

Lot 510 Old Ledge Point Rd
Lancelin
Flora and Vegetation Survey



Prepared for Bayley Environmental Services



FEBRUARY 2021



Plantecology Consulting

ABN 18 849 210 133

50 New Cross Rd

Kingsley WA 6026

Telephone: 0429 061 094



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Executive Summary

Plantecology Consulting was commissioned by Bayley Environmental Services to undertake a detailed flora and vegetation survey of Lot 510 Old Ledge Point Rd, Lancelin, in the Shire of Gingin. The site is approximately 17.6 ha in area and currently mostly supports native vegetation.

A field survey of the site was undertaken by two botanists from Plantecology Consulting on the 15th October 2020. A detailed survey of the vegetation was undertaken at five 100 m² sampling plots (10m x 10m quadrats), selected to adequately sample the flora within a stand. Plots were positioned to sample a representative and homogeneous area (i.e. not located in transitional areas between communities) and also to not overlap with the plots used by Ecoscape (2007) so as to provide a wider sampling coverage of the site. A relevé as defined by the EPA (2016) rather than a detailed plot was located in each of the *Spyridium globulosum* Closed Heath and the *Melaleuca lanceolata* Tall Shrubland mapped by Ecoscape (2007). The stands of these communities are small and as they had been surveyed with quadrats previously, the data gathered by Ecoscape (2007) was used to evaluate any changes in the interim. The location of each corner of a plot was recorded with a hand-held GPS unit and a photograph of the plot taken looking inward to the quadrat. All vascular plant species were recorded and an estimate of the Foliage Projective Cover (FPC) percentage was made for each species.

A total of 70 native and 8 non-native (exotic) taxa were recorded within the site, representing 37 families and 65 genera. The dominant families containing mostly native taxa were Fabaceae (7 native taxa), Asteraceae (6 native taxa), and Myrtaceae (5 native taxa).

No Threatened Flora pursuant to the Biodiversity Conservation Act (2016) nor the EPBC Act (1999) were recorded during the survey.

Two species listed as Priority Flora by the PWS were recorded during the survey. *Stylidium maritimum* (P3) and *Conostylis ?pauciflora* var. *euryrhipis* (P4) occur across the dunes and swales in the central and southern parts of the site.

The survey identified four plant communities within the site:

Melaleuca systema Low Shrubland

Low shrubland of *Melaleuca systema*, *Olearia axillaris* and *Spyridium globulosum* with *Cryptandra mutila* over a herbland of *Conostylis candicans* subsp. *calicicola*, *Conostylis ?pauciflora* subsp. *euryrhipis* and *Hemiandra glabra* on grey-cream sand on dunes.

Acacia rostellifera Tall Shrubland

Tall shrubland of *Acacia rostellifera*, *Spyridium globulosum* and *Santalum acuminatum* over a herbland of *Acanthocarpus preissii*, *Lomandra maritima* and *Rhagodia baccata* subsp. *baccata* on grey-cream sands of flats and swales.

Spyridium globulosum Closed Shrubland

Closed shrubland of *Spyridium globulosum*, *Melaleuca huegelii* subsp. *huegelii* and *Templetonia retusa* over a herbland of *Lepidosperma gladiatum*, *Rhagodia baccata* subsp. *baccata* and *Acanthocarpus preissii* on grey-cream sands of swales.

Melaleuca lanceolata Low Closed Forest

Closed low forest of *Melaleuca lanceolata* over Open shrubland of *Melaleuca huegelii* subsp. *huegelii* over a sedgeland of *Ficinia nodosa* and *Lepidosperma pubisquameum* on grey-cream sands of swales.

Hierarchical clustering assignments indicated that the communities within the site are either FCT 29a – ‘Coastal shrublands on shallow sands’ or FCT 29b ‘Acacia shrublands on taller dunes’, both of which are ranked as Priority 3 communities under Western Australian state policy.



The vegetation for most of the site including the *Melaleuca lanceolata* Low Closed Forest, *Spyridium globulosum* Closed Shrubland and *Melaleuca systema* Low Shrubland remains in an 'Excellent' condition and retains most of its original botanical value (Figure 3). A small blowout has developed adjacent to the northern boundary and is in a 'Completely Degraded' condition. Much of the *Acacia rostelifera* Tall Shrubland has improved to a 'Very Good' rating and some of the sand mined area has regenerated enough to now be considered in 'Good' condition with the bare areas rated as 'Completely Degraded'.

Eight of the taxa recorded during the survey are exotics (weeds). None is a Declared Pest under the Biosecurity and Agriculture Management Act 2007.

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Introduction

Plantecology Consulting was commissioned by Bayley Environmental Services to undertake a detailed flora and vegetation survey of Lot 510 Old Ledge Point Rd, Lancelin, in the Shire of Gingin (Figure 1). The site is approximately 17.6 ha in area and currently mostly supports native vegetation.

1.1 Previous Surveys

The site was surveyed by Ecoscape (Australia) Pty Ltd (Ecoscape) (2007). That survey identified four plant communities: a *Melaleuca lanceolata* Tall Shrubland was located in the north-western corner of the site; a *Spyridium globulosum* Closed Heath was mapped adjacent to the southern boundary of the *Melaleuca lanceolata* Tall Shrubland; a *Melaleuca systema*, *Santalum acuminatum* and *Cryptandra mutila* Closed Low Heath was mapped through the central and southern areas of the site; and an *acacia rostellifera* Tall Open Scrub was mapped on the western part of the site adjacent to a large blowout.

Vegetation condition was described as ranging from 'Good' for the *Acacia rostellifera* scrub to 'Excellent' across the remainder of the site apart from the large blowout, which was rated as 'Completely Degraded'. No Threatened Flora were recorded during the previous survey but two taxa of Priority Flora were recorded in the *Melaleuca systema*, *Santalum acuminatum* and *Cryptandra mutila* Closed Low Heath.

1.2 Existing Environment

The site is currently vegetated apart from firebreaks around the perimeter and the remnants of sand extraction in the north-eastern sector. The vegetation condition and structure is largely intact, with some evidence of historical access tracks, much of which is regenerating. Inspection of historical aerial photography indicates a small area of sand blowout has formed adjacent to the northern boundary since the time of the Ecoscape (2007) survey.

1.3 Climate

The Lancelin area experiences a dry Mediterranean climate of hot dry summers and cool wet winters. Long-term climatic averages indicate the site is located in an area of moderate to high rainfall, receiving 600 mm on average annually (data for Lancelin, station number 9114, the nearest currently reporting station) (Bureau of Meteorology 2021) with the majority of rainfall received between May and August. The area experiences rainfall on an average of 80 days per year. Mean maximum temperatures range from 19.3 °C in July to 29.9 °C in February. Mean minimum temperatures range from 9.9 °C in July and August, to 18.1 °C in February.

1.4 Soils

The Atlas of Australian Soils maps the soils for the site as Map Unit A13, which is a coastal dune formation backed by low-lying deposits of inlets and estuaries. The chief soils of the dunes are calcareous sands (Uc1.11) with smaller areas of acid peat in the swales (Natural Resource Information Centre 1991).

1.5 Conservation Significant Flora

Under the Biodiversity Conservation Act 2016 ('BC Act'), the Minister for the Environment produces a gazetted list of Threatened Flora under three categories: Critically Endangered, Endangered and Vulnerable. The Parks and Wildlife Service (PWS) also produces a list of Priority Flora that have not been assigned statutory protection under the BC Act but may be under some degree of threat (PWS 2019a). The PWS recognises four Priority Flora levels. The definitions for each category of Threatened and Priority Flora are shown in Appendix E.

As well as protection under State legislation, selected flora are also afforded statutory protection at a Federal level pursuant to the Environment Protection and Biodiversity Conservation Act 1999 (EPBC

Act). The EPBC Act provides for the protection of Threatened species, pursuant to Schedule 1 of the Act, and are defined as “Critically Endangered”, “Endangered”, “Vulnerable” or “Conservation Dependent” under Section 179. Definitions of these categories are shown in Appendix E. Any action likely to have a significant impact on a species listed under the EPBC Act requires approval from the Commonwealth Minister for the Environment.

Searches of the State databases identified 66 taxa with the potential to occur within the site (Table 1). Of these taxa, nine are listed as Threatened under the BC Act, of which one is an orchid. *Drakaea elastica* occurs in sands of low-lying areas adjacent to damp sites. This species are unlikely to occur within the site.

1.6 Conservation Significant Communities

The PWS defines an ecological community as “a naturally occurring assemblage that occurs in a particular type of habitat” (PWS 2019b). A Threatened Ecological Community (TEC) is one that has declined in area or was originally limited in distribution. Uncommon ecological communities that do not strictly meet TEC defined criteria, or are inadequately defined, are listed by the PWS as a Priority Ecological Community (PEC). Definitions of the categories of Threatened and Priority Ecological Communities are given in Appendix E.

As well as protection under State legislation, selected ecological communities are also afforded statutory protection at a Federal level pursuant to the EPBC Act. The EPBC Act provides for the protection of TECs, which are listed under section 181 of the Act, and are defined as “Critically Endangered”, “Endangered” or “Vulnerable” under Section 182. Similar to flora listed under the EPBC Act, any action likely to have a significant impact on a TEC listed under the EPBC Act requires Commonwealth approval.

One terrestrial TEC endorsed under State legislation is recorded as occurring within 10 km of the site:

- Floristic Community Type (FCT) 19a - ‘Sedgeland in Holocene dune swales of the southern Swan Coastal Plain’.

Two other terrestrial FCTs listed as PECs are recorded as occurring within 10 km of the site:

- ‘Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain’ (Priority 3); and
- ‘Banksia dominated woodlands of the Swan Coastal Plain IBRA Region’ (Priority 3).

The ‘Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain ecological community’ is also categorised as ‘Critically Endangered’ by the Commonwealth, and the ‘Banksia-dominated woodlands of the Swan Coastal Plain IBRA Region’ and the ‘Sedgeland in Holocene dune swales of the southern Swan Coastal Plain’ are both listed as ‘Endangered’ TECs by the Commonwealth.

None of the communities listed above are mapped as occurring within the site.

1.7 Vegetation Complexes

Vegetation complexes are a series of plant communities forming a regularly repeating pattern associated with a particular soil unit (Government of Western Australia 2000). The vegetation complex mapped as occurring within the site is the Quindalup Complex, which has approximately 60% of its original 55 570 ha pre-European extent remaining and 8.4% of its current extent has some level of protection (Government of Western Australia 2017).

Table 1: Threatened and Priority Flora potentially occurring within the survey area based on database searches. (VU = Vulnerable; EN = Endangered; CR = Critically Endangered; T = Threatened; 1 – 4 = Priority Flora Category)

Taxon	PWS Ranking	EPBC Act Category	Flowering Period
<i>Allocasuarina grevilleoides</i>	3		Sep-Nov
<i>Andersonia gracilis</i>	T	EN	Oct-Nov
<i>Anigozanthos humilis</i> subsp. <i>Badgingarra</i> (S.D. Hopper 7114)	2		Sep-Oct
<i>Anigozanthos humilis</i> subsp. <i>chrysanthus</i>	4		Jul-Sep
<i>Anigozanthos viridis</i> subsp. <i>terraspectans</i>	T	VU	Oct-Nov
<i>Arnocrinum drummondii</i>	3		Mar-Sep-Dec
<i>Babingtonia delicata</i>	1		
<i>Babingtonia urbana</i>	3		Jan-Mar
<i>Baeckea</i> sp. <i>Limestone</i> (N. Gibson & M.N. Lyons 1425)	1		
<i>Banksia dallanneyi</i> subsp. <i>pollostia</i>	3		Aug
<i>Banksia fraseri</i> var. <i>crebra</i>	3		Jul-Aug
<i>Beyeria cinerea</i> subsp. <i>cinerea</i>	3		Nov
<i>Caladenia speciosa</i>	4		Sep-Oct
<i>Calothamnus accedens</i>	4		Feb
<i>Calothamnus pachystachyus</i>	4		Aug-Oct
<i>Calytrix ecalycata</i> subsp. <i>brevis</i>	3		Aug-Oct
<i>Chamaescilla gibsonii</i>	3		Sep
<i>Chorizema varium</i>	T		Jun, Sep-Oct
<i>Conostylis bracteata</i>	3		Aug-Sep
<i>Conostylis pauciflora</i> subsp. <i>euryrhipis</i>	4		Aug-Oct
<i>Dampiera tephrea</i>	2		Aug
<i>Darwinia acerosa</i>	T	EN	Sep-Nov
<i>Darwinia carnea</i>	T	EN	Oct-Dec
<i>Desmocladius nodatus</i>	3		
<i>Dillwynia dillwynioides</i>	3		Aug-Dec
<i>Dodonaea hackettiana</i>	4		Jul-Oct
<i>Drakaea elastica</i>	T	EN	Oct-Nov
<i>Eleocharis keigheryi</i>	T	VU	
<i>Eucalyptus argutifolia</i>	T	VU	Mar-Apr
<i>Eucalyptus macrocarpa</i> subsp. <i>elachantha</i>	4		Apr-Sep
<i>Gratiola pedunculata</i>	2		Jan-May
<i>Grevillea evanescens</i>			
<i>Grevillea rudis</i>	4		Jul-Feb
<i>Grevillea thyrsoidea</i> subsp. <i>thyrsoidea</i>	3		All
<i>Gyrostemon</i> sp. <i>Mogumber</i> (T.J. Hawkeswood 250)	1		
<i>Haemodorum loratum</i>	3		Sep-Nov
<i>Hakea oligoneura</i>	4		Aug-Oct
<i>Hensmania stoniella</i>	3		Sep-Nov
<i>Hibbertia leptotheca</i>	3		
<i>Hypocalymma</i> sp. <i>Cataby</i> (G.J. Keighery 5151)	2		Aug-Sep

Taxon	PWS Ranking	EPBC Act Category	Flowering Period
<i>Isotropis cuneifolia</i> subsp. <i>glabra</i>	3		Sep
<i>Lepidosperma rostratum</i>	T		
<i>Leucopogon</i> sp. Yanchep (M. Hislop 1986)	3		Apr-Jun, Sep
<i>Leucopogon squarrosus</i> subsp. <i>trigynus</i>	2		
<i>Macarthuria keigheryi</i>	T	EN	Sep-Dec, Feb-Mar
<i>Marianthus paralius</i>	T		Sep-Nov
<i>Persoonia rudis</i>	3		Sep-Nov
<i>Petrophile biternata</i>	3		Sep
<i>Phlebocarya pilosissima</i> subsp. <i>pilosissima</i>	3		Aug-Sep
<i>Pimelea calcicola</i>	3		Sep-Nov
<i>Platysace ramosissima</i>	3		
<i>Ptychosema pusillum</i>	T	VU	Oct-Nov
<i>Rumex drummondii</i>	4		
<i>Sarcozona bicarinata</i>	3		Aug
<i>Schoenus pennisetis</i>	3		Aug-Sep
<i>Scholtzia laciniata</i>	2		
<i>Stylidium aceratum</i>	3		Oct-Nov
<i>Stylidium hymenocraspedum</i>	3		Oct
<i>Stylidium maritimum</i>	3		Sep-Nov
<i>Stylidium</i> sp. Moora (J.A. Wege 713)	2		Oct
<i>Thelymitra apiculata</i>	4		Jun-Jul
<i>Thryptomene</i> sp. Lancelin (M.E. Trudgen 14000)	3		Sep
<i>Trithuria australis</i>	4		Oct
<i>Trithuria australis</i>	4		Oct
<i>Verticordia lindleyi</i> subsp. <i>lindleyi</i>	4		Nov-Jan

1.8 Purpose

The purpose of the survey was to assess the botanical values within the site by:

- Undertaking a detailed flora and vegetation survey in accordance with the Environmental Protection Authority's (EPA) *Technical Guidance: Flora and Vegetation Survey for Environmental Impact Assessment* (2016).
- Identifying the presence of any Threatened Ecological Communities (TECs) and Priority Ecological Communities (PECs);
- Undertaking a systematic search for all vascular plant taxa present; and
- Recording the locations and numbers present of any Threatened Flora and Priority Flora.

Methods

1.9 Field Survey

A field survey of the site was undertaken by two botanists from Plantecology Consulting on the 15th October 2020. A detailed survey of the vegetation was undertaken at five 100 m² sampling plots (10m x 10m quadrats), selected to adequately sample the flora within a stand (Figure 2). Plots were positioned to sample a representative and homogeneous area (i.e. not located in transitional areas between communities) and also to not overlap with the plots used by Ecoscape (2007) so as to provide a wider sampling coverage of the site. A relevé as defined by the EPA (2016) rather than a detailed plot was located in each of the *Spyridium globulosum* Closed Heath and the *Melaleuca lanceolata* Tall Shrubland mapped by Ecoscape (2007). The stands of these communities are small and as they had been surveyed with quadrats previously, the data gathered by Ecoscape (2007) was used to evaluate any changes in the interim. The location of each corner of a plot was recorded with a hand-held GPS unit and a photograph of the plot taken looking inward to the quadrat. All vascular plant species were recorded and an estimate of the Foliage Projective Cover (FPC) percentage was made for each species.

Environmental data recorded included topographic position, aspect, slope, soil colour and texture class, rock outcropping, litter cover as well as the degree of disturbance and an estimate of the time since the last fire event. The condition of the vegetation of the site was assessed to assist in determining the conservation values of the site. The vegetation condition was rated according to Keighery (1994), a vegetation condition scale commonly used in the metropolitan and southwest regions. The categories are listed and defined in Table 2. Data on the vegetation structure was also recorded and included the height of the three main strata and the dominant species within each stratum. The vegetation structural description follows that of the National Vegetation Information System (Thackway et al. 2006).

Table 2: Vegetation Condition Scale (Keighery 1994)

Vegetation Condition	Definition
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	Vegetation structure altered, obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs.

All plant specimens collected during the field survey were dried, pressed and then sorted in accordance with requirements of the Western Australian Herbarium. Identification of specimens occurred through comparison with named material and through the use of taxonomic keys. Taxonomic determinations were made using reference material at the Western Australian State Herbarium. Taxa names utilise the current terminologies from FloraBase (2020). Family names utilise the revised phylogeny of the Angiosperm Phylogeny Group - APGIII (FloraBase 2020).

1.10 Survey Limitations

Various factors can limit the effectiveness of a vegetation survey. Pursuant to EPA Technical Guidance: Flora and Vegetation Survey for Environmental Impact Assessment (EPA 2016), these factors have been identified and their potential impact on the effectiveness of the survey has been assessed (Table 3).

The initial survey was undertaken October 2020 and would likely have intercepted the flowering period of annuals of conservation concern with the potential to occur within the site. However, the preceding three months were drier than normal (mainly in August), which may have affected the flowering of some species.

Table 3: Potential limitations affecting the vegetation survey

Potential limitations	Constraint	Comment
Availability of contextual information	No	Sufficient regional and local information was available to place the survey site in its environmental context.
Competency and experience of the botanists	No	The survey was undertaken by botanists with a comprehensive knowledge of Swan Coastal Plain vegetation, with at least 15 years experience in vegetation surveys in Western Australia.
Seasonality	Minor	The survey was undertaken in spring 2020. The rainfall in the three months prior to the survey was near average for the area. Maximum and minimum temperatures in September and October were approximately 1-2° higher than the mean.
Adequate coverage and intensity of survey	No	The survey area was traversed on foot. It is considered the survey quadrats and mapping points provided adequate coverage given the degraded nature of most of the site.
Proportion of Flora identified	No	The survey recorded an estimated 90% of the plant taxa present (Chao2 estimator).
Disturbance	Minor	The vegetation was mostly intact, with a large blowout and bare areas from past resource extraction. A small blowout has formed since the previous survey in 2007.
Resources	No	Adequate resources were available to conduct the survey.
Access restrictions	No	All parts of the site were accessible

1.11 Data Analysis

The remnant vegetation of the southern Swan Coastal Plain (SCP) was surveyed by Gibson et al. (1994) to provide an understanding of the major floristic gradients across the region. The major plant

communities (or FCTs) were defined by classifying the data according to the similarities in species composition between plots. When determining the FCT of a new record, a floristic analysis of species composition provides the most robust method that is consistent with the original classification, although presently a single consistent method for the determination of FCTs for vegetation data in the Swan Coastal Plain is not available.

Hierarchical agglomerative clustering is the usual first stage in classifying vegetation data into community types. This involves calculating the similarity (or more often, the dissimilarity) between plots within the dataset and then sequentially fusing the plots into groups according to their similarity. This type of method was used in the analysis of the original Swan Coastal Plain dataset (Gibson et al. 1994), but its use as the basis for assigning new plot data to the regional classification has some drawbacks. Firstly, a hierarchical clustering only applies to the relationships between plots, and the relative distances between them, within that particular dataset. The addition of new data often alters the relative distances and disrupts the clustering output. Secondly, as an unsupervised method, hierarchical clustering does not define rules for the membership of the defined groups, and so the addition of new plots requires the rebuilding of the entire hierarchy (De Cáceres and Wiser 2012).

The data for the Swan Coastal Plain regional survey (Gibson et al. 1994) was downloaded from the NatureMap website. This is largely similar to the original survey except for one site (OATES-1), which has now been excluded. The species nomenclature of the original dataset was updated to be consistent with current usage. Where original names could not be matched clearly to the updated usage, those taxa were removed from the analysis. The new data from the Old Ledge Point Rd survey was added to the matrix one plot at a time to remove any effect of spatial correlation between the new plots. Each new dataset was then analysed calculating the Bray-Curtis distance coefficient (or resemblance measure) and the flexible beta linkage method ($\beta = -0.1$). Assignment of the Old Ledge Point Rd plots was to the nearest distinct group by inspection of the resulting dendrogram. The analyses were undertaken using R packages Cluster and Vegan.

Results

1.12 Flora

1.12.1 Floristic Summary

A total of 70 native and 8 non-native (exotic) taxa were recorded within the site, representing 37 families and 65 genera. The dominant families containing mostly native taxa were Fabaceae (7 native taxa), Asteraceae (6 native taxa), and Myrtaceae (5 native taxa). For a complete species list and the individual site data refer to Appendix A and Appendix B, respectively.

1.12.2 Threatened and Priority Flora

No Threatened Flora pursuant to the Biodiversity Conservation Act (2016) nor the EPBC Act (1999) were recorded during the survey.

Two species listed as Priority Flora by the PWS were recorded during the survey. *Stylidium maritimum* (P3) is a perennial herb growing to around 0.7 m in height and was recorded from eight occurrences (Table 4) in the *Melaleuca systema* Low Shrubland community (see below). *Conostylis ?pauciflora* var. *euryrhipis* (P4) was also common in the *Melaleuca systema* Low Shrubland community, as well as being recorded in the *Acacia rostellifera* Tall Shrubland. Three specimens of *Conostylis ?pauciflora* var. *euryrhipis* were collected and none could be identified to subspecies rank with complete confidence. However, it is the most likely identification and it should also be noted that the taxon was recorded by Ecoscape (2007) as being common on the site.

Table 4: Recorded locations of *Stylidium maritimum* (P3) within the surveyed area.

Taxon Name	Rank	Abundance	Latitude	Longitude
<i>Stylidium maritimum</i>	P3	1	115.35632	-31.06813
<i>Stylidium maritimum</i>	P3	4	115.3564	-31.06837
<i>Stylidium maritimum</i>	P3	1	115.3572	-31.06903
<i>Stylidium maritimum</i>	P3	5	115.35733	-31.06909
<i>Stylidium maritimum</i>	P3	2	115.35785	-31.06946
<i>Stylidium maritimum</i>	P3	1	115.35777	-31.06947
<i>Stylidium maritimum</i>	P3	2	115.35877	-31.06954
<i>Stylidium maritimum</i>	P3	6	115.3589	-31.06963

1.13 Vegetation

1.13.1 Plant Associations

The survey identified four plant communities within the site (Figure 2):

Melaleuca systema Low Shrubland (Plates 1, 2 & 4)

Low shrubland of *Melaleuca systema*, *Olearia axillaris* and *Spyridium globulosum* with *Cryptandra mutila* over a herbland of *Conostylis candicans* subsp. *calicicola*, *Conostylis ?pauciflora* subsp. *euryrhipis* and *Hemiandra glabra* on grey-cream sand on dunes.

Acacia rostellifera Tall Shrubland (Plates 3 & 5)

Tall shrubland of *Acacia rostellifera*, *Spyridium globulosum* and *Santalum acuminatum* over a herbland of *Acanthocarpus preissii*, *Lomandra maritima* and *Rhagodia baccata* subsp. *baccata* on grey-cream sands of flats and swales.

Spyridium globulosum Closed Shrubland (Plate 6)

Closed shrubland of *Spyridium globulosum*, *Melaleuca huegelii* subsp. *huegelii* and *Templetonia retusa* over a herbland of *Lepidosperma gladiatum*, *Rhagodia baccata* subsp. *baccata* and *Acanthocarpus preissii* on grey-cream sands of swales.

Melaleuca lanceolata Low Closed Forest

Closed low forest of *Melaleuca lanceolata* over Open shrubland of *Melaleuca huegelii* subsp. *huegelii* over a sedgeland of *Ficinia nodosa* and *Lepidosperma pubisquameum* on grey-cream sands of swales.

1.13.2 Vegetation Condition

Ecoscape (2007) previously reported most of the vegetation to be in 'Excellent' condition with the *Acacia rostellifera* Tall Shrubland mainly in 'Good' condition and the sand mining and blowout areas in 'Degraded' condition. The vegetation for most of the site including the *Melaleuca lanceolata* Low Closed Forest, *Spyridium globulosum* Closed Shrubland and *Melaleuca systema* Low Shrubland remains in an 'Excellent' condition and retains most of its original botanical value (Figure 3). A small blowout has developed adjacent to the northern boundary and is in a 'Completely Degraded' condition. Much of the *Acacia rostellifera* Tall Shrubland has improved to a 'Very Good' rating and some of the sand mined area has regenerated enough to now be considered in 'Good' condition with the bare areas rated as 'Completely Degraded'.

1.13.3 Conservation Significance

The hierarchical clustering assignments indicated that both of the vegetation units within the site are either FCT 29a – 'Coastal shrublands on shallow sands' or FCT 29b 'Acacia shrublands on taller dunes' (Appendix D). This result would be consistent with the locality, soils and position adjacent to the coast on the Swan Coastal Plain. Both FCT 29a and 29b are ranked as Priority 3 communities under Western Australian state policy.

Plot PC01 showed some similarity to the FCT 30a2 sub-type of the '*Callitris preissii* (or *Melaleuca lanceolata*) forests and woodlands'. This assignment is likely unreliable as FCT 30a is a woodland dominated by either *Callitris preissii* or *Melaleuca lanceolata*. To check the conservation status of the *Melaleuca lanceolata* woodland and ascertain if it is part of FCT 30a, the plot data for Plot Q2 from Ecoscape (2007) was also analysed. The results indicated an affinity to Swan Coastal Plain 19a, 'Sedgelands in Holocene dune swales', which is listed as a 'Critically Endangered' TEC under Western Australian criteria and as an 'Endangered' TEC under the EPBC Act. This result is also likely unreliable as FCT 19a is structurally a sedgeland and the assignment is likely due to the presence of species such as *Ficinia nodosa*, *Poa porphyroclados*, **Crassula glomerata* and **Bromus diandrus*, which are common in FCT 19a. The immediately adjacent vegetation of the neighbouring property to the north of the *Melaleuca lanceolata* woodland was observed to support sedges in a dampland and this may be influencing the assignment of Ecoscape Plot Q2.

1.13.4 Weeds

Eight of the taxa recorded during the survey are exotics (weeds). None is a Declared Pest under the Biosecurity and Agriculture Management Act 2007.

Discussion

The site has retained its botanical values since the previous survey and in some places the extent of native vegetation has increased.

1.14 Flora

No species of Threatened Flora were recorded during the survey.

Two species of Priority Flora were recorded within the site. Twenty-two plants of *Stylidium maritimum* (P3) were recorded at six locations within the *Melaleuca systema* Low Shrubland. An inspection of recorded occurrences by Ecoscape (2007) found no plants in the northern part of that community and additional occurrences in the southern part. This is not unusual as some plants will have senesced and new plants established in the interim. The number of individuals observed is similar indicating a relatively stable population size within the site.

Conostylis ?pauciflora subsp. *euryrhipis* was common throughout the *Melaleuca systema* Low Shrubland along with the congeneric *Conostylis candicans* subsp. *calicicola*, as well as parts of the *Acacia rostellifera* Tall Shrubland, but was too numerous to count accurately. This result also agrees with the observation of Ecoscape (2007). Three specimens were collected to confirm the identity of the taxon and it is the most likely result and consistent with the previous survey, but none of the identifications were definitive.

1.15 Plant Communities

The results of the FCT analysis indicate that the vegetation units identified within the site are either of FCT 29a 'Coastal shrublands on shallow sands' or FCT 29b 'Acacia shrublands on taller dunes'. Although the regional survey of Gibson *et al.* (1994) did not include the Lancelin area, the south-western and southern coastlines of Western Australia share similar environments and similar vegetation types and so an assignment to FCT using the Swan Coastal Plain dataset is considered appropriate. Both FCT 29a and 29b are listed as Priority 3 communities under state policy.

Similarity to other FCTs in the classification are likely due to misclassifications. Misclassifications occur because hierarchical clustering uses relative similarities between plots to form groups, which can be affected by the addition of new data. This can be common with the Swan Coastal Plain dataset as it is based on presence/absence of species rather than dominance (abundance). Plot PC01 was assigned to FCT 30a2, but this FCT is a woodland dominated by either *Callitris preissii* or *Melaleuca lanceolata* and the vegetation at PC01 is a *Melaleuca systema* shrubland as at the PC02 and PC04 plots. The FCT for the Ecoscape (2007) plot Q2 was assessed before the field survey as it is dominated by *Melaleuca lanceolata* and therefore was potentially part of FCT 30a, which listed as a TEC. The nearest assignment for the plot was to FCT 19a 'Sedgeland in Holocene dune swales', which is also a TEC, and secondarily to a FCT 29a/29b cluster. Again, the vegetation at this site is structurally incorrect for this assignment and is likely due to the presence in the understorey of sedge species such *Ficinia nodosa*. Sedge species were observed to be dominant in areas within the adjacent property to the north and FCT 19a may be present there and is influencing the understorey of the *Melaleuca lanceolata* woodland.

The Quindalup vegetation complex mapped as occurring within the site has more than 30% of its original extent remaining.

1.16 Vegetation Condition

Vegetation condition across the site has not altered significantly since the 2007 survey and has even improved in parts of the old sand mining area. A new blowout has formed in the north of the site, likely in the last ten years from inspection of historical aerial photography.

1.17 Weeds

None of the weeds recorded within the site is a Declared Pest under the Biosecurity and Agriculture Management Act 2007.

Summary

Lot 510 Old Ledge Point Rd, Lancelin has retained its botanical values since the previous survey and the extent of native vegetation has increased. In the intervening 13 years. Two Priority 3 communities have been identified within the site as well as two Priority Flora: *Stylidium maritimum* (P3) and *Conostylis ?pauciflora* subsp. *euryrhipis* (P4). The major habitat for the Priority Flora is the *Melaleuca systema* Low Shrubland, which occurs across the dunes and swales in the central and southern parts of the site and is the most extensive community within the site.

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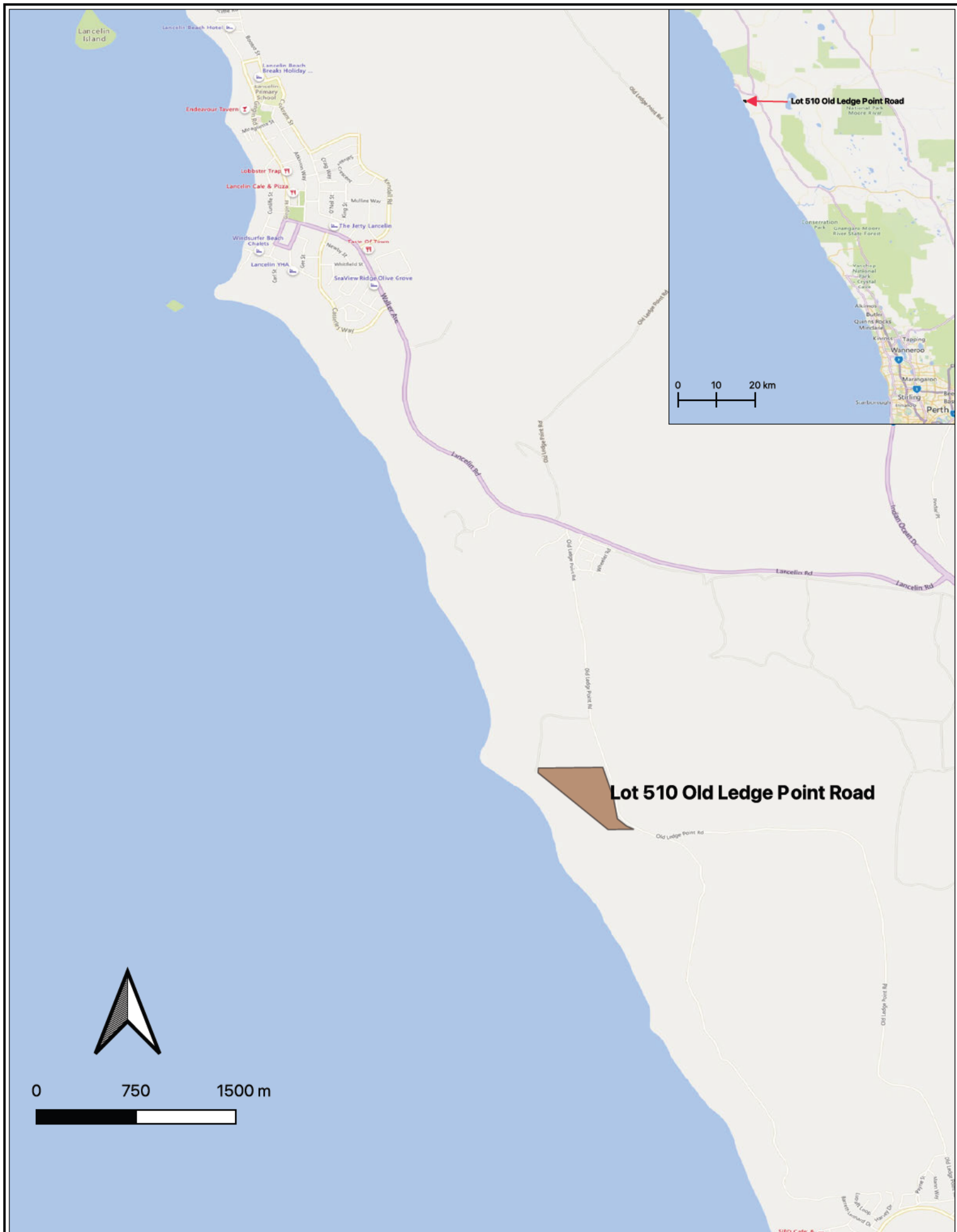


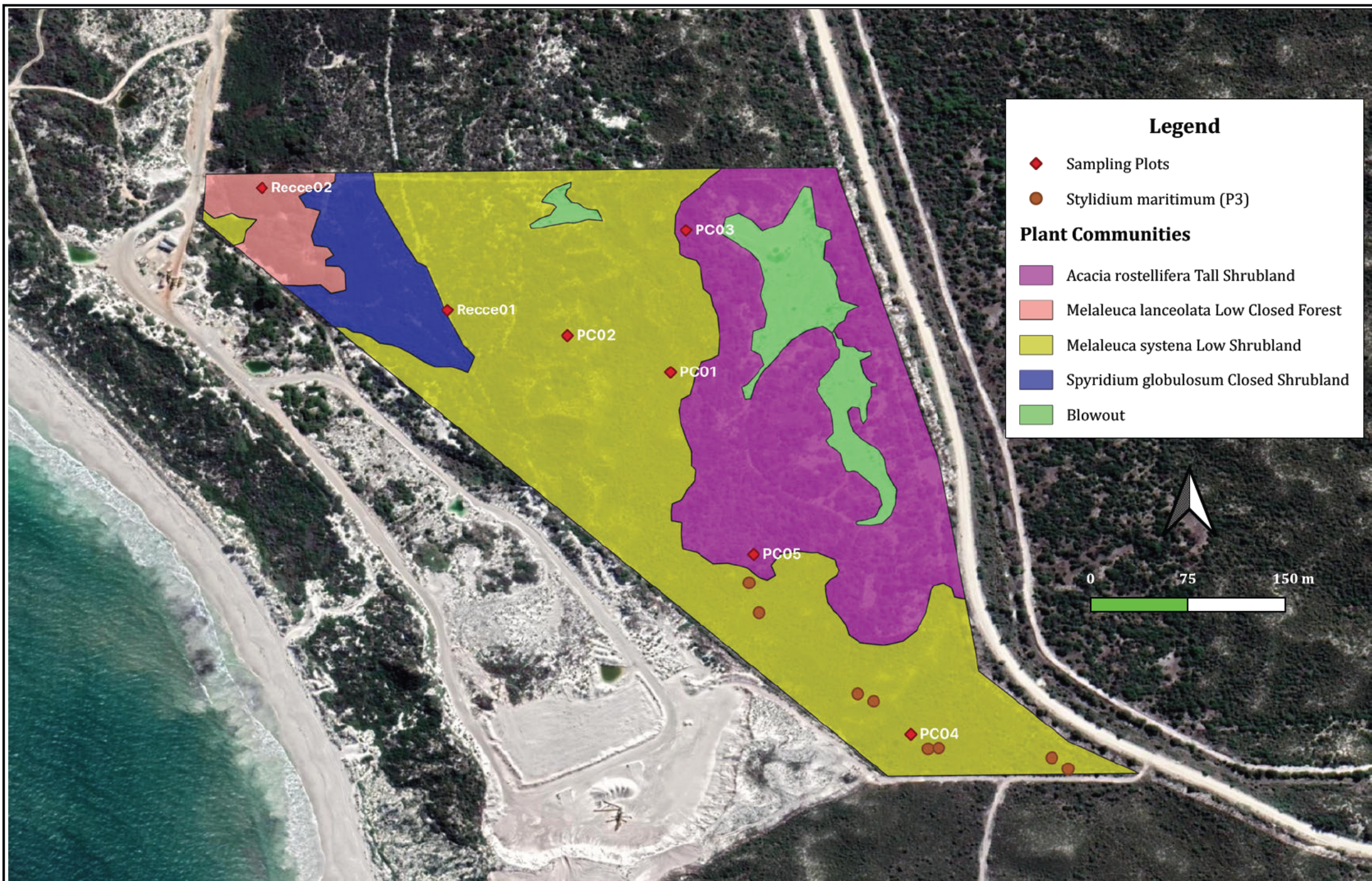
Figures

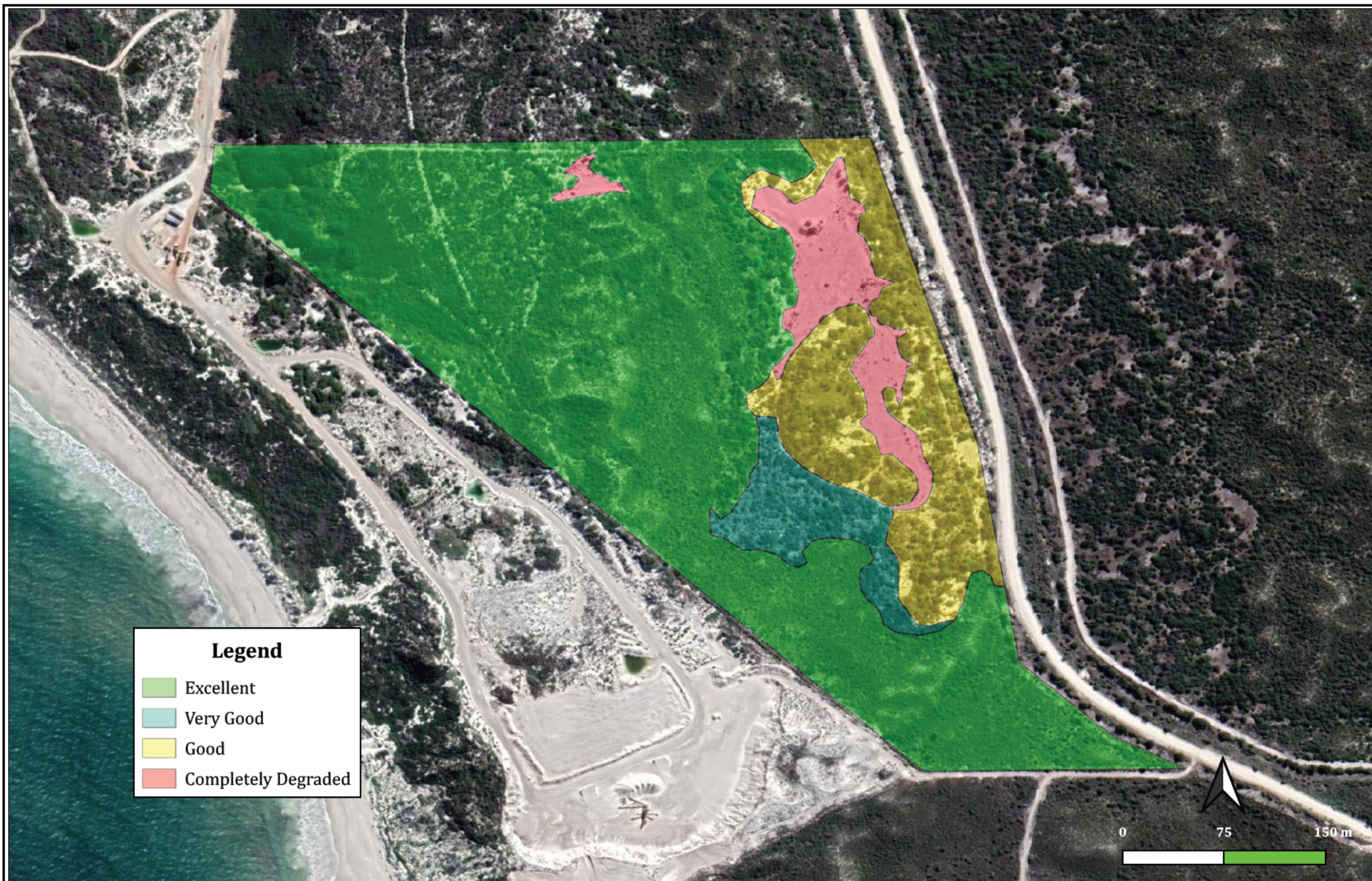
Figure 1: Locality Plan Lot 510 Old Ledge Point Road Flora and Vegetation Survey

Figure 2: Plant Communities Lot 510 Old Ledge Point Road Flora and Vegetation Survey

Figure 3: Vegetation Condition Lot 510 Old Ledge Point Road Flora and Vegetation Survey









Plates



Plate 1: View of sampling plot PC01: *Melaleuca systema* Low Shrubland



Plate 2: View of sampling plot PC02: *Melaleuca systema* Low Shrubland



Plate 3: View of sampling plot PC03: *Acacia rostellifera* Tall Shrubland



Plate 4: View of sampling plot PC04: *Melaleuca systema* Low Shrubland



Plate 5: View of sampling plot PC05: *Acacia rostellifera* Tall Shrubland



Plate 6: View of sampling plot Recce01: *Spyridium globulosum* Closed Shrubland



Appendix A

List of flora recorded within the survey area

NB: * indicates introduced flora

Family	Taxon
Lauraceae	<i>Cassytha aurea</i> var. <i>aurea</i> <i>Cassytha racemosa</i>
Asparagaceae	<i>Acanthocarpus preissii</i> <i>Lomandra maritima</i> <i>Thysanotus arenarius</i>
Asphodelaceae	<i>Trachyandra divaricata</i>
Hemerocallidaceae	<i>Dianella revoluta</i> var. <i>divaricata</i>
Haemodoraceae	<i>Conostylis ?pauciflora</i> subsp. <i>euryrhipis</i> <i>Conostylis candicans</i> subsp. <i>calicicola</i>
Cyperaceae	<i>Ficinia nodosa</i> <i>Lepidosperma gladiatum</i> <i>Lepidosperma pubisquameum</i> <i>Lepidosperma tetraquetrum</i>
Restionaceae	<i>Desmocladius flexuosus</i>
Poaceae	* <i>Austrostipa flavescens</i> * <i>Avena barbata</i> * <i>Bromus diandrus</i> * <i>Lolium rigidum</i> <i>Poa porphyroclados</i> <i>Rytidosperma occidentale</i> <i>Spinifex longifolius</i>
Ranunculaceae	<i>Clematis linearifolia</i>
Dilleniaceae	<i>Hibbertia racemosa</i>
Crassulaceae	<i>Crassula glomerata</i>
Fabaceae	<i>Acacia cyclops</i> <i>Acacia lasiocarpa</i> var. <i>lasiocarpa</i> <i>Acacia rostellifera</i> <i>Acacia truncata</i> <i>Gastrolobium nervosum</i> <i>Hardenbergia comptoniana</i> <i>Templetonia retusa</i>
Polygalaceae	<i>Comesperma confertum</i>
Rhamnaceae	<i>Cryptandra mutila</i> <i>Spyridium globulosum</i> <i>Trymalium ledifolium</i> var. <i>ledifolium</i>
Casuarinaceae	<i>Allocasuarina lehmanniana</i> subsp. <i>lehmanniana</i>

Family	Taxon
Celastraceae	<i>Stackhousia pubescens</i>
Euphorbiaceae	* <i>Euphorbia terracina</i>
Phyllanthaceae	<i>Phyllanthus calycinus</i>
Geraniaceae	* <i>Pelargonium capitatum</i>
Myrtaceae	<i>Calothamnus quadrifidus</i> subsp. <i>quadrifidus</i> <i>Melaleuca cardiophylla</i> <i>Melaleuca huegelii</i> subsp. <i>huegelii</i> <i>Melaleuca lanceolata</i> <i>Melaleuca systema</i>
Thymeleaceae	<i>Pimelea ferruginea</i>
Brassicaceae	* <i>Heliophila pusilla</i>
Santalaceae	<i>Exocarpos sparteus</i> <i>Leptomeria cunninghamii</i> <i>Santalum acuminatum</i>
Chenopodiaceae	<i>Rhagodia baccata</i> subsp. <i>baccata</i> <i>Rhagodia preissii</i> subsp. <i>preissii</i> <i>Threlkeldia diffusa</i>
Aizoaceae	<i>Carpobrotus virescens</i> <i>Tetragonia decumbens</i>
Montiaceae	<i>Calandrinia tholiformis</i>
Ericaceae	<i>Acrotriche cordata</i> <i>Leucopogon parviflorus</i> <i>Lysinema pentapetalum</i> <i>Styphelia insularis</i>
Rubiaceae	<i>Opercularia vaginata</i>
Scrophulariaceae	* <i>Dischisma arenarium</i> <i>Eremophila glabra</i> subsp. <i>albicans</i> <i>Myoporum insulare</i>
Lamiaceae	<i>Hemiandra glabra</i>
Campanulaceae	<i>Isotoma hypocrateriformis</i>
Stylidiaceae	<i>Stylidium scariosum</i>
Goodeniaceae	<i>Scaevola crassifolia</i> <i>Scaevola nitida</i>

Family	Taxon
Goodeniaceae	<i>Scaevola thesioides</i> subsp. <i>thesioides</i>
Asteraceae	<i>Asteridea pulverulenta</i> <i>Brachyscome bellidioides</i> <i>Olearia axillaris</i> <i>Rhodanthe citrina</i> <i>Senecio pinnatifolius</i> var. <i>latilobus</i> <i>Waitzia acuminata</i> var. <i>acuminata</i>
Araliaceae	<i>Trachymene cyanopetala</i>
Apiaceae	<i>Daucus glochidiatus</i>



Appendix B

Site x species matrix of flora recorded within plots in the survey area.

Taxon	PC01	PC02	PC03	PC04	PC05	Recce01	Recce02
<i>Acacia cyclops</i>	0.5						
<i>Acacia lasiocarpa</i> var. <i>lasiocarpa</i>	0.5	0.3	0.3	0.3	0.3		
<i>Acacia rostellifera</i>			10		15		
<i>Acacia truncata</i>		0.5					
<i>Acanthocarpus preissii</i>	2	10	3		2		
<i>Allocasuarina lehmanniana</i> subsp. <i>lehmanniana</i>						0.3	
<i>Asteridea pulverulenta</i>					0.1		
<i>Austrostipa flavescens</i>	0.1	0.2		0.1	0.2		
<i>Avena barbata</i>			0.2				
<i>Brachyscome bellidioides</i>				0.2			
<i>Bromus diandrus</i>	2	2	2		4		
<i>Calothamnus quadrifidus</i> subsp. <i>quadrifidus</i>						0.3	
<i>Carpobrotus virescens</i>		1	0.3				
<i>Cassytha aurea</i> var. <i>aurea</i>	0.1	0.2		0.1			
<i>Cassytha racemosa</i>		0.2	0.1	0.2			
<i>Clematis linearifolia</i>	0.2	0.2	0.1		2		
<i>Comesperma confertum</i>	23			0.2			
<i>Conostylis ?pauciflora</i> subsp. <i>euryrhipis</i>				0.1			
<i>Conostylis candicans</i> subsp. <i>calcicola</i>	0.2	0.2	0.1		0.2		
<i>Crassula glomerata</i>		0.1	0.1		0.1		
<i>Cryptandra mutila</i>				4			
<i>Daucus glochidiatus</i>		0.1	0.1				
<i>Dischisma arenarium</i>		0.1					
<i>Eremophila glabra</i> subsp. <i>albicans</i>	0.3			0.3			
<i>Euphorbia terracina</i>							
<i>Exocarpos sparteus</i>	0.3						
<i>Gastrolobium nervosum</i>		0.3					
<i>Hardenbergia comptoniana</i>					0.5		
<i>Heliophila pusilla</i>	0.5						
<i>Hemiandra glabra</i>	0.3	0.3		0.3	0.3		
<i>Hibbertia racemosa</i>		0.2					
<i>Isotoma hypocrateriformis</i>				0.1			
<i>Lepidosperma gladiatum</i>		1					
<i>Lepidosperma pubisquameum</i>	0.3		0.3	0.2			
<i>Leptomeria cunninghamii</i>				0.3			
<i>Leucopogon parviflorus</i>	2						
<i>Lolium rigidum</i>	10	0.2	1	0.5	0.3		
<i>Lomandra maritima</i>	3		0.5	2	0.5		
<i>Melaleuca cardiophylla</i>						0.3	
<i>Melaleuca huegelii</i> subsp. <i>huegelii</i>						35	
<i>Melaleuca lanceolata</i>							60
<i>Melaleuca systema</i>	9	1	1	20			
<i>Myoporum insulare</i>		3			7		
<i>Olearia axillaris</i>	0.3	1		0.4	0.3		
<i>Opercularia vaginata</i>		0.1					
<i>Poa porphyroclados</i>	0.5	0.2		0.5	0.2		
<i>Rhagodia baccata</i> subsp. <i>baccata</i>	1	1	1	0.3	1		
<i>Rhodanthe citrina</i>				0.1	0.1		
<i>Rytidosperma occidentale</i>				0.1			
<i>Santalum acuminatum</i>		0.3	25				
<i>Scaevola thesioides</i> subsp. <i>thesioides</i>			0.2	0.2			
<i>Senecio pinnatifolius</i> var. <i>latibolus</i>	0.1	0.1					
<i>Spinifex longifolius</i>		0.2					
<i>Spyridium globulosum</i>	1	6	15	2	5	35	
<i>Styphelia insularis</i>		0.3			0.4		
<i>Threlkeldia diffusa</i>		0.1					
<i>Trachyandra divaricata</i>	0.3		0.2				
<i>Trachymene cyanopetala</i>			0.1				
<i>Trymalium ledifolium</i> var. <i>ledifolium</i>	0.3	0.3					



Appendix C

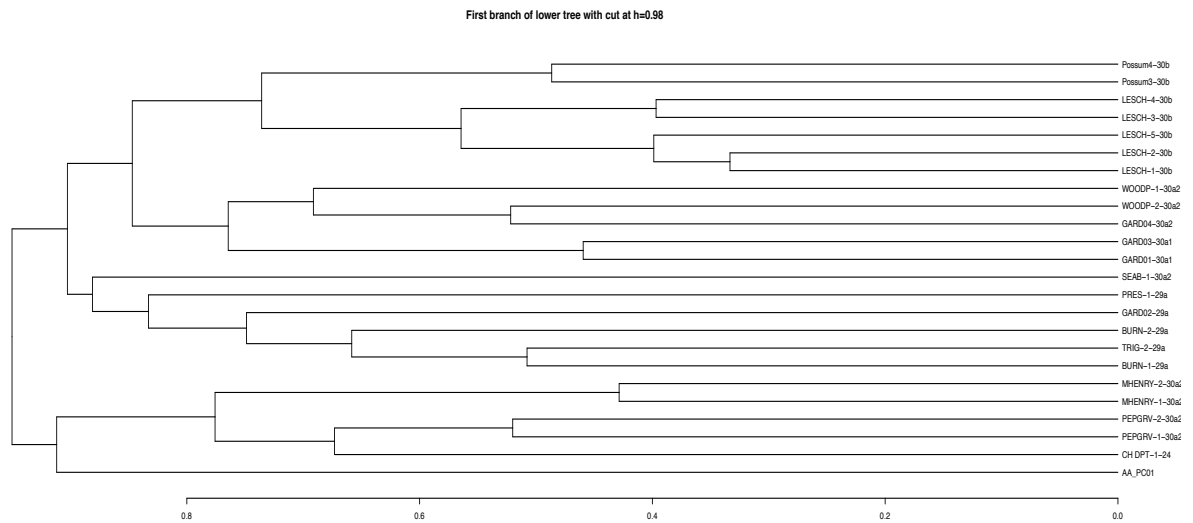
Sampling plot environmental data

Plot	PC1	PC02	PC03	PC04	PC05	Recce01	Recce02
Latitude (°)	-31.066431	-31.066136	-31.065285	-31.069354	-31.067902	-31.06593	-31.064943
Longitude (°)	115.35569	115.354858	115.355815	115.357628	115.35636	115.35389	115.352393
Aspect (classes)	W	W	E	N/A	SW	N/A	N/A
Slope (°)	2	5	1	0	3	N/A	N/A
Plot Shape	Quadrat	Quadrat	Quadrat	Quadrat	Quadrat	Recce	Recce
Plot Size (m ²)	100	100	100	100	100	N/A	N/A
Plot Width (m)	10	10	10	10	10	N/A	N/A
Plot Length (m)	10	10	10	10	10	N/A	N/A
Placement strategy	Preferential	Preferential	Preferential	Preferential	Preferential	Preferential	Preferential
Date	15/10/2020	15/10/2020	15/10/2020	15/10/2020	15/10/2020	15/10/2020	15/10/2020
Time Since Fire	>5	>5	>5	>5	>5	>5	>5
Bare Ground (%)	10	40	10	15	5	5	20
Bare Rock (%)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Litter (%)	3	10	20	5	35	20	55
Landform	Swale	Crest	Swale	Flat	Swale	Swale	Flat
Soil Colour	Cream	cream	Cream	Cream	Cream	Cream	Cream
Soil Texture	Sand	sand	Sand	Sand	Sand	Sand	Sand
Rock Type	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Vegetation Condition	Excellent	Excellent	Excellent	Excellent	Very good	Excellent	Very Good

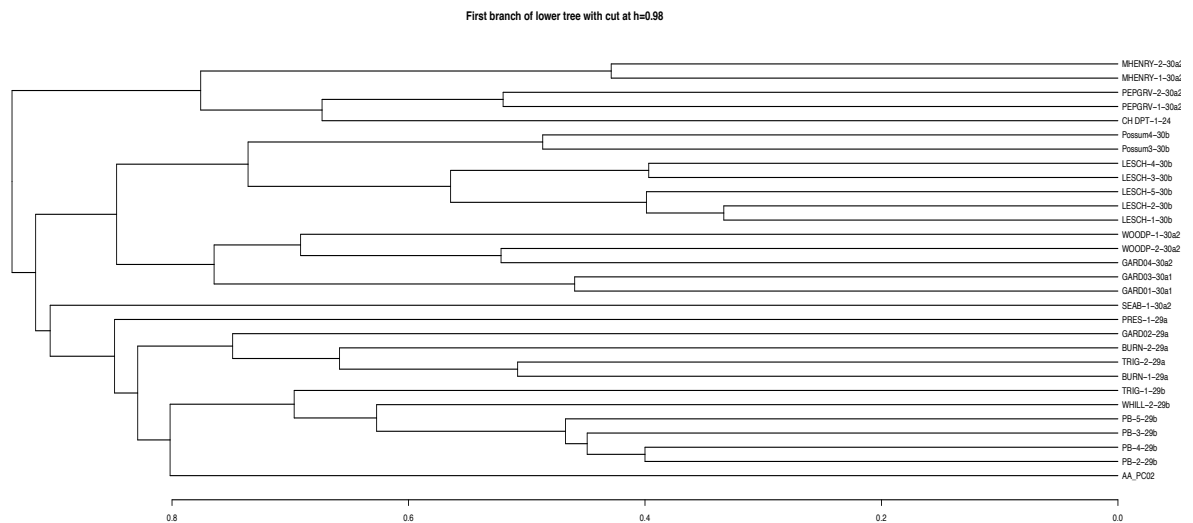


Appendix D

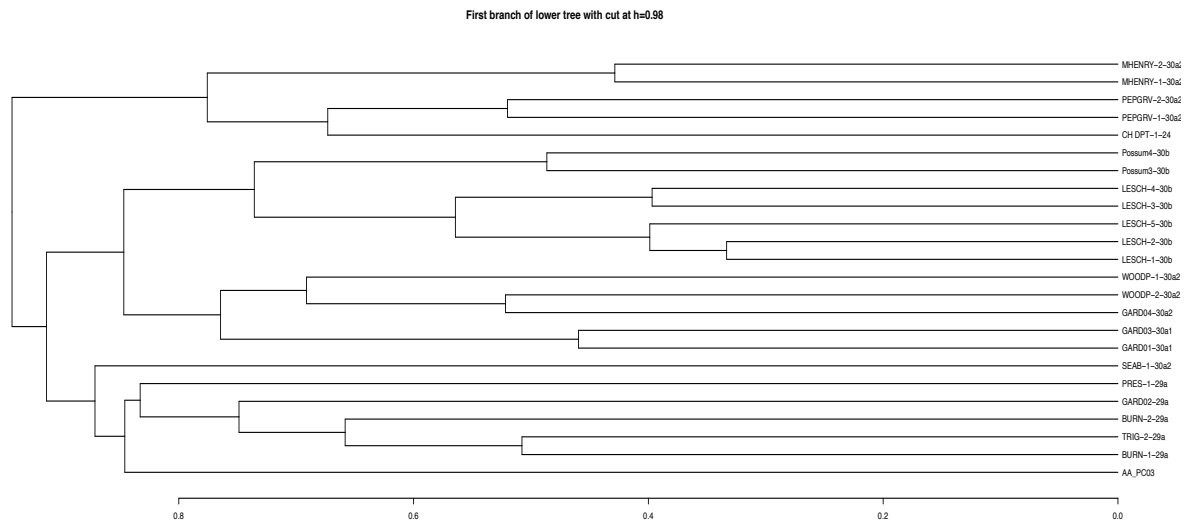
Partial dendrograms from hierarchical clustering assignment of plot floristics to the Swan Coastal Plain classification (Gibson et al. 1994)



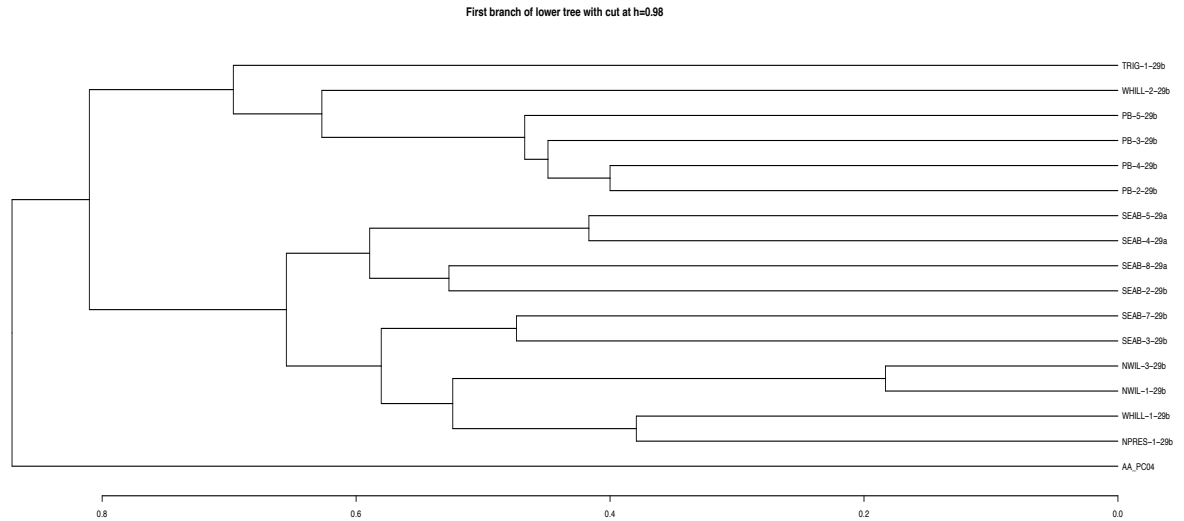
Partial Dendrogram for Plot PC01



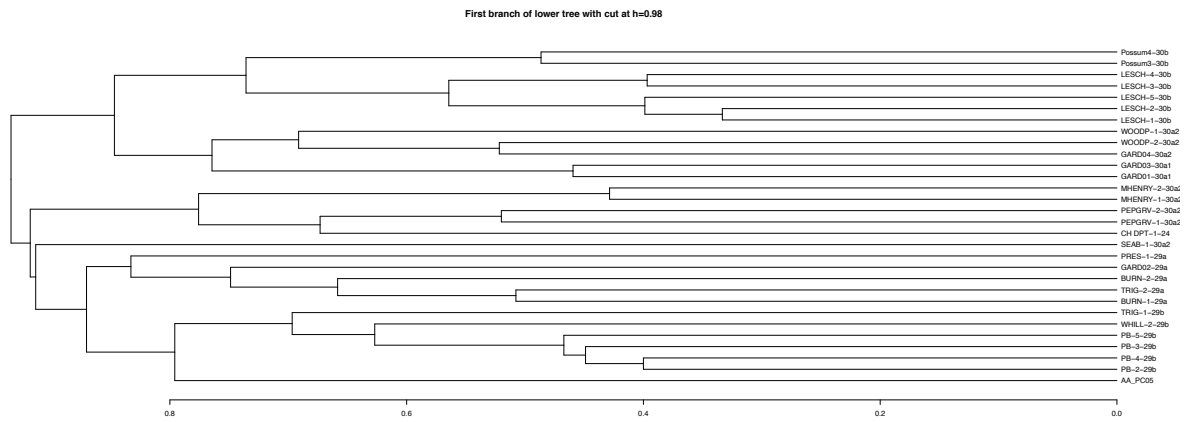
Partial Dendrogram for Plot PC02



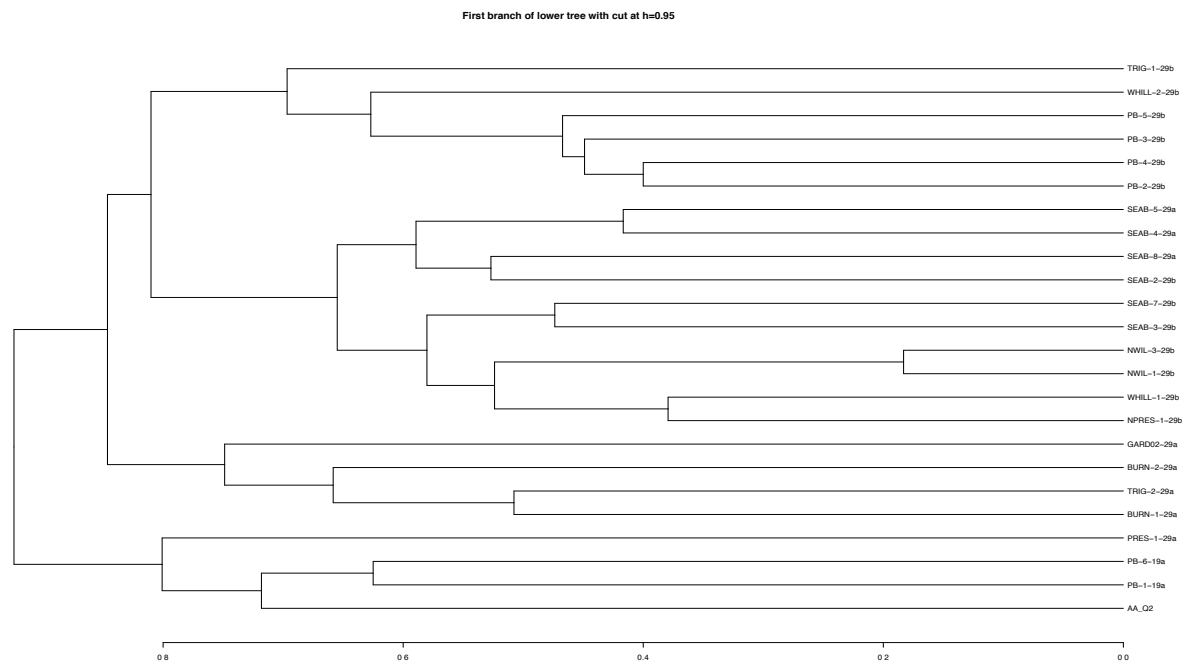
Partial Dendrogram for Plot PC03



Partial Dendrogram for Plot PC 04



Partial Dendrogram for Plot PC 05



Partial Dendrogram for Ecoscape Plot Q2



Appendix E

Definitions of Threatened and Priority Flora and Communities



CONSERVATION CODES

For Western Australian Flora and Fauna

Specially protected fauna or flora¹ are species² which have been adequately searched for and are deemed to be, in the wild, either rare, at risk of extinction, or otherwise in need of special protection, and have been gazetted as such.

Categories of specially protected fauna and flora are:

T Threatened species

Published as Specially Protected under the *Wildlife Conservation Act 1950*, and listed under Schedules 1 to 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora (which may also be referred to as Declared Rare Flora).

Threatened fauna is that subset of 'Specially Protected Fauna' declared to be 'likely to become extinct' pursuant to section 14(4) of the Wildlife Conservation Act.

Threatened flora is flora that has been declared to be 'likely to become extinct or is rare, or otherwise in need of special protection', pursuant to section 23F(2) of the Wildlife Conservation Act.

The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria as detailed below.

CR Critically endangered species

Threatened species considered to be facing an extremely high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.

EN Endangered species

Threatened species considered to be facing a very high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.

VU Vulnerable species

Threatened species considered to be facing a high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.

EX Presumed extinct species

Species which have been adequately searched for and there is no reasonable doubt that the last individual has died. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Presumed Extinct Fauna and Wildlife Conservation (Rare Flora) Notice for Presumed Extinct Flora.

IA Migratory birds protected under an international agreement

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 the Bonn Convention, relating to the protection of migratory birds. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice.

CD Conservation dependent fauna

Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 6 of the Wildlife Conservation (Specially Protected Fauna) Notice.

OS Other specially protected fauna

Fauna otherwise in need of special protection to ensure their conservation. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 7 of the Wildlife Conservation (Specially Protected Fauna) Notice.

P Priority species

Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened flora or fauna.

Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring.

Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.

1 Priority 1: Poorly-known species

Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.

2 Priority 2: Poorly-known species

Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.

3 Priority 3: Poorly-known species

Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.

4 Priority 4: Rare, Near Threatened and other species in need of monitoring

(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands.

(b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for Vulnerable, but are not listed as Conservation Dependent.

(c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

¹ The definition of flora includes algae, fungi and lichens

² Species includes all taxa (plural of taxon - a classificatory group of any taxonomic rank, e.g. a family, genus, species or any infraspecific category i.e. subspecies or variety, or a distinct population).

Categories of Threatened Species pursuant to the Environment Protection and Biodiversity Conservation Act 1999

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

Categories of Threatened Communities pursuant to the Environment Protection and Biodiversity Conservation Act 1999

Category	Definition
Critically Endangered	(1) An ecological community is eligible to be included in the <i>critically endangered</i> category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
Endangered	(2) An ecological community is eligible to be included in the <i>endangered</i> category at a particular time if, at that time: (a) it is not critically endangered; and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
Vulnerable	(3) An ecological community is eligible to be included in the <i>vulnerable</i> category at a particular time if, at that time: (a) it is not critically endangered nor endangered; and (b) it is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.

DEFINITIONS, CATEGORIES AND CRITERIA FOR THREATENED AND PRIORITY ECOLOGICAL COMMUNITIES

1. GENERAL DEFINITIONS

Ecological Community

A naturally occurring biological assemblage that occurs in a particular type of habitat.

Note: The scale at which ecological communities are defined will often depend on the level of detail in the information source, therefore no particular scale is specified.

A **threatened ecological community** (TEC) is one which is found to fit into one of the following categories; “presumed totally destroyed”, “critically endangered”, “endangered” or “vulnerable”.

Possible threatened ecological communities that do not meet survey criteria are added to DEC’s Priority Ecological Community Lists under Priorities 1, 2 and 3. Ecological Communities that are adequately known, are rare but not threatened, or meet criteria for Near Threatened, or that have been recently removed from the threatened list, are placed in Priority 4. These ecological communities require regular monitoring. Conservation Dependent ecological communities are placed in Priority 5.

An **assemblage** is a defined group of biological entities.

Habitat is defined as the areas in which an organism and/or assemblage of organisms lives. It includes the abiotic factors (eg. substrate and topography), and the biotic factors.

Occurrence: a discrete example of an ecological community, separated from other examples of the same community by more than 20 metres of a different ecological community, an artificial surface or a totally destroyed community.

By ensuring that every discrete occurrence is recognised and recorded future changes in status can be readily monitored.

Adequately Surveyed is defined as follows:

“An ecological community that has been searched for thoroughly in most likely habitats, by relevant experts.”

Community structure is defined as follows:

“The spatial organisation, construction and arrangement of the biological elements comprising a biological assemblage” (eg. *Eucalyptus salmonophloia* woodland over scattered small shrubs over dense herbs; structure in a faunal assemblage could refer to trophic structure, eg. dominance by feeders on detritus as distinct from feeders on live plants).

Definitions of Modification and Destruction of an ecological community:

Modification: “changes to some or all of ecological processes (including abiotic processes such as hydrology), species composition and community structure as a

direct or indirect result of human activities. The level of damage involved could be ameliorated naturally or by human intervention.”

Destruction: “modification such that reestablishment of ecological processes, species composition and community structure within the range of variability exhibited by the original community is unlikely within the foreseeable future even with positive human intervention.”

Note: Modification and destruction are difficult concepts to quantify, and their application will be determined by scientific judgement. Examples of modification and total destruction are cited below:

Modification of ecological processes: The hydrology of Toolibin Lake has been altered by clearing of the catchment such that death of some of the original flora has occurred due to dependence on fresh water. The system may be brought back to a semblance of the original state by redirecting saline runoff and pumping waters of the rising watertable away to restore the hydrological balance. Total destruction of downstream lakes has occurred due to hydrology being altered to the point that few of the original flora or fauna species are able to tolerate the level of salinity and/or water logging.

Modification of structure: The understorey of a plant community may be altered by weed invasion due to nutrient enrichment by addition of fertiliser. Should the additional nutrients be removed from the system the balance may be restored, and the original plant species better able to compete. Total destruction may occur if additional nutrients continue to be added to the system causing the understorey to be completely replaced by weed species, and death of overstorey species due to inability to tolerate high nutrient levels.

Modification of species composition: Pollution may cause alteration of the invertebrate species present in a freshwater lake. Removal of pollutants may allow the return of the original inhabitant species. Addition of residual highly toxic substances may cause permanent changes to water quality, and total destruction of the community.

Threatening processes are defined as follows:

“Any process or activity that threatens to destroy or significantly modify the ecological community and/or affect the continuing evolutionary processes within any ecological community.”

Examples of some of the continuing threatening processes in Western Australia include: general pollution; competition, predation and change induced in ecological communities as a result of introduced animals; competition and displacement of native plants by introduced species; hydrological changes; inappropriate fire regimes; diseases resulting from introduced microorganisms; direct human exploitation and disturbance of ecological communities.

Restoration is defined as returning an ecological community to its pre-disturbance or natural state in terms of abiotic conditions, community structure and species composition.

Rehabilitation is defined as the re-establishment of ecological attributes in a damaged ecological community although the community will remain modified.

2. DEFINITIONS AND CRITERIA FOR PRESUMED TOTALLY DESTROYED, CRITICALLY ENDANGERED, ENDANGERED AND VULNERABLE ECOLOGICAL COMMUNITIES

Presumed Totally Destroyed (PD)

An ecological community that has been adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future.

An ecological community will be listed as presumed totally destroyed if there are no recent records of the community being extant **and either** of the following applies (A or B):

- A) Records within the last 50 years have not been confirmed despite thorough searches of known or likely habitats **or**
- B) All occurrences recorded within the last 50 years have since been destroyed

Critically Endangered (CR)

An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated.

An ecological community will be listed as **Critically Endangered** when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future. This will be determined on the basis of the best available information, by it meeting **any one or more of** the following criteria (A, B or C):

- A) The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% **and either or both** of the following apply (i or ii):

- i) geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately 10 years);
- ii) modification throughout its range is continuing such that in the immediate future (within approximately 10 years) the community is unlikely to be capable of being substantially rehabilitated.

- B) Current distribution is limited, **and one or more** of the following apply (i, ii or iii):

- i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately 10 years);

ii) there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes;

iii) there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes.

C) The ecological community exists only as highly modified occurrences that may be capable of being rehabilitated if such work begins in the immediate future (within approximately 10 years).

Endangered (EN)

An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future.

An ecological community will be listed as **Endangered** when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. This will be determined on the basis of the best available information by it meeting **any one or more of** the following criteria (A, B, or C):

A) The geographic range, and/or total area occupied, and/or number of discrete occurrences have been reduced by at least 70% since European settlement **and either or both** of the following apply (i or ii):

i) the estimated geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is likely in the short term future (within approximately 20 years);

ii) modification throughout its range is continuing such that in the short term future (within approximately 20 years) the community is unlikely to be capable of being substantially restored or rehabilitated.

B) Current distribution is limited, **and one or more** of the following apply (i, ii or iii):

i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short term future (within approximately 20 years);

ii) there are few occurrences, each of which is small and/or isolated and all or most occurrences are very vulnerable to known threatening processes;

iii) there may be many occurrences but total area is small and all or most occurrences are small and/or isolated and very vulnerable to known threatening processes.

C) The ecological community exists only as very modified occurrences that may be capable of being substantially restored or rehabilitated if such work begins in the short-term future (within approximately 20 years).

Vulnerable (VU)

An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range.

An ecological community will be listed as **Vulnerable** when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction or significant modification in the medium (within approximately 50 years) to long-term future. This will be determined on the basis of the best available information by it meeting **any one or more of** the following criteria (A, B or C):

A) The ecological community exists largely as modified occurrences that are likely to be capable of being substantially restored or rehabilitated.

B) The ecological community may already be modified and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations.

C) The ecological community may be still widespread but is believed likely to move into a category of higher threat in the medium to long-term future because of existing or impending threatening processes.

3. DEFINITIONS AND CRITERIA FOR PRIORITY ECOLOGICAL COMMUNITIES

Possible threatened ecological communities that do not meet survey criteria or that are not adequately defined are added to the Priority Ecological Community List under priorities 1, 2 and 3. These three categories are ranked in order of priority for survey and/or definition of the community. Ecological communities that are adequately known, and are rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list, are placed in Priority 4. These ecological communities require regular monitoring. Conservation Dependent ecological communities are placed in Priority 5.

Priority One: Poorly-known ecological communities

Ecological communities that are known from very few occurrences with a very restricted distribution (generally ≤ 5 occurrences or a total area of $\leq 100\text{ha}$). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.

Priority Two: Poorly-known ecological communities

Communities that are known from few occurrences with a restricted distribution (generally ≤ 10 occurrences or a total area of $\leq 200\text{ha}$). At least some occurrences are not believed to be under immediate threat (within approximately 10 years) of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.

Priority Three: Poorly known ecological communities

- (i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or:
- (ii) communities known from a few widespread occurrences, which are either large or with significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat (within approximately 10 years), or;
- (iii) communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, inappropriate fire regimes, clearing, hydrological change etc.

Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.

Priority Four: Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring.

- (i) Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands.
- (ii) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for a higher threat category.
- (iii) Ecological communities that have been removed from the list of threatened communities during the past five years.

Priority Five: Conservation Dependent ecological communities

Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.