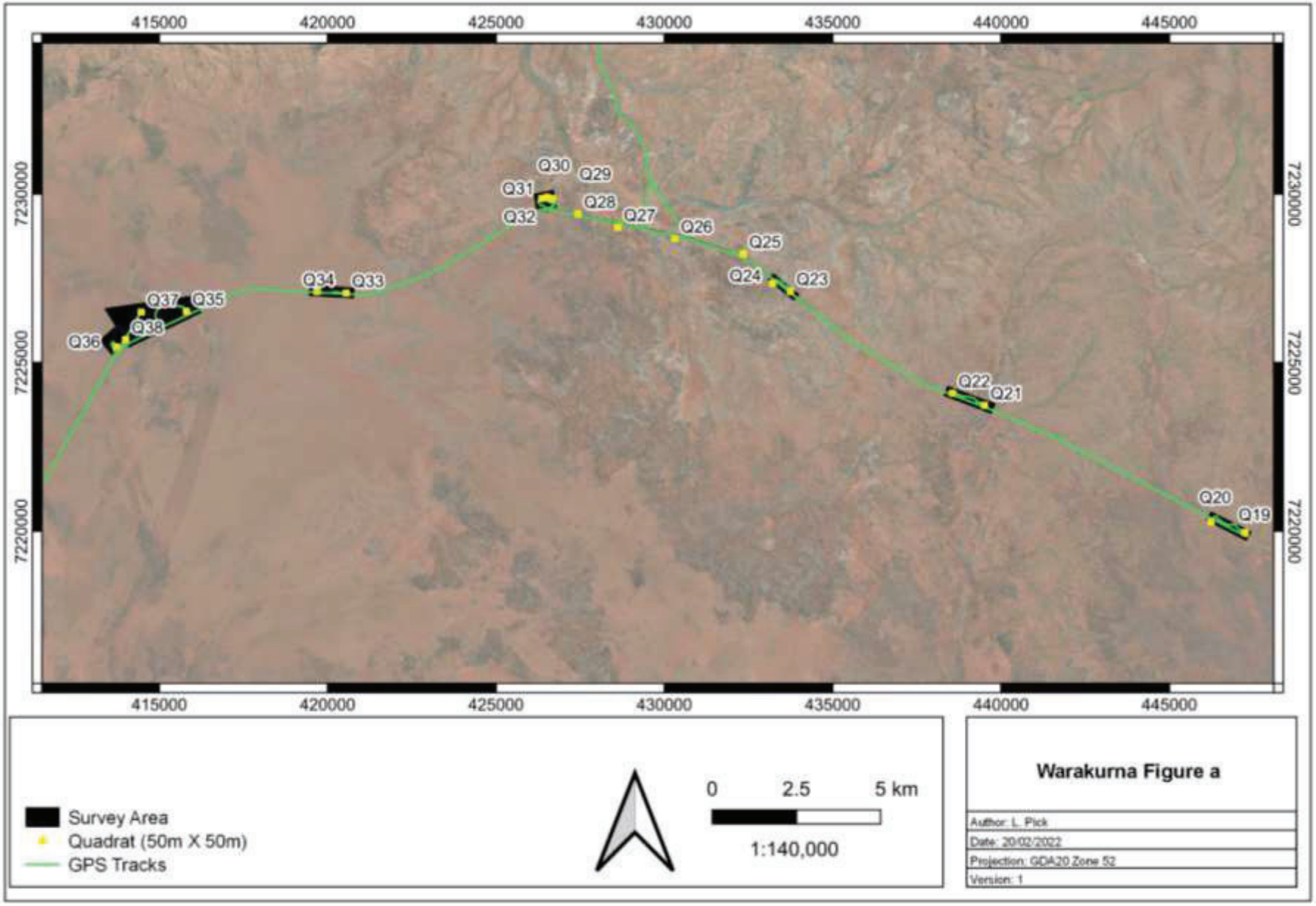
Field Survey
Author: L. Pick
Date: 20/12/2021
Projection: GDA20 Zone 52
Version: 1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Quadrat (50m X 50m)
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Warakurna Figure a
Author: L. Pick
Date: 20/02/2022
Projection: GDA20 Zone 52
Version: 1

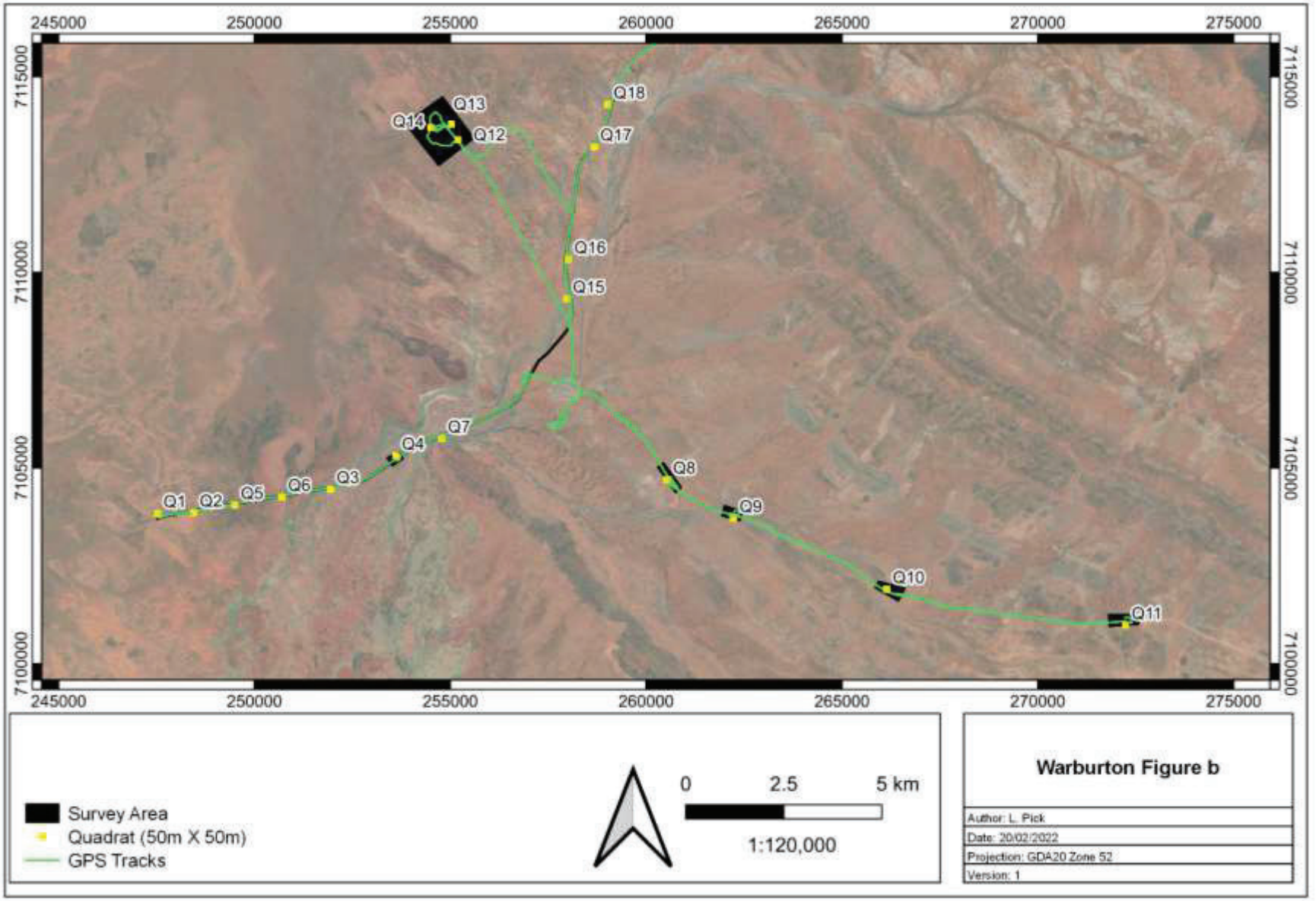


Figure 4-1: Quadrat locations, survey area boundary and GPS tracks traversed throughout the survey area

4.2.1 Vegetation Mapping

Prior to the commencement of field work, aerial photography was inspected and obvious differences in the vegetation assemblages were identified. The different vegetation types identified were then inspected during the field survey to assess their validity. A handheld GPS unit was used to record the coordinates of the boundaries between vegetation types.

At each sample point, the following information was recorded:

- GPS location;
- Photograph of vegetation;
- Dominant taxa for each stratum (including height and percentage cover of dominant taxa);
- All vascular taxa (including annual taxa);
- Landform classification;
- Vegetation condition rating;
- Collection and documentation of unknown plant specimens; and
- Collection of flora of significance if encountered.

Vegetation types were classified in accordance with the NVIS Level V-Association classification.

4.2.2 Detailed Flora and Vegetation Survey

Thirty-eight 50 m X 50 m quadrats were established within the survey area (Figure 4-1 and Appendix F) in accordance with the recommended quadrat size specified in the Environmental Protection Authority (EPA) Guidelines for the Central Ranges, Gibson Desert and Great Victoria Desert Bioregions. The quadrats were established by inserting metal pickets into the NW corner, and measuring the length of the resultant boundaries to verify the quadrats were 50 m X 50 m (square quadrats). The objective was to have at least three quadrats per vegetation type to capture the floristic variations within the survey area (in accordance within the EPA Guidelines).

Following their establishment and boundary verification, the NW corner of each quadrat was recorded by GPS (Appendix F) and three photographs of the quadrat were taken from the NW corner (Appendix H). All vascular plants within the quadrat were recorded (Appendix G). This included recording of dominant taxa from the upper, middle and lower stratum, and sampling of all unknown taxa. Unknown taxa were identified using Botanica's own reference herbarium and relevant taxonomic keys or by a taxonomic consultant. Data on level of disturbance, presence of coarse fragments on surface, topographical position, elevation, aspect, percentage litter, percentage bare ground, percentage surface rock (bedrock and surface deposits), soil types (colour, profile, field texture and surface type), and vegetation structure were collected from each quadrat (Appendix G). Methods of recording data from these quadrats largely follow those outlined in CSIRO's *Australian Soil and Land Survey Field Handbook* (McDonald *et al.* 1998) and in accordance with EPA Guidelines (2016). Presence/absence data of taxa from sample sites were used to compile the representative vegetation types.

4.2.3 Targeted Flora Survey

A targeted search for Threatened and Priority flora was conducted, including assessing the location of any DBCA records of Priority flora within the survey area. Potential habitats for Threatened and Priority Flora were searched on foot (meandering through suitable habitat within the survey area) by two Botanica staff members to identify and record the locations of Threatened and Priority flora. Any locations of Threatened and Priority flora were recorded using a hand-held GPS and a simple plant count (not differentiated between juvenile/mature plants, flowering or non-flowering plants) was conducted for each record.

Flora of significance identified during the literature review and database searches as previously being recorded in the general area were assessed and ranked for their likelihood of occurrence within the survey area. The rankings and criteria used were:

- Unlikely: Area is outside of the currently documented distribution for the species/no suitable habitat (type, quality and extent) was identified as being present during the field/desktop study.
- Possible: Area is within the known distribution of the species in question and habitat of at least marginal quality was identified as being present during the field/desktop study, supported in some cases by recent records being documented from within or near the area.
- Known to Occur: The species in question was positively identified as being present during previous field surveys.

4.2.4 Flora Identification

Unknown specimens collected during the survey were identified with the aid of samples housed at the Botanica Herbarium and the Western Australian Herbarium.

4.3 Data Analysis Tools

Following field assessments, vegetation types and condition were mapped using the GIS program QGIS, and the hectare area/ percentage area of each vegetation type and condition within the survey area was calculated. Spatial maps illustrating the location of vegetation types and any significant flora/ vegetation and fauna were generated using QGIS.

4.3.1 PATN Analysis

The PATN software package was used to assess the similarities/ dissimilarities between quadrats based on presence/absence of species. Ten annual taxa were recorded during the survey which were excluded from the analysis. Singleton taxa were included in the analysis (24 taxa). A total of 66 taxa recorded within the quadrats were included in the analysis.

The analysis produced a quantitative estimate of the relationship between species composition of each quadrat. The classifications were based upon a Bray-Curtis association matrix using a flexible Unweighted Pair Group Arithmetic Mean (UPGMA) method (with a beta value of -0.1) which standardises the data enabling the analysis to be completed. Semi-strong hybrid (SSH) ordination of the quadrat is then undertaken to show spatial relationships between groups and to elucidate possible environmental correlates with the classification.

The analysis also produced a stress value which is a measure of the ‘strength’ of the analysis (i.e., how well the quadrats are grouped together into the appropriate floristic groups). The lower the stress value the greater the strength of the analysis with a value of less than 0.3 showing that the analysis appropriately grouped quadrats. A stress value greater than 0.3 suggests that the analysis was unable to group quadrats appropriately due to extraneous variables (i.e., other factors influencing differences in floristic groups other than species composition e.g., fire, clearing disturbance etc.).

4.3.2 EstimateS

EstimateS software was used to estimate species richness present using the Chao2 richness estimator. For any number of samples, the estimator uses the existing pattern of species accumulation to estimate the true number of species at a site. The estimators tend to under-estimate species number when sample size is small, hence the estimated number of true species can be seen to increase with sample size. This software was also used to compute Coleman rarefaction curves estimates which were used to calculate species accumulation curves.

4.4 Terrestrial Fauna Field Assessment

Botanica conducted a basic fauna survey of the survey area from the 31st of October to 2nd November 2021. The survey area was traversed by two people via 4WD and on foot (Figure 4-1). Fauna habitat types were identified across the survey area based on broad major vegetation groups and associated landform. A handheld GPS unit was used to record the coordinates of the boundaries between fauna habitats and each habitat was photographed (see Table 5-15).

The main aim of the fauna habitat assessment was to determine the likelihood of species of significance utilising habitat within the survey area. The habitat information obtained was also used to aid in finalising the overall potential fauna list.

Available information on the habitat requirements of the species of significance listed as possibly occurring in the area (determined from the desktop assessment) was researched. During the field survey, the habitats within the survey area were assessed and specific elements identified, if present, to determine the likelihood of listed Threatened and Priority species utilising habitat within the survey area. Opportunistic observations of fauna species were made during all field survey work.

Fauna of significance identified during the literature review and database searches as previously being recorded in the general area were assessed and ranked for their likelihood of occurrence within the survey area. The rankings and criteria used were:

- Would Not Occur: There is no suitable habitat for the species in the survey area and/or there is no documented record of the species in the general area since records have been kept and/or the species is generally accepted as being locally/regionally extinct (supported by a lack of recent records).

- Locally Extinct: Populations no longer occur within a small part of the species natural range, in this case within 10 or 20 km of the survey area. Populations do however persist outside of this area.

- Regionally Extinct: Populations no longer occur in a large part of the species natural range, in this case within the goldfields region. Populations do however persist outside of this area.

- Unlikely to Occur: The survey area is outside of the currently documented distribution for the species in question, or no suitable habitat (type, quality and extent) was identified as being present during the field assessment. Individuals of some species may occur occasionally as vagrants/transients especially if suitable habitat is located nearby but the site itself would not support a population or part population of the species.

- Possibly Occurs: Survey area is within the known distribution of the species in question and habitat of at least marginal quality was identified as likely to be present during the field survey and literature review, supported in some cases by recent records being documented in literature from within or near the survey area. In some cases, while a species may be

classified as possibly being present at times, habitat may be marginal (e.g. poor quality, fragmented, limited in extent) and therefore the frequency of occurrence and/or population levels may be low.

- Known to Occur: The species in question has been positively identified as being present (for sedentary species) or as using the survey area as habitat for some other purpose (for non-sedentary/mobile species) during field surveys within or near the survey area. This information may have been obtained by direct observation of individuals or by way of secondary evidence (e.g. tracks, foraging debris, scats). In some cases, while a species may be classified as known to occur, habitat may be marginal (e.g. poor quality, fragmented, limited in extent) and therefore the frequency of occurrence and/or population levels may be low.

4.5 Personnel Involved

Table 4-1: Personnel involved with the flora, vegetation and fauna survey/ reporting

Staff Member	Position/ Qualifications	Experience	Tasks conducted during survey
Jim Williams	Environmental Consultant/Botanist/ Director (Diploma of Horticulture)	30 years experience across WA	Project Management (Lead Botanist). Flora and vegetation survey- identifying flora species within quadrats and opportunistic flora observations. Identifying and recording vegetation types. Review of report.
Aidan Williams	Zoologist (BSc Conservation Biology)	8 years experience across WA	Project Management (Lead Zoologist) Fauna survey-identifying fauna species observed and recording fauna habitats. Fauna data entry/ analysis and reporting.
Lauren Pick	Senior Environmental Consultant (BSc Conservation Biology)	13 years experience across WA	Reporting-flora and vegetation data entry/ analysis and reporting. Spatial mapping (flora, vegetation and fauna)

4.6 Scientific Licences

Table 4-2: Scientific Licences of Botanica Staff coordinating the survey

Licensed Staff	Permit Number	Valid
Jim Williams	FB20000108 (licence to take flora for scientific purposes)	27/05/2019-27/05/2022

4.7 Survey Limitations and Constraints

It is important to note that flora/ vegetation and fauna surveys will entail limitations notwithstanding careful planning and design. Potential limitations are listed in Table 4-3.

Table 4-3: Limitations and constraints associated with the flora/ vegetation and fauna survey

Variable	Potential Impact on Survey	Details
Access problems	Not a constraint	The survey was conducted via 4WD, ATV and on foot. Access was readily available with the Great Central Road extending through the survey area.

Variable	Potential Impact on Survey	Details
Competency/ Experience	Not a constraint	The Botanica personnel that conducted the survey were regarded as suitably qualified and experienced. **Coordinating Staff**: Jim Williams (Botanist) and Aidan Williams (Zoologist) **Field Staff**: Jim Williams (Botanist) and Aidan Williams (Zoologist) **Data Interpretation**: Jim Williams (Botanist), Aidan Williams (Zoologist), Greg Harewood (Zoologist) and Lauren Pick (Senior Environmental Consultant).
Timing of survey, weather & season	Minor constraint	Fieldwork was conducted in October-November 2021, outside of the EPA recommended approximate timing (i.e. six-eight weeks post wet season) for the Central Ranges, Gibson Desert and Great Victoria Desert Bioregions. Rainfall received in the months preceding the survey was below average. Limited flowering material was available however multiple annual species were present during the survey.
Area disturbance	Not a constraint	The majority of the survey area was in very good condition and comprised of native vegetation. Disturbance in the area was a result of road siding of the Great Central Road and proximity to communities.
Survey Effort/ Extent	Not a constraint	Survey intensity was appropriate for the size/significance of the area with a detailed flora survey and basic fauna survey completed to identify vegetation types/ fauna habitats and significant flora, fauna and vegetation. A targeted search to identify significant flora was conducted within potential habitats within the survey area.
Availability of contextual information at a regional and local scale	Not a constraint	Significant flora database searches provided by the DBCA were used to identify any potential locations of Threatened/Priority flora species. BoM, DWER, DPIRD, DBCA and DAWE databases were reviewed to obtain appropriate regional desktop information on the biophysical environment of the local region. Botanica has conducted a number of surveys within Coolgardie Bioregion and was also able to obtain information about the area from previous research conducted within the area. Results of previous assessments in the local area were reviewed to provide context on the local environment.
Data Analysis	Minor constraint	Botanica staff conducting the PATN statistical analyses are not statistical analysts and have basic statistics training. These analyses were used to provide basic information on the relationships between vegetation communities delineated in the field.
Completeness	Not a constraint	In the opinion of Botanica, the survey area was covered sufficiently in order to identify vegetation assemblages. Survey work was conducted during optimal flowering period for majority of taxa (Spring). Despite being conducted outside EPAs recommended approximate timing for primary surveys for the Central Ranges, Gibson Desert and Great Victoria Desert Bioregions, all observed flora were able to be identified to species level and multiple annual species present. The vegetation associations for this study were based on visual descriptions of locations in the field. The distribution of these vegetation associations outside the study area is not known, however vegetation associations identified were categorised via comparison to vegetation distributions throughout WA given on NVIS (DotEE, 2017).

5 RESULTS

5.1 Desktop Assessment

5.1.1 Flora/ Vegetation

According to the results of the NatureMap search (DBCA, 2021d), a total of 335 flora taxa have been recorded within a 40 km radius of the survey area. Dominant genera include *Acacia, Eremophila, Senna* and *Eucalyptus.* Results of database searches identified nine introduced taxa as potentially occurring within a 40 km radius of the survey area. None of these taxa are listed as a Declared Pest under the BAM Act and a Weed of National Significance (WoNS) by the Commonwealth DAWE.

Table 5-1: Introduced flora potentially occurring within 40 km of the survey area

Taxon	Common Name
Brassica tournefortii	Mediterranean Turnip
Carrichtera annua	Wards Weed
Cenchrus ciliaris	Buffel Grass
Cenchrus echinatus	Burr Grass
Eragrostis barrelieri	
Malvastrum americanum	Spiked Malvastrum
Rumex vesicarius	Ruby Dock
Sisymbrium orientale	Indian Hedge Mustard
Tribulus terrestris	Caltrop

The results of the literature review, combined search of the DBCA's Flora of Conservation Significance databases (DBCA, 2021a), NatureMap search (DBCA, 2021d) and DAWE protected matters search (DAWE, 2021a) indicated that no Threatened Flora or Priority Flora species were previously recorded within the survey area. As listed in Table 5-2 below, one Threatened flora and 11 Priority flora were listed by the databases as potentially occurring within a 40 km radius of the survey area (map of flora locations provided in Appendix B).

Table 5-2: Likelihood of occurrence for Threatened and Priority flora within the survey area

Taxon	EPBC Act	BC Act	DBCA Priority Rating	Habitat Description (WAHERB, 2021; DBCA, 2021a)	Comments	Likelihood of Occurrence
Comesperma viscidulum[1,2]			P4	No description available	Previously recorded within 10 km of survey area, habitat may be present	Possible
Dicrastylis subterminalis[1,2]			P1	Red sand. By creeklines.	Previously recorded ~30 km north-east of survey area, habitat may be present	Possible
Fuirena nudiflora[1,2]			P3	Sand. Swamps, creek beds.	Previously recorded within 12 km of survey area, habitat may be present	Possible
Goodenia gibbosa[1,2]			P3	Sandy soils.	Previously recorded within 10 km of survey area, habitat may be present	Possible
Indigofera gilesii[1,2]			P3	Pebbly loam. Amongst boulders & outcrops, hills.	Previously recorded within 5 km of survey area, habitat may be present	Possible
Isotropis winneckei[1,2]			P1	Skeletal soils. Sandstone ranges, rocky rises.	Previously recorded within 10 km of survey area, habitat may be present	Possible
Prostanthera centralis[1,2]			P3	Gravelly soils, red sand. Rocky quartzite scree slopes.	Previously recorded within 10 km of survey area, habitat may be present	Possible
Ptilotus royceanus[1,2]			P1	Rocky walls & cliffs.	Previously recorded within 20 km of survey area, habitat unlikely to be present	Unlikely
Schoenus centralis[1,2]			P1	Red sand. Rocky creek beds, seepage areas.	Previously recorded within 20 km of survey area, habitat unlikely to be present	Unlikely
Seringia exastia[1,2]	CR	CR		Grows in pindan (red soil) heathland on almost flat land and associated vegetation includes *Triodia schinzii* and scattered trees of *Acacia colei, Eucalyptus dampieri* and several other common species with a variety of intermediate sized shrubs	Previously recorded within 10 km of survey area, habitat may be present	Possible
Tephrosia sp. Central (P.K. Latz 17037) [1,2]			P3	In creek bed, by rocky outcrop.	Previously recorded within 10 km of survey area, habitat may be present	Possible
Thysanotus sp. Desert East of Newman (R.P. Hart 964) [1,2]			P2	Red-brown loamy sand or red sand, sometimes silty. Sand plain, pisolitic buckshot plain.	Previously recorded ~30 km west of survey area, habitat may be present	Possible

Note: [1] sourced from NatureMap database; [2] sourced from DBCA spatial database search

The results of the DBCA's Priority/ Threatened Ecological Communities Database Search (DBCA, 2021c) identified no Threatened Ecological Communities (TEC) or Priority Ecological Communities (PEC) as occurring within the survey area or within a 100 km radius of the survey area.

5.1.2 Fauna

With respect to native vertebrate fauna, 3 amphibians, 21 mammals, 99 bird and 55 reptile species have previously been recorded in the wider area, based on database search results (provided in Appendix J), some of which have the potential to occur in or utilise sections of the survey area at times. Six species of introduced animals could also frequent the area as listed in Table 5-3.

Table 5-3: Introduced fauna potentially occurring within 40 km of the survey area

Taxon	Common Name
Camelus dromedarius	Camel
Canis lupus familiaris	Domestic Dog
Felis catus	Cat
Mus musculus	House Mouse
Oryctolagus cuniculus	Rabbit
Vulpes vulpes	Fox

Of the 178 native vertebrate animals that are listed as potentially occurring, thirteen are considered to be Threatened or in need of special protection under State and/or Commonwealth law. These particular species are discussed in further detail in **Section 5.2.9**.

5.2 Field Assessment

5.2.1 Vegetation Types

Six vegetation types (not including cleared vegetation) were identified within the survey area. These vegetation types were located within three landform types and comprised of five major vegetation groups, which were represented by a total of 20 families, 43 genera and 82 taxa (inclusive of 79 flora taxa recorded within the quadrats and three opportunistic flora records). The total species list is provided in Appendix C. Maps showing the vegetation types present in the survey area are provided in Figure 5-1 and Figure 5-2. More detailed vegetation type maps are provided in Appendix D. A summary of vegetation types is presented in Table 5-4.

Table 5-4: Summary of vegetation types within the survey area

Landform	NVIS Major Vegetation Group	Vegetation Type	Vegetation Code	Quadrat	Area (ha)	Area (%)
Clay-Loam Plain	Acacia Forest and Woodland (MVG 6)	Low woodland of *Acacia aptaneura/ A. incurvaneura/ A. paraneura* over mid shrubland of *Eremophila latrobei/ Ptilotus obovatus/ Senna artemisioides* and tussock grassland of *Aristida contorta/ Eragrostis eriopoda* on clay-loam plain	CLP-AFW1	Q1, Q5, Q8, Q11, Q12, Q13, Q16, Q17, Q18, Q19, Q24, Q25, Q27, Q30, Q38	237	30.4
		Low woodland of *Acacia caesaneura/ A. incurvaneura* over mid shrubland of *Eremophila latrobei/ Senna artemisioides* and low shrubland of *Ptilotus obovatus* on clay-loam plain	CLP-AFW2	Q20, Q21, Q22, Q23	67	8.6
	Other Forest and Woodland (MVG 10)	Mid woodland of *Corymbia opaca* over low woodland of *Acacia incurvaneura* and tussock grassland of *Aristida contorta* on clay-loam plain	CLP-OFW1	Q6, Q9, Q10, Q34	48	6.2
Open Depression	Eucalypt Woodland (MVG 5)	Mid woodland of *Eucalyptus camaldulensis* subsp. *obtusa* over mid shrubland of *Acacia victoriae* subsp. *victoriae/ Eremophila longifolia* and tussock grassland of *Cenchrus ciliaris* in drainage line	OD-EW1	Q7, Q15	2	0.2
Sandplain	Acacia Forest and Woodland (MVG 6)	Low woodland *Acacia incurvaneura/ A. pruinocarpa* over *Eremophila latrobei/ Acacia paraneura* and hummock grassland of *Triodia basedowii/ T. melvillei* on sandplain	SP-AFW1	Q2, Q3, Q4, Q14, Q26, Q28, Q29, Q31, Q32	121	15.5
	Mallee Woodland and Shrubland (MVG 13)	Mid mallee woodland of *Eucalyptus gamophylla* over low woodland of *Acacia paraneura* and hummock grassland of *Triodia basedowii* on sandplain	SP-MWS1	Q33, Q35, Q36, Q37	213	27.3
N/A	N/A	Cleared Vegetation	CV	N/A	92	11.8
TOTAL				**38**	**779**	**100**

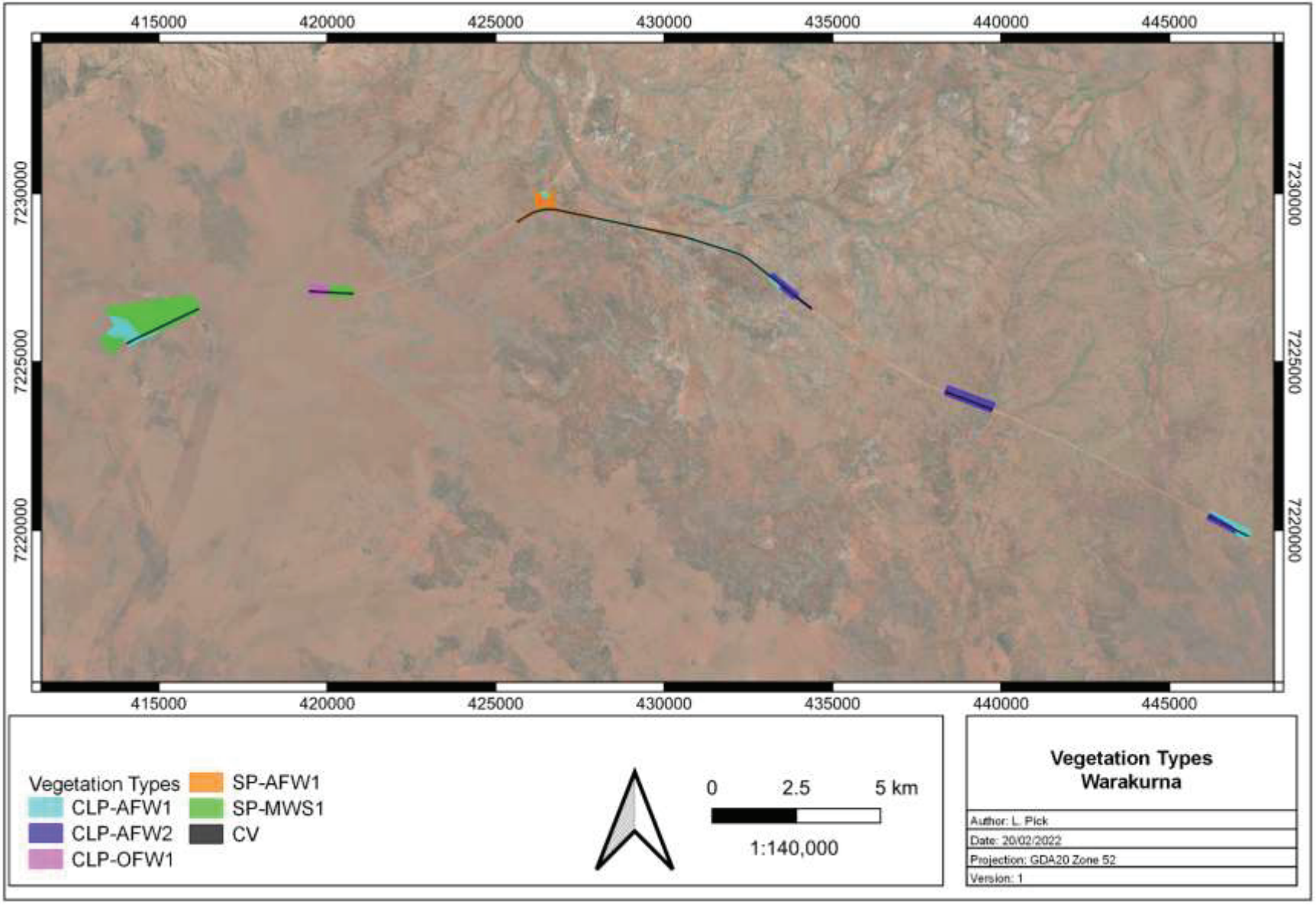


Figure 5-1: Vegetation types within the survey area-Warakurna

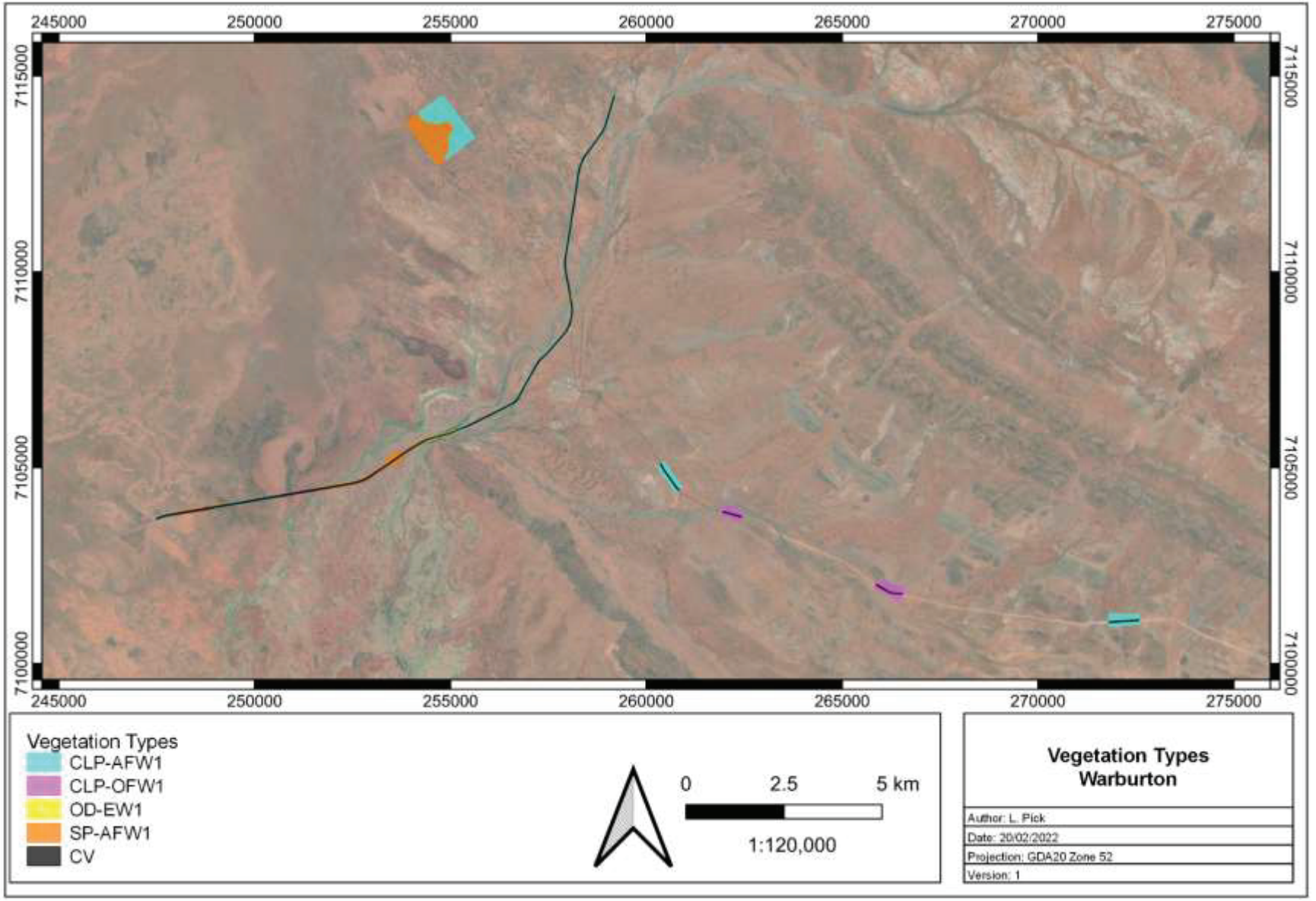


Figure 5-2: Vegetation types within the survey area-Warburton

Clay-Loam Plain: Acacia Forest and Woodland

5.2.1.1 Low woodland of *Acacia aptaneura/ A. incurvaneura/ A. paraneura* over mid shrubland of *Eremophila latrobei/ Ptilotus obovatus/ Senna artemisioides* and tussock grassland of *Aristida contorta/ Eragrostis eriopoda* on clay-loam plain (CLP-AFW1)

The total flora recorded within this vegetation type was represented by a total of 14 families, 27 genera and 48 taxa (Plate 1 and Appendix C). Dominant taxa from the vegetation type are shown in Table 5-5. According to the NVIS, this vegetation type is best represented by the MVG 6 – Acacia Forest and Woodland (DotEE, 2017).

Table 5-5: Vegetation assemblage for Low woodland of *Acacia aptaneura/ A. incurvaneura/ A. paraneura* over mid shrubland of *Eremophila latrobei/ Ptilotus obovatus/ Senna artemisioides* and tussock grassland of *Aristida contorta/ Eragrostis eriopoda* on clay-loam plain

Life Form/Height Class	Canopy Cover	Dominant Taxa
Tree <10m	10-30%	*Acacia aptaneura* *Acacia incurvaneura* *Acacia paraneura*
Shrub 1-2m	30-70%	*Eremophila latrobei* subsp. *glabra* *Eremophila latrobei* subsp. *latrobei* *Ptilotus obovatus* *Senna artemisioides* subsp. x *artemisioides* *Senna artemisioides* subsp. *filifolia*
Tussock Grass <1m	30-70%	*Aristida contorta* *Eragrostis eriopoda*

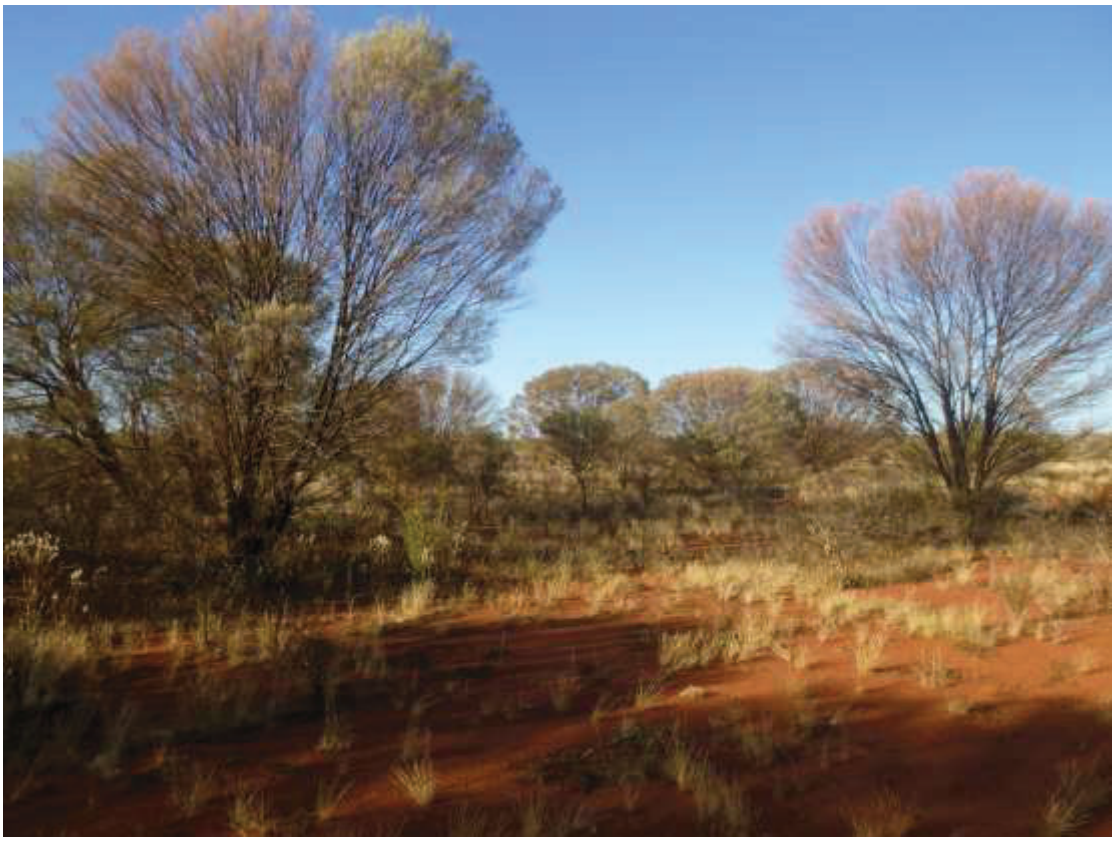


Plate 1: Low woodland of *Acacia aptaneura/ A. incurvaneura/ A. paraneura* over mid shrubland of *Eremophila latrobei/ Ptilotus obovatus/ Senna artemisioides* and tussock grassland of *Aristida contorta/ Eragrostis eriopoda* on clay-loam plain

5.2.1.2 Low woodland of *Acacia caesaneura/ A. incurvaneura* over mid shrubland of *Eremophila latrobei/ Senna artemisioides* and low shrubland of *Ptilotus obovatus* on clay-loam plain (CLP-AFW2)

The total flora recorded within this vegetation type was represented by a total of 12 families, 20 genera and 28 taxa (Plate 2 and Appendix C). Dominant taxa from the vegetation type are shown in Table 5-6. According to the NVIS, this vegetation type is best represented by the MVG 6 – Acacia Forest and Woodland (DotEE, 2017).

Table 5-6: Vegetation assemblage for Low woodland of *Acacia caesaneura/ A. incurvaneura* over mid shrubland of *Eremophila latrobei/ Senna artemisioides* and low shrubland of *Ptilotus obovatus* on clay-loam plain

Life Form/Height Class	Canopy Cover	Dominant Taxa
Tree <10m	10-30%	*Acacia caesaneura* *Acacia incurvaneura*
Shrub 1-2m	30-70%	*Eremophila latrobei* subsp. *glabra* *Eremophila latrobei* subsp. *latrobei* *Senna artemisioides* subsp. x *artemisioides* *Senna artemisioides* subsp. *filifolia*
Shrub <1m	10-30%	*Ptilotus obovatus*

Plate 2: Low woodland of *Acacia caesaneura/ A. incurvaneura* over mid shrubland of *Eremophila latrobei/ Senna artemisioides and* low shrubland of *Ptilotus obovatus* on clay-loam plain

Clay-Loam Plain: Other Forest and Woodland

5.2.1.3 Mid woodland of *Corymbia opaca* over low woodland of *Acacia incurvaneura* and tussock grassland of *Aristida contorta* on clay-loam plain (CLP-OFW1)

The total flora recorded within this vegetation type was represented by a total of 10 families, 15 genera and 21 taxa (Plate 3 and Appendix C). Dominant taxa from the vegetation type are shown in Table 5-7. According to the NVIS, this vegetation type is best represented by the MVG 10 – Other Forest and Woodland (DotEE, 2017).

Table 5-7: Vegetation assemblage for Mid woodland of *Corymbia opaca* over low woodland of *Acacia incurvaneura* and tussock grassland of *Aristida contorta* on clay-loam plain

Life Form/Height Class	Canopy Cover	Dominant Taxa
Tree >10m	10-30%	*Corymbia opaca*
Tree <10m	10-30%	*Acacia incurvaneura*
Tussock Grass <1m	30-70%	*Aristida contorta*

Plate 3: Mid woodland of *Corymbia opaca* over low woodland of *Acacia incurvaneura* and tussock grassland of *Aristida contorta* on clay-loam plain

Open Depression: Eucalypt Woodland

5.2.1.4 Mid woodland of *Eucalyptus camaldulensis* subsp. *obtusa* over mid shrubland of *Acacia victoriae* subsp. *victoriae/ Eremophila longifolia* and tussock grassland of *Cenchrus ciliaris* in drainage line (OD-EW1)

The total flora recorded within this vegetation type was represented by a total of 8 families, 9 genera and 10 taxa (Plate 4 and Appendix C). Dominant taxa from the vegetation type are shown in Table 5-8. According to the NVIS, this vegetation type is best represented by the MVG 5 – Eucalypt Woodland (DotEE, 2017).

Table 5-8: Vegetation assemblage for Mid woodland of *Eucalyptus camaldulensis* subsp. *obtusa* over mid shrubland of *Acacia victoriae* subsp. *victoriae/ Eremophila longifolia* and tussock grassland of *Cenchrus ciliaris* in drainage line

Life Form/Height Class	Canopy Cover	Dominant Taxa
Tree >10m	10-30%	*Eucalyptus camaldulensis* subsp. *obtusa*
Shrub 1-2m	30-70%	*Acacia victoriae* subsp. *victoriae* *Eremophila longifolia*
Tussock Grass <1m	30-70%	*Cenchrus ciliaris*

Plate 4: Mid woodland of *Eucalyptus camaldulensis* subsp. *obtusa* over mid shrubland of *Acacia victoriae* subsp. *victoriae/ Eremophila longifolia* and tussock grassland of *Cenchrus ciliaris* in drainage line

Sandplain: Acacia Forest and Woodland

5.2.1.5 Low woodland *Acacia incurvaneura/ A. pruinocarpa* over *Eremophila latrobei/ Acacia paraneura* and hummock grassland of *Triodia basedowii/ T. melvillei* on sandplain (SP-AFW1)

The total flora recorded within this vegetation type was represented by a total of 12 families, 20 genera and 32 taxa (Plate 5 and Appendix C). Dominant taxa from the vegetation type are shown in Table 5-9. According to the NVIS, this vegetation type is best represented by the MVG 6 – Acacia Forest and Woodland (DotEE, 2017).

Table 5-9: Vegetation assemblage for Low woodland *Acacia incurvaneura/ A. pruinocarpa* over *Eremophila latrobei/ Acacia paraneura* and hummock grassland of *Triodia basedowii/ T. melvillei* on sandplain

Life Form/Height Class	Canopy Cover	Dominant Taxa
Tree <10m	10-30%	*Acacia incurvaneura* *Acacia pruinocarpa*
Shrub >2m	10-30%	*Acacia paraneura*
Shrub 1-2m	10-30%	*Eremophila latrobei* subsp. *glabra* *Eremophila latrobei* subsp. *latrobei*
Hummock Grass <1m	30-70%	*Triodia basedowii* *Triodia melvillei*

Plate 5: Low woodland *Acacia incurvaneura/ A. pruinocarpa* over *Eremophila latrobei/ Acacia paraneura* and hummock grassland of *Triodia basedowii/ T. melvillei* on sandplain

Sandplain: Mallee Woodland and Shrubland

5.2.1.6 Mid mallee woodland of *Eucalyptus gamophylla* over low woodland of *Acacia paraneura* and hummock grassland of *Triodia basedowii* on sandplain (SP-MWS1)

The total flora recorded within this vegetation type was represented by a total of 11 families, 17 genera and 19 taxa (Plate 6 and Appendix C). Dominant taxa from the vegetation type are shown in Table 5-10. According to the NVIS, this vegetation type is best represented by the MVG 13 – Mallee Woodland and Shrubland (DotEE, 2017).

Table 5-10: Vegetation assemblage for Mid mallee woodland of *Eucalyptus gamophylla* over low woodland of *Acacia paraneura* and hummock grassland of *Triodia basedowii* on sandplain

Life Form/Height Class	Canopy Cover	Dominant Taxa
Tree Mallee <10m	10-30%	*Eucalyptus gamophylla*
Tree <10m	10-30%	*Acacia paraneura*
Hummock Grass <1m	30-70%	*Triodia basedowii*

Plate 6: Mid mallee woodland of *Eucalyptus gamophylla* over low woodland of *Acacia paraneura* and hummock grassland of *Triodia basedowii* on sandplain

5.2.2 Floristic Composition

Statistical analysis was conducted on quadrat data obtained from the survey to determine the similarities or differences in floristic composition between vegetation associations. Appendix I provides the dendrogram, two-way table and ordination graph generated from the PATN statistical analysis. A list of the 38 quadrats and their respective vegetation associations are provided in Table 5-11 below. The PATN analysis produced a stress value of 0.2342.

Table 5-11: **Vegetation types with corresponding quadrats**

Vegetation Type	Vegetation Code	Quadrat
Low woodland of *Acacia aptaneura/ A. incurvaneura/ A. paraneura* over mid shrubland of *Eremophila latrobei/ Ptilotus obovatus/ Senna artemisioides* and tussock grassland of *Aristida contorta/ Eragrostis eriopoda* on clay-loam plain	CLP-AFW1	Q1, Q5, Q8, Q11, Q12, Q13, Q16, Q17, Q18, Q19, Q24, Q25, Q27, Q30, Q38
Low woodland of *Acacia caesaneura/ A. incurvaneura* over mid shrubland of *Eremophila latrobei/ Senna artemisioides* and low shrubland of *Ptilotus obovatus* on clay-loam plain	CLP-AFW2	Q20, Q21, Q22, Q23
Mid woodland of *Corymbia opaca* over low woodland of *Acacia incurvaneura* and tussock grassland of *Aristida contorta* on clay-loam plain	CLP-OFW1	Q6, Q9, Q10, Q34
Mid woodland of *Eucalyptus camaldulensis* subsp. *obtusa* over mid shrubland of *Acacia victoriae* subsp. *victoriae/ Eremophila longifolia* and tussock grassland of *Cenchrus ciliaris* in drainage line	OD-EW1	Q7, Q15
Low woodland *Acacia incurvaneura/ A. pruinocarpa* over *Eremophila latrobei/ Acacia paraneura* and hummock grassland of *Triodia basedowii/ T. melvillei* on sandplain	SP-AFW1	Q2, Q3, Q4, Q14, Q26, Q28, Q29, Q31, Q32
Mid mallee woodland of *Eucalyptus gamophylla* over low woodland of *Acacia paraneura* and hummock grassland of *Triodia basedowii* on sandplain	SP-MWS1	Q33, Q35, Q36, Q37

Six species groups were identified in the analysis (species group A to F) as shown in the two-way table (Appendix I).

The first floristic group comprised of 19 quadrats, including majority of the CLP-AFW1 quadrats (12 quadrats) and CLP-AFW2 quadrats (3 quadrats) two of the four CLP-OFW1 quadrats and two of the nine SP-AFW1 quadrats. This floristic group was characterised by species group A (see two-way table provided in Appendix I) with an average species richness of 7 taxa per quadrat (ranged from 3 to 10 taxa per quadrat).

The second floristic group comprised of two CLP-AFW1 quadrats and one quadrat from both the CLP-OFW1 and CLP-AFW2 vegetation types. This floristic group was mostly characterised by species group A and E (Appendix I). This floristic group had an average species richness of 6 taxa per quadrat (ranged from 2 to 10 taxa per quadrat).

The third floristic group comprised of three SLP-AFW1 quadrats (Q2-Q4) which were located within the Warburton survey area. This floristic group was mostly characterised by species group F (Appendix I). This floristic group had an average species richness of 6 taxa per quadrat (ranged from 5 to 7 taxa per quadrat).

The fourth floristic group comprised of the remaining four SLP-AFW1 quadrats and remaining CLP-OFW1 quadrat, all of which were located within the Warakurna survey area. This floristic group was mostly characterised by species group C (Appendix I). This floristic group had an average species richness of 7 taxa per quadrat (ranged from 6 to 9 taxa per quadrat).

The fifth floristic group comprised of all four SP-MWS1 quadrats and one CLP-AFW1 quadrat. This floristic group was mostly characterised by species group A and C (Appendix I). This floristic group had an average species richness of 7 taxa per quadrat (ranged from 5 to 8 taxa per quadrat).

The sixth floristic group comprised of both OD-EW1 quadrats. This floristic group was mostly characterised by species group D (Appendix I). This floristic group had an average species richness of 4 taxa per quadrat (ranged from 2 to 6 taxa per quadrat).

Results of the PATN analysis indicate there was minimal heterogeneity in species composition of the clay-loam plain vegetation types, with the majority of quadrats from these vegetation types intermixed into floristic groups despite differences in dominant stratum taxa. The Eucalypt and Mallee woodland vegetation types were mostly identified as distinct floristic groups which supports the delineations made in the field. Despite similarities in landform and dominant understorey stratum of the SP-AFW1 vegetation type, variation in species composition was identified between the Warakurna and Warburton survey areas.

Species Richness and Accumulation Estimates

The Chao 2 richness estimator provided an estimated species richness of 85 species in 50 sample sites (quadrats). Species richness recorded for the 38 quadrats surveyed was 78 species. A species accumulation curve was created to display the rate of species accumulation. The R^2 value (0.99) suggests that the data “fits” the species accumulation curve shown in Figure 5-3. Species accumulation ranged from seven to two species per quadrat from 1-17 sample sites and one species per quadrat beyond 18 sample sites. Botanica has determined that according to this data a sufficient number of quadrats were established in the survey area to adequately assess the floristic composition of the area.

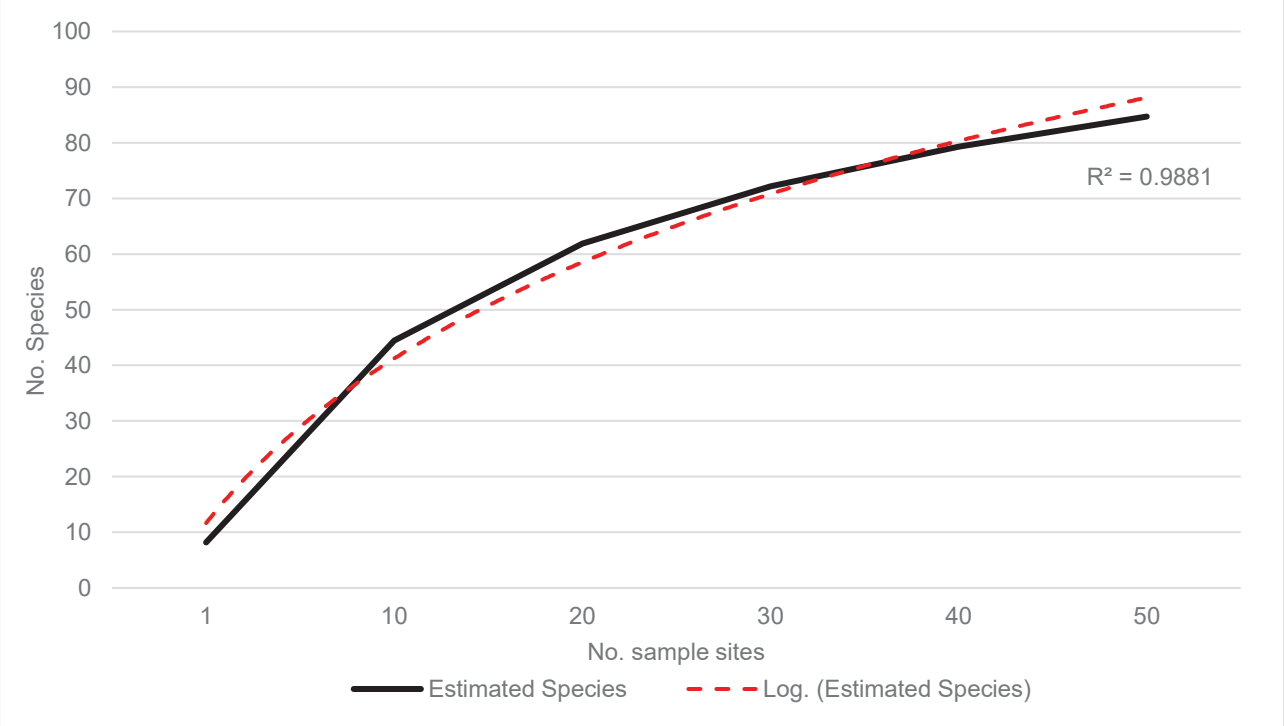


Figure 5-3: Species accumulation curve

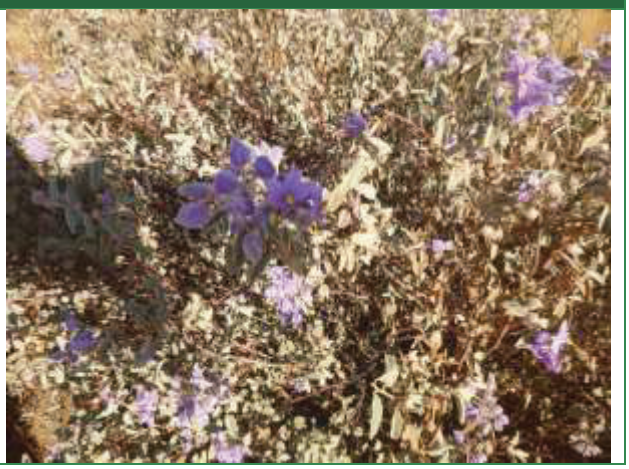
5.2.3 Significant Flora

According to the EPA *Environmental Factor Guideline for Flora and Vegetation* (EPA, 2016b) significant flora includes:

- flora being identified as Threatened or Priority species;
- locally endemic flora or flora associated with a restricted habitat type (e.g. surface water or groundwater dependent ecosystems);
- new species or anomalous features that indicate a potential new species;
- flora representative of the range of a species (particularly, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range);
- unusual species, including restricted subspecies, varieties or naturally occurring hybrids; and
- flora with relictual status, being representative of taxonomic groups that no longer occur widely in the broader landscape.

One Threatened Flora taxon listed as Critically Endangered under the EPBC Act and BC Act was identified within the survey area; *Seringia exastia*. This taxon is currently being nominated to be de-listed as a Threatened Flora taxon under the BC Act. This taxon is described as an erect, compact, multi-stemmed shrub that can grow to 0.9 m high. The flowers are purple, the lobes ovate and 9–12 mm, and the flowering period is from April to December (WAHERB, 2021). Four locations of this taxon were recorded during the survey (Table 5-12) within the Low woodland *Acacia incurvaneura/ A. pruinocarpa* over *Eremophila latrobei/ Acacia paraneura* and hummock grassland of *Triodia basedowii/ T. melvillei* on sandplain (SP-AFW1) vegetation type. The locations of this taxon are shown spatially in Figure 5-4 and Figure 5-5. No other significant flora (as described above) were identified within the survey area.

Table 5-12: Significant Flora recorded during the survey

Taxon	Coordinates (GDA20)	Abundance	Image
Seringia exastia	52 J 426592 7229594	1000	
Seringia exastia	52 J 247883 7103810	100	
Seringia exastia	52 J 247909 7103815	100	
Seringia exastia	52 J 247949 7103822	100	

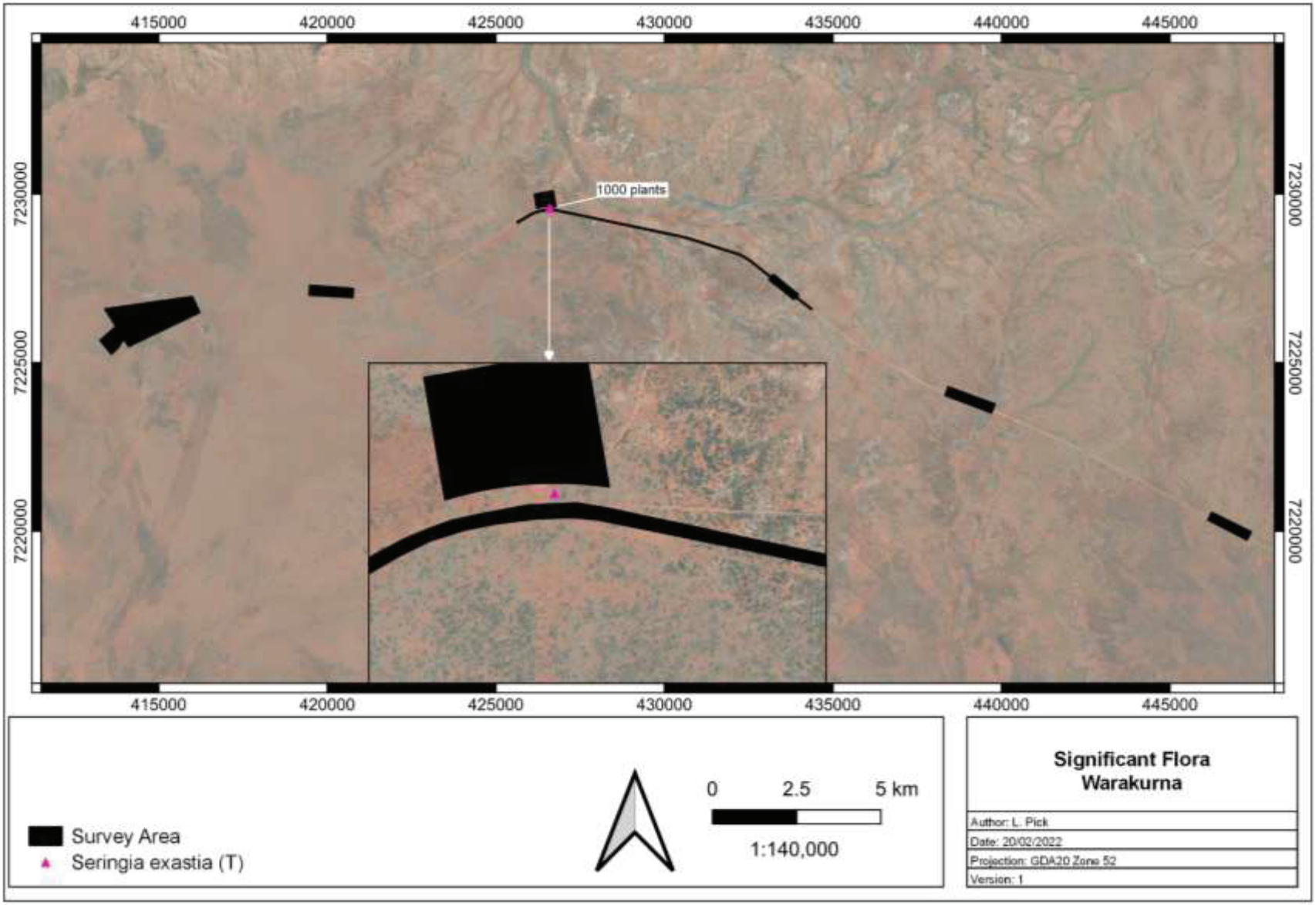


Figure 5-4: Significant Flora recorded during the field survey-Warakurna

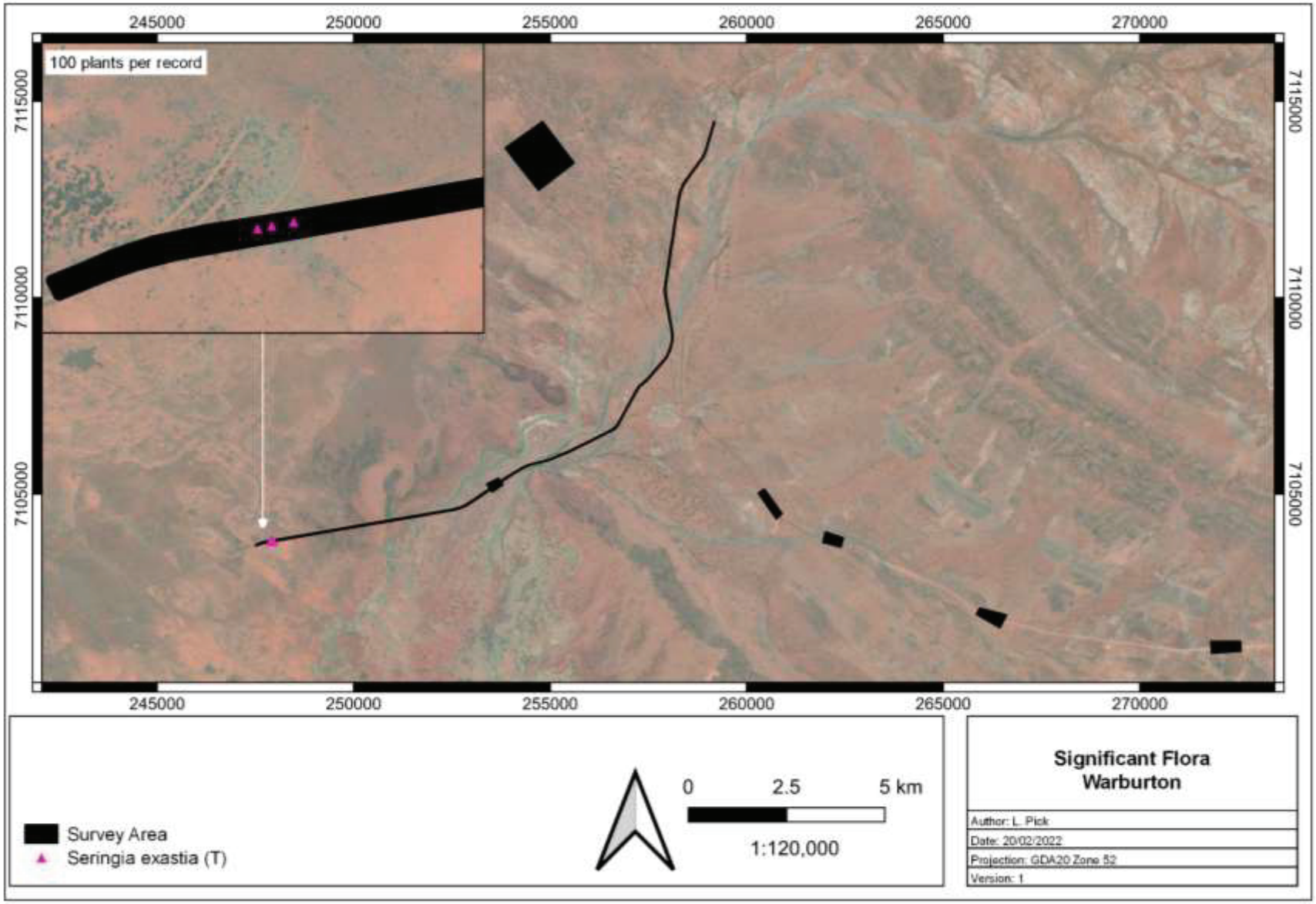


Figure 5-5: Significant Flora recorded during the field survey-Warburton

Based on the results of the field survey, six of the nine Priority Flora identified in the desktop assessment as possible to occur within the survey area are considered as unlikely to occur, as described below. The remaining three Priority Flora were identified as possible to occur within the survey area, however these taxa were not recorded during the field survey.

1. *Comesperma viscidulum* (P4) - unlikely to occur
Preferred habitat for this taxon is unknown, however it is a non-cryptic and perennial species that was actively searched for during the field assessment and not located.

2. *Dicrastylis subterminalis* (P1) - unlikely to occur
Preferred habitat based on previous field observations of this taxon includes red sands by creeklines which were present within the survey area, however it is a non-cryptic and perennial species that was actively searched for during the field assessment and not located. The nearest DBCA record of this taxon is located approximately 30 km north-east of the survey area.

3. *Indigofera gilesii* (P3) - unlikely to occur
Preferred habitat based on previous field observations of this taxon includes pebbly loam soils amongst boulders and outcrops, hills which were not present within the survey area. It is a non-cryptic and perennial species that was actively searched for during the field assessment and not located.

4. *Isotropis winneckei* (P1) – unlikely to occur
Known from very few records. Preferred habitat is considered to be skeletal soils of sandstone ranges and rocky rises which were not present within the survey area. It is a non-cryptic and perennial species that was actively searched for during the field assessment and not located.

5. *Prostanthera centralis* (P3) - unlikely to occur
Preferred habitat based on previous field observations of this taxon gravelly soils and red sand of rocky quartzite scree slopes. which were not present within the survey area. It is a non-cryptic perennial species that was actively searched for during the field assessment and not located.

6. *Thysanotus* sp. Desert East of Newman (R.P. Hart 964) (P2)- unlikely to occur
Preferred habitat based on previous field observations of this taxon includes red-brown loamy sand or red sand, sometimes silty of sandplains or pisolitic buckshot plain. Suitable soils were present within the survey area, however it is a non-cryptic and perennial species that was actively searched for during the field assessment and not located. The nearest DBCA record of this taxon is located approximately 30 km west of the survey area.

5.2.4 Significant Vegetation

According to the EPA *Environmental Factor Guideline for Flora and Vegetation* (EPA, 2016b) significant vegetation includes:

- vegetation being identified as Threatened or Priority Ecological Communities;
- vegetation with restricted distribution;
- vegetation subject to a high degree of historical impact from threatening processes;
- vegetation which provides a role as a refuge; and
- vegetation providing an important function required to maintain ecological integrity of a significant ecosystem.

No TEC or PEC, restricted vegetation, highly disturbed vegetation, vegetation providing important refuge or significant ecological function was identified within the survey area. According to the BoM Atlas of Groundwater Dependent Ecosystems (BoM, 2021) database, there are no known aquatic or terrestrial GDEs located within the survey area; however, the GDE database (BoM, 2021b) indicates that the survey area has low potential to contain two terrestrial GDE (refer to **Section 3.6**). No potential GDE vegetation was identified during the field survey.

5.2.5 Vegetation Condition

Based on the vegetation condition rating scale obtained from the EPA (2016a) provided in Appendix E, vegetation ranged from 'good' to 'very good' condition with the majority of vegetation in 'good' condition (Table 5-13). Disturbance in the area was a result of recent and/ or frequent fires and road siding of the Great Central Road. Maps of the vegetation condition across the survey area are provided in Figure 5-6 and Figure 5-7. More detailed vegetation condition maps are provided in Appendix D.

Table 5-13: Vegetation condition rating within the survey area

Condition rating	Description (EPA, 2016a)	Area (ha)	Area (%)
Very Good	Some relatively slight signs of damage caused by human activities since European settlement. For example, some signs of damage to tree trunks caused by repeated fire, the presence of some relatively non-aggressive weeds, or occasional vehicle tracks.	54	6.9
Good	More obvious signs of damage caused by human activity since European settlement, including some obvious impact on the vegetation structure such as that caused by low levels of grazing or slightly aggressive weeds.	633	81.3
Cleared Vegetation	Existing Clearing (Great Central Road)	92	11.8
TOTAL		**779**	**100**

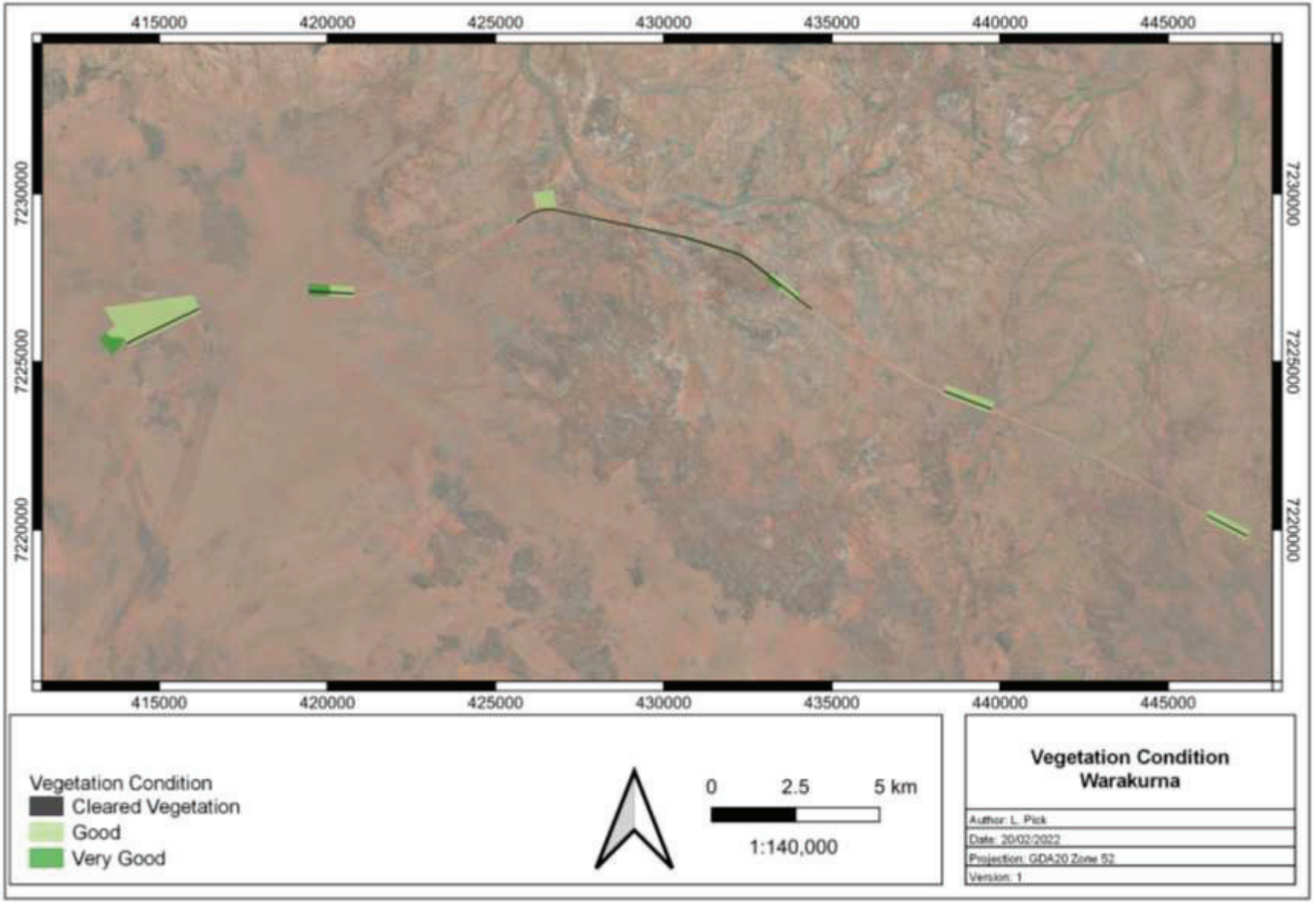


Figure 5-6: Vegetation condition rating of the survey area-Warakurna

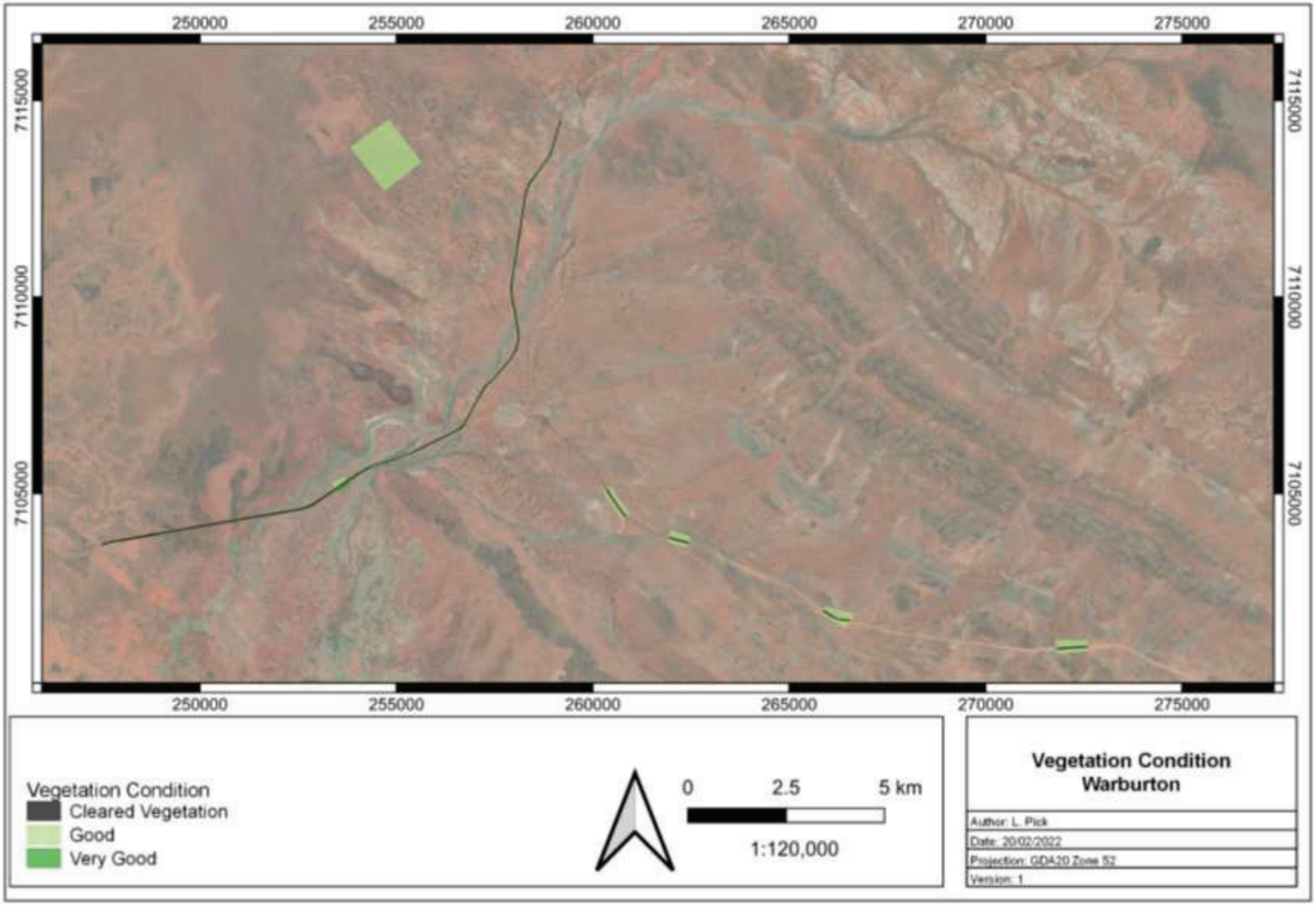


Figure 5-7: Vegetation condition rating of the survey area-Warburton

5.2.6 Introduced Flora

Three introduced species were identified within the survey area as described in Table 5-14 below and shown spatially in Figure 5-8 and Figure 5-9.

Table 5-14: Introduced Flora recorded during the survey

Taxon	Common Name	Coordinates (GDA20)	Image
Cucumis myriocarpus	Prickly Paddy Melon	52 J 251066 7104355	
Rumex vesicarius	Ruby Dock	52 J 251941 7104496	
Cenchrus ciliaris	Buffel Grass	52 J 251941 7104496 52 J 253610 7105318 52 J 254782 7105753 52 J 262226 7103718 52 J 272236 7100985 52 J 257972 7109324 52 J 258673 7113208 52 J 446227 7220274	

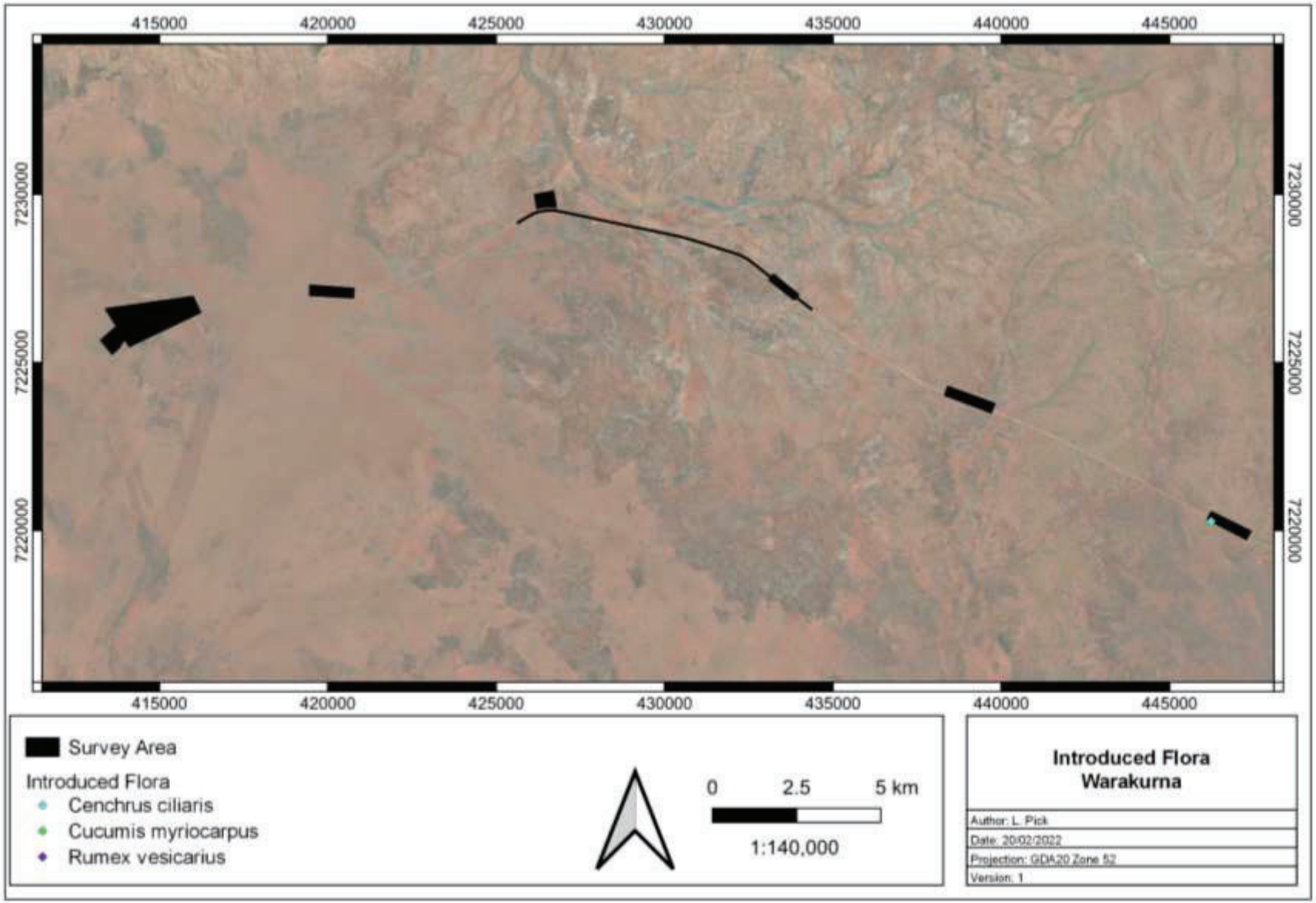


Figure 5-8: Introduced Flora recorded within the survey area-Warakurna

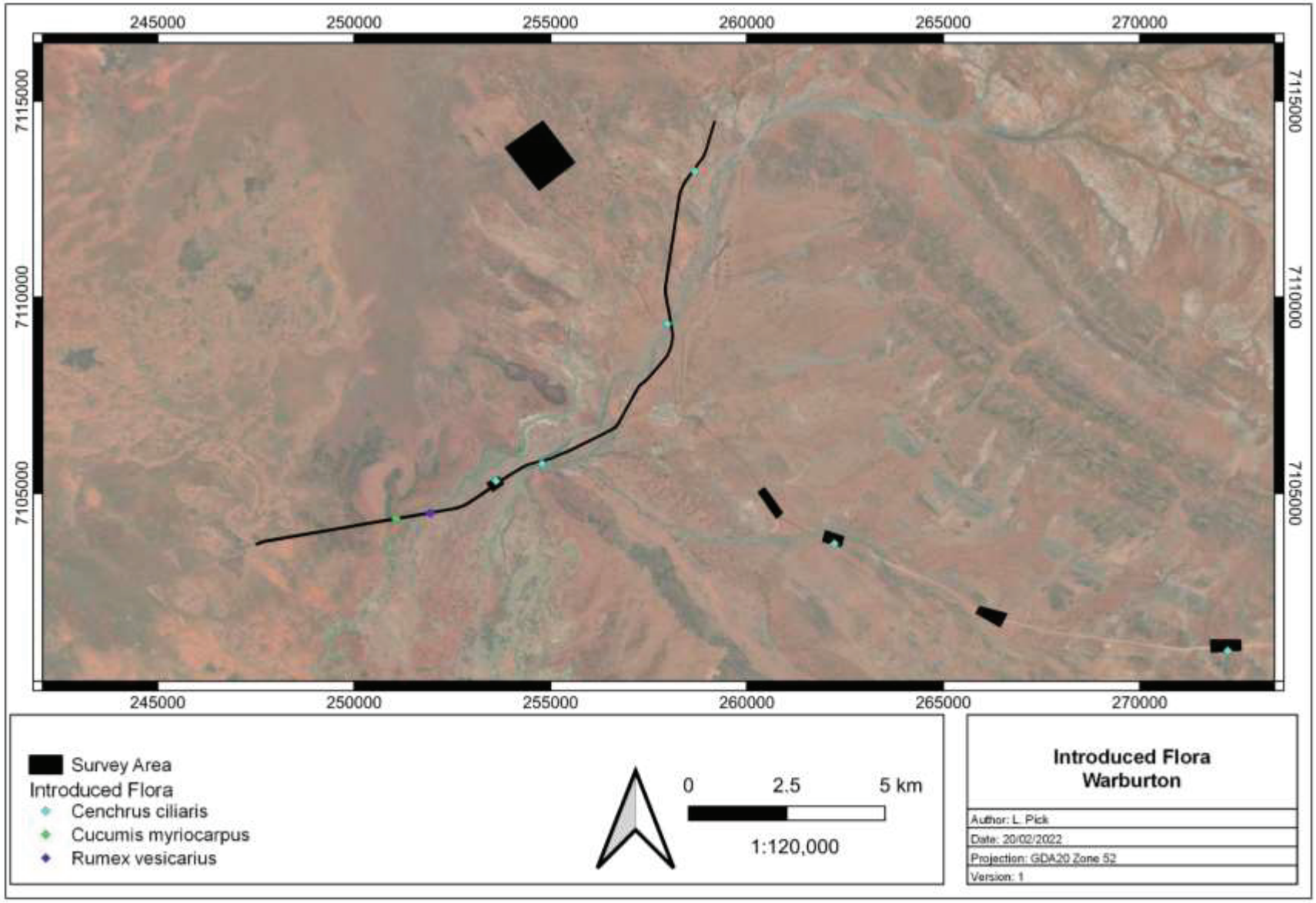


Figure 5-9: Introduced Flora recorded within the survey area-Warburton

5.2.7 Fauna Habitat

Three broad scale terrestrial fauna habitat (not including cleared vegetation) were identified within the survey area. The extent of the identified fauna habitat and a summary description is provided in Table 5-15 below. Maps of fauna habitats are provided in Figure 5-10 and Figure 5-11. More detailed fauna habitat maps are provided in Appendix D.

Table 5-15: Main terrestrial fauna habitats within the survey area

Fauna Habitat	Description	Representative Fauna Attributes	Conservation Significant Species that possibly occur in habitat	Example Image
<u>Clay-Loam Plain</u> Acacia Woodland/ Corymbia Woodland Area= 352 ha (45.1%)	Clay-loam plain comprising of Acacia/ Corymbia woodland over low mixed shrubs and tussock grassland	• Ground not especially suited to burrowing species. • Moderately diverse vegetation strata supporting diverse avifauna assemblage. • Moderately dense vegetation and low to moderate leaf litter.	Grey Falcon *Falco hypoleucos* Peregrine Falcon *Falco peregrinus*	
<u>Open Depression</u> Eucalypt Woodland Area= 2 ha (0.2%)	Ephemeral creekline comprising of Eucalypt woodland over low mixed shrubs and Buffel Grass	• Ground suited to burrowing species. • Moderately diverse vegetation strata supporting diverse avifauna assemblage. • Freshwater source during periods of high rainfall. • Moderately dense vegetation and moderate to high leaf litter.	Grey Falcon *Falco hypoleucos* Princess Parrot *Polytelis alexandrae* Peregrine Falcon *Falco peregrinus* Striated Grasswren (inland) *Amytornis striatus* subsp. *striatus* Great Desert Skink *Liopholis kintorei*	

Fauna Habitat	Description	Representative Fauna Attributes	Conservation Significant Species that possibly occur in habitat	Example Image
<u>Sandplain</u> Acacia Woodland/ Mallee Woodland Area= 334 ha (42.8%)	Sandplain comprising of Acacia/ Mallee woodland over low mixed shrubs and spinifex grassland	• Substrate very well suited to a variety of burrowing small mammals and reptiles. • Less diverse vegetation strata supporting a less diverse avifauna assemblage.	Grey Falcon *Falco hypoleucos* Princess Parrot *Polytelis alexandrae* Peregrine Falcon *Falco peregrinus* Striated Grasswren (inland) *Amytornis striatus* subsp. *striatus* Great Desert Skink *Liopholis kintorei*	

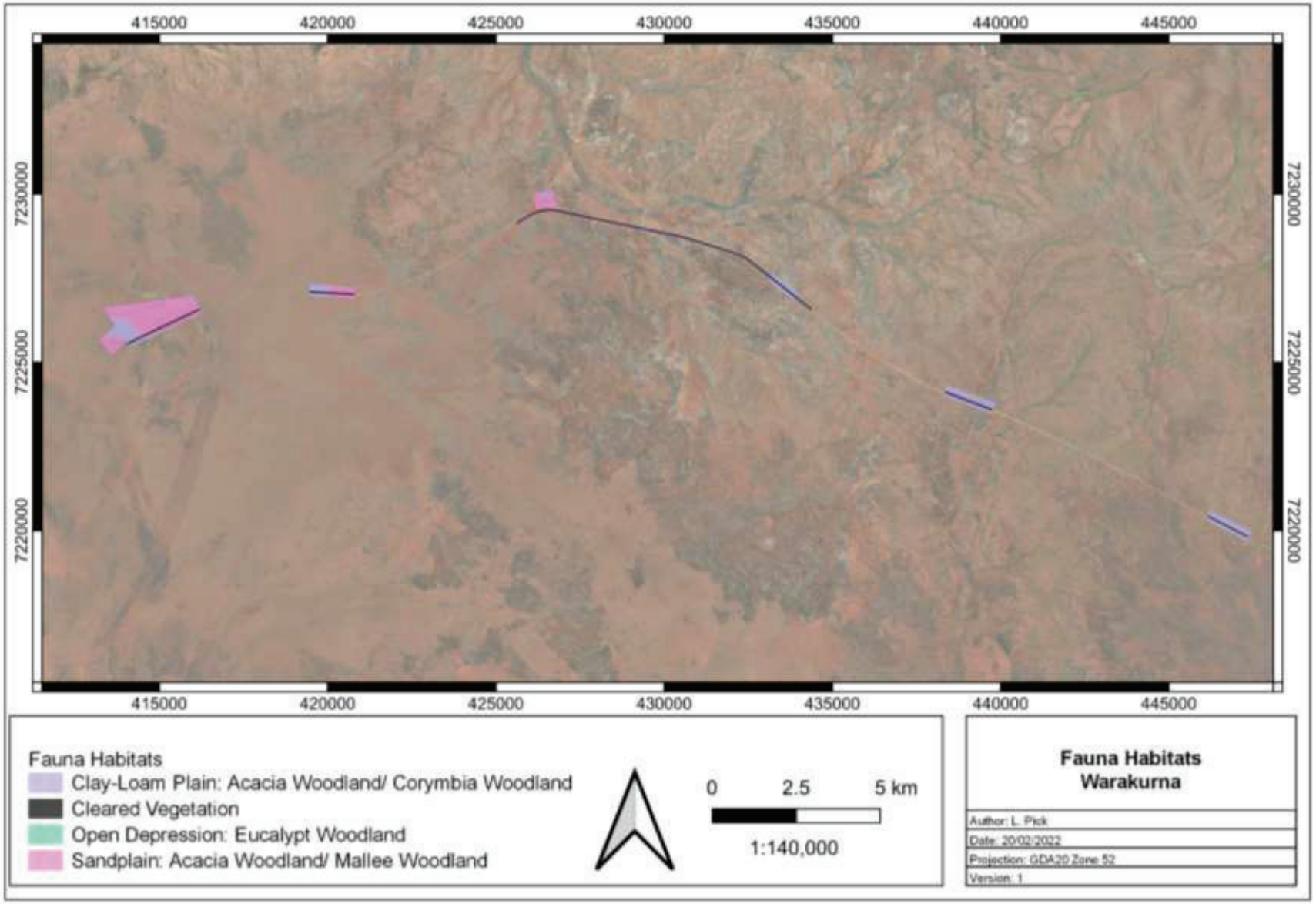


Figure 5-10: Fauna habitats within the survey area-Warakurna

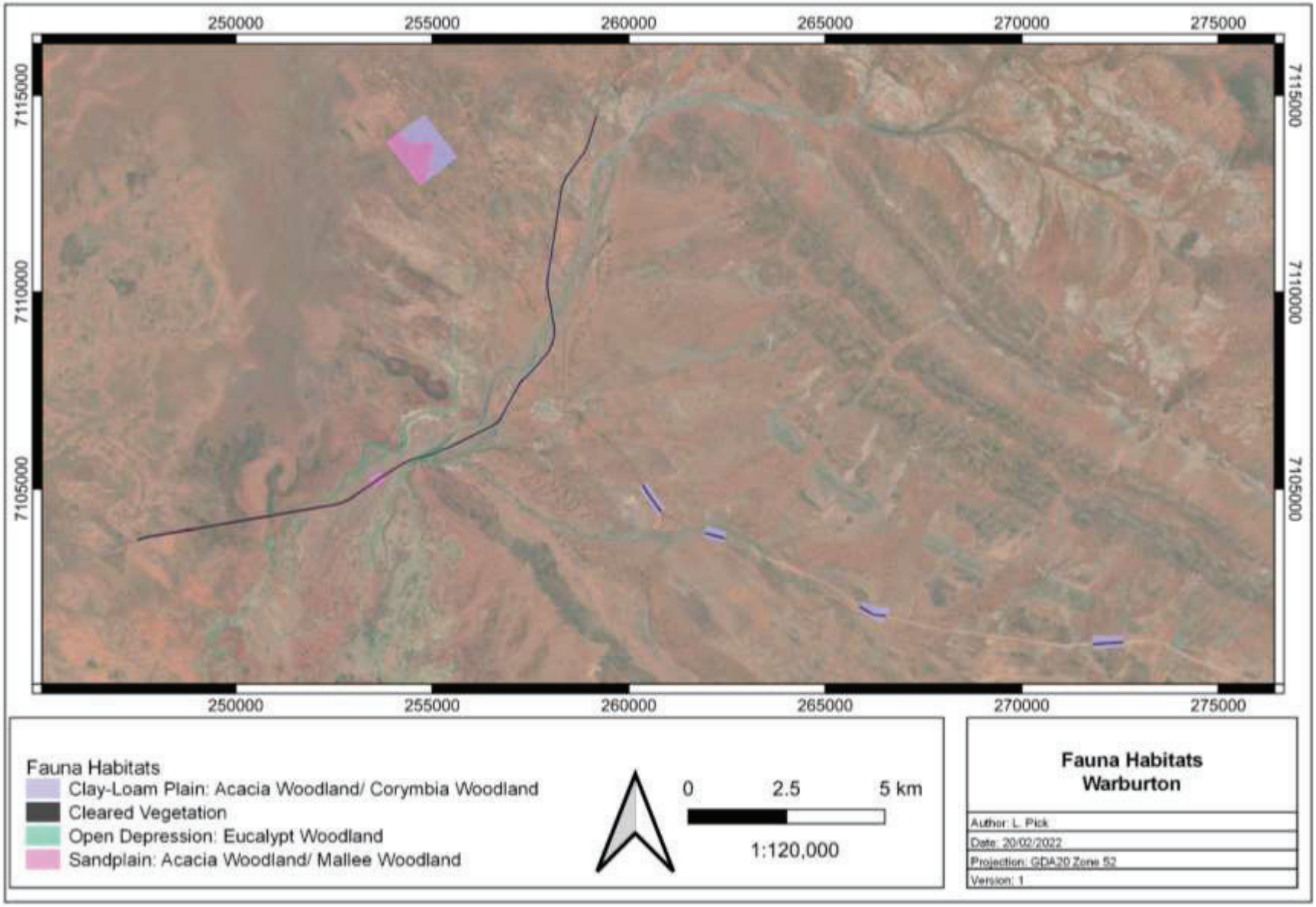


Figure 5-11: Fauna habitats within the survey area-Warburton

5.2.8 Fauna Species

Table 5-16 summarises the number of fauna species potentially occurring within or utilising at times the survey area, based on results from the literature review and observations made during the field assessment. Database search results used for the literature review are provided in Appendix J. A list of fauna species observed during the field survey is provided in Table 5-17.

Table 5-16: Summary of potential vertebrate fauna species

Group	Total number of Potential species	Potential number of Specially Protected species	Potential number of Migratory species	Potential number of Priority species	Number of species recorded during Field Survey
Amphibians	3	0	0	0	1
Birds	99	6	3	1	44
Non-Volant Mammals	19(6)	6	0	3	4(3)
Volant Mammals (Bats)	2	0	0	0	0
Reptiles	55	1	0	0	13
Total	**178(6)**	**13**	**3**	**4**	**62(3)**

Superscript = number of introduced species included in the total. Note: Where a species State and Federal conservation status is different, the highest category is used.

Table 5-17: Fauna species observed during the field survey

Taxon Name	Common Name
Amphibians	
Cyclorana maini	Mains Frog
Birds	
Acanthagenys rufogularis	Spiny-cheeked Honeyeater
Acanthiza uropygialis	Chestnut-rumped Thornbill
Anas gracilis	Grey Teal
Anthus australis	Australian Pipit
Aphelocephala leucopsis	Southern Whiteface
Artamus cinereus	Black-faced Woodswallow
Artamus personatus	Masked Woodswallow
Chalcites basalis	Horsfield's Bronze Cuckoo
Cheramoeca leucosterna	White-backed Swallow
Cincloramphus cruralis	Brown Songlark
Cincloramphus mathewsi	Rufous Songlark
Circus assimilis	Spotted Harrier
Corvus bennetti	Little Crow
Emblema pictum	Painted Finch
Eolophus roseicapilla	Galah
Epthianura tricolor	Crimson Chat
Falco berigora	Brown Falcon
Falco cenchroides	Nankeen Kestrel
Gavicalis virescens	Singing Honeyeater
Geopelia cuneata	Diamond Dove

Taxon Name	Common Name
Grallina cyanoleuca	Magpie-lark
Gymnorhina tibicen	Australian Magpie
Haliastur sphenurus	Whistling Kite
Hamirostra melanosternon	Black-breasted Buzzard
Hieraaetus morphnoides	Little Eagle
Lalage tricolor	White-winged Triller
Malurus lamberti	Variegated Fairywren
Malurus splendens	Splendid Fairywren
Manorina flavigula	Yellow-throated Miner
Melopsittacus undulatus	Budgerigar
Nymphicus hollandicus	Cockatiel
Ocyphaps lophotes	Crested Pigeon
Oreoica gutturalis	Crested Bellbird
Pachycephala rufiventris	Rufous Whistler
Petrochelidon ariel	Fairy Martin
Petrochelidon nigricans	Tree Martin
Petroica goodenovii	Red-capped Robin
Phaps chalcoptera	Common Bronzewing
Pomatostomus superciliosus	White-browed Babbler
Ptilotula penicillata	White-plumed Honeyeater
Rhipidura leucophrys	Willie Wagtail
Taeniopygia guttata	Zebra Finch
Todiramphus pyrrhopygius	Red-backed Kingfisher
Turnix velox	Little Button-quail
Mammals	
Camelus dromedarius	Camel
Canis familiaris	Dog
Oryctolagus cuniculus	Rabbit
Pseudomys hermannsburgensis	Sandy Inland Mouse
Reptiles	
Ctenophorus Isolepis	Central Military Dragon
Ctenophorus nuchalis	Central Netted Dragon
Ctenophorus reticulatus	Western Netted Dragon
Ctenotus leonhardii	
Gehyra variegata	Variegated Gehyra
Heteronotia binoei	Bynoe's Gecko
Lerista timida	Wood mulch-slider
Lophognathus longirostris	Long-nosed Water Dragon
Pygopus nigriceps	Hooded scaly-foot
Rhynchoedura ornata	Western Beaked Gecko
Tiliqua multifasciata	Central Blue-tongue
Tympanocryptis centralis	Central Earless Dragon
Varanus gouldii	Bungarra

5.2.9 Significant Fauna

According to the EPA *Environmental Factor Guideline for Terrestrial Fauna* (EPA, 2016c) significant fauna includes:

- Fauna being identified as a Threatened or Priority species;
- Fauna species with restricted distribution;
- Fauna subject to a high degree of historical impact from threatening processes; and
- Fauna providing an important function required to maintain the ecological integrity of a significant ecosystem.

Table 5-18 below provides an assessment of the likelihood of occurrence of fauna species of significance previously recorded in the general area and reasons for the inclusion and omission from the potential fauna list. No significant fauna taxa were confirmed as occurring within the survey area. The current status of some species on site and/or in the general area is difficult to determine, however, based on the habitats present and/ or recent nearby records, the following species of significance can be regarded as possibly occurring in the wider area (but not necessarily within the survey area):

- **Grey Falcon *Falco hypoleucos***– Vulnerable (EPBC Act and BC Act)

  Survey area may form part of larger home range and has potential to pass through the survey area. Only potential breeding site would be Elder Creek in a high rainfall period, however no nesting sites/ direct bird observations identified during the field survey.

- **Princess Parrot *Polytelis alexandrae***– Vulnerable (EPBC Act) Priority 4 (DBCA)

  Recent records (2012) located at Lake Christopher near the Rawlinson Range, located approximately 70km north-west of the survey area. This species has the potential to pass through the survey area, however no potential breeding trees identified within the survey area.

- **Peregrine Falcon *Falco peregrinus*** –Other Specially Protected Species (BC Act)

  This species potentially occurs aerially over the survey area as part of a much larger home range, though records in this area are rare and therefore it is likely to be present occasionally. No potential nest sites observed.

- **Striated Grasswren (inland) *Amytornis striatus* subsp*. striatus***– Priority 4 (DBCA)

  The survey area is located within its known range and suitable habitat is present, however this taxon was not observed during the field survey.

- **Great Desert Skink *Liopholis kintorei***– Vulnerable (EPBC Act and BC Act)

  The survey area is located within its known range and suitable habitat is present, however this taxon was not observed during the field survey.

It should be noted that while habitats onsite for the species listed above are considered possibly suitable, some or all may be marginal in extent/quality and therefore the fauna species considered as possibly occurring may in fact only visit the area for short periods as infrequent vagrants. The result of the literature review and observations made during the field survey suggest that the probability of any of the above-mentioned fauna species actually occurring with the survey area would be low.

Table 5-18: Likelihood of occurrence for fauna of conservation significance within the survey area

Taxon	Conservation Status			Habitat Description	Comments	Likelihood
	EPBC Act	BC Act	DBCA Priority			
Night Parrot *Pezoporus occidentalis*	EN	CR	-	Most habitat records are of *Triodia* (Spinifex) grasslands and/or chenopod shrublands in the arid and semi-arid zones, or *Astrebla* spp. (Mitchell grass), shrubby samphire and chenopod associations, scattered trees and shrubs, *Acacia aneura* (Mulga) woodland, treeless areas and bare gibber are associated with sightings of the species. Roosting and nesting sites are consistently reported as within clumps of dense vegetation, primarily old and large Spinifex (*Triodia*) clumps, but sometimes other vegetation types (DAWE, 2021b).	No suitable habitat identified within the survey area.	Unlikely to occur
Grey Falcon *Falco hypoleucos*	VU	VU		The Grey Falcon occurs at low densities across inland Australia. The species frequents timbered lowland plains, particularly acacia shrublands that are crossed by tree-lined water courses. The species has been observed hunting in treeless areas and frequents tussock grassland and open woodland, especially in winter. While breeding Grey Falcons feed almost exclusively on birds (DAWE, 2021b).	Survey area may form part of larger home range. Potential to pass through the survey area. Only potential breeding site would be Elder Creek in a high rainfall period.	Possibly occurs
Princess Parrot *Polytelis alexandrae*	VU	-	P4	Confined to arid regions of Western Australia, the Northern Territory, and South Australia. In Western Australia, it is sparsely distributed from near Coolgardie in the west and the Murchison River to the east, and north to near the Fitzroy River in Western Australia and to Howell Ponds in the Northern Territory. It is believed that the population is mainly concentrated in the Great Sandy, Gibson, Tanami and Great Victoria Deserts, and in the central ranges. It inhabits sand dunes and sand flats in the arid zone of western and central Australia, in open savanna woodlands and shrublands that usually consist of scattered stands of Eucalyptus (including *E. gongylocarpa*, *E. chippendalei* and mallee species), Casuarina or Allocasuarina trees; an understorey of shrubs such as *Acacia* (especially *A. aneura*), *Senna*, *Eremophila*, *Grevillea*, *Hakea* and *Senna*; and a ground cover dominated by *Triodia* species (DAWE, 2021b).	Recent records (2012) located at Lake Christopher near the Rawlinson Range (located approximately 70km north-west of the survey area. Potential to pass through the survey area, no potential breeding trees identified within the survey area.	Possibly occurs
Malleefowl *Leipoa ocellata*	VU	VU	-	Scrublands and woodlands dominated by mallee and wattle species (DAWE, 2021b).	Habitat within survey area appears to be marginal and unsuitable for breeding. Close proximity to communities, potential predation by dogs.	Unlikely to occur
Peregrine Falcon *Falco peregrinus*	OS	-	-	The Peregrine Falcon is found in most habitats, from rainforests to the arid zone, and at most altitudes, from the coast to alpine areas. It requires abundant prey and secure nest sites, and prefers coastal and inland cliffs or open woodlands near water, and may even be found nesting on high city buildings (Birdlife Australia, 2019).	Survey area may form part of larger home range but habitat appears to be marginal and unsuitable for breeding.	Possibly occurs

Taxon	Conservation Status			Habitat Description	Comments	Likelihood
	EPBC Act	BC Act	DBCA Priority			
Greater Sand Plover *Charadrius leschenaultii*	VU	VU		In the non-breeding grounds in Australasia, the species is almost entirely coastal, inhabiting littoral and estuarine habitats. Greater Sand Plovers usually feed from the surface of wet sand or mud on open intertidal flats of sheltered embayments, lagoons or estuaries. They usually roost on sand-spits and banks on beaches or in tidal lagoons, and occasionally on rocky points. The species does not breed in Australia (DAWE, 2021b).	No suitable habitat.	Would not occur
Fork-tailed Swift *Apus pacificus*	MI	MI	-	Low to very high airspace over varied habitat from rainforest to semi desert (Birdlife Australia, 2019).	Almost totally aerial. Very occasional transients only.	Unlikely to occur
Grey Wagtail *Motacilla cinerea*	MI	-	-	Running water in disused quarries, sandy, rocky streams in escarpments and rainforest, sewerage ponds, ploughed fields and airfields (Morecombe 2004).	No suitable habitat.	Would not occur
Yellow Wagtail *Motacilla flava*	MI	-	-	Open habitats often near water, swamp margins, salt marshes, sewerage ponds, playing fields or similar. Very occasionally drier inland plains (Morecombe 2004).	No suitable habitat.	Would not occur
Striated Grasswren (inland) *Amytornis striatus* subsp. *striatus*			P4	Open mallee over a sparse layer of shrubs and a ground layer dominated by spinifex (Triodia), though they are sometimes found in other vegetation types (DEH, 2020)	Within known range. Suitable habitat present.	Possibly occurs
Migratory Shorebirds (Various species)	IA/MI	IA/MI	P4	Prefer muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. This includes lagoons, swamps, lakes and pools near the coast, and dams, waterholes, soaks, bore drains and bore swamps, saltpans and hypersaline salt lakes inland (DAWE, 2021b).	No suitable habitat.	Would not occur
Greater Bilby *Macrotis lagotis*	VU	VU		Bilby distribution is now largely restricted to two broad habitat types: mulga woodlands with lateritic red earth and spinifex grasslands with high fire frequency, again with the red earth (DAWE, 2021b).	Recent record (2018) located at near Lighting Rock (located approximately 115km south-east of the survey area. Habitat within survey area appears to be marginal and unsuitable (stony substrate). Close proximity to communities, potential predation by dogs.	Unlikely to occur
Central-Australian Rock Wallaby *Petrogale lateralis* subsp. *centralis*	VU	VU		The species occurs in rocky ranges, cliffs, gorges outcrops and associated steep rocky slopes and boulder fields (DAWE, 2021b).	No suitable habitat.	Unlikely to occur
Sandhill Dunnart *Sminthopsis psammophila*	EN	EN		Occurs in isolated sandy arid and semi arid areas in the Great Victoria Desert and the Eyre Peninsula. It occurs in vegetation dominated by hummock (Triodia) grassland. The species shelters during the day in nests in the centre of large hummocks, especially in hummocks that have started to die off in the centre, where they dig a circular depression (DAWE, 2021b).	Limited old growth spinifex present within the survey area. Outside of known range.	Unlikely to occur

Taxon	Conservation Status			Habitat Description	Comments	Likelihood
	EPBC Act	BC Act	DBCA Priority			
Brush-tailed Mulgara *Dasycercus blythi*			P4	Occurs on sand dunes with sparse cover of sandhill caingrass or areas around salt lakes (Molyneux, Pavey, James & Carthew, 2018).	Within known range, with historic records (1978) within 5km of the survey area. Habitat within survey area appears to be marginal and unsuitable (stony substrate). Close proximity to communities, potential predation by dogs.	Unlikely to occur
Golden Bandicoot (mainland) *Isodon auratus* subsp. *auratus*	VU	VU		Habitat of extant Golden Bandicoot (mainland) populations includes rainforest margins and viney thickets on rugged sandstone (the north Kimberley area), eucalypt woodland (Yampi Peninsula) and rugged sandstone with eucalypt woodland over hummock grassland (Augustus Island). On Marchinbar Island, the Golden Bandicoot is found in heath and open woodland vegetation types but not in sand dunes, coastal thickets or rainforest (DAWE, 2021b).	This subspecies is restricted to Marchinbar Island (offshore Arnhem Land).	Unlikely to occur
Numbat *Myrmecobius fasciatus*	EN	EN		The species' habitat is generally dominated by eucalypts that provide hollow logs and branches for shelter and termites for food. Although its range has contracted to jarrah (Eucalyptus marginata) forest and wandoo (Eucalyptus wandoo) woodland, the numbat was found in a wide range of woodland types, including York gum (Eucalyptus loxophleba) and mallee (Eucalyptus spp.) woodland in Western Australia, mulga woodland in central Australia, and mallee woodland in South Australia (DAWE, 2021b).	Outside of known current range (range located within south-west of WA)	Unlikely to occur
Northern Marsupial Mole *Notoryctes caurinus*			P4	Inhabits sand dunes and, to a lesser extent, adjacent swales where there is suitable deep, loose sand (DAWE, 2021b).	Within known range, however suitable habitat (sand dunes) not present within survey area. Survey area located along existing Great Central Road.	Unlikely to occur
Southern Marsupial Mole *Notoryctes typhlops*			P4	Inhabits sand dunes and, to a lesser extent, adjacent swales where there is suitable deep, loose sand (DAWE, 2021b).	Within known range, however suitable habitat (sand dunes) not present within survey area. Survey area located along existing Great Central Road.	Unlikely to occur
Black-footed Rock Wallaby *Petrogale lateralis* subsp. *lateralis*	EN	EN		Occur on a wide variety of rock types but require complex caves and crevices as opposed to large, smooth surfaces. Permanent water does appear to be an essential component of rock-wallaby habitat (DBCA, 2017).	No suitable habitat.	Unlikely to occur
Great Desert Skink *Liopholis kintorei*	VU	VU		The Great Desert Skink generally occurs on red sandplains and sand ridges. Vegetation usually consists of hummock grassland (Triodia basedowii, Triodia pungens and Triodia schinzii), with some scattered shrubs and occasional trees (e.g. Acacia spp., Eucalyptus spp., Hakea spp., Grevillea spp. and Allocasuarina decaisneana) (DAWE, 2021b).	Within known range. Suitable habitat present, however limited by proximity to the communities	Possibly occurs

5.2.10 Other areas of Significance

The DBCA lists 'Priority' species and communities which are under consideration for declaration as 'Threatened' under the BC Act. These Priority species/ communities have no formal legal protection until they are endorsed by the Minister as being Threatened.

No Priority species or PEC as listed by DBCA were identified within the survey area. There are no wetlands of international importance (Ramsar Wetlands) or national importance (Australian Nature Conservation Agency Wetlands) within the survey area.

There are no proposed or gazetted conservation reserves within the survey area. Both proposed and gazetted conservation reserves are managed by DBCA with gazetted conservation reserves vested with the Conservation and Parks Commission of Western Australia. The Conservation and Parks Commission is an independent statutory authority that was established under the Conservation and Land Management (CALM) Act 1984 in November 2000 and is the controlling body in which the State's conservation estate, including national parks, conservation parks, nature reserves, state forests and timber reserves, are vested. The Conservation and Parks Commission develops policies and provides independent advice to the Minister for Environment with respect to conservation, the management of ecological biodiversity and the application of ecologically sustainable forest management. The DBCA manages land on behalf of the Conservation and Parks Commission.

A map showing areas of significance in relation to the survey area is provided in Appendix A.

5.3 Discussion

One significant flora taxon was identified within the survey area; Seringia exastia. This taxon is listed as Critically Endangered under the EPBC Act and BC Act. This taxon is currently being nominated to be de-listed as a Threatened Flora taxon under the BC Act. Within a 50m radius of each plant is protected as an Environmentally Sensitive Area under the EP Act. No significant fauna or vegetation were identified during the field survey. There are no areas of significance (conservation wetlands, DBCA managed lands) located within the survey area.

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Appendix A:
Significant Species/ Communities Categories (BC Act and EPBC Act)

Definitions of Conservation Significant Species

Code	Category
State categories of Threatened and Priority species	
Threatened Species (T) Listed by order of the Minister as Threatened in the category of critically endangered, endangered or vulnerable under section 19(1), or is a rediscovered species to be regarded as Threatened species under section 26(2) of the Biodiversity Conservation Act 2016 (BC Act).	
CR	**Critically Endangered** Threatened species considered to be "facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as critically endangered under section 19(1)(a) of the BC Act in accordance with the criteria set out in section 20 and the ministerial guidelines. Published under schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for critically endangered fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for critically endangered flora.
EN	**Endangered** Threatened species considered to be "facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as endangered under section 19(1)(b) of the BC Act in accordance with the criteria set out in section 21 and the ministerial guidelines. Published under schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for endangered fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for endangered flora.
VU	**Vulnerable** Threatened species considered to be "facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as vulnerable under section 19(1)(c) of the BC Act in accordance with the criteria set out in section 22 and the ministerial guidelines. Published under schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for vulnerable fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for vulnerable flora.
Extinct species Listed by order of the Minister as extinct under section 23(1) of the BC Act as extinct or extinct in the wild.	
EX	**Extinct** Species where "*there is no reasonable doubt that the last member of the species has died*", and listing is otherwise in accordance with the ministerial guidelines (section 24 of the BC Act). Published as presumed extinct under schedule 4 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for extinct fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for extinct flora.
EW	**Extinct in the Wild** Species that *"is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; and it has not been recorded in its known habitat or expected habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its life cycle and form*", and listing is otherwise in accordance with the ministerial guidelines (section 25 of the BC Act). Currently there are no Threatened fauna or Threatened flora species listed as extinct in the wild. If listing of a species as extinct in the wild occurs, then a schedule will be added to the applicable notice.
Specially protected species Listed by order of the Minister as specially protected under section 13(1) of the BC Act. Meeting one or more of the following categories: species of special conservation interest; migratory species; cetaceans; species subject to international agreement; or species otherwise in need of special protection. Species that are listed as Threatened species (critically endangered, endangered or vulnerable) or extinct species under the BC Act cannot also be listed as Specially Protected species.	
IA	**International Agreement/ Migratory** Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth; and listing is otherwise in accordance with the ministerial guidelines (section 15 of the BC Act). Includes birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and fauna subject to the *Convention on the Conservation of Migratory Species of Wild Animals* (Bonn Convention), an environmental treaty under the United Nations Environment Program. Migratory species listed under the BC Act are a subset of the migratory animals, that are known to visit Western Australia, protected under the international agreements or treaties, excluding species that are listed as Threatened species.

Code	Category
	Published as migratory birds protected under an international agreement under schedule 5 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018*.
CD	**Species of special conservation interest** Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as Threatened, and listing is otherwise in accordance with the ministerial guidelines (section 14 of the BC Act). Published as conservation dependent fauna under schedule 6 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018*.
OS	**Other specially protected species** Fauna otherwise in need of special protection to ensure their conservation, and listing is otherwise in accordance with the ministerial guidelines (section 18 of the BC Act). Published as other specially protected fauna under schedule 7 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018*.
Priority species Possibly Threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of Priority for survey and evaluation of conservation status so that consideration can be given to their declaration as Threatened Fauna or Flora. Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring. Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.	
P1	**Priority 1: Poorly-known species** Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.
P2	**Priority 2: Poorly-known species** Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.
P3	**Priority 3: Poorly-known species** Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.
P4	**Priority 4: Rare, Near Threatened and other species in need of monitoring** (a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands. (b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as Conservation Dependent. (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.
Commonwealth categories of Threatened species	
EX	**Extinct** Taxa where there is no reasonable doubt that the last member of the species has died.
EW	**Extinct in the Wild** Taxa where it is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or 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.

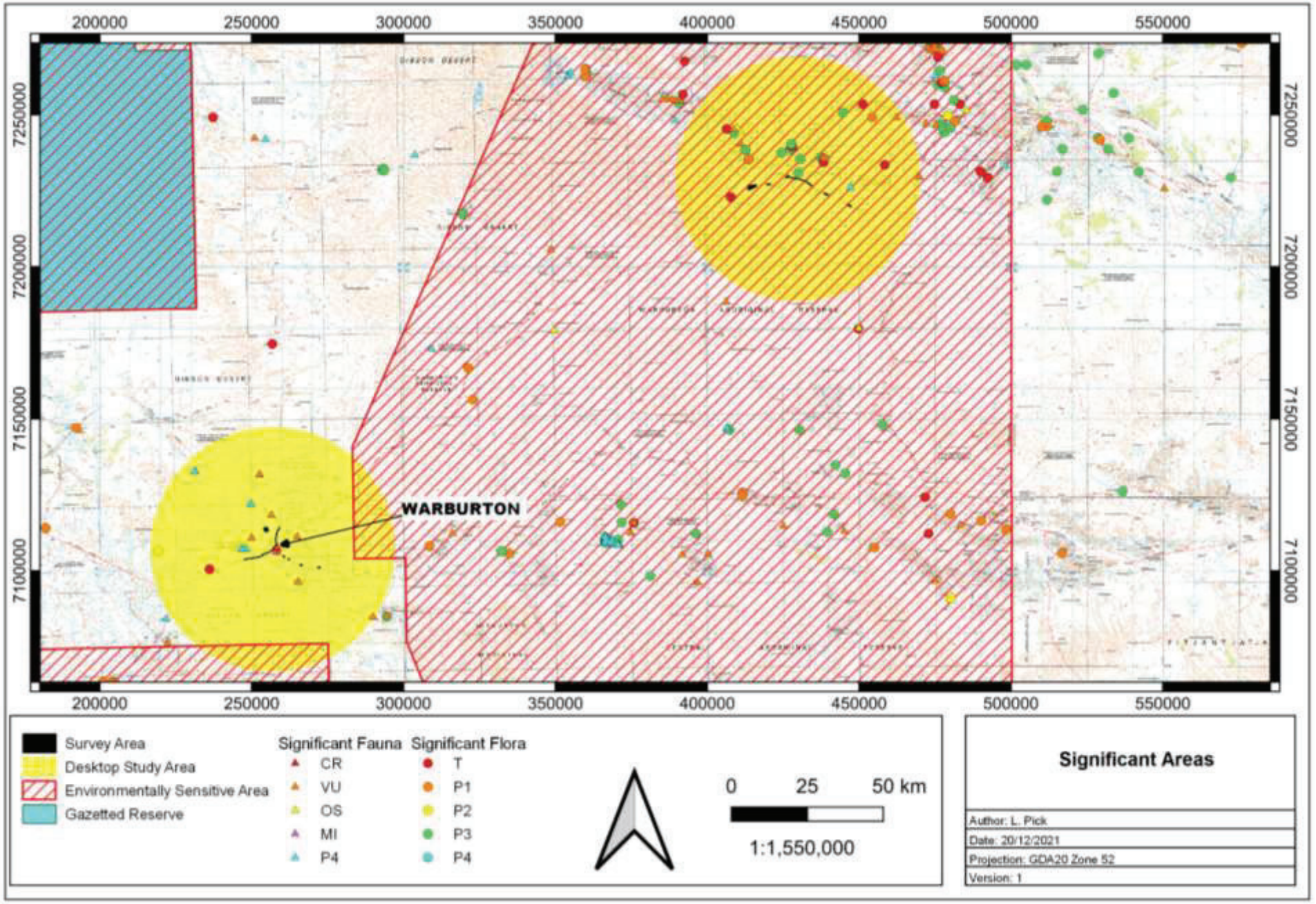
Code	Category
CR	**Critically Endangered** Taxa that are facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
EN	**Endangered** Taxa which are not critically endangered and is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
VU	**Vulnerable** Taxa which are not critically endangered or endangered and is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
CD	**Conservation Dependent** Taxa which are 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 actions necessary to stop the decline of, and support the recovery of, the species so that its chances of long term survival in nature are maximised; (iii) the plan of management is in force under a law of the Commonwealth or of a State or Territory; (iv) cessation of the plan of management would adversely affect the conservation status of the species.

Definitions of conservation significant communities

Category Code	Category
State categories of Threatened Ecological Communities (TEC)	
PD	**Presumed Totally Destroyed**
	An ecological community will be listed as Presumed Totally Destroyed if there are no recent records of the community being extant and either of the following applies:
	• records within the last 50 years have not been confirmed despite thorough searches or known likely habitats or;
	• all occurrences recorded within the last 50 years have since been destroyed.
CR	**Critically Endangered**
	An ecological community will be listed as Critically Endangered when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future, meeting any one of the following criteria:
	The estimated geographic range and distribution has been reduced by at least 90% and is either continuing to decline with total destruction imminent, or is unlikely to be substantially rehabilitated in the immediate future due to modification;
	The current distribution is limited i.e. highly restricted, having very few small or isolated occurrences, or covering a small area;
	The ecological community is highly modified with potential of being rehabilitated in the immediate future.
EN	**Endangered**
	An ecological community will be listed as Endangered when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. The ecological community must meet any one of the following criteria:
	The estimated geographic range and distribution has been reduced by at least 70% and is either continuing to decline with total destruction imminent in the short-term future, or is unlikely to be substantially rehabilitated in the short-term future due to modification;
	The current distribution is limited i.e. highly restricted, having very few small or isolated occurrences, or covering a small area;
	The ecological community is highly modified with potential of being rehabilitated in the short-term future.
VU	**Vulnerable**

Category Code	Category
	An ecological community will be listed as Vulnerable when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing high risk of total destruction in the medium to long term future. The ecological community must meet any one of the following criteria:
	The ecological community exists largely as modified occurrences that are likely to be able to be substantially restored or rehabilitated;
	The ecological community may already be modified and would be vulnerable to threatening process, and restricted in range or distribution;
	The ecological community may be widespread but has potential to move to a higher threat category due to existing or impending threatening processes.
Commonwealth categories of Threatened Ecological Communities (TEC)	
CE	**Critically Endangered** If, at that time, an ecological community is facing an extremely high risk of extinction in the wild in the immediate future (indicative timeframe being the next 10 years).
EN	**Endangered** If, at that time, an ecological community is not critically endangered but is facing a very high risk of extinction in the wild in the near future (indicative timeframe being the next 20 years).
VU	**Vulnerable** If, at that time, an ecological community is not critically endangered or endangered, but is facing a high risk of extinction in the wild in the medium–term future (indicative timeframe being the next 50 years).
Priority Ecological Communities	
P1	**Poorly-known ecological communities**
	Ecological communities with apparently few, small occurrences, all or most not actively managed for conservation (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) and for which current threats exist.
P2	**Poorly-known ecological communities**
	Communities that are known from few small occurrences, all or most of which are actively managed for conservation (e.g. within national parks, conservation parks, nature reserves, State forest, un-allocated Crown land, water reserves, etc.) and not under imminent threat of destruction or degradation.
P3	**Poorly known ecological communities**
	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:
	Communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or;
	Communities made up of large, and/or widespread occurrences, that may or not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing and inappropriate fire regimes.
P4	**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.
P5	**Conservation Dependent ecological communities**
	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.

Appendix B:
Regional maps of the desktop study area/ survey area in relation to areas of significance


200000
250000
300000
350000
400000
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550000
7250000
7200000
7150000
7100000
WARBURTON
Survey Area
Desktop Study Area
Environmentally Sensitive Area
Gazetted Reserve
Significant Fauna
CR
VU
OS
MI
P4
Significant Flora
T
P1
P2
P3
P4
0
25
50 km
1:1,550,000
Significant Areas
Author: L. Pick
Date: 20/12/2021
Projection: GDA20 Zone 52
Version: 1

Appendix C:
List of species identified within each vegetation type

(A) and blue text-denotes annual taxa; (W) and green text-denotes introduced flora; (T) and red text-denotes Threatened Flora (WAHERB, 2022)

Family	Genus	Taxon	CLP-AFW1	CLP-AFW2	CLP-OFW1	OD-EW1	SP-AFW1	SP-MWS1
Amaranthaceae	*Ptilotus*	*clementii (A)*			*			*
Amaranthaceae	*Ptilotus*	*exaltatus (A)*		*				
Amaranthaceae	*Ptilotus*	*obovatus*	*	*	*		*	
Amaranthaceae	*Ptilotus*	*polystachyus (A)*	*		*		*	*
Amaranthaceae	*Ptilotus*	*schwartzii* var. *schwartzii*	*	*				
Apocynaceae	*Leichhardtia*	*australis*						*
Asteraceae	*Centipeda*	*thespidioides (A)*				*		
Asteraceae	*Pterocaulon*	*sphacelatum*				*		
Chenopodiaceae	*Dissocarpus*	*paradoxus*	*		*			
Chenopodiaceae	*Maireana*	*georgei*	*	*	*			
Chenopodiaceae	*Rhagodia*	*eremaea*		*				
Chenopodiaceae	*Salsola*	*australis (A)*	*	*	*			
Chenopodiaceae	*Sclerolaena*	*bicornis*	*					
Chenopodiaceae	*Sclerolaena*	*cuneata*	*	*				
Chenopodiaceae	*Sclerolaena*	*densiflora*	*					
Chenopodiaceae	*Sclerolaena*	*diacantha*	*					
Chenopodiaceae	*Sclerolaena*	*eriacantha*	*					
Cleomaceae	*Arivela*	*viscosa (A)*	*	*	*	*		
Convolvulaceae	*Bonamia*	*erecta*	*					*
Convolvulaceae	*Convolvulus*	*clementii (A)*	*					
Cucurbitaceae	*Cucumis*	*argenteus*	*					
Cucurbitaceae	*Cucumis*	*myriocarpus (W)*			*			
Fabaceae	*Acacia*	*aptaneura*	*	*	*			
Fabaceae	*Acacia*	*ayersiana*					*	
Fabaceae	*Acacia*	*caesaneura*		*				
Fabaceae	*Acacia*	*incurvaneura*	*	*	*		*	
Fabaceae	*Acacia*	*kempeana*	*					
Fabaceae	*Acacia*	*melleodora*					*	
Fabaceae	*Acacia*	*pachyacra*	*				*	
Fabaceae	*Acacia*	*paraneura*	*				*	*
Fabaceae	*Acacia*	*pruinocarpa*	*		*		*	
Fabaceae	*Acacia*	*ramulosa* var. *ramulosa*					*	
Fabaceae	*Acacia*	*rhodophloia*	*	*	*		*	
Fabaceae	*Acacia*	*subcontorta*	*					
Fabaceae	*Acacia*	*tetragonophylla*	*	*		*		

Family	Genus	Taxon	CLP-AFW1	CLP-AFW2	CLP-OFW1	OD-EW1	SP-AFW1	SP-MWS1
Fabaceae	*Acacia*	*victoriae* subsp. *victoriae*	*			*		
Fabaceae	*Senna*	*artemisioides* subsp. *x artemisioides*		*				
Fabaceae	*Senna*	*artemisioides* subsp. *x sturtii*	*	*	*			*
Goodeniaceae	*Brunonia*	*australis*					*	
Goodeniaceae	*Goodenia*	*collaris*			*		*	*
Goodeniaceae	*Scaevola*	*parvifolia* subsp. *parvifolia*					*	
Goodeniaceae	*Scaevola*	*spinescens*	*	*				
Lamiaceae	*Dicrastylis*	*doranii*					*	*
Lamiaceae	*Dicrastylis*	*exsuccosa*					*	
Malvaceae	*Abutilon*	*cryptopetalum*		*				
Malvaceae	*Abutilon*	*otocarpum*					*	
Malvaceae	*Alyogyne*	*pinoniana*	*				*	*
Malvaceae	*Androcalva*	*loxophylla*	*					*
Malvaceae	*Seringia*	*exastia (T)*					*	
Malvaceae	*Sida*	*calyxhymenia*		*				
Malvaceae	*Sida*	sp. Excedentifolia (J/L Egan 1925)	*		*		*	
Myrtaceae	*Corymbia*	*opaca*			*			
Myrtaceae	*Eucalyptus*	*camaldulensis* subsp. *obtusa*				*		
Myrtaceae	*Eucalyptus*	*gamophylla*						*
Myrtaceae	*Melaleuca*	*glomerata*					*	
Poaceae	*Aristida*	*contorta (A)*	*	*	*		*	
Poaceae	*Aristida*	*holathera* var. *holathera* (A)	*		*		*	*
Poaceae	*Cenchrus*	*ciliaris (W)*	*	*	*	*		
Poaceae	*Cymbopogon*	*obtectus*		*				
Poaceae	*Eragrostis*	*eriopoda*	*	*			*	*
Poaceae	*Eriachne*	*flaccida*					*	
Poaceae	*Eriachne*	*mucronata*	*					*
Poaceae	*Monachather*	*paradoxus*	*					
Poaceae	*Triodia*	*basedowii*			*		*	*
Poaceae	*Triodia*	*melvillei*	*				*	*
Polygonaceae	*Rumex*	*vesicarius (W)*					*	
Proteaceae	*Grevillea*	*eriostachya*	*					*
Proteaceae	*Grevillea*	*striata*	*					
Proteaceae	*Hakea*	*lorea* subsp. *lorea*	*	*	*		*	*
Pteridaceae	*Cheilanthes*	*sieberi*	*	*			*	
Rubiaceae	*Psydrax*	*latifolia*	*					
Santalaceae	*Anthobolus*	*leptomerioides*	*					

Family	Genus	Taxon	CLP-AFW1	CLP-AFW2	CLP-OFW1	OD-EW1	SP-AFW1	SP-MWS1
Santalaceae	*Santalum*	*lanceolatum*				*		
Santalaceae	*Santalum*	*lanceolatum*		*				
Scrophulariaceae	*Eremophila*	*forrestii* subsp. *forrestii*	*					*
Scrophulariaceae	*Eremophila*	*latrobei* subsp. *glabra*	*	*			*	
Scrophulariaceae	*Eremophila*	*latrobei* subsp. *latrobei*	*	*			*	
Scrophulariaceae	*Eremophila*	*longifolia*				*		
Scrophulariaceae	*Eremophila*	*paisleyi*	*					
Scrophulariaceae	*Eremophila*	*punctata*	*					
Solanaceae	*Solanum*	*lasiophyllum*				*		
Solanaceae	*Solanum*	*orbiculatum* subsp. *orbiculatum*		*			*	

Appendix D:
Vegetation Type and Vegetation Condition Maps/ Fauna Habitat Maps

Appendix E:
Vegetation Condition Rating

Vegetation Condition Rating	South West and Interzone Botanical Provinces	Eremaean and Northern Botanical Provinces
Pristine	Pristine or nearly so, no obvious signs of disturbance or damage caused by human activities since European settlement.	
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species. Damage to trees caused by fire, the presence of non-aggressive weeds and occasional vehicle tracks.	Pristine or nearly so, no obvious signs of damage caused by human activities since European settlement.
Very Good	Vegetation structure altered, obvious signs of disturbance. Disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.	Some relatively slight signs of damage caused by human activities since European settlement. For example, some signs of damage to tree trunks caused by repeated fire, the presence of some relatively non-aggressive weeds, or occasional vehicle tracks.
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.	More obvious signs of damage caused by human activity since European settlement, including some obvious impact on the vegetation structure such as that caused by low levels of grazing or slightly aggressive weeds.
Poor		Still retains basic vegetation structure or ability to regenerate it after very obvious impacts of human activities since European settlement, such as grazing, partial clearing, frequent fires or aggressive weeds.
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds at high density, partial clearing, dieback and grazing.	Severely impacted by grazing, very frequent fires, clearing or a combination of these activities. Scope for some regeneration but not to a state approaching good condition without intensive management. Usually with a number of weed species present including very aggressive species.
Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees and shrubs.	Areas that are completely or almost completely without native species in the structure of their vegetation; i.e., areas that are cleared or 'parkland cleared' with their flora comprising weed or crop species with isolated native trees or shrubs.

Appendix F:
Quadrat Locations (NW Corner-GDA94)

Quadrat	Vegetation Code	Zone	Easting	Northing

Q1	CLP-AFW1	52 J	247523	7103844
Q2	SP-AFW1	52 J	248447	7103857
Q5	SP-AFW1	52 J	249496	7104053
Q6	SP-AFW1	52 J	250702	7104259
Q3	CLP-AFW1	52 J	251942	7104458
Q4	CLP-OFW1	52 J	253610	7105318
Q7	OD-EW1	52 J	254782	7105753
Q8	CLP-AFW1	52 J	260530	7104703
Q9	CLP-OFW1	52 J	262226	7103718
Q10	CLP-OFW1	52 J	266139	7101904
Q11	CLP-AFW1	52 J	272236	7100985
Q12	CLP-AFW1	52 J	255196	7113390
Q13	CLP-AFW1	52 J	255026	7113789
Q14	SP-AFW1	52 J	254500	7113703
Q15	OD-EW1	52 J	257972	7109324
Q16	CLP-AFW1	52 J	258010	7110330
Q17	CLP-AFW1	52 J	258673	7113208
Q18	CLP-AFW1	52 J	259010	7114288
Q19	CLP-AFW1	52 J	447239	7219960
Q20	CLP-AFW2	52 J	446227	7220274
Q21	CLP-AFW2	52 J	439504	7223736
Q22	CLP-AFW2	52 J	438552	7224093
Q23	CLP-AFW2	52 J	433739	7227121
Q24	CLP-AFW1	52 J	433216	7227349
Q25	CLP-AFW1	52 J	432334	7228222
Q26	SP-AFW1	52 J	430308	7228677
Q27	CLP-AFW1	52 J	428616	7229017
Q28	SP-AFW1	52 J	427432	7229407
Q29	SP-AFW1	52 J	426665	7229862
Q30	CLP-AFW1	52 J	426516	7229912
Q31	SP-AFW1	52 J	426351	7229866
Q32	SP-AFW1	52 J	425678	7229216
Q33	SP-MWS1	52 J	420546	7227063
Q34	CLP-OFW1	52 J	419684	7227111
Q35	SP-MWS1	52 J	415801	7226523
Q36	SP-MWS1	52 J	413730	7225464
Q37	SP-MWS1	52 J	414461	7226499
Q38	CLP-AFW1	52 J	413996	7225686

Appendix G:
Quadrat Datasheets

Appendix H:
Quadrat Photographs

Quadrat 1			
Direction	**East**	**South-East**	**South**
Quadrat 2			
Direction	**East**	**South-East**	**South**
Quadrat 3			
Direction	**East**	**South-East**	**South**

Quadrat 4			
Direction	**East**	**South-East**	**South**
Quadrat 5			
Direction	**East**	**South-East**	**South**
Quadrat 6			
Direction	**East**	**South-East**	**South**

Quadrat 7			
Direction	**East**	**South-East**	**South**
Quadrat 8			
Direction	**East**	**South-East**	**South**
Quadrat 9			
Direction	**East**	**South-East**	**South**

Quadrat 10			
Direction	**East**	**South-East**	**South**
Quadrat 11			
Direction	**East**	**South-East**	**South**
Quadrat 12			
Direction	**East**	**South-East**	**South**

Quadrat 13			
Direction	**East**	**South-East**	**South**
Quadrat 14			
Direction	**East**	**South-East**	**South**
Quadrat 15			
Direction	**East**	**South-East**	**South**

Quadrat 16			
Direction	**East**	**South-East**	**South**
Quadrat 17			
Direction	**East**	**South-East**	**South**
Quadrat 18			
Direction	**East**	**South-East**	**South**

Quadrat 19			
Direction	**East**	**South-East**	**South**
Quadrat 20			
Direction	**East**	**South-East**	**South**
Quadrat 21			
Direction	**East**	**South-East**	**South**

Quadrat 22			
Direction	**East**	**South-East**	**South**
Quadrat 23			
Direction	**East**	**South-East**	**South**
Quadrat 24			
Direction	**East**	**South-East**	**South**

Quadrat 25			
Direction	**East**	**South-East**	**South**
Quadrat 26			
Direction	**East**	**South-East**	**South**
Quadrat 27			
Direction	**East**	**South-East**	**South**

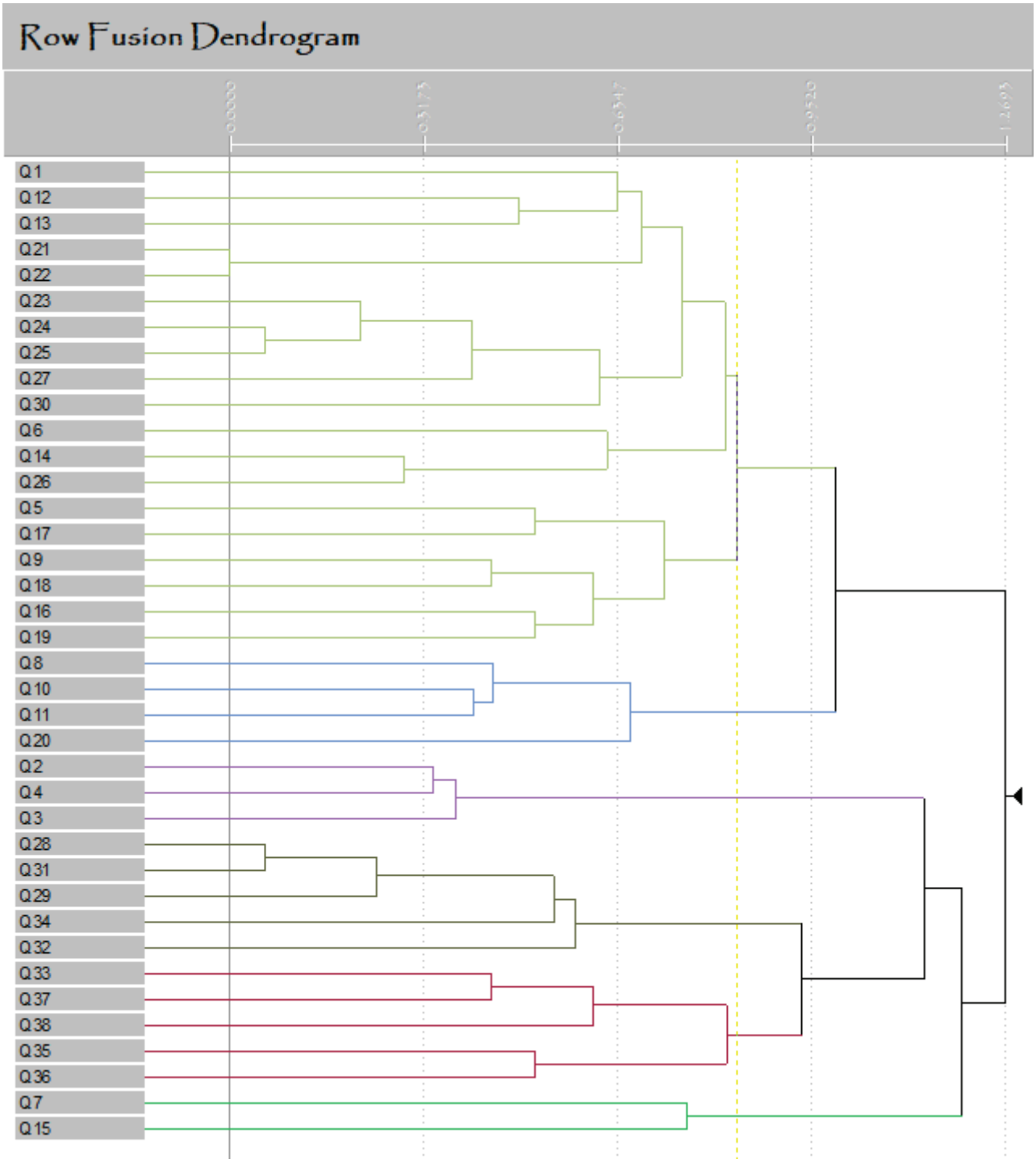
Quadrat 28			
Direction	**East**	**South-East**	**South**
Quadrat 29			
Direction	**East**	**South-East**	**South**
Quadrat 30			
Direction	**East**	**South-East**	**South**

Quadrat 31			
Direction	**East**	**South-East**	**South**
Quadrat 32			
Direction	**East**	**South-East**	**South**
Quadrat 33		No image available	No image available
Direction	**East**	**South-East**	**South**

Quadrat 34			
Direction	**East**	**South-East**	**South**
Quadrat 35			
Direction	**East**	**South-East**	**South**
Quadrat 36			
Direction	**East**	**South-East**	**South**

Quadrat 37			
Direction	**East**	**South-East**	**South**
Quadrat 38		No image available	No image available
Direction	**East**	**South-East**	**South**

Appendix I:
PATN Analysis Results


Row Fusion Dendrogram
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0.6347
0.9520
1.2693
Q1
Q12
Q13
Q21
Q22
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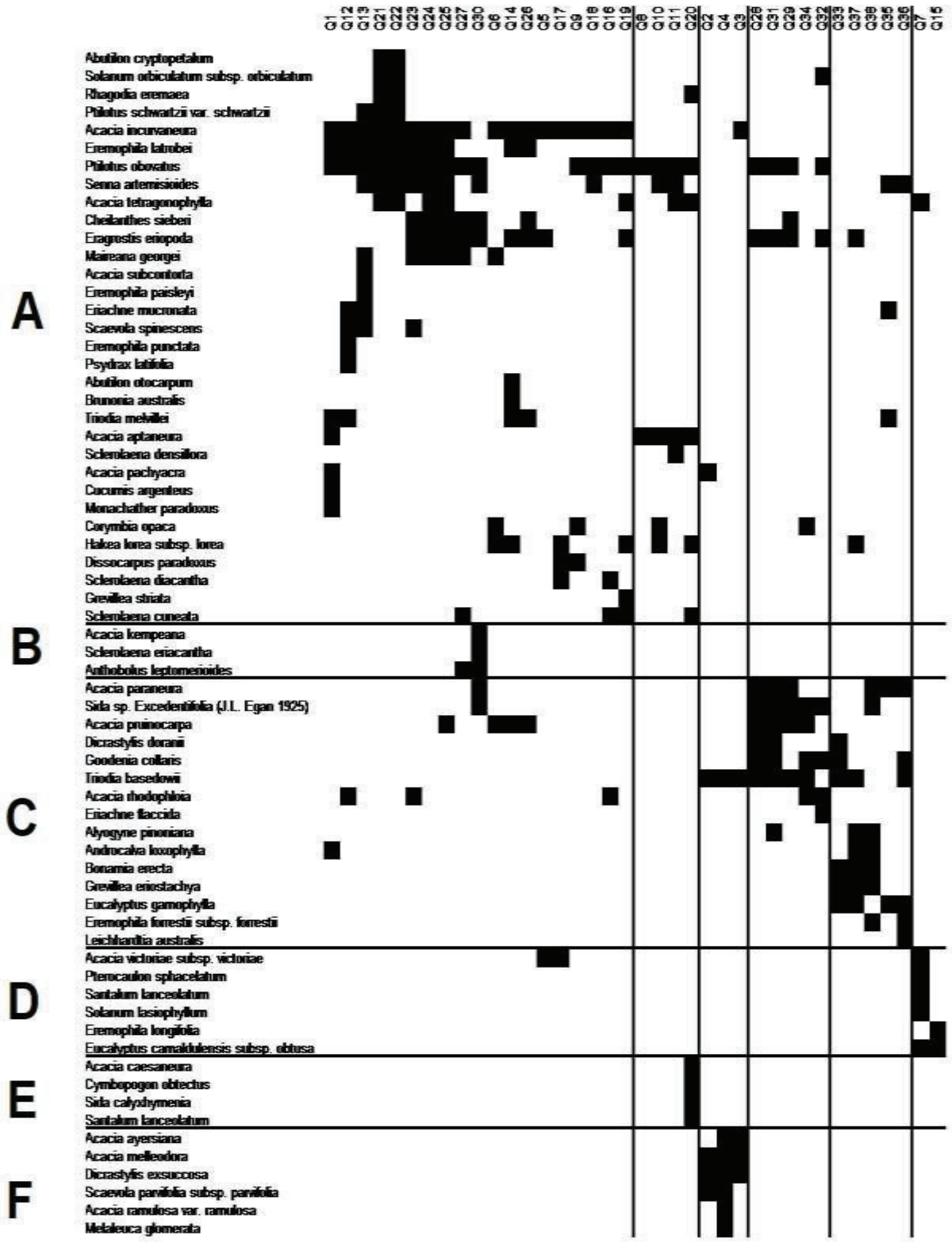
Q7
Q15


Q1
Q12
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Q21
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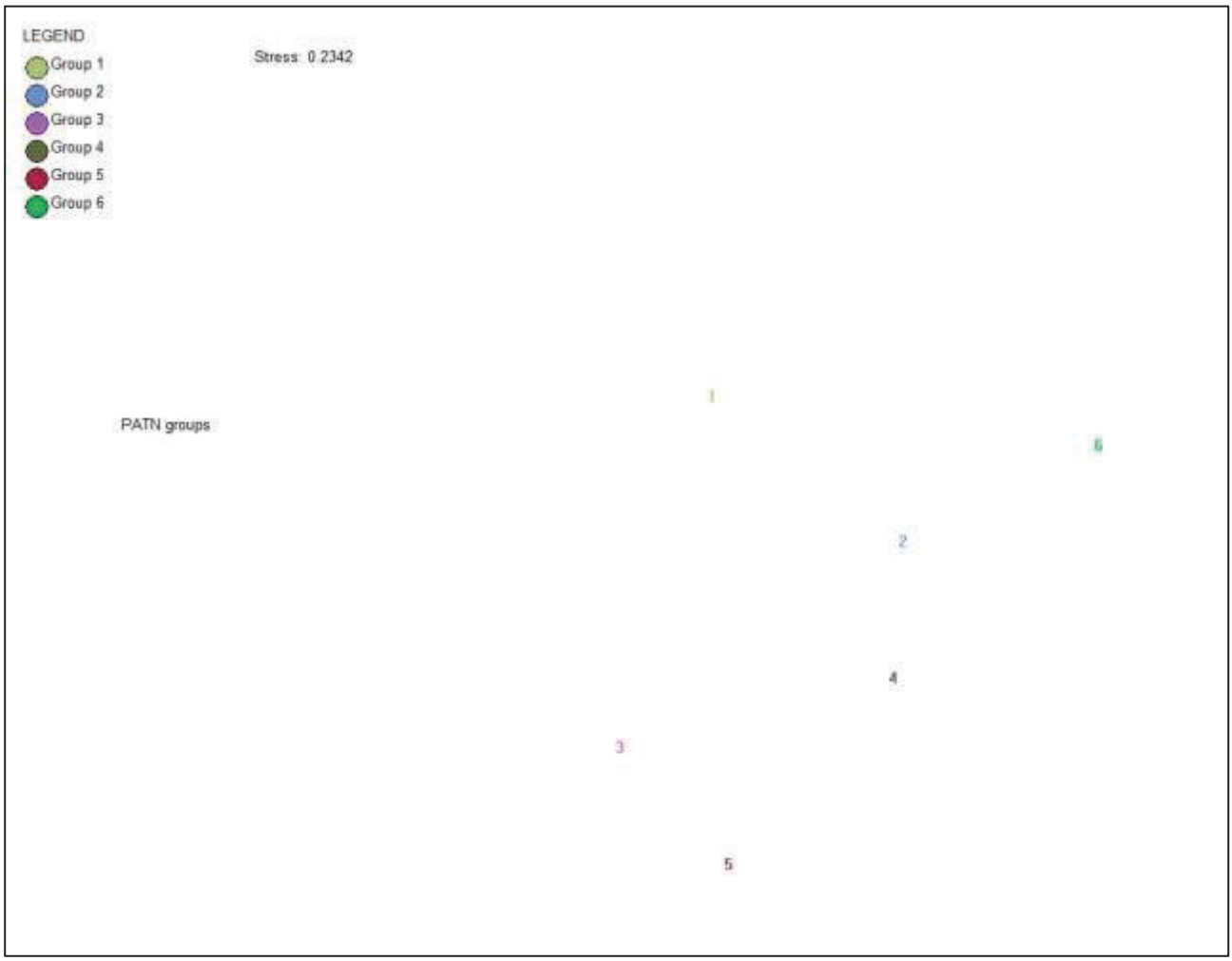
Q9
Q18
Q16
Q19
Q8
Q10
Q11
Q20
Q2
Q4
Q3
Q28
Q31
Q29
Q34
Q32
Q33
Q37
Q39
Q35
Q36
Q7
Q15
Abutilon cryptopetalum
Solanum orbiculatum subsp. orbiculatum
Rhagodia eremaea
Ptilotus schwartzii var. schwartzii
Acacia incurvaneura
Eremophila latrobei
Ptilotus obovatus
Senna artemisioides
Acacia tetragonophylla
Cheilanthes sieberi
Eragrostis eriopoda
Maireana georgei
Acacia subcontorta
Eremophila paisleyi
Eriachne mucronata
Scaevola spinescens
Eremophila punctata
Psydrax latifolia
Abutilon otocarpum
Brunonia australis
Triodia melvillei
Acacia aptaneura
Sclerolaena densiflora
Acacia pachyacra
Cucumis argenteus
Monachather paradoxus
Corymbia opaca
Hakea lorea subsp. lorea
Dissocarpus paradoxus
Sclerolaena diacantha
Grevillea striata
Sclerolaena cuneata
Acacia kempeana
Sclerolaena eriacantha
Anthobolus leptomerioides
Acacia paraneura
Sida sp. Excedentifolia (J.L. Egan 1925)
Acacia pruinocarpa
Dicrastylis doranii
Goodenia collaris
Triodia basedowii
Acacia rhodophloia
Eriachne flaccida
Alyogyne pinoniana
Androcalva loxophylla
Bonamia erecta
Grevillea eriostachya
Eucalyptus gamophylla
Eremophila forrestii subsp. forrestii
Leichhardtia australis
Acacia victoriae subsp. victoriae
Pterocaulon sphacelatum
Santalum lanceolatum
Solanum lasiophyllum
Eremophila longifolia
Eucalyptus camaldulensis subsp. obtusa
Acacia caesaneura
Cymbopogon obtectus
Sida calyxhymenia
Santalum lanceolatum
Acacia ayersiana
Acacia melleodora
Dicrastylis exsuccosa
Scaevola parvifolia subsp. parvifolia
Acacia ramulosa var. ramulosa
Melaleuca glomerata
A
B
C
D
E
F


LEGEND
Group 1
Group 2
Group 3
Group 4
Group 5
Group 6
Stress: 0.2342
PATN groups
1
6
2
4
3
5

Appendix J:
Database Search Results