Flora, vegetation and fauna assessment

Newdegate Grain Receival Site Expansion

Prepared for
CBH Group

13 December 2018




DOCUMENT TRACKING

Item	Detail
Project Name	CBH Newdegate Grain Receival Site Approvals
Project Number	18PER-11736
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Status	FINAL
Version Number	2
Last saved on	13 December 2018
Cover photo	(L-R) Eucalypt woodland of the WA Wheatbelt TEC (R. Hide 2018); *Eucalyptus salmonophloia* woodland (Eco Logical Australia 2018); Mural on CBH grain silos in Newdegate (J. Morris 2018); *Tecticornia* and *Atriplex* heath (R. Hide 2018).

This report should be cited as 'Eco Logical Australia 2018. *Newdegate Grain Receival Site Expansion flora, vegetation and fauna assessment*. Prepared for CBH Group.'

ACKNOWLEDGEMENTS

This document has been prepared by Eco Logical Australia Pty Ltd with support from CBH Group

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Abbreviations

Abbreviation	Description
BAM Act	State *Biosecurity and Agriculture Management Act 2007*
BoM	Bureau of Meteorology
CBH	CBH Group
CLUSTER	Hierarchical Clustering
CR	Critically Endangered
DAFWA	Department of Agriculture and Food Western Australia
DBCA	Department of Biodiversity Conservation and Attractions
DoEE	Department of the Environment and Energy

DPIRD	Department of Primary Industries and Regional Development
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities
ELA	Eco Logical Australia
EN	Endangered
EP Act	State *Environmental Protection Act 1986*
EPA	Environmental Protection Authority
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
ESA	Environmentally Sensitive Areas
GPS	Global Positioning System
ha	hectare
HQC	Habitat quality category
IBRA	Interim Biogeographical Regionalisation for Australia
km	kilometre
MAL2	Western Mallee IBRA subregion
mm	millimetres
NVIS	National Vegetation Information System
P	Priority
PEC	Priority Ecological Community
PMST	Protected Matters Search Tool
PRIMER	Plymouth Routines in Multivariate Ecological Research v6
SIMPER	Similarity Percentages
SIMPROF	Similarity Profile
TEC	Threatened Ecological Community
VU	Vulnerable
WA	Western Australia
WAH	Western Australian Herbarium
WAM	Western Australian Museum
WC Act	State *Wildlife Conservation Act 1950*

Executive summary

Eco Logical Australia (ELA) was engaged by CBH Group (CBH) to undertake a flora, vegetation and fauna assessment at a 24.8 ha expansion site adjacent to the existing Newdegate Grain Receival Site (the study area). A detailed flora and vegetation survey, targeted flora survey, a Level 1 fauna survey and a targeted Malleefowl (*Leipoa ocellata*) survey was required to fill in previous ecological survey information gaps within the study area in accordance with relevant State and Commonwealth guidance, prior to the submission of an *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Referral and a Native Vegetation Clearing Permit under Part V of the *Environmental Protection Act 1986* for the future development. The field survey was conducted from the 5 to 7 November 2018. Results were combined with data from previous ecological surveys undertaken at the site, predominately a Level 2 flora and vegetation survey undertaken by 360 Environmental (2015a) and a Level 1 flora, vegetation and fauna survey completed by Cardno (2014).

A total of 178 taxa (including species, subspecies, varieties and forms, and specimens not identified to species level) from 111 genera and 42 families were recorded from quadrats, relevés and opportunistic collections in the study area during the current and previous surveys (360 Environmental 2015a; Cardno 2014). Of these taxa, 32 were introduced. The ELA and 360 Environmental (2015a) quadrat species richness ranged from 7 to 35 taxa with an average of 17.2 taxa per quadrat.

Priority 1 flora species *Thysanotus lavanduliflorus* was recorded in the north-west corner of the study area. A total of 15 individuals were observed in vegetation association Es. No other threatened or priority flora taxa were recorded within the study area during the current or past surveys. A post-field likelihood of occurrence assessment determined that one other priority species, *Haegiela tatei* (P4), had the potential to occur in the study area, and may have been overlooked due to its small stature.

Six vegetation communities were originally mapped within the study area (360 Environmental 2015a), and are predominantly comprised of *Eucalyptus* open forest, with some areas of *Melaleuca* shrubland and *Tecticornia* heath. The current survey completed eight additional quadrats, which following statistical analysis, were found to correlate with the existing vegetation communities. Vegetation within the study area was primarily in Very Good condition (86.6% of the study area). The remainder was in Good, Degraded and Completely Degraded condition, with some areas cleared for tracks.

An assessment utilising the key diagnostic characteristics (DoE 2015) of the Eucalypt woodlands of the Western Australian Wheatbelt community, a Critically Endangered Threatened Ecological Community (TEC) listed under the EPBC Act and a State-listed Priority 3 Priority Ecological Community (PEC), determined that 16.6 ha of this TEC/PEC was present in the study area. Of this area, 8.8 ha is also considered to represent the Red Morrel Woodlands of the Wheatbelt, a Priority 1 PEC that can co-occur with the Eucalypt woodlands of the Western Australian Wheatbelt TEC/PEC.

Three broad fauna habitats are present within the study area, *Eucalyptus* open forest, *Eucalyptus* mallee over *Melaleuca* shrubland and *Tecticornia* heath. Fifteen species of native vertebrate fauna were recorded during current and previous fauna surveys, including two mammals, twelve birds and one reptile. Three introduced mammals and two introduced birds were also recorded (Cardno 2014; 360 Environmental 2015a, b; ELA 2018a).

One conservation listed fauna species has previously been observed within the study area, the Red-tailed Phascogale (*Phascogale calura*). A likelihood of occurrence assessment for other conservation listed fauna species determined two species were likely to occur within the study area, Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) and the Western Rosella (*Platycercus icterotis xanthogenys*). A

further ten species were considered to potentially occur, with six of these species considered to be vagrant birds that may occasionally visit the study area. Malleefowl were not observed during the field survey, but may potentially utilise the area on occasion to forage.

1 Introduction

1.1 Background

CBH Group (CBH) is proposing an expansion to the existing Newdegate Grain Receival Site. Eco Logical Australia (ELA) was engaged by CBH to undertake a flora, vegetation and fauna assessment at the expansion site (the study area). This assessment is proposed to ensure ecological information gaps for the site are filled prior to the submission of a Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Referral and Western Australian Native Vegetation Clearing Permit application under Part V of the *Environmental Protection Act 1986* (EP Act) in support of the future development. The assessment included targeted *Thysanotus lavanduliflorus* and Malleefowl (*Leipoa ocellata*) surveys. The results from the field survey have been combined with data from previous ecological surveys undertaken at the site, predominately a Level 2 flora and vegetation survey undertaken by 360 Environmental (2015a) and a Level 1 flora, vegetation and fauna survey completed by Cardno (2014).

1.2 Study area

The study area is 24.8 hectare (ha) vegetated area located on Lake Biddy Road, Newdegate, approximately 400 kilometres (km) south-east of Perth, Western Australia. The study area comprises partial Lots 102 and 208, unallocated crown land, an unmade road reserve and a rail reserve located at Lake Biddy Road, and lies adjacent to CBH's existing grain receival site and the Water Corporation's waste water treatment ponds. The study area is approximately 0.5 km south east from the main street of Newdegate town (**Figure 1**). The town cemetery is located adjacent to the north west border, and Lake Stubbs is located to the north east. The CBH railway is runs along the south west border, parallel to Lake Biddy Road. Under the Shire of Lake Grace Local Planning Scheme, the site is a mixture of general agriculture zoning and conservation reserve.

Figure 1: Location of the study area

2 Desktop assessment

2.1 Biophysical environment

2.1.1 Regional context

The study area is located in the Western Mallee (MAL2) subregion within the Mallee Interim Biogeographic Regionalisation for Australia (IBRA) bioregion (Department of the Environment and Energy (DoEE) 2018). The Mallee bioregion is the south-eastern part of Yilgarn Craton. It is described as having a gently undulating landscape, with partially obstructed drainage. Mallee over myrtaceous-proteaceous heaths on duplex (sand over clay) soils are common. A mosaic of mixed eucalypt woodlands and mallee occur on calcareous earth plains and sandplains overlying Eocene limestone strata in the east. The landscape is fragmented, with particular surface-types almost completely cleared as wheat fields (Beecham and Danks 2001).

2.1.2 Climate

The Western Mallee subregion experiences a warm, Mediterranean climate, with annual rainfall between 250 – 500 mm. The Newdegate Research Station (station number 10692), located approximately 16 km to the west of the study area, reports that on average, the area receives 372.4 mm of rainfall per annum (Bureau of Meteorology (BoM) 2018a). This rainfall falls throughout the year, with the greatest falls during winter. Maximum mean monthly temperatures range from 31.2°C (January) to 15.2°C (July). Minimum mean monthly temperatures range from 14.1°C (February) to 4.1°C (July).

2.1.3 Broad-scale vegetation mapping

Vegetation type and extent have been mapped at a regional scale by Beard (1972) who categorised vegetation into broad vegetation associations. Based on this mapping, the Department of Primary Industries and Regional Development (DPIRD; previously Department of Agriculture and Food Western Australia; DAFWA) has compiled a list of vegetation extent and types across WA (Shepherd et al. 2002).

Five of these vegetation associations were found to occur within the broader vicinity of the study area (**Table 1**), and comprise of shrublands, medium woodland and salt lakes. The study area is mapped as vegetation association Hyden 511 (e8,9Mi; medium woodland; Salmon Gum and Morrel). A total of 38,059 ha (37%) of Hyden 511 remains within the Western Mallee sub-region (Government of WA 2018).

Table 1: Beard (1972) / Shepherd *et al.* (2002) vegetation associations in the vicinity of the study area.

Vegetation association	Description	Mapping code	Class	Structural formation
125	Bare areas; salt lakes	sl	N/A	N/A
380	Shrublands; scrub-heath on sandplain	x3SZc	Mallee	Open mallee shrubland
511	Medium woodland; salmon gum & morrel	e8,9Mi	Tree	Woodland
519	Shrublands; mallee scrub, *Eucalyptus eremophila*	e15Si	Tree	Isolated trees
945	Mosaic: Medium woodland; salmon gum / Shrublands; mallee scrub, redwood & black marlock	e8Mi/e10,27Si	Tree	Woodland
			Mallee	Open mallee shrubland

2.1.4 Geology and soils

The site is mapped as the following broad scale geology units (1:250,000 scale geological maps from Geological Survey of WA and Geoscience Australia 2008):

- Qdlu (lunette dunes 72955): Quartz and gypsum dunes and mounds (kopi); may include minor silt, sand, gravel, and clay flats adjacent to playas; locally includes some playa sediments; and
- Czs (sand plain 38499): Sand or gravel plains; quartz sand sheets commonly with ferruginous pisoliths or pebbles, minor clay; local calcrete, laterite, silcrete, silt, clay, alluvium, colluvium, aeolian sand.

Soil-landscape mapping describes broad soil and landscape characteristics from regional to local scales. The study area is within the South-eastern Zone of Ancient Drainage within the Avon Province, which is described as a smooth to irregularly undulating plain dominated by salt lake chains in the main valleys with duplex and lateritic soils on the uplands. It supports mallee vegetation on duplex soils, and proteaceous vegetation on gravels and sands (DAFWA 2014).

2.1.5 Surface and groundwater

The majority of the study area lies within the Albany Coast basin, the Magenta Internal catchment and the Lake Stubbs sub-catchment (Department of Water and Environment Regulation (DWER) 2018a). The study area slopes gradually towards Lake Stubbs, a salt lake located to the north east. The groundwater in the study area is mapped as very saline, at >35,000 mg/L TSD (DPIRD 2018). The study area is not located within in any designated wetlands or watercourses.

2.1.6 Areas of conservation significance

While a portion of the study area is reserved for conservation under the Shire of Lake Grace Local Planning Scheme, this area is classified as Unallocated Crown Land and road reserve, and is not vested with the Conservation and Parks Commission as conservation estate. The study area is not located in proximity to a conservation area. The closest conservation area is Lake Biddy Nature Reserve, a C Class reserve for the purpose of conservation and fauna, which is located 9 km from the study area.

Environmentally Sensitive Areas (ESAs) are defined in the Environmental Protection (Environmentally Sensitive Areas) Notice 2005 under section 51B of the EP Act. ESAs include areas declared as World Heritage, included on the Register of the National Estate[1], defined wetlands, and vegetation containing rare (Threatened) flora and Threatened Ecological Communities (TECs).

Priority Ecological Communities (PECs) are biological flora or fauna communities that are recognised to be of significance, but do not meet the criteria for a TEC. There are five categories of PECs, none of which are currently protected under legislation.

A Department of Biodiversity, Conservation and Attractions (DBCA) Threatened and Priority Communities database search (DBCA 2018c) identified the presence of the Eucalypt woodlands of the Western Australian Wheatbelt community, a Critically Endangered TEC listed under the EPBC Act, and a DBCA Priority 3 PEC within the study area. Previous ecological surveys (360 Environmental 2015a) have also identified the presence of Red Morrel Woodlands of the Wheatbelt community, a DBCA Priority 1 PEC, within the study area.

[1]Note the Register of National Estate was closed in 2007 and is no longer a statutory list. The Register of National Estate has been replaced by the National Heritage List under the EPBC Act.

2.2 Database searches and literature review

A desktop review was undertaken to inform the field survey and to identify the likelihood of occurrence of conservation significant flora and fauna species and ecological communities within the study area. The desktop review consisted of database searches and a review of any available literature relevant to the study area.

2.2.1 Database searches

The following Commonwealth and State databases were searched for information relating to conservation listed flora, fauna and ecological communities in order to compile and summarise existing data to inform the field survey and the likelihood of occurrence assessments. **Table 2** below presents the database searches undertaken around the central coordinates -33.084214° S, 119.015699° E. It should be noted that the buffers for the DBCA database searches are selected by DBCA on a case-by-case basis, and are therefore not always consistent with other searches undertaken in the area.

Table 2: Database searches undertaken as part of the desktop assessment

Database	Reference	Buffer (km)
Commonwealth EPBC Act Protected Matters Search Tool (PMST) for Threatened species and communities listed under the EPBC Act.	DoEE 2018b	40
Department of Parks and Wildlife (Parks and Wildlife) and Western Australian Museum's (WAM) NatureMap online database.	Parks and Wildlife 2007-2018	40 (fauna) 15 (flora)
DBCA Threatened and Priority fauna database search	DBCA 2018a	50
DBCA Threatened and Priority flora database search	DBCA 2018b	20
DBCA Threatened and Priority communities database search	DBCA 2018c	50
DWER ESA database	DWER 2018b	N/A

2.2.2 Previous ecological surveys

Four previous field studies have been undertaken in the study area in relation to flora, vegetation and fauna, a Level 1 (reconnaissance) flora and fauna survey by Cardno (2014), Level 2 (detailed) flora and vegetation survey by 360 Environmental (2015a), a targeted black cockatoo assessment by 360 Environmental (2015b) and a targeted Red-tailed Phascogale assessment by ELA (2018). These studies are outlined in **Table 3** (flora and vegetation) and **Table 4** (fauna) below.

Table 3: Previous flora and vegetation surveys conducted in the study area

Attribute	Cardno 2014	360 Environmental 2015a
Report name	CBH Grain Facility Expansion, Newdegate. Flora, Fauna and Vegetation	Newdegate Flora and Vegetation assessment
Level of survey	Level 1 (reconnaissance) – three relevés conducted (one per vegetation association)	Level 2 (detailed), single season – 10 quadrats and three relevés conducted
Survey area (ha)	13 ha; however vegetation mapping encompassed a greater area	21.6 ha
Field survey timing	1-2 October 2014	2-4 September 2015
Field effort	Two days with two ecologists	Equivalent to two days with two ecologists
Recorded survey limitations	Not all plants would have been present or flowering during the survey period; species list not considered exhaustive.	13 sites were surveyed; 10 quadrants and three relevés. Each of the six vegetation communities contained at least two sites, with the exception of ElgMl which only contained one site due to its small size.
Number of vascular plant species	88 vascular plant species from 69 genera from 29 families, including 16 introduced species. The most diverse families were Asteraceae (14 species), Poaceae (10 species) and Chenopodiaceae (10 species).	130 vascular plant taxa from 90 genera from 37 families, including 20 introduced species. The most diverse families were Asteraceae (20 taxa), Chenopodiaceae (17 taxa) and Myrtaceae (13 taxa).
WONS or Declared weeds	None	None
Vegetation communities	Three vegetation communities: *Eucalyptus kondoniensis* and *E. salmonophloia* woodland over *Atriplex bunburyana* and *A. cinerea* low sparse shrubland.	Six vegetation communities: EkElg: *Eucalyptus kondininensis*, *E. longicornis* open forest over *Atriplex paludosa* subsp. *baudinii* scattered low shrubs. Some parts included where *E. longicornis* occurs as the single dominant tree species (7.8 ha).

Attribute	Cardno 2014	360 Environmental 2015a
	Eucalyptus loxophleba subsp. *gratiae* low woodland over *Dodonaea ptarmicaefolia* and *Acacia hemitales* open shrubland over *A. eriaceae*, *Enchylaena tomentosa* and *Olearia muelleri* low open shrubland. *Eucalyptus loxophleba* subsp. *gratiae* low open woodland over *Melaleuca acuminata* subsp. *acuminata* tall open shrubland over *Austrostipa elegantissima* very open grassland.	EkAv: *Eucalyptus kondininensis* open forest over *Atriplex vesicaria* low open shrubland over *Threlkeldia diffusa* very open low herbland (4.5 ha). Elx: *Eucalyptus loxophleba* subsp. *gratiae* low open mallee forest over *Melaleuca acuminata* subsp. *acuminata* scattered tall shrubs to tall open shrubland (open to closed scrub in parts) over *Dodonaea ptarmicaefolia*, *Acacia hemiteles* shrubland over *Austrostipa elegantissima* very open grassland (3.9 ha). Es: *Eucalyptus salmonophloia* open to closed forest over *Dodonaea stenozyga* scattered shrubs to open shrubland over *Olearia muelleri, Acacia erinacea* low open shrubland (2.9 ha). TuAv: *Tecticornia undulata*, *Atriplex vesicaria, Tecticornia syncarpa* low open heath over *Disphyma crassifolium* subsp. *clavellatum* very open herbland (1.8 ha). ElgMl: *Eucalyptus longicornis* open forest over *Melaleuca lanceolata* open scrub over *Atriplex paludosa* subsp. *baudinii* scattered low shrubs (0.6 ha).
Vegetation condition	Majority of vegetation in Excellent to Very Good Condition, with some small Degraded areas.	The majority of the vegetation was in Very Good (20.3 ha) condition. The remainder was in Good (0.1 ha), Degraded (1.1 ha) and Completely Degraded (0.1 ha) condition.
Presence of conservation significant flora species	None identified	No Threatened or Priority species were recorded. The Priority 1 species *Thysanotus lavanduliflorus* was considered likely to occur in the study area, although no individuals were recorded during the field survey. Four species were of interest due to range extensions, or due to their location near the edge of their current known distribution.
Presence of conservation significant vegetation communities	None identified	A qualitative assessment of floristic values determined 15.8 ha of the study area represented the Eucalypt Woodlands of the Western Australian Wheatbelt community, a Critically Endangered TEC listed under the EPBC Act, and a DBCA Priority 3 PEC. 8.4 ha of this area was also considered to represent the Red Morrel Woodlands of the Wheatbelt, a DBCA Priority 1 PEC.

Attribute	Cardno 2014	360 Environmental 2015a
Survey gaps identified	Study area size not quantified. Unsure if survey effort was contained to the 13 ha 'proposed expansion area' or a larger 'study area' (area not provided). Area of each vegetation community not quantified.	360 Environmental (2015a) acknowledge that it is possible that the Priority 1 flora species, *Thysanotus lavandulifl orus*, could have been present, but overlooked during the survey due to its low form and absence of flowers during the survey period. Survey effort does not meet current guidance – a minimum of three quadrats should be sample in each vegetation association. Presence of the TEC has not been quantified using the diagnostic characteristics and condition thresholds (DoE 2015).

Table 4: Previous fauna surveys conducted in the study area

Attribute	Cardno 2014	360 Environmental 2015b	ELA 2018a
Report name	CBH Grain Facility Expansion, Newdegate. Flora, Fauna and Vegetation	Newdegate Black Cockatoo Habitat Assessment	Red-tailed Phascogale Assessment, Lots 102, 194 and 208 Lake Biddy Road, Newdegate
Level of survey	Level 1 (broad scale general fauna assessment)	Targeted Black Cockatoo survey	Targeted Red-tailed Phascogale survey
Survey area (ha)	13 ha; however vegetation mapping encompassed a greater area (size not disclosed)	21.9 ha	22 ha
Field survey timing	1-2 October 2014	26-27 May 2015	11-15 June 2018
Field effort	Two days with two ecologists	Two days with two ecologists	Four nights with two ecologists: • 713 Elliott trap nights; • 36 camera trap nights; and • 72 cage trap nights.

Attribute	Cardno 2014	360 Environmental 2015b	ELA 2018a
Recorded survey limitations	None	None	None
Fauna species recorded	Australian Shelduck, Australian Ringneck Parrot, Grey Kurrawong, Galah, White-browed Scrub Wren, Australian Raven, Bronzewing Pigeon, Bobtail, Cat, unidentified macropod.	Galah, Elegant Parrot and unidentified bee species. A Red-tailed Phascogale was captured on a motion sensor camera (G. Penter, pers. comm. 2018).	Red-tailed Phascogale, House Mouse, Cat
Fauna habitats	Not mapped or described. Suitability to provide habitat discussed for conservation significant fauna considered likely to occur.	Black Cockatoo habitat was classed by habitat quality categories (HQC), and consisted of: • 1.4 ha of HQC 1 (potential nesting and foraging habitat); and • 18.9 ha of HQC 2 (foraging habitat). The 1.4 ha of HQC 1 contained 92 potential breeding trees: • 84 Salmon Gum; • Three Red Morrel; and • Five stags (species unknown). These trees had 31 observable hollows suitable to be used for Black Cockatoo nesting.	All vegetation within the study area was suitable to provide habitat for the Red-tailed Phascogale.
Presence of conservation significant fauna species or communities	None identified as observed during the survey. Seven species were assessed as a 'high' likelihood of occurring in the study area, of which three are currently conservation listed: • Carnaby's Black Cockatoo; • Chuditch; and • Western Brush Wallaby.	Carnaby's Black Cockatoo potential breeding and foraging habitat. No Black Cockatoos or foraging evidence were heard or observed during the survey.	Red-tailed Phascogale (four individuals)

Attribute	Cardno 2014	360 Environmental 2015b	ELA 2018a
	A further three species were considered to have a 'medium' likelihood of occurrence, of which two are currently conservation listed: • Peregrine Falcon; and • Fork-tailed Swift.		
Survey gaps identified	Fauna habitats were not mapped or described in the text, as required by the relevant guidelines. Study area size was not quantified, leaving to uncertainties whether the survey effort was contained to the 13 ha 'proposed expansion area' or a larger 'study area' (area not provided). Conservation listing of some fauna species has changed since the publication of the report. Potential Quenda diggings were noted; however this species was not included in the likelihood of occurrence assessment and records are not present in the general area. Digging evidence may have been misinterpreted.	Habitat quality was not defined using a scale (e.g. low, medium or high quality). Hollow signs of use were not recorded. Roosting habitat was not quantified. The report did not include information about the closest known breeding, foraging and roosting sites.	None.

2.3 Likelihood of occurrence assessment

Likelihood of occurrence assessments are undertaken in order to identify conservation listed flora and fauna species that may occur within the study area from a review of key datasets and literature. Previous likelihood of occurrence assessments were undertaken for the study area as part of previous ecological surveys (Cardno 2014; 360 Environmental 2015a). Based on new database records and the results of the current field survey, these likelihood of occurrence assessments were updated as part of the assessment (see section 4.1.2 and 4.2.3); with the exception of flora species considered unlikely to occur by 360 Environmental (2015a). The criteria used are outlined in **Appendix D**, and the full likelihood of occurrence assessments are detailed in **Appendix E** and **Appendix F**.

3 Methodology

3.1 Survey team and timing

The flora, vegetation and fauna assessment was undertaken by Sarah Dalgleish (Botanist) and Jeni Morris (Ecologist). The surveys were undertaken over three days from 5-7 November 2018. The timing of the surveys was appropriate for the scope (EPA 2016a, c). Rainfall in the months preceding the survey was lower than average, however temperatures were consistent with the long term mean (BoM 2018b; **Figure 2**). Survey limitations are discussed in section 3.8.

The survey team's relevant qualifications, experience and licences are provided in **Table 5**.

Table 5: Survey team

Name	Qualification	Relevant experience	Licences
Sarah Dalgleish	BSc Environmental Management (Hons)	Sarah has extensive experience undertaking flora and vegetations surveys across the South-West Botanical Province, with previous survey experience in the Mallee and Avon Wheatbelt bioregions. She has previously undertaken a detailed flora and vegetation and a level 1 fauna survey in Newdegate.	Flora scientific collection licence: SL012349 DRF collection licence: 194-1718
Jeni Morris	BSc Conservation and Wildlife Biology	Jeni has undertaken flora and vegetations surveys across the South-West Botanical Province, with previous survey experience in the Mallee and Avon Wheatbelt bioregions. She has previously undertaken a targeted Red-tailed Phascogale survey in the study area.	Flora scientific collection licence: SL012347 DRF collection licence: 196-1718

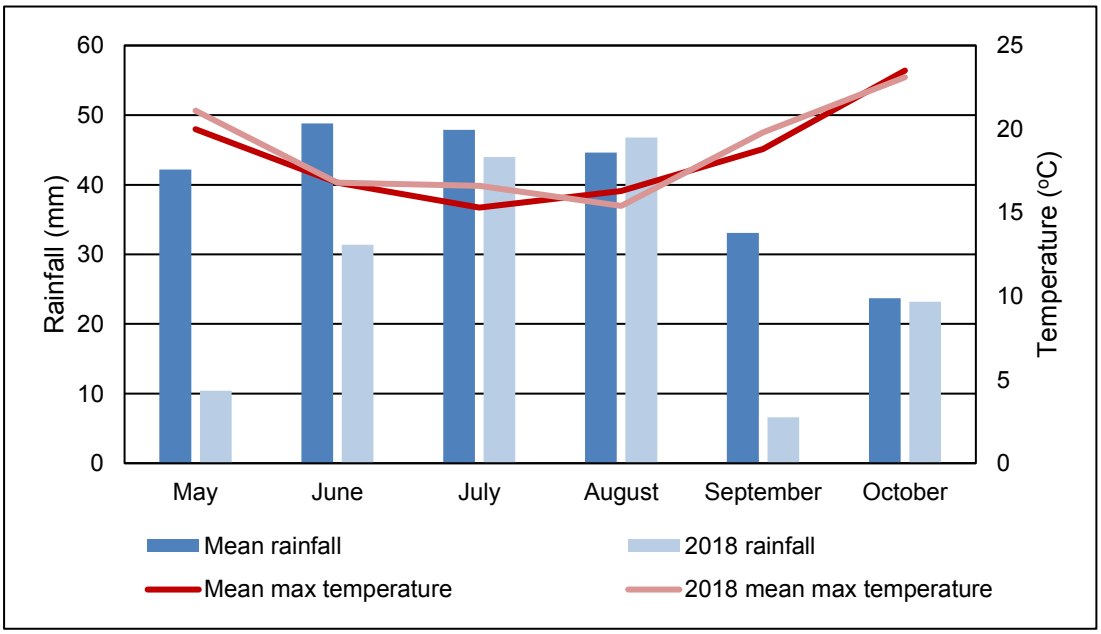

Figure 2: Rainfall and max mean temperatures in the six months preceding the field survey, compared to the long term mean. Data source: Newdegate Research Station (station 010692); BOM 2018b

3.2 Flora and vegetation survey

Current EPA guidance (EPA 2016a) states that a minimum of three quadrats should be sampled in each vegetation association during a detailed survey. However, a previous flora and vegetation survey (360 Environmental 2015a) conducted in the study area surveyed two 10 m x 10 m quadrats per vegetation association (this was in accordance with the available guidance at the time of the survey), with the exception of a restricted vegetation association that contained a single relevé. ELA's flora and vegetation survey aimed to fill the identified ecological information gaps (see **Table 3** and ELA 2018b) and was conducted in accordance with the following current guidance:

- EPA Technical Guide – *Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016a); and
- *Approved Conservation Advice for the Eucalypt Woodlands of the Western Australian Wheatbelt* (DoE 2015).

A total of eight additional 10 m x 10 m quadrats (20 m x 20 m overstorey) were established across the study area (**Figure 3**), to ensure three quadrats were located in each vegetation association. In the restricted vegetation association ElgMl, two quadrats were established. The following information was recorded at each quadrat:

- A colour photograph of representative vegetation;
- Coordinate location;
- Description of vegetation associations in accordance with Level V of the National Vegetation Information System (NVIS) and Aplin's (1979) modification of vegetation classification adapted from Specht (1970). For each stratum, this included:
    - Dominant growth form;
    - Height;
    - Cover;
    - Three dominant genera;
- Description of vegetation condition classification, in accordance with EPA (2016a);
- Average % cover of leaf litter and bare ground;
- Disturbance details including:
    - Fire history (time since last fire);
    - Physical disturbance including evidence of erosion;
    - Evidence of grazing; and
    - Weed invasion.

Other tasks undertaken included the:

- Description and mapping of TECs and PECs, including collection of data to allow for an assessment against the key diagnostic characteristics of the Eucalypt Woodlands of the Western Australian Wheatbelt TEC;
- Adding to the existing flora species inventory (including weeds) and undertaking opportunistic sampling;
- Mapping of Declared Pest Plants listed under the *Biosecurity and Agriculture Management Act 2007* (BAM Act) and Weeds of National Significance (WONS), if observed; and
- Updating the vegetation condition mapping, in accordance with EPA (2016a).

3.3 Targeted flora survey

A targeted survey for conservation significant flora has been previously conducted as part of an earlier ecological survey (360 Environmental 2015a), and a likelihood of occurrence assessment dismissed all flora species, with the exception of *Thysanotus lavanduliflorus*, which was not flowering during September 2015. This current assessment targeted *Thysanotus lavanduliflorus* and new conservation significant flora species not included in the previous assessment (identified by current database searches).

The targeted surveys were conducted in accordance with EPA (2016a). The target survey methodology involved personnel walking transects spaced less than 50 m apart in suitable habitat. Locations of survey transects are shown in **Figure 4**.

The following information was recorded for any conservation significant flora observed:

- A colour photograph;
- GPS location;
- Population size estimate;
- Location of population boundaries (if applicable);
- Associated habitat/landscape element;
- Time and date observed;
- Observer details; and
- A voucher specimen suitable for use as a reference specimen (if appropriate to do so for conservation significant flora).

The field survey was undertaken using an Android Nexus 7 tablet operating the ArcGIS Collector app. It should be noted that these units can have errors of 3-20 m (subject to availability of satellites on the day) with an average of 5 m, which is comparable to a standard GPS unit. Some data such as the traverse paths were recorded on Garmin GPSmap 62s GPS units.

3.4 Fauna survey

A Level 1 Fauna survey was conducted in accordance with the following guidelines:

- EPA Technical Guidance - *Terrestrial fauna surveys* (EPA 2016b); and
- EPA Technical Guidance - *Sampling methods for Terrestrial vertebrate fauna* (EPA 2016c).

General fauna habitats were not mapped or described in a previous Level 1 fauna survey undertaken in the study area (Cardno 2014). However, fauna habitats had been extrapolated from the vegetation mapping in ELA (2018a). The field survey ground truthed and mapped these habitats.

Opportunistic fauna observations were recorded for all species, and included direct observations, opportunistic sightings and other signs of fauna such as tracks, scats, burrows, mounds, foraging / diggings etc. All points of interest were recorded on a GPS and a photo of the species/habitat taken for inclusion in the report.

3.5 Targeted Malleefowl survey

Targeted searches for signs of Malleefowl, such as birds, mounds, tracks and scats were undertaken in areas of suitable habitat (*Eucalyptus* mallee over *Melaleuca* shrubland), in accordance within the EPBC Act *Survey guidelines for Australia's threatened birds* (Department of the Environment, Water, Heritage and the Arts 2010). The target survey methodology involved personnel walking transects spaced less than 50 m apart. Survey effort for the targeted Malleefowl survey is shown in **Figure 4**.

3.6 Specimen identification and nomenclature

Nomenclature used for the flora species within this report follows the WA Plant Census as available on FloraBase (Western Australian Herbarium (WAH) 1998-2018).

Voucher specimens were collected in the field of all actual or potential conservation significant flora species where required, where sufficient material was available. Collections were made of other species, if required, to enable correct identification. All collections were assigned a unique collecting number.

Specimen identification was undertaken by Sarah Dalgleish. Species identification utilised taxonomic literature and keys and where required specimens were confirmed using the WAH reference collection. Suitable material that meets WAH specimen lodgement requirements, such as flowering material and range extensions, was submitted along with Threatened and Priority Report forms to DBCA, as required by conditions of collection licences issued under the State *Wildlife Conservation Act 1950* (WC Act).

The *Thysanotus* sp. 1 specimen could not be adequately identified to species level in-house, so was submitted to WAH for identification, where it was confirmed to be *Thysanotus lavanduliflorus* (P1).

Fauna species were identified in situ. Nomenclature used for the vertebrate fauna species within this report follows the WAM Checklist of the Vertebrates of Western Australia (WAM 2018).

3.7 Data analysis

3.7.1 Flora species accumulation curve

A flora species accumulation curve was undertaken to indicate adequacy of the survey effort (Clarke and Gorley 2006). As the number of survey sites increases, and correspondingly the size of the area surveyed increases, there should be a diminishing number of new species recorded. At some point, the number of new species recorded becomes essentially asymptotic. The asymptotic value was determined using Michaelis-Menten modelling and provided an incidence-based coverage estimator of species richness. When the number of new species being recorded for survey effort expended approaches this asymptotic value, the survey effort can be considered adequate.

3.7.2 Vegetation Communities

Plymouth Routines in Multivariate Ecological Research v6 (PRIMER) statistical analysis software was used to analyze species-by-site data and discriminate survey sites based on their species composition (Clarke and Gorley 2006). A presence/absence transformation was applied to the dataset prior to analysis. Introduced species (weeds), specimens not identified to species level and singletons (species recorded at a single quadrat and not forming a dominant structural component) were excluded from the data set prior to analysis. In addition, annuals were also removed from the dataset prior to analysis due to the likelihood of substantial differences between years based on seasonality of local rainfall events. Computation of similarity matrices was based on the Bray-Curtis similarity measure. Data were analysed using a series of multivariate analysis routines including Similarity Profile (SIMPROF), Hierarchical Clustering (CLUSTER) and Similarity Percentages (SIMPER). Results were used to inform and support interpretation of aerial photography and delineation of individual plant communities.

3.8 Limitations

The EPA *Technical Guide – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016a) and *Technical Guidance – Sampling methods for terrestrial vertebrate fauna* (EPA 2016b) recommends including discussion of the constraints and limitations of the survey methods used. Constraints and limitations for the flora, vegetation and fauna assessment are summarised in **Table 6**.

Table 6: Limitations of the survey

Factor	Limitations
Sources of information	Flora, vegetation and fauna surveys have previously been undertaken in the study area and this information was readily available. Broad-scale vegetation mapping at a scale of 1:1,000,000 was also available. The information which was available was sufficient and as such sources of information were not considered a major limitation.
Scope of works	The survey requirement of a detailed flora and vegetation survey, targeted flora survey, a Level 1 fauna survey and a targeted Malleefowl survey to fill in previous ecological survey information gaps within the study area in accordance with relevant State and Commonwealth guidance was met was adequately met.
Completeness and intensity of survey	The study area was surveyed to the satisfaction of the scope and the relevant survey guidelines, and the data will be pooled with existing ecological survey data to provide a comprehensive ecological information base. Together with existing data, the number of quadrats established was sufficient to determine the vegetation types and identify vegetation communities of significance.
Timing, weather, season, cycle	The study area is located in the Western Mallee subregion of Western Australia. The recommended flora survey timing for this region is Spring (September – November) for flora (EPA 2016a) and in the season following maximum rainfall for fauna (EPA 2016b). The field survey was conducted in early November, following the wet season, and was undertaken to coincide in Spring and with the November/December flowering period of the Priority 1 species *Thysanotus lavanduliflorus*. However, lower than average rainfall (particularly in September; BoM 2018b) meant the timing was sub-optimal for the identification of many annual flora species. However, as the survey was specifically designed as a supplementary survey to satisfy gaps associated with previous ecological surveys, the absence of annuals was not considered a significant limitation as a high number of annual species were recorded in the September 2015 survey (360 Environmental 2015a). With the exception of the Priority 4 annual herb *Haegiela tatei*, the additional conservation listed flora species identified in the database assessment that were not previously assessed by 360 Environmental (2015a) were perennial species and would have been readily visible despite the site conditions. The early November timing was appropriate for conducting a Level 1 fauna survey and a targeted Malleefowl assessment.
Disturbances	Disturbances within the study area included clearing of vegetation for tracks, presence of introduced (feral) fauna species and dumping of rubbish (cars, bottles etc.). Disturbances did not limit the study.
Resources	Field staff were suitably qualified and experienced to identify target and non-target species in the field. One specimen that potentially represented the Priority 1 flora species *Thysanotus lavanduliflorus* was sent to WAH for expert identification.
Accessibility	The study area was easily accessed via a road adjacent to the study area and was able to be surveyed on foot. Accessibility was not a survey limitation.

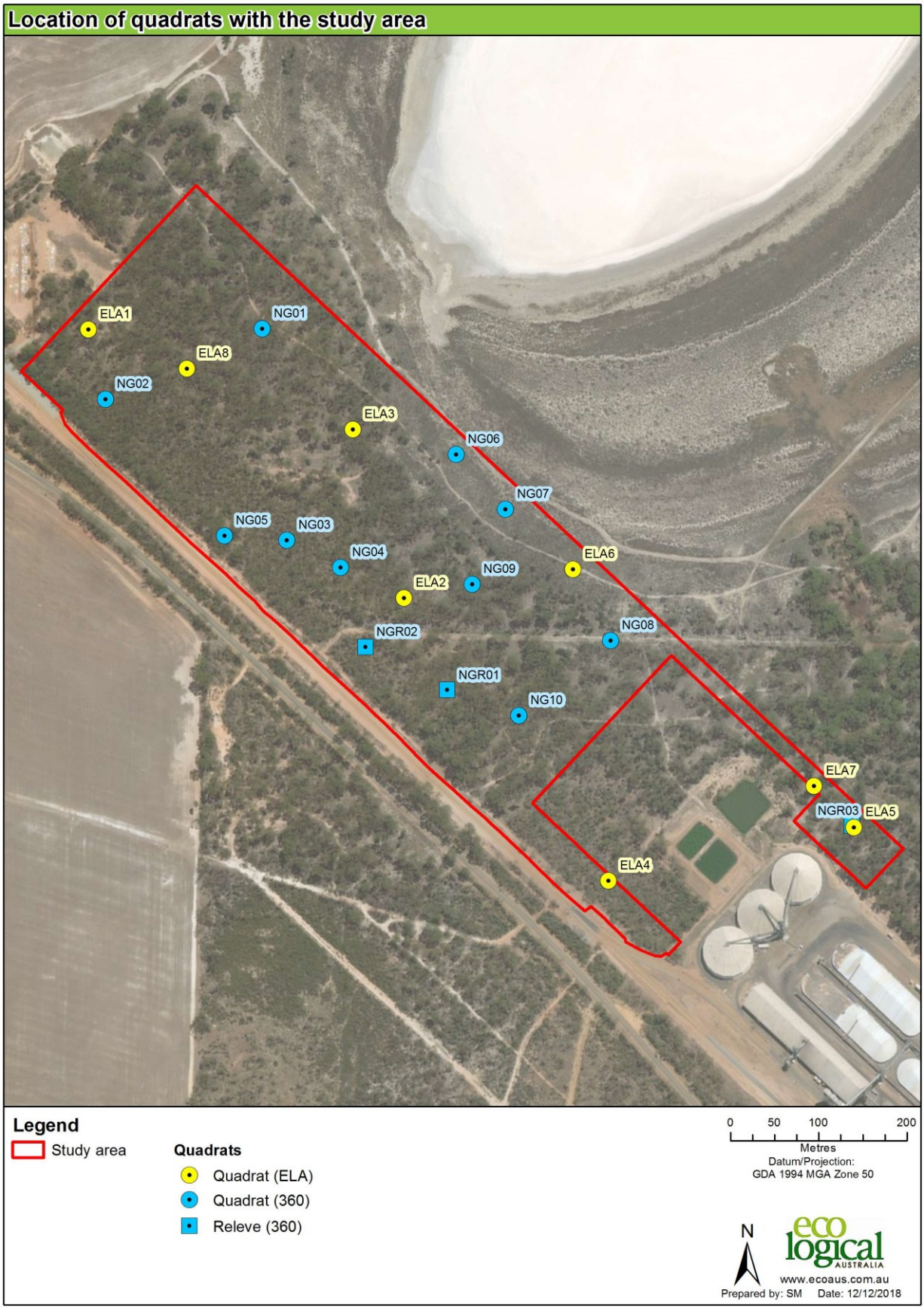

Figure 3: Location of quadrats with the study area.

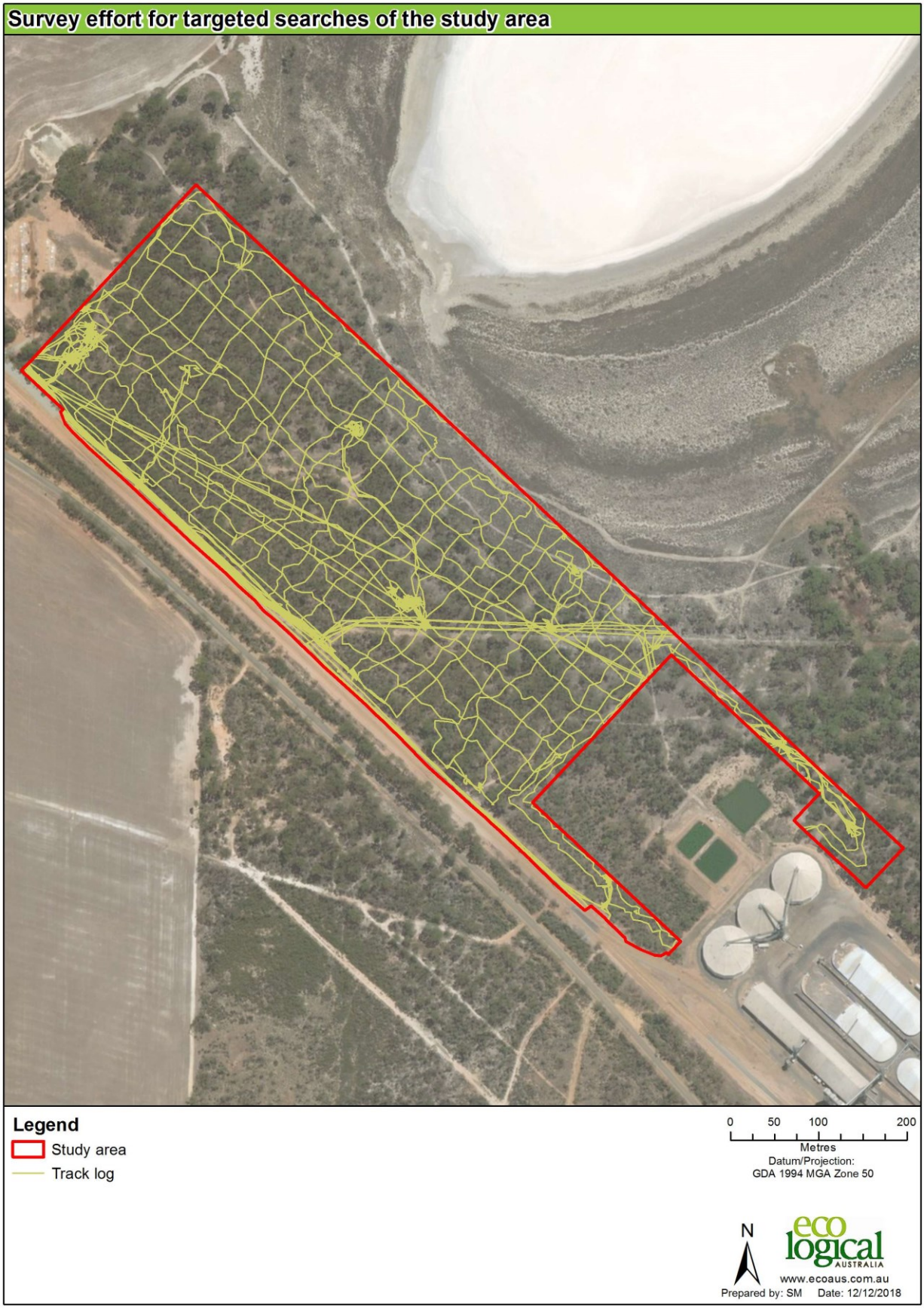

Figure 4: Survey effort for targeted searches of the study area.

4 Results

4.1 Flora and vegetation survey

4.1.1 Flora overview

The current survey recorded a total of 59 taxa (including species, subspecies, varieties and forms and specimens not identified to species level) from 43 genera and 18 families from eight quadrats and opportunistic collections during the field survey. Quadrat species richness varied from 7 (ELA5 and ELA 7) to 20 (ELA 2) taxa.

A total of 178 taxa (including species, subspecies, varieties and forms, and specimens not identified to species level) from 111 genera and 42 families were recorded from quadrats, relevés and opportunistic collections in the study area during the current and previous surveys (360 Environmental 2015a; Cardno 2014). Of these taxa, 32 were introduced, including three taxa not identified to species level. None of these species are listed as WONS or Declared under the BAM Act. The current survey added five additional taxa to the flora inventory, excluding two taxa that could not be identified to species level (**Appendix C**). The ELA and 360 Environmental (2015a) quadrat species richness ranged from 7 to 35 taxa with an average of 17.2 taxa per quadrat (**Appendix A** and **Appendix B**).

Collectively, the most commonly occurring families were Asteraceae (30 taxa), Chenopodiaceae (23 taxa) and Poaceae (19 taxa) over the three surveys (360 Environmental 2015a; Cardno 2014). The most frequently recorded genera were *Melaleuca* (eight taxa), *Austrostipa* (six taxa), and *Eucalyptus*, *Maireana*, *Acacia* and *Tecticornia* (five taxa each). One specimen could not be identified due to poor material ('Indeterminant sp.'; 360 Environmental 2015a) while three specimens could only be identified to family level and further nine taxa to genus level.

A species accumulation curve (**Figure 5**) was used to evaluate the adequacy of sampling (Clarke and Gorley 2006), using a combined ELA/360 Environmental (2015a) dataset. Only species data recorded from defined survey sites (quadrats) were used; no opportunistic flora collections and relevé data were included. Using this analysis, the incidence-based coverage estimator of species richness was calculated to be 143.8. Based on this value, and the total of 102 species recorded within quadrats, approximately 71% of the flora species potentially present within the study area were recorded. When data from relevés (Cardno 2014; 360 Environmental 2015a) and opportunistic sightings is included, the taxa records rise to 175 (includes taxa not identified to species level).

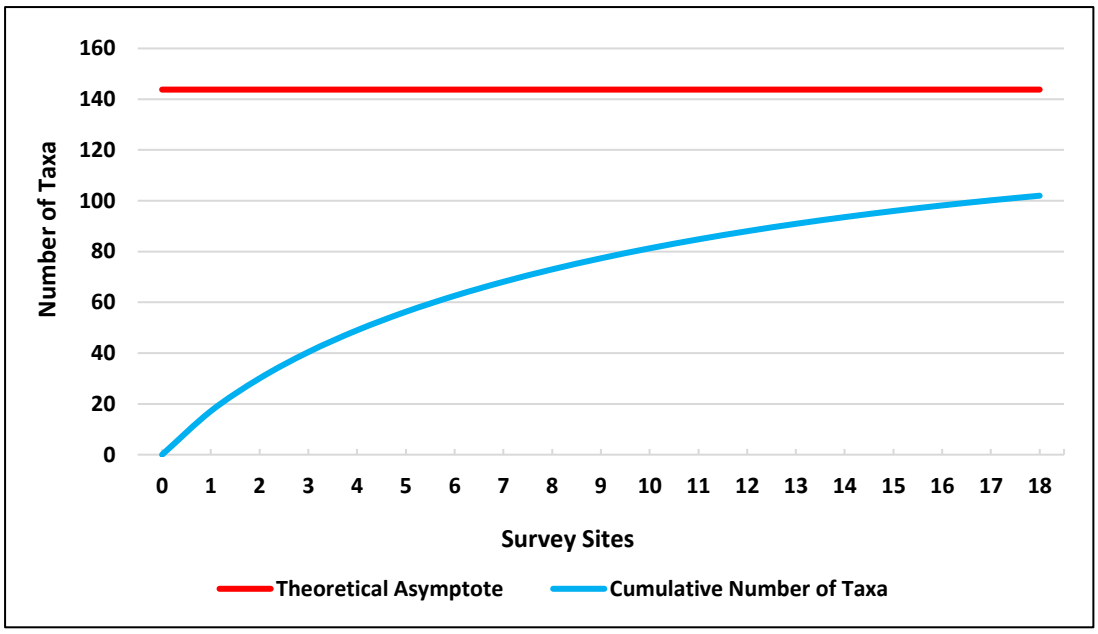

Figure 5: Averaged randomised species accumulation curve.
Note: Only native species recorded from quadrats were used to calculate the species accumulation curve and theoretical maximum number of species (asymptotic value). Includes data from 360 Environmental (2015a).

4.1.2 Conservation significant flora

The Priority 1 flora species *Thysanotus lavanduliflorus* was recorded during the current survey, with its identification confirmed by the WAH (see **Plate 1**). A total of 15 individuals of this species were recorded in vegetation association Es within a 20 m radius of the coordinates - 33.082859 ºS 119.012644 ºE; the location of the records of *Thysanotus lavanduliflorus* are mapped in **Figure 7**. No other threatened or priority flora taxa were recorded within the study area during the current or past surveys.

Plate 1: *Thysanotus lavanduliflorus*

Previous surveys recorded several non-conservation listed flora taxa records of interest due to range extensions, or due to their location near the edge of their current known distribution (360 Environmental 2015a):

- *Austrostipa acrociliata*;
- *Chenopodium desertorum* subsp. *desertorum*;
- *Tecticornia undulate*; and
- *Trymalium myrtillus* subsp. *myrtillus.*

A likelihood of occurrence assessment for other conservation listed flora species was undertaken (**Appendix E**). One species, *Haegiela tatei* (listed as Priority 4 by DBCA), was assessed as having potential to occur within the study area. The remaining 58 taxa were considered unlikely to occur within the study area.

4.1.3 Vegetation associations

Six vegetation communities were originally mapped within the study area (360 Environmental 2015a), and are predominantly comprised of *Eucalyptus* open forest, with some areas of *Melaleuca* shrubland. The current survey completed eight additional quadrats, which following statistical analysis, were found to correlate with the existing vegetation communities (**Figure 6**).

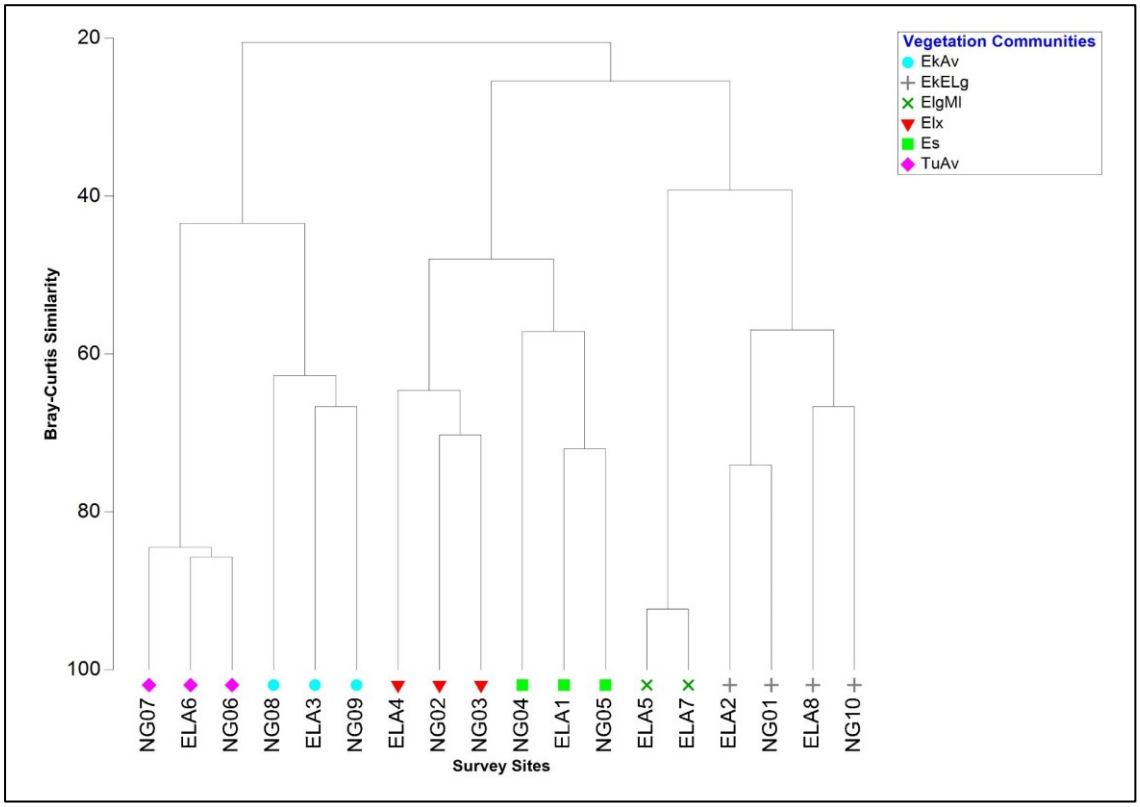

Figure 6: Results of the Bray-Curtis Similarity measure, comparing ELA and 360 Environmental (2015a) quadrats ('NG').

The six vegetation communities contained within the study area are (**Table 7**; **Figure 8**):

- **EkElg**: *Eucalyptus kondininensis*, *E. longicornis* open forest over *Atriplex paludosa* subsp. *baudinii* scattered low shrubs. Some parts included where *Eucalyptus longicornis* occurs as the single dominant tree species;
- **Elx**: *Eucalyptus loxophleba* subsp. *gratiae* low open mallee forest over *Melaleuca acuminata* subsp. *acuminata* scattered tall shrubs to tall open shrubland (open to closed scrub in parts) over *Dodonaea ptarmicaefolia*, *Acacia hemiteles* shrubland over *Austrostipa elegantissima* very open grassland;
- **EkAv**: *Eucalyptus kondininensis* open forest over *Atriplex vesicaria* low open shrubland over *Threlkeldia diffusa* very open low herbland;
- **Es**: *Eucalyptus salmonophloia* open to closed forest over *Dodonaea stenozyga* scattered shrubs to open shrubland over *Olearia muelleri, Acacia erinacea* low open shrubland;
- **TuAv**: *Tecticornia undulata*, *Atriplex vesicaria, Tecticornia syncarpa* low open heath over *Disphyma crassifolium* subsp. *clavellatum* very open herbland;
- **ElgMl**: *Eucalyptus longicornis* open forest over *Melaleuca lanceolata* open scrub over *Atriplex paludosa* subsp. *baudinii* scattered low shrubs.

The remaining 0.8 ha (3.2% of the study area), is considered to be cleared and has not been mapped as vegetation.

Table 7: Vegetation associations within the study area. Vegetation descriptions from 360 Environmental (2015a).

Image	Vegetation Description	Quadrats/ relevés	Extent in study area (ha)	Portion of study area (%)
	**EkElg**: *Eucalyptus kondininensis*, *E. longicornis* open forest over *Atriplex paludosa* subsp. *baudinii* scattered low shrubs. Some parts included where *Eucalyptus longicornis* occurs as the single dominant tree species	ELA2 ELA8 NG01 NG10 NGR01	7.90	31.85
	**Elx**: *Eucalyptus loxophleba* subsp. *gratiae* low open mallee forest over *Melaleuca acuminata* subsp. *acuminata* scattered tall shrubs to tall open shrubland (open to closed scrub in parts) over *Dodonaea ptarmicaefolia*, *Acacia hemiteles* shrubland over *Austrostipa elegantissima* very open grassland	ELA4 NG02 NG03 NGR02	5.72	23.07

	**EkAv**: *Eucalyptus kondininensis* open forest over *Atriplex vesicaria* low open shrubland over *Threlkeldia diffusa* very open low herbland	ELA3 NG08 NG09	4.56	18.38
	**Es**: *Eucalyptus salmonophloia* open to closed forest over *Dodonaea stenozyga* scattered shrubs to open shrubland over *Olearia muelleri, Acacia erinacea* low open shrubland	ELA1 NG04 NG05	3.26	13.13
	**TuAv**: *Tecticornia undulata*, *Atriplex vesicaria, Tecticornia syncarpa* low open heath over *Disphyma crassifolium* subsp. *clavellatum* very open herbland	ELA6 NG06 NG07	1.71	6.89
	**ElgMl**: *Eucalyptus longicornis* open forest over *Melaleuca lanceolata* open scrub over *Atriplex paludosa* subsp. *baudinii* scattered low shrubs	ELA5 ELA7 NGR03	0.87	3.49
Cleared: cleared areas, completely devoid of vegetation		N/A	0.79	3.19

4.1.4 Vegetation condition

The majority of the vegetation was in Very Good condition (21.5 ha; 86.6% of the study area). The remainder was in Good (2.0 ha), Degraded (0.5 ha) and Completely Degraded (0.1 ha) condition (**Table 8** and **Figure 9**). A total of 0.8 ha of the study area is cleared of vegetation. Disturbances within the project area, in addition to clearing of vegetation for tracks, include the presence of introduced (feral) fauna species and dumping of rubbish (cars, bottles etc.).

Table 8: Vegetation condition within the study area.

Condition	Extent (ha)	Proportion of study area (%)
Very Good	21.48	86.60
Good	1.97	7.93
Degraded	0.49	1.96
Completely Degraded	0.08	0.32
Total vegetation	24.01	96.81
Cleared	0.79	3.19
Grand total	24.80	100.00

4.1.5 Vegetation of conservation significance

A qualitative assessment of floristic values (360 Environmental 2015a) determined that the Eucalypt woodlands of the Western Australian Wheatbelt community, a Critically Endangered TEC listed under the EPBC Act and a DBCA Priority 3 PEC, was present in the study area. The Eucalypt woodlands of the Western Australian Wheatbelt community is described as (DBCA 2017):

Eucalypt-dominated woodlands in the Western Australian Wheatbelt region as defined by the IBRA Avon Wheatbelt 1 and 2 and Western Mallee subregions with the specific exceptions of woodlands and forests dominated by Jarrah (*Eucalytpus marginata*) or Marri (*Corymbia calophylla*) where they occur without York Gum present; and non-woodland communities dominated by eucalypts, specifically those dominated by eucalypts with a mallee growth form. Community is defined primarily by its structure as a woodland. The presence in the canopy layer of eucalypt trees - most commonly Salmon Gum (*E. salmonophloia*), York Gum (*Eucalyptus loxophleba*), Red Morrel (*E. longicornis*) or Gimlet (*E. salubris*) defines the Wheatbelt woodlands. Several of the other emergent eucalypt species which may be present as a defining species (e.g. Kondinin Blackbutt (*E. kondinensis*), *E. myriadena*, Salt River Gum (*E. sargentii*), Silver Mallet (*E. ornata*) and Mallet (*E. singularis*)) are found only in the Western Australian Wheatbelt.

An assessment, presented in **Table 9** and **Table 10**, has now been undertaken utilising the key diagnostic characteristics of the TEC (DoE 2015). This assessment has concluded that 16.58 ha of vegetation (related to vegetation associations EkAv, EkElg, ElgMl and Es) within the study area is characterised as the Eucalypt woodlands of the Western Australian Wheatbelt TEC (and subsequently, the associated State listed PEC).

Of this area, 8.77 ha (related to vegetation associations ElgML and EkElg) is also considered to represent the Red Morrel Woodlands of the Wheatbelt, a DBCA Priority 1 PEC that can co-occur with the Eucalypt woodlands of the Western Australian Wheatbelt TEC/PEC. This PEC is described as (DBCA 2017):

Tall open woodlands of *Eucalyptus longicornis* (Red Morrel) found in the Wheatbelt on lateritic, ironstone or granitic soil types. Sometimes found with *E. salmonophloia* (Salmon Gum), or *E. loxophleba* (York Gum) woodlands and has very little understorey. It is also found directly above lake systems in the central and eastern Wheatbelt. The landscape unit in which it is found is valley floors, usually adjacent to saline areas.

These areas of conservation listed vegetation communities are mapped in **Figure 10**.

Table 9: Assessment of the Eucalypt woodlands of the Western Australian Wheatbelt community within the study area for TEC status

Key diagnostic characteristics (DoE 2015)	Outcome
Indicators	
Location and physical environment The distribution of the ecological community is limited to these IBRA bioregions and subregions: • Avon Wheatbelt - subregions AVW01 Merredin and AVW02 Katanning; • Mallee - MAL02 Western Mallee only; and • Jarrah Forest – outlying patches in the eastern parts of JAF01 Northern Jarrah Forests and JAF02 Jarrah Forests adjacent to the Avon Wheatbelt, that are off the Darling Range, and receive less than 600 mm mean annual rainfall. They are effectively an extension of the Avon Wheatbelt landscape in that they comprise areas subject to similar climate, landscape and threats.	Yes – the study area is located in the Mallee bioregion, in the Western mallee subregion (MAL02).
Structure The structure of the ecological community is a woodland in which the minimum crown cover of the tree canopy in a mature woodland is 10% (crowns measured as if they are opaque).	Yes – the crown cover in the woodland vegetation associations EkAv, EkElg, ElgMl, Es and ELx is ≥10%. Vegetation association TuAv is a low open heathland, so is excluded.
Presence of key species The key species of the tree canopy are species of Eucalyptus as identified in Table 2a (DoE 2015). These are species that typically have a single trunk. One or more of the tree species in Table 2a are dominant or co-dominant within a patch of the ecological community. If other species are present in the tree canopy (e.g. species in Table 2b or other taxa) then these collectively do not occur as dominants in the tree canopy.	Yes – *Eucalyptus kondininensis*, *E. longicornis and E. salmonophloia* are dominants/co-dominants within vegetation associations EkAv, EkElg, ElgMl and Es and are listed in Table 2a. Vegetation association Elx does not contain a dominant/co-dominant listed in Table 2a, so is excluded.
Presence of understorey A native understorey is present but is of variable composition, being a combination of grasses, other herbs and shrubs, as specified in section 2.3.2 and in Table A1 of Appendix A (DoE 2015).	Yes – native understorey is present. 45 of the 87 taxa recorded in the quadrats associated with vegetation associations EkAv, EkElg, ElgMl and Es are listed in Table A1 of Appendix A (DoE 2015). However, the plant species list in Table A1 of Appendix A (DoE 2015) does not include all plant species that may be encountered in the WA Wheatbelt woodland ecological community.

Key diagnostic characteristics (DoE 2015)	Outcome
Contra-indicators	
A dominant presence of eucalypts with a mallee growth form. However, mallee species can occur as an understorey or minor canopy component of the ecological community, as noted in the diagnostic features, above.	No – Mallee eucalypts are not dominant in vegetation associations EkAv, EkElg, ElgMl and Es.
A dominant presence of non-eucalypt species in the tree canopy, for instance *Acacia acuminata* (jam) or *Allocasuarina huegeliana* (rock sheoak). However, these non-eucalypt species can be present as an understorey or minor canopy component of the ecological community.	No - There are no dominant non-eucalypt species present in the tree canopy.
Shrublands or herblands in which the tree canopy layer is very sparse to absent, either naturally or maintained so through long-term disturbance. Native vegetation where a tree canopy was formerly present is often referred to as 'derived' or 'secondary' vegetation. These sites would fall below the 10 per cent minimum canopy cover threshold for a woodland, noted in the diagnostic features, above.	No - Vegetation associations EkAv, EkElg, ElgMl and Es are woodlands with a tree canopy present.
Woodlands that have the same key eucalypt species but occur in adjacent bioregions, notably the Coolgardie, Esperance Sandplains, Yalgloo and Geraldton Sandplains bioregions. These are not part of the national ecological community. All woodlands that occur in bioregions outside the wheatbelt, as defined in this conservation advice, are not part of the WA Wheatbelt Woodland ecological community.	No - The study area is not located in the Coolgardie, Esperance Sandplains, Yalgloo and Geraldton Sandplains bioregions.
Woodlands dominated by eucalypts that are restricted to granite outcrops and rocky rises, for instance *Eucalyptus caesia* (caesia or gungurru). However, some woodlands occur on the base round rock outcrops, but not on the actual outcrop, and these may be part of the ecological community, for instance York gum – jam woodlands.	No - The woodlands within the study area do not occur on granite outcrops or rocky rises.
Condition thresholds and minimum patch size	
Where native vegetation meets the description and key diagnostic characteristics of the WA Wheatbelt Woodland ecological community, above, the condition thresholds and considerations in Table 3 (DoE 2015) apply. There are four categories a patch can be classified as: • Category A: Patches likely to correspond to a condition of Pristine / Excellent / Very good (Keighery, 1994) or a High RCV (RCC, 2014). • Category B: Patches likely to correspond to a condition of Good (Keighery, 1994) or a Medium-High RCV (RCC, 2014), AND retains important habitat features.	Yes – together, the vegetation associations EkAv, EkElg, ElgMl and Es meet the criteria for Category A (see **Table 10**): • Exotic plant species account for 0 to 30% of total vegetation cover in the understorey layers (i.e. below the tree canopy) • Mature trees may be present or absent • Patch size 2 hectares or more.

Key diagnostic characteristics (DoE 2015)	Outcome
• Category C: Patches likely to correspond to a condition of Good (Keighery, 1994) or a Medium-High RCV (RCC, 2014). • Category D: Patches likely to correspond to a condition of Degraded to Good (Keighery, 1994) or a Medium-Low to Medium-High RCV (RCC, 2014) BUT retains important habitat features. The criteria for these categories are listed in **Table 10** below.	While areas of vegetation mapped as Good, Degraded and Completely Degraded occur within vegetation associations ElgMl and Es, weed species were below 30% cover in all quadrats, so Category A is still relevant. A small area of Es (0.4 ha) is isolated from the rest of the mapped area of the TEC within the study area due to the presence of other vegetation associations, however was classified as part of the same patch. This is due to the patch definition (DoE 2015) where 'A patch is defined as a discrete and mostly continuous area of the ecological community. A patch may include small-scale variations and disturbances, such as tracks or breaks, watercourses/drainage lines or localised changes in vegetation that do not act as a permanent barrier or significantly alter its overall functionality.'

Table 10: Minimum condition for patches of the WA Wheatbelt Woodlands ecological community. For each category, both the weed cover and mature tree presence criteria must apply plus one of either patch size or patch width, depending on whether the patch is a roadside remnant or not. Source: Table 3 (DoE 2015).

Cover of exotic plants (weeds) AND	Mature trees[1] AND	Minimum patch size (non-roadside patches)[2] OR	Minimum patch width (roadside patches only)[3]
Category A: *Patches likely to correspond to a condition of Pristine / Excellent / Very good (Keighery, 1994) or a High RCV (RCC, 2014).*			
Exotic plant species account for 0 to 30% of total vegetation cover in the understorey layers (i.e. below the tree canopy).	Mature trees may be present or absent.	2 hectares or more	5 metres or more
Category B: *Patches likely to correspond to a condition of Good (Keighery, 1994) or a Medium-High RCV (RCC, 2014), AND retains important habitat features.*			
Exotic plant species account for more than 30, to 50% of total vegetation cover in the understorey layers (i.e. below the tree canopy)	Mature trees are present with at least 5 trees per 0.5 ha.	2 hectares or more	5 metres or more
Category C: *Patches likely to correspond to a condition of Good (Keighery, 1994) or a Medium-High RCV (RCC, 2014).*			

Exotic plant species account for more than 30, to 50% of total vegetation cover in the understorey layers (i.e. below the tree canopy).	Mature trees either absent or less than 5 trees per 0.5 ha are present.	5 hectares or more	5 metres or more
Category D: *Patches likely to correspond to a condition of Degraded to Good (Keighery, 1994) or a Medium-Low to Medium-High RCV (RCC, 2014) BUT retains important habitat features.*			
Exotic plant species account for more than 50 to 70% of total vegetation cover in the understorey layers (i.e. below the tree canopy).	Mature trees are present with at least 5 trees per 0.5 ha.	5 hectares or more	5 metres or more

[1] Mature trees have a diameter at breast height (DBH) of 30 cm or above. Trunk diameter varies among eucalypt species, for instance gimlet and mallets tend to have slender trunks (Gosper et al. 2013b, as cited in DoE 2015). The DBH for mature trees aligns with the EPBC referral guidelines for the breeding habitat of threatened black cockatoo species (DSEWPaC 2012). These note that, for salmon gum and wandoo trees, suitable nest hollows can develop in trees with a DBH of 30 cm or more. Note that larger trees may be killed by factors such as intense fire or flood but the patch may still be in reasonable condition if there are immature trees regenerating.

[2] The minimum patch size thresholds apply to native vegetation remnants that do not occur along roadsides.

[3] Minimum patch width applies only to vegetation remnants along roadsides and tend to be long but narrow. This criterion recognises the importance of native vegetation remnants along road verges, e.g their value as wildlife corridors particularly if linking to other non-roadside remnants, habitat for threatened species and other reasons as detailed by Jackson (2002) and RCC (2015), as cited in DoE (2015). The width here is based on the native understorey component rather than width of the tree canopy. Some allowance must be made for small breaks or variations in native species cover along linear patches. Given the generally open nature of the tree canopy and some understorey structures, a break in the continuity of native vegetation cover of 50 metres or more, is likely to indicate that separate patches are present. An exception is for main, often bitumen-covered, roads that bisect otherwise continuous vegetation; most local government roads in the Wheatbelt have a road reserve of 20 metres. In these cases, native vegetation along either side of the road is considered to be a separate patch.

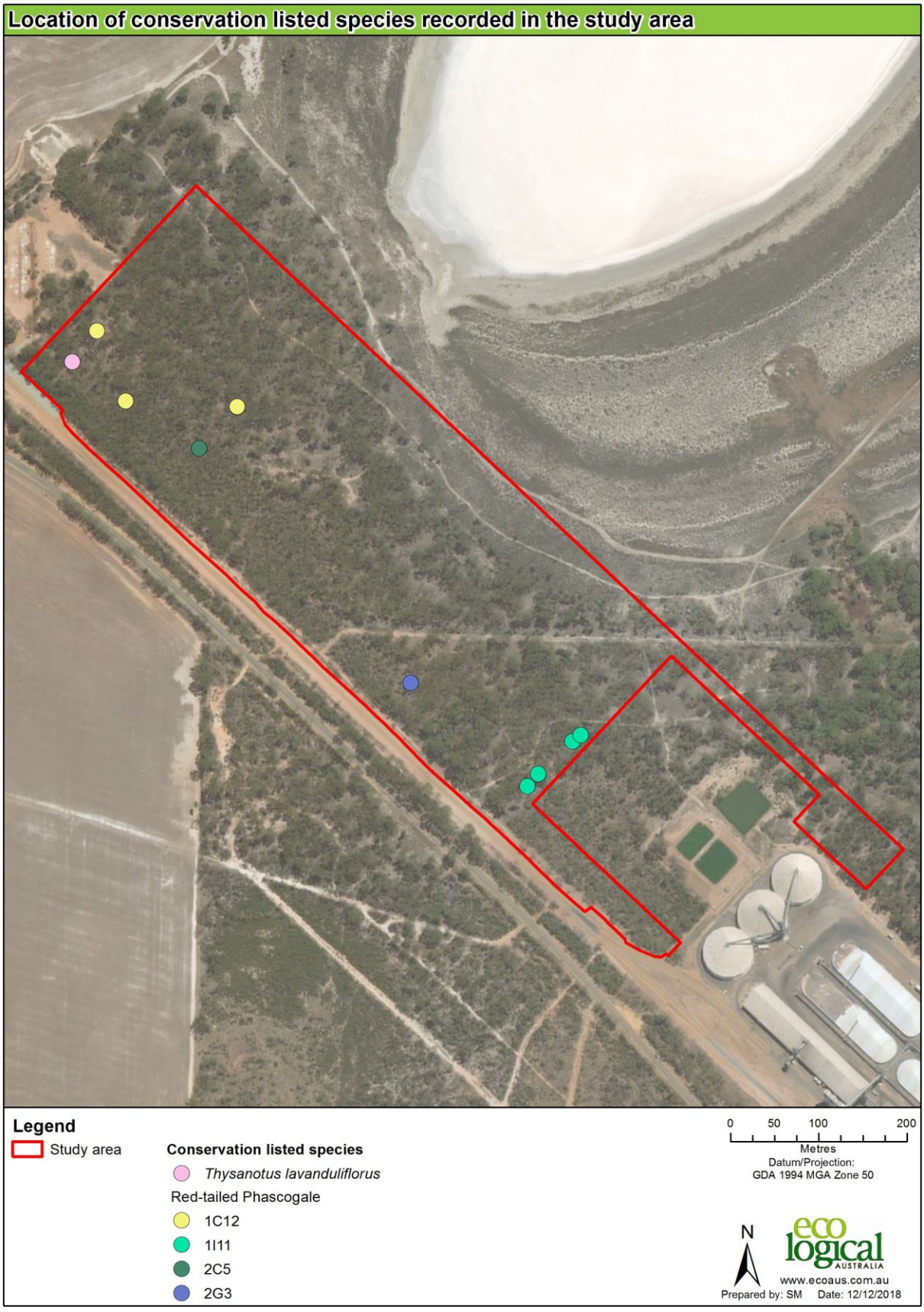

Figure 7: Location of *Thysanotus lavanduliflorus* and Red-tailed Phascogale within the study area. Red-tailed Phascogale records are presented displaying the field ID number of the animal, showing the captures over four nights.

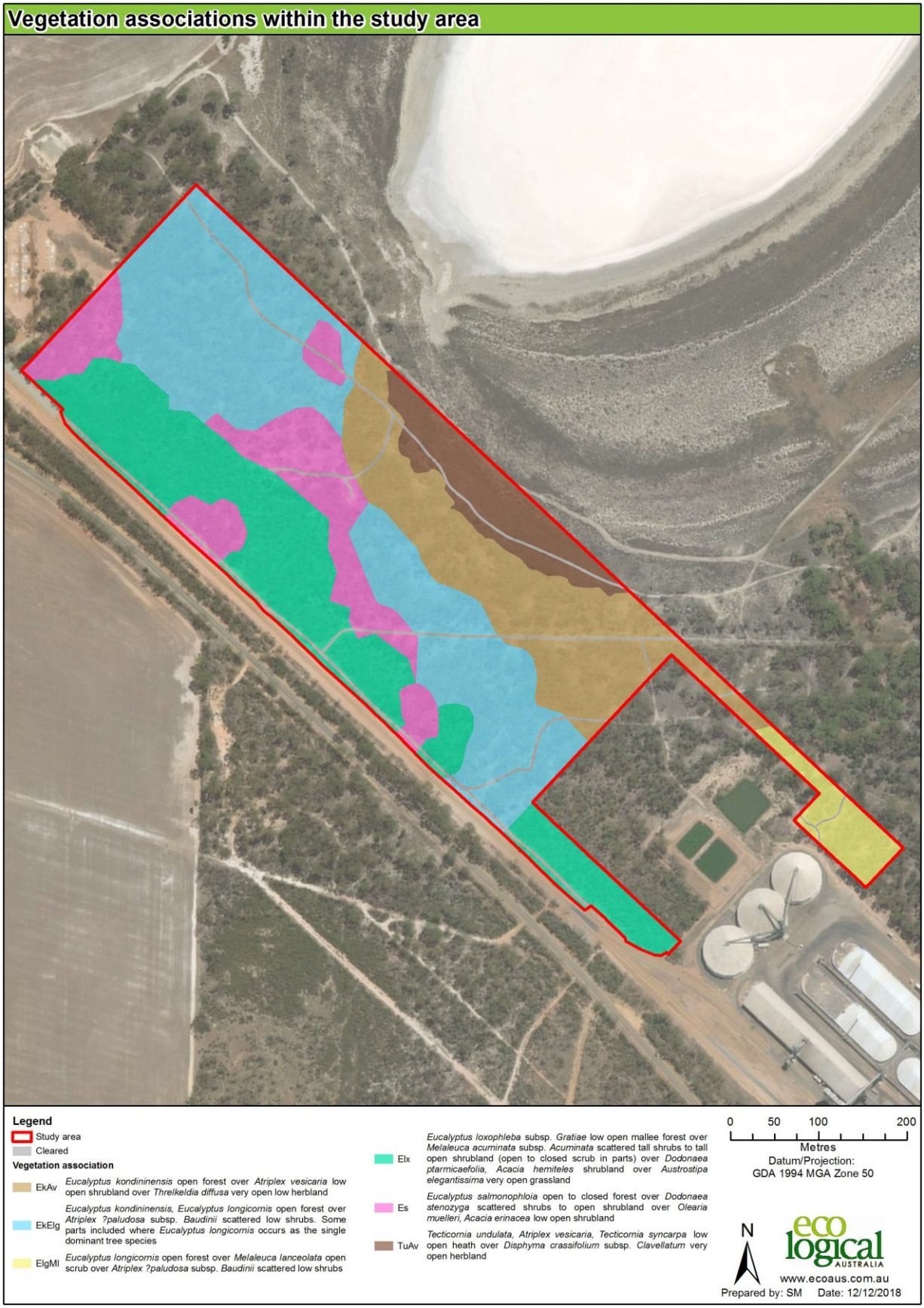

Figure 8: Vegetation associations within the study area. Adapted from 360 Environmental 2015a.

Figure 9: Vegetation condition within the study area.

Figure 10: Extent of TECs and PECs within the study area.

4.2 Fauna survey

4.2.1 Fauna overview

Fifteen species of native vertebrate fauna were recorded during current and previous fauna surveys, including two mammals, twelve birds and one reptile (**Table 11**). Three introduced mammals and two introduced birds were also recorded (Cardno 2014; 360 Environmental 2015a, b; ELA 2018a).

Table 11: Fauna species recorded in the study area.

Scientific name	Common name	Record	Source
Native species			
Anthochaera carunculata	Red Wattlebird	Heard	This survey
Corvus coronoides	Australian Raven	Direct observation	Cardno 2014, this survey
Cacatua roseicapilla	Galah	Direct observation	Cardno 2014, 360 Environmental 2015b, this survey
Hirundo neoxena	Welcome Swallow	Direct observation	This survey
Macropus fuliginosus melanops	Western Grey Kangaroo	Skeletal remains and scats	Cardno 2014, this survey
Merops ornatus	Rainbow Bee-eater	Direct observation	This survey
Neophema elegans	Elegant Parrot	Direct observation	360 Environmental 2015b
Phaps chalcoptera	Common Bronzewing	Direct observation	Cardno 2014
Phascogale calura	Red-tailed Phascogale	Direct observation (trapped)	ELA 2018a
Platycercus zonarius	Australian Ringneck Parrot	Direct observation	Cardno 2014, this survey
Sericornis frontalis	White-browed Scrub Wren	Direct observation	Cardno 2014
Smicrornis brevirostris	Weebill	Heard	This survey
Strepera versicolor	Grey Currawong	Direct observation	Cardno 2014, this survey
Tadorna tadornoides	Australian Shelduck	Direct observation	Cardno 2014
Tiliqua rugosa	Bobtail	Direct observation	This survey, Cardno 2014
Introduced species			
Dacelo novaeguineae	Kookaburra	Heard	This survey
Felis catus	Cat	Direct observation (trapped); skeletal remains, scats	ELA 2018a, Cardno 2014, this survey
Mus musculus	House Mouse	Direct observation (trapped)	ELA 2018a
Ovis aries	Sheep	Scats and tracks	Cardno 2014

Trichoglossus moluccanus	Rainbow Lorikeet	Direct observation	This survey

4.2.2 Fauna habitats

Three broad fauna habitats are present within the study area (**Figure 11**):

- *Eucalyptus* open forest (16.6 ha; 66.8% of the study area);
- *Eucalyptus* mallee over *Melaleuca* shrubland (5.7 ha; 23.1% of the study area); and
- *Tecticornia* heath (1.7 ha; 6.9% of the study area).

The remaining 0.8 ha (3.2% of the study area) is cleared, and does not provide habitat to fauna.

4.2.3 Conservation significant fauna

The Red-tailed Phascogale (listed as Vulnerable under the EPBC Act and Conservation Dependent under the WC Act) was previously trapped during a targeted field survey (ELA 2018a). This species is the only conservation listed fauna species directly observed during field studies, including the current survey (ELA 2018a; 360 Environmental 2015b; Cardno 2014).

A likelihood of occurrence assessment for other conservation listed fauna species was undertaken (**Appendix F**). Two species were assessed as likely to occur within the study area:

- Carnaby's Black Cockatoo, *Calyptorhynchus latirostris* (listed as Endangered under the EPBC Act and the WC Act); and
- Western Rosella (inland), *Platycercus icterotis xanthogenys* (listed as Priority 4 by DBCA).

A further ten species were considered to potentially occur, with six of these species considered to be vagrant birds that may occasionally visit the study area:

- Bradshaw's bothriembryontid land snail (Tambellup), *Bothriembryon bradshawi* (listed as Priority 3 by DBCA);
- Western Brush Wallaby, *Notamacropus irma* (listed as Priority 4 by DBCA);
- Western Whipbird (western mallee), *Psophodes nigrogularis oberon* (listed as Priority 4 by DBCA);
- Malleefowl, *Leipoa ocellata*, (listed as Vulnerable under the EPBC Act and WC Act);
- Peregrine Falcon, *Falco peregrinus* (listed as Other Specially Protected Fauna under the WC Act) – vagrant;
- Fork-tailed Swift, *Apus pacificus* (listed as Migratory under the EPBC Act and WC Act) – vagrant;
- Red-necked Stint, *Calidris ruficollis* (listed as Migratory under the EPBC Act and WC Act) – vagrant;
- Sharp-tailed Sandpiper, *Calidris acuminata* (listed as Migratory under the EPBC Act and WC Act) – vagrant;
- Common Greenshank, *Tringa nebularia* (listed as Migratory under the EPBC Act and WC Act) – vagrant; and
- Hooded Plover, *Thinornis rubricollis* (listed as Priority 4 by DBCA) – vagrant.

Figure 11: Fauna habitats within the study area.

5 Discussion

5.1 Flora

A total of 178 taxa (including species, subspecies, varieties and forms, and specimens not identified to species level) from 111 genera and 42 families were recorded from quadrats, relevés and opportunistic collections in the study area during the current and previous surveys (360 Environmental 2015a; Cardno 2014). The ELA and 360 Environmental (2015a) quadrat species richness ranged from 7 to 35 taxa with an average of 17.2 taxa per quadrat. A species accumulation curve was used to evaluate the adequacy of sampling, using a combined ELA/360 Environmental (2015a) dataset. Using this analysis, the incidence-based coverage estimator of species richness was calculated to be 143.8; based on this value, and the total of 102 species recorded within quadrats only, approximately 71% of the flora species potentially present within the study area were recorded. However, when data from relevés (Cardno 2014; 360 Environmental 2015a), weeds and opportunistic sightings is included, the taxa records rise to 175 (includes taxa not identified to species level), exceeding the species richness estimator value of 143.8. Therefore, the level of sampling conducted over the three surveys is considered appropriate.

Woodland Watch was a collaborative project involving WWF Australia and the WAM. The objective of the project was to carry out floristic surveys of selected remnant eucalypt woodlands (and other priority under-represented vegetation types) on private farmlands of the Avon Wheatbelt and Western Mallee Bioregions. The Woodland Watch survey recorded seven sites within the vicinity of Newdegate (WAH 2007, 2009a, b). The species richness for these quadrats ranged from 8-29 (mean of 16 taxa). This is similar to the species richness recorded in the quadrats in the study area; indicating that the species richness of the study area contains a comparable flora diversity to nearby eucalypt woodland communities.

The early November timing of the current survey is in line with the recommenced EPA guidance (EPA 2016a, 2016b); the survey was also planned to account for the November/December flowering period of the Priority 1 species *Thysanotus lavanduliflorus*. While lower than average rainfall (particularly in September; BoM 2018b) meant the timing was sub-optimal for the identification of many annual flora species, as the survey was specifically designed as a supplementary survey to satisfy gaps associated with previous ecological surveys, the absence of annuals was not considered a significant limitation as a high number of annual species were recorded in the September 2015 survey (360 Environmental 2015a).

A likelihood of occurrence assessment was undertaken as part of the previous flora and vegetation assessment completed at the site in 2015 (360 Environmental 2015a). Following the field survey, one species (*Thysanotus lavanduliflorus*) was considered likely to occur, and a further nine species were considered to potentially occur (360 Environmental 2015a). The remaining 35 species were considered unlikely to be present in the study area. The likelihood of occurrence assessment was updated as part of the current survey for new taxa, identified utilising up-to-date database searches. The likelihood of occurrence assessment was not repeated for species considered unlikely to occur by 360 Environmental (2015a).

Priority 1 species *Thysanotus lavanduliflorus* was recorded in the study area during the current survey. This species is a caespitose perennial herb with tuberous roots that grows to 0.25 m in height. It produces purple flowers in November and December and is found in sand/sandy loam soils in the Lake Grace area (WAH 1998-2018). There are four previous records within 20 km of the study area (DBCA 2018b), which recorded the individuals in November/December in similar habitat, where specified (Eucalypt woodland and/or mallee on sandy loam).

The updated likelihood of occurrence assessment determined *Haegiela tatei* (listed as Priority 4 by DBCA) has the potential to occur within the study area. *Haegiela tatei* is an ascending to erect annual herb that grows approximately 2-8 cm high (WAH 1998-2018). The closest record is 17 km from the study area. While the flowering period for this species is August to November, given the dry site conditions in early November 2018 and its small stature, this cryptic species could have been overlooked during the field surveys. This species is found on clay, sandy loam and gypsum soils in saline habitats. The vegetation association TuAv adjacent to Lake Stubbs could contain 1.7 ha of suitable habitat; thus this species is considered to have the potential to occur within the study area.

The remaining taxa were considered unlikely to occur within the study area; with the exception of *Haegiela tatei*, the 14 additional conservation listed flora species identified in the database assessment that were not previously assessed by 360 Environmental (2015a) were perennial species and would have been visible despite the dry site conditions. Previous surveys at the site (Cardno 2014; 360 Environmental (2015a), also failed to observe these species. The nine taxa that were considered to have potential to occur in the study area by 360 Environmental (2015a), were also downgraded to unlikely to occur following the recent field survey, following the same reasoning.

5.2 Vegetation and communities

Following statistical analysis, the eight additional quadrats undertaken as part of the current survey in line with current guidance (EPA 2016a) were found to correlate with the six existing vegetation communities originally mapped within the study area (360 Environmental 2015a). With the exception of the restricted vegetation association ElgMl, which contained had one relevé (360 Environmental 2015a) and two ELA quadrats, all vegetation associations contained at least three quadrats.

Vegetation condition within the study area was also updated, and was found to roughly align with the previous condition mapping (360 Environmental 2015a), with some minor differences. The majority of the study area remains in Very Good condition. The vegetation association mapping remained consistent with 360 Environmental (2015a), with the exception of the ‘completely degraded’ area of vegetation mapped in the south-eastern corner around a drain. This area was previously considered not to align with a mapped vegetation association (and therefore was not considered ‘vegetation’), however, based on the results of the current survey, this area has remained in ‘completely degraded’ condition, however was assessed to contain enough structure and composition to be considered part of vegetation association ElgMl.

Disturbances within the project area include the clearing of vegetation for tracks, the presence of introduced (feral) fauna species and dumping of rubbish (cars, bottles etc.). A total of 18% of flora taxa recorded were weed species (32 taxa in total), including three taxa not identified to species level. None of these species are listed as WONS or Declared under the BAM Act. Quadrats within vegetation associations EkLg (10 taxa) and TuAv (8 taxa) recorded the highest weed diversity.

The Eucalypt woodlands of the Western Australian Wheatbelt community TEC/PEC was previously mapped in the study area (360 Environmental 2015a); however, an assessment utilising the key diagnostic characteristics of the TEC (DoE 2015) had not been previously completed. This assessment was undertaken as part of the current study, and determined 16.6 ha of this TEC occurred within the study area (and subsequently the State-listed PEC), aligned with the mapped occurrences of vegetation associations EkAv, EkElg, ElgMl and Es.

The patch of the TEC present within the study area was classified (DoE 2015) as ‘Category A: Patches likely to correspond to a condition of Pristine / Excellent / Very good (Keighery, 1994) or a High RCV (RCC, 2014)’. While areas of vegetation mapped as Good, Degraded and Completely Degraded occur

within vegetation associations ElgMl and Es, weed species were below 30% cover in all quadrats, so Category A was still considered appropriate.

A small area of Es (0.4 ha), while isolated from the rest of the mapped area of the TEC within the study area by vegetation association Elx, was classified as part of the same patch, as patches are defined (DoE 2015) as '…a discrete and mostly continuous area of the ecological community. A patch may include small-scale variations and disturbances, such as tracks or breaks, watercourses/drainage lines or localised changes in vegetation that do not act as a permanent barrier or significantly alter its overall functionality.'

A total of 8.8 ha of the Red Morrel Woodlands of the Wheatbelt PEC (Priority 1), which can co-occur with the Eucalypt woodlands of the Western Australian Wheatbelt TEC/PEC, was also mapped within the study area.

5.3 Fauna

Three broad fauna habitats were mapped within the study area, with the most common habitat *Eucalyptus* open forest (66.8% of the study area). There were also smaller occurrences of *Eucalyptus* mallee over *Melaleuca* shrubland (23.1% of the study area) and *Tecticornia* heath adjacent to Lake Stubbs (6.9% of the study area).

During current and previous fauna surveys (Cardno 2014; 360 Environmental 2015b, ELA 2018a), 15 species of native vertebrate fauna were recorded, including two mammals, twelve birds and one reptiles. Three introduced mammals and two introduced birds were also recorded. One previous conservation listed fauna species, the Red-tailed Phascogale, was previously observed during a targeted field survey in June 2018 (ELA 2018a), where four individuals were trapped. A likelihood of occurrence assessment for other conservation listed fauna species determined that two species were assessed as likely to occur within the study area, Carnaby's Black Cockatoo and Western Rosella (inland). This was on the basis of suitable habitat and nearby records; in the case of the Western Rosella closest record was less than 1 km from the study area. A Carnaby's Black Cockatoo assessment has previously been undertaken on site (360 Environmental 2015b), and mapped 22.5 ha of foraging habitat and 1.5 ha of potential breeding habitat (contained within the mapped foraging habitat; areas altered to account for slight changes in the study area and the removal of cleared areas). A total of 92 potential breeding trees, predominantly Salmon Gum, were recorded, with 31 hollows observed that were potentially suitable to be used for Black Cockatoo nesting (360 Environmental 2015b).

A further ten conservation listed fauna species were considered to potentially occur, with six of these species considered to be vagrant birds that may occasionally fly over the study area or visit the area to forage. Four of these vagrant species are associated with salt lakes, and are likely to only utilise the 1.7 ha of *Tecticornia* heath habitat present within the study area. While the targeted Malleefowl assessment failed to find evidence of this species (e.g. sightings of individuals, mounds or prints), given the proximity and number of nearby records (23 records within 10 km, within the closest non-historical record 1.1 km away) and the mobile nature of this species, it is possible that this species could occasionally utilise the study area for foraging purposes. No species were considered to rely solely on the habitats present in the study area for survival.

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Appendix A ELA Floristic quadrat data

Site name and number	Date	Site type	Observer
ELA1	05/11/2018	10 x 10 m understory 20 x 20 m overstory	SD & JM
Condition	Disturbance	Fire history - years	Landscape type
Very Good	Weeds	Old (>20 years)	Flat
Soil type	Soil colour	Leaf litter cover (%)	Bare ground cover (%)
Sandy loam	Brown	60	20
Latitude		Longitude	
-33.082529 ºS		119.012831 ºE	

Species	Cover (%)	Height Class	Stratum (U=Upper, M=Middle, G=Ground)
Acacia erinacea	1	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
Acacia hemiteles		3 (1-2m)	Shrub, cycad, grass-tree, tree-fern (M)
Austrostipa elegantissima		1 (<0.5 m)	Other grass (G)
Crassula colorata		1 (<0.5 m)	Forb (G)
Dodonaea stenozyga		3 (1-2m)	Shrub, cycad, grass-tree, tree-fern (M)
Enchylaena tomentosa		1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
Eucalyptus salmonophloia	10	7 (10-30)	Tree, palm (U)
Eucalyptus loxophleba subsp. *gratiae*		6 (<10)	Tree, palm (U)
Olearia muelleri	2	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)

**Raphanus raphanistrum*		1 (<0.5 m)	Forb (G)
Rhagodia drummondii		1 (<0.5 m)	Chenopod shrub (M)
Rhagodia preissii subsp. *preissii*		2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)
Rytidosperma acerosum		1 (<0.5 m)	Other grass (G)
Sclerolaena diacantha		1 (<0.5 m)	Forb (G)
Sclerolaena diacantha		1 (<0.5 m)	Chenopod shrub (M)
Templetonia rossii		2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)
Thysanotus lavanduliflorus		1 (<0.5 m)	Forb (G)

Site name and number	Date	Site type	Observer
ELA2	05/11/2018	10 x 10 m understory 20 x 20 m overstory	SD & JM
Condition	Disturbance	Fire history - years	Landscape type
Very Good	Weeds	Old (>20 years)	Flat
Soil type	Soil colour	Leaf litter cover (%)	Bare ground cover (%)
Sandy loam	Dark brown	90	0
Latitude		Longitude	
-33.085214 ºS		119.016726 ºE	

Species	Cover (%)	Height Class	Stratum (U=Upper, M=Middle, G=Ground)
Austrostipa elegantissima		1 (<0.5 m)	Other grass (G)
Austrostipa trichophylla		1 (<0.5 m)	Other grass (G)
**Avena barbata*		1 (<0.5 m)	Other grass (G)
Calandrinia sp.		1 (<0.5 m)	Forb (G)
Enchylaena tomentosa	0.1	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
Eucalyptus kondininensis	15	7 (10-30)	Tree, palm (U)
Eucalyptus longicornis	30	7 (10-30)	Tree, palm (U)
Eucalyptus loxophleba subsp. *gratiae*		6 (<10)	Tree, palm (U)
Lepidium rotundum		1 (<0.5 m)	Forb (G)
**Lolium rigidum*		1 (<0.5 m)	Other grass (G)
**Pentameris airoides*		1 (<0.5 m)	Forb (G)
Pittosporum angustifolium		2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)

**Raphanus raphanistrum*		1 (<0.5 m)	Forb (G)
Rhagodia drummondii		1 (<0.5 m)	Chenopod shrub (M)
Rhagodia drummondii		1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
Sclerolaena diacantha		1 (<0.5 m)	Chenopod shrub (M)
Sclerolaena diacantha		1 (<0.5 m)	Chenopod shrub (M)
Senna artemisioides subsp. *filifolia*		2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)
**Sonchus oleraceus*		1 (<0.5 m)	Forb (G)
Templetonia rossii		2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)
**Trifolium* sp.		1 (<0.5 m)	Forb (G)
**Ursinia anthemoides*		1 (<0.5 m)	Forb (G)

Site name and number	Date	Site type	Observer
ELA3	05/11/2018	10 x 10 m understory 20 x 20 m overstory	SD & JM
Condition	Disturbance	Fire history - years	Landscape type
Very Good	Weeds	Old (>20 years)	Flat
Soil type	Soil colour	Leaf litter cover (%)	Bare ground cover (%)
Sandy loam	Dark brown	90	0
Latitude		Longitude	
-33.083502 ºS		119.016065 ºE	

Species	Cover (%)	Height Class	Stratum (U=Upper, M=Middle, G=Ground)
**Cirsium vulgare*		1 (<0.5 m)	Forb (G)
Atriplex vesicaria	40	2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)
Austrostipa elegantissima		1 (<0.5 m)	Other grass (G)
Eucalyptus kondininensis	30	7 (10-30)	Tree, palm (U)
Exocarpos aphyllus		2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)
Lepidium rotundum		1 (<0.5 m)	Forb (G)
Rhagodia drummondii		1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
Rytidosperma acerosum		2 (0.5-1 m)	Sedge (G)
Sclerolaena diacantha		1 (<0.5 m)	Chenopod shrub (M)
**Sonchus oleraceus*		1 (<0.5 m)	Forb (G)
Templetonia rossii		1 (<0.5 m)	Forb (G)
Threlkeldia diffusa		1 (<0.5 m)	Chenopod shrub (M)

Thysanotus patersonii		1 (<0.5 m)	Forb (G)
**Vulpia* sp.		1 (<0.5 m)	Other grass (G)

Site name and number	Date	Site type	Observer
ELA4	06/11/2018	10 x 10 m understory 20 x 20 m overstory	SD & JM
Condition	Disturbance	Fire history - years	Landscape type
Very Good	Edge effects	Old (>20 years)	Flat
Soil type	Soil colour	Leaf litter cover (%)	Bare ground cover (%)
Clay loam	Light brown /orange	20	50
Latitude		Longitude	
-33.088065 ºS		119.019277 ºE	

Species	Cover (%)	Height Class	Stratum (U=Upper, M=Middle, G=Ground)
Acacia erinacea	2	2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)
Acacia hemiteles		2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)
Alyxia buxifolia	0.5	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
Arthropodium curvipes		1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
Austrostipa elegantissima		1 (<0.5 m)	Other grass (G)
Cryptandra wilsonii		1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
Eremophila decipiens subsp. *decipiens*		1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
Eucalyptus loxophleba subsp. *gratiae*	2	6 (<10)	Tree mallee (U)
Melaleuca acuminata subsp. *acuminata*	30	6 (<10)	Shrub, cycad, grass-tree, tree-fern (M)

Melaleuca scalena	1	3 (1-2m)	Shrub, cycad, grass-tree, tree-fern (M)
Olearia muelleri	5	2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)
Ptilotus spathulatus		1 (<0.5 m)	Forb (G)
Rhagodia drummondii		1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
Rytidosperma acerosum		1 (<0.5 m)	Other grass (G)
Sclerolaena diacantha		1 (<0.5 m)	Chenopod shrub (M)
Thysanotus patersonii		1 (<0.5 m)	Forb (G)

Site name and number	Date	Site type	Observer
ELA5	06/11/2018	10 x 10 m understory 20 x 20 m overstory	SD & JM
Condition	Disturbance	Fire history - years	Landscape type
Good	Clearing/edge effects	Old (>20 years)	Flat
Soil type	Soil colour	Leaf litter cover (%)	Bare ground cover (%)
Loam	Dark brown	80	2
Latitude		Longitude	
-33.087472 ºS		119.022244 ºE	

Species	Cover (%)	Height Class	Stratum (U=Upper, M=Middle, G=Ground)
Atriplex paludosa subsp. *baudinii*	10	2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)
Eucalyptus longicornis	5	6 (<10)	Tree, palm (U)
Maireana suaedifolia		1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
Melaleuca lanceolata	5	6 (<10)	Shrub, cycad, grass-tree, tree-fern (M)
Rhagodia crassifolia		1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
Sclerolaena diacantha		1 (<0.5 m)	Chenopod shrub (M)
Threlkeldia diffusa	0.1	1 (<0.5 m)	Chenopod shrub (M)

Site name and number	Date	Site type	Observer
ELA6	06/11/2018	10 x 10 m understory 20 x 20 m overstory	SD & JM
Condition	Disturbance	Fire history - years	Landscape type
Very Good	Tracks nearby	Old (>20 years)	Clay plain
Soil type	Soil colour	Leaf litter cover (%)	Bare ground cover (%)
Clay loam	Grey	1	5
Latitude		Longitude	
-33.084888 ºS		119.018775 ºE	

Species	Cover (%)	Height Class	Stratum (U=Upper, M=Middle, G=Ground)
Atriplex vesicaria	0.5	1 (<0.5 m)	Chenopod shrub (M)
Brachyscome eyrensis		1 (<0.5 m)	Forb (G)
**Cotula bipinnata*		1 (<0.5 m)	Forb (G)
Crassula colorata		1 (<0.5 m)	Forb (G)
Disphyma crassifolium subsp. *clavellatum*	5	2 (0.5-1 m)	Chenopod shrub (M)
Sclerolaena diacantha		1 (<0.5 m)	Chenopod shrub (M)
**Sonchus oleraceus*		2 (0.5-1 m)	Forb (G)
Tecticornia indica subsp. *bidens*	1	1 (<0.5 m)	Samphire shrub (M)
Tecticornia syncarpa	5	1 (<0.5 m)	Samphire shrub (M)
Tecticornia undulata	30	2 (0.5-1 m)	Samphire shrub (M)

Site name and number	Date	Site type	Observer
ELA7	06/11/2018	10 x 10 m understory 20 x 20 m overstory	SD & JM
Condition	Disturbance	Fire history - years	Landscape type
Good	Clearing	Old (>20 years)	Flat
Soil type	Soil colour	Leaf litter cover (%)	Bare ground cover (%)
Clay loam	Brown	10	50
Latitude		Longitude	
-33.087058 ºS		119.021753 ºE	

Species	Cover (%)	Height Class	Stratum (U=Upper, M=Middle, G=Ground)
Atriplex paludosa subsp. *baudinii*	5	2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)
Enchylaena tomentosa	0.5	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
Eucalyptus longicornis	30	6 (<10)	Tree, palm (U)
Melaleuca lanceolata	15	6 (<10)	Shrub, cycad, grass-tree, tree-fern (M)
Rhagodia crassifolia	3	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
Sclerolaena diacantha		1 (<0.5 m)	Chenopod shrub (M)
Threlkeldia diffusa	1	1 (<0.5 m)	Chenopod shrub (M)

Site name and number	Date	Site type	Observer
ELA8	06/11/2018	10 x 10 m understory 20 x 20 m overstory	SD & JM
Condition	Disturbance	Fire history - years	Landscape type
Very Good	-	Old (>20 years)	Flat
Soil type	Soil colour	Leaf litter cover (%)	Bare ground cover (%)
Sandy loam	Brown	90	0
Latitude		Longitude	
-33.082913 ºS		119.014036 ºE	

Species	Cover (%)	Height Class	Stratum (U=Upper, M=Middle, G=Ground)
Atriplex paludosa subsp. *baudinii*	1	2 (0.5-1 m)	Chenopod shrub (M)
Austrostipa exilis		1 (<0.5 m)	Other grass (G)
Calandrinia sp.		1 (<0.5 m)	Forb (G)
Disphyma crassifolium subsp. *clavellatum*		1 (<0.5 m)	Forb (G)
Enchylaena tomentosa	0.5	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
Eucalyptus kondininensis	5	7 (10-30)	Tree, palm (U)
Eucalyptus longicornis	10	7 (10-30)	Tree, palm (U)
Olearia muelleri	0.5	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
Rhagodia drummondii		1 (<0.5 m)	Chenopod shrub (M)
Rhagodia drummondii	1	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
Rhagodia preissii subsp. *preissii*		1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
Rytidosperma acerosum		1 (<0.5 m)	Other grass (G)
Sclerolaena diacantha		1 (<0.5 m)	Chenopod shrub (M)

Appendix B Flora taxa by quadrat matrix

Quadrat data from this survey (quadrats 'ELA') and 360 Environmental (2015a; quadrats 'NG').

Taxa	ELA1	ELA2	ELA3	ELA4	ELA5	ELA6	ELA7	ELA8	NG01	NG02	NG03	NG04	NG05	NG06	NG07	NG08	NG09	NG10
Acacia erinacea	1	0	0	1	0	0	0	0	0	1	1	1	1	0	0	0	0	0
Acacia hemiteles	1	0	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0
Acacia merrallii	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Alyxia buxifolia	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arthropodium curvipes	0	0	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0
Asteridea athrixioides	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0
Atriplex paludosa subsp. *baudinii*	0	0	0	0	1	0	1	1	1	0	0	0	0	0	0	0	0	1
Atriplex vesicaria	0	0	1	0	0	1	0	0	0	0	0	0	0	1	1	1	1	0
Austrostipa acrociliata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Austrostipa elegantissima	1	1	1	1	0	0	0	0	1	1	1	1	1	1	0	0	1	0
Austrostipa exilis	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Austrostipa sp.	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0	1	0
Austrostipa trichophylla	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
**Avena barbata*	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brachyscome eyrensis	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0
**Brassica napus*	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
**Bromus rubens*	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0
Caladenia dimidia	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Caladenia hirta subsp. *rosea*	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0
Calandrinia sp.	0	1	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0
Calotis hispidula	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Cassytha melantha	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0
Chenopodiaceae sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Chenopodium desertorum subsp. *desertorum*	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0
**Cirsium vulgare*	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Comesperma integerrimum	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0

Taxa	ELA1	ELA2	ELA3	ELA4	ELA5	ELA6	ELA7	ELA8	NG01	NG02	NG03	NG04	NG05	NG06	NG07	NG08	NG09	NG10
Corunastylis fuscoviridis	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1	1
Cotula bipinnata	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0
Crassula colorata	1	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0
Crassula colorata var. *acuminata*	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0
Cryptandra wilsonii	0	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0	0
Daucus glochidiatus	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0
Disphyma crassifolium subsp. clavellatum	0	0	0	0	0	1	0	1	0	1	0	0	0	1	1	1	1	0
Dodonaea ptarmicaefolia	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0
Dodonaea stenozyga	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0
Drosera bulbosa	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Enchylaena tomentosa	1	1	0	0	0	0	1	1	1	1	1	0	1	0	0	0	0	0
Eremophila decipiens subsp. *decipiens*	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Ericksonella saccharata	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Eriochilus dilatatus subsp. *undulatus*	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0
Erymophyllum tenellum	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Eucalyptus kondininensis	0	1	1	0	0	0	0	1	1	0	0	0	0	0	0	1	1	1
Eucalyptus longicornis	0	1	0	0	1	0	1	1	1	0	0	1	0	0	0	0	0	1
Eucalyptus loxophleba subsp. *gratiae*	1	1	0	1	0	0	0	0	0	1	1	1	1	0	0	0	0	0
Eucalyptus salmonophloia	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0
Exocarpos aphyllus	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Goodenia berardiana	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0
**Hypochaeris glabra*	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	1	0	0
Lawrencia squamata	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
Lepidium rotundum	0	1	1	0	0	0	0	0	1	0	1	0	1	0	0	1	1	0
**Lolium rigidum*	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
**Lysimachia arvensis*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0

Taxa	ELA1	ELA2	ELA3	ELA4	ELA5	ELA6	ELA7	ELA8	NG01	NG02	NG03	NG04	NG05	NG06	NG07	NG08	NG09	NG10
Maireana enchylaenoides	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Maireana erioclada	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Maireana marginata	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0
Maireana suaedifolia	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Melaleuca acuminata subsp. *acuminata*	0	0	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0
Melaleuca lanceolata	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0
Melaleuca thyoides	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Melaleuca scalena	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Olearia muelleri	1	0	0	1	0	0	0	1	1	0	1	1	1	0	0	0	0	1
Omphalolappula concava	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Oxalis perennans	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0
Pelargonium havlasae	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0
Pentameris airoides	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pittosporum angustifolium	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Plantago debilis	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0
Poaceae sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
Pterostylis mutica	0	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	1	1
Pterostylis scabra	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0
Ptilotus holosericeus	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0
Ptilotus spathulatus	0	0	0	1	0	0	0	0	0	1	0	1	1	0	0	0	0	0
**Raphanus raphanistrum*	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhagodia crassifolia	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	1	1
Rhagodia drummondii	1	1	1	1	0	0	0	1	1	0	1	0	1	0	0	0	0	1
Rhagodia preissii subsp. *preissii*	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
Roepera glauca	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	1
Rytidosperma acerosum	1	0	1	1	0	0	0	1	1	1	1	1	0	0	0	0	0	0
Sclerolaena diacantha	1	1	1	1	1	1	1	1	1	0	1	0	1	1	1	1	1	1

Taxa	ELA1	ELA2	ELA3	ELA4	ELA5	ELA6	ELA7	ELA8	NG01	NG02	NG03	NG04	NG05	NG06	NG07	NG08	NG09	NG10
Senecio glomeratus	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Senecio glossanthus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0
Senna artemisioides subsp. *filifolia*	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0
Senna sp. Pallinup River (J.W. Green 4847)	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0
**Sonchus oleraceus*	0	1	1	0	0	1	0	0	1	0	1	0	0	1	1	1	0	0
Stellaria filiformis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Stenopetalum lineare var. *lineare*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Tecticornia indica subsp. *bidens*	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0
Tecticornia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Tecticornia syncarpa	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0	1	0
Tecticornia undulata	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0
Templetonia rossii	1	1	1	0	0	0	0	0	1	0	0	0	0	0	0	1	1	1
Thelymitra graminea	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0
Threlkeldia diffusa	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	1	1	0
Thysanotus patersonii	0	0	1	1	0	0	0	0	0	1	1	0	0	0	0	0	1	0
Thysanotus lavanduliflorus	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trachymene pilosa	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
**Trifolium* sp. 1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
**Trifolium* sp. 2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Trymalium myrtillus subsp. *myrtillus*	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0
**Ursinia anthemoides*	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
**Vulpia* sp.	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Waitzia suaveolens var. *suaveolens*	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Total number of taxa	**16**	**20**	**14**	**16**	**7**	**10**	**7**	**12**	**28**	**35**	**35**	**14**	**18**	**17**	**11**	**18**	**19**	**12**

Appendix C Flora species list

Family	Known name
	Indeterminant sp.
Aizoaceae	*Carpobrotus modestus*
	Disphyma crassifolium subsp. *clavellatum*
	**Mesembryanthemum nodiflorum*
Amaranthaceae	*Ptilotus holosericeus*
	Ptilotus spathulatus
Apiaceae	*Daucus glochidiatus*
Apocynaceae	*Alyxia buxifolia*
Araliaceae	*Hydrocotyle pilifera* var. *glabrata*
	Trachymene ornata
	Trachymene pilosa
Asparagaceae	*Arthropodium curvipes*
	Lomandra effusa
	Thysanotus manglesianus
	Thysanotus patersonii
	Thysanotus lavanduliflorus
Asteraceae	**Arctotheca calendula*
	Asteraceae sp.
	Asteridea athrixioides
	Blennospora drummondii
	Blennospora phlegmatocarpa
	Brachyscome ciliaris
	Brachyscome eyrensis
	Brachyscome perpusilla
	Calotis hispidula
	**Cirsium vulgare*
	**Conyza bonariensis*
	**Cotula bipinnata*
	Erymophyllum tenellum

	Helichrysum leucopsideum
	Helichrysum luteoalbum
	Hyalosperma glutinosum
	**Hypochaeris glabra*
	Millotia myosotidifolia
	**Monoculus monstrosus*
	Olearia muelleri
	Olearia subspicata
	Pogonolepis sp.
	Rhodanthe heterantha
	Rhodanthe pygmaea
	Senecio glomeratus
	Senecio glossanthus
	Siloxerus humifusus
	**Sonchus oleraceus*
	**Ursinia anthemoides*
	Waitzia suaveolens var. *suaveolens*
Boraginaceae	*Omphalolappula concava*
Brassicaceae	**Brassica napus*
	**Brassica tournefortii*
	Lepidium rotundum
	Lepidium sp.
	**Raphanus raphanistrum*
	Stenopetalum lineare var. *lineare*
Caryophyllaceae	*Stellaria filiformis*
Chenopodiaceae	*Atriplex bunburyana*
	Atriplex cinerea
	Atriplex paludosa subsp. baudinii
	Atriplex vesicaria
	Chenopodiaceae sp.
	Chenopodium desertorum subsp. *desertorum*
	Enchylaena tomentosa
	Enchylaena lanata

	Maireana enchylaenoides
	Maireana erioclada
	Maireana marginata
	Maireana suaedifolia
	Maireana trichoptera
	Rhagodia crassifolia
	Rhagodia drummondii
	Rhagodia preissii subsp. *preissii*
	Sclerolaena diacantha
	Tecticornia indica subsp. *bidens*
	Tecticornia pergranulata subsp. *pergranulata*
	Tecticornia sp.
	Tecticornia syncarpa
	Tecticornia undulata
	Threlkeldia diffusa
Colchicaceae	*Wurmbea tenella*
Convolvulaceae	*Wilsonia rotundifolia*
Crassulaceae	*Crassula colorata*
	Crassula colorata var. *acuminata*
Cyperaceae	*Lepidosperma diurnum*
	Lepidosperma drummondii
Droseraceae	*Drosera bulbosa*
Fabaceae	*Acacia acanthoclada* subsp. *acanthoclada*
	Acacia erinacea
	Acacia hemiteles
	Acacia leptospermoides subsp. *leptospermoides*
	Acacia merrallii
	Daviesia scoparia
	Senna artemisioides subsp. *filifolia*
	Senna sp. Pallinup River (J.W. Green 4847)
	Templetonia rossii
	**Trifolium* sp. 1
	**Trifolium* sp. 2

	**Trifolium hirtum*
	**Trifolium tomentosum* var. *tomentosum*
Geraniaceae	**Erodium cicutarium*
	Erodium cygnorum
	Dianella revoluta
	Pelargonium havlasae
Goodeniaceae	*Coopernookia strophiolata*
	Dampiera lavandulacea
	Goodenia berardiana
	Goodenia pusilliflora
	Scaevola spinescens
Hypoxidaceae	*Pauridia glabella*
Lamiaceae	**Salvia verbenaca*
	Teucrium sessiliflorum
	Westringia cephalantha
	Westringia rigida
Lauraceae	*Cassytha melantha*
Malvaceae	*Lawrencia squamata*
Myrtaceae	*Eucalyptus kondininensis*
	Eucalyptus longicornis
	Eucalyptus loxophleba subsp. *gratiae*
	Eucalyptus salmonophloia
	Eucalyptus salubris
	Melaleuca acuminata subsp. *acuminata*
	Melaleuca adnata
	Melaleuca lanceolata
	Melaleuca lateriflora
	Melaleuca pauperiflora subsp. *pauperiflora*
	Melaleuca scalena
	Melaleuca sp.
	Melaleuca thyoides
Orchidaceae	*Caladenia dimidia*
	Caladenia hirta subsp. *rosea*

	Corunastylis fuscoviridis
	Ericksonella saccharata
	Eriochilus dilatatus subsp. *undulatus*
	Pterostylis mutica
	Pterostylis scabra
	Thelymitra graminea
Oxalidaceae	*Oxalis perennans*
	**Oxalis pes-caprae*
	Prasophyllum gracile
	Pterostylis picta
	Thelymitra macrophylla
Parmeliaceae	*Xanthoparmelia semiviridis*
Pittosporaceae	*Pittosporum angustifolium*
Plantaginaceae	*Plantago debilis*
	**Plantago coronopus* subsp. *commutata*
Poaceae	*Austrostipa acrociliata*
	Austrostipa elegantissima
	Austrostipa exilis
	Austrostipa pycnostachya
	Austrostipa sp.
	Austrostipa trichophylla
	**Avena barbata*
	**Bromus rubens*
	**Cenchrus clandestinus*
	**Ehrharta longiflora*
	**Hordeum leporinum*
	**Lolium rigidum*
	Neurachne alopecuroidea
	**Pentameris airoides*
	Poaceae sp.
	Rytidosperma acerosum
	**Triticum aestivum*
	**Vulpia myuros forma myuros*

	**Vulpia* sp.
Polygalaceae	*Comesperma integerrimum*
	**Rumex crispus*
Portulacaceae	*Calandrinia* sp.
	Calandrinia calyptrata
Primulaceae	**Lysimachia arvensis*
Rhamnaceae	*Cryptandra minutifolia* subsp. *minutifolia*
	Cryptandra nutans
	Cryptandra wilsonii
	Trymalium myrtillus subsp. *myrtillus*
Rutaceae	*Microcybe multiflora* subsp. *multiflora*
Santalaceae	*Exocarpos aphyllus*
	Santalum acuminatum
Sapindaceae	*Dodonaea ptarmicaefolia*
	Dodonaea stenozyga
Scrophulariaceae	*Eremophila decipiens* subsp. *decipiens*
	Eremophila deserti
Solanaceae	*Lycium australe*
Zygophyllaceae	*Roepera glauca*

Data from current survey, 360 Environmental (2015a) and Cardno (2014).

Appendix D Likelihood of occurrence criteria

Criteria used for likelihood of assessment

Likelihood	Criteria
Known to occur:	Recorded from the study area, through database search results and/or from previous surveys of the study area (<20 years)
Likely to occur:	The study area is within the species current distribution and contains suitable habitat for the species, however; • The species utilises seasonal habitat or has a large home range, so is not always present/visible in the study area; and/or • Survey limitations identified.
Potential to occur:	The study area is within the species current distribution and contains habitat, however (at least two of below); • The study area is located on the edge of the species range or it has a patchy distribution; and/or • Survey limitations identified; and/or • Habitat is less suitable; and/or • Species is cryptic, and/or difficult to record utilising traditional survey methods.
Potential to occur - vagrant	Species has the potential to occur on a transient, or vagrant, basis only in that: • may occasionally occur within the site; • may occasionally fly or forage over the site (aerial species only); • are unlikely to utilise the site for foraging, breeding or nesting; and • are unlikely to utilise the site on an ongoing or permanent basis.
Unlikely to occur	The study area is within the species current distribution and either: • contains habitat, was adequately surveyed (including for seasonal, migratory and cryptic species and fauna species with large home ranges) and did not record the species; or • the habitat is modified and unlikely to support the species and survey limitations identified.
Does not occur	The study area is within the species current distribution, and was adequately surveyed (including for seasonal, migratory and cryptic species and fauna species with large home ranges) and did not record the species. The study area may not contain suitable habitat. There is certainty that the species is not present in the study area.

Appendix E Flora likelihood of occurrence assessment

Scientific name	Conservation status[3]		Source[4]				Likelihood
	EPBC Act[1]	WC Act/ DBCA[2]	WAH	TPFL	NM	PMST	
Acacia auratiflora	EN	VU	X	X	X	X	**Unlikely**. The study area contained suitable habitat and the closest record is 10 km away. However, this species is a spreading shrub 0.3-1 m high, to 2 m wide, and would have been visible if present.
Acacia depressa	VU	EN	X		X		**Unlikely[5]**. Species is highly localised near Lake Grace. Laterite which is closely associated with this species is not present in the study area.
Acacia drewiana subsp. *minor*		P2	X	X	X		**Unlikely[5]**. No suitable habitat in the study area.
Acacia lanuginophylla	EN	VU	X	X	X	X	**Unlikely**. Known only from near Lake Biddy (North of Newdegate), near Lake Lockhart (c. 30 km South of Lake Biddy) and the type collection area c.120 km NE of Lake Biddy. The study area contains part of Salt Lake at the eastern boundary. While the closest record is within 13 km, this species is a dense shrub, 0.5-1.2 m high, and would have been visible if present.
Acacia leptalea	EN	VU				X	**Unlikely**. Species is confined to near Chinocup and Nyabing in the Katanning District. Closest record is approximately 60 km away.
Acacia mutabilis subsp. *stipulifera*		P3	X				**Unlikely**. Habitat is potentially suitable and the closest record is 19 km away, however this species is a shrub 0.3-1 m high and would have been visible if present.
Acacia sclerophylla var. *teretiuscula*		P1	X	X	X		**Unlikely**. Poorly collected variety known only from a few localities between Bruce Rock and Lake Grace. The study area contained suitable habitat. Shrub is 0.25-2.5 high, and would have been visible if present.

Scientific name	Conservation status[3]		Source[4]				Likelihood
	EPBC Act[1]	WC Act/ DBCA[2]	WAH	TPFL	NM	PMST	
Acacia sedifolia subsp. *pulvinata*		P3	X				**Unlikely**. No laterite hills or gravelly ridges are present in the study area. Shrub is 0.75-1.8 m high and would have been visible if present.
Acacia singula		P3	X		X		**Unlikely**[5]. No laterite or white/yellow sand is present in the study area.
Astroloma chloranthum		P2	X		X		**Unlikely**. The study area contained suitable habitat and the closest record is within 15 km. however this species is a shrub very low, spreading shrub (10 cm high and 100 cm wide) and would have been visible if present.
Astroloma sp. Dumbleyung (A.J.G. Wilson 146)		P3	X		X		**Unlikely**[5]. No laterite or granite is present in the study area.
Banksia rufa subsp. chelomacarpa		P3	X		X		**Unlikely**[5]. No gravelly soils are present in the study area
Banksia idiogenes		P2	X		X		**Unlikely**[5]. No gravelly soils are present in the study area.
Banksia xylothemelia		P3	X		X		**Unlikely**[5]. No gravelly soils are present in the study area
Bentleya spinescens		P4	X	X	X		**Unlikely**[5]. The study area contained suitable habitat with nearby records (<2 km). However, this species is a perennial herb or shrub growing between 0.05-0.2 m high, and would have been visible if present.
Caladenia hoffmanii	EN	EN				X	**Unlikely**[5]. This taxon is only found between Geraldton and Murchison River.
Calectasia obtusa		P3	X	X			**Unlikely**. Closest record is 18 km away, however no gravelly soils or laterite are present in the study area.
Calectasia pignattiana	VU	VU				X	**Unlikely**. This species is an erect shrub to 0.5 m high with stilt roots. The closest record is 32 km away. No suitable habitat (laterite) is present in the study area.

Scientific name	Conservation status[3]		Source[4]				Likelihood
	EPBC Act[1]	WC Act/ DBCA[2]	WAH	TPFL	NM	PMST	
Dampiera orchardii		P2	X	X			**Unlikely**. This species is an erect perennial herb that grows to 0.2-0.4 m high on sand. The closest record is 16 km away. This species would have been observed, if present in the study area.
Daviesia implexa		P3	X	X	X		**Unlikely[5]**. No laterite is present in the study area.
Daviesia lineata		P2	X				**Unlikely**. This species is an erect, bushy shrub, 0.6-2 m high. While potentially suitable habitat is present, this species would have been observed if located within the study area.
Daviesia uncinata		P3	X	X			**Unlikely**. This species is an intricate, many-stemmed shrub that grows between 0.2-0.7 m high. While potentially suitable habitat is present, this species would have been observed if located within the study area.
Duma horrida subsp. *abdita*	CR	EN				X	**Unlikely[5]**. Currently all known records are from the Lake Bryde system.
Eremophila serpens		P4	X				**Unlikely**. This species, while prostrate, forms large patches to 2 m wide. Suitable habitat is present adjacent to the salt lake; however this species would have been readily observed if present.
Eremophila subteretifolia	EN	CR				X	**Unlikely[5]**. Currently this species is only known from 4 populations at 3 localities in the Wheatbelt.
Eremophila veneta		P4	X	X	X		**Unlikely[5]**. The study area contained suitable habitat with nearby records (<2 km). However, this species is a spreading or straggly shrub between 0.3-1.2 m high, and would have been visible if present in the study area.
Eremophila verticillata	EN	CR		X		X	**Unlikely[5]**. Currently this species is only known from 2 populations near Lake Cobham.

Scientific name	Conservation status[3]		Source[4]				Likelihood
	EPBC Act[1]	WC Act/ DBCA[2]	WAH	TPFL	NM	PMST	
Eucalyptus microschema		P3	X				**Unlikely**. This Eucalypt is a Mallee that grows between 1.2-3 m high. It would have been observed in the study area if present.
Eucalyptus mimica subsp. *continens*		P1	X		X		**Unlikely**. The study area contains suitable habitat; however this species is a mallee or tree to 2 to 6 m high, and would have been easily observed if present.
Eucalyptus mimica subsp. *mimica*		P3	X	X	X		**Unlikely**. The study area contained suitable habitat; however this species is a mallee that grow between 3.5 to 8 m high, and would have been easily observed if present.
Eucalyptus ornata		P3	X		X		**Unlikely**[5]. No laterite is present in the study area
Fitzwillia axilliflora		P2	X		X		**Unlikely**[5]. The study area contained suitable habitat with nearby records (<2 km). However, this annual species would have been visible during the 360 Environmental (2015a) survey, if present.
Frankenia drummondii		P3	X				**Unlikely**. This prostrate shrub occurs in sand on lake edges. While suitable habitat is available, it would have been observed in the study area if present.
Gastrolobium cruciatum		P3	X	X	X		**Unlikely**[5]. No laterite or gravel is present in the study area
Gastrolobium euryphyllum		P1	X				**Unlikely**[5]. No laterite is present in the study area.
Grevillea involucrata	EN	EN	X	X	X	X	**Unlikely**[5]. No laterite is present in the study area.
Grevillea prostrata		P4	X	X	X		**Unlikely**[5]. No laterite is present in the study area
Guichenotia asteriskos		P2	X	X	X		**Unlikely**[5]. No gravelly soils are present in the study area.
Haegiela tatei		P4	X	X			**Potential**. This small annual herb occurs in saline habitats. The closest record is 17 km away. Given its small form and as it is an annual herb, it may not have been readily visible during the field survey. It was not specifically targeted by 360 Environmental (2015a).

Scientific name	Conservation status[3]		Source[4]				Likelihood
	EPBC Act[1]	WC Act/ DBCA[2]	WAH	TPFL	NM	PMST	
Hemigenia sp. Newdegate (E. Bishop 75)		P1	X				**Unlikely**. This shrub grows 0.2-0.45 m high to 0.5 m wide. It would have been visible if present in the study area.
Hydrocotyle muriculata		P1	X	X	X		**Unlikely[5]**. The study area contained suitable habitat with nearby records (<2 km). This species is a low spreading to prostrate annual herb with yellow flowers. The 360 Environmental (2015a) survey was taken after suitable winter rainfall with high number of annual species being present, which indicates that this species would visible during this survey, if present.
Jacksonia debilis		P1	X		X		**Unlikely**. The study area contained suitable habitat however there are no records in the immediate area. This shrub would have been visible if present in the study area.
Leucopogon sp. Lake Magenta (K.R. Newbey 3387)		P1	X		X		**Unlikely[5]**. No laterite is present in the study area.
Mirbelia densiflora		P3	X		X		**Unlikely[5]**. The study area contained suitable habitat with nearby records (<2km).
Olearia laciniifolia		P2	X		X		**Unlikely**. The study area contained suitable habitat. However, this species is a shrub that grows to 0.6-1.2 m high, and would have been readily visible during the surveys.
Persoonia brevirhachis		P3	X	X	X		**Unlikely[5]**. No gravelly soils are present in the study area.
Persoonia hakeiformis		P2	X		X		**Unlikely[5]**. No laterite is present in the study area.
Ricinocarpos trichophorus	EN	VU				X	**Unlikely[5]**. This species grows in Fitzgerald River National Park and north east of Esperance.
Rinzia affinis		P4	X		X		**Unlikely[5]**. No laterite is present in the study area.
Roycea pycnophylloides	EN	VU				X	**Unlikely**. The study area contains some suitable habitat along the margin of the salt lake however there are no records in the immediate vicinity; the closest record is 37

Scientific name	Conservation status[3]		Source[4]				Likelihood
	EPBC Act[1]	WC Act/ DBCA[2]	WAH	TPFL	NM	PMST	
							km from the study area. It is a perennial herb, forming densely branched, silvery mats to 1 m wide, and would have been visible if present within the study area.
Stylidium thylax		P2	X	X			**Unlikely**. This small, creeping perennial herb grows 0.04-0.08 m high, and flowers in October. Some suitable habitat is present in the study area, and the closest record is 18 km away. However, although small, this species would have been visible if present within the study area.
Synaphea bifurcata		P3	X		X		**Unlikely**. This bushy shrub grows to 0.3-0.5 m high and flowers in Sep to Nov. It would have been readily visible if present in the study area.
Synaphea cervifolia		P2	X		X		**Unlikely[5]**. No gravelly soils are present in the study area.
Tetratheca aphylla subsp. *megacarpa*	VU	VU	X	X	X	X	**Unlikely[5]**. No banded iron formation is in the study area.
Thysanotus acerosifolius		P2	X	X	X		**Unlikely[5]**. No laterite or sandplains are present in the study area.
Thysanotus lavanduliflorus		P1	X	X	X		**Known.** This species was recorded in the study area during the current survey, with a specimen positively identified by the WAH.
Tribonanthes purpurea	VU	VU	X	X	X	X	**Unlikely[5]**. No granite outcrops occur in the study area.
Verticordia integra		P4	X		X		**Unlikely[5]**. No laterite is present in the study area
Verticordia staminosa var. *cylindracea*	EN	VU				X	**Unlikely[5]**. No granite outcrops occur in the study area.
Verticordia staminosa var. *erecta*		CR	X		X		**Unlikely[5]**. No granite outcrops occur in the study area.

[1] EPBC Act = Environment Protection and Biodiversity Conservation Act 1999 List of Threatened Flora

[2] WC Act = Wildlife Conservation Act 1950 Threatened Flora (Rare Flora)

[3] Conservation codes:

CR = listed as Critically Endangered under the EPBC Act.

EN = listed as Endangered under the EPBC Act.

VU = listed as Vulnerable under the EPBC Act.

CR = Flora that is rare or is likely to become extinct as critically endangered flora

EN = Flora that is rare or likely to become extinct as endangered flora

VU = Flora that are considered likely to become extinct or rare, as vulnerable flora.

P1 = Species that are known from one or a few locations (generally five or less) which are potentially at risk.

P2 = 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.

P3 = Priority 3: Poorly known 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.

P4 = Priority 4: Rare, Near Threatened and other species in need of monitoring but not currently threatened; could become threatened if present circumstances change. Listed by DBCA.

[4] WAM = Western Australian Herbarium Specimen database

TPFL = DBCA Threatened (Declared Rare) and Priority Flora database

NM = NatureMap database search (Parks and Wildlife 2007 - 2018)

PMST = EPBC Act Protected Matters Report (DoEE 2018b)

[5] Indicates the likelihood of occurrence assessment was completed by 360 Environmental (2015a), and was not altered for the purpose of this current assessment.

Appendix F Fauna likelihood of occurrence assessment

Scientific name	Common name	Conservation status[3]		Source[4]			Likelihood
		EPBC Act[1]	WC Act/ DBCA[2]	DBCA	NM	PMST	
Apus pacificus	Fork-Tailed Swift	M	IA			X	**Potential - vagrant**. The closest record is 80 km away. This aerial forager has a wide distribution and may occasionally fly over the study area.
Actitis hypoleucos	Common Sandpiper	M	IA			X	**Unlikely.** Suitable habitat is not present. This species forages in shallow water and bare soft mud at the edges of wetlands and lakes.
Bettongia penicillata ogilbyi	Woylie, Brush-Tailed Bettong	EN	CR	X	X	X	**Does not occur**. This species is regionally extinct.
Botaurus poiciloptilus	Australasian Bittern	EN	EN	X	X		**Unlikely.** Suitable habitat is not present. This species occurs in permanent and seasonal freshwater habitats, particularly those dominated by sedges, rushes and reeds.
Bothriembryon bradshawi	Bradshaw's Bothriembryontid Land Snail (Tambellup)		P3	X			**Potential.** Closest record is 42 km from the study area. Suitable habitat is unknown. It is likely this species is understudied and records do not reflect its true distribution. Conservatively listed as potentially occurring due to the lack of data.
Calidris acuminata	Sharp-Tailed Sandpiper	M	IA	X	X	X	**Potential - vagrant.** The closest record is 35 km away. This migratory species occurs on muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. It may occasionally forage in the study area.
Calidris ferruginea	Curlew Sandpiper	CR/M	CR/IA			X	**Unlikely**. The closest record is 60 km away, and there are very few records in the region. This species mainly occurs on intertidal

Scientific name	Common name	Conservation status[3]		Source[4]			Likelihood
		EPBC Act[1]	WC Act/ DBCA[2]	DBCA	NM	PMST	
							mudflats in sheltered coastal areas. While they are also recorded inland, in both fresh and brackish waters. They forage on mudflats and nearby shallow water. The habitat present within the study area is unlikely to be suitable for this species.
Calidris melanotos	Pectoral Sandpiper	M	IA			X	**Unlikely**. The closest record is 128 km away, and this species is rarely recorded in WA. It occurs in shallow fresh to saline wetlands, usually near coastal habitat but occasionally found further inland. They forage in shallow water or soft mud at the edge of wetlands. The habitat present within the study area is unlikely to be suitable for this species.
Calidris ruficollis	Red-Necked Stint	M	IA	X	X		**Potential - vagrant**. The closest record is 1.2 km from the study area, in Lake Burkett. This migratory species mainly forages on bare wet mud on intertidal mudflats or sandflats, or in very shallow water. They have been known to forage in samphire. It may occasionally forage in the study area.
Calyptorhynchus latirostris	Carnaby's Black Cockatoo	EN	EN	X	X	X	**Likely**. Suitable breeding and foraging habitat is present within the study area, and there are records within 18 km.
Dasyurus geoffroii	Chuditch, Western Quoll	VU	VU	X	X	X	**Unlikely**. This species has been recorded recently (2014 and 2015) in Dragon Rocks Nature Reserve. The closest record is 34 km from the study area. While potentially suitable habitat is present in the study area (woodlands and mallee shrublands), given the lack of records in the remnant vegetation surrounding Newdegate and the level of fragmentation of the vegetation in the region, it is considered unlikely to occur in the study area. Low density cage trapping (72 trap nights) and camera trapping (36 trap nights) undertaken as part

Scientific name	Common name	Conservation status[3]		Source[4]			Likelihood
		EPBC Act[1]	WC Act/ DBCA[2]	DBCA	NM	PMST	
							of a targeted Red-tailed Phascogale survey did not record the species.
Falco peregrinus	Peregrine Falcon		OS	X	X		**Potential - vagrant**. The closest record is 9 km from the study area. This species inhabits a wide range of habitats and has a wide distribution. It may occasionally fly over or forage in the study area.
Hylaeus globuliferus	Woolybush Bee		P3	X	X		**Unlikely**. While the closest record is 24 km from the study area, this species is known to feed on *Adenanthos* sp., *Grevillea* spp. and *Banksia* spp., which are not present within the study area.
Isoodon fusciventer	Quenda, Southern Brown Bandicoot		P4	X			**Unlikely**. The closest record is 40 km from the study area in Lake Magenta Nature Reserve, however Quenda are no longer detectable in this reserve (Morris et al. 2008). This species prefers low, dense vegetation such as heath and swampy habitat and is often associated with forests, woodland, shrubland and riparian areas. While potentially suitable habitat is present in the study area, given the lack of records in the remnant vegetation surrounding Newdegate and the level of fragmentation of the vegetation in the region, it is considered unlikely to occur in the study area. Low density cage trapping (72 trap nights) and camera trapping (36 trap nights) undertaken as part of a targeted Red-tailed Phascogale survey did not record the species. Cardno (2014) recorded potential diggings, however, these have been dismissed as unlikely to be caused by Quenda.
Leipoa ocellata	Malleefowl	VU	VU	X	X	X	**Potential**. A small area of suitable habitat is present in the study area, however targeted searches failed to find evidence of this species. However, given the proximity and number of nearby records (23 records within 10 km, within the closest non-historical

Scientific name	Common name	Conservation status[3]		Source[4]			Likelihood
		EPBC Act[1]	WC Act/ DBCA[2]	DBCA	NM	PMST	
							record 1.1 km away), this species could occasionally utilise the study area.
Limosa lapponica	Bar-tailed Godwit	M	IA		X		**Unlikely** - this species is mainly found in coastal habitats.
Macrotis lagotis	Bilby	VU	VU	X	X		**Does not occur.** This species is regionally extinct.
Motacilla cinerea	Grey Wagtail	M	IA			X	**Unlikely.** Closest record is over 300 km from the study area.
Myrmecobius fasciatus	Numbat	EN	EN	X		X	**Unlikely**. Records at Dragon Rocks Reserve (42 km from the study area) are from a translocated population. The only known remnant populations are located in the Dryandra Woodland and the Upper Warren area.
Notamacropus eugenii derbianus	Tammar Wallaby		P4	X	X		**Unlikely**. The only record within 50 km is from 1988, and this species is only known from a selection number of locations.
Notamacropus irma	Western Brush Wallaby		P4	X	X		**Potential.** There is suitable habitat present within the study area. This species occurs in open forest and woodland with open scrubby thickets and low grasses. There are three records of this species within 20 km of the study area.
Numenius madagascariensis	Eastern Curlew	CR/M	CR/IA			X	**Unlikely.** The closest record of this migratory coastal species is over 150 km from the study area.
Oxyura australis	Blue-billed Duck		P4	X	X		**Unlikely.** Suitable habitat is not present within the study area, as it prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation.
Pandion haliaetus	Osprey	M	IA			X	**Unlikely**. The closest record of this coastal species is 120 km from the study area.

Scientific name	Common name	Conservation status[3]		Source[4]			Likelihood
		EPBC Act[1]	WC Act/ DBCA[2]	DBCA	NM	PMST	
Parantechinus apicalis	Dibbler	EN	EN			X	**Does not occur**. There are no records in the region of this species
Phascogale calura	Red-tailed Phascogale	VU	CD	X	X	X	**Known.** Recorded in the study area by ELA (2018a).
Platycercus icterotis xanthogenys	Western Rosella (Inland)		P4	X	X		**Likely.** The closest record is less than 1 km from the study area. This species, while relatively uncommon, is found in open dry eucalypt forest and timbered areas.
Pseudocheirus occidentalis	Western Ringtail Possum	VU	CR		X		**Does not occur**. This species is regionally extinct.
Pseudomys occidentalis	Western Mouse		P4	X	X		**Unlikely**. While suitable habitat is present within the study area and the closest record is 20 km away, Elliott trapping (713 trap nights) did not record this species within the study area.
Pseudomys shortridgei	Heath Mouse	VU	VU	X	X	X	**Unlikely.** As this species is primarily recorded in heath, the habitat present within the study area is unlikely to be suitable. Elliott trapping (713 trap nights) did not record this species within the study area.
Psophodes nigrogularis oberon	Western Whipbird (Western Mallee)		P4	X	X		**Potential. T**his species occurs in mallee, often in open mallee vegetation with a dense, tall shrub layer up to 1.5 m tall. The closest record is 16 km away; given some suitable habitat is present on site, this species has the potential to occur within the study area.
Thinornis rubricollis	Hooded Plover, Hooded Dotterel		P4	X	X		**Potential - vagrant**. This species moves from the coast to salt lakes some distance inland in winter. There are records within 6 km of the study area. This species may be found in proximity to the salt lake within the study area on occasion.

Scientific name	Common name	Conservation status[3]		Source[4]			Likelihood
		EPBC Act[1]	WC Act/ DBCA[2]	DBCA	NM	PMST	
Tringa nebularia	Common Greenshank	M	IA	X			**Potential - vagrant**. This species is found in a wide variety of inland wetlands and sheltered coastal habitats of varying salinity. It is known to forage at edges of wetlands, in soft mud on mudflats, in channels, or in shallows around the edges of water around sparse, emergent or fringing vegetation, such as sedges or saltmarsh. The closest record is 35 km from the study area; this species may occasionally forage within the study area.

[1] EPBC Act = Environment Protection and Biodiversity Conservation Act 1999 List of Threatened Fauna

[2] WC Act = Wildlife Conservation Act 1950 Threatened Fauna (Rare Fauna)

[3] Conservation codes:

CR = listed as Critically Endangered under the EPBC Act.

EN = listed as Endangered under the EPBC Act.

VU = listed as Vulnerable under the EPBC Act.

IA = listed as Migratory under the EPBC Act.

CR = Fauna that is rare or is likely to become extinct as critically endangered fauna.

EN = Fauna that is rare or likely to become extinct as endangered fauna.

VU = Fauna that are considered likely to become extinct or rare, as vulnerable fauna.

IA = Migratory birds protected under an international agreement.

CD = Fauna that is of special conservation need as conservation dependent fauna.

OS = Other specially protected fauna

P3 = Priority 3: Poorly known 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.

P4 = Priority 4: Rare, Near Threatened and other species in need of monitoring but not currently threatened; could become threatened if present circumstances change. Listed by DBCA.

[4] DBCA = DBCA Threatened and Priority Fauna database

NM = NatureMap database search (Parks and Wildlife 2007 - 2018)

PMST = EPBC Act Protected Matters Report (DoEE 2018b)

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