



# **Greenbushes Lithium Mine Stanifer Street Intersection Detailed Flora and Vegetation Survey**

**Prepared for Talison Lithium  
12 April 2022**





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# EXECUTIVE SUMMARY

Talison Lithium Pty Ltd (Talison) currently operates a lithium mine at Greenbushes, situated approximately 250 km south of Perth in south-west Western Australia. As part of the current expansion of mining operations at the site, Talison is constructing a new Mine Services Area (MSA). Onshore Environmental Consultants Pty Ltd (Onshore Environmental) was commissioned by Talison to undertake a single season detailed flora and vegetation survey of the Stanifer Street road verge marking the intersection into the MSA, herein referred to as the study area.

The field survey was completed by a Principal Botanist from Onshore Environmental working over one day on the 21<sup>st</sup> of March 2022. A total number of 48 plant taxa (including varieties and subspecies) from 26 families and 35 genera were recorded from the study area. Species representation was greatest among the Fabaceae, Asparagaceae, Ericaceae and Myrtaceae, with the most speciose genus being *Lomandra* (five taxa), followed by *Billardiera*, *Bossiaea*, *Hibbertia* and *Leucopogon* (two taxa each).

None of the plant taxa recorded from the study area were gazetted as Threatened Flora (T) under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) or the Western Australian *Biodiversity Conservation Act (2016)* (BC Act). As well, none of the plant species recorded from the study area are currently listed as Priority flora by the Department of Biodiversity Conservation and Attractions (DBCA), and none represent a range extension from their current known distribution.

A total of nine introduced species were recorded from the study area, of which one taxon was listed as a Declared Plant under the *Biosecurity and Agriculture Management Act (2007)* (BAM Act) and are also considered Weeds of National Significance (WONS):

- *\*Rubus anglocandicans* (Blackberry) - s22(2) (C3 Exempt).

There was one vegetation type described and mapped from the study area. Field assessment confirmed that vegetation was not aligned with any known Threatened Ecological Communities (TECs) or Priority Ecological Communities (PECs) represented within the South West Region. Vegetation within the study area was determined to well represented at the state, bioregional and local government authority levels.

Vegetation condition ranged from good to degraded with the main degrading features related to the close proximity of the study area to Stanifer Street, and associated weed colonisation within the road reserve. The cover provided by introduced species increased at the northern degraded end of the study area which also supports the non-provenance tree species *Eucalyptus resinifera*.

Overall, vegetation within the study area was determined to be of low conservation value.

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# 1.0 INTRODUCTION

## 1.1 Preamble

Talison is a Western Australian mining company with operations based at Greenbushes in the south-west of Western Australia. The Greenbushes Mine is located approximately 250 km south of Perth and 80 km south-east of the port of Bunbury (Figure 1).

The site comprises a number of open cut mining operations for tantalum, tin and spodumene (lithium). An underground tantalum operation has also been developed but is currently under care and maintenance. The Greenbushes pegmatite is the world's largest hard rock tantalum resource and the largest and highest-grade lithium minerals resource in the world. Minerals produced at Talison's Greenbushes Mine can be found in many different applications including mobile phones, computers, surgical implants, electronic devices, glassware, ceramics and batteries.

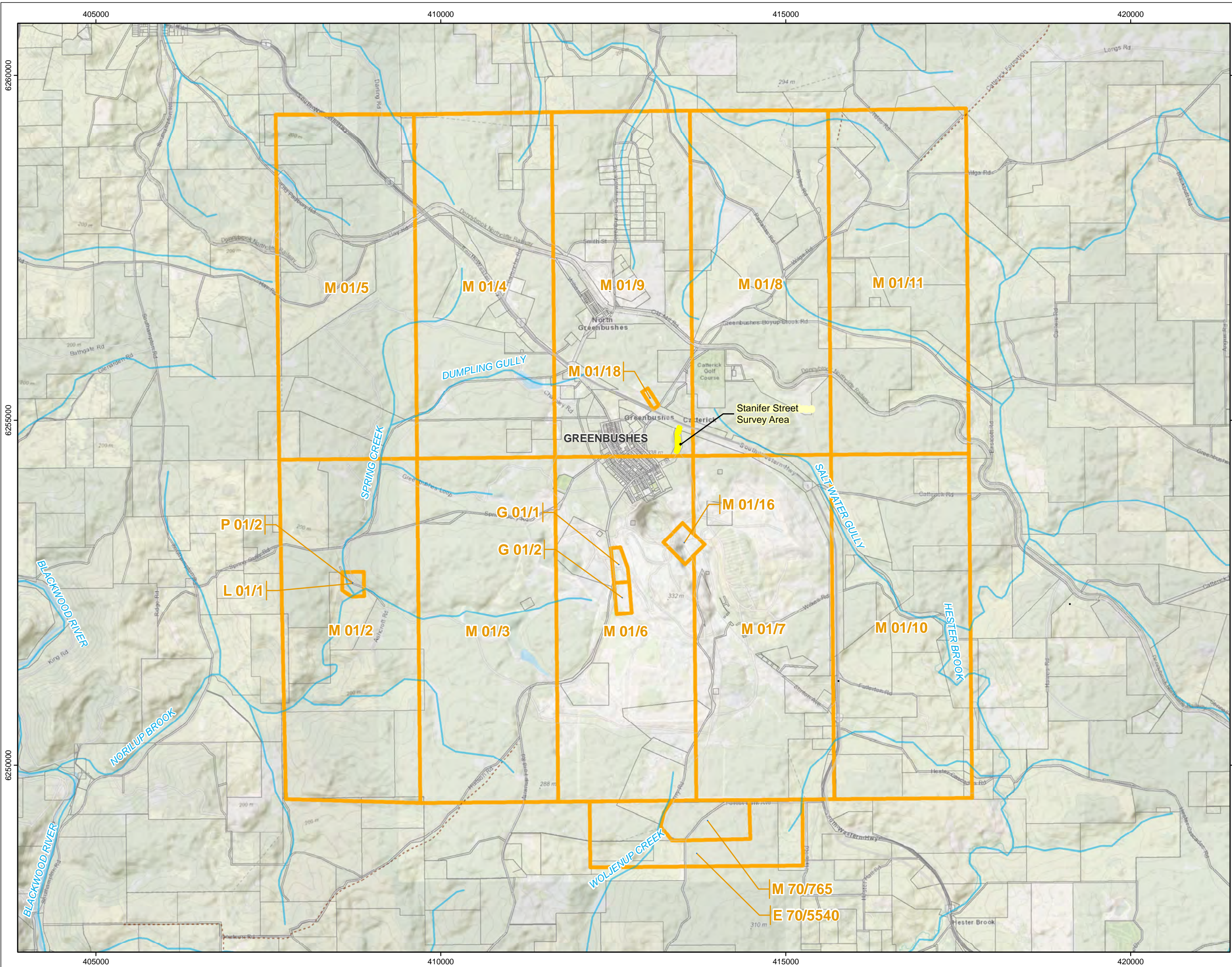
Talison is currently undertaking an expansion of mining activities to increase output from the Greenbushes Mine, which includes constructing a new Mine Services Area (MSA). Access into the MSA requires clearing of native vegetation along the Stanifer Street verge at the intersection of both roads. Associated approvals require a flora and vegetation survey to be completed over a 0.78 hectare (ha) area of the road reserve.

## 1.2 Previous Surveys

There have been nine previous flora and vegetation surveys undertaken within the Greenbushes Mine area. The previous surveys are listed below and described in more detail in Section 3.1.1:

- Trudgen and Morgan (1991) *A Flora and Vegetation Survey of part of the Greenbushes Leases*;
- Onshore Environmental Consultants (2006) *Flora and Vegetation Survey Greenbushes Mine Site: Vegetation surrounding south east corner of the TSF*;
- AECOM Australia Pty Ltd (2010) *Bridgetown RWSS Pipelines Millstream Dam to Greenbushes Link Biological Survey*;
- Onshore Environmental (2012) *Flora and Vegetation Survey Greenbushes Mining Leases*;
- Onshore Environmental (2018) *Greenbushes Mining Operations Detailed Flora and Vegetation Survey*;
- Onshore Environmental Consultants (2019a) *Greenbushes Infrastructure Corridors Detailed Flora and Vegetation Survey*;
- Onshore Environmental Consultants (2019b) *Targeted Flora Survey Greenbushes Lithium Mine*;
- Onshore Environmental Consultants (2020) *Targeted Survey for Eucalyptus relictus Greenbushes Lithium Operations*; and
- Onshore Environmental (2022) *Detailed Flora and Vegetation Survey, Greenbushes Mine Expansion Area 2 and Area 4*.





**TALISON**

**Location of the  
Study Area**

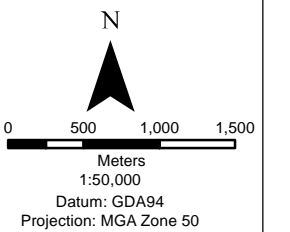
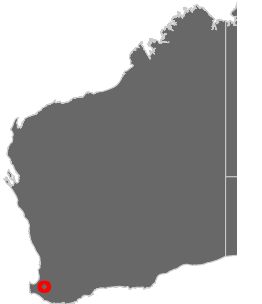
**Figure 1**

**Legend**

Talison Tenements

**Survey Area**

Study Area



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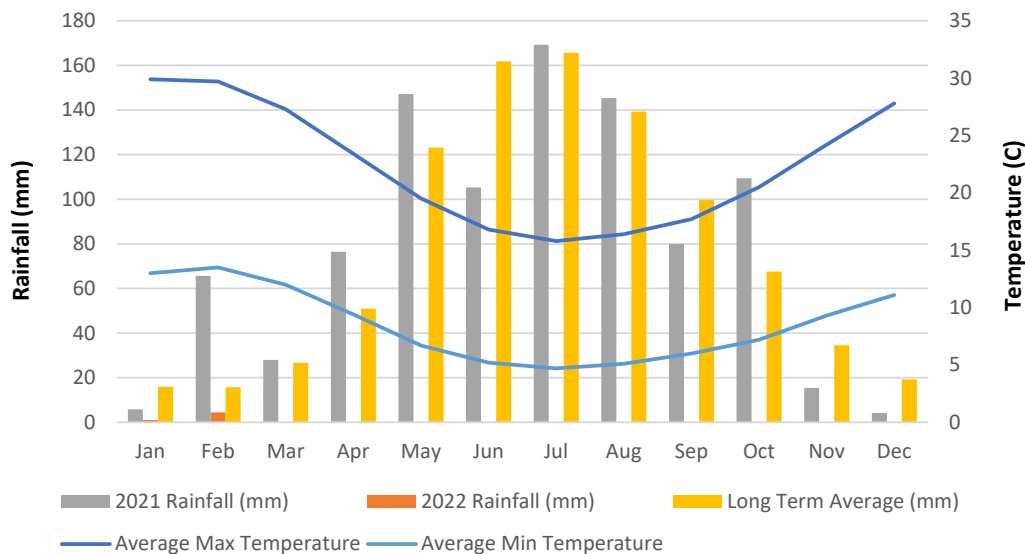




## 1.3 Climate

The study area occurs on a boundary between the dry Mediterranean region to the north which experiences six dry months per year, and the moderate Mediterranean region to the south which experiences four dry months per year (Beard 1981). The Greenbushes region has cool wet winters and hot dry summers. Average annual rainfall for the town of Greenbushes is 923.0 mm (Bureau of Meteorology [BOM] 2022), with the majority of falls occurring during the winter months of June and July associated with cold fronts moving across the south-west of Western Australia.

The annual rainfall for the three-month period prior to the March 2022 field survey was 9.6 mm, compared to 50.8 mm for the long term average (Figure 2). The timing of the field survey was outside of the recommended spring (September to November) period, and preceding summer and autumn rainfall was relatively low. This resulted in poor seasonal conditions at the time of the field survey.



**Figure 2** Climatic data for Greenbushes with monthly rainfall figures for 2021 and January to February 2022 (Bureau of Meteorology 2022).

## 1.4 Biogeographic Regions

The latest version of the Interim Biogeographic Regionalisation for Australia (IBRA7) divides Australia into 89 bioregions based on climate, geology, landform, native vegetation and species information, and includes 419 sub-regions (Department of Environment 2013). The bioregions and sub-regions are the reporting unit for assessing the status of native ecosystems and their level of protection in the National Reserve System.

The study area is located within the Southern Jarrah Forest (JF2) sub-region within the Jarrah Forest bioregion. The Southern Jarrah Forest sub-region is described as, "Duricrusted plateau of Yilgarn Craton characterised by Jarrah-Marri forest on laterite gravels and, in the eastern part, by Marri-Wandoo woodlands on clayey soils. Eluvial and alluvial deposits support Agonis shrublands. In areas of Mesozoic sediments, Jarrah forests occur in a mosaic with a variety of species-rich shrublands. The



climate is Warm Mediterranean" (Hearn *et al.* 2002).

The vegetation of the sub-region is described as "Jarrah - Marri forest in the west grading to Marri and Wandoo woodlands in the east. There are extensive areas of swamp vegetation in the south-east, dominated by Paperbarks and Swamp Yate. The understory component of the forest and woodland reflects the more mesic nature of this area. The majority of the diversity in the communities occurs on the lower slopes or near granite soils where there are rapid changes in site conditions" (Hearn *et al.* 2002).

## 1.5 Land Use

The study area is situated entirely within the Stanifer Street road reserve (Public Road Reserve) within the Shire of Bridgetown-Greenbushes, and immediately adjacent to the existing sealed road forming Stanifer Street. Stanifer Street is one of two formal entry points to access the town of Greenbushes via South Western Highway.

The current and final land use for the project area is 'Road Transport'.

## 1.6 Landforms, Soils

Tille (1996) has mapped soils of the Wellington-Blackwood District, which includes the town sites of Greenbushes and Bridgetown on its southern boundary. The study area occurs within the Hester Sub-system of the Darling Plateau System, and consists of undulating ridges and hill crests formed on laterite and gneiss which typically slope downwards off the main plateau into the surrounding Lowden Valleys System. The soils are mostly loamy gravels, sandy gravels and loamy earths.

The geology of the Greenbushes area is described as Archean granite of the Yilgarn Block (Wilde and Walker 1982) and the major soil types are listed below (Tille 1961):

### Darling Plateau

- Dwellingup Subsystem (DW): Ridge Crests and Divides - broad undulating lateritic divides formed over granite and gneiss. Loamy gravels and sandy gravels are the most common soils with pockets of deep sands; and
- Yarragil Upstream Valleys Phase (YGU): Minor Valleys - 5-20 m deep with gradients of 3-10% on the slopes. The valley floor is broader than downstream. Being shallowly incised these valleys have a higher proportion of gravels and sands derived from laterite.

## 1.7 Flora and Vegetation

The study area occurs in the Menzies Sub-district of the Darling Botanical District, in the South-West Botanical Province (Beard 1981). The Menzies Sub-district (southern jarrah forest) covers a total area of 26,572 km<sup>2</sup>, of which 18,715 km<sup>2</sup> (70%) originally supported jarrah and jarrah-marri forest (Beard 1990). It is estimated that approximately 61% of the total area has been cleared since European settlement, mainly in the valleys which are free of laterite, leaving the forest intact on laterised higher plateau levels.

The Menzies Sub-district is characterised by Jarrah stands on laterite within some Marri and Wandoo woodlands. Valley soils are often richer and Blackbutt (*Eucalyptus patens*) is more dominant in these areas. Flooded Gum (*Eucalyptus rudis*) is common along stream banks and Bullich (*Eucalyptus megacarpa*) is also present in some areas. Within the study area vegetation is dominated by Jarrah (*Eucalyptus marginata*) and Marri (*Corymbia calophylla*) forest over the tall shrubs bull banksia (*Banksia grandis*) and snotty gobble (*Persoonia longifolia*). The lower understorey strata contains a range of plant genera including *Hakea*, *Acacia*, *Xanthorrhoea*, *Adenanthos*, *Hovea*, *Leucopogon*, *Macrozamia*, *Leucopogon*, *Bossiaea*, *Daviesia*, *Grevillea*, *Patersonia*, *Styphelia* and *Kennedia*.

A variety of published studies that relate to flora and vegetation of the southern jarrah forest are listed below:

- Distribution and prehistory of karri, jarrah & marri - Churchill (1968);
- Structure and composition of the karri forest around Pemberton - McArthur and Clifton (1975);
- Vegetation mapping of the Manjimup-Pemberton area - (Smith 1972);
- Vegetation mapping of the Swan area - Beard (1981);
- Vegetation mapping of the Darling System - Heddle *et al.* (1980); and
- Vegetation mapping as part of the Regional Forest Agreement - Mattiske and Havel (1998).

Vegetation complexes of the southern jarrah forest have most recently been defined by Heddle *et al.* (1980) and updated by Mattiske and Havel (1998). Mattiske and Havel (1998) describe vegetation of the survey area as 'mixture of open forest of *Eucalyptus marginata* - *Corymbia calophylla* with some *Eucalyptus patens* on slopes'.



## 2.0 METHODOLOGY

### 2.1 Legislation and Guidance Statements

The detailed flora and vegetation survey followed as closely as practicable the EPA requirements for the environmental surveying and reporting of flora and vegetation in Western Australia:

- Technical Guidance Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016a);
- Environmental Factor Guideline: Flora and Vegetation (EPA 2016b); and
- Statement of Environmental Principles, Factors and Objectives (EPA 2020).

### 2.2 Desktop Assessment

#### 2.2.1 Literature Review

Regional scale reports relevant to the study area locality were reviewed, including:

- a summary of bioregional data (Hearn *et al.* 2002); and
- vegetation description and mapping by Beard (1981), and more recently by Heddle, Loneragan and Havel (1980) and by Mattiske and Havel (1998).

In addition, there was a review of all publicly available literature and internal reports commissioned and held by Talison Lithium. There were nine flora and vegetation surveys previously completed between 1991 and 2022 within close proximity to the study area. As part of the desktop review total flora lists for the nine flora assessments were reviewed to ensure nomenclature was accurate, consistent and current. The previous survey work is summarised in more detail in Section 3.1.1.

#### 2.2.2 Database Searches

Desktop searches included information relating to significant flora, TECs and PECs previously collected or described within, or in close proximity to, the study area. For this report the search was extended beyond the study area to place flora values into a local and regional context. The following databases were searched:

- NatureMap: This database represents the most comprehensive source of information on the distribution of Western Australia's flora, comprising records from the DBCA database and the Western Australian (WA) Herbarium Specimen Database (40 km radial search) (DBCA 2018a);
- DBCA's Threatened and Priority flora database was searched to confirm the NatureMap results (40 km radial search) (DBCA 2018b);
- DBCA's TEC, PEC and Environmentally Sensitive Areas (ESAs) database was searched to identify significant communities (100 km radial search) (DBCA 2018c);
- EPBC Act Protected Matters Database (10 km radial search) (DAWE 2021); and
- International Union for Conservation of Nature (IUCN) database) (IUCN 2021).

### 2.2.3 Assessment of Likelihood of Occurrence in the study area

A list of conservation significant species occurring within a 40 km radius of the study area was compiled during the literature review and database searches. The likelihood of each taxon occurring within the study area was assessed using a set of rankings and criteria (Table 1) based on presence of suitable landform (inferred from aerial imagery with contours overlaid and from knowledge of the adjacent areas) and distance to known records.

**Table 1** Ranking system used to assign the likelihood that a species would occur in the study area.

Rank	Criteria
Recorded	The species has been recorded in the study area.
Likely to occur	The species has previously been recorded from a landform which is present within the study area, and there are previous records within a 20 km radius of the study area.
Possible to occur	The species has previously been recorded from a landform which is present within the study area, and there are previous records within a 40 km radius of the study area.
Unlikely to occur	The landform from which the species has previously been recorded is absent within the study area, and/or there are no previous records within a 40 km radius of the study area.

## 2.3 Field Survey Methodology

### 2.3.1 *Timing and Personnel*

The detailed flora and vegetation survey was completed by Principal Botanist Dr Jerome Bull on the 21<sup>st</sup> of March 2022.

### 2.3.2 *Sampling of Study Sites*

The field survey involved systematic sampling using quadrats (referred to as study sites). The study sites were 10 m by 10 m in dimension which is standard for the Jarrah Forest bioregion. The number of study sites sampled was determined by the size and heterogeneity of the study area, and confirmed by a species accumulation curve. To comply with the EPA guidance statement (2016) a minimum of three study sites were formally assessed within the sole vegetation type mapped within the study area. A total of three quadrats were formally assessed, with additional relevé sites used to confirm vegetation condition boundaries and provide site descriptions for points of interest. The locations of all quadrats sampled are provided in Figure 3.





**TALISON  
LITHIUM**

**Location of study  
sites within the  
study area**

**FIGURE 3**

**Legend**

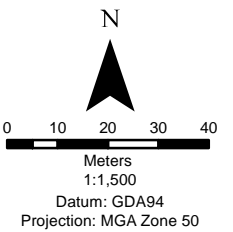
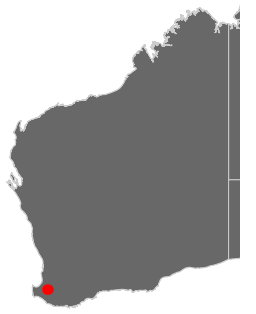
**Study Sites**

Study Site (quadrat)

Talison Tenements

**Study Area**

Study Area



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The study sites were assessed to provide a list of the total flora occurring within the study area and a description of the vegetation structure. Data collected covered a range of environmental parameters including:

- Landform and habitat;
- Aspect;
- Soil colour and soil type;
- Rock type;
- Slope (angle);
- Vegetation condition;
- Disturbance (caused by fire, clearing, grazing etc);
- Age since fire;
- Broad floristic formation;
- Vegetation type description; and
- Height and percentage ground cover provided by individual plant taxa.

Vegetation condition for each of the study sites was determined using a recognised rating scale (based on Keighery 1994, see Appendix 1).

#### *2.3.3 Targeted Surveys for Conservation Significant Species*

Targeted searches for species of conservation significance were completed throughout the study area. Ground truthing provided an opportunity to record opportunistic locations for Threatened and Priority listed flora, and undertake closer examination of specific landforms where conservation significant flora may be expected to occur.

#### *2.3.4 Weed Survey and Mapping*

Introduced species were recorded from the study sites formally assessed within the study area. Opportunistic collections were also made while moving throughout native vegetation remnants within the study area, with targeted weed searches were completed in any high moisture habitats encountered.

#### *2.3.5 Floristic Analysis*

A multivariate statistical analysis of the floristic quadrat data (three quadrats) was completed to assist in understanding the vegetation-habitat relationships within the study area. A two-way classification (Agglomerative Hierarchical Fusion) of the presence/absence quadrat data was carried out on the 48 taxon x 3 quadrat dataset using the program PATN (Belbin, 2003). The flexible UPGMA classification strategy was used ( $\beta = -0.1$ ), together with the Bray-Curtis site similarity measure. The number of groups to be determined was set at two. The primary output of the classification was in the form of a dendrogram and a two-way table of taxa and quadrats (Appendix 2).

#### *2.3.6 Vegetation Type and Condition Mapping*

The classification of vegetation types within the study area follow the height, life form and density classes of Muir (1977) (see Appendix 3). This is largely a structural classification suitable for broader scale mapping, but taking all ecologically significant strata into account. Vegetation types recorded within the study area were grouped according to broad floristic formation. A broad floristic formation describes the



dominant growth form, cover and height as well as the dominant genus for the dominant stratum (Department of Environment and Heritage (DEH) 2003).

Vegetation type mapping utilised high-resolution aerial photography of the entire study area at a scale of 1:4,000, with definition of vegetation polygons based on contrasting shading patterns. Ground-truthing of the study area was completed during the field survey with vegetation descriptions made within selected vegetation polygons to confirm dominant structural layers and associated plant taxa. High resolution aerial photography and associated flora and vegetation data was used to provide vegetation type descriptions, and determine any variation across the study area.

### 2.3.7 Vouchering

Voucher specimens were taken for all taxa where the identification could not be confirmed in the field. Taxonomy was completed by Dr Jerome Bull, and use was made of the Western Australian Herbarium.

### 2.3.8 Field Survey Constraints

The EPA Technical Guidance for Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia (EPA 2016a) list seven potential limitations that field surveys may encounter. These limitations are addressed in Table 2.

**Table 2**      **Relevance of limitations to the flora and vegetation survey, as identified by EPA (2016a).**

Constraint	Relevance
Availability of contextual information at a regional and local scale	There have been nine previous flora and vegetation surveys within close vicinity of the study area, including a previous broadscale assessment of a larger tenement area in spring 2018 (Onshore Environmental 2019a) providing a comprehensive local database.
Proportion of flora recorded and/or collected, any identification issues	There was a high sampling intensity that included assessment of native vegetation occurring within the study area at March 2022. The proportion of flora recorded in March 2022 was likely to represent an underestimate owing to the timing of the field survey (autumn) which was outside the spring period recommended by the EPA (2016a).
Survey timing, rainfall, season of survey	The survey was completed over one day in autumn 2022 and following the period of lowest annual rainfall. Seasonal conditions were rated as poor, with annual and ephemeral flora taxa not anticipated to be present.
Disturbance that may have affected the results of survey such as fire, flood or clearing	The study area formed part of the Stanifer Street verge, the main access road linking the South Western Highway to the town of Greenbushes. Edge effects associated with the road apron were evident, as was the impact of adjacent historical mine rehabilitation, as evidenced by the occurrence of non-provenance plant taxa.
Was the appropriate area fully surveyed (effort and extent)	A Principal Botanist spent one field day covering the 0.78 ha study area. A total of three formal quadrats provided formal assessment of the sole vegetation type represented within the study area. This represents an appropriate effort to survey remnant native vegetation within the study area.

Constraint	Relevance
Access restrictions within the survey area	The study area was accessed on foot, noting that vegetation mapping was facilitated by high-resolution aerial photography (1:4,000). There were no access restrictions encountered.
Competency/experience of the team carrying out the survey, including experience in the bioregion surveyed	The Principal Botanist, Dr Jerome Bull, has 20 years' experience working within the southern jarrah forest, and has worked extensively in state forest surrounding the Greenbushes Mine in recent years.

### 2.3.9 Assessment of Conservation Significance

The conservation significance of flora and ecological communities are classified at a Commonwealth, State and Local level on the basis of various Acts and Agreements, including:

#### International Level:

- IUCN: The IUCN 'Red List' lists species at risk under nine categories (status codes) (Appendix 4).

#### Commonwealth Level:

- EPBC Act: The Department of Agriculture, Water and the Environment (DAWE) lists Threatened flora and ecological communities, which are determined by the Threatened Species Scientific Committee according to criteria set out in the Act. The Act lists flora that are considered to be of conservation significance under one of six categories (Appendix 4).

#### State Level:

- BC Act: At a State level, native flora species are protected under the BC Act - Wildlife Conservation Notice. A number of species are assigned an additional level of conservation significance based on a limited number of known populations and the perceived threats to these locations (Appendix 4); and
- DBCA Priority list: DBCA produces a list of Priority species and ecological communities that have not been assigned statutory protection under the BC Act. Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added under Priorities 1, 2 or 3. Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been removed from the threatened species list for other taxonomic reasons, are placed in Priority 4. These species require regular monitoring (see Appendix 4). The list of PECs identifies those that need further investigation before nomination for TEC status at a State level.

#### Local Level:

- Species may be considered of local conservation significance because of their patterns of distribution and abundance. Although not formally protected by legislation, such species are acknowledged to be in decline as a result of threatening processes, primarily habitat loss through land clearing.

## 3.0 RESULTS

### 3.1 Desktop Review

#### 3.1.1 Previous Flora Surveys

The results from previous flora and vegetation surveys completed within close proximity to the study area are presented in Table 3 and summarised below. The nine surveys have recorded one Threatened Flora taxon and four Priority flora taxa within a 20 km radius of the study area:

- *Caladenia harringtoniae* (Threatened, Vulnerable);
- *Eucalyptus relicta* (Priority 2);
- *Melaleuca viminalis* (Priority 2);
- *Tetradlea parvifolia* (Priority 3); and
- *Acacia semitrullata* (Priority 4).

Two species have been identified as occurring outside of their known distribution (i.e. range extensions):

- *\*Cyperus involucratus* (80 km southeast); and
- *Hybanthus epacroides* (180 km west).

Vegetation types recorded during the previous surveys are not aligned with any Commonwealth or State listed TECs or DBCA listed PECs, and are regarded as well represented and adequately reserved.

The previous surveys have typically recorded a high representation of introduced species within the total flora, reflecting heavy logging and related disturbance of the State Forest precinct around Greenbushes.

**Table 3 Results from flora and vegetation surveys previously completed within, or in close proximity to, the study area.**

Survey	Consultant	Year	Field Survey Date	Flora Statistics	Significant Flora	Introduced (Weed) Taxa
A Flora and Vegetation Survey of Part of the Greenbushes Leases	Trudgen and Morgan	1991	13-14 April 1991	91 plant taxa 35 families 65 genera	None	9 introduced taxa including one Declared Plant listed under the BAM Act; <i>*Rubus anglocandicans</i> (Blackberry)
Flora and Vegetation Survey Greenbushes Mine Site: Vegetation surrounding south east corner of the TSF	Onshore Environmental Consultants	2006	13 <sup>th</sup> April 2006	135 plant taxa 37 families 97 genera	None	27 introduced taxa including one Declared Plant listed under the BAM Act; <i>*Rubus anglocandicans</i> (Blackberry)
Bridgetown RWSS Pipelines Millstream Dam to Greenbushes Link Biological Survey	AECOM Australia Pty Ltd	2010	Spring 2009	86 plant taxa 37 families 70 genera	None	29 introduced taxa including three Declared Plant listed under the BAM Act; <i>*Rubus ulmifolius</i> (Blackberry), <i>*Asparagus asparagoides</i> (Bridal Creeper), <i>*Echium plantagineum</i> (Paterson's Curse)
Flora and Vegetation Survey Greenbushes Mining Leases	Onshore Environmental Consultants	2012	13-21 October 2011	368 plant taxa 73 families 208 genera	<i>Caladenia harringtoniae</i> (T); <i>Tetratheca parvifolia</i> (P3)	86 introduced taxa including three Declared Plants listed under the BAM Act; <i>*Asparagus asparagoides</i> (Bridal Creeper), <i>*Galium aparine</i> (Goosegrass), <i>*Rubus ulmifolius</i> (Blackberry)
Greenbushes Mining Operations Detailed Flora and Vegetation Survey	Onshore Environmental Consultants	2018	27 February - 2 March and 26 September, 4, 16-18 October 2018	365 plant taxa 63 families 200 genera	<i>Acacia semitrullata</i> (P4), <i>*Cyperus involucratus</i> (range extension)	66 introduced taxa, including three Declared Plants listed under the BAM Act; <i>*Asparagus asparagoides</i> (Bridal Creeper), <i>*Rubus anglocandicans</i> (Blackberry) and <i>*Rumex acetosella</i> (Sorrell)



Survey	Consultant	Year	Field Survey Date	Flora Statistics	Significant Flora	Introduced (Weed) Taxa
Greenbushes Infrastructure Corridors Detailed Flora and Vegetation Survey	Onshore Environmental Consultants	2019a	30 July - 6 August and 26-27, 29-30 September, 3-4 and 18 October 2018	280 plant taxa 60 families 157 genera	<i>Acacia semitrullata</i> (P4), <i>Melaleuca viminalis</i> (P2), <i>Hybanthus epacroides</i> (range extension)	45 introduced taxa, including two Declared Plants listed under the BAM Act; <i>*Asparagus asparagoides</i> (Bridal Creeper) and <i>*Rubus anglocandicans</i> (Blackberry)
Targeted Flora Survey Greenbushes Lithium Mine	Onshore Environmental Consultants	2019b	19-20 September and 10 October 2019	Not assessed	<i>Acacia semitrullata</i> (P4)	Not assessed
Targeted Survey for <i>Eucalyptus relict</i> Greenbushes Lithium Operations	Onshore Environmental Consultants	2020	20-24 July and 5-15 August 2020	Not assessed	<i>Eucalyptus relict</i> (P2)	Not assessed
Detailed Flora and Vegetation Survey, Greenbushes Mine Expansion Area 2 and Area 4	Onshore Environmental Consultants	2021	26-31 October 2021	272 plant taxa 60 families 162 genera	None	49 introduced taxa, including one Declared Plant listed under the BAM Act; <i>*Rubus ulmifolius</i> (Blackberry)

### 3.1.2 *Threatened Flora listed under the EPBC Act*

A search of the EPBC Act Protected Matters database was undertaken for a 10 km radius around the study area (DAWE 2021). The search identified three records of Threatened flora potentially occurring within the buffer outside of the study area; *Caladenia hoffmanii* (Endangered), *Caladenia harringtoniae* and *Diuris micrantha* (Vulnerable).

There were no TECs listed from the Commonwealth database occurring within or surrounding the study area.

### 3.1.3 *Threatened Flora listed under the IUCN Red List*

A search of the IUCN database (IUCN 2021) determined that no Threatened Flora taxon was likely to occur within the study area.

### 3.1.4 *Threatened Flora listed under the WA Wildlife Conservation (Rare Flora) Notice*

Three Threatened Flora taxa were identified within a 40 km radius of the study area from the DBCA's rare flora and NatureMap database searches (DBCA 2018a, 2018b); *Caladenia harringtoniae*, *Caladenia christineae* and *Diuris drummondii*. *Caladenia harringtoniae* is the closest population, previously recorded within state forest approximately 5 km west northwest from the western boundary of the study area (Onshore Environmental 2012).

### 3.1.5 *Priority Flora Recognised by the DBCA*

The DBCA rare flora database and NatureMap searches (DBCA 2018a, 2018b) identified 22 Priority flora taxa as potentially occurring within a 40 km radius of the study area (Table 4). None of these taxa were considered *likely* to occur within the study area, however it was considered *possible* that three taxa may *possibly* occur within the study area (as per criteria set out in Table 1) (Table 4).

**Table 4** Priority flora taxa previously recorded within a 50 km radius of the study area (DBCA 2018a), and the likelihood of these taxa occurring within the study area.

Taxon	Cons Code	Habitat Preference	Likelihood in the study area
<i>Acacia parkerae</i>	3	Loam soils.	Unlikely
<i>Acacia tayloriana</i>	4	Grey or yellow/orange sandy soils, lateritic gravel, clay loam.	Possible
<i>Andersonia barbata</i>	2	White sand. Swampy areas.	Unlikely
<i>Aponogeton hexatepalus</i>	4	Freshwater: ponds, rivers, claypans.	Unlikely
<i>Caladenia uliginosa</i> subsp. <i>patulens</i>	1	Clay loam and gravel. Well drained soils amongst dense shrubs.	Unlikely
<i>Carex tereticaulis</i>	3	Black peaty sand.	Unlikely
<i>Chorizema carinatum</i>	3	Sand, sandy clay.	Unlikely
<i>Dampiera heteroptera</i>	3	Sandy soils. Swampy areas.	Unlikely
<i>Dillwynia</i> sp. Capel (P.A. Jurjevich 1771)	1	Littered grey loamy sand, rocky soils. Valleys, rangelands.	Unlikely
<i>Eucalyptus relictia</i>	2	Grey clay-loam. Undulating upper slopes, along creeklines.	Unlikely
<i>Gastrolobium formosum</i>	3	Clay loam. Along river banks or in swamps.	Unlikely
<i>Grevillea bronwenae</i>	3	Grey sand over laterite, lateritic loam. Hillslopes.	Unlikely
<i>Grevilla ripicola</i>	4	Sandy clay, clay or gravelly loam. Swampy flats, granite outcrops, along watercourses.	Unlikely
<i>Melaleuca viminalis</i>	2	Drainage lines and flats.	Unlikely
<i>Pultenaea skinneri</i>	4	Sandy or clayey soils. Winter-wet depressions.	Unlikely
<i>Scaevola ballajupensis</i>	1	Brown sandy gravel, laterite, granite. Outcrops.	Unlikely
<i>Synaphea otlostigma</i>	3	Clayey laterite, gravelly loam, sand.	Possible
<i>Tetralia</i> sp. Blackwood River (A.R. Annels 3043)	3	Loam soil.	Unlikely
<i>Tetralia</i> sp. Nannup (P.A. Jurjevich 1133)	1	Laterite.	Unlikely
<i>Tetralia parvifolia</i>	3	Loam soils.	Possible
<i>Thysanotus formosus</i>	1	Clayey sand, sandy loam. In situations often inundated in winter.	Unlikely
<i>Thysanotus gageoides</i>	3	Sand, clay, granite, sandstone, laterite.	Unlikely

### 3.1.6 *TECs listed under State and Federal legislation*

A search of the EPBC Protected Matters database confirmed there were no Commonwealth listed TECs previously recorded within or adjacent to, the study area. A search of the DBCA ecological community database confirmed there were no State listed TEC records for a 90 km radius around the study area.

### 3.1.7 *PECs recognised by DBCA*

In addition to TECs, DBCA has generated a list of PECs occurring in the South-West Region of Western Australia. The list identifies communities that require further investigation prior to nomination for TEC status. A search of DBCA's ecological community database confirmed there were no PECs known to occur within a 90 km radius of the study area.

### 3.1.8 *Environmentally Sensitive Areas*

There is one Environmentally Sensitive Area (ESA) identified approximately 5 km south-west of the study area, and 560 m northwest from the intersection of Huitson Road and Maranup Ford Road. The ESA incorporates the winter-wet dampland supporting the Threatened *Caladenia harringtoniae* population. This landform / habitat type was not represented within the study area.

## 3.2 Flora Species

A total number of 48 plant taxa (including varieties and subspecies) from 26 families and 35 genera was recorded from the study area (Table 5, Appendix 5). Species representation was greatest among the Fabaceae, Asparagaceae, Ericaceae and Myrtaceae, with the most speciose genus being *Lomandra* (five taxa), followed by *Billardiera*, *Bossiaea*, *Hibbertia* and *Leucopogon* (two taxa each).

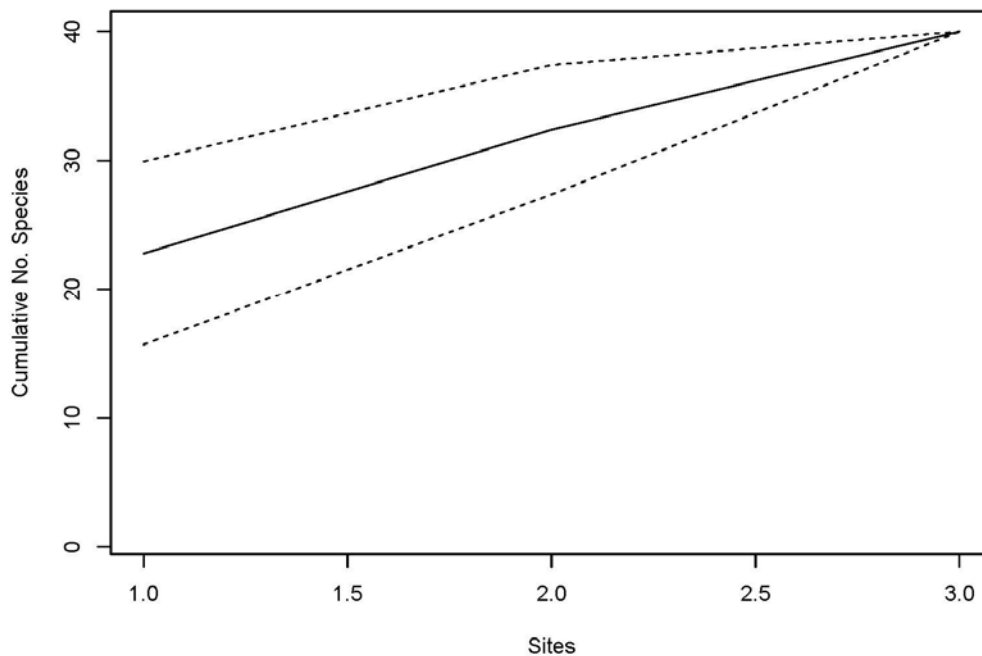
A species by site matrix and raw data for the three study sites is presented in Appendices 6 and 7 respectively. The species accumulation curve demonstrates that the study area was adequately sampled, with the curve reaching an asymptote (Figure 4).

**Table 5 Statistics for total flora recorded from the study area.**

Parameter	No. Taxa
No. Families	26
No. Genera	35
No. Species (incl. subspecies & varieties)	48
No. Native Species (incl. subsp. & var.)	39
No. Threatened Flora	0
No. Priority Flora	0
No. Range Extensions	0
No. Introduced Species	9
<b>Speciose Families</b>	
Fabaceae	9
Asparagaceae	5
Ericaceae	3
Myrtaceae	3



Speciose Genera	
<i>Lomandra</i>	5
<i>Bossiaea</i>	2
<i>Hibbertia</i>	2
<i>Billardiera</i>	2
<i>Leucopogon</i>	2



**Figure 4** Species accumulation curve for the three study sites formally assessed within the study area.

### 3.3 Conservation Significant Flora Species

#### 3.3.1 Threatened Flora listed under the EPBC Act and BC Act

None of the plant taxa recorded from the study area were gazetted as Threatened Flora (T) under the EPBC Act or the BC Act.

#### 3.3.2 Priority Flora

None of the plant taxa recorded from the study area were listed by the DBCA as Priority Flora.

#### 3.3.3 Range Extensions

None of the plant taxa recorded from the study area were identified as occurring outside of their known distribution or range (i.e. range extensions).

## 3.4 Introduced Flora

A total of nine introduced species were recorded from within the study area (Table 6), of which one taxon was listed as Declared Plants under the BAM Act and also considered WONS:

- *\*Rubus ulmifolius* (Blackberry) - s22(2) (C3 Exempt).

The diversity of weeds within the study area was relatively high given the small size of the study area. Weed colonisation was promoted by soil disturbance along the verge of Stanifer Street, combined with the numerous vehicle movements acting as potential vectors.

**Table 6** Introduced species recorded from the study area.

Species	Common Name	Category
<i>*Acacia baileyana</i>	Cootamundra Wattle	Permitted - s11
<i>*Acacia decurrens</i>	Black Wattle	Permitted - s11
<i>*Acacia podalyriifolia</i>	Pearl Acacia	Permitted - s11
<i>*Acacia pycnantha</i>	Golden Wattle	Permitted - s11
<i>*Briza maxima</i>	Blowfly Grass	Permitted - s11
<i>*Cotoneaster glaucophyllus</i>	Grey-leaved Cotoneaster	Permitted - s11
<i>*Eucalyptus resinifera</i>	Red Mahogany	Permitted - s11
<i>*Lavandula stoechas</i>	Italian Lavender	Permitted - s11
<i>*Rubus ulmifolius</i>	Elmleaf Blackberry	Declared Pest - s22(2) Exempt

## 3.5 Vegetation

There was one vegetation type described and mapped from the study area (Figure 5):

- Low Forest A of *Eucalyptus marginata* subsp. *marginata* and *Corymbia calophylla* over Low Scrub B of *Bossiaea linophylla* (*Pteridium esculentum*, *Macrozamia riedlei*) over Open Dwarf Scrub D of *Bossiaea ornata* and *Leucopogon capitellatus* (*Xanthorrhoea gracilis*, *Opercularia hispidula*) on brown sandy loam on lateritic hill slopes.

Raw data for each of the three formal quadrats assessed is provided in Appendix 7.

The vegetation type was not aligned with any Commonwealth or State listed TECs or DBCA listed PECs from the South West Region.

Broad Floristic Formation  
Vegetation Type

*Eucalyptus* Low Forest A

HS Bo - Low Forest A of *Eucalyptus marginata* subsp. *marginata* and *Corymbia calophylla* over Low Scrub B of *Bossiaea linophylla* (*Pteridium esculentum*, *Macrozamia riedlei*) over Open Dwarf Scrub D of *Bossiaea ornata* and *Leucopogon capitellatus* (*Xanthorrhoea gracilis*, *Opercularia hispidula*) on brown sandy loam on lateritic hill slopes



Area Mapped	0.420 ha or 47% of the study area
Quadrats Sampled	SR01, SR02, SR03
Soils	Brown sandy loam
Land Form	Lateritic hill slopes
Priority Ecological Community	No
Conservation Significant Flora	None
Introduced Species	<i>*Acacia baileyana</i> , <i>*Acacia decurrens</i> , <i>*Acacia podalyriifolia</i> , <i>*Acacia pycnantha</i> , <i>*Briza maxima</i> , <i>*Cotoneaster glaucophyllus</i> , <i>*Eucalyptus resinifera</i> , <i>*Lavandula stoechas</i> , <i>*Rubus ulmifolius</i>
Vegetation Condition	Good to Degraded
Disturbances	Road verge, weeds, soil disturbance (historic), rubbish, non-provenance eastern states eucalypt that has volunteered from adjacent mine rehabilitation
Average Fire Age	Old (6+ years)

## 3.6 Vegetation Condition

Vegetation condition was rated as good across the majority of the study area (82%), with condition declining to a rating of degraded at the northern most extent nearest to the South Western Highway and adjacent powerline corridor (Table 7, Figure 6). The main degrading features within the study area related to the close proximity of the study area to Stanifer Street, and weed colonisation promoted within the road reserve. At the northern end of the study area canopy vegetation included the non-provenance tree species *Eucalyptus resinifera*, which had volunteered from adjacent historical mine rehabilitation.

**Table 7 Area of vegetation condition classes within the study area.**

Vegetation Condition	Area (ha)	% of Study Area
Good	0.64	82.1
Degraded	0.14	17.9
Total	0.78	100.0




# TALISON LITHIUM

**FIGURE 5**  
Vegetation Type Map  
Stanifer Street  
Intersection




## Legend

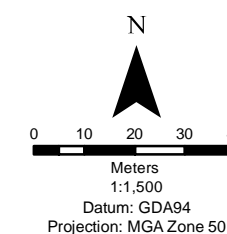
 Talison Tenements

## Study Area

 Stanifer Street

## Vegetation Type

 Hs Bo Low Forest A of *Eucalyptus marginata* subsp. *marginata* and *Corymbia calophylla* over Low Scrub B of *Bossiaea linophylla* (*Pteridium esculentum*, *Macrozamia riedlei*) over Open Dwarf Scrub D of *Bossiaea ornata* and *Leucopogon capitellatus* (*Xanthorrhoea gracilis*, *Opercularia hispidula*) on brown sandy loam on lateritic hill slopes



Date: 11/04/2022  
Status: Draft  
Figure: 5  
Sheet Size: A3  
Internal Reference: TAL\_MSA\_VegTyp\_2022  
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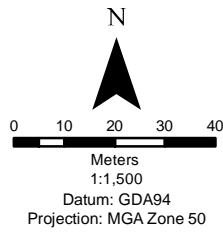
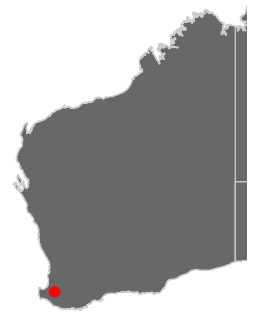


# TALISON LITHIUM

**FIGURE 6**  
**Vegetation Condition Map**  
**Stanifer Street**

## Legend

-  Talison Tenements
- Study Area**
-  Stanifer Street
- Vegetation Condition**
-  Degraded
-  Good



Date: 11/04/2022  
Status: Draft  
Figure: 6  
Sheet Size: A3  
Internal Reference: TAL\_MSA\_VegCon\_2022  
Drawn by: GSM  
Requested by: DB





## 3.7 Vegetation Significance

### 3.7.1 *Beard (1981) Vegetation Associations*

Regional vegetation mapping completed by Beard (1981) was utilised to assess representation of vegetation within the study area. A single Beard vegetation association was represented within the study area; 3 Medium forest; jarrah-marri (Table 8, Figure 7). In terms of representation, the Western Australian Government is committed to the National Objectives Targets for Biodiversity Conservation which includes a target that prevents clearance of ecological communities with an extent below 30% of that present at pre-European settlement (Department of Natural Resources and Environment 2002, EPA 2000). When considering representation at the State level, Beard vegetation association 3 currently has 67.76% of the pre-European extent remaining (Table 8, Government of Western Australia 2018). The study area is located within the Jarrah Forest Bioregion, specifically within the Southern Jarrah Forest Subregion (as discussed in Section 1.3). When considering the representation of vegetation association 3 at the IBRA regional and sub-regional levels, 67.10% and 59.40% of the pre-European extent remains respectively (Table 8). The study area falls entirely within the Shire of Bridgetown-Greenbushes. At this local level 56.35% of the pre-European extent remains for vegetation association 3 (Table 8). Vegetation within the study area is therefore determined to be well represented at all levels (state-wide, bioregional [IBRA region and IBRA sub-region] and local government authority).

In terms of reservation, there is a benchmark for a minimum of 15% of each Beard (1981) vegetation association to be protected in Class I-IV reserves (Commonwealth of Australia 1997). The proportion of the current extent of vegetation association 3 occurring within Class I-IV reserves at a state-wide, bioregional and local government authority level ranges between 23.44% and 31.13%, noting that larger proportions (ranging from 78.50% to 86.77%) occur within DBCA managed lands (Table 8). Hence the reservation status is determined to be above the minimum benchmark confirming adequate reservation for vegetation association 3.

### 3.7.2 *Mattiske and Havel (1998) Vegetation Complexes*

The pre-1750 distribution of vegetation complexes of the South West Forest Region of Western Australia has been mapped at 1:50,000 scale by Mattiske and Havel (1998) as part of the biodiversity assessment for the comprehensive regional assessment for the South West Forest Region. Interrogation of this database confirmed there was one vegetation complex intersecting the study area:

- D1 (Dwellingup) - Open forest of *Eucalyptus marginata* subsp. *marginata*-*Corymbia calophylla* on lateritic uplands in mainly humid and subhumid zones.

The vegetation complex currently has 86.83% of the pre-European extent remaining within the South West Forest Region, 8.35% of the current extent within Class I-IV conservation reserves, and 82.29% of the current extent within DBCA managed lands (Table 8).



**Table 8 Pre-European and current extent of vegetation represented within the study area (Government of Western Australia 2018).**

Vegetation System / Association	Pre-European Extent (ha)	Current Extent (ha)	% Pre-European Extent Remaining	Current Extent in Class I-IV Reserves (ha)	% Current Extent in Class I-IV Reserves	Current Extent DBCA Managed Lands (ha)	% Current Extent DBCA Managed Lands
<b>State-wide</b>							
3 Medium forest; jarrah-marri	2,661,404.62	1,803,437.48	67.76	485,223.00	26.91	1,469,765.60	81.50
<b>IBRA Region</b>							
JAF - Jarrah Forest	2,390,591.54	1,604,101.56	67.10	385,183.08	24.01	1,299,263.74	81.00
<b>IBRA Sub-Region</b>							
JAF02 - Southern Jarrah Forest	1,482,491.85	880,655.65	59.40	274,167.05	31.13	691,319.44	78.50
<b>Local Government Authority</b>							
Shire of Bridgetown-Greenbushes	121,152.70	68,275.41	56.35	16,006.81	23.44	59,243.12	86.77
<b>Mattiske &amp; Havel Complexes</b>							
Dwellingup Complex D1	208,490.90	181,038.81	86.83	17,407.23	8.35	171,561.01	82.29







## 3.8 Vegetation Significance

### 3.8.1 *Commonwealth Level*

The vegetation type recorded from the study area did not support Threatened Flora listed under the EPBC Act, nor was it aligned with any Commonwealth listed TECs. Therefore, vegetation within the study area was not considered to be of national significance.

### 3.8.2 *State Level*

The vegetation type recorded from the study area did not support Threatened Flora listed under the BC Act, nor was it aligned with any state listed TECs or PECs. Furthermore, there were no Priority flora taxa listed by DBCA recorded from the study area. Hence, vegetation within the study area was not considered to be of state significance.

### 3.8.3 *Local Level*

None of the plant taxa recorded from within the study area were determined to occur outside their known distribution, i.e. range extensions, and potentially represent new plant taxa. Therefore, vegetation was not determined to be of local conservation significance.



## 4.0 SUMMARY

Onshore Environmental completed a detailed flora and vegetation survey of the Stanifer Street road verge marking the intersection into Talison Lithium's new MSA. The field survey was completed by a Principal Botanist working over one day in mid March 2022.

A total number of 48 plant taxa (including varieties and subspecies) from 26 families and 35 genera were recorded from the study area. Species representation was greatest among the Fabaceae, Asparagaceae, Ericaceae and Myrtaceae, with the most speciose genus being *Lomandra* (five taxa), followed by *Billardiera*, *Bossiaea*, *Hibbertia* and *Leucopogon* (two taxa each).

None of the plant taxa recorded from the study area were gazetted as Threatened Flora (T) under the Commonwealth EPBC Act or the Western Australian BC Act. As well, none of the plant species were currently listed as Priority flora by the DBCA, and none represented a range extension from their current known distribution.

A total of nine introduced species were recorded from the study area, of which *\*Rubus ulmifolius* (Blackberry) was listed as a Declared Plant under the BAM Act and was also considered a WONS.

One vegetation type was described and mapped from the study area. Field assessment confirmed that vegetation was not aligned with any known TECs or PECs represented within the South West Region. Vegetation was determined to generally be well represented at the state, bioregional and local government authority levels.

Vegetation condition ranged from good to degraded with the main degrading features related to the close proximity of the study area to Stanifer Street, and associated weed colonisation within the road reserve. The cover provided by introduced species increased at the northern degraded end of the study area which also supports the non-provenance tree species *Eucalyptus resinifera*.

Overall, vegetation within the study area was determined to be of low conservation value.

## 5.0 STUDY TEAM

The detailed flora and vegetation survey was planned, co-ordinated and executed by the following personnel:

### **Onshore Environmental Consultants P/L**

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### *Project Staff*

Dr Darren Brearley	PhD	Project Manager and Principal Botanist
Dr Jerome Bull	PhD	Principal Botanist
Mrs Kerry Keenan		Data Analyst
Mr Todd Griffin	BSc	GIS and Mapping Specialist

### *Licences*

The field survey was conducted under the authorisation of the following licences issued by DBCA:

- Jerome Bull, Onshore Environmental Consultants 'Flora Taking (Biological Assessment)' Licence No. FB62000102.

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# APPENDIX 1

Vegetation condition scale  
(as developed by Keighery 1994)



Condition	Scale	Description
Pristine	1	Pristine or nearly so, no obvious signs of disturbance.
Excellent	2	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
Very Good	3	Vegetation structure altered; obvious signs of disturbance.
Good	4	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it.
Degraded	5	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching Very Good condition without intensive management.
Completely Degraded	6	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species.

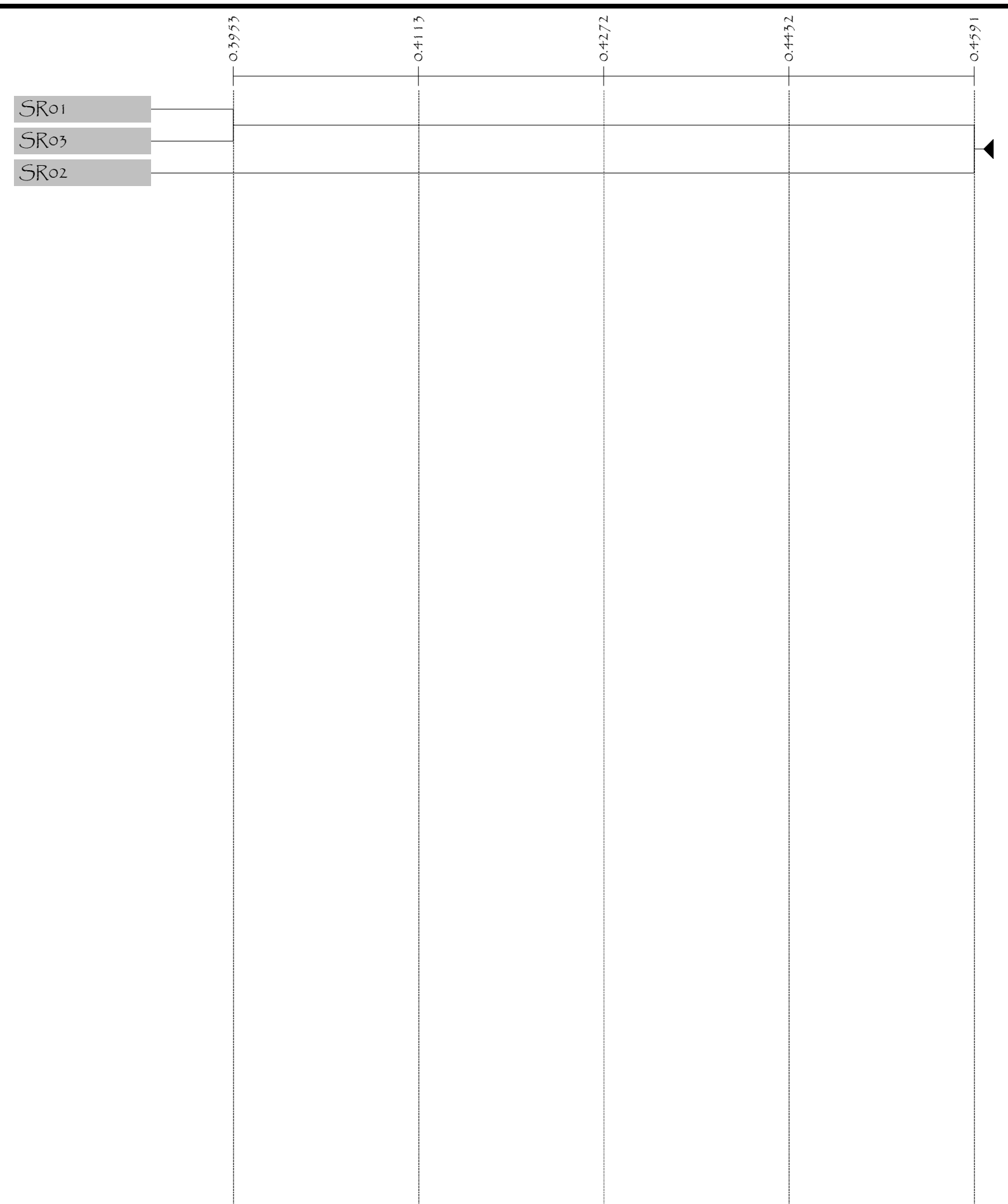
## APPENDIX 2

Dendrogram of floristic quadrat groups produced by the flexible  
UPGMA classification

Fusion Type: Flexible UPGMA    Beta = -0.10

On Association: Bray & Curtis (Columns)    Created on: 16:27:16, March 31, 2022

# Column Fusion Dendrogram



# APPENDIX 3

## Vegetation Classifications following Muir (1997)



LIFE FORM / HEIGHT	Canopy Cover			
	DENSE 70 % - 100%	MID DENSE 30% - 70%	SPARSE 10% - 30%	VERY SPARSE 2% - 10%
Trees > 30 m	Dense Tall Forest	Tall Forest	Tall Woodland	Open Tall Woodland
Trees 15 – 30 m	Dense Forest	Forest	Woodland	Open Woodland
Trees 5 – 15 m	Dense Low Forest A	Low Forest A	Low Woodland A	Open Low Woodland A
Trees < 5 m	Dense Low Forest B	Low Forest B	Low Woodland B	Open Low Woodland B
Mallee tree form	Dense Tree Mallee	Tree Mallee	Open Tree Mallee	Very Open Tree Mallee
Mallee shrub form	Dense Shrub Mallee	Shrub Mallee	Open Shrub Mallee	Very Open Shrub Mallee
Shrubs > 2 m	Dense Thicket	Thicket	Scrub	Open Scrub
Shrubs 1.5 – 2 m	Dense Heath A	Heath A	Low Scrub A	Open Low Scrub A
Shrubs 1 - 1.5 m	Dense Heath B	Heath B	Low Scrub B	Open Low Scrub B
Shrubs 0.5 – 1 m	Dense Low Heath C	Low Heath C	Dwarf Scrub C	Open Dwarf Scrub C
Shrubs 0 - 0.5 m	Dense Low Heath D	Low Heath D	Dwarf Scrub D	Open Dwarf Scrub D
Mat plants	Dense Mat Plants	Mat Plants	Open Mat Plants	Very Open Mat Plants
Hummock grass	Dense Hummock Grass	Mid-Dense Hummock Grass	Hummock Grass	Open Hummock Grass
Bunch grass > 0.5 m	Dense Tall Grass	Tall Grass	Open Tall Grass	Very Open Tall Grass
Bunch grass < 0.5 m	Dense Low Grass	Low Grass	Open Low Grass	Very Open Low Grass
Herbaceous spp.	Dense Herbs	Herbs	Open Herbs	Very Open Herbs
Sedges > 0.5 m	Dense Tall Sedges	Tall Sedges	Open Tall Sedges	Very Open Tall Sedges
Sedges < 0.5 m	Dense Low Sedges	Low Sedges	Open Low Sedges	Very Open Low Sedges
Ferns	Dense Ferns	Ferns	Open Ferns	Very Open Ferns
Mosses, liverworts	Dense Mosses	Mosses	Open Mosses	Very Open Mosses

# APPENDIX 4

## Conservation Codes

### Definition of Threatened Flora Categories under the EPBC Act

Category	Description
Extinct	A species is extinct if there is no reasonable doubt that the last member of the species has died.
Extinct in the Wild	A species is categorised as extinct in the wild if it is only known to survive in cultivations, in captivity, or as a naturalised population well outside its past range; or if it has not been recorded in its known/expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
Critically Endangered	The species is facing an extremely high risk of extinction in the wild and in the immediate future.
Endangered	The species is likely to become extinct unless the circumstances and factors threatening its abundance, survival, or evolutionary development cease to operate; or its numbers have been reduced to such a critical level, or its habitats have been so drastically reduced, that it is in immediate danger of extinction.
Vulnerable	Within the next 25 years, the species is likely to become endangered unless the circumstances and factors threatening its abundance, survival or evolutionary development cease to operate.
Conservation Dependent	The species is the focus of a specific conservation program, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within a period of 5 years.

Threatened, Extinct and Specially Protected fauna or flora are species which have been adequately searched for and are deemed to be, in the wild, threatened, extinct or in need of special protection, and have been gazetted as such.

The *Wildlife Conservation (Specially Protected Fauna) Notice 2018* and the *Wildlife Conservation (Rare Flora) Notice 2018* have been transitioned under regulations 170, 171 and 172 of the *Biodiversity Conservation Regulations 2018* to be the lists of Threatened, Extinct and Specially Protected species under Part 2 of the *Biodiversity Conservation Act 2016*.

#### Definition of Categories of Threatened, Extinct and Specially Protected fauna and flora under the BC Act

<b>T</b>	<b>Threatened species</b>
Listed by order of the Minister as Threatened in the category of critically endangered, endangered or vulnerable under section 19(1), or is a rediscovered species to be regarded as threatened species under section 26(2) of the <i>Biodiversity Conservation Act 2016</i> (BC Act).	
<b>Threatened fauna</b> is that subset of 'Specially Protected Fauna' listed under schedules 1 to 3 of the <i>Wildlife Conservation (Specially Protected Fauna) Notice 2018</i> for Threatened Fauna.	
<b>Threatened flora</b> is that subset of 'Rare Flora' listed under schedules 1 to 3 of the <i>Wildlife Conservation (Rare Flora) Notice 2018</i> for Threatened Flora.	
The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria as detailed below.	
<b>CR</b>	<b>Critically endangered species</b>
Threatened species considered to be “facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines”.	
<b>EN</b>	<b>Endangered species</b>
Threatened species considered to be “facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines”.	
<b>VU</b>	<b>Vulnerable species</b>
Threatened species considered to be “facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines”.	



Extinct species	
Listed by order of the Minister as extinct under section 23(1) of the BC Act as extinct or extinct in the wild.	
EX	Extinct species
Species where “ <i>there is no reasonable doubt that the last member of the species has died</i> ”, and listing is otherwise in accordance with the ministerial guidelines (section 24 of the BC Act).	
EW	Extinct in the wild species
Species that “ <i>is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; and it has not been recorded in its known habitat or expected habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its life cycle and form</i> ”, and listing is otherwise in accordance with the ministerial guidelines (section 25 of the BC Act).	
Currently there are no threatened fauna or threatened flora species listed as extinct in the wild. If listing of a species as extinct in the wild occurs, then a schedule will be added to the applicable notice.	
Specially protected species	
Listed by order of the Minister as specially protected under section 13(1) of the BC Act. Meeting one or more of the following categories: species of special conservation interest; migratory species; cetaceans; species subject to international agreement; or species otherwise in need of special protection.	
Species that are listed as threatened species (critically endangered, endangered or vulnerable) or extinct species under the BC Act cannot also be listed as Specially Protected species.	
MI	Migratory species
Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth; and listing is otherwise in accordance with the ministerial guidelines (section 15 of the BC Act).	
Includes birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and fauna subject to the <i>Convention on the Conservation of Migratory Species of Wild Animals</i> (Bonn Convention), an environmental treaty under the United Nations Environment Program. Migratory species listed under the BC Act are a subset of the migratory animals, that are known to visit Western Australia, protected under the international agreements or treaties, excluding species that are listed as Threatened species.	
CD	Species of special conservation interest (conservation dependent fauna)
Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened, and listing is otherwise in accordance with the ministerial guidelines (section 14 of the BC Act).	
OS - Other specially protected species	
Fauna otherwise in need of special protection to ensure their conservation, and listing is otherwise in accordance with the ministerial guidelines (section 18 of the BC Act).	

Priority species
<p>Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened fauna or flora.</p> <p>Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring.</p> <p>Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.</p>
Priority 1: Poorly-known species
<p>Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.</p>
Priority 2: Poorly-known species
<p>Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.</p>
Priority 3: Poorly-known species
<p>Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.</p>
Priority 4: Rare, Near Threatened and other species in need of monitoring
<p>a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands.</p>
<p>b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as Conservation Dependent.</p>
<p>c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.</p>

# APPENDIX 5

## Total flora list from the study area

Family	Genus	Species	Rank	Name
Asparagaceae	<i>Lomandra</i>	<i>caespitosa</i>		
Asparagaceae	<i>Lomandra</i>	<i>drummondii</i>		
Asparagaceae	<i>Lomandra</i>	<i>sericea</i>		
Asparagaceae	<i>Lomandra</i>	<i>sonderi</i>		
Asparagaceae	<i>Lomandra</i>		sp.	indet
Cyperaceae	<i>Netrostylis</i>		sp.	Jarrah Forest (R. Davis 7391)
Dennstaedtiaceae	<i>Pteridium</i>	<i>esculentum</i>		
Dilleniaceae	<i>Hibbertia</i>	<i>amplexicaulis</i>		
Dilleniaceae	<i>Hibbertia</i>	<i>commutata</i>		
Elaeocarpaceae	<i>Tetratheca</i>	<i>hirsuta</i>	subsp.	<i>viminea</i>
Ericaceae	<i>Leucopogon</i>	<i>capitellatus</i>		
Ericaceae	<i>Leucopogon</i>	<i>verticillatus</i>		
Ericaceae	<i>Styphelia</i>	<i>propinqua</i>		
Fabaceae	* <i>Acacia</i>	<i>baileyana</i>		
Fabaceae	* <i>Acacia</i>	<i>decurrens</i>		
Fabaceae	* <i>Acacia</i>	<i>podalyriifolia</i>		
Fabaceae	* <i>Acacia</i>	<i>pycnantha</i>		
Fabaceae	<i>Acacia</i>	<i>celastrifolia</i>		
Fabaceae	<i>Bossiaea</i>	<i>linophylla</i>		
Fabaceae	<i>Bossiaea</i>	<i>ornata</i>		
Fabaceae	<i>Chorizema</i>	<i>cordatum</i>		
Fabaceae	<i>Hardenbergia</i>	<i>comptoniana</i>		
Goodeniaceae	<i>Dampiera</i>	<i>linearis</i>		
Goodeniaceae	<i>Scaevola</i>	<i>calliptera</i>		
Haemodoraceae	<i>Haemodorum</i>	<i>spicatum</i>		
Hemerocallidaceae	<i>Agrostocrinum</i>	<i>scabrum</i>		
Lamiaceae	* <i>Lavandula</i>	<i>stoechas</i>		
Loganiaceae	<i>Orianthera</i>	<i>serpyllifolia</i>	subsp.	<i>angustifolia</i>
Malvaceae	<i>Thomasia</i>	<i>grandiflora</i>		
Myrtaceae	* <i>Eucalyptus</i>	<i>resinifera</i>		
Myrtaceae	<i>Corymbia</i>	<i>calophylla</i>		
Myrtaceae	<i>Eucalyptus</i>	<i>marginata</i>	subsp.	<i>marginata</i>
Pittosporaceae	<i>Billardiera</i>	<i>heterophylla</i>		
Pittosporaceae	<i>Billardiera</i>	<i>variifolia</i>		
Poaceae	* <i>Briza</i>	<i>maxima</i>		
Poaceae	<i>Tetrarrhena</i>	<i>laevis</i>		
Polygalaceae	<i>Comesperma</i>	<i>virgatum</i>		
Proteaceae	<i>Banksia</i>	<i>grandis</i>		
Proteaceae	<i>Persoonia</i>	<i>longifolia</i>		
Ranunculaceae	<i>Clematis</i>	<i>pubescens</i>		
Restionaceae	<i>Desmocladus</i>	<i>fasciculatus</i>		
Rosaceae	* <i>Cotoneaster</i>	<i>glaucophyllus</i>		
Rosaceae	* <i>Rubus</i>	<i>ulmifolius</i>		
Rubiaceae	<i>Opercularia</i>	<i>hispidula</i>		
Rutaceae	<i>Philothea</i>	<i>spicata</i>		
Stylidiaceae	<i>Stylidium</i>	<i>amoenum</i>		
Xanthorrhoeaceae	<i>Xanthorrhoea</i>	<i>gracilis</i>		
Zamiaceae	<i>Macrozamia</i>	<i>riedlei</i>		

# APPENDIX 6

Species by site matrix for the three quadrats formally  
assessed within the study area



Taxon	SR01	SR02	SR03
* <i>Acacia pycnantha</i>		x	
* <i>Briza maxima</i>	x	x	x
* <i>Cotoneaster glaucophyllus</i>			x
<i>Acacia celastrifolia</i>	x		
<i>Agrostocrinum scabrum</i>	x		
<i>Banksia grandis</i>	x	x	
<i>Billardiera heterophylla</i>		x	x
<i>Bossiaea linophylla</i>	x	x	x
<i>Bossiaea ornata</i>	x	x	
<i>Chorizema cordatum</i>		x	
<i>Clematis pubescens</i>		x	x
<i>Comosperma virgatum</i>		x	
<i>Corymbia calophylla</i>	x	x	x
<i>Dampiera linearis</i>	x	x	
<i>Eucalyptus marginata</i>	x	x	x
<i>Hardenbergia comptoniana</i>	x	x	x
<i>Hibbertia amplexicaulis</i>	x		x
<i>Hibbertia comutata</i>	x		
<i>Leucopogon capitellatus</i>	x	x	x
<i>Leucopogon verticillatus</i>			x
<i>Lomandra drummondii</i>	x		
<i>Lomandra caespitosa</i>		x	
<i>Lomandra seriacea</i>	x		
<i>Lomandra sericea</i>		x	
<i>Lomandra sonderi</i>	x		
<i>Lomandra</i> sp. indet			x
<i>Macrozamia riedlei</i>	x		x
<i>Netrostylis</i> sp. Jarrah Forest (R. Davis 7391)	x		
<i>Opercularia hispidula</i>	x	x	x
<i>Orianthera serpyllifolia</i>		x	
<i>Persoonia longifolia</i>		x	
<i>Philothea spicata</i>		x	
<i>Pteridium esculentum</i>	x		x
<i>Scaevola calliptera</i>	x	x	x
<i>Stylidium amoenum</i>		x	
<i>Styphelia propinqua</i>		x	
<i>Tetrarrhena laevis</i>	x	x	x
<i>Tetradlea hirsuta</i>	x	x	
<i>Thomasia grandiflora</i>			x
<i>Xanthorrhoea gracilis</i>	x	x	x

# APPENDIX 7

Raw data for three quadrats formally assessed within  
the study area

## Study Sites

Site	Landform	Vegetation Type	Condition	Slope	Soil Type	Last Fire	Disturbance	Easting	Northing
SR01	Hillslope	Low Forest A of <i>Eucalyptus marginata</i> subsp. <i>marginata</i> and <i>Corymbia calophylla</i> over Low Scrub B of <i>Bossiaea linophylla</i> over Open Dwarf Scrub D of <i>Bossiaea ornata</i> and <i>Leucopogon capitellatus</i> ( <i>Pteridium esculentum</i> , <i>Xanthorrhoea gracilis</i> , <i>Macrozamia riedlei</i> , <i>Opercularia hispidula</i> )	Good	Low	Sandy loam	Old (6+ yr)	Road/ Access Track	413424	6254702
SR02	Hillslope	Low Forest A of <i>Corymbia calophylla</i> and <i>Eucalyptus marginata</i> subsp. <i>marginata</i> over Low Scrub B of <i>Bossiaea linophylla</i> over Open Dwarf Scrub D of <i>Bossiaea ornata</i> , <i>Xanthorrhoea gracilis</i> and <i>Billardiera heterophylla</i>	Good	Low	Sandy loam	Old (6+ yr)	Road/ Access Track	413416	6254822
SR03	Hillslope	Low Forest A of <i>Eucalyptus marginata</i> subsp. <i>marginata</i> and <i>Corymbia calophylla</i> over Heath B of <i>Bossiaea linophylla</i> ( <i>Pteridium esculentum</i> , <i>Billardiera heterophylla</i> ) over Open Dwarf Scrub C of <i>Macrozamia riedlei</i> and <i>Xanthorrhoea gracilis</i> over Open Dwarf Scrub D of <i>Leucopogon capitellatus</i> ( <i>Opercularia hispidula</i> )	Good	Low	Sandy loam	Old (6+ yr)	Road/ Access Track	413455	6254609

## Flora

Site	Method	Genus	Species	Rank	Name	Introduced/Native	% Cover	Height (m)
AB	Opportunistic	* <i>Acacia</i>	<i>baileyana</i>			Introduced	1	3
AD	Opportunistic	* <i>Acacia</i>	<i>decurrens</i>			Introduced	30	2-15
AD	Opportunistic	* <i>Acacia</i>	<i>podalyriifolia</i>			Introduced	5	2
AD	Opportunistic	* <i>Eucalyptus</i>	<i>resinifera</i>			Introduced	40	17
SR01	Opportunistic	* <i>Acacia</i>	<i>pycnantha</i>			Introduced	3	2-2.5
SR01	Quadrat	* <i>Briza</i>	<i>maxima</i>			Introduced	+	0.3
SR01	Opportunistic	* <i>Lavandula</i>	<i>stoechas</i>			Introduced	+	0.4
SR01	Opportunistic	* <i>Rubus</i>	<i>ulmifolius</i>			Introduced	+	0.1
SR01	Quadrat	<i>Acacia</i>	<i>celastrifolia</i>			Native	0.5	0.5-1
SR01	Quadrat	<i>Agrostocrinum</i>	<i>scabrum</i>			Native	+	0.6
SR01	Quadrat	<i>Banksia</i>	<i>grandis</i>			Native	1	2
SR01	Opportunistic	<i>Billardiera</i>	<i>heterophylla</i>			Native		
SR01	Quadrat	<i>Bossiaea</i>	<i>linophylla</i>			Native	28	1-2
SR01	Quadrat	<i>Bossiaea</i>	<i>ornata</i>			Native	3	0.4
SR01	Quadrat	<i>Corymbia</i>	<i>calophylla</i>			Native	25	15
SR01	Quadrat	<i>Dampiera</i>	<i>linearis</i>			Native	0.5	0.1
SR01	Opportunistic	<i>Desmocladius</i>	<i>fasciculatus</i>			Native		
SR01	Quadrat	<i>Eucalyptus</i>	<i>marginata</i>	subsp.	<i>marginata</i>	Native	30	5-10
SR01	Opportunistic	<i>Haemodorum</i>	<i>spicatum</i>			Native		
SR01	Quadrat	<i>Hardenbergia</i>	<i>comptoniana</i>			Native	+	Cl
SR01	Quadrat	<i>Hibbertia</i>	<i>amplexicaulis</i>			Native	+	0.3
SR01	Quadrat	<i>Hibbertia</i>	<i>commutata</i>			Native	+	0.2
SR01	Quadrat	<i>Leucopogon</i>	<i>capitellatus</i>			Native	0.5	0.3
SR01	Quadrat	<i>Lomandra</i>	<i>drummondii</i>			Native	+	0.3
SR01	Quadrat	<i>Lomandra</i>	<i>seriacea</i>			Native	+	0.3
SR01	Quadrat	<i>Lomandra</i>	<i>sonderi</i>			Native	+	0.4
SR01	Quadrat	<i>Macrozamia</i>	<i>riedlei</i>			Native	1	0.7

Site	Method	Genus	Species	Rank	Name	Introduced/Native	% Cover	Height (m)
SR01	Quadrat	<i>Netrostylis</i>		sp.	Jarraah Forest (R. Davis 7391)	Native	1	0.3
SR01	Quadrat	<i>Opercularia</i>	<i>hispidula</i>			Native	1	0.4
SR01	Quadrat	<i>Pteridium</i>	<i>esculentum</i>			Native	3	0.5
SR01	Quadrat	<i>Scaevola</i>	<i>calliptera</i>			Native	+	0.2
SR01	Quadrat	<i>Tetrarrhena</i>	<i>laevis</i>			Native	+	0.2
SR01	Quadrat	<i>Tetratheca</i>	<i>hirsuta</i>	subsp.	<i>viminea</i>	Native	1	0.2
SR01	Quadrat	<i>Xanthorrhoea</i>	<i>gracilis</i>			Native	1.5	0.5
SR02	Quadrat	* <i>Acacia</i>	<i>pycnantha</i>			Introduced	1	2
SR02	Quadrat	* <i>Briza</i>	<i>maxima</i>			Introduced	+	0.2
SR02	Quadrat	<i>Banksia</i>	<i>grandis</i>			Native		
SR02	Quadrat	<i>Billardiera</i>	<i>heterophylla</i>			Native	1	0.5-1
SR02	Opportunistic	<i>Billardiera</i>	<i>variifolia</i>			Native		
SR02	Quadrat	<i>Bossiaea</i>	<i>linophylla</i>			Native	17	1-2
SR02	Quadrat	<i>Bossiaea</i>	<i>ornata</i>			Native	0.5	0.2
SR02	Quadrat	<i>Chorizema</i>	<i>cordatum</i>			Native	+	0.2
SR02	Quadrat	<i>Clematis</i>	<i>pubescens</i>			Native	+	Cl
SR02	Quadrat	<i>Comosperma</i>	<i>virgatum</i>			Native	+	1.5
SR02	Quadrat	<i>Corymbia</i>	<i>calophylla</i>			Native	33	12-15
SR02	Quadrat	<i>Dampiera</i>	<i>linearis</i>			Native	+	0.2
SR02	Quadrat	<i>Eucalyptus</i>	<i>marginata</i>	subsp.	<i>marginata</i>	Native	25	5-15
SR02	Quadrat	<i>Hardenbergia</i>	<i>comptoniana</i>			Native	+	Cl
SR02	Quadrat	<i>Leucopogon</i>	<i>capitellatus</i>			Native	+	0.3
SR02	Quadrat	<i>Lomandra</i>	<i>caespitosa</i>			Native	+	0.2
SR02	Quadrat	<i>Lomandra</i>	<i>sericea</i>			Native	+	0.2
SR02	Quadrat	<i>Opercularia</i>	<i>hispidula</i>			Native	+	0.3
SR02	Quadrat	<i>Orianthera</i>	<i>serpyllifolia</i>			Native	+	0.1
SR02	Quadrat	<i>Persoonia</i>	<i>longifolia</i>			Native	+	0.2
SR02	Quadrat	<i>Philothea</i>	<i>spicata</i>			Native	+	0.3
SR02	Quadrat	<i>Scaevola</i>	<i>calliptera</i>			Native	+	0.2



Site	Method	Genus	Species	Rank	Name	Introduced/Native	% Cover	Height (m)
SR02	Quadrat	<i>Stylidium</i>	<i>amoenum</i>			Native	+	0.1
SR02	Quadrat	<i>Styphelia</i>	<i>propinqua</i>			Native	+	0.2
SR02	Quadrat	<i>Tetrarrhena</i>	<i>laevis</i>			Native	+	0.3
SR02	Quadrat	<i>Tetradlea</i>	<i>hirsuta</i>	subsp.	<i>viminea</i>	Native	+	0.3
SR02	Quadrat	<i>Xanthorrhoea</i>	<i>gracilis</i>			Native	2	0.5
SR03	Quadrat	* <i>Briza</i>	<i>maxima</i>			Introduced	+	0.3
SR03	Quadrat	* <i>Cotoneaster</i>	<i>glaucohyllus</i>			Introduced	+	0.5
SR03	Quadrat	<i>Billardiera</i>	<i>heterophylla</i>			Native	1	1-1.5
SR03	Quadrat	<i>Bossiaea</i>	<i>linophylla</i>			Native	35	1-2.5
SR03	Quadrat	<i>Clematis</i>	<i>pubescens</i>			Native	+	Cl
SR03	Quadrat	<i>Corymbia</i>	<i>calophylla</i>			Native	30	10-15
SR03	Quadrat	<i>Eucalyptus</i>	<i>marginata</i>	subsp.	<i>marginata</i>	Native	10	5-15
SR03	Quadrat	<i>Hardenbergia</i>	<i>comptoniana</i>			Native	+	Cl
SR03	Quadrat	<i>Hibbertia</i>	<i>amplexicaulis</i>			Native	+	0.1
SR03	Quadrat	<i>Leucopogon</i>	<i>capitellatus</i>			Native	2	0.2
SR03	Quadrat	<i>Leucopogon</i>	<i>verticillatus</i>			Native	+	0.3-1
SR03	Quadrat	<i>Lomandra</i>		sp.	indet	Native	+	0.2
SR03	Quadrat	<i>Macrozamia</i>	<i>riedlei</i>			Native	1	1.3
SR03	Quadrat	<i>Opercularia</i>	<i>hispidula</i>			Native	0.5	0.4
SR03	Quadrat	<i>Pteridium</i>	<i>esculentum</i>			Native	2	0.5-1.5
SR03	Quadrat	<i>Scaevola</i>	<i>calliptera</i>			Native	+	0.2
SR03	Quadrat	<i>Tetrarrhena</i>	<i>laevis</i>			Native	1	0.3
SR03	Quadrat	<i>Thomasia</i>	<i>grandiflora</i>			Native	+	0.1
SR03	Quadrat	<i>Xanthorrhoea</i>	<i>gracilis</i>			Native	3	1

SR01



SR02





SR03

