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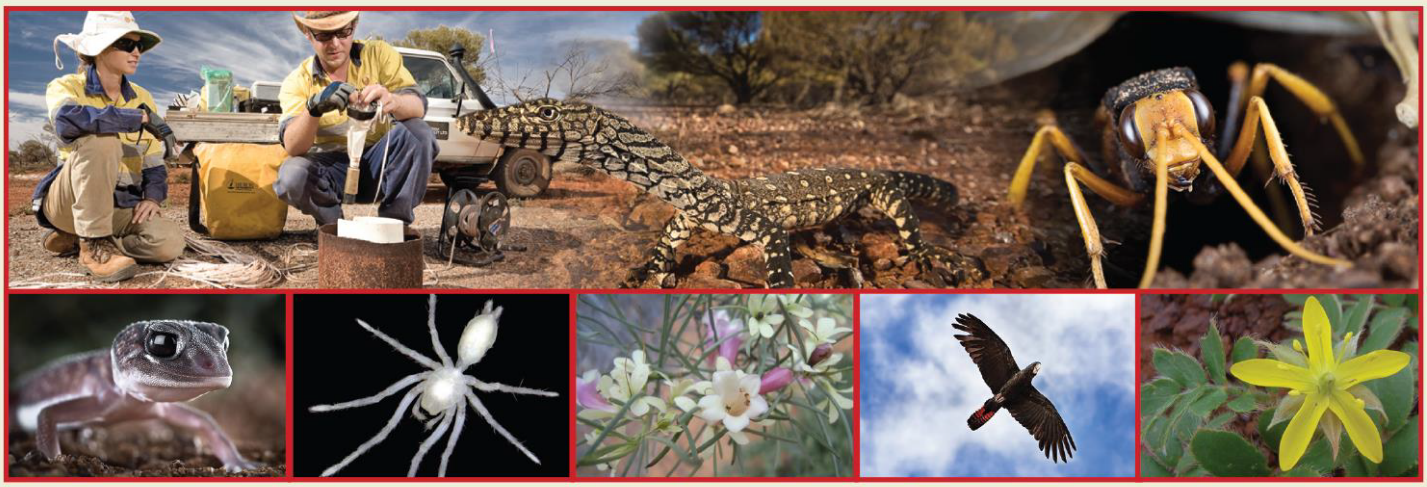
Flora and vegetation survey and terrestrial fauna survey for the Pilbara Regional Waste Management Facility

Prepared for Talis Consultants

September 2017

Final Report



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Prepared for Talis Consultants

Final Report

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EXECUTIVE SUMMARY

The Shire of Ashburton (the Shire) is seeking approval to develop the Pilbara Regional Waste Manaagement Facility (the Project), located within Lot 150 Onslow Road, Thalanyji, approximately 32 kilometres (km) southeast of Onslow in the Carnarvon bioregion. In September 2017, Phoenix Environmental Sciences Pty Ltd (Phoenix) was commissioned by Talis Consultants (Talis), on behalf of the Shire to undertake an ecological survey of the 422.2 hectares (ha) site (the Study Area) to inform a native vegetation clearing permit application for the Project.

The survey was undertaken on 14–15 September 2017 and included:

- A desktop review to identify significant flora, fauna and ecological communities that may occur In the Study Area;
- Single season reconniassance flora and vegetation survey; and
- Level 1 targeted terrestrial fauna survey.

The desktop review included searches of relevant biological databases and a literature review. Field methods for flora and vegetation comprised surveying of relevés, targeted flora searches and vegetation association and condition mapping. Survey methods for fauna included active searches, avifauna surveys, bat echolocation and Night Parrot (*Pezoporus occidentalis*) call recordings and targeted Bilby (*Macrotis lagotis*) survey plots.

Four vegetation types were mapped in Study Area. The Study Area was mainly represented by a *Triodia basedowii* grassland with isolated *Corymbia hamersleyana* and/or *C. zygophylla* mallee on flat plain (86% of the Study Area). Two low open shrublands over *Triodia basedowii* and *T. epactia* grassland (with isolated tall *Grevillea stenobotrya* shrubs) were present and an open *Corymbia zygophylla* mallee woodland was found on a longitudinal inland sand dune top within small swales.

The vegetation of the Study Area does not align with any Commonwealth or State listed Threatened Ecological Communities (TECs) or state listed Priority Ecological Communities (PECs).

A total of 45 flora species and subspecies representing 17 families and 32 genera were recorded. The most prominent families were Fabaceae, Poaceae, Malvaceae and Amaranthaceae. One introduced species, **Cenchrus ciliaris*, was recorded. Species richness ranged from 7-18 species between sites.

No Commonwealth or State listed Threatened flora were recorded during the survey. Two Priority flora were recorded: *Abutilon* sp. Pritzelianum (P1) and *Triumfetta echinata* (P3). Based on habitats present, a further three conservation significant flora may occur in the Study Area: *Abutilon* sp. Onslow (P1), *Eremophila forrestii* subsp. *viridis* (P3) and *Goodenia nuda* (P4).

The Study Area was delineated into two broad fauna habitats: mosaic of hummock grassland and shrubland on plain (representing 86%); and shrubland on sand dune (14%).

Seventeen vertebrate fauna species were recorded in the field survey comprising two reptiles, ten birds and five mammals (three native and two introduced, Cat and Red Fox). No Threatened or Priority fauna were recorded; the State listed Migratory species, Rainbow Bee-eater (*Merops ornatus*), was observed in the shrubland on sand dune habitat. Based on habitats present, a further eight significant species may occur in the Study Area:

- *Lerista planiventralis maryani*, Maryan's Keeled Slider (P1);
- *Apus pacificus*, Fork-tailed Swift (Migratory);

- *Falco peregrinus*, Peregrine Falcon (Specially Protected under *Wildlife Conservation Act 1950* (WC Act));
- *Pezoporus occidentalis*, Night Parrot (Endangered under Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act), Critically Endangered under WC Act), although it is noted that the species was not detected through the acoustic recordings;
- *Falco hypoleucos*, Grey Falcon (Vulnerable under WC Act);
- *Leggadina lakedownensis*, Short-tailed Mouse (P4); and
- *Pseudomys chapmani*, Western Pebble-mound Mouse (P4).

Most of these species are likely to occur only as occasional visitors to the Study Area. The habitats of the Study Area provide low potential for short range endemic invertebrates (SREs) to be present.

1 INTRODUCTION

The Shire of Ashburton (the Shire) is seeking approval to develop the Pilbara Regional Waste Management Facility (the Project), located within Lot 150 Onslow Road, Thalanyi, approximately 32 km southeast of Onslow (Figure 1-1). In September 2017, Phoenix Environmental Sciences Pty Ltd (Phoenix) was commissioned by Talis Consultants (Talis), on behalf of the Shire to undertake a flora and vegetation survey and terrestrial fauna survey for the Project.

As part of the potential development of the Project, a range of intrusive hydrogeological and geotechnical investigations are required which will necessarily require some impact to and removal of native vegetation. The disturbance to the vegetation will include access tracks, boreholes and trial pits. To allow such works to occur, Talis is of the view that a native vegetation clearing permit (NVCP) will be required and, as such, the need for an ecological survey be undertaken to support the application for the NVCP was determined.

1.1 SURVEY OBJECTIVE AND SCOPE

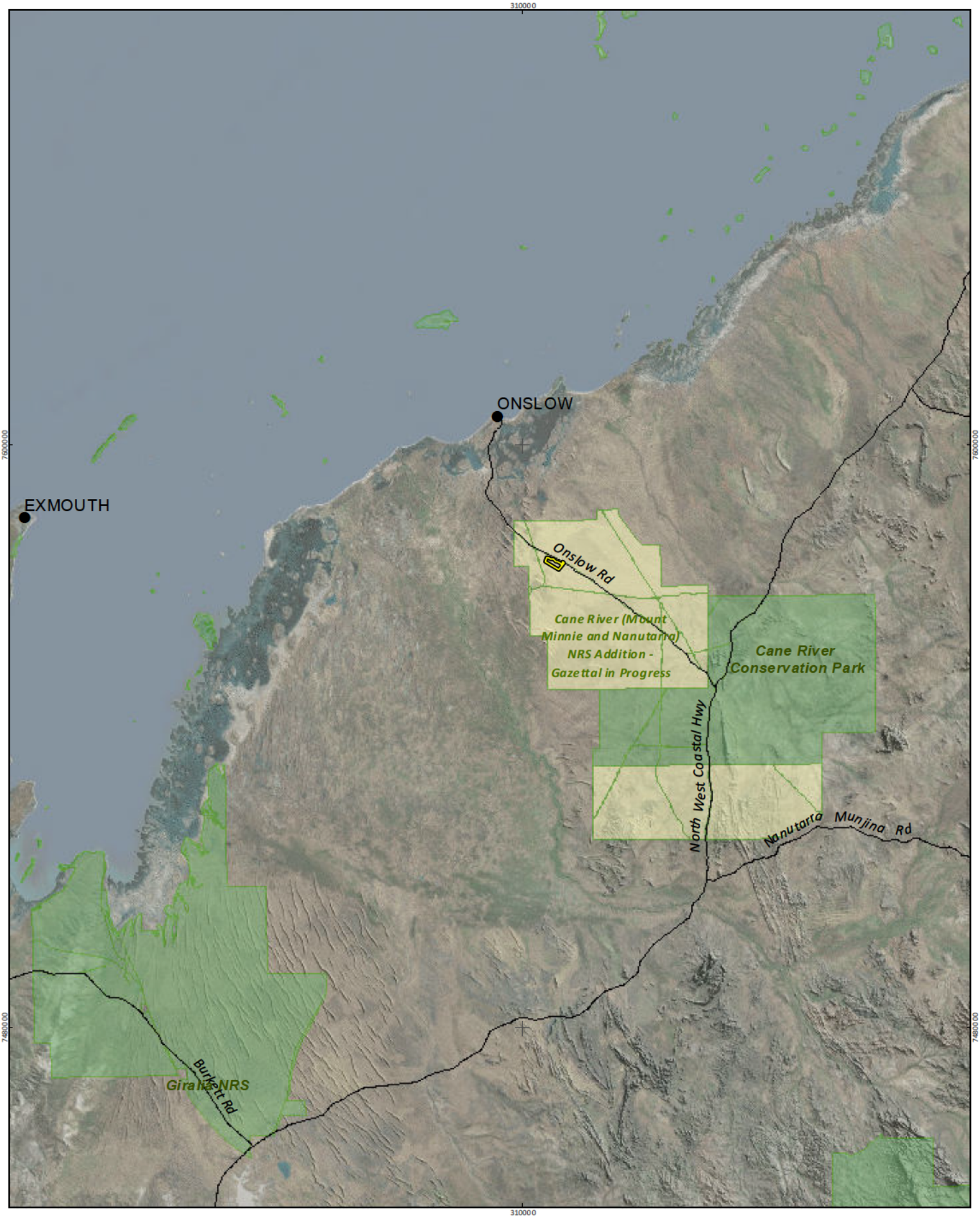
The objective of the survey was to:

- Conduct a desktop review of all existing flora and vegetation and terrestrial fauna information to identify conservation significant flora, fauna and communities that may occur in the Study Area;
- Field survey in the Study Area to verify / ground truth the desktop assessment findings comprising:
    - Single season reconnaissance flora and vegetation survey;
    - Level 1 targeted terrestrial vertebrate fauna survey; and
- Preparation of a succinct technical report detailing the findings of the survey.

Preliminary desktop review of habitat suitability for short range endemic invertebrates (SREs) identified low potential for SREs to be present in the Study Area. The fauna survey was therefore focussed on vertebrate fauna.

1.2 STUDY AREA

The Study Area was 422.2 hectares (ha) in size, consisting of a large rectangular polygon parallel to the Onslow Road with a narrow corridor connecting the two (Figure 1-1).



Talis Consultants

Pilbara Regional Waste Management Facility

Project No	1174
Date	27/09/2017
Drawn by	AL
Map author	KC

0 10 20 40

Kilometres

1:1,000,000(at A4) GDA 1994 MGA Zone 50

Study Area

Australian Protected Areas Database (CAPAD)

Gazettal in Progress:

Cane River (Mount Minnie and Nanutarra) NRS Addition

Figure 1-1

Project location and study area

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2 LEGISLATIVE CONTEXT

The protection of flora and fauna in Western Australia (WA) is principally governed by three acts:

- *Commonwealth Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act);
- *Western Australian Wildlife Conservation Act 1950* (WC Act); and
- *Western Australian Environmental Protection Act 1986* (EP Act).

2.1 COMMONWEALTH

The EPBC Act is administered by the Federal Department of the Environment and Energy (DotEE). Under the EPBC Act, actions that have, or are likely to have, a significant impact on a Matter of National Environmental Significance (NES), require approval from the Australian Government Minister for the Environment through a formal referral process. The EPBC Act provides for the listing of threatened native flora, fauna and threatened ecological communities (TECs) as matters of NES.

Conservation categories applicable to Threatened Flora and Threatened Fauna species under the EPBC Act are as follows:

- Extinct (EX)[1] – there is no reasonable doubt that the last individual has died;
- Extinct in the Wild (EW) – taxa known to survive only in captivity;
- Critically Endangered (CR) – taxa facing an extremely high risk of extinction in the wild in the immediate future;
- Endangered (EN) – taxa facing a very high risk of extinction in the wild in the near future;
- Vulnerable (VU) – taxa facing a high risk of extinction in the wild in the medium-term;
- Conservation Dependent (CD)[1] – taxa whose survival depends upon ongoing conservation measures; without these measures, a conservation dependent taxon would be classified as; and
- Vulnerable or more severely threatened.

Ecological communities are defined as 'naturally occurring biological assemblages that occur in a particular type of habitat' (English & Blyth 1997). There are three categories under which ecological communities can be listed as TECs under the EPBC Act: Critically Endangered, Endangered and Vulnerable.

The EPBC Act is also the enabling legislation for protection of migratory species as matters of NES under a number of international agreements:

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

[1] Species listed as Extinct and Conservation Dependent are not matters of NES and therefore do not trigger the EPBC Act.

2.2 STATE

2.2.1 Threatened and Priority species

In WA, the WC Act provides for the listing of flora and fauna species which are under identifiable threat of extinction as specially protected (threatened species). Threatened flora listed under the WC Act receive statutory protection and, under current classifications (Western Australian Government 2017a), are assigned to one of four categories (under four schedules in the act):

- Schedule 1 (S1) – flora that are considered likely to become extinct or rare as critically endangered (CR) flora;
- Schedule 2 (S2) – flora that are considered likely to become extinct or rare as endangered (EN) flora;
- Schedule 3 (S3) – flora that are considered likely to become extinct or rare as vulnerable (VU) flora; and
- Schedule 4 (S4) – flora presumed to be extinct (EX).

Under current classifications, protected fauna are assigned to one of seven categories under the WC Act (Western Australian Government 2017b):

- Schedule 1 (S1) – fauna that is rare or is likely to become extinct as critically endangered (CR) fauna;
- Schedule 2 (S2) – fauna that is rare or is likely to become extinct as endangered (EN) fauna;
- Schedule 3 (S3) – fauna that is rare or is likely to become extinct as vulnerable (VU) fauna;
- Schedule 4 (S4) – fauna presumed to be extinct (EX);
- Schedule 5 (S5) – Migratory birds protected under an international agreement (Mig.);
- Schedule 6 (S6) – fauna that is of special conservation need (SC) as conservation dependent fauna; and
- Schedule 7 (S7) – other specially protected (SP) fauna.

Threatened fauna species are listed under schedules 1-4. Assessments for listing of both flora and fauna are based on the International Union for Conservation of Nature threat categories.

The Department of Biodiversity Conservation and Attractions (DBCA; formerly Department of Parks and Wildlife (DPaW)) administers the WC Act and also maintains a non-statutory list of Priority Flora and Priority Fauna species (updated each year). Priority species are still considered to be of conservation significance – that is they may be rare or threatened – but cannot be considered for listing under the WC Act until there is adequate understanding of threat levels imposed on them. Species on the Priority Flora and Fauna lists are assigned to one of five priority (P) categories, P1 (highest) – P4 (lowest), based on level of knowledge/concern.

2.2.2 Threatened and Priority Ecological Communities

The Minister for Environment may list ecological communities, which are at risk of becoming destroyed as 'Threatened'. DBCA maintains a list of ministerial-endorsed TECs which fall into three categories:

- Critically endangered (CR);

- Endangered (EN); and
- Vulnerable (VU).

There is an additional category, Presumed Totally Destroyed, where all records of the ecological community within the last 50 years have been destroyed or presumed to be destroyed.

The DBCA also maintains a non-statutory list of Priority Ecological Communities (PECs), which may become TECs in the future, however currently that do not meet survey criteria or that are not adequately defined. PECs are assigned to one of five categories depending on their priority for survey or definition, with Priority 1 of highest concern and Priority 5 of lowest concern.

2.2.3 Significant flora and vegetation

Flora and vegetation may be considered significant for a range of reasons, including, but not limited to the following (EPA 2016d):

- Flora:
    - being identified as threatened or priority species;
    - locally endemic or association with a restricted habitat type (e.g. surface water or groundwater dependent ecosystems);
    - new species or anomalous features that indicate a potential new species representative of the range of a species (particularly, at the extremes of range recently discovered range extensions, or isolated outliers of the main range);
    - unusual species, including restricted subspecies, varieties or naturally occurring hybrids; and
    - relictual status, being representative of taxonomic groups that no longer occur widely in the broader landscape.
- Vegetation:
    - being identified as threatened or priority ecological communities;
    - restricted distribution;
    - degree of historical impact from threatening processes;
    - a role as a refuge; and
    - providing an important function required to maintain ecological integrity of a significant ecosystem.

2.2.4 Clearing of native vegetation

The clearing of native vegetation in WA is not generally permitted where the biodiversity values, land conservation and water protection roles of native vegetation would be significantly affected. Any clearing of native vegetation in WA requires a permit under Part V Division 2 of the EP Act, except where an exemption applies under the Act, or is prescribed by the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* (the Regulations), and the vegetation is not in an Environmentally Sensitive Area (ESA). Permit applications to clear native vegetation require assessment against the '10 Clearing Principles', as outlined in the regulations.

2.2.5 Environmentally Sensitive Areas

Under section 51B of the EP Act the Minister for Environment may declare by notice either a specified area of the State or a class of areas of the State to be Environmentally Sensitive Areas (ESAs). ESAs are declared in the *Environmental Protection (Environmentally Sensitive Areas) Notice 2005*, which was gazetted on 8 April 2005 (DMP 2008).

ESAs are areas where the vegetation has high conservation value. Several types of areas are declared ESAs including:

- the area covered by vegetation within 50 m of Threatened Flora, to the extent to which the vegetation is continuous with the vegetation in which the Threatened Flora is located;
- the area covered by a TEC;
- a defined wetland (Ramsar wetlands, conservation category wetlands and nationally important wetlands) and the area within 50 m of the wetland; and
- Bush Forever sites.

2.3 INTRODUCED FLORA

Introduced flora pose threats to biodiversity and natural values by successfully out-competing native species for available nutrients, water, space and sunlight; reducing the natural structural and biological diversity by smothering native plants or preventing them from growing back after clearing, fire or other disturbance; replacing the native plants that animals use for shelter, food and nesting; and altering fire regimes, often making fires hotter and more destructive (AWC 2007).

Management of some weed species is required under Commonwealth or State frameworks. Key classifications for significant introduced flora that are relevant to this report are:

- Declared pest – the *Biosecurity and Agriculture Management Act 2007* (BAM Act), Section 22 makes provision for a plant taxon to be listed as a declared pest organism in parts of, or the entire State. Under the *Biosecurity and Agriculture Management Regulations 2013* declared pests are assigned to one of three control categories that dictate level of management required (DAFWA 2016).
- Weed of National Significance (WoNS) – high impact, established introduced flora causing major economic, environmental, social and/or cultural impacts in a number of states/territories, and which have strong potential for further spread (Australian Weeds Committee 2012). Management is required in accordance with Department of Agriculture and Food guidelines for particular WoNS.

Throughout this report, introduced flora species are indicated with an asterisk (*).

3 EXISTING ENVIRONMENT

3.1 INTERIM BIOGEOGRAPHIC REGIONALISATION OF AUSTRALIA

The Interim Biogeographic Regionalisation of Australia (IBRA) defines 'bioregions' as large land areas characterised by broad, landscape-scale natural features and environmental processes that influence the functions of entire ecosystems (Department of the Environment and Energy 2016; Thackway & Cresswell 1995). They categorise the large-scale geophysical patterns that occur across the Australian continent that are linked to fauna and flora assemblages and processes at the ecosystem scale (Thackway & Cresswell 1995). The Study Area falls within the Carnarvon bioregion, which covers an area of 8,430,172 ha (DEWHA 2008; Thackway & Cresswell 1995) and is divided into two subregions (May & McKenzie 2003): Cape Range (CAR1) and Wooramel (CAR2). The Study Area is situated within the northern extent of the Cape Range subregion, approximately 7 km from the border of the Roebourne subregion of the Pilbara bioregion (Figure 3-1). The Cape Range subregion is characterised by (Kendrick & Mau 2001):

> Quaternary alluvial, Aeolian and marine sediments overlying Cretaceous strata. A mosaic of saline alluvial plains with samphire and saltbush low shrublands, Bowgada low woodland on sandy ridges and plains, Snakewood scrub on clay flats, and tree to shrub steppe over hummock grasslands on and between red sand dune fields. Limestone strata with *Acacia stuartii* or *A. bivenosa* shrubland outcrop in the north, where extensive tidal flats in sheltered embayments support mangal. Climate is arid, semi-desert to sub-tropical climate, with variable summer and winter rainfall. Cyclonic activity can be significant, and cyclonic systems may affect the coast and hinterland annually.

3.2 LAND SYSTEMS

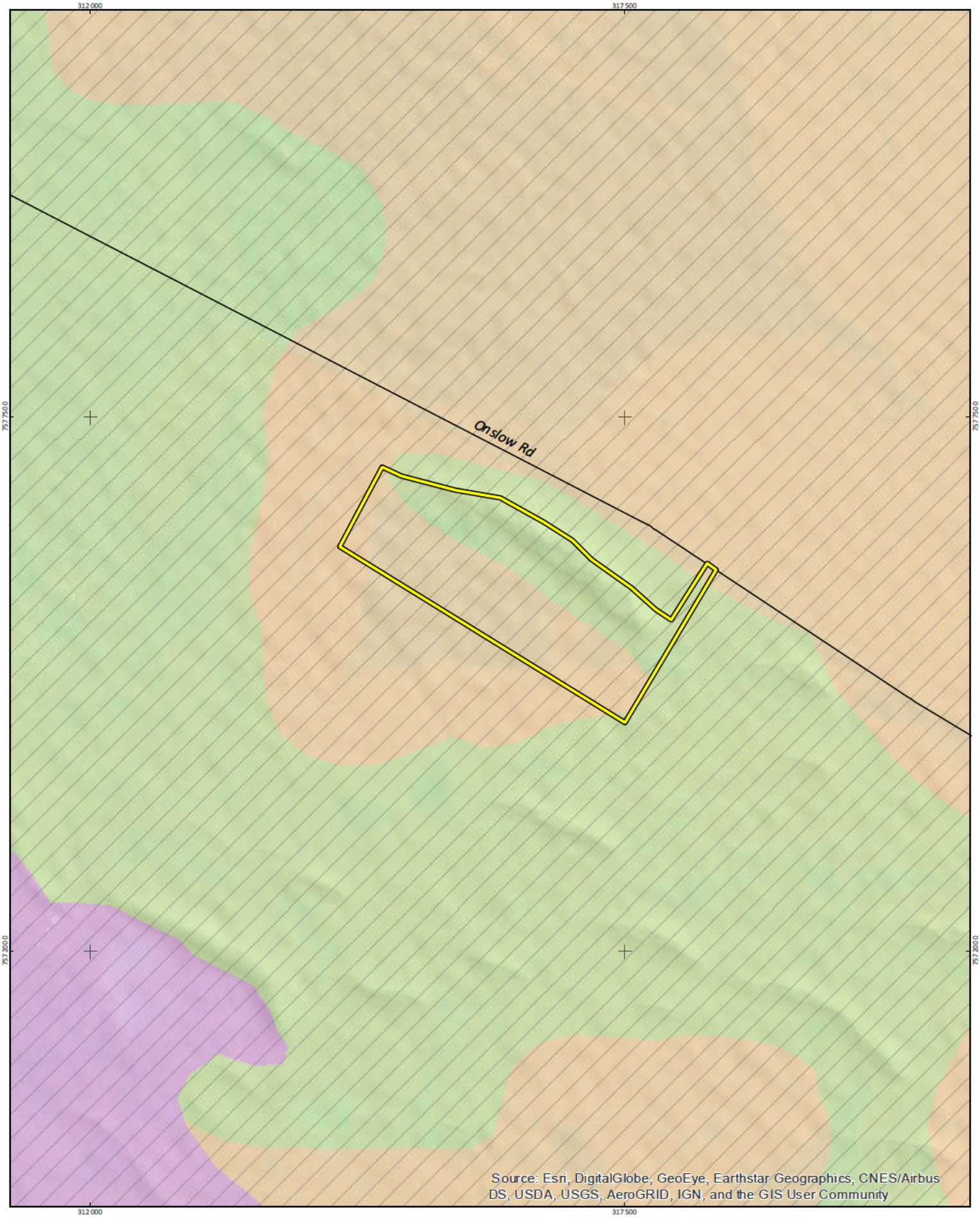
The Department of Agriculture and Food (DAFWA) has mapped the land systems of the Study Area as part of land system mapping of the Pilbara region (Payne & Leighton 2004). The Study Area intersects two land systems, the Giralia and Uaroo systems. The proportion of the Study area located within each of these land systems is shown in Table 3-1 and Figure 3-1.

Table 3-1 Description of land systems intersecting the Study Area

Land system	Land system description	Area (ha)	% of Study Area
Giralia	Linear dunes and broad sandy plains supporting hard and soft spinifex grasslands.	180.5	42.7
Uaroo	Broad sandy plains supporting shrubby hard and soft spinifex grasslands.	241.7	57.3

3.3 CONSERVATION RESERVES AND ENVIRONMENTALLY SENSITIVE AREAS

The Study Area is located within a DBCA managed land parcel designated as Unallocated Crown Land – former leasehold proposed for conservation (ex Mount (Mt) Minnie pastoral lease) (Figure 1-1). The former Mt Minnie Station is proposed to be added to the Cane River Conservation Park, located southeast of the Study Area.



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Project No	1174
Date	27/09/2017
Drawn by	AL
Map author	JC

0 0.5 1 2
Kilometers

1:50,000 (at A4) GDA 1994 MGA Zone 50

Study Area

IBRA region

Canarvon, subregion: Cape Range (CAR01)

Land system

Giralia System

Minderoo System

Uaroo System

Figure 3–1

IBRA subregions and land systems of the study area

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3.4 CLIMATE AND WEATHER

The climate of the Cape Range subregion is described as arid, semi-desert to sub-tropical climate, with variable summer and winter rainfall (Kendrick & Mau 2001). The nearest Bureau of Meteorology (BoM) weather station with comprehensive data collection and historic climate data is located at Onslow Airport (no. 005017, Latitude: -21.67°S Longitude: 115.11°E) approximately 28 km northwest of the Study Area. Onslow Airport records the highest maximum mean monthly temperature (36.4°C) in January and February, the lowest maximum mean (25.4°C) in July (BoM 2017) (Figure 3-2). Highest minimum mean (25.4°C) is recorded in February and lowest (13.0°C) in July (BoM 2017) (Figure 3-2). Average annual rainfall is 315.1 mm with March and February recording the highest monthly averages (72.9 and 62.2 mm respectively).

Daily mean temperatures and rainfall for Onslow Airport in the 12 months preceding the survey (September 2016–August 2017) were variable to annual long-term averages (Figure 3-2). Mean maximum temperatures were above or equal to average for most months with the exception of January and February 2017 while mean minimum temperatures were equal to slightly above average for all months (Figure 3-2). Rainfall was highly variable against long term annual averages with well above average rainfall recorded in February and August 2017 and well below averages recorded the remaining months except for January and March which were near equal annual averages (Figure 3-2).

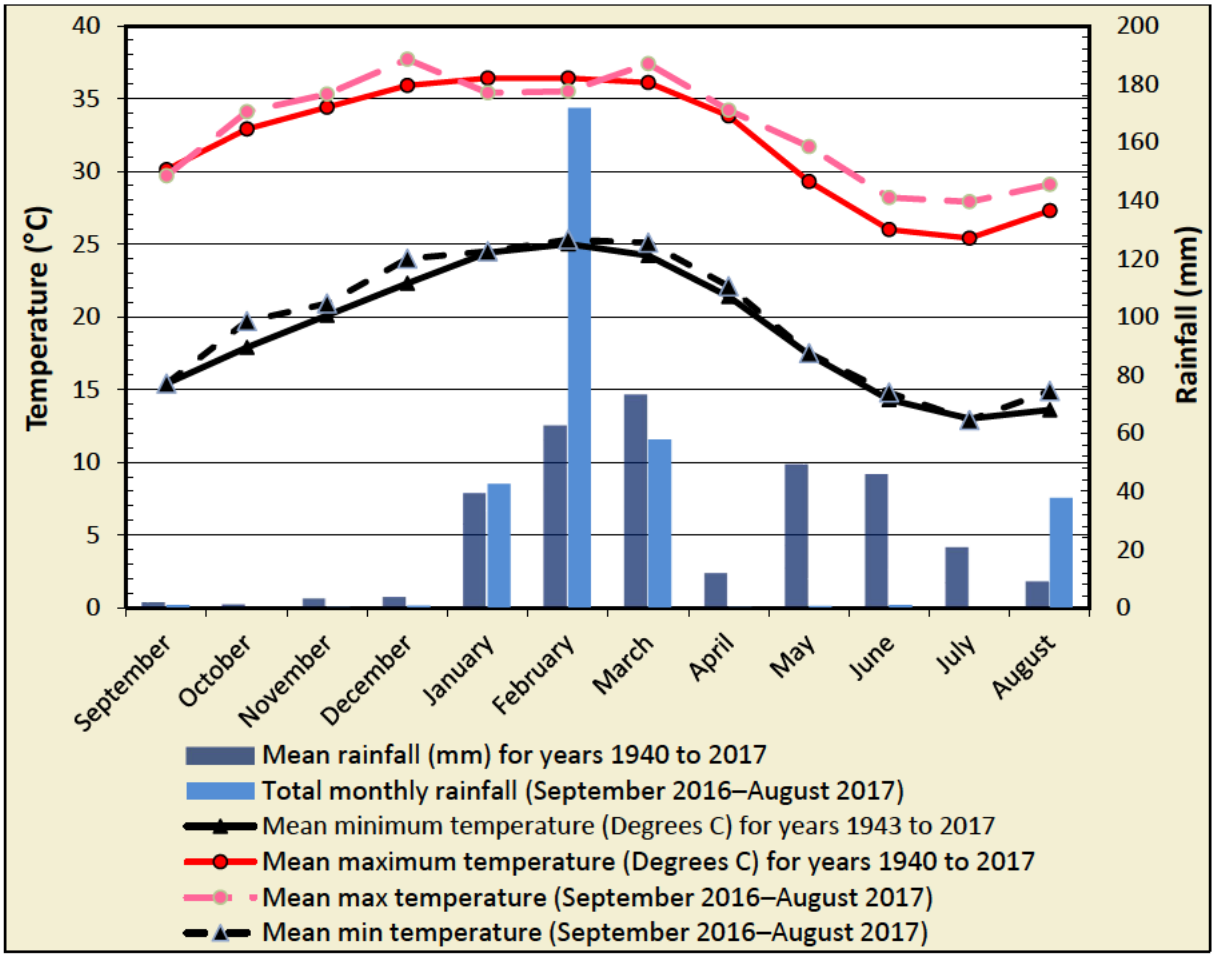


Figure 3-2 **Annual climate and weather data for Onslow Airport (no. 005017) (BoM 2017) and mean monthly data for the 12 months preceding the field survey**

4 METHODS

Survey design, methodology and report-writing adhered to relevant principles and guidelines, including:

- EPA *Statement of Environmental Principles, Factors and Objectives* (EPA 2016c);
- EPA *Environmental Factor Guideline: Flora and vegetation* (EPA 2016a);
- EPA *Technical Guidance: Flora and vegetation surveys for Environmental Impact Assessment* (EPA 2016d);
- EPA *Environmental Factor Guideline: Terrestrial fauna* (EPA 2016b);
- EPA *Technical Guidance: Terrestrial fauna surveys* (EPA 2016f);
- EPA *Technical Guidance: Sampling methods for terrestrial vertebrate fauna* (EPA 2016e); and
- DPaW *Interim guidelines for preliminary surveys of Night Parrot (Pezoporus occidentalis) in Western Australia* (DPaW 2017b).

4.1 DESKTOP REVIEW

4.1.1 Database searches and literature review

Database searches and a literature review (Table 4-1) were undertaken to identify the significant flora, vegetation and fauna that may occur within the Study Area. The following database searches were undertaken within a 40 km buffer around the Study Area:

- EPBC Act Protected Matters Search Tool (Department of the Environment and Energy 2017b)
- DBCA Threatened Flora, Fauna and Ecological Communities database searches (DPaW 2017d)
- DBCA/WA Museum NatureMap database (DPaW 2017c).

A site visit was conducted for part of the Study Area on 22–23 April 2014 (Terratree 2014), which provided some site-specific information on the vegetation and fauna habitats present.

Table 4-1 Flora and vegetation survey reports incorporated in the desktop review

Report author	Survey type	Project
Main Roads WA (2011)	Desktop review	Onslow Road widening and overtaking lanes
ENV (2012)	Level 1 terrestrial fauna survey	Ashburton North Strategic Industrial Area
Terratree (2014)	Level 1 flora and terrestrial fauna survey/reconnaissance	Shire of Ashburton potential landfill site, 'Area 10'

4.1.2 Habitat assessment

Initial characterisation of terrestrial fauna habitats and vegetation in the Study Area was undertaken using various remote geographical tools, including aerial photography (incl. Google Earth™), land

system maps, Beard vegetation mapping (Beard 1990) and topographic maps. Desktop habitat characterisation was verified and broad fauna habitats were defined and mapped within the Study Area during the field survey. The potential for the habitats of the Study Area to support conservation significant flora, ecological communities and terrestrial fauna was then assessed based on species-specific habitat preferences and nearest records.

4.2 FIELD SURVEY

The concurrent flora and vegetation and terrestrial fauna survey was undertaken over two consecutive days from 14–15 September 2017.

4.2.1 Flora and vegetation

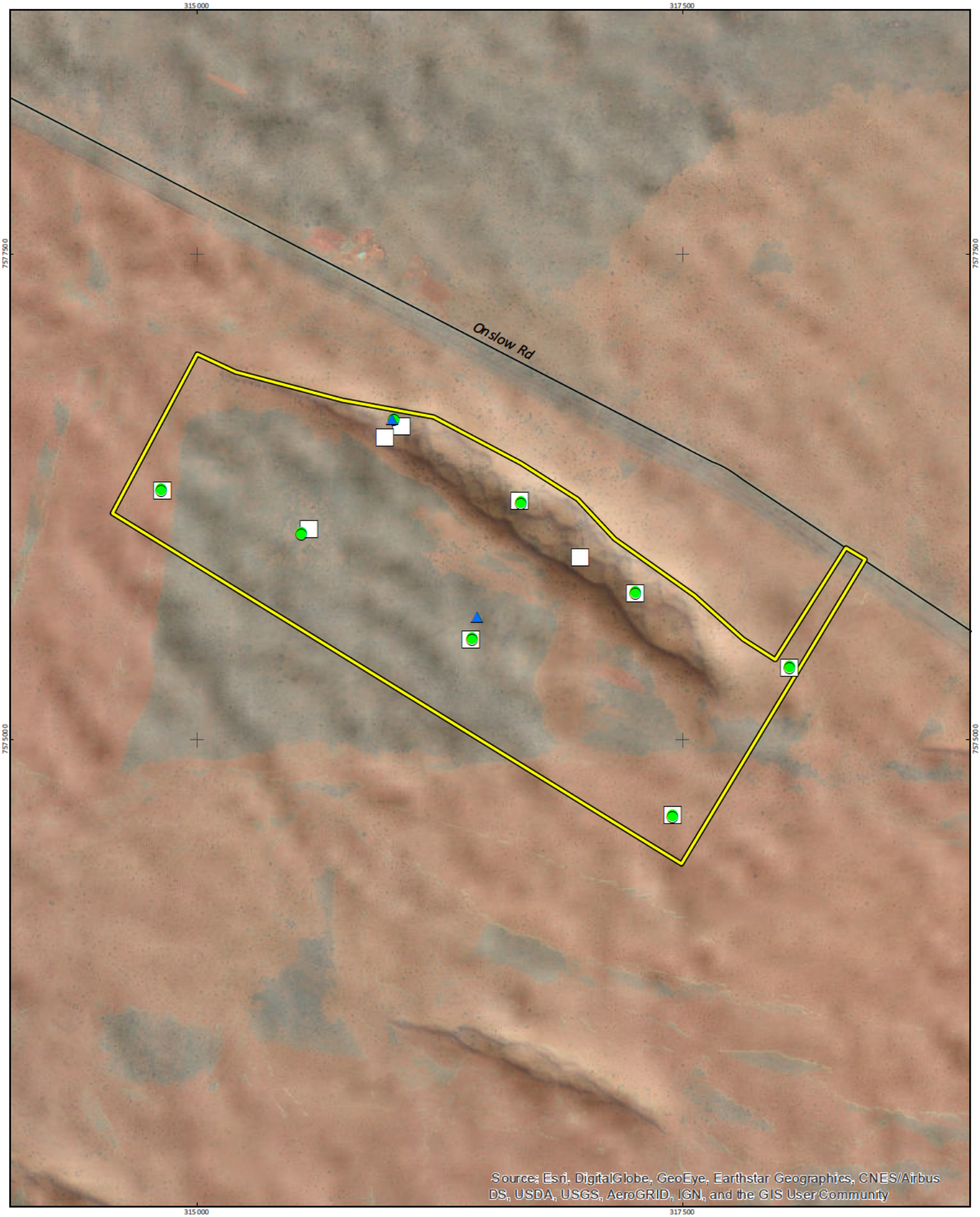
Field methods for the flora and vegetation survey of the Study Area included:

- Surveying of relevés (see 4.2.1.1);
- Targeted flora searches (see 4.2.1.2);
- Vegetation association mapping (see 4.2.1.3); and
- Vegetation condition mapping (see 4.2.1.4).

Prior to the commencement of the field surveys, data including satellite imagery, estimated survey boundary, and pre-selected vegetation relevés were loaded onto tablets using the application GIS Pro version 3.18 (Garafa 2016). The field survey involved assessing and mapping vegetation boundaries, conducting, where possible, at least three relevés sites per vegetation unit and collecting opportunistic flora specimens. GPS locations of vegetation and condition boundaries, and relevés and flora specimen data were recorded on an Apple™ digital tablet using Mobile Data Studio (MDS) version 8.0 (CreativityCorp 2016). Photographs were taken at each relevé (in a south-easterly direction from the north-west corner).

4.2.1.1 Relevés

Relevé locations were selected to ensure that an accurate representation of the major vegetation types within the Study Area were sampled adequately. Two methods were used for the selection of relevé placement within the Study Area. Preliminary quadrat locations were pre-selected using high quality aerial photography; with selection based on apparent changes in the vegetation visible in the aerial imagery. The preliminary relevé locations were re-assessed during the site visit, while ground-truthing the Study Area on foot. In total, eight relevés were surveyed across the Study Area (Figure 4-1; Appendix 1). A solitary GPS co-ordinate was recorded for each relevé.



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Project No	1174
Date	27/09/2017
Drawn by	AL
Map author	JC

0 0.25 0.5 1
Kilometers

1:25,000 (at A4) GDA 1994 MGA Zone 50

- Study Area
- Level 1 flora and fauna sites
- Bilby plot
- Song meter site

Figure 4-1

Survey sites

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The following information was recorded for each relevé:

- Location – the geographic coordinates of all four corners of the quadrat in WGS84 projection;
- Description of vegetation – a broad description utilising the structural formation and height classes based on National Vegetation Information System (ESCAVI 2003) and in accordance with EPA (2016d);
- Habitat – a brief description of landform and habitat;
- Geology – a broad description of surface soil type and rock type;
- Disturbance history – a description of any observed disturbance including an estimate of time since last fire, weed invasions, soil disturbance, human activity and fauna activity;
- Vegetation condition – the condition of the vegetation was recorded utilising the condition scale of Trudgen (1988 in EPA 2016d) (Table 4-2);
- Height and percentage foliage cover (PFC) – a visual estimate of the canopy cover of each species present within the 30 m x 30 m quadrat was recorded as a percentage, as was the total vegetation cover, cover of shrubs and trees >2 m tall, cover of shrubs <2 m, total grass cover and total herb cover;
- Photograph – a colour photograph of the vegetation within each quadrat in a south-easterly direction from the north-west corner of the quadrat; and
- Flora species list – a list including the name of every flora species present within the relevé; to ensure accurate taxonomic identification of flora species present within the Study Area, collections were made of each specimen at least once and each collection was pressed and documented for identification using the WA Herbarium resources.

4.2.1.2 Targeted flora searches

Targeted flora searches were undertaken simultaneously with the flora and vegetation survey to determine whether any of the conservation significant species identified from the desktop review occurred in the Study Area. The searches focused on relevé survey areas, selected to be representative of all habitats encountered in the Study Area, and meandering transect searches while traversing the Study Area.

If a flora species was considered to potentially be a conservation significant species (i.e. similar floristic characteristics and occurring within suitable habitat) the following information was collected:

- Global Positioning System (GPS) coordinates, including population boundary where applicable;
- Description of the habitat and floristic community in which the potential conservation significant species was located;
- Population size estimate (i.e. Estimated number of individual plants) where applicable;
- Specimen collection for taxonomic identification and lodgement at the WA Herbarium; and
- Photograph of live plant in situ and description of important details, such as flower colour, height of individual or average height of population.

4.2.1.3 Vegetation mapping

The vegetation descriptions from the eight relevés from the survey were grouped according to similarity of community structure (i.e. canopy levels), species composition and combination of species and the prevalent community structure (i.e. woodland, shrubland, etc.). The vegetation boundaries were mapped utilising high-quality colour aerial photography and from vegetation boundaries recorded on GPS during the field survey.

4.2.1.4 Condition mapping

The condition of vegetation was mapped across the Study Area based on the Trudgen (1988 in EPA 2016d) scale, an appropriate condition rating scale for the Eremaean Province where the Cape Range subregion is located (EPA 2016d).

The vegetation condition ratings relate to vegetation structure, the level of disturbance and weed cover at each structural layer and the ability of the vegetation unit to regenerate. Vegetation condition ranges from 'Excellent' being the highest rating to 'Completely Degraded' as the lowest (Table 4-2).

Table 4-2 Vegetation condition rating scale (Trudgen 1988, in EPA 2016d)

Vegetation condition	Description
Excellent	Pristine or nearly so, no obvious signs of damage caused by human activities since European settlement.
Very Good	Some relatively slight signs of damage caused by human activities since European settlement. For example, some signs of damage to tree trunks caused by repeated fire, the presence of some relatively non-aggressive weeds, or occasional vehicle tracks.
Good	More obvious signs of damage caused by human activity since European settlement, including some obvious impact on the vegetation structure such as that caused by low levels of grazing or slightly aggressive weeds.
Poor	Still retains basic vegetation structure or ability to regenerate it after very obvious impacts of human activities since European settlement, such as grazing, partial clearing, frequent fires or aggressive weeds.
Degraded	Severely impacted by grazing, very frequent fires, clearing or a combination of these activities. Scope for some regeneration but not to a state approaching good condition without intensive management. Usually with a number of weed species present including very aggressive species.
Completely Degraded	Areas that are completely or almost completely without native species in the structure of their vegetation; i.e. areas that are cleared or 'parkland cleared' with their flora comprising weed or crop species with isolated native trees or shrubs.

4.2.2 Fauna and fauna habitat

4.2.2.1 Site selection

Initial habitat characterisation was undertaken using various remote geographical tools, including aerial photography (Google Earth®), land system maps and topographic maps. Habitats with the potential to support conservation significant terrestrial fauna species were identified based on known habitats of such species within the Dampierland bioregion. Tentative sites corresponding with flora and vegetation survey quadrats were selected for the terrestrial fauna survey to represent all habitat types. Final survey site selection was conducted after ground-truthing of site characteristics.

At the broadest scale, site selection considered aspect, topography and land systems. At the finer scale, consideration was given to proximity to water bodies or drainage lines, vegetation complexes and condition and soil types. Sites were primarily chosen to represent the best example of distinct habitats within the broader habitat associations of the Study Area. Consideration was also given to the potential project footprint, as available at the time, which predominantly occurred in the northern section for the Study Area.

4.2.2.2 Vertebrate fauna

Eight level 1 terrestrial fauna sites were surveyed comprising all botany relevés within the Study Area. These covered all fauna habitats in the Study Area. In addition, eight targeted Bilby plot surveys were undertaken at each of the level 1 sites (Figure 4-1). Habitat descriptions and characteristics were recorded at all sites (Appendix 1). Survey work was undertaken over two consecutive days and comprised of:

- Active searches (for details see section 4.2.2.2.1);
- Avifauna surveys (see 4.2.2.2.1);
- Bat echolocation and night parrot call recordings (see 4.2.2.2.2);
- Opportunistic records (see 4.2.2.2.3); and
- Targeted bilby survey plots (see 4.2.2.2.4).

4.2.2.2.1 **Active searches**

Active searches were undertaken at each of the eight level 1 fauna survey sites and primarily targeted diurnal herpetofauna and mammals from direct sightings and secondary evidence. Searches were undertaken in any observable microhabitats considered likely to support mammals, reptiles and amphibians. Techniques included: raking leaf and bark litter, overturning logs, searching beneath the bark of trees, investigating dead trees and logs, investigating burrows and identifying any secondary evidence including tracks, diggings, scats, fur or sloughs (shed skins), predation or feeding sites, and fauna constructed structures such as nests. A minimum of one person hour was spent active searching at each site for a total of eight hours over the duration of the field survey.

4.2.2.2.1 **Avifauna surveys**

Thirty-minute avifauna surveys were undertaken at each of the eight level 1 fauna survey sites (Figure 4-1). Avifauna surveys were confined to the habitat type (up to 2 ha) represented by each level 1 survey site to collect assemblage data for each habitat. Avifauna surveys were undertaken

throughout the day with a focus on periods of higher activity around sunrise and sunset. Surveys consisted of bird recordings from visual sightings and call recognition.

Additional avifauna observations were also recorded at opportunistically while other field work was being completed, including observations made during travel and active searches or during targeted Bilby plot surveys.

A total of approximately four person hours of avifauna census was undertaken during the field survey.

4.2.2.2.2 Bat echolocation and Night Parrot call recordings

SongMeter SM2 recording devices were used to record bat echolocation and night parrot calls at two opportunistic sites (Figure 4-1). Recording devices were deployed at each site for one night of recording for between eight and 12 continuous hours per night for bats and for three hours prior to and post sunrise and sunset for Night Parrot. Recording devices were aimed at a 45° angle to the ground. Areas of habitat likely to have increased insect activity and to attract bats (i.e. likely movement corridors) and potential roosting and nesting sites for Night Parrots (*Pezoporus occidentalis*) (DPaW 2017b) were targeted. The recorded data were analysed by Mr. Bob Bullen, Bat Call WA.

4.2.2.2.3 Opportunistic records

Any opportunistic observations of vertebrate species were recorded during the survey, particularly conservation significant species. Opportunistic sampling involved recording all sightings of vertebrate fauna species while working and travelling within the Study Area between sites.

4.2.2.2.4 Targeted Bilby survey plots

Targeted Bilby plot surveys were undertaken to search for evidence of occurrence of the species in the Study Area using standardised 2 ha plots adopted from Southgate *et al.* (2005) and Southgate and Moseby (2008). Due to the size of the Study Area the distance between placements of plots was reduced for a greater survey effort within the Study Area. A 2 ha plots (~142 m x 142 m) was surveyed at each of the level 1 fauna survey sites (Figure 4-1). Each plot was surveyed for 0.5 person hour (1 observer = 30 min) during which searches will be undertaken for any evidence of the species including tracks, scats, foraging diggings and/or burrows. Suitability of habitat for Bilby was assessed at all plots based on substrate and vegetation structure or density.

Transect searches were also undertaken while traversing between Bilby survey plots and level 1 survey sites for evidence of Bilby occurrence.

4.2.1 Taxonomy and nomenclature

Plant species were identified using local and regional flora keys, and comparisons with named species held at the WA Herbarium. Nomenclature for flora and vegetation used in this report follows that used by FloraBase (DPaW 2017a) and the WA Herbarium. The conservation status of all recorded flora was compared against the current lists available on FloraBase (DPaW 2017a) and the EPBC Act Threatened species database provided by the DotEE (Department of the Environment and Energy 2017a).

The taxonomy and nomenclature of terrestrial vertebrate fauna follows several taxon-specific references (Table 4-3).

Table 4-3 Nomenclatural references, morphospecies designations and reference collections

Taxonomic group	Taxonomic reference for described species and higher taxa
Mammals	Menkhorst and Knight (2011)
Birds	Simpson and Day (2010) Christidis and Boles (2008)
Reptiles	Wilson and Swan (2013)
Amphibians	Tyler and Doughty (2009)

4.3 SURVEY PERSONNEL

The personnel involved in the survey are presented (Table 4-4).

Table 4-4 Project team

Name	Qualifications	Role/s
[redacted]	BSc. (Env. Biol.) (Hons)	Project management and report review
	BESc. (Cons. Wildlife Biol.) Dip. (Cons. Land Mgmt.)	Field survey, fauna taxonomy (vertebrates) and reporting
	PhD (Botany)	Flora taxonomy and report review
	PhD (Plant Con.)	GIS and vegetation mapping, data analysis and reporting
	BSc. (Enc. Sci.)	Field survey and flora taxonomy
	B. Eng. (Aero. Eng.)	Bat echolocation analysis

5 RESULTS

5.1 DESKTOP REVIEW

5.1.1 Flora and vegetation

5.1.1.1 Conservation significant flora

Eight conservation significant flora species were identified from the database searches and literature review as previously recorded within 40 km of the Study Area (Table 5-1; Figure 5-1).

Table 5-1 Conservation significant flora species identified from the desktop review

Species	Conservation status	Nearest record to Study Area
Abutilon sp. Onslow (F. Smith s.n. 10/9/61)	P1	~5.5 km west northwest
Abutilon sp. Pritzelianum (S. van Leeuwen 5095)	P1	~25 km north northwest
Helichrysum oligochaetum	P1	~40 km southeast
Eleocharis papillosa	P3	~15 km northwest
Eremophila forrestii subsp. *viridis*	P3	~6 km northwest
Stackhousia clementii	P3	~26 km north-northwest
Triumfetta echinata	P3	~11 km southeast
Goodenia nuda	P4	~38.5 west-northwest

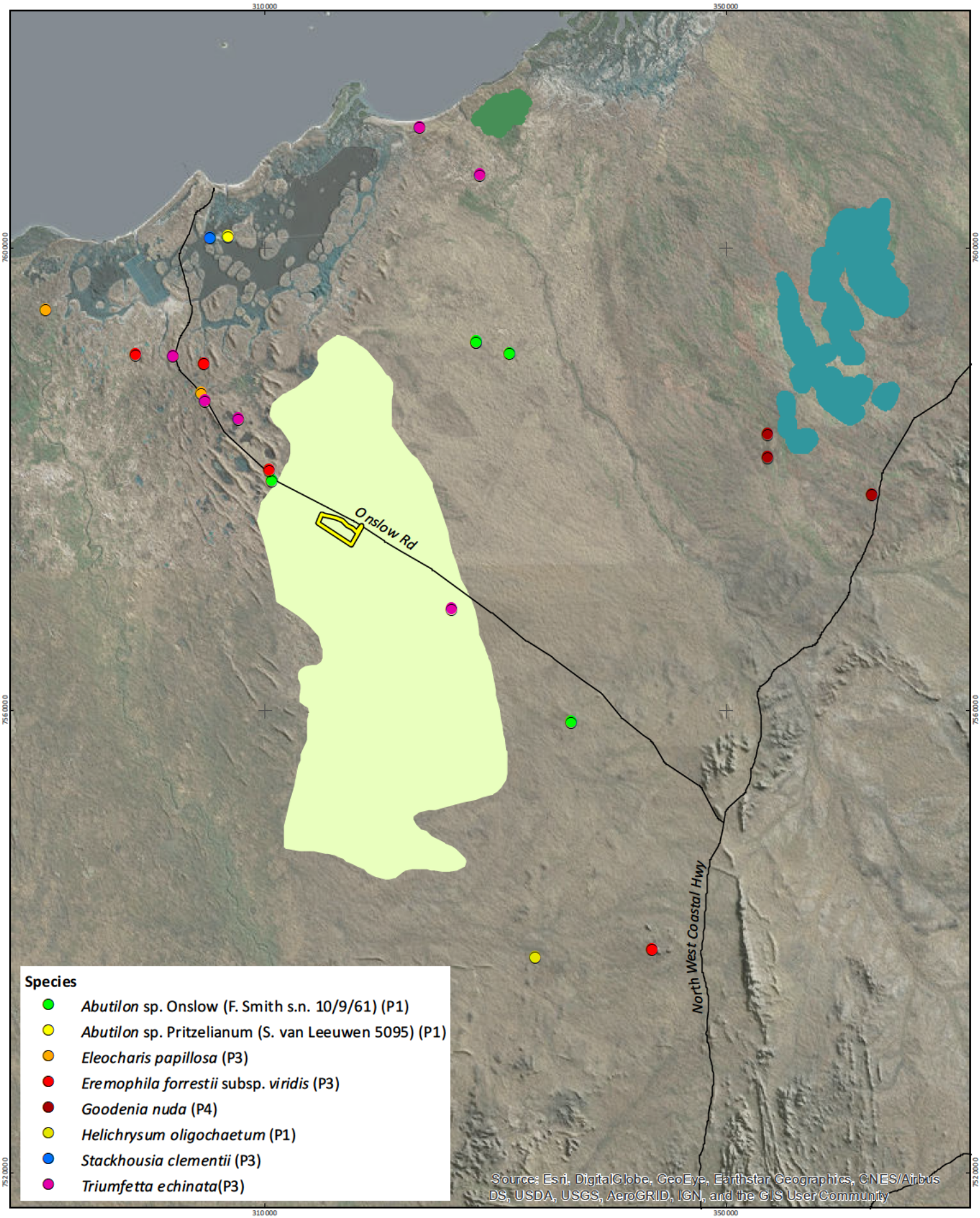
5.1.1.2 Introduced flora

The desktop assessment identified records for 25 introduced species within 40 km of the Study Area, two of which are Declared Pests and WoNS (Table 5-2).

Table 5-2 Weed species identified from the desktop review

Family	Name	Declared Pest	WoNS
Amaranthaceae	**Aerva javanica* (Kapok Bush)		
Amaranthaceae	**Alternanthera pungens* (Khaki Weed)		
Arecaceae	**Phoenix dactylifera* (Date Palm)		
Asteraceae	**Conyza bonariensis* (Flaxleaf Fleabane)		
Asteraceae	**Flaveria trinervia* (Speedy Weed)		
Asteraceae	**Sonchus oleraceus* (Common Sowthistle)		
Asteraceae	**Tridax procumbens* (Tridax)		
Brassicaceae	**Brassica tournefortii* (Mediterranean Turnip)		
Convolvulaceae	**Ipomoea quamoclit* (Cupid's Flower)		
Euphorbiaceae	**Euphorbia hirta* (Asthma Plant)		
Fabaceae	**Leucaena leucocephala* (Leucaena)		

Family	Name	Declared Pest	WoNS
Fabaceae	**Parkinsonia aculeata* (Parkinsonia)	●	●
Fabaceae	**Prosopis pallida* (Mesquite)	●	●
Fabaceae	**Vachellia farnesiana* (Mimosa Bush)		
Malvaceae	**Gossypium hirsutum* (Upland Cotton)		
Malvaceae	**Malvastrum americanum* (Spiked Malvastrum)		
Onagraceae	**Oenothera laciniata* (Evening Primrose)		
Poaceae	**Avena barbata* (Bearded Oat)		
Poaceae	**Cenchrus ciliaris* (Buffel-grass)		
Poaceae	**Chloris barbata* (Purpletop Chloris)		
Poaceae	**Digitaria ciliaris* (Summer Grass)		
Poaceae	**Setaria verticillata* (Whorled Pigeon Grass)		
Portulacaceae	**Portulaca pilosa* (Djanggara)		
Rhamnaceae	**Ziziphus mauritiana* (Zornia)		
Solanaceae	**Solanum nigrum* (Black Berry Nightshade)		



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Project No	1174
Date	27/09/2017
Drawn by	AL
Map author	JC

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Kilometers

1:420,000 (at A4) GDA 1994 MGA Zone 50

Study Area

Vegetation association

98: Hummock grasslands, shrub steppe; kanji over soft spinifex and *Triodia basedowii*

Priority Ecological Community

Peedamulla (Cane River) Swamp Community

Tanpool Land System

Figure 5–1

Desktop records of conservation significant flora, ecological communities and regional vegetation mapping Shepherd *et al.* (2002)

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5.1.1.3 Vegetation associations

Regional scale vegetation mapping by Shepherd *et al.* (2002, after Beard) mapped a single vegetation association, 98 Cape Yannare Coastal Plain in the Study Area (Figure 5-1), defined as Hummock grasslands, shrub steppe; kanji over soft spinifex & *Triodia basedowii*. The vegetation association is extensively represented in the Cape Range subregion and has over 99% extent remaining according to Government of Western Australia (2016).

Terratree (2014) described the vegetation of part of the Study Area as occasional *Corymbia hamersleyana* over *Acacia bivenosa*, *Grevillea eriostachya* sparse shrubland over *Triodia epactia* grassland.

5.1.1.4 Threatened and Priority Ecological Communities

No Commonwealth or State listed TECs or DBCA listed PECs intersect the Study Area. Two Priority 1 PECs were identified in the desktop review for the Project; Peedamulla Swamp Community and Tanpool Land System, located within 40 km of the Study Area (Figure 5-1; Table 5-3).

Based on the PECs descriptions, land system of the Study Area and regional vegetation association of Study Area (section 5.1.1.3), neither PECs identified in the desktop review are related to land systems or vegetation associations occurring within the Study Area and it was considered unlikely that the vegetation of the Study Area would align with any of the communities.

Table 5-3 Priority ecological communities identified in the desktop review

Community name	Description	Conservation status	Proximity to Study Area
Peedamulla Swamp Community	Peedamulla (Cane River) Swamp Cyperaceae community, near mouth of Cane River. Plants are unusual.	Priority 1	~36 km north-northeast
Tanpool Land System	A highly-restricted land system that occurs between Pannawonica and Onslow. Consists of stony plains and low ridges of sandstone and other sedimentary rocks supporting hard spinifex grasslands and snakewood shrublands	Priority 1	~40 km east-northeast

5.1.2 Fauna and fauna habitat

A total of 56 species or subspecies of conservation significance were identified in the desktop review including 18 listed under the EPBC Act and/or WC Act as Threatened, Conservation Dependent or Specially Protected (Table 5-4; Figure 5-2). Forty-two species are listed as 'Migratory' under the EPBC Act and WC Act, including eight also listed as Threatened under the EPBC Act and/or WC Act, and five species are listed as Priority species (Table 5-4).

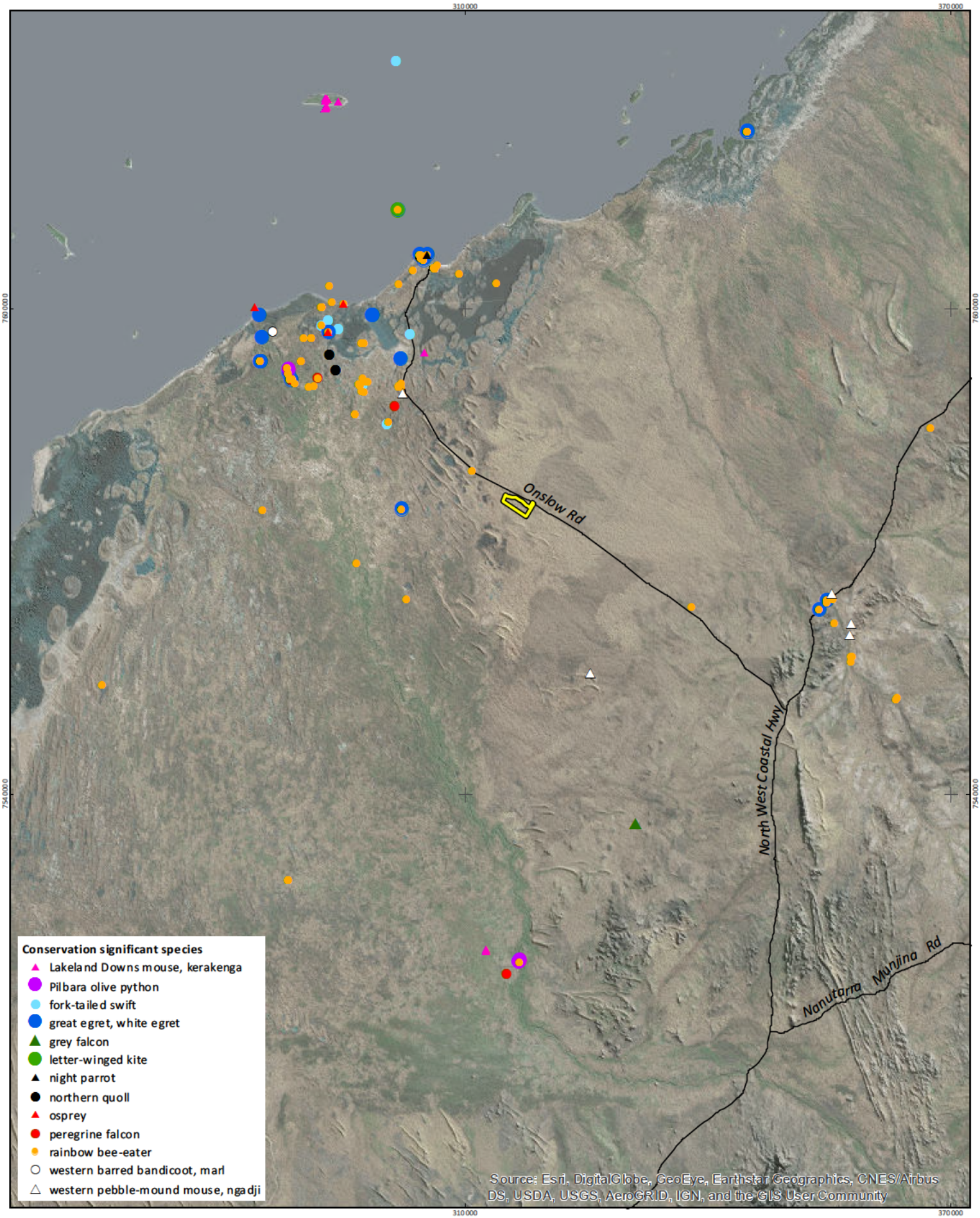
Due to the size of the desktop search area intersecting coastal and marine habitats, a large number of migratory shorebirds and marine species of conservation significance were returned, many of which are unlikely to occur within the Study Area due to the absence of suitable habitat to support the species. Marine or aquatic conservation significant mammal and reptile species (including fish, marine turtles, crocodiles, sea snakes, dolphins and whales) have been excluded are not discussed further.

Table 5-4 Conservation significant terrestrial fauna identified through the desktop review

Scientific name	Common name	Conservation status[1]		
		EPBC Act	WC Act	DBCA
REPTILES				
Lerista planiventralis maryani	Maryan's Keeled Slider			P1
Liasis olivaceus barroni	Pilbara Oliver Python	VU	VU	
BIRDS				
Tringa hypoleucos	Common Sandpiper	Mig	Mig	
Apus pacificus	Fork-tailed Swift	Mig	Mig	
Ardea modesta	Great Egret		Mig	
Arenaria interpres	Ruddy Turnstone	Mig	Mig	
Calidris acuminata	Sharp-tailed Sandpiper	Mig	Mig	
Calidris alba	Sanderling	Mig	Mig	
Calidris canutus rogersi	Red Knot (north-eastern Siberia)	EN/Mig	VU/Mig	
Calidris ferruginea	Curlew Sandpiper	CR/Mig	VU/Mig	
Calidris ruficollis	Red-necked Stint	Mig	Mig	
Calidris tenuirostris	Great Knot	CR/Mig	VU/Mig	
Charadrius leschenaultii	Greater Sand Plover	VU/Mig	VU/Mig	
Charadrius mongolus	Lesser Sand Plover	EN/Mig	EN/Mig	
Charadrius veredus	Oriental Plover	Mig	Mig	
Chlidonias leucopterus	White-winged Black Tern	Mig	Mig	
Falco peregrinus	Peregrine Falcon		SP	
Gelochelidon nilotica	Gull-bileld Tern	Mig	Mig	
Glareola maldivarum	Oriental Pratincole	Mig	Mig	
Limosa lapponica menzbieri	Bar-tailed Godwit (northern Siberian)	CR/Mig	VU/Mig	
Limosa lapponica baueri	Bar-tailed Godwit (western Alaskan)	VU/Mig	VU/Mig	
Merops ornatus	Rainbow Bee-eater		Mig	
Numenius madagascariensis	Eastern Curlew	CR/Mig	VU/Mig	
Numenius minutus	Little Curlew	Mig	Mig	
Numenius phaeopus	Whimbrel	Mig	Mig	
Pandion haliaetus	Osprey	Mig	Mig	
Pezoporus occidentalis	Night Parrot	EN	CR	
Pluvialis squatarola	Grey Plover		Mig	
Puffinus pacificus	Wedge-tailed Shearwater	Mig	Mig	
Sterna caspia	Caspian Tern	Mig	Mig	
Sterna dougallii	Roseate Tern	Mig	Mig	
Sterna hirundo	Common Tern	Mig	Mig	
Sterna nereis nereis	Fairy Tern	VU	VU	
Tringa brevipes	Grey-tailed Tattler	Mig	Mig	P4
Tringa glareola	Wood Sandpiper	Mig	Mig	
Tringa nebularia	Common Greenshank	Mig	Mig	
Elanus scriptus	Letter-winged Kite			P4
Falco hypoleucos	Grey Falcon		VU	
Limosa limosa	Black-tailed Godwit	Mig	Mig	
Pluvialis fulva	Pacific Golden Plover		Mig	
Sterna albifrons	Little Tern	Mig	Mig	
Sula leucogaster	Brown Booby	Mig	Mig	

Scientific name	Common name	Conservation status[1]		
		EPBC Act	WC Act	DBCA
Tringa stagnatilis	Marsh Sandpiper	Mig	Mig	
Anous stolidus	Common noddy	Mig	Mig	
Calonectris leucomelas	Streaked Shearwater	Mig	Mig	
Hirundo rustica	Barn Swallow	Mig	Mig	
Motacilla cinerea	Grey Wagtail	Mig	Mig	
Motacilla flava	Yellow Wagtail	Mig	Mig	
Calidris melanotos	Pectoral Sandpiper	Mig	Mig	
MAMMALS				
Dasyurus hallucatus	Northern Quoll	EN	EN/Mig	
Leggadina lakedownensis	Short-tailed Mouse			P4
Perameles bougainville	Western Barred Bandicoot	EN	VU	
Pseudomys chapmani	Western Pebble-mound Mouse			P4
Macroderma gigas	Ghost Bat	VU	VU	
Macrotis lagotis	Greater Bilby	VU	VU	
Rhinonicteris aurantia (Pilbara form)	Pilbara Leaf-nosed Bat	VU	VU	

[1] — CR – Critically Endangered; EN – Endangered; VU – Vulnerable; SP – Specially Protected; Mig — Migratory; P1–P4 —Priority 1–4.



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Project No	1174
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Drawn by	AL
Map author	JC

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Kilometers

1:600,000 (at A4) GDA 1994 MGA Zone 50

Study Area

Figure 5–2

Desktop records of conservation significant fauna

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5.2 FIELD SURVEY

5.2.1 Flora and vegetation

A total of 45 flora species and subspecies representing 17 families and 32 genera were recorded during the field surveys (Appendix 2). Species richness ranged from 7-18 species between sites (Appendix 1). The assemblage included 40 perennial species and 5 annual or short-lived species. The most prominent families recorded were the Fabaceae (12), Poaceae (4) Malvaceae (4) and Amaranthaceae (4). One introduced species, **Cenchrus ciliaris*, was recorded.

5.2.1.1 Conservation significant flora

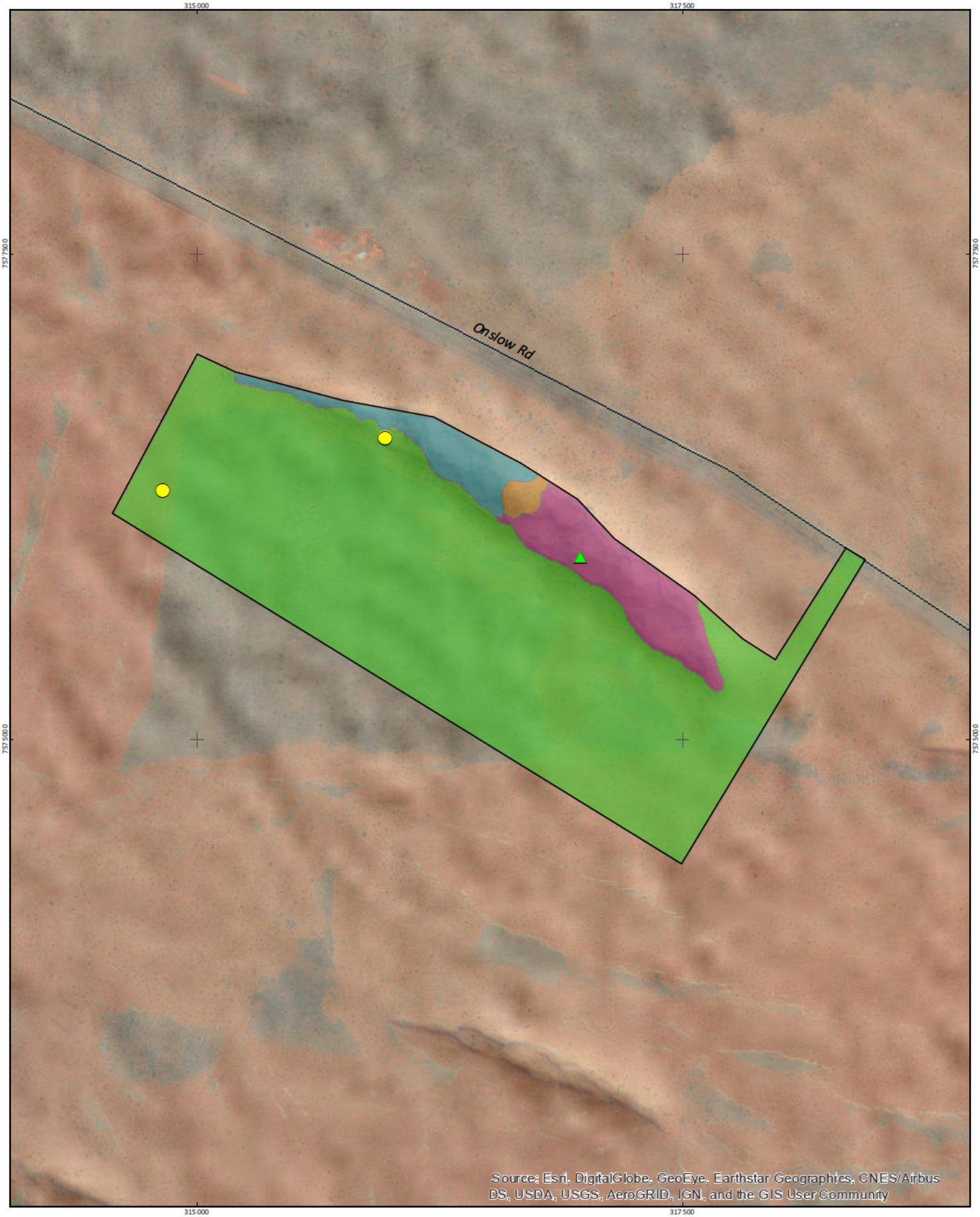
No Commonwealth or State listed Threatened flora were recorded in the Study Area during the survey. Two Priority flora were recorded during the survey (Figure 5-3):

- *Abutilon* sp. Pritzelianum (P1); and
- *Triumfetta echinata* (P3).

Based on habitats present, a further three of the six significant flora species identified in the desktop review may occur in the Study Area (Table 5-5).

Table 5-5 Likelihood of occurrence for conservation significant flora

Species	Conservation status	Likelihood of occurrence
Abutilon sp. Pritzelianum	P1	Recorded in isolated low *Corymbia hamersleyana* and/or *C. zygophylla* mallee over isolated mixed shrubs over low *Triodia basedowii* hummock grassland in red sandy clay on sandplain.
Abutilon sp. Onslow (F. Smith s.n. 10/9/61)	P1	Likely, all vegetation types and soil types within the Study Area are suitable habitat.
Helichrysum oligochaetum	P1	Unlikely, lack of suitable soils (clay) and vegetation types (woodlands) and habitat (alluvial plains) in Study Area.
Eleocharis papillosa	P3	Unlikely, lack of suitable soils (clay) and habitat (clay pans) in Study Area.
Eremophila forrestii subsp. *viridis*	P3	Likely, majority of vegetation types and soil types within the Study Area are suitable habitat.
Stackhousia clementii	P3	Unlikely, lack of suitable soils (skeletal soils) and habitat (sandstone hills) in Study Area.
Triumfetta echinata	P3	Recorded in mid open *Grevillea stenobotrya* shrubland over low open *Tephrosia virens* shrubland over low *Triodia basedowii*, *T. epactia* and *Aristida holathera* grassland in red sand on sand dune.
Goodenia nuda	P4	Possible, occasionally recorded on red sand plain but typically recorded on floodplains which do not occur in the Study Area.



Western Australia

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Project No	1174
Date	27/09/2017
Drawn by	AL
Map author	JC

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Kilometers

1:25,000 (at A4) GDA 1994 MGA Zone 50

Study Area

Conservation significant species

- *Abutilon* sp. Pritzelianum (S. van Leeuwen 5095) (P1)
- *Triumfetta echinata* (P3)

Vegetation type

- ChCzTb: Tb Hummock Grassland
- CzSsTb: Open Mallee Woodland
- GsQlTbTe: Open Shrubland 1
- GsTvTbTe: Open Shrubland 2

Figure 5-3

Conservation significant flora records and vegetation types from the study area

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5.2.1.1.1 *Abutilon* sp. Pritzelianum

Status: Priority 1

Description: Perennial, erect open shrub up to 1.8 m high and 1.6 m wide. Yellow-orange flowers and fruits in August.

Plate 1 *Abutilon* sp. Pritzelianum

Distribution and ecology: Occurs in the Carnarvon, Murchison and Pilbara bioregions (DBCA 2017). This species is known from 38 records (ALA 2017), with habitat descriptions including:

- *Eucalyptus camaldulensis* subsp. *obtuse* sparse open trees over sparse or open *Corchorus incanus* subsp. *incanus*, *Cullen martini* over *Aristida contorta* sparse or open tussock grass and *Triodia lanigera* hummock grassland
- *Acacia ancistrocarpa* and *A. inaequilatera* tall open shrubland over shrubland *A. stellaticeps* over *Triodia epactia* hummock grassland and *Triodia lanigera* hummock grassland
- Emergent trees of *Corymbia zygophylla* over *Triodia* ?*lanigera* and *T. epactia*
- *Eragrostis eriopoda* tussock grassland with *Aristida hygrometrica*, *Corchorus incanus*, *Triumfetta chaetocarpa* and *Aerva javanica*
- *Acacia* spp. with *Eremophila* spp., *Thryptomene* spp. and *Triumfetta chaetocarpa*
- Low shrubland with *Sida clementii*, *S. rohlenae*, *S. pilbarensis*, *Corchorus walcottii*, *Ipomoea muelleri*, *Acacia tumida*, *Abutilon otocarpum*, *Waltheria indica* and *Cajanus pubescens*

- Open *Melaleuca* shrubland with *Acacia* shrubland over *Chenopodium* spp. and *Sida* spp.
- *Verticordia* and *Grevillea stenobotrya* with scattered emergent *Corymbia hamersleyana* over dwarf scrub of *Sida* sp., *Acacia stellaticeps* and *A. adsurgens* over open forbland of *Ptilotus polystachyus* and *Calandrinia* sp. over mid-dense hummock grass of *Triodia* sp.
- *Acacia tetragonophylla* and *A. sclerosperma* open scrub over *Scholtzia* sp., *Rhagodia preissii* and *Pityrodia loxocarpa* open dwarf scrub over *Eragrostis lanipes* open dwarf scrub over mixed very open forbland.

Population sizes provided in records for the species (DBCA 2017) range from a solitary plant to in excess of 50 plants to comments of the species being frequent or common.

Records and distribution in Study Area: A total of three plants from two different populations were recorded in the Study Area (Figure 5-3). Both populations occurred in the same vegetation type:

- Isolated low *Corymbia hamersleyana* and/or *C. zygophylla* mallee over isolated mixed shrubs over low *Triodia basedowii* hummock grassland.

5.2.1.1.2 *Triumfetta echinata*

Status: Priority 3

Description: Prostrate shrub to 0.3 m high with yellow flowers in August that occurs in red sandy soils on sand dunes.

Plate 2 Triumfetta echinata

Distribution and ecology: Occurs in the Carnarvon, Gascoyne and Pilbara bioregions (DBCA 2017). This species is known from 10 records (ALA 2017), with habitat descriptions including:

- Shrubland of *Grevillea stenobotrya* and *Scaevola pulchella* over open grassland of *Triodia schinzii*, *Triodia epactia* and *Triumfetta echinata*.
- Open Shrubland of *Grevillea stenobotrya*, *Acacia coriacea* subsp. *coriacea* and *Tephrosia rosea* var. *clementii* low open shrubland *Pityrodia toxocarpa* over open hummock Grassland *Triodia epactia* and *Triodia schinzii*.
- Low open woodland, *Corymbia hamersleyana* and *Eucalyptus xerothermica* over open shrubland of *Acacia trachycarpa*, *Acacia ancistrocarpa*, *Acacia bivenosa* over very open hummock grassland of *Triodia lanigera*.
- Soft hummock grassland of *Triodia pungens*.

No population sizes are provided in records for the species (DBCA 2017).

Records and distribution in Study Area: A solitary plant was recorded in the Study Area (Figure 5-3) at the crest of a dune in vegetation type:

- Mid open *Grevillea stenobotrya* shrubland over low open *Tephrosia virens* shrubland over low *Triodia basedowii*, *T. epactia* and *Aristida holathera* grassland.

5.2.1.2 Introduced flora

One introduced flora species**Cenchrus ciliaris* was recorded in the survey (Figure 5-4). The species is not a declared pest nor WoNS.

5.2.1.1 Range extensions

There were no range extensions for any of the flora species recorded.

5.2.1.2 Unidentified flora

All taxa were identified to species level.

5.2.1.3 Vegetation types

A total of four vegetation types were defined for the Study Area (Table 5-6; Figure 5-3). The majority (86%) of vegetation types comprised a *Triodia basedowii* grassland (with isolated *Corymbia hamersleyana* and/or *C. zygophylla* mallee) on flat plain.

Two low open shrublands over *Triodia basedowii* and *T. epactia* grassland (with isolated tall *Grevillea stenobotrya* shrubs) and an open *Corymbia zygophylla* mallee woodland was found on a longitudinal inland sand dune top within small swales.

No major water bodies or drainage lines were seen in the Study Area.

5.2.1.4 Vegetation condition

The condition of vegetation across the Study Area was excellent according to the applied condition scale (Figure 5-4) with 2–3 small isolated scatterings of introduced species **Cenchrus ciliaris* on the northern lip of the longitudinal sand dune only and no tracks, erosion, or evidence of grazing.

There was evidence of a fire within the last year at site OWM05. The vegetation included a number of low ephemeral species in the herb layer.

5.2.1.1 Threatened and Priority Ecological Communities

No vegetation types identified within the Study Area were classified as either a TEC or PEC.

5.2.1.2 Local and regional significance of vegetation

Two vegetation types, Tb Hummock Grassland (ChCzTb) on flat plain and Open shrubland 2 (GsTvTbTe) on sand dune were classified as locally significant as they contain Priority flora, *Abutilon* sp. Pritzelianum (S. van Leeuwen 5095, P1) and *Triumfetta echinata* (P3) respectively.

Table 5-6 Vegetation types recorded in the Study Area

Vegetation type	Site/s	Vegetation description	Extent in Study Area (ha)	Photograph
GsQlTbTe	OWM01	**Open Shrubland 1** Isolated tall *Grevillea stenobotrya* shrubs over low open *Quoya loxocarpa*, *Acacia stellaticeps* and *Tephrosia rosea* var. Fortescue creeks shrubland over low sparse **Cenchrus ciliaris*, *Triodia basedowii* and *T. epactia* grassland	3.53	
GsTvTbTe	OWM02 OWM02A	**Open shrubland 2** Mid open Grevillea stenobotrya shrubland over low open Tephrosia virens shrubland over low *Triodia basedowii*, *T. epactia* and *Aristida holathera* grassland.	35.65	
ChCzTb	OWM03 OWM04 OWM05 OWM06 OWM07 OWM08A	**Hummock Grassland** Isolated low *Corymbia hamersleyana* and/or *C. zygophylla* mallee over isolated mixed shrubs over low *Triodia basedowii* hummock grassland	362.83	
CzSsTb	OWM08	**Open Mallee Woodland** Open mid *Corymbia zygophylla* mallee woodland over isolated low *Scaevola spinescens*, *Verticordia forrestii* and *Petalostylis labicheoides* shrubs over low *Triodia basedowii* hummock grassland.	20.21	

Talis Consultants
Pilbara Regional Waste Management Facility

Project No	1174
Date	27/09/2017
Drawn by	AL
Map author	JC

0 0.25 0.5 1
Kilometers

1:25,000 (at A4) GDA 1994 MGA Zone 50

Study Area

Cenchrus ciliaris

Vegetation condition

Excellent

Figure 5-4

Weed records and vegetation condition of the study area

PHOENIX ENVIRONMENTAL SCIENCES

5.2.2 Fauna and fauna habitats

5.2.2.1 Fauna habitats

The Study Area contains two broad fauna habitats (Table 5-7; Figure 5-5):

- **Mosaic of hummock grassland and shrubland on plain**: Approximately 85.9% of the Study Area comprised of a mosaic of hummock grassland and shrubland vegetation dominated by *Acacia* and *Grevillea* species on varying sandy to clay-loam and gravelly substrates. Vegetation consisted of scattered areas of mixed shrub cover ranging from 1–3 m over mixed smaller shrubs and hummock grasses and areas dominated by patches of immature and mature *Triodia* grasses. The habitat occurred predominantly in the western half of the Study Area and is well represented beyond the boundary of the Study Area. Mixed grassland and shrubland on plain habitat within the Study Area provides potential habitat for several species of conservation significance including Night Parrot, Greater Bilby, Short-tailed Mouse and Maryan's Keeled Slider in addition to potential foraging habitat for conservation significant birds of prey including the Grey Falcon and Peregrine Falcon.
- **Shrubland on sand dune**: The remaining 14.1% of the Study Area comprised of mixed shrubland on sand dune habitat, often dominated by *Acacia* and *Grevillea* species to 3 m over mixed smaller shrubs and mixed hummock and tussock grasses with large open areas of exposed dune. This habitat predominantly occurred along the eastern border of the Study Area and consisted of a single dune system running parallel to Onslow Road. Shrubland on sand dune habitat present within the Study Area provides suitable habitat for a number of conservation significant species including Greater Bilby, Rainbow Bee-eater and Maryan's Keeled Slider in addition to potential foraging habitat for conservation significant birds of prey including the Grey Falcon and Peregrine Falcon.

No prospective SRE invertebrate habitat was identified within the Study Area.

Table 5-7 Fauna habitats of the Study Area

Habitat	Area (ha)	Percentage
Mosaic of hummock grassland and shrubland on plain	362.83	85.9%
Shrubland on sand dune	59.39	14.1%
Total	422.22	100%

5.2.2.1 Fauna species

Seventeen vertebrate fauna species were recorded within the Study Area during the field survey (Table 5-8). No Threatened or Priority fauna were recorded; however, one WC Act listed Migratory species was recorded, Rainbow Bee-eater (*Merops ornatus*). The species was recorded twice from direct observation and call in shrubland on sand dune habitat within the Study Area (Figure 5-5); however, the species is considered likely to occur frequently in both broad fauna habitats mapped within the Study Area. Suitable habitat was identified for a further eight conservation significant species within the Study Area (Table 5-9). The remaining 47 conservation significant species identified in the desktop review, predominantly migratory shorebirds and waterbirds, are considered unlikely to occur within the Study Area due to the lack of any suitable habitat.

Talis Consultants

Pilbara Regional Waste Management Facility

Project No	1174
Date	27/09/2017
Drawn by	AL
Map author	JC

0 0.25 0.5 1

Kilometers

1:25,000 (at A4) GDA 1994 MGA Zone 50

- Study Area
- *Merops ornatus* (Rainbow Bee-eater) (mig.)

Fauna Habitat Description

- Mosaic of hummock grassland and shrubland on plain
- Shrubland on sand dune

Figure 5-5

Fauna habitats and conservation significant fauna records for the survey

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Table 5-8 Vertebrate taxa recorded during the survey

Species	Common name
Reptiles	
Ctenophorus isolepis	Central Military Dragon
Tiliqua multifasciata	Central Blue-tongue
Birds	
Ardeotis australis	Australian Bustard
Dicaeum hirundinaceum	Mistletoebird
Eremiornis carteri	Spinifex-bird
Geopelia cuneata	Diamond Dove
Malurus leucopterus	White-winged Fairy-wren
Merops ornatus	Rainbow Bee-eater
Ocyphaps lophotes	Crested Pigeon
Rhipidura leucophrys	Willie Wagtail
Taeniopygia guttata	Zebra Finch
Turnix velox	Little Button-quail
Mammals	
Chalinolobus gouldii	Gould's Wattled Bat
Scotorepens greyii	Little Broad-nosed Bat
Saccolaimus flaviventris	Yellow-bellied Sheath-tailed Bat
Felis catus	Cat
Vulpes vulpes	Red Fox

Table 5-9 Likelihood of occurrence assessment for conservation significant fauna

Scientific name	Common name	Conservation status[1]			Likelihood of occurrence	Fauna habitat		Summary of records and occurrence	Nearest record to the Study Area (DPaW 2017)
		EPBC Act	WC Act	DBCA		Mosaic of hummock grassland and shrubland on plain	Shrubland on sand dune		
REPTILES									
Lerista planiventralis maryani	Maryan's Keeled Slider			P1	Likely	•	•	Likely to occur in areas where loose sandy substrates and leaf litter present throughout the Study Area.	~32 km north-northwest
Liasis olivaceus barroni	Pilbara Oliver Python	VU	VU		Unlikely			Suitable habitat not present	~32 km north-northwest
BIRDS									
Tringa hypoleucos	Common Sandpiper	Mig	Mig		Unlikely			Suitable habitat not present	~31 km northwest
Apus pacificus	Fork-tailed Swift	Mig	Mig		Likely	•	•	Likely to occasionally occur above the study are to forage; however, unlikely to land or nest within the Study Area.	~17.5 km west-northwest
Ardea modesta	Great Egret		Mig		Unlikely			Suitable habitat not present	~14 km west
Arenaria interpres	Ruddy Turnstone	Mig	Mig		Unlikely			Suitable habitat not present	~31 km northwest
Calidris acuminata	Sharp-tailed Sandpiper	Mig	Mig		Unlikely			Suitable habitat not present	~31 km northwest
Calidris alba	Sanderling	Mig	Mig		Unlikely			Suitable habitat not present	~31 km northwest
Calidris canutus rogersi	Red Knot (north-eastern Siberia)	EN/Mig	VU/Mig		Unlikely			Suitable habitat not present	~38 km northwest
Calidris ferruginea	Curlew Sandpiper	CR/Mig	VU/Mig		Unlikely			Suitable habitat not present	~30 km north-northwest
Calidris ruficollis	Red-necked Stint	Mig	Mig		Unlikely			Suitable habitat not present	~29 km northwest

Scientific name	Common name	Conservation status[1]			Likelihood of occurrence	Fauna habitat		Summary of records and occurrence	Nearest record to the Study Area (DPaW 2017)
		EPBC Act	WC Act	DBCA		Mosaic of hummock grassland and shrubland on plain	Shrubland on sand dune		
Calidris tenuirostris	Great Knot	CR/Mig	VU/Mig		Unlikely			Suitable habitat not present	~31 km northwest
Charadrius leschenaultii	Greater Sand Plover	VU/Mig	VU/Mig		Unlikely			Suitable habitat not present	~31 km northwest
Charadrius mongolus	Lesser Sand Plover	EN/Mig	EN/Mig		Unlikely			Suitable habitat not present	~31 km northwest
Charadrius veredus	Oriental Plover	Mig	Mig		Unlikely			Suitable habitat not present	~23 km northwest
Chlidonias leucopterus	White-winged Black Tern	Mig	Mig		Unlikely			Suitable habitat not present	~31 km northwest
Falco peregrinus	Peregrine Falcon		SP		Possible	•	•	May occasionally occur within Study Area to forage, though unlikely to nest due to the absence of suitbale nesting sites.	~18 km northwest
Gelochelidon nilotica	Gull-bileld Tern	Mig	Mig		Unlikely			Suitable habitat not present	~31 km northwest
Glareola maldivarum	Oriental Pratincole	Mig	Mig		Unlikely			Suitable habitat not present	~21 km northwest
Limosa lapponica menzbieri	Bar-tailed Godwit (northern Siberian)	CR/Mig	VU/Mig		Unlikely			Suitable habitat not present	~31 km northwest
Limosa lapponica baueri	Bar-tailed Godwit (western Alaskan)	VU/Mig	VU/Mig		Unlikely			Suitable habitat not present	Unknown, not records of subspecies within desktop search area.

Scientific name	Common name	Conservation status[1]			Likelihood of occurrence	Fauna habitat		Summary of records and occurrence	Nearest record to the Study Area (DPaW 2017)
		EPBC Act	WC Act	DBCA		Mosaic of hummock grassland and shrubland on plain	Shrubland on sand dune		
Merops ornatus	Rainbow Bee-eater		Mig		Recorded	•	•	Recorded twice in the Study Area during the field survey in shrubland on sand dune habitat. Previously recorded multiple times within 20 km of the Study Area.	~5 km west-northwest
Numenius madagascariensis	Eastern Curlew	CR/Mig	VU/Mig		Unlikely			Suitable habitat not present	~30 km northwest
Numenius minutus	Little Curlew	Mig	Mig		Unlikely			Suitable habitat not present	~30 km northwest
Numenius phaeopus	Whimbrel	Mig	Mig		Unlikely			Suitable habitat not present	~31 km northwest
Pandion haliaetus	Osprey	Mig	Mig		Unlikely			Suitable habitat not present	~31 km northwest
Pezoporus occidentalis	Night Parrot	EN	CR		Possible	•		Species habitat preferences poorly known; however, may occur in areas where suitable vegetation present to forage or nest, particularly areas with mature *Triodia* which may be used for nesting.	~31 km north-northwest
Pluvialis squatarola	Grey Plover		Mig		Unlikely			Suitable habitat not present	~30 km northwest
Puffinus pacificus	Wedge-tailed Shearwater	Mig	Mig		Unlikely			Suitable habitat not present	~30 km north-northwest
Sterna caspia	Caspian Tern	Mig	Mig		Unlikely			Suitable habitat not present	~31 km northwest
Sterna dougallii	Roseate Tern	Mig	Mig		Unlikely			Suitable habitat not present	~31 km northwest
Sterna hirundo	Common Tern	Mig	Mig		Unlikely			Suitable habitat not present	~31 km northwest

Scientific name	Common name	Conservation status[1]			Likelihood of occurrence	Fauna habitat		Summary of records and occurrence	Nearest record to the Study Area (DPaW 2017)
		EPBC Act	WC Act	DBCA		Mosaic of hummock grassland and shrubland on plain	Shrubland on sand dune		
Sterna nereis nereis	Fairy Tern	VU	VU		Unlikely			Suitable habitat not present	~32 km north-northwest
Tringa brevipes	Grey-tailed Tattler	Mig	Mig	P4	Unlikely			Suitable habitat not present	~31 km northwest
Tringa glareola	Wood Sandpiper	Mig	Mig		Unlikely			Suitable habitat not present	~31 km northwest
Tringa nebularia	Common Greenshank	Mig	Mig		Unlikely			Suitable habitat not present	~31 km northwest
Elanus scriptus	Letter-winged Kite			P4	Unlikely			Study area outside of species known range. Single record from 1979 likely to be a misidentification of a more common Black-shouldered Kite (*Elanus acillaris*)	~38 km north-northwest
Falco hypoleucos	Grey Falcon		VU		Possible	•	•	May occasionally occur within Study Area to forage, though unlikely to nest due to the absence of suitbale tall nesting structures.	~41 km south-southeast
Limosa limosa	Black-tailed Godwit	Mig	Mig		Unlikely			Suitable habitat not present	~36 km northwest
Pluvialis fulva	Pacific Golden Plover		Mig		Unlikely			Suitable habitat not present	~56 km north-northeast
Sterna albifrons	Little Tern	Mig	Mig		Unlikely			Suitable habitat not present	~31 km northwest
Sula leucogaster	Brown Booby	Mig	Mig		Unlikely			Suitable habitat not present	~55 km northwest
Tringa stagnatilis	Marsh Sandpiper	Mig	Mig		Unlikely			Suitable habitat not present	~52 km northeast
Anous stolidus	Common noddy	Mig	Mig		Unlikely			Suitable habitat not present	unknown, no records of species within desktop search

Scientific name	Common name	Conservation status[1]			Likelihood of occurrence	Fauna habitat		Summary of records and occurrence	Nearest record to the Study Area (DPaW 2017)
		EPBC Act	WC Act	DBCA		Mosaic of hummock grassland and shrubland on plain	Shrubland on sand dune		
									area.
Calonectris leucomelas	Streaked Shearwater	Mig	Mig		Unlikely			Suitable habitat not present	unknown, no records of species within desktop search area.
Hirundo rustica	Barn Swallow	Mig	Mig		Unlikely			Suitable habitat not present	unknown, no records of species within desktop search area.
Motacilla cinerea	Grey Wagtail	Mig	Mig		Unlikely			Suitable habitat not present	unknown, no records of species within desktop search area.
Motacilla flava	Yellow Wagtail	Mig	Mig		Unlikely			Suitable habitat not present	unknown, no records of species within desktop search area.
Calidris melanotos	Pectoral Sandpiper	Mig	Mig		Unlikely			Suitable habitat not present	unknown, no records of species within desktop search area.
MAMMALS									
Dasyurus hallucatus	Northern Quoll	EN	EN/Mig		Unlikely			Suitable habitat not present	~27 km northwest
Leggadina lakedownensis	Short-tailed Mouse			P4	Likely	•		Likely to occur througout the Study Area where suitable vegetation cover present.	~21 km northwest

Scientific name	Common name	Conservation status[1]			Likelihood of occurrence	Fauna habitat		Summary of records and occurrence	Nearest record to the Study Area (DPaW 2017)
		EPBC Act	WC Act	DBCA		Mosaic of hummock grassland and shrubland on plain	Shrubland on sand dune		
Perameles bougainville	Western Barred Bandicoot	EN	VU		Unlikely			Study area outside of species current known range. Considered to be extinct on the mainland.	~37 km northwest
Pseudomys chapmani	Western Pebble-mound Mouse			P4	Possible	•		May occur in areas where suitable stony or gravelly substrates providing suitable pebbles present; however, sparse within the Study Area. Species often recorded in areas of low undulating topography and gentle stony slopes througout most of its range.	~19 km northwest
Macroderma gigas	Ghost Bat	VU	VU		Unlikely			Suitable roost not present.	unknown, no records of species within desktop search area.
Macrotis lagotis	Greater Bilby	VU	VU		Unlikely	•	•	Study area outside of species current known range; however, within known historic range. Suitable habitat present wihtin the Study Area; however, the large scale historic decline and reduction of distibution indicates species unlikely to occur.	unknown, no records of species within desktop search area.
Rhinonicteris aurantia (Pilbara form)	Pilbara Leaf-nosed Bat	VU	VU		Unlikely			Suitable roost not present.	unknown, no records of species within desktop search area.

5.3 SURVEY LIMITATIONS

The limitations of the survey have been considered (Table 5-10) in accordance with EPA technical guidance (EPA 2016d, f).

Table 5-10 Survey limitations

Limitations	Limitation for this survey?	Comments
Competency/experience of survey personnel, including taxonomy	No	The field team and report authors have extensive experience in terrestrial fauna and flora and vegetation surveys within the region and across WA.
Scope and completeness	Yes	All target groups, conservation significant species and habitats within the Study Area were surveyed adequately. A reconnaissance flora survey was conducted and subsequently full plant assemblages were not recorded.
Intensity / effort and extent	No	The survey intensity was appropriate for the areas that were surveyed and conservation significant species targeted.
Proportion of flora and fauna identified, recorded and/or collected.	No	All fauna was identified to species level in the field with the exception of analysis of bat echolocation call recordings. Bat echolocation call recordings were analysed by an external expert on return to Perth.
Availability of adequate contextual information	Partial	With the exception of extensive marine and shorebird surveys to the northwest of the Study Area around Onslow, there have been limited surveys within the vicinity and broader region of the Study Area.
Timing, weather, season, cycle	No	Weather preceding and during the survey was comparable to annual averages for previous years.
Disturbances which affected the results of the survey	No	No disturbances occurred during the field survey which are considered to have impacted the results.
Remoteness and/or access problems	No	The whole of the Study Area was accessible by foot.

6 DISCUSSION

6.1 FLORA AND VEGETATION VALUES

Two of the eight Priority flora identified as potentially present in the Study Area in the desktop review were recorded during the field survey, *Abutilon* sp. Pritzelianum (P1) and *Triumfetta echinata* (P3). The Study Area represents suitable habitat for a further three Priority flora identified in the desktop review, *Abutilon* sp. Onslow (P1), *Eremophila forrestii* subsp. *viridis* (P3) and *Goodenia nuda* (P4). The presence of the remaining three Priority flora identified from the desktop review is considered unlikely due to a lack of suitable soil and/or habitat type.

The identity of both Priority flora are pending verification from the state herbarium at the time of preparing this report. The records for the two Priority flora in the Study Area, *Abutilon* sp. Pritzelianum (Priority 1) and *Triumfetta echinata* (Priority 3) are not considered to be of high significance.

The two records for *Abutilon* sp. Pritzelianum would represent new populations for the species with the nearest previously known record located approximately 25 km from the Study Area. *Abutilon* sp. Pritzelianum has as a wide distribution occurring across the Carnarvon, Murchison and Pilbara bioregions. Florabase (DBCA 2017) lists thirty one records with population sizes ranging from single individuals to in excess of fifty plants. Only three plants were recorded in the Study Area, representing a very small proportion of the records provided in Florabase. The Study Area is located well within the species' distribution, therefore the records for the Study Area do not represent a population at the edge of its known range.

The record for *Triumfetta echinata* represents a new record for the species with the nearest previously known record located approximately 11 km from the Study Area and records for the species are spread across the Carnarvon, Gascoyne and Pilbara bioregions. Only a single plant was recorded in the Study Area, which is located well within the species recorded distribution. A lack of population numbers for all of DBCA (2017) records precludes the capacity to determine what proportion the single plant recorded in the Study Area represents of the total population of the species.

None of the vegetation types defined for the Study Area a representative of any Federal or State listed TEC or PEC.

The vegetation types defined for the Study Area are representative of the broad vegetation type mapped by Shepherd *et al.* (2002) defined as Hummock grasslands, shrub steppe; kanji over soft spinifex & *Triodia basedowii*. Consequently, the vegetation in the Study Area represents a widespread community well represented at a regional level with 99% of pre-European extent remaining. The vegetation in the Study Area is therefore considered to have low regional conservation significance.

Almost half of the vegetation in the Study Area was considered locally significant due to the presence of conservation significant flora.

6.2 FAUNA VALUES

One species of conservation significant fauna was recorded during the field survey and a further eight may occur based on the presence of suitable habitat within the Study Area; however, both broad fauna habitats identified are widely distributed and well represented outside of the Study

Area, including other parts of ex Mt Minnie Station currently proposed for addition to the Cane River Nature Reserve (Figure 1-1).

The Study Area contains suitable habitat for nine significant fauna species (Table 5-9); however, most of these are likely to occur as occasional visitors only. The only significant fauna species recorded in the survey, the Migratory Rainbow Bee-eater is a common and widespread species and is unlikely to be significantly impacted by the Project.

Potential habitat for Night Parrot is present but the species was not detected in acoustic call recordings conducted during the survey. Current guidance identifies broad habitat requirements for the species as including areas of old-growth spinifex (*Triodia*) for roosting and nesting, together with foraging habitats that are likely to include various native grasses and herbs, and may or may not contain shrubs or low trees (DPaW 2017b). At the local (site) level, roosting and nesting sites are in clumps of dense vegetation, primarily old and large spinifex clumps (often >50 years unburnt), especially hummocks that are ring-forming; these may be in expanses or isolated patches, but sometimes associated with other vegetation types, such as dense chenopod shrubs (DPaW 2017b).

Scattered small patches of mature spinifex was identified throughout parts of the Study Area, particularly within areas mapped as mosaic of hummock grassland and shrubland on plain fauna habitat. The Study Area is within the area defined as 'medium priority' for survey by the current guidance (DPaW 2017b). The acoustic survey for calls of the species was conducted in accordance current guidance (DPaW 2017b). When considering the likelihood of Night Parrots to occur in the Study Area, it is important to consider that no available survey technique can irrefutably demonstrate that the species is absent from a site (DPaW 2017b).

6.3 Matters of National Environmental Significance Summary

No matters of NES listed under the EPBC Act were recorded in the Study Area.

The fauna assessment identified potential for the Night Parrot, which is Endangered under the EPBC Act, to occur based on presence of suitable habitat. Refer to Section 6.2 for discussion on this species.

The fauna assessment identified potential for the Fork-tailed Swift to occur which is Migratory under the EPBC Act. It was considered to occasionally occur above the study are to forage; however, unlikely to land or nest within the Study Area. It is therefore unlikely that the species would be impacted by the Project.

6.4 Commentary against the 10 clearing principles

Preliminary comments are provided on the potential for native vegetation clearing within the Study Area to be at variance with any of the clearing principles (Table 6-1).

Table 6-1 Commentary against the clearing principles

Principle	Statement against principle
A) Native vegetation should not be cleared if it comprises a high level of biological diversity	**Potential to trigger Principle A: unlikely** Vegetation in the Study Area is of low species diversity. The vegetation in the Study Area is representative of Pindan shrubland which is extensive throughout the Pindanland subregion. The vegetation of the Study Area does not comprise any PECs.

	Vegetation within the Study Area supports populations of Priority flora; however, the vegetation is not an isolated remnant and is not diverse: - Suitable habitat for *Abutilon* sp. Pritzelianum (Priority 1) present. Species has as a wide distribution (Carnarvon, Murchison and Pilbara bioregions). Florabase lists 31 records with counts ranging from single individuals to in excess of 50 plants. Only three plants were recorded in the Study Area. Suitable habitat for *Triumfetta echinata* (Priority 3) is present. Species has as a wide distribution (Carnarvon, Gascoyne and Pilbara bioregions). Florabase lists seven records, no population sizes provided. Only a single plant was recorded in the Study Area.
B) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia	**Potential to trigger Principle B: unlikely** The Study Area contains suitable habitat for nine significant fauna species. Of these one was recorded in the survey –Rainbow Bee-eater (Migratory). The Rainbow Bee-eater is a common and widespread species and is unlikely to be significantly impacted by the Project. Potential habitat for Night Parrot is present but the species was not detected in acoustic call recordings conducted during the survey. The other potential species are likely to be occasional visitors only. Similar fauna habitat to that within the Study Area is extensively represented elsewhere more broadly on Mt Marion Station.
C) Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora	**Potential to trigger Principle C: unlikely** No rare (Threatened) flora species were recorded in the Study Area during the flora and vegetation survey.
D) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a Threatened Ecological Community (TEC)	**Potential to trigger Principle D: unlikely** No TEC is located within the Study Area.
E) Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has extensively cleared	**Potential to trigger Principle E: unlikely** The Study Area does not occur in an area that has been extensively cleared. The broad vegetation association mapped by Beard for the Study Area (Shepherd *et al.* 2002), association 98 – Hummock grasslands, shrub steppe; kanji over soft spinifex & *Triodia basedowii*, is extensively represented in the Cape Range subregion with 221,812 ha (nearly 100% of original extent) remaining based on Government of Western Australia (2016).
F) Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse of wetland	**Potential to trigger Principle F: unlikely** There are no watercourses or wetlands present in the Study Area.
G) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land	**Potential to trigger Principle G: unlikely** Clearing of a comparatively small area in the absence of water courses presents a low risk of excessive erosion that may cause land degradation.

degradation	
H) Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area	**Potential to trigger Principle H: possible** The Study Area is located within DBCA managed land parcel designated as Unallocated Crown Land – former leasehold proposed for conservation (ex Mt Minnie pastoral lease). The former Mt Minnie Station is proposed to be added to the Cane River Conservation Park, located southeast of the Study Area. Development of the Project will need to ensure appropriate onsite controls are implemented to prevent adverse impacts on the remainder of the DBCA land parcel proposed to be transferred to the conservation estate.
I) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water	**Potential to trigger Principle I: unlikely** No surface water systems are present within or in the vicinity of the Study Area. Groundwater values were not covered under this scope of works.
J) Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence of flooding	**Potential to trigger Principle J: unlikely** There are no watercourses or wetlands present in the Study Area, therefore low potential to exacerbate the incidence of flooding.

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Appendix 2 Flora species inventory

Family	Species
Aizoaceae	*Trianthema pilosum*
Amaranthaceae	*Ptilotus astrolasius*
	Ptilotus axillaris
	Ptilotus fusiformis
	Ptilotus nobilis
Asteraceae	*Streptoglossa liatroides*
Chenopodiaceae	*Maireana melanocoma*
Cleomaceae	*Cleome uncifera*
Euphorbiaceae	*Adriana tomentosa*
Fabaceae	*Acacia ancistrocarpa*
	Acacia bivenosa
	Acacia stellaticeps
	Acacia trachycarpa
	Acacia victoriae
	Indigofera colutea
	Isotropis atropurpurea
	Petalostylis labicheoides
	Senna artemisioides
	Tephrosia rosea var. Fortescue creeks (M.I.H. Brooker 2186)
	Tephrosia uniovulata
	Tephrosia virens
Goodeniaceae	*Goodenia microptera*
	Scaevola spinescens
Gyrostemonaceae	*Codonocarpus cotinifolius*
	Gyrostemon ramulosus
Hemerocallidaceae	*Corynotheca pungens*
Lamiaceae	*Dicrastylis cordifolia*
	Quoya loxocarpa
	Quoya paniculata
Malvaceae	*Abutilon* sp. Pritzelianum (S. van Leeuwen 5095) (P1 WC Act)
	Gossypium australe
	Sida rohlenae subsp. *rohlenae*

Family	Species
	Triumfetta echinata (P3 WC Act)
Myrtaceae	*Corymbia hamersleyana*
	Corymbia zygophylla
	Verticordia forrestii
Plantaginaceae	*Stemodia* sp. Onslow (A.A. Mitchell 76/148)
Poaceae	*Aristida holathera*
	**Cenchrus ciliaris*
	Triodia basedowii
	Triodia epactia
Proteaceae	*Grevillea eriostachya*
	Grevillea stenobotrya
	Hakea lorea
Solanaceae	*Solanum lasiophyllum*