ARROWSMITH HYDROGEN PROJECT ENVIRONMENTAL SURVEY

Infinite Blue Energy

ecoscape

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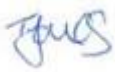
draft	Lyn Atkins Terri Jones	 D. Kaesehagen Director	 D. Kaesehagen Director	22/01/2021
final	Lyn Atkins	 Terri Jones Senior Ecologist	 Terri Jones Senior Ecologist	23/04/2021
final rev1	Lyn Atkins	 L Stewart Director	 L Stewart Director	7/10/2021
final rev2	Lyn Atkins	 L Stewart Director	 L Stewart Director	11/11/2021

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ACKNOWLEDGEMENTS

Ecoscape would like to thank Tim Hodge and Andrea Wills (Infinite Blue Energy), and Clair Hobson (Xodus Group) for their assistance.

SUMMARY

Infinite Blue Energy (IBE) has purchased land in Arrowsmith, south of Dongara, and is proposing to construct a combination of solar PV arrays and wind turbines to generate energy to power hydrogen production on site. The hydrogen is proposed to be both used locally and exported.

The area comprising the Arrowsmith Wind and Solar Farm is currently a combination of cleared farmland and grazed and ungrazed bushland. It contains an area with shallow freshwater lakes, including Arramall Lake, and a limestone karst system supporting at least two known caves (Arramall and River Caves). IBE is not proposing to clear or develop in the lakes area.

Ecoscape was appointed to conduct a Reconnaissance level flora and vegetation survey and Basic fauna survey to identify the significant biological attributes of the site which occupies 1,929.70 ha.

The desktop assessment identified the following significant features of the survey area:

- it is located immediately adjacent to Beekeepers Nature Reserve
- the nearest Threatened or Priority Ecological Community is approximately 25 km from the survey area
- 83 conservation-listed flora have been recorded within 25 km of the site, including eight Threatened Flora (TF) and a further six TF (or their habitat) are likely to or may occur
- 12 Priority-listed flora (PF) have a high desktop likelihood of occurring or (for one P4 species; *Eucalyptus zopherophloia*) are known to occur within the survey area
- 27 conservation-listed fauna species have been recorded from within 30 km of the survey area (DBCA and *NatureMap* search results) and a further 25 EPBC-listed species or their habitat are known to or could occur within the survey area; two were considered to have a High desktop likelihood of occurring: Malleefowl and Carnaby's Cockatoo, both listed as Threatened under both Commonwealth and Western Australian legislation. The survey area is not within the mapped breeding range of Carnaby's Cockatoo.

The flora and vegetation field survey, conducted during October 2020 as a Reconnaissance survey in accordance with the requirements of the Environmental Protection Authority (EPA) 2016 Flora and Vegetation Technical Guidance, and subsequent review, identified:

- 191 vascular flora species recorded from five floristic quadrats, 15 detailed relevés and during targeted conservation-listed flora searches and traverses of the site, including:
  - three Priority-listed flora (*Anthocercis intricata*, P3; *Beyeria cinerea* subsp. *cinerea*, P3; *Eucalyptus zopherophloia*, P4)
  - no TF or P1 species were assessed as having a High post-survey likelihood of occurring
  - two P2 (*Acacia vittata* and *Scholtzia calcicola*), two P3 (*Haloragis foliosa* and *Thryptomene* sp. Lancelin (M.E. Trudgen 14000) and one P4 (*Stawellia dimorphantha*) had a High post-survey likelihood of occurring. Impacts on clearing (if present) are unlikely to be significant for these, except possibly *Scholtzia calcicola* that is a poorly known and poorly collected species, and it is not possible to determine impacts on its population.
  - 39 introduced flora (weeds) including one Declared Pest species (**Echium plantagineum*, Patterson's Curse) and one Weed of National Significance (**Lycium ferocissimum*, African Boxthorn). There are no management requirements as a result of these species' presence.
  - two species are considered to have minor significance as a small range extension *(Melaleuca strobophylla*) and range infill (*Pelargonium littorale*)

- eight broad structural vegetation types:
  - **ArLOF**; *Acacia rostellifera* low open forest and **As1As2TOS**; *Acacia saligna* and *Acacia scirpifolia* tall open shrubland largely on disturbed uplands; neither are considered locally or regionally significant
  - **ArMrTS**; *Acacia rostellifera* and *Melaleuca rhaphiophylla* tall shrubland on karst limestone; this vegetation type is locally and regionally significant due the presence of the phreatophytic species *Eucalyptus camaldulensis* (indicative of a Groundwater Dependent Ecosystem; GDE) and its role maintaining the ecological integrity of a significant ecological community (the karst system), however, was in Degraded-Completely Degraded condition
  - **EcArMW**; *Eucalyptus camaldulensis* subsp. *obtusa* and *Acacia rostellifera* mid woodland in riparian areas and floodplains; considered locally and regionally significant due the presence of the phreatophytic species *Eucalyptus camaldulensis* (indicative of a GDE), however, was in Degraded-Completely Degraded condition
  - **EeLW**; *Eucalyptus erythrocorys* low woodland and **McArGaTS**; *Melaleuca cardiophylla*, *Acacia rostellifera* and *Grevillea argyrophylla* tall shrubland on limestone uplands, neither of which are considered locally or regionally significant
  - **LcBsJhMOS**; *Labichea cassioides*, *Banksia sessilis* var. *cygnorum* and *Jacksonia hakeoides* mid open shrubland on sandplain with limestone pavement; this vegetation type incorporated small areas of *Banksia prionotes* woodland, and is not considered locally or regionally significant
  - **MsCoMrMOW**; *Melaleuca strobophylla*, *Casuarina obesa* and *Melaleuca rhaphiophylla* mid open woodland associated with ephemeral lakes and floodplain areas; this vegetation type is locally and regionally significant for a number of reasons. These include its small extent, association with a restricted landform, degree of historical impact from grazing, importance for fauna as wetland fringing vegetation, and presence of the phreatophytic species *Eucalyptus camaldulensis* that is indicative of a GDE and important in maintaining the ecological integrity of a significant ecosystem (karst system). However, it was in Degraded-Completely Degraded condition.
- the vegetation condition ranged from Excellent (mostly on the sandplain in vegetation type **LcBsJhMOS**) to Completely Degraded.

The fauna and fauna habitat survey, conducted as a Basic survey in accordance with the EPA's 2020 Fauna Survey Technical Guidance identified the following significant attributes:

- 57 vertebrate fauna species including:
- one Threatened bird species: *Calyptorhynchus latirostris* (Carnaby's Cockatoo), listed as Endangered under both the EPBC Act and BC Act
- one Migratory bird species: *Calidris acuminata* (Sharp-tailed Sandpiper), listed under the EPBC Act
- one Marine bird species: *Merops ornatus* (Rainbow Bee-eater) listed under the EPBC Act, although not considered threatened
- the post-survey likelihood assessment identified a further Migratory bird as having a High likelihood of occurring in the survey area; *Actitis hypoleucos* (Common Sandpiper)
- two microbat species recorded during the survey (*Austronomus australis* and *Vespadelus baverstocki*) are significant as range extensions, and one mammal, *Sminthopsis dolichura* (Little Long-tailed Dunnart), represents a range infill; none of these are conservation-listed
- eight fauna habitat types are present in the survey area (Heath, Mallee Woodland, Pastoral, Riparian, Shrubland, Waterbody (seasonal), Wetland and Woodland), of which the Waterbody and Wetland habitats are considered important for conservation-listed migratory wading birds

- the Pastoral and Wetland habitats are considered significant for Carnaby's Cockatoo, noting that Heath and Shrubland may also represent foraging habitat, particularly areas with *Banksia prionotes* trees that are considered as a premium food source.

As a result of the survey IBE has revised the proposed site layout to minimise impacts (clearing) within Carnaby's Cockatoo habitat.

ACRONYMS AND ABBREVIATIONS

Table 1: Acronyms and abbreviations

Acronyms and abbreviations	
BAM Act	Western Australian *Biosecurity and Agriculture Management Act 2007*
BC Act	Western Australian *Biodiversity Conservation Act 2016*
BoM	Bureau of Meteorology
C1, C2, C3	Declared Pest categories under the BAM Act
CALM	Western Australian Department of Conservation and Land Management (1985-2006, now DBCA)
CD	Conservation Dependent (fauna; specially protected species under the Western Australian BC Act)
CR	Critically Endangered (listed under Commonwealth EPBC Act and/or Western Australian BC Act)
DAWE	Commonwealth Department of Agriculture, Water and Environment (2020-)
DBCA	Western Australian Department of Biodiversity, Conservation and Attractions
DEC	Western Australian Department of Environment and Conservation (2006-2013, now DBCA)
DEWHA	Commonwealth Department of the Environment, Water, Heritage and the Arts (2007-2010, now DAWE)
DMIRS	Western Australian Department of Mines, Industry Regulation and Safety
DPaW	Western Australian Department of Parks and Wildlife (2013-2017, now DBCA)
DoE	Commonwealth Department of the Environment (2013-2016, now DAWE)
DotEE	Commonwealth Department of the Environment and Energy (2016-2020)
DPIRD	Western Australian Department of Primary Industries and Rural Development
DSEWPaC	Commonwealth Department of Sustainability, Environment, Water, Population and Communities (2010-2013, now DAWE)
DWER	Western Australian Department of Water and Environmental Regulation
EN	Endangered (listed under Commonwealth EPBC Act and/or Western Australian BC Act)
Ecoscape	Ecoscape (Australia) Pty Ltd
EP Act	Western Australian *Environmental Protection Act 1986*
EPA	Western Australian Environmental Protection Authority
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
GDA 94	Geographic Datum of Australia 1994
GDE/GDV	Groundwater Dependent Ecosystem/Groundwater Dependent Vegetation
GPS	Global Positioning System
ha	hectare/hectares
IBRA	Interim Biogeographic Regionalisation for Australia
IUCN	International Union for Conservation of Nature
km	kilometre/kilometres
m	metre/metres
MA	Marine species (fauna; specially protected species under the Commonwealth EPBC Act)
MI	Migratory species (fauna; specially protected species under the Western Australian BC Act)
NVIS	National Vegetation Inventory System
MNES	Matters of National Environmental Significance
OS	Other specially protected species (fauna; specially protected species under the Western Australian BC Act)
P; P1, P2, P3, P4, P5	Priority Flora and Fauna species rankings (P1-P4) or Priority Ecological Communities (P1-P5)
PEC	Priority Ecological Community
PA	Potential Black Cockatoo breeding trees with available hollows
PF	Priority Flora

Acronyms and abbreviations	
PMST	Protected Matters Search Tool (hosted by DAWE, used to search for MNES)
SoW	Scope of Works
sp.	Species (generally referring to an unidentified taxon or when a phrase name has been applied)
subsp.	Subspecies (infrataxon)
S1	Schedule 1 Fauna species listed under the BC Act
TEC	Threatened Ecological Community
TF	Threatened Flora (formerly termed Declared Rare Flora, DRF, in Western Australia)
var.	Variety (infrataxon)
VU	Vulnerable (listed under Commonwealth EPBC Act and/or Western Australian BC Act)
WAH	Western Australian Herbarium
WAM	Western Australian Museum
WAOL	Western Australian Organism List
WONS	Weeds of National Significance
*****	Introduced flora species (i.e. weed)

1 INTRODUCTION

1.1 BACKGROUND

Infinite Blue Energy (IBE) specialises in renewable energy production from solar photo voltaic (solar PV), wind turbines, hydrogen, fuel cell technologies and biomass.

IBE is proposing to construct a combination of solar PV arrays and wind turbines in Arrowsmith, south of Dongara WA, to generate energy to power hydrogen production on site. The hydrogen is proposed to be both used locally and exported.

The area comprising the Arrowsmith Wind and Solar Farm is currently a combination of cleared farmland and grazed and ungrazed bushland. It contains an area with shallow freshwater lakes, including Arramall Lake, and a limestone karst system supporting at least two known caves (Arramall and River Caves). IBE is not proposing to clear or develop in the lakes area.

IBE appointed Ecoscape to conduct a biological survey of its Arrowsmith holdings, the results of which will be used in support of environmental approvals.

1.2 SURVEY AREA

The IBE Arrowsmith Wind and Solar Farm project area, known as the 'survey area' in this report, is located within the Shire of Irwin in the Mid West region of Western Australia, approximately 30 km south of Dongara and 320 km north of Perth (**Figure 1**). The total extent of the survey area, including cleared paddocks, was 1,929.70 ha.

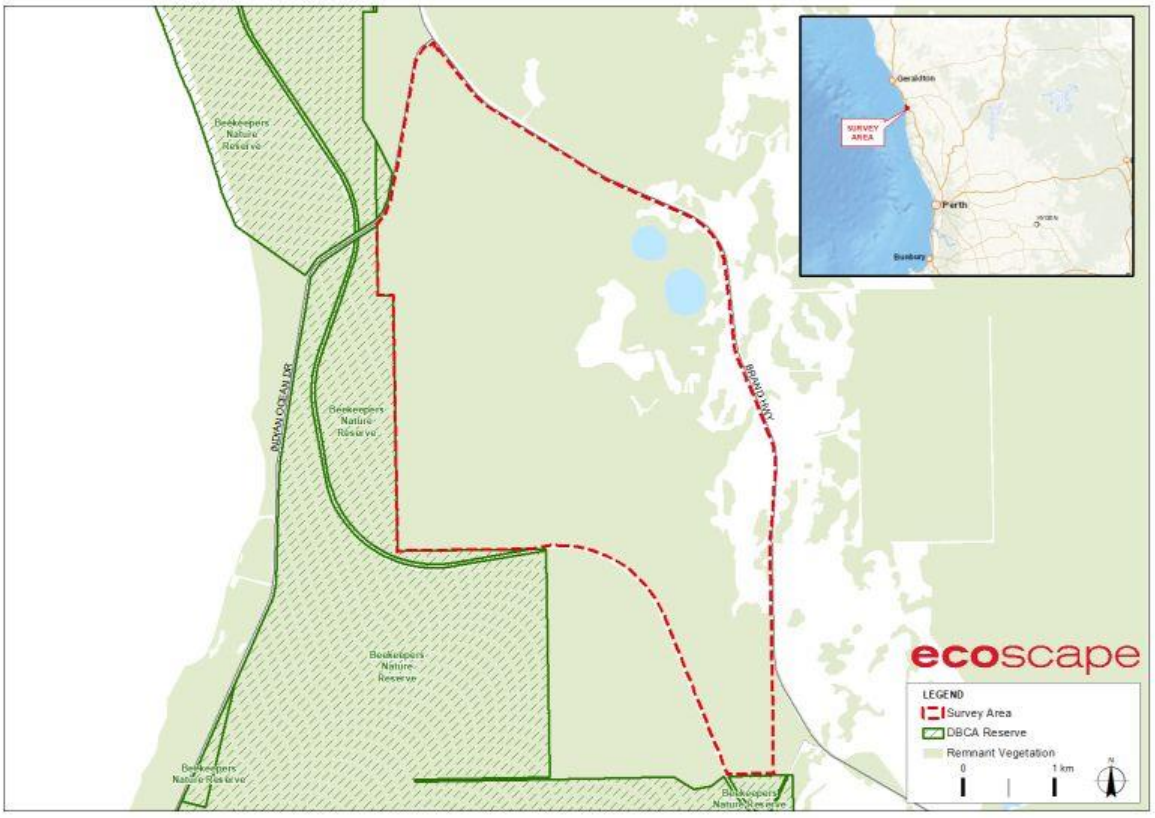

Figure 1: Survey area location

1.3 SURVEY REQUIREMENTS

The requirements of the survey were to:

- conduct a Reconnaissance flora and vegetation survey to describe the botanical attributes of the site and:
  - identify if there are any significant constraints to clearing on any parts of the site
  - determine if additional survey is required
- conduct a Basic fauna survey to identify the fauna assemblage and habitat of the site.

1.4 COMPLIANCE

This environmental assessment was conducted in accordance with Commonwealth and State legislation and guidelines:

- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- Western Australian *Environmental Protection Act 1986* (EP Act)
- Western Australian *Biodiversity Conservation Act 2016* (BC Act)
- Western Australian *Biodiversity Conservation Regulations 2018*
- Western Australian *Animal Welfare Act 2002*
- Department of Environment, Water, Heritage and the Arts (DEWHA 2009) *Matters of National Environmental Significance. Significant impact guidelines 1.1 - Environment Protection and Biodiversity Conservation Act 1999*
- Department of Sustainability Environment Water Population and Communities (DSEWPaC 2011a) *Survey guidelines for Australia's threatened mammals*
- DSEWPaC (2011b) *Survey guidelines for Australia's threatened reptiles*
- DEWHA (2010a) *Survey guidelines for Australia's threatened bats*
- DEWHA (2010b) *Survey guidelines for Australia's threatened birds*
- DSEWPaC (2012) *EPBC Act referral guidelines for three threatened black cockatoo species: Carnaby's cockatoo (endangered) Calyptorhynchus latirostris, Baudin's cockatoo (vulnerable) Calyptorhynchus baudinii, Forest red-tailed black cockatoo (vulnerable) Calyptorhynchus banksii naso, known in this document as the Black Cockatoo Referral Guidelines*
- Commonwealth of Australia (2017) *Revised draft referral guideline for three threatened black cockatoo species: Carnaby's Cockatoo, Baudin's Cockatoo and the Forest Red-tailed Black Cockatoo, known in this document as the Revised Draft Referral Guideline.*

As well as those listed above, the assessment complied with Environmental Protection Authority (EPA) requirements for environmental survey and reporting in Western Australia, as outlined in:

- EPA (2020a) *Technical Guidance – Terrestrial vertebrate fauna surveys for environmental impact assessment*, known herein as the Fauna Technical Guidance
- EPA (2016) *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment*, known herein as the Flora and Vegetation Technical Guidance
- EPA (2020b) *Statement of Environmental Principles, Factors and Objectives*.

1.4.1 COMMONWEALTH ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999

The EPBC Act is a legal framework to protect and manage matters of national environmental significance (MNES) including important flora, fauna, ecological communities and heritage areas listed under the Act.

Threatened taxa (flora and fauna) are protected under the EPBC Act, which lists species and ecological communities that have been assessed as meeting the criteria to be listed as Critically Endangered, Endangered, Vulnerable, Conservation Dependant, Extinct, or Extinct in the Wild, as detailed in **Table 13** in **Appendix One**. Threatened Ecological Communities are categorised as Critically Endangered, Endangered or Vulnerable, also detailed in this table.

1.4.2 WESTERN AUSTRALIAN ENVIRONMENTAL PROTECTION ACT 1986

The Western Australian EP Act was created to provide for an Environmental Protection Authority (the EPA) that has the responsibility for:

- prevention, control and abatement of pollution and environmental harm
- conservation, preservation, protection, enhancement and management of the environment
- matters incidental to or connected with the above.

The EPA is responsible for providing the guidance and policy under which environmental assessments are conducted. It conducts environmental impact assessments (based on the information provided by the proponent), initiates measures to protect the environment and provides advice to the Minister responsible for environmental matters.

1.4.3 WESTERN AUSTRALIAN BIODIVERSITY CONSERVATION ACT 2016

The Western Australian BC Act provides for the conservation, protection and ecologically sustainable use of biodiversity and biodiversity components in Western Australia.

Threatened species (both flora and fauna) and ecological communities that meet the categories listed within the BC Act are protected under this legislation and require authorisation by the Minister to take or disturb. These are known as Threatened Flora, Threatened Fauna and Threatened Ecological Communities. The conservation categories of Critically Endangered, Endangered and Vulnerable are detailed in **Table 14** in **Appendix One**; these categories align with those of the EPBC Act.

Flora and fauna species may be listed as being of special conservation interest if they have a naturally low population, restricted natural range, are subject to or recovering from a significant population decline or reduction of range or are of special interest, and the Minister considers that taking may result in depletion of the species. Migratory species and those subject to international agreement are also listed under the Act. These are known as specially protected species in the BC Act.

The most recent flora and fauna listings were published in the *Government Gazette* on 11 September 2018 (Government of Western Australia 2018a).

1.5 FLORA

1.5.1 THREATENED AND PRIORITY FLORA

Conservation significant flora species are those that are listed as (Threatened Flora (TF) and (within Western Australia) as Priority Flora (PF). TF species are listed as Threatened by the Western Australian DBCA and protected under the provisions of the BC Act. Some State-listed TF are provided with additional protection as they are also listed under the Commonwealth EPBC Act (see **Table 13** in **Appendix One** for conservation status category descriptions).

Flora are listed as PF where populations are geographically restricted or threatened by local processes, or where there is insufficient information to formally assign them to TF categories. Whilst PF are not specifically listed

in the BC Act, some may qualify as being of special conservation interest and thereby have a greater level of protection than unlisted species.

There are seven categories covering Western Australian-listed TF and PF species which are outlined in **Table 14** in **Appendix One**. PF for Western Australia are regularly reviewed by the DBCA whenever new information becomes available, with species status altered or removed from the list when data indicates that they no longer meet the requirements outlined in **Table 14**.

1.5.2 OTHER SIGNIFICANT FLORA

According to the Flora and Vegetation Technical Guidance (EPA 2016) other than being listed as Threatened or Priority Flora, a species can be considered as significant if it is considered to be:

- locally endemic or association with a restricted habitat type (e.g. Groundwater Dependent Ecosystems)
- a new species or has anomalous features that indicate a potential new species
- at the extremes of range, recently discovered range extensions (generally considered greater than 100 km or in a different bioregion), or isolated outliers of the main range)
- unusual species, including restricted subspecies, varieties or naturally occurring hybrids
- relictual status, being representative of taxonomic groups that no longer occur widely in the broader landscape.

1.5.3 INTRODUCED FLORA

Introduced plant species, known as weeds, are plants that are not indigenous to an area and have been introduced either directly or indirectly (unintentionally) through human activity. Species are regarded as introduced if they are listed as 'alien' on *FloraBase* (Western Australian Herbarium [WAH] 1998-2020) and are designated with an asterisk (*) in this document.

1.5.3.1 Weeds of National Significance

At a national level there are 36 weed species listed as Weeds of National Significance (WoNS) (Weeds Australia & Centre for Invasive Species Solutions 2020). The Commonwealth *Australian Weeds Strategy 2017-2027* (Invasive Plants and Animals Committee 2016) describes broad goals and objectives to manage these species.

1.5.3.2 Declared Pest Plants

The Western Australian Organism List (WAOL) details organisms listed as Declared Pests under the *Biosecurity and Agriculture Management Act 2007* (BAM Act). Under the BAM Act, Declared Pests are listed as one of the three categories, or exempt:

- C1 (exclusion), that applies to pests not established in Western Australia; control measures are to be taken to prevent their entry and establishment
- C2 (eradication), that applies to pests that are present in Western Australia but in low numbers or in limited areas where eradication is still a possibility
- C3 (management), that applies to established pests where it is not feasible or desirable to manage them in order to limit their damage
- exempt (no category).

1.6 ECOLOGICAL COMMUNITIES/VEGETATION

Most, although not all, conservation-listed ecological communities are defined by vegetation, usually within the context of a defined landform or unique habitat. Although 'vegetation' and 'ecological communities' are

not interchangeable terms, this assessment describes the vegetation of the survey area with conservation status taking into consideration the interactions of the vegetation with the biological and physical environment within which it occurs (i.e. the ecological community as a whole).

1.6.1 EPBC-LISTED THREATENED ECOLOGICAL COMMUNITIES

Ecological communities are naturally occurring biological assemblages associated with a particular type of habitat (DBCA 2020). At Commonwealth level, Threatened Ecological Communities (TECs) are protected under the Commonwealth EPBC Act. Ecological communities are categorised as Critically Endangered, Endangered and Vulnerable as described in **Table 13** in **Appendix One**.

1.6.2 WESTERN AUSTRALIAN THREATENED ECOLOGICAL COMMUNITIES

Western Australian TECs are protected under the BC Act. TECs are categorised much like those of the EPBC Act, shown in **Table 15** in **Appendix One**.

Currently described TECs are listed on the DBCA website, with the most recent list endorsed by the Minister for Environment in June 2018 (DBCA 2018).

1.6.3 WESTERN AUSTRALIAN PRIORITY ECOLOGICAL COMMUNITIES

DBCA maintains a list of Priority Ecological Communities (PECs). PECs include potential TECs that do not meet survey criteria, or that are not adequately defined. They are not protected under legislation but are taken into consideration as part of the environmental approvals process.

Currently described PECs are listed on the DBCA website, with the most recent list dated 15 July 2021 (Species and Communities Program; DBCA 2021).

1.6.4 OTHER SIGNIFICANT VEGETATION

According to the Flora and Vegetation Technical Guidance (EPA 2016), other than being listed as a TEC or PEC, vegetation can be considered as significant if it is considered to have:

- restricted distribution
- a degree of historical impact from threatening processes
- a role as a refuge
- provides an important function required to maintain ecological integrity of a significant ecosystem.

Due to its importance towards the function of a significant ecosystem and restricted distribution, Groundwater Dependent Ecosystems, in particular the vegetation that comprises them, can be considered as significant vegetation. A definition is provided below.

1.6.4.1 Groundwater Dependent Ecosystems

Groundwater Definition

Groundwater is water that is found in the saturated zone of the soil, where all soil pores are filled with water. The water table is the upper surface of the saturated zone in an unconfined aquifer. Groundwater may also occur as a perched aquifer located above unsaturated rock formations as a result of a discontinuous permeable layer or held under pressure in a confined aquifer (Goulburn-Murray Water 2010).

Groundwater Dependent Ecosystems Definition

Groundwater Dependent Ecosystems (GDEs) have been defined as ecosystems that are dependent on groundwater for their survival at some stage or stages of their lifecycle, however groundwater use cannot be equated with groundwater dependence (Eamus 2009). In some contexts, GDEs are also known as Groundwater Dependent Vegetation (GDVs).

Hatton and Evans (1998) identified four types of GDEs based on their geographic setting: terrestrial vegetation (vegetation communities and dependent fauna that have seasonal or episodic dependence on groundwater), river base flow systems (aquatic and riparian ecosystems that exist in or adjacent to streams that are fed by groundwater base flow), aquifer and cave ecosystems, and wetlands.

Eamus *et al.* (2006) identified three primary classes based on type of groundwater reliance:

1. Aquifer and cave ecosystems.
2. All ecosystems dependent on the surface expression of groundwater:
    a) river base flows
    b) wetlands, swamplands
    c) seagrass beds in estuaries
    d) floodplains
    e) mound springs
    f) riparian vegetation
    g) saline discharge to lakes
    h) low lying forests.
3. All ecosystems dependent on the subsurface presence of groundwater, often accessed via the capillary fringe (non-saturated zone above the water table) when roots penetrate this zone:
    a) River Red Gum (*Eucalyptus camaldulensis*) forests
    b) Banksia woodlands
    c) Riparian vegetation in the wet/dry tropics.

Atlas of Groundwater Dependent Ecosystems

The Groundwater Dependent Ecosystems Atlas (BoM 2020a) indicates the presence of known GDEs and Inflow Dependent Ecosystems (IDEs) in Australia.

An Inflow Dependent Ecosystem is one in which the vegetation within the landscape is likely to be accessing water in addition to rainfall, from soil or surface water or groundwater, assessed using remotely sensed data. The likelihood of a landscape using additional water is rated from one to 10 (low to high), with a rating above six indicating that a landscape is likely to be inflow dependent (BoM 2020a).

1.7 FAUNA

1.7.1 EPBC-LISTED THREATENED FAUNA

At a Commonwealth level, Threatened Fauna are protected under the EPBC Act, which lists species and ecological communities that are considered Critically Endangered, Endangered, Vulnerable, Conservation Dependant, Extinct, or Extinct in the Wild (detailed in **Table 13** in **Appendix One**).

Migratory species subject to international agreements are also protected under the EPBC Act. The definition of a migratory species under the Act follows that prescribed by the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention) (DotEE 2020):

> *Migratory species are the entire population or any geographically separate part of the population of any species or lower taxon of wild animals, a significant proportion of whose members cyclically and predictably cross one or more national jurisdictional boundaries.*

Species listed by the following international agreements are currently protected under the EPBC Act:

- *Convention on the Conservation of Migratory Species of Wild Animals* (Bonn Convention)
- *China-Australia Migratory Bird Agreement* (CAMBA)
- *Japan-Australia Migratory Bird Agreement* (JAMBA)
- *Republic of Korea-Australia Migratory Bird Agreement* (ROKAMBA).

1.7.2 WESTERN AUSTRALIAN BC ACT-LISTED FAUNA

Threatened fauna that meet the categories listed within the BC Act are protected and require authorisation by the Minister to take or disturb. The conservation categories of Critically Endangered, Endangered and Vulnerable have been aligned with those detailed in the EPBC Act.

Fauna species may be listed as being of special conservation interest if they have a naturally low population, restricted natural range, are subject to or recovering from a significant population decline or reduction of range or are of special interest, and the Minister considers that taking may result in depletion of the species. These are known as Specially Protected Species in the BC Act.

The categories covering State-listed threatened fauna species are outlined in **Table 14** in **Appendix One**.

1.7.3 WESTERN AUSTRALIAN PRIORITY FAUNA

Conservation significant fauna species are listed by the DBCA as Priority Fauna where populations are geographically restricted or threatened by local processes, or where there is insufficient information to formally assign them to threatened fauna categories. Whilst Priority Fauna are not specifically listed in the BC Act, these have a greater level of significance than other native species. The categories covering Priority Fauna species are outlined in **Table 14** in **Appendix One**.

1.8 ENVIRONMENTALLY SENSITIVE AREA

There are a number of areas around Western Australia identified as being of environmental significance within which the exemptions to the Native Vegetation Clearing Regulations do not apply. These are referred to as Environmentally Sensitive Areas (ESAs), and are declared under section 51B of the EP Act and described in the *Environmental Protection (Environmentally Sensitive Areas) Notice*.

1.9 CONSERVATION ESTATE

The National Reserve System is a network of protected areas managed for conservation under international guidelines. The objective of placing areas of bushland into the Conservation Estate is to achieve and maintain a comprehensive, adequate and representative reserve system for Western Australia. The Conservation and Parks Commission is the vesting body for conservation lands, forest and marine reserves that are managed by DBCA (Government of Western Australia 2018b).

2 EXISTING ENVIRONMENT (DESKTOP ASSESSMENT)

2.1 PHYSICAL ENVIRONMENT

2.1.1 CLIMATE

According to the Köppen-Geiger climate classification, the survey area has a temperate climate with hot, dry summers (Class Csa) (Peel, Finlayson & McMahon 2007). This classification is considered to represent a Mediterranean climate where average summer maximum temperatures exceed 22°C and the average coldest month maximum is between 18 and -3°C, and summer rainfall is less than one third of winter rainfall.

The closest Bureau of Meteorology (BoM) station with long term rainfall records is Green Grove (BoM 2020b station 8057, operating since 1951) located approximately 6 km from of the survey area. The mean annual rainfall is 483.5 mm with the highest rainfall from May through to August.

The closest near-coastal BoM station with long term temperature records is Jurien Bay (station 9131, operating since 1968) located approximately 85 km south of the survey area. February is the hottest month with a mean maximum temperature of 30.8° and minimum of 18.0°. July is the coldest month with a mean maximum of 19.6° and minimum of 9.5°.

Figure 2 shows the average rainfall and temperatures of the survey area, with rainfall for the months preceding the field survey.

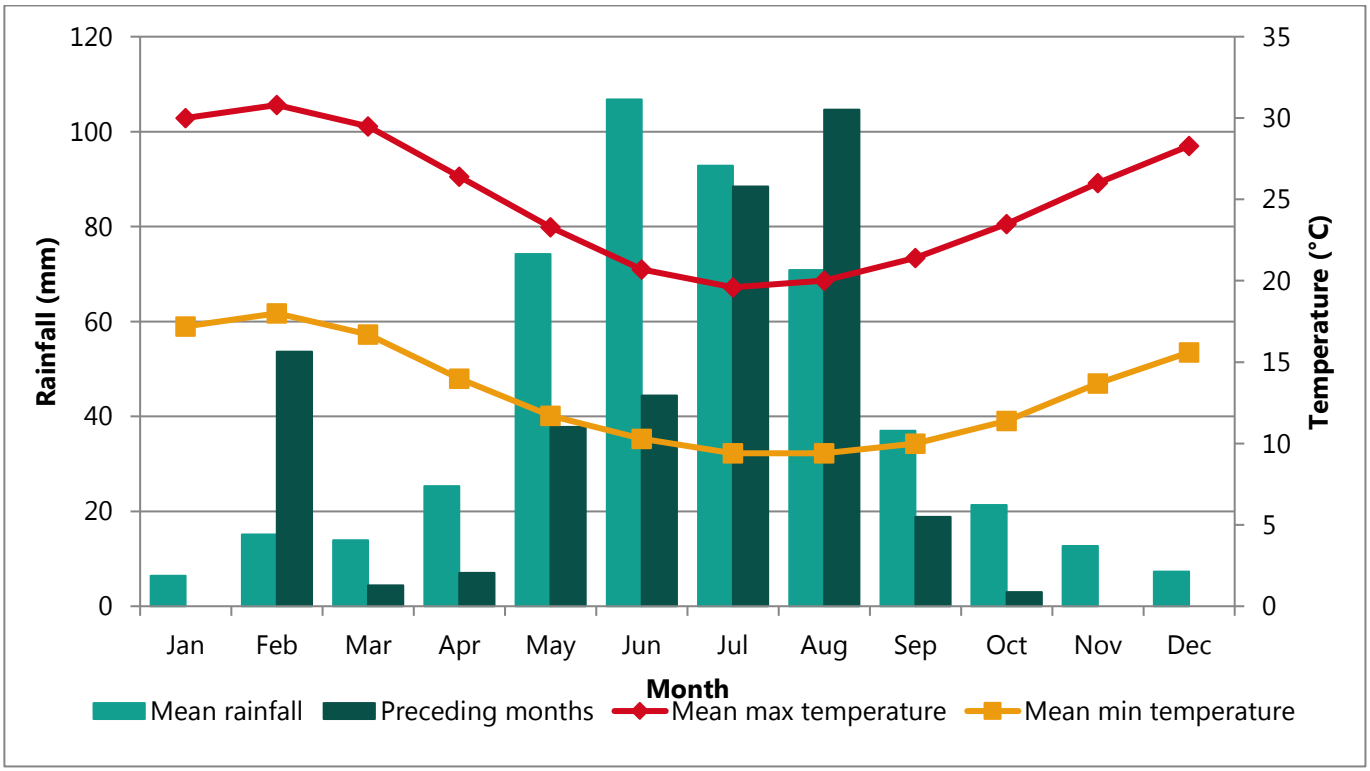

Figure 2: Rainfall and temperature data for the survey area (BoM 2020b)

2.1.2 LAND SYSTEMS

According to Department of Primary Industries and Rural Development (DPIRD 2020) soil landscape mapping, the following land systems intersect the survey area (**Table 2** and **Map 1**).

Table 2: Land systems (DPIRD 2020)

Mapping unit	Land system	Description	Extent (ha)	%
221Cy_3	Correy 3 Subsystem	Rarely inundated flats and depressions; Cracking and non-cracking clays and pale sandy earths	199.59	10.34
221Ta_3	Tamala South 3 Subsystem	Low hills with relict dunes and some limestone outcrop; Deep and shallow yellow sand over limestone	537.14	27.84
221Ta_4	Tamala South 4 Subsystem	Low hills with relict dunes and some limestone outcrop; yellow shallow sand with limestone outcrops and yellow deep sand	397.63	20.61
221Ta_5	Tamala South 5 Subsystem	Low hills with relict dunes and some limestone outcrop; Calcareous shallow and deep sands	795.12	41.21

2.1.3 GEOLOGY

The survey area is associated with Mingenew-Dongara map sheet and the Arrowsmith-Beagle Island map sheet of the 1:100,000 Geological Series of Western Australia (DMIRS 2020a, DMIRS 2020b). Three geological units intersect the survey area, shown in **Table 3**.

Table 3: Geological units that intersect the survey area

Mapping unit	Description	Extent (ha)	%
Qa	Alluvium sand, silt, and clay	233.45	12.10
Qp	Swamp and lacustrine deposits, clay, silt, and diatomite	26.31	1.58
Qt	Eolian limestone and sandstone with secondary concretionary and residual calcareous deposits, minor fossilferous limestone	1669.94	86.54

2.1.4 WETLANDS AND DRAINAGE

The survey area corresponds with three catchments: Arrowsmith River catchment and two coastal catchments in the Greenough River and Moore-Hill Rivers basins (Landgate 2020).

A major tributary of Arrowsmith River intersects the eastern portion of the survey area, terminating in a series of non-perennial (i.e. not permanently wet) lakes (Landgate 2020). Arrowsmith River does not have a ground surface connection to the ocean.

The survey area includes the ephemeral wetland known as Lake Arramall (or Arramall Lakes, taking smaller lakes in the vicinity into consideration), however, it is not formally listed as a wetland.

2.1.5 GROUNDWATER DEPENDENT ECOSYSTEMS

The Groundwater Dependent Ecosystems Atlas (Australian Government & BoM 2020) indicates that the survey area is considered as low to medium potential for terrestrial GDEs to occur, with an IDE likelihood of 10.

2.1.6 ENVIRONMENTALLY SENSITIVE AREAS

The survey area does not intersect any ESAs. The nearest ESA is approximately 500 m to the south.

2.1.7 CONSERVATION LANDS

The survey area does not intersect any conservation estates (i.e. National Parks, Nature Reserves or other lands vested for conservation), however, is immediately adjacent to Beekeepers Nature Reserve along part of the western and the southern boundaries.

2.1.8 LAND USE HISTORY

The survey area has been partly cleared and cropped in the eastern portion where it has also been subject to grazing, including in uncleared portions, as part of previous farming activities.

The western portion of the survey area is unfenced and has not been formally grazed. Gas exploration has occurred within the western portion of the survey area.

2.2 BIOLOGICAL ENVIRONMENT

2.2.1 BIOGEOGRAPHIC REGION

Biogeographic regions are delineated on the basis of similar climate, geology, landforms, vegetation and fauna and are defined in the Interim Biogeographical Regionalisation for Australia (IBRA) (Department of Agriculture Water and the Environment 2020a).

The survey area is located in the Geraldton Sandplains IBRA region in the Lesueur Sandplain subregion, described as:

> *The Geraldton Sandplains bioregion is composed mainly of proteaceous scrub-heaths, rich in endemics, on the sandy earths of an extensive, undulating, lateritic sandplain mantling Permian to Cretaceous strata. Extensive York Gum and Jam woodlands occur on outwash plains associated drainage. The Lesueur Sandplain (GS3) comprises coastal Aeolian and limestones, Jurassic siltstones and sandstones (often heavily lateritised) of central Perth Basin. Alluvials are associated with drainage systems. There are extensive yellow sandplains in south-eastern parts, especially where the subregions overlaps the western edge of the Pilbara Craton. Shrub-heaths rich in endemics occur on a mosaic of lateritic mesas, sandplains, coastal sands and limestones. Heath on lateritised sandplains along the subregions north-eastern margins. The climate is Mediterranean and the subregional area is 1,358,915 ha* (Department of Parks and Wildlife 2013a).

2.2.2 PRE-EUROPEAN VEGETATION

During the 1970s, John Beard and associates conducted a systematic survey of native vegetation, describing the vegetation systems in Western Australia at a scale of 1:250 000 in the south-west and at a scale of 1:1 000 000 in less developed areas.

Beard's vegetation maps attempted to depict the native vegetation as it was presumed to be at the time of settlement and is known as the pre-European vegetation type and extent. Beard's vegetation maps have since been developed in digital form by Shepherd, Beeston & Hopkins (2002) and updated by DPIRD (2019). Extents are updated every two years by DBCA (2019a). This mapping indicates that the survey areas intersects four pre-European vegetation units:

- Association Cliff Head 255: Eucalypt shrubland; *Eucalyptus eremophila*, *E. redunca, E.* spp.
- Association Illyarrie 377: Mixed heath with scattered tall shrubs *Acacia* spp., Proteaceae and Myrtaceae
- Association Illyarrie 433: Mosaic shrublands; *Acacia rostellifera* & *Melaleuca cardiophylla* thicket/sparse low woodland; Illyarrie

- Association Illyarrie 619: Wheatbelt; York gum, salmon gum etc. *Eucalyptus loxophleba, E. salmonophloia*. Goldfields; gimlet, redwood etc. *E. salubris, E. oleosa*. Riverine; rivergum *E. camaldulensis*. Tropical; messmate, woolybush.

The pre-European vegetation association/s identified from the survey area (DPIRD 2019) and its/their pre-European and current extents are listed in **Table 4** (DBCA 2019a) and shown on **Map 2**.

Table 4: Pre-European vegetation association representation (DBCA 2019a)

Region	Vegetation association	Original extent (ha)	Current extent (ha)	% remaining
Western Australia	Cliff Head 255	3,176.54	2,933.27	92.34
	Illyarie 377	63,099.54	62,724.44	99.41
	Illyarie 433	32,460.48	14,746.34	45.43
	Illyarrie 619	119,373.78	118,205.01	99.02
IBRA biogeographic region (Geraldton Sandplains)	Cliff Head 255	3,064.34	2,933.06	95.72
	Illyarie 377	63,099.54	62,724.44	99.41
	Illyarie 433	32,460.48	14,746.34	45.43
	Illyarrie 619	154.54	50.80	32.87
IBRA biogeographic sub-region (Lesueur Sandplain)	Cliff Head 255	3,064.34	2,933.06	95.72
	Illyarie 377	63,099.54	62,724.44	99.41
	Illyarie 433	18,096.74	11,457.68	63.31
	Illyarrie 619	154.54	50.80	32.87
LGA (Shire of Irwin)	Cliff Head 255	3,176.54	2,933.27	92.34
	Illyarie 377	22,618.31	22,395.04	99.01
	Illyarie 433	32,141.03	14,640.90	45.55
	Illyarrie 619	53.96	48.20	89.32

2.2.3 THREATENED AND PRIORITY ECOLOGICAL COMMUNITIES

The Protected Matters Search Tool (PMST) search (Australian Government & DAWE 2020; search reference 6654IA) using a 30 km buffer around a point approximating the centre of the survey areas identified one EPBC-listed TEC within the buffer area: the Vulnerable *Subtropical and Temperate Coastal Saltmarsh*. As the survey area is not on the coast or an estuary, this TEC does not occur within the survey area.

The DBCA database search (search reference 24-0920EC using a 30 km buffer around the survey area) identified no TECS and the following two PECS within the search area buffer:

- *Subtropical and Temperate Coastal Saltmarsh* (P3), which is the equivalent of the TEC listed above.
- *Coastal sands dominated by Acacia rostellifera, Eucalyptus oraria and Eucalyptus obtusiflora (Geraldton area)* (P1).

The *Coastal sands dominated by Acacia rostellifera, Eucalyptus oraria and Eucalyptus obtusiflora* PEC is described (Species and Communities Program, DBCA 2020) as:

> *Floristically, this community is similar to other Acacia rostellifera communities but is differentiated on structure, being dominated by mallee eucalypts. The community occurs on limestone ridges, in some swales in the coastal dunes between Cape Burney and Dongara, on the Greenough*

Alluvial Flats on limestone soil and near Tarcoola Beach. Some very small occurrences have also been recorded on the limestone scarp north of the Buller River.

Map 3 shows the locations of ecological communities identified by the DBCA database search.

2.2.4 THREATENED AND PRIORITY FLORA

The PMST search (as above) identified one EPBC-listed TF that is known to occur within the 25 km search buffer area (*Paracaleana dixonii*), five as 'species or habitat likely to occur within area' and six 'species or species habitat may occur within the area'.

The requested DBCA databases (search reference 14-0920FL) was conducted and 25 km buffer was applied around the shapefiles. The results incorporate the TPFL List, taken from Threatened and Priority Flora Report Forms and DBCA surveys, and WA Herb, taken from vouchered specimens held in the Western Australian Herbarium.

Map 3 shows the locations of conservation-listed flora identified by the DBCA database search.

The combined database searches identified the species listed in **Table 20** in **Appendix Two**, consisting of 14 TF (eight from records known to occur within the database search buffer and six from the PMST where associated habitat is likely to / may occur), nine P1, 13 P2, 36 P3 and 17 P4 (89 taxa in total).

2.2.4.1 Threatened and Priority Flora Likelihood Assessment

Ecoscape conducted a likelihood assessment to identify TF and PF species that have potential to occur within the survey area. The likelihood of a species occurring is based on the following attributes, as listed on *FloraBase* (WAH 1998-2020, 2020, including specimen collection information), incorporating an assessment of habitats likely to be present in the survey area. The attributes taken into consideration were:

- broad soil type usually associated with the species
- broad landform usually associated with the species
- usual vegetation (characteristic species) with which the species is usually associated
- species having previously been recorded from within approximately 10 km of the survey area (considered as 'nearby') taking locational accuracy into account
- time since recorded (i.e. within the previous 25 years), taking into consideration land use changes since collection.

The likelihood rating is assigned using the categories listed in **Table 5**.

Table 5: Categories for likelihood of occurrence of TF and PF

Likelihood	Category
Recorded	Species recorded within the survey area.
High (i.e. possible)	May occur within the survey area (but has not been recorded); broadly, 2-4 of the required attributes (but always including records from nearby) are present in the survey area.
Medium (i.e. unlikely)	Could occur but is not expected; 1-3 of the required attributes are present in the survey area but: • it is not known from nearby, or • it is known from nearby but has no other required attributes, or • it is known from nearby but has at least one well-defined attribute that does not occur in the survey area (e.g. it is associated with a specific landform or soil type that does not occur in the survey area), or • it is known from nearby but: o the record is old (>25 years), or o the locational data is highly likely to be inaccurate, or o the area has been significantly cleared at and around the location of the record and survey area and as such the habitat almost certainly no longer occurs within the survey area.
Low (i.e. highly unlikely)	The species characteristics include only one or none of the required attributes of soil, landform, associated vegetation and having previously been recorded nearby, or a critical element (often landform) is not within the survey area and as such it almost certainly does not occur.

The likelihood assessment is available in **Table 20** in **Appendix Two**. No TF were considered to have a High likelihood of occurring. One P1, three P2, five P3 and three P4 were identified as having been recorded previously or have a High likelihood of occurring based on the information available during the desktop assessment. These were considered the most likely to occur and were prioritised for field survey.

Following the field survey when actual survey area characteristics (vegetation types, vegetation condition, visibility for individual species) are better understood, and the level of survey effort was considered, the likelihood of occurrence was re-evaluated. The post-survey likelihood is also incorporated into this table and discussed further in **Section 5.1.1.2**.

2.2.5 THREATENED AND PRIORITY FAUNA

Exclusively marine species (e.g. whales, sea turtles etc.) are not included in the Threatened and Priority Fauna lists as their habitat does not occur within with the survey area.

2.2.5.1 NatureMap

NatureMap (DBCA 2007-2020) is maintained collaboratively by the DBCA and the WAM. These records represent a combination of vouchered museum specimens and records obtained via the Fauna Survey Returns Database maintained by the DBCA.

The *NatureMap* search identified 223 terrestrial vertebrate fauna species previously recorded within the applied 30 km buffer area:

- 14 mammals (eight native; six introduced)
- 163 birds (160 native; three introduced)
- 39 reptiles (39 native)
- seven amphibians (seven native).

Of these, 26 species are conservation-listed. The results are incorporated into **Table 21** in **Appendix Two**.

2.2.5.2 DBCA Database Search

A search of the DBCA databases was conducted (search reference 2020/000669 #6444) using a 30 km buffer around the supplied shapefiles. 20 conservation-listed vertebrate fauna were identified as having previously been recorded from within the search area buffer, consisting of:

- two mammals
- 17 birds
- one reptile.

The results incorporate the conservation-listed species identified from the *NatureMap* search (as above), with following additional species:

- *Sterna dougallii* (Roseate tern) – MI (EPBC Act), MI (BC Act).

DBCA database search results are incorporated into **Table 21** in **Appendix Two** and shown on **Map 4**.

2.2.5.3 Protected Matters Search

The Protected Matters Search Tool (PMST) search (Australian Government & DAWE 2020; search reference 3455S3) using a 30 km buffer around a point approximating the centre of the survey area, identified:

- four mammals
- 56 birds
- two reptiles.

The PMST results are incorporated into **Table 21** in **Appendix Two**. Thirty-six species identified by the PMST search do not have DBCA/Western Australian Museum (WAM) records (*NatureMap* and DBCA database searches). The majority are migratory birds, some protected only under international agreements (12 taxa) although some have additional protection by being also listed under the EPBC Act and BC Act (16 taxa). The following non-migratory species were identified by the PMST search but not by the DBCA and *NatureMap* searches:

- *Egernia stokesii badia* (Western Spiney-tailed Skink) - EN (EPBC Act), VU (BC Act)
- *Falco hypoleucos* (Grey Falcon) - VU (EPBC Act), VU (BC Act)
- *Limosa lapponica baueri* (Western Alaskan Bar-Tailed Godwit) - VU (EPBC Act)
- *Parantechinus apicalis* (Dibbler) – EN (EPBC Act), EN (BC Act)
- *Pterodroma mollis* (Soft-plumaged Petrel) - VU (EPBC Act)
- *Rostratula benghalensis australis* (Australian Painted Snipe) - EN (EPBC Act), EN (BC Act)
- *Sterna nereis nereis* (Fairy Tern) - VU (EPBC Act), VU (BC Act)
- *Thinornis cucullatus* (Hooded Plover (Hooded Dotterel)) - P4 (BC Act).

2.2.5.4 Threatened and Priority Fauna Likelihood Assessment

The likelihood of occurrence of significant fauna species identified by the database and literature searches was assessed using the following criteria:

- suitability of habitat types within the survey area
- distance between previous record of conservation-listed species and the survey area
- frequency and number of records in the region
- date of record of conservation-listed species (recent or historical).

The following were also taken into consideration during the assessment:

- sufficiency of information
- behavioural and ecological characteristics such as cryptic behaviours
- record certainty
- not being captive populations.

The categories of likelihood of occurrence, assessed using the above criteria, are shown in **Table 6**.

Table 6: Categories for likelihood of occurrence of conservation-listed fauna

Likelihood	Category
Recorded	Species recorded within the survey area within a reasonable timeframe (0-25 years)
High	Species recorded in close proximity to the survey area (<5 km) within the past 25 years; and suitable habitat occurs within the survey area
Medium	Species historically recorded in close proximity (<5 km) to the survey area, more than 25 years ago; and suitable habitat may exist within the survey area
Low	Species not recorded in the proximity of the survey area or rarely recorded within 10 km of the survey area; and suitable habitat unlikely to occur within the survey area
Very Low	Species not recorded by multiple surveys/databases within 20 km of the survey area and suitable habitat does not occur within the survey area, however, species or suitable habitat is listed as potentially occurring in the wider region

The likelihood of species occurring within the survey area are indicated in **Table 21** in **Appendix Two**. Two species were assessed as having a High likelihood of occurring within the survey area: *Calyptorhynchus latirostris* (Carnaby's Cockatoo) and *Leipoa ocellata* (Malleefowl).

Following the field survey when actual survey area characteristics are better understood, and the level of survey effort was considered, the likelihood of occurrence was re-evaluated. The post-survey likelihood is also incorporated into this table and discussed further in **Section 5.3.3.1**.

2.3 LITERATURE REVIEW

A search of the *Index of Biodiversity Surveys for Assessments* (IBSA) portal (DWER 2020) using a 50 km radius of the approximate centre of the survey area did not identify any known surveys that have required environmental approvals within the search radius.

The following documents were identified as having relevance to the survey area:

- Ecoscape (2010) *Dongara to Cape Burney Coastal Vegetation Survey*, detailing the results of a coastal vegetation survey for Northern Agricultural Catchment Council, the southern terminus of which is approximately 25 km to the north of the survey area
- GHD (2015) *Mid West Coastal Nodes Biological Survey Report*, detailing a biological assessment of three coastal areas: Halfway Bay/Lucky Bay in the Shire of Northampton, Little Anchorage in the Shire of Coorow and Sandy Cape in the Shire of Dandaragan.
- Bamford Consulting Ecologists (2012) *Fauna Assessment of Tiwest's Dongara Project*, detailing a fauna survey from approximately 10 km east of the survey area. The survey recorded six conservation-listed fauna species: Black-striped Snake, Carnaby's Cockatoo, Rainbow Bee-eater (no longer considered as significant), Rufous Fieldwren (western wheatbelt) (not currently conservation-listed), Crested Bellbird (not currently conservation-listed) and White-breasted Robin (not currently conservation-listed), and a further 15 conservation-listed species as likely to occur.

- Brett Lane & Associates (2008) *Proposed Badgingarra Wind Farm Flora and Fauna Assessment*, detailing a primarily fauna survey of an area approximately 80 km to the south. Carnaby's Cockatoo was the only significant fauna species recorded, with the report's author suggesting that this species is unlikely to be collide with wind turbines, although roosting and foraging habitat may be impacted by proposed wind turbines.
- Susac (2007) *A Literature Review & Report of Karst Biodiversity, Palaeontology & Hydrology in the Northern Agricultural Region, Western Australia*. This literature review documents information relating to karst areas in the Eneabba, Jurien, South Hill, East Moore and Moora karst area zones, including E-22 Arramall Cave and E-23 River Cave, both of which located within the survey area. Arramall Cave is reported as having evidence of bats (guano piles), including *Macroderma gigas* (Ghost Bat) that is now extinct from the region and now replaced by *Chalinolobus morio* (Chocolate Wattled Bat), nesting in the cave entrance by *Hirundo neoxena* (Welcome Swallow), *Litoria moorei* (Motorbike Frog) and a large array of invertebrate troglofauna residents and arthropods washed into the cave. River Cave has greater surface connectivity and more vertebrate fauna including snakes, geckos and frogs, and an array of invertebrate troglofaunal although it is noted that the cave dries out significantly in summer and autumn.
- Hart, Simpson and Associates Pty Ltd (2003) *Flora & Fauna Investigation Report.* This report details a survey for Origin Energy, with the study located approximately 2.5 km north (at its closest point) of this survey area. The survey identified a shrub mallee vegetation type as being significant (dominated by *Eucalyptus obtusifolia* subsp. *dongarraensis*); this is now recognised as a P1 PEC, three conservation-listed flora (*Anthocercis intricata*, P3; *Haloragis foliosa*; P3, and *Eucalyptus zopherophloia*; P4) and three conservation-listed fauna species (Carnaby's Cockatoo, Malleefowl, Peregrine Falcon).

3 METHODS

3.1 SURVEY AIMS

The aims of the survey were to:

- identify the key biological attributes of the survey area (terrestrial flora, vegetation, terrestrial vertebrate fauna and fauna habitat)
- conduct the surveys according to current EPA guidances
- identify any key constraints that may affect environmental approvals of the proposed development.

3.2 GUIDING PRINCIPLES

The flora and vegetation survey was conducted as a reconnaissance survey according to the Flora and Vegetation Technical Guidance (EPA 2016). The EPA recommends a reconnaissance survey should:

- provide context and gather broad information
- verify the findings of the desktop assessment
- include low intensity sampling of the flora and vegetation to describe the general vegetation characteristics and condition
- clarify if the area may support any significant flora and vegetation
- identify if a detailed survey is required.

Targeted searches were also conducted in areas of habitat suitable for TF and PF identified during the desktop assessment and previous surveys as having potential to occur.

The fauna and fauna habitat survey was conducted as a basic survey according to the Fauna Technical Guidance (EPA 2020a). The EPA recommends a basic survey should:

- be conducted as a low intensity survey to gather broad fauna and habitat information
- verify the adequacy of the desktop assessment
- map, describe and photograph habitats
- record opportunistic fauna observations
- identify possible future survey site locations, access and logistics
- determine if a detailed survey is required.

Targeted surveys were also conducted to gather information on significant fauna and/or habitats.

3.3 FLORA AND VEGETATION FIELD SURVEY

3.3.1 FIELD SURVEY METHODS

The methods utilised during the field survey followed those outlined in the Flora and Vegetation Technical Guidance (EPA 2016), conducted as a single phase survey.

Conservation criteria used in this assessment are included in **Table 13**, **Table 14** and **Table 15** in **Appendix One**.

Survey method details are outlined below.

3.3.1.1 Floristic Quadrats

Floristic quadrat ('quadrat') locations were selected using aerial photography, environmental values and field observations to represent the vegetation values existing at the site. The unmarked quadrats were 10 m x 10 m in dimension, as required according to the Flora and Vegetation Technical Guidance (EPA 2016).

The following information was collected from within each quadrat:

- observer
- date
- quadrat/site number
- GPS location (GDA94) of the northwest corner
- digital photograph (spatially referenced with a reference number), taken from the northwest corner, looking diagonally across the quadrat
- broad soil type and colour
- topography
- list of flora species recorded with the average height and total cover within the quadrat for each species
- vegetation description (as per below)
- vegetation condition.

One quadrat per broad vegetation type as perceived during the field survey was recorded where there were areas in Good or better condition, with additional detailed relevés recorded in areas of lesser condition to provide additional information. A similar level of detail was recorded in relevés except that they were unmeasured, thus information is comparative.

All quadrat and relevé locations are displayed in the **Map 5** series.

3.3.1.2 Targeted Searches

Threatened and Priority Flora identified during the desktop analysis and previous surveys as known or having potential to occur were targeted for searches in areas of potential habitat. Due to the large area, much of which was inaccessible, and the survey being conducted as a Reconnaissance level survey, grid searches were not conducted.

The locations of all targeted taxa collected were recorded using a handheld GPS with the following data recorded:

- observer, date and time
- reproductive status and other features such as health of plants, percentage flowering and fruiting
- local abundance/population size and/or population boundary
- landform
- brief vegetation community description
- representative photos of each species and habitat
- collection of representative specimens.

3.3.1.3 Introduced Species

Introduced species (weeds) were recorded during the collection of the overall flora inventory.

3.3.1.4 Vegetation Description and Classification

Vegetation was described from each of the quadrats using the height and estimated cover of dominant and characteristic species of each stratum based on the National Vegetation Information System, recorded at Level V (NVIS Technical Working Group & DotEE 2017) (**Table 16** and **Table 17** in **Appendix One**). Up to three species per stratum from each stratum (upper, mid and ground) were used to formulate vegetation descriptions for each quadrat and each vegetation type. Rapid assessment points were also used to aid with mapping.

Vegetation type descriptions were created by combining quadrat descriptions and modifying, where necessary, based on the wider vegetation. Vegetation codes for these were formulated using the characteristic species of the highest stratum within the vegetation type that had >2% cover (i.e. not scattered) if present, with the first series of letter codes referring to the component species (upper case first letter referring to the genus, lower case one or two letters referring to the species, with the upper case letters at the end referring to the stratum structure e.g. **EeLW** refers to ***E****ucalyptus* ***e****rythrocorys* low woodland. Where more than one definitive taxa have the same initial, a number is used to differentiate. In this case, in vegetation type **As1As2TOS**, As1 refers to *Acacia saligna* and As2 refers to *Acacia scirpifolia*.

3.3.1.5 Vegetation Condition Assessment

Vegetation condition was assessed broadly and continuously throughout the survey area and at each quadrat using the Vegetation Condition Scale for the Southwest Botanical Province (EPA 2016) (**Table 18** in **Appendix One**). As quadrats are located in the best condition parts of a vegetation type, the condition rating of the quadrat may not match that of the broader vegetation type due to the scale of mapping.

3.3.1.6 Field Survey Timing

The field survey was conducted during 12-16 October 2020 which is within the optimal period for a primary survey within the bioregion according the Flora and Vegetation Technical Guidance (EPA 2016).

3.3.2 STATISTICAL ANALYSIS

3.3.2.1 Post-survey Likelihood Assessment

Following the field survey, a post-survey likelihood assessment was conducted to identify conservation-listed species that have potential to occur on site. This assessment was based on survey effort and habitat known to occur in the survey area and updated the desktop likelihood assessment.

3.3.2.2 Floristic Analysis

Floristic analysis is generally not required for a Reconnaissance-level survey. However, analyses were conducted to identify if the purely structural and composition-based vegetation types had a basis in the floristic composition of the quadrats and relevés.

PATN© software (Belbin & Collins 2006) was used to undertake statistical analysis to generate floristic groups using the data collected from the quadrats and relevés, in order to better understand local significance of floristic units. PATN analysis has been used for several local floristic analyses including Gibson *et al.* (1994) for the Swan Coastal Plain.

PATN is a multivariate analysis tool that generates estimates of association (resemblance, affinity, distance) between sets of objects described by a suite of variables (attributes) and classifies the objects into groups and condenses the information and displays the patterns in the data graphically. It offers a choice of data transformations prior to multivariate analysis.

3.3.2.3 Adequacy of Sampling

In order to demonstrate adequacy of sampling, a species accumulation curve was generated by the software Species Diversity and Richness IV (Pisces Conservation Ltd 2010) using five random selections of sample order, using quadrat data only. However, for a reconnaissance survey with low intensity sampling, the species inventory is not anticipated to be comprehensive.

3.4 FAUNA FIELD SURVEY

3.4.1 FIELD SURVEY METHODS

The methods utilised during the field survey followed those outlined in the Fauna Technical Guidance (EPA 2020a), conducted as a Basic survey.

Conservation criteria used in this assessment are included in **Table 13** and **Table 14** in **Appendix One**.

Survey method details are outlined below.

3.4.1.1 Fauna Survey

The basic fauna survey incorporated a number of survey techniques as per the Terrestrial Fauna Technical Guidance (EPA 2020a) including habitat assessment, active searches (day and night time), raking of spoil heaps and leaf litter, searches for secondary evidence such as scats and tracks and use of trail cameras for the detection of fauna, as well as opportunistic searches.

Terrestrial vertebrate fauna were the main targets of the field survey. Survey techniques included:

- opportunistic bird observations while moving through the survey area
- turning of surface debris (rocks, logs, vegetation spoil heaps) that reptiles and mammals may shelter beneath
- raking of litter beds using a three pronged cultivator rake to locate fossorial reptile species
- tree hollow inspection to detect arboreal fauna
- spotlight surveys to detect nocturnal species
- baited motion cameras (Reconyx HC500) to capture evidence of cryptic and nocturnal fauna species not easily observed directly
- Songmeter acoustic recorders fitted with both acoustic and ultrasonic microphones to sample for birds and bats.

Fauna species were identified opportunistically based on sightings, calls, remains, diggings and other signs. Potential habitats for conservation significant species were identified and evaluated and their likelihood of occurrence assessed.

3.4.1.2 Fauna Habitat Assessment

The fauna habitats present within the survey areas were identified and mapped. Fauna habitats were described as an area which is distinguishable from its surrounding area by its land form, vegetation and fauna assemblage occupying the area. In addition, its likelihood to harbour specialised fauna species which are not found in adjacent areas was taken into consideration.

The following information was used to identify and map all fauna habitats within the survey area:

- previous fauna habitat mapping
- land systems
- vegetation type and condition mapping

- aerial imagery
- landforms
- soil characteristic
- fauna assemblage information.

The composition and characteristics of each fauna habitat type was recorded, including noting suitability for various fauna suites or conservation-listed species. Habitat types were delineated in the field and digitised upon return from the field survey.

3.4.1.3 Targeted Survey Methods

Black Cockatoo Assessment

Black Cockatoo Species (Carnaby's Cockatoo; Baudin's Cockatoo EN, Forest Red-tailed Black-cockatoo VU (EPBC Act, BC Act))

As the survey area is not within the breeding range of any conservation-listed Black Cockatoo species tree habitat surveys were not conducted. The survey area was surveyed for presence of Black Cockatoos and assessed for suitability as foraging habitat.

3.4.2 DATA ANALYSIS

Bat call analysis was conducted by Kyle Armstrong from Specialised Zoological. Bats are also included in the overall species inventory.

4 FIELD SURVEY RESULTS

4.1 FLORA AND VEGETATION SURVEY

The flora and vegetation survey was conducted by Lyn Atkins (Principal Ecologist, Flora Collecting Permit FB62000003; Threatened Flora Collecting Permit TFL 73-1920 during 12-16 October 2020.

Taxonomic plant identification was conducted by Dr Udani Sirisena who consulted various specialists where necessary.

4.1.1 FLORA

4.1.1.1 Flora Inventory

Five floristic quadrats and 15 relevés were recorded from within the survey area.

A total 191 vascular flora were recorded from 137 genera and 61 families from the quadrats, relevés, opportunistic observations and searches for conservation-listed flora. Of these, 39 were introduced (20.42%) and nine (4.71%) could not be identified to species level due to insufficient diagnostic reproductive material.

The most commonly represented families were Poaceae (22 taxa), Myrtaceae (19), Asteraceae (17), Proteaceae (15) and Fabaceae (13). The most commonly represented genera were *Melaleuca* with seven taxa, *Banksia* and *Eucalyptus* (five) and *Acacia*, *Austrostipa*, *Grevillea* and *Ptilotus* (four).

The number of species per quadrat ranged from seven in relevé D20R01 to 39 in quadrat D20Q05, with an average species diversity per quadrat of 20.30. The most commonly recorded species were *Acacia rostellifera* recorded from 12 quadrats and **Brassica tournefortii*, **Ehrharta longiflora* and **Vulpia myuros* (11 quadrats).

The combined flora inventory is presented in **Table 22** in **Appendix Three**. Quadrat and relevé data is presented in **Appendix Four**.

4.1.1.2 Conservation-listed Flora

Threatened Flora

No Commonwealth EPBC Act or Western Australian BC Act-listed Threatened Flora were recorded during the field survey.

Priority Flora

Three Priority-listed flora from confirmed taxonomic identifications were recorded during the field survey:

- *Anthocercis intricata* (P3)
- *Beyeria cinerea* subsp. *cinerea* (P3)
- *Eucalyptus zopherophloia* (P4).

DBCA records indicate that *Eucalyptus zopherophloia* has been previously recorded from within the survey area.

Locations of confirmed PF are indicated on **Map 5** and described in more detail in **Table 7**.

Table 7: TF and PF recorded during the field survey

***Anthocercis intricata* (P3)**	
Description: Dense spinescent shrub to 3 m high, growing in sand or loam over limestone (WAH 2021). Within the survey area this species was observed as an intricate, spinescent shrub although open and significantly smaller than the recorded size. 	**Habitat**: in vegetation type **McArGaTS**; *Melaleuca cardiophylla*, *Acacia rostellifera* and *Grevillea argyrophylla* tall shrubland, on near-coastal limestone outcropping. **Location:** Northwestern (more coastal) portion of the survey area. **Survey results**: 3 records (<10 plants) in survey area, although the species is anticipated to occur widely within the vegetation type. **Populations:** 1 population, but likely sparsely distributed within the vegetation type. **Known records and distribution**: According to *NatureMap* (DBCA 2007-2021) there are 37 records of this species from the Geraldton Sandplains, Yalgoo and (one record) Carnarvon bioregions, with an overall distribution of approximately 430 km (north-south), confined to near-coastal areas. The survey area is located at the extreme southern range edge of the species' distribution.
***Beyeria cinerea* subsp. *cinerea* (P3)**	
Description: Prostrate, spreading or erect shrub to 50 cm high growing on coastal dunes and limestone (Barrett & Tay 2016). Within the survey area this species was observed as a low shrub that was a common, at times dominant, ground stratum species.  **Photo from Ecoscape (2011)**	**Habitat:** in vegetation type **McArGaTS**; *Melaleuca cardiophylla*, *Acacia rostellifera* and *Grevillea argyrophylla* tall shrubland, on near-coastal limestone outcropping. **Location:** Northwestern (more coastal) portion of the survey area. **Survey results**: 1 record (individual plants not counted) in survey area where it was a dominant ground stratum species; it is anticipated to occur through much of this vegetation type. **Populations:** 1 population, but likely distributed through much of the vegetation type. **Known records and distribution**: According to *NatureMap* (DBCA 2007-2021) there are 63 records of this species from the Swan Coastal Plain, Geraldton Sandplains and (one record) Yalgoo bioregions, with an overall distribution of approximately 700 km (north-south), confined to coastal and near-coastal areas. The survey area is at approximately the mid point of this species' distribution.

***Eucalyptus zopherophloia* (P4)**	
Description: Spreading mallee to 6 m high with rough, fibrous bark (WAH 2021). Within the survey area this species was as described, forming occasional clumps or small stands. 	**Habitat:** in vegetation type **McArGaTS**; *Melaleuca cardiophylla*, *Acacia rostellifera* and *Grevillea argyrophylla* tall shrubland, on near-coastal limestone outcropping, and vegetation type **ArLOF**; *Acacia rostellifera* low open forest, in disturbed upland areas. **Location:** Northern and north-western portions of the survey area. **Survey results**: 70+ individuals recorded in survey area. **Populations:** 2 populations, although additional plants have been recorded (DBCA database search results) between records from this survey, thus this species is likely to constitute a single population within the survey area. **Known records and distribution**: According to *NatureMap* (DBCA 2007-2021) there are 76 records of this species largely from the Geraldton Sandplains bioregion, and also (one record each) Swan Coastal Plain and Carnarvon bioregions. Its overall distribution is approximately 530 km (north-south) and inland up to 65 km. The survey area is within this species' usual distribution.

4.1.1.3 Other Significant Flora

According to the criteria outlined in the Flora and Vegetation Technical Guidance (EPA 2016), *Pelargonium littorale* may be considered as significant as a minor range infill, with the closest records approximately 90 km north and south of the survey area. However, this species has a wide distribution over most of near coastal parts of southern Australia (ALA 2021) thus its significance as a range infill is minor.

Melaleuca strobophylla is a minor range extension of approximately 30 km northwards (thus new range edge), and a new record for the local government area. However, taking this species' distribution over much of the southern parts of Western Australia, this range extension is of only minor significance.

4.1.1.4 Flora of Taxonomic Interest

No flora of taxonomic interest were recorded during the field survey.

4.1.1.5 Introduced Flora

Thirty nine introduced flora species (weeds) were recorded during the field survey, representing 20.42% of the overall flora inventory. All are agricultural weeds or commonly occurring in the region.

**Brassica tournefortii*, **Ehrharta longiflora* and **Vulpia myuros* were all recorded commonly, including from within quadrats.

**Echium plantagineum* (Patterson's Curse) is a Declared Pest plant in the Shire of Irwin. However, it is in the Exempt category and thus has no management requirements as a result of its presence. It was recorded from one previously grazed relevé and is a sparse occurrence in the previously grazed parts of the survey area.

**Lycium ferocissimum* (African Boxthorn) is WoNS species that was recorded from one relevé on karst limestone east of Arramall Lake. Although only observed in the one location it is likely to occur sparsely along the limestone ridge. There are no management requirements in relation to its listing as a WoNS species.

4.1.2 VEGETATION

4.1.2.1 Vegetation Types

Eight broad structural vegetation types were recorded from within the survey area based on field observations (**Table 8**, **Map 5**). Whilst floristic analysis was conducted, the results of the analysis indicated vegetation condition had a significant effect on the results, and floristic groups were not clear-cut (see **Section 4.1.2.2**).

The vegetation types within the survey area, grouped broadly based on landform types, were:

- Near-coastal limestone uplands:
  - **EeLW**; *Eucalyptus erythrocorys* low woodland
  - **McArGaTS**; *Melaleuca cardiophylla*, *Acacia rostellifera* and *Grevillea argyrophylla* tall shrubland – this vegetation type has emergent mallees, in patches (i.e. as a mosaic) sufficient to form an upper stratum
- Karst:
  - **ArMrTS**; *Acacia rostellifera* and *Melaleuca rhaphiophylla* tall shrubland
- Sandplain (with limestone pavement):
  - **LcBsJhMOS**; *Labichea cassioides*, *Banksia sessilis* var. *cygnorum* and *Jacksonia hakeoides* mid open shrubland – this vegetation type has patches of mallees and, in deeper sands, patches of *Banksia prionotes*
- Riparian areas and floodplain:
  - **EcArMW**; *Eucalyptus camaldulensis* subsp. *obtusa* and *Acacia rostellifera* mid woodland
- Lakes and floodplain (flat) areas:
  - **MsCoMrMOW**; *Melaleuca strobophylla*, *Casuarina obesa* and *Melaleuca rhaphiophylla* mid open woodland
- Uplands (disturbed):
  - **ArLOF**; *Acacia rostellifera* low open forest
  - **As1As2TOS**; *Acacia saligna* and *Acacia scirpifolia* tall open shrubland

Additional sampling, which is not required for the purpose of this impact assessment, would likely result in vegetation types **LcBsJhMOS** and **McArGaTS** in particular being further refined.

Table 8: Vegetation types

Representative photographs are from the quadrat or relevé in **bold** font (where applicable).

Landform	Mapping unit	Vegetation type	Floristic quadrats/ relevés	Representative photograph	Other characteristic species	Area (ha) and extent (%)
Uplands (disturbed)	**ArLOF**	*Acacia rostellifera* low open forest over **Hordeum leporinum*, **Ehrharta longiflora* and **Bromus diandrus* low closed grassland **NVIS**: U+ ^*Acacia rostellifera*\^tree\6\c;G ^*Hordeum leporinum*,^*Ehrharta longiflora*,*Bromus diandrus*\^other grass\1\d Completely Degraded condition, grazed relevé. This vegetation type is adjacent to cleared areas and represents a disturbed vegetation as a result of grazing, and possibly also regenerating vegetation following clearing.	DR20R02		**Arctotheca calendula* *Austrostipa elegantissima* **Ehrharta brevifolia* **Hypochaeris glabra* **Reichardia tingitana*	49.39 ha 2.56%

Landform	Mapping unit	Vegetation type	Floristic quadrats/ relevés	Representative photograph	Other characteristic species	Area (ha) and extent (%)
Karst (limestone upland)	**ArMrTS**	*Acacia rostellifera* and *Melaleuca rhaphiophylla* tall shrubland over **Bromus diandrus*, **Brassica tournefortii* and **Hordeum leporinum* low closed grassland/forbland with *Eucalyptus camaldulensis* subsp. *obtusa* mid scattered trees **NVIS**: U ^*Eucalyptus camaldulensis* subsp. *obtusa*\^tree\7\bi;M+ ^*Acacia rostellifera*,^*Melaleuca rhaphiophylla*\^shrub\4\c;G ^^*Bromus diandrus*,*Brassica tournefortii*,*Hordeum leporinum*\^other grass,forb\1\d Quadrat on limestone ridge on karst formation, notable for having wetland flora species present (*Eucalyptus camaldulensis* and *Melaleuca rhaphiophylla* – although this identification requires confirmation). Relevé and patch with relevé in Completely Degraded condition (very weedy). The majority of this vegetation type has been mapped using interpretation of aerial imagery and known karst locations due to lack of accessibility in this part of the survey area. It is likely that the larger, western patch is smaller than as is mapped and may not have *Eucalyptus camaldulensis*.	D20R08		*Crassula* sp. **Ehrharta longiflora* **Lycium ferocissimum* **Lysimachia arvensis* **Petrorhagia dubia* *Rhagodia preissii* subsp. *obovata*	88.95 ha 4.61%

Landform	Mapping unit	Vegetation type	Floristic quadrats/ relevés	Representative photograph	Other characteristic species	Area (ha) and extent (%)
Upland (disturbed)	**As1As2TOS**	*Acacia saligna* and *Acacia scirpifolia* tall open shrubland over **Vulpia myuros*, **Pentameris airoides* and **Hypochaeris glabra* low closed grassland/forbland **NVIS:** M+ ^*Acacia saligna*,^*Acacia scirpifolia*\^shrub\4\i;G ^^*Vulpia myuros*,*Pentameris airoides*,*Hypochaeris glabra*\^other grass,forb\1\d Disturbed vegetation type.	D20R03		*Acacia rostellifera* *Amyema preissii* **Arctotheca calendula* **Brassica tournefortii* **Bromus diandrus* *Crassula* sp. **Ehrharta longiflora* **Petrorhagia dubia* **Trifolium arvense*	26.17 ha 1.36%
Riparian areas (drainage lines and floodplain)	**EcArMW**	*Eucalyptus camaldulensis* subsp. *obtusa* and *Acacia rostellifera mid* woodland over *Acacia scirpifolia* and *Rhagodia preissii* subsp. *obovata* tall shrubland/chenopod shrubland over **Ehrharta longiflora*, **Avena barbata* and **Lysimachia arvensis* low open grassland/forbland **NVIS:** U+ ^*Eucalyptus camaldulensis* subsp. *obtusa*,*Acacia rostellifera*\^tree\7\i;M ^^*Acacia scirpifolia*,*Rhagodia preissii* subsp. *obovata*\^shrub,chenopod shrub\4\c;G ^^*Ehrharta longiflora*,*Avena barbata*,*Lysimachia arvensis*\^other grass,forb\1\i All relevés were in Degraded or Completely Degraded condition. DR20R09 is somewhat anomalous as it was upslope; it may be more similar to vegetation on the karst formation (vegetation type **ArMrTS**).	D20R01 D20R07 D20R09 **D20R11**		**Arctotheca calendula* **Brassica tournefortii* **Bromus diandrus* *Crassula* sp. **Hordeum leporinum* **Hypochaeris glabra* **Lolium multiflorum* *Melaleuca rhaphiophylla* *Muehlenbeckia adpressa* **Petrorhagia dubia* *Rytidosperma setaceum* *Trachymene pilosa* **Trifolium campestre* **Ursinia anthemoides* **Vulpia myuros*	126.83 ha 6.57%

Landform	Mapping unit	Vegetation type	Floristic quadrats/ relevés	Representative photograph	Other characteristic species	Area (ha) and extent (%)
Limestone uplands	**EeLW**	*Eucalyptus erythrocorys* low woodland over *Acacia scirpifolia, Rhagodia preissii* subsp. *preissii* and *Guichenotia ledifolia* mid open shrubland/chenopod shrubland over *Acanthocarpus canaliculatus*, *Hibbertia hypericoides* subsp. *septentrionalis* and *Desmocladus asper* mid open forbland/shrubland/rushland **NVIS:** U+ ^*Eucalyptus erythrocorys*\^tree\6\i;M ^*Acacia scirpifolia*,^*Rhagodia preissii* subsp. *preissii*,*Guichenotia ledifolia*\^shrub,^chenopod shrub\3\i;G ^^*Acanthocarpus canaliculatus*,*Hibbertia hypericoides* subsp. *septentrionalis*,*Desmocladus asper*\^forb,shrub,rush\2\i Vegetation type description is taken from quadrats/relevés in 'better' (less weedy) condition. Vegetation type occurs on limestone outcropping.	D20Q05 D20R04 D20R06 **D20R12**		*Acacia rostellifera* *Austrostipa elegantissima* *Austrostipa flavescens* *Austrostipa macalpinei* **Brassica tournefortii* *Calandrinia* sp. Shark Bay (A. Markey 1405) *Conostylis candicans* subsp. *calcicola* **Ehrharta longiflora* *Hybanthus floribundus* subsp. *floribundus* **Hypochaeris glabra* **Lysimachia arvensis* *Macrozamia fraseri* *Muehlenbeckia adpressa* *Thysanotus manglesianus* *Trachymene pilosa* *Trymalium ledifolium* **Ursinia anthemoides* **Vulpia myuros* *Waitzia suaveolens* var. *suaveolens*	117.09 ha 6.07%

Landform	Mapping unit	Vegetation type	Floristic quadrats/ relevés	Representative photograph	Other characteristic species	Area (ha) and extent (%)
Sandplain (with limestone pavement)	**LcBsJhMOS**	*Labichea cassioides*, *Banksia sessilis* var. *cygnorum* and *Jacksonia hakeoides* mid open shrubland over *Hibbertia hypericoides* subsp. *septentrionalis*, *Ecdeiocolea monostachya* and *Desmocladus asper* low open shrubland/rushland with *Eucalyptus erythrocorys* and *Banksia prionotes* isolated clumps of low trees **NVIS:** U+ ^*Eucalyptus erythrocorys*,*Banksia prionotes*\^tree\6\bc;M+ ^^*Labichea cassioides*,*Banksia sessilis* var. *cygnorum*,*Jacksonia hakeoides*\^shrub\3\i;G ^^*Hibbertia hypericoides* subsp. *septentrionalis*,*Ecdeiocolea monostachya*,*Desmocladus asper*\^shrub,rush\1\i Survey at Detailed level would likely result in refinement of vegetation into several additional units, including patches of *Banksia prionotes* woodland and differentiation of types on deeper sands vs. types on more defined limestone pavement.	**D20Q03** D20Q04 **D20R10**	 	*Acacia scirpifolia* *Acanthocarpus canaliculatus* *Austrostipa flavescens* *Austrostipa macalpinei* *Banksia prionotes* *Conostylis candicans* subsp. *calcicola* *Grevillea leucopteris* *Hyalosperma cotula* *Lepidobolus chaetocephalus* *Melaleuca carrii* *Neurachne alopecuroidea* *Thysanotus manglesianus* *Trachymene pilosa* **Ursinia anthemoides* **Vulpia myuros* *Waitzia suaveolens* var. *suaveolens*	408.91 ha 21.19%

Landform	Mapping unit	Vegetation type	Floristic quadrats/ relevés	Representative photograph	Other characteristic species	Area (ha) and extent (%)
Limestone uplands (near coastal)	**McArGaTS**	*Melaleuca cardiophylla*, *Acacia rostellifera* and *Grevillea argyrophylla* tall shrubland over *Beyeria cinerea* subsp. *cinerea*, *Acanthocarpus canaliculatus* and *Diplolaena leemaniana* low open shrubland with *Eucalyptus oraria* and *Eucalyptus erythrocorys* isolated clumps of low trees/mallee shrubs **NVIS:** U+ ^*Eucalyptus oraria*,*Eucalyptus erythrocorys*^tree,mallee shrub\6\bc;M+ ^^*Melaleuca cardiophylla*,*Acacia rostellifera*,*Grevillea argyrophylla*\^shrub\4\c;G ^^*Beyeria cinerea* subsp. *cinerea*,*Acanthocarpus canaliculatus*,*Diplolaena leemaniana*\^shrub\2\i Survey at Detailed level would result in further breakdown of this vegetation type, including into portions dominated by mallees, likely including additional species.	D20Q01 D20Q02 **D20R13** D20R14 D20R15		*Alyogyne hakeifolia* *Anthocercis intricata* *Austrostipa flavescens* **Avellinia michelii* **Avena barbata* **Brassica tournefortii* *Calandrinia* sp. Shark Bay (A. Markey 1405) *Commersonia borealis* *Conostylis prolifera* *Desmocladus asper* *Dioscorea hastifolia* **Ehrharta longiflora* **Erodium botrys* *Guichenotia ledifolia* *Hibbertia subvaginata* **Hypochaeris glabra* *Labichea cassioides* **Lysimachia arvensis* *Melaleuca huegelii* *Melaleuca trichophylla* *Olearia axillaris* **Reichardia tingitana* *Scholtzia umbellifera* *Trachymene pilosa* **Trifolium campestre* **Vulpia myuros* *Waitzia suaveolens* var. *suaveolens*	872.79 ha 45.23%

Landform	Mapping unit	Vegetation type	Floristic quadrats/ relevés	Representative photograph	Other characteristic species	Area (ha) and extent (%)
Lakes and floodplain	**MsCoMrMOW**	*Melaleuca strobophylla*, *Casuarina obesa* and *Melaleuca rhaphiophylla* mid open woodland over **Vulpia myuros*, **Plantago coronopus* and **Hordeum leporinum* low dense grassland/forbland **NVIS:** U+ ^*Melaleuca strobophylla*,^*Casuarina obesa*,*Melaleuca rhaphiophylla*\^tree\7\r;G ^^*Vulpia myuros*,*Plantago coronopus*,*Hordeum leporinum*\^other grass,forb\1\d This vegetation type occurs in the historical floodplain (low-lying) portion of the survey area, towards the northeast, and includes ephemeral lakes and modified structures (dams). It is unlikely that the area now floods, except perhaps during cyclonic events, due to long-term changes to the climate, with surface water flow changes perhaps exacerbated by landscape modifications for roads and agriculture.	D20R05 (lower photo Arramall Lake)	 	*Eucalyptus camaldulensis* subsp. *obtusa* **Hordeum leporinum* **Lolium multiflorum* **Mesembryanthemum nodiflorum* **Petrorhagia dubia* *Rhodanthe oppositifolia* subsp. *oppositifolia* **Trifolium arvense*	42.89 ha 2.22%
		Not native vegetation (cleared)				196.65 ha 10.19%
		TOTAL				**1,929.68 ha** **100%**

4.1.2.2 Vegetation Significance

TECs and PECs

No vegetation recorded from the survey area was assessed as being representative of any currently described TEC or PEC.

Whilst floristically similar, vegetation type **McArGtTS** does not qualify for inclusion in the *Coastal sands dominated by Acacia rostellifera, Eucalyptus oraria and Eucalyptus obtusiflora* P1 PEC (Species and Communities Program; DBCA 2021) as not all definitive species are present within the vegetation type and the vegetation is not dominated by mallee Eucalypts (see **Section 2.2.3**).

4.1.2.3 Other Significant Vegetation

According to the criteria outlined in the Flora and Vegetation Technical Guidance (EPA 2016), three vegetation types may be considered as significant (**MsCoMrMOW**, **ArMrTs**, **EcArMW**) due largely to their small extents within the survey area and more regionally, and their association with groundwater. Their significance is discussed in more detail in **Section 5.2.2**.

4.1.2.4 Floristic Analysis

The floristic analysis dendrogram (**Figure 3**) indicates little floristic fidelity to the structural vegetation types assessed during the field survey, rather it indicates that additional recording sites (quadrats/relevés) would be required to 'tease out' smaller scale variations not detected by the broad mapping used for a Reconnaissance survey.

Of note, the floristics dendrogram indicates that vegetation types **McArGtTS** (on near-coastal limestone uplands) and **EeLW** (on limestone caps) are closely related floristically but are responding to a floristic factor (or factors) not readily apparent in the limited data. Vegetation condition (represented as weed species or lack of floristic diversity) may be the relevant factor. Also of note, vegetation type **LcBsJhMOS** (on sandplain) is more closely grouped floristically than initially considered, although a Detailed survey with additional recording sites would likely detect greater variation than the three recording sites in this analysis indicate.

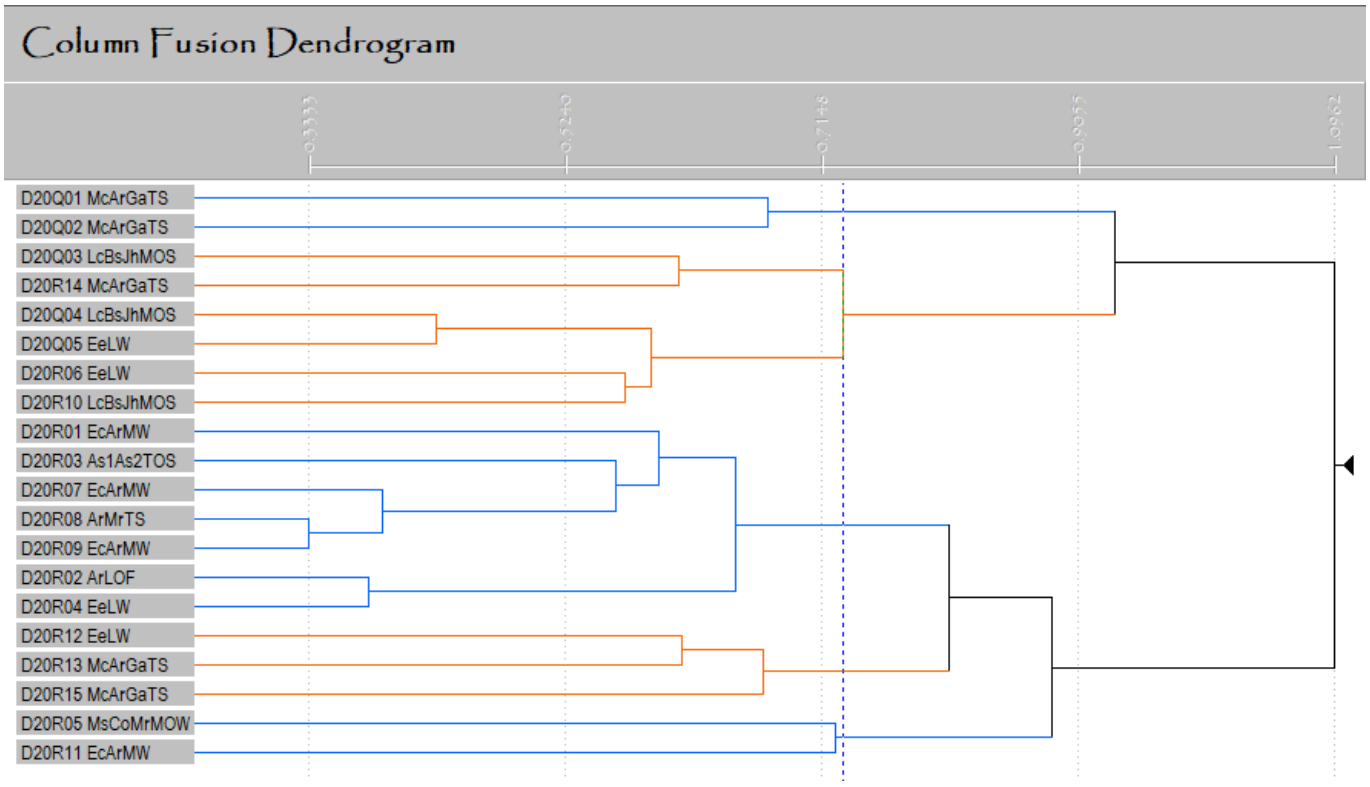

Figure 3: Floristic analysis dendrogram

4.1.2.5 Vegetation Condition

The vegetation condition within the survey area ranged from Completely Degraded to Excellent condition, with the majority in Very Good condition (**Table 9**, **Map 6**). The main factors affecting vegetation condition were weed cover and lack of native ground stratum species, including in areas that are unfenced and therefore not historically grazed by livestock.

Table 9: Vegetation condition

Vegetation condition	Extent (ha)	Proportion (%)
Pristine	-	-
Excellent	276.27	14.32%
Very Good	824.59	42.73%
Good	91.23	4.73%
Degraded	254.81	13.20%
Completely Degraded	286.12	14.83%
Not vegetated	196.65	10.19%

4.1.2.6 Adequacy of Survey

Adequacy of survey can be demonstrated using a species accumulation curve; if the curve has reached (or almost reached) an asymptote it is considered that most species are likely to have been recorded from the survey area. However, it should not be expected that a reconnaissance flora and vegetation survey would record a complete flora inventory.

A species accumulation curve was generated using quadrat data (**Figure 4**). Opportunistic observations, which increase the number of species recorded, are not included in the analysis.

Figure 4 suggests that the curve is flattening and is close to reaching an asymptote. The Bootstrap estimate of species richness is 186.5 which, when taking opportunistic records into account, is approximately the number of species recorded (191).

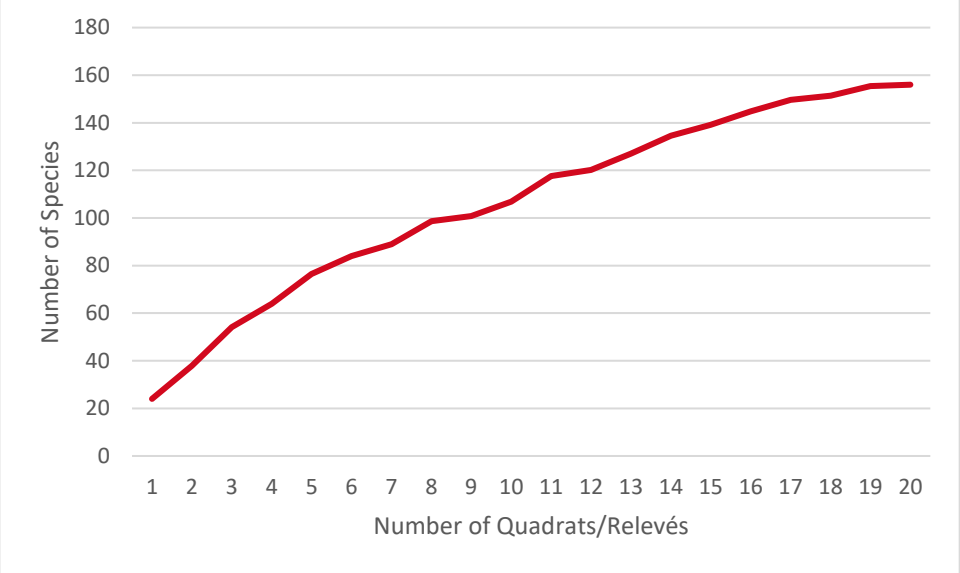

Figure 4: Species accumulation curve

4.1.3 BOTANICAL LIMITATIONS

Survey design: single phase, quadrat-based flora and vegetation survey with extensive traverses searching for conservation significant flora.

Survey type: reconnaissance level flora and vegetation survey with extensive searches for significant flora searches conducted over a single phase.

Type of vegetation classification system: vegetation was classified at NVIS Level V (NVIS Technical Working Group & DotEE 2017) using largely structural vegetation types defined using dominant and characteristic species and vegetation structure as recorded during the field surveys.

A summary of botanical limitations is presented in **Table 10**.

Table 10: Botanical limitations

Possible limitations	Constraints (yes/no): Significant, moderate or negligible	Comment
Availability of contextual information at a regional and local scale	Negligible	There are few known flora and vegetation surveys that have been conducted in close proximity to the survey area. However, the majority of the survey area is representative of near-coastal vegetation that is well understood from the bioregion. The constraint is considered negligible as the role of a Reconnaissance survey is to broadly describe the flora and vegetation attributes of the survey area, which has been achieved.

Possible limitations	Constraints (yes/no): Significant, moderate or negligible	Comment
Competence/experience of the team conducting the survey, including experience in the bioregion surveyed	No	The lead botanist conducting the field survey has over 30 year' experience conducting flora and vegetation surveys within Western Australia, including the bioregion.
Proportion of the flora recorded and/or collected, and any identification issues	Negligible	191 vascular flora taxa were recorded during the field survey of which nine (4.71%) could not be identified with certainty to species level due to the lack of diagnostic reproductive material. This is considered a negligible constraint. One species, identified as *Triodia* sp., may represent a conservation-listed species from the region. However, the likelihood is low and, if Priority-listed, would be representative of a P3 or P4 species thus unlikely to significantly affect the environmental approvals process.
Was the appropriate area fully surveyed (effort and extent)	Negligible	Despite access issues (see below) the survey effort was sufficient to describe the flora and vegetation values of the survey area at Reconnaissance level.
Access restrictions within the survey area	Moderate	The survey area had large areas that were inaccessible due to lack of track access and dense, impenetrable *Cassytha*-tangled vegetation (**Image 1**) that impeded the ability to move through the area. However, this is only a moderate constraint as the survey was of sufficient intensity to describe the flora and vegetation values of the survey area at Reconnaissance level. The inaccessible portions of the survey area are not likely to be representative of a TEC, although there is a low chance that some may be representative of a PEC.
Survey timing, rainfall, season of survey	Negligible	The field survey was conducted during October which is within the primary season for survey in the bioregion. Although it would have been ideal to conduct the survey during September when a higher proportion of flora species are likely to have been flowering, few (4.71% of the flora inventory) could not be identified with certainty (and there is no certainty they would have been more identifiable if recorded earlier), none of which are likely to be of significance thus representing a negligible constraint. The rainfall in the 6 months prior to the field survey was approximately 74% of the mean for this period (**Figure 2**), also indicated by the rainfall deciles (**Figure 5**). This represents a negligible constraint.
Disturbance that may have affected the results of the survey e.g. fire, flood, clearing	No	There were no recent disturbances that would have affected the results of the survey. None of the survey area had been recently burnt.

Image 1: Impenetrable vegetation

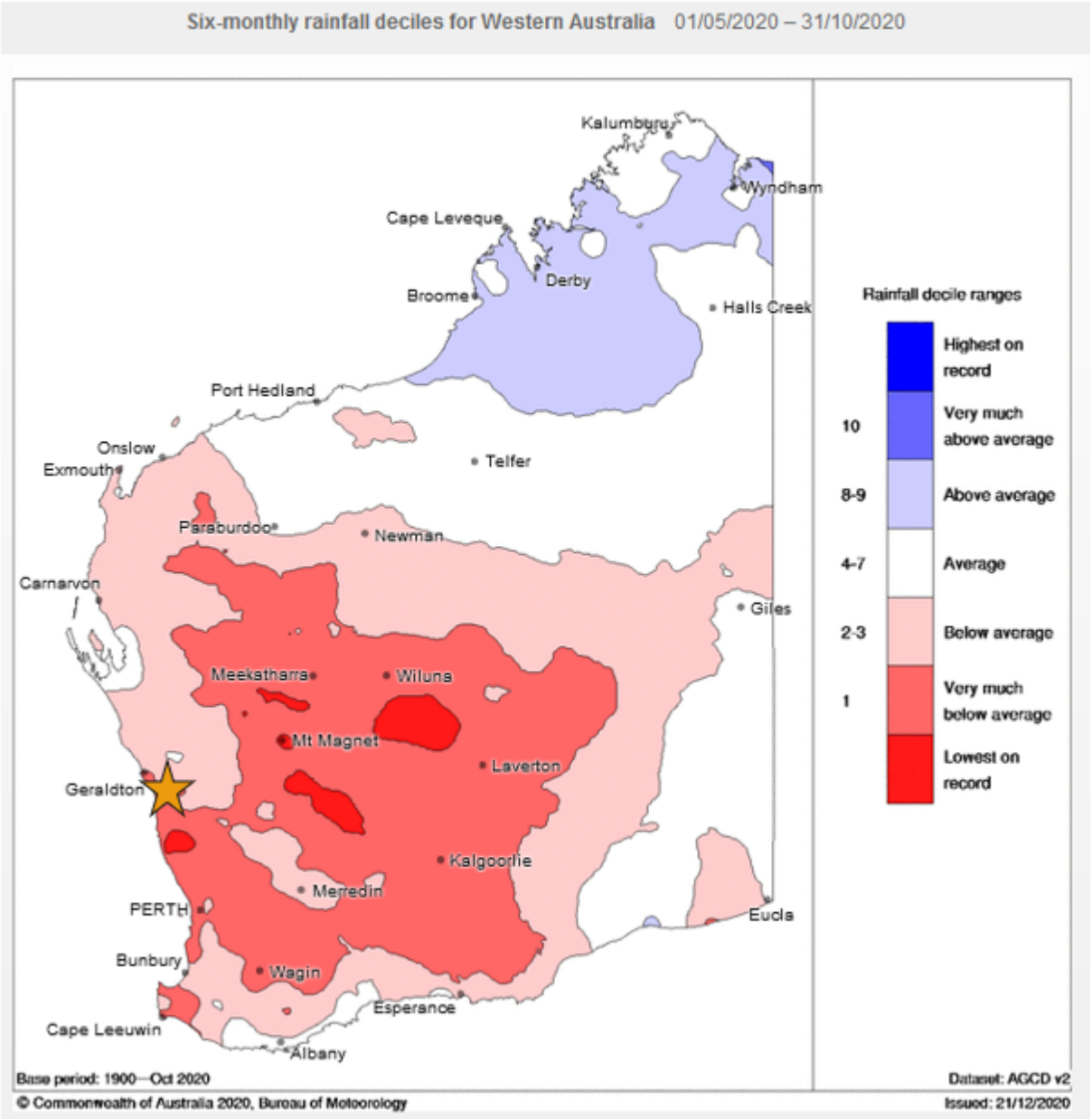

Figure 5: Rainfall deciles for the 6 months prior to the field survey (the star indicates the approximate survey area location) (BoM 2020c)

4.2 VERTEBRATE FAUNA SURVEY

The fauna survey was conducted by Terri Jones (Senior Ecologist) during 12-16 October 2020. The survey was conducted in accordance with the requirements outlined in the Fauna Technical Guidance (EPA 2020a).

The site was traversed on foot and by vehicle and all habitats were assessed for quality and capability of supporting both locally common and significant fauna species, although large parts were inaccessible due to dense vegetation.

4.2.1 FAUNA ASSEMBLAGE

A total of 57 vertebrate fauna species were recorded during the survey. Of these, three are conservation-listed:

- *Calyptorhynchus latirostris* (Carnaby's Cockatoo) – Endangered under the BC Act and EPBC Act
- *Calidris acuminata* (Sharp-tailed Sandpiper) – Listed Migratory species under the EPBC Act
- *Merops ornatus* (Rainbow Bee-eater) – Listed Marine species under the EPBC Act.

Observations during the survey were predominantly of avifauna (birds), with overall records consisting of 42 bird species, 12 mammal species and three reptile species. No amphibians were observed.

Seven fauna species recorded are introduced:

- *Bos taurus* (European Cattle)
- *Canis lupis* subsp.*familiaris* (Dog)
- *Capra hircus* (Goat)
- *Oryctolagus cuniculus* (Rabbit)
- *Vulpes vulpes* (Red Fox)
- *Dacelo novaeguineae* (Laughing Kookaburra) – Introduced to Western Australia.

Bat call analysis was completed by Dr Kyle Armstrong of Specialised Zoological. Five bat species were identified with certainty from recordings made within the survey area, none of which are conservation listed. Three of these (*Chalinolobus gouldii, C. morio* and *Nyctophilus geoffroyi*) are commonly known from the region, whilst two species (*Austronomus australis* and *Vespadelus baverstocki*) do not have previous DBCA records from the area and thus represent range extensions. One additional bat species (*Ozimops kitcheneri*) was potentially recorded during the survey, however, the call could not be confidently attributed to the species with certainty and thus has been excluded from the overall species list.

A list of fauna species recorded during survey is included in **Table 23** in **Appendix Three**. Survey sites are listed in **Table 24** in **Appendix Three**.

4.2.2 FAUNA HABITAT

Habitat evaluation was carried out across 34 habitat assessment points (DWS01-DWS35), with multiple assessment points within each generalised habitat type observed. Additional information for characterising habitat types was gathered during ornithological surveys and opportunistic observations.

Eight fauna habitat types were recorded within the survey area (**Table 11**):

- H: Heath
- Mw: Mallee Woodland
- P: Pastoral
- R: Riparian
- S: Shrubland

- Wb: Waterbody (seasonal)
- Wl: Wetland
- W: Woodland.

The majority of the survey area was comprised of Mallee Woodland or Shrubland habitat, with moderate areas of Woodland or Pastoral habitat in the eastern portion, and Heath in the southern central section. Wetland and Riparian habitats were restricted to the vicinity of the two waterbodies in the northwest of the survey area, and along the Arrowsmith River tributary flowing into these waterbodies from the southeast.

Areas of Shrubland and Heath in the south contain patches of *Banksia prionotes*, which are a preferred forage species for Carnaby's Cockatoo. Seed from pasture and cropping grasses in the Pastoral habitat, and large paperbark trees within the Wetland habitat, also provide food for this endangered bird species. The Wetland habitat is additionally important for migratory waders in the locality seasonally.

The assessment of each habitat type was based on the field surveyor's experience and takes into consideration the level of disturbance to habitats from weeds, the amount of native vegetation, vegetation cover (density) and the context of the habitat with the surrounding landscape.

Table 11: Fauna habitat types

Habitat type	Description	Photograph
Heath	**Tall heath on sandplain, with emergent tall shrubs or isolated mallee.** Areas of open sand with occasional small outcroppings exist amongst diverse low or mid-height flowering shrubs. Suitable habitat for nectivorous birds (e.g. honeyeaters), reptiles and predating raptors. Areas with low patches of *Banksia prionotes* present may provide forage for Carnaby's Cockatoo. **Assessment points:** B04, DWS06, DWS07, DWS08, DWS09, DWS10 **Extent**: 190.3 ha; 9.86%	
Mallee Woodland	**Low mallee woodland with tall shrubs and stands of low Eucalypts.** Dense thickets of understorey shrubs and climbers in some areas, with more open canopy of eucalypts. Habitat is suitable for a range of small to medium sized nectivorous and insectivorous birds, reptiles and small to medium mammals. **Assessment points:** B01, DWS02, DWS03 **Extent**: 490.9 ha; 25.44%	

Habitat type	Description	Photograph
Pastoral	**Pastoral plain of farmland pasture and cropped grasses, with scattered small woodland or shrubland remnants.** This habitat provides forage habitat for seed-eating bird species (including parrot and cockatoo species), as well as insectivorous birds that prefer edge of woodland habitat. Fauna that require tree hollows for breeding, or predate on bird eggs/nestlings (such as monitor lizards or Chuditch) may also utilise treed remnants in this habitat. **Assessment points:** DWS16, DWS17, DWS18, DWS24, DWS30, DWS34 **Extent**: 220.3 ha; 11.42%	
Riparian	**Mature Eucalypts (primarily *Eucalyptus camaldulensis*) along a seasonal creek line, over grasses or shrubs.** Numerous tree hollows exist in mature Eucalypts within this habitat type, providing breeding habitat for multiple bird species such as larger parrots, hollow-nesting ducks and kingfishers, as well as microbat species. Seasonal water flow and pools support Sacred Kingfisher and Rainbow Bee-eaters, and are a water source for mammals and reptiles. **Assessment points:** B05, DWS01, DWS19, DWS20, DWS21, DWS23 **Extent**: 124.7 ha; 6.46%	

Habitat type	Description	Photograph
Shrubland	**Tall shrubland of *Acacia* and/or *Melaleuca* with patches of mallee, on sandplain and limestone karst.** Less degraded areas of this shrubland habitat have dense patches of diverse mid- and understorey, supporting honeyeater and wren bird species. Mammals including kangaroos and wallabies, as well as introduced mammal species, are likely to utilise this habitat. Some proteaceous shrub species (including *Banksia prionotes*), more common in the south-eastern sections, may provide forage habitat for Carnaby's Cockatoo. Limestone karst and outcroppings are present throughout much of the northern extent of this habitat unit, providing breeding habitat for reptiles and microbats. **Assessment points:** B02, DWS04, DWS05, DWS11, DWS12, DWS13, DWS14, DWS15, DWS31 **Extent**: 742.7 ha; 38.49%	
Waterbody (seasonal)	**Seasonal lake with clay substrate and fringing vegetation.** This aquatic habitat is fed by the Arrowsmith River tributary flowing from the southeast corner of the survey area. It supports local bird and mammalian fauna as a water source, and provides forage habitat for insectivorous birds and microbats, and local and migratory waders. **Assessment points:** **n/a** **Extent**: 8.4 ha; 0.44%	

Habitat type	Description	Photograph
Wetland	**Seasonal wetland of fringing Melaleuca vegetation.** Mature *Melaleuca* trees are supportive of Carnaby's Cockatoo and other psittacine bird species, with lower shrubs at the edge of the waterbody proper suitable for nesting insectivorous birds. **Assessment points:** B03, DWS25, DWS26, DWS27, DWS29 **Extent**: 42.9 ha; 2.22%	
Woodland	**Low eucalypt woodland, over mixed understorey shrubs or *Acacia/Melaleuca* scrub.** This habitat is suitable as foraging or breeding habitat for numerous woodland bird species. Supportive of a broad range of reptile and mammal species, including microbats. **Assessment points:** DWS22, DWS31, DWS32, DWS33 **Extent**: 109.5 ha; 5.67%	

4.2.3 SIGNIFICANT FAUNA AND ASSOCIATED HABITAT

The significant fauna species observed during the field survey are discussed below with respect to each species' habitat requirements, taking into consideration the findings of the field survey and survey effort.

4.2.3.1 Carnaby's Cockatoo *(Calyptorhynchus latirostris)* – EN;EN

Carnaby's Cockatoo was recorded within the survey area on several occasions, within Pastoral and Wetland habitats. Small groups were observed feeding on mature *Melaleuca* trees near assessment point DWS27 in the northeast of the survey area (**Image 2**) and feeding on proteaceous shrubs along the eastern boundary fence in Pastoral habitat near assessment point DWS30 (**Image 3**).

Image 2: Carnaby's Cockatoo (foraging in *Melaleuca*)

Image 3: Carnaby's Cockatoo (in flight)

Areas of suitable foraging habitat for Carnaby's Cockatoo occur across the survey area, however, there is limited availability of preferred forage vegetation. Several locations of *Banksia prionotes*, a priority forage tree for Carnaby's Cockatoo (DEC 2011), were observed in the south and southeast portions of the survey area (**Map 7**). These may provide preferred forage habitat but are of limited extent and plant density, therefore, are considered unlikely to support large flocks of Carnaby's Cockatoo or prolonged feeding activity.

The survey area is located within the mapped distribution of Carnaby's Cockatoo, however, is not within the mapped breeding range (DSEWPaC 2012), therefore aspects relevant to breeding were not taken into consideration. No other conservation-listed Black Cockatoo species is likely to occur within the survey area.

4.2.3.2 Rainbow Bee-eater *(Merops ornatus)* – -; MA

Rainbow Bee-eaters were observed at several locations within Wetland, Riparian and Woodland habitat units of the survey area. One possible, disused, nesting burrow was observed within the survey area (**Images 4** and **5**) but could not be confirmed. It was recorded in sandy substrate within the Riparian habitat unit, near the eastern access gate. No colonial nest sites or active nest burrows were sighted.

Image 4: Potential disused Rainbow Bee-eater burrow

Image 5: Burrow entrance showing scale

4.2.3.3 Sharp-tailed Sandpiper *(Calidris acuminata)* – MI; MI

This small, migratory wading bird was observed on several occasions as a single individual foraging in the larger waterbody (Lake Arramall) near assessment point DWS26 in the northeast of the survey area. The species was not observed at any other locations. Other waterbodies within the survey area do not present suitable habitat for this species as these waterbodies lack the shallow margins and muddy substrate that are suitable for foraging by this bird.

4.2.4 OTHER FAUNA OF NOTE

4.2.4.1 Little Long-tailed Dunnart (*Sminthopsis dolichura*)

This small mammal was identified from motion sensing camera imagery (**Image 6**) recorded at the southwestern corner of the survey area, in dense shrubland habitat. The Little Long-tailed Dunnart is not a conservation-listed species under State or Commonwealth legislation, however, the record from the survey area fills a gap in distribution records for the species (with the nearest being 35 km to the southeast) and is therefore of note.

Image 6: Little Long-tailed Dunnart

4.2.5 FAUNA SURVEY LIMITATIONS

Factors which may potentially represent limitations of survey have been considered and evaluated as presented in **Table 12**. Overall, limitations to survey were negligible excluding access within the survey area, which was considered a moderate constraint.

Table 12: Fauna survey limitations

Possible limitations	Constraints (yes/no): Significant, moderate or negligible	Comment
Availability of data and information	Negligible	There are few published faunal surveys that have been conducted in close proximity to the survey area. However, the majority of the survey area is representative of near-coastal habitat that is well understood from the bioregion. The constraint is considered negligible as the role of a Basic fauna survey is to broadly describe the habitat attributes of the survey area and potential for conservation listed fauna species to occur, which has been achieved.
Competency/experience of the survey team, including bioregion experience	No	The lead zoologist has 15+ years' experience in fauna ecology, with 10+ years' experience conducting fauna survey and environmental impact assessment in Western Australia.
Scope of survey e.g. excluded fauna groups	No	All fauna groups were sampled with the exception of amphibians due to the timing of the survey. Survey was conducted as a Basic survey, with the emphasis on describing habitat and assessing its suitability for conservation-listed species.
Timing, weather, season	No	The field survey was conducted during October, which is considered optimal in this region for all fauna groups excepting amphibians, which were not targeted during survey. The timing is considered appropriate for a Basic level fauna survey. The rainfall in the 6 months prior to the field survey was below the mean for this period (**Figure 2**), also indicated by the rainfall deciles (**Figure 5**). There is no constraint posed by the preceding weather conditions for this level of survey.
Disturbances that may have affected results	No	There were no recent disturbances that would have affected the results of the survey. None of the survey area had been recently burnt.
Proportion of fauna identified, recorded or collected	No	Fauna assemblage identified is representative of a Basic level survey with species that are identified in the field by observation, trail camera images, audio recordings, and evidence of presence e.g. scats and tracks.
Adequacy of survey intensity and proportion of survey achieved	No	A total of 57 vertebrate fauna taxa were recorded during the survey, representing taxa from bird, mammal and reptile groups. The survey area is considered to be adequately evaluated for a Basic level of fauna survey.
Access	Moderate	The survey area had large areas that were inaccessible due to lack of track access and dense, impenetrable *Cassytha*-tangled vegetation (**Image 1**) that impeded the ability to move through the area. However, this is only a moderate constraint as the survey was of sufficient intensity to describe the habitat values of the survey area as required for Basic fauna survey.

5 DISCUSSION

5.1 FLORA SIGNIFICANCE

A total 191 vascular flora were recorded from five floristic quadrats and 15 unmeasured relevés, as well as from opportunistic observations during site traverses.

5.1.1 LOCAL AND REGIONAL ASSESSMENT OF FLORA SIGNIFICANCE

5.1.1.1 Conservation-listed Flora

Threatened Flora

No Threatened Flora were recorded during the field survey.

Priority Flora

Three Priority-listed flora were recorded during the field survey: *Anthocercis intricata* (P3), *Beyeria cinerea* subsp. *cinerea* (P3) and *Eucalyptus zopherophloia* (P4). *Eucalyptus zopherophloia* has previously been recorded from within the survey area, and the others from nearby (within 3.5 km). They were recorded in areas with limestone capping in vegetation type **McSrGaTS**, with one occurrence of *Eucalyptus zopherophloia* in disturbed vegetation type **ArLOF** adjacent to cleared lands.

Priority 3 and 4 species are not currently considered to be under imminent threat (DBCA 2019b), therefore potential impacts of clearing in the vegetation type that most of the individuals of the recorded conservation-listed species occur is unlikely to significantly affect the populations of these species as a whole.

***Anthocercis intricata* (P3)**

Anthocercis intricata was recorded occasionally (<10 plants observed) as individual plants scattered in vegetation type **McSrGaTS**. It is likely to occur intermittently (sparsely) throughout this vegetation type, particularly in more coastal (western) and northern portions as the survey area represents the southern edge of the extent of this species, perhaps to a maximum population of a few hundred individuals. Elsewhere (north of Dongara), Ecoscape has observed this species as a disturbance opportunist, forming large, prickly, dense shrubs (with *Acacia rostellifera*) in otherwise cleared areas (**Image 7**) (Ecoscape 2010).

Image 7: *Acacia rostellifera* and *Anthocercis intricata* clumps in otherwise bare paddock (Ecoscape 2010)

Hart, Simpson and Associates (2003) recorded *Anthocercis intricata* and *Eucalyptus zopherophloia* in similar vegetation to the north of the survey area. Although no population estimates were given in the report, the description of *Anthocercis intricata* as 'relatively widespread and abundant regionally' (p.25) and its known distribution (**Figure 6**; the approximate location of the survey area is indicated by a star, with the various colours indicating bioregions) supports the likelihood that loss of individual plants (or a large portion of the population) within this survey area is unlikely to have a significant impact on the population as a whole.

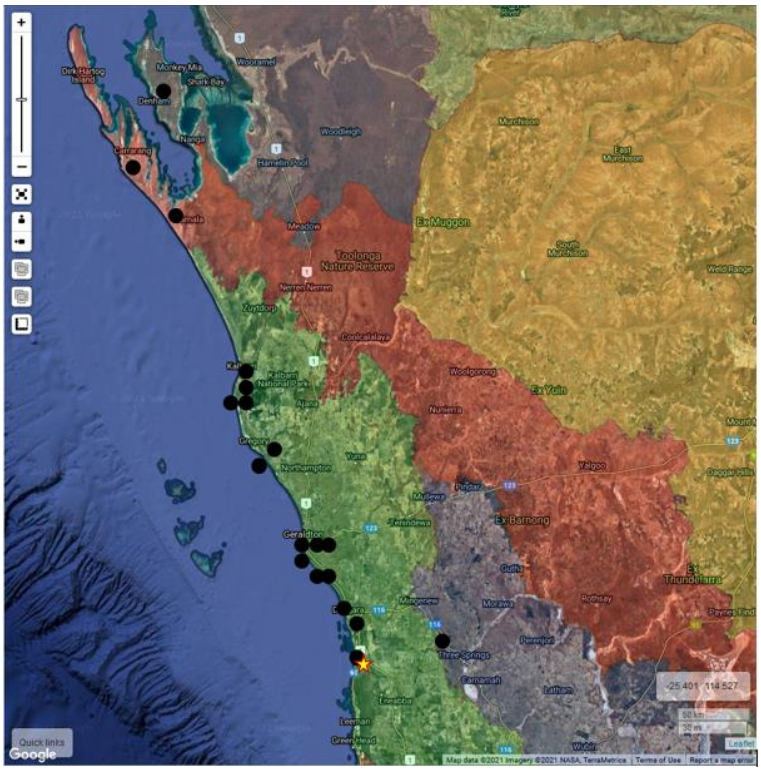

Figure 6: *Anthocercis intricata* distribution (ALA 2021)

Beyeria cinerea subsp. *cinerea* (P3)

Beyeria cinerea subsp. *cinerea* was recorded as a dominant ground stratum species within one quadrat recorded in vegetation type **McSrGaTS**. It is likely to occur sporadically, at times as a dominant ground stratum shrub, within all of this vegetation type, numbering hundreds of individual plants.

Hart, Simpson and Associates (2003) did not record *Beyeria cinerea* subsp. *cinerea* in their survey area to the north. This species has previously been recorded from close to the survey area (DBCA database search results), however, given that it is an unobtrusive small shrub with insignificant flowers, and that there have been few surveys known to have been conducted in the vicinity, it is likely to have not been noticed rather than not being present in the wider area. Given this taxon has an overall distribution of approximately 700 km north-south (**Figure 7**), clearing some or all of the population within the survey area is unlikely to have a significant impact on the species as a whole.

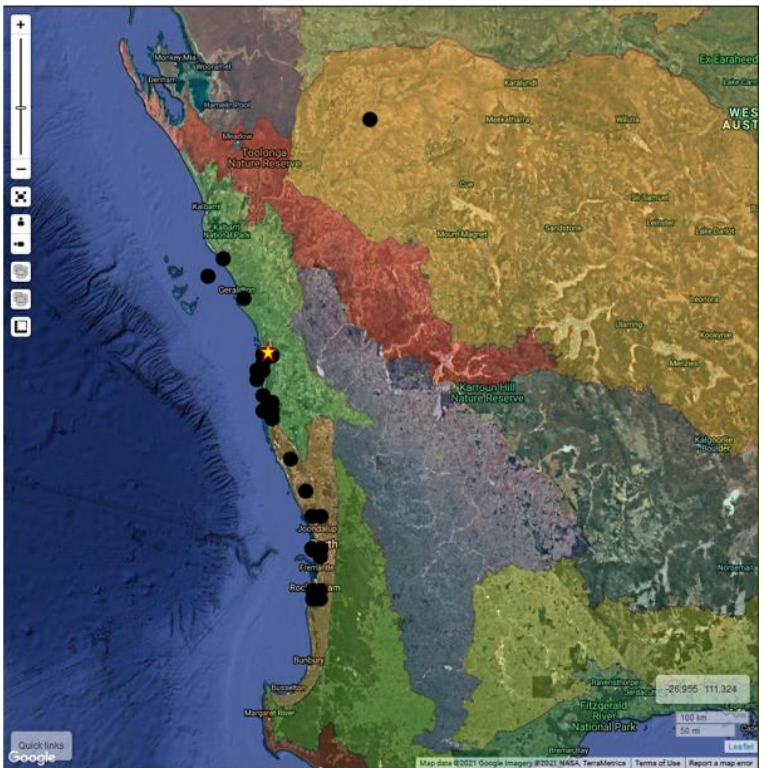

Figure 7: *Beyeria cinerea* subsp. *cinerea* distribution (ALA 2021)

Eucalyptus zopherophloia (P4)

Eucalyptus zopherophloia was observed to occur in patches; 72 individual mallees were counted during the survey. This species is likely to occur sporadically within the entirety of vegetation type **McSrGaTS**, numbering up to hundreds of individuals within the survey area.

Eucalyptus zopherophloia was recorded by Hart, Simpson and Associates (2003) as occurring in 'small numbers in two areas'(p. 25) in their survey area, however, their aspersion that this species has only a small extent is no longer accurate as it occurs from (approximately) Shark Bay to Jurien Bay (**Figure 8**), with the greatest density of records near this survey area. Therefore, removal of some, or all, individuals of this species would be unlikely to have a significant impact on the species as a whole.

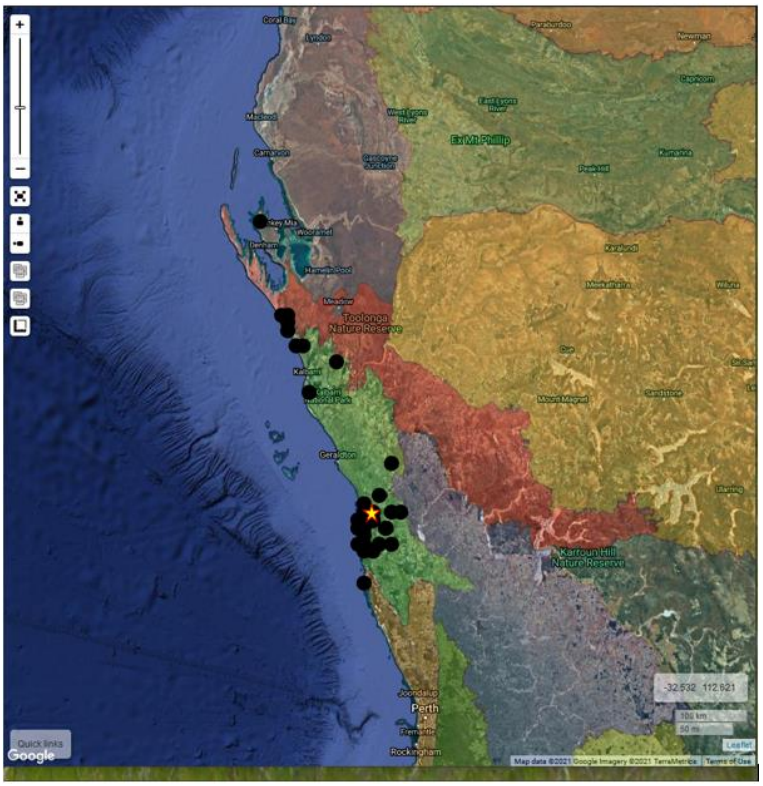

Figure 8: *Eucalyptus zopherophloia* distribution (ALA 2021)

5.1.1.2 Post-survey Likelihood Assessment

The likelihood of conservation significant flora occurring in the survey area was revised following the field survey. This revised likelihood, that took into account vegetation condition, grazing and other disturbances, actual habitat availability and search effort, is included in **Table 20** in **Appendix Two**.

No TF were identified as having a High likelihood of occurring during the desktop assessment phase, and no likelihoods were altered following the field survey.

The following taxa were identified as having a High likelihood of occurring at desktop stage. Following the field survey they no longer are considered as having this likelihood:

- *Drosera pedicellaris* (P1); this species grows on deep beige sand that is considered a requirement for this species (Lowrie 2002); aside from deep sand being uncommon or perhaps not occurring at all in the survey area (the sandy parts are likely to be shallow over limestone pavement), the sand is not beige. The nearest vouchered specimen was collected in 1969, and therefore has dubious locational accuracy (the location description is 'north of Arrowsmith Lake'). Additionally, all other vouchered specimens occur more inland than the survey area and, where available, vegetation descriptions are not similar to vegetation recorded from the survey area (WAH specimen records 2021). Therefore, this species is unlikely to occur and has been re-evaluated as having a Medium likelihood.
- *Comesperma griffinii* (P2); this poorly known species is a very small annual or perennial herb to 15 cm high, recorded from sandplains, all of which are significantly more inland than the survey area. Associated vegetation from the specimen records are not overly similar to vegetation occurring within the survey area (WAH specimen records 2021), therefore is has been re-evaluated as having a Medium likelihood of occurring within the survey area.
- *Schoenus* sp. Eneabba (F. Obbens & C. Godden I154) (P2); this undescribed species is a robust sedge to 0.75 m high growing in sandplain heath and Banksia woodlands (WAH specimen records 2021). All records

are from further inland than the survey area; this, combined with only broadly similar associated vegetation occurring within the survey area has led to its re-evaluation of having a Medium likelihood of occurring within the survey area.

- *Banksia elegans* (P4); this shrub to 4 m high grows in sand including on consolidated dunes, most frequently in Banksia woodland and heathland (WAH specimen records 2021). All records are from further inland than the survey area locations (DBCA 2007-2021), therefore due to only broadly similar habitat occurring, this species has been re-evaluated as having a Medium likelihood of occurring. If it occurs it would be in the south-eastern portion of the survey area.

The following five taxa were identified as having a High likelihood of occurring at desktop stage, and retain this likelihood following field survey. Each is discussed below.

Acacia vittata (P2)

Acacia vittata is a dense shrub to 4 m high growing in sand and sandy clay, including several records from 1992 and earlier adjacent to the railway line located south of the survey area. Its habitat includes shrubland similar to that of the survey area, including vegetation type **LcBsJhMOS** that extents southwards and outside the survey area to the railway that corresponds with records of this species, and the edges of ephemeral lakes (WAH specimen records 2021). Whilst it is unlikely to occur in the vicinity of the ephemeral lakes within the survey area due to previous grazing that has left the vegetation in Completely Degraded condition, it may occur within vegetation type **LcBsJhMOS** particularly near the railway.

There are 23 records listed for *Acacia vittata* on *NatureMap* (DBCA 2007-2021), with several disjunct populations in the Geraldton Sandplains (mostly) and Avon Wheatbelt IBRA regions. Due to the extent of this species' occurrence (including within Beekeepers Nature Reserve, where the populations is secure), if it occurs it is unlikely to be significantly impacted by clearing in the survey area.

Scholtzia calcicola (P2)

Scholtzia calcicola is an erect shrub to 2 m high, recorded as occurring on shallow and over limestone in heath vegetation (Rye 2019). Small-flowered Myrtaceae are notoriously difficult to differentiate from related species, thus it may have been overlooked during the survey or occur elsewhere that was not accessed during the survey. Suitable habitat and broadly similar vegetation (vegetation type **LcBsJhMOS**, including Banksia woodland that corresponds with one record for this species) occurs within the survey area.

There are only six records of this species listed on *NatureMap* (DBCA 2007-2021), all within the Geraldton Sandplains IBRA region. Additional survey would be required to determine if *Scholtzia calcicola* occurs within the survey area, noting that such surveys would require significant effort (targeted grid searches) to eliminate the possibility of it occurring. If it occurs within the survey area it is not possible to determine the impact to this species that clearing would have due to the poorly known nature of the species.

Haloragis foliosa (P3)

Haloragis foliosa is a perennial herb or shrub to 0.5 m high, growing on sand over limestone (WAH 2021). Vegetation type **McSrGaTS** is very similar to that listed for specimens vouchered in the WAH, and therefore broadly suitable habitat is highly likely to occur within the survey area. Hart, Simpson and Associates (2003) recorded *Haloragis foliosa* from approximately 7 km to the north of the survey area, in burnt vegetation (WAH specimen description 2021), where it was noted to be recruiting and not abundant. The habitat was described as being 'areas with lagoonal and estuarine deposits over Tamala Limestone'; it is unknown if similar habitat

occurs within the survey area. As suitable habitat may occur and it has been recorded from nearby, although not recently (in 1995, according to the WAH specimen data), it retains its High likelihood of occurring.

There are 28 records listed for this species on *NatureMap* (DBCA 2007-2021), from three IBRA regions. Despite the small number of records, specimen descriptions indicate this species may be a disturbance opportunist and clearing may actually favour its presence.

Thryptomene sp. Lancelin (M.E. Trudgen 14000) (P3)

This species has been recorded growing on calcareous sand (WAH 2021) in mainly near-coastal locations (DBCA 2007-2021). As a low-growing shrub less than 1 m high that may not have been flowering at the time of survey, and the large areas of potential habitat that were not accessed (or accessible), including vegetation type **McSrGaTS**, it retains its High likelihood of occurring.

There are 28 records listed for this species on *NatureMap* (DBCA 2007-2021) over approximately 200 km north-south in the Geraldton Sandplains and Swan Coastal Plain IBRA regions. Therefore (if it occurs), it is unlikely that clearing in the survey area would significantly impact on the population of this species as a whole.

Stawellia dimorphantha (P4)

This low (only up to 20 cm high), unobtrusive herb grows on sandy substrates in vegetation similar to that occurring in the south-east portion of the survey area, and in *Banksia prionotes* woodlands that occur sporadically (vegetation type **LcBsJhMOS**), although most records are from further inland than the survey area (DBCA 2007-2021). It appears vegetatively similar to some *Alexgeorgea* and (non-flowering) *Laxmannia* species, thus may be easily overlooked. It therefore retains is High likelihood of occurring.

There are 67 records listed for *Stawellia dimorphantha* on *NatureMap* (DBCA 2007-2021), all within the Geraldton Sandplains IBRA regions, with a north-south distribution over approximately 90 km. If it occurs, clearing within the survey area is unlikely to have a significant impact on the population of this species as a whole.

5.1.1.3 Other Significant Flora

One flora species was considered to have a degree of significance according to the criteria outlined in the Flora and Vegetation Technical Guidance (EPA 2016); *Pelargonium littorale* is a range infill. However, when taking it's largely southern Australia-wide distribution into consideration (ALA 2021), this range infill is considered to be of only minor significance and likely a result of lack of previous surveys along the coastal strip south of Dongara rather than an extension to its distribution.

No other flora species are likely to be considered significant according to the EPA criteria (EPA 2016).

5.1.1.4 Introduced Flora

Thirty-nine introduced flora species (weeds) were recorded during the field survey, representing 20.42% of the overall flora inventory. All are agricultural weeds or commonly occurring in the region. All areas that have been grazed by livestock have a moderate (or greater) weed cover; the average weed cover of the 20 quadrats and relevés was 35% with only one quadrat not having any weed species present. Weeds were the main contributor to the vegetation condition assessment.

**Echium plantagineum* (Patterson's Curse) is a Declared Pest plant (Exempt category in the Shire of Irwin), occurring sparsely in grazed parts of the survey area, that has no management requirements. It is a common occurrence in agricultural areas of the south of Western Australia and in South Australia, Victoria, New South

Wales, southern Queensland and Tasmania, also occurring more sparsely in other parts of Queensland and the Northern Territory (ALA 2021).

**Lycium ferocissimum* (African Boxthorn) is WoNS species that was recorded from one relevé on karst limestone east of Arramall Lake and is likely to occur sparsely along the limestone ridge. Whilst there are no management requirements in relation to its listing as a WoNS species, this listing recognises the invasive nature of the species which can form dense, impenetrable thorny thickets if unmanaged, and can impede access to infrastructure. **Lycium ferocissimum* has berries that are eaten by birds and foxes, contributing to its spread (Weeds Australia 2021). It is likely that feral goats would also eat the berries. **Lycium ferocissimum* occurs in all states of Australia, particularly in the southern half of the continent, including Tasmania (ALA 2021). It is particularly common in near coastal areas between Geraldton and Dongara (Ecoscape 2007, 2010).

No weeds within the survey area have any specific management requirements due to their presence.

5.2 VEGETATION SIGNIFICANCE

Eight broad vegetation types were recorded from the survey area:

- Near-coastal limestone uplands:
  - **EeLW**; *Eucalyptus erythrocorys* low woodland
  - **McArGaTS**; *Melaleuca cardiophylla*, *Acacia rostellifera* and *Grevillea argyrophylla* tall shrubland – this vegetation type has emergent mallees, in patches (i.e. as a mosaic) sufficient to form an upper stratum
- Karst:
  - **ArMrTS**; *Acacia rostellifera* and *Melaleuca rhaphiophylla* tall shrubland
- Sandplain (with limestone pavement):
  - **LcBsJhMOS**; *Labichea cassioides*, *Banksia sessilis* var. *cygnorum* and *Jacksonia hakeoides* mid open shrubland – this vegetation type has patches of mallees and, in deeper sands, patches of *Banksia prionotes*
- Riparian areas and floodplain:
  - **EcArMW**; *Eucalyptus camaldulensis* subsp. *obtusa* and *Acacia rostellifera* mid woodland
- Lakes and floodplain (flat) areas:
  - **MsCoMrMOW**; *Melaleuca strobophylla*, *Casuarina obesa* and *Melaleuca rhaphiophylla* mid open woodland
- Uplands (disturbed):
  - **ArLOF**; *Acacia rostellifera* low open forest
  - **As1As2TOS**; *Acacia saligna* and *Acacia scirpifolia* tall open shrubland.

5.2.1 THREATENED AND PRIORITY ECOSYSTEMS

The EPBC-listed Vulnerable *Subtropical and Temperate Coastal Saltmarsh* TEC that is the equivalent of a Western Australian P3 PEC of the same name occurs within 30 km of the survey area. However, the survey area is not coastal or estuarine and no saltmarsh species are present thus this ecological community does not occur within the survey area.

Two occurrences of the Western Australian P1 *Coastal sands dominated by Acacia rostellifera, Eucalyptus oraria and Eucalyptus obtusiflora (Geraldton area)* PEC (Species and Communities Program, DBCA 2021) were identified by the DBCA database search (search reference 24-0920EC) commissioned prior to the survey from approximately 30 km north of the survey area (north of the area indicated on **Map 3**). This PEC is not present

within the survey area as not all definitive species occur, nor is there a vegetation type dominated by Eucalypt mallees.

5.2.2 LOCAL AND REGIONAL ASSESSMENT OF VEGETATION SIGNIFICANCE

The vegetation types of the survey area are discussed in terms of the significance factors outlined in the Flora and Vegetation Technical Guidance (EPA 2016) below, taking into consideration local and regional significance.

Vegetation Type ArLOF

Vegetation type **ArLOF** (*Acacia rostellifera* low open forest) occupies formerly grazed areas, most frequently on the edges of the cleared paddocks. Some parts of this vegetation type may represent regeneration following clearing. The entire 49.39 ha (representing 2.56% of the survey area) was in Degraded-Completely Degraded condition and as such does not represent extant native vegetation.

It does not have any local or regional significance, representing a commonly occurring vegetation type in disturbed areas within the region.

Vegetation Type ArMrTS

Vegetation type **ArMrTS** (*Acacia rostellifera* and *Melaleuca rhaphiophylla* tall shrubland) occurs on karst formation may be significant because:

- it occupies a small extent within the survey area (88.95 ha; 4.61%, although this extent may be smaller as the western patch was inaccessible and its extent, composition and condition were interpreted from aerial imagery), however, is anticipated to be locally and regionally uncommon due to its association with a karst system
- it also has *Eucalyptus camaldulensis* subsp. *obtusa* present, although not as a dominant species, therefore may be representative of GDV and thus important to maintaining ecological integrity of a significant ecosystem associated with the karst system.

Eucalyptus camaldulensis sens. lat. is considered to be an obligate phreatophyte that is representative of GDV and GDE (Eamus *et al.* 2006). Karst systems are considered to represent a Class 1 GDE (*ibid.*).

This vegetation type has been mapped as being in Degraded-Completely Degraded condition, noting that the condition assessment for the inaccessible western patch was interpreted from aerial imagery and may not be accurate. Vegetation condition in Degraded-Completely Degraded condition is generally not considered to represent extant native vegetation, therefore its local and regional significance lies in its role in supporting a significant ecosystem, namely the karst ecosystem.

Vegetation Type As1As2TOS

Vegetation type **As1As2TOS** (*Acacia saligna* and *Acacia scirpifolia* tall open shrubland) occupies 26.17 ha (1.36% of the survey area), in the southeast portion of the survey area. The majority of the vegetation type was in Degraded-Completely Degraded condition due to grazing and possibly, in parts, having been cleared and regenerated. The more southern portion was in Good condition (8.81 ha).

According to the criteria outlined in the Flora and Vegetation Technical Guidance (EPA 2016) this vegetation type may be significant (where in Good or better condition) due to it having a restricted distribution. However, it is likely to be only restricted in extent within the survey area and appears similar to nearby vegetation within Beekeepers Nature Reserve. Therefore, it is unlikely to have any specific local or regional significance.

Vegetation Type EcArMW

Vegetation type **EcArMW** (*Eucalyptus camaldulensis* subsp. *obtusa* and *Acacia rostellifera* mid woodland) from riparian areas (streamlines) may also be significant for one of the reasons applicable to vegetation type **ArMrTs**:

- it also has *Eucalyptus camaldulensis* subsp. *obtusa* present, therefore may be representative of GDV and thus important to maintaining ecological integrity of a significant ecosystem
- it has been significantly historically grazed (i.e. historical impact from threatening processes).

Vegetation type **EcArMW** occupies 126.83 ha (6.57% of the survey area), however, is Degraded-Completely Degraded condition throughout and is therefore not considered to represent extant native vegetation. Of interest this vegetation type is similar to the Presumed Destroyed *Greenough River Flats* TEC, which has remnants in Completely Degraded condition on the Greenough Alluvial Flats.

As this vegetation type is in such poor condition, likely as a result of being preferentially grazed by livestock, the vegetation condition itself has no local or regional significance, rather its definitive species (*Eucalyptus camaldulensis*) is significant as being representative of GDV.

Vegetation Type EeLW

Vegetation type **EeLW** (*Eucalyptus erythrocorys* low woodland) occurs on the limestone uplands in the eastern portion of the survey area and as isolated pockets of limestone outcropping within the sandplain areas (vegetation type **LcBsJhMOS**), occupying in total 117.09 ha; 6.07% of the survey area. Vegetation condition ranged from Good (33.20 ha) to Degraded-Completely Degraded.

Vegetation type **EeLW** does not meet any of the criteria outlined in the Flora and Vegetation Technical Guidance (EPA 2016) to be considered as significant and is, broadly, a common local vegetation type from north of Dongara to near Jurien Bay (based on the characteristic species' distribution; DBCA 2007-2021; French & Nicolle 2019), confirmed by the names of some of the pre-European vegetation associations intersection the survey area: 'Illyarrie', referring to the common name of *Eucalyptus erythrocorys* (see **Section 2.2.2**). It is not likely to be considered as locally or regionally significant.

Vegetation Type LcBsJhMOS

LcBsJhMOS (*Labichea cassioides*, *Banksia sessilis* var. *cygnorum* and *Jacksonia hakeoides* mid open shrubland) occupied 408.91 ha (21.19% of the survey area), in the southern and southeastern portions of the survey area. It occurred on undulating sandplain, usually with some limestone pavement exposed although there were sections of deeper sands towards the east, some of which had *Banksia prionotes* woodland that, due to lack of general accessibility, was not mapped as a separate vegetation unit at Reconnaissance level.

The condition of this vegetation type was mostly assessed as being Excellent (273.02 ha; 66.77% of the vegetation type), with the remainder (except for isolated disturbances) in Very Good to Good condition.

Vegetation type **LcBsJhMOS** does not meet any of the criteria outlined in the Flora and Vegetation Technical Guidance (EPA 2016) to be considered as significant and is, broadly, a common local vegetation type observed to correspond with large areas of the adjacent Beekeepers Nature Reserve.

Its significance lies largely in its value as foraging habitat for the endangered Carnaby's Cockatoo, particularly the patches of *Banksia prionotes* woodland and where Proteaceous shrubs (particularly *Banksia sessilis* and *Grevillea* species) that occur within the vegetation type.

Vegetation Type McArGaTS

Vegetation type **McArGaTS** (*Melaleuca cardiophylla*, *Acacia rostellifera* and *Grevillea argyrophylla* tall shrubland) occupied the more coastal (western) portion of the survey area, occupying 872.79 ha (45.23% of the survey area), the majority of which was in Very Good or Good condition (738.03 ha). As mapped, the vegetation type does not meet any of the criteria outlined in the Flora and Vegetation Technical Guidance (EPA 2016) to be considered as significant and is, broadly, a common local vegetation type (Ecoscape 2010; Hart Simpson and Associates Pty Ltd 2003).

Much of this vegetation type was inaccessible and has thus been described broadly i.e. at Reconnaissance flora and vegetation survey level according to the Flora and Vegetation Technical Guidance (EPA 2016). A Detailed flora and vegetation survey would have differentiated this vegetation type into patches dominated by various mallee Eucalypt species, however, greater access would be required for this to be possible. Mapping this vegetation type at Detailed level is unlikely to identify any significant vegetation within this vegetation type. This vegetation type is not considered to be locally or regionally significant.

Vegetation Type MsCoMrMOW

Vegetation type **MsCoMrMOW** (*Melaleuca strobophylla*, *Casuarina obesa* and *Melaleuca rhaphiophylla* mid open woodland). This vegetation type may be considered significant as:

- it occupies a small extent within the survey area (42.90 ha; 2.22%), however, is anticipated to be locally uncommon (i.e. has a locally restricted distribution) due to its association with a restricted landform, being the ephemeral lakes and floodplain
- the vegetation type within the survey area has been historically grazed (i.e. historical impact from threatening processes) with little evidence of recruitment of the characteristic and definitive upper stratum species (that also include *Eucalyptus camaldulensis* subsp. *obtusa*). Formal grazing has now ceased, however, there is a significant population of feral goats present that likely would continue the grazing pressure at least to some degree, and cessation of grazing would also increase the weed cover that also inhibits recruitment.
- it includes vegetation that forms a fringe around the ephemeral lakes, and is likely to be important for fauna (birds in particular) that utilise the water when present (i.e. its role as a refuge)
- *Eucalyptus camaldulensis* is considered to be definitive of a GDE (Eamus *et al.* 2006) and essential to maintain the ecological integrity of the significant karst ecosystem (Barron *et al.* 2012)[1]. Its presence is specifically likely to be significant for the subterranean fauna, troglofaunal and stygofauna occupying the karst (cave) system (Nevill *et al.* 2010), which are poorly understood, as well as the ecosystem as a whole.
- *Melaleuca strobophylla* is at the extreme edge of its natural distribution (i.e. is a minor range extension from its previously known occurrences).

Therefore, maintaining this vegetation type is important to maintaining the ecological integrity of an ecosystem, in this case the subterranean ecosystem as well as terrestrial ecosystem. However, the vegetation type is in Completely Degraded condition and not representative of extant native vegetation. Its local and regional significance is therefore large a result of its role in maintaining a restricted ecosystem.

[1] Barron *et al.* (2012) does not specifically refer to *Eucalyptus camaldulensis*, rather this discussion is in terms of *Eucalyptus camaldulensis* being a keystone species.

5.2.3 VEGETATION CONDITION

Approximately 10% of the survey area (196.65 ha) has been cleared for farming and does not have native vegetation.

Over one quarter of the survey area (540.93 ha; 28.03%) has vegetation in Degraded-Completely Degraded condition, largely adjacent to the cleared areas. Livestock grazing that has led to weed invasion and lack of diversity in ground and mid strata species is the main threatening process, although some clearing that has now naturally regenerated is possible in some *Acacia*-dominated vegetation types. Feral goats, rabbits and potentially feral cattle are present throughout the site, with sheep grazing continuing in the eastern portion which is likely to continue the grazing pressure that reduces the prospect of natural regeneration in some vegetation types (e.g. in vegetation type **MsCoMrMOW** associated with the ephemeral lakes and floodplain).

The remainder of the survey area, largely in the west, south and southeast, is in Good to Excellent condition (1,192.10 ha; 61.78% of the survey area). The better (Excellent) condition vegetation was largely in vegetation type **LcBsJhMOS** that over most of its extent has been fenced from grazing by farm livestock.

5.3 FAUNA SIGNIFICANCE

5.3.1 FAUNA HABITAT TYPES

The eight fauna habitat types observed within the survey area are likely to support a range of fauna species and assemblages.

No specific areas of disturbance were noteworthy outside of the Pastoral habitat, which is characteristically disturbed, although there was some disturbance from goat, cattle and rabbit activity through all habitat types, with more evidence of cattle trampling within central Shrubland habitat.

The habitat types within the survey area considered to have greatest importance for conservation significant species are the extents of Waterbody and Wetland habitat, which are supportive of listed migratory and wading birds, as well as areas of Heath or Shrubland which contain the preferred Carnaby's Cockatoo forage tree *Banksia prionotes*.

5.3.2 FAUNA ASSEMBLAGE

The survey area is supportive of an assemblage of bird, mammal and reptile species commonly found in similar habitats of the local area. Avifauna are predominant in this assemblage, as would be expected based on the various habitats represented on site. The seasonal waterbody in the north of the survey area additionally attracts local and migratory waterbirds, particularly waders.

5.3.3 CONSERVATION-LISTED SPECIES

The conservation listed fauna recorded during survey are all known from the area and are commonly observed species on a seasonal basis. None are geographically restricted to the vicinity of the survey area, and suitable habitat for each taxon is available outside of the survey area. Discussion of the significance of each species occurrence in the survey area is made below.

Carnaby's Cockatoo *(Calyptorhynchus latirostris)* – EN; EN

Carnaby's Cockatoo is a large species of cockatoo endemic to south-western Western Australia which has predominantly black plumage with white cheek patches and tail feather panels. The known distribution for the species runs roughly south-west of a line between Kalbarri and Esperance, extending along the south coast to

Cape Arid National Park (Commonwealth of Australia 2017), with birds foraging in Proteaceous woodlands and shrublands in coastal areas from January to July, then moving inland to woodlands with suitable nesting hollows during the breeding season of late July to December (Saunders 1980). There has been an estimated 50% decline in Carnaby's Cockatoo numbers over the last 70 years, primarily due to loss of foraging habitat and nesting hollows of suitable size in breeding areas (DPaW 2013b). The taxon is classified as Endangered under both the BC Act and EPBC Act.

The survey area falls within the known distribution for Carnaby's Cockatoo and a number of recent records exist in the local area. As the species moves between foraging resources along the broader coastline (particularly the Geraldton Sandplains and Swan Coastal Plain bioregions) during warmer months, observation of this taxon in the vicinity during survey was anticipated, and its recorded presence within the survey boundary not unexpected.

The species occurs primarily in uncleared or remnant native eucalypt woodlands, and shrubland or kwongan heathland dominated by *Hakea, Banksia* and *Grevillea* species (DPaW 2013b). It is also known to forage on farm crops or pasture, preferencing Canola and other Brassicaceae species. Areas of vegetation containing *Banksia prionotes* trees are considered to represent the most valuable foraging habitat for Carnaby's Cockatoo within the survey area. Other vegetation present, whilst still affording value as a feeding resource, represents lesser quality habitat and is more extensively found across the site and in surrounding lands.

Although tree hollows of sufficient size for use as nesting hollows by this bird were observed on site, the survey area is not situated within the mapped breeding range for Carnaby's Cockatoo and thus does not represent suitable breeding habitat for the species.

This species is likely to utilise vegetation within the survey area for foraging purposes on a seasonal basis. It is unknown if they are also attracted to the water sources present and if, during summer and autumn when the lakes and dams dry out, if they will still be present.

As a result of the field survey findings IBE has revised its site layout to minimise clearing within Carnaby's Cockatoo habitat areas, including the positioning of solar arrays and wind turbines (**Map 8**). As such impacts on this species as a result of loss of habitat and possible turbine strike have been minimised, as the movements of Carnaby's Cockatoo are likely to be towards water or foraging habitat that are located to the east and south of wind turbines, with no water sources or foraging habitat within the wind turbine footprint or to the west of the wind turbines.

Rainbow Bee-eater *(Merops ornatus)* – MA

The Rainbow Bee-eater is a colourful, medium-sized bird abundant and widespread across Australia. It occurs in a wide range of habitats (including open woodland, shrubland and farmland), usually near permanent water, where it feeds on flying insects it catches in flight (DAWE 2020b). It is usually seen in pairs or small flocks, with breeding typically undertaken between August and January in loose colonies but occasionally as solitary pairs. Nests are comprised of an underground burrow chamber and entrance tunnel up to 1 m long, excavated in sandy soils of level or gently sloping ground (Boland 2004). Nests are not re-used in subsequent seasons.

The species is classified as 'Least Concern' under IUCN listings and is not considered globally threatened. Within Australia it is listed as a Marine species under the EPBC Act, but it does not hold any State listing under the BC Act. It is abundant across the state and commonly sighted in a variety of environments, including disturbed habitats. Small numbers are likely to occur in the survey seasonally as migratory visitors and potentially during the breeding period.

There are limited potential nesting sites within the survey area as most of the site is not sloping and the soil surface has limestone caprock, thus is not suitable for this activity. Most of the sloping land is outside the development footprint as it also represents potential Carnaby's Cockatoo foraging habitat. Therefore, there is unlikely to be any significant impact on Rainbow Bee-eaters as a result of the proposed development.

Sharp-tailed Sandpiper *(Calidris acuminata)* – MI; MI

This species is a small to medium migratory wader which can be found at locations across Australia during its non-breeding season from July to April. Forage habitat for the Sharp-tailed Sandpiper includes muddy margins of shallow wetlands, preferencing ephemeral terrestrial wetlands over coastal mudflats when sufficient water is present (DAWE 2020b). They commonly forage on crustaceans, molluscs and aquatic insects as individuals or in small numbers, rather than as large flocks, and roost on wet sand or in shallow water at the edge of wetlands. When ephemeral waterbodies dry out they will move on to another location. They are particularly impacted by changes in hydrology which alter feeding habitat (DAWE 2020b).

A single Sharp-tailed Sandpiper was observed during survey. At the time of survey the waterbody utilised by the individual was drying demonstrably each day, and it is likely the bird would have moved on shortly afterwards. Given the migratory and preferred foraging behaviour of this species, it is anticipated that small numbers will visit and utilise the Waterbody and/or Wetland habitat of the survey area on a seasonal basis only when water is present. However, no other suitable habitat occurs within the survey area and, other than when flying to and from the site, they are unlikely to be present.

5.3.3.1 Post-survey Likelihood Assessment

The remaining (i.e. those not recorded) conservation-listed fauna species identified during the desktop assessment as having a High likelihood of occurring are discussed below with respect to each species' habitat requirements, taking into consideration the findings of the field survey and survey effort. The post-survey likelihood assessment is incorporated into **Table 21** in **Appendix Two**.

Common Sandpiper *(Actitis hypoleucos)* – MI;MI

This species was not recorded during survey but is considered likely to occur based on availability of suitable habitat and known behaviour. The Common Sandpiper is a small, migratory wader which overwinters from July to February in Australia, predominantly in northern and western coastal areas. It utilises a range of waterbodies and wetlands to forage for molluscs, crustaceans and insects in mud at wetland edges, usually in small groups or as solitary individuals (DAWE 2020b). Roosting is typically on rocks, roots or branches of vegetation, and may be undertaken with other wading species. Flocks are formed prior to migration.

Habitat suitable for the Sharp-tailed Sandpiper recorded during survey is suitable also for the Common Sandpiper. Therefore, it is similarly anticipated that small numbers of the species will visit and utilise the Waterbody and/or Wetland habitat of the survey area on a seasonal basis as water is present but will be confined to these habitat types other than when flying to and from the site.

5.3.4 WIND TURBINE BIRD STRIKE RISK

Bird strike resulting in death is possible from impacts with wind turbine blades.

Woehler and Belbin (2019) present a list of bird and bat species impacted by collisions with wind turbines in Tasmania, although there is no indication of the number of individuals of each species. Listed birds range in size from Silvereyes to larger water birds and raptors including Australian Pelicans and Tasmanian Wedge-tailed Eagles, indicating that size alone may not be significant in determining if a species is likely to occur within

the rotating arc of wind turbines thus likely to collide with the turbine blades. Studies by Hull *et al.* (2013), also in Tasmania, identified Petrels and Shearwaters as the most likely taxonomic group to collide with wind turbines, followed by raptors, however, foraging strategies, foraging zones and key morphological features such as the ability to detect moving turbine blades, agility and behaviour of each species meant identification of risk at the taxonomic level was not reliable.

There is no publicly available data on bird strikes from wind turbines in Western Australia. Based on the avifauna recorded during this assessment, the species considered most likely to spend significant time within the range of rotating wind turbines are the raptors (Brown Goshawk, Australian Kestrel, Australian Hobby and Whistling Kite, noting that other species may also occur) due to their hovering (stationary) behaviour when they have the potential to be 'sucked' into the rotating blades. It is not possible to estimate if, or how many, individuals of these, and other, species may be struck by wind turbine blades. Raptors are likely to forage over the entire site as their prey (reptiles, small mammals and smaller birds) whilst hovering occurs throughout.

Whilst Carnaby's Cockatoo may also be struck, IBE has located the wind turbines outside of their foraging habitat and in a direction the species is less likely to occur in due to the lack of foraging species or water, thus lowering the risk of strike.

6 CONCLUSIONS AND RECOMMENDATIONS

6.1 ASSUMPTIONS

Discussion of potential impacts to significant factors is based on assumptions current at the time of report writing, in particular:

- IBE is proposing wind turbines in the western portion of the survey area and PV arrays in the south and south-eastern portions of the survey area, with infrastructure to the north of the PV arrays.
- IBE is not proposing developments within the north-eastern portion of the survey area associated with the lakes.
- water extraction will be required as part of the project. There is no evidence that the Arrowsmith River tributary present within the survey area has had any recent surface flows and is likely to only flow very intermittently, possibly only during cyclone events. Therefore, changes to surface hydrology are not anticipated as a result of the proposed development. Only broad comments can be made in regard to changed groundwater conditions as this is beyond the scope of these works.

IBE is using the results of this survey to refine its footprint, with the overall aim of minimising clearing in areas of higher biological value.

Difficulties with site access due to large areas with impenetrable vegetation and lack of track access has led to some assumptions being made in the course of describing the flora, vegetation, fauna and fauna habitat values of the survey area. Whilst the access issues were a constraint, Ecoscape is of the opinion that the survey area was sufficiently accessible to adequately describe at Reconnaissance level for the flora and vegetation survey (EPA 2016) and Basic level for the fauna and fauna habitat survey (EPA 2020a).

6.2 BIOLOGICAL SIGNIFICANCE

6.2.1 FLORA AND VEGETATION VALUES

The Reconnaissance flora and vegetation survey identified a total of 191 vascular flora species, three of which are conservation-listed:

- *Anthocercis intricata* (P3)
- *Beyeria cinerea* subsp. *cinerea* (P3)
- *Eucalyptus zopherophloia* (P4).

Priority 3 and 4 species are considered to not be currently under threat (although, for P3, are poorly known) and as such should not have a major impact on the environmental approvals process. These taxa all have wide distributions within coastal Western Australia (see **Section 5.1.1.1**) and removal of a small number of individuals within a small portion of the overall populations is unlikely to significantly impact on these species as a whole.

Following the survey, the likelihood of additional conservation-listed flora occurring was re-evaluated based on known conditions and taking survey effort into consideration. No TF or P1-listed flora were considered to have a High post-survey likelihood of occurring. Two P2 species were considered to have a High post-survey likelihood of occurring: *Acacia vittata* is known from nearby, however, if it occurs within the survey area any clearing is considered unlikely to significantly impact on the species' population as a whole. However, if *Scholtzia calcicola* occurs it is not possible to assess impacts on its population as the species is poorly collected and poorly understood. Two P3 (*Haloragis foliosa* and *Thryptomene* sp. Lancelin (M.E. Trudgen 14000)) and

one P4 species (*Stawellia dimorphantha*) also had a High post-survey likelihood, however, P3 and P4 species are not currently considered threatened and clearing including any of these is unlikely to significantly impact on their populations as a whole.

No flora species have any other form of significance according to the Flora and Vegetation Technical Guidance (EPA 2016) except as minor range extensions/infills (*Melaleuca strobophylla* and *Pelargonium littorale*).

Eight broad vegetation types were recorded, none of them representing or similar to any extant TEC or PEC.

The Flora and Vegetation Technical Guidance (EPA 2016) outlines a number of reasons why vegetation can be considered as significant besides being conservation listed. Three vegetation types met at least some of these criteria, including having a restricted distribution (which took into consideration small extent within the survey area and more broadly, and being restricted to an uncommon landscape feature):

- vegetation type **ArMrTs** (4.61% of the survey area), confined to a limestone karst system (locally and regionally significant) and having a significant role in maintaining the health of a significant ecosystem (the karst system), particularly due to the presence of the phreatophytic species *Eucalyptus camaldulensis* which is also indicative of a GDE
- vegetation type **EcArMW** (6.57% of the survey area), representing the vegetation of the riparian areas and floodplain, and considered significant largely due to the presence of the phreatophytic species *Eucalyptus camaldulensis*/GDE
- vegetation type **MsCoMrMOW** (2.22% of the survey area), corresponding with the ephemeral lake and floodplain that is significant for a number of reasons including:
  - its small extent
  - association with a restricted landform
  - degree of historical impact from threatened processes (grazing)
  - the wetland fringing vegetation is likely to represent important habitat for fauna species (i.e. role as a refuge)
  - the presence of the phreatophytic species *Eucalyptus camaldulensis* that is significant to maintain the ecological integrity of a significant ecosystem (the karst system) and representative of a GDE.

However, all of the above significant vegetation types are in Degraded-Completely Degraded condition and, in the strict sense, do not meet the requirements to be considered as extant native vegetation.

Vegetation type **LcBsJhMOS** does not meet any of the criteria outlined in the Flora and Vegetation Technical Guidance (EPA 2016) to be considered as significant and is, broadly, a common local vegetation type observed to be similar to vegetation within large areas of the adjacent Beekeepers Nature Reserve. Its significance lies largely in parts of it having value as foraging habitat for the endangered Carnaby's Cockatoo.

6.2.2 FAUNA AND FAUNA HABITAT

Fifty seven vertebrate fauna species were recorded during the field survey including seven introduced species and three that are conservation-listed:

- *Calyptorhynchus latirostris* (Carnaby's Cockatoo) – Endangered under the BC Act and EPBC Act
- *Calidris acuminata* (Sharp-tailed Sandpiper) – Listed Migratory species under the EPBC Act
- *Merops ornatus* (Rainbow Bee-eater) – Listed Marine species under the EPBC Act.

Rainbow Bee-eaters and a possible disused nest were observed, however, the IUCN considers this species to be of 'Least Concern', and it is not currently threatened in Western Australia. Clearing is not likely to significant impact on this species.

The Sharp-tailed Sandpiper was observed foraging in the large water body within the survey area (Lake Arramall) foraging in the shallow muddy lake edge, however, it is only likely to be present in small numbers when conditions are suitable i.e. when water is present, likely for 5-6 months during the year. IBE is not proposing to clear vegetation in this habitat, although changes to hydrology as a result of water extraction may impact on the habitat quality and therefore habitat suitability for this species.

Carnaby's Cockatoo were observed on several occasions within the Pastoral and Wetland habitat types, including foraging in a large Melaleuca tree. Whilst suitable foraging habitat exists, including small areas of Banksia woodland and Heath and Shrubland habitat types with Proteaceous species, it is not anticipated that there are sufficient resources available to sustain large flocks or prolonged visitation. The survey area is not within the mapped breeding range of this species, and no evidence of breeding activity was observed.

Eight fauna habitat types were recorded: Heath, Mallee Woodland, Pastoral, Riparian, Shrubland, Waterbody (seasonal), Wetland and Woodland. The majority of the survey area was comprised of Mallee Woodland or Shrubland habitat. The most significant habitat types were those associated with Carnaby's Cockatoo (Pastoral and Wetland) and potential foraging habitat (Heath and Shrubland).

6.3 RECOMMENDATIONS

6.3.1 ADDITIONAL SURVEYS

Ecoscape considers that the surveys conducted during 2020 are adequate to describe the flora, fauna and vegetation values within the survey area for the purposes of this impact assessment. Any requirements for additional survey would be subject to discussion with regulatory authorities.

6.3.2 CARNABY'S COCKATOO

As a result of the survey IBE has reconfigured its proposed site layout to minimise clearing in potential Carnaby's Cockatoo habitat (**Map 8**).

IBE understands that it will be required to keep regulatory authorities informed of the project and potential impacts.

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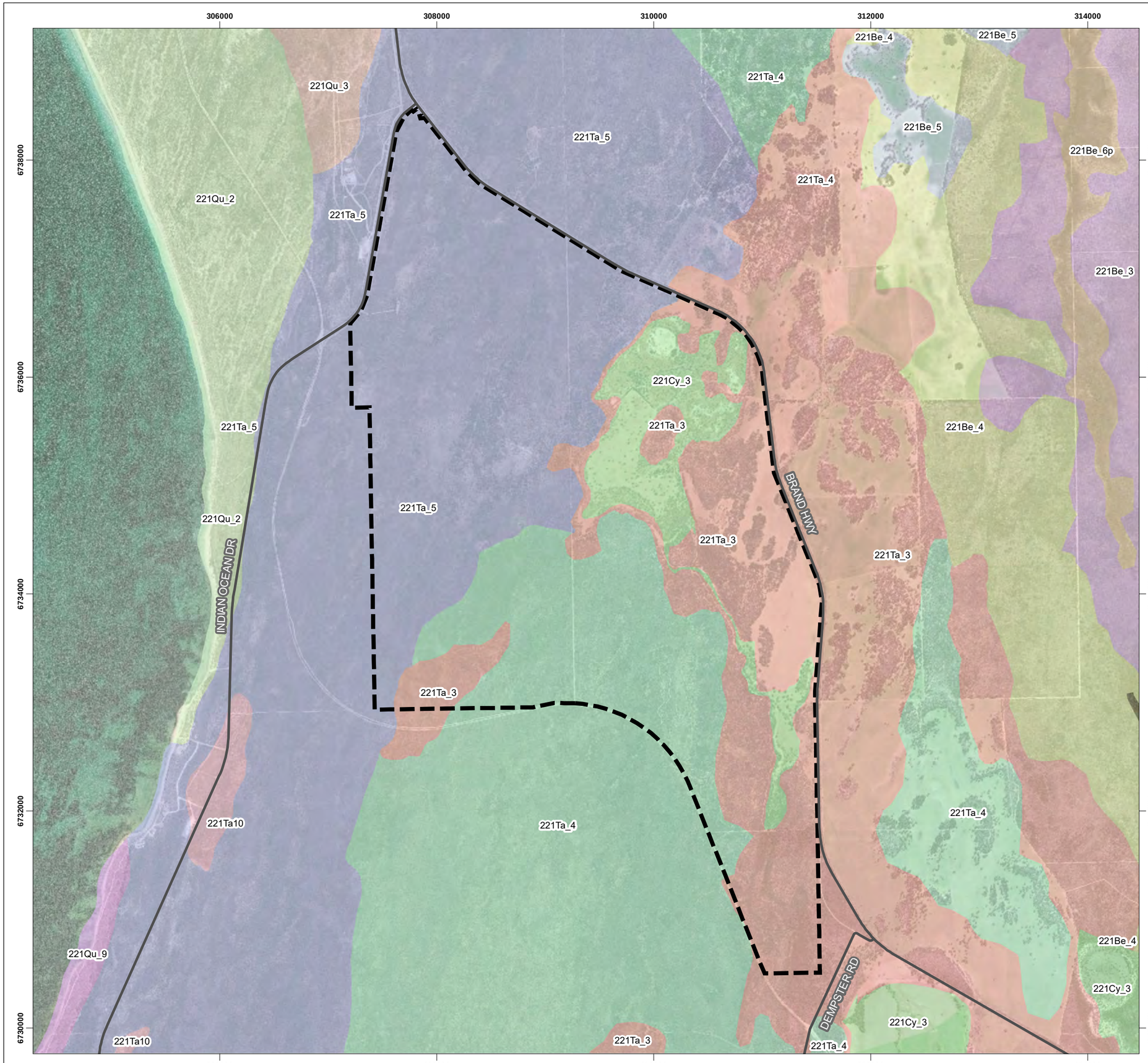
MAPS



LEGEND

Survey Area

Roads

Land Systems

- 221Be_3 - Beharra 3 Subsystem: Level to gently undulating sandplain; Yellow deep sand
- 221Be_4 - Beharra 4 Subsystem: Level to gently undulating sandplain with numerous small playas and swampy depressions; Yellow and pale deep sands with some swamp soils
- 221Be_5 - Beharra 5 Subsystem: Swamps and playas; shallow loams and sands, commonly wet
- 221Be _6p - Beharra 6 Plain Phase: Ironstone ridges
- 221Cy_3 - Correy 3 Subsystem: Rarely inundated flats and depressions; Cracking and non-cracking clays and pale sandy earths
- 221Qu_2 - Quindalup Central 2 Subsystem: Coastal dune system, no fixed drainage
- 221Qu_3 - Quindalup Central 3 Subsystem: Coastal dune system, no fixed drainage
- 221Qu_9 - Quindalup Central 9 Subsystem: Beach ridge plain, usually with numerous low stranded beach ridges which were parallel with receding coast. Includes relict foredune systems and beaches
- 221Ta_3 - Tamala South 3 Subsystem: Low hills with relict dunes and some limestone outcrop; Deep and shallow yellow sand over limestone
- 221Ta_4 - Tamala South 4 Subsystem: Low hills with relict dunes and some limestone outcrop; yellow shallow sand with limestone outcrops and yellow deep sand
- 221Ta_5 - Tamala South 5 Subsystem: Low hills with relict dunes and some limestone outcrop; Calcareous shallow and deep sands
- 221Ta10 - Tamala South 10 Subsystem: Broad swales with; fine pinkish brownish calcareous sands

DATASOURCES:
SOURCE DATA: SOIL-LANDSCAPE MAPPING WESTERN AUSTRALIA – BEST AVAILABLE SOILS (2018); TRANSPORT ROAD CENTRELINES (MRWA 2012)
AERIAL: ESRI BASEMAP (2018-2019)
SERVICE LAYERS: SOURCE: ESRI, MAXAR, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY

ecoscape

SOIL LANDSCAPE MAPPING

ARROWSMITH WIND AND SOLAR FARM ENVIRONMENTAL SURVEY

Infinite Blue Energy
Fuelling The Future

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N

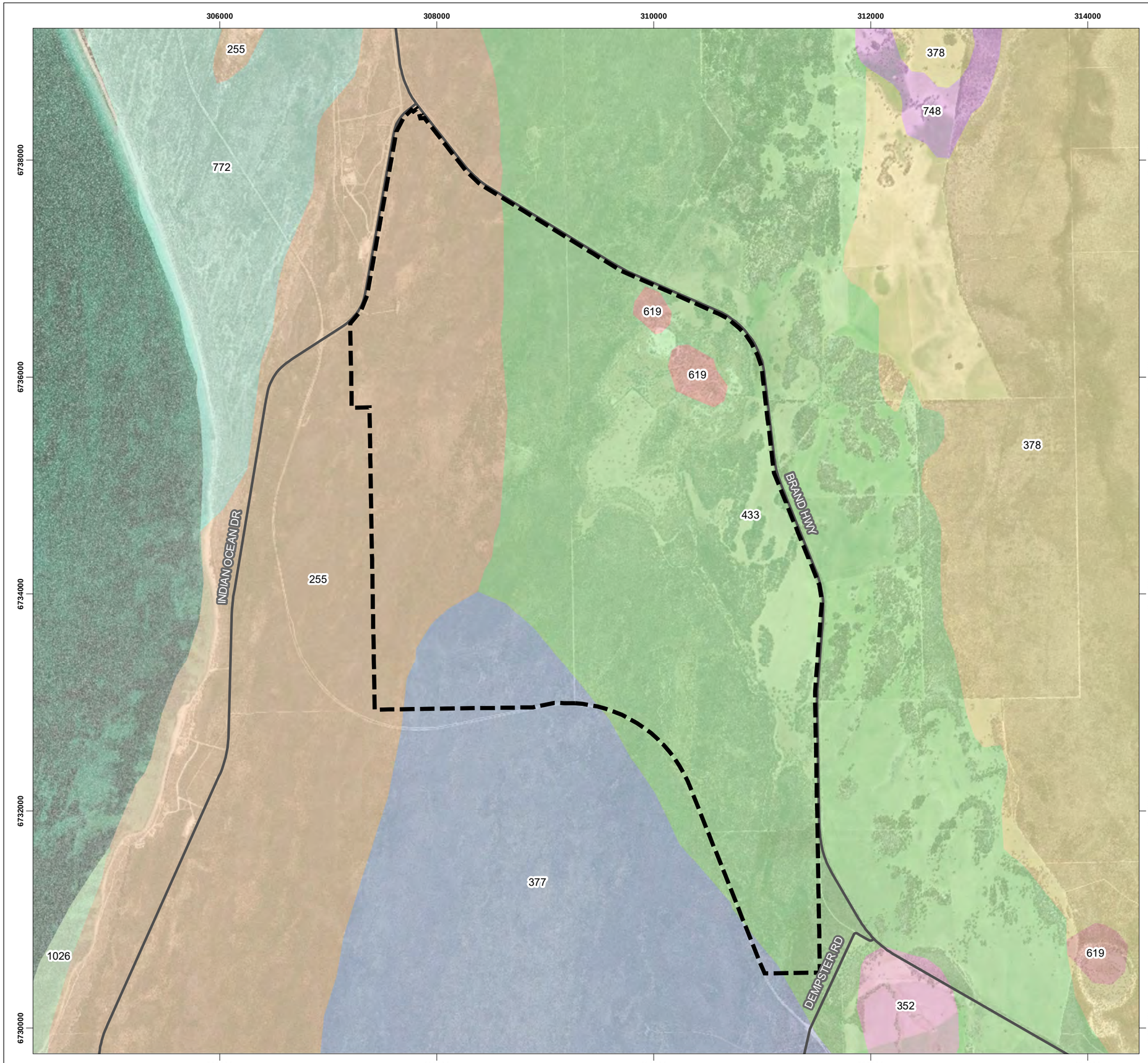
SCALE: 1:35,000 @ A3

0 0.2 0.4 0.6 0.8 1 km

PROJECT NO: 4562-20

REV	AUTHOR	APPROVED	DATE
0	KP	SB	18/01/2021

MAP 1



LEGEND

- Survey Area
- Roads

Pre-European Vegetation Associations

- Cliff Head 1026: Scrub-heath/thicket
- Cliff Head 255: Eucalypt shrubland *Eucalyptus eremophila, E. redunca, E.* spp.
- Cliff Head 772: Low shrubs of mixed composition
- Eridoon 378: Mixed heath with scattered tall shrubs *Acacia* spp., Proteacea and Myrtaceae
- Eridoon 748: Teatree with York gum, Wandoo or *Casuarina*. *Melaleuca* spp. with *Eucalyptus loxophleba*, *E. wandoo, Allocasuarina* spp.
- Illyarrie 352: Wheatbelt; York gum, Salmon gum etc. *Eucalyptus loxophleba, E. salmonophloia*. Goldfields; gimlet, redwood etc. *E. salubris, E. oleosa*. Riverine; rivergum *E. camaldulensis*. Tropical; messmate, woolybush
- Illyarrie 377: Mixed heath with scattered tall shrubs *Acacia* spp., Proteacea and Myrtaceae.
- Illyarrie 433: Low woodland/scrub
- Illyarrie 619: Wheatbelt; York gum, Salmon gum etc. *Eucalyptus loxophleba, E. salmonophloia*. Goldfields; gimlet, redwood etc. *E. salubris, E. oleosa*. Riverine; rivergum *E. camaldulensis*. Tropical; messmate, woolybush

DATASOURCES:
SOURCE DATA: PRE-EUROPEAN VEGETATION – WESTERN AUSTRALIA (NVIS COMPLIANT VERSION 20110715); TRANSPORT ROAD CENTRELINES (MRWA 2012)
AERIAL: ESRI BASEMAP (2018-2019)
SERVICE LAYERS: SOURCE: ESRI, MAXAR, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY

ecoscape

PRE-EUROPEAN VEGETATION ASSOCIATIONS

ARROWSMITH WIND AND SOLAR FARM ENVIRONMENTAL SURVEY

Infinite Blue Energy
Fuelling The Future

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N

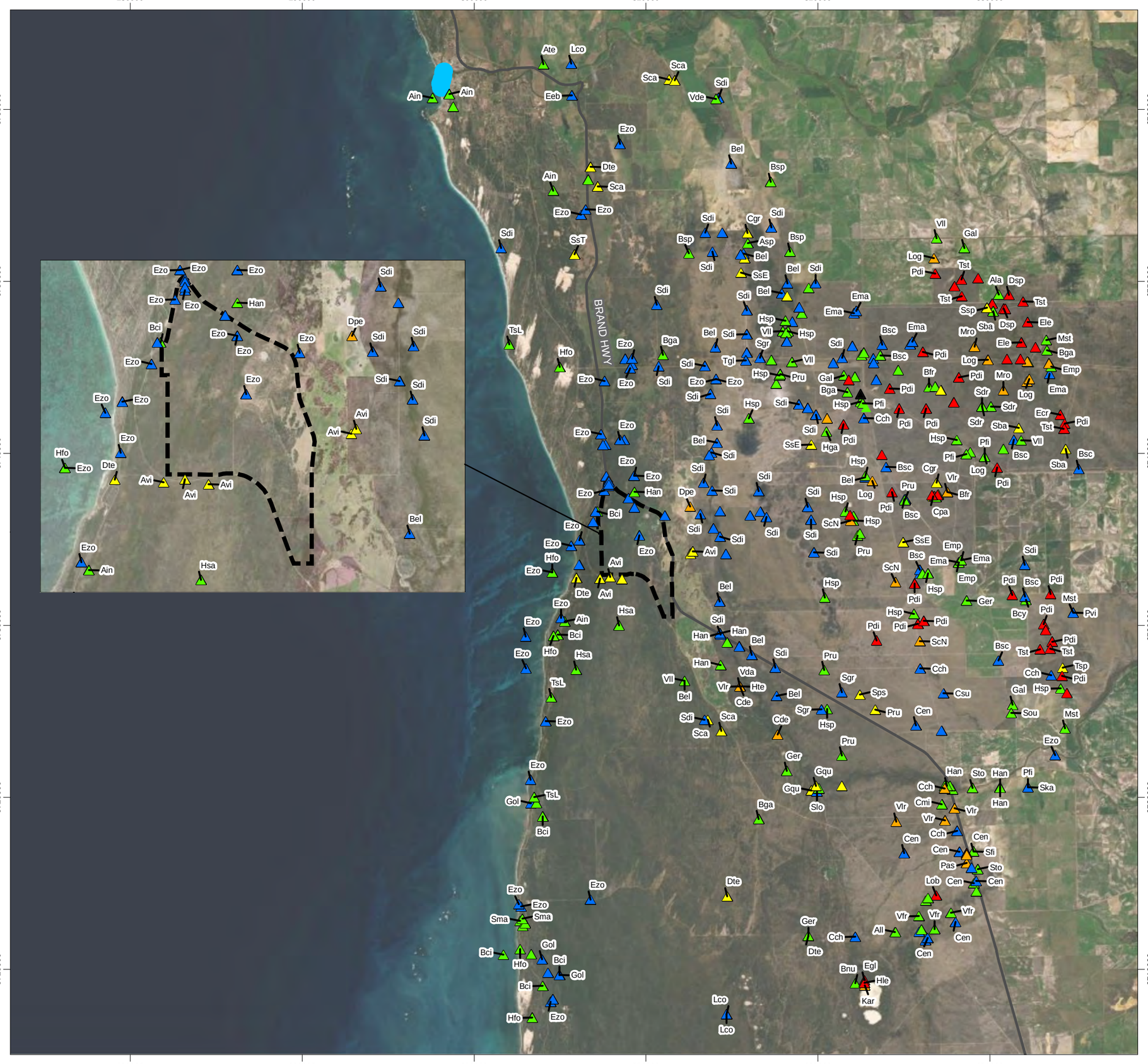
SCALE: 1:35,000 @ A3

0 0.2 0.4 0.6 0.8 1 km

PROJECT NO: 4562-20

REV	AUTHOR	APPROVED	DATE
0	KP	SB	18/01/2021

MAP 2



LEGEND

Survey Area

Roads

Conservation Significant Flora (DBCA 2020)

- Threatened
- Priority 1
- Priority 2
- Priority 3
- Priority 4

TEC/PEC (DBCA 2020)

Subtropical and Temperate Coastal Saltmarsh

Code	Taxon	Status	Code	Taxon	Status
Ala	*Acacia lanceolata*	3	Hga	*Hypocalymma gardneri*	3
All	*Acacia latipes* subsp. *licina*	3	Hte	*Hypocalymma tetrapterum*	3
Ate	*Acacia telmica*	3	Kar	*Korthalsella arthroclada*	1
Avi	*Acacia vittata*	2	Log	*Lasiopetalum ogilvieanum*	1
Ain	*Anthocercis intricata*	3	Lob	*Leucopogon obtectus*	T
Asp	*Austrostipa* sp. Cairn Hill (M.E. Trudgen 21176)	3	Lco	*Liparophyllum congestiflorum*	4
Bsp	*Baeckea* sp. Walkaway (A.S. George 11249)	3	Mst	*Mesomelaena stygia* subsp. *deflexa*	3
Bcy	*Banksia cypholoba*	3	Mro	*Micromyrtus rogeri*	1
Bel	*Banksia elegans*	4	Pdi	*Paracaleana dixonii*	T
Bfr	*Banksia fraseri* var. *crebra*	3	Pch	*Persoonia chapmaniana*	3
Bsc	*Banksia scabrella*	4	Pfi	*Persoonia filiformis*	3
Bci	*Beyeria cinerea* subsp. *cinerea*	3	Pru	*Persoonia rudis*	3
Bga	*Beyeria gardneri*	3	Pvi	*Pityrodia viscida*	4
Bnu	*Blackallia nudiflora*	3	Pas	*Paranthera asybosca*	1
Cde	*Caladenia denticulata* subsp. *albicans*	1	Ska	*Scaevola kallophylla*	4
Cpa	*Calectasia palustris*	2	Sba	*Schoenus badius*	2
Cch	*Calytrix chrysantha*	4	Sgr	*Schoenus griffinianus*	4
Cen	*Calytrix eneabbensis*	4	SsE	*Schoenus* sp. Eneabba (F. Obbens & C. Godden 1154)	2
Csu	*Calytrix superba*	4	Sca	*Scholtzia calcicola*	2
Cmi	*Centrolepis milleri*	3	Sdi	*Stawellia dimorphantha*	4
Cgr	*Comesperma griffinii*	2	ScN	*Stylidium carnosum* subsp. Narrow leaves (J.A. Wege 490)	1
Crh	*Comesperma rhadinocarpum*	3	Sdr	*Stylidium drummondianum*	3
Dte	*Dampiera tephrea*	2	Slo	*Stylidium longitubum*	4
Dsp	*Daviesia speciosa*	T	Sma	*Stylidium maritimum*	3
Dpe	*Drosera pedicellaris*	1	Sps	*Stylidium pseudocaespitosum*	2
Eke	*Eleocharis keigheryi*	T	SsT	*Stylidium* sp. Three Springs (J.A. Wege & C. Wilkins JAW 600)	2
Egl	*Eremophila glabra* subsp. *chlorella*	T	Sto	*Stylidium torticarpum*	3
Ecr	*Eucalyptus crispata*	T	Sfi	*Stypheliа filifolia*	3
Eeb	*Eucalyptus ebbanoensis* subsp. *phatina*	4	Sou	*Synaphea oulopha*	3
Ele	*Eucalyptus leprophloia*	T	Ssp	*Synaphea sparsiflora*	2
Ema	*Eucalyptus macrocarpa* subsp. *elachantha*	4	Tst	*Thelymitra stellata*	T
Emp	*Eucalyptus macrocarpa* x *pyriformis*	3	TsL	*Thryptomene* sp. Lancelin (M.E. Trudgen 14000)	3
Ezo	*Eucalyptus zopherophloia*	4	Tgl	*Thysanotus glaucus*	4
Ger	*Grevillea erinacea*	3	Tsp	*Tricoryne* sp. Wongan Hills (B.H. Smith 794)	2
Gol	*Grevillea olivacea*	4	Tpr	*Triglochin protuberans*	3
Gal	*Guichenotia alba*	3	Var	*Verticordia argentea*	2
Gqu	*Guichenotia quasicalva*	2	Vda	*Verticordia dasystylis* subsp. *oestopoia*	1
Hfo	*Haloragis foliosa*	3	Vde	*Verticordia densiflora* var. *roseostella*	3
Hsp	*Hemiandra* sp. Eneabba (H. Demarz 3687)	3	Vfr	*Verticordia fragrans*	3
Hsa	*Hemigenia saligna*	3	Vll	*Verticordia luteola* var. *luteola*	3
Han	*Hopkinsia anoectocolea*	3	Vlr	*Verticordia luteola* var. *rosea*	1
Hle	*Hydrocotyle lemnoides*	4			

DATA SOURCES:
SOURCE DATA: FLORA AND COMMUNITIES DATA; TEC/PEC DATA (DBCA 2020); TRANSPORT ROAD CENTRELINES (MRWA 2012)
AERIAL: ESRI BASEMAP (2019)
BASEMAP: GEOSCIENCE AUSTRALIA
SERVICE LAYERS: SOURCE: ESRI, MAXAR, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY

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FLORA & COMMUNITIES DATABASE SEARCH RESULTS

ARROWSMITH WIND AND SOLAR FARM ENVIRONMENTAL SURVEY

Infinite Blue Energy
Fuelling The Future

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N

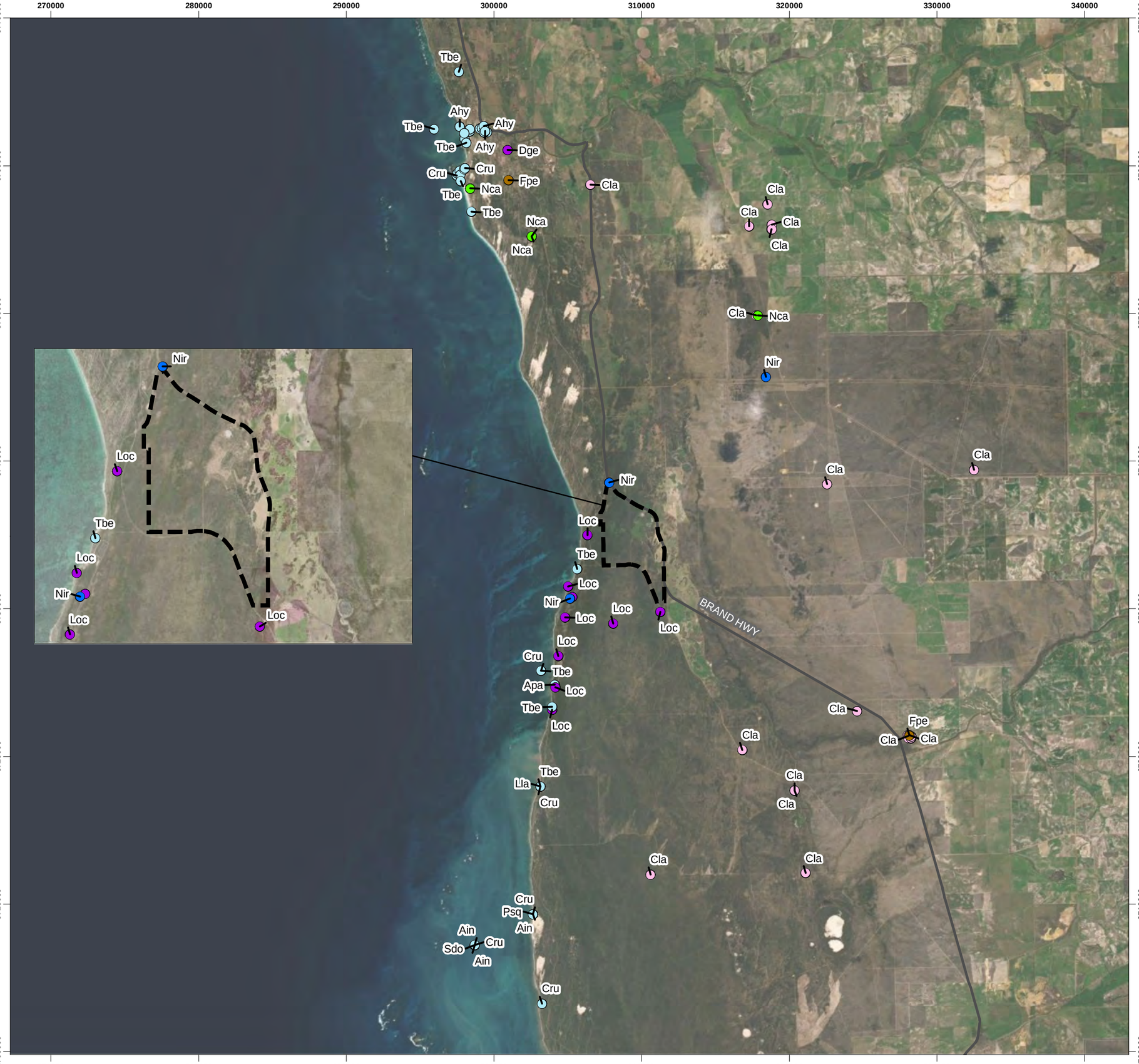
SCALE: 1:225,000 @ A3

0 1.5 3 4.5 6 7.5 km

PROJECT NO: 4562-20

REV	AUTHOR	APPROVED	DATE
0	KP	SB	18/01/2021

MAP 3



LEGEND

Survey Area

Roads

Conservation Significant Fauna (DBCA 2020)

- Endangered
- Vulnerable
- Migratory
- Other specially protected species
- Priority 2
- Priority 3
- Priority 4

Code	Taxon	Status
Ahy	*Actitis hypoleucos*	MI
Ate	*Anous tenuirostris melanops*	EN
Apa	*Apus pacificus*	MI
Ain	*Arenaria interpres*	MI
Cac	*Calidris acuminata*	MI
Cru	*Calidris ruficollis*	MI
Cla	*Calyptorhynchus latirostris*	EN
Csp	*Calyptorhynchus* sp. 'white-tailed black cockatoo'	EN
Dge	*Dasyurus geoffroii*	VU
Fpe	*Falco peregrinus*	OS
Hca	*Hydroprogne caspia*	MI
Loc	*Leipoa ocellata*	VU
Lla	*Limosa lapponica*	MI
Nca	*Neelaps calonotos*	P3
Nir	*Notamacropus irma*	P4
Pcr	*Pandion cristatus*	MI
Psq	*Pluvialis squatarola*	MI
Sdo	*Sterna dougallii*	MI
Tbe	*Thalasseus bergii*	MI
Tne	*Tringa nebularia*	MI
Tst	*Tringa stagnatilis*	MI

DATA SOURCES:
SOURCE DATA: FAUNA DATA (DBCA 2020); TRANSPORT ROAD CENTRELINES (MRWA 2012)
AERIAL: ESRI BASEMAP (2019)
BASEMAP: GEOSCIENCE AUSTRALIA
SERVICE LAYERS: SOURCE: ESRI, MAXAR, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY

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FAUNA DATABASE SEARCH RESULTS

ARROWSMITH WIND AND SOLAR FARM ENVIRONMENTAL SURVEY

Infinite Blue Energy
Fuelling The Future

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N

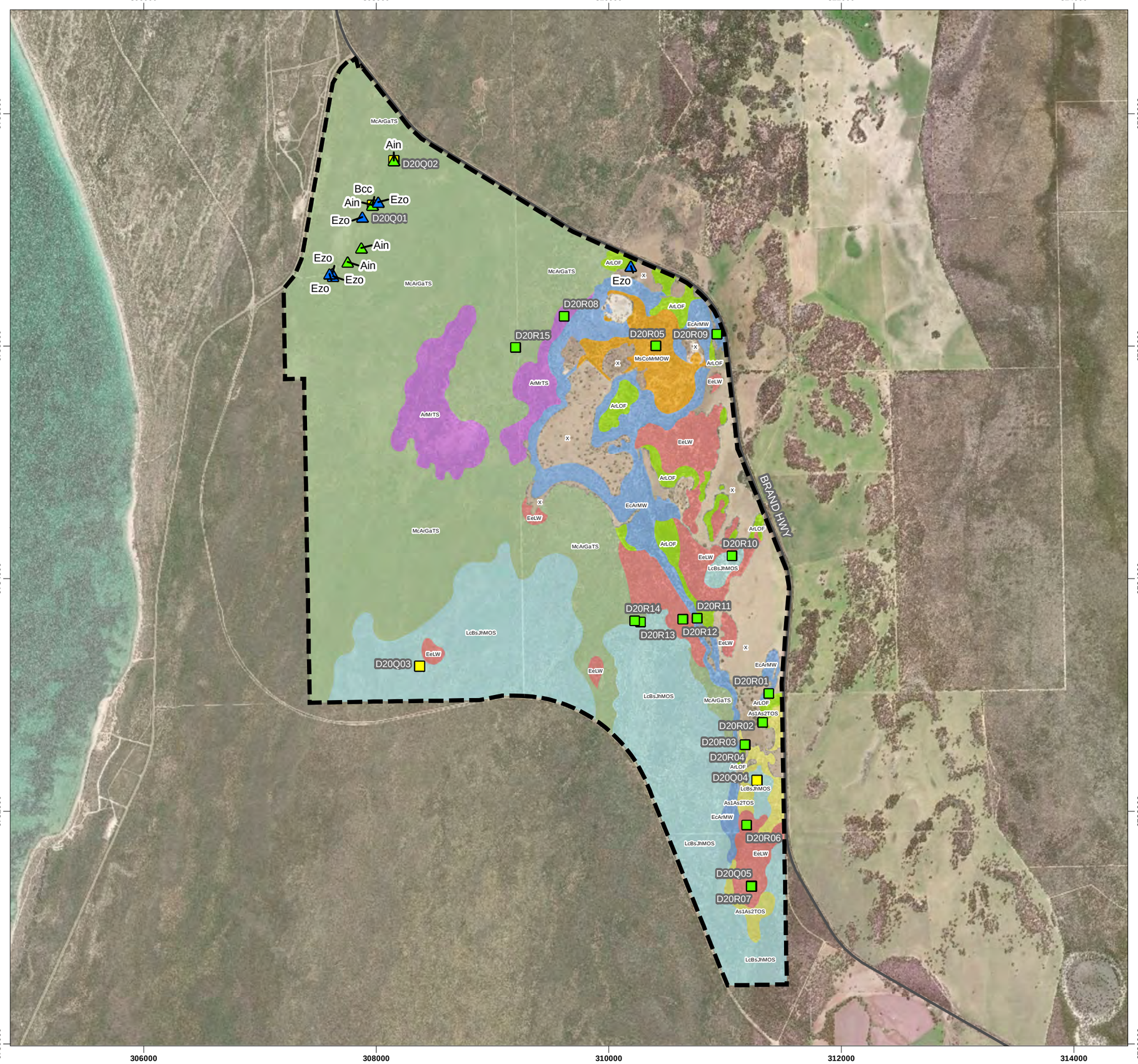
SCALE: 1:260,000 @ A3

0 1.5 3 4.5 6 7.5 km

PROJECT NO: 4562-20

REV	AUTHOR	APPROVED	DATE
0	KP	SB	18/01/2021

MAP 4



LEGEND

- Survey Area
- Roads

Site Type

- Quadrat
- Releve

Conservation-listed Flora (Ecoscape 2020)

- Priority 3
- Priority 4

Vegetation Types (Ecoscape 2020)

- ArLOF: *Acacia rostellifera* low open forest
- ArMrTS: *Acacia rostellifera* and *Melaleuca rhaphiophylla* tall shrubland
- As1As2TOS: *Acacia saligna* and *Acacia scirpifolia* tall open shrubland
- EcArMW: *Eucalyptus camaldulensis* subsp. *obtusa* and *Acacia rostellifera* mid woodland
- EeLW: *Eucalyptus erythrocorys* low woodland
- LcBsJhMOS: *Labichea cassioides, Banksia sessilis* var. *cygnorum* and *Jacksonia hakeoides* mid open shrubland
- McArGaTS: *Melaleuca cardiophylla, Acacia rostellifera* and *Grevillea argyrophylla* tall shrubland
- MsCoMrMOW: *Melaleuca strobophylla* and *Casuarina obesa* mid open woodland
- X: No vegetation

Code	Taxon	Status
Ain	*Anthocercis intricata*	3
Bcc	*Beyeria cinerea* subsp. *cinerea*	3
Ezo	*Eucalyptus zopherophloia*	4

DATA SOURCES:
SOURCE DATA: FLORA DATA (ECOSCAPE 2020); TRANSPORT ROAD CENTRELINES (MRWA 2012)
AERIAL: ESRI BASEMAP (2019)
SERVICE LAYERS: SOURCE: ESRI, MAXAR, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY

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VEGETATION TYPES AND CONSERVATION-LISTED FLORA

ARROWSMITH WIND AND SOLAR FARM ENVIRONMENTAL SURVEY

Infinite Blue Energy
Fuelling The Future

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N

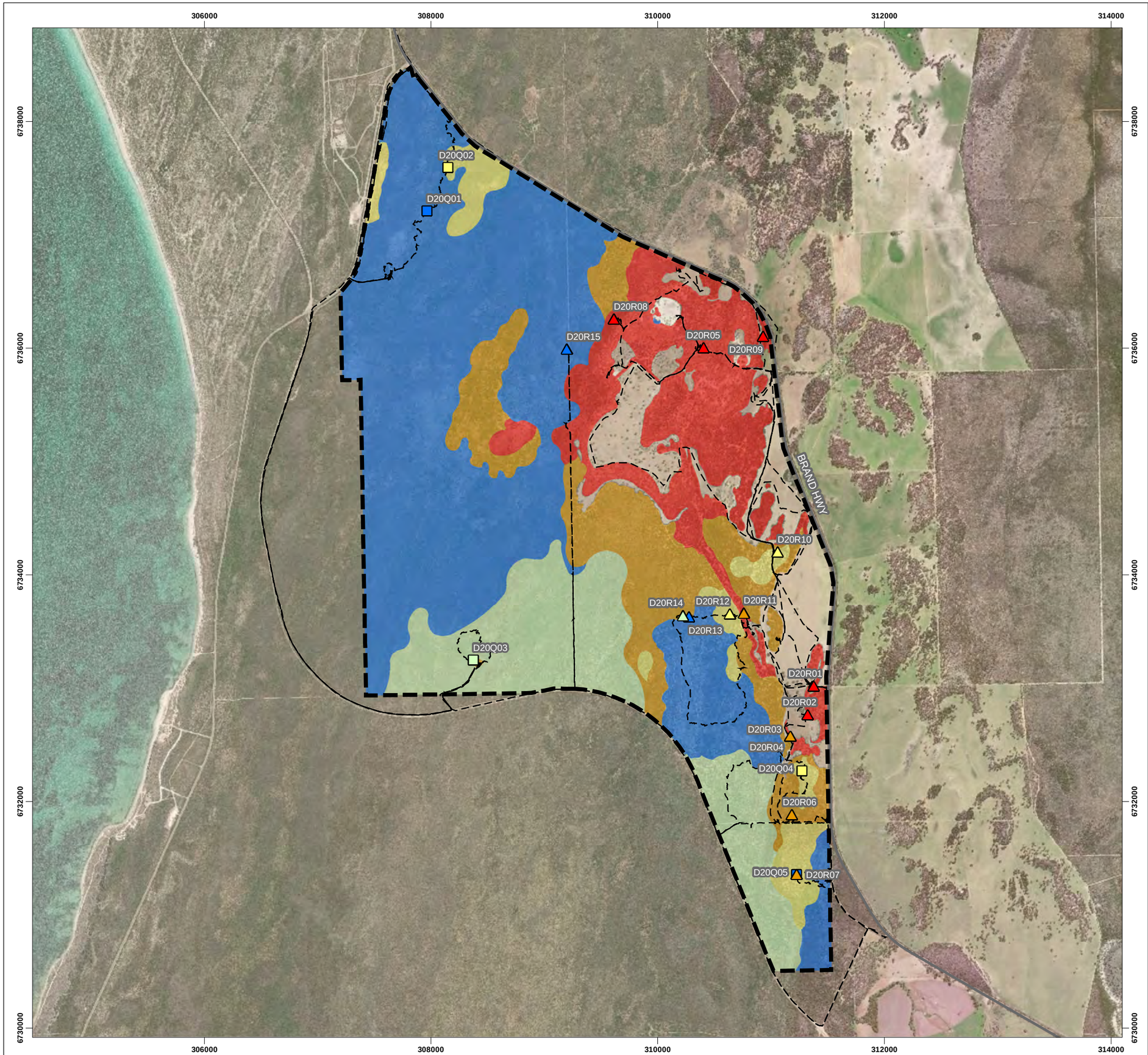
SCALE: 1:33,000 @ A3

0 0.2 0.4 0.6 0.8 1 km

PROJECT NO: 4562-20

REV	AUTHOR	APPROVED	DATE
0	KP	SB	18/01/2021

MAP 5



LEGEND

- Survey Area
- Roads
- Survey Tracks

Site Type and Condition

Quadrat

- Excellent
- Very Good
- Good

Releve

- Excellent
- Very Good
- Good
- Degraded
- Completely Degraded

Vegetation Condition (Ecoscape 2020)

- Excellent
- Very Good
- Good
- Degraded
- Completely Degraded
- N/A

DATA SOURCES:
SOURCE DATA: VEGETATION DATA (ECOSCAPE 2020); TRANSPORT ROAD CENTRELINES (MRWA 2012)
AERIAL: ESRI BASEMAP (2019)
SERVICE LAYERS: SOURCE: ESRI, MAXAR, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY

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VEGETATION CONDITION

ARROWSMITH WIND AND SOLAR FARM ENVIRONMENTAL SURVEY

Infinite Blue Energy
Fuelling The Future

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N

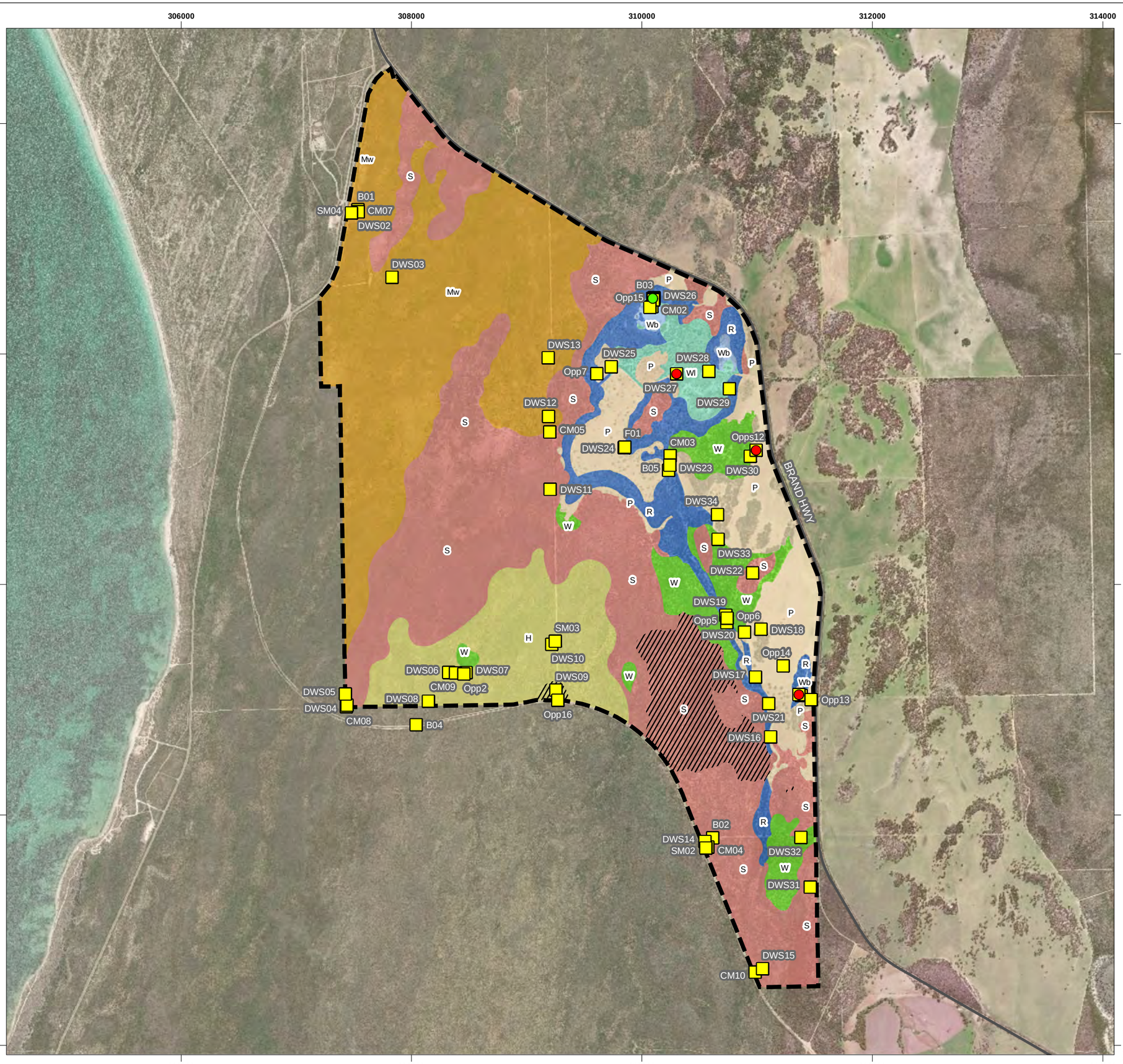
SCALE: 1:33,000 @ A3

0 0.2 0.4 0.6 0.8 1 km

PROJECT NO: 4562-20

REV	AUTHOR	APPROVED	DATE
0	KP	SB	18/01/2021

MAP 6



LEGEND

- Survey Area
- Roads
- Fauna Assessment Points
- *Calyptorhynchus latirostris* (EN)
- *Calidris acuminata* (MI)

Fauna Habitat Types (Ecoscape 2020)

- H: Heath
- Mw: Mallee woodland
- P: Pastoral
- S: Shrubland
- W: Woodland
- R: Riparian
- Wb: Waterbody (seasonal)
- Wl: Wetland
- //// *Banksia prionotes* present

DATA SOURCES:
SOURCE DATA: FAUNA DATA (ECOSCAPE 2020); TRANSPORT ROAD CENTRELINES (MRWA 2012)
AERIAL: ESRI BASEMAP (2019)
SERVICE LAYERS: SOURCE: ESRI, MAXAR, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY

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FAUNA SITES, HABITAT & SIGNIFICANT FAUNA LOCATIONS

ARROWSMITH WIND AND SOLAR FARM ENVIRONMENTAL SURVEY

Infinite Blue Energy
Fuelling The Future

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N

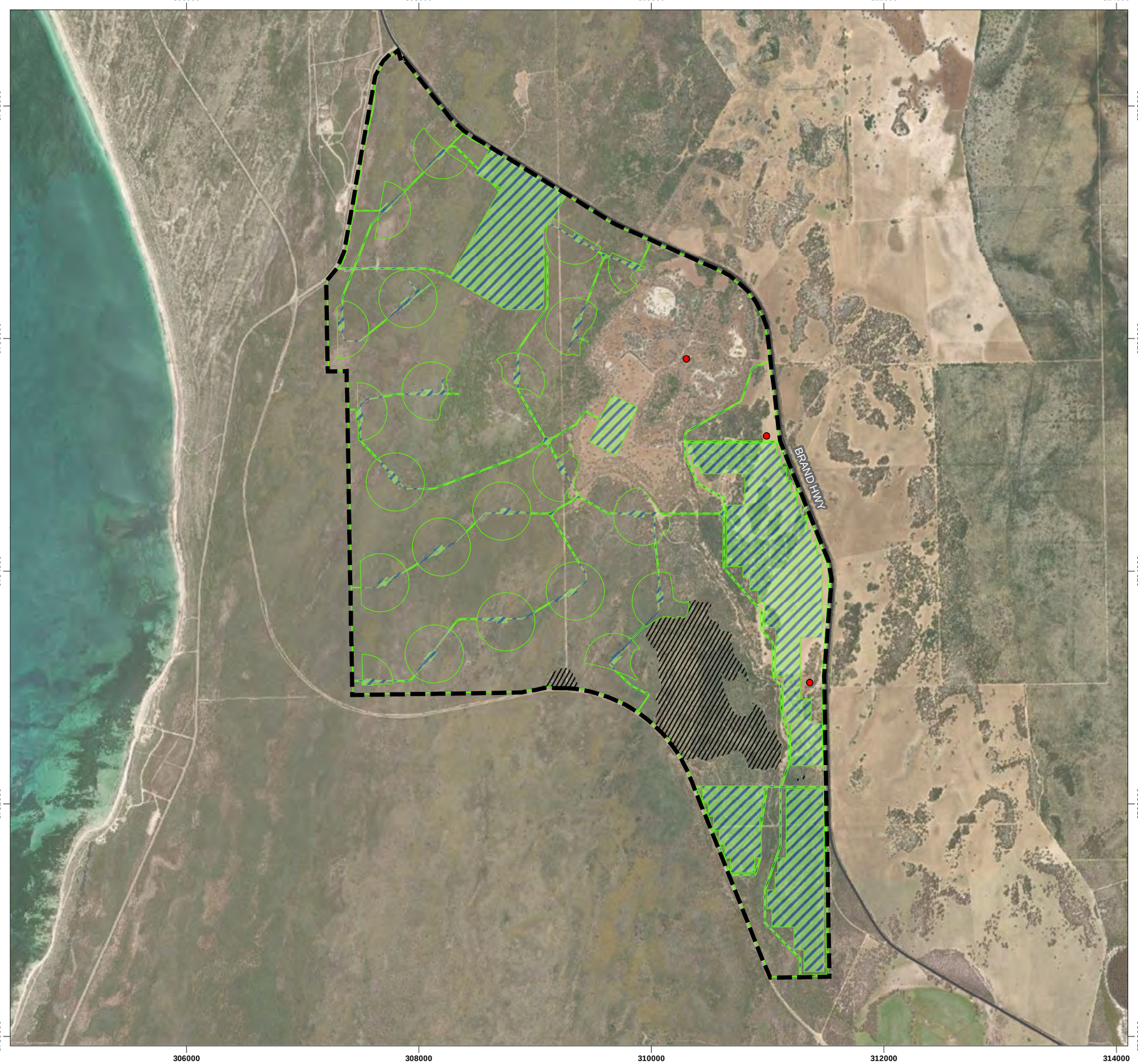
SCALE: 1:33,000 @ A3

0 0.2 0.4 0.6 0.8 1 km

PROJECT NO: 4562-20

REV	AUTHOR	APPROVED	DATE
0	KP	SB	18/01/2021

MAP 7



LEGEND

- Survey Area
- Roads
- *Calyptorhynchus latirostris* (EN)
- Project Layout Approval (Development Envelope)
- Project Layout Approval (Disturbance Footprint)
- Carnaby's Cockatoo foraging habitat

DATASOURCES:
SOURCE DATA: FAUNA DATA (ECOSCAPE 2020); TRANSPORT ROAD CENTRELINES (MRWA 2012)
AERIAL: ESRI BASEMAP (2019)
SERVICE LAYERS: SOURCE: ESRI, MAXAR, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY

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CARNABY'S COCKATOO HABITAT & INFRASTRUCTURE LAYOUT

ARROWSMITH WIND AND SOLAR FARM ENVIRONMENTAL SURVEY

Infinite Blue Energy
Fuelling The Future

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N

SCALE: 1:33,000 @ A3

0 0.2 0.4 0.6 0.8 1 km

PROJECT NO: 4562-20

REV	AUTHOR	APPROVED	DATE
0	AHC	SB	18/01/2021

MAP 8

APPENDIX ONE DEFINITIONS AND CRITERIA

Table 13: EPBC Act categories for flora, fauna and ecological communities

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

Table 14: Conservation codes for Western Australian flora and fauna (DBCA 2019b)

Conservation Codes for Western Australian Flora and Fauna	
Threatened, Extinct and Specially Protected fauna or flora[1] are species[2] which have been adequately searched for and are deemed to be, in the wild, threatened, extinct or in need of special protection, and have been gazetted as such. **The *Wildlife Conservation (Specially Protected Fauna) Notice 2018* and the *Wildlife Conservation (Rare Flora) Notice 2018* have been transitioned under regulations 170, 171 and 172 of the *Biodiversity Conservation Regulations 2018* to be the lists of Threatened, Extinct and Specially Protected species under Part 2 of the *Biodiversity Conservation Act 2016*.** **Categories of Threatened, Extinct and Specially Protected fauna and flora are:**	
T	**Threatened species** Listed by order of the Minister as Threatened in the category of critically endangered, endangered or vulnerable under section 19(1), or is a rediscovered species to be regarded as threatened species under section 26(2) of the *Biodiversity Conservation Act 2016* (BC Act). Threatened fauna is that subset of 'Specially Protected Fauna' listed under schedules 1 to 3of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for Threatened Fauna. Threatened flora is that subset of 'Rare Flora' listed under schedules 1 to 3of the *Wildlife Conservation (Rare Flora) Notice 2018* for Threatened Flora. The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria as detailed below.
CR	**Critically endangered species** Threatened species considered to be "*facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines*". Listed as critically endangered undersection 19(1)(a) of the BC Act in accordance with the criteria set out in section 20 and the ministerial guidelines. Published under schedule 1 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for critically endangered fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for critically endangered flora.
EN	**Endangered species** Threatened species considered to be "*facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines*". Listed as endangered under section 19(1)(b) of the BC Act in accordance with the criteria set out in section 21 and the ministerial guidelines. Published under schedule 2 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for endangered fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for endangered flora.
VU	**Vulnerable species** Threatened species considered to be "*facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines*". Listed as vulnerable undersection 19(1)(c) of the BC Act in accordance with the criteria set out in section 22 and the ministerial guidelines. Published under schedule 3of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for vulnerable fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for vulnerable flora.
Extinct species **Listed by order of the Minister as extinct under section 23(1) of the BC Act as extinct or extinct in the wild.**	
EX	**Extinct species** Species where "*there is no reasonable doubt that the last member of the species has died*", and listing is otherwise in accordance with the ministerial guidelines (section 24 of the BC Act). Published as presumed extinct under schedule 4of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for extinct fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for extinct flora.
EW	Extinct in the wild species Species that "*is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; and it has not been recorded in its known habitat or expected habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its life cycle and form*", and listing is otherwise in accordance with the ministerial guidelines (section 25of 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.

Conservation Codes for Western Australian Flora and Fauna	
Specially protected species **Listed by order of the Minister as specially protected under section 13(1) of the BC Act. Meeting one or more of the following categories: species of special conservation interest; migratory species; cetaceans; species subject to international agreement; or species otherwise in need of special protection.** **Species that are listed as threatened species (critically endangered, endangered or vulnerable) or extinct species under the BC Act cannot also be listed as Specially Protected species.**	
MI	**Migratory species** Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth; and listing is otherwise in accordance with the ministerial guidelines (section 15of the BC Act). Includes birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and fauna subject to the *Convention on the Conservation of Migratory Species of Wild Animals* (Bonn Convention), an environmental treaty under the United Nations Environment Program. Migratory species listed under the BC Act are a subset of the migratory animals that are known to visit Western Australia, protected under the international agreements or treaties, excluding species that are listed as Threatened species. Published as migratory birds protected under an international agreement under schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.
CD	**Species of special conservation interest (conservation dependent fauna)** Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened, and listing is otherwise in accordance with the ministerial guidelines (section 14of 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 18of the BC Act). Published as other specially protected fauna under schedule 7of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018.*
P	**Priority species** Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened fauna or flora. Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring. Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.
1	**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.
2	**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.

Conservation Codes for Western Australian Flora and Fauna	
3	**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.
4	**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.

[1] The definition of flora includes algae, fungi and lichens.
[2] Species includes all taxa (plural of taxon - a classificatory group of any taxonomic rank, e.g. a family, genus, species or any infraspecific category i.e. subspecies or variety, or a distinct population).

Table 15: DBCA definitions and criteria for TECs and PECs (DEC 2013)

Criteria	Definition
Threatened Ecological Communities	
Presumed Totally Destroyed (PD)	An ecological community that has been adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future. 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 (A or B): A. Records within the last 50 years have not been confirmed despite thorough searches of known or likely habitats or B. All occurrences recorded within the last 50 years have since been destroyed
Critically Endangered (CR)	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated. 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. This will be determined on the basis of the best available information, by it meeting any one or more of the following criteria (A, B or C): A. The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% and either or both of the following apply (i or ii): i. geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately 10 years); ii. modification throughout its range is continuing such that in the immediate future (within approximately 10 years) the community is unlikely to be capable of being substantially rehabilitated. B. Current distribution is limited, and one or more of the following apply (i, ii or iii): i. geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately 10 years); ii. there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes; iii. there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes. C. The ecological community exists only as highly modified occurrences that may be capable of being rehabilitated if such work begins in the immediate future (within approximately 10 years).

Criteria	Definition
Endangered (EN)	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future. 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. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (A, B, or C): A. The geographic range, and/or total area occupied, and/or number of discrete occurrences have been reduced by at least 70% since European settlement and either or both of the following apply (i or ii): i. the estimated geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is likely in the short term future (within approximately 20 years); ii. modification throughout its range is continuing such that in the short term future (within approximately 20 years) the community is unlikely to be capable of being substantially restored or rehabilitated. B. Current distribution is limited, and one or more of the following apply (i, ii or iii): i. geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short term future (within approximately 20 years); ii. there are few occurrences, each of which is small and/or isolated and all or most occurrences are very vulnerable to known threatening processes; iii. there may be many occurrences but total area is small and all or most occurrences are small and/or isolated and very vulnerable to known threatening processes. The ecological community exists only as very modified occurrences that may be capable of being substantially restored or rehabilitated if such work begins in the short-term future (within approximately 20 years).
Vulnerable (VU)	An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range. An ecological community will be listed as Vulnerable when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction or significant modification in the medium to long-term future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (A, B or C): A. The ecological community exists largely as modified occurrences that are likely to be capable of being substantially restored or rehabilitated. B. The ecological community may already be modified and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations. C. The ecological community may be still widespread but is believed likely to move into a category of higher threat in the medium to long term future because of existing or impending threatening processes.
Priority ecological communities	
Priority One	*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. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.
Priority Two	*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, unallocated Crown land, water reserves, etc.) and not under imminent threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities, but do not meet adequacy of survey requirements, and / or are not well defined, and appear to be under threat from known threatening processes.

Criteria	Definition
Priority Three	*Poorly known ecological communities* i. Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or; ii. 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; iii. Communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes. Communities may be included if they are comparatively well known from several localities, but do not meet adequacy of survey requirements and / or are not well defined, and known threatening processes exist that could affect them.
Priority Four	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. i. Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change These communities are usually represented on conservation lands. ii. Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. iii. Ecological communities that have been removed from the list of threatened communities during the past five years.
Priority Five	*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.

Table 16: NVIS structural formation terminology, terrestrial vegetation (NVIS Technical Working Group; DotEE 2017)

	Cover characteristics							
	Foliage cover *	70-100	30-70	10-30	<10	» 0 (scattered)	0-5 (clumped)	unknown
	Cover code	d	c	i	r	bi	bc	unknown
Growth Form	**Height Ranges (m)**	**Structural Formation Classes**						
tree, palm	<10,10-30, >30	closed forest	open forest	woodland	open woodland	isolated trees	isolated clumps of trees	tree, palm
tree mallee	<3, <10, 10-30	closed mallee forest	open mallee forest	mallee woodland	open mallee woodland	isolated mallee trees	isolated clumps of mallee trees	tree mallee
shrub, cycad, grass-tree, tree-fern	<1,1-2,>2	closed shrubland	shrubland	open shrubland	sparse shrubland	isolated shrubs	isolated clumps of shrubs	shrub, cycad, grass-tree, tree-fern
mallee shrub	<3, <10, 10-30	closed mallee shrubland	mallee shrubland	open mallee shrubland	sparse mallee shrubland	isolated mallee shrubs	isolated clumps of mallee shrubs	mallee shrub
heath shrub	<1,1-2,>2	closed heathland	heathland	open heathland	sparse heathland	isolated heath shrubs	isolated clumps of heath shrubs	heath shrub
chenopod shrub	<1,1-2,>2	closed chenopod shrubland	chenopod shrubland	open chenopod shrubland	sparse chenopod shrubland	isolated chenopod shrubs	isolated clumps of chenopod shrubs	chenopod shrub
samphire shrub	<0.5,>0.5	closed samphire shrubland	samphire shrubland	open samphire shrubland	sparse samphire shrubland	isolated samphire shrubs	isolated clumps of samphire shrubs	samphire shrub
hummock grass	<2,>2	closed hummock grassland	hummock grassland	open hummock grassland	sparse hummock grassland	isolated hummock grasses	isolated clumps of hummock grasses	hummock grass
tussock grass	<0.5,>0.5	closed tussock grassland	tussock grassland	open tussock grassland	sparse tussock grassland	isolated tussock grasses	isolated clumps of tussock grasses	tussock grass
other grass	<0.5,>0.5	closed grassland	grassland	open grassland	sparse grassland	isolated grasses	isolated clumps of grasses	other grass
sedge	<0.5,>0.5	closed sedgeland	sedgeland	open sedgeland	sparse sedgeland	isolated sedges	isolated clumps of sedges	sedge
rush	<0.5,>0.5	closed rushland	rushland	open rushland	sparse rushland	isolated rushes	isolated clumps of rushes	rush
herb	<0.5,>0.5	closed herbland	herbland	open herbland	sparse herbland	isolated herbs	isolated clumps of herbs	herb
fern	<1,1-2,>2	closed fernland	fernland	open fernland	sparse fernland	isolated ferns	isolated clumps of ferns	fern
bryophyte	<0.5	closed bryophyte-land	bryophyte-land	open bryophyteland	sparse bryophyteland	isolated bryophytes	isolated clumps of bryophytes	bryophyte
lichen	<0.5	closed lichenland	lichenland	open lichenland	sparse lichenland	isolated lichens	isolated clumps of lichens	lichen
vine	<10,10-30, >30	closed vineland	vineland	open vineland	sparse vineland	isolated vines	isolated clumps of vines	vine

Table 17: NVIS height classes (NVIS Technical Working Group; DotEE 2017)

Height		Growth form				
Height Class	**Height Range (m)**	**Tree, vine (M & U), palm (single-stemmed)**	**Shrub, heath shrub, chenopod shrub, ferns, samphire shrub, cycad, tree-fern, grass-tree, palm (multi-stemmed)**	**Tree mallee, mallee shrub**	**Tussock grass, hummock grass, other grass, sedge, rush, forbs, vine (G)**	**Bryophyte, lichen, seagrass, aquatic**
8	>30	tall	NA	NA	NA	NA
7	10-30	mid	NA	tall	NA	NA
6	<10	low	NA	mid	NA	NA
5	<3	NA	NA	low	NA	NA
4	>2	NA	tall	NA	tall	NA
3	1-2	NA	mid	NA	tall	NA
2	0.5-1	NA	low	NA	mid	tall
1	<0.5	NA	low	NA	low	low
Source: (based on Walker & Hopkins 1990)						

Table 18: Vegetation condition scale for the South West and Interzone Botanical Provinces (EPA 2016)

Condition rating	Description
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.
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.
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.
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.
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.

Table 19: Commonwealth Black Cockatoo foraging quality scoring tool (Commonwealth of Australia 2017)

Starting Score	Foraging habitat for Carnaby's Cockatoo	Foraging habitat for Baudin's Cockatoo	Foraging habitat for Forest Red-tailed Black cockatoo
10 (Very high quality)	Foraging habitat that is being managed for black cockatoos such as habitat that is the focus of successful rehabilitation, and/or has some level of protection from clearing, and/or is quality habitat described below with attributes contributing to meet a sore of ≥10	Foraging habitat that is being managed for black cockatoos such as habitat that is the focus of successful rehabilitation, and/or has some level of protection from clearing, and/or is quality habitat described below with attributes contributing to meet a sore of ≥10	Foraging habitat that is being managed for black cockatoos such as habitat that is the focus of successful rehabilitation, and/or has some level of protection from clearing, and/or is quality habitat described below with attributes contributing to meet a sore of ≥10
7 (High quality)	Native shrubland, kwongan heathland and woodland dominated by proteaceous plant species such as Banksia spp. (including Dryandra spp.), Hakea spp. and Grevillea spp., as well as native eucalypt woodland and forest that contains foraging species, including along roadsides. Does not include orchards, canola, or areas under a RFA	Native eucalypt woodlands and forest, and proteaceous woodland and heath, particularly marri, including along roadsides. Does not include orchards or areas under a RFA	Jarrah and marri woodlands and forest, and edges of karri forests, including wandoo and blackbutt, within the range of the subspecies, including along roadsides. Does not include areas under a RFA
5 (Quality)	Pine plantation or introduced eucalypts	Pine plantation or introduced eucalypts	Pine plantation or introduced eucalypts
1 (Low quality)	Individual foraging plants or small stand of foraging plants	Individual foraging plants or small stand of foraging plants	Individual foraging plants or small stand of foraging plants
Additions	**Context adjustor - attributes improving functionality of foraging habitat**	**Context adjustor - attributes improving functionality of foraging habitat**	**Context adjustor - attributes improving functionality of foraging habitat**
+3	Is within the Swan Coastal Plain (important foraging area).	Is within the known foraging area (see map).	Jarrah and/or marri show good recruitment (i.e. evidence of young trees).
+3	Contains trees with suitable nest hollows	Contains trees with suitable nest hollows	Contains trees with suitable nest hollows
+2	Primarily contains marri	Primarily contains marri	Primarily contains marri and/or jarrah
+2	Contains trees with potential to be used for breeding (dbh ≥ 500 mm or ≥ 300 mm dbh for salmon gum and wandoo)	Contains trees with potential to be used for breeding (dbh ≥ 500 mm or ≥ 300 mm dbh for salmon gum and wandoo)	Contains trees with potential to be used for breeding (dbh ≥ 500 mm or ≥ 300 mm dbh for salmon gum and wandoo)
+1	Is known to be a roosting site	Is known to be a roosting site	Is known to be a roosting site

Starting Score Subtractions	Foraging habitat for Carnaby's Cockatoo Context adjustor - attributes reducing functionality of foraging habitat	Foraging habitat for Baudin's Cockatoo Context adjustor - attributes reducing functionality of foraging habitat	Foraging habitat for Forest Red-tailed Black cockatoo Context adjustor - attributes reducing functionality of foraging habitat
-2	No clear evidence of feeding debris	No clear evidence of feeding debris	No clear evidence of feeding debris
-2	No other foraging habitat within 6 km	No other foraging habitat within 6 km	No other foraging habitat within 6 km
-1	Is > 12 km from a known breeding location	Is > 12 km from a known breeding location	Is > 12 km from a known breeding location
-1	Is > 12 km from a known roosting site	Is > 12 km from a known roosting site	Is > 12 km from a known roosting site
-1	Is > 2 km from a watering point	Is > 2 km from a watering point	Is > 2 km from a watering point
-1	Disease present (e.g. *Phytophthora cinnamomi* or marri canker	Disease present (e.g. *Phytophthora cinnamomi* or marri canker)	Disease present (e.g. *Phytophthora cinnamomi* or marri canker)

APPENDIX TWO DESKTOP ASSESSMENT RESULTS AND LIKELIHOOD ASSESSMENTS

Table 20: Flora database search results, habitat and likelihood assessment

Blue shading indicates high likelihood; dark blue indicates species is known (recorded) from the survey area

DBCA*	PMST**	Species name	Habitat from: • *FloraBase* (WAH 1998-2020) • (for *Acacia* species) *World Wide Wattle* (WAH *et al.* 2019)	Flowering	Likelihood of occurrence	
					Desktop	Post-survey
		Threatened Flora* **				
	Likely	*Conostylis dielsii* subsp. *teres*	White, grey or yellow sand, gravel. Low open woodland.	Jul-Aug	Low	Low
	May	*Conostylis micrantha*	White or grey sand. Sandplains.	Jul-Aug	Low	Low
WAH	Likely	*Daviesia speciosa*	Gravelly lateritic soils. Undulating plains, rises.	Apr-May	Medium	Medium
TP		*Eleocharis keigheryi*	Clay, sandy loam. Emergent in freshwater: creeks, claypans.	Aug-Nov	Low	Low
WAH		*Eremophila glabra* subsp. *chlorella*	Sandy clay. Winter-wet depressions.	Jul-Nov	Medium	Medium
TP	May	*Eucalyptus crispata*	Sand, loam with lateritic gravel. Lateritic breakaways.	Mar-Jun	Medium	Medium
	May	*Eucalyptus impensa*	Yellow sand. Lateritic hills.	Jun-Jul	Low	Low
WAH, TP	Likely	*Eucalyptus leprophloia*	White or grey sand over laterite. Valley slopes.	Aug-Oct	Low	Low
	May	*Hemiandra gardneri*	Grey or yellow sand, clayey sand. Sandplains.	Aug-Oct	Low	Low
WAH, TP	Known	*Paracaleana dixonii*	Grey sand over granite.	Oct-Jan	Low	Low
TP	Likely	*Styphelia obtecta* ***	Grey-white or yellow sand. Gently undulating slope or plain.	Oct-Nov	Medium	Medium
	May	*Tetratheca nephelioides*	White-grey sand, yellow-brown clayey sand, gravel laterite. Outcrops, undulating hills, ridges.	Sep	Low	Low
WAH, TP	Likely	*Thelymitra stellata*	Sand, gravel, lateritic loam.	Oct-Nov	Medium	Medium
	May	*Wurmbea tubulosa*	Clay, loam. River-banks, seasonally-wet places.	Jun-Aug	Low	Low
		DBCA Priority 1				
WAH		*Caladenia denticulata* subsp. *albicans*	Riverbanks, wet flats, depressions. Clay or sandy soil.	Aug	Medium	Medium
WAH		*Drosera pedicellaris*	Deep sand.	Oct-Nov	High	Medium
WAH		*Korthalsella arthroclada*	White, sandy clay around lake edges.	Dec	Low	Low
WAH, TP		*Lasiopetalum ogilvieanum*	White/grey or yellow sand, stony loam. Undulating plains, lateritic rises.	Jul-Oct	Medium	Low
WAH, TP		*Micromyrtus rogeri*	Yellow-brown sandy soils, gravel, laterite. Breakaways.	Jul - Oct	Low	Low
WAH		*Poranthera asybosca*	White sand.	Oct	Low	Low
WAH		*Stylidium carnosum* subsp. Narrow leaves (J.A. Wege 490)	Slopes on low hills, low plains. White/grey sand with laterite.	Oct	Low	Low
WAH		*Verticordia dasystylis* subsp. *oestopoia*	Gritty soils over granite. Outcrops.	Oct	Medium	Low
WAH, TP		*Verticordia luteola* var. *rosea*	White sand. Flats.	Dec-Jan	Medium	Medium

DBCA*	PMST**	Species name	Habitat from: • *FloraBase* (WAH 1998-2020) • (for *Acacia* species) *World Wide Wattle* (WAH *et al.* 2019)	Flowering	Likelihood of occurrence	
					Desktop	Post-survey
		DBCA Priority 2				
WAH, TP		*Acacia vittata*	Grey sand, sandy clay. Margins of seasonal lakes.	Aug	High	High
WAH		*Calectasia palustris*	White or grey sand. Seasonally inundated swamplands.	Jul-Oct	Medium	Medium
WAH		*Comesperma griffinii*	Yellow or grey sand. Plains.	Oct	High	Medium
WAH		*Dampiera tephrea*	Sand, gravelly loam.	Jul	Medium	Medium
WAH, TP		*Guichenotia quasicalva*	Drainage lines. Sandy clay over laterite.	Sep-Oct	Low	Low
WAH		*Schoenus badius*	Grey sand. Moist areas.	Sep - Oct	Medium	Medium
WAH		*Schoenus* sp. Eneabba (F. Obbens & C. Godden I154)	Grey, yellow or white sand. Undulating sandplains, mid slopes, tops of rises.	Dec	High	Medium
WAH		*Scholtzia calcicola*	Yellow/grey sand, over limestone. Slopes.	Oct	High	High
WAH		*Stylidium pseudocaespitosum*	White, grey or yellow sand over laterite. Breakaways and hillslopes.	Sep-Nov	Low	Low
WAH		*Stylidium* sp. Three Springs (J.A. Wege & C. Wilkins JAW 600)	Upper slopes, ironstone breakaways, flats. Yellow-brown clayey sand over laterite, red rocky soil.	Sep	Low	Low
TP		*Synaphea sparsiflora*	Sandy loam over laterite.	Aug – Sep	Low	Low
WAH		*Tricoryne* sp. Wongan Hills (B.H. Smith 794)	Yellow to grey sand, gravelly clay quartz, laterite, limestone. Mid-slopes and uplands.		Medium	Medium
WAH		*Verticordia argentea*	White, grey or yellow sand. Sand ridges, undulating plains.	Nov-Apr	Medium	Medium
		DBCA Priority 3				
WAH		*Acacia latipes* subsp. *licina*	White sand, granitic soils. Limestone hills, sandplains.	Jun-Sep	Medium	Medium
WAH		*Acacia lanceolata*	Lateritic hills & breakaways.		Low	Low
WAH		*Acacia telmica*	Sand, loam or loamy clay. Low-lying seasonally moist areas.	Jul-Sep	Medium	Medium
WAH		*Anthocercis intricata*	Sand or loam over limestone. Consolidated sand dunes.	Jun-Sep	High	Recorded
WAH		*Austrostipa* sp. Cairn Hill (M.E. Trudgen 21176)	Slopes. Grey clayey or yellow brown sandy soil.		Low	Low
WAH		*Baeckea* sp. Walkaway (A.S. George 11249)	Yellow/brown or white sand. Undulating plains, hillslopes.	Dec-Jan	Medium	Medium
WAH		*Banksia cypholoba*	Sand & gravelly loam.	Aug	Low	Low
WAH		*Banksia fraseri* var. *crebra*	Shallow valley, sandplains, slopes, laterite hills. Yellow-brown sand, gravelly clay loam.	Jul-Aug	Medium	Medium
WAH, TP		*Beyeria cinerea* subsp. *cinerea*	Depressions, limestone ridges, hill tops. Brown or grey sand, sand over limestone.	Jul-Aug	High	Recorded
WAH		*Beyeria gardneri*	Yellow sand.	Aug-Sep	High	Medium
WAH		*Blackallia nudiflora*	Clay or sandy clay with granite. On hills or breakaways, plains.		Low	Low
WAH		*Centrolepis milleri*	Sandplains.		Medium	Medium

DBCA*	PMST**	Species name	Habitat from: • *FloraBase* (WAH 1998-2020) • (for *Acacia* species) *World Wide Wattle* (WAH *et al.* 2019)	Flowering	Likelihood of occurrence	
					Desktop	Post-survey
WAH		*Comesperma rhadinocarpum*	Sandy soils, sand over laterite. Hill slopes, undulating plains.	Oct-Nov	Medium	Medium
WAH, TP		*Eucalyptus macrocarpa* x *pyriformis*	Sand, lateritic sandy soils. Hills, rocky ironstone ridges, sandplains.	Aug-Oct	Low	Low
WAH		*Grevillea erinacea*	White, grey or yellow sand, often with lateritic gravel.	Jul-Dec	Medium	Low
WAH		*Guichenotia alba*	Sandy & gravelly soils. Low-lying flats, depressions.	Jul-Aug	Medium	Medium
WAH		*Haloragis foliosa*	White/grey sand over limestone.	Dec	High	High
WAH		*Hemiandra* sp. Eneabba (H. Demarz 3687)	Sand over laterite, sandplains. Disturbed sites.	Nov	Medium	Low
WAH		*Hemigenia saligna*	Lateritic and sandy soils.	Jul-Oct	Medium	Low
WAH		*Hopkinsia anoectocolea*	White or grey sand, often saline. Winter-wet depressions, floodplains, salt lakes.	Sep-Dec	Medium	Low
WAH		*Hypocalymma gardneri*	Grey-brown sand, laterite. Sandplains, upper slopes, heathland.	Aug-Sep	Low	Low
WAH		*Hypocalymma tetrapterum*	Grey sand, loam, lateritic gravel. Riverbanks, breakaways.	Aug	Low	Low
WAH		*Mesomelaena stygia* subsp. *deflexa*	White, grey or lateritic sand, clay, gravel.	Mar-Oct	Low	Low
WAH		*Persoonia chapmaniana*	White sandy clay, yellow sand. Vicinity of salt lakes.	Sep-Nov	Low	Low
WAH		*Persoonia filiformis*	Yellow or white sand over laterite.	Nov-Dec	Low	Low
WAH, TP		*Persoonia rudis*	White, grey or yellow sand, often over laterite.	Sep-Jan	Medium	Low
WAH		*Stylidium drummondianum*	Sand or clayey sand over laterite. Upper hillslopes, breakaways. Low heath, mallee shrubland.	Aug-Oct	Low	Low
WAH, TP		*Stylidium maritimum*	Sand over limestone. Dune slopes and flats. Coastal heath and shrubland, open Banksia woodland.	Sep-Nov	Medium	Medium
WAH		*Stylidium torticarpum*	Sandy clay and clay loam over laterite. Adjacent to creek lines, depressions and beneath breakaways.	Sep-Nov	Low	Low
WAH		*Styphelia filifolia*	Yellow/brown sand. Flats or slopes.	Feb-Apr	Medium	Medium
WAH		*Synaphea oulopha*	Lateritic breakaways and rises. Grey sand, gravelly loam, clay.	Jul-Oct	Low	Low
WAH		*Thryptomene* sp. Lancelin (M.E. Trudgen 14000)	Calcareous sand.	Sep	High	High
WAH		*Triglochin protuberans*	Red loam, grey mud over clay. Winter-wet sites, claypans, near salt lakes, margins of pools.	Oct	Low	Low
WAH		*Verticordia densiflora* var. *roseostella*	Sandy gravelly soils.	Sep-Dec	Medium	Medium
WAH, TP		*Verticordia fragrans*	White, grey or yellow sand, clay loam. Low-lying areas, sandplains.	Sep-Nov	Medium	Medium
WAH, TP		*Verticordia luteola* var. *luteola*	Grey sand over gravel. Flats.	Nov-Dec	Medium	Medium
		DBCA Priority 4				
WAH		*Banksia elegans*	Yellow, white or red sand. Sandplains, low consolidated dunes.	Oct-Nov	High	Medium

DBCA*	PMST**	Species name	Habitat from: • *FloraBase* (WAH 1998-2020) • (for *Acacia* species) *World Wide Wattle* (WAH *et al.* 2019)	Flowering	Likelihood of occurrence	
					Desktop	Post-survey
WAH		*Banksia scabrella*	White, grey or yellow sand, sometimes with lateritic gravel. Sandplains, lateritic ridges.	Sep-Jan	Low	Low
WAH, TP		*Calytrix chrysantha*	White, grey or yellow/brown sand. Flats.	Dec-Feb	Medium	Medium
WAH, TP		*Calytrix eneabbensis*	White, grey or yellow sand over laterite. Sandplains.	Jul-Oct	Low	Low
WAH		*Calytrix superba*	Sand over laterite. Flats.	Dec-Feb	Low	Low
WAH		*Eucalyptus ebbanoensis* subsp. *photina*	Sandy clay, red sand. Lateritic breakaways, sandplains.	Sep - Dec or Jan - Mar	Low	Low
WAH, TP		*Eucalyptus macrocarpa* subsp. *elachantha*	White or grey sand over laterite. Hillslopes, ridges, sandplains.	Aug-Dec	Low	Low
WAH, TP		*Eucalyptus zopherophloia*	Grey/white sand with limestone rubble. Coastal areas.	Oct-Jan	Recorded	Recorded
WAH		*Grevillea olivacea*	Coastal dunes, limestone rocks.	Jun-Sep	Medium	Medium
WAH		*Hydrocotyle lemnoides*	Swamps.	Aug-Oct	Medium	Medium
WAH		*Liparophyllum congestiflorum*	Grey sand/loam over laterite. Flats, seasonally wet areas.	Sep - Oct	Low	Low
WAH		*Pityrodia viscida*	Lateritic sand.	Sep - Dec or Jan - Feb	Medium	Low
WAH		*Scaevola kallophylla*	Sandy soils over limestone. Coastal plain.	May or Aug-Dec	Low	Low
WAH		*Schoenus griffinianus*	White sand.	Sep-Oct	Medium	Medium
WAH, TP		*Stawellia dimorphantha*	White, grey, yellow sand.	Jun-Nov	High	High
WAH		*Stylidium longitubum*	Sandy clay, clay. Seasonal wetlands.	Oct-Dec	Medium	Medium
TP		*Thysanotus glaucus*	White, grey or yellow sand, sandy gravel.	Oct-Mar	Low	Low

* WAH = herbarium record (vouchered specimen)
TP = Threatened and Priority Flora Report Form record; may be unconfirmed i.e. without vouchered specimen

** PMST likelihood of occurrence or likelihood of habitat occurring

*** renamed recently: now *Leucopogon obtectus*

Table 21: Fauna database results and likelihood assessments

Blue shading indicates high likelihood; darker blue indicates species is known (recorded) from the survey area

Species (*)	Common name	Conservation status		Database			Likelihood of occurrence	
		EPBC Act	Western Australian	PMST**	DBCA	*NatureMap*	Desktop	Post-survey
Mammals								
Dasyurus geoffroii fortis	Western Quoll, Chuditch	VU	VU	known	x	x	Low	Low
Hydromys chrysogaster	Water Rat	-	P4	-	-	x	Very low	Very low
Notamacropus irma	Western Brush Wallaby	-	P4	-	x	x	Medium	Medium
Parantechinus apicalis	Dibbler	EN	EN	may	-	-	Very low	Very low
Birds								
Actitis hypoleucos	Common Sandpiper	MI	MI	known	x	x	Low	High
Anous stolidus	Common Noddy (Brown Noddy)	MI	MI	likely	-	-	Very low	Very low
Anous tenuirostris melanops	Australian Lesser Noddy	VU	EN	may	x	x	Very low	Very low
Apus pacificus	Pacific Swift (Fork-tailed Swift)	MI	MI	likely	x	x	Low	Low
Ardea alba	Great Egret	MA	-	known	-	-	Low	Medium
Ardea ibis	Cattle Egret	MA	-	may	-	-	Very low	Medium
Arenaria interpres	Ruddy Turnstone	MI	MI	-	x	x	Very low	Very low
Calidris acuminata	Sharp-tailed Sandpiper	MI	MI	likely	x	x	Low	Recorded
Calidris canutus	Red Knot	EN & MI	EN	known	-	-	Low	Low
Calidris ferruginea	Curlew Sandpiper	CR & MI	CR	likely	-	-	Very low	Very Low
Calidris melanotos	Pectoral Sandpiper	MI	MI	may	-	-	Very low	Low
Calidris ruficollis	Red-necked Stint	MI	MI	-	x	x	Low	Medium
Calyptorhynchus latirostris	Carnaby's Cockatoo	EN	EN	known	x	x	High	Recorded
Chrysococcyx osculans	Black-eared Cuckoo	MA	-	likely	-	-	Very low	Very low
Diomedea amsterdamensis	Amsterdam Albatross	EN	CR	may	-	-	Very low	Very low
Diomedea epomophora	Southern Royal Albatross	VU & MI	VU	may	-	-	Very low	Very low
Diomedea exulans	Wandering Albatross	VU & MI	VU	may	-	-	Very low	Very low
Diomedea sanfordi	Northern Royal Albatross	EN & MI	EN	may	-	-	Very low	Very low
Falco hypoleucos	Grey Falcon	VU	VU	likely	-	-	Very low	Very low

Species (*)	Common name	Conservation status		Database			Likelihood of occurrence	
		EPBC Act	Western Australian	PMST**	DBCA	*NatureMap*	Desktop	Post-survey
Falco peregrinus	Peregrine Falcon	-	OS	-	x	x	Low	Low
Haliaeetus leucogaster	White-bellied Sea-Eagle	MA	-	likely	-	-	Very low	Very low
Hydroprogne caspia	Caspian Tern	MI	MI	known	x	-	Very low	Very low
Larus pacificus	Pacific Gull	MA	-	known	-	-	Low	Low
Leipoa ocellata	Malleefowl	VU	VU	known	x	x	High	Low
Limosa lapponica	Bar-tailed Godwit	MI (& VU or CR at subsp. level)	MI (& VU or CR at subsp. level)	known	x	x	Low	Low
Limosa lapponica baueri	Western Alaskan Bar-Tailed Godwit	VU	-	may	-	-	Very low	Low
Limosa lapponica menzbieri	Bar-tailed godwit (Northern Siberian)	CR (& MI at sp. level)	CR (& MI at sp. level)	may	-	-	Very low	Low
Macronectes giganteus	Southern Giant Petrel	EN & MI	MI	may	-	-	Very low	Very low
Macronectes halli	Northern Giant Petrel	VU & MI	MI	may	-	-	Very low	Very low
Merops ornatus	Rainbow Bee-eater	MA		may	-	-	Very low	Recorded
Motacilla cinerea	Grey Wagtail	MI	MI	may	-	-	Very low	Very low
Numenius madagascariensis	Far Eastern Curlew (Eastern Curlew)	CR & MI	CR	may	-	-	Very low	Very low
Pandion cristatus	Eastern Osprey	MI	MI	-	x	x	Low	Very low
Pandion haliaetus	Osprey	MI	-	known	-	-	Low	Very low
Pluvialis fulva	Pacific Golden Plover	MI	MI	-	-	x	Very low	Very Low
Pluvialis squatarola	Grey Plover	MI	MI	-	x	x	Very low	Very Low
Pterodroma mollis	Soft-plumaged Petrel	VU	-	may	-	-	Very low	Very low
Puffinus assimilis	Little Shearwater	MA	-	known	-	-	Low	Very low
Puffinus carneipes	Fleshy-footed Shearwater	MI	VU	likely	-	-	Very low	Very low
Puffinus pacificus	Wedge-tailed Shearwater	-	MI	-	-	x	Low	Very low
Rostratula benghalensis australis	Australian Painted Snipe	EN	EN	may	-	-	Very low	Very low
Sterna albifrons	White-shafted Little Tern (Little Tern)	MI	MI	-	-	x	Very low	Very low
Sterna anaethetus	Bridled Tern	MI	MI	likely	-	-	Very low	Very low
Sterna dougallii	Roseate Tern	MI	MI	likely	x	x	Very low	Very low
Sterna nereis nereis	Fairy Tern	VU	VU	known	-	-	Low	Very low

Species (*)	Common name	Conservation status		Database			Likelihood of occurrence	
		EPBC Act	Western Australian	PMST**	DBCA	*NatureMap*	Desktop	Post-survey
Thalasseus bergii	Crested Tern (Greater Crested Tern)	-	MI	-	x	x	Medium	Very low
Thalassarche cauta cauta	Shy Albatross	VU & MI	VU	may	-	-	Very low	Very low
Thalassarche cauta steadi	White-capped Albatross	VU & MI	VU	likely	-	-	Very low	Very low
Thalassarche chlororhynchos carteri	Indian Yellow-nosed Albatross	VU & MI	EN	may	-	-	Very low	Very low
Thalassarche melanophris	Black-browed Albatross	VU & MI	EN	may	-	-	Very low	Very low
Thalassarche melanophris impavida	Campbell Island Albatross	VU & MI	VU	may	-	-	Very low	Very low
Thinornis cucullatus	Hooded Plover (Hooded Dotterel)	-	P4	may	-	-	Very low	Very low
Tringa brevipes	Grey-tailed Tattler	MI	MI & P4	-	-	x	Very low	Very Low
Tringa cinerea	Terek Sandpiper	-	MI	-	-	x	Very low	Very low
Tringa nebularia	Common Greenshank	MI	MI	likely	x	x	Low	Medium
Tringa stagnatilis	Marsh Sandpiper	MI	MI	-	x	x	Very low	Very low
Reptiles								
Egernia stokesii badia	Western Spiney-tailed Skink	EN	VU	may	-	-	Very low	Very low
Neelaps calonotos	Black-striped Snake	-	P3	-	x	x	Low	Low

* introduced

** PMST likelihood of occurrence or likelihood of habitat occurring

APPENDIX THREE FIELD SURVEY RESULTS

Table 22: Flora inventory (site x species)

Family	Species	Naturalised	Cons. status	D20Q01	D20Q02	D20Q03	D20Q04	D20Q05	D20R01	D20R02	D20R03	D20R04	D20R05	D20R06	D20R07	D20R08	D20R09	D20R10	D20R11	D20R12	D20R13	D20R14	D20R15	Opportunistic
Aizoaceae	*Mesembryanthemum nodiflorum*	*											X											
Amaranthaceae	*Ptilotus drummondii*																							X
	Ptilotus gaudichaudii				X																			
	Ptilotus polystachyus																							X
	Ptilotus stirlingii subsp. *stirlingii*							X																
Anarthriaceae	*Lyginia barbata*						X																	
Apiaceae	*Eryngium pinnatifidum*																		X					
Araliaceae	*Trachymene pilosa*				X	X	X	X				X		X	X			X				X		
Asparagaceae	*Acanthocarpus canaliculatus*			X	X	X	X	X										X		X				
	Laxmannia sessiliflora subsp. *drummondii*							X										X						
	Lomandra sp.					X	X																	
	Thysanotus manglesianus					X	X	X						X										
	Thysanotus patersonii				X																			
Asteraceae	*Arctotheca calendula*	*								X	X				X				X					
	Brachyscome iberidifolia																	X						
	Centaurea melitensis	*																						X
	Cotula bipinnata	*																						X
	Gnephosis angianthoides													X										
	Hyalosperma cotula					X	X																	
	Hypochaeris glabra	*					X			X	X	X			X		X		X	X	X		X	
	Millotia tenuifolia																				X			
	Myriocephalus appendiculatus																		X					
	Olearia axillaris			X																			X	
	Podotheca gnaphalioides																	X		X				
	Reichardia tingitana	*			X					X		X			X						X			
Asteraceae	*Rhodanthe oppositifolia* subsp. *oppositifolia*												X											

Family	Species	Naturalised	Cons. status	D20Q01	D20Q02	D20Q03	D20Q04	D20Q05	D20R01	D20R02	D20R03	D20R04	D20R05	D20R06	D20R07	D20R08	D20R09	D20R10	D20R11	D20R12	D20R13	D20R14	D20R15	Opportunistic
	Siloxerus multiflorus																		X					
	Sonchus oleraceus	*															X			X	X			
	Ursinia anthemoides	*					X	X						X				X	X				X	
	Waitzia suaveolens var. *suaveolens*				X		X	X						X				X					X	
Boraginaceae	*Echium plantagineum*	*							X															
Brassicaceae	*Brassica tournefortii*	*			X			X	X		X	X		X	X	X	X			X			X	
Campanulaceae	*Isotoma hypocrateriformis*					X		X																
	Lobelia heterophylla				X																			
	Wahlenbergia capensis	*																X						
	Wahlenbergia gracilenta						X	X																
Caryophyllaceae	*Petrorhagia dubia*	*									X		X		X	X	X			X			X	
	Polycarpon tetraphyllum	*																						X
	Silene gallica	*													X								X	
	Spergularia sp.																							X
	Stellaria media	*																					X	
Casuarinaceae	*Allocasuarina campestris*																							X
	Allocasuarina humilis																							X
	Casuarina obesa												X											
Celastraceae	*Stackhousia monogyna*							X																
Chenopodiaceae	*Rhagodia preissii* subsp. *obovata*			X								X			X	X			X	X				
Convolvulaceae	*Cuscuta planiflora*	*																					X	
Crassulaceae	*Crassula* colorata var. *acuminata*																		X					
	Crassula colorata var. *colorata*																		X				X	
	Crassula sp.										X				X	X	X							
Cupressaceae	*Callitris pyramidalis*																							X
Cyperaceae	*Eleocharis acuta*																							X
	Mesomelaena pseudostygia																	X						
Dilleniaceae	*Hibbertia hypericoides* subsp. *septentrionalis*					X	X	X										X				X		

Family	Species	Naturalised	Cons. status	D20Q01	D20Q02	D20Q03	D20Q04	D20Q05	D20R01	D20R02	D20R03	D20R04	D20R05	D20R06	D20R07	D20R08	D20R09	D20R10	D20R11	D20R12	D20R13	D20R14	D20R15	Opportunistic
	Hibbertia subvaginata					X		X															X	
Dioscoreaceae	*Dioscorea hastifolia*					X															X	X		
Droseraceae	*Drosera erythrorhiza*													X										
Ecdeiocoleaceae	*Ecdeiocolea monostachya*						X											X						
Ericaceae	*Styphelia insularis*					X																X		
Euphorbiaceae	*Beyeria cinerea* subsp. *cinerea*		P3	X																				
Fabaceae	*Acacia rostellifera*			X	X		X	X		X				X	X	X	X	X	X				X	
	Acacia scirpifolia						X	X			X			X	X									
	Acacia saligna										X	X			X									
	Acacia spathulifolia							X																
	Bossiaea eriocarpa					X																		
	Gompholobium tomentosum																					X		
	Jacksonia hakeoides					X												X						
	Jacksonia nutans													X										
	Labichea cassioides					X																X		
	Labichea lanceolata subsp. *lanceolata*																							
	Trifolium arvense	*									X		X										X	
	Trifolium campestre	*													X				X		X		X	
	Trifolium hirtum	*																						X
Geraniaceae	*Erodium botrys*	*			X																			
	Pelargonium littorale				X																			
Goodeniaceae	*Dampiera spicigera*																							X
	Goodenia berardiana																	X		X				
	Scaevola lanceolata																							X
Gyrostemonaceae	*Gyrostemon ramulosus*																							X
Haemodoraceae	*Anigozanthos humilis* subsp. *humilis*																	X						
	Conostylis candicans subsp. *calcicola*					X		X						X				X						
Haemodoraceae	*Conostylis prolifera*																			X		X	X	

Family	Species	Naturalised	Cons. status	D20Q01	D20Q02	D20Q03	D20Q04	D20Q05	D20R01	D20R02	D20R03	D20R04	D20R05	D20R06	D20R07	D20R08	D20R09	D20R10	D20R11	D20R12	D20R13	D20R14	D20R15	Opportunistic
	Conostylis sp.																							X
Hemerocallidaceae	*Corynotheca micrantha*																							X
	Dianella revoluta						X																	
	Tricoryne elatior						X	X																
Iridaceae	*Patersonia occidentalis*																							X
Juncaceae	*Juncus bufonius*	*																	X					
Juncaginaceae	*Triglochin* sp. A Flora of Australia (G.J. Keighery 2477)																		X					
Lamiaceae	*Quoya loxocarpa*																						X	
Lauraceae	*Cassytha melantha*				X	X																		
	Cassytha sp.				X																			
Loranthaceae	*Amyema miquelii*																		X					
	Amyema preissii										X													
	Nuytsia floribunda																							X
Malvaceae	*Alyogyne hakeifolia*			X	X																			
	Alyogyne huegelii																						X	
	Commersonia borealis			X	X																		X	
	Guichenotia ledifolia			X	X	X		X																
	Lasiopetalum angustifolium			X																				
	Seringia hermanniifolia																							X
Montiaceae	*Calandrinia* sp.							X																
	Calandrinia sp. Shark Bay (A. Markey 1405)				X									X						X	X			
Myrtaceae	*Beaufortia aestiva*					X																		
	Calothamnus quadrifidus subsp. *angustifolius*					X																		
	Calytrix strigosa																							X
	Chamelaucium uncinatum																X							
	Eremaea beaufortioides var. *microphylla*																							X
Myrtaceae	*Eucalyptus camaldulensis* subsp. *obtusa*								X						X	X	X		X					

Family	Species	Naturalised	Cons. status	D20Q01	D20Q02	D20Q03	D20Q04	D20Q05	D20R01	D20R02	D20R03	D20R04	D20R05	D20R06	D20R07	D20R08	D20R09	D20R10	D20R11	D20R12	D20R13	D20R14	D20R15	Opportunistic
	Eucalyptus erythrocorys					X		X				X		X				X		X	X		X	
	Eucalyptus foecunda																							X
	Eucalyptus oraria			X																				
	Eucalyptus zopherophloia		P4																					X
	Melaleuca cardiophylla			X	X																X	X	X	
	Melaleuca carrii					X	X	X																
	Melaleuca huegelii				X																	X		
	Melaleuca rhaphiophylla														X	X			X					
	Melaleuca strobophylla												X											
	Melaleuca systena					X																		
	Melaleuca trichophylla																				X	X	X	
	Scholtzia laxiflora													X										
	Scholtzia umbellifera						X															X		
Phyllanthaceae	*Phyllanthus calycinus*							X															X	
	Phyllanthus scaber			X		X																		
Pittosporaceae	*Billardiera fraseri*							X																
Plantaginaceae	*Plantago coronopus*	*											X						X					
Poaceae	*Austrostipa elegantissima*					X				X		X		X						X	X			
	Austrostipa flavescens			X		X		X						X				X				X		
	Austrostipa macalpinei					X	X	X						X				X						
	Austrostipa sp.											X								X				
	Avellinia michelii	*			X																			
	Avena barbata	*			X										X		X			X			X	
	Briza maxima	*																					X	
	Briza minor	*																	X					
	Bromus diandrus	*							X	X	X	X			X	X	X		X				X	
	Bromus hordeaceus	*																	X					
Poaceae	*Bromus rubens*	*																	X					

Family	Species	Naturalised	Cons. status	D20Q01	D20Q02	D20Q03	D20Q04	D20Q05	D20R01	D20R02	D20R03	D20R04	D20R05	D20R06	D20R07	D20R08	D20R09	D20R10	D20R11	D20R12	D20R13	D20R14	D20R15	Opportunistic
	Ehrharta brevifolia	*								X		X												
	Ehrharta longiflora	*							X	X	X	X		X	X	X	X	X			X		X	
	Hordeum leporinum	*			X				X	X		X	X			X			X					
	Lolium multiflorum	*							X				X						X					
	Neurachne alopecuroidea						X	X										X						
	Pentameris airoides	*									X			X										
	Poa drummondiana							X										X						
	Polypogon monspeliensis	*																						X
	Rytidosperma setaceum																		X					
	Triodia sp.																							X
	Vulpia myuros	*			X	X	X	X			X		X	X				X	X	X		X		
Polygalaceae	*Comesperma ?ntegerrimum*														X									
	Comesperma confertum			X																				
	Comesperma integerrimum					X									X									
Polygonaceae	*Muehlenbeckia adpressa*						X	X							X					X				
Primulaceae	*Lysimachia arvensis*	*				X						X			X	X	X		X	X	X	X		
Proteaceae	*Banksia attenuata*																							X
	Banksia dallanneyi							X																
	Banksia leptophylla var. *melletica*																							X
	Banksia prionotes						X																	
	Banksia sessilis var. *cygnorum*					X	X	X																
	Conospermum triplinervium																							X
	Grevillea argyrophylla				X																			
	Grevillea eriostachya																							X
	Grevillea leucopteris						X							X										
	Grevillea preissii subsp. *glabrilimba*																					X		
	Hakea lissocarpha						X	X														X		
Proteaceae	*Hakea trifurcata*																							X

Family	Species	Naturalised	Cons. status	D20Q01	D20Q02	D20Q03	D20Q04	D20Q05	D20R01	D20R02	D20R03	D20R04	D20R05	D20R06	D20R07	D20R08	D20R09	D20R10	D20R11	D20R12	D20R13	D20R14	D20R15	Opportunistic
	Petrophile axillaris					X																		
	Petrophile brevifolia							X																
	Petrophile macrostachya																							X
Restionaceae	*Desmocladus asper*					X	X	X				X		X				X				X		
	Lepidobolus chaetocephalus																	X						
Rhamnaceae	*Cryptandra pungens*			X																				
	Stenanthemum notiale						X	X																
	Trymalium ledifolium													X						X			X	
Rubiaceae	*Opercularia spermacocea*					X																	X	
Rutaceae	*Diplolaena leemaniana*			X																X			X	
	Geleznowia verrucosa																							X
Santalaceae	*Anthobolus foveolatus*							X																
	Exocarpos sparteus			X											X									
	Santalum acuminatum																		X					
Sapindaceae	*Dodonaea aptera*			X																				
Scrophulariaceae	*Zaluzianskya divaricata*	*																						X
Solanaceae	*Anthocercis intricata*		P3	X	X																			
	Anthocercis littorea																							X
	Lycium ferocissimum	*														X								
Stylidiaceae	*Levenhookia octomaculata*																							X
	Stylidium elongatum																						X	
Surianaceae	*Stylobasium australe*														X									
Violaceae	*Hybanthus floribundus* subsp. *floribundus*							X						X				X						
Vitaceae	*Clematicissus angustissima*														X								X	
Xanthorrhoeaceae	*Xanthorrhoea* sp.						X																	
Zamiaceae	*Macrozamia fraseri*							X						X								X		

Table 23: Recorded fauna species

Species	Common name	EPBC Act status	Western Australian status
Mammals			
Austronomus australis	White-striped Free-tailed Bat	-	-
Bos taurus	European Cattle	Introduced	Introduced
Canis lupis subsp.familiaris	Dog	Introduced	Introduced
Capra hircus	Goat	Introduced	Introduced
Chalinolobus gouldii	Gould's Wattled Bat	-	-
Chalinolobus morio	Chocolate Wattled Bat	-	-
Macropus fuliginosus	Western Grey Kangaroo	-	-
Nyctophilus geoffroyi	Lesser Long-eared Bat	-	-
Oryctolagus cuniculus	Rabbit	Introduced	Introduced
Sminthopsis dolichura	Little Long-tailed Dunnart	-	-
Vespadelus baverstocki	Inland Forest Bat	-	-
Vulpes vulpes	Red Fox	Introduced	Introduced
Birds			
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	-	-
Acanthiza inornata	Western Thornbill	-	-
Accipiter fasciatus	Brown Goshawk	-	-
Anas superciliosa	Pacific Black Duck	-	-
Anthochaera carunculata	Red Wattlebird	-	-
Cacatua roseicapilla	Galah	-	-
Cacatua sanguinea	Little Corella	-	-
Calamanthus campestris	Rufous Fieldwren	-	-
Calidris acuminata	Sharp-tailed Sandpiper	-	-
Calyptorhynchus latirostris	Carnaby's Cockatoo	EN	EN
Chenonetta jubata	Australian Wood Duck	-	-
Colluricincla harmonica	Grey Shrike-thrush	-	-
Coracina novaehollandiae	Black-faced Cuckoo-shrike	-	-
Corvus coronoides	Australian Raven	-	-
Cracticus tibicen	Australian Magpie	-	-
Cracticus torquatus	Grey Butcherbird	-	-
Dacelo novaeguineae	Laughing Kookaburra	-	Introduced
Dromaius novaehollandiae	Emu	-	-
Falco cenchroides	Australian Kestrel	-	-
Falco longipennis	Australian Hobby	-	-
Gavicalis virescens	Singing Honeyeater	-	-
Gerygone fusca	Western Gerygone	-	-
Grallina cyanoleuca	Magpie-lark	-	-
Haliastur sphenurus	Whistling Kite	-	-
Himantopus himantopus	Black-winged Stilt	-	-
Hirundo nigricans	Tree Martin	-	-
Lichmera indistincta	Brown Honeyeater	-	-
Malurus lamberti	Variegated Fairy-wren	-	-
Malurus splendens	Splendid Fairy-wren	-	-
Merops ornatus	Rainbow Bee-eater	MA	-

Species	Common name	EPBC Act status	Western Australian status
Microeca fascinans	Jacky Winter	-	-
Ocyphaps lophotes	Crested Pigeon	-	-
Pachycephala pectoralis	Golden Whistler	-	-
Pachycephala rufiventris	Rufous Whistler	-	-
Pardalotus striatus	Striated Pardalote	-	-
Phaps chalcoptera	Common Bronzewing	-	-
Phylidonyris niger	White-cheeked Honeyeater	-	-
Platycercus zonarius subsp. *semitorquatus*	Twenty-eight Parrot	-	-
Rhipidura leucophrys	Willie Wagtail	-	-
Smicrornis brevirostris	Weebill	-	-
Strepera versicolor	Grey Currawong	-	-
Todiramphus sanctus	Sacred Kingfisher	-	-
Reptiles			
Ctenophorus isolepis subsp. gularis	Central Military Dragon	-	-
Pogona minor subsp. minor	Dwarf Bearded Dragon	-	-
Pseudonaja affinis	Dugite	-	-

Table 24: Fauna sites (GDA94, Zone 50)

Site Name	Site Type	Easting	Northing
B01	Fauna: Ornithological Survey	307533.595	6737251.814
B02	Fauna: Ornithological Survey	310612.075	6731799.924
B03	Fauna: Ornithological Survey	310093.672	6736483.551
B04	Fauna: Ornithological Survey	308039.463	6732780.994
B05	Fauna: Ornithological Survey	310231.67	6734992.417
CM01	Fauna: Motion Camera	311380.316	6733035.54
CM02	Fauna: Motion Camera	310085.96	6736411.581
CM03	Fauna: Motion Camera	310244.223	6735116.685
CM04	Fauna: Motion Camera	310572.5	6731720.211
CM05	Fauna: Motion Camera	309198.982	6735324.657
CM07	Fauna: Motion Camera	307533.804	6737250.931
CM08	Fauna: Motion Camera	307434.628	6732937.194
CM09	Fauna: Motion Camera	308325.934	6733235.102
CM10	Fauna: Motion Camera	310982.9	6730635.311
DWS01	Fauna: Habitat Assessment	311361.077	6733043.754
DWS02	Fauna: Habitat Assessment	307535.697	6737236.661
DWS03	Fauna: Habitat Assessment	307829.761	6736664.726
DWS04	Fauna: Habitat Assessment	307437.875	6732951.44
DWS05	Fauna: Habitat Assessment	307425.63	6733049.459
DWS06	Fauna: Habitat Assessment	308321.728	6733237.248
DWS07	Fauna: Habitat Assessment	308474.227	6733233.632
DWS08	Fauna: Habitat Assessment	308146.009	6732987.136
DWS09	Fauna: Habitat Assessment	309251.574	6733082.627
DWS10	Fauna: Habitat Assessment	309216.032	6733480.809
DWS11	Fauna: Habitat Assessment	309202.664	6734826.268
DWS12	Fauna: Habitat Assessment	309188.454	6735459.624
DWS13	Fauna: Habitat Assessment	309186.567	6735966.689

Site Name	Site Type	Easting	Northing
DWS14	Fauna: Habitat Assessment	310545.798	6731768.653
DWS15	Fauna: Habitat Assessment	311045.218	6730665.293
DWS16	Fauna: Habitat Assessment	311116.682	6732675.913
DWS17	Fauna: Habitat Assessment	310984.356	6733194.314
DWS18	Fauna: Habitat Assessment	311032.359	6733610.417
DWS19	Fauna: Habitat Assessment	310727.864	6733731.914
DWS20	Fauna: Habitat Assessment	310889.129	6733587.504
DWS21	Fauna: Habitat Assessment	311099.394	6732966.753
DWS22	Fauna: Habitat Assessment	310960.545	6734099.344
DWS23	Fauna: Habitat Assessment	310240.645	6735035.361
DWS24	Fauna: Habitat Assessment	309846.186	6735186.255
DWS25	Fauna: Habitat Assessment	309732.669	6735890.106
DWS26	Fauna: Habitat Assessment	310103.759	6736489.375
DWS27	Fauna: Habitat Assessment	310300.051	6735827.934
DWS28	Fauna: Habitat Assessment	310579.113	6735849.919
DWS29	Fauna: Habitat Assessment	310757.415	6735697.703
DWS30	Fauna: Habitat Assessment	310939.878	6735111.964
DWS31	Fauna: Habitat Assessment	311458.671	6731372.889
DWS32	Fauna: Habitat Assessment	311380.2	6731803.392
DWS33	Fauna: Habitat Assessment	310660.637	6734391.426
DWS34	Fauna: Habitat Assessment	310655.463	6734607.082
SM01	Fauna: Sound Recorded (Anabat / SM2)	310068.392	6736406.518
SM02	Fauna: Sound Recorded (Anabat / SM2)	310553.526	6731712.686
SM03	Fauna: Sound Recorded (Anabat / SM2)	309247.103	6733507.056
SM04	Fauna: Sound Recorded (Anabat / SM2)	307479.051	6737224.941

APPENDIX FOUR FLORISTIC QUADRAT DATA

D20Q01

Staff LJA **Date** 13/10/2020 **Season** A

Revisit

Type Q 10 m x 10 m

Location

MGA Zone 50 307965 **mE** 6737214 **mN** **Lat.** -29.4799 **Long.** 115.0194

Habitat Flat

Aspect N/A **Slope** N/A

Soil Type Grey sand

Rock Type None

Loose Rock 0 % cover **Litter** 30 % cover ; <1 cm in depth

Bare ground 60 % cover **Weeds** 0 % cover

Vegetation U+ ^*Eucalyptus oraria*\^mallee shrub\6\c;G ^^*Beyeria cinerea* subsp. *cinerea*,*Acanthocarpus canaliculatus*,*Diplolaena leemaniana*\^shrub\2\i

Veg. Condition Very Good

Disturbance Fire or perhaps rolled

Fire Age >10 years

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia rostellifera		2	1	
Acanthocarpus canaliculatus		0.3	2	
Alyogyne hakeifolia		0.3	<1	
Anthocercis intricata	P 3	1	<1	
Austrostipa flavescens		0.3	<1	

Beyeria cinerea subsp. *cinerea*	P 3	0.3	5
Comesperma confertum		0.5	<1
Commersonia borealis		0.5	<1
Cryptandra pungens		0.3	<1
Diplolaena leemaniana		0.5	2
Dodonaea aptera		0.7	<1
Eucalyptus oraria		3	40
Exocarpos sparteus		1.3	<1
Guichenotia ledifolia		0.4	<1
Lasiopetalum angustifolium		0.7	<1
Melaleuca cardiophylla		1	<1
Olearia axillaris		0.7	<1
Phyllanthus scaber		0.3	<1
Rhagodia preissii subsp. *obovata*		0.6	<1

D20Q02

Staff LJA **Date** 13/10/2020 **Season** A

Revisit

Type Q 10 m x 10 m

Location

MGA Zone 50 308149 **mE** 6737596 **mN** **Lat.** -29.4764 **Long.** 115.0213

Habitat

Aspect N/A **Slope** N/A

Soil Type Grey sand

Rock Type Limestone

Loose Rock 20-50 % cover **Litter** 50 % cover ; <1 cm in depth

Bare ground 20 % cover **Weeds** 40 % cover

Vegetation M+ ^^*Acacia rostellifera*,*Grevillea argyrophylla*,*Melaleuca cardiophylla*\^shrub\4\c;G ^^*Vulpia myuros*,*Avellinia michelii*,*Erodium botrys*\^other grass,forb\1\c

Veg. Condition Good

Disturbance Possibly grazed

Fire Age >10 years

Notes Quadrat not measured

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia rostellifera		4	25	
Acanthocarpus canaliculatus		0.3	<1	
Alyogyne hakeifolia		2	<1	
Anthocercis intricata	P 3	0.5	<1	
**Avellinia michelii*		0.1	5	

**Avena barbata*	0.5	<1
**Brassica tournefortii*	0,3	<1
Calandrinia sp. Shark Bay (A. Markey 1405)	0.1	<1
Cassytha melantha	2	<1
Cassytha sp.	1.5	<1
Commersonia borealis	0.5	<1
**Erodium botrys*	0.1	5
Grevillea argyrophylla	2	10
Guichenotia ledifolia	1	<1
**Hordeum leporinum*	0.2	<1
Lobelia heterophylla	0.4	<1
Melaleuca cardiophylla	2	10
Melaleuca huegelii	2.5	<1
Pelargonium littorale	0.1	<1
Ptilotus gaudichaudii	0.2	<1
**Reichardia tingitana*	0.3	<1
Thysanotus patersonii	1	<1
Trachymene pilosa	0.1	<1
**Vulpia myuros*	0.1	20
Waitzia suaveolens var. *suaveolens*	0.3	2

D20Q03

Staff LJA **Date** 13/10/2020 **Season** A

Revisit

Type Q 10 m x 10 m

Location

MGA Zone 50 308373 **mE** 6733249 **mN** **Lat.** -29.5157 **Long.** 115.0229

Habitat

Aspect W **Slope** Very Gentle

Soil Type Grey sand

Rock Type Limestone

Loose Rock 2-10 % cover; 200 mm in size **Litter** 40 % cover ; <1 cm in depth

Bare ground 30 % cover **Weeds** 1 % cover

Vegetation U ^*Eucalyptus erythrocorys*\^tree\6\r;M+ ^^*Labichea cassioides*,*Banksia sessilis* var. *cygnorum*, *Guichenotia ledifolia*\^shrub\3\c;G ^*Desmocladus asper*,^*Acanthocarpus canaliculatus*\^rush, forb\1\r

Veg. Condition Excellent

Disturbance Old bore in quadrat but little evidence of other disturbances

Fire Age >10 years

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
Acanthocarpus canaliculatus		0.3	2	
Austrostipa elegantissima		0.5	<1	
Austrostipa flavescens		1	<1	
Austrostipa macalpinei		0.3	<1	

Banksia sessilis var. *cygnorum*	2	8
Beaufortia aestiva	1	<1
Bossiaea eriocarpa	0.5	2
Calothamnus quadrifidus subsp. *angustifolius*	1.6	<1
Cassytha melantha	0.5	<1
Comesperma integerrimum	1.2	<1
Conostylis candicans subsp. *calcicola*	0.1	<1
Desmocladus asper	0.2	3
Dioscorea hastifolia	.3	<1
Eucalyptus erythrocorys	7	5
Guichenotia ledifolia	1.4	8
Hibbertia hypericoides subsp. *septentrionalis*	0.3	<1
Hibbertia subvaginata	0.6	<1
Hyalosperma cotula	0.1	<1
Isotoma hypocrateriformis	0.3	<1
Jacksonia hakeoides	0.5	<1
Labichea cassioides	1.3	20
Leucopogon insularis	0.6	<1
Lomandra sp. indet.	0.3	<1
**Lysimachia arvensis*	0.2	<1
Melaleuca carrii	0.3	<1
Melaleuca systena	1	<1
Opercularia spermacocea	0.3	<1
Petrophile axillaris	0.5	<1
Phyllanthus scaber	0.3	<1
Thysanotus manglesianus	0.6	<1
Trachymene pilosa	0.1	<1
**Vulpia myuros*	0.1	<1

D20Q04

Staff LJA **Date** 14/10/2020 **Season** A

Revisit

Type Q 10 m x 10 m

Location

MGA Zone 50 311273 **mE** 6732269 **mN** **Lat.** -29.5250 **Long.** 115.0526

Habitat Upper-Slope

Aspect W **Slope** Gentle

Soil Type Yellow grey sand

Rock Type Limestone

Loose Rock <2 % cover; 60-200 mm in size **Litter** 5 % cover ; <1 cm in depth

Bare ground 50 % cover **Weeds** 2 % cover

Vegetation M+ ^^*Melaleuca carrii*,*Acacia ?saligna*,*Banksia sessilis* var. *cygnorum*\^heath shrub,shrub\3\i;G ^^*Hibbertia hypericoides* subsp. *septentrionalis*,*Ecdeiocolea monostachya*,*Desmocladus asper*\^shrub,rush\1\c

Veg. Condition Good

Disturbance Grazed

Fire Age >10 years

Notes Banksia prionotes scattered in vicinity but none in quadrat

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia ?saligna		1.5	2	
Acacia rostellifera		1.3	1	
Acanthocarpus canaliculatus		0.3	<1	
Austrostipa macalpinei		0.2	<1	

Banksia prionotes	0.1	<1
Banksia sessilis var. *cygnorum*	1.5	2
Desmocladus asper	0.2	3
Dianella revoluta	0.3	<1
Ecdeiocolea monostachya	0.5	8
Grevillea leucopteris	3.5	2
Hakea lissocarpha	0.6	<1
Hibbertia hypericoides subsp. *septentrionalis*	0.4	10
Hyalosperma cotula	0.1	<1
**Hypochaeris glabra*	0.2	<1
Lomandra sp. indet.	0.4	<1
Lyginia barbata	0.4	<1
Melaleuca carrii	1.5	15
Muehlenbeckia adpressa	0.4	<1
Neurachne alopecuroidea	0.1	<1
Scholtzia umbellifera	1.3	5
Stenanthemum notiale	0.1	<1
Thysanotus manglesianus	0.4	<1
Trachymene pilosa	0.	<1
Tricoryne elatior	0.3	<1
**Ursinia anthemoides*	0.2	<1
**Vulpia myuros*	0.2	<1
Wahlenbergia gracilenta	0.3	<1
Waitzia suaveolens var. *suaveolens*	0.3	<1
Xanthorrhoea sp.	0.3	<1

D20Q05

Staff LJA **Date** 14/10/2020 **Season** A

Revisit

Type Q 10 m x 10 m

Location

MGA Zone 50 311226 **mE** 6731357 **mN** **Lat.** -29.5332 **Long.** 115.0520

Habitat Upper-Slope

Aspect S **Slope** Very Gentle

Soil Type Yellow grey sand

Rock Type Limestone

Loose Rock <2 % cover; 20-60 mm in size **Litter** 35 % cover ; <1 cm in depth

Bare ground 60 % cover **Weeds** 2 % cover

Vegetation U+ ^*Eucalyptus erythrocorys*\^tree\6\r;M ^*Acacia spathulifolia*,^*Acacia ?saligna*,*Guichenotia ledifolia*\^shrub\3\i;G ^^*Hibbertia hypericoides* subsp. *septentrionalis*,*Desmocladus asper*, *Conostylis candicans* subsp. *calcicola*\^shrub,rush,forb\2\i

Veg. Condition Very Good

Disturbance Burnt

Fire Age >10 years

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia ?saligna		2	6	
Acacia rostellifera		1	<1	
Acacia spathulifolia		2	10	
Acanthocarpus canaliculatus		0.2	1	

Anthobolus foveolatus	.4	<1
Austrostipa flavescens	1	<1
Austrostipa macalpinei	0.3	<1
Banksia dallanneyi	0.2	<1
Banksia sessilis var. *cygnorum*	1.6	1
Billardiera fraseri	2	<1
**Brassica tournefortii*	0.3	<1
Calandrinia sp.	0.3	<1
Conostylis candicans subsp. *calcicola*	0.3	3
Desmocladus asper	0.2	5
Eucalyptus erythrocorys	8	3
Guichenotia ledifolia	2	2
Hakea lissocarpha	0.7	
Hibbertia hypericoides subsp. *septentrionalis*	0.6	15
Hibbertia subvaginata	0.5	1
Hybanthus floribundus subsp. *floribundus*	0,3	<1
Isotoma hypocrateriformis	0.3	<1
Laxmannia sessiliflora subsp. *drummondii*	0.1	<1
Macrozamia fraseri	1.2	1
Melaleuca carrii	0.8	<1
Muehlenbeckia adpressa	1	<1
Neurachne alopecuroidea	0.2	<1
Petrophile brevifolia	0.5	1
Phyllanthus calycinus	0.6	<1
Poa drummondiana	0.6	<1
Ptilotus stirlingii subsp. *stirlingii*	0.3	<1
Stackhousia monogyna	0.4	<1
Stenanthemum notiale	0.	<1
Thysanotus manglesianus	0.5	<1
Trachymene pilosa	0.	<1
Tricoryne elatior	0.4	<1
**Ursinia anthemoides*	0.2	<1
**Vulpia myuros*	0,2	<1
Wahlenbergia gracilenta	0.3	<1
Waitzia suaveolens var. *suaveolens*	0.2	<1

D20R01

Staff LJA **Date** 12/10/2020 **Season** A

Revisit

Type R

Location

MGA Zone 50 311375 **mE** 6733015 **mN** **Lat.** -29.5183 **Long.** 115.0538

Habitat Lower-Slope

Aspect N/A **Slope** N/A

Soil Type Grey sand

Rock Type None

Loose Rock 0 % cover **Litter** 100 % cover

Bare ground 2 % cover **Weeds** 95 % cover

Vegetation U+ ^*Eucalyptus camaldulensis* subsp. *obtusa*\^tree\7\c;G ^*Hordeum leporinum*,*Ehrharta longiflora*,*Lolium multiflorum*\^other grass\1\d

Veg. Condition Completely Degraded

Disturbance Grazed; parkland cleared

Fire Age

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
**Brassica tournefortii*		0.3	1	
**Bromus diandrus*		0.3	<1	
**Echium plantagineum*		0.3	<1	
**Ehrharta longiflora*		0.6	5	
Eucalyptus camaldulensis subsp. *obtusa*		22	50	

**Hordeum leporinum*	0.2	80
**Lolium multiflorum*	0.3	5

D20R02

Staff LJA **Date** 12/10/2020 **Season** A

Revisit

Type R

Location

MGA Zone 50 311324 **mE** 6732765 **mN** **Lat.** -29.5205 **Long.** 115.0532

Habitat Flat

Aspect N/A **Slope** N/A

Soil Type Grey sand

Rock Type None

Loose Rock 0 % cover **Litter** 95 % cover

Bare ground 5 % cover **Weeds** 60 % cover

Vegetation U+ ^*Acacia rostellifera*\^tree\6\c;G ^*Hordeum leporinum*,^*Ehrharta longiflora*,*Bromus diandrus*\^other grass\1\d

Veg. Condition Completely Degraded

Disturbance Grazed; probably regenerated following clearing

Fire Age

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia rostellifera		7	60	
**Arctotheca calendula*		0.2	<1	
Austrostipa elegantissima		1.2	<1	
**Bromus diandrus*		0.3	5	
**Ehrharta brevifolia*		0.3	<1	

**Ehrharta longiflora*	0.4	25
**Hordeum leporinum*	0.2	30
**Hypochaeris glabra*	0.2	<1
**Reichardia tingitana*	0.4	<1

D20R03

Staff LJA **Date** 12/10/2020 **Season** A

Revisit

Type R

Location

MGA Zone 50 311171 **mE** 6732574 **mN** **Lat.** -29.5222 **Long.** 115.0516

Habitat Flat

Aspect N/A **Slope** N/A

Soil Type Grey sand

Rock Type None

Loose Rock 0 % cover **Litter** 40 % cover

Bare ground 20 % cover **Weeds** 80 % cover

Vegetation M+ ^*Acacia saligna*,^*Acacia ?saligna*\^shrub\4\i;G ^^*Vulpia myuros* forma *myuros*,*Pentameris airoides*,*Hypochaeris glabra*\^other grass,forb\1\d

Veg. Condition Completely Degraded

Disturbance Grazed; probably regen following clearing

Fire Age

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia ?saligna		2	5	
Acacia saligna		3.5	20	
Amyema preissii		1.5	<1	
**Arctotheca calendula*		0.1	<1	
**Brassica tournefortii*		0.3	<1	

**Bromus diandrus*	0.4	<1
Crassula sp.	0.1	<1
**Ehrharta longiflora*	0.4	<1
**Hypochaeris glabra*	0.3	5
**Pentameris airoides*	0.1	10
**Petrorhagia dubia*	0.3	<1
**Trifolium arvense*	0.2	<1
**Vulpia myuros*	0.2	30

D20R04

Staff LJA **Date** 12/10/2020 **Season** A

Revisit

Type R

Location

MGA Zone 50 311170 **mE** 6732575 **mN** **Lat.** -29.5222 **Long.** 115.0516

Habitat Crest

Aspect N/A **Slope** N/A

Soil Type Grey sand

Rock Type Limestone

Loose Rock <2 % cover **Litter** 50 % cover

Bare ground 20 % cover **Weeds** 30 % cover

Vegetation U+ ^*Eucalyptus erythrocorys*,^*Acacia saligna*\^tree mallee,tree\6\c;G ^^*Hordeum leporinum*, *Brassica tournefortii*,*Ehrharta longiflora*\^other grass,forb\1\c

Veg. Condition Degraded

Disturbance Grazed

Fire Age

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia saligna		3	10	
Austrostipa elegantissima		1.3	<1	
Austrostipa sp.		0.6	<1	
**Brassica tournefortii*		0.4	5	
**Bromus diandrus*		0.3	<1	

Desmocladus asper	0.2	<1
**Ehrharta brevifolia*	0.4	<1
**Ehrharta longiflora*	0.4	2
Eucalyptus erythrocorys	8	35
**Hordeum leporinum*	0.2	20
**Hypochaeris glabra*	0.2	<1
**Lysimachia arvensis*	0.2	<1
**Reichardia tingitana*	0.2	<1
Rhagodia preissii subsp. *obovata*	1	<1
Trachymene pilosa	0.1	<1

D20R05

Staff LJA **Date** 12/10/2020 **Season** A

Revisit

Type R

Location

MGA Zone 50 310403 **mE** 6736004 **mN** **Lat.** -29.4912 **Long.** 115.0443

Habitat Open Depression

Aspect N/A **Slope** Very Gentle

Soil Type Grey clay

Rock Type None

Loose Rock 0 % cover **Litter** 30 % cover

Bare ground 5 % cover **Weeds** 95 % cover

Vegetation U+ ^*Melaleuca lanceolata*,^*Casuarina obesa*\^tree\7\r;G ^^*Vulpia myuros*,*Plantago coronopus*, *Hordeum leporinum*\^other grass,forb\1\d

Veg. Condition Completely Degraded

Disturbance Grazed

Fire Age

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
Casuarina obesa		12	2	
**Hordeum leporinum*		0.2	10	
**Lolium multiflorum*		0.3	5	
Melaleuca strobophylla		12	5	
**Mesembryanthemum nodiflorum*		0.1	<1	

**Petrorhagia dubia*	0.3	<1
**Plantago coronopus*	0.1	35
Rhodanthe oppositifolia subsp. *oppositifolia*	0.2	<1
**Trifolium arvense*	0.1	<1
**Vulpia myuros*	0.2	50

D20R06

Staff LJA **Date** 14/10/2020 **Season** A

Revisit

Type R

Location

MGA Zone 50 311182 **mE** 6731883 **mN** **Lat.** -29.5284 **Long.** 115.0516

Habitat Upper-Slope

Aspect W **Slope** Gentle

Soil Type Grey sand

Rock Type None

Loose Rock 0 % cover **Litter** 70 % cover

Bare ground 20 % cover **Weeds** 25 % cover

Vegetation U ^*Eucalyptus erythrocorys*\^tree\6\bi;M+ ^*Acacia ?saligna*,^*Scholtzia laxiflora*\^shrub\4\c;G ^^*Vulpia myuros*,*Trachymene pilosa*,*Waitzia suaveolens* var. *suaveolens*\^other grass,forb\1\i

Veg. Condition Degraded

Disturbance Grazed; potentially cleared and regenerated

Fire Age

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia ?saligna		3	60	
Acacia rostellifera		1	1	
Austrostipa elegantissima		1	<1	
Austrostipa flavescens		0.8	<1	
Austrostipa macalpinei		0.3	<1	

*Brassica tournefortii	0.3	<1
Calandrinia sp. Shark Bay (A. Markey 1405)	0.1	<1
Conostylis candicans subsp. *calcicola*	0.3	<1
Desmocladus asper	0.1	<1
Drosera erythrorhiza	0.1	<1
*Ehrharta longiflora	0.3	<1
Eucalyptus erythrocorys	7	
Gnephosis angianthoides	0.1	<1
Grevillea leucopteris	3	
Hybanthus floribundus subsp. *floribundus*	0.3	<1
Jacksonia nutans	0.3	<1
Macrozamia fraseri	0.6	<1
*Pentameris airoides	0.1	<1
Scholtzia laxiflora	3.5	5
Thysanotus manglesianus		<1
Trachymene pilosa	0.1	2
Trymalium ledifolium	0.4	<1
*Ursinia anthemoides	0.2	<1
*Vulpia myuros	0.2	10
Waitzia suaveolens var. *suaveolens*	0.3	2

D20R07

Staff LJA **Date** 14/10/2020 **Season** A

Revisit

Type R 10 m x 10 m

Location

MGA Zone 50 311226 **mE** 6731357 **mN** **Lat.** -29.5332 **Long.** 115.0520

Habitat River

Aspect N/A **Slope** N/A

Soil Type Grey sand

Rock Type None

Loose Rock 0 % cover **Litter** 100 % cover

Bare ground 0 % cover **Weeds** 20 % cover

Vegetation U+ ^*Eucalyptus camaldulensis* subsp. *obtusa*\^tree\7\i;M ^^*Acacia ?saligna*,*Acacia rostellifera*, *Rhagodia preissii* subsp. *obovata*\^shrub,chenopod shrub\4\c;G ^^*Ehrharta longiflora*,*Avena barbata*,*Lysimachia arvensis*\^other grass,forb\1\i

Veg. Condition Degraded

Disturbance Probably grazed

Fire Age

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia ?saligna		2.5	20	
Acacia rostellifera		4	10	
Acacia saligna		2	2	
**Arctotheca calendula*		0.1	1	

*Avena barbata	0.4	5
*Brassica tournefortii	0.5	<1
*Bromus diandrus	0.3	<1
Clematicissus angustissima	0.2	<1
Comesperma ?integerrimum	0.3	<1
Comesperma integerrimum	2	<1
Crassula sp.	0.	<1
*Ehrharta longiflora	0.4	10
Eucalyptus camaldulensis subsp. obtusa	2	20
Exocarpos sparteus	5	2
*Hypochaeris glabra	0.2	1
*Lysimachia arvensis	0,2	2
Melaleuca rhaphiophylla	2	2
Muehlenbeckia adpressa	1	<1
*Petrorhagia dubia	0.3	<1
*Reichardia tingitana	0.4	<1
Rhagodia preissii subsp. obovata	2	5
*Silene gallica	0.3	<1
Stylobasium australe	1.5	3
Trachymene pilosa	0.	<1
*Trifolium campestre	0.1	<1

D20R08

Staff LJA **Date** 15/10/2020 **Season** A

Revisit

Type R

Location

MGA Zone 50 309612 **mE** 6736257 **mN** **Lat.** -29.4887 **Long.** 115.0362

Habitat Upper-Slope

Aspect N **Slope** Very Gentle

Soil Type Black sand

Rock Type Limestone

Loose Rock 2-10 % cover **Litter** 80 % cover

Bare ground 0 % cover **Weeds** 100 % cover

Vegetation U ^*Eucalyptus camaldulensis* subsp. *obtusa*\^tree\7\bi;M+ ^*Acacia rostellifera*,^*Melaleuca rhaphiophylla*\^shrub\4\c;G ^^*Bromus diandrus*,*Brassica tournefortii*,*Hordeum leporinum*\^other grass,forb\1\d

Veg. Condition Completely Degraded

Disturbance Grazed

Fire Age

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia rostellifera		3	20	
**Brassica tournefortii*		0.5	20	
**Bromus diandrus*		0.3	50	
Crassula sp.		0.1	<1	

*Ehrharta longiflora	0.2	5
Eucalyptus camaldulensis subsp. *obtusa*	20	
*Hordeum leporinum	0.2	20
*Lycium ferocissimum		<1
*Lysimachia arvensis	0.1	5
Melaleuca rhaphiophylla	3	10
*Petrorhagia dubia	0.4	<1
Rhagodia preissii subsp. *obovata*	1	<1

D20R09

Staff LJA **Date** 15/10/2020 **Season** A

Revisit

Type R

Location

MGA Zone 50 310929 **mE** 6736104 **mN** **Lat.** -29.4903 **Long.** 115.0497

Habitat Mid-Slope

Aspect W **Slope** Very Gentle

Soil Type Grey sand

Rock Type None

Loose Rock 0 % cover **Litter** 10 % cover

Bare ground 60 % cover **Weeds** 30 % cover

Vegetation U ^*Eucalyptus camaldulensis* subsp. *obtusa*\^tree\6\bi;M+ ^*Chamelaucium uncinatum*,^*Acacia rostellifera*\^shrub\4\c;G ^^*Brassica tournefortii*,*Ehrharta longiflora*,*Bromus diandrus*\^forb,other grass\1\i

Veg. Condition Completely Degraded

Disturbance Grazed

Fire Age

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia rostellifera		4	10	
**Avena barbata*		1	<1	
**Brassica tournefortii*		0.5	5	
**Bromus diandrus*		0.3	2	

Chamelaucium uncinatum	2	20
Crassula sp.	0.	<1
**Ehrharta longiflora*	0.3	5
Eucalyptus camaldulensis subsp. *obtusa*	6	<1
**Hypochaeris glabra*	0.2	<1
**Lysimachia arvensis*	0.1	<1
**Petrorhagia dubia*	0.3	<1
**Sonchus oleraceus*	0.3	<1

D20R10

Staff LJA **Date** 15/10/2020 **Season** A

Revisit

Type R 10 m x 10 m

Location

MGA Zone 50 311058 **mE** 6734200 **mN** **Lat.** -29.5075 **Long.** 115.0507

Habitat Lower-Slope

Aspect W **Slope** Very Gentle

Soil Type Yellow grey sand

Rock Type None

Loose Rock 0 % cover **Litter** 30 % cover

Bare ground 60 % cover **Weeds** 2 % cover

Vegetation U+ ^*Eucalyptus erythrocorys*\^tree\6\i;M ^*Jacksonia hakeoides*,^*Hibbertia hypericoides* subsp. *septentrionalis*\^shrub\3\i;G ^^*Ecdeiocolea monostachya*,*Lepidobolus chaetocephalus*, *Mesomelaena pseudostygia*\^rush,sedge\2\i

Veg. Condition Good

Disturbance Grazed

Fire Age

Notes Banksia prionotes sparse but not in releve

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia ?rostellifera		2.5	<1	
Acanthocarpus canaliculatus		0.3	<1	
Anigozanthos humilis		0.1	<1	
Austrostipa flavescens		0.7	<1	

Austrostipa macalpinei	0.3	<1
Brachyscome iberidifolia	0.2	<1
Conostylis candicans subsp. *calcicola*	0.2	<1
Desmocladus asper	0.1	1
Ecdeiocolea monostachya	0.8	3
**Ehrharta longiflora*	0.3	<1
Eucalyptus erythrocorys	8	10
Goodenia berardiana	0.2	<1
Hibbertia hypericoides subsp. *septentrionalis*	1	5
Hybanthus floribundus subsp. *floribundus*	0.3	<1
Jacksonia hakeoides	1.8	4
Laxmannia sessiliflora subsp. *drummondii*	0.1	<1
Lepidobolus chaetocephalus	0.4	2
Mesomelaena pseudostygia	0.3	2
Neurachne alopecuroidea	0.3	<1
Poa drummondiana	0.6	<1
Podotheca gnaphalioides	0.3	<1
Trachymene pilosa	0.1	<1
**Ursinia anthemoides*	0.2	<1
**Vulpia myuros*	0.2	<1
**Wahlenbergia capensis*	0.2	<1
Waitzia suaveolens var. *suaveolens*	0.3	<1

D20R11

Staff LJA **Date** 15/10/2020 **Season** A

Revisit

Type R

Location

MGA Zone 50 310758 **mE** 6733662 **mN** **Lat.** -29.5123 **Long.** 115.0476

Habitat River

Aspect N/A **Slope** N/A

Soil Type Grey sand

Rock Type None

Loose Rock 0 % cover **Litter** 20 % cover

Bare ground 10 % cover **Weeds** 40 % cover

Vegetation U+ ^^*Eucalyptus camaldulensis* subsp. *obtusa*,*Acacia rostellifera*,*Melaleuca rhaphiophylla*\^tree\6\c;M ^*Rhagodia preissii* subsp. *obovata*\^chenopod shrub\3\r;G ^^*Vulpia myuros*,*Rytidosperma setaceum*,*Hordeum leporinum*\^other grass,tussock grass\1\c

Veg. Condition Degraded

Disturbance Grazed

Fire Age

Notes Riverbed. Three species of mistletoes!

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia rostellifera		4	10	
Amyema miquelii		2-4	<1	
**Arctotheca calendula*		0.	<1	
**Briza minor*			<1	

**Bromus diandrus*	0.2	<1
**Bromus hordeaceus*	0.2	<1
**Bromus rubens*	0.1	<1
Crassula colorata var. *acuminata*		<1
Crassula colorata var. *colorata*	0.1	<1
Eryngium pinnatifidum	0.2	1
Eucalyptus camaldulensis subsp. *obtusa*	10	15
**Hordeum leporinum*	0.2	5
**Hypochaeris glabra*	0.2	<1
**Juncus bufonius*	0.	<1
**Lolium multiflorum*	0.3	<1
**Lysimachia arvensis*	0.2	2
Melaleuca rhaphiophylla	3	5
Myriocephalus appendiculatus	0.1	<1
**Plantago coronopus*	0.1	<1
Rhagodia preissii subsp. *obovata*	2	5
Rytidosperma setaceum	0.3	5
Santalum acuminatum	4	<1
Siloxerus multiflorus	0.1	1
**Trifolium campestre*	0.1	<1
Triglochin sp. A Flora of Australia (G.J. Keighery 2477)	0.1	<1
**Ursinia anthemoides*	0.2	<1
**Vulpia myuros*	0.2	25

D20R12

Staff LJA **Date** 15/10/2020 **Season** A

Revisit

Type R

Location

MGA Zone 50 310636 **mE** 6733654 **mN** **Lat.** -29.5124 **Long.** 115.0463

Habitat Mid-Slope

Aspect E **Slope** Gentle

Soil Type Pink sand

Rock Type Limestone

Loose Rock 10-20 % cover **Litter** 25 % cover

Bare ground 40 % cover **Weeds** 15 % cover

Vegetation U+ ^*Eucalyptus erythrocorys*\^tree\6\i;M ^^*Acanthocarpus canaliculatus*,*Diplolaena leemaniana*, *Rhagodia preissii* subsp. *obovata*\^shrub,chenopod shrub\3\i;G ^^*Vulpia myuros*,*Petrorhagia dubia*,*Brassica tournefortii*\^other grass,forb\1\i

Veg. Condition Good

Disturbance Probably grazed

Fire Age

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
Acanthocarpus canaliculatus		1.3	10	
Austrostipa elegantissima		1	<1	
Austrostipa sp.		0.3	<1	
**Avena barbata*		0.4	<1	

*Brassica tournefortii	0.4	2
Calandrinia sp. Shark Bay (A. Markey 1405)	0.3	<1
Conostylis prolifera	0.1	<1
Diplolaena leemaniana	1.2	5
Eucalyptus erythrocorys	8	10
Goodenia berardiana	0.2	<1
Hypochaeris glabra	0.	<1
Lysimachia arvensis	0.1	<1
Muehlenbeckia adpressa	1	<1
Petrorhagia dubia	0.3	2
Podotheca gnaphalioides	0.2	<1
Rhagodia preissii subsp. *obovata*	1.5	5
Sonchus oleraceus	0.8	<1
Trymalium ledifolium	1	<1
Vulpia myuros	0.2	5

D20R13

Staff LJA **Date** 15/10/2020 **Season**

Revisit

Type R

Location

MGA Zone 50 310274 **mE** 6733629 **mN** **Lat.** -29.5126 **Long.** 115.0426

Habitat Upper-Slope

Aspect E **Slope** Gentle

Soil Type Dark grey sand

Rock Type Limestone

Loose Rock 20-50 % cover **Litter** 60 % cover

Bare ground 35 % cover **Weeds** 30 % cover

Vegetation U ^*Eucalyptus erythrocorys*\^tree\6\bi;M+ ^*Melaleuca cardiophylla*\^shrub\4\c;G ^^*Lysimachia arvensis*,*Ehrharta longiflora*,*Hypochaeris glabra*\^forb,other grass\1\c

Veg. Condition Very Good

Disturbance Possibly grazed

Fire Age

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
Austrostipa elegantissima		1	<1	
Calandrinia sp. Shark Bay (A. Markey 1405)		0.1	<1	
Dioscorea hastifolia		0.2	<1	
**Ehrharta longiflora*		0.2	5	
Eucalyptus erythrocorys		6	<1	

**Hypochaeris glabra*	0.2	2
**Lysimachia arvensis*	0.2	10
Melaleuca cardiophylla	4	40
Melaleuca trichophylla	0.4	<1
Millotia tenuifolia		<1
**Reichardia tingitana*	0.3	<1
**Sonchus oleraceus*	0.3	<1
**Trifolium campestre*	0.2	<1

D20R14

Staff LJA **Date** 15/10/2020 **Season**

Revisit

Type R

Location

MGA Zone 50 310223 **mE** 6733641 **mN** **Lat.** -29.5124 **Long.** 115.0420

Habitat Upper-Slope

Aspect S **Slope** Gentle

Soil Type Orange sand

Rock Type Limestone

Loose Rock 2-10 % cover **Litter** 5 % cover

Bare ground 60 % cover **Weeds** 2 % cover

Vegetation M+ ^^*Melaleuca cardiophylla*,*Melaleuca huegelii, Labichea cassioides*\^shrub\4\c;G ^^*Desmocladus asper*,*Conostylis prolifera*,*Scholtzia umbellifera*\^rush,forb,heath shrub\1\c

Veg. Condition Excellent

Disturbance Fire

Fire Age

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
Austrostipa flavescens		0.7	<1	
Conostylis prolifera		0.2	5	
Desmocladus asper		0.1	20	
Dioscorea hastifolia		0.2	<1	
Gompholobium tomentosum		0.3	<1	

Grevillea preissii subsp. *glabrilimba*	0.5	<1
Hakea lissocarpha	0.5	<1
Hibbertia hypericoides subsp. *septentrionalis*	0.3	<1
Labichea cassioides	1.5	2
Leucopogon insularis	1	<1
**Lysimachia arvensis*	0.1	<1
Macrozamia fraseri	0.3	<1
Melaleuca cardiophylla	2.5	25
Melaleuca huegelii	2.5	5
Melaleuca trichophylla	0.6	<1
Scholtzia umbellifera	0.4	2
Trachymene pilosa	0.1	<1
**Vulpia myuros*	0.1	

D20R15

Staff LJA **Date** 16/10/2020 **Season** A

Revisit

Type R

Location

MGA Zone 50 309198 **mE** 6735991 **mN** **Lat.** -29.4911 **Long.** 115.0319

Habitat Upper-Slope

Aspect N/A **Slope** N/A

Soil Type Grey pink sand

Rock Type Limestone

Loose Rock <2 % cover **Litter** 40 % cover

Bare ground 30 % cover **Weeds** 30 % cover

Vegetation U+ ^*Eucalyptus erythrocorys*,^*Acacia rostellifera*\^tree\6\i;M ^^*Olearia axillaris*,*Diplolaena leemaniana*,*Hibbertia subvaginata*\^shrub\4\c;G ^^*Avena barbata*,*Brassica tournefortii*,*Ehrharta longiflora*\^other grass,forb\1\i

Veg. Condition Very Good

Disturbance Weedy but doesn't seem to have been cleared or deliberately grazed

Fire Age

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia rostellifera		4	8	
Alyogyne huegelii		0.5	<1	
**Avena barbata*		0.5	2	
**Brassica tournefortii*		0.5	2	

*Briza maxima	0.2	<1
*Bromus diandrus	0.2	<1
Clematicissus angustissima	0.3	<1
Commersonia borealis	0.5	<1
Conostylis prolifera	0.1	1
Crassula colorata var. *colorata*	0.1	<1
Cuscuta planiflora	0.1	<1
Diplolaena leemaniana	1.3	8
Ehrharta longiflora	0.3	2
Eucalyptus erythrocorys	5	10
Hibbertia subvaginata	1	8
Hypochaeris glabra	0.2	<1
Melaleuca cardiophylla	1.3	<1
Melaleuca trichophylla	0.5	<1
Olearia axillaris	2.5	8
Opercularia spermacocea	0.1	<1
Petrorhagia dubia	0.2	2
Phyllanthus calycinus	0.6	<1
Quoya loxocarpa	0.7	<1
Silene gallica	0.2	<1
Stellaria media	0.1	<1
Stylidium elongatum	0.4	<1
Trifolium arvense	0.1	<1
Trifolium campestre	0.1	<1
Trymalium ledifolium	0,8	<1
Ursinia anthemoides	0.2	<1
Waitzia suaveolens var. *suaveolens*	0.2	<1

APPENDIX FIVE DBCA REPORT FORMS

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Threatened and Priority Flora Report Form

Version 1.4 March 2021

Please complete as much of the form as possible, with emphasis on those sections bordered in black. For information on how to complete the form please refer to the Threatened & Priority Flora Report Form (TPRF) manual on the DBCA website at www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/threatened-plants

TAXON: Anthocercis intricata **TPFL Pop. No:**

OBSERVATION DATE: 13/10/2020 **CONSERVATION STATUS:** P3 **New population** ☐

OBSERVER/S: Lyn Atkins **PHONE** 9430 8955

ROLE: Principal Ecologist/Botanist **ORGANISATION:** Ecoscape

EMAIL: lyna@ecoscape.com.au

DESCRIPTION OF LOCATION (Provide at least nearest town/named locality, and the distance and direction to that place)**:**

Near the corner of Brand Highway and Indian Ocean Drive, Arrowsmith

Reserve No:

DBCA DISTRICT: Moora **LGA:** Irwin Land manager present: ☐

DATUM:
GDA94 / MGA94 x
AGD84 / AMG84 ☐
WGS84 ☐
Unknown ☐

COORDINATES: (If UTM coords provided, **Zone** is also required)
DecDegrees x DegMinSec ☐ UTMs ☐

Lat / Northing: **6737213.822**

Long / Easting: **307965.139**

ZONE: **50**

METHOD USED:
GPS x Differential GPS ☐ Map ☐

No. satellites: ____ Map used: _____

Boundary polygon captured: ☐ Map scale: _____

LAND TENURE:

Nature reserve ☐	Timber reserve ☐	Private property x	Rail reserve ☐	Shire road reserve ☐
National park ☐	State forest ☐	Pastoral lease ☐	MRWA road reserve ☐	Other Crown reserve ☐
Conservation park ☐	Water reserve ☐	UCL ☐	SLK/Pole _____ to _____	Specify other: _____

AREA ASSESSMENT: Edge survey ☐ Partial survey ☐ Full survey ☐ Area observed (m²): _____

EFFORT: Time spent surveying (minutes): _____ No. of minutes spent / 100 m²: _____

POP'N COUNT ACCURACY: Actual ☐ Extrapolation ☐ Estimate ☐ Count method: _____
(Refer to field manual for list)

WHAT COUNTED: Plants ☐ Clumps ☐ Clonal stems ☐

TOTAL POP'N STRUCTURE:	**Mature:**	**Juveniles:**	**Seedlings:**	**Totals:**
Alive				
Dead				

Area of pop (m²): _____

Note: Pls record count as numbers (not percentages) for database.

QUADRATS PRESENT: No. ___ Size _____ Data attached ☐ Total area of quadrats (m²): _____

Summary Quad. Totals: Alive				

REPRODUCTIVE STATE: Clonal ☐ Vegetative ☐ Flowerbud ☐ Flower ☐
Immature fruit ☐ Fruit ☐ Dehisced fruit ☐ Percentage in flower: _____%

CONDITION OF PLANTS: Healthy ☐ Moderate x Poor ☐ Senescent ☐

COMMENT:

THREATS - type, agent and supporting information: Eg clearing, too frequent fire, weed, disease. Refer to field manual for list of threats & agents. **Specify agent** where relevant. Rate current and potential threat impact: N=Nil, L=Low, M=Medium, H=High, E=Extreme Estimate time to potential impact: S=Short (<12mths), M=Medium (<5yrs), L=Long (5yrs+)	**Current impact (N-E)**	**Potential Impact (L-E)**	**Potential Threat Onset (S-L)**
•			
•			
•			

Please return completed form to **Species And Communities Program** DBCA,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983 **OR** email to: flora.data@dbca.wa.gov.au

RECORDS: Please forward to **Flora Administrative Officer,** Species and Communities Program.

Record entered by:_____ **Sheet No.:**_____ **Record Entered in Database** ❑

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Threatened and Priority Flora Report Form

Version 1.4 March 2021

HABITAT INFORMATION:

LANDFORM:
Crest ☐
Hill ☐
Ridge ☐
Outcrop ☐
Slope ☐
Flat x
Open depression ☐
Drainage line ☐
Closed depression ☐
Wetland ☐

ROCK TYPE:
Granite ☐
Dolerite ☐
Laterite ☐
Ironstone ☐
Limestone x
Quartz ☐
Specify other: _____

LOOSE ROCK:
(on soil surface; eg gravel, quartz fields)
0-10% ☐
10-30% ☐
30-50% ☐
50-100% ☐

SOIL TYPE:
Sand x
Sandy loam ☐
Loam ☐
Clay loam ☐
Light clay ☐
Peat ☐
Specify other: _____

SOIL COLOUR:
Red ☐
Brown ☐
Yellow ☐
White ☐
Grey x
Black ☐
Specify other: _____

DRAINAGE:
Well drained x
Seasonally inundated ☐
Permanently inundated ☐
Tidal ☐

Specific **Landform** Element: _____
(Refer to field manual for additional values)

CONDITION OF SOIL: Dry x Moist ☐ Waterlogged ☐ Inundated ☐

VEGETATION CLASSIFICATION*:

Eg: **1**. Banksia woodland (B. attenuata, B. ilicifolia); **2**. Open shrubland (Hibbertia sp., Acacia spp.) ; **3**. Isolated clumps of sedges (M.tetragona)

1. *Eucalyptus oraria* and *Eucalyptus erythrocorys* isolated clumps of low trees/mallee shrubs
2. *Melaleuca cardiophylla*, *Acacia rostellifera* and *Grevillea argyrophylla* tall shrubland
3. *Beyeria cinerea* subsp. *cinerea*, *Acanthocarpus canaliculatus* and *Diplolaena leemaniana* low open shrubland
4.

ASSOCIATED SPECIES:

Other (non-dominant) spp

Alyogyne hakeifolia, Anthocercis intricata, Austrostipa flavescens, *Avellinia michelii, *Avena barbata, *Brassica tournefortii, Calandrinia sp. Shark Bay (A. Markey 1405), Commersonia borealis, Conostylis prolifera, Desmocladus asper, Dioscorea hastifolia, *Ehrharta longiflora, *Erodium botrys, Guichenotia ledifolia, Hibbertia subvaginata, *Hypochaeris glabra, Labichea cassioides, *Lysimachia arvensis, Melaleuca huegelii, Melaleuca trichophylla, Olearia axillaris, *Reichardia tingitana, Scholtzia umbellifera, Trachymene pilosa, *Trifolium campestre, *Vulpia myuros, Waitzia suaveolens var. suaveolens

* Please record up to four of the most representative vegetation layers (with up to three dominant species in each layer). Structural Formations should follow 2009 *Australian Soil and Land Survey Field Handbook* guidelines – refer to field manual for further information and structural formation table.

CONDITION OF HABITAT: Pristine ☐ Excellent ☐ Very good x Good ☐ Degraded ☐ Completely degraded ☐

COMMENT: _____

FIRE HISTORY: **Last Fire:** Season/Month: _____ Year: _____ **Fire Intensity:** High ☐ Medium ☐ Low ☐ No signs of fire x

FENCING: Not required x Present ☐ Replace / repair ☐ Required ☐ Length req'd: _____

ROADSIDE MARKERS: Not required x Present ☐ Replace / reposition ☐ Required ☐ Quantity req'd: _____

OTHER COMMENTS: (Please include recommended management actions and/or implemented actions - include date. Also include details of additional data available, and how to locate it.)

Other locations:

308149.066 mE, 6737595.779 mN

307753.276 mE, 6736724.51 mN

307869.762 mE, 6736844.789 mN

FLORA AUTHORISATION / LICENCE No: FB62000003 Note if only observing plants (i.e. no specimens or plant matieral is taken) then no authorisation/licence is required. For further information on authorisation and licening requirements see the Threatened Flora and Wildlife Licensing pages on DBCA's website. Any actions carried out under authorisations/licences should be recorded above in the OTHER COMMENTS section.

SPECIMEN: Collectors No: _____ WA Herb. ☐ Regional Herb. ☐ District Herb. ☐ Other: _____

LODGEMENT: WA Herb Lodgement No: Not lodged – likely known population

ATTACHED: Map ☐ Mudmap ☐ Photo ☐ GIS data ☐ Field notes ☐ Other: _____

COPY SENT TO: Regional Office ☐ District Office ☐ Other: _____

Submitter of Record: Lyn Atkins Role: Principal Ecologist Signed: LA Date: 01/10/2021

Please return completed form to **Species And Communities Program** DBCA,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983 **OR** email to: flora.data@dbca.wa.gov.au

RECORDS: Please forward to **Flora Administrative Officer,** Species and Communities Program.

Record entered by:_____ **Sheet No.:**_____ **Record Entered in Database** ❑

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Threatened and Priority Flora Report Form

Version 1.4 March 2021

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TAXON: Beyeria cinerea subsp. cinerea **TPFL Pop. No:**

OBSERVATION DATE: 13/10/2020 **CONSERVATION STATUS:** P3 **New population** ☐

OBSERVER/S: Lyn Atkins **PHONE** 9430 8955

ROLE: Principal Ecologist/Botanist **ORGANISATION:** Ecoscape

EMAIL: lyna@ecoscape.com.au

DESCRIPTION OF LOCATION (Provide at least nearest town/named locality, and the distance and direction to that place)**:**

Near the corner of Brand Highway and Indian Ocean Drive, Arrowsmith

Reserve No:

DBCA DISTRICT: Moora **LGA:** Irwin Land manager present: ☐

DATUM:
GDA94 / MGA94 x
AGD84 / AMG84 ☐
WGS84 ☐
Unknown ☐

COORDINATES: (If UTM coords provided, **Zone** is also required)
DecDegrees x DegMinSec ☐ UTMs ☐

Lat / Northing: 6737213.822

Long / Easting: 307965.139

ZONE: 50

METHOD USED:
GPS x Differential GPS ☐ Map ☐

No. satellites: ____ Map used: _____

Boundary polygon captured: ☐ Map scale: _____

LAND TENURE:

Nature reserve ☐	Timber reserve ☐	Private property x	Rail reserve ☐	Shire road reserve ☐
National park ☐	State forest ☐	Pastoral lease ☐	MRWA road reserve ☐	Other Crown reserve ☐
Conservation park ☐	Water reserve ☐	UCL ☐	SLK/Pole _____ to _____	Specify other: _____

AREA ASSESSMENT: Edge survey ☐ Partial survey ☐ Full survey ☐ Area observed (m²): _____

EFFORT: Time spent surveying (minutes): _____ No. of minutes spent / 100 m²: _____

POP'N COUNT ACCURACY: Actual ☐ Extrapolation ☐ Estimate ☐ Count method: _____ (Refer to field manual for list)

WHAT COUNTED: Plants ☐ Clumps ☐ Clonal stems ☐

TOTAL POP'N STRUCTURE:	**Mature:**	**Juveniles:**	**Seedlings:**	**Totals:**
Alive				
Dead				

Area of pop (m²): _____

Note: Pls record count as numbers (not percentages) for database.

QUADRATS PRESENT: No. ___ Size _____ Data attached ☐ Total area of quadrats (m²): _____

Summary Quad. Totals: Alive				

REPRODUCTIVE STATE: Clonal ☐ Vegetative ☐ Flowerbud ☐ Flower ☐
Immature fruit ☐ Fruit ☐ Dehisced fruit ☐ Percentage in flower: _____%

CONDITION OF PLANTS: Healthy ☐ Moderate x Poor ☐ Senescent ☐

COMMENT:

THREATS - type, agent and supporting information: Eg clearing, too frequent fire, weed, disease. Refer to field manual for list of threats & agents. **Specify agent** where relevant. Rate current and potential threat impact: N=Nil, L=Low, M=Medium, H=High, E=Extreme Estimate time to potential impact: S=Short (<12mths), M=Medium (<5yrs), L=Long (5yrs+)	**Current impact (N-E)**	**Potential Impact (L-E)**	**Potential Threat Onset (S-L)**
•			
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Please return completed form to **Species And Communities Program** DBCA,
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RECORDS: Please forward to **Flora Administrative Officer,** Species and Communities Program.

Record entered by:_____ **Sheet No.:**_____ **Record Entered in Database** ❑

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Threatened and Priority Flora Report Form

Version 1.4 March 2021

HABITAT INFORMATION:

LANDFORM:
Crest ☐
Hill ☐
Ridge ☐
Outcrop ☐
Slope ☐
Flat x
Open depression ☐
Drainage line ☐
Closed depression ☐
Wetland ☐

ROCK TYPE:
Granite ☐
Dolerite ☐
Laterite ☐
Ironstone ☐
Limestone x
Quartz ☐
Specify other: _____

LOOSE ROCK:
(on soil surface; eg gravel, quartz fields)
0-10% ☐
10-30% ☐
30-50% ☐
50-100% ☐

SOIL TYPE:
Sand x
Sandy loam ☐
Loam ☐
Clay loam ☐
Light clay ☐
Peat ☐
Specify other: _____

SOIL COLOUR:
Red ☐
Brown ☐
Yellow ☐
White ☐
Grey x
Black ☐
Specify other: _____

DRAINAGE:
Well drained x
Seasonally inundated ☐
Permanently inundated ☐
Tidal ☐

Specific **Landform** Element: _____
(Refer to field manual for additional values)

CONDITION OF SOIL: Dry x Moist ☐ Waterlogged ☐ Inundated ☐

VEGETATION CLASSIFICATION*:

Eg: **1**. Banksia woodland (B. attenuata, B. ilicifolia); **2**. Open shrubland (Hibbertia sp., Acacia spp.) ; **3**. Isolated clumps of sedges (M.tetragona)

1. *Eucalyptus oraria* and *Eucalyptus erythrocorys* isolated clumps of low trees/mallee shrubs
2. *Melaleuca cardiophylla*, *Acacia rostellifera* and *Grevillea argyrophylla* tall shrubland
3. *Beyeria cinerea* subsp. *cinerea*, *Acanthocarpus canaliculatus* and *Diplolaena leemaniana* low open shrubland
4.

ASSOCIATED SPECIES:

Other (non-dominant) spp

Alyogyne hakeifolia, Anthocercis intricata, Austrostipa flavescens, *Avellinia michelii, *Avena barbata, *Brassica tournefortii, Calandrinia sp. Shark Bay (A. Markey 1405), Commersonia borealis, Conostylis prolifera, Desmocladus asper, Dioscorea hastifolia, *Ehrharta longiflora, *Erodium botrys, Guichenotia ledifolia, Hibbertia subvaginata, *Hypochaeris glabra, Labichea cassioides, *Lysimachia arvensis, Melaleuca huegelii, Melaleuca trichophylla, Olearia axillaris, *Reichardia tingitana, Scholtzia umbellifera, Trachymene pilosa, *Trifolium campestre, *Vulpia myuros, Waitzia suaveolens var. suaveolens

* Please record up to four of the most representative vegetation layers (with up to three dominant species in each layer). Structural Formations should follow 2009 *Australian Soil and Land Survey Field Handbook* guidelines – refer to field manual for further information and structural formation table.

CONDITION OF HABITAT: Pristine ☐ Excellent ☐ Very good x Good ☐ Degraded ☐ Completely degraded ☐

COMMENT: _____

FIRE HISTORY: **Last Fire:** Season/Month: _____ Year: _____ **Fire Intensity:** High ☐ Medium ☐ Low ☐ No signs of fire x

FENCING: Not required x Present ☐ Replace / repair ☐ Required ☐ Length req'd: _____

ROADSIDE MARKERS: Not required x Present ☐ Replace / reposition ☐ Required ☐ Quantity req'd: _____

OTHER COMMENTS: (Please include recommended management actions and/or implemented actions - include date. Also include details of additional data available, and how to locate it.)

Dominant ground stratum species in vegetation type

FLORA AUTHORISATION / LICENCE No: FB62000003 Note if only observing plants (i.e. no specimens or plant matieral is taken) then no authorisation/licence is required. For further information on authorisation and licening requirements see the Threatened Flora and Wildlife Licensing pages on DBCA's website. Any actions carried out under authorisations/licences should be recorded above in the OTHER COMMENTS section.

SPECIMEN: Collectors No: _____ WA Herb. ☐ Regional Herb. ☐ District Herb. ☐ Other: _____

LODGEMENT: WA Herb Lodgement No: Not lodged – likely known population

ATTACHED: Map ☐ Mudmap ☐ Photo ☐ GIS data ☐ Field notes ☐ Other: _____

COPY SENT TO: Regional Office ☐ District Office ☐ Other: _____

Submitter of Record: Lyn Atkins Role: Principal Ecologist Signed: LA Date: 01/10/2021

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GOVERNMENT OF WESTERN AUSTRALIA

Threatened and Priority Flora Report Form

Version 1.4 March 2021

Please complete as much of the form as possible, with emphasis on those sections bordered in black. For information on how to complete the form please refer to the Threatened & Priority Flora Report Form (TPRF) manual on the DBCA website at www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/threatened-plants

TAXON: Eucalyptus zopherophloia **TPFL Pop. No:**

OBSERVATION DATE: 13/10/2020 **CONSERVATION STATUS:** P4 **New population** ☐

OBSERVER/S: Lyn Atkins **PHONE** 9430 8955

ROLE: Principal Ecologist/Botanist **ORGANISATION:** Ecoscape

EMAIL: lyna@ecoscape.com.au

DESCRIPTION OF LOCATION (Provide at least nearest town/named locality, and the distance and direction to that place)**:**

Near the corner of Brand Highway and Indian Ocean Drive, Arrowsmith

Reserve No:

DBCA DISTRICT: Moora **LGA:** Irwin Land manager present: ☐

DATUM:
GDA94 / MGA94 x
AGD84 / AMG84 ☐
WGS84 ☐
Unknown ☐

COORDINATES: (If UTM coords provided, **Zone** is also required)
DecDegrees x DegMinSec ☐ UTMs ☐

Lat / Northing: **6736602.292**

Long / Easting: **307627.125**

ZONE: **50**

METHOD USED:
GPS x Differential GPS ☐ Map ☐

No. satellites: ____ Map used: _____

Boundary polygon captured: ☐ Map scale: _____

LAND TENURE:

Nature reserve ☐	Timber reserve ☐	Private property x	Rail reserve ☐	Shire road reserve ☐
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AREA ASSESSMENT: Edge survey ☐ Partial survey ☐ Full survey ☐ Area observed (m²): _____

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OTHER COMMENTS: (Please include recommended management actions and/or implemented actions - include date. Also include details of additional data available, and how to locate it.)

Other locations:

307621.434 mE, 6736623.149 mN
307595.08 mE, 6736621.369 mN
307878.807 mE, 6737111.132 mN
308014.278 mE, 6737239.16 mN
310189.956 mE, 6736687.388 mN

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