Warwick Bushland flora survey and vegetation condition assessment

Prepared for
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Abbreviations

Abbreviation	Description
ANOSIM	Analysis of Similarities
BAM Act	State *Biosecurity and Agriculture Management Act 2007*
BoM	Bureau of Meteorology
DAFWA	Department of Agriculture and Food Western Australia
DEC	Department of Environment and Conservation
DotEE	Department of the Environment and Energy
DPIRD	Department of Primary Industries and Regional Development
DRF	Declared Rare Flora
DWER	Department of Water and Environmental Regulation
ELA	Eco Logical Australia
EP Act	State *Environmental Protection Act 1986*
EPA	Environmental Protection Authority
EPBC Act	Commonwealth *Environment Protection and Biodiversity Act 1999*
ESA	Environmentally Sensitive Area
FCT	Floristic Community Type
ha	hectare
IBRA	Interim Biogeographical Regionalisation for Australia
IUCN	International Union for Conservation of Nature
km	kilometre
m	metre
MDS	Multi-Dimensional Scaling
mm	millimetre
P	Priority
PEC	Priority Ecological Community
PMST	Protected Matters Search Tool
SIMPER	Similarity Percentages
SIMPROF	Similarity Profile
TEC	Threatened Ecological Community
the City	City of Joondalup
WAH	Western Australian Herbarium
WAM	Western Australian Museum

Abbreviation	Description
WAOL	Western Australian Organism List
WC Act	State *Wildlife Conservation Act 1950*
WoNS	Weed of National Significance

Executive summary

Eco Logical Australia was engaged by the City of Joondalup to undertake a Detailed and Targeted flora survey and vegetation condition assessment of Warwick Bushland, a parcel of bushland approximately 60 hectares in size, located in Warwick, 15 kilometres north of Perth, Western Australia. The information provided from this assessment will be used by the City of Joondalup to inform an update and major review of the existing *Warwick Open Space Management Plan*, developed by the City of Joondalup in 2013.

A comprehensive desktop review was undertaken of relevant database searches and previous studies undertaken within the study area. The field survey was conducted in Spring from 2nd to 5th October 2018 in accordance with the Environmental Protection Authority *Technical Guidance*: *Flora and Vegetation Surveys for Environmental Impact Assessment* 2016.

Vegetation communities were described through the establishment of twelve 10x10 metre quadrats, ten of which had been previously established by Eco Logical Australia in 2012. A Targeted flora survey was conducted to record occurrences of any conservation significant flora species or communities listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*, the State *Wildlife Conservation Act 1950* or by the Department of Biodiversity, Conservation and Attractions. Opportunistic flora species were also recorded across the study area.

A Targeted weed survey was conducted to record weed species within the study area, including mapping of City of Joondalup pest plants (Caltrop), City of Joondalup priority weed species and species listed as a Weed of National Significance or as a Declared Pest under the State *Biosecurity and Agriculture Management Act 2007*.

Fungi and fauna species present within the study area were also recorded opportunistically.

A total of 200 flora taxa were recorded within the study area from both quadrats and opportunistic collections, including 138 native and 62 introduced taxa. The number of flora species recorded within the study area has increased since Eco Logical Australia's survey of the study area in 2012, with 26 additional species recorded comprising 15 native and 11 weed species. No Threatened (Declared Rare) flora species were recorded from within the study area. One conservation significant species, *Jacksonia sericea*, listed as Priority 4 by the Department of Biodiversity, Conservation and Attractions and as a Bush Forever significant species, was identified from within the study area with a total of 564 individuals recorded.

Three vegetation communities were described within the study area:

- **EmBa**: *Eucalyptus marginata* subsp. *marginata* and *Banksia attenuata* open forest to low open woodland over open heath to open shrubland;
- **AfEmBa**: *Allocasuarina fraseriana*, *Eucalyptus marginata* subsp. *marginata* and *Banksia attenuata* low open forest to low woodland over open shrubland; and
- **EgBaBm**: *Eucalyptus gomphocephala*, *Banksia attenuata* and *Banksia menziesii* open forest to low woodland over shrubland.

Vegetation communities within the study area correlated predominantly with Floristic Community Type 28, with weak affiliations to FCT 24 also being present. Following assessment of vegetation within the study area against key diagnostic characteristics outlined in the Threatened Species Scientific Committee 'Approved Conservation Advice (incorporating listing advice) for the Banksia Woodlands of the Swan Coastal Plain ecological community' 2016, vegetation within the study area is considered likely to

represent the Banksia Woodlands of the Swan Coastal Plain Threatened Ecological Community, listed as Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. A total of 57.96 hectares of this Threatened Ecological Community was recorded, accounting for 95.62% of the study area. Vegetation within the study area was also assessed against key diagnostic characteristics outlined in the Department of the Environment and Energy 'Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain Ecological Community Draft Conservation Advice'. Vegetation was considered unlikely to represent this ecological community.

Vegetation condition within the study area ranged from Completely Degraded to Excellent, based on the Keighery Vegetation Scale 1994 as outlined in the Environmental Protection Authority *Technical Guidance*: *Flora and Vegetation Surveys for Environmental Impact Assessment* 2016. Disturbances recorded within the study area include weed infestation, edge effects, potential signs of disease/pathogens or drought (dead trees) and recent fire scars. The presence of pest species (rabbits) was also noted within the study area.

No opportunistic fungi species were recorded during the field survey. A total of 14 fauna species were recorded opportunistically during the field survey, comprising 11 birds, two mammals and one reptile. None of the fauna species recorded within the study area represent conservation significant species listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*, the State *Wildlife Conservation Act 1950* or by the Department of Biodiversity, Conservation and Attractions. Two introduced (feral) fauna species were recorded within the study area, namely the Rainbow Lorikeet and European Rabbit.

Recommendations to conserve native flora, vegetation and environmental values within the study area include continued monitoring and management of weed populations, monitoring the condition of conservation significant flora and vegetation, a review and update of fire monitoring and management practices, monitoring vegetation health, in particular for Dieback, restrict unauthorised access to the bushland, control feral animal populations, retain dead trees (old-growth) for fauna habitat values and continue support and further development with friends of Warwick bushland to enhance conservation and public awareness of the biodiversity and natural history values of Warwick Open Space.

1 Introduction

1.1 Project background

Eco Logical Australia (ELA) was engaged by the City of Joondalup (the City) to undertake a Detailed and Targeted flora survey and a vegetation condition assessment of Warwick Open Space, an area approximately 70 hectares (ha) in size comprised of 60 ha of bushland (the study area) and 10 ha of 'other use' areas. The study area is located in the suburb of Warwick, 15 kilometres (km) north of Perth, Western Australia (WA; **Figure 1**).

Warwick Bushland is categorised as one of the City's five major conservation areas due to its ecological connectivity to locally significant remnants. The study area is also registered as a Bush Forever site (number 202) due to the regional significance of the vegetation within the site. The most recent assessment of the Bushland was undertaken by ELA in 2012 (ELA 2013) to inform the development of the *Warwick Open Space Management Plan*, developed by the City in 2013 (City of Joondalup 2013). The information provided from the current assessment will be used by the City to inform an update and major review of the existing Management Plan.

More specifically, the objectives of this survey include:

- An assessment of flora and vegetation communities in accordance with the Environmental Protection Authority (EPA) *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016);
- Undertake a vegetation condition assessment using the Keighery Vegetation Condition Scale (1994);
- A Targeted survey for State, Federal and/or Department of Biodiversity, Conservation and Attractions (DBCA) conservation listed flora, including Bush Forever significant flora and/or vegetation;
- An assessment to verify if the vegetation meets the requirements specified in the Commonwealth *Environment Protection and Biodiversity Act 1999* (EPBC Act) 'Approved Conservation Advice (incorporating listing advice) for the Banksia Woodlands of the Swan Coastal Plain ecological community', using the four-stage assessment process itemised in the Approved Conservation Advice (Threatened Species Scientific Committee [TSSC] 2016);
- An assessment to verify if the vegetation meets the requirement specified in the Department of Environment and Energy (DotEE) 'Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain ecological community Draft Conservation Advice including Draft Listing Advice', using the assessment process outlines in the Draft Conservation Advice (DotEE 2017); and
- Record all weed species encountered including State, Federal (Weed of National Significance [WoNS], Declared Pests) and/or priority weeds in the City of Joondalup (priority species list provided by the City).

Figure 1: Study area location

2 Environmental setting

2.1.1 Climate

The Swan Coastal Plain experiences a warm, Mediterranean climate with hot dry summers and mild wet winters (Mitchell *et al.* 2002). Based on climate data from the nearby Bureau of Meteorology (BoM) Wanneroo weather station (station number 9105; climate data 1905 – current; located approximately 13 km north of the study area) the area receives an annual average rainfall of 796.8 millimetres (mm), with most rainfall occurring during the winter months of June, July and August (162.2 mm, 162.3 mm and 123.2 mm respectively; BoM 2018; **Table 1**). In the 12 months preceding the field survey, the area received a total of 743.5 mm of rainfall which is below the long-term average (**Table 1**). A total of 352 mm of rainfall was recorded in the three months prior to the field survey in October, which is comparable to the long-term average for the same time period (369.7 mm). Rainfall received prior to the field survey resulted in ideal conditions for undertaking a flora and vegetation survey on the Swan Coastal Plain during this period.

Based on temperature data from the nearby Hillary's Boat Harbour weather station (station number 9265; climate data 1991 – current; located approximately 8 km west of the study area), mean maximum air temperature in the area ranges from 10.0 °C in September to 19.0 °C in February, while mean monthly maximum temperatures range from 16.7 °C in September to 26.9 °C in January (BoM 2018).

Table 1: Rainfall data recorded at the Wanneroo weather station (9105) 12 months prior to the field survey compared to the long-term average (BoM 2018)

Month	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Total monthly rainfall 2017-18 (mm)	28.0	0.0	20.4	100.5	0.0	2.4	28.3	62.0	149.9	145.3	170.7	36.0	743.5
Average monthly rainfall 1905-current	47.3	21.4	10.0	12.2	13.5	16.1	38.5	109.2	162.2	162.3	123.2	84.2	796.8

2.1.2 Regional context

Environmental values for the region relevant to the study area are presented in **Table 2**.

Table 2: Environmental values of the region

Existing environmental attribute	Study area
Interim Biogeographical Regionalisation for Australia (IBRA) Bioregion (DotEE 2018a)	Swan Coastal Plain (SWA)
IBRA Subregion	Perth (SWA02) – commonly characterised by Tuart and heath on limestone soils and Banksia-Jarrah-Marri woodland on sandy soils. The subregional area is 1,333,901 ha (Mitchell *et al.* 2002).

Existing environmental attribute	Study area
Geology, landform and soils	Situated on the Spearwood Dune System (Spearwood 6) with soils derived from Tamala Limestone (Government of Western Australia 2000). The Spearwood Sand Phase occurs within the study area, characterised by undulating dunes with rocky crests on Aeolian sand over limestone.

2.1.3 Broad-scale vegetation mapping

Vegetation type and extent have been mapped at a regional scale by Beard (1979) who categorised vegetation into broad vegetation associations. Based on this mapping at a scale of 1:1,000,000, 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).

One vegetation association occurs within the study area, namely Spearwood 6 (**Table 3**; **Figure 2**). This vegetation association has less than 25% of its total pre-European extent remaining within the Swan Coastal Plain bioregion (Government of Western Australia 2018).

Table 3: Beard (1979) / Shepherd *et al.* (2002) vegetation associations of the study area

Vegetation association	Description	Pre-European extent (ha) within the Perth (SWA02) sub-region	Current extent (ha) within the Perth (SWA02) sub-region	Remaining (%)
Spearwood 6	Eucalyptus woodland (predominantly *Eucalyptus gomphocephala*, *E. marginata* and *Corymbia calophylla*) over Acacia mixed open shrubland / Acacia mixed heath.	54,427.13	13,228.68	24.31

2.1.4 Areas of conservation significance

Environmentally Sensitive Areas (ESAs) are defined in the Environmental Protection (Environmentally Sensitive Areas) Notice 2005 under section 51B of the State *Environmental Protection Act 1986* (EP Act). ESAs include areas declared as World Heritage, included on the Register of the National Estate, 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 by the WA Minister for Environment to be of significance, but which do not meet the criteria for a TEC. There are five categories of PECs, none of which are currently protected under State or Federal legislation.

The Bush Forever project developed and implemented a plan to protect 51,000 ha of regionally significant vegetation within the Swan Coastal Plain portion of the Perth metropolitan area. This occurred through the identification of 287 Bush Forever sites representing a minimum (where possible) of 10% of each of the 26 vegetation complexes identified in the Bush Forever study area (Government of Western Australia 2000). Bush Forever identified the study area as being required to meet retention targets and it was subsequently designated as Bush Forever site 202 (Government of Western Australia 2000).

Vegetation of the southern Swan Coastal Plain was systematically surveyed and defined into Floristic Community Types by Gibson *et al*. (FCTs; 1994). Floristic analysis defined 30 FCTs with some groups further subdivided and, in all, a total of 43 types and sub-types have been recognised (Gibson *et al.* 1994). The Spearwood Dune System unit predominately supports FCTs 24, 25, 26a, 26b, 27 and 28. The study area was surveyed by Gibson *et al.* (1994) through the establishment of two flora plots WARI-1 and WARI-2 and assigned to FCT 28 – 'Spearwood *Banksia attenuata* or *B. attenuata* – *Eucalyptus* woodlands' through statistical analysis of floristic data. FCT 28 forms part of the *Banksia Woodlands of the Swan Coastal Plain* ecological community, which is currently listed as Threatened under the EPBC Act.

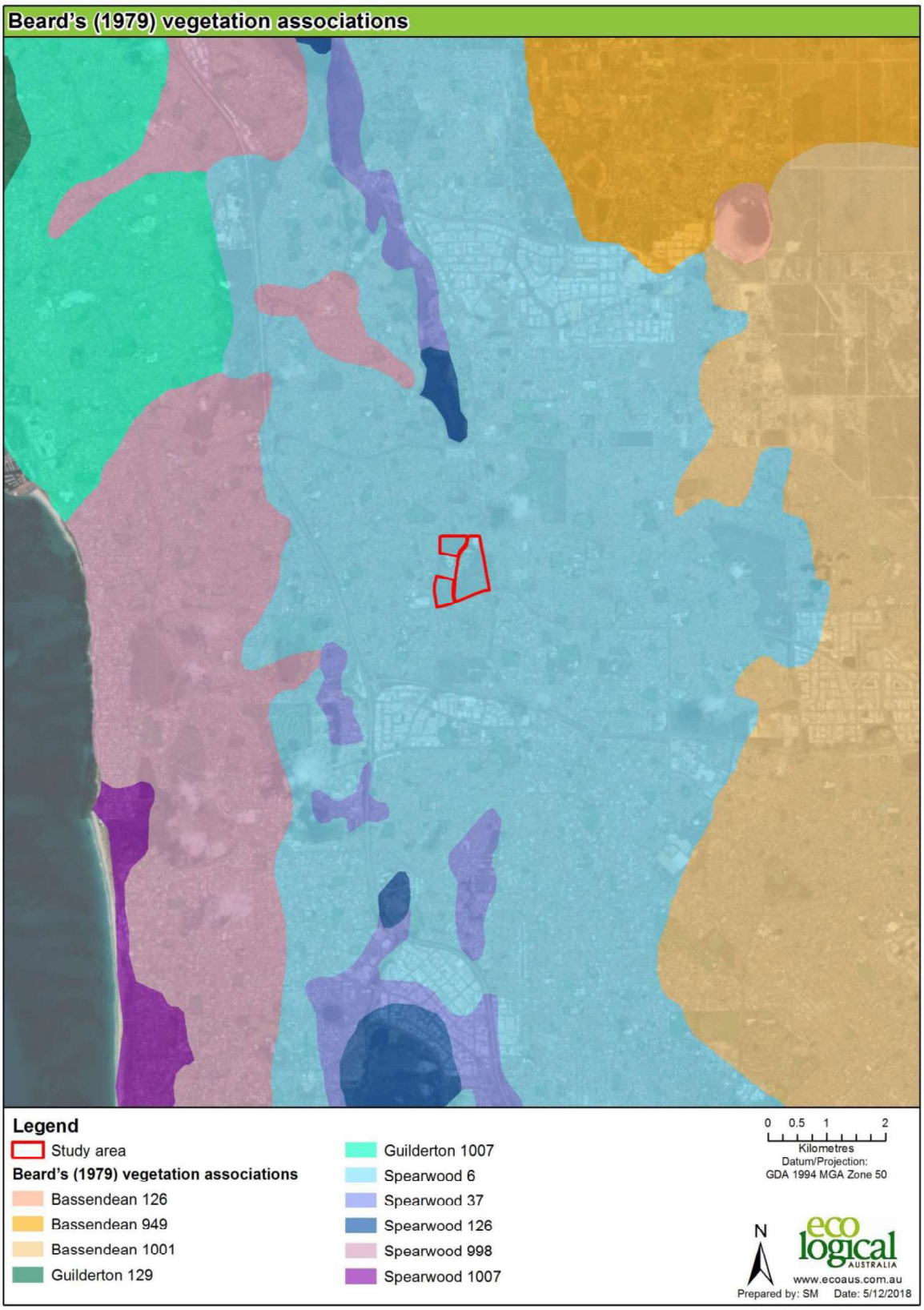

Figure 2: Beard's (1979) vegetation associations

3 Methodology

3.1 Desktop review

3.1.1 Database searches and literature review

The following Commonwealth and State databases were searched for information relating to conservation listed flora and ecological communities in order to compile and summarise existing data to inform the field survey. **Table 4** below presents the database searches undertaken around the central coordinate m 388100E, m 6476885N. Applied buffers below are considered suitable based on flora and fauna assemblages expected to occur within the study area. 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 4: Database searches undertaken for the study area

Database	Reference	Buffer (km)
EPBC Act Protected Matters Search Tool (PMST) for Threatened species and communities listed under the EPBC Act.	DotEE 2018b	20
DBCA NatureMap online database.	DBCA 2007-2018	20
DBCA Threatened and Priority flora database searches for Declared Rare Flora (DRF) listed under the latest WA Wildlife Conservation (Rare Flora) Notice and Priority Flora.	DBCA 2018a	5
DBCA Threatened and Priority Ecological Communities' database search	DBCA 2018b	7
DAFWA Western Australian Organism List (WAOL)	DAFWA 2018	-
DPIRD Soil Landscape Mapping	DPIRD 2018	-
Department of Water and Environmental Regulation (DWER) ESA Database	DWER 2018	-
Weeds Australia	Australian Weeds Committee 2015	-
International Union for Conservation of Nature (IUCN)	IUCN 2018	-

In addition, the following documents were also reviewed:

- *Warwick Open Space Bushland Management Plan* (City of Joondalup 2013);
- *Warwick Open Space Flora, Fauna and Fungi Assessment* (ELA 2013);
- *The Vegetation and Flora of Warwick Bushland* (Brundrett and Clarke 2001);
- *Warwick Open Space Field Assessment* (D. Pike 2005 and S. Mitrevski 2011); and
- *A Floristic Survey of the Southern Swan Coastal Plain* (Gibson *et al*. 1994).

3.1.2 Likelihood of occurrence assessment

A likelihood of occurrence assessment was undertaken to identify conservation listed flora species that possibly occur within the study area, identified from a review of key datasets and literature outlined in Section 3.1.1. Specific criteria used to assess the likelihood of occurrence of conservation significant flora potentially occurring in the study area are presented in **Appendix A**.

3.2 Field survey

3.2.1 Survey team and timing

A Detailed and Targeted flora and vegetation survey including a Targeted weed survey was conducted by Sarah Dalgleish (Botanist) and Jeni Morris (Ecologist) from 2nd to 5th October 2018. The survey team's relevant qualifications, experience and licences are provided in **Table 5** below. A total of 7.6 mm of rainfall was recorded from the Wanneroo weather station (station number 9105) during the field survey (BoM 2018).

Table 5: Survey team

Name	Qualification	Relevant experience	Licences
Sarah Dalgleish	BSc. Environmental Management (Hons.)	Sarah has over 7 years' experience undertaking flora and vegetation surveys on the Swan Coastal Plain, including completing a flora and vegetation assessment in Warwick Bushland in 2012.	Flora scientific collection licence: SL012349 DRF collection licence: 11-1718
Jeni Morris	BSc. Conservation and Wildlife Biology	Jeni has completed several flora and vegetation surveys on the Swan Coastal Plain and within the City of Joondalup including at Craigie Bushland Reserve and Yellagonga Regional Park.	Flora scientific collection licence: SL012347 DRF collection licence: 9-1718

3.3 Flora and vegetation survey

A Detailed and Targeted flora and vegetation survey was conducted in accordance with the EPA *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016). Ten existing quadrats originally established by ELA in 2012 (ELA 2013) were re-sampled during the current survey. Two additional quadrats were established in order to meet the requirement of three quadrats being sampled per vegetation community, as outlined in the EPA guidance statement (EPA 2016). Additional sites were chosen based on previous vegetation mapping (ELA 2013) and ground-truthed in the field.

Stainless steel fence droppers were used to permanently mark the north-west corner of each quadrat. Dominant vegetation communities were described, with respect to dominant species, structure and overall condition. The survey involved the use of 10 x 10 m quadrats as recommended for the Swan Coastal Plain bioregion (EPA 2016). Opportunistic sampling of species not recorded within the quadrats was undertaken to supplement the existing list of species recorded from within the study area.

A total of 12 quadrats were surveyed across the study area (**Figure 3**). Where possible, photos were taken from same position as those undertaken in 2012. Otherwise, photos were taken from the northeast and southeast corner of each quadrat. The following data was recorded within each quadrat:

- Site details (site name, site number, observers, date and location);
- Environmental information including landform, soil type and colour, bare ground and leaf litter cover, rock outcropping and time since last fire event; and
- Biological information including vegetation structure, vegetation condition in accordance with Keighery (1994), degree of disturbance, species present and species percentage cover.

A targeted survey was completed within the study area to identify any conservation significant flora or communities potentially occurring, including:

- Threatened flora or TECs listed under the EPBC Act;
- Threatened (Declared Rare) Flora listed under the latest WA Wildlife Conservation (Rare Flora) Notice under the State *Wildlife Conservation Act 1950* (WC Act);
- PEC's endorsed by the Western Australian Minister for the Environment;
- Priority flora recognised by DBCA; and
- Bush Forever significant flora (Government of Western Australia 2000).

The survey methodology involved personnel walking transects across the study area, with transects spaced (on average) 5-20 metres (m) apart. Locations of survey transects is shown in **Figure 3** below. Flora species able to be identified in the field were recorded, and voucher specimens of unfamiliar species were collected for later identification. All collections were assigned a unique collecting number. For conservation significant flora species identified in the field, the following was recorded:

- A colour photograph;
- GPS location;
- Population size estimate;
- Location of population boundaries;
- 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).

3.4 Weed survey and mapping

The study area was surveyed and mapped for State, Federal and/or Priority weeds as specified by the City of Joondalup, including all WoNS and Declared Pests listed under the State *Biosecurity and Agriculture Management Act 2007* (BAM Act). The City of Joondalup priority weed list is provided in **Table 6**.

For each priority weed species, including WoNS and/or Declared Pest species encountered, a GPS location coordinate was recorded using points for individual plants or polygons for populations. Weed data was collected in accordance to the DBCA (previously Department of Environment and Conservation [DEC]) Standard Operating Procedure 22.1 *Techniques for mapping weed distribution and cover in bushland and wetlands* (DEC 2011).

Table 6: City of Joondalup priority weed species

Species	Common name
**Acacia iteaphylla*	Flinders Ranges Wattle
**Acacia longifolia*	Sydney Golden Wattle
**Acacia ?trigonophylla*^	-
**Chamelaucium uncinatum*	Geraldton Wax
**Ehrharta calycina*	Perennial Veldt Grass
**Ehrharta longiflora*	Annual Veldt Grass
**Eragrostis curvula*	Lovegrass
**Euphorbia terracina*	Geraldton Carnation Weed
**Ferraria crispa*	Black Flag
**Freesia* sp.^	Freesia
**Gazania linearis*	Gazania
**Moraea flaccida*	One-leaf Cape Tulip
**Olea europaea*	Olive
*Oxalis *pes-caprae*	Soursob
**Pelargonium capitatum*	Rose Pelargonium
**Pennisetum setaceum*	Fountain Grass
**Schinus terebinthifolius*	Japanese Pepper
**Trachyandra divaricata*	Dune Onion Weed
**Tribulus terrestris*	Caltrop
**Vulpia* sp.^	Vulpia grass
**Watsonia* sp.^	Watsonia

^Identification to be confirmed post-field survey and results outlined in Section 4.2.4

3.5 Data analysis

3.5.1 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.

3.5.2 Vegetation communities

Plymouth Routines in Multivariate Ecological Research v6 (PRIMER) statistical analysis software was used to analyse species-by-site data and discriminate survey sites based on their species composition (Clarke and Gorley 2006). To down weight the relative contributions of quantitatively dominant species a 4th root transformation was applied to the dataset. 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.

Previously used vegetation mapping codes (ELA 2013) were updated to reflect results of the current assessment. Vegetation descriptions have, where possible, remained the same as those used in previous mapping.

FCT analysis

Species within the Gibson *et al*. (1994) data set were updated to align with current names as specified by FloraBase (DBCA and WAH 2018). Using current records, a number of species in the Gibson *et al*. (1994) data set were shown to be significant range extensions from the Swan Coastal Plain, where appropriate such cases were removed. In addition, excluded and misapplied names were removed from the data set and infra-specific names were reduced. The merged dataset was analysed using a combination of pre-treatments such as the inclusion and/or removal of introduced species and singletons. The removal of both singletons and introduced species from the merged dataset, an accepted pre-treatment for such analysis, produced the best results (e.g. stronger correlations; Clarke and Gorley, 2006). Inclusion of such data merely served to confound the dataset by introducing stochastic and 'site' artefact data. Transformed data were analysed using a combination of multivariate analysis routines including Bray-Curtis Similarity Matrices, Multi-Dimensional Scaling (MDS) and Analysis of Similarities (ANOSIM).

To identify potential TECs and PECs in the project area, ELA quadrats and vegetation communities were compared to Floristic Community Types (FCT) defined by Gibson *et al*. (1994). To identify the presence of FCT's appropriate multivariate analyses comparing current data to that of Gibson *et al*. (1994) species by quadrat data, and inferences based on dominant species and geomorphology were used. Given the nature of the data, results and subsequent extrapolations, assigned FCT's within the project area were inferred and not absolute, i.e. a vegetation code assigned to an FCT was inferred to comprise, to varying degrees, floristic aspects of that FCT as defined by Gibson *et al*. (1994). To aid interpretation of final results, data from both the full Gibson *et al.* (1994) dataset and FCTs specifically affiliated with the Spearwood Landform were analysed. These FCTs were subsequently compared with vegetation communities delineated by ELA.

Assessment of diagnostics to assess presence of Threatened Ecological Communities

The 'Banksia Woodlands of the Swan Coastal Plain' TEC is listed as Endangered under the EPBC Act (TSSC 2016). For information to assist in referral, environmental assessment and compliance issues, it has been recommended to refer to the Listing Advice and/or Conservation Advice and Recovery Plan on the DotEE Species Profile and Threats Database (TSSC 2016). The Listing Advice and/or Conservation Advice defines the national ecological community and includes key diagnostic characteristics, condition thresholds and additional considerations (TSSC 2016).

In order to determine whether the 'Banksia Woodlands of the Swan Coastal Plain' TEC is present in the study area; key diagnostic characteristics must be met under Section 2 of the Conservation Advice (TSSC 2016). The four-stage assessment identified by DotEE to ascertain the presence of the Banksia woodlands endangered ecological community within the site was undertaken by ELA following the field survey.

In 2016, the 'Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain' ecological community of Western Australia was nominated to the Australian Government to be considered for listing as Threatened. For information to assist in referral, environmental assessment and compliance issues, it has been recommended to refer to the Draft Listing Advice on the DotEE Species Profile and Threats Database (DotEE 2017). This community is not currently formally listed under the EPBC Act (DotEE 2017).

In order to determine whether the 'Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain' ecological community is present within the study area; key diagnostic characteristics must be met under Section 2.5 of the Conservation Advice (DotEE 2017). An assessment of key-diagnostic characteristics identified by DotEE to ascertain the presence of the Tuart woodlands ecological community within the site was undertaken by ELA following the field survey.

3.6 Opportunistic fauna and fungi

Any fungi species that were encountered during the field survey were identified in the field or from photos taken in the field. Opportunistic fauna species were recorded at all times during the field survey. These included visual sightings of active fauna such as reptiles and birds; records of bird calls; and signs of species presence such as tracks, diggings, burrows, scats and any other signs of fauna activity.

3.7 Flora identification and nomenclature

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

Nomenclature used for the flora species within this report follows the WA Plant Census as available on FloraBase (DBCA and WAH 2018).

3.8 Limitations

The EPA *Technical Guide – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016) recommends including discussion of the constraints and limitations of the survey methods used. Constraints and limitations for the Detailed and Targeted flora and vegetation for the study area summarised in **Table 7** below.

Table 7: Survey limitations

Constraint	Limitations
Sources of information	**Not a constraint:** The Swan Coastal Plain has been relatively well surveyed, with increasing survey work occurring due to the ongoing urban development of the Perth metropolitan area. A number of flora and fauna surveys have been undertaken in the study area which have been utilised for the purposes

Constraint	Limitations
	of this survey. Gibson *et al* 1994 was a primary source for determination of methods, analysis and results for assessing FCTs. Broad-scale vegetation mapping at a scale of 1:1,000,000 was available. Land system mapping at a scale of 1:2,000,000 and soil and landform mapping was also available. The information which was available was sufficient and as such sources of information were not considered a major limitation.
Scope of work	**Not a constraint:** The survey requirement for a Detailed and Targeted flora and vegetation survey in accordance with the EPA Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016) was adequately met.
Completeness of survey	**Not a constraint:** The study area was surveyed to the satisfaction of the scope and a Detailed and Targeted flora and vegetation survey as per relevant guidelines.
Intensity of survey	**Not a constraint:** The survey effort was adequately met. The area was surveyed for conservation significant flora species and vegetation communities by field staff undertaking transects across the study area spaced 5-20 m apart on average. This method provided an accurate assessment of habitat characteristics and likelihood of conservation significant species. The number of quadrats established was sufficient to determine the vegetation communities present and to identify any vegetation of conservation significance. Adequacy of sampling effort was testes via a species accumulation curve; approximately 84.8% of the flora potentially present within the study area was recorded.
Timing, weather, season, cycle	**Not a constraint:** The study area is located in the Swan Coastal Plain bioregion of Western Australia. Recommended survey timing for this region is in spring (September – November; EPA 2016). The field survey was undertaken at the beginning of October. Many flora species were flowering at the time of the field survey or had sufficient material (fruit) available to identify the dominant and target species. The timing was appropriate for conducting this level of survey.
Disturbances	**Not a constraint:** Disturbances within the study area included the presence of weeds, declined vegetation health (potential dieback/other pathogens), fire and edge effects. These disturbances did not negatively impact the ability to meet objectives outlined in the scope of works.
Resources	**Not a constraint:** The personnel conducting this field survey were both suitably qualified to identify specimens, having previously undertaken flora and vegetation assessments on the Swan Coastal Plain, including in several reserves for the City of Joondalup.
Accessibility	**Not a constraint:** All relevant areas of the study area were easily accessed and able to be surveyed.

Figure 3: Survey effort and quadrat locations

4 Results

4.1 Desktop review

4.1.1 Conservation significant flora species and ecological communities

A DBCA Threatened and Priority Flora and Communities database search (DBCA 2018a and DBCA 2018b respectively) was undertaken to identify conservation significant species and communities recorded within, or nearby to, the study area.

The DBCA Threatened and Priority Flora search identified known occurrences of two flora species listed as Priority by DBCA within a 5 km buffer of the study area (DBCA 2018a):

- *Acacia benthamii* (listed by DBCA as Priority [P] 2); and
- *Jacksonia sericea* (listed by DBCA as P4).

Two occurrences of the P4 species *Jacksonia sericea* were found to occur within the study area (DBCA 2018a). The closest occurrence of *Acacia benthamii* (P2) is approximately 2.2 km north of the study area (**Figure 4**). *Jacksonia sericea* has been previously recorded within the study area by ELA (2013) at a number of locations, as shown in **Figure 4**.

The DBCA Threatened and Priority Flora communities search identified four known occurrences of conservation significant ecological communities within a 5 km of the study area (DBCA 2018b), one of which occurs within the study area: *Banksia Dominated Woodlands of the Swan Coastal Plain* (**Table 8**; **Figure 4**). Buffers are included by DBCA around each occurrence of a TEC or PEC to help ensure that nearby developments with potential for impact are taken into account, to ensure essential ecological functions are maintained and to account for mapping inaccuracies (DBCA 2018b).

Table 8: Conservation significant ecological communities located within a 5 km radius of the study area (DBCA 2018c)

Community ID	Community description	Conservation code		Closest occurrence
		EPBC Act	Endorsed by the WA Minister / listed by DBCA	
FCT20a	*Banksia attenuata* woodlands over species rich dense shrublands	Endangered	Endangered	0.8 km to the east of the study area
Banksia WL SPC	*Banksia* Dominated Woodlands of the Swan Coastal Plain	Endangered	Priority 3	Occurs within the study area
FCT29a	Coastal Shrublands on shallow sands	-	Priority 3	4 km to the northwest of the study area
FCT24	Northern Spearwood shrublands and woodlands	-	Priority 3	4 km to the west / northwest of the study area

4.1.2 Expected flora assemblages

A summary of the number of flora species (native and introduced) previously recorded from within Warwick Bushland is provided in **Table 9** below.

Table 9: Summary of number of flora species and conservation significant species recorded within Warwick Bushland from previous studies

Study	Number of species			Number of quadrats established	Conservation significant species/communities recorded
	Native	Introduced	Total		
Gibson *et al*. (1994) (WARI-1, WARI-2)	73	24	97	2	*Jacksonia sericea* (listed as P4 by DBCA)
City of Wanneroo (1995) *	78	18	96	Data unavailable	*Jacksonia sericea* (P4)
City of Joondalup field assessments (D. Pike 2005 and S. Mitrevski 2011) *	81	17	98	6 (2005), 6 (2011)	*Jacksonia sericea* (P4) Bush Forever significant species: *Caesia micrantha, Conostylis aculeata* subsp. *cygnorum*
Brundrett and Clarke 2001, 2004 & 2013 (City of Joondalup 2013) *	209	125	334	4 (established in 2001)	*Jacksonia sericea* (P4) Bush Forever significant species: *Caesia micrantha, Glischrocaryon aureum*
Eco Logical Australia (2013) *	174	51	123	10	*Jacksonia sericea* (P4) Bush Forever significant species: *Agonis flexuosa, Caesia micrantha, Callitris preissii* and *Conostylis aculeata* subsp. *cygnorum*.

*Data sourced from City of Joondalup (2013)

An initial 40 conservation listed flora species were identified as possibly occurring within the study area based on the database searches undertaken in Section 3.1.1 and using the criteria outlined in Section 3.1.2. A likelihood of occurrence assessment table is presented in **Appendix A**[1].

[1] The likelihood assessment in **Appendix A** has been updated to incorporate field survey results.

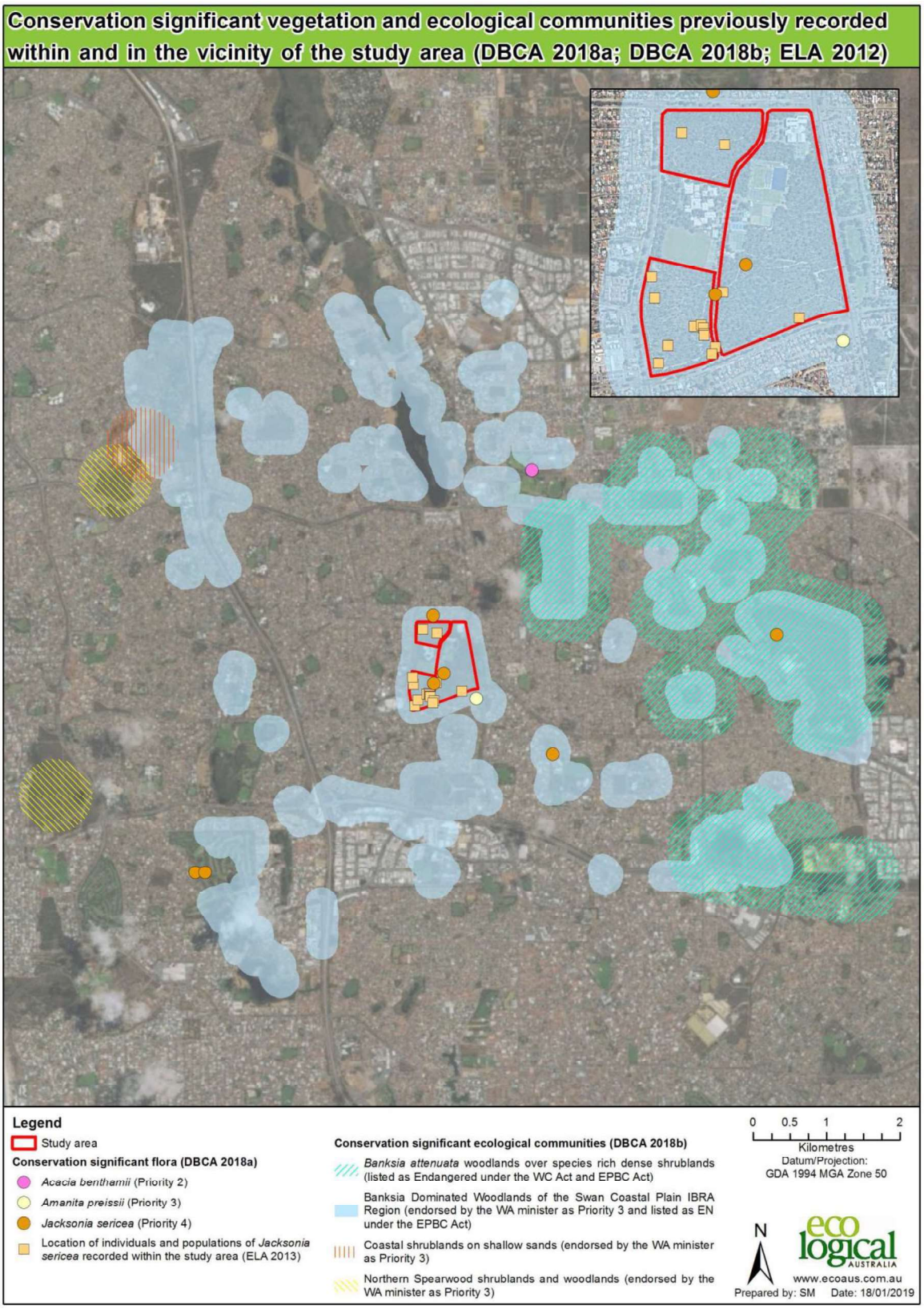

Figure 4: Conservation significant vegetation and ecological communities previously recorded within and in the vicinity of the survey area (DBCA 2018; DBCA 2018b; ELA 2013)

4.2 Flora and vegetation survey

4.2.1 Flora overview

A total of 200 taxa (138 native and 62 introduced taxa) from 148 genera and 56 families were recorded across 12 quadrats established within the study area and from opportunistic collections. A flora species list, complete with previous studies findings (City of Joondalup 2013) is provided in **Appendix C**. Average native perennial species richness per quadrat was 41.9 species, ranging from a low of 36 at ECO_18_05 and ECO_18_10 to a high of 52 species at ECO_18_03 and ECO_18_06. Families with the highest number of species included Fabaceae (32 species) and Proteaceae (17 species). *Acacia* and *Hakea* were the best represented genera throughout the study area with 10 and 5 taxa recorded, respectively. Quadrat site data is presented in **Appendix D**.

4.2.2 Accumulated species – site surveyed (species-area curve)

A species accumulation curve (**Figure 5**) was used to evaluate the adequacy of sampling (Clarke and Gorley 2006). Only species data recorded from defined quadrats were used; no opportunistic flora collections were included. The asymptotic value was determined using Michaelis Menten modelling. Using this analysis, the incidence-based coverage estimator of species richness was calculated to be 141.51. Based on this value, and the total of 120 species recorded within quadrats, approximately 84.8% of the flora species potentially present within the study area were recorded. This result, in addition to opportunistic collections, indicates that the majority of flora potentially present within the study area were recorded.

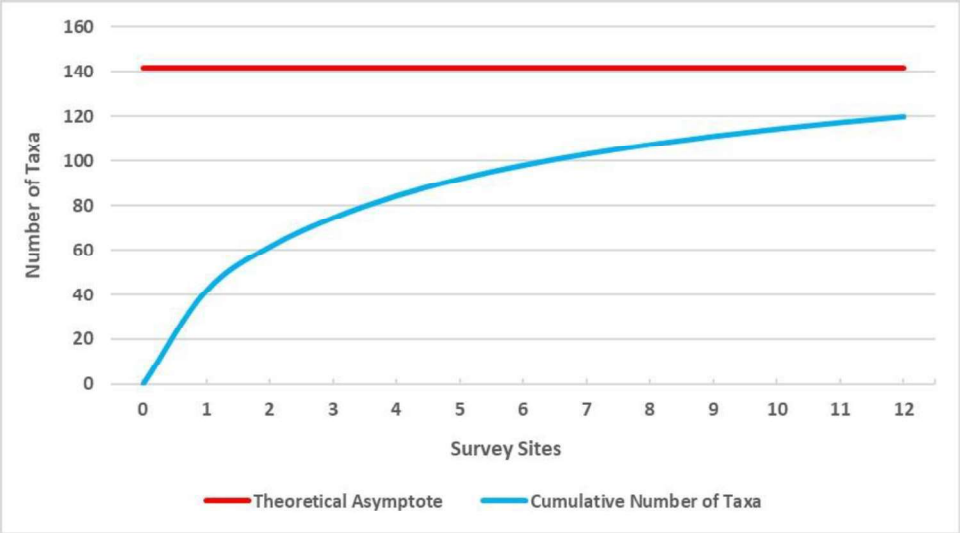

Figure 5: Averaged randomised species accumulation curve

Note: Only species recorded from survey sites were used to calculate the species accumulation curve and theoretical maximum number of species (asymptotic value).

4.2.3 Conservation significant flora

No Threatened flora listed under the EPBC Act or the WC Act were recorded within the study area. One conservation significant flora species, *Jacksonia sericea* (listed as P4 by DBCA) was recorded within the study area, with 564 individuals recorded (**Figure 6** and **Figure 7**). Location coordinates of individuals and polygon centroids for *Jacksonia sericea* are shown below in **Table 10**. This species occurred in each vegetation community within the study area, with greater numbers occurring along the southern boundary, and as isolated patches elsewhere throughout the study area (**Figure 7**). This species is previously known from the study area from previous studies outlined in **Table 9** above. This species is also listed in

Bush Forever as a significant flora of the Perth Metropolitan Region due to its being endemic to the Swan Coastal Plain (Government of Western Australia 2000).

A further two Bush Forever significant flora species were recorded from within the study area, *Callitris preissii* and *Conostylis aculeata* subsp. *cygnorum*. *Conostylis aculeata* subsp. *cygnorum* was recorded across the entire study area at a <1% cover and *Callitris preissii* was recorded from 13 locations (19 individuals) within the study area (**Figure 7**). Location coordinates of individuals and polygon centroids for *Callitris preissii* are shown below in **Table 10**. These species are also considered significant due to them being endemic to the Swan Coastal Plain (Government of Western Australia 2000).

The Bush Forever significant species *Caesia micrantha* was recorded during the current field survey. However, Bush Forever specifically lists this species as being significant only in its 'large swamp form' (Government of Western Australia 2000). Habitat within the study area does not meet requirements for this growth form, and as such this species was omitted from consideration as a conservation significant flora species.

Of the 40 conservation listed flora species identified in the desktop assessment as possibly occurring within the study area, *Jacksonia sericea* (P4) was the only species recorded. The remaining 39 species identified in the likelihood of occurrence assessment are considered unlikely to occur, based on habitat requirements and intensity of survey effort undertaken within the study area. The full likelihood of occurrence assessment is provided in **Appendix A.**

Table 10: Coordinates of conservation significant flora species *Jacksonia sericea* (Priority 4) and *Conostylis aculeata* subsp. *cygnorum* (Bush Forever significant) within the study area

Species	Coordinates		Population Size	Type
	Easting	Northing		
Jacksonia sericea (Priority 4)	[redacted]		1	Location of individual
Jacksonia sericea (Priority 4)			1	Location of individual
Jacksonia sericea (Priority 4)			1	Location of individual
Jacksonia sericea (Priority 4)			1	Location of individual
Jacksonia sericea (Priority 4)			1	Location of individual
Jacksonia sericea (Priority 4)			1	Location of individual
Jacksonia sericea (Priority 4)			1	Location of individual
Jacksonia sericea (Priority 4)			1	Location of individual
Jacksonia sericea (Priority 4)			1	Location of individual
Jacksonia sericea (Priority 4)			1	Location of individual
Jacksonia sericea (Priority 4)			6	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			10	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			25	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			5	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			10	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			5	Centroid of surveyed polygon

Species	Coordinates		Population Size	Type
	Easting	Northing		
Jacksonia sericea (Priority 4)	[redacted]		2	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			2	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			4	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			5	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			5	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			5	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			10	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			5	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			10	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			1	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			5	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			1	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			2	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			20	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			1	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			2	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			2	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			2	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			15	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			2	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			2	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			25	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			1	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			30	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			1	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			1	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			40	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			3	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			3	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			5	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			2	Centroid of surveyed polygon

Species	Coordinates		Population Size	Type
	Easting	Northing		
Jacksonia sericea (Priority 4)	[redacted]		40	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			10	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			3	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			3	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			50	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			3	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			10	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			10	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			1	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			1	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			20	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			2	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			2	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			2	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			15	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			4	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			10	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			1	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			2	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			5	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			20	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			20	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			4	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			25	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			2	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			1	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			10	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			1	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			1	Centroid of surveyed polygon
Jacksonia sericea (Priority 4)			1	Centroid of surveyed polygon
Callitris preissii (Bush Forever significant)			1	Centroid of surveyed polygon

Species	Coordinates		Population Size	Type
	Easting	Northing		
Callitris preissii (Bush Forever significant)	[redacted]		1	Centroid of surveyed polygon
Callitris preissii (Bush Forever significant)			3	Centroid of surveyed polygon
Callitris preissii (Bush Forever significant)			3	Centroid of surveyed polygon
Callitris preissii (Bush Forever significant)			3	Centroid of surveyed polygon
Callitris preissii (Bush Forever significant)			1	Location of individual
Callitris preissii (Bush Forever significant)			1	Location of individual
Callitris preissii (Bush Forever significant)			1	Location of individual
Callitris preissii (Bush Forever significant)			1	Location of individual
Callitris preissii (Bush Forever significant)			1	Location of individual
Callitris preissii (Bush Forever significant)			1	Location of individual
Callitris preissii (Bush Forever significant)			1	Location of individual
Callitris preissii (Bush Forever significant)			1	Location of individual

Figure 6: *Jacksonia sericea* (Priority 4) recorded within the study area

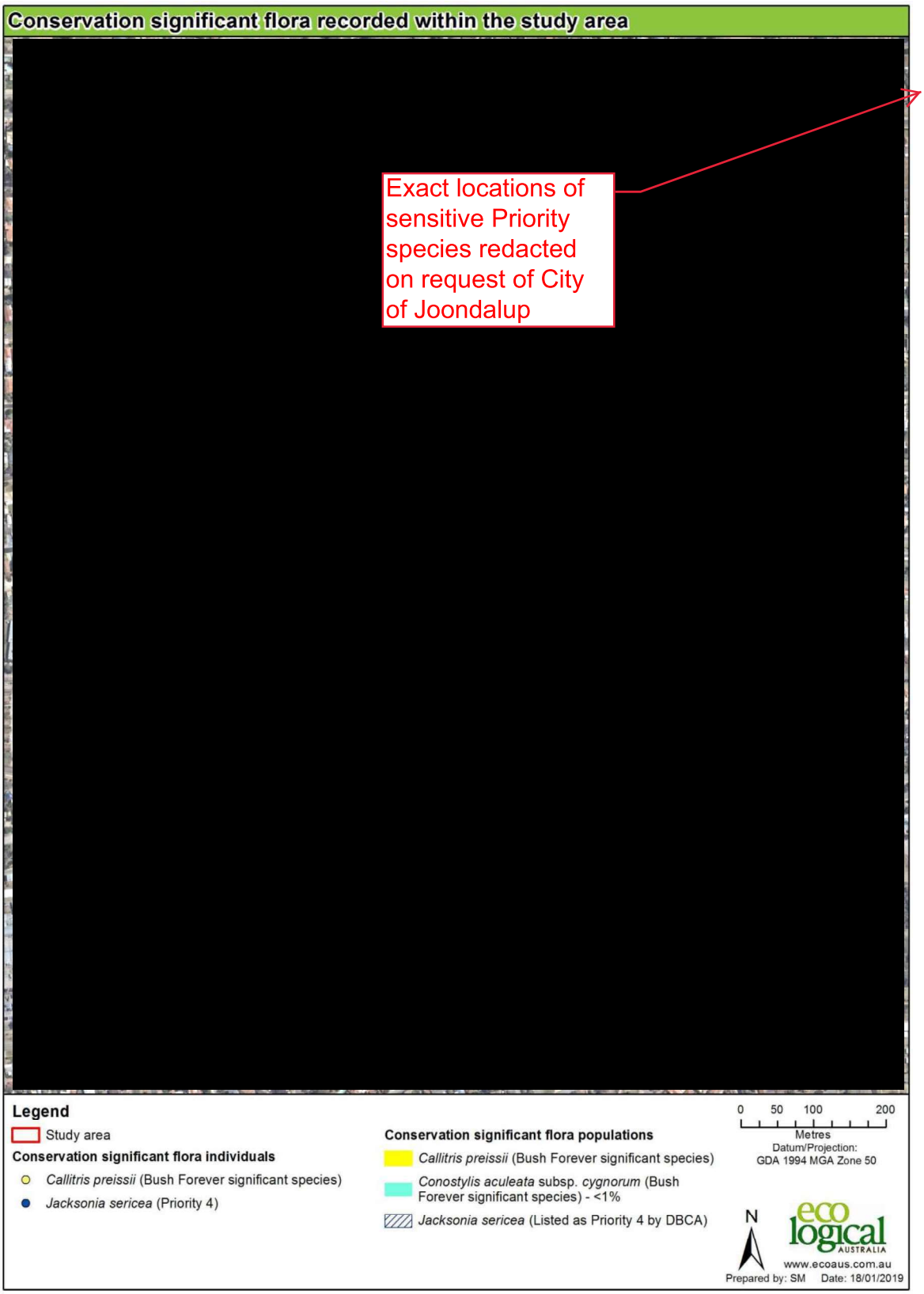

Figure 7: Conservation significant flora recorded within the study area

4.2.4 Introduced flora

A total of 62 introduced (weed) species were recorded as occurring within the study area, representing 31% of the total species recorded. One species, **Moraea flaccida* (One-leaf Cape Tulip), is listed as a Declared Plant under the BAM Act. This species is categorised as s22(2) (exempt). Declared pests "must satisfy any applicable import requirements when imported and may be subject to an import permit if they are potential carriers of high-risk organisms. They may also be subject to control and keeping requirements once within Western Australia" (DPIRD 2018). This species has been recorded previously by Brundrett and Clarke (2001), during City of Joondalup field assessments (D. Pike 2005 and S. Mitrevski 2011) and by ELA (2012). Brundrett and Clarke have also previously recorded the Declared Plants **Echium plantagineum* (S22(2) exempt) and **Chondrilla juncea* (S22(2) C2, C3) and the WoNS **Lantana* camara (City of Joondalup 2013) within the study area, however these introduced species have not been recorded since this assessment within the study area.

Of the weed species recorded within the study area, 19 are listed as City of Joondalup priority weeds for Warwick Bushland, while one weed, **Moraea flaccida*, is listed as a Declared Pest under the BAM Act (**Table 11**). The City's declared pest plant, **Tribulus terrestris* (Caltrop), was not recorded within the study area. Mapping of City of Joondalup priority weeds and of **Moraea flaccida* within the study area is presented in **Appendix E**.

Table 11: CoJ Priority weed species, Declared Pests or WoNS recorded within Warwick Bushland

Species	Common name	Ranking
**Acacia iteaphylla*	Flinders' Range Wattle	CoJ priority weed
**Acacia longifolia*	Sydney Golden Wattle	CoJ priority weed
**Acacia trigonophylla*	-	CoJ priority weed
**Cenchrus setaceus*	Fountain Grass	CoJ priority weed
**Chamelaucium uncinatum*	Geraldton Was	CoJ priority weed
**Ehrharta calycina*	Perennial Veldt Grass	CoJ priority weed
**Ehrharta longiflora*	Annual Veldt Grass	CoJ priority weed
**Eragrostis curvula*	African Lovegrass	CoJ priority weed
**Euphorbia terracina*	Geraldton Carnation Weed	CoJ priority weed
**Freesia alba x leichtlinii*	Freesia	CoJ priority weed
**Gazania linearis*	Gazania	CoJ priority weed
**Moraea flaccida*	One-leaf Cape Tulip	Declared Pest under the BAM Act
**Olea europaea*	Olive	CoJ priority weed
**Oxalis pes-caprae*	Soursob	CoJ priority weed
**Pelargonium capitatum*	Rose Pelargonium	CoJ priority weed
**Schinus terebinthifolia*	Japanese Pepper	CoJ priority weed
**Trachyandra divaricata*	Dune Onion Weed	CoJ priority weed
**Vulpia muralis*	Vulpia Grass	CoJ priority weed
**Watsonia ?meriana* var. *mariana*	Watsonia	CoJ priority weed

4.2.5 Vegetation communities

Profile Analysis (SIMPROF) separated the 12 quadrats established within the study area into three statistically dissimilar groupings (Global R = 1.823; Significance level of sample statistic, p = 0.04; **Appendix F**). Based on this result, three vegetation communities were delineated and mapped within the study area. Where appropriate, vegetation codes previously used (ELA 2013) have been updated to reflect results of the current survey. Details of the three communities, including associated species, and mapping boundaries are presented in **Table 12** and **Figure 8**, respectively. Vegetation communities account for 98.02% of the study area. In addition to these communities shown in **Table 12** below, a total of 0.67 ha (1.1%) of the study area was mapped as cleared vegetation and 0.53 ha (0.9%) as remnant trees (**Figure 8**).

Table 12: Vegetation communities recorded within the study area

Vegetation code	Vegetation description	Associated species	Quadrats	Extent within the study area (ha)	Portion of the study area (%)
EmBa	*Eucalyptus marginata* subsp. *marginata* and *Banksia attenuata* open forest to low open woodland over *Xanthorrhoea preissi, Grevillea vestita* subsp. *vestita* and *Daviesia divaricata* open heath to open shrubland over *Hibbertia hypericoides, Gompholobium tomentosum* and *Petrophile macrostachya* low open shrubland over *Mesomelaena pseudostygia* and *Lepidospermum striatum* very open sedgeland over **Gladiolus caryophyllaceus,* and *Burchardia congesta* very open herbland.	*Caesia micrantha, Conostylis aculeata* subsp. *cygnorum, Crassula colorata, Dasypogon bromeliifolius, Daviesia nudiflora, Daviesia triflora, Desmocladus asper, Dianella revoluta* var. *revoluta, Diuris magnifica, Haemodorum paniculatum, Hardenbergia comptoniana, Hibbertia racemosa, Macrozamia riedlei, Mesomelaena pseudostygia, Petrophile brevifolia, Petrophile linearis, Pterostylis sanguinea, Scaevola canescens, Scaevola crassifolia, Sowerbaea laxiflora, Stirlingia latifolia, Tetraria octandra, Trachymene pilosa, Tricoryne elatior.*	ECO_18_01, ECO_18_05, ECO_18_08, ECO_18_10	24.46	40.3

Vegetation code	Vegetation description	Associated species	Quadrats	Extent within the study area (ha)	Portion of the study area (%)
AfEmBa	*Allocasuarina fraseriana, Eucalyptus marginata* subsp. *marginata* and *Banksia attenuata* low open forest to low woodland over *Xanthorrhoea preissii* open shrubland over *Hibbertia hypericoides* and *Petrophile macrostachya* low open shrubland over *Mesomelaena pseudostygia* and *Lepidospermum striatum* very open sedgeland over **Gladiolus caryophyllaceus* very open herbland over **Ehrharta calycina* very open grassland	*Acacia cochlearis, Acacia cyclops, Acacia pulchella* var. *glaberrima, Acanthocarpus preissii, Alexgeorgea nitens, Amphipogon turbinatus, Anigozanthos humilis, Anigozanthos manglesii, Austrostipa compressa, Banksia dallanneyi* var. *dallanneyi, Banksia menziesii, Bossiaea eriocarpa, Burchardia congesta, Caesia micrantha, Caladenia flava, Calandrinia granulifera, Conostephium pendulum, Conostylis aculeata* subsp. *cygnorum, Conostylis setigera* subsp. *setigera, Corynotheca micrantha, Crassula colorata, Dampiera linearis, Dasypogon bromeliifolius, Daucus glochidiatus, Daviesia divaricata, Daviesia nudiflora, Daviesia triflora, Desmocladus asper, Desmocladus flexuosus, Dianella revoluta* var. *revoluta, Diuris magnifica, Drosera erythrorhiza, Drosera macrantha, Drosera pallida, Erodium cygnorum, Eryngium pinnatifidum, Eucalyptus gomphocephala, Gastrolobium capitatum, Gompholobium tomentosum, Grevillea vestita* subsp. *vestita, Haemodorum paniculatum, Hakea prostrata, Hakea ruscifolia, Hardenbergia comptoniana, Hibbertia huegelii, Hibbertia racemosa, Hovea trisperma, Hybanthus calycinus, Hypocalymma robustum, Isotropis cuneifolia, Isotropis cuneifolia* subsp. *cuneifolia, Kennedia prostrata, Lepidosperma squamatum, Lepidosperma pubisquameum, Lepidosperma striatum, Leucopogon propinquus, Lomandra caespitosa,*	ECO_18_02, ECO_18_03, ECO_18_04, ECO_18_07, ECO_18_09, ECO_18_11	26.49	43.7

Vegetation code	Vegetation description	Associated species	Quadrats	Extent within the study area (ha)	Portion of the study area (%)
		Lomandra sp. (sterile), *Lomandra caespitosa, Macrozamia riedlei, Monotaxis grandiflora, Opercularia vaginata, Orthrosanthus laxus* var. *laxus, Patersonia occidentalis, Petrophile brevifolia, Petrophile linearis, Pimelea leucantha, Podolepis gracilis, Podotheca gnaphalioides, Poranthera microphylla, Pterostylis sanguinea, Ptilotus manglesii, Ptilotus polystachyus, Pyrorchis nigricans, Quinetia urvillei, Ricinocarpos undulatus, Scaevola canescens, Scaevola crassifolia, Scaevola repens* var. *angustifolia, Schoenus curvifolius, Sowerbaea laxiflora, Stenanthemum notiale subsp. chamelum, Stirlingia latifolia, Stylidium brunonianum, Stylidium calcaratum, Stylidium repens, Tetraria octandra, Thysanotus manglesianus, Thysanotus patersonii, Trachymene pilosa, Tricoryne elatior, Waitzia suaveolens, Xanthosia huegelii.*			

Vegetation code	Vegetation description	Associated species	Quadrats	Extent within the study area (ha)	Portion of the study area (%)
EgBaBm	*Eucalyptus gomphocephala, Banksia attenuata* and *Banksia menziesii* open forest to low woodland over *Xanthorrhoea preissii* shrubland over *Hibbertia hypericoides* and *Gompholobium tomentosum* low open shrubland over *Mesomelaena pseudostygia* very open sedgeland over **Gladiolus caryophyllaceus* and *Burchardia congesta* very open herbland over **Ehrharta calycina* very open grassland	*Alexgeorgea nitens, Conostylis aculeata* subsp. *cygnorum, Daviesia divaricata, Desmocladus flexuosus, Hardenbergia comptoniana, Hibbertia racemosa, Isotropis cuneifolia* subsp. *cuneifolia, Leucopogon propinquus, Petrophile macrostachya, Podotheca gnaphalioides, Scaevola canescens, Sowerbaea laxiflora, Thysanotus patersonii, Trachymene pilosa.*	ECO_18_06, ECO_18_12*	8.47	14.0

*It was determined that two quadrats would be adequate to delineate the community and to provide a floristic account of species present for this vegetation community.

4.2.6 Conservation significant ecological communities

FCT analysis

To identify potential TECs and PECs in the project area, ELA quadrats and vegetation communities were compared to FCTs defined by Gibson *et al*. (1994). To aid interpretation of final results, FCTs affiliated with the Spearwood Dunes landform were then separated from the broad Gibson *et al*. 1994 FCT dataset. These FCTs were subsequently compared with vegetation communities delineated by ELA. Results of this analysis are shown below in **Table 13**.

Quadrats within vegetation community **EmBa** showed weak affiliations with FCT 24 and FCT 28 in both Gibson's full dataset and the Spearwood Dune landform dataset (**Table 13**). This community was not considered to represent floristic aspects of a single FCT and may represent a mixture between FCT 24 and FCT 28.

Quadrats within vegetation community **AfEmBa** showed strong affiliation with FCT 28 in both Gibson's full dataset and the Spearwood Dune landform dataset, and weak affiliation with FCT 24 within the Spearwood Dunes landform dataset (**Table 13**). This community was considered to represent floristic aspects of FCT 28 only.

Quadrats within vegetation community **EbBaBm** showed strong affiliation with FCT 28 and weak affiliation with FCT 24 in both Gibson's full dataset and the Spearwood Dune landform dataset (**Table 13)**. This community was considered to represent floristic aspects of FCT 28 only.

Table 13: Relationships between ELA vegetation communities and FCTs defined by Gibson *et al.* (1994)

Community code	Affiliated FCT	ELA quadrats	ANOSIM*	
			Full Gibson dataset	Spearwood Dune landform dataset
EmBa	FCT 24 FCT 28	ECO_18_01, ECO_18_05, ECO_18_08, ECO_18_10	R=0.476, p=0.01 R=0.525, p=0.001	R=0.488, p=0.001 R=0.525, p=0.001
AfEmBa	FCT 28 FCT 24	ECO_18_02, ECO_18_03, ECO_18_04, ECO_18_07, ECO_18_09, ECO_18_11	R=0.118, p=0.14 Nil affiliation	R=0.118, p=0.1 R=0.586, p=0.001
EgBaBm	FCT 28 FCT 24	ECO_18_06, ECO_18_12	R=0.136, p=0.22 R= 0.421, p=0.01	R=0.135, p=0.2 R=0.425, p=0.01

*R = strength of relationship with 0=similar and 1=dissimilar

P = significance of relationship

The FCT 24: '*Northern Spearwood shrublands and woodlands*' is listed by DBCA as a Priority 3 ecological community. FCT 28 is recognised as being part of the '*Banksia Woodlands of the Swan Coastal Plain*' ecological community, which is currently listed as Threatened under the EPBC Act (TSSC 2016) and as Priority 3 by DBCA.

Relationships between ELA vegetation communities and FCTs defined by Gibson *et al*. (1994) and between ELA vegetation communities and Spearwood Dune landform affiliated FCTs defined by Gibson *et al*. (1994) are presented in **Appendix G** and **Appendix H**.

Banksia Woodlands TEC diagnostic

Following the steps provided in the Conservation Advice for the Banksia Woodlands of the Swan Coastal Plain TEC (TSSC 2016) administered by the Federal government as mentioned in Section 3.5.2, vegetation present within the study area assigned a condition rating of Good or above has been assessed to likely represent the EPBC Act listed '*Banksia Woodlands of the Swan Coastal Plain*' (TSSC 2016).

Vegetation present within the study area meets relevant criteria for this TEC, with a number of key diagnostic characteristics met:

- **Location/landform –** the study area is located on the Swan Coastal Plain and occurs on the Spearwood Dune System.
- **Structure and composition –** vegetation within the study area is dominated or co-dominated by *Banksia attenuata* and, in some areas, *Banksia menziesii*, with emergent trees of *Eucalyptus* and *Allocasuarina* species present. A number of indicator species are also present. The understory contains high species diversity.
- **Condition thresholds -** the community was assessed and sampled in the highest condition representation available in the study area and was completed in the most appropriate season for the Swan Coastal Plain.
- **Minimum patch size –** vegetation meets the minimum patch size requirements for vegetation in Good or greater condition. Areas in Degraded condition are not considered part of the EPBC Act ecological community.

A total of 57.96 ha of vegetation within the study area was assessed to likely represent the Banksia Woodlands TEC, comprising 15.12 ha of Excellent condition, 25.35 ha of Very Good condition and 17.49 ha of Good condition. To be considered as part of the Banksia Woodlands TEC a patch needs to meet at least the Good condition category (TSSC 2016), therefore areas of Degraded or Completely Degraded condition within the survey area (1.46 ha and 1.2 ha respectively) are not included in this assessment. The full four-stage assessment against key diagnostic characteristics for this TEC is presented in **Appendix I**.

Tuart (E. gomphocephala) woodlands and forests of the Swan Coastal Plain ecological community diagnostic

Following the steps provided in the Draft Conservation Advice for the 'Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain ecological community' (DotEE 2017) administered by the Federal government as mentioned in Section 3.5.2, vegetation present within the study area is deemed not to represent this ecological community.

A number of criteria for this community were met, including:

- **Location/landform –** the study area is located on the Swan Coastal Plain and occurs on the Spearwood Dune System.
- **Structure/established trees–** vegetation within the study area occurs as a woodland and contains established (>15 cm Diameter at Breast Height) *Eucalyptus gomphocephala* individuals.
- **Dominant canopy species –** this criterion was partly met with one patch of the vegetation community **EgBaBm** occurring with *E. gomphocephala* as the dominant canopy species (southwest patch).
- **Other diagnostic considerations –** several associated species were present within the **EgBaBm** vegetation community.
- **Relationship with other ecological communities –** the Tuart woodlands ecological community overlaps with the Banksia Woodlands of the Swan Coastal Plain community, which is inferred to occur within the study area.

Key criteria relating to species composition and condition classes and thresholds were not met for this vegetation community. Vegetation community **EgBaBm** contains Tuart mapped in two areas, a patch in the southwest of the study area and a patch in the southeast. This species does not occur as a dominant species in the southeast patch. Where it does occur as a dominant species in the southwest patch, it does not meet the required condition class thresholds for Very Good-Good (minimum patch size 1 ha) or Degraded (minimum patch size 2 ha; DotEE 2017). Therefore, no vegetation within the study area is considered as representing the 'Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain' ecological community. The full assessment against key diagnostic characteristics for this community is presented in **Appendix J**.

4.2.7 Vegetation condition

Vegetation condition within the study area ranged from Completely Degraded to Excellent condition, based on the Keighery (1994) vegetation scale provided in the EPA *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment* (2016). Majority of the study area was found to be in Very Good condition (41.8%; 25.35 ha), Good condition (28.9%; 17.49 ha) and Excellent condition (24.9%; 15.12 ha). Areas classed as Completely Degraded (cleared areas and remnant trees) accounted for 1.2 ha (2%) of the study area.

Disturbances present within the study area included occurrences of recent fire, the presence of weeds, feral fauna (rabbit diggings, droppings) and edge effects. Some tree deaths were recorded from within the study area, in particular around the eastern boundary, however it is unclear whether this was caused by dieback or from other diseases, pests and/or drought.

Vegetation condition within the study area is presented in **Table 14** and in **Figure 10**. Vegetation condition per vegetation community is presented in **Table 15** and **Figure 11**.

Table 14: Vegetation condition within the study area

Vegetation condition	Total area (ha)	Portion of the study area (%)
Pristine	0	0
Excellent	15.12	24.9
Very Good	25.35	41.8
Good	17.49	28.9
Degraded	1.46	2.4
Completely Degraded	1.20	2.0
Total	**60.62**	**100.0**

Table 15: Vegetation condition per vegetation community within the study area

Vegetation community	Condition % (ha)						
	Pristine	Excellent	Very Good	Good	Degraded	Completely Degraded	Total % (ha)
EmBa	0	34.5 (8.43)	48.3 (11.81)	16.0 (3.91)	1.2 (0.3)	0	**40.3 (24.46)**
AfEmBa	0	24.4 (6.47)	38.8 (10.29)	36.3 (6.63)	0.4 (0.1)	0	**43.7 (26.49)**
EgBaBm	0	2.6 (0.22)	38.3 (3.24)	46.7 (3.95)	12.5 (1.05)	0	**14.0 (8.47)**
Remnant trees	0	0	0	0	0	0.9 (0.53)	**0.9 (0.53)**
Cleared areas	0	0	0	0	0	1.1 (0.67)	**1.1 (0.67)**
Total % (ha)	**0**	**24.9 (15.12)**	**41.8 (25.35)**	**28.9 (17.49)**	**2.4 (1.46)**	**2 (1.2)**	**100 (60.62)**

4.3 Opportunistic fauna and fungi

No opportunistic fungi species were recorded during the field survey. A total of 14 fauna species were recorded opportunistically during the field survey, comprising 11 birds, two mammals and one reptile. None of the fauna species recorded within the study area represent conservation significant species listed under the EPBC Act, WC Act or by DBCA. Two introduced (feral) fauna species were recorded within the study area, namely the Rainbow Lorikeet and European Rabbit. A fauna species list is provided in **Table 16** below.

Table 16: Fauna species recorded opportunistically within Warwick Bushland

Species	Common name	Evidence type
Birds		
Anthochaera carunculata	Red Wattlebird	Observed
Barnardius zonarius	Australian Ringneck	Observed
Corvus coronoides	Australian Raven	Observed
Cracticus tibicen	Australian Magpie	Observed
Dacelo novaeguineae	Laughing Kookaburra	Heard
Eolophus roseicapilla	Galah	Observed
Lichenostomus virescens	Singing Honeyeater	Heard
Lichmera indistincta	Brown Honeyeater	Heard
Merops ornatus	Rainbow Bee-eater	Heard/observed
Rhipidura leucophrys	Willy Wagtail	Observed
Trichoglossus moluccanus	Rainbow Lorikeet	Heard/observed
Mammals		
Macropus fuliginosus	Western Grey Kangaroo	Evidence (scats)
Oryctolagus cuniculus	European Rabbit	Observed
Reptiles		
Tiliqua rugosa	Bobtail Lizard	Observed

Figure 8: Vegetation communities recorded within the study area

Figure 9: Conservation significant vegetation communities recorded within the study area

Figure 10: Vegetation condition recorded within the study area

Figure 11: Vegetation condition per vegetation community within the study area

5 Discussion and recommendations

5.1 Flora

A total of 200 taxa (138 native and 62 introduced taxa) from 148 genera and 56 families were recorded across 12 quadrats established within the study area and from opportunistic collections. The number of native flora species recorded was significantly higher than the number of native species previously recorded from within the study area by Gibson *et al*. (1994), the City of Wanneroo (1995) and City of Joondalup field assessments (2005 & 2011; 73 species, 78 species and 81 species respectively) and comparable to those recorded by ELA (123 species; ELA 2013) and by Brundrett and Clarke (209 species; City of Joondalup 2013).

An additional 15 native species were recorded in comparison to ELA's 2012 survey of the study area. The increase in species is likely to be a result of increased survey effort (4-day survey compared to ELA's 2-day survey in 2012) which provided more time and opportunity for opportunistic collections and from the instalment of 2 additional quadrats within the study area.

Average native perennial species richness per quadrat was 41.9 species, (range 36 to 52 species per quadrat), which is comparable to Gibson *et al*. 1994 data (plots WARI1 and WARI2 - 52 and 51 species respectively). A survey undertaken by ELA at the nearby Craigie Bushland (located approximately 9 km northwest of the study area) recorded an average native perennial species richness of 21.07 species per quadrat (range 10-33 species; ELA 2017), which is significantly less than recorded at Warwick Bushland. A species accumulation curve determined that approximately 84.8% of the flora species potentially present within the study area were recorded. This result, in addition to opportunistic collections, indicates that the majority of flora potentially present within the study area were recorded. Based on these results, a comprehensive flora inventory of the study area has been developed.

Weed species comprised 31% (62 species) of the total flora taxa recorded, an increase of 11 species since ELA's 2012 survey (51 introduced species recorded; ELA 2013). This increase of weed species recorded is likely due to a combination of increased field survey effort and sustained weed invasion over time. One Declared Pest listed under the BAM Act, **Moraea flaccida* (One-left Cape Tulip) was recorded from within the study area. **M. flaccida* has a legal status of S22(2) and "may be subject to control and keeping requirements once within Western Australia" (DPIRD 2018). Brundrett and Clarke have also previously recorded the Declared Plants **Echium plantagineum* (S22(2) exempt) and **Chondrilla juncea* (S22(2) C2, C3) and the WoNS **Lantana* camara (City of Joondalup 2013) within the study area, however these introduced species have not been recorded since this assessment within the study area.

No Threatened flora listed under the EPBC Act or the WC Act were recorded within the study area. One Priority species, *Jacksonia sericea* (listed as P4 by DBCA) was identified, with 564 individuals recorded from within the study area. This species occurred in each vegetation community within the study area, with greater numbers occurring along the southern boundary and as isolated patches elsewhere throughout the study area. This species has been previously recorded within the study area by City of Wanneroo (1995) Brundrett and Clarke (2001, 2004 & 2013), during City of Joondalup field assessments (D. Pike 2005 and S. Mitrevski 2011) and by ELA (2012; City of Joondalup 2013). ELA recorded a similar distribution of this species in the 2012 survey (ELA 2013). This population appears to be healthy and showing signs of recruitment, with a large increase of occurrences recorded since the last survey undertaken in Warwick Bushland in 2012 (115 plants; ELA 2013). This species is fairly common on the Swan Coastal Plain and has been recorded from 87 locations over a range of approximately 100 km, from Wanneroo in the north to Mandurah in the south (DBCA 2007-2018).

Priority 4 species are defined as species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons. These species require regular monitoring. *J. sericea* is also listed in Bush Forever as a significant flora species of the Perth metropolitan area due to it being endemic to the Swan Coastal Plain (Government of WA 2000).

A further two Bush Forever significant species, *Callitris preissii* and *Conostylis aculeata* subsp. *cygnorum*, were also recorded from within the study area. *C. preissii* was recorded across vegetation within the study area at a <1% cover and *C. aculeata* subsp. *cygnorum* was recorded from 13 locations within the study area. These species are also fairly common on the Swan Coastal Plain, known from 303 and 50 locations, respectively (DBCA 2007-2018).

The Bush Forever significant species *Agonis flexuosa*, although recorded from within the study area during ELA's 2012 field survey (ELA 2013), was not recorded from the current field survey.

5.2 Vegetation

Three vegetation communities were delineated and mapped within the study area.

- **EmBa**: *Eucalyptus marginata* subsp. *marginata* and *Banksia attenuata* open forest to low open woodland over *Xanthorrhoea preissi, Grevillea vestita* subsp. *vestita* and *Daviesia divaricata* open heath to open shrubland over *Hibbertia hypericoides, Gompholobium tomentosum* and *Petrophile macrostachya* low open shrubland over *Mesomelaena pseudostygia* and *Lepidospermum striatum* very open sedgeland over **Gladiolus caryophyllaceus,* and *Burchardia congesta* very open herbland.
- **AfEmBa**: *Allocasuarina fraseriana, Eucalyptus marginata* subsp. *marginata* and *Banksia attenuata* low open forest to low woodland over *Xanthorrhoea preissii* open shrubland over *Hibbertia hypericoides* and *Petrophile macrostachya* low open shrubland over *Mesomelaena pseudostygia* and *Lepidospermum striatum* very open sedgeland over **Gladiolus caryophyllaceus* very open herbland over **Ehrharta calycina* very open grassland.
- **EgBaBm**: *Eucalyptus gomphocephala, Banksia attenuata* and *Banksia menziesii* open forest to low woodland over *Xanthorrhoea preissii* shrubland over *Hibbertia hypericoides* and *Gompholobium tomentosum* low open shrubland over *Mesomelaena pseudostygia* very open sedgeland over **Gladiolus caryophyllaceus* and *Burchardia congesta* very open herbland over **Ehrharta calycina* very open grassland.

These vegetation communities are comparable with those previously recorded within the study area by ELA in 2012 (ELA 2013). However, re-survey of these quadrats, including the addition of new data from quadrats ECO_18_11 and ECO_18_12 led to a slight reclassification and altered distribution of these communities within the study area.

Vegetation community **AfEmBa** was more widespread than previously mapped, covering a total of 43.7% of the study area compared to the previously mapped area of 7% (ELA 2013). Several more quadrats grouped into this community type compared to in the 2012 analysis including ECO_18_2, ECO_18_3, ECO_18_7 and ECO_18_ 11.

Vegetation community **EgBaBm**, previously mapped by ELA (2013) as **EgEm** (comprising ECO_11_06 and ECO_11_08), was also found to be more widespread than previously recorded, with a coverage of 14.0% of the study area compared to the previously mapped area of 5.7% (ELA 2013). The newly established quadrat ECO_18_12 was grouped into this vegetation type, while ECO_18_08 was re-grouped into vegetation community **EmBa**.

Vegetation community **EmBa** (Previously **EmBaBm**) had a reduction in cover within the study area (83.9% to 40.3%), as several quadrats from this community were grouped into **AfEmBa**, including ECO_18_2, ECO_18_3 and ECO_18_7.

Updated mapping is considered a more accurate representation of vegetation communities present within the study area given the increase in replication (greater number of quadrats) and greater diversity of species recorded. Quadrats were positioned within each vegetation type to avoid boundaries and transitional zones, within intact mature vegetation and in areas of best condition, as outlined in the EPA *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016).

To identify potential TECs and PECs in the project area, ELA quadrats and vegetation communities were compared to FCTs defined by Gibson *et al*. (1994). Each of the three vegetation types present within the study area (shown above) showed affiliation (to varying degrees) to FCT 24 and FCT 28. These FCTs form part of the FCT Supergroup 4: 'Uplands centred on Spearwood and Quindalup Dunes' (Government of Western Australia 2000).

Quadrats within vegetation communities **EmBa**, **AfEmBa** and **EgBaBm** all showed a weak affiliation with FCT 24: '*Northern Spearwood shrublands and woodlands*'. This FCT is described as 'heaths or heaths with scattered *Eucalyptus gomphocephala* occurring on deeper soils north from Woodman's Point. All but three sites in this community type occur on the Cottesloe unit of the Spearwood system' (Gibson *et al*. 1994). The average species richness for FCT 24 is 41.8 species, which is comparable to the range recorded by ELA (36 to 52 species). Some floristic aspects of FCT 24 are present to some degree, with a weak overlap in species composition between ELA vegetation communities and FCT 24. Common species include *Hardenbergia comptoniana*, *Phyllanthus calycinus*, *Xanthorrhoea preissii*, *Conostylis aculeata* and *Dianella revoluta* (Gibson *et al*. 1994). FCT 24 is listed as a Priority 3 ecological community by DBCA.

Quadrats within vegetation communities **AfEmBa** and **EgBaBm** showed a strong affiliation to FCT 28, while **EmBa** showed a weak affiliation to this FCT. FCT 28 is largely made up of *Banksia attenuata* woodlands, *Eucalyptus calophylla* - *B. attenuata* woodlands or *E. marginata* - *B. attenuata* woodlands (Gibson *et al*. 1994). The average species richness for FCT 28 is 55.2 species, which is slightly higher than that recorded during this survey (36 to 52 species). Gibson *et al*. data represents the highest condition and species found for each FCT within the region, therefore, lower species counts are expected when sampling areas with lower vegetation condition. There was strong overlap in species composition between vegetation community **AfEmBa** and **EgBaBm** (and to a lesser extent **EmBa**) and FCT 28, with common species including *Banksia attenuata, Hibbertia hypericoides, Xanthorrhoea preissii, Drosera erythrorhiza, Mesomelaena pseudostygia* and *Trachymene pilosa* (Gibson et al. 1994). FCT 28 forms part of the *Banksia Woodlands of the Swan Coastal Plain* ecological community, which is currently listed as Threatened under the EPBC Act and as Priority 3 by DBCA.

Although weak affiliations were recorded between vegetation communities within the study area and FCT 24, it is likely that vegetation communities comprise floristic aspects more closely associated with FCT 28, as supported in the analysis discussed above. This confirms inferences made by Gibson *et al.* (1994) from flora plots established within Warwick Bushland, WARI-1 and WARI-2, which were also assigned to FCT 28 (Gibson *et al.* 1994).

Vegetation within the study area was assessed against key diagnostic characteristics outlined in the Approved Conservation Advice for the Banksia Woodlands of the Swan Coastal Plain ecological community (TSSC 2016). Following steps provided in this document, vegetation within the study area (comprising communities **EmBa**, **AgEmBa** and **EgBaBm** at a Good or above vegetation condition) was

assessed to likely represent the EPBC Act listed 'Banksia Woodlands of the Swan Coastal Plain' (TSSC 2016).

Key characteristics outlined in the conservation advice for this community that were met by vegetation within the study area are as follows: the study area is located on the Swan Coastal Plain and occurs on the Spearwood Dune System. Vegetation within the study area is dominated or co-dominated by *Banksia attenuata* and, in some areas, *Banksia menziesii*, with emergent trees of *Eucalyptus* and *Allocasuarina* species present. A number of indicator species are also present. The community was assessed and sampled in the highest condition representation available in the study area and was completed in the most appropriate season for the Swan Coastal Plain. Vegetation present within the study area meets the minimum patch size requirements for vegetation in Good or greater condition, with patches of Degraded or lesser condition not included in the assessment. A total of 57.96 ha of vegetation within the study area was assessed to likely represent the Banksia Woodlands TEC, comprising 15.12 ha of Excellent condition, 25.35 ha of Very Good condition and 17.49 ha of Good condition. To be considered as part of the Banksia Woodlands TEC a patch needs to meet at least the Good condition category (TSSC 2016), therefore areas of Degraded or Completely Degraded condition within the survey area (1.46 ha and 1.2 ha respectively) are not included in this assessment.

Vegetation within the study area was also assessed against key diagnostic characteristics outlined in the Draft Conservation Advice for the Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain ecological community (DotEE 2017). Although a number of criteria for this community were met, such as location, landform, structure and (to a degree) dominant canopy species, it was found that, for patches that did meet these key characteristics, they did not meet the minimum condition classes and thresholds required. Therefore, vegetation within the study area is not considered to represent the Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain ecological community. The full assessment against key diagnostic characteristics for this community is presented in **Appendix J**.

Vegetation condition within the study area ranged from Excellent to Completely Degraded, with majority of the study area (41.8%) classed as Very Good condition. This is a reduction of this condition class with 67.21% of the study area classified as being in Very Good condition by ELA in 2012 (ELA 2013). This change in condition over time could be attributed to a number of potential factors, including an increase in weed species (sustained weed invasion over time), the presence of pest species (rabbit diggings, herbivory), unrestricted pedestrian access (rubbish dumping, trampling), changes in vegetation structure due to potential disease/pathogens or frequent fires within the reserve. Vegetation in the southwest corner of the study area, previously classed as Very Good condition (ELA 2012), was classed as Good condition due to the presence of a fire scar.

In addition, areas in Excellent and Good condition (24.9% and 28.9% respectively) were found to have increased since mapped by ELA in 2012 (18.32% classed as Excellent and 8.87% classed as Good condition).

A range of disturbances are present which negatively impact vegetation condition within the study area. These include weed infestation, edge effects, signs of potential disease or drought (dead trees) and recent fire. The presence of pest species (rabbits) was also noted within the study area. The smaller patch size of the study area, surrounded by urbanisation, also increases the edge effects of these threatening processes and it was noted these patches were of a lesser condition.

Fire scars (1-10 years old) were observed within the study area, particularly in the southwestern corner of the study area. Fire has a direct impact on vegetation, affecting the growth, survival and reproduction of species, and subsequently alters the structure of vegetation communities (Burrows and Wardell-

Johnson 2003). The vegetation in areas affected by fire in the study area was found to be in Good condition due to the altered lower and mid-storey, a reduced species diversity and a higher weed count following fire events.

Some tree deaths, particularly *Banksia* species, were recorded from ECO_18_07 within the study area. It is unclear whether these deaths are caused by dieback or from other diseases, pests and/or drought.

5.3 Fungi and fauna

No opportunistic fungi species were recorded during the field survey. A total of 14 fauna species were recorded opportunistically during the field survey, comprising 11 birds, two mammals and one reptile. None of the fauna species recorded within the study area represent conservation significant species listed under the EPBC Act, WC Act or by DBCA. Two introduced (feral) fauna species were recorded within the study area, namely the Rainbow Lorikeet and European Rabbit.

5.4 Recommendations

Based on the current survey the following recommendations have been made to conserve native flora, vegetation and environmental values present within Warwick bushland:

- Continue long-term monitoring of weed populations within the study area. Implement weed control, particularly for the Declared Pest **Moraea flaccida* and for City of Joondalup priority weeds. Concentrate weed control activities along track edges and boundaries between remnant bushland and cleared areas.
- Monitor populations of the conservation listed species *Jacksonia sericea* (P4). The population is currently healthy, with a large increase of occurrences recorded since the last survey undertaken in Warwick Bushland in 2012 (ELA 2013). This species appears to favour areas adjacent to roads/tracks, particularly along the southern boundary of the study area.
- Review and update existing fire monitoring and management practices where appropriate or required.
- Monitor vegetation health, in particular for dieback. Some tree deaths were recorded within the study area; however, it is unclear whether this was caused by dieback or from other diseases, pests and/or drought. It is recommended to continue monitoring for evidence of dieback and other pathogens, and to continue maintaining correct hygiene practices.
- Ensure that unauthorised access is restricted to defined tracks/paths only to prevent habitat degradation and weed spread.
- Control feral animal species, such as rabbits.
- Retain dead old-growth trees for fauna habitat value.
- Continued support of and further develop collaboration with the Friends of Warwick Bushland to enhance conservation and public awareness of the biodiversity and natural history values of Warwick Open Space.

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Appendix A Likelihood of occurrence assessment criteria

Likelihood rating	Criteria
Recorded	The species has previously been recorded within study area from DBCA database search results and/or from previous surveys of the study area, and/or the species has been confirmed through a current vouchered specimen at WA Herbarium.
Likely	The species has not previously been recorded from within the study area. However, (to qualify requires one or more criteria to be met): • the species has been recorded in close proximity to the study area, and occurs in similar habitat to that which occurs within the study area • core habitat and suitable landforms for the species occurs within the study area either year-round or seasonally. In relation to fauna species, this could be that a host plant is seasonally present on site, or habitat features such as caves are present that may be used during particular times during its life cycle e.g. for breeding. In relation to both flora and fauna species, it may be there are seasonal wetlands present • there is a medium to high probability that a species uses the study area.
Potential	The species has not previously been recorded from within the study area. However, (one or more criteria requires to be met): • targeted surveys may locate the species based on records occurring in proximity to the study area and suitable habitat occurring in the study area • the study area has been assessed as having potentially suitable habitat through habitat modelling • the species is known to be cryptic and may not have been detected despite extensive surveys • the species is highly mobile and has an extensive foraging range so may not have been detected during previous surveys The species has been recorded in the study area by a previous consultant survey or there is historic evidence of species occurrence within the study area. However, (one or more criteria requires to be met): • doubt remains over taxonomic identification, or the majority of habitat does not appear suitable (although presence cannot be ruled out due to factors such as species ecology or distribution) • coordinates are doubtful.
Unlikely	The species has been recorded locally through DBCA database searches. However, it has not been recorded within the study area and • it is unlikely to occur due to the site lacking critical habitat, having at best marginally suitable habitat, and/or being severely degraded • it is unlikely to occur due to few historic record/s and no other current collections in the local area. The species has been recorded within the bioregion based on literature review but has not been recorded locally or within the study area through DBCA database searches. The species has not been recorded in the study area despite adequate survey efforts, such as a standardised methodology or targeted searching within potentially suitable habitat.

Likelihood rating	Criteria
Does not occur (one or more criteria requires to be met).	The species is not known to occur within the IBRA bioregion based on current literature and distribution. The conspicuous species has not been recorded in the study area despite adequate survey efforts at an appropriate time of year to detect the species within potentially suitable habitat. The study area lacks important habitat for a species that has highly selective habitat requirements. The species has been historically recorded within study area or locally; however, it is considered locally extinct due to significant habitat changes such as land clearing and/or introduced predators.

Appendix B Flora likelihood of occurrence assessment

Species	Conservation status		Habitat	Source[4]	Likelihood of occurrence	Justification for likelihood
	EPBC Act[1]	WC Act[2] / DBCA[3]				
Darwinia foetida	CR	S2	Known from three populations in swampy, seasonally wet habitat in the Muchea area, approximately 70km north of Perth.	PMST	Unlikely	Not suitable habitat and adequacy of search effort
Synaphea sp. Fairbridge Farm (D. Papenfus 696)	CR	S1	Occurs on grey, clayey sand with lateritic pebbles in low woodland areas near winter flats.	PMST	Unlikely	Not suitable habitat and adequacy of search effort
Caladenia huegelii	EN	S1	Throughout its range the species tends to favour areas of dense undergrowth. Soil is usually deep grey-white sand usually associated with the Bassendean sand-dune system. However, rare plants have been known to extend into the Spearwood system (in which calcareous yellow sands dominate) in some areas.	PMST, NatureMap	Unlikely	Not suitable habitat and adequacy of search effort
Drakaea elastica	EN	S1	White sand over a dark sandy loam on low-lying damp areas near ephemeral lakes, or on the slopes adjacent to winter wet depressions, swamps	PMST	Unlikely	Not suitable habitat and adequacy of search effort
Grevillea curviloba subsp. *curviloba*	EN	S1	The curved-leaf grevillea occurs on typically winter wet, deep peaty grey sands over limestone at depth, and occurs with a suite of shrubs including *Acacia saligna*, *Melaleuca huegelii* and *M. systena* that are more commonly associated with limestone soils near the coast.	PMST	Unlikely	Not suitable habitat and adequacy of search effort

Species	Conservation status		Habitat	Source[4]	Likelihood of occurrence	Justification for likelihood
	EPBC Act[1]	WC Act[2] / DBCA[3]				
Thelymitra dedmaniarum	EN	S1	The cinnamon sun orchid grows in *Eucalyptus wandoo* (wandoo) and *E. accedens* (powderbark wandoo) woodlands on red-brown sandy-loam soil associated with dolerite and granite outcrops.	PMST	Unlikely	Not suitable habitat and adequacy of search effort
Trithuria occidentalis	EN	S1	Grows on partly submerged on the edge of shallow, winter-wet claypans in very open shrubland of Robin Redbreast Bush (*Melaleuca lateritica*) and numerous annual herbs.	PMST	Unlikely	Not suitable habitat and adequacy of search effort
Calytrix breviseta subsp. *breviseta*	EN	S1	Sandy clay. Swampy flats.	PMST	Unlikely	Not suitable habitat and adequacy of search effort
Eucalyptus x *balanites*	EN	S1	Sandy soils with lateritic gravel.	PMST	Unlikely	Not suitable habitat and adequacy of search effort
Diuris purdiei	EN	S2	Grey-black sand, moist. Winter-wet swamps.	PMST	Unlikely	Not suitable habitat and adequacy of search effort
Eremophila glabra subsp. *chlorella*	EN	S2	Winter-wet depressions, grey-brown sand over clay based sub-soils.	PMST	Unlikely	Not suitable habitat and adequacy of search effort

Species	Conservation status		Habitat	Source[4]	Likelihood of occurrence	Justification for likelihood
	EPBC Act[1]	WC Act[2] / DBCA[3]				
Grevillea christineae	EN	S2	Occurs on narrow, weed-infested road verges, which in many places are almost the only surviving representatives of the natural vegetation in those areas.	PMST	Unlikely	Not suitable habitat and adequacy of search effort
Grevillea curviloba subsp. *incurva*	EN	S2	Grows in open heath in winter-wet areas on sand over limestone, or over ironstone at sites with a high watertable. It is associated with the EPBC Act listed threatened ecological communities 'Shrublands and Woodlands on Perth to Gingin *Grevillea curviloba* subsp. *incurva* (narrow curved-leaf grevillea) Ironstone' and the 'Shrublands and Woodlands on Muchea Limestone' ecological communities of the Swan Coastal Plain.	PMST	Unlikely	Not suitable habitat and adequacy of search effort
Lepidosperma rostratum	EN	S2	Associated with Marsh Banksia (*Banksia telmatiaea*) and Hairy Clawflower (*Calothamnus hirsutus*) and grows in sandy soil among low heath in a winterwet swamp.	PMST	Unlikely	Not suitable habitat and adequacy of search effort
Marianthus paralius	EN	S2	White sand over limestone. Low coastal cliffs.	PMST	Unlikely	Not suitable habitat and adequacy of search effort
Diplolaena andrewsii	EN	S2	Occurs in the loam and clay soils of granite outcrops and hillsides in the Darling Scarp.	PMST	Unlikely	Not suitable habitat and adequacy of search effort
Macarthuria keigheryi	EN	S2	The species is found in low-lying winter-wet damp, grey/white sands and grows in open patches with low tree canopy cover	PMST	Unlikely	Not suitable habitat and

Species	Conservation status		Habitat	Source[4]	Likelihood of occurrence	Justification for likelihood
	EPBC Act[1]	WC Act[2] / DBCA[3]				
			among heathland, jarrah (*Eucalyptus marginata*) and Allocasuarina/Banksia woodland			adequacy of search effort
Thelymitra stellata	EN	S2	The species grows in gravelly loam among low heath and scrub in *Eucalyptus marginata* and *E. wandoo* woodland, and in low heath on lateritic hill tops.	PMST	Unlikely	Not suitable habitat and adequacy of search effort
Andersonia gracilis	EN	S3	Found on seasonally damp, black sandy clay flats near or on the margins of swamps, often on duplex soils supporting low open heath vegetation with species such as *Calothamnus hirsutus*, *Verticordia densiflora* and *Kunzea recurva* over sedges.	PMST	Unlikely	Not suitable habitat and adequacy of search effort
Chamelaucium sp. Gingin (N. G. Marchant 6)	EN	S3	The species occurs on white/yellow sand supporting open low woodland with *Eucalyptus todtiana* (pricklybark), *Banksia attenuata* (candle banksia), and *Hibbertia* sp.	PMST	Unlikely	Not suitable habitat and adequacy of search effort
Drakaea micrantha	VU	S2	Cleared firebreaks or open sandy patches that have been disturbed. Occurs in infertile grey sands, in Jarrah and Common Sheoak woodland or forest associated with *Banksia* species.	PMST	Unlikely	Not suitable habitat and adequacy of search effort
Diuris micrantha	VU	S3	Brown loamy clay. Winter-wet swamps, in shallow water.	PMST	Unlikely	Not suitable habitat and adequacy of search effort
Eleocharis keigheryi	VU	S3	Grows in small clumps in a substrate of clay or sandy loam. This species is emergent in freshwater creeks and claypans.	PMST	Unlikely	Not suitable habitat and

Species	Conservation status		Habitat	Source[4]	Likelihood of occurrence	Justification for likelihood
	EPBC Act[1]	WC Act[2] / DBCA[3]				
						adequacy of search effort
Anigozanthos viridis subsp. *terraspectans*	VU	S3	Occurs in winter-wet depressions where it grows on grey sandy clay loam, or grey sand, in low post-fire regenerating heath. It is associated with species such as Slender-leaved Banksia (*Banksia leptophylla*), melaleucas (*Melaleuca* spp.), Compact Featherflower (*Verticordia densiflora*), coneflowers (*Conostylis* spp.) and sedges.	PMST	Unlikely	Not suitable habitat and adequacy of search effort
Conospermum undulatum	VU	S3	Occurs on sand and sandy clay soils, often over laterite, on flat or gently sloping sites between the Swan and Canning Rivers. A few records are from slightly swampy habitat.	PMST	Unlikely	Not suitable habitat and adequacy of search effort
Eucalyptus argutifolia	VU	S3	Grows on slopes or gullies close to the summits of limestone ridges, where soils are shallow, well drained and grey with outcrops of limestone.	PMST	Unlikely	Not suitable habitat and adequacy of search effort
Drosera patens	-	P1	Sandy soils. Margins of winter-wet depressions, swamps and lakes.	NatureMap	Unlikely	Not suitable habitat and adequacy of search effort
Drosera x sidjamesii	-	P1	Peaty sand. Along lake margins, close to winter high-water line.	NatureMap	Unlikely	Not suitable habitat and adequacy of search effort
Lepidium pseudohyssopifolium	-	P1	Swampy ground.	NatureMap	Unlikely	Not suitable habitat and

Species	Conservation status		Habitat	Source[4]	Likelihood of occurrence	Justification for likelihood
	EPBC Act[1]	WC Act[2] / DBCA[3]				
						adequacy of search effort
Baeckea sp. Limestone (N. Gibson & M.N. Lyons 1425)	-	P1	Yellow/grey sand over limestone	NatureMap	Unlikely	Not suitable habitat and adequacy of search effort
Acacia benthamii	-	P2	Limestone breakaways, brown sand, seasonal wetlands	NatureMap, DBCA	Unlikely	Not suitable habitat and adequacy of search effort
Cyathochaeta teretifolia	-	P3	Grey sand, sandy clay. Swamps, creek edges.	NatureMap	Unlikely	Not suitable habitat and adequacy of search effort
Dampiera triloba	-	P3	Dark brown/black peaty soils on low shrubland.	NatureMap	Unlikely	Not suitable habitat and adequacy of search effort
Conostylis bracteata	-	P3	Confined to coastal heath and scrub; sand, well-watered depressions in undulating sand dunes close to limestone	NatureMap	Unlikely	Not suitable habitat and adequacy of search effort
Pimelea calcicola	-	P3	Sand. Coastal limestone ridges.	NatureMap	Unlikely	Not suitable habitat and

Species	Conservation status		Habitat	Source[4]	Likelihood of occurrence	Justification for likelihood
	EPBC Act[1]	WC Act[2] / DBCA[3]				
						adequacy of search effort
Styphelia filifolia	-	P3	Flat sandplain, yellow sands in open woodland over heath.	NatureMap	Unlikely	Not suitable habitat and adequacy of search effort
Jacksonia sericea	-	P4	Calcareous and sandy soils in Banksia/Eucalypt woodland	NatureMap , DBCA	Recorded	Recorded during current survey
Anigozanthos humilis subsp. *chrysanthus*	-	P4	Grey or yellow sand.	NatureMap	Unlikely	Not suitable habitat and adequacy of search effort
Drosera occidentalis subsp. *occidentalis*	-	P4	Sandy & clayey soils. Swamps & wet depressions.	NatureMap	Unlikely	Not suitable habitat and adequacy of search effort
Verticordia lindleyi subsp. *lindleyi*	-	P4	Sand, sandy clay. Winter-wet depressions.	NatureMap	Unlikely	Not suitable habitat and adequacy of search effort

[1]EPBC Act = Flora listed under the *Environment Protection and Biodiversity Conservation Act 1999.*
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
[2]WC Act = Flora listed under the *Wildlife Conservation Act 1950.*
S1 = Schedule 1: Flora that are considered likely to become extinct or rare, as critically endangered flora
S2 = Schedule 2: Flora that are considered likely to become extinct or rare, as endangered flora

S3 = Schedule 3: Flora that are considered likely to become extinct or rare, as vulnerable flora
[3]DBCA = Flora listed as Priority species under the Department of Biodiversity, Conservation and Attractions
P1 = Priority 1: Species that are known from one or a few locations (generally five or less) which are potentially at risk. Listed by DBCA
P2 = Priority 2: Poorly known species that are known from one or a few locations. Listed by DBCA.
P3 = Priority 3: Poorly known species that are known from several locations and the species does not appear to be under imminent threat. Listed by DBCA.
P4 = Priority 4: Rare, Near Threatened and other species in need of monitoring. Listed by DBCA.
[4]DBCA = Department of Biodiversity, Conservation and Attractions *Threatened and Priority Flora database search* (DBCA 2018a).
NatureMap = NatureMap database search (DBCA 2007-2018)
PMST = EPBC Act Protected Matters Search Tool report (DotEE 2018).

Appendix C Flora species list

Family	Latin Name	Common Name	Introduced	Status	Previously recorded (City of Joondalup 2013)				Recorded ELA (2018)
					City of Wanneroo (1995)	Recorded Brundrett & Clarke (2001, 2004 & 2013)	City of Joondalup Field Assessments (2005 & 2011)	Recorded (ELA 2013)	
Aizoaceae	*Carpobrotus edulis*	Hottentot Fig	Y		Y	Y		Y	Y
Aizoaceae	*Carpobrotus virescens*	Coastal Pigface					Y		
Aizoaceae	*Galenia pubescens*	Coastal Galenia	Y			Y			
Amaranthaceae	*Ptilotus drummondii*	Narrowleaf Mulla				Y	Y		
Amaranthaceae	*Ptilotus manglesii*	Pom Poms				Y		Y	Y
Amaranthaceae	*Ptilotus polystachyus*	Prince of Wales Feather				Y		Y	Y
Anacardiaceae	*Schinus terebinthifolius*	Japanese Pepper	Y	VH (Swan)		Y			
Anarthriaceae	*Lyginia barbata*						Y		
Anarthriaceae	*Lyginia imberbis*					Y			Y
Apiaceae	*Daucus glochidiatus*	Australian Carrot				Y		Y	Y
Apiaceae	*Eryngium pinnatifidum (*formerly *Eryngium rostratum)*	Blue Devils						Y	Y
Apiaceae	*Foeniculum vulgare*	Fennel	Y			Y			
Apiaceae	*Homalosciadium homalocarpum*							Y	Y
Apiaceae	*Xanthosia huegelii*					Y	Y	Y	Y

Family	Latin Name	Common Name	Introduced	Status	Previously recorded (City of Joondalup 2013)				Recorded ELA (2018)
					City of Wanneroo (1995)	Recorded Brundrett & Clarke (2001, 2004 & 2013)	City of Joondalup Field Assessments (2005 & 2011)	Recorded (ELA 2013)	
Araliaceae	*Trachymene pilosa*	Native Parsnip			Y	Y		Y	Y
Asparagaceae	*Acanthocarpus preissii*								Y
Asparagaceae	*Agave americana*	Century Plant	Y			Y			
Asparagaceae	*Lachenalia bulbifera*		Y	H (Swan)		Y			
Asparagaceae	*Lomandra caespitosa*	Tufted Mat Rush			Y	Y		Y	Y
Asparagaceae	*Lomandra hermaphrodita*					Y			Y
Asparagaceae	*Lomandra maritima*					Y	Y		
Asparagaceae	*Lomandra nigricans*				Y	Y			
Asparagaceae	*Lomandra preissii*					Y	Y		
Asparagaceae	*Lomandra* sp. (sterile)								Y
Asparagaceae	*Ornithogalum arabicum*	Lesser Cape Lily	Y			Y			
Asparagaceae	*Sowerbaea laxiflora*	Purple Tassels				Y		Y	Y
Asparagaceae	*Thysanotus arenarius*					Y			
Asparagaceae	*Thysanotus manglesianus*	Fringed Lily			Y	Y		Y	Y
Asparagaceae	*Thysanotus sparteus*					Y	Y		Y

Family	Latin Name	Common Name	Introduced	Status	Previously recorded (City of Joondalup 2013)				Recorded ELA (2018)
					City of Wanneroo (1995)	Recorded Brundrett & Clarke (2001, 2004 & 2013)	City of Joondalup Field Assessments (2005 & 2011)	Recorded (ELA 2013)	
Asparagaceae	*Thysanotus thyrsoideus*					Y			
Asparagaceae	*Thysanotus triandrus*				Y	Y			
Asparagaceae	*Thysanotus patersonii*								Y
Asphodelaceae	*Trachyandra divaricata*	False Onion Weed	Y			Y		Y	
Asteraceae	*Arctotheca calendula*	Cape Weed	Y	H (Swan)		Y		Y	Y
Asteraceae	*Asteridea pulverulenta*	Common Bristle Daisy			Y	Y			
Asteraceae	*Centaurea melitensis*	Maltese Cockspur	Y	H (Swan)		Y			
Asteraceae	*Chondrilla juncea*	Skeleton Weed	Y	#		Y			
Asteraceae	*Conyza sumatrensis (*formerly *Conyza albida)*	Broadleaf Fleabane	Y			Y			Y
Asteraceae	*Cotula turbinata*	Funnel Weed	Y			Y		Y	Y
Asteraceae	*Craspedia variabilis*					Y			
Asteraceae	*Dittrichia graveolens*	Stinkwort	Y			Y			
Asteraceae	*Euchiton sphaericus*					Y			

Family	Latin Name	Common Name	Introduced	Status	Previously recorded (City of Joondalup 2013)				Recorded ELA (2018)
					City of Wanneroo (1995)	Recorded Brundrett & Clarke (2001, 2004 & 2013)	City of Joondalup Field Assessments (2005 & 2011)	Recorded (ELA 2013)	
Asteraceae	*Gamochaeta coarctata*		Y			Y			
Asteraceae	*Gazania linearis*		Y			Y	Y	Y	Y
Asteraceae	*Hypochaeris glabra*	Smooth Catsear	Y	H (Swan)	Y	Y	Y	Y	Y
Asteraceae	*Lactuca serriola*		Y						Y
Asteraceae	*Lagenophora huegelii*					Y			Y
Asteraceae	*Leontodon rhagadioloides* (formerly *Hedypnois rhagadioloides* subsp. *cretica*)	Cretan Weed	Y					Y	
Asteraceae	*Monoculus monstrosus* (formerly *Osteospermum clandestinum*)		Y			Y		Y	Y
Asteraceae	*Olearia axillaris*	Coastal Daisybush				Y			
Asteraceae	*Olearia elaeophila*					Y			
Asteraceae	*Osteospermum ecklonis* (formerly *Dimorphotheca ecklonis*)		Y			Y	Y		Y

Family	Latin Name	Common Name	Introduced	Status	Previously recorded (City of Joondalup 2013)				Recorded ELA (2018)
					City of Wanneroo (1995)	Recorded Brundrett & Clarke (2001, 2004 & 2013)	City of Joondalup Field Assessments (2005 & 2011)	Recorded (ELA 2013)	
Asteraceae	*Pithocarpa cordata*					Y	Y		
Asteraceae	*Podolepis gracilis*	Slender Podolepis				Y		Y	Y
Asteraceae	*Podotheca angustifolia*	Sticky Longheads				Y			
Asteraceae	*Podotheca chrysantha*	Yellow Podotheca				Y			
Asteraceae	*Podotheca gnaphalioides*	Golden Longheads				Y		Y	Y
Asteraceae	*Podotheca gnaphalioides*								Y
Asteraceae	*Quinetia urvillei*								Y
Asteraceae	*Senecio vulgaris*	Common Groundsel	Y			Y			
Asteraceae	*Siloxerus humifusus*	Procumbent Siloxerus				Y			
Asteraceae	*Sonchus oleraceus*	Common Sowthistle	Y			Y	Y	Y	Y
Asteraceae	*Urospermum picroides*	False Hawkbit	Y			Y			
Asteraceae	*Ursinia anthemoides* subsp. *anthemoides*		Y		Y	Y		Y	Y
Asteraceae	*Waitzia suaveolens*	Fragrant Waitzia			Y	Y	Y		Y

Family	Latin Name	Common Name	Introduced	Status	Previously recorded (City of Joondalup 2013)				Recorded ELA (2018)
					City of Wanneroo (1995)	Recorded Brundrett & Clarke (2001, 2004 & 2013)	City of Joondalup Field Assessments (2005 & 2011)	Recorded (ELA 2013)	
Boraginaceae	*Echium plantagineum*	Paterson's Curse	Y	H (Swan), #		Y			
Brassicaceae	*Alyssum linifolium*	Flax-leaf Alyssum	Y			Y			
Brassicaceae	*Brassica tournefortii*	Mediterranean Turnip	Y	H (EWSWA), H (Swan)		Y			Y
Brassicaceae	*Heliophila pusilla*		Y			Y		Y	Y
Brassicaceae	*Raphanus raphanistrum*	Wild Radish	Y					Y	
Caesalpiniaceae	*Ceratonia siliqua*	Carob Tree	Y			Y			
Campanulaceae	*Isotoma hypocrateriformis*	Woodbridge Poison				Y			
Campanulaceae	*Lobelia tenuior*	Slender Lobelia				Y			
Campanulaceae	*Wahlenbergia capensis*	Cape Bluebell	Y		Y	Y		Y	Y
Campanulaceae	*Wahlenbergia preissii*					Y			
Caprifoliaceae	*Centranthus macrosiphon*	Spanish Valerian	Y		Y	Y		Y	

Family	Latin Name	Common Name	Introduced	Status	Previously recorded (City of Joondalup 2013)				Recorded ELA (2018)
					City of Wanneroo (1995)	Recorded Brundrett & Clarke (2001, 2004 & 2013)	City of Joondalup Field Assessments (2005 & 2011)	Recorded (ELA 2013)	
Caryophyllaceae	*Cerastium glomeratum*	Mouse Ear Chickweed	Y			Y			
Caryophyllaceae	*Petrorhagia dubia* (formerly *Petrorhagia velutina)*		Y		Y	Y		Y	Y
Caryophyllaceae	*Polycarpon tetraphyllum*	Fourleaf Allseed	Y			Y			
Caryophyllaceae	*Silene gallica*	French Catchfly	Y			Y			Y
Caryophyllaceae	*Silene gallica* var. *gallica*		Y			Y			
Caryophyllaceae	*Stellaria media*	Chickweed	Y			Y			Y
Casuarinaceae	*Allocasuarina fraseriana*	Sheoak			Y	Y	Y	Y	Y
Casuarinaceae	*Allocasuarina humilis*	Dwarf Sheoak			Y	Y	Y	Y	Y
Centrolepidaceae	*Centrolepis drummondiana*					Y		Y	Y
Colchicaceae	*Burchardia congesta* (formerly *Burchardia umbellata)*				Y	Y	Y	Y	Y
Crassulaceae	*Crassula colorata*	Dense Stonecrop		Planted	Y	Y		Y	Y

Family	Latin Name	Common Name	Introduced	Status	Previously recorded (City of Joondalup 2013)				Recorded ELA (2018)
					City of Wanneroo (1995)	Recorded Brundrett & Clarke (2001, 2004 & 2013)	City of Joondalup Field Assessments (2005 & 2011)	Recorded (ELA 2013)	
Cupressaceae	*Callitris preissii*	Rottnest Island Pine	Y					Y	Y
Cyperaceae	*Isolepis marginata*	Coarse Club-rush			Y	Y		Y	
Cyperaceae	*Lepidosperma leptostachyum*				Y			Y	
Cyperaceae	*Lepidosperma pubisquameum*							Y	Y
Cyperaceae	*Lepidosperma squamatum*					Y			Y
Cyperaceae	*Lepidosperma striatum*							Y	Y
Cyperaceae	*Mesomelaena pseudostygia*					Y	Y	Y	Y
Cyperaceae	*Schoenus curvifolius*	Large Flowered Bogrush			Y	Y	Y	Y	Y
Cyperaceae	*Tetraria octandra*				Y	Y	Y		Y
Dasypogonaceae	*Dasypogon bromeliifolius*	Pineapple Bush			Y	Y	Y	Y	Y
Dilleniaceae	*Hibbertia huegelii*				Y	Y	Y	Y	Y
Dilleniaceae	*Hibbertia hypericoides*	Yellow Buttercups			Y	Y	Y	Y	Y

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Dilleniaceae	*Hibbertia racemosa*	Stalked Guinea Flower			Y	Y	Y	Y	Y
Droseraceae	*Drosera erythrorhiza* (formerly *Drosera erythrorhiza* subsp. *erythrorhiza)*				Y	Y	Y	Y	Y
Droseraceae	*Drosera macrantha*	Bridal Rainbow				Y		Y	Y
Droseraceae	*Drosera menziesii*	Pink Rainbow				Y			
Droseraceae	*Drosera paleacea*	Dwarf Sundew				Y	Y		
Droseraceae	*Drosera pallida*	Pale Rainbow				Y		Y	Y
Droseraceae	*Drosera platystigma*	Black-eyed Sundew						Y	
Droseraceae	*Drosera stolonifera*	Leafy Sundew				Y			
Ericaceae	*Astroloma ciliatum*	Candle Cranberry				Y			
Ericaceae	*Astroloma pallidum*	Kick Bush				Y		Y	Y
Ericaceae	*Conostephium pendulum*	Pearl Flower			Y	Y	Y	Y	Y
Ericaceae	*Conostephium preissii*				Y	Y	Y		
Ericaceae	*Leucopogon parviflorus*	Coast Beard-heath					Y		

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Ericaceae	*Leucopogon propinquus*				Y	Y	Y	Y	Y
Euphorbiaceae	*Monotaxis grandiflora* var. *grandiflora*					Y		Y	Y
Euphorbiaceae	*Ricinocarpos glaucus*					Y			
Euphorbiaceae	*Ricinocarpos tuberculatus*			P2		Y			
Euphorbiaceae	*Ricinocarpos undulatus*								Y
Euphorbiaceae	*Ricinus communis*	Castor Oil Plant	Y			Y			
Euphorbiaceae	*Euphorbia ?cyathophora*		Y			Y			
Euphorbiaceae	*Euphorbia peplus*	Petty Spurge	Y	H (Swan)		Y		Y	Y
Euphorbiaceae	*Euphorbia terracina*	Geraldton Carnation Weed	Y	H (EWSWA), VH (Swan)		Y		Y	
Fabaceae	*Acacia applanata*	Golden Grass Wattle				Y			
Fabaceae	*Acacia baileyana*	Cootamundra Wattle	Y			Y			

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Fabaceae	*Acacia cochlearis*	Rigid Wattle				Y	Y	Y	Y
Fabaceae	*Acacia cyclops*	Coastal Wattle				Y		Y	Y
Fabaceae	*Acacia dealbata*		Y			Y			Y
Fabaceae	*Acacia huegelii*					Y			
Fabaceae	*Acacia iteaphylla*		Y			Y	Y	Y	Y
Fabaceae	*Acacia lasiocarpa*	Panjang				Y			
Fabaceae	*Acacia longifolia*	Sydney Golden Wattle	Y			Y	Y		
Fabaceae	*Acacia podalyriifolia*	Queensland Silver Wattle	Y			Y			
Fabaceae	*Acacia pulchella*	Prickly Moses				Y			
Fabaceae	*Acacia pulchella* var. *glaberrima*				Y	Y	Y	Y	Y
Fabaceae	*Acacia saligna*	Orange Wattle				Y			
Fabaceae	*Acacia saligna* subsp. *saligna*				Y	Y	Y	Y	Y
Fabaceae	*Acacia stenoptera*	Narrow Winged Wattle			Y	Y	Y	Y	Y
Fabaceae	*Acacia trigonophylla*	Curara				Y		Y	

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Fabaceae	*Acacia wildenowiana*	Grass Wattle				Y	Y		
Fabaceae	*Acacia xanthina*	White-stemmed Wattle					Y		
Fabaceae	*Bossiaea eriocarpa*	Common Brown Pea			Y	Y	Y	Y	Y
Fabaceae	*Chamaecytisus palmensis*	Tagasaste	Y			Y			Y
Fabaceae	*Daviesia decurrens*	Prickly Bitter-pea			Y				
Fabaceae	*Daviesia divaricata*	Marno			Y	Y	Y	Y	Y
Fabaceae	*Daviesia nudiflora*				Y	Y	Y	Y	Y
Fabaceae	*Daviesia triflora*				Y	Y	Y	Y	Y
Fabaceae	*Gastrolobium capitatum* (formerly *Nemcia capitata)*				Y	Y	Y	Y	Y
Fabaceae	*Genista monspessulana*		Y	VH (Swan)		Y			
Fabaceae	*Gompholobium tomentosum*	Hairy Yellow Pea			Y	Y	Y	Y	Y
Fabaceae	*Hardenbergia comptoniana*	Native Wisteria			Y	Y	Y	Y	Y
Fabaceae	*Hovea pungens*	Devil's Pins				Y	Y		

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Fabaceae	*Hovea trisperma* var. *trisperma*					Y			
Fabaceae	*Hovea trisperma*	Common Hovea				Y	Y		Y
Fabaceae	*Isotropis cuneifolia*	Granny Bonnets						Y	Y
Fabaceae	*Isotropis cuneifolia* subsp. *cuneifolia*					Y			Y
Fabaceae	*Jacksonia calcicola*					Y			
Fabaceae	*Jacksonia furcellata*	Grey Stinkwood				Y	Y	Y	Y
Fabaceae	*Jacksonia sericea*	Waldjumi		Priority 4, S	Y	Y	Y	Y	Y
Fabaceae	*Jacksonia sternbergiana*	Stinkwood				Y			Y
Fabaceae	*Kennedia prostrata*	Scarlet Runner			Y	Y	Y	Y	Y
Fabaceae	*Lathyrus tingitanus*	Tangier Pea				Y			
Fabaceae	*Lupinus angustifolius*	Narrowleaf Lupin	Y			Y			
Fabaceae	*Lupinus cosentinii*	Blue Lupin	Y	H (EWSWA)		Y		Y	Y
Fabaceae	*Medicago polymorpha*	Burr Medic	Y			Y			Y

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Fabaceae	*Melilotus indicus*	Yellow Sweet Clover	Y			Y			Y
Fabaceae	*Ornithopus pinnatus*	Slender Serradella	Y			Y		Y	
Fabaceae	*Podalyria sericea*		Y						Y
Fabaceae	*Trifolium arvense*		Y			Y			Y
Fabaceae	*Trifolium campestre*	Hop Clover	Y			Y		Y	Y
Fabaceae	*Trifolium dubium*	Suckling Clover	Y			Y			
Fabaceae	*Trifolium repens*	White Clover	Y			Y			
Fabaceae	*Trifolium subterraneum*	Subterranean Clover	Y					Y	
Fabaceae	*Trifolium tomentosum*	Woolly Clover	Y			Y			
Fabaceae	*Vicia sativa*	Common Vetch	Y			Y			Y
Gentianaceae	*Centaurium erythraea*	Common Centaury	Y			Y			
Gentianaceae	*Cicendia filiformis*	Slender Cicendia	Y			Y			
Geraniaceae	*Erodium botrys*	Long Storksbill	Y			Y		Y	
Geraniaceae	*Erodium cicutarium*	Common Storksbill	Y			Y			
Geraniaceae	*Erodium cygnorum*	Blue Heronsbill	Y					Y	Y
Geraniaceae	*Erodium moschatum*	Musky Crowfoot	Y			Y			

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Geraniaceae	*Pelargonium capitatum*	Rose Pelargonium	Y	H (EWSWA)	Y	Y	Y	Y	Y
Goodeniaceae	*Dampiera linearis*	Common Dampiera			Y	Y	Y	Y	Y
Goodeniaceae	*Scaevola canescens*	Grey Scaevola			Y	Y	Y	Y	Y
Goodeniaceae	*Scaevola crassifolia*								Y
Goodeniaceae	*Scaevola globulifera*						Y		
Goodeniaceae	*Scaevola nitida*	Shining Fanflower				Y			
Goodeniaceae	*Scaevola repens* var. *angustifolia*						Y	Y	Y
Goodeniaceae	*Scaevola repens* var. *repens*					Y			
Gyrostemonaceae	*Tersonia cyathiflora*	Button Creeper				Y		Y	
Haemodoraceae	*Anigozanthos humilis*	Catspaw			Y	Y		Y	Y
Haemodoraceae	*Anigozanthos manglesii*	Mangles Kangaroo Paw			Y	Y	Y	Y	Y
Haemodoraceae	*Conostylis aculeata*	Prickly Conostylis			Y	Y			
Haemodoraceae	*Conostylis aculeata* subsp. *cygnorum*			S			Y	Y	Y

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Haemodoraceae	*Conostylis candicans* subsp. *candicans*				Y	Y			
Haemodoraceae	*Conostylis setigera* subsp. *setigera*	Bristly Cottonhead			Y	Y	Y	Y	Y
Haemodoraceae	*Haemodorum laxum*				Y	Y			
Haemodoraceae	*Haemodorum paniculatum*	Mardja				Y		Y	Y
Haemodoraceae	*Haemodorum spicatum*	Mardja			Y	Y	Y		
Haemodoraceae	*Phlebocarya ciliata*					Y			
Haloragaceae	*Glischrocaryon aureum*	Common Popflower		S		Y			
Hemerocallidaceae	*Agrostocrinum scabrum*	Blue Grass Lily			Y	Y			
Hemerocallidaceae	*Caesia micrantha* (formerly *Caesia parviflora)*	Pale Grass-lily				Y	Y	Y	Y
Hemerocallidaceae	*Corynotheca micrantha*	Sand Lily				Y	Y	Y	Y
Hemerocallidaceae	*Dianella revoluta* var. *revoluta*				Y	Y	Y	Y	Y

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Hemerocallidaceae	*Tricoryne elatior*	Yellow Autumn Lily			Y	Y	Y	Y	Y
Iridaceae	*Freesia alba* x *leichtlinii*	Freesia	Y	VH (Swan)		Y		Y	
Iridaceae	*Gladiolus angustus*	Long Tubed Painted Lady	Y			Y			
Iridaceae	*Gladiolus caryophyllaceus*	Wild Gladiolus	Y		Y	Y	Y	Y	Y
Iridaceae	*Hesperantha falcata*		Y	H (Swan)		Y			
Iridaceae	*Moraea flaccida* (formerly *Homeria flaccida)*	One-leaf Cape Tulip	Y	H (EWSWA), VH (Swan), #		Y	Y	Y	Y
Iridaceae	*Orthrosanthus laxus* var. *laxus*	Morning Iris				Y		Y	Y
Iridaceae	*Patersonia occidentalis*	Purple Flag			Y	Y	Y	Y	Y
Iridaceae	*Romulea flava*		Y			Y			

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Iridaceae	*Romulea rosea*		Y	H (EWSWA)		Y		Y	Y
Iridaceae	*Watsonia meriana* var. *meriana*	Watsonia	Y			Y			Y
Juncaceae	*Luzula meridionalis*	Field Woodrush				Y			
Juncaginaceae	*Triglochin centrocarpa*					Y			
Juncaginaceae	*Triglochin isingiana*							Y	
Lamiaceae	*Hemiandra pungens*	Snakebush				Y			
Lamiaceae	*Lavandula stoechas*	Italian Lavender	Y			Y			
Lamiaceae	*Stachys arvensis*	Staggerweed	Y			Y			
Loranthaceae	*Nuytsia floribunda*	Christmas Tree				Y		Y	Y
Malvaceae	*Malva parviflora*	Marshmallow	Y					Y	
Meliaceae	*Melia azedarach*	White Cedar	Y			Y			
Montiaceae	*Calandrinia granulifera*								Y
Montiaceae	*Calandrinia granulifera*	Pygmy Purslane						Y	
Montiaceae	*Calandrinia* sp.					Y			
Myrtaceae	*Agonis flexuosa*	Peppermint	Y	Planted				Y	

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Myrtaceae	*Eucalyptus caesia*	Caesia	Y	Planted		Y			
Myrtaceae	*Calothamnus quadrifidus*	One-sided Bottlebrush	Y			Y	Y	Y	Y
Myrtaceae	*Calothamnus sanguineus*	Silky-leaved Blood Flower				Y			Y
Myrtaceae	*Calytrix flavescens*	Summer Starflower				Y			Y
Myrtaceae	*Calytrix angulata*	Yellow Starflower			Y	Y			
Myrtaceae	*Calytrix fraseri*	Pink Summer Calytrix				Y			Y
Myrtaceae	*Chamelaucium uncinatum*	Geraldton Wax	Y			Y	Y	Y	
Myrtaceae	*Corymbia calophylla*	Marri			Y	Y	Y		Y
Myrtaceae	*Eremaea asterocarpa*					Y			
Myrtaceae	*Eremaea pauciflora*					Y		Y	Y
Myrtaceae	*Eucalyptus gomphocephala*	Tuart			Y	Y	Y	Y	Y
Myrtaceae	*Eucalyptus marginata* subsp. *marginata*	Jarrah			Y	Y	Y	Y	Y
Myrtaceae	*Hypocalymma robustum*	Swan River Myrtle			Y	Y	Y	Y	Y

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Myrtaceae	*Kunzea glabrescens*								Y
Myrtaceae	*Leptospermum laevigatum*	Coast Teatree	Y	H (EWSWA), VH (Swan)		Y	Y	Y	Y
Myrtaceae	*Melaleuca lanceolata*	Rottnest Teatree	Y	Planted , H (Swan)			Y		
Myrtaceae	*Melaleuca systena (*formerly *Melaleuca acerosa)*					Y			Y
Myrtaceae	*Scholtzia involucrata*	Spiked Scholtzia				Y			
Myrtaceae	*Thryptomene saxicola*	Rock Thryptomene				Y			
Oleaceae	*Olea europaea*	Olive	Y			Y			
Onagraceae	*Oenothera glazioviana*	Evening Primrose	Y			Y			
Onagraceae	*Oenothera* sp.					Y			
Onagraceae	*Oenothera stricta*	Common Evening Primrose	Y			Y			
Orchidaceae	*Caladenia arenicola*					Y		Y	
Orchidaceae	*Caladenia discoidea*	Dancing Orchid				Y			

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Orchidaceae	*Caladenia flava*	Cowslip Orchid				Y		Y	Y
Orchidaceae	*Caladenia latifolia*	Pink Fairy Orchid				Y		Y	
Orchidaceae	*Caladenia longicauda*	Common White Spider Orchid				Y		Y	
Orchidaceae	*Disa bracteata (*formerly *Monodenia bracteata)*		Y			Y			
Orchidaceae	*Diuris magnifica*					Y		Y	Y
Orchidaceae	*Elythranthera brunonis*	Purple Enamel Orchid				Y		Y	Y
Orchidaceae	*Eriochilus dilatatus*	White Bunny Orchid				Y			
Orchidaceae	*Leporella fimbriata*	Hare Orchid				Y			
Orchidaceae	*Leptoceras menziesii*					Y			
Orchidaceae	*Microtis media*	Tall Mignonette Orchid				Y			
Orchidaceae	*Pheladenia deformis (*formerly *Cyanicula deformis)*					Y			
Orchidaceae	*Prasophyllum elatum*	Tall Leek Orchid				Y			

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Orchidaceae	*Pterostylis pyramidalis (*formerly *Pterostylis nana)*	Snail Orchid				Y			
Orchidaceae	*Pterostylis recurva*	Jug Orchid				Y	Y		
Orchidaceae	*Pterostylis sanguinea*					Y		Y	Y
Orchidaceae	*Pyrorchis nigricans*	Red Beaks				Y		Y	Y
Orchidaceae	*Thelymitra ?macrophylla*								Y
Orchidaceae	*Thelymitra crinita*	Blue Lady Orchid				Y			
Orchidaceae	*Thelymitra fuscolutea*	Leopard Orchid				Y			
Orchidaceae	*Thelymitra macrophylla*					Y			
Orchidaceae	*Thelymitra vulgaris*					Y			
Orobanchaceae	*Orobanche minor*	Lesser Broomrape	Y			Y			
Oxalidaceae	*Oxalis incarnata*		Y			Y			
Oxalidaceae	*Oxalis pes-caprae*	Soursob	Y	H (Swan)		Y		Y	
Oxalidaceae	*Oxalis purpurea*	Largeflower Wood Sorrel	Y			Y			Y

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Papaveraceae	*Fumaria capreolata*	Whiteflower Fumitory	Y			Y		Y	Y
Phyllanthaceae	*Phyllanthus calycinus*	False Boronia				Y	Y	Y	Y
Phyllanthaceae	*Poranthera microphylla*	Small Poranthera						Y	Y
Phytolaccaceae	*Phytolacca octandra*	Red Ink Plant	Y			Y			
Pittosporaceae	*Billardiera fraseri* (formerly *Pronaya fraseri)*	Elegant Pronaya				Y			Y
Poaceae	*Aira caryophyllea*	Silvery Hairgrass	Y			Y			
Poaceae	*Aira cupaniana*	Silvery Hairgrass	Y					Y	Y
Poaceae	*Amphipogon turbinatus*					Y		Y	Y
Poaceae	*Austrostipa flavescens*								
Poaceae	*Austrostipa compressa*				Y	Y			Y
Poaceae	*Avena barbata*	Bearded Oat	Y	VH (Swan)		Y		Y	Y
Poaceae	*Briza maxima*	Blowfly Grass	Y		Y	Y	Y	Y	Y
Poaceae	*Briza minor*	Shivery Grass	Y		Y	Y		Y	

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Poaceae	*Bromus diandrus*	Great Brome	Y	H (EWSWA), VH (Swan)				Y	Y
Poaceae	*Bromus hordeaceus*	Soft Brome	Y		Y	Y			
Poaceae	*Bromus madritensis*	Madrid Brome	Y		Y	Y			
Poaceae	*Cenchrus echinatus*	Burrgrass	Y			Y			
Poaceae	*Cenchrus setaceus* (formerly *Pennisetum setaceaum)*	Fountain Grass	Y			Y			
Poaceae	*Cortaderia selloana*	Pampas Grass	Y	H (EWSWA), VH (Swan)		Y			
Poaceae	*Cynodon dactylon*	Couch	Y	VH (Swan)		Y		Y	Y
Poaceae	*Dichelachne crinita*	Longhair Plumegrass				Y			
Poaceae	*Ehrharta calycina*	Perennial Veldt Grass	Y	H (EWSWA), VH (Swan)	Y	Y	Y	Y	Y

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Poaceae	*Ehrharta longiflora*	Annual Veldt Grass	Y			Y		Y	
Poaceae	*Eragrostis curvula*	African Lovegrass	Y	H (EWSWA), VH (Swan)		Y	Y	Y	
Poaceae	*Hordeum leporinum*	Barley Grass	Y	H (Swan)		Y		Y	Y
Poaceae	*Lagurus ovatus*	Hare's Tail Grass	Y	H (EWSWA), VH (Swan)		Y	Y		Y
Poaceae	*Lolium perenne*	Perennial Ryegrass	Y			Y			
Poaceae	*Melinis repens*		Y		Y	Y			
Poaceae	*Microlaena stipoides*	Weeping Grass				Y			
Poaceae	*Pentameris airoides*	False Hairgrass	Y					Y	Y
Poaceae	*Pentameris pallida (*formerly *Pentaschistis thumbergii)*		Y		Y	Y			
Poaceae	*Poa annua*	Winter Grass	Y		Y	Y			
Poaceae	*Poa drummondiana*	Knotted Poa				Y			

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Poaceae	*Poa porphyroclados*				Y	Y			
Poaceae	*Polypogon monspeliensis*	Annual Beardgrass	Y		Y	Y			
Poaceae	*Rytidosperma caespitosum* (formerly *Austrodanthonia caespitosa)*				Y	Y			
Poaceae	*Rytidosperma occidentale*					Y	Y		
Poaceae	*Sporobolus ?indicus*		Y			Y			
Poaceae	*Sporobolus africanus*	Parramatta Grass	Y			Y			
Poaceae	*Stenotaphrum secundatum*	Buffalo Grass	Y	H (Swan)		Y			
Poaceae	*Triticum aestivum*	Wheat	Y			Y			
Poaceae	*Vulpia fasciculata (formerly Vulpia membranacea)*		Y		Y	Y			
Poaceae	*Vulpia myuros*	Rat's Tail Fescue	Y			Y		Y	Y
Polygalaceae	*Comesperma calymega*	Blue-spike Milkwort			Y	Y			

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Polygalaceae	*Polygala myrtifolia*	Myrtleleaf Milkwort	Y	H (Swan)		Y			
Polygonaceae	*Rumex hypogaeus* (formerly *Emex australis)*	Doublegee	Y			Y			
Primulaceae	*Lysimachia arvensis* (formerly *Anagalis arvensis)*	Pimpernel	Y			Y		Y	Y
Proteaceae	*Stirlingia latifolia*	Blueboy			Y	Y	Y	Y	Y
Proteaceae	*Synaphea spinulosa*					Y	Y		
Proteaceae	*Adenanthos cygnorum*	Common Woolly Bush				Y	Y		
Proteaceae	*Adenanthos sericeus*	Woolly Bush				Y			
Proteaceae	*Banksia attenuata*	Slender Banksia			Y	Y	Y	Y	Y
Proteaceae	*Banksia dallanneyi* var. dallanneyi (formerly Dryandra lindleyana)					Y		Y	Y
Proteaceae	*Banksia grandis*	Bull Banksia				Y		Y	Y
Proteaceae	*Banksia menziesii*	Firewood Banksia			Y	Y	Y	Y	Y

Family	Latin Name	Common Name	Introduced	Status	Previously recorded (City of Joondalup 2013)				Recorded ELA (2018)
					City of Wanneroo (1995)	Recorded Brundrett & Clarke (2001, 2004 & 2013)	City of Joondalup Field Assessments (2005 & 2011)	Recorded (ELA 2013)	
Proteaceae	*Banksia prionotes*	Acorn Banksia				Y	Y	Y	
Proteaceae	*Banksia sessilis* (formerly *Dryandra sessilis)*	Parrot Bush							
Proteaceae	*Conospermum stoechadis*	Common Smokebush				Y			Y
Proteaceae	*Conospermum triplinervium*	Tree Smokebush	Y	Planted		Y			
Proteaceae	*Grevillea bipinnatifida*	Fuchsia Grevillea				Y			
Proteaceae	*Grevillea crithmifolia*					Y		Y	Y
Proteaceae	*Grevillea sp.*		Y	Planted					Y
Proteaceae	*Grevillea vestita* subsp. *vestita*				Y	Y	Y	Y	Y
Proteaceae	*Hakea laurina*	Pincushion Hakea				Y			
Proteaceae	*Hakea lissocarpha*	Honey Bush				Y	Y		
Proteaceae	*Hakea petiolaris*	Sea Urchin Hakea				Y			
Proteaceae	*Hakea prostrata*	Harsh Hakea			Y	Y		Y	Y
Proteaceae	*Hakea ruscifolia*	Candle Hakea				Y			Y
Proteaceae	*Hakea trifurcata*	Two-leaf Hakea				Y		Y	Y

Family	Latin Name	Common Name	Introduced	Status	Previously recorded (City of Joondalup 2013)				Recorded ELA (2018)
					City of Wanneroo (1995)	Recorded Brundrett & Clarke (2001, 2004 & 2013)	City of Joondalup Field Assessments (2005 & 2011)	Recorded (ELA 2013)	
Proteaceae	*Hakea ?multilineata*		Y	Planted					Y
Proteaceae	*Hakea petiolaris* subsp. *angusta*								Y
Proteaceae	*Persoonia saccata*	Snottygobble				Y		Y	
Proteaceae	*Petrophile brevifolia*					Y		Y	Y
Proteaceae	*Petrophile linearis*	Pixie Mops			Y	Y	Y	Y	Y
Proteaceae	*Petrophile macrostachya*				Y	Y		Y	Y
Ranunculaceae	*Clematis linearifolia*					Y			
Restionaceae	*Alexgeorgea nitens*				Y	Y	Y	Y	Y
Restionaceae	*Desmocladus asper*							Y	Y
Restionaceae	*Desmocladus flexuosus*				Y	Y	Y	Y	Y
Restionaceae	*Hypolaena exsulca*				Y	Y	Y		Y
Restionaceae	*Lepidobolus preissianus*					Y		Y	
Rhamnaceae	*Spyridium globulosum*	Basket Bush						Y	Y
Rhamnaceae	*Stenanthemum notiale* subsp. *chamelum*					Y	Y		Y

Family	Latin Name	Common Name	Introduced	Status	Previously recorded (City of Joondalup 2013)				Recorded ELA (2018)
					City of Wanneroo (1995)	Recorded Brundrett & Clarke (2001, 2004 & 2013)	City of Joondalup Field Assessments (2005 & 2011)	Recorded (ELA 2013)	
Rubiaceae	*Galium divaricatum*					Y			Y
Rubiaceae	*Opercularia vaginata*	Dog Weed			Y	Y	Y	Y	Y
Rutaceae	*Diplolaena dampieri*	Southern Diplolaena				Y		Y	
Rutaceae	*Philotheca spicata*	Pepper and Salt			Y	Y	Y	Y	Y
Scrophulariaceae	*Dischisma capitatum*	Woolly-headed Dischisma	Y			Y			
Scrophulariaceae	*Phyllopodium cordatum*		Y			Y			
Solanaceae	*Solanum ?linnaeanum*	Apple of Sodom	Y	H (Swan)		Y			
Solanaceae	*Solanum nigrum*	Black Berry Nightshade	Y			Y		Y	Y
Stylidiaceae	*Levenhookia stipitata*	Common Stylewort			Y	Y			
Stylidiaceae	*Stylidium brunonianum*	Pink Fountain Triggerplant			Y	Y		Y	Y
Stylidiaceae	*Stylidium calcaratum*	Book Triggerplant			Y	Y		Y	Y
Stylidiaceae	*Stylidium carnosum*	Fleshy-leaved Triggerplant				Y			
Stylidiaceae	*Stylidium piliferum*	Common Butterfly Triggerplant				Y			

Family	Latin Name	Common Name	Introduced	Status	Previously recorded (City of Joondalup 2013)				Recorded ELA (2018)
					City of Wanneroo (1995)	Recorded Brundrett & Clarke (2001, 2004 & 2013)	City of Joondalup Field Assessments (2005 & 2011)	Recorded (ELA 2013)	
Stylidiaceae	*Stylidium repens*	Matted Triggerplant			Y	Y		Y	Y
Stylidiaceae	*Stylidium schoenoides*	Cow Kicks			Y	Y			
Thymelaeaceae	*Pimelea leucantha*					Y		Y	Y
Thymelaeaceae	*Pimelea sulphurea*	Yellow Banjine			Y	Y	Y	Y	Y
Verbenaceae	*Lantana camara*	Common Lantana	Y	# *		Y			
Violaceae	*Hybanthus calycinus*	Wild Violet				Y		Y	Y
Xanthorrhoeaceae	*Xanthorrhoea preissii*	Grass tree			Y	Y	Y	Y	Y
Zamiaceae	*Macrozamia riedlei*	Zamia			Y	Y	Y	Y	Y
Zygophyllaceae	*Tribulus terrestris*	Caltrop	Y	Pest		Y			

Appendix D Quadrat data

Site name and number	Date	Site type	Observer
ECO_18_01	02/10/18	10 x 10 m	SD & JM
Condition	Disturbances	Fire history (years)	Landscape type
Good	Fire, weeds	1-10	Flat
Soil type	Soil colour	Leaf litter cover (%)	Bare ground cover (%)
Sand	Pale yellow	5	10
Easting		Northing	
387902		6476343	

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Eucalyptus marginata subsp. *marginata*	10-30	U	Tree, palm
Daviesia divaricata	10-30	M	Shrub, cycad, grass-tree, tree-fern
Xanthorrhoea preissii	10-30	M	Shrub, cycad, grass-tree, tree-fern
Hibbertia hypericoides	2-10	M	Shrub, cycad, grass-tree, tree-fern
Petrophile macrostachya	1	M	Shrub, cycad, grass-tree, tree-fern
Banksia dallanneyi var. *dallanneyi*	0.5	M	Shrub, cycad, grass-tree, tree-fern
Daviesia triflora	0.25	M	Shrub, cycad, grass-tree, tree-fern
Daviesia nudiflora	0.1	M	Shrub, cycad, grass-tree, tree-fern
Gompholobium tomentosum	0.1	M	Shrub, cycad, grass-tree, tree-fern
Grevillea vestita subsp. *vestita*	0.1	M	Shrub, cycad, grass-tree, tree-fern

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Petrophile brevifolia	0.1	M	Shrub, cycad, grass-tree, tree-fern
Scaevola canescens	0.1	M	Shrub, cycad, grass-tree, tree-fern
**Ehrharta calycina*	1	G	Other grass
Mesomelaena pseudostygia	0.5	G	Sedge
Lepidosperma striatum	0.1	G	Sedge
Burchardia congesta	0.1	G	Forb
Caesia micrantha	0.1	G	Forb
Conostylis aculeata subsp. cygnorum	0.1	G	Forb
Crassula colorata	0.1	G	Forb
Desmocladus asper	0.1	G	Forb
Diuris magnifica	0.1	G	Forb
**Gladiolus caryophyllaceus*	0.1	G	Forb
Haemodorum paniculatum	0.1	G	Forb
Hybanthus calycinus	0.1	G	Forb
**Hypochaeris glabra*	0.1	G	Forb
Lomandra caespitosa	0.1	G	Forb
**Moraea flaccida*	0.1	G	Forb
**Pelargonium capitatum*	0.1	G	Forb
**Petrorhagia dubia*	0.1	G	Forb
Podolepis gracilis	0.1	G	Forb
**Romulea rosea*	0.1	G	Forb
**Silene gallica*	0.1	G	Forb
Sowerbaea laxiflora	0.1	G	Forb
Trachymene pilosa	0.1	G	Forb
Tricoryne elatior	0.1	G	Forb

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
**Ursinia anthemoides* subsp. *anthemoides*	0.1	G	Forb
**Wahlenbergia capensis*	0.1	G	Forb
Hardenbergia comptoniana	0.1	G	Vine

Site name and number	Date	Site type	Observer
ECO_18_02	02/10/18	10 x 10 m	SD & JM
Condition	Disturbance	Fire history (years)	Landscape type
Very Good	Weeds, fire, tracks	1-10	Gentle slope
Soil type	Soil colour	Leaf litter cover (%)	Bare ground cover (%)
Sand	Pale yellow	10	5
Easting		Northing	
387769		6476473	

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Eucalyptus marginata subsp. *marginata*	10-30	U	Tree, palm
Banksia attenuata	2-10	U	Tree, palm
Banksia menziesii	2-10	U	Tree, palm
Hibbertia hypericoides	10-30	M	Shrub, cycad, grass-tree, tree-fern
Xanthorrhoea preissii	10-30	M	Shrub, cycad, grass-tree, tree-fern
Daviesia divaricata	2-10	M	Shrub, cycad, grass-tree, tree-fern
Gompholobium tomentosum	2-10	M	Shrub, cycad, grass-tree, tree-fern
Hibbertia huegelii	0.1	M	Shrub, cycad, grass-tree, tree-fern
Isotropis cuneifolia	0.1	M	Shrub, cycad, grass-tree, tree-fern
Scaevola canescens	0.1	M	Shrub, cycad, grass-tree, tree-fern
**Ehrharta calycina*	0.1	L	Other grass
**Pentameris airoides*	0.1	L	Other grass

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Lepidosperma striatum	2-10	L	Sedge
Mesomelaena pseudostygia	2-10	L	Sedge
Lepidosperma pubisquameum	0.1	L	Sedge
Schoenus curvifolius	0.1	L	Sedge
Tetraria octandra	0.1	L	Sedge
Anigozanthos humilis	0.1	L	Forb
**Briza maxima*	0.1	L	Forb
Burchardia congesta	0.1	L	Forb
Caesia micrantha	0.1	L	Forb
Conostylis aculeata subsp. *cygnorum*	0.1	L	Forb
Drosera erythrorhiza	0.1	L	Forb
Drosera macrantha	0.1	L	Forb
**Gladiolus caryophyllaceus*	0.1	L	Forb
Haemodorum paniculatum	0.1	L	Forb
**Hypochaeris glabra*	0.1	L	Forb
Lomandra sp. (sterile)	0.1	L	Forb
Opercularia vaginata	0.1	L	Forb
Poranthera microphylla	0.1	L	Forb
Pterostylis sanguinea	0.1	L	Forb
Pyrorchis nigricans	0.1	L	Forb
**Romulea rosea*	0.1	L	Forb
Stylidium calcaratum	0.1	L	Forb
Thysanotus patersonii	0.1	L	Forb
Trachymene pilosa	0.1	L	Forb
**Ursinia anthemoides* subsp. *anthemoides*	0.1	L	Forb

Site name and number	Date	Site type	Observer
ECO_18_03	03/01/18	10 x 10 m	SD & JM
Condition	Disturbance	Fire history (years)	Landscape type
Excellent	Weeds	10-20	Flat
Soil type	Soil colour	Leaf litter cover (%)	Bare ground cover (%)
Sand	Pale yellow	2	2
Easting		Northing	
387994		6477162	

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Banksia menziesii	2-10	U	Tree, palm
Banksia attenuata	2-10	U	Tree, palm
Eucalyptus marginata subsp. *marginata*	1	U	Tree, palm
Xanthorrhoea preissii	10-30	M	Shrub, cycad, grass-tree, tree-fern
Hibbertia hypericoides	2-10	M	Shrub, cycad, grass-tree, tree-fern
Grevillea vestita subsp. *vestita*	2-10	M	Shrub, cycad, grass-tree, tree-fern
Petrophile macrostachya	2-10	M	Shrub, cycad, grass-tree, tree-fern
Daviesia divaricata	0.5	M	Shrub, cycad, grass-tree, tree-fern
**Acacia iteaphylla*	0.1	M	Shrub, cycad, grass-tree, tree-fern
Gastrolobium capitatum	0.1	M	Shrub, cycad, grass-tree, tree-fern
Gompholobium tomentosum	0.1	M	Shrub, cycad, grass-tree, tree-fern

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Hibbertia huegelii	0.1	M	Shrub, cycad, grass-tree, tree-fern
Hovea trisperma	0.1	M	Shrub, cycad, grass-tree, tree-fern
Hypocalymma robustum	0.1	M	Shrub, cycad, grass-tree, tree-fern
Isotropis cuneifolia subsp. *cuneifolia*	0.1	M	Shrub, cycad, grass-tree, tree-fern
Monotaxis grandiflora	0.1	M	Shrub, cycad, grass-tree, tree-fern
Petrophile linearis	0.1	M	Shrub, cycad, grass-tree, tree-fern
Ricinocarpos undulatus	0.1	M	Shrub, cycad, grass-tree, tree-fern
Scaevola canescens	0.1	M	Shrub, cycad, grass-tree, tree-fern
Stirlingia latifolia	0.1	M	Shrub, cycad, grass-tree, tree-fern
**Ehrharta calycina*	1	L	Other grass
Mesomelaena pseudostygia	2-10	L	Sedge
Lepidosperma striatum	0.1	L	Sedge
Tetraria octandra	0.1	L	Sedge
**Aira cupaniana*	0.1	L	Forb
Alexgeorgea nitens	0.1	L	Forb
**Briza maxima*	0.1	L	Forb
Burchardia congesta	0.1	L	Forb
Calandrinia granulifera	0.1	L	Forb
Conostylis aculeata subsp. *cygnorum*	0.1	L	Forb
Conostylis setigera subsp. setigera	0.1	L	Forb
Crassula colorata	0.1	L	Forb

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Desmocladus flexuosus	0.1	L	Forb
Dianella revoluta var. *revoluta*	0.1	L	Forb
Eryngium pinnatifidum	0.1	L	Forb
**Gladiolus caryophyllaceus*	0.1	L	Forb
Haemodorum paniculatum	0.1	L	Forb
**Hypochaeris glabra*	0.1	L	Forb
Lomandra caespitosa	0.1	L	Forb
**Lysimachia arvensis*	0.1	L	Forb
Opercularia vaginata	0.1	L	Forb
Patersonia occidentalis	0.1	L	Forb
Pterostylis sanguinea	0.1	L	Forb
Ptilotus manglesii	0.1	L	Forb
Pyrorchis nigricans	0.1	L	Forb
Quinetia urvillei	0.1	L	Forb
Stylidium calcaratum	0.1	L	Forb
Stylidium repens	0.1	L	Forb
Thysanotus manglesianus	0.1	L	Forb
Trachymene pilosa	0.1	L	Forb
**Ursinia anthemoides* subsp. *anthemoides*	0.1	L	Forb
Waitzia suaveolens	0.1	L	Forb

Site name and number	Date	Site type	Observer
ECO_18_04	03/10/18	10 x 10 m	SD & JM
Condition	Disturbance	Fire history (years)	Landscape type
Excellent	Weeds	10-20	Gentle slope
Soil type	Soil colour	Leaf litter cover (%)	Bare ground cover (%)
Sand	Pale yellow	2	2
Easting		Northing	
387920		6477274	

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Allocasuarina fraseriana	10-30	U	Tree, palm
Banksia attenuata	10-30	U	Tree, palm
Eucalyptus marginata subsp. *marginata*	2-10	U	Tree, palm
Xanthorrhoea preissii	2-10	M	Shrub, cycad, grass-tree, tree-fern
Acacia pulchella var. *glaberrima*	2-10	M	Shrub, cycad, grass-tree, tree-fern
Daviesia nudiflora	1	M	Shrub, cycad, grass-tree, tree-fern
Hibbertia hypericoides	1	M	Shrub, cycad, grass-tree, tree-fern
Petrophile macrostachya	1	M	Shrub, cycad, grass-tree, tree-fern
Daviesia divaricata	0.1	M	Shrub, cycad, grass-tree, tree-fern
Daviesia triflora	0.1	M	Shrub, cycad, grass-tree, tree-fern
Gompholobium tomentosum	0.1	M	Shrub, cycad, grass-tree, tree-fern

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Hibbertia racemosa	0.1	M	Shrub, cycad, grass-tree, tree-fern
Hibbertia racemosa	0.1	M	Shrub, cycad, grass-tree, tree-fern
Isotropis cuneifolia subsp. *cuneifolia*	0.1	M	Shrub, cycad, grass-tree, tree-fern
Kennedia prostrata	0.1	M	Shrub, cycad, grass-tree, tree-fern
Leucopogon propinquus	0.1	M	Shrub, cycad, grass-tree, tree-fern
Pimelea leucantha	0.1	M	Shrub, cycad, grass-tree, tree-fern
Scaevola canescens	0.1	M	Shrub, cycad, grass-tree, tree-fern
Stirlingia latifolia	0.1	M	Shrub, cycad, grass-tree, tree-fern
**Ehrharta calycina*	0.1	L	Other grass
Mesomelaena pseudostygia	1	L	Sedge
Tetraria octandra	0.5	L	Sedge
Lepidosperma pubisquameum	0.1	L	Sedge
Lepidosperma striatum	0.1	L	Sedge
**Briza maxima*	0.1	L	Forb
Burchardia congesta	0.1	L	Forb
Calandrinia granulifera	0.1	L	Forb
Conostylis aculeata subsp. *cygnorum*	0.1	L	Forb
Crassula colorata	0.1	L	Forb
Desmocladus flexuosus	0.1	L	Forb
Diuris magnifica	0.1	L	Forb
Drosera erythrorhiza	0.1	L	Forb
Drosera pallida	0.1	L	Forb
Drosera pallida	0.1	L	Forb

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
**Gladiolus caryophyllaceus*	0.1	L	Forb
**Hypochaeris glabra*	0.1	L	Forb
**Hypochaeris glabra*	0.1	L	Forb
**Moraea flaccida*	0.1	L	Forb
**Petrorhagia dubia*	0.1	L	Forb
Lomandra caespitosa	0.1	L	Forb
Pterostylis sanguinea	0.1	L	Forb
**Romulea rosea*	0.1	L	Forb
**Silene gallica*	0.1	L	Forb
**Sonchus oleraceus*	0.1	L	Forb
Sowerbaea laxiflora	0.1	L	Forb
Trachymene pilosa	0.1	L	Forb
**Trifolium campestre*	0.1	L	Forb
**Ursinia anthemoides* subsp. *anthemoides*	0.1	L	Forb
Waitzia suaveolens	0.1	L	Forb

Site name and number	Date	Site type	Observer
ECO_18_05	03/10/18	10 x 10 m	SD & JM
Condition	Disturbance	Fire history (years)	Landscape type
Very Good	Weeds	10-20	Flat
Soil type	Soil colour	Leaf litter cover (%)	Bare ground cover (%)
Sand	Pale yellow	10	5
Easting		Northing	
388192		6476536	

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Banksia attenuata	10-30	U	Tree, palm
Eucalyptus marginata subsp. *marginata*	2-10	U	Tree, palm
Xanthorrhoea preissii	30-70	M	Shrub, cycad, grass-tree, tree-fern
Daviesia divaricata	2-10	M	Shrub, cycad, grass-tree, tree-fern
Daviesia nudiflora	0.1	M	Shrub, cycad, grass-tree, tree-fern
Daviesia triflora	0.1	M	Shrub, cycad, grass-tree, tree-fern
Gompholobium tomentosum	0.1	M	Shrub, cycad, grass-tree, tree-fern
Hakea prostrata	0.1	M	Shrub, cycad, grass-tree, tree-fern
Hibbertia hypericoides	0.1	M	Shrub, cycad, grass-tree, tree-fern
Petrophile linearis	0.1	M	Shrub, cycad, grass-tree, tree-fern

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Petrophile macrostachya	0.1	M	Shrub, cycad, grass-tree, tree-fern
Stirlingia latifolia	0.1	M	Shrub, cycad, grass-tree, tree-fern
Bossiaea eriocarpa	0.1	G	Other grass
Lepidosperma striatum	1	G	Sedge
Schoenus curvifolius	0.1	G	Sedge
Tetraria octandra	0.1	G	Sedge
**Aira cupaniana*	0.1	G	Forb
**Briza maxima*	0.1	G	Forb
Burchardia congesta	0.1	G	Forb
Caesia micrantha	0.1	G	Forb
Caladenia flava	0.1	G	Forb
Conostylis aculeata subsp. *cygnorum*	0.1	G	Forb
Crassula colorata	0.1	G	Forb
Dasypogon bromeliifolius	0.1	G	Forb
Desmocladus asper	0.1	G	Forb
Drosera pallida	0.1	G	Forb
**Gladiolus caryophyllaceus*	0.1	G	Forb
Haemodorum paniculatum	0.1	G	Forb
**Hypochaeris glabra*	0.1	G	Forb
Patersonia occidentalis	0.1	G	Forb
Pterostylis sanguinea	0.1	G	Forb
Stylidium calcaratum	0.1	G	Forb
Trachymene pilosa	0.1	G	Forb
**Ursinia anthemoides* subsp. *anthemoides*	0.1	G	Forb
Macrozamia riedlei	0.1	G	Fern
Hardenbergia comptoniana	0.1	G	Vine

Site name and number	Date	Site type	Observer
ECO_18_06	03/10/18	10 x 10 m	SD & JM
Condition	Disturbance	Fire history (years)	Landscape type
Good	Weeds, fire	1-10	Flat
Soil type	Soil colour	Leaf litter cover (%)	Bare ground cover (%)
Sand	Pale yellow	15	5
Easting		Northing	
388420		6476524	

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Eucalyptus gomphocephala	0.1	U	Tree, palm
Xanthorrhoea preissii	10-30	M	Shrub, cycad, grass-tree, tree-fern
Acacia cyclops	2-10	M	Shrub, cycad, grass-tree, tree-fern
Petrophile macrostachya	2-10	M	Shrub, cycad, grass-tree, tree-fern
Banksia attenuata	1	M	Shrub, cycad, grass-tree, tree-fern
Banksia menziesii	1	M	Shrub, cycad, grass-tree, tree-fern
Daviesia divaricata	1	M	Shrub, cycad, grass-tree, tree-fern
Gompholobium tomentosum	1	M	Shrub, cycad, grass-tree, tree-fern
Hibbertia hypericoides	1	M	Shrub, cycad, grass-tree, tree-fern
Austrostipa compressa	0.1	M	Shrub, cycad, grass-tree, tree-fern

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Conostephium pendulum	0.1	M	Shrub, cycad, grass-tree, tree-fern
Corynotheca micrantha	0.1	M	Shrub, cycad, grass-tree, tree-fern
Daviesia triflora	0.1	M	Shrub, cycad, grass-tree, tree-fern
Gastrolobium capitatum	0.1	M	Shrub, cycad, grass-tree, tree-fern
Hibbertia racemosa	0.1	M	Shrub, cycad, grass-tree, tree-fern
Hovea trisperma	0.1	M	Shrub, cycad, grass-tree, tree-fern
Hypocalymma robustum	0.1	M	Shrub, cycad, grass-tree, tree-fern
Isotropis cuneifolia subsp. *cuneifolia*	0.1	M	Shrub, cycad, grass-tree, tree-fern
Leucopogon propinquus	0.1	M	Shrub, cycad, grass-tree, tree-fern
Petrophile linearis	0.1	M	Shrub, cycad, grass-tree, tree-fern
Petrophile macrostachya	0.1	M	Shrub, cycad, grass-tree, tree-fern
Scaevola canescens	0.1	M	Shrub, cycad, grass-tree, tree-fern
**Ehrharta calycina*	1	G	Other grass
Amphipogon turbinatus	0.1	G	Other grass
Mesomelaena pseudostygia	0.25	G	Sedge
Lepidosperma squamatum	0.1	G	Sedge
Lepidosperma pubisquameum	0.1	G	Sedge
Patersonia occidentalis	1	G	Forb
Alexgeorgea nitens	0.1	G	Forb
Burchardia congesta	0.1	G	Forb
Caesia micrantha	0.1	G	Forb

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Conostylis aculeata subsp. *cygnorum*	0.1	G	Forb
Desmocladus flexuosus	0.1	G	Forb
Dianella revoluta var. *revoluta*	0.1	G	Forb
Diuris magnifica	0.1	G	Forb
Drosera erythrorhiza	0.1	G	Forb
Drosera pallida	0.1	G	Forb
**Gladiolus caryophyllaceus*	0.1	G	Forb
**Hypochaeris glabra*	0.1	G	Forb
Lomandra caespitosa	0.1	G	Forb
**Lysimachia arvensis*	0.1	G	Forb
**Monoculus monstrosus*	0.1	G	Forb
**Moraea flaccida*	0.1	G	Forb
**Petrorhagia dubia*	0.1	G	Forb
Podotheca gnaphalioides	0.1	G	Forb
Ptilotus manglesii	0.1	G	Forb
**Romulea rosea*	0.1	G	Forb
**Silene gallica*	0.1	G	Forb
**Sonchus oleraceus*	0.1	G	Forb
Sowerbaea laxiflora	0.1	G	Forb
Thysanotus patersonii	0.1	G	Forb
Trachymene pilosa	0.1	G	Forb
**Ursinia anthemoides* subsp. *anthemoides*	0.1	G	Forb
Hardenbergia comptoniana	0.1	G	Vine

Site name and number	Date	Site type	Observer
ECO_18_07	03/10/18	10 x 10 m	SD & JM
Condition	Disturbance	Fire history (years)	Landscape type
Good	Weeds, fire	1-10	Flat
Soil type	Soil colour	Leaf litter cover (%)	Bare ground cover (%)
Sand	White/grey	15	2
Easting		Northing	
388406		6476785	

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Eucalyptus marginata subsp. *marginata*	30-70	U	Tree, palm
Allocasuarina fraseriana	0.1	U	Tree, palm
Xanthorrhoea preissii	10-30	M	Shrub, cycad, grass-tree, tree-fern
Gompholobium tomentosum	1	M	Shrub, cycad, grass-tree, tree-fern
Hibbertia hypericoides	1	M	Shrub, cycad, grass-tree, tree-fern
Banksia attenuata	0.5	M	Shrub, cycad, grass-tree, tree-fern
Daviesia divaricata	0.1	M	Shrub, cycad, grass-tree, tree-fern
Gastrolobium capitatum	0.1	M	Shrub, cycad, grass-tree, tree-fern
Hakea ruscifolia	0.1	M	Shrub, cycad, grass-tree, tree-fern
Kennedia prostrata	0.1	M	Shrub, cycad, grass-tree, tree-fern

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Leucopogon propinquus	0.1	M	Shrub, cycad, grass-tree, tree-fern
Petrophile linearis	0.1	M	Shrub, cycad, grass-tree, tree-fern
**Ehrharta calycina*	0.5	G	Other grass
Mesomelaena pseudostygia	0.5	G	Sedge
Lepidosperma pubisquameum	0.1	G	Sedge
Lepidosperma striatum	0.1	G	Sedge
Tetraria octandra	0.1	G	Sedge
Patersonia occidentalis	2-10	G	Forb
Alexgeorgea nitens	0.1	G	Forb
**Briza maxima*	0.1	G	Forb
Burchardia congesta	0.1	G	Forb
Caesia micrantha	0.1	G	Forb
Conostylis aculeata subsp. *cygnorum*	0.1	G	Forb
Desmocladus flexuosus	0.1	G	Forb
**Gladiolus caryophyllaceus*	0.1	G	Forb
Haemodorum paniculatum	0.1	G	Forb
**Hypochaeris glabra*	0.1	G	Forb
**Moraea flaccida*	0.1	G	Forb
Orthrosanthus laxus var. *laxus*	0.1	G	Forb
Podotheca gnaphalioides	0.1	G	Forb
Pterostylis sanguinea	0.1	G	Forb
Ptilotus manglesii	0.1	G	Forb
**Romulea rosea*	0.1	G	Forb
**Silene gallica*	0.1	G	Forb
Sowerbaea laxiflora	0.1	G	Forb
Trachymene pilosa	0.1	G	Forb

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
**Ursinia anthemoides* subsp. *anthemoides*	0.1	G	Forb
Hardenbergia comptoniana	0.1	G	Vine

Site name and number	Date	Site type	Observer
ECO_18_08	03/10/18	10 x 10 m	SD & JM
Condition	Disturbance	Fire history (years)	Landscape type
Good	Weeds, fire, edge effects	1-10	Gentle slope
Soil type	Soil colour	Leaf litter cover (%)	Bare ground cover (%)
Sand	Grey	1	10
Easting		Northing	
387778		6476179	

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Eucalyptus marginata subsp. *marginata*	10-30	U	Tree, palm
Eucalyptus gomphocephala	1	U	Tree mallee
Xanthorrhoea preissii	2-10	M	Shrub, cycad, grass-tree, tree-fern
Daviesia divaricata	2-10	M	Shrub, cycad, grass-tree, tree-fern
Hibbertia hypericoides	2-10	M	Shrub, cycad, grass-tree, tree-fern
Banksia attenuata	1	M	Shrub, cycad, grass-tree, tree-fern
Grevillea vestita subsp. *vestita*	1	M	Shrub, cycad, grass-tree, tree-fern
Hibbertia racemosa	0.5	M	Shrub, cycad, grass-tree, tree-fern
Macrozamia riedlei	0.25	M	Shrub, cycad, grass-tree, tree-fern
Daviesia nudiflora	0.1	M	Shrub, cycad, grass-tree, tree-fern

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Gompholobium tomentosum	0.1	M	Shrub, cycad, grass-tree, tree-fern
Hypocalymma robustum	0.1	M	Shrub, cycad, grass-tree, tree-fern
Petrophile brevifolia	0.1	M	Shrub, cycad, grass-tree, tree-fern
Petrophile linearis	0.1	M	Shrub, cycad, grass-tree, tree-fern
Scaevola crassifolia	0.1	M	Shrub, cycad, grass-tree, tree-fern
**Ehrharta calycina*	0.1	G	Other grass
Lepidosperma pubisquameum	0.1	G	Sedge
Mesomelaena pseudostygia	0.1	G	Sedge
Tetraria octandra	0.1	G	Sedge
Acanthocarpus preissii	0.25	G	Forb
Conostylis aculeata subsp. *cygnorum*	0.25	G	Forb
**Brassica tournefortii*	0.1	G	Forb
Caesia micrantha	0.1	G	Forb
**Conyza sumatrensis*	0.1	G	Forb
Crassula colorata	0.1	G	Forb
Desmocladus asper	0.1	G	Forb
Dianella revoluta var. *revoluta*	0.1	G	Forb
**Gladiolus caryophyllaceus*	0.1	G	Forb
Haemodorum paniculatum	0.1	G	Forb
**Hypochaeris glabra*	0.1	G	Forb
**Monoculus monstrosus*	0.1	G	Forb
**Moraea flaccida*	0.1	G	Forb
**Pelargonium capitatum*	0.1	G	Forb
**Petrorhagia dubia*	0.1	G	Forb

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Ptilotus polystachyus	0.1	G	Forb
**Romulea rosea*	0.1	G	Forb
**Silene gallica*	0.1	G	Forb
**Sonchus oleraceus*	0.1	G	Forb
Sowerbaea laxiflora	0.1	G	Forb
Trachymene pilosa	0.1	G	Forb
Tricoryne elatior	0.1	G	Forb
**Trifolium campestre*	0.1	G	Forb
**Ursinia anthemoides* subsp. *anthemoides*	0.1	G	Forb
**Wahlenbergia capensis*	0.1	G	Forb
Hardenbergia comptoniana	1	G	Vine

Site name and number	Date	Site type	Observer
ECO_18_09	03/10/18	10 x 10 m	SD & JM
Condition	Disturbance	Fire history (years)	Landscape type
Excellent	Weeds	10-20	Gentle slope
Soil type	Soil colour	Leaf litter cover (%)	Bare ground cover (%)
Sand	Pale yellow	15	2
Easting		Northing	
388002		6477235	

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Allocasuarina fraseriana	10-30	U	Tree, palm
Banksia attenuata	10-30	U	Tree, palm
Banksia menziesii	2-10	U	Tree, palm
Petrophile macrostachya	2-10	M	Shrub, cycad, grass-tree, tree-fern
Xanthorrhoea preissii	2-10	M	Shrub, cycad, grass-tree, tree-fern
Hibbertia hypericoides	2-10	M	Shrub, cycad, grass-tree, tree-fern
Corynotheca micrantha	0.1	M	Shrub, cycad, grass-tree, tree-fern
Daviesia divaricata	0.1	M	Shrub, cycad, grass-tree, tree-fern
Gompholobium tomentosum	0.1	M	Shrub, cycad, grass-tree, tree-fern
Hovea trisperma	0.1	M	Shrub, cycad, grass-tree, tree-fern
Isotropis cuneifolia subsp. *cuneifolia*	0.1	M	Shrub, cycad, grass-tree, tree-fern

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Scaevola canescens	0.1	M	Shrub, cycad, grass-tree, tree-fern
Scaevola repens var. *angustifolia*	0.1	M	Shrub, cycad, grass-tree, tree-fern
Stirlingia latifolia	0.1	M	Shrub, cycad, grass-tree, tree-fern
**Ehrharta calycina*	0.1	G	Other grass
Mesomelaena pseudostygia	2-10	G	Sedge
Lepidosperma pubisquameum	0.1	G	Sedge
Lepidosperma striatum	0.1	G	Sedge
Tetraria octandra	0.1	G	Sedge
**Briza maxima*	0.1	G	Forb
Burchardia congesta	0.1	G	Forb
Conostylis aculeata subsp. *cygnorum*	0.1	G	Forb
Desmocladus flexuosus	0.1	G	Forb
Dianella revoluta var. revoluta	0.1	G	Forb
Drosera erythrorhiza	0.1	G	Forb
**Gladiolus caryophyllaceus*	0.1	G	Forb
Hybanthus calycinus	0.1	G	Forb
**Hypochaeris glabra*	0.1	G	Forb
Lomandra caespitosa	0.1	G	Forb
**Moraea flaccida*	0.1	G	Forb
Opercularia vaginata	0.1	G	Forb
Pterostylis sanguinea	0.1	G	Forb
Ptilotus manglesii	0.1	G	Forb
Quinetia urvillei	0.1	G	Forb
Sowerbaea laxiflora	0.1	G	Forb
Stylidium brunonianum	0.1	G	Forb

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Stylidium repens	0.1	G	Forb
Thysanotus manglesianus	0.1	G	Forb
Trachymene pilosa	0.1	G	Forb
**Ursinia anthemoides* subsp. *anthemoides*	0.1	G	Forb
Waitzia suaveolens	0.1	G	Forb

Site name and number	Date	Site type	Observer
ECO_18_10	03/10/18	10 x 10 m	SD & JM
Condition	Disturbance	Fire history (years)	Landscape type
Excellent	Weeds, fire	1-10	Flat
Soil type	Soil colour	Leaf litter cover (%)	Bare ground cover (%)
Sand	Light yellow	1	0.1
Easting		Northing	
388171		6477303	

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Eucalyptus marginata subsp. *marginata*	30-70	U	Tree, palm
Banksia attenuata	2-10	U	Tree, palm
Banksia menziesii	2-10	U	Tree, palm
Xanthorrhoea preissii	10-30	M	Shrub, cycad, grass-tree, tree-fern
Daviesia divaricata	0.5	M	Shrub, cycad, grass-tree, tree-fern
Acacia cochlearis	0.1	M	Shrub, cycad, grass-tree, tree-fern
Corynotheca micrantha	0.1	M	Shrub, cycad, grass-tree, tree-fern
Daviesia nudiflora	0.1	M	Shrub, cycad, grass-tree, tree-fern
Gompholobium tomentosum	0.1	M	Shrub, cycad, grass-tree, tree-fern
Hibbertia racemosa	0.1	M	Shrub, cycad, grass-tree, tree-fern
Pimelea leucantha	0.1	M	Shrub, cycad, grass-tree, tree-fern

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Scaevola canescens	0.1	M	Shrub, cycad, grass-tree, tree-fern
Scaevola crassifolia	0.1	M	Shrub, cycad, grass-tree, tree-fern
Stirlingia latifolia	0.1	M	Shrub, cycad, grass-tree, tree-fern
**Ehrharta calycina*	0.1	G	Other grass
Tetraria octandra	2-10	G	Sedge
Lepidosperma striatum	0.1	G	Sedge
Mesomelaena pseudostygia	0.1	G	Sedge
Dasypogon bromeliifolius	1	G	Forb
**Briza maxima*	0.1	G	Forb
Burchardia congesta	0.1	G	Forb
Caesia micrantha	0.1	G	Forb
Conostylis aculeata subsp. *cygnorum*	0.1	G	Forb
Dampiera linearis	0.1	G	Forb
Daucus glochidiatus	0.1	G	Forb
Desmocladus asper	0.1	G	Forb
Dianella revoluta var. *revoluta*	0.1	G	Forb
Diuris magnifica	0.1	G	Forb
Eryngium pinnatifidum	0.1	G	Forb
**Gladiolus caryophyllaceus*	0.1	G	Forb
**Hypochaeris glabra*	0.1	G	Forb
Pterostylis sanguinea	0.1	G	Forb
Pyrorchis nigricans	0.1	G	Forb
Thysanotus manglesianus	0.1	G	Forb
Xanthosia huegelii	0.1	G	Forb
Hardenbergia comptoniana	0.1	G	Vine

Site name and number	Date	Site type	Observer
ECO_18_11	03/10/18	10 x 10 m	SD & JM
Condition	**Disturbance**	**Fire history (years)**	**Landscape type**
Very Good	Weeds, edge effects	10-20	Flat
Soil type	**Soil colour**	**Leaf litter cover (%)**	**Bare ground cover (%)**
Sand	Pale yellow	2	2
Easting		**Northing**	
387867		6477138	

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Eucalyptus marginata subsp. *marginata*	10-30	U	Tree, palm
Banksia attenuata	10-30	U	Tree, palm
Allocasuarina fraseriana	2-10	U	Tree, palm
Xanthorrhoea preissii	10-30	M	Shrub, cycad, grass-tree, tree-fern
Hibbertia hypericoides	2-10	M	Shrub, cycad, grass-tree, tree-fern
Gompholobium tomentosum	1	M	Shrub, cycad, grass-tree, tree-fern
Daviesia divaricata	0.5	M	Shrub, cycad, grass-tree, tree-fern
Hibbertia huegelii	0.1	M	Shrub, cycad, grass-tree, tree-fern
Hypocalymma robustum	0.1	M	Shrub, cycad, grass-tree, tree-fern
Isotropis cuneifolia subsp. *cuneifolia*	0.1	M	Shrub, cycad, grass-tree, tree-fern
Monotaxis grandiflora	0.1	M	Shrub, cycad, grass-tree, tree-fern

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Petrophile linearis	0.1	M	Shrub, cycad, grass-tree, tree-fern
Scaevola canescens	0.1	M	Shrub, cycad, grass-tree, tree-fern
Stenanthemum notiale subsp. *chamelum*	0.1	M	Shrub, cycad, grass-tree, tree-fern
Stirlingia latifolia	0.1	M	Shrub, cycad, grass-tree, tree-fern
**Ehrharta calycina*	1	G	Other grass
Mesomelaena pseudostygia	0.5	G	Sedge
Tetraria octandra	0.5	G	Sedge
Lepidosperma pubisquameum	0.1	G	Sedge
Lepidosperma striatum	0.1	G	Sedge
Schoenus curvifolius	0.1	G	Sedge
Anigozanthos manglesii	0.1	G	Forb
**Briza maxima*	0.1	G	Forb
Burchardia congesta	0.1	G	Forb
Conostylis aculeata subsp. *cygnorum*	0.1	G	Forb
Conostylis setigera subsp. *setigera*	0.1	G	Forb
Desmocladus flexuosus	0.1	G	Forb
Drosera erythrorhiza	0.1	G	Forb
**Gladiolus caryophyllaceus*	0.1	G	Forb
**Hypochaeris glabra*	0.1	G	Forb
Lomandra caespitosa	0.1	G	Forb
Orthrosanthus laxus var. *laxus*	0.1	G	Forb
Patersonia occidentalis	0.1	G	Forb
Podotheca gnaphalioides	0.1	G	Forb
Pterostylis sanguinea	0.1	G	Forb

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Ptilotus manglesii	0.1	G	Forb
Pyrorchis nigricans	0.1	G	Forb
**Romulea rosea*	0.1	G	Forb
Sowerbaea laxiflora	0.1	G	Forb
Stylidium calcaratum	0.1	G	Forb
Stylidium repens	0.1	G	Forb
Trachymene pilosa	0.1	G	Forb
**Ursinia anthemoides* subsp. *anthemoides*	0.1	G	Forb
Waitzia suaveolens	0.1	G	Forb

Site name and number	Date	Site type	Observer
ECO_18_12	03/10/18	10 x 10 m	SD & JM
Condition	**Disturbance**	**Fire history (years)**	**Landscape type**
Very Good	Weeds, fire	1-10	Slight rise
Soil type	**Soil colour**	**Leaf litter cover (%)**	**Bare ground cover (%)**
Sand	Pale yellow	3	3
Easting		**Northing**	
388418		6476629	

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Banksia attenuata	2-10	U	Tree, palm
Eucalyptus gomphocephala	2-10	U	Tree, palm
Banksia menziesii	2-10	U	Tree, palm
Xanthorrhoea preissii	10-30	M	Shrub, cycad, grass-tree, tree-fern
Hibbertia hypericoides	2-10	M	Shrub, cycad, grass-tree, tree-fern
Daviesia divaricata	0.5	M	Shrub, cycad, grass-tree, tree-fern
Hakea prostrata	0.25	M	Shrub, cycad, grass-tree, tree-fern
Acacia pulchella var. *glaberrima*	0.1	M	Shrub, cycad, grass-tree, tree-fern
Gompholobium tomentosum	0.1	M	Shrub, cycad, grass-tree, tree-fern
Hibbertia racemosa	0.1	M	Shrub, cycad, grass-tree, tree-fern
Isotropis cuneifolia subsp. *cuneifolia*	0.1	M	Shrub, cycad, grass-tree, tree-fern

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
Leucopogon propinquus	0.1	M	Shrub, cycad, grass-tree, tree-fern
Petrophile macrostachya	0.1	M	Shrub, cycad, grass-tree, tree-fern
Scaevola canescens	0.1	M	Shrub, cycad, grass-tree, tree-fern
**Ehrharta calycina*	0.1	G	Other grass
Mesomelaena pseudostygia	0.1	G	Sedge
Alexgeorgea nitens	0.1	G	Forb
**Briza maxima*	0.1	G	Forb
Burchardia congesta	0.1	G	Forb
Calandrinia granulifera	0.1	G	Forb
Conostylis aculeata subsp. *cygnorum*	0.1	G	Forb
Crassula colorata	0.1	G	Forb
Desmocladus flexuosus	0.1	G	Forb
Erodium cygnorum	0.1	G	Forb
**Gladiolus caryophyllaceus*	0.1	G	Forb
**Hypochaeris glabra*	0.1	G	Forb
Lomandra caespitosa	0.1	G	Forb
**Lysimachia arvensis*	0.1	G	Forb
**Moraea flaccida*	0.1	G	Forb
**Petrorhagia dubia*	0.1	G	Forb
Podotheca gnaphalioides	0.1	G	Forb
**Romulea rosea*	0.1	G	Forb
Sowerbaea laxiflora	0.1	G	Forb
Thysanotus patersonii	0.1	G	Forb
Trachymene pilosa	0.1	G	Forb
**Trifolium campestre*	0.1	G	Forb

Species	Cover (%)	Stratum (U=Upper, M=Middle, G=Ground)	Sub-Stratum
**Ursinia anthemoides* subsp. *anthemoides*	0.1	G	Forb
Hardenbergia comptoniana	0.1	G	Vine

Appendix E Weed mapping


*Acacia iteaphylla (Flinders' Range Wattle)
Legend
Study area
City of Joondalup priority weed species
*Acacia iteaphylla (Flinders' Range Wattle) cover percentage
1 (<5%)
2 (6-75%)
3 (76-100%)
*Acacia iteaphylla (Flinders' Range Wattle) individual
0 50 100 200
Metres
Datum/Projection:
GDA 1994 MGA Zone 50
N
eco logical AUSTRALIA
www.ecoaus.com.au
Prepared by: SM Date: 18/01/2019


*Acacia longifolia (Sydney Golden Wattle)
Legend
Study area
Track
City of Joondalup priority weed species
*Acacia longifolia (Sydney Golden Wattle) cover percentage
1 (<5%)
0 50 100 200
Metres
Datum/Projection:
GDA 1994 MGA Zone 50
N
eco logical AUSTRALIA
www.ecoaus.com.au
Prepared by: SM Date: 13/12/2018


*Acacia trigonophylla
Legend
Study area
Track
City of Joondalup priority weed species
*Acacia trigonophylla cover percentage
1 (<5%)
0 50 100 200
Metres
Datum/Projection:
GDA 1994 MGA Zone 50
N
eco logical AUSTRALIA
www.ecoaus.com.au
Prepared by: SM Date: 13/12/2018


*Cenchrus setaceus (Fountain Grass)
Legend
Study area
City of Joondalup priority weed species
*Cenchrus setaceus (Fountain Grass) cover percentage
1 (<5%)
*Cenchrus setaceus (Fountain Grass) individual
0 50 100 200
Metres
Datum/Projection:
GDA 1994 MGA Zone 50
N
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*Eragrostis curvula (African Lovegrass)
Legend
Study area
City of Joondalup priority weed species
*Eragrostis curvula (African Lovegrass) cover percentage
1 (<5%)
2 (6-75%)
*Eragrostis curvula (African Lovegrass) individual
0 50 100 200
Metres
Datum/Projection:
GDA 1994 MGA Zone 50
N
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*Freesia alba x leichtlinii (Freesia)
Legend
Study area
Track
City of Joondalup priority weed species
*Freesia alba x leichtlinii (Freesia) cover percentage
1 (<5%)
0 50 100 200
Metres
Datum/Projection:
GDA 1994 MGA Zone 50
N
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*Gazania linearis (Gazania)
Legend
Study area
City of Joondalup priority weed species
*Gazania linearis (Gazania) cover percentage
1 (<5%)
2 (6-75%)
*Gazania linearis (Gazania) individual
0 50 100 200
Metres
Datum/Projection:
GDA 1994 MGA Zone 50
N
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*Trachyandra divaricata (Dune Onion Weed)
Legend
Study area
Track
City of Joondalup priority weed species
*Trachyandra divaricata (Dune Onion Weed) cover percentage
1 (<5%)
0 50 100 200
Metres
Datum/Projection:
GDA 1994 MGA Zone 50
N
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*Watsonia ?meriana var. meriana (Watsonia)
Legend
Study area
Track
City of Joondalup priority weed species
*Watsonia ?meriana var. meriana (Watsonia) cover percentage
1 (<5%)
0 50 100 200
Metres
Datum/Projection:
GDA 1994 MGA Zone 50
N
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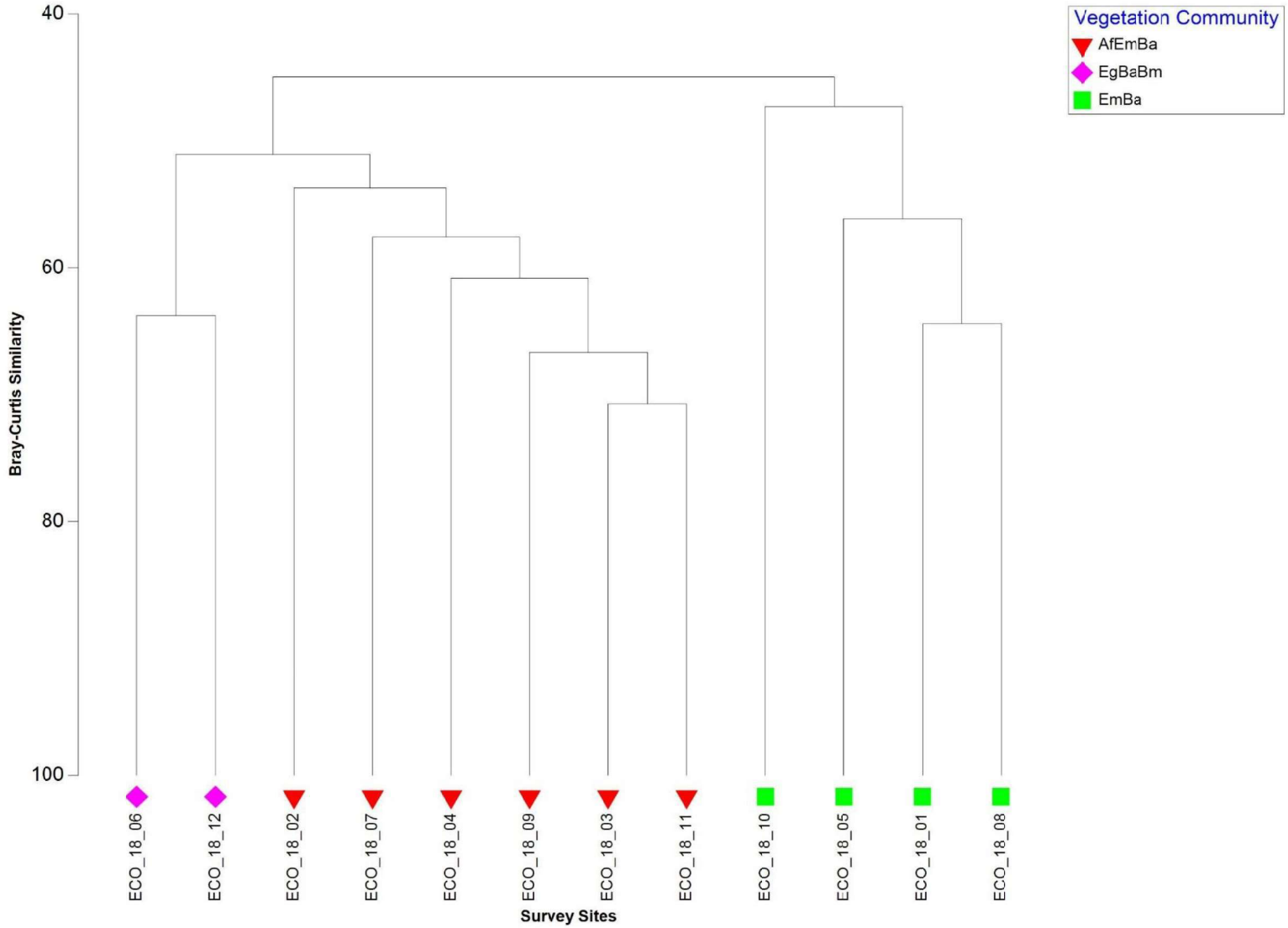
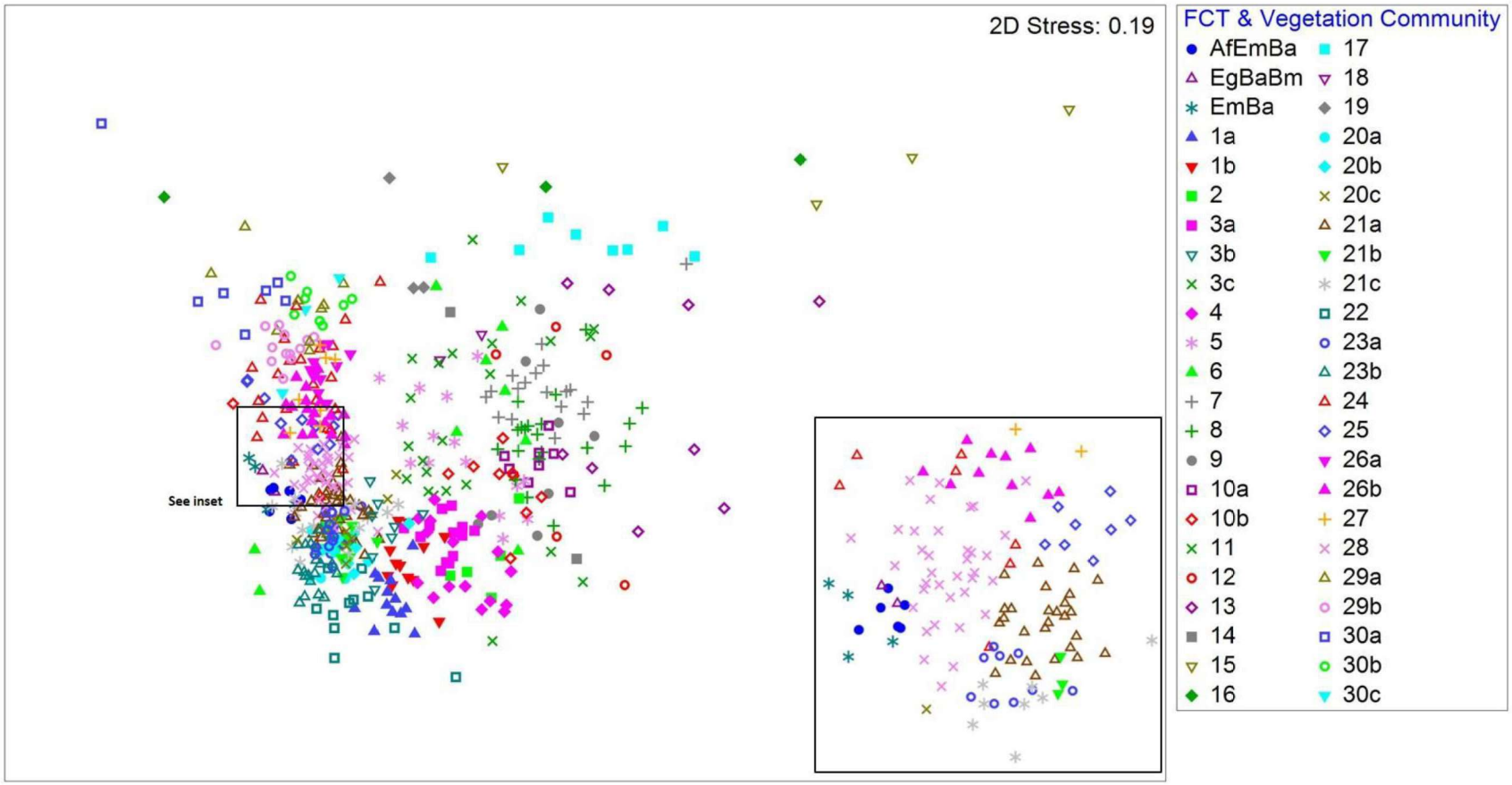
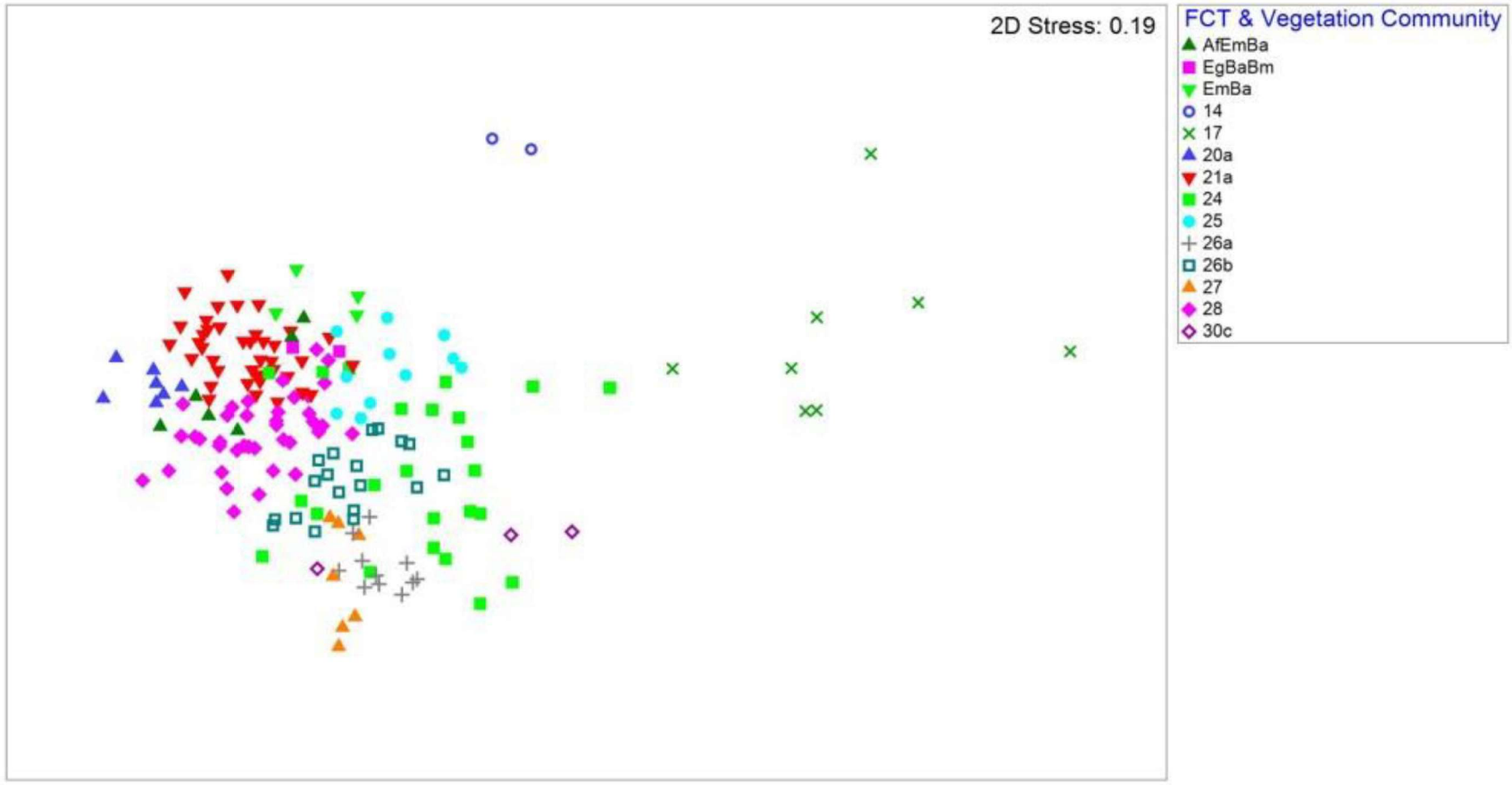
Appendix F Hierarchical clustering dendrogram



Appendix G MDS: Relationships between ELA vegetation communities and Floristic Community Types (FCTs) defined by Gibson et al. (1994)



Appendix H MDS: Relationships between ELA vegetation communities and Spearwood Landform affiliated Floristic Community Types (FCTS) defined by Gibson et al. (1994)



Appendix I Banksia Woodlands TEC assessment

Step	Key diagnostic characteristics	Outcome
1	**Location and physical environment** The Banksia Woodlands ecological community primarily occurs in the Swan Coastal Plain IBRA bioregion	The study area is located on the Swan Coastal Plain
	Soil and landform The *Banksia* Woodlands typically occurs on well drained, low nutrient soils on sandplain landforms, particularly deep Bassendean and Spearwood sands and occasionally on Quindalup sands	The study area is located on the Spearwood Dune system
	Structure The structure of the Banksia Woodlands is a low woodland to forest with these features: • A distinctive upper sclerophyllous layer of low trees* (occasionally large shrubs more than 2 m tall), typically dominated or co-dominated by one or more of the Banksia species identified under composition • Emergent trees of medium or tall (>10 m) height *Eucalyptus* or *Allocasuarina* species may sometimes be present above the Banksia canopy • An often highly species-rich understorey that consists of: ○ A layer of sclerophyllous shrubs of various heights; and, ○ A herbaceous ground layer of cord rushes, sedges and perennial and ephemeral forbs, that sometimes includes grasses. The development of a ground layer may vary depending on the density of the shrub layer and disturbance history.	The three vegetation communities recorded within the study area consist of the following: 1. **EmBa**: Open forest to low open woodland dominated by the key diagnostic species *Banksia attenuata*; 2. **AfEmBa**: Low open forest to low woodland dominated by the key diagnostic species *Banksia attenuata;* and 3. **EgBaBm**: Open forest to low woodland dominated by the key diagnostic species *Banksia attenuata* and *Banksia menziesii*. Each of these vegetation communities have species rich understories that consist of a layer of sclerophyllous shrubs of various heights, and an herbaceous ground layer of cord rushes, sedges and perennial and ephemeral forbs, that sometimes includes grasses. Refer to **Appendix D** for quadrat site data.
	Composition • The canopy is most commonly dominated or co-dominated by *Banksia attenuata* (candlestick banksia, slender banksia) and/or *B. menziesii* (firewood banksia). Other Banksia species that dominate in some examples of the ecological community are *B. prionotes* (acorn banksia) or *B. ilicifolia* (holly-leaved banksia); and • The patch must include at least one of the following diagnostic species:	The canopy is dominated by the key diagnostic species *Banksia attenuata* and *Banksia menziesii*. There is the presence of other co-dominant species including *Eucalyptus marginata* subsp. *marginata*, and *E. gomphocephala*. Other indicator species recorded include *Nuytsia floribunda* and *Allocasuarina*

Step	Key diagnostic characteristics	Outcome
	○ *Banksia attenuata* (candlestick banksia) ○ *Banksia menziesii* (firewood banksia) ○ *Banksia prionotes* (acorn banksia) ○ *Banksia ilicifolia* (holly-leaved banksia). • If present, the emergent tree layer often includes *Corymbia calophylla* (marri), *E. marginata* (jarrah), or less commonly *Eucalyptus gomphocephala* (tuart); and • Other trees of a medium height that may be present, and may be codominant with the Banksia species across a patch, include *Eucalyptus todtiana* (blackbutt, pricklybark), *Nuytsia floribunda* (Western Australian Christmas tree), *Allocasuarina fraseriana* (western sheoak), *Callitris arenaria* (sandplain cypress), *Callitris pyramidalis* (swamp cypress) and *Xylomelum occidentale* (woody pear); and • The understorey typically contains a high to very high diversity of shrub and herb species that often vary from patch to patch*** • Contra-indicators: ○ Patches clearly dominated by *Banksia littoralis* are not part of the Banksia Woodlands ecological community but indicates a different, dampland community is present. ○ Patches clearly dominated by *Banksia burdettii* are not part of the Banksia Woodlands ecological community but indicates a tall shrubland and not the Banksia Woodlands ecological community. ○ FCT 20c – Eastern shrublands and woodlands, corresponds with a separate EPBC ecological community listing, Shrublands and Woodlands of the eastern Swan Coastal Plain. Occurrences of this FCT should be considered under that separate listing.	*fraseriana*. The community has a high diversity of shrubs and herb species with many indicator species recorded. The contra-indicator species *Banksia littoralis* and *Banksia burdettii* were not recorded. None of these communities represent FCT 20c – Eastern shrublands and woodlands.
2	**Condition thresholds** • Assessments of a patch should initially be centered on the area of highest native floristic diversity and/or cover, i.e. the best condition area of the patch.	The community was assessed and sampled in the highest condition representation available in the study area. The survey was completed in spring, which is the most appropriate season to survey on the Swan Coastal Plain. The community has been

Step	Key diagnostic characteristics	Outcome
	• Consideration must be given to the timing of surveys and recent disturbance. Ideally surveys should be undertaken in spring with two sampling periods to capture early and late flowering species. • The surrounding context of a patch must also be taken into account when considering factors that add to the importance of a patch that meets the condition thresholds. • Certain vegetation components of the Banksia Woodlands ecological community merit consideration as critical elements to protect. Three components are recognised as threatened in their own right in WA and, as such, are priorities for protection; refer to Table 1 in the Approved Conservation Advice (TSSC 2016). • A relevant expert (e.g. ecological consultant, local NRM or environment agency) may be useful to help identify the ecological community and its condition.	determined to represent the FCT 28 Spearwood *Banksia attenuata* or *Banksia attenuata* - Eucalyptus woodlands (Gibson et al. 1994). FCT 28 forms part of the Banksia Woodlands ecological community listing (TSSC 2016).
3	**Minimum patch size** Minimum patch sizes apply for consideration of a patch as part of the listed ecological community for EPBC Act referral, assessment and compliance purposes. Where patches meet different levels of condition, different minimum patch sizes apply: • 'Pristine' – no minimum patch size applies • 'Excellent' – 0.5 ha or 5,000 m2 (e.g. 50 m x 100 m) • 'Very Good' – 1 ha or 10,000 m2 (e.g. 100 m x 100 m) • 'Good' – 2 ha or 20,000 m2 (e.g. 200 m x 100 m). Note: To be considered as part of the EPBC Act ecological community, a patch should meet at least the Good Condition category.	The areas of vegetation communities present within the study area are presented in **Table 12**. The **EmBa** community covered a total of 24.46 ha within the study area. This comprised 8.43 ha of Excellent condition, 11.81 ha of Very Good condition, 3.91 ha of Good condition and 0.3 ha of Degraded condition. The **AfEmBa** community covered a total of 26.49 ha within the study area. This comprised 6.47 ha of Excellent condition, 10.29 ha of Very Good condition, 9.63 ha of Good condition and 0.10 ha of Degraded condition. The **EgBaBm** community covered a total of 8.47 ha within the study area. This comprised 0.22 ha of Excellent condition, 3.24 ha of Very Good condition, 3.95 ha of Good condition and 1.05 ha of Degraded condition. Each of these communities meets the minimum patch size requirements for vegetation in Good or greater condition. Areas in Degraded condition are not considered part of the EPBC Act ecological community.

Step	Key diagnostic characteristics	Outcome
4	**Further information to assist in determining the presence of the ecological community and significant impacts** • The landscape position of the patch, including its position relative to surrounding vegetation also influences how important it is in the broader landscape. For example, if it enables movement of native fauna or plant material or supports other ecological processes • A patch is a discrete and mostly continuous area of the ecological community. A patch may include small-scale (<30 m) variations, gaps and disturbances, such as tracks, paths or breaks. Where there is a break in native vegetation cover, from the edge of the tree canopy of 30 m or more (e.g. due to permanent artificial structures, wide roads or other barriers; or due to water bodies typically more than 30m wide) then the gap typically indicates that separate patches are present. • Variation in canopy cover, quality or condition of vegetation across a patch should not initially be considered to be evidence of multiple patches. Patches can be spatially variable and are often characterised by one or more areas within a patch that meet the key diagnostic characteristics and condition threshold criteria amongst areas of lower condition. Average canopy cover and quality across the broadest area that meets the general description of the ecological community should be used initially in determining overall canopy cover and vegetation condition. Also note any areas that are either significantly higher or lower in quality, gaps in canopy cover and the condition categories that would apply across different parts of the site respectively. Where the average canopy cover or quality falls below the minimum thresholds, the next largest area or areas that meet key diagnostics (including minimum canopy cover requirements) and minimum condition thresholds should be specified and protected. This may result in multiple patches being identified within the overall area first considered. • A buffer zone is a contiguous area immediately adjacent to a patch of the ecological community that is important for protecting its integrity. The purpose of the buffer zone is to help protect and manage the national threatened ecological community. The	A total of 57.96 ha of vegetation within the study area was assessed to likely represent the Banksia Woodlands of the Swan Coastal Plain ecological community (TEC), comprising 15.12 ha of Excellent condition, 25.35 ha of Very Good condition and 17.49 ha of Good condition.

Step	Key diagnostic characteristics	Outcome
	edges of a patch are considered particularly susceptible to disturbance and the presence of a buffer zone is intended to act as a barrier to further direct disturbance. • The recommended minimum buffer zone for the ecological community is 20–50 m from the outer edge of a patch, and the appropriate size depends on the nature of the buffer and local context (e.g. slope). A larger buffer zone should be applied, where practical, to protect patches that are of particularly high conservation value, or if patches are down slope of drainage lines or a source of nutrient enrichment, or groundwater drawdown.	

* The term 'woodland' has been chosen as the most typical structure, but the ecological community may also be considered to include examples of shrubland, open woodland or forest under some classification systems. The percentage canopy cover is more than 2% and typically less than 50%. The structure and appearance may also vary due to disturbance history. Similarly, component species of the dominant upper sclerophyllous layer may be variously considered 'tall or large shrubs' or 'small trees'.

** Refers to relevant *Banksia* species typically being amongst the most common plant species in the upper sclerophyllous layer. There may be localised exceptions to this, either as natural variation or due to disturbance history (e.g. fire).

*** Key species in the sclerophyllous shrub layer of the ecological community include members of the families Asteraceae, Dilleniaceae, Ericaceae, Fabaceae, Myrtaceae and Proteaceae. Widespread species include *Adenanthos cygnorum* (woolly bush), *Allocasuarina humilis* (dwarf sheoak), *Bossiaea eriocarpa* (common brown pea), *Conostephium pendulum* (pearl flower), *Daviesia* spp., *Eremaea pauciflora*, *Gompholobium tomentosum* (hairy yellow pea), *Hibbertia hypericoides* (yellow buttercups), *Jacksonia* spp., *Kunzea glabrescens, Petrophile linearis* (pixie mops), *Philotheca spicata* (pepper and salt), *Stirlingia latifolia* (blueboy), *Phlebocarya ciliata, Hypolaena exsulca* and *Xanthorrhoea preissii* (balga). Key species in the herbaceous ground layer include members of the families Cyperaceae, Droseraceae, Haemodoraceae, Orchidaceae, Restionaceae and "lilies" from various families. Widespread species include *Amphipogon turbinatus* (tufted beard grass), *Burchardia congesta* (milkmaids), *Caladenia* spp. (spider orchids), *Dasypogon bromeliifolius* (pineapple bush), *Desmocladus flexuosus, Drosera erythrorhiza* (red ink sun dew), *Lepidosperma squamatum* (a tufted sedge), *Lomandra hermaphrodita, Lyginia barbata* (southern rush), *Lyginia imberbis, Mesomelaena pseudostygia* (semaphore sedge), *Patersonia occidentalis* (purple flag), *Podolepis* spp., *Stylidium brunonianum* (pink fountain trigger plant), *Stylidium piliferum* (common butterfly trigger plant), *Trachymene pilosa* (dwarf parsnip), and *Xanthosia huegelii* (heath xanthosia).

Appendix J Tuart Woodlands TEC assessment

Step	Key diagnostic characteristics	Outcome
1	Occurs in the Swan Coastal Plain Bioregion (Department of the Environment, 2012) within the state of Western Australia	The study area is located on the Swan Coastal Plain
	Primarily occurs on the Spearwood and Quindalup dune systems but can also occur on the Bassendean dunes and Pinjarra Plain. It can occur on the banks of rivers and wetlands. It occurs below the Darling and Whicher escarpments where they define a plateau to the east of the Swan Coastal Plain.	The study area is located on the Spearwood Dune system
	Most often occurs as a woodland but can occur in a variety of structural forms, including closed forest, open forest, woodland, open woodland, closed mallee forest, open mallee forest, mallee woodland and open mallee woodland (Department of the Environment and Heritage, 2003)	The three vegetation communities recorded within the study area consist of the following: 1. **EmBa**: Open forest to low open woodland dominated by the key diagnostic species *Banksia attenuata*; 2. **AfEmBa**: Low open forest to low woodland dominated by the key diagnostic species *Banksia attenuata;* and 3. **EgBaBm**: Open forest to low woodland dominated by the key diagnostic species *Banksia attenuata* and *Banksia menziesii*.
	The dominant canopy species is tuart (*Eucalyptus gomphocephala*), being the most abundant tree species in the canopy. It may occur either as a single stemmed tree or occasionally as a mallee. While other tree species may be present in the canopy, they are less abundant than tuart.	The species *Eucalyptus gomphocephala* occurs only within the **EgBaBm** vegetation community. *E. gomphocephala* occurs in this community as a tree form. There are two occurrences of this vegetation community within the study area (Figure 8), one in the southeast section and one in the southwest section. In the southeast patch, this species does not occur as the most abundant tree species in the canopy, with *Banksia attenuata* and *Banksia menziesii* occurring as the dominant canopy species. Occurrences of Tuart within this patch of this community were sporadic. In the southwest patch, this species does occur as a dominant overstory species.

Step	Key diagnostic characteristics	Outcome
	For a patch of vegetation to be identified as the ecological community, there must be established tuart trees present, meeting the patch definition (see section 0 for more information on defining patches).	Tuart within the study are is considered as established (>15cm DBH).
2	**Other diagnostic considerations** • Other tree species frequently present in the canopy or sub-canopy are: *Agonis flexuosa* (peppermint) and *Banksia grandis* (bull banksia) (both in the southern part of the range); *Banksia attenuata* (candlestick banksia), *Eucalyptus marginata* (jarrah); less commonly, *Corymbia calophylla* (marri). • An understorey of native plants, which may include grasses, herbs and shrubs is typically present. The composition and structure of this understorey varies across the range of the ecological community. Some understorey plant species that are commonly present are listed in section 2.3.2.	The associated species *Banksia attenuata* is present within this vegetation community. Several commonly present understorey occur in this vegetation community, including: *Gompholobium tomentosum*, *Hakea prostrata*, *Hibbertia hypericoides*, *Xanthorrhoea preissii*, *Hardenbergia comptoniana*, *Dianella revoluta*, *Corynotheca micrantha*, *Thysanotus patersonii*, *Crassula colorata*, *Trachymene pilosa*, and *Lepidosperma squamatum*.
3	**Relationship with other ecological communities** The range of the ecological community overlaps and interacts with other ecological communities of the Swan Coastal Plain, including some listed under the EPBC Act. At some locations more than one ecological community may be present. The following considerations apply to the identification of the ecological community where it is likely to overlap with some other listed ecological communities: • Banksia woodlands of the Swan Coastal Plain • Sedgelands in Holocene Dune Swales • Aquatic root mat community of caves of the Swan Coastal Plain	The vegetation community co-occurs with the Banksia woodlands of the Swan Coastal Plain
4	**Condition classes and thresholds** A patch that meets the key diagnostic characteristics for tuart woodlands and forests should be considered part of the nationally protected ecological community if it meets the description of categories • A (Pristine- Excellent) – non-native[a] cover <10%, minimum patch size 0.5 ha; • B (Very Good- Good) – non-native cover <50%, minimum patch size 1 ha; and	The **EgBaBm** community covered a total of 8.47 ha within the study area. This comprised 0.22 ha of Excellent condition, 3.24 ha of Very Good condition, 3.95 ha of Good condition and 1.05 ha of Degraded condition. The southwest patch of this vegetation community that meets the dominant canopy species requirements (Section 1 above) comprises 0.58 ha of Very Good, 0.60 ha of Good condition and

Step	Key diagnostic characteristics	Outcome
	• C (Degraded but retaining important identified habitat, regeneration or landscape features) – non-native cover >50%, minimum patch size 2 ha. Categories A and B suggest a standard for restoration of patches of the ecological community to better condition, as well as helping to identify some of the most valuable areas for conservation. Only patches meeting the description of category D (Degraded or Completely Degraded condition with no identified important habitat, regeneration or landscape features remaining) do not meet the requirements for national protection through the EPBC Act.	0.86 ha of Degraded condition, and therefore does not meet the required condition classes and thresholds for this ecological community.
5	**Further information to assist in determining the presence of the ecological community** • Land use history influences the state of vegetation, while the structural form of the ecological community also affects its species richness and diversity. For example, the frequency and intensity of fire may influence the level of cover or floristic assemblage, such as the relative dominance of Agonis flexuosa (peppermint) in the canopy or subcanopy. The landscape position of the patch, including its position relative to surrounding vegetation also influences how important it is in the broader landscape, for example, if it enables movement of native fauna or plant material or supports other ecological processes. • A patch is a discrete and mostly continuous area of the ecological community. It contains a minimum of three established tuart trees, with no greater than 40m between the outer edges of their canopies. At least two of these trees must be living. The edge of any patch is defined as 20m beyond the outer edge of the canopy of individual tuart trees where the understorey consists of native vegetation, as defined in the condition classes at 2.6 (Figure 1). Following disturbance events that have caused the loss of established trees (for example, fire), the patch is part of the ecological community if there are at least five young tuarts with no more than 40m between the stems of each and tuart is the most abundant of trees species present at the site, regardless of maturity. A patch may include small-scale (<40m) variations, gaps and disturbances, such as roads, paths, breaks, watercourses, or other localised variations in vegetation that do not significantly alter the overall function of the ecological community (Figure 2). Such breaks are still considered to	Vegetation within the study area is isolated from other patches of similar vegetation by >40 m. There are two patches of vegetation within this study area that contain the dominant canopy species *E. gomphocephala*. This species does not occur as a dominant species in the south-eastern patch, and, while it does occur as a dominant in the south-western patch, this patch of vegetation does not meet the required condition class thresholds for this vegetation type to be considered as representing the Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain ecological community.

Step	Key diagnostic characteristics	Outcome
	be part of the patch and are generally included in patch size calculations. Where there is a break in native vegetation cover, from the edge of the tuart tree canopy of 40 m or more (e.g. due to permanent artificial structures, wide roads or other barriers; or due to water bodies more than 40m wide) then the gap typically indicates that separate patches are present. Large gaps (>40m across) are not included in patch size calculations. • A buffer zone is a contiguous area adjacent to a patch that is important for protecting the integrity of the ecological community. As the risk of damage to an ecological community is usually greater where actions occur close to a patch, the purpose of the buffer zone is to minimise this risk by guiding land managers to be aware that the ecological community is nearby and take extra care. For instance, the buffer zone will help protect the root zone of edge trees and other components of the ecological community from spray drift (fertiliser, pesticide or herbicide sprayed in adjacent land), weed invasion, water runoff and other damage. • The recommended minimum buffer zone is 30 m from the outer edge of the patch (the patch boundary being defined as 20m past the canopy of established tuart trees, so the minimum buffer is 50m past the canopy) as this distance accounts for likely influences upon the root zone. A larger buffer zone (e.g. 50m) should be applied, where practical, to protect patches that are of very high conservation value or if patches are located below drainage lines or a source of nutrient enrichment or groundwater drawdown, as tuart trees are considered likely to be vulnerable to rapid change in groundwater conditions	

a Non-native vegetation cover as % of perennial vegetation present in the ground layer or shrub layer

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