

# Bunbury Outer Ring Road Southern Section Vegetation and Flora Study (BORR IPT 2019a)

- Part 12 of 12

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Family	Genus	Species	Status	BORR IPT 2018	GHD 2015	GHD 2014	Biota 2016	Biota 2018
Restionaceae	<i>Leptocarpus</i>	<i>kraussii</i>		X				
Restionaceae	<i>Leptocarpus</i>	<i>laxus</i>		X				
Restionaceae	<i>Lepyrodia</i>	<i>glauca</i>		X				
Restionaceae	sp.				X	X		
Rhamnaceae	<i>Spyridium</i>	<i>globulosum</i>		X	X			X
Rubiaceae	<i>Galium</i>	<i>murale</i>	*	X	X		X	
Rubiaceae	<i>Opercularia</i>	<i>apiciflora</i>		X			X	X
Rubiaceae	<i>Opercularia</i>	<i>hispidula</i>		X		X		
Rubiaceae	<i>Opercularia</i>	<i>vaginata</i>		X	X			
Rutaceae	<i>Boronia</i>	<i>spathulata</i>		X				
Rutaceae	<i>Philotheca</i>	<i>spicata</i>		X	X	X		
Solanaceae	<i>Solanum</i>	<i>nigrum</i>	*	X	X	X		
Stylidiaceae	<i>Levenhookia</i>	<i>pusilla</i>		X				
Stylidiaceae	<i>Stylidium</i>	<i>? repens</i>				X		
Stylidiaceae	<i>Stylidium</i>	<i>araeophyllum</i>						X
Stylidiaceae	<i>Stylidium</i>	<i>brunonianum</i>		X			X	
Stylidiaceae	<i>Stylidium</i>	<i>calcaratum</i>		X				X
Stylidiaceae	<i>Stylidium</i>	<i>ciliatum</i>		X				
Stylidiaceae	<i>Stylidium</i>	<i>repens</i>					X	
Stylidiaceae	<i>Stylidium</i>	<i>schoenoides</i>		X			X	
Thymelaeaceae	<i>Pimelea</i>	<i>? rosea</i> subsp. <i>rosea</i>			X			
Thymelaeaceae	<i>Pimelea</i>	<i>rosea</i> subsp. <i>rosea</i>		X				
Typhaceae	<i>Typha</i>	<i>orientalis</i>				X		
Typhaceae	<i>Typha</i>	<i>orientalis</i>		X				
Verbenaceae	<i>Lantana</i>	<i>camara</i>	DP *	X				
Violaceae	<i>Hybanthus</i>	<i>calycinus</i>			X			X
Violaceae	<i>Hybanthus</i>	<i>floribundus</i>			X			
Xanthorrhoeaceae	<i>Chamaescilla</i>	<i>corymbosa</i>		X				
Xanthorrhoeaceae	<i>Xanthorrhoea</i>	<i>brunonis</i>		X	X	X	X	X
Xanthorrhoeaceae	<i>Xanthorrhoea</i>	<i>gracilis</i>		X				
Xanthorrhoeaceae	<i>Xanthorrhoea</i>	<i>preissii</i>			X			
Zamiaceae	<i>Macrozamia</i>	<i>riedlei</i>		X	X	X	X	X

\* Denotes introduced species

### Priory Flora locations (PCG)

Taxon	Status	Easting	Northing
<i>Acacia semitrullata</i>	P4	35420	101317
<i>Acacia semitrullata</i> (MGA50)	P4	375371	6301889
<i>Acacia semitrullata</i> (MGA50)	P4	375767	6301944
<i>Acacia semitrullata</i> (MGA50)	P4	375872	6301877
<i>Acacia semitrullata</i> (MGA50)	P4	375872	6301858
<i>Caladenia speciosa</i>	P4	31440	99048
<i>Caladenia speciosa</i>	P4	32060	99458
<i>Caladenia speciosa</i>	P4	32293	99511
<i>Caladenia speciosa</i>	P4	32162	99510
<i>Caladenia speciosa</i>	P4	32488	99535
<i>Caladenia speciosa</i>	P4	32502	99559
<i>Caladenia speciosa</i>	P4	32523	99558
<i>Caladenia speciosa</i>	P4	32545	99582
<i>Caladenia speciosa</i>	P4	32560	99588
<i>Caladenia speciosa</i>	P4	32581	99545
<i>Caladenia speciosa</i>	P4	32543	99567
<i>Caladenia speciosa</i>	P4	32501	99559
<i>Caladenia speciosa</i>	P4	34200	100374
<i>Caladenia speciosa</i>	P4	31474	99269

### Declared Weed locations (PCG)

Taxon	Easting	Northing
<i>Zantedeschia aethiopica</i>	35945.8417	103535.5991
<i>Zantedeschia aethiopica</i>	36131.7239	103680.8176
<i>Zantedeschia aethiopica</i>	36438.5306	103774.0649
<i>Moraea flaccida</i>	36438.5306	103774.0649
<i>Zantedeschia aethiopica</i>	35223.095	104264.2506
<i>Zantedeschia aethiopica</i>	35323.122	104370.791
<i>Zantedeschia aethiopica</i>	36131.6416	103504.3384
<i>Moraea flaccida</i>	36155.8708	103524.1302
<i>Zantedeschia aethiopica</i>	35214.0509	103465.0103
<i>Zantedeschia aethiopica</i>	35724.7057	103120.6743
<i>Leptospermum laevigatum</i>	32259.822	99468.4197
<i>Zantedeschia aethiopica</i>	31845.5941	99276.3679
<i>Asparagus asparagoides</i>	35315.8569	101656.1596
<i>Lantana camara</i>	32985.12784	102204.6898
<i>Zantedeschia aethiopica</i>	31607.279	99054.08438
<i>Zantedeschia aethiopica</i>	31521.28924	99000.63844
<i>Asparagus asparagoides</i>	31845.5941	99276.3679
<i>Zantedeschia aethiopica</i>	32107.2985	99559.309
<i>Moraea flaccida</i>	32107.2985	99559.309
<i>Moraea flaccida</i>	36131.7239	103680.8176



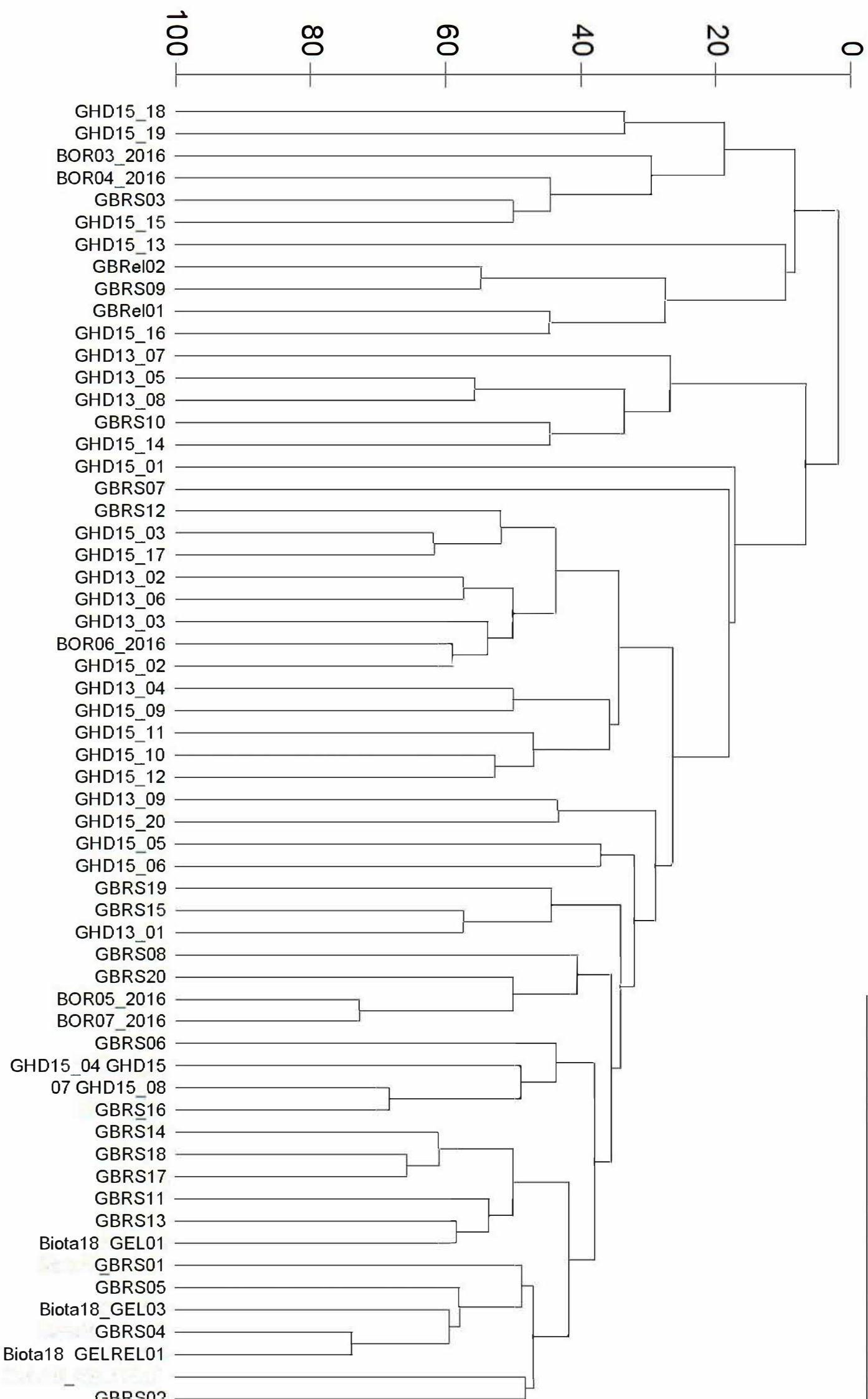
## APPENDIX F

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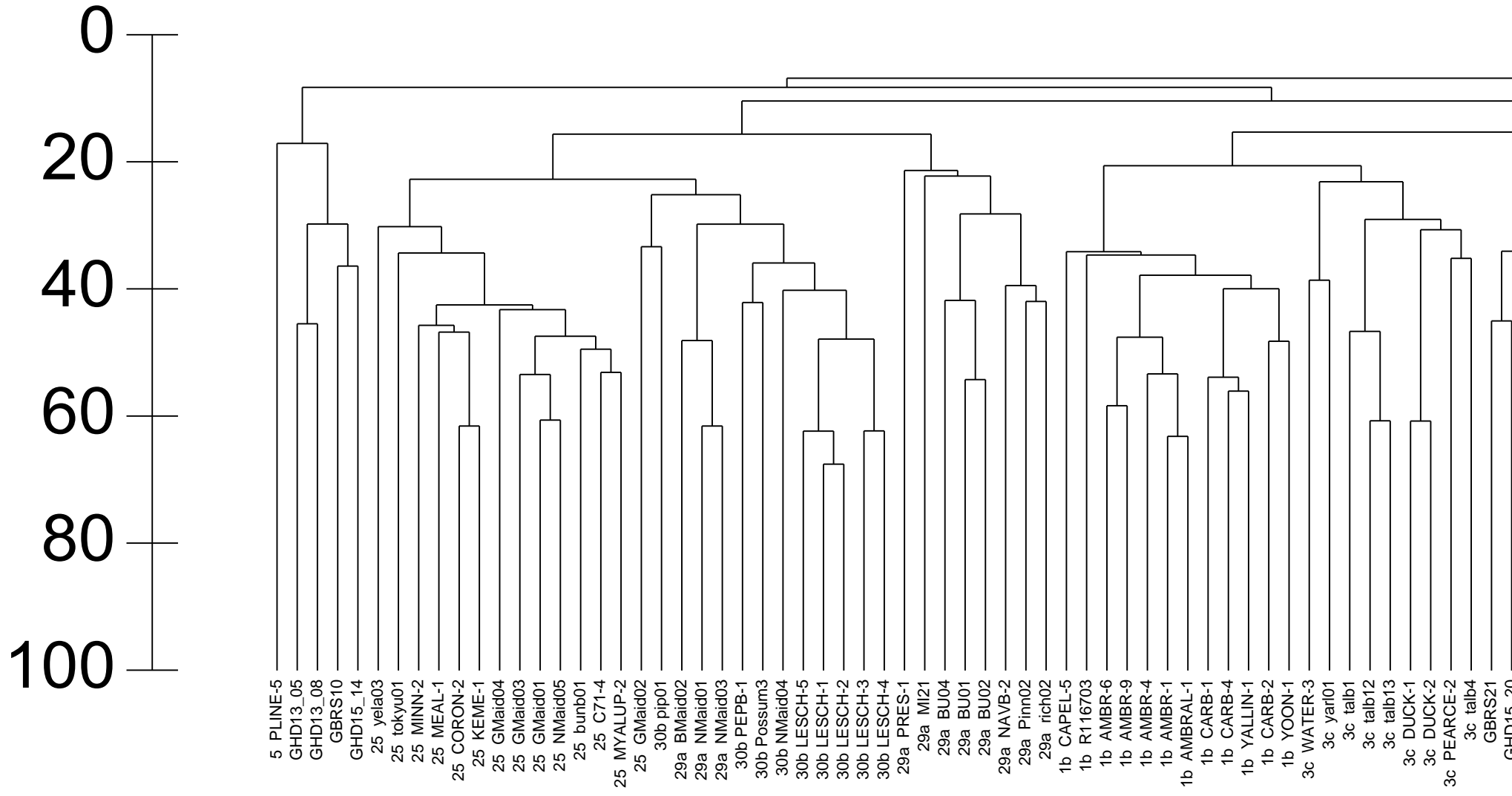
# Vegetation Statistics

# Quadrats (no weeds)

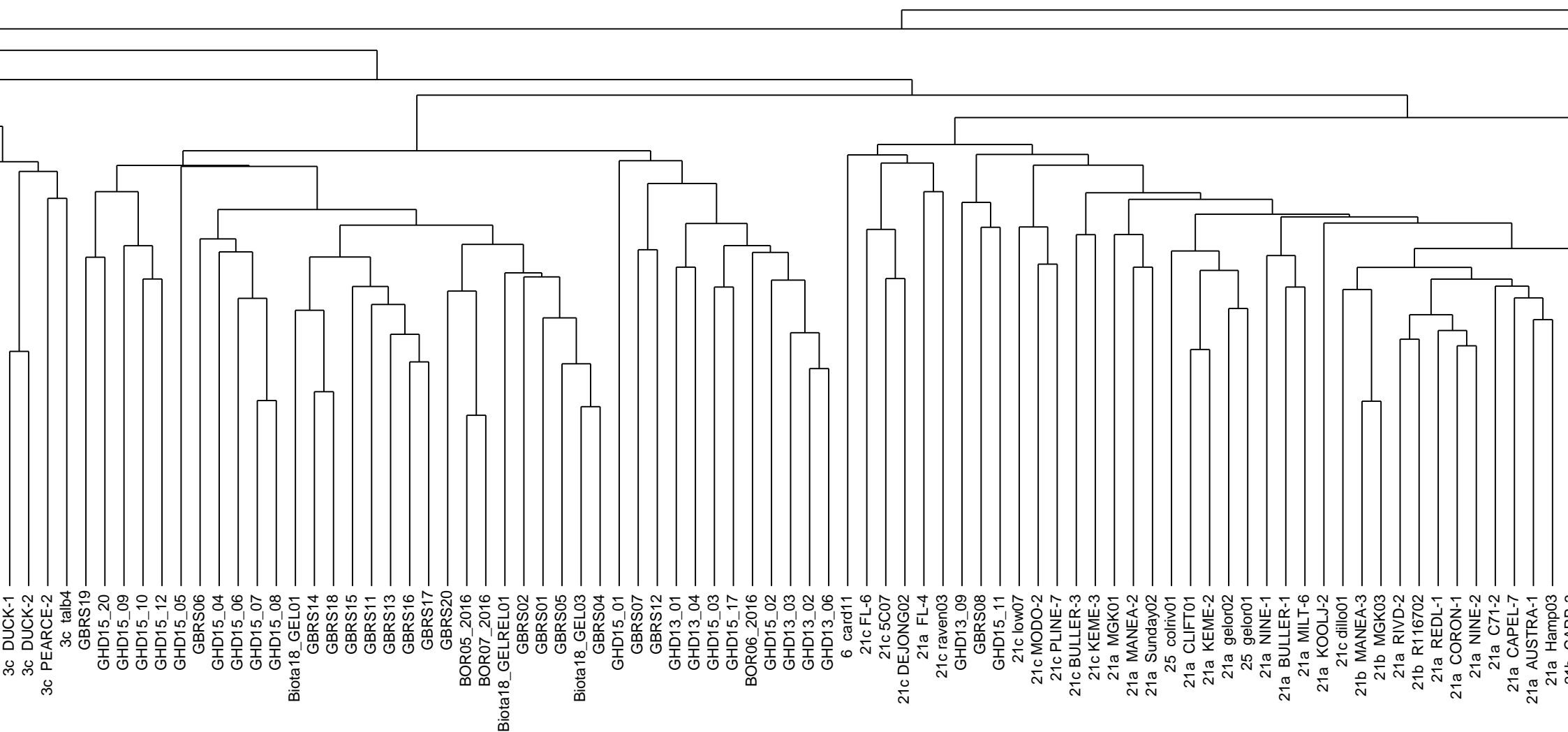
Resemblance: S17 Bray Curtis similarity



Similarity



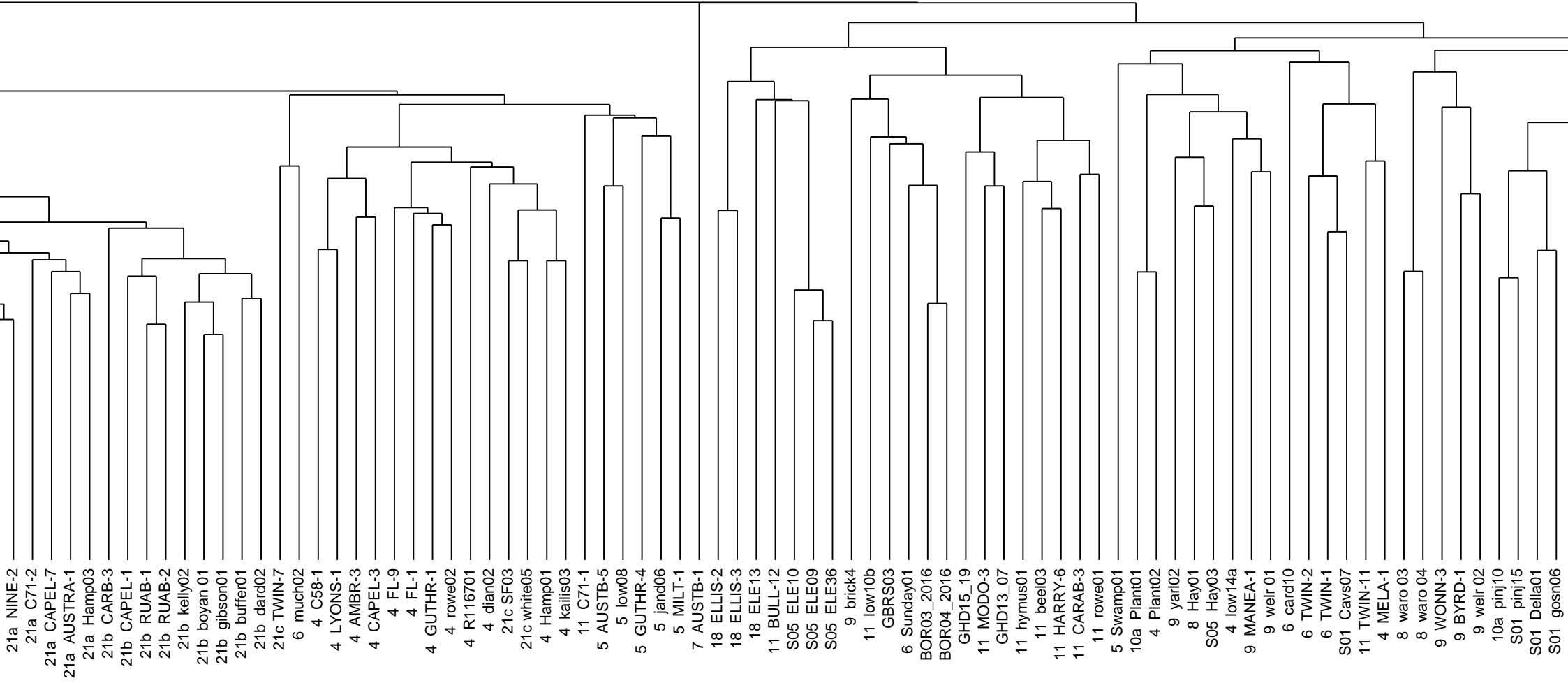
Group av



Sample

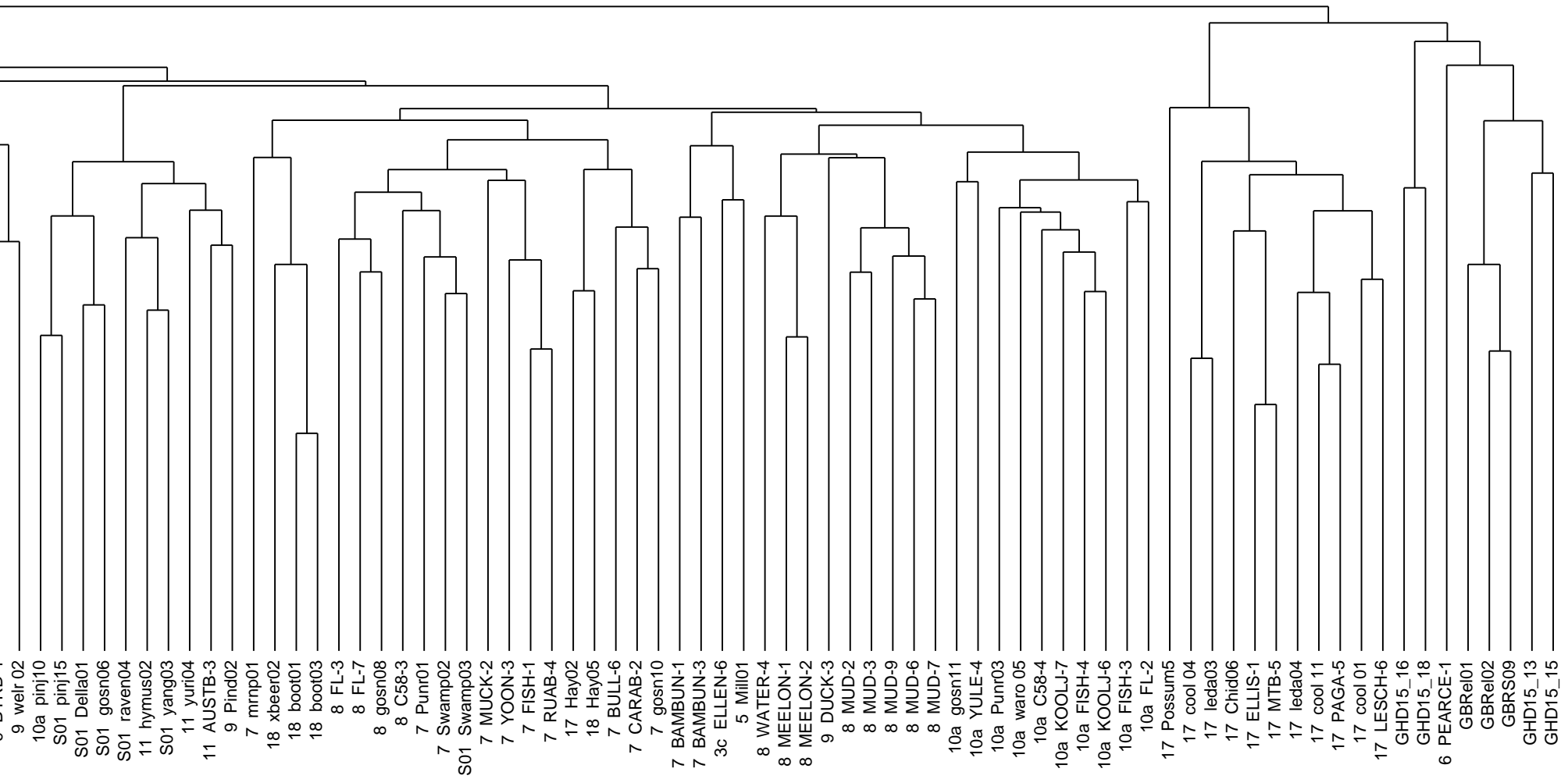


average



Samples


# Resemblance: S17 Bray Curtis similarity



# Threatened Ecological Community (TEC) Assessment

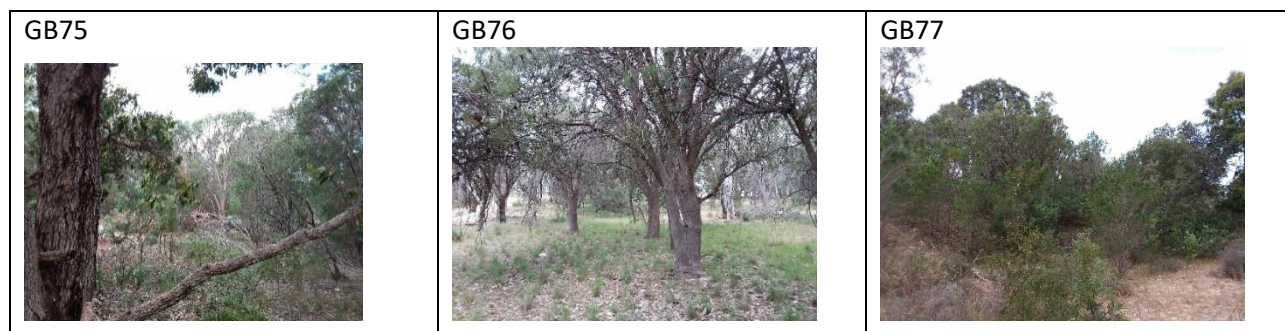
## Centenary Road – Banksia TEC Assessment

Patch Name	Location	Polygon Size	Vegetation Type
Centenary Road	Centenary Road, near Bussel Highway	7.45 ha within survey areas and connected to Mannea Park and airport bushland (much larger remnant – greater than 200 ha – not assessed for vegetation types / banksia TEC.	VT1 – Open forest of <i>Eucalyptus marginata</i> , <i>Corymbia calophylla</i> and <i>Banksia attenuata</i> on Karrakatta deep sands.
Landform and soil		Condition	
Low hill, grey sand.		Ranges from Very Good to Good with a small section of Good – Degraded (near Bussel Highway – GB76 and 77).	
Notes: Connected to a broader patch outside of the survey area – would meet patch size and condition threshold. One representative quadrat for the patch (Q11) and photographic points; GB75,  Note that the eastern end of the polygon transitions into damper / wetland areas with <i>Kunzea glabrescens</i> present / becoming dominant.			
Outcome: patch meets vegetation condition and structural / floristic requirements for Banksia TEC.			

Site		GBQ11			
Type: Quadrat		Size: 10 x 10	Date: 31/10/2018	Described by: MT	
Co-ordinates (PCG94)		Easting:	34440.5372	Northing:	104446.3494
Location: P Road					
Vegetation Type: VT1					
Landform: Mid Slope Slope: Gentle		Drainage: Good			
Soil Colour & Type: Yellow Silty Sand					
Vegetation Condition: Good (4)					
Disturbances: Weeds, clearing for adjacent fire break					
Fire Age & Intensity: Old > 5 yr – few trees killed					
Bare Ground: 11-30% Humus/Litter: Moderate – 31-70%					
Wood Litter: Moderate					

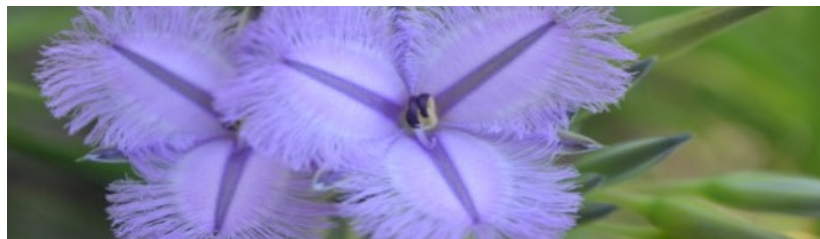
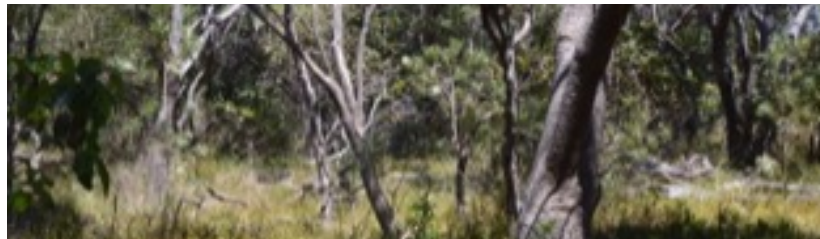
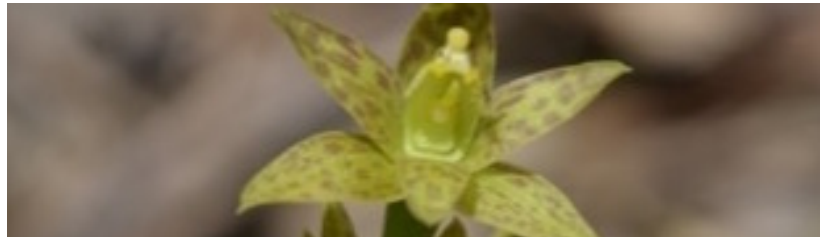
Family	Taxon	Status	Stratum	Cover (%)	Height (m)
Araliaceae	<i>Trachymene pilosa</i>	0	G1	<2N	0.05
Asparagaceae	<i>Dichopogon capillipes</i>	0	G1	<2N	0.1
Asparagaceae	<i>Phlebocarya ciliata</i>	0	G1	<10	0.3
Asparagaceae	<i>Sowerbaea laxiflora</i>		G1	<2N	0.4
Asteraceae	<i>Hypochaeris glabra</i>	*	G2	<2N	0.02
Asteraceae	<i>Lagenophora huegelii</i>	0	G2	<2N	0.05
Cyperaceae	<i>Lepidosperma pubisquameum</i>	0	G1	<2T	0.3
Dilleniaceae	<i>Hibbertia hypericoides</i> subsp <i>hypericoides</i>	0	M1	30-10	0.4
Droseraceae	<i>Drosera stolonifera</i>	0	G2	<2N	0.1
Ericaceae	<i>Leucopogon propinquus</i>		M1	<2T	0.6

Ericaceae	<i>Petrophile linearis</i>	0	M3	<2T	0.1
Fabaceae	<i>Hardenbergia comptoniana</i>		M3	<2T	0.2
Fabaceae	<i>Trifolium campestre</i>	*	G2	<2N	0.1
Haemodoraceae	<i>Conostylis aculeata</i> subsp <i>preissii</i>	0	G2	<2N	0.1
Hemerocallidaceae	<i>Dianella revoluta</i>	0	G1	<2N	0.3
Hemerocallidaceae	<i>Stypandra glauca</i>	0	G1	<2N	0.1
Iridaceae	<i>Patersonia occidentalis</i>	0	G1	<2T	0.2
Iridaceae	<i>Romulea rosea</i>	*	G2	<2N	0.05
Myrtaceae	<i>Agonis flexuosa</i>	0	U2	70-30	8
Myrtaceae	<i>Corymbia calophylla</i>		U1	10-30	8
Orchidaceae	<i>Microtis</i> sp. nf tall (45 cm)	0	G1	<2T	0.4
Orchidaceae	<i>Thelymitra benthamiana</i>	0	G1	<2T	0.2
Poaceae	<i>Briza maxima</i>	*	G1	<2N	0.2
Poaceae	<i>Ehrharta calycina</i>	*	G1	<2N	0.1
Primulaceae	<i>Lysimachia arvensis</i>	*	G2	<2N	0.05
Proteaceae	<i>Banksia attenuata</i>	0	U1	30-10	4-6
Restionaceae	<i>Desmocladus fascicularis</i>	0	G2	<2N	0.1
Restionaceae	<i>Desmocladus flexuosa</i>	0	G1	<2N	0.1
Rubiaceae	<i>Opercularia hispidula</i>		G1	<10	0.4
Xanthorrhoeaceae	<i>Chamaescilla corymbosa</i>	0	G1	<2N	0.1
Xanthorrhoeaceae	<i>Xanthorrhoea brunonis</i>	0	M1	<2T	0.4
Zamiaceae	<i>Macrozamia riedlei</i>	0	M1	<2T	0.4





# **Bunbury Outer Ring Road Southern Section – *Banksia* Woodlands TEC Assessment**







© Biota Environmental Sciences Pty Ltd 2018  
ABN 49 092 687 119  
Level 1, 228 Carr Place  
Leederville Western Australia 6007  
Ph: (08) 9328 1900 Fax: (08) 9328 6138

Job No.: 1343

Prepared by: P.L de Kock

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# Bunbury ORR – TEC Assessment

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# 1.0 Summary

## 1.1 Background and Scope of the Study

Main Roads Western Australia (Main Roads) is currently in the process of obtaining approval for the development of the Bunbury Outer Ring Road (BORR) Southern Section ('the study area'), extending 9.6 km from South Western Highway to Bussell Highway, Gelorup.

The Commonwealth listed Threatened Ecological Community (TEC) '*Banksia* Woodlands of the Swan Coastal Plain' (hereafter the Commonwealth TEC) corresponds to several high level floristic community types (FCTs) that were identified by Gibson et al. (1994) following a survey of the southern Swan Coastal Plain (SCP) (see Commonwealth of Australia 2016). Areas of *Banksia* woodlands communities must be in at least 'Good' condition to be considered part of the Commonwealth TEC, and must also meet minimum patch size requirements, which vary with the condition ranking (e.g. there is no minimum size for areas in Pristine condition, however areas that are in 'Good' condition must be 2 ha or greater).

Previous sampling by GHD (2015), followed by a reassessment of floristic communities by Biota Environmental Sciences (Biota) (2016), identified the presence of one of the relevant SCP FCTs in the study area: FCT 21a ('Central *Banksia attenuata*–*Eucalyptus marginata* woodlands'). Biota was commissioned to undertake a targeted vegetation and flora survey of the study area in 2017. The study was aimed at clarifying the extent of the Commonwealth TEC, with the specific objectives being to:

- record additional flora data within the *Banksia* woodlands in the study area;
- analyse these data against the regional data set from the SCP survey (Gibson et al. 1994); and
- confirm the extent of the Commonwealth TEC in the study area.

## 1.2 Methods

A desktop assessment was conducted to identify "Target Areas" in the study area with the potential to support the Commonwealth TEC. The desktop assessment considered the criteria outlined by the Commonwealth of Australia (2016), along with existing botanical data (GHD 2015, Biota 2016).

This process identified 24 Target Areas (T1 through T24). Further to the above, an initial assessment was then made for each of the Target Areas to determine the likelihood of the Commonwealth TEC being present.

The field survey was conducted between the 4<sup>th</sup> and 6<sup>th</sup> of November 2017 by Pierre-Louis de Kock and Simon Colwill (botanists with Biota). Each Target Area was traversed to record fine-scale differences in vegetation structure and condition, and to confirm if the Commonwealth TEC was present. Five standard 10 m x 10 m quadrats and one relevé of equivalent size (i.e. 100 m<sup>2</sup>) were established across six of the Target Areas that were considered likely to represent the Commonwealth TEC.

All taxa present in the quadrats were recorded, and the resulting presence / absence data were subsequently used to run a number of analyses using PATN v3.12. In keeping with the original SCP analysis by Gibson et al. (1994), all weeds were included; singletons and taxa identified only to genera were removed; and some species were combined in the data set.

The analyses comprised:

1. Classification of sites and species using an agglomerative hierarchical fusion technique (sites: 30 groups, Bray Curtis association followed by flexible "unweighted pair-group mean average" (UPGMA); species: 35 groups, TWOSTEP association followed by flexible UPGMA).
2. Nearest Neighbour (NNB) analysis of sites to identify the 10 most similar sites to each new quadrat (Bray Curtis association followed by NNB).

Each quadrat and relev  was added individually to the SCP data set. The dendrograms produced from the floristic classifications were investigated together with the results of the NNB analysis to identify the most probable FCT for each quadrat, and then an overall FCT for the vegetation type.

A final assessment was made for each of the Target Areas to confirm whether the Commonwealth TEC was present, and to delineate boundaries around those areas (i.e. patches) that were considered to qualify.

## 1.3 Results

The desktop assessment identified that of the 24 Target Areas, the Commonwealth TEC was thought to be 'not present' in seven of these, 'unlikely' in two, 'possible' in three, and 'likely' in 12. With the data recorded from the field assessment, four of the 24 Target Areas were found to consist entirely of the Commonwealth TEC and six of the Target Areas included sections of the TEC (e.g. one or more patches). The remaining 14 Target Areas did not contain any Commonwealth TEC.

The total mapped extent of the Commonwealth TEC across the Target Areas comprised 175.1 ha, which was distributed in 12 patches from T8 west to T22. The two largest patches were at T22 (117.0 ha) and T12 (14.0 ha), while the smallest occurrence was in T19 (1.7 ha).

Only 23.3 ha of this total extent occurred within the study area (i.e. within impact areas), and two of the patches of the Commonwealth TEC were entirely outside the study area (T8 and T16). The patches of the Commonwealth TEC intersected by the study area occurred from T11 to T22 (i.e. in the western half of the study area). The largest occurrences of the Commonwealth TEC within the study area were in T18 (6.0 ha) and T17 (5.5 ha), both in the far west of the study area. The smallest occurrence of the TEC within the study area was 0.2 ha at T23.

Condition of the Target Areas ranged from 'Completely Degraded' to 'Excellent'. Disturbance from introduced flora (weeds), trampling by large numbers of Kangaroos, and tracks dissecting the Target Areas have had a significant impact on the health of the vegetation. In addition, agricultural properties were prevalent east of Yalinda Road and many of the Target Areas carried cattle. Large areas were subsequently rated as being in 'Degraded to Completely Degraded' condition, comprising only a remnant overstorey with a weedy understorey (i.e. little to no native understorey present).

The condition of the six sampling sites ranged from 'Very Good' to 'Excellent'. The understorey in the majority of quadrats was mostly intact, however there were varying levels of disturbance including heavy trampling by Kangaroos, and invasion by weeds. A total of 92 native flora taxa from 55 genera in 30 families were recorded from the study area, which did not include any Threatened or Priority flora species. A total of 20 introduced flora species were recorded during the survey. Two of these, *\*Asparagus asparagoides* (Bridal Creeper) and *\*Zantedeschia aethiopica* (Arum Lily), are listed as declared pests for the Shire of Capel, with *\*A. asparagoides* also listed as a Weed of National Significance.

Investigation of the floristic classification placed all sites from the current survey within FCT21a: Central *Banksia attenuata* – *Eucalyptus marginata* woodlands, which is one of a number of FCTs included within the Commonwealth TEC (see Commonwealth of Australia 2016).

## 2.0 Introduction

Main Roads is proposing to develop the BORR on the southern SCP. It is anticipated that this road will provide an alternative route for inter-regional traffic around Bunbury, to reduce congestion on the existing network, and improve access to the developing industrial areas southeast of Bunbury. The southern section of the BORR is 9.6 km long, and extends from the South Western Highway to Bussell Highway in Gelorup.

The proposed alignment of the southern section of the BORR intersects 10 areas of remnant bushland (S1 through S10; hereafter referred to as the study area) (see Figure 2.1). These areas of remnant bushland were initially surveyed by GHD (2012, 2015), and reassessed for FCTs by Biota (2016).

The 'Banksia Woodlands of the Swan Coastal Plain' Commonwealth TEC was recently listed (September 2016) as a TEC for the SCP under the *Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act), and is currently listed as Endangered. The Commonwealth TEC corresponds to several high level FCTs identified by Gibson et al. (1994), some of which are also recognised as Threatened or Priority Ecological Communities at the State level (see Table 2.1). One of the floristic groups included in the Commonwealth TEC, FCT 21a, has previously been identified within the study area (GHD 2015, Biota 2016). FCT 21a is not currently listed as Threatened at the State level.

**Table 2.1: Floristic community types that occur on the Swan Coastal Plain and have relationships to the 'Banksia Woodlands of the Swan Coastal Plain' Commonwealth TEC (Commonwealth of Australia 2016).**

Community Name	Floristic Community Type (Gibson et al. 1994)	State Listing
<i>Banksia attenuata</i> woodlands over species rich dense shrublands	FCT 20a	Threatened: Endangered
Eastern <i>Banksia attenuata</i> and/or <i>Eucalyptus marginata</i> woodlands	FCT 20b	Threatened: Endangered
Eastern shrublands and woodlands	FCT 20c	Threatened: Critically Endangered
Central <i>Banksia attenuata</i> - <i>Eucalyptus marginata</i> woodlands	FCT 21a	–
Southern <i>Banksia attenuata</i> woodlands	FCT 21b	Priority 3
Low lying <i>Banksia attenuata</i> woodlands or shrublands	FCT 21c	Priority 3
<i>Banksia ilicifolia</i> woodlands	FCT 22	Priority 3
Central <i>Banksia attenuata</i> - <i>Banksia menziesii</i> woodlands	FCT 23a	–
Northern <i>Banksia attenuata</i> - <i>Banksia menziesii</i> woodlands	FCT 23b	Priority 3
North-eastern <i>Banksia attenuata</i> - <i>Banksia menziesii</i> woodlands	FCT 23c	–
Northern Spearwood shrublands and woodlands	FCT 24	Priority 3
Southern <i>Eucalyptus gomphocephala</i> – <i>Agonis flexuosa</i> woodlands	FCT 25	Priority 3
Spearwood <i>Banksia attenuata</i> or <i>Banksia attenuata</i> - <i>Eucalyptus</i> woodlands	FCT 28	–
<i>Banksia attenuata</i> woodlands over dense low shrublands	FCT S9	–

The Commonwealth of Australia (2016) describes the Commonwealth TEC as "a woodland associated with the Swan Coastal Plain of southwest Western Australia". Key structural features of the ecological community include:

- a prominent tree layer of *Banksia*<sup>1</sup>, with scattered eucalypts and other tree species often present among, or emerging above, the *Banksia* canopy;
- the understorey is a species rich mix of sclerophyllous shrubs, graminoids and forbs; and
- high endemism and considerable localised variation in species composition across its range (Commonwealth of Australia 2016).

The Commonwealth TEC typically occurs on well-drained, low nutrient soils on sandplain landforms, particularly deep Bassendean and Spearwood sands and occasionally on Quindalup sands (Commonwealth of Australia 2016). *Banksia* woodlands were formerly the dominant vegetation type of the Swan Coastal Plain bioregion, particularly in the Perth region, but are now under severe threat from the following processes:

- clearing and fragmentation;
- dieback;
- invasive species;
- altered fire regimes;
- hydrological degradation;
- climate change;
- grazing (including overabundance of Kangaroos); and
- decline in pollen and seed dispersing fauna and loss of keystone *Banksia* species and fragmenting of nectar/ pollen networks (Commonwealth of Australia 2016).

## 2.1 Objectives of the Study

Biota was commissioned to undertake a targeted vegetation and flora survey of the study area in 2017. The study was aimed at clarifying the extent of the Commonwealth TEC, with the specific objectives being to:

- record additional flora data within the *Banksia* woodlands in the study area;
- analyse these data against the existing regional data set from the SCP survey (Gibson et al. 1994); and
- confirm the extent of the Commonwealth TEC in the study area.

<sup>1</sup> The canopy is most commonly dominated or co-dominated by *Banksia attenuata* (Candlestick Banksia) and/or *B. menziesii* (Firewood Banksia). Other *Banksia* species that dominated in some examples of the ecological community are *B. prionotes* (Acorn Banksia) or *B. ilicifolia* (Holly-leaved Banksia). Note: To be considered the Commonwealth TEC, the patch must include at least one of the above species.

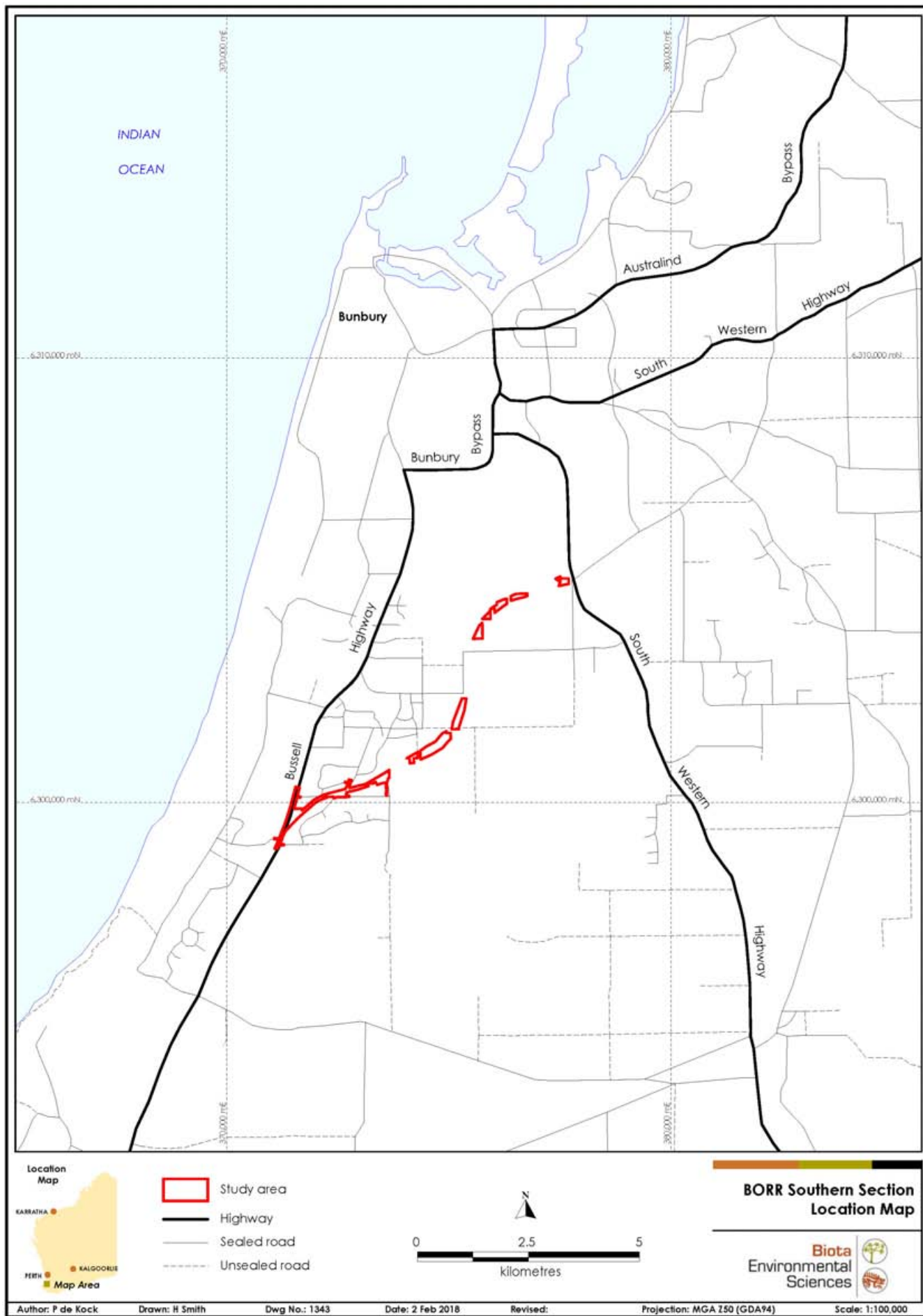


Figure 2.1: Location of the BORR - Southern Section study area.



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## 3.0 Methodology

To meet the objectives of this study a desktop assessment was undertaken (Section 3.1), followed by a field survey (see Section 3.2).

### 3.1 Desktop Assessment

The desktop assessment was conducted to identify 'Target Areas' in the study area with the potential to support the Commonwealth TEC. The desktop assessment considered the criteria outlined by the Commonwealth of Australia (2016) (Section 3.1.1), along with existing botanical data, to identify these areas as outlined in Section 3.1.2.

#### 3.1.1 Criteria to Determine the Presence of the Commonwealth TEC

Commonwealth of Australia (2016) provides guidance for determining whether a *Banksia* woodland protected under the EPBC Act is present. These criteria are summarised in Table 3.1.

**Table 3.1: Diagnostic characteristics and condition thresholds to determine *Banksia* Woodlands TEC (Commonwealth of Australia 2016).**

Diagnostic characteristics / condition thresholds	Criteria
Determination of Floristic Community Type:	<p>Location and physical environment:</p> <ul style="list-style-type: none"> <li>Occurs in the Swan Coastal Plain IBRA bioregion.</li> </ul> <p>Soil and landform:</p> <ul style="list-style-type: none"> <li>Typically occurs on well drained, low nutrient soils on sandplain landforms, particularly deep Bassendean and Spearwood sands and occasionally on Quindalup sands.</li> </ul> <p>Structure and composition:</p> <ul style="list-style-type: none"> <li>The TEC encompasses a number of recognised sub-communities (Floristic Community Types). The community in question must be representative of the relevant FCT (see Table 2.1).</li> </ul>
Vegetation condition <sup>^</sup> and minimum patch size threshold:	<ul style="list-style-type: none"> <li>'Pristine' – no minimum</li> <li>'Excellent' – 0.5 ha or 5,000 m<sup>2</sup></li> <li>'Very Good' – 1 ha or 10,000 m<sup>2</sup></li> <li>'Good' – 2 ha or 20,000 m<sup>2</sup></li> </ul>
Surrounding context:	<p>Relevant criteria to consider:</p> <ul style="list-style-type: none"> <li>"A patch is a discrete and mostly continuous area of the ecological community. A patch may include small-scale (&lt;30 m) variations, gaps and disturbances, such as tracks, that do not significantly alter the overall functionality of the ecological community. Such breaks are generally included in patch size calculation. The landscape position of the patch, including its position relative to surrounding vegetation also influences how important it is in the broader landscape."</li> </ul>

<sup>^</sup> Keighery (1994) as presented in Bush Forever (Government of Western Australia 2000).

#### 3.1.2 Identification of Target Areas for additional survey

Target Areas with the potential to support the Commonwealth TEC were identified using the existing botanical data, with consideration of the criteria described by Commonwealth of Australia (2016) (see Section 3.1.1). Specifically, Target Areas were determined via the following:

1. Vegetation mapping by GHD (2015) was reviewed and areas of *Banksia* woodland were identified.

2. To address the 'surrounding context' criteria (see Table 3.1), areas of *Banksia* woodland identified by GHD (2015) were extrapolated beyond the study area, where appropriate. Aerial photography was used to determine where *Banksia* woodland within the study area formed part of a larger area of the vegetation, and boundaries were delineated around areas of vegetation that appeared to be homogenous and continuous (i.e. without any gaps greater than 30 m wide). This resulted in Target Areas that, in most cases, were much larger than the extent of the vegetation within the study area.

The desktop component also considered the floristic analysis undertaken by Biota (2016), which used quadrat data collected in October 2016, together with relevant quadrat data from GHD (2012), in a floristic analysis against regional data from the SCP<sup>2</sup>. The analysis assigned, with reasonable confidence, five of the 10 relevant quadrats (three Biota quadrats: BOR05, BOR06 and BOR07, and two GHD quadrats: Q11 and Q12) into FCT 21a 'Central *Banksia attenuata* – *Eucalyptus marginata* woodlands'. The other quadrats were assigned to FCTs which did not meet the basic structural criteria of the Commonwealth TEC (i.e. were not dominated or co-dominated by *Banksia*) and were therefore not considered as part of this study.

This process identified 24 Target Areas, labelled T1 through T24, as presented in Appendix 1. Further to the above, an initial assessment was then made for each of the Target Areas to determine the likelihood of the Commonwealth TEC being present (see Appendix 2).

The desktop assessment confirmed that the vegetation communities within the study area had already met the first two Commonwealth TEC criteria (see Table 3.1), given that:

- the study area occurs in the Swan Coastal Plain IBRA bioregion; and
- the study area intersects both the Bassendean and Spearwood dunes.

Of the 24 Target Areas, the Commonwealth TEC was considered to be 'not present' in seven of these, 'unlikely' in two, 'possible' in three, and 'likely' in 12 (see Appendix 2).

## 3.2 Field Survey

A field survey of the Target Areas was conducted to:

- expand on the botanical data collected by GHD (2015) and Biota (2016); and
- collect data from previously unsurveyed sections of *Banksia* woodland, to confirm the continuity of vegetation beyond the study area and to determine the size of areas that support suitable *Banksia* woodland.

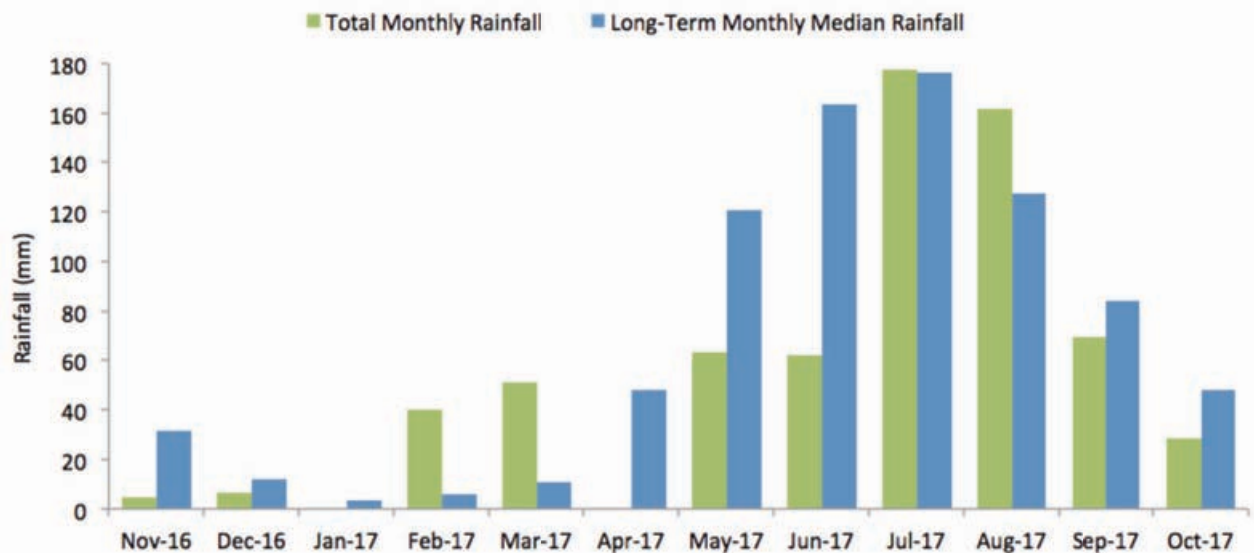
### 3.2.1 Study Team and Survey Timing

The field survey was conducted between the 4<sup>th</sup> and 6<sup>th</sup> of November 2017 by Pierre-Louis de Kock (Level 2 Botanist) and Simon Colwill (Level 1 Botanist), both of Biota. Ciaran Gibson (Level 2 Botanist, Biota) conducted the floristic analyses using the collected data.

Seasonal timing and the amount of rainfall received prior to a survey can have a major influence on the flora species recorded during a field survey. The current survey was conducted in spring, which is an optimal time for surveys on the SCP (EPA 2016). Data from the Bureau of Meteorology weather recording station at Bunbury<sup>3</sup> show that rainfall recorded during the month prior to the survey (28.4 mm) was similar to the long-term average (30.3 mm). The total rainfall received during the three months prior to the survey (259.2 mm) was also equivalent to the long-term median (259.5 mm) (see Figure 3.1). The survey timing was therefore considered adequate for the collection of ephemeral and cryptic perennial flora, and was reflected in the array of annual taxa being recorded.

<sup>2</sup> Data set supplied by Dr. Neil Gibson (Department of Biodiversity, Conservation and Attractions; DBCA).

<sup>3</sup> The Bunbury weather recording station (#9965) is located approximately 8 km north of the study area.



**Figure 3.1:** Total monthly rainfall for the Bunbury recording station for the 12 months preceding the survey, compared to the long-term monthly median (1957-2017) for Marriwood recording station<sup>4</sup>. Data supplied by the Bureau of Meteorology.

### 3.2.2 Site Selection

Target Areas were sampled using quadrats and a relevé (Section 3.2.3), together with mapping traverses (Section 3.2.4). Notes regarding the sampling requirements that were identified for each Target Area through the desktop review are presented in Appendix 2, while the sampling conducted within each Target Area is summarised in Table 3.2.

Sampling sites were chosen in the field and were located in the best quality examples<sup>5</sup> of vegetation representative of *Banksia* woodland. Survey effort was focused on traversing the Target Areas to map vegetation structure and condition. Therefore, not all Target Areas were sampled with quadrats (12 were sampled with mapping notes only). Five Target Areas were not visited on foot:

- For four of these, the condition and structure of the vegetation was clearly visible from nearby (between 5 m and 180 m away);
- For the fifth Target Area (T24), no field observations were required, as the desktop assessment identified that it did not qualify for the Commonwealth TEC due to its condition and size (see Section 5.0, and Appendix 2).

Data from two quadrats (Q11 and Q12) by GHD (2015), together with three historic quadrats from Biota (2016), were also considered as part of this study (see Section 3.1).

<sup>4</sup> The Marriwood weather recording station (#9629) is located approximately 8.4 km southeast of the study area and has been recording since 1957, compared to Bunbury, which has only been recording since 1996.

<sup>5</sup> "Assessments of a patch should initially be centred on the area of highest native floristic diversity and/or cover, i.e. the best condition area of the patch" (Commonwealth of Australia 2016).

**Table 3.2: Summary of sampling effort within each Target Area.**

Target Area	Sampling Effort
T1	Mapping notes
T2	Quadrat GEL05, mapping notes
T3	Not sampled; observations made when sampling T4
T4	Mapping notes
T5	Mapping notes
T6	Not sampled; observations made during traverse to T5
T7	Mapping notes
T8	Mapping notes
T9	Not sampled; observations made from Ducane Road
T10	Not sampled; observations made from Ducane Road
T11	Mapping notes
T12	Quadrat GEL04, mapping notes
T13	Mapping notes
T14	Mapping notes
T15	Not sampled; observations made from Yalinda Drive
T16	Mapping notes
T17	Quadrat GEL03, mapping notes
T18	Mapping notes
T19	Quadrat GEL01, mapping notes
T20	Mapping notes
T21	Mapping notes
T22	Quadrat GEL02, mapping notes
T23	Relevé GELREL01, mapping notes
T24	Not sampled: aerial imagery confirms 'Completely Degraded' condition

### 3.2.3 Quadrat and Relevé Sampling

Sampling was undertaken using the 10 m by 10 m quadrat size that is the recognised standard for the SCP (see EPA 2016). All quadrats were established using an optical square and tape measures, with each quadrat permanently marked at each corner with a steel fence dropper. The location coordinates for each corner were recorded using a hand held GPS (GDA94 datum, MGA Zone 50).

The following information was recorded for each quadrat:

- location coordinates ( $\pm 5$  m) for each quadrat corner (see Appendix 1);
- habitat description;
- broad soil type;
- vegetation description based on the height and estimated cover value of dominant species (Keighery 1994, see Appendix 3);
- vegetation condition ranking (Keighery 1994, Government of Western Australia 2000); see Appendix 3);
- fire history (approximate time since last fire, where applicable);
- all species present within the quadrat; and
- the estimated percent foliar cover of each flora species present within the quadrat. Estimates were generally made to the nearest percent; a cover of 0.1% was assigned where only occasional individuals were present.

A similar suite of information was recorded for the relevé (unbounded flora sampling site).

Raw site data are presented in Appendix 4, along with photographs of both the overstorey and understorey at each quadrat.

### 3.2.4 Mapping traverses

A series of mapping notes were recorded during traverses within each Target Area to delineate boundaries in vegetation structure and condition, and to describe areas of *Banksia* woodland. Mapping notes were located within the central section of the vegetation stands and/or at their boundaries.

For each mapping note a brief set of data similar to a quadrat or relevé was recorded, however only up to five associated species were recorded at each location. Condition of the surrounding vegetation within the Target Area was also recorded. Mapping traverses also informed where quadrat and relevé placement was most suitable (i.e. the best quality example of the vegetation).

## 3.3 Specimen Identifications and Data Entry

Common species that were well known to the survey botanists were identified in the field. Voucher specimens of all other species were collected and later identified using flora keys, consulting appropriate publications, using voucher reference collections and comparison to the collections held at the WA Herbarium.

The specimens were mainly identified by Pierre-Louis de Kock (Level 2 Botanist – Specialist Taxonomist) and Michi Maier (Principal Botanist at Biota). Andrew Brown (private consultant ex. WA Herbarium), a specialist in the Orchidaceae family, confirmed four orchid specimens. Malcolm Trudgen (Principal of M.E Trudgen and Associates) and Rob Davis (Identification Botanist at the WA Herbarium) confirmed some of the more difficult taxa (e.g. *Astartea*, *Astroloma*, *Craspedia*, *Lomandra*, *Gompholobium* and *Waitzia*).

A full flora species list is provided in Appendix 5. Nomenclature used in this report is consistent with the current listing of WA flora recognised by the WA Herbarium on FloraBase<sup>6</sup> at the time of preparation of this report.

## 3.4 Floristic Analysis

A floristic analysis was conducted using PATN v3.1 to compare quadrats from the study area with those from the existing Swan Coastal Plain vegetation data set arising from Gibson et al. (1994). The analysis was used to identify the most probable FCT, as defined by Gibson et al. (1994), for each quadrat, together with an overall FCT for the vegetation type, in order to determine the presence of conservation significance vegetation including TECs and PECs.

In keeping with the original floristic analysis completed by Gibson et al. (1994), the following protocols were used for the analysis and applied to the quadrat data set recorded during the current survey:

- Presence/absence data were used.
- All weeds were included.
- Singleton taxa (those occurring in only one quadrat) were excluded.
- Records of taxa that were only identified to genus level (e.g. *Juncus* sp.) were also excluded, as these could refer to multiple taxa.

<sup>6</sup> <http://florabase.dpaw.wa.gov.au>

- Some taxa were combined for the analysis. These were typically those that were considered difficult to accurately differentiate without sufficient flowering material (e.g. the taxa listed in Appendix 3 of Gibson et al. 1994), or those that were represented by a broader level taxon in the NatureMap data set (e.g. there were single records of *Conostylis aculeata* subsp. *gracilis* and *C. aculeata* subsp. *preissii*, together with multiple records of *C. aculeata*). A list of the species that were combined or omitted from the BORR data set is provided in Table 1 in Appendix 6.

The clustering analysis technique was kept consistent with that used by Gibson et al. (1994):

- Sites were classified into 30 groups using the Bray Curtis (Czekanowski) association measure, followed by an agglomerative hierarchical fusion classification using "flexible unweighted pairgroup mean average" (flexible UPGMA). The beta value was set at -0.1.
- Species were classified into 35 groups using the TWOSTEP association measure, followed by flexible UPGMA. The beta value was again set at -0.1.

For the current analysis, the five quadrats and one relevé assessed in the current study were combined with the SCP data set. It is widely recognised that adding multiple new samples (in this case, quadrats/relevés) to a data set can result in considerable reassignment of samples to different groups than those produced through the original hierarchical clustering process. To minimise disruption to the existing floristic groups identified by Gibson et al. (1994), each quadrat/relevé was added individually to the data set (i.e. seven separate analyses were conducted). This process was referred to as Single Site Insertion by Trudgen and Trudgen (2010); we have modified this to Single Sample Insertion (SSI), due to the use of the "single-site insertion" term in the genetics field.

A further analysis, Nearest Neighbour (NNB), was completed in PATN to determine the 10 sites that were most similar to the new quadrats. The NNB analysis determines the most similar sites on the basis of species composition, and forms linkages without imposing clustering. This technique often reveals relationships that may be lost when a clustering technique is used.

Summary outputs from the analyses are provided in Appendix 6. Due to the size of the data set, the input matrix has not been reproduced in this report, however it can be provided on request.

### 3.5 Study Limitations and Comments on the Floristic Analysis

The standard quadrat size for surveys on the SCP is 10 m by 10 m, which is the smallest quadrat size in use in WA (20 m<sup>2</sup> to 50 m<sup>2</sup> quadrats are used in other regions). The 10 m by 10 m quadrats may not always sample all species characteristic of a community type, particularly if these only occur as scattered individuals through the vegetation. Individual quadrats in a particular vegetation type may therefore lack some key diagnostic species that are typical of an FCT.

Some individual specimens appear to have been re-determined and/or some additional sampling may have been done within the SCP quadrats since the original analysis was conducted, as collections of particular taxa are vouchered with the WA Herbarium for some sites but are not present in the NatureMap data set. In addition, while non-current nomenclature was updated wherever possible, some old names have been retained where this would have led to merging of taxa, and some current names now reflect taxa that would no longer be expected to occur on the SCP due to recent taxonomic revisions (e.g. *Stylidium breviscapum*). It was beyond the scope of the current study to attempt to vet all records in the SCP data sets to address these issues.

The original SCP analysis included weeds. This means that quadrats in similar vegetation types but with differing levels of disturbance, which result in variable amounts of weed invasion, may be placed in different floristic communities. This has also resulted in introduced flora species being identified as key diagnostic species for some FCTs by Gibson et al. (1994), which seems counter-intuitive given the subsequent listing of many of these as TECs or PECs.

In addition, Gibson et al. (1994) did not apply any differential weighting to the species making up the SCP data set, which is a valid approach if one seeks to minimise the subjective selection of floristic groups. However, 605 species or 55% of those in the final analysis data set (i.e. not including singletons) are represented by less than 10 records. In some cases these are genuinely restricted species, which only occur in particular habitats or vegetation types (e.g. *Taxandria parviceps* (2 records), a shrub typically occurring in seasonal wetlands; and *Aponogeton hexatepalus* (8 records), a water plant). In this case, it is desirable for the species to participate in the site clustering, as they will contribute to valid ecological groupings. However, other species are widespread and/or have generalist habitat preferences, but appear to have been recorded only a small number of times (e.g. the weeds *\*Euphorbia peplus* (11 records) and *\*Fumaria capreolata* (4 records)). This is likely to result in particular sites being linked together, when the presence of these species actually represents a relatively random occurrence. In these cases it may be valid to either down-weight or remove such species entirely from the analysis. This approach was not followed for the current study to maintain consistency with the original analysis.



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## 4.0 Results

### 4.1 Site Sampling

#### 4.1.1 Flora

A total of 92 native vascular flora taxa from 55 genera and 30 families were recorded during the survey. The dominant native plant families and genera recorded from the current survey are presented in Table 4.1. These families and genera are typically well represented in species lists from this region. A full list of flora taxa identified from the survey is presented in Appendix 5.

**Table 4.1: Dominant families and genera recorded from the current survey.**

Family	No. of Native Taxa	Genera	No. of Native Taxa
Myrtaceae	11	<i>Lomandra</i>	5
Fabaceae	10	<i>Hibbertia</i>	4
Asparagaceae	9	<i>Banksia, Eucalyptus, Drosera, Melaleuca, Thysanotus</i>	3
Asteraceae, Orchidaceae, Proteaceae	6		

#### 4.1.2 Introduced Flora (Weeds)

A total of 20 introduced flora species were recorded during the current survey (see Appendix 5). Details on the level of weed invasion for each quadrat are provided in Section 4.1.3.

Two of the recorded species, *\*Asparagus asparagoides* (Bridal Creeper) and *\*Zantedeschia aethiopica* (Arum Lily), are listed as declared pests for the Shire of Capel under the *Biosecurity and Agriculture Management Act 2007* (the BAM Act), with *\*Asparagus asparagoides* also listed as a Weed of National Significance (WoNS; Thorp and Lynch 2000).

Each species is described briefly below:

##### **\*Asparagus asparagoides (Bridal Creeper)**

Bridal Creeper is a declared pest in WA and is also listed as a WoNS species. It is a serious, highly invasive environmental weed, which occurs across a wide range of habitats throughout the warm-temperate region of southwest WA. It has the ability to invade and destroy large areas of native vegetation. One individual of this species was recorded from T23.

##### **\*Zantedeschia aethiopica (Arum Lily)**

Arum Lily is a declared pest in all parts of WA and is an aggressive and effective competitor with native flora species. It was recorded from quadrat GEL05 at <1% cover.

#### 4.1.3 Vegetation Condition

The condition of vegetation was assessed for all sites and mapping notes using the rating scale developed by Keighery (1994) (see Appendix 3).

##### 4.1.3.1 Condition of Target Areas

Condition of the Target Areas ranged from 'Completely Degraded' to 'Excellent'. Disturbance from introduced flora, trampling by an overabundance of Kangaroos, and tracks dissecting the Target Areas had significantly impacted the health of the vegetation. In addition, agricultural properties were prevalent east of Yalinda Road, and thus many of the Target Areas carried cattle. Large areas were subsequently rated as being in 'Degraded' to 'Completely Degraded' condition, comprising only a remnant overstorey with a weedy understorey (i.e. little to no native understorey was present).

It was noted during the field survey that the condition of individual patches varied, often with very disturbed boundaries (i.e. "edge effects"). The condition ratings for the patches were initially centred on the area of highest native floristic diversity and/or cover (i.e. the best condition area of the patch), with consideration later given to the disturbance levels through the broader area.

#### 4.1.3.2 Condition of Quadrats and Relevés

The vegetation condition of the sampling sites ranged from 'Very Good' to 'Excellent' (Table 4.2). Historical clearing in the vicinity of the sampling sites and the presence of aggressive weed species had influenced the structure and composition of the native vegetation at all sites. A disturbed understorey was observed in all quadrats, due to the presence of a range of weed species. Occasionally these were recorded at high abundance, including some that are listed as declared pests (e.g. *\*Zantedeschia aethiopica* (Arum Lily); see Section 4.1.2).

**Table 4.2: Vegetation condition for sampling sites from the current survey (based on Keighery 1994).**

Site	Condition Ranking	Factors Influencing Vegetation Condition
GEL01	2-3 (‘Very Good’ to ‘Excellent’)	Vegetation structure intact. <u>Weeds with <math>\geq 1\%</math> cover:</u> <i>*Ixia</i> sp. (1% cover). <u>Total no. of weed species:</u> 2
GEL02	3 (‘Very Good’)	Vegetation structure mostly intact. <u>Weeds with <math>\geq 1\%</math> cover:</u> <i>*Briza maxima</i> (5%), <i>*Ixia</i> sp. (2%). <u>Total no. of weed species:</u> 4
GEL03	3 (‘Very Good’)	Vegetation structure mostly intact. <u>Weeds with <math>\geq 1\%</math> cover:</u> <i>*Ixia</i> sp. (3%). <u>Total no. of weed species:</u> 10
GEL04	2 (‘Excellent’)	Vegetation structure intact; weed species non-aggressive and at low density. <u>Weeds with <math>\geq 1\%</math> cover:</u> None. <u>Total no. of weed species:</u> 2
GEL05	3 (‘Very Good’)	Vegetation structure mostly intact. <u>Weeds with <math>\geq 1\%</math> cover:</u> <i>*Briza maxima</i> (7%), <i>*Zantedeschia aethiopica</i> (Arum Lily) also recorded (<1% cover). <u>Total no. of weed species:</u> 10
GELREL01	3 (‘Very Good’)	Vegetation structure mostly intact. <u>Weeds with <math>\geq 1\%</math> cover:</u> <i>*Briza maxima</i> (2 %). <i>*Ixia</i> sp. (1% cover). <u>Total no. of weed species:</u> 3

## 4.2 Vegetation Units

A total of 17 vegetation units were described from the study, with between one and four units recorded from each of the Target Areas. Nine of the vegetation units were dominated or co-dominated by *Banksia*, as listed in Table 4.3. All of these meet the structural criteria of the Commonwealth TEC, however only six of these qualify given consideration of the full list of criteria (i.e. three of the *Banksia* dominated units did not meet the criteria for the Commonwealth TEC; see Section 5.0, and Appendix 7). A complete list of all vegetation units (and their condition rating) recorded during the field survey is presented in Appendix 7.

**Table 4.3: Summary of *Banksia* dominated or co-dominated vegetation units recorded during the current survey.**

Vegetation Unit	Target Area
<i>Corymbia calophylla</i> , <i>Banksia attenuata</i> open forest	T2, T18, T19, T22
<i>Corymbia calophylla</i> , <i>Agonis flexuosa</i> ( <i>Banksia attenuata</i> ) woodland to open forest	T2, T17
<i>Banksia ilicifolia</i> ( <i>B. attenuata</i> , <i>Eucalyptus marginata</i> ) low open forest	T4
<i>Eucalyptus marginata</i> , <i>Agonis flexuosa</i> ( <i>Banksia attenuata</i> , <i>B. ilicifolia</i> ) woodland	T5
<i>Agonis flexuosa</i> , <i>Eucalyptus marginata</i> ( <i>Banksia attenuata</i> ) woodland	T7, T16
<i>Eucalyptus marginata</i> , <i>Banksia attenuata</i> , <i>B. ilicifolia</i> , <i>Corymbia calophylla</i> open forest	T8
<i>Corymbia calophylla</i> , <i>Eucalyptus marginata</i> , <i>Banksia attenuata</i> woodland to open forest	T8, T11, T23
<i>Eucalyptus marginata</i> , <i>Banksia attenuata</i> low open forest to open forest	T11, T12
<i>Corymbia calophylla</i> , <i>Eucalyptus marginata</i> , <i>Agonis flexuosa</i> , <i>Banksia attenuata</i> open forest	T13

## 4.3 Floristic Analysis

Investigation of the floristic classification placed all sites within FCT21a (Central *Banksia attenuata* – *Eucalyptus marginata* woodlands). A summary of the determinations of floristic groupings is provided in Table 4.4.

Four of the six sites were strongly associated with FCT 21a by both the UPGMA classification and NNB analysis (see Table 4.4 and Appendix 6). The results of the SSI process for quadrats GEL03 and GEL04 were less conclusive, as the sites were most closely grouped with sites from FCT28 and FCT21b respectively in the dendrogram (see Figures 3 and 4 in Appendix 6). The NNB was used to further investigate these site relationships.

The association of GEL03 with FCT 28 is considered unlikely, as this FCT generally occurs north of Perth, with only one site recorded south of the City (Gibson et al. 1994). Further investigation of the analysis showed that this quadrat also had an infinity to FCT 21a: sites from this FCT were also placed closely to GEL03 in the dendrogram produced by the SSI process (see Appendix 6), while seven of the 10 most similar sites the NNB analysis were from FCT 21a (Table 4.4.). Considering all of the above, FCT 21a is considered to be the most probable grouping for GEL03.

The association of quadrat GEL04 with FCT 21b is plausible. This site shared several dominant species with FCT 21b, including *Melaleuca thymoides*, *Lomandra hermaphrodita* and *L. sericea*, none of which were recorded at any other sites during the current survey. However, the analysis also showed that GEL04 had an infinity to FCT21a: the SSI process grouped sites from FCT 21a closely to GEL04 in the dendrogram (see Appendix 6), and the NNB analysis showed that five of the 10 most similar sites were from FCT21a (compared to only three sites from FCT 21b; see Table 4.4 and Appendix 6). These results, along with the close association of the other quadrats with FCT 21a<sup>7</sup>, suggests that the most probable grouping for GEL04 is FCT 21a.

<sup>7</sup> The results of the other quadrats is relevant as one 10 x 10 m quadrat may not always sample all species characteristic of a community type, as described in Section 3.5. In light of this, several quadrats within similar vegetation units may provide a better overall grouping.

**Table 4.4: Summary of floristic groups identified by the current study.**

<b>Quadrat / Relevé</b>	<b>FCT from Flexible UPGMA</b>	<b>Comments on the UPGMA Classification</b>	<b>FCTs of 10 Most Similar Sites from NNB Analysis</b>	<b>Comments on the NNB Analysis</b>	<b>Most Probable FCT</b>
GEL01	FCT 21a	No movement of other sites into or out of FCT 21a group.	FCT 21a, 21b, 28	Eight most similar sites from FCT 21a.	FCT 21a
GEL02	FCT 21a	No movement of other sites into or out of FCT 21a group.	FCT 21a, 25	Nine most similar sites from FCT 21a.	FCT 21a
GEL03	FCT 28 / FCT 21a	Movement of sites from FCT 21a and FCT 28.	FCT 21a, 25, 28	Most similar site from FCT25, however seven of the 10 most similar sites were from FCT 21a.	FCT 21a
GEL04	FCT 21b / FCT 21a	Movement of sites from FCT 21a, FCT 21b and FCT 23a.	FCT 20b, 21a, 21b	Most similar site from FCT21b, however five of the 10 most similar sites were from FCT 21a.	FCT 21a
GEL05	FCT 21a	No movement of other sites into or out of FCT 21a group.	FCT 1b, 21a, 21b, 21c, 25	Six most similar sites from FCT 21a.	FCT 21a
GELREL01	FCT 21a	No movement of other sites into or out of FCT 21a group.	FCT 1b, 21a, 21b	Eight most similar sites from FCT 21a.	FCT 21a

## 5.0 Final Assessment to Determine if the Target Areas contain the Commonwealth TEC

A final assessment was made for each of the 24 Target Areas, based on all available information (see Appendix 7).

The Target Areas were scored according to the following three outcomes:

1. No: The Target Area does not correspond to the Commonwealth TEC.
2. Yes, entirely: The Target Area entirely corresponds to the Commonwealth TEC (i.e. the Target Area comprises a single patch; see Table 3.1 for definition of a patch).
3. Yes, partially: The Target Area partially corresponds to the Commonwealth TEC (i.e. includes one or more patches, as well as other vegetation that is not consistent with the Commonwealth TEC).

Based on this final assessment (see Appendix 7):

- four of the 24 Target Areas corresponded entirely to the Commonwealth TEC;
- six of the Target Areas corresponded partially to the Commonwealth TEC (i.e. one or more patches); and
- 14 Target Areas did not correspond to the Commonwealth TEC at all.

Target Areas that corresponded entirely or partially to the Commonwealth TEC are summarised in Table 5.1 and presented in Appendix 8.

The total mapped extent of the Commonwealth TEC across the Target Areas comprised 175.1 ha, which was distributed in 12 patches from T8 west to T22. The two largest patches were at T22 (117.0 ha) and T12 (14.0 ha), while the smallest occurrence was in T19 (1.7 ha).

Only 23.3 ha of this total extent occurred within the study area (i.e. within impact areas), and two of the patches of the Commonwealth TEC were entirely outside the study area (T8 and T16). The patches of the Commonwealth TEC intersected by the study area occurred from T11 to T22 (i.e. in the western half of the study area). The largest occurrences of the Commonwealth TEC within the study area were in T18 (6.0 ha) and T17 (5.5 ha), both in the far west of the study area. The smallest occurrence of the TEC within the study area was 0.2 ha at T23.

**Table 5.1: Summary of Target Areas containing the Commonwealth TEC.**

Target Area	Status of Target Area / Corresponding Vegetation Unit	No. of Patches	Total Area of TEC within Target Areas (ha)	Area of TEC within Study Area (ha)
T8	Partially comprises the TEC: <i>Corymbia calophylla</i> , <i>Eucalyptus marginata</i> , <i>Banksia attenuata</i> woodland to open forest	1	2.7	–
T11	Partially comprises the TEC: <i>Eucalyptus marginata</i> , <i>Banksia attenuata</i> low open forest to open forest	1	4.9	4.0
T12	Entire Target Area comprises the TEC: <i>Eucalyptus marginata</i> , <i>Banksia attenuata</i> low open forest to open forest	1	14.0	0.5
T13	Partially comprises the TEC: <i>Corymbia calophylla</i> , <i>Eucalyptus marginata</i> , <i>Agonis flexuosa</i> , <i>Banksia attenuata</i> open forest	1	6.5	4.5
T16	Partially comprises the TEC: <i>Agonis flexuosa</i> , <i>Eucalyptus marginata</i> ( <i>Banksia attenuata</i> ) woodland	2	3.8	–
T17	Partially comprises the TEC: <i>Corymbia calophylla</i> , <i>Agonis flexuosa</i> ( <i>Banksia attenuata</i> ) woodland to open forest	1	11.0	5.5
T18	Partially comprises the TEC: <i>Corymbia calophylla</i> , <i>Banksia attenuata</i> open forest	2	11.4	6.0
T19	Entire Target Area comprises the TEC: <i>Corymbia calophylla</i> , <i>Banksia attenuata</i> open forest	1	1.7	0.8
T22	Entire Target Area comprises the TEC: <i>Corymbia calophylla</i> , <i>Banksia attenuata</i> open forest	1	117.0	1.3
T23	Entire Target Area comprises the TEC: <i>Corymbia calophylla</i> , <i>Eucalyptus marginata</i> , <i>Banksia attenuata</i> woodland to open forest	1	2.1	0.2
<b>Total</b>		<b>12</b>	<b>175.1</b>	<b>23.2</b>

A total of seven Target Areas contained areas of *Banksia* dominated or co-dominated vegetation that did not meet all criteria to qualify for the Commonwealth TEC. These occurrences were either mapped over too small an area, or were rated as 'Degraded' (i.e. one category less than 'Good'; see Appendix 7). These occurrences are summarised in Table 5.2.

**Table 5.2: Summary of Target Areas containing *Banksia* dominated vegetation that did not meet the criteria to qualify for the Commonwealth TEC.**

Target Area	No. of Occurrences	Criteria Not Met	Total Area of Vegetation (ha)	Area of TEC within Study Area (ha)
T2	2, part of Target Area	<u>Size</u> : Both occurrences were below the minimum size thresholds (0.5 ha and 0.7 ha)	1.2	0
T4	1, entire Target Area	<u>Condition</u> : Vegetation was 'Degraded'	3.3	0.2
T5	1, part of Target Area	<u>Condition</u> : Vegetation was 'Degraded'	8.3	0.5
T8	1, part of Target Area	<u>Condition</u> : Vegetation was Degraded to 'Good'	1.2	0.6
T11	1, part of Target Area	<u>Size</u> : 0.8 ha.	0.8	0.1
T20	2, entire Target Area	Occurrence 1: <u>Condition</u> : Vegetation was 'Degraded'	1.4	1.4
		Occurrence 2: <u>Size</u> : Below the minimum size threshold (0.7 ha).		
T21	1, entire Target Area	<u>Condition</u> : Vegetation was 'Degraded'	0.7	0.7
<b>Total</b>			<b>16.9</b>	<b>3.5</b>

## 6.0 Discussion

The Commonwealth TEC was recorded from a total of 12 patches within 10 of the Target Areas. Two of the patches were not intersected by the study area (T8 and T16). Of the total 175.1 ha of the Commonwealth TEC recorded from the Target Areas, only 23.2 ha (13%) occurred within the study area (i.e. within impact areas within the proposed road alignment).

Within the study area, the Commonwealth TEC was recorded from T11 to T22 (i.e. the western half of the study area). The largest occurrences within the study area were 6.0 ha in T18 and 5.5 ha in T17, with both of these occurring in the far west of the study area.

Even the best examples of the Commonwealth TEC (e.g. at T22) were disturbed to some degree; mostly by invasion of introduced flora, in addition to some of the patches being dissected by tracks. Trampling by an overabundance of Kangaroos had also significantly impacted the health of the vegetation in the study area.

Agricultural properties were prevalent east of Yalinda Road, and thus many of the Target Areas carried cattle. As a consequence, large areas were rated as being in 'Degraded to Completely Degraded' condition, comprising only a remnant overstorey with a weedy understorey (i.e. little to no native understorey present). Only one unfenced patch in this area met the condition criteria for the TEC (within T11); the grazing in this area was noted as being light, and thus the understorey still retained basic vegetation structure and a moderate level of native flora diversity.

Two of the Target Areas located within the Bussell Highway road reserve (T20 and T21), whilst not qualifying as the Commonwealth TEC, were both *Banksia* dominated. These Target Areas were considered of importance in providing a corridor link with three patches of the Commonwealth TEC: one to the north within T19, one to the west within T22, and a patch within T18 to the east. These two road reserve sections are therefore considered to be of significance in the wider context of the Commonwealth TEC.

Although very degraded or modified patches of an ecological community are not protected under the EPBC Act, it is recognised that some patches can still retain some important natural values that may be crucial for certain species or habitats (Commonwealth of Australia 2016). Such sites may also be protected through State and local laws or schemes. Therefore, these patches should not be excluded from recovery and other management actions. Suitable recovery and management actions may improve some of these patches to the point that they may be regarded as part of the ecological community that is fully protected under the EPBC Act (Commonwealth of Australia 2016).

In addition to identifying areas of the Commonwealth TEC, the field exercise also identified several areas of *Banksia* dominated vegetation that were close to qualifying as the Commonwealth TEC (see Section 5.0). These were recorded as small occurrences from T2 to T21, and included some that fell within the survey polygons (a total of 3.5 ha). Some of these patches (e.g. within T20 and T8) may potentially qualify for the Commonwealth TEC should extensive restoration strategies be employed.



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## 7.0 Glossary and Acronyms

*	Used prior to a species name to denote introduced flora (weeds).
Annual (plant)	A plant that lives for only one year or season.
Association measure	The Bray Curtis association measure between sites based on floristic composition. This measure ranges from 0 to 1; a value of 0 indicates that two sites share all species and a value of 1 indicates that the sites share no species.
Cryptic	Plants that die back to a perennial root-stock under dry conditions. Considered cryptic (meaning hidden) because although they are consistently present, it is difficult to tell unless suitable conditions prevail.
DBCA	The WA Department of Biodiversity, Conservation and Attractions.
Dendrogram	A tree diagram, which for this study represents the degree of similarity between quadrats on the basis of their floristic composition. The length of the vertical lines on the diagram indicates the degree of similarity, with longer lines indicating a greater difference between quadrats. An excellent explanation of how to interpret a dendrogram is provided at <a href="http://wheatoncollege.edu/lexomics/files/2012/08/How-to-Read-a-Dendrogram-Web-Ready.pdf">http://wheatoncollege.edu/lexomics/files/2012/08/How-to-Read-a-Dendrogram-Web-Ready.pdf</a> .
Dominant	The species that occurred most abundantly in a stratum of vegetation or in an area.
Ephemeral	A plant that lives a very short time; less than one year or, usually, less than six months.
FCT	Floristic Community Type as identified through the study by Gibson et al. (1994).
Flora keys	Botanical publications containing a series of questions regarding a plant's characteristics, which aid in the identification of taxa.
NNB	Nearest Neighbour analysis; a technique in PATN that determines the most similar sites on the basis of the species composition.
Patch	As described by Commonwealth of Australia (2016), a patch is a discrete and mostly continuous area of the ecological community. A patch may include small-scale (<30 m) variations, gaps and disturbances, such as tracks, that do not significantly alter the overall functionality of the ecological community. Such breaks are generally included in patch size calculation. The landscape position of the patch, including its position relative to surrounding vegetation also influences how important it is in the broader landscape.
PEC	Priority Ecological Community
Perennial	A plant that lives for more than two years; often with a tree or shrub growth form.
Quadrat	A bounded sample area of uniform vegetation in which all species present are recorded; the standard for the Southwest of WA is 100 m <sup>2</sup> , usually 10 m by 10 m.
SCP	Swan Coastal Plain.
sens. lat.	Abbreviation of <i>sensu lato</i> (Latin), meaning 'in the broad sense'.
sp. (plural: spp.)	Abbreviation of "species".
SSI	Single Sample Insertion; modified from Single Site Insertion after Trudgen and Trudgen (2010). A process of adding data from a single sample (quadrat) to an existing floristic classification, in order to minimise disruption to the existing floristic groups.

Stratum (plural: strata)	A horizontal level of vegetation defined by growth form and/or height; e.g. low trees (up to 10 m tall), tall shrubs (greater than 2 m tall), tussock grasses, etc.
subsp.	Abbreviation of “subspecies”.
Taxon (plural: taxa)	A taxonomic entity, typically at species level or below.
TEC	Threatened Ecological Community.
var.	Abbreviation of “variety”.

## 8.0 References

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# Appendix 1

## Target Areas Delineated During the Desktop Study, Together with Sample Site Locations







# Map Index

Map 1

Map 3

Map 2



## Location Map

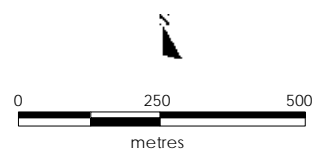


Survey polygon

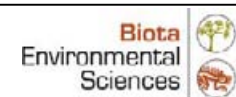
Target area

Relevé location

Quadrat location



## BORR Southern Section - Location of Survey Polygons, Target Areas and Sample Sites: Map 1



Author: P de Kock

Drawn: H Smith

Job No.: 1343

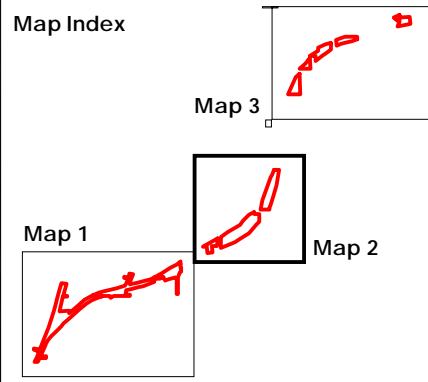
Date: 02 Feb 2018




Revised:

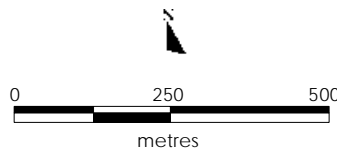
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Scale: 1:20,000 @ A4





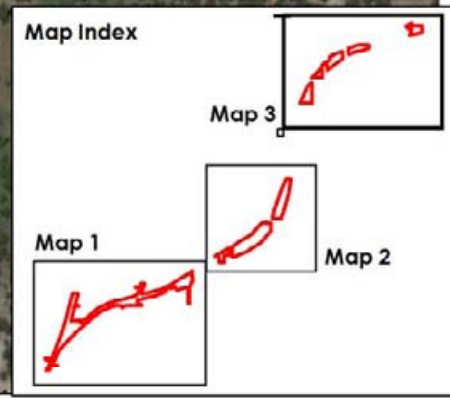
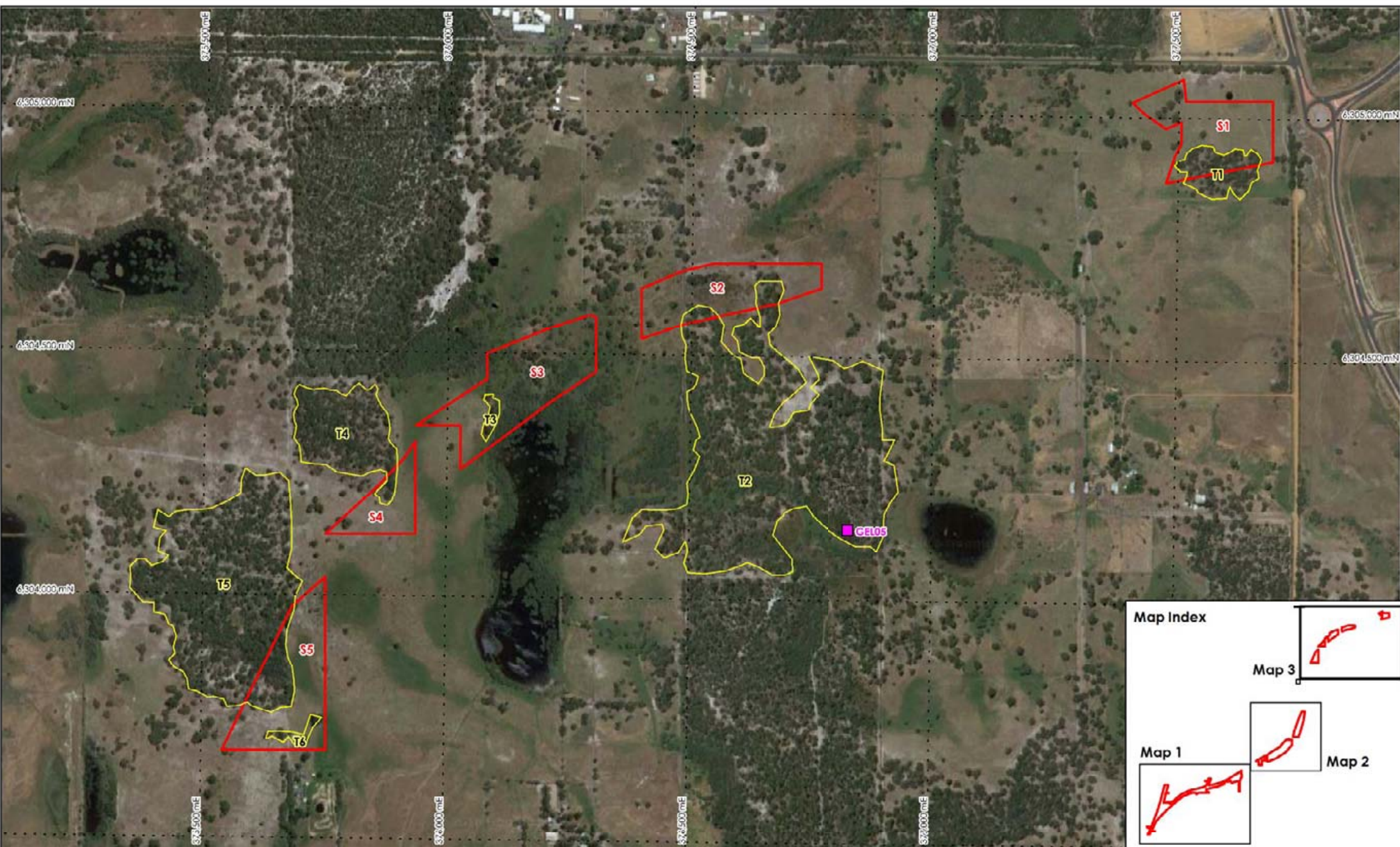
-  Survey polygon
-  Target area
-  Quadrat location



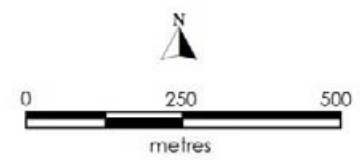
**BORR Southern Section - Location of Survey Polygons, Target Areas and Sample Sites: Map 2**







- Survey polygon
- Target area
- Quadrat location



**BORR Southern Section - Location of Survey Polygons, Target Areas and Sample Sites: Map 3**



Quadrat	Peg	Easting (mN)	Northing (mN)
GEL01	1	371570	6300277
	2	371568	6300267
	3	371577	6300265
	4	371578	6300271
	<b>Central</b>	<b>371573</b>	<b>6300270</b>
GEL02	1	371365	6300266
	2	371358	6300261
	3	371365	6300255
	4	371369	6300264
	<b>Central</b>	<b>371364</b>	<b>6300262</b>
GEL03	1	372579	6300247
	2	372571	6300245
	3	372576	6300236
	4	372583	6300240
	<b>Central</b>	<b>372577</b>	<b>6300242</b>
GEL04	1	374055	6301220
	2	374064	6301214
	3	374072	6301222
	4	374064	6301231
	<b>Central</b>	<b>374064</b>	<b>6301222</b>
GEL05	1	376827	6304152
	2	376822	6304144
	3	376830	6304141
	4	376832	6304150
	<b>Central</b>	<b>376828</b>	<b>6304147</b>
GELREL01	Central	371105	6299113

## Appendix 2

Preliminary Assessment (Based on  
the Desktop Investigation) to  
Determine if the Target Areas  
Contain the Commonwealth TEC







Survey Polygon	Polygon size (ha)	Vegetation types mapped (GHD 2015)	Condition (GHD)	Target Area No.	~Target Area size (ha)	~Area within polygon (ha)	Preliminary Assessment – Target Area represents the TEC?	Existing sites	Notes
S1	3.41	Scattered remnant vegetation of <i>Eucalyptus</i> spp., <i>Banksia attenuata</i> and <i>Agonis flexuosa</i>	6 (Completely Degraded)	T1	1.6	1.1	No	-	Condition of Target Area Completely Degraded: Confirm vegetation mapping and condition during field survey.
S2	3.49	Scattered remnant vegetation of <i>Eucalyptus</i> spp., <i>Banksia attenuata</i> and <i>Agonis flexuosa</i>	5 (Degraded)	T2	2.1	0.5	Possible	-	Some scattered trees in north might be <i>Banksia</i> but condition of Target Area Degraded, field assessment required to confirm: 1) Vegetation units present within Target Area; and 2) Condition of associated Target Area.
S3	4.62	Scattered remnant vegetation of <i>Eucalyptus</i> spp., <i>Banksia attenuata</i> and <i>Agonis flexuosa</i>	6 (Completely Degraded)	T3	0.3	0.3	Unlikely	-	Some scattered trees in north might be <i>Banksia</i> but condition of the Target Area Completely Degraded: Confirm vegetation mapping and condition during field survey.
S4	1.63	Scattered remnant vegetation of <i>Eucalyptus</i> spp., <i>Banksia attenuata</i> and <i>Agonis flexuosa</i>	5 (Degraded)	T4	3.9	0.2	Possible	-	Condition of Target Area Degraded: Confirm vegetation mapping and condition during field survey.
S5	4.38	Scattered remnant vegetation of <i>Eucalyptus</i> spp., <i>Banksia attenuata</i> and <i>Agonis flexuosa</i>	5 (Degraded)	T 5	13.7	0.6	Possible	-	Condition of Target Area Degraded. Some wetland vegetation present within Target Area. Field assessment required to confirm: 1) Vegetation units present within Target Area; and 2) Condition of associated Target Area.
		Scattered remnant vegetation of <i>Eucalyptus</i> spp., <i>Banksia attenuata</i> and <i>Agonis flexuosa</i>	5-6 (Degraded-Completely Degraded)	T6	2.7	0.2	No	-	Condition of Target Area Degraded-Completely Degraded: Confirm vegetation mapping and condition during field survey.
S6	10.37	Scattered remnant vegetation of <i>Eucalyptus</i> spp., <i>Banksia attenuata</i> and <i>Agonis flexuosa</i>	5-6 (Degraded-Completely Degraded)	T7	2.4	0.3	No	-	Condition of Target Area Degraded-Completely Degraded. Confirm vegetation mapping and condition during field survey.
		Scattered remnant vegetation of <i>Eucalyptus</i> spp., <i>Banksia attenuata</i> and <i>Agonis flexuosa</i>	4-5 (Good-Degraded)	T8	52.6	2.6	Likely	BOR06 (Biota 2016) T02 and T04 (GHD 2015)	Condition of Target Area Good-Degraded, field survey required to confirm: 1) Vegetation units present within Target Area; and 2) Condition of associated Target Area.
		Scattered remnant vegetation of <i>Eucalyptus</i> spp., <i>Banksia attenuata</i> and <i>Agonis flexuosa</i>	5-6 (Degraded-Completely Degraded)	T9	1.3	0.7	No	-	Condition of Target Area Degraded-Completely Degraded. Confirm vegetation mapping and condition during field survey.
S7	16.8	Scattered remnant vegetation of <i>Eucalyptus</i> spp., <i>Banksia attenuata</i> and <i>Agonis flexuosa</i>	5-6 (Degraded-Completely Degraded)	T10	1.0	1.0	No	-	Condition of Target Area Degraded-Completely Degraded. Confirm vegetation mapping and condition during field survey.
		Scattered remnant vegetation of <i>Eucalyptus</i> spp., <i>Banksia attenuata</i> and <i>Agonis flexuosa</i>	4-5 (Good-Degraded)	T11	9.9	9.3	Likely	BOR05 and BOR07 (Biota 2016) T06 and Q12 (GHD 2015)	Condition of Target Area Good-Degraded, field survey required to confirm: 1) Vegetation units present within Target Area; and 2) Condition of associated Target Area.
S8	2.68	Open forest of <i>Eucalyptus</i> spp., <i>Banksia attenuata</i> and <i>Agonis flexuosa</i>	1-5 (Pristine - Degraded)	T12	16.8	0.7	Likely	Q11 (GHD 2015)	Condition of Target Area Pristine-Degraded, field survey required to confirm: 1) Vegetation units present within Target Area; and 2) Condition of associated Target Area.

Survey Polygon	Polygon size (ha)	Vegetation types mapped (GHD)	Condition (GHD)	Target Area No.	~Target Area size (ha)	~Area within polygon (ha)	Preliminary Assessment	Existing sites	Notes
S9&S10	42.54	Open forest of <i>Eucalyptus</i> spp., <i>Banksia attenuata</i> and <i>Agonis flexuosa</i>	1 (Pristine)	T13	15.0	8.5	Likely	-	Condition of Target Area Pristine, field survey required to confirm: 1) Vegetation units present within Target Area; and 2) Condition of associated Target Area.
		Open forest of <i>Eucalyptus</i> spp., <i>Banksia attenuata</i> and <i>Agonis flexuosa</i>	5-6 (Degraded-Completely Degraded)	T14	14.8	3.5	Likely	-	Condition of Target Area Degraded-Completely Degraded, however Target Area likely to contain vegetation in better condition, field survey required to confirm: 1) Vegetation units present within Target Area; and 2) Condition of associated Target Area.
		Open forest of <i>Eucalyptus</i> spp., <i>Banksia attenuata</i> and <i>Agonis flexuosa</i>	5 (Degraded)	T15	1.1	1.1	No	-	Condition of Target Area Degraded. Confirm vegetation mapping and condition during field survey.
		Open forest of <i>Eucalyptus</i> spp., <i>Banksia attenuata</i> and <i>Agonis flexuosa</i>	5 (Degraded)	T16	11.7	0.1	Likely	-	Condition of Target Area Degraded, however Target Area likely to contain vegetation in better condition, field survey required to confirm: 1) Vegetation units present within Target Area; and 2) Condition of associated Target Area.
		Open forest of <i>Eucalyptus</i> spp., <i>Banksia attenuata</i> and <i>Agonis flexuosa</i>	3-4 (Very Good-Good)	T17	17.3	8.0	Likely	-	Condition of Target Area Very Good to Good, field survey required to confirm: 1) Vegetation units present within Target Area; and 2) Condition of associated Target Area.
		Open forest of <i>Eucalyptus</i> spp., <i>Banksia attenuata</i> and <i>Agonis flexuosa</i>	3-5 (Very Good-Degraded)	T18	52.7	15.0	Likely	-	Condition of Target Area Very Good to Degraded field survey required to confirm: 1) Vegetation units present within Target Area; and 2) Condition of associated Target Area.
		Open forest of <i>Eucalyptus</i> spp., <i>Banksia attenuata</i> and <i>Agonis flexuosa</i>	3 (Very Good)	T19	2.1	1.1	Likely	-	Condition of Target Area Very Good, field survey required to confirm: 1) Vegetation units present within Target Area; and 2) Condition of associated Target Area.
		Open forest of <i>Eucalyptus</i> spp., <i>Banksia attenuata</i> and <i>Agonis flexuosa</i>	3-5 (Very Good-Degraded)	T20	1.6	1.6	Likely	-	Condition of Target Area Very Good to Degraded, field survey required to confirm: 1) Vegetation units present within Target Area; and 2) Condition of associated Target Area.
		Open forest of <i>Eucalyptus</i> spp., <i>Banksia attenuata</i> and <i>Agonis flexuosa</i>	3-5 (Very Good-Degraded)	T21	0.9	0.9	Unlikely	-	Condition of Target Area Very Good to Degraded field survey required to confirm: 1) Vegetation units present within Target Area; and 2) Condition of associated Target Area.
		Open forest of <i>Eucalyptus</i> spp., <i>Banksia attenuata</i> and <i>Agonis flexuosa</i>	3-5 (Very Good-Degraded)	T22	140.0	1.5	Likely	-	Condition of Target Area Very Good to Degraded, field survey required to confirm: 1) Vegetation units present within Target Area; and 2) Condition of associated Target Area.
		Open forest of <i>Eucalyptus</i> spp., <i>Banksia attenuata</i> and <i>Agonis flexuosa</i>	3 (Very Good)	T23	2.5	0.3	Likely	-	Condition of Target Area Very Good, field survey required to confirm: 1) Vegetation units present within Target Area; and 2) Condition of associated Target Area.
		Open forest of <i>Eucalyptus</i> spp., <i>Banksia attenuata</i> and <i>Agonis flexuosa</i>	6 (Completely Degraded)	T24	0.1	0.1	No	-	Condition of Target Area (Completely Degraded), and very small size of polygon does not qualify the Target Area as the TEC.

## Appendix 3

### Vegetation Structural Classification and Condition Ranking







**Vegetation Structural Classes\***

<b>Stratum</b>	<b>Canopy Cover (%)</b>				
	<b>70-100%</b>	<b>30-70%</b>	<b>10-30%</b>	<b>2-10%</b>	<b>&lt;2%</b>
Trees over 30 m	Tall closed forest	Tall open forest	Tall woodland	Tall open woodland	Scattered tall trees
Trees 10-30 m	Closed forest	Open forest	Woodland	Open woodland	Scattered trees
Trees under 10 m	Low closed forest	Low open forest	Low woodland	Low open woodland	Scattered low trees
Tree Mallee	Closed tree mallee	Tree mallee	Open tree mallee	Very open tree mallee	Scattered tree mallee
Shrub Mallee	Closed shrub mallee	Shrub mallee	Open shrub mallee	Very open shrub mallee	Scattered shrub mallee
Shrubs over 2 m	Tall closed scrub	Tall open scrub	Tall shrubland	Tall open shrubland	Scattered tall shrubs
Shrubs 1-2 m	Closed heath	Open heath	Shrubland	Open shrubland	Scattered shrubs
Shrubs under 1 m	Low closed heath	Low open heath	Low shrubland	Low open shrubland	Scattered low shrubs
Hummock grasses	Closed hummock grassland	Hummock grassland	Open hummock grassland	Very open hummock grassland	Scattered hummock grasses
Grasses, Sedges, Herbs	Closed tussock grassland / bunch grassland / sedgeland / herbland	Tussock grassland / bunch grassland / sedgeland / herbland	Open tussock grassland / bunch grassland / sedgeland / herbland	Very open tussock grassland / bunch grassland / sedgeland / herbland	Scattered tussock grasses / bunch grasses / sedges / herbs

- Based on Keighery (1994), adapted from Muir (1977), and Aplin's (1979) modification of the vegetation classification system of Specht (1970):
  - Keighery B.J. (1994). *Bushland Plant Survey: A Guide for Community Surveys*. Wildflower Society of Western Australia, Perth WA;
  - Aplin T.E.H. (1979). The Flora. Chapter 3 In O'Brien, B.J. (ed.) (1979). *Environment and Science*. University of Western Australia Press;
  - Muir B.G. (1977). Biological Survey of the Western Australian Wheatbelt. Part II: Vegetation and habitat of Bendering Reserve. *Records of the Western Australian Museum, Suppl. No. 3*;
  - Specht R.L. (1970). Vegetation. In *The Australian Environment*. 4th edn (Ed. G.W. Leeper). Melbourne.

<b>Keighery (1994) Vegetation Condition Scale (Government of Western Australia 2000)</b>	<b>Indicative condition measures/thresholds</b>	
	<b>Typical native vegetation composition</b>	<b>Typical weed cover</b>
<b>Pristine</b> No obvious signs of disturbance.	Native plant species diversity fully retained or almost so <sup>1</sup>	Zero or almost no weed cover/abundance
<b>Excellent</b> Vegetation structure intact. Disturbance only affecting individual species. Weeds are non-aggressive species.	High native plant species diversity <sup>1</sup>	Less than 10%
<b>Very Good</b> Vegetation structure altered. Obvious signs of disturbance; e.g. from repeated fires, dieback, logging, grazing. Aggressive weeds present.	Moderate native plant species diversity <sup>1</sup>	5 – 20%
<b>Good</b> Vegetation structure altered but retains basic vegetation structure or ability to regenerate it. Obvious signs of disturbance, e.g. from partial clearing, dieback, logging, grazing. Presence of very aggressive weeds.	Low native plant species Diversity <sup>1</sup>	5 – 50%
<b>Degraded</b> Basic vegetation structure severely impacted by disturbance. Requires intensive management. Disturbance evident such as partial clearing, dieback, logging and grazing. Presence of very aggressive weeds at high density.	Very low native plant species diversity <sup>1</sup>	20 – 70%
<b>Completely Degraded</b> Vegetation structure is no longer intact and the area is completely or almost completely without native flora. Equivalent to 'Parkland Cleared'.	Very low to no native species diversity <sup>1</sup>	Greater than 70%

<sup>1</sup> Relative to expected natural range of diversity for that vegetation unit (e.g. Floristic Community Type), where comparative data exists.

## Appendix 4

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### Raw Quadrat Data and Photographs







**Quadrat – GEL01**



**Overstorey**



**Understorey**

**Quadrat – GEL02**



**Overstorey**



**Understorey**



**Quadrat – GEL03**



**Overstorey**



**Understorey**

**Quadrat – GEL04**



**Overstorey**



**Understorey**



Quadrat – GEL05



Overstorey



Understorey

Relevé – GELREL01



Overstorey



Understorey



**Gelorum Banksia TEC Assessment****Site** GEL01**Described by** PL/SC**Date** 04/11/2017**Type** Quadrat 10 x 10 m**Central Coordinate** 50 371573 mE 6300270 mN**Habitat** Flat coastal plain.**Soil** Grey Sand, high humic content.**Vegetation** *Corymbia calophylla* and *Banksia attenuata* low open forest over *Xanthorrhoea brunonis*, *Phlebocarya ciliata*, *Caesia micrantha*, *Gompholobium tomentosum*, *Hibbertia hypericoides* subsp. *hypericoides* low open shrubland over *Conostylis aculeata* subsp. *preissii* and *Desmocladius fasciculatus* scattered herbs.**Veg Condition** 'Very Good' to 'Excellent'; weeds present: *\*Ehrharta calycina* and *\*Ixia* sp.**Fire Age** No sign of recent fire.**Notes** Not considered excellent due to presence of *\*Ehrharta calycina* and *\*Ixia* sp.

Species	Cover (%)	Height (cm)	Specimen	Notes
<i>Acacia stenoptera</i>	0.1	40	GEL01-06	
<i>Astroloma pallidum</i>	0.1	20	GEL01-24	
<i>Banksia attenuata</i>	15	750		
<i>Billardiera variifolia</i>	0.1	85		
<i>Bossiaea eriocarpa</i>	0.1	25	GEL01-09	
<i>Burchardia congesta</i>	0.1	60	GEL01-08	
<i>Caesia micrantha</i>	0.5	50	GEL01-03	
<i>Conostylis aculeata</i> subsp. <i>preissii</i>	0.5	25	GEL01-04	
<i>Corymbia calophylla</i>	16	900		
<i>Desmocladius fasciculatus</i>	1	25	GEL01-02	
<i>Drosera</i> ? <i>stolonifera</i>	0.1	10	GEL01-21	Insufficient material: sterile.
<i>*Ehrharta calycina</i>	0.1	90		
<i>Gompholobium polymorphum</i>	0.1	60	GEL01-25	
<i>Gompholobium tomentosum</i>	1	90		
<i>Hardenbergia comptoniana</i>	0.1	40		
<i>Hibbertia hypericoides</i> subsp. <i>hypericoides</i>	11	40		
<i>*Ixia</i> sp.	1	40	GEL01-27	Insufficient material: sterile.
<i>Jacksonia sternbergiana</i>	0.1	50		
<i>Lepidosperma pubisquameum</i>	0.1	60	GEL01-12	
<i>Lomandra caespitosa</i>	0.1	25	GEL01-14	
<i>Lomandra nigricans</i>	0.1	35	GEL01-15	
<i>Macrozamia riedlei</i>	0.1	90		
<i>Microtis media</i> subsp. <i>media</i>	0.1	45	GEL01-20	
<i>Orthrosanthus laxus</i> var. <i>laxus</i>	0.1	40	GEL01-17	
<i>Patersonia occidentalis</i>	1	40		
<i>Petrophile linearis</i>	0.1	30	GEL01-23	
<i>Phlebocarya ciliata</i>	2	70	GEL01-26	
<i>Phyllanthus calycinus</i>	0.1	40		
<i>Podolepis gracilis</i>	0.1	20	GEL01-22	
<i>Pyrorchis nigricans</i>	0.1	3	GEL01-10	Photos 802-3
<i>Scaevola calliptera</i>	0.1	25	GEL01-11	
<i>Sowerbaea laxiflora</i>	0.1	40	GEL01-19	
<i>Spyridium globulosum</i>	0.5	80		
<i>Thysanotus arbuscula</i>	0.1	45	GEL01-16	
<i>Thysanotus patersonii</i>	0.1	60	GEL01-05	
<i>Trachymene pilosa</i>	0.1	15	GEL01-07	
<i>Xanthorrhoea brunonis</i>	6	90	GEL01-01	Photos 804-6.
<i>Xanthosia huegelii</i>	0.1	20	GEL01-13	

**Gelorup Banksia TEC Assessment****Site** GEL02**Described by** PL/SC**Date** 04-Nov-17**Type** Quadrat 10 x 10 m**Central coordinate** 50 371364 mE 6300262 mN**Habitat** Coastal plain.**Soil** Grey humic sand.

**Vegetation** *Corymbia calophylla* open forest over *Banksia attenuata* (*Eucalyptus marginata*) low open forest over *Hibbertia hypericoides* subsp. *hypericoides*, *Phlebocarya ciliata*, *Macrozamia riedlei*, *Xanthorrhoea brunonis* low open shrubland over *Lepidosperma pubisquameum* very open sedgeland with *\*Ixia* sp. very open herbland.

**Veg Condition** 'Very good' to 'Excellent'; weeds present, including *\*Briza maxima*, *\*Lotus subbiflorus*, *\*Hypochaeris glabra*, *\*Ixia* sp.

**Fire Age** No sign of recent fire.**Notes** Not considered Excellent due to presence of *\*Briza maxima* and *\*Ixia* sp.

Species	Cover (%)	Height (cm)	Specimen	Notes
<i>Banksia attenuata</i>	25	800		
<i>Banksia grandis</i>	0.1	450		
<i>*Briza maxima</i>	5	40		400 plants.
<i>Conostylis aculeata</i> subsp. <i>gracilis</i>	0.1	25	GEL02-02	
<i>Corymbia calophylla</i>	35	1300		
<i>Craspedia variabilis</i>	0.1	40	GEL02-01	
<i>Eucalyptus marginata</i>	3	800		
<i>Gompholobium polymorphum</i>	0.1	45	GEL01-25=	
<i>Hardenbergia comptoniana</i>	0.1	10		
<i>Hibbertia hypericoides</i> subsp. <i>hypericoides</i>	6	40		
<i>Hibbertia racemosa</i>	0.1	30	GEL02-10	
<i>Hovea trisperma</i>	0.1	25	GEL02-08	
<i>*Hypochaeris glabra</i>	0.1	30	GEL02-11	
<i>*Ixia</i> sp.	2	35	GEL01-27=	Insufficient material: sterile, 53 plants.
<i>Lagenophora huegelii</i>	0.1	10		
<i>Lepidosperma pubisquameum</i>	2	45	REL01=	
<i>Lobelia tenuior</i>	0.1	25	GEL02-04	
<i>*Lotus subbiflorus</i>	0.1	10	GEL02-06	
<i>Macrozamia riedlei</i>	3	80		
<i>Microlaena stipoides</i> var. <i>stipoides</i>	0.1	40	GEL02-03	
<i>Orthrosanthus laxus</i> var. <i>laxus</i>	0.1	35	GEL01-17=	
<i>Patersonia occidentalis</i>	0.1	35		
<i>Phlebocarya ciliata</i>	6	42	GEL02-09	
<i>Podolepis gracilis</i>	0.1	20	GEL02-05	
<i>Scaevola calliptera</i>	0.1	25	GEL01-11=	
<i>Tetraria octandra</i>	0.1	35	GEL02-07	
<i>Trachymene pilosa</i>	0.1	10		
<i>Xanthorrhoea brunonis</i>	2	80		

**Gelorup Banksia TEC Assessment****Site** GEL03**Described by** PL/SC**Date** 05-Nov-17**Type** Quadrat 10 x 10 m**Central Coordinate** 50 372577 mE 6300242 mN**Habitat** Slope of ?tertiary dune, N/NW aspect.**Soil** Grey sand; humic content high.

**Vegetation** *Agonis flexuosa*, *Banksia attenuata* (*Eucalyptus marginata*) low open forest over *Leucopogon propinquus* open shrubland over *Hibbertia hypericoides* subsp. *hypericoides* (*Phyllanthus calycinus*, *Macrozamia riedlei*) low shrubland over *Lepidosperma pubisquameum* very open sedgeland over *\*Briza maxima*, *\*Ehrharta calycina* very open tussock grassland with *\*Ixia* sp. very open hermland.

**Veg Condition** 'Very Good to Excellent'; weeds present, e.g. *\*Ehrharta calycina*, *\*Briza maxima*, *\*Hypochaeris glabra*, *\*Ixia* sp. (high density), *\*Ursinia anthemoides*.

**Fire Age** No sign of recent fire.

**Notes** Condition not considered 'Excellent' due to presence of weeds, particularly *\*Ixia* sp. and *\*Ehrharta calycina*.

Species	Cover (%)	Height (cm)	Specimen	Notes
<i>Acacia pulchella</i> var. <i>pulchella</i>	0.1	35	GEL03-11	
<i>Agonis flexuosa</i>	30	900		
<i>Asteridea pulverulenta</i>	0.1	25	GEL03-02	
<i>*Avena barbata</i>	0.1	90	GEL03-14	1 plant
<i>Banksia attenuata</i>	12	500		
<i>Bossiaea eriocarpa</i>	0.1	30	GEL01-09=	
<i>*Briza maxima</i>	1	30		200 plants
<i>Burchardia congesta</i>	0.1	60	GEL03-17	
<i>Caesia micrantha</i>	0.1	30	GEL03-18	
<i>Conostylis aculeata</i> subsp. <i>gracilis</i>	0.1	25	GEL03-01	
<i>Desmocladius fasciculatus</i>	0.1	20	GEL03-06	
<i>Dianella revoluta</i>	0.1	45		
<i>Drosera</i> ? <i>pallida</i>	0.1	45	GEL03-08	Insufficient material: sterile
<i>*Ehrharta calycina</i>	1	80		3 plants
<i>Eucalyptus marginata</i>	2	420		
<i>Gompholobium tomentosum</i>	0.1	70		
<i>Hardenbergia comptoniana</i>	0.1	40		
<i>Hibbertia hypericoides</i> subsp. <i>hypericoides</i>	14	50		
<i>Hibbertia racemosa</i>	0.1	25	GEL03-19	
<i>Hovea trisperma</i>	0.1	30	GEL03-07	
<i>Hybanthus calycinus</i>	0.1	30	GEL03-16	
<i>*Hypochaeris glabra</i>	0.1	40	GEL03-10	
<i>*Ixia</i> sp.	3	40	GEL01-27=	Insufficient material: sterile, 50 plants
<i>Kennedia prostrata</i>	0.1	10		
<i>Lagenophora huegelii</i>	0.1	10		
<i>Lepidosperma pubisquameum</i>	2	40	GEL03-04	
<i>Leucopogon propinquus</i>	3	130		
<i>Lobelia tenuior</i>	0.1	20	GEL02-04=	
<i>Lomandra caespitosa</i>	0.1	25	GEL03-15	
<i>*Lysimachia arvensis</i>	0.1	15		
<i>Macrozamia riedlei</i>	1	90		
<i>*Oxalis</i> sp.	0.1	25	GEL03-03	Insufficient material: sterile
<i>*Petrorhagia dubia</i>	0.1	40	GEL03-09	
<i>Phyllanthus calycinus</i>	2	60		
<i>Schoenus grandiflorus</i>	0.1	60	GEL03-13	
<i>Thelymitra benthamiana</i>	0.1	40		

Species	Cover (%)	Height (cm)	Specimen	Notes
<i>Thysanotus patersonii</i>	0.1	30	GEL01-05=	
<i>Trachymene pilosa</i>	0.1	10		
<i>Tricoryne elatior</i>	0.1	40	GEL03-12	
* <i>Trifolium campestre</i> var. <i>campestre</i>	0.1	15	GEL03-05	
* <i>Ursinia anthemoides</i>	0.5	30		50 plants
<i>Xanthosia huegelii</i>	0.1	10		

**Gelorup Banksia TEC Assessment****Site** GEL04**Described by** PL/SC**Date** 05-Nov-17**Type** Quadrat 10 x 10 m**Central Coordinate** 50 374064 mE 6301222 mN**Habitat** Slight rise, slightly undulating plain, SE aspect.**Soil** Grey sand.**Vegetation** *Banksia attenuata*, *Eucalyptus marginata* low closed forest over *Kunzea glabrescens* tall shrubland over *Hibbertia hypericoides* subsp. *hypericoides* (*Stirlingia latifolia*) low shrubland over *Lepidosperma pubisquameum* scattered sedges.**Veg Condition** Excellent; weeds present: \**Lotus subbiflorus*, \**Ursinia anthemoides*.**Fire Age** No sign of recent fire.

Species	Cover (%)	Height (cm)	Specimen	Notes
<i>Acacia pulchella</i> var. <i>pulchella</i>	0.1	50		
<i>Banksia attenuata</i>	52	800		
<i>Bossiaea eriocarpa</i>	0.1	30	GEL04-04	
<i>Burchardia congesta</i>	0.1	60	GEL04-08	
<i>Cassytha glabella</i>	0.1	25	GEL04-12	'sens. lat.'
<i>Dasypogon bromeliifolius</i>	1	30	GEL04-13	
<i>Desmocladus fasciculatus</i>	0.1	20	GEL04-07	
<i>Eucalyptus marginata</i>	18	900		
<i>Gompholobium tomentosum</i>	0.1	35		
<i>Hibbertia hypericoides</i> subsp. <i>hypericoides</i>	12	50		
<i>Hovea trisperma</i>	0.1	25		
<i>Hypocalymma robustum</i>	0.1	45		
<i>Kunzea glabrescens</i>	22	700	GEL04-02	
<i>Lepidosperma pubisquameum</i>	1	50	GEL04-05	
<i>Lomandra hermaphrodita</i>	0.1	30	GEL04-09	Det. by R. Davis (WAH)
<i>Lomandra integra</i>	0.1	35	GEL04-18	
<i>Lomandra sericea</i>	0.1	40	GEL04-10	
* <i>Lotus subbiflorus</i>	0.1	8	GEL04-20	
<i>Macrozamia riedlei</i>	0.1	90		
<i>Melaleuca thymoides</i>	0.1	190	GEL04-16	
<i>Microtis media</i> subsp. <i>media</i>	0.1	35	GEL04-19	
<i>Patersonia occidentalis</i>	0.1	40		
<i>Phlebocarya ciliata</i>	0.1	45	GEL04-14	
<i>Pterostylis vittata</i>	0.1	35	GEL04-11	
<i>Pyrorchis nigricans</i>	0.1	3		Det. by A. Brown
<i>Stirlingia latifolia</i>	1	60	GEL04-03	
<i>Stylidium araeophyllum</i>	0.1	30	GEL04-01	
<i>Tetraria octandra</i>	0.1	40	GEL04-22	
<i>Thysanotus arbuscula</i>	0.1	50	GEL04-23	
<i>Trachymene pilosa</i>	0.1	8		
* <i>Ursinia anthemoides</i>	0.1	25	GEL04-21	
<i>Xanthorrhoea brunonis</i>	0.1	80		

**Gelorup Banksia TEC Assessment****Site** GEL05**Described by** PL/SC**Date** 06-Nov-17**Type** Quadrat 10 x 10 m**Central Coordinate** 50 376832 mE 6304150 mN**Habitat** Plain, swamp to the north, S aspect.**Soil** Grey sand.**Vegetation** *Corymbia calophylla* open forest over *Banksia attenuata* low open woodland over *Xanthorrhoea brunonis*, *Dasypogon bromeliifolius* low shrubland over *\*Briza maxima*, *\*Ehrharta calycina* very open grassland.**Veg Condition** 'Very Good'; some low native shrub species present, but abundant weeds: *\*Briza maxima*, *\*Ehrharta calycina*, *\*Hypochaeris glabra*, *\*Lotus subbiflorus*, *\*Orobanche minor*, *\*Oxalis* sp., *\*Sonchus oleraceus* and *\*Zantedeschia aethiopica*.**Fire Age** No sign of recent fire**Notes** Low cover of *\*Zantedeschia aethiopica* (Arum Lilly) (plants juvenile), substantial Kangaroo disturbance (trampling, grazing).

Species	Cover (%)	Height (cm)	Specimen	Notes
<i>Banksia attenuata</i>	9	700		
<i>*Briza maxima</i>	7	45		350 plants
<i>*Bromus diandrus</i>	0.1	30	GEL05-02	15 plants
<i>Corymbia calophylla</i>	55	1400		
<i>Dasypogon bromeliifolius</i>	6	70		
<i>Desmocladius fasciculatus</i>	0.1	25	GEL05-04	
<i>Drosera ? erythrorhiza</i>	0.1	3	GEL05-08	Insufficient material: sterile
<i>*Ehrharta calycina</i>	1	80		30 plants
<i>Hibbertia vaginata</i>	0.1	40	GEL05-07	
<i>Hovea trisperma</i>	0.1	25	GEL05-09	
<i>*Hypochaeris glabra</i>	0.1	40	GEL05-01	40 plants
<i>*Lotus subbiflorus</i>	0.1	20		10 plants
<i>Microtis media</i> subsp. <i>media</i>	0.1	25	GEL05-11	
<i>*Orobanche minor</i>	0.1	25		3 plants
<i>Scaevola calliptera</i>	0.1	35	GEL05-03	
<i>*Sonchus oleraceus</i>	0.1	25		8 plants
<i>Thysanotus patersonii</i>	0.1	40	GEL05-05	
<i>Trachymene pilosa</i>	0.1	25		
<i>*Trifolium repens</i> var. <i>repens</i>	0.1	25	GEL05-06	2 plants
<i>*Trifolium subterraneum</i>	0.1	5	GEL05-10	
<i>Xanthorrhoea brunonis</i>	13	80		
<i>*Zantedeschia aethiopica</i>	0.1	20		48 plants

**Gelorup Banksia TEC Assessment****Site** GELREL01**Described by** PL/SC**Date** 04-Nov-17**Type** Relevé 10 x 10 m**Central Coordinate** 50 371105 mE 6299113 mN**Habitat** Flat coastal plain.**Soil** Sand; humic grey.

**Vegetation** *Banksia attenuata* and *Corymbia calophylla* closed forest over *Xylomelum occidentale* scattered low trees over *Hibbertia hypericoides* subsp. *hypericoides* open low heath over *Phlebocarya ciliata* low open shrubland over *\*Briza maxima* very open grassland with *\*Ixia* sp. scattered herbs.

**Veg Condition** 'Very Good'; weeds present: *\*Briza maxima*, *\*Ehrharta calycina* and *\*Ixia* sp.**Fire Age** No sign of recent fire

**Notes** Condition ranking downgraded from 'Very Good' – 'Excellent' to 'Very Good' based on presence of *\*Ixia* sp. at 1% cover; a few less taxa in this site and more sparse vegetation.

Species	Cover (%)	Height (cm)	Specimen	Notes
<i>Banksia attenuata</i>	70	1200		
<i>Banksia grandis</i>	0.1	800		
<i>Bossiaea eriocarpa</i>	0.1	45	GEL01-09=	
<i>*Briza maxima</i>	2	40		300 plants
<i>Burchardia congesta</i>	0.1	50	GEL01-08=	
<i>Conostylis aculeata</i> subsp. <i>preissii</i>	0.1	30	GEL01-04=	
<i>Corymbia calophylla</i>	10	1100		
<i>*Ehrharta calycina</i>	0.1	80		50 plants
<i>Gompholobium polymorphum</i>	0.1	40	GEL01-25=	
<i>Gompholobium tomentosum</i>	0.1	45		
<i>Haemodorum</i> sp.	0.1	100		Insufficient material: sterile
<i>Hibbertia hypericoides</i> subsp. <i>hypericoides</i>	40	40		
<i>Hovea trisperma</i>	0.1	30	GELR1-04	
<i>*Ixia</i> sp.	1	40	GEL01-27=	Insufficient material: sterile, 30 plants
<i>Lagenophora huegelii</i>	0.1	20		
<i>Lepidosperma pubisquameum</i>	0.1	40	GELR1-03	
<i>Lobelia tenuior</i>	0.1	30	GEL01-02=	
<i>Opercularia apiciflora</i>	0.1	45	GELR1-01	
<i>Phlebocarya ciliata</i>	2	45	GEL01-26=	
<i>Phyllanthus calycinus</i>	0.1	40		
<i>Thelymitra benthamiana</i>	0.1	60	GELPL01=	
<i>Trachymene pilosa</i>	0.1	10		
<i>Xylomelum occidentale</i>	1	900		

## Appendix 5

### Vascular Flora Species List







Family	Taxon
<b>Apiaceae</b>	<i>Xanthosia huegelii</i>
<b>Araceae</b>	* <i>Zantedeschia aethiopica</i>
<b>Araliaceae</b>	<i>Trachymene pilosa</i>
<b>Asparagaceae</b>	* <i>Asparagus asparagoides</i>
	<i>Lomandra caespitosa</i>
	<i>Lomandra hermaphrodita</i>
	<i>Lomandra integra</i>
	<i>Lomandra nigricans</i>
	<i>Lomandra sericea</i>
	<i>Sowerbaea laxiflora</i>
	<i>Thysanotus arbuscula</i>
	<i>Thysanotus multiflorus</i>
	<i>Thysanotus patersonii</i>
<b>Asteraceae</b>	<i>Asteridea pulverulenta</i>
	<i>Craspedia variabilis</i>
	* <i>Hypochaeris glabra</i>
	<i>Lagenophora huegelii</i>
	<i>Podolepis gracilis</i>
	* <i>Sonchus oleraceus</i>
	<i>Trichocline spathulata</i>
	* <i>Ursinia anthemoides</i>
	<i>Waitzia suaveolens</i> var. <i>suaveolens</i>
<b>Campanulaceae</b>	<i>Lobelia tenuior</i>
<b>Caryophyllaceae</b>	* <i>Petrohragia dubia</i>
<b>Colchicaceae</b>	<i>Burchardia congesta</i>
<b>Cyperaceae</b>	<i>Lepidosperma pubisquameum</i>
	<i>Schoenus grandiflorus</i>
	<i>Tetraria octandra</i>
<b>Dasypogonaceae</b>	<i>Dasypogon bromeliifolius</i>
<b>Dilleniaceae</b>	<i>Hibbertia cuneiformis</i>
	<i>Hibbertia hypericoides</i> subsp. <i>hypericoides</i>
	<i>Hibbertia racemosa</i>
	<i>Hibbertia vaginata</i>
<b>Droseraceae</b>	<i>Drosera</i> ? <i>erythrorhiza</i>
	<i>Drosera</i> ? <i>pallida</i>
	<i>Drosera</i> ? <i>stolonifera</i>
<b>Elaeocarpaceae</b>	<i>Platytheca galioides</i>
<b>Ericaceae</b>	<i>Astroloma pallidum</i>
	<i>Leucopogon propinquus</i>
<b>Fabaceae</b>	* <i>Acacia longifolia</i>
	<i>Acacia pulchella</i> var. <i>pulchella</i>
	<i>Acacia stenoptera</i>
	<i>Bossiaea eriocarpa</i>
	<i>Euchilopsis linearis</i>
	<i>Gompholobium polymorphum</i>
	<i>Gompholobium tomentosum</i>
	<i>Hardenbergia comptoniana</i>
	<i>Hovea trisperma</i>
	<i>Jacksonia sternbergiana</i>
	<i>Kennedia prostrata</i>
	* <i>Lotus subbiflorus</i>
	* <i>Trifolium campestre</i> var. <i>campestre</i>
	* <i>Trifolium repens</i> var. <i>repens</i>
	* <i>Trifolium subterraneum</i>
<b>Goodeniaceae</b>	<i>Scaevola calliptera</i>
<b>Haemodoraceae</b>	<i>Conostylis aculeata</i> subsp. <i>gracilis</i>

Family	Taxon
	<i>Conostylis aculeata</i> subsp. <i>preissii</i>
	<i>Haemodorum</i> sp.
	<i>Phlebocarya ciliata</i>
<b>Hemerocallidaceae</b>	<i>Agrostocrinum hirsutum</i>
	<i>Caesia micrantha</i>
	<i>Dianella revoluta</i>
	<i>Tricoryne elatior</i>
<b>Iridaceae</b>	* <i>Ixia</i> sp.
	<i>Orthrosanthus laxus</i> var. <i>laxus</i>
	<i>Patersonia occidentalis</i>
<b>Lamiaceae</b>	<i>Hemiandra pungens</i>
<b>Lauraceae</b>	<i>Cassytha glabella</i>
<b>Loranthaceae</b>	<i>Nuytsia floribunda</i>
<b>Myrtaceae</b>	<i>Agonis flexuosa</i>
	<i>Astartea scoparia</i>
	<i>Corymbia calophylla</i>
	<i>Eucalyptus gomphocephala</i>
	<i>Eucalyptus marginata</i>
	<i>Eucalyptus rudis</i>
	<i>Hypocalymma robustum</i>
	<i>Kunzea glabrescens</i>
	<i>Melaleuca nesophila</i>
	<i>Melaleuca preissiana</i>
	<i>Melaleuca raphiophylla</i>
	<i>Melaleuca thymoides</i>
<b>Orchidaceae</b>	<i>Cryptostylis ovata</i>
	<i>Microtis media</i> subsp. <i>media</i>
	<i>Pterostylis vittata</i>
	<i>Pyrorchis nigricans</i>
	<i>Thelymitra benthamiana</i>
	<i>Thelymitra paludosa</i>
<b>Orobanchaceae</b>	* <i>Orobanche minor</i>
<b>Oxalidaceae</b>	<i>Oxalis</i> sp.
<b>Phyllanthaceae</b>	<i>Phyllanthus calycinus</i>
<b>Pittosporaceae</b>	<i>Billardiera variifolia</i>
<b>Poaceae</b>	* <i>Avena barbata</i>
	* <i>Briza maxima</i>
	* <i>Bromus diandrus</i>
	* <i>Ehrharta calycina</i>
	<i>Microlaena stipoides</i> var. <i>stipoides</i>
	<i>Rytidosperma occidentale</i>
<b>Primulaceae</b>	* <i>Lysimachia arvensis</i>
<b>Proteaceae</b>	<i>Banksia attenuata</i>
	<i>Banksia grandis</i>
	<i>Banksia ilicifolia</i>
	<i>Petrophile linearis</i>
	<i>Stirlingia latifolia</i>
	<i>Xylomelum occidentale</i>
<b>Restionaceae</b>	<i>Desmocladius fasciculatus</i>
<b>Rhamnaceae</b>	<i>Spyridium globulosum</i>
<b>Rubiaceae</b>	<i>Opercularia apiciflora</i>
<b>Stylidiaceae</b>	<i>Stylidium araeophyllum</i>
	<i>Stylidium calcaratum</i>
<b>Violaceae</b>	<i>Hybanthus calycinus</i>
<b>Xanthorrhoeaceae</b>	<i>Xanthorrhoea brunonis</i>
<b>Zamiaceae</b>	<i>Macrozamia riedlei</i>

\* Denotes introduced taxa.

## Appendix 6

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### Selected Inputs and Outputs of the Floristic Analyses





**Table 1: Species that were omitted or combined for the floristic classification.**

NB. In addition to those listed in Appendix 3 of Gibson et al. (1994).

<b>Species rationalisations made for Biota quadrat data</b>	
<b>Taxon Name</b>	<b>Lookup</b>
<i>Acacia pulchella</i> var. <i>pulchella</i>	<i>Acacia pulchella</i>
<i>Avena barbata</i>	<i>Avena fatua</i>
<i>Bromus hordeaceus</i>	omitted (present as singleton in SCP data set so not included in the analysis)
<i>Burchardia congesta</i>	<i>Burchardia umbellata</i>
<i>Conostylis aculeata</i> subsp. <i>gracilis</i>	<i>Conostylis aculeata</i>
<i>Conostylis aculeata</i> subsp. <i>preissii</i>	<i>Conostylis aculeata</i>
<i>Craspedia variabilis</i>	<i>Craspedia</i> sp. scps (Perth Flora GJK 13121)
<i>Drosera</i> ? <i>erythrorhiza</i>	<i>Drosera erythrorhiza</i>
<i>Drosera</i> ? <i>pallida</i>	<i>Drosera pallida</i>
<i>Drosera</i> ? <i>stolonifera</i>	<i>Drosera stolonifera</i>
<i>Corymbia calophylla</i>	<i>Eucalyptus calophylla</i>
<i>Hibbertia hypericoides</i> subsp. <i>hypericoides</i>	<i>Hibbertia hypericoides</i>
<i>Kunzea glabrescens</i>	<i>Kunzea ericifolia</i>
<i>Lepidosperma pubisquameum</i>	<i>Lepidosperma squamatum</i>
<i>Lysimachia arvensis</i>	<i>Anagallis arvensis</i>
<i>Lotus subbiflorus</i>	<i>Lotus suaveolens</i>
<i>Desmocladus fasciculatus</i>	<i>Loxocarya fasciculata</i>
<i>Pyrorchis nigricans</i>	<i>Lyperanthus nigricans</i>
<i>Microlaena stipoides</i> var. <i>stipoides</i>	<i>Microlaena stipoides</i>
<i>Microtis media</i> subsp. <i>media</i>	<i>Microtis media</i>
<i>Haemodorum</i> sp.	omitted
<i>Ixia</i> sp.	omitted
<i>Oxalis</i> sp.	omitted
<i>Lomandra integra</i>	omitted; singleton
<i>Orthrosanthus laxus</i> var. <i>laxus</i>	<i>Orthrosanthus laxus</i>
<i>Petrorhagia dubia</i>	<i>Petrorhagia velutina</i>
<i>Stylidium araeophyllum</i>	<i>Stylidium brunonianum</i>
<i>Thysanotus patersonii</i>	<i>Thysanotus</i> sp. <i>manglesianus/patersonii</i> scps
<i>Trifolium campestre</i> var. <i>campestre</i>	<i>Trifolium campestre</i>
<i>Trifolium repens</i> var. <i>repens</i>	<i>Trifolium campestre</i>

**Table 2: Ten most similar sites to each of the quadrats subject to a NNB analysis for the current study.**

Quadrat		1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>	5 <sup>th</sup>	6 <sup>th</sup>	7 <sup>th</sup>	8 <sup>th</sup>	9 <sup>th</sup>	10 <sup>th</sup>
<b>GEL01</b>	Site	KEME-2	C71-3	AUSTRA-1	C71-2	CRAMPT-1	GUTHR-5	CRAMPT-2	boyan 01	KING-1	MANEA-2
	Assoc	0.2131	0.2542	0.2759	0.3214	0.3214	0.3214	0.3455	0.3704	0.3704	0.3704
	FCT	21a	21a	21a	21a	21a	21a	21a	21b	28	21a
<b>GEL02</b>	Site	KEME-2	C71-3	C71-2	CRAMPT-2	CLIF-1	HARRY-5	CAPEL-7	CRAMPT-1	GUTHR-5	KEME-1
	Assoc	0.1489	0.2273	0.2558	0.2558	0.2857	0.2857	0.3171	0.3171	0.3171	0.3171
	FCT	21a	21a	21a	21a	21a	21a	21a	21a	21a	25
<b>GEL03</b>	Site	KEME-1	CRAMPT-2	C71-2	GUTHR-3	GUTHR-5	CLIF-1	KEME-2	KING-1	CORON-2	CRAMPT-1
	Assoc	0.2308	0.25	0.2698	0.2698	0.2903	0.3115	0.3115	0.3115	0.3333	0.3333
	FCT	25	21a	21a	21a	21a	21a	21a	28	25	21a
<b>GEL04</b>	Site	boyan 01	CRAMPT-2	BULLER-2	dard02	AUSTRA-1	MANEA-3	GUTHR-5	C71-2	card2	card5
	Assoc	0.2157	0.2157	0.24	0.24	0.2653	0.2653	0.2917	0.3191	0.3191	0.3191
	FCT	21b	21a	21a	21b	21a	21b	21a	21a	20b	20b
<b>GEL05</b>	Site	CRAMPT-2	CAPEL-1	KEME-2	MANEA-2	FL-4	KEME-1	low06b	AMBR-4	AUSTRA-1	BULLER-1
	Assoc	0.3143	0.3939	0.3939	0.3939	0.4194	0.4194	0.4194	0.4375	0.4375	0.4375
	FCT	21a	21b	21a	21a	21a	25	21c	1b	21a	21a
<b>GELREL01</b>	Site	KEME-2	C71-2	CRAMPT-2	CAPEL-7	C71-3	AMBR-9	AUSTRA-1	CAPEL-1	CORON-1	FL-4
	Assoc	0.1351	0.2222	0.2353	0.2727	0.2941	0.3125	0.3125	0.3125	0.3125	0.3125
	FCT	21a	21a	21a	21a	21a	1b	21a	21b	21a	21a

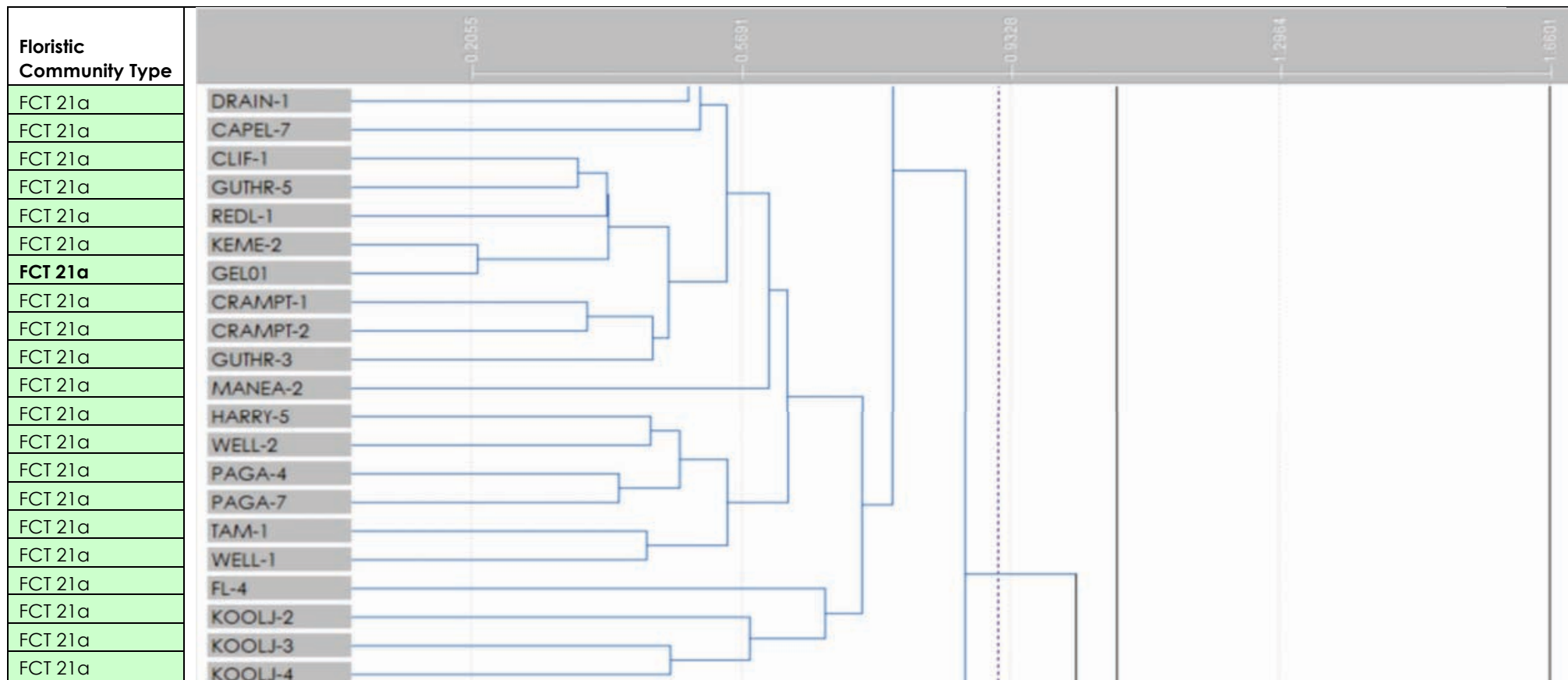


Figure 1: Section of dendrogram from floristic clustering analysis against the Gibson SCP data set – quadrat GEL01.



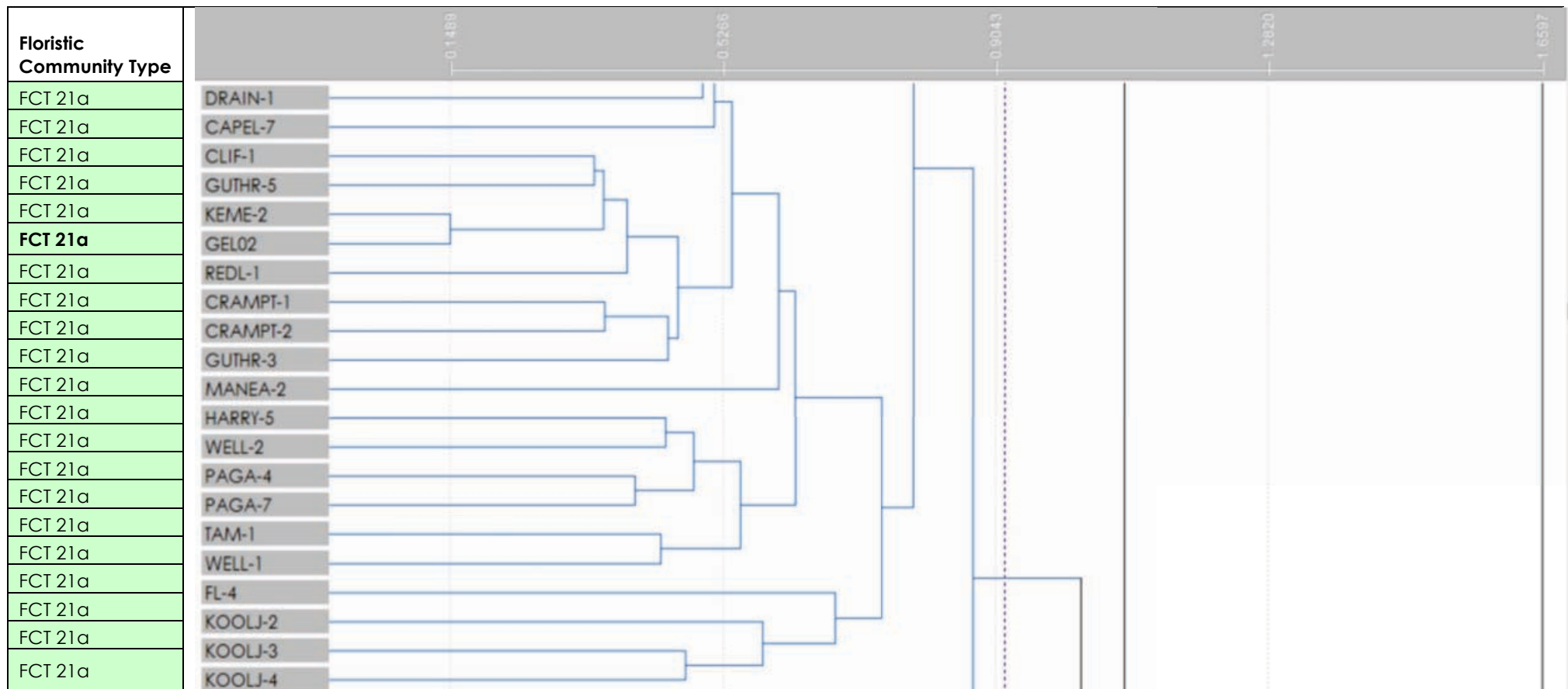


Figure 2: Section of dendrogram from floristic clustering analysis against the Gibson SCP data set – quadrat GEL02.

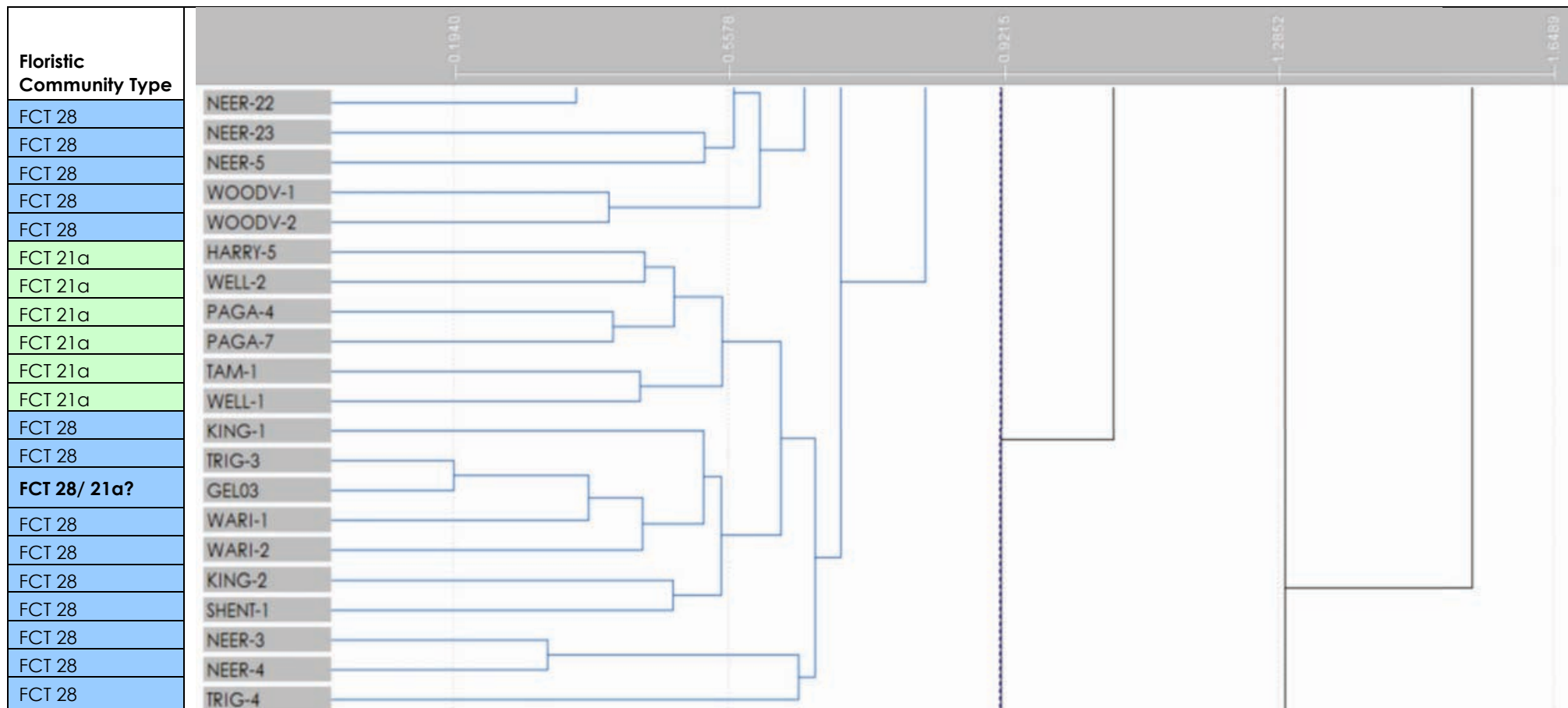
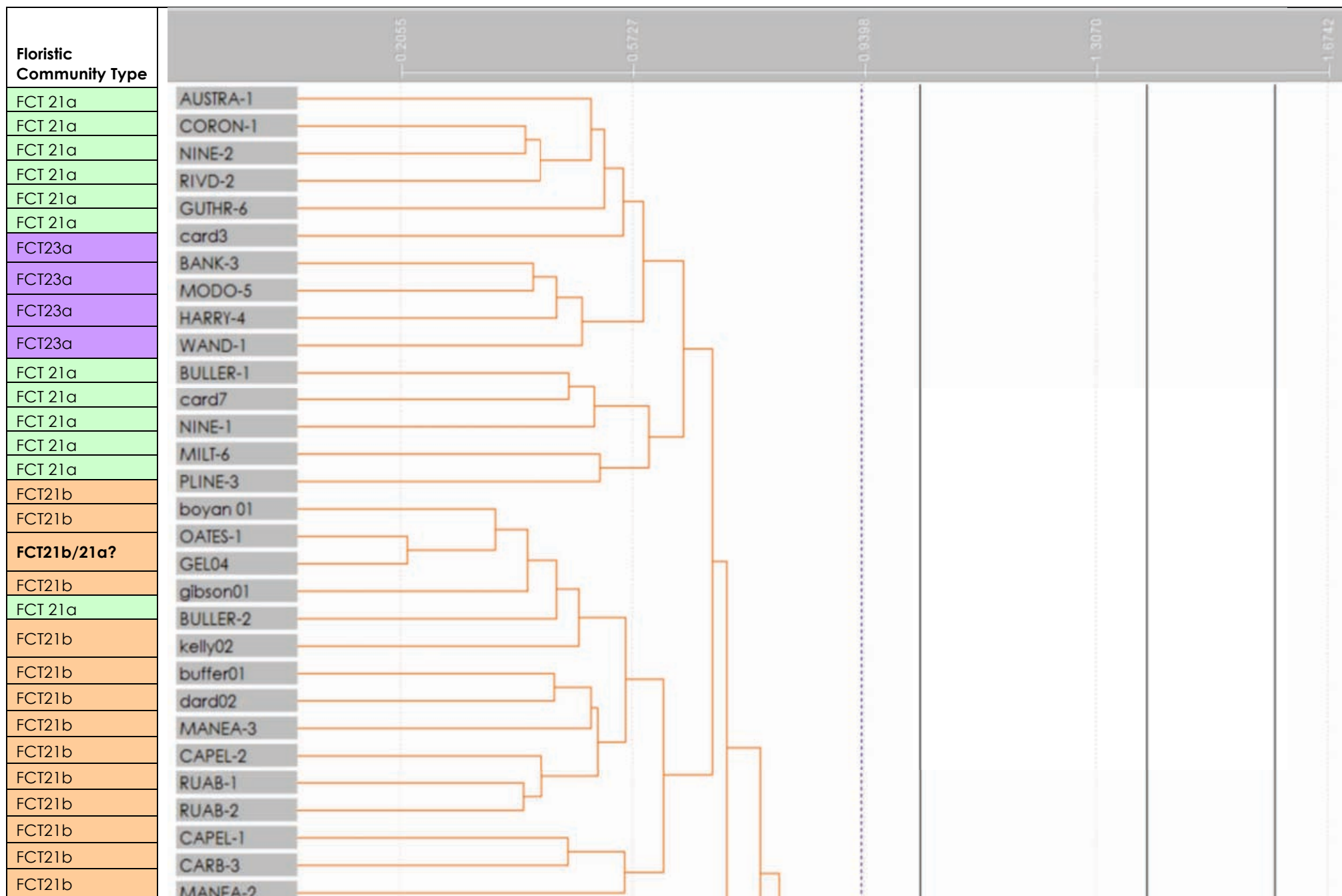


Figure 3: Section of dendrogram from floristic clustering analysis against the Gibson SCP data set – quadrat GEL03.



**Figure 4:** Section of dendrogram from floristic clustering analysis against the Gibson SCP data set – quadrat GEL04.

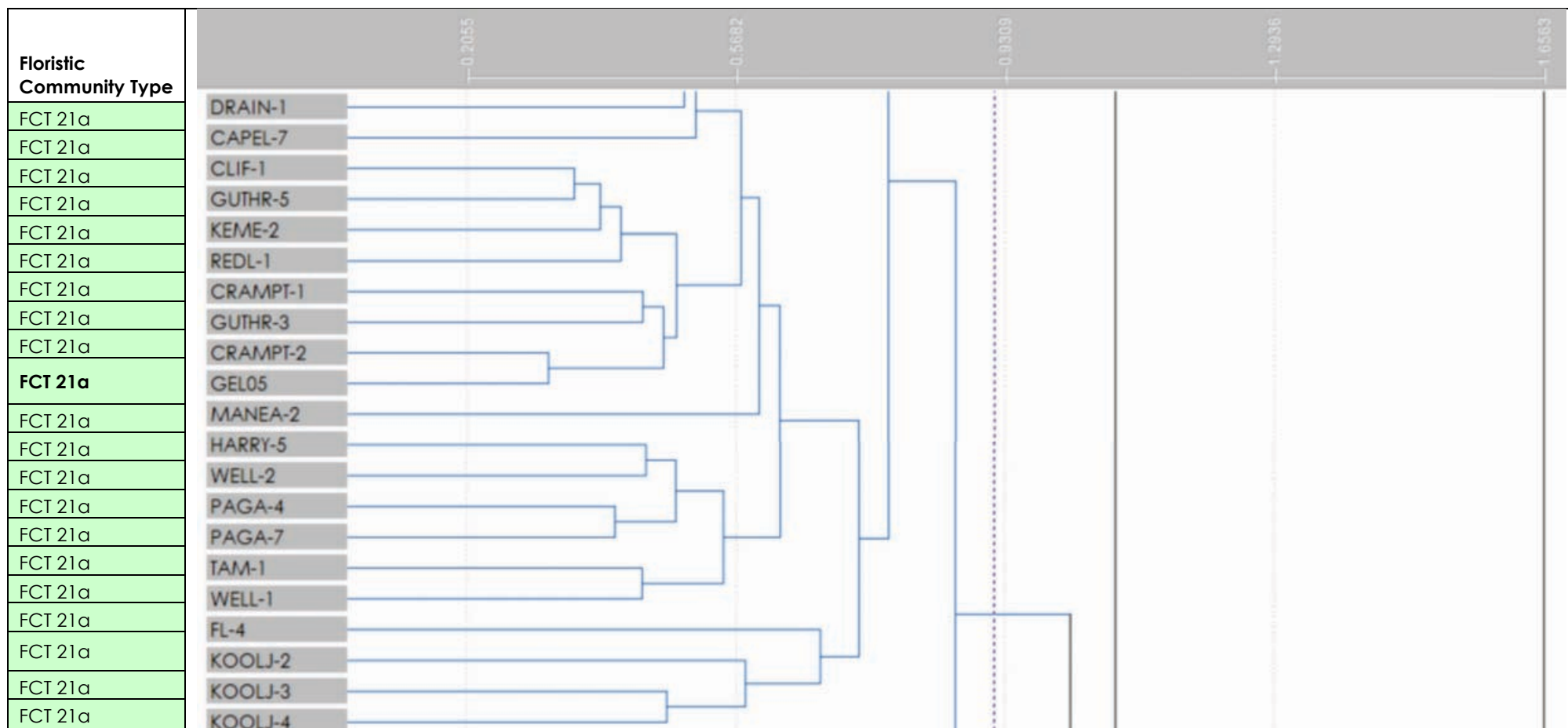


Figure 5: Section of dendrogram from floristic clustering analysis against the Gibson SCP data set – quadrat GEL05.

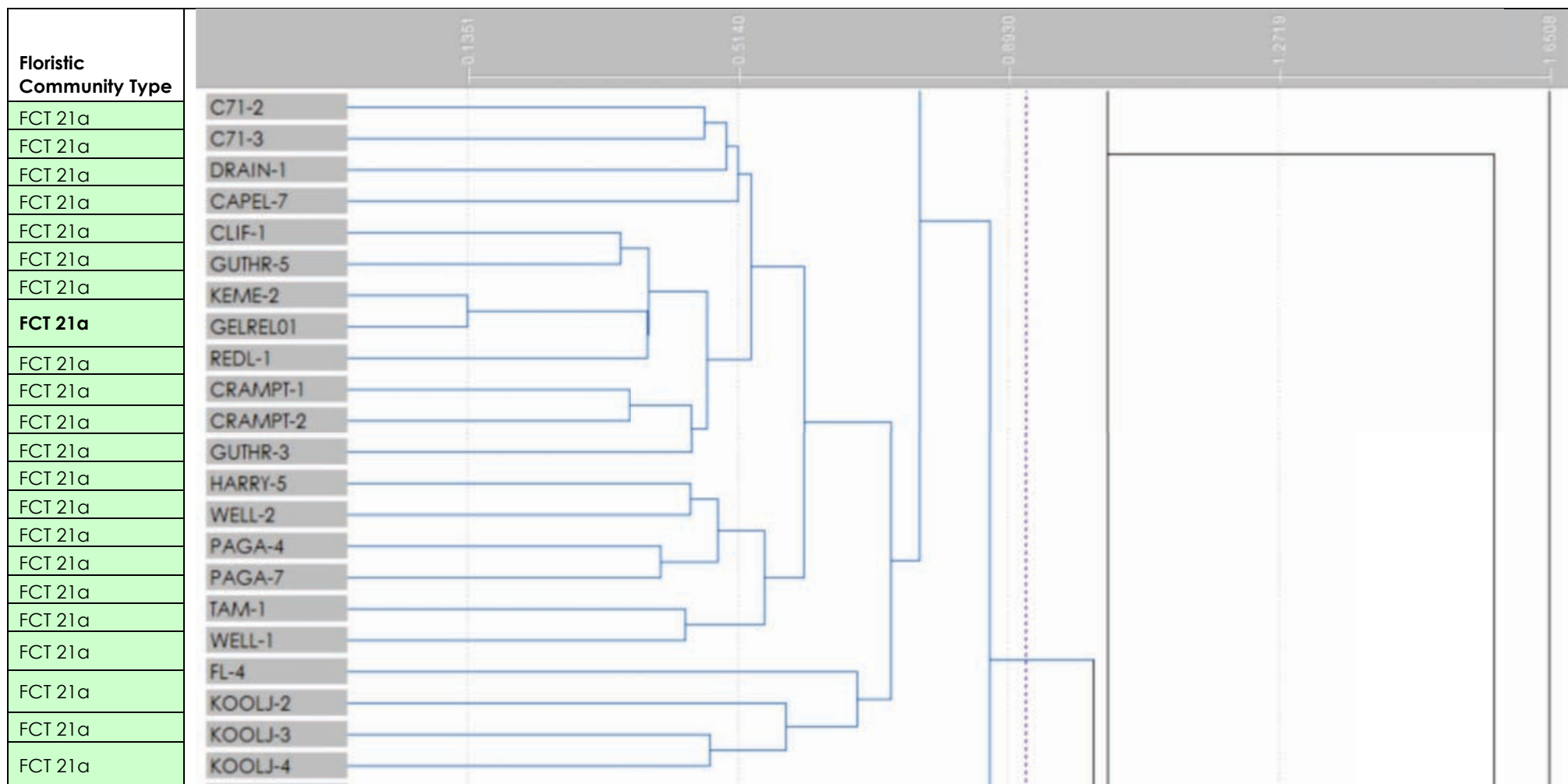


Figure 6: Section of dendrogram from floristic clustering analysis against the Gibson SCP data set – quadrat GELREL01.

**Table 2: Ten most similar sites to each of the quadrats subject to a NNB analysis for the current study.**

Quadrat		1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>	5 <sup>th</sup>	6 <sup>th</sup>	7 <sup>th</sup>	8 <sup>th</sup>	9 <sup>th</sup>	10 <sup>th</sup>
<b>GEL01</b>	Site	KEME-2	C71-3	AUSTRA-1	C71-2	CRAMPT-1	GUTHR-5	CRAMPT-2	boyan 01	KING-1	MANEA-2
	Assoc	0.2131	0.2542	0.2759	0.3214	0.3214	0.3214	0.3455	0.3704	0.3704	0.3704
	FCT	21a	21a	21a	21a	21a	21a	21a	21b	28	21a
<b>GEL02</b>	Site	KEME-2	C71-3	C71-2	CRAMPT-2	CLIF-1	HARRY-5	CAPEL-7	CRAMPT-1	GUTHR-5	KEME-1
	Assoc	0.1489	0.2273	0.2558	0.2558	0.2857	0.2857	0.3171	0.3171	0.3171	0.3171
	FCT	21a	21a	21a	21a	21a	21a	21a	21a	21a	25
<b>GEL03</b>	Site	KEME-1	CRAMPT-2	C71-2	GUTHR-3	GUTHR-5	CLIF-1	KEME-2	KING-1	CORON-2	CRAMPT-1
	Assoc	0.2308	0.25	0.2698	0.2698	0.2903	0.3115	0.3115	0.3115	0.3333	0.3333
	FCT	25	21a	21a	21a	21a	21a	21a	28	25	21a
<b>GEL04</b>	Site	boyan 01	CRAMPT-2	BULLER-2	dard02	AUSTRA-1	MANEA-3	GUTHR-5	C71-2	card2	card5
	Assoc	0.2157	0.2157	0.24	0.24	0.2653	0.2653	0.2917	0.3191	0.3191	0.3191
	FCT	21b	21a	21a	21b	21a	21b	21a	21a	20b	20b
<b>GEL05</b>	Site	CRAMPT-2	CAPEL-1	KEME-2	MANEA-2	FL-4	KEME-1	low06b	AMBR-4	AUSTRA-1	BULLER-1
	Assoc	0.3143	0.3939	0.3939	0.3939	0.4194	0.4194	0.4194	0.4375	0.4375	0.4375
	FCT	21a	21b	21a	21a	21a	25	21c	1b	21a	21a
<b>GELREL01</b>	Site	KEME-2	C71-2	CRAMPT-2	CAPEL-7	C71-3	AMBR-9	AUSTRA-1	CAPEL-1	CORON-1	FL-4
	Assoc	0.1351	0.2222	0.2353	0.2727	0.2941	0.3125	0.3125	0.3125	0.3125	0.3125
	FCT	21a	21a	21a	21a	21a	1b	21a	21b	21a	21a

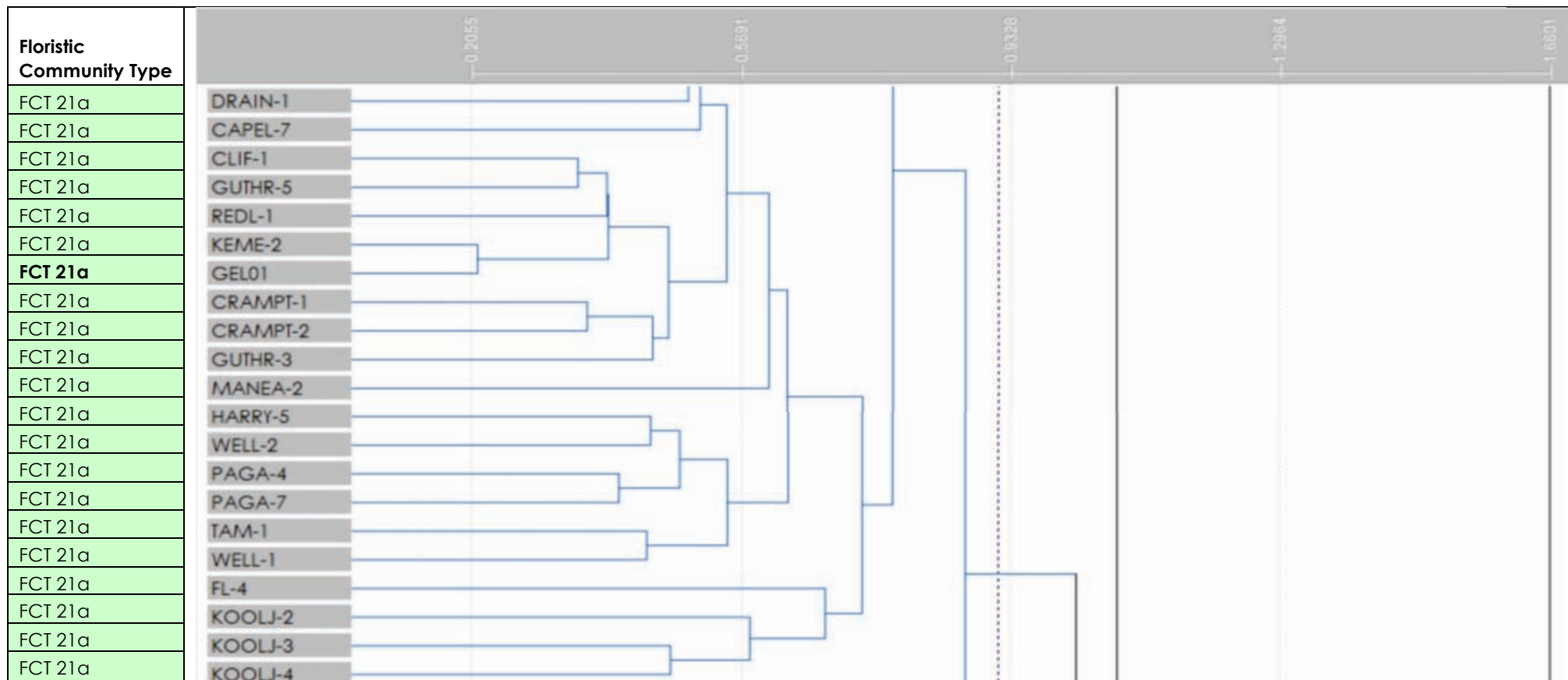


Figure 1: Section of dendrogram from floristic clustering analysis against the Gibson SCP data set – quadrat GEL01.

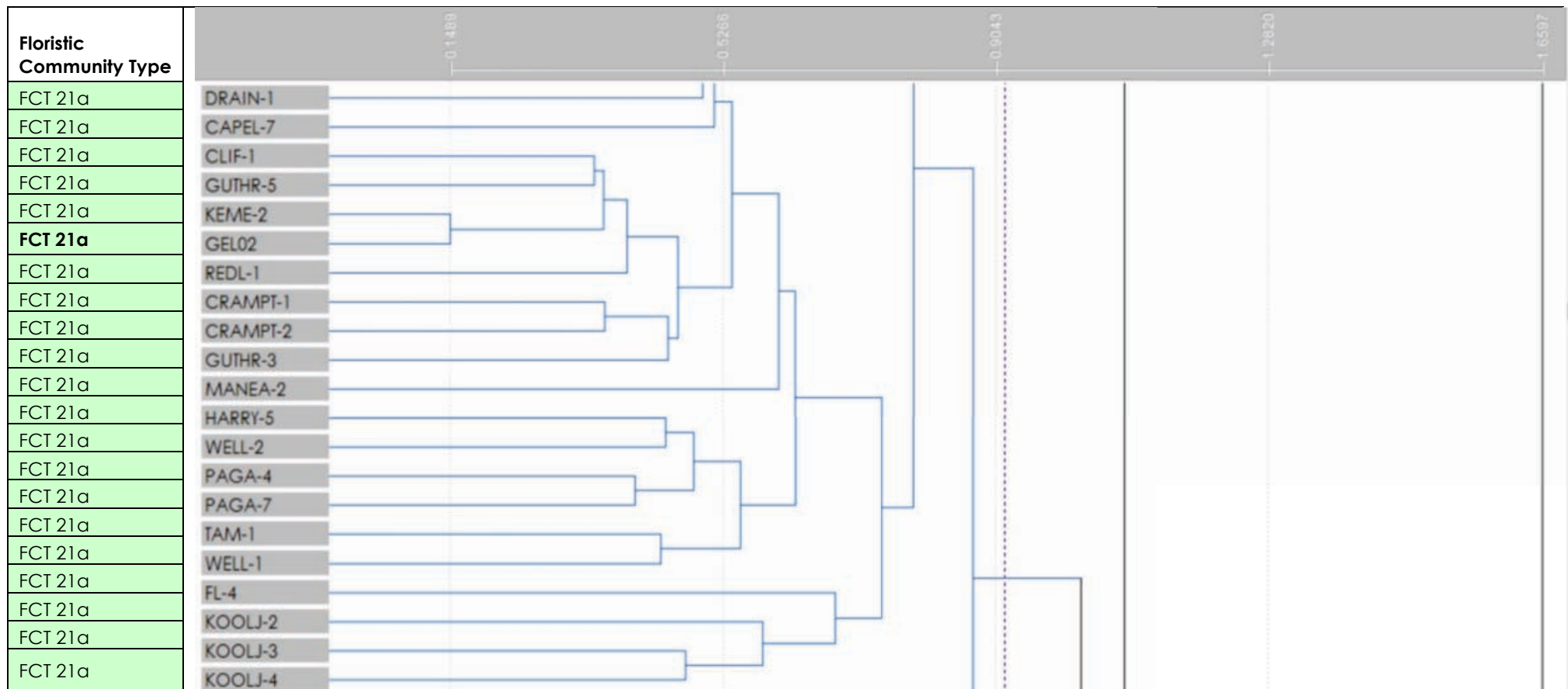


Figure 2: Section of dendrogram from floristic clustering analysis against the Gibson SCP data set – quadrat GEL02.



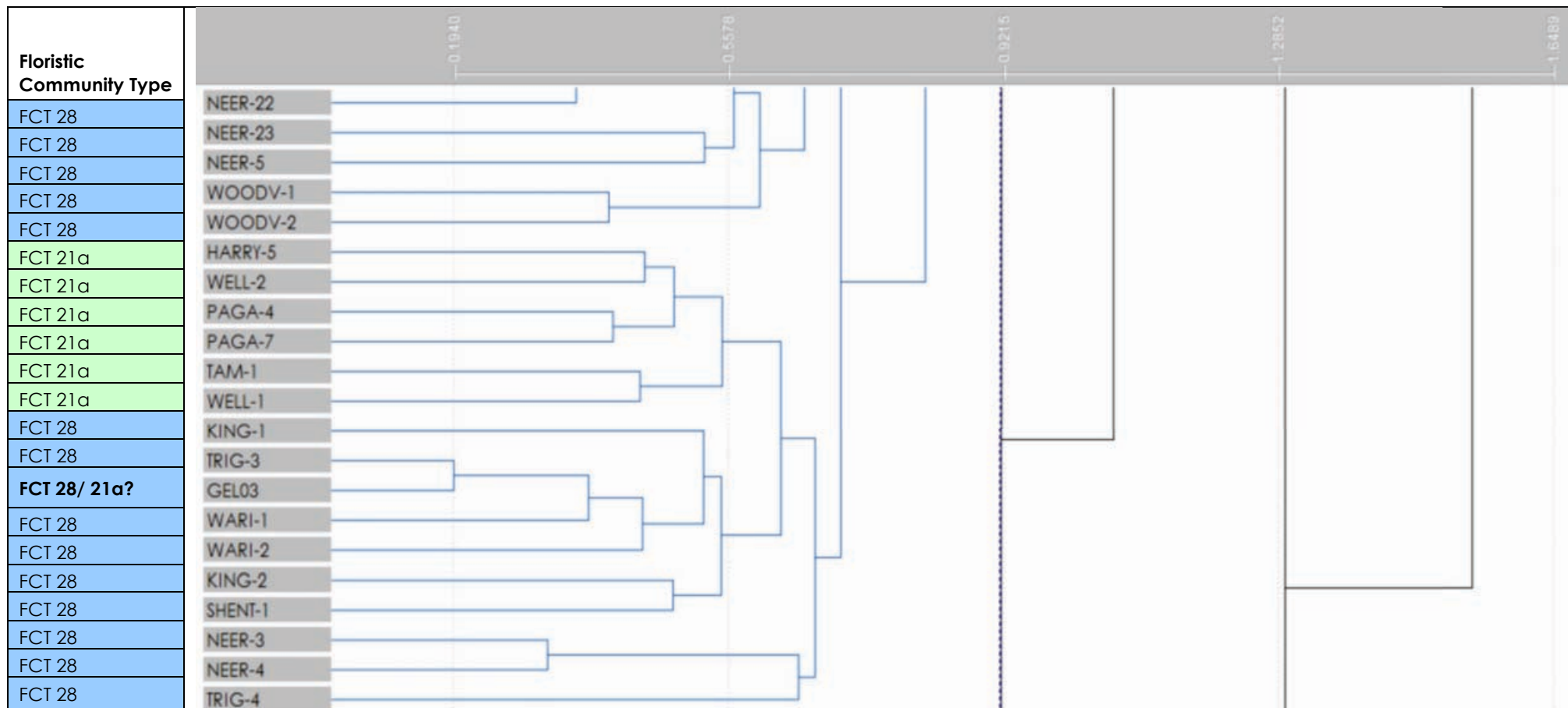
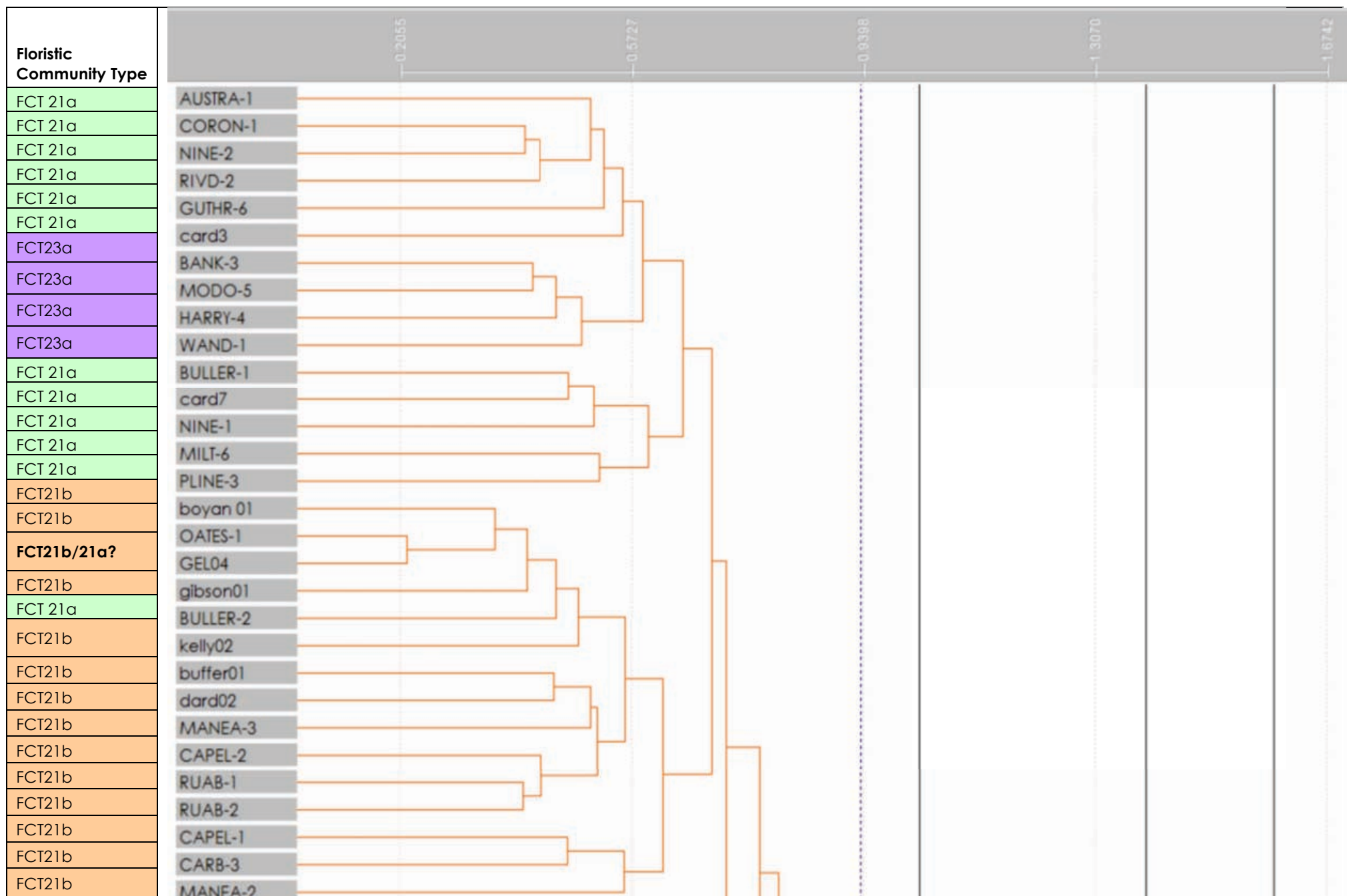


Figure 3: Section of dendrogram from floristic clustering analysis against the Gibson SCP data set – quadrat GEL03.



**Figure 4:** Section of dendrogram from floristic clustering analysis against the Gibson SCP data set – quadrat GEL04.

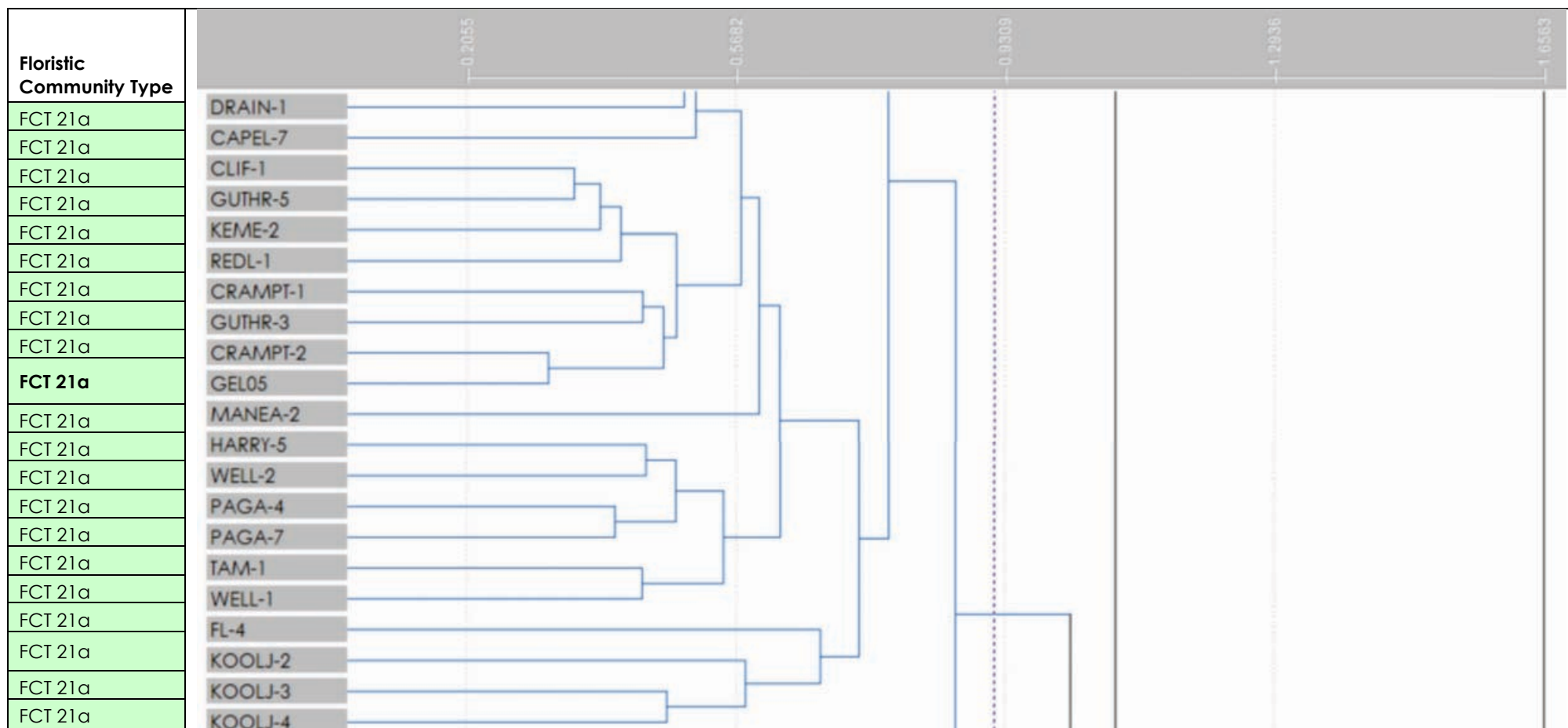


Figure 5: Section of dendrogram from floristic clustering analysis against the Gibson SCP data set – quadrat GEL05.

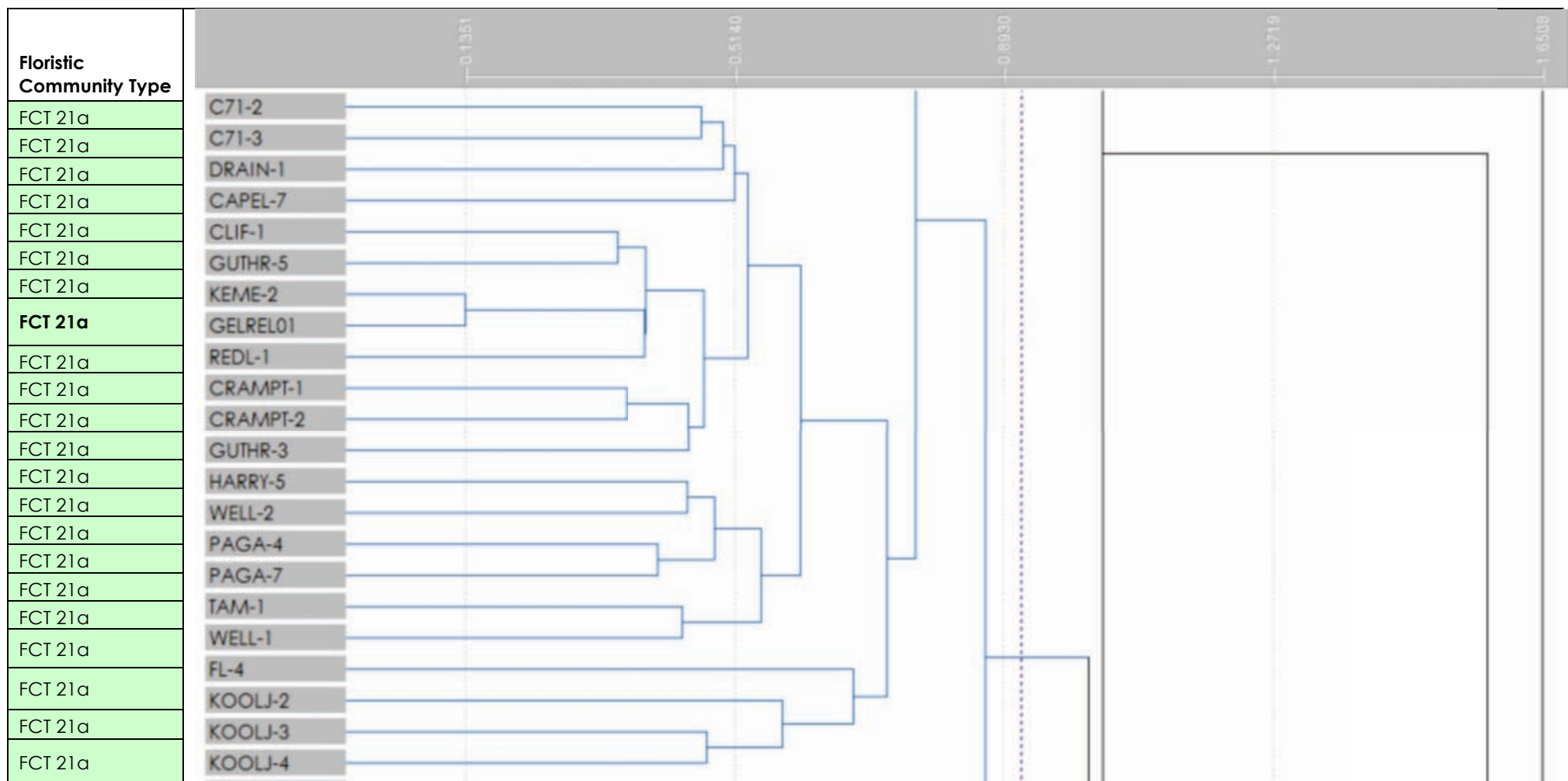


Figure 6: Section of dendrogram from floristic clustering analysis against the Gibson SCP data set – quadrat GELREL01.



## Appendix 7

### Final Assessment to Determine if the Target Areas Contain the Commonwealth TEC







Survey Polygon	Polygon size (ha)	Target Area	~Target Area size (ha)	~Area within polygon (ha)	Vegetation types mapped (Current Survey)	Condition (Current Survey)	Final Assessment – Target Area correspond to TEC?	Sampling From Current Survey	Notes
S1	3.41	T1	1.6	1.1	<i>Agonis flexuosa</i> open forest	Completely Degraded	No	Map notes	<b>Does not qualify:</b> <ul style="list-style-type: none"> <li>- Vegetation structure criteria not met: <ul style="list-style-type: none"> <li>➤ Vegetation <i>Agonis flexuosa</i> open forest.</li> </ul> </li> </ul>
S2	3.49	T2	2.1	0.5	1) <i>Corymbia calophylla</i> , <i>Banksia attenuata</i> open forest	Degraded	No	Map notes and quadrat GEL05	<b>Does not qualify:</b> <ul style="list-style-type: none"> <li>- Vegetation structure criteria not met: <ul style="list-style-type: none"> <li>➤ Vegetation <i>Corymbia calophylla</i> open forest.</li> </ul> </li> </ul> <p>Most of Patch 2, including immediately adjacent to the survey polygon, was mapped as <i>Corymbia calophylla</i> open forest.</p> <p>The two vegetation units comprising <i>Banksia</i>: <i>Corymbia calophylla</i>, <i>Agonis flexuosa</i> (<i>B. attenuata</i>) woodland, and <i>C. calophylla</i>, <i>B. attenuata</i> open forest (0.7 ha and 0.5 ha, respectively)) were located between 380 m and 440 m to the south of the survey polygon. Neither of these would be considered the TEC due to their small size.</p>
					2) <i>Corymbia calophylla</i> , <i>Agonis flexuosa</i> ( <i>Banksia attenuata</i> ) woodland	Very Good			
					3) <i>C. calophylla</i> open forest	Good			
					4) <i>Melaleuca raphiophylla</i> low open forest	Degraded to Completely Degraded			
S3	4.62	T3	0.3	0.3	Remnant native overstorey species over pastureland	Completely Degraded	No	Not sampled; observations made when sampling T4	<b>Does not qualify:</b> <ul style="list-style-type: none"> <li>- Condition criteria not met: <ul style="list-style-type: none"> <li>➤ Vegetation Completely Degraded.</li> </ul> </li> </ul> <p>Target Area 3 occurs along the boundary of a paddock used for carrying cattle, and comprised of remnant native overstorey species (not <i>Banksia</i> dominated) over pastureland (introduced grass species).</p>
S4	1.63	T4	3.9	0.2	<i>Banksia Illicifolia</i> ( <i>B. attenuata</i> , <i>Eucalyptus marginata</i> ) low open forest	Degraded	No	Map notes	<b>Does not qualify:</b> <ul style="list-style-type: none"> <li>- Condition criteria not met: <ul style="list-style-type: none"> <li>➤ Vegetation Degraded.</li> </ul> </li> </ul> <p>Target Area 4 occurs within a paddock used for carrying cattle, and is comprised of remnant native overstorey species (<i>Banksia</i> dominated) over grassland, with few native groundstorey species present.</p>
S5	4.38	T5	13.7	0.6	1) <i>Eucalyptus marginata</i> , <i>Agonis flexuosa</i> ( <i>Banksia attenuata</i> , <i>B. illicifolia</i> ) woodland	Degraded	No	Map notes	<b>Does not qualify:</b> <ul style="list-style-type: none"> <li>- Condition criteria not met: <ul style="list-style-type: none"> <li>➤ Vegetation Degraded.</li> </ul> </li> </ul> <p>The vegetation within and immediately adjacent to the survey polygon was comprised of two vegetation units:</p> <p>1) <i>E. marginata</i>, <i>A. flexuosa</i> (<i>B. attenuata</i>, <i>B. illicifolia</i>) woodland). This unit was recorded in a Degraded condition, due to the very sparse native groundstorey cover and high density of weeds.</p> <p>2) <i>Melaleuca preissiana</i> woodland, which would not qualify as the TEC.</p> <p>A third unit (<i>A. flexuosa</i> closed forest) (i.e. not <i>Banksia</i> dominated) was mapped 140 m to the west.</p>
		T6			2) <i>Melaleuca preissiana</i> woodland	Excellent			
					3) <i>Agonis flexuosa</i> closed forest	Degraded to Completely Degraded			
					Remnant native overstorey species ( <i>Corymbia calophylla</i> ) over pastureland.		No	Not sampled; observations made during traverse to T5	<b>Does not qualify:</b> <ul style="list-style-type: none"> <li>- Vegetation structure criteria not met: <ul style="list-style-type: none"> <li>➤ Remnant native overstorey species (<i>Corymbia calophylla</i>) over pastureland (introduced species).</li> </ul> </li> <li>- Condition criteria not met. <ul style="list-style-type: none"> <li>➤ Vegetation Completely Degraded.</li> </ul> </li> </ul> <p>Target Area 6 occurs within a paddock used for carrying cattle.</p>

Survey Polygon	Polygon size (ha)	Target Area	~Target Area size (ha)	~Area within polygon (ha)	Vegetation types mapped (Current Survey)	Condition (Current Survey)	Final Assessment – Target Area correspond to TEC?	Sampling From Current Survey	Notes
S6	10.37	T7	2.4	0.3	<i>Agonis flexuosa</i> , <i>Eucalyptus marginata</i> ( <i>Banksia attenuata</i> ) woodland	6 Completely Degraded	No	Map notes	<b>Does not qualify:</b> <ul style="list-style-type: none"> <li>Condition criteria not met: <ul style="list-style-type: none"> <li>➤ Vegetation Completely Degraded.</li> </ul> </li> </ul> <p>Target Area 7 occurs within a paddock, and comprised of remnant native overstorey species (<i>Banksia</i> co-dominated) over a weedy grassland.</p>
		T8	52.6	2.6	1) <i>Eucalyptus marginata</i> , <i>Banksia attenuata</i> , <i>B. illicifolia</i> , <i>Corymbia calophylla</i> open forest	Degraded to Good	Yes, partially	Map notes	<b>Part Target Area qualifies as the TEC:</b> <ul style="list-style-type: none"> <li>Vegetation structure criteria met: <ul style="list-style-type: none"> <li>➤ Vegetation <i>C. calophylla</i>, <i>E. marginata</i>, <i>B. attenuata</i> woodland to open forest.</li> </ul> </li> <li>Condition criteria met: <ul style="list-style-type: none"> <li>➤ Vegetation Good</li> </ul> </li> </ul> <p>One small patch within T8 contains vegetation (<i>C. calophylla</i>, <i>E. marginata</i>, <i>B. attenuata</i> woodland to open forest) considered TEC (rated as being in Good condition, and mapped across 2.7 ha). The patch is located 460 m east of survey polygon, along the southern boundary of Target Area.</p> <p>Vegetation within the survey polygon and immediately adjacent comprised of two vegetation units:</p> <p>1) <i>E. marginata</i>, <i>B. attenuata</i>, <i>B. illicifolia</i>, <i>C. calophylla</i> open forest), however it was recorded in a Degraded to Good condition (1.2 ha).</p> <p>2) <i>E. marginata</i>, <i>C. calophylla</i>, <i>A. flexuosa</i> woodland: occurred over most of the Target Area, does not qualify as the TEC due to incorrect structure (<i>Banksia attenuata</i> was only recorded as isolated individuals).</p>
					2) <i>Eucalyptus marginata</i> , <i>Corymbia calophylla</i> , <i>Agonis flexuosa</i> woodland	Degraded			
					3) <i>Corymbia calophylla</i> , <i>E. marginata</i> , <i>Banksia attenuata</i> woodland to open forest	Good			
					4) <i>Eucalyptus rudis</i> ( <i>Melaleuca preissiana</i> ) woodland	Degraded			
		T9	1.3	0.7	Remnant native overstorey species ( <i>Corymbia calophylla</i> ) over pastureland	Completely Degraded	No	Not sampled; observations made from Ducane Road	<b>Does not qualify:</b> <ul style="list-style-type: none"> <li>Vegetation structure criteria not met: <ul style="list-style-type: none"> <li>➤ Vegetation remnant native overstorey species (<i>Corymbia calophylla</i>) over pastureland (introduced grass taxa).</li> </ul> </li> <li>Condition criteria not met: <ul style="list-style-type: none"> <li>➤ Vegetation Completely Degraded).</li> </ul> </li> </ul> <p>Target Area 9 occurs within a paddock used for carrying cattle.</p>
S7	16.8	T10	1.0	1.0	Remnant native overstorey species ( <i>Corymbia calophylla</i> ) over pastureland	Completely Degraded	No	Not sampled; observations made from Ducane Road	<b>Does not qualify:</b> <ul style="list-style-type: none"> <li>Vegetation structure criteria not met: <ul style="list-style-type: none"> <li>➤ Vegetation Remnant native overstorey species (<i>Corymbia calophylla</i>) over pastureland.</li> </ul> </li> <li>Condition criteria not met: <ul style="list-style-type: none"> <li>➤ Vegetation Completely Degraded.</li> </ul> </li> </ul> <p>Target Area 10 occurs within a paddock used for carrying cattle.</p>

Survey Polygon	Polygon size (ha)	Target Area	~Target Area size (ha)	~Area within polygon (ha)	Vegetation types mapped (Current Survey)	Condition (Current Survey)	Final Assessment – Target Area correspond to TEC?	Sampling From Current Survey	Notes
S7	16.8	T11	9.9	9.3	1) <i>Corymbia calophylla</i> , <i>Eucalyptus marginata</i> , <i>Banksia attenuata</i> woodland to open forest	Good to Degraded - Completely Degraded	Yes, partially	Map notes	<p><b>Part patch qualifies as the TEC:</b></p> <ul style="list-style-type: none"> <li>- Vegetation structure criteria met: <ul style="list-style-type: none"> <li>➤ Vegetation <i>C. calophylla</i>, <i>E. marginata</i>, <i>B. attenuata</i> woodland to open forest.</li> </ul> </li> <li>- Condition criteria met: <ul style="list-style-type: none"> <li>➤ Vegetation rated as Good.</li> </ul> </li> </ul> <p>Only the northernmost half of target Area 11 comprised vegetation (4.92 ha) meeting the condition criteria for the TEC (e.g. Good). Two Biota quadrats (BOR05, BOR07) within this section were rated in Very Good condition; however, these quadrats were located in the best examples of the vegetation, not necessarily representative of the entire patch (severely disturbed edges bound the patch, in addition to a series of tracks running through the centre).</p> <p>The rest of the patch was Degraded to Completely Degraded, or too small an area to qualify (e.g. the southern most section of the patch (<i>C. calophylla</i>, <i>E. marginata</i>, <i>B. attenuata</i> woodland to open forest; 0.82 ha)).</p>
					2) <i>Eucalyptus marginata</i> , <i>Banksia attenuata</i> low open to open forest	Good			
S8	2.68	T12	16.8	0.7	<i>E. marginata</i> , <i>Banksia attenuata</i> low open to open forest	Very Good to Excellent	Yes, entirely	Quadrat GEL04, map notes	<p><b>Entire patch qualifies as the TEC:</b></p> <ul style="list-style-type: none"> <li>- Vegetation structure criteria: <ul style="list-style-type: none"> <li>➤ Vegetation <i>E. marginata</i>, <i>B. attenuata</i> low open to open forest.</li> </ul> </li> <li>- Condition criteria met: <ul style="list-style-type: none"> <li>➤ Vegetation rated as Very Good to Excellent (some boundaries rates as degraded, but these were small in scale).</li> </ul> </li> <li>- Size criteria met: <ul style="list-style-type: none"> <li>➤ Patch size 14 ha.</li> </ul> </li> </ul>

Survey Polygon	Polygon size (ha)	Target Area No.	~Target Area size (ha)	~Area within polygon (ha)	Vegetation types mapped (current survey)	Condition (current survey)	Final Assessment – Target Area correspond to TEC?	Existing sites	Notes
S9&S10	42.54	T13	15.0	8.5	1) <i>Corymbia calophylla</i> , <i>Eucalyptus marginata</i> , <i>Agonis flexuosa</i> , <i>Banksia attenuata</i> open forest	Very Good to Degraded	Yes, partially	Map notes	<b>Part patch qualifies as the TEC:</b> <ul style="list-style-type: none"> <li>- Vegetation structure criteria met: <ul style="list-style-type: none"> <li>➤ Most of the patch is comprised of <i>C. calophylla</i>, <i>E. marginata</i>, <i>A. flexuosa</i>, <i>B. attenuata</i> open forest.</li> </ul> </li> <li>- Condition criteria met: <ul style="list-style-type: none"> <li>➤ Vegetation Very Good.</li> </ul> </li> </ul> <p>Only the central section of the patch (mostly intersects the survey polygon) contains vegetation in Very Good quality, covering 6.5 ha. This section therefore qualifies as the TEC. It does not include much of the bordering vegetation within residential properties, or the small section of wetland vegetation (<i>Melaleuca preissiana</i>) in the far north of the patch.</p>
					2) <i>Melaleuca preissiana</i> woodland	Degraded			
S9&S10	42.54	T14	14.8	3.5	<i>Agonis flexuosa</i> ( <i>Corymbia calophylla</i> ) open forest	Good to Degraded	No	Map notes	<b>Does not qualify:</b> <ul style="list-style-type: none"> <li>- Vegetation structure criteria not met: <ul style="list-style-type: none"> <li>➤ Vegetation recorded as <i>A. flexuosa</i> (<i>C. calophylla</i>) open forest.</li> </ul> </li> <li>- Condition criteria not met: <ul style="list-style-type: none"> <li>➤ Vegetation condition Good to Degraded.</li> </ul> </li> </ul> <p>Target Area 14 occurs within a mixed residential/ rural area (residential blocks and large rural style blocks) with adjacent paddocks), and comprised of remnant native overstorey species over a sparse native understorey. <i>Banksia attenuata</i> was only recorded as isolated individuals.</p>
		T15	1.1	1.1	Remnant native overstorey species ( <i>Corymbia calophylla</i> ) over grassland.	Completely Degraded	No	Not sampled; observations made from Yalinda Drive	<b>Does not qualify:</b> <ul style="list-style-type: none"> <li>- Vegetation structure criteria not met: <ul style="list-style-type: none"> <li>➤ Vegetation remnant native overstorey species (<i>Corymbia calophylla</i>) over grassland.</li> </ul> </li> <li>- Condition criteria not met: <ul style="list-style-type: none"> <li>➤ Vegetation Completely Degraded.</li> </ul> </li> </ul> <p>Target Area 15 occurs as a small remnant of native overstorey species over grassland (introduced species), within a paddock.</p>
		T16	11.7	0.1	<i>Agonis flexuosa</i> , <i>Eucalyptus marginata</i> ( <i>Banksia attenuata</i> ) woodland	Very Good to Degraded – Completely Degraded	Yes, partially	Map notes	<b>Does not qualify:</b> <ul style="list-style-type: none"> <li>- Vegetation structure met: <ul style="list-style-type: none"> <li>➤ Vegetation recorded as <i>A. flexuosa</i>, <i>E. marginata</i> (<i>B. attenuata</i>) woodland.</li> </ul> </li> <li>- Condition criteria met: <ul style="list-style-type: none"> <li>➤ Vegetation rated as Very Good.</li> </ul> </li> </ul> <p>Two patches of the Target Area would constitute the TEC; they were mapped between 60 m and 150 m to the north and northwest of the survey polygon (a total of 3.8 ha).</p> <p>However, the area of vegetation immediately adjacent to the survey polygon occurs within residential properties, and thus rated as Degraded to Completely Degraded, and would not constitute the TEC.</p>

Survey Polygon	Polygon size (ha)	Target Area No.	~Target Area size (ha)	~Area within polygon (ha)	Vegetation types mapped (current survey)	Condition (current survey)	Final Assessment – Target Area correspond to TEC?	Existing sites	Notes
		T17	17.3	8.0	<i>Corymbia calophylla</i> , <i>Agonis flexuosa</i> ( <i>Banksia attenuata</i> ) woodland to open forest	Very Good to Degraded – Completely Degraded	Yes, partially	Map notes, quadrat GEL03	<p><b>Part Target Area qualifies as the TEC:</b></p> <ul style="list-style-type: none"> <li>- Vegetation structure criteria met: <ul style="list-style-type: none"> <li>➤ Vegetation recorded as <i>C. calophylla</i>, <i>Agonis flexuosa</i> (<i>B. attenuata</i>) woodland to open forest.</li> </ul> </li> <li>- Condition criteria met: <ul style="list-style-type: none"> <li>➤ Vegetation for majority of the sections (11 ha) within the patch were recorded in Very Good condition, and thus correspond to the TEC (approximately 87%).</li> </ul> </li> </ul> <p>The remaining area (1.65 ha), mostly along the northern boundary of the target Area, was recorded in Degraded to Completely Degraded condition in areas associated with residential properties.</p>
S9&S10	42.54	T18	52.7	15.0	<i>Corymbia calophylla</i> , <i>Banksia attenuata</i> open forest	Good to Degraded – Completely Degraded	Yes, partially	Map notes	<p><b>Part patch qualifies as the TEC:</b></p> <ul style="list-style-type: none"> <li>- Vegetation structure criteria met: <ul style="list-style-type: none"> <li>➤ Vegetation recorded as <i>C. calophylla</i>, <i>B. attenuata</i> open forest.</li> </ul> </li> <li>- Condition criteria met: <ul style="list-style-type: none"> <li>➤ Vegetation for central sections of the Target Area were recorded in Good condition.</li> </ul> </li> </ul> <p>Only two of the four polygons within Target Area 18 correspond to the TEC (approximately 29%). These patches occur as one small polygon (3.43 ha) adjacent to the Bussell highway road reserve, in addition to a second narrow patch of remnant vegetation (7.93 ha) running along the survey polygon.</p> <p>The remaining area was recorded in Degraded to Completely Degraded condition, in areas associated with residential properties.</p>
		T19	2.1	1.1	<i>Corymbia calophylla</i> , <i>Banksia attenuata</i> open forest	Very Good	Yes, entirely	Map notes and quadrat GEL01	<p><b>Entire patch qualifies as the TEC:</b></p> <ul style="list-style-type: none"> <li>- Vegetation structure criteria met: <ul style="list-style-type: none"> <li>➤ Vegetation mapped as <i>C. calophylla</i>, <i>B. attenuata</i> closed forest.</li> </ul> </li> <li>- Condition criteria met: <ul style="list-style-type: none"> <li>➤ Vegetation condition rated as Very Good. Quadrat GEL01 rated as Excellent, however overall patch in slightly poorer quality due to surrounding edge effects.</li> </ul> </li> <li>- Size criteria met: <ul style="list-style-type: none"> <li>➤ Size of patch 1.73 ha.</li> </ul> </li> </ul>
		T20	1.6	1.6	<i>Corymbia calophylla</i> , <i>Banksia attenuata</i> open forest	Very Good to Degraded	No	Map notes	<p><b>Does not qualify:</b></p> <ul style="list-style-type: none"> <li>- Condition criteria met: <ul style="list-style-type: none"> <li>➤ Vegetation condition rated as Very Good.</li> </ul> </li> <li>- <u>However</u>, size criteria not met: <ul style="list-style-type: none"> <li>➤ Southern half of patch in Very Good condition is only 0.7 ha in size, the northern section is similar in size but rated as Degraded.</li> </ul> </li> </ul> <p>Target Area 20 was not rated as Excellent, due to the significant edge effects bounding the vegetation.</p> <p>Target Area 20 is located in the same median strip as T21.</p>

Survey Polygon	Polygon size (ha)	Target Area No.	~Target Area size (ha)	~Area within polygon (ha)	Vegetation types mapped (current survey)	Condition (current survey)	Final Assessment – Target Area correspond to TEC?	Existing sites	Notes
		T21	0.9	0.9	<i>Corymbia calophylla</i> , <i>Banksia attenuata</i> open forest	Degraded	No	Map notes	<b>Does not qualify:</b> <ul style="list-style-type: none"> <li>- Condition criteria not met: <ul style="list-style-type: none"> <li>➤ Vegetation Degraded.</li> </ul> </li> </ul> <p>Target Area 21 occurs within a narrow median strip along Bussell Highway, and therefore has significant edge effects (dominance of weeds and rubbish etc.).</p>
		T22	140.0	1.5	<i>Corymbia calophylla</i> , <i>Banksia attenuata</i> open forest	Very Good	Yes, entirely	Map notes and quadrat GEL02	<b>Entire patch qualifies as the TEC:</b> <ul style="list-style-type: none"> <li>- Vegetation structure criteria met: <ul style="list-style-type: none"> <li>➤ Vegetation mapped as <i>B. attenuata</i>, <i>E. marginata</i> low open forest.</li> </ul> </li> <li>- Condition criteria met: <ul style="list-style-type: none"> <li>➤ Vegetation condition rated as Very Good (patch boundaries and tracks within patch rated as degraded to completely degraded, but these were small in scale).</li> </ul> </li> <li>- Size criteria met: <ul style="list-style-type: none"> <li>➤ Size of patch 117 ha.</li> </ul> </li> </ul>
S9&S10	42.54	T23	2.5	0.3	<i>Corymbia calophylla</i> , <i>Eucalyptus marginata</i> , <i>Banksia attenuata</i> woodland to open forest	Good	Yes, entirely	Relevé GELREL01, Mapping notes	<b>Entire patch qualifies as TEC:</b> <ul style="list-style-type: none"> <li>- Vegetation structure criteria met: <ul style="list-style-type: none"> <li>➤ Vegetation mapped as <i>C. calophylla</i>, <i>E. marginata</i>, <i>B. attenuata</i> woodland to open forest.</li> </ul> </li> <li>- Condition criteria met: <ul style="list-style-type: none"> <li>➤ Vegetation condition rated as Good (patch boundaries and tracks within patch rated as degraded to completely degraded, but these were small in scale).</li> </ul> </li> <li>- Size criteria met: <ul style="list-style-type: none"> <li>➤ Size of patch 2.1 ha.</li> </ul> </li> </ul>
		T24	0.1	0.1	Not recorded during current survey, likely to be open forest of <i>Eucalyptus</i> spp., <i>Banksia attenuata</i> and <i>Agonis flexuosa</i> (GHD 2015)	Completely Degraded	No	-	<b>Does not qualify:</b> <ul style="list-style-type: none"> <li>- Condition criteria not met: <ul style="list-style-type: none"> <li>➤ Vegetation Completely Degraded.</li> </ul> </li> </ul> <p>Patch 24 occurs a very small section of remnant bushland within the Bussell Highway road reserve.</p>



## Appendix 8

### Distribution of the Commonwealth TEC within the Study Area





# Map Index

Map 1

Map 3

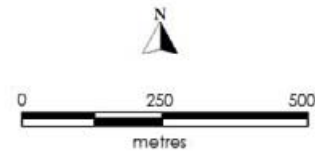
Map 2

## Location Map



- Survey polygon
- Target area

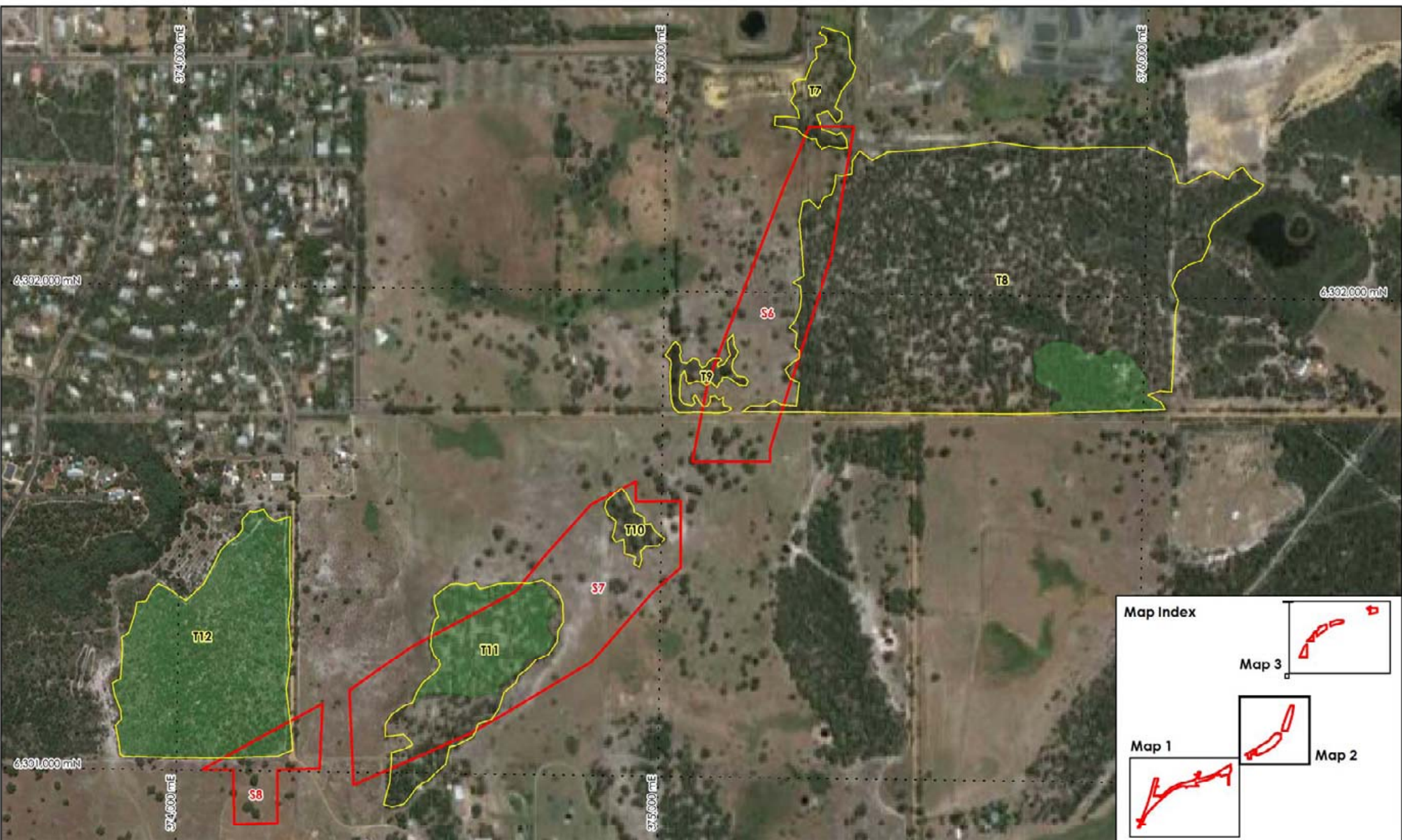
Banksia woodlands TEC



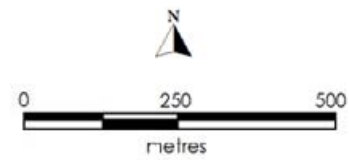
## BORR Southern Section - Distribution of the Banksia Woodlands TEC: Map 1

Biota Environmental Sciences





- Survey polygon
- Target area
- Banksia woodlands TEC



**BORR Southern Section - Distribution of the Banksia Woodlands TEC: Map 2**



## Memorandum

<b>Client:</b>	GHD MRWA BORR team
<b>Attention:</b>	Fionnuala Hannon < <a href="mailto:Fionnuala.Hannon@ghd.com">Fionnuala.Hannon@ghd.com</a> >
<b>From:</b>	Debbie Brace < <a href="mailto:debbie@ecoedge.com.au">debbie@ecoedge.com.au</a> > debbie@ecoedge.com.au 0484 771 825
<b>Date:</b>	19 August 2019
<b>Subject:</b>	Review of Potential Claypan Occurrences in the BORR Southern Section

### Background

In July 2019 Ecoedge was requested by the Bunbury Outer Ring Road (BORR) Integrated Planning Team to carry out a desktop review of the BORR Southern Referral Corridor for the location of potential claypan wetlands that could be occurrences of the Commonwealth-listed Threatened Ecological Community (TEC) 'Clay pans of the Swan Coastal Plain'. Any areas of potential claypan wetland would then be visited with Andrew Webb from Department of Conservation and Attractions (DBCA) and a Main Roads WA (MRWA) representative to verify its conservation status.

### Methods and Results

Previous vegetation mapping of the BORR Southern Section GHD (2012), recent high quality aerial imagery together with mapping of soil-landscape phases (Schoknecht *et al.*, 2004) was used to evaluate potential claypan areas within the BORR Southern Section. Only one potential claypan wetland was identified, situated on privately managed property lots 5 and 160 south of Centenary Road (**Figure 1**). This area had previously been mapped as 'Low open forest of *Melaleuca preissiana* and *Melaleuca viminea* over sedgeland' by GHD (2012) and was situated partly on Pinjarra Plain soil and partly on Bassendean sand.

The site was visited on 1 August 2019 by Ecoedge Botanists (Russell Smith & Colin Spencer), DBCA Senior Botanist (Andrew Webb) and a MRWA representative, Senior Environmental Officer (Freea Itzstein-Davey).

The wetland was found not to be a claypan community, the soil being a sandy-loam at the surface. The vegetation was dominated by *Melaleuca raphiophylla* and *M. viminea*, with an open sedgeland of *Lepidosperma longitudinale* over a grassland of *Sporobolus virginicus*. On Lot 160 *Opercularia hispidula* is one of the understorey species (**Figure 2**). With normal winter rains the wetland is inundated to a depth of 0.5-0.7 m.

## Conclusion

The wetland visited on Lots 5 and 160 south of Centenary Road was found not to be a clay-based wetland, and therefore is not a potential occurrence of the 'Clay pans of the Swan Coastal Plain' TEC.

## References

- GHD (2012). Report for Bunbury Outer Ring Road - Southern Section (South Western Highway to Bussell Highway) Environmental Impact Assessment. Report for Main Roads WA.
- Schoknecht, N., Tille, P., and Purdie, B. (2004). Soil-landscape mapping in south-western Australia. Resource Management Technical Report 280. Department of Agriculture and Food, 3 Baron-Hay Court, South Perth, Western Australia, 6155.



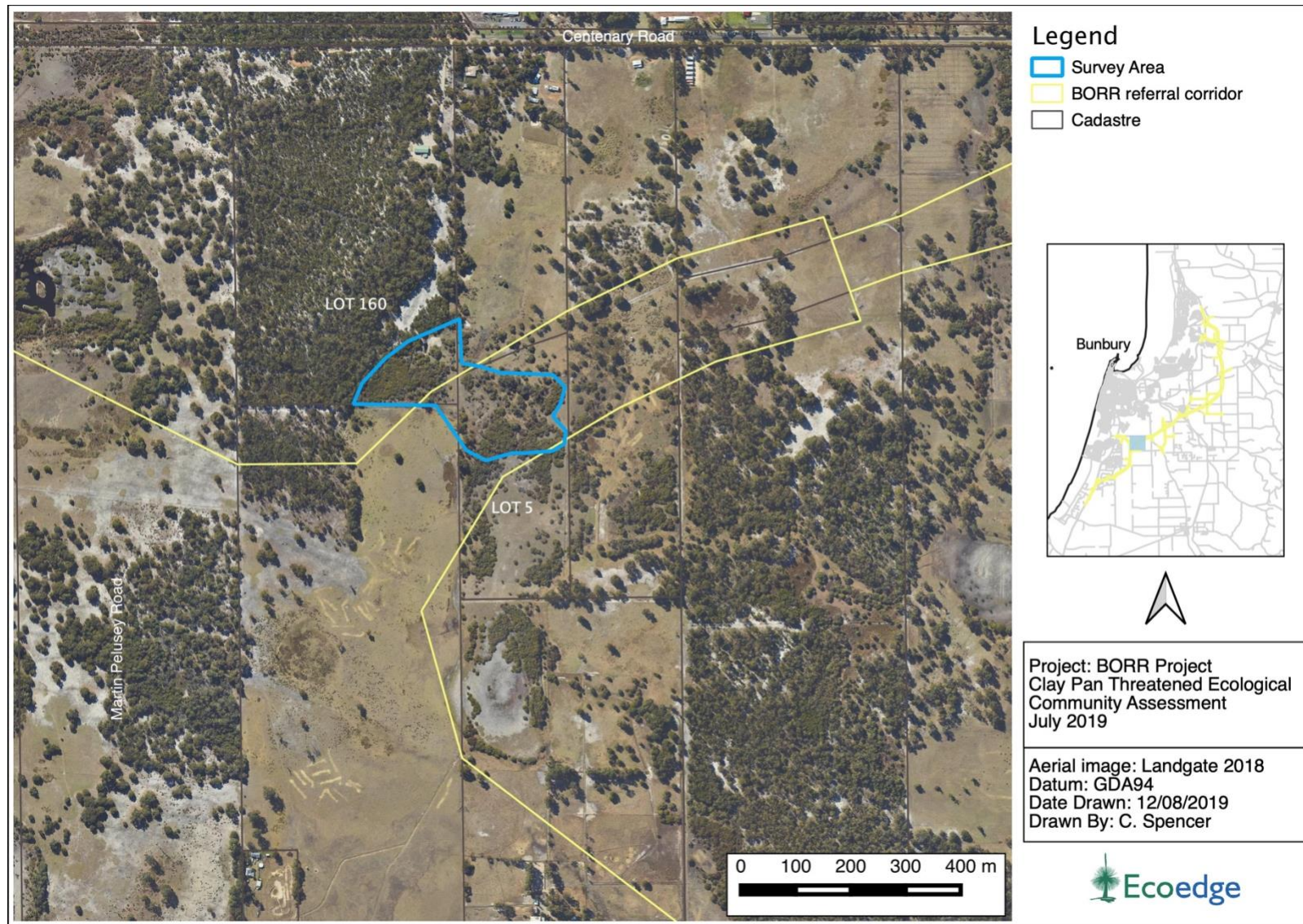


Figure 1. Location of the Survey Area, Lot 160 and Lot 5 with BORR footprint overlay.





Figure 2. Photograph of the wetland where it extends into Lot 160.

# Flora Likelihood of Occurrence Assessment

### Flora likelihood of occurrence assessment guidelines

Likelihood of occurrence	Guideline
Known	Species recorded within survey area from current and historical field survey results.
Likely	Species previously recorded within 5 km and large areas of suitable habitat occur in the project area.
Possible	Species previously recorded within 5 km and areas of suitable habitat occur/may occur in the project area.
Unlikely	Species previously recorded within 5 km, but suitable habitat does not occur in the project area.
Highly unlikely	Species not previously recorded within 5 km, suitable habitat does not occur in the project area and/or the project area is outside the natural distribution of the species.
Other considerations	Intensity of survey, availability of access, growth form type, recorded flowering times, cryptic nature of species

#### Source information - desktop searches

PMST – DotEE Protected Matters Search Tool (PMST) to identify flora listed under the EPBC Act potentially occurring within the study area

TPFL and WAHERB – records of threatened flora from TPFL and WAHERB database searches within the study area

NM – DBCA NatureMap (accessed January 2019)

Family	Taxon	Status		Description and closest record information (if available) (WA Herbarium 1998-, DBCA 2018, Species Profile and Threats Database – DotEE 2019)	Likelihood of occurrence	Source
		BC Act	EPBC Act			
Apiaceae	<i>Brachyscias verecundus</i>	T	CE	Annual (or ephemeral), herb, 0.012-0.022 m high, entirely glabrous. Fl. white/cream. In a moss sward. On a granite outcrop.	Unlikely – this species has not been recorded within 5 km of the survey area and suitable habitat is considered unlikely to be present within the survey area.	PMST
Apiaceae	<i>Platysace ramosissima</i>	P3	-	Perennial, herb, to 0.3 m high. Fl. white-cream, Oct to Nov. Sandy soils.	Possible – this species occurs within 5 km of survey area and habitat occurs within the survey area.	NatureMap
Aponogetonaceae	<i>Aponogeton hexatepalus</i>	P4	-	Rhizomatous or cormous, aquatic perennial, herb, leaves floating. Fl.	Likely – species occurs within 5 km of survey area and habitat occurs within survey area.	NatureMap

Family	Taxon	Status		Description and closest record information (if available) (WA Herbarium 1998-, DBCA 2018, Species Profile and Threats Database – DotEE 2019)	Likelihood of occurrence	Source
		BC Act	EPBC Act			
				green-white, Jul to Oct. Mud. Freshwater: ponds, rivers, claypans.		
Asteraceae	<i>Angianthus drummondii</i>	P3	-	Erect annual, herb, to 0.1 m high. Fl. yellow, Oct to Dec. Grey or brown clay soils, ironstone. Seasonally wet flats.	Possible – species occurs within 5 km of survey area and habitat occurs within survey area.	NatureMap
Asteraceae	<i>Blennospora doliiformis</i>	P3	-	Erect annual, herb, to 0.15 m high. Fl. yellow, Oct to Nov. Grey or red clay soils over ironstone. Seasonally-wet flats.	Possible – species is know from claypan wetlands in Manea Park and identified by DBCA Flora Officer as potentially occurring.	DBCA Flora Officer
Cyperaceae	<i>Carex tereticaulis</i>	P3	-	Monoecious, rhizomatous, tufted perennial, grass-like or herb (sedge), 0.7 m high. Fl. brown, Sep to Oct. Black peaty sand.	Possible – this species occurs within 5 km of survey area and habitat occurs within the survey area.	NatureMap
Cyperaceae	<i>Eleocharis keigheryi</i>	T	V	Rhizomatous, clumped perennial, grass-like or herb (sedge), to 0.4 m high. Fl. green, Aug to Nov. Clay, sandy loam. Emergent in freshwater: creeks, claypans.	Unlikely – this species has not been recorded within 5 km of the survey area.	PMST
Cyperaceae	<i>Schoenus benthamii</i>	P3	-	Tufted perennial, grass-like or herb (sedge), 0.15-0.45 m high. Fl. brown, Oct to Nov. White, grey sand, sandy clay. Winter-wet flats, swamps.	Possible – this species occurs within 5 km of survey area and habitat occurs within the survey area.	NatureMap

Family	Taxon	Status		Description and closest record information (if available) (WA Herbarium 1998-, DBCA 2018, Species Profile and Threats Database – DotEE 2019)	Likelihood of occurrence	Source
		BC Act	EPBC Act			
Cyperaceae	<i>Schoenus loliaceus</i>	P2	-	Annual, grass-like or herb (sedge), 0.03-0.06 m high. Fl. Aug to Nov. Sandy soils. Winter-wet depressions.	Possible – this species occurs within 5 km of survey area and habitat occurs within the survey area.	NatureMap
Cyperaceae	<i>Schoenus natans</i>	P4	-	Aquatic annual, grass-like or herb (sedge), 0.3 m high. Fl. brown, Oct. Winter-wet depressions.	Possible – this species is known from claypans in Manea Park and identified by DBCA Flora Officer as potentially occurring	DBCA Flora Officer
Ericaceae	<i>Andersonia gracilis</i>	T	E	Slender erect or open straggly shrub, 0.1-0.5 m high. Flowers white-pink/purple from September to November. White/grey sand, sandy clay, gravelly loam. Winter-wet areas, near swamps.	Unlikely – this species has not been recorded within 5 km of the survey area and is known from a restricted area.	PMST
Ericaceae	<i>Leucopogon</i> sp. Busselton (D. Cooper 243)	P2	-	Erect shrub to 0.7 m, Fl white.	Unlikely – this species occurs within 5 km of survey area with most records south of Capel.	NatureMap
Fabaceae	<i>Acacia flagelliformis</i>	P4	-	Rush-like, erect or sprawling shrub, 0.3-0.75(-1.6) m high. Fl. yellow, May to Sep. Sandy soils. Winter-wet areas.	Possible – this species occurs within 5 km of survey area and habitat occurs within the survey area.	NatureMap
Fabaceae	<i>Acacia semitrullata</i>	P4	-	Slender, erect, pungent shrub, (0.1-) 0.2-0.7(-1.5) m high. Fl. cream-white, May to Oct. White/grey sand, sometimes over laterite, clay. Sandplains, swampy areas.	Known – plants were recorded during the GHD (2015) and GHD (2014) survey. This species has also been recorded within 5 km of the survey area.	NatureMap

Family	Taxon	Status		Description and closest record information (if available) (WA Herbarium 1998-, DBCA 2018, Species Profile and Threats Database – DotEE 2019)	Likelihood of occurrence	Source
		BC Act	EPBC Act			
Fabaceae	<i>Gastrolobium papilio</i>	T	E	Tangled, clumped shrub, to 1.5 m high. Fl. cream-red, Oct to Dec. Sandy clay over ironstone and laterite. Flat plains.	Unlikely – this species has not been recorded within 5 km of the survey area.	PMST
Fabaceae	<i>Gastrolobium whicherense</i>	P2	-	Slender, open shrub, to 1.6 m high. Fl. orange/yellow/red, Oct. Red-grey sandy clay over quartzite. Steep westerly slopes.	Unlikely – this species occurs within 5 km of survey area. Limited suitable habitat present.	NatureMap
Fabaceae	<i>Pultenaea skinneri</i>	P4	-	Slender shrub, 1-2 m high. Fl. yellow/orange & red, Jul to Sep. Sandy or clayey soils. Winter-wet depressions.	Possible – this species occurs within 5 km of survey area and habitat occurs within the survey area.	NatureMap
Hydatellaceae	<i>Trithuria australis</i>	P4	-	Aquatic herb	Possible – this species occurs within 5 km of survey area and habitat occurs within the survey area.	NatureMap
Loganiaceae	<i>Adelphacme minima</i>	P3	-	Annual 10 -20 cm tall. Fl. White. Records mostly from the South Coast (Walpole) near swamps.	Unlikely – known to occur within 5 km of the survey area however generally restricted to the South Coast.	NatureMap
Malvaceae	<i>Lasiopetalum membranaceum</i>	P3	-	Multi-stemmed shrub, 0.2-1 m high. Fl. pink-blue-purple, Sep to Dec. Sand over limestone.	Possible – this species occurs within 5 km of survey area and habitat occurs within the survey area.	NatureMap
Menyanthaceae	<i>Ornduffia submersa</i>	P4	-	Small waterlily-like plant with hairy white flowers and oval, glossy	Possible – this species occurs within 5 km of survey area and habitat occurs within the survey area.	NatureMap

Family	Taxon	Status		Description and closest record information (if available) (WA Herbarium 1998-, DBCA 2018, Species Profile and Threats Database – DotEE 2019)	Likelihood of occurrence	Source
		BC Act	EPBC Act			
				leaves that float flat on the surface of the shallow water.		
Myrtaceae	<i>Chamelaucium</i> sp. S coastal plain (R.D. Royce 4872)	T	V	Intricately branched, spreading shrub up to 1.2 and 0.6 m across. Greenish-white flowers. Swamp margins in winter-wet sandy clay sites.	Unlikely – this species has not been recorded within 5 km of the survey area.	PMST
Myrtaceae	<i>Eucalyptus rudis</i> subsp. <i>cratyantha</i>	P4	-	Tree, 5-20 m high, bark rough, box-type. Fl. white, Jul to Sep. Loam. Flats, hillsides	Possible – this species occurs within 5 km of survey area and habitat occurs within the survey area.	Naturemap
Myrtaceae	<i>Verticordia attenuata</i>	P3	-	Shrub, 0.4-1 m high. Fl. pink, Dec or Jan to May. White or grey sand. Winter-wet depressions.	Possible – this species occurs within 5 km of survey area and habitat occurs within the survey area.	NatureMap
Myrtaceae	<i>Verticordia densiflora</i> var. <i>pedunculata</i>	T	E	Erect to spreading shrub, 0.3-0.6 m high. Fl. pink/pink-white, Dec or Jan. Grey/yellow sand, sandy loam. Winter-wet low-lying areas.	Unlikely – this species has not been recorded within 5 km of the survey area.	PMST
Orchidaceae	<i>Diuris drummondii</i>	T	V	Tuberous, perennial, herb, 0.5-1.05 m high. Fl. yellow, Nov to Dec or Jan. Low-lying depressions, swamps.	Possible – this species occurs within 5 km of survey area and habitat occurs within the survey. However a targeted survey by Ecoedge (2017) did not identify any <i>D. drummondii</i> plants within the survey area. However, this did not survey all potential habitat areas.	PMST, Naturemap



Family	Taxon	Status		Description and closest record information (if available) (WA Herbarium 1998-, DBCA 2018, Species Profile and Threats Database – DotEE 2019)	Likelihood of occurrence	Source
		BC Act	EPBC Act			
Orchidaceae	<i>Diuris micrantha</i>	T	V	Tuberous, perennial, herb, 0.3-0.6 m high. Fl. yellow & brown, Sep to Oct. Brown loamy clay. Winter-wet swamps, in shallow water.	Possible – this species occurs within 5 km of survey area and habitat occurs within the survey area.	PMST, NatureMap
Orchidaceae	<i>Diuris purdiei</i>	T	E	Tuberous, perennial, herb, 0.15-0.35 m high. Fl. yellow, Sep to Oct. Grey black sand, moist. Winter-wet swamps.	Unlikely – this species has not been recorded within 5 km of the survey area.	PMST
Orchidaceae	<i>Drakaea elastica</i>	T	E	Tuberous, perennial, herb, 0.12-0.3 m high. Fl. red & green & yellow, Oct to Nov. White or grey sand. Low-lying situations adjoining winter-wet swamps.	Unlikely – this species has not been recorded within 5 km of the survey area.	PMST
Orchidaceae	<i>Drakaea micrantha</i>	T	V	Tuberous, perennial, herb, 0.15-0.3 m high. Fl. red & yellow, Sep to Oct. White-grey sand.	Possible – this species occurs within 5 km of survey area and habitat occurs within the survey area.	PMST, NatureMap
Orchidaceae	<i>Caladenia huegelii</i>	T	E	Tuberous, perennial, herb, 0.25-0.6 m high. Fl. green & cream & red, Sep to Oct. Grey or brown sand, clay loam.	Possible – this species occurs within 5 km of survey area and habitat occurs within the survey area.	PMST, NatureMap
Orchidaceae	<i>Caladenia speciosa</i>	P4	-	Tuberous, perennial, herb, 0.35-0.6 m high. Fl. white-pink, Sep to Oct. White, grey or black sand.	Known – this species was recorded during the GHD (2015) survey. Database records show this species as recorded within the survey area and in a 5 km buffer of the survey area.	NatureMap

Family	Taxon	Status		Description and closest record information (if available) (WA Herbarium 1998-, DBCA 2018, Species Profile and Threats Database – DotEE 2019)	Likelihood of occurrence	Source
		BC Act	EPBC Act			
Orchidaceae	<i>Thelymitra variegata</i>	P2	-	Tuberous, perennial, herb, 0.1-0.35 m high. Fl. orange & red & purple & pink, Jun to Sep. Sandy clay, sand, laterite.	Possible – this species occurs within 5 km of survey area and habitat occurs within the survey area.	NatureMap
Poaceae	<i>Austrostipa bronwenae</i>	T	E	Perennial grass, 0.6 m high x 0.3 m wide. Flowers green. Sept to October.	Possible – known to occur within 5 km of the survey area. Previous records in <i>Melaleuca</i> swamps.	PMST, NatureMap
Poaceae	<i>Austrostipa jacobiana</i>	T	CE	Tufted rhizomatous herb, to 1.2 m, leaf sheaths hairy. Marri woodland, Melaleuca tall shrubland.	Possible – this species occurs within 5 km of survey area and habitat occurs within the survey area.	PMST, NatureMap
Proteaceae	<i>Banksia nivea</i> subsp. <i>uliginosa</i>	T	E	Dense, erect, non-lignotuberous shrub, 0.2-1.5 m high. Fl. yellow-brown, Aug to Sep. Sandy clay, gravel.	Unlikely – this species has not been recorded within 5 km of the survey area and has a limited distribution, near Busselton and Augusta. This Banksia grows in areas of ironstone (not present in survey area).	PMST
Proteaceae	<i>Banksia squarrosa</i> subsp. <i>argillacea</i>	T	V	Erect, open, non-lignotuberous shrub, 1.2-4 m high. Fl. yellow, Jun to Nov. White/grey sand, gravelly clay or loam. Winter-wet flats, clay flats.	Unlikely – this species has not been recorded within 5 km of the project area, has a limited distribution, near Busselton. Surveys were conducted during flowering times and this species was not seen.	PMST
Proteaceae	<i>Franklandia triaristata</i>	P4	-	Erect, lignotuberous shrub, 0.2-1 m high. Fl. white-cream-yellow/brown-	Unlikely – this species occurs within 5 km of survey area and habitat occurs within the survey area.	Naturemap

Family	Taxon	Status		Description and closest record information (if available) (WA Herbarium 1998-, DBCA 2018, Species Profile and Threats Database – DotEE 2019)	Likelihood of occurrence	Source
		BC Act	EPBC Act			
				purple, Aug to Oct. White or grey sand.		
Proteaceae	<i>Lambertia echinata</i> subsp. <i>occidentalis</i>	T	E	Prickly, much-branched, non-lignotuberous shrub, to 3 m high. Fl. yellow, Feb or Apr or Dec. White sandy soils over laterite, orange/brown-red clay over ironstone. Flats to foothills, winter-wet sites.	Unlikely – this species has not been recorded within 5 km of the survey area.	PMST
Proteaceae	<i>Petrophile latericola</i>	T	E	Multi-stemmed shrub, 0.4-1.5 m high. Fl. yellow, Nov. Red lateritic clay. Winter-wet flats.	Unlikely – species has not been recorded within 5 km of the survey area and has a very limited distribution. Suitable habitat is considered unlikely to be present within the survey area.	PMST
Proteaceae	<i>Synaphea hians</i>	P3	-	Prostrate or decumbent shrub, 0.15-0.6 m high, to 1 m wide. Fl. yellow, Jul or Sep to Nov. Sandy soils. Rises.	Possible – this species occurs within 5 km of survey area and habitat occurs within the survey area.	NatureMap
Proteaceae	<i>Synaphea</i> sp. Fairbridge Farm (D. Papenfus 696)	T	CE	Dense, clumped shrub, to 0.3 m high, to 0.4 m wide. Fl. yellow, Oct. Sandy with lateritic pebbles. Near winter-wet flats, in low woodland with weedy grasses.	Unlikely – this species has not been recorded within 5 km of the survey area.	PMST

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		BC Act	EPBC Act			
Proteaceae	<i>Synaphea</i> sp. Serpentine (G.R. Brand 103)	T	CE	Flowers from late August to November and fruits have been seen in December, occurs predominantly on flat terrain on grey-brown sandy loams to clay in seasonally wet areas.	Unlikely – this species has not been recorded within 5 km of the survey area.	PMST
Proteaceae	<i>Synaphea stenoloba</i>	T	E	Caespitose shrub, 0.3-0.45 m high. Fl. yellow, Aug to Oct. Sandy or sandy clay soils. Winter-wet flats, granite.	Unlikely – this species has not been recorded within 5 km of the survey area.	PMST
Stylidiceae	<i>Stylidium longitubum</i>	P4	-	Erect annual (ephemeral), herb, 0.05-0.12 m high. Fl. pink, Oct to Dec. Sandy clay, clay. Seasonal wetlands.	Possible – this species occurs within 5 km of survey area and habitat occurs within the survey area.	NatureMap
Stylidiceae	<i>Stylidium paludicola</i>	P3	-	Reed-like perennial, herb, 0.35-1 m high, Leaves tufted, linear or subulate or narrowly oblanceolate, 0.5-4 cm long, 0.5-1.5 mm wide, apex acute, margin entire, glabrous. Scape mostly glabrous, inflorescence axis glandular. Inflorescence racemose. Fl. pink, Oct to Dec. Peaty sand over clay. Winter wet habitats. Marri and <i>Melaleuca</i> woodland, <i>Melaleuca</i> shrubland.	Possible – species was identified by DBCA flora officer as potentially occurring on the edge of wetlands near Centenary Road.	DBCA Flora Officer

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		BC Act	EPBC Act			
Rutaceae	<i>Boronia tetragona</i>	P3	-	Perennial, herb, 0.3-0.7 m high, leaves sessile, entire, with papillate margins, branches quadrangular, sepals ciliate. Fl. pink & red, Oct to Dec. Black/white sand, laterite, brown sandy loam. Winter-wet flats, swamps, open woodland.	Possible – this species occurs within 5 km of survey area and habitat occurs within the survey area.	NatureMap
Santalaceae	<i>Leptomeria furtiva</i>	P2	-	Lax, sprawling shrub, 0.2-0.45 m high. Fl. orange-brown, Aug to Oct. Grey or black peaty sand. Winter-wet flats.	Possible – this species occurs within 5 km of survey area and habitat occurs within the survey area.	NatureMap
Xanthorrhoeaceae	<i>Chamaescilla gibsonii</i>	P3	-	Clumped tuberous, herb. Fl. blue, Sep. Clay to sandy clay. Winter-wet flats, shallow water-filled claypans.	Possible – this species occurs within 5 km of survey area and habitat occurs within the survey area.	NatureMap

TSSC (2018a). Conservation Advice *Austrostipa bronwenae* [http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon\\_id=87808](http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=87808)





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