FLORA AND VEGETATION SURVEY

Branch Circus and Hammond Road, Success

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EXECUTIVE SUMMARY

Flora

A total of 229 taxa were recorded from the survey area, of which 155 or 68% were native.

No DRF species protected under the *Wildlife Conservation Act, 1950* were recorded within the survey area. No species protected under the *Environmental Protection Biodiversity Conservation Act, 1999* were recorded within the survey area.

One Priority 2, *?Byblis gigantea and* two Priority 4, *Dodonaea hackettiana* and *Eucalyptus rudis* subsp. *cratyantha* were recorded from within the survey area

Vegetation

There are 3 Vegetation Complexes defined within the survey area; *'Bassendean Dunes: Central and South'* with the adjoining complex '*Spearwood Dunes: Karrakatta Central and South'* and the wetlands suite of *'Spearwood: Herdsman Complex'*. (Heddle *et al*., 1980).

The Karrakatta Complex Central and South has significant representation onsite as less than 10% of the remaining extent of this complex is reserved for conservation in Bush Forever and less than 30% of the original extent of the complex remains in both the local and regional area (Del Marco *et al.,* 1994).

A multivariate statistical analysis, comparing data from Gibson *et al.* (1994) with plots established in the survey area, concluded that the five Vegetation Units defined for the survey area represent two Floristic Community Types (FCTs), 11 and 28. Both of these FCTs are well reserved and at low conservation risk (Gibson *et al.,* 1994).

No Threatened Ecological Communities (TECs) were defined for the survey area.

Overall the vegetation within the survey area is in Completely Degraded condition with fragmented remnant bushland across the survey area ranging from Degraded to Excellent condition.

Conservation Significance

The flora and vegetation of the survey area was assessed against the Del Marco *et al.* (2004) criteria for a Locally Significant Natural Area, under which the survey area does meet criteria with regional conservation value due to the presence of poorly reserved Vegetation Complex (Karrakatta Complex Central and South), the presence of 3 Priority Flora taxa along with a diversity of upland and lowland vegetation types.

Due to the fragmented condition of remnant vegetation onsite, it recommended that conservation efforts are best directed to managing the impact of the proposed development in the context of it close proximity to regionally significant bushland, Bush Forever Site 391.

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1.0 INTRODUCTION

1.1 Survey Area

The area described within this report includes Lots 2, 3 and 4 Branch Circus, Lots 760, 761 and 767 Gadd Street and Lots 3, 4, 5, 12, 13 and 22 Hammond Road, Success. This is subsequently referred to as the 'survey area'.

The survey area is approximately 20 kilometes south of the Perth CBD, in the southern Perth Metropolitan Region (Figure 1).

1.2 Survey Objective

This report was prepared for Koltatz Smith on behalf of Muntoc Pty Ltd and Silverstone Asset Pty Ltd for the Branch Circus Land Owner Group.

The principal objective of this study was to meet the requirements of a Level 2 Flora and Vegetation Survey, in accordance with the Environmental Protection Authority's (EPA's) Guidance Statement 51 for the *'Assessment of Environmental Factors for Terrestrial Flora and Vegetation Surveys'*.

This report is suitable for use in all aspects of the Environmental Impact Assessment (EIA) process within Western Australia.

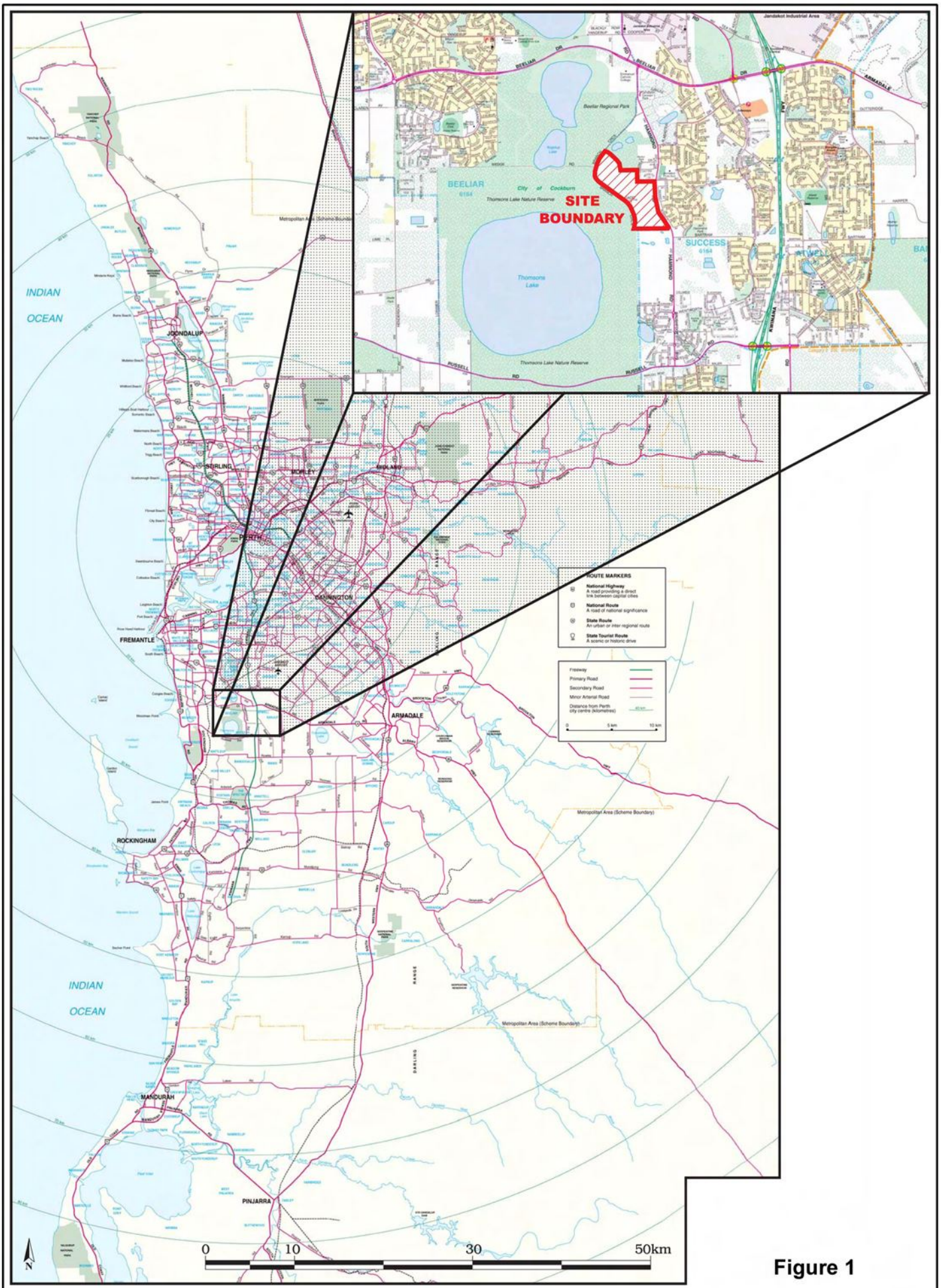

Figure 1

Site Location

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2.0 BACKGROUND

2.1 Soils and Landforms

The survey area is mapped as Opb: *'Bassendean Sand – quartz sand fixed dunes'* and Orw: *'Swamp and lacustrine deposits – peat, peaty sand and clay'* (Geological Survey of Western Australia, 1980).

2.2 Seasonal Conditions

Rainfall for the Perth region for the months leading up to the survey (April to August 2007) was 506mm compared to a long term average for the same period of 586mm. This represents a rainfall anomaly of 14%.

Data obtained from Bureau of Meteorology (2008).

2.3 Other Existing Data

2.3.1 Flora

2.3.1.1 DRF and Priority Flora

A search of the Western Australian Herbarium (WAH) and Department of Environment and Conservation (DEC) databases was undertaken for known Declared Rare Flora (DRF or R) and Priority Flora records for a 10km radius from the coordinates 32° 08' 22" S and 115° 50' 32" E. Seventeen species, including five DRF, three Priority 1, one Priority 2, three Priority 3 and five Priority 4 species were identified (Table 1). None of these known records were from the survey area.

Table 1: DEC DRF and Priority Search Results (10km radius from 32° 08' 22" S and 115° 50' 32" E)

Species	Conservation Code
Caladenia huegelii	DRF or R
Diuris purdiei	DRF or R
Drakaea elastica	DRF or R
Drakaea micrantha	DRF or R
Verticordia plumosa var. *ananeotes*	DRF or R
Acacia lasiocarpa var. *brateolata* long peduncle variant (G.J. Keighery 5026)	P1
Eremaea asterocarpa subsp. *brachyclada*	P1
Tripterococcus paniculatus	P1

Species	Conservation Code
Byblis gigantea	P2
Aotus cordifolia	P3
Cyathochaeta teretifolia	P3
Phlebocarya pilosissima subsp. *pilosissima*	P3
Anthotium junciforme	P4
Dodonaea hackettiana	P4
Grevillea olivaceae	P4
Microtis media subsp. *quadrata*	P4
Verticordia lindleyi subsp. *lindleyi*	P4

2.3.2 Vegetation

2.3.2.1 IBRA Region

The survey area is within the Interim Biogeographical Regionalisation of Australia (IBRA) region of the Swan Coastal Plain (SCP), in sub-region SWA2: Swan Coastal Plain (Thackway and Cresswell, 1995, as amended)(DEH, 2000).

2.3.2.2 Vegetation Complexes (Heddle *et al.*, 1980)

According to the 1:250,000 scale vegetation mapping completed by Heddle *et al.* (1980), the survey area is mapped as *'Bassendean Complex – Central and South'* with some *'Herdsman Complex'* along the western edge. *'Karrakatta Complex - Central and South'* is immediately to the west, which means the survey area is on the *'Bassendean – Spearwood (Karrakatta)'* interface.

2.3.2.3 Vegetation Survey of Western Australia (Beard, 1979)

Beard (1979) mapped the survey area at a 1:250,000 scale, as on the Spearwood and Bassendean Systems. The survey area is described as being part of an area that has a *'Low Woodland with scattered trees: Banksia Low Woodland with scattered Jarrah and Sheoak'* and an *'undulating sandy plain with numerous Teatree and Paperbark swamp'*.

2.3.2.4 Threatened Ecological Communities

This search relates to Threatened Ecological Communities (TECs) listed under the State *Wildlife Conservation Act, 1950* (as amended) (Section 3.4.2.2). Some of these listed TECs have further protection under the Federal *Environmental Protection and Biodiversity Conservation Act 1999* (*EPBC Act*) (Section 3.4.2.4).

An area search was undertaken of the DEC's TEC database from a 10km radius from the coordinates 32° 08' 22" S and 115° 50' 32" E (centre of study area). No records were identified within this search area. However, there were two TECs identified as existing within 15km: *'SCP07 Herb rich saline shrublands in claypans'* (Vulnerable) and *'Shrublands and Woodlands on Muchea Limestone'* (Endangered).

2.3.2.5 BushForever

Bush Forever Site 391: *'Thomsons Lake Nature Reserve and Adjacent Bushland, Beeliar'* is adjacent to the survey area, along the north and west boundaries (Figure 2).

2.3.2.6 Ecological Linkages

There is a Perth Greenways (WAPC, 1999) linkage adjacent to the north and west boundary of the survey area, which coincides with the boundary of Bush Forever Site 391: *'Thomsons Lake Nature Reserve and Adjacent Bushland, Beeliar'* (Figure 2).

2.4 Legislation and Framework

This section outlines the guidelines and legislation used to assess the conservation significance of flora and vegetation within the survey area.

2.4.1 Flora

2.4.1.1 Declared Rare Flora

DRF are flora that have been adequately surveyed and are considered to be in danger of extinction, rare or otherwise in need of special protection within Western Australia. DRF are protected under the *Wildlife Conservation Act 1950* (as amended).

2.4.1.2 Priority Flora

In Western Australia there are four categories of Priority Flora. Flora species are categorised based on the number of known populations, and the degree of threat to those populations. Three categories of Priority Flora are allocated to species that are poorly known (Priority 1 to 3). These require more information to be assessed for inclusion as DRF. A fourth category of priority flora (Priority 4) is included for those species that have been adequately surveyed and are considered to be rare but not currently threatened. The Priority Flora list is maintained by the Threatened Species Branch section of the DEC and is published annually as a list (Atkins, 2008).

Priority Flora are flora that require close monitoring to determine their status, either because they are poorly known or are otherwise potentially under threat. They are not specifically covered under current legislation, but their conservation status warrants some protection, particularly as they are under consideration for future DRF status, if investigations on individual species show that they are likely to be uncommon or under threat. Under the *Wildlife Conservation Act, 1950* and *Environmental Protection Act, 1986*, there are general 'prevention of extinction' and precautionary principles which apply to the conservation of Priority Flora species.

2.4.1.3 Threatened Flora Species (*EPBC Act, 1999*)

Some flora species have additional protection under the *EPBC Act.* In Western Australia, the species that are Threatened Flora Species under the *EPBC Act* predominantly consist of DRF species. Penalties apply for damage to individuals, populations or habitats of protected species.

2.4.1.4 Other Flora Species of Conservation Significance

The EPA's Guidance Statement 51 (GS51) (EPA, 2004) lists species of conservation significance (other than DRF and Priority Flora status) if a species has:

- A keystone role.
- Relictual status.
- Anomalous features indicating a potential new discovery.
- A representation of a species range (range extensions, extremes or an outlier population).
- Status as a restricted subspecies, variety, or naturally occurring hybrid.
- Poor reservation.
- Status as a local endemic or has a restricted distribution.

GS51 states that conservation significance includes these criteria, but is not limited to them. In this instance, it may include flora that are poorly represented in the Western Australian Herbarium or flora with few known populations.

2.4.2 Vegetation

2.4.2.1 Floristic Community Types (Gibson et al, 1994)

Floristic Community Types (FCTs) are based on a survey of the vegetation of the Swan Coastal Plain from Seabird to Dunsborough, completed by Gibson *et al.,* (1994). The purpose of the Gibson *et al.* (1994) survey was to determine the number and type of vegetation communities present across the southern SCP, and to then assess how much of each remained and whether they were protected within reserves. There were 509 survey plots surveyed using the same methodology outlined in this report. Each FCT defined as a result of Gibson *et al.* (1994) was given a Reservation Status and a Conservation Status (Tables 2 and 3).

Most of the Swan Coastal Plain TECs and/or Priority Ecological Communities protected under state and federal legislation (Section 3.4.2.2 to 3.4.2.4) are defined by their Floristic Community Type in Gibson *et al.* (1994).

Table 2: Reservation Status Categories (Gibson *et al.,* 1994)

Reservation Status	Description
Well Reserved	Known from two or more A class National Parks or Nature Reserves
Poorly Reserved	Known from a single A class National Park or Nature Reserve
Unreserved	Not known to occur in any A class National Park or Nature Reserve.

Table 3: Conservation Status Categories (Gibson *et al.,* 1994)

Conservation Status	Description
Presumed Destroyed	A community that is totally destroyed or so extensively modified that it is unlikely to re-establish ecosystem processes in the foreseeable future.
Critical	A community with most or all of its known occurrences facing severe modification or destruction in the immediate future.
Endangered	A community in danger of severe modification or destruction throughout its range, if causal factors continue operating.
Vulnerable	A community likely to move into the endangered category in the near future if the causal factors continue operating.
Susceptible	A community of concern because there is evidence that it can be modified or destroyed by human activities or would be vulnerable to new threatening process.
Low Risk	A community that does not qualify for one of the above categories
Insufficiently Known	A community for which there is inadequate data to assign to one of the above categories.

2.4.2.2 Threatened Ecological Communities (*Wildlife Conservation Act, 1950*)

Within Western Australia, TECs are defined by the DEC as those which are found to fit into one of the categories in Table 4. The categories "Data Deficient" and "Lower Risk" can be used to provide a list of communities not classified as threatened, but that require more information.

Within Western Australia, TECs have limited protection under the *Wildlife Conservation Act 1950* and the *Environmental Protection Act 1986* (as amended) under 'prevention of extinction' and the precautionary principal. TECs will be protected by the proposed *Biodiversity Conservation Act* (in preparation).

There are 69 TECs listed for Western Australia.

Table 4: Threatened Ecological Community Category of Threat (English and Blyth, 1997)

Category	Definition
Presumed Totally Destroyed (PD)	An ecological community will be listed as presumed totally destroyed if there are no recent records of the community being extant and either of the following applies: A) Records within the last 50 years have not been confirmed despite thorough searches or known or likely habitats, or B) All occurrences recorded within the last 50 years have since been destroyed.
Critically Endangered (CR)	An ecological community will be listed as **Critically Endangered** when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future. This will be determined on the basis of the best available information, by it meeting **any one or more** of the following criteria: A) The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% and **either or both** of the following apply: • geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately 5 years). • modification throughout its range is continuing such that in the immediate future (within approximately 5 years) the community is unlikely to be capable of being substantially rehabilitated. B) Current distribution is limited, and **one or more** of the following apply (i, ii or iii): • geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately 5 years). • there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes. • there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes. C) The ecological community exists only as highly modified occurrences which may be capable of being rehabilitated if such work begins in the immediate future (within approximately 5 years).
Endangered (EN)	An ecological community will be listed as Endangered when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. This will be determined on the basis of the best available information, by it meeting any one or more of the following criteria (A, B or C): A) The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 70% and either or both of the following apply (i or ii) • geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is likely in the short term (within approximately 10 years) • modification throughout its range is continuing such that in the short term future (within approximately 10 years) the community is unlikely to be capable of being substantially restored or rehabilitated. B) Current distribution is limited, and one or more of the following apply (i, ii or iii): • geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short term future (within approximately 10 years) • there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes • there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes C) The ecological community exists only as highly modified occurrences which may be capable of being rehabilitated if such work begins in the short term future (within approximately 10 years).

Category	Definition
Vulnerable (VU)	An ecological community will be listed as Vulnerable when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction in the medium to long term future. This will be determined on the basis of the best available information, by it meeting any one or more of the following criteria (A, B or C): A) The ecological community exists largely as modified occurrences which are likely to be capable of being substantially restored or rehabilitated. B) The ecological community can be modified or destroyed and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations. C) The ecological community may still be widespread but is believed likely to move into a category of higher threat in the medium to long term future because of existing or impending threatening processes.
Data Deficient (DD)	An ecological community which has not been adequately evaluated with respect to status or where there is currently insufficient information to assign it to a particular category. (An ecological community with poorly known distribution or biology that is suspected to belong to any of the above categories. These ecological communities have a high priority for survey and/or research.)
Lower Risk (LR)	An ecological community that has been adequately surveyed and does not qualify for any of the above categories of threat and appears unlikely to be under threat of significant modification or destruction in the short to medium term future.

2.4.2.3 Priority Ecological Communities

Potential TECs that do not yet meet survey criteria or that are not adequately defined are added to the DEC's Priority Ecological Community (PEC) list as Priority 1, 2 and 3. These three categories are ranked in order of priority for survey and/or definition of the community, and evaluation of conservation status, so that consideration can be given to their declaration as a TEC. Ecological communities that are adequately known, and are rare but not threatened or meet criteria for Priority 1, 2 or 3, or that have been recently removed from the TEC list, are placed in Priority 4 (P4). P4 ecological communities require regular monitoring. Conservation dependent ecological communities are placed in Priority 5. Detailed definitions are outlined in Table 5. There are 25 Priority Ecological Communities listed for the Swan NRM region, which includes the survey area.

Table 5: Definitions for Priority Ecological Communities by the DEC (DEC, 2008)

PRIORITY ECOLOGICAL COMMUNITIES
Priority One: poorly-known ecological communities
Ecological communities with apparently few, small occurrences, all or most not actively managed for conservation (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) and for which current threats exist. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.
Priority Two: poorly-known ecological communities
Communities that are known from few small occurrences, all or most of which are actively managed for conservation (e.g. within national parks, conservation parks, nature reserves, State forest, unallocated Crown land, water reserves, etc.) and not under imminent threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.

PRIORITY ECOLOGICAL COMMUNITIES
Priority Three: poorly known ecological communities
i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or: ii) communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or; iii) communities made up of large, and/or widespread occurrences, that may or not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes. Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.
Priority Four: ecological communities that are adequately known, rare but not threatened or meet criteria for near threatened, or that have been recently removed from the threatened list. These communities require regular monitoring.
i) Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands. ii) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. iii) (iii) Ecological communities that have been removed from the list of threatened communities during the past five years.
Priority Five: Conservation Dependent ecological communities.
Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

2.4.2.4 Threatened Ecological Communities (*EPBC Act, 1999*)

The *EPBC Act, 1999* provides protection for TECs under federal legislation, which are those communities which are defined as:

- **Critically Endangered** (if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future).
- **Endangered** (if, at that time, it is not critically endangered and is facing a very high risk of extinction in the wild in the near future).
- **Vulnerable** (if, at that time, it is not critically endangered or endangered, and is facing a high risk of extinction in the wild in the medium-term future).

There are 39 TECs currently listed under the *EPBC Act (1999)*, of which nine are known from the southern SCP (DEH, 2008). These are also listed as TECs under Western Australian legislation (Section 3.4.2.2).

2.4.2.5 Regionally Significant Bushland

Bush Forever (WAPC, 2000) provides a framework to identify and protect bushland of regional significance within the Perth Metropolitan Region. Bush Forever sites and site boundaries are subject to ongoing review and updates.

The criteria used in Bush Forever for identifying regionally significant natural areas were:

- Representation of Ecological Communities.
- Diversity.
- Rarity.
- Maintaining Ecological Processes or Natural Systems.
- Scientific or Evolutionary Importance.
- General Criteria for Protection of Wetland, Streamline and Estuarine Fringing Vegetation and Coastal Vegetation.

2.4.2.6 Locally Significant Natural Areas

Locally Significant Natural Areas (LSNAs) are Local Natural Areas that meet one or more ecological criteria of significance and have been verified in the field. The fact that a natural area is confirmed as 'locally significant' does not necessarily mean that it must and can be protected (Del Marco *et al.,* 2004). LNAs refers to all natural areas – not just bushland - that exists outside of the DEC Managed Estates, regional parks and Bush Forever sites (Del Marco *et al*., 2004)

The ecological criteria for LSNAs are listed in Table 6. Many of these criteria also have regional conservation value as they are directly based on the criteria for regional significance in Bush Forever. Del Marco *et al.* (2004) states that Local Governments, communities and developers must appreciate that Bush Forever excluded some sites of regional significance based on ecological value because of the social and economic constraints that existed at the time.

These ecological criteria were established by the "Local Government Biodiversity Planning Guidelines for the Perth Metropolitan Region" (Del Marco *et al*. 2004) and are directly based on an extension of the State government's *Bush Forever* strategy (Western Australian Planning Commission, 2000) along with the criteria proposed in the Urban Bushland Strategy (Government of Western Australia, 1995).

Table 6: Ecological Criteria for Use in Determining Locally Significant Natural Areas of the SCP (Del Marco *et al.,* 2004)

1. REPRESENTATION
1a. Regional Representation
i) Any natural area with recognised International, National, State or Regional Conservation Value (outside Bush Forever Sites and Department of Conservation and Land Management [CALM] Managed Estate) that is not yet protected and/ or managed for conservation (Essential).
ii) Natural areas of an ecological community with only 1500 ha or 30% or less (whichever is greater) of their pre-European extent remaining in the Interim Biogeographically Regionalisation of Australia (IBRA) subregion (Essential – Jarrah Forest, Desirable – SCP).
iii) Large (greater than 20 ha), viable natural area in good or better condition of an ecological community with over 30% of its pre-European extent remaining in the IBRA subregion (Desirable).
iv) of an ecological community with only 1500 ha or 15% or less (whichever is the greater) protected for conservation in the Jarrah Forest IBRA subregion.
v) Natural area of an ecological community with only 400 ha or 10% or less (whichever is greater) protected for conservation in the Bush Forever Study Area (Essential).
1b. Local Representation
i) Natural area of an ecological community with 10% or less of its pre-European extent remaining within the Local Government area (Essential).
ii) Natural area of an ecological community with 30% or less of its pre-European extent remaining within the Local Government area (Essential – Jarrah Forest, Desirable SCP).
iii) Large (greater than 10 ha), viable natural areas in good or better condition of an ecological community with more than 30% of its pre-European extent remaining within the Local Government area (Desirable).
2. DIVERSITY
i) Natural areas in good or better condition that contain both upland and wetland structural plant communities (Essential).
3. RARITY
i) Natural areas of an ecological community with only 1500 ha or 10% or less (whichever is the greater) of their pre-European extent remaining in the IBRA subregion (Essential).
ii) Natural areas of an ecological community with only 400ha or 10% or less (whichever is the greater) of their pre- European extent remaining in the Bush Forever Study Area (Essential).
iii) areas classified by CALM as containing Threatened Ecological Communities (TEC's) (English & Blyth 1997, 1999; CALM TEC GIS database, undated) (Essential).
iv) Natural areas containing Declared Rare Flora (DRF), Specially Protected Fauna (SPF) or significant habitat for Specially Protected Fauna (Essential).
v) Natural areas containing Priority or other significant flora or fauna or significant habitat for these fauna (Essential).
4. MAINTAINING ECOLOGICAL PROCESSES OR NATURAL SYSTEMS – CONNECTIVITY
i) Natural areas acting as stepping stones within a Regional Ecological Linkage (Essential).
ii) Natural areas acting as stepping stones within a within a local ecological linkage determined by a Local Government (Essential).
5. PROTECTION OF WETLAND, STREAMLINE AND ESTUARINE FRINGING VEGETATION AND COASTAL VEGETATION
i) Wetlands meeting the criteria for listing as Conservation Category or Resource Enhancement Wetlands plus an appropriate buffer (minimum 50m) in addition to the wetland dependant vegetation (Essential).
ii) Wetlands listed under the Environmental Protection (SCP Lakes) Policy (EPP Lakes) plus an appropriate buffer (Essential).
iii) Riparian vegetation along rivers, creeklines and other channel wetlands plus an appropriate buffer (minimum 50m) in addition to the riparian (wetland dependant) vegetation (Essential).
iv) Floodplains delineated on the basis of ecological and geomorphic features plus an appropriate buffer (minimum 50m) in addition to the floodplain area (Essential).
v) Estuarine fringing vegetation plus an appropriate buffer (minimum 50m) of non-estuarine vegetation (Essential).
vi) Coastal vegetation on the foredunes and secondary dunes (Essential).

3.0 METHODS

3.1 Field Survey

Survey methodology was based on a Level 2 Flora and Vegetation Survey, as outlined in the EPA's Guidance Statement 51 (EPA, 2004) and is consistent with methodology established in Gibson *et al.* (1994) for the Swan Coastal Plain.

Ten 10m by 10m plots (detailed flora sites) were established by botanists A. Mercier and K. McCreery. Two visits were undertaken to survey each plot in order to sample across the main flowering period for the area. Both of these surveys were undertaken in the 'Spring' flowering season. The first survey was completed between 13 and 14 August 2007 and the second was between 25 and 26 October 2007. The detailed flora sites are shown in Figure 2.

The information recorded at each 10m by 10m plot included:

- A GPS location at the NW corner (WGS84, accuracy <5m).
- Photographs.
- Vegetation structure (WAPC, 2000)(Table 7).
- Species present (including height and density).
- Soil description.
- Landform description.
- Aspect.
- Condition (WAPC, 2000)(Table 8).
- Bare ground and litter cover estimates.

Table 7: Vegetation Structure Classes (WAPC, 2000)

Life Form/Height Class	Canopy Cover (percentage)			
	100% - 70%	70% - 30%	30% - 10%	10% - 2%
Trees 10-30m Trees < 10m	Closed Forest Low Closed Forest	Open Forest Low Open Forest	Woodland Low Woodland	Open Woodland Low Open Woodland
Shrub Mallee	Closed Shrub Mallee	Shrub Mallee	Open Shrub Mallee	Very Open Shrub Mallee
Shrubs > 2m Shrubs 1-2m Shrubs <1m	Closed Tall Scrub Closed Heath Closed Low Heath	Tall Open Scrub Open Heath Open Low Heath	Tall Shrubland Shrubland Low Shrubland	Tall Open Shrubland Open Shrubland Low Open Shrubland
Grasses	Closed Grassland	Grassland	Open Grassland	Very Open Grassland
Herbs	Closed Herbland	Herbland	Open Herbland	Very Open Herbland

Life Form/Height Class	Canopy Cover (percentage)			
	100% - 70%	70% - 30%	30% - 10%	10% - 2%
Sedges	Closed Sedgeland	Sedgeland	Open Sedgeland	Very Open Sedgeland

Table 8: Vegetation Condition Scale (WAPC, 2000)

Condition		Definition
P	**Pristine**	No obvious signs of disturbance.
E	**Excellent**	Vegetation structure intact, disturbance affecting individual species; weeds are non-aggressive species
V	**Very Good**	Vegetation structure altered; obvious signs of disturbance
G	**Good**	Vegetation structure significantly altered by very obvious signs of multiple disturbance; basic vegetation structure or ability to regenerate it is retained
D	**Degraded**	Basic vegetation structure severely impacted by disturbance; scope for regeneration but not to a state approaching good (sic) condition without intensive management
C	**Completely Degraded**	Vegetation structure not intact; the area completely or almost completely without native species ('parkland cleared').

3.2 Data Analysis

3.2.1 Flora Taxonomy and Inventory

The flora inventory was produced from all collections made, including plots, relevés and opportunistic records. Flora specimens were identified using the resources of the Western Australian Herbarium. Nomenclature is based on the DEC flora database, FloraBase (Western Australian Herbarium, 2008). Atkins (2008) was used as the reference list for DRF and Priority Flora.

3.2.2 Vegetation Mapping

Condition assessment mapping was conducted using 1:4,000 aerial photo-interpretation and on-site confirmation.

Vegetation community mapping was conducted using a combination of aerial photo-interpretation, on-ground confirmation, floristics and structure of vegetation as well as nearest neighbour 'R' multivariate analysis (Section 4.2.3).

3.2.3 R Multivariate Analysis

A multivariate nearest-neighbour analysis, 'R' (R Development Core Team, 2007) was conducted by RPS to compare the ten plots within the survey area with the Floristic Community Types (FCTs) defined by Gibson *et al.* (1994).

Gibson *et al.* (1994) grouped each of their 509 sites into one of 30 major FCTs defined for the Swan Coastal Plain, based on the results of their own multivariate analysis (PATN Statistical Package). The grouping of the survey area plots with Gibson *et al.* (1994) plots in the Hierarchical Cluster Dendrogram of the 'R" Analysis allows FCTs to be assigned to the survey area.

The agglomeration method used for the hierarchical cluster 'R' analysis was Ward linkage and Euclidean distance. Average and Complete linkage methods were also applied for comparative purposes. Taxonomy and nomenclature of the survey area flora data was reconciled with the historical nomenclature of Gibson *et al.* (1994) so that the two data sets were consistent.

The basic principal of this analysis is to group sites together in a hierarchical manner based on how many species there are in common between sites. The sites with the most species in common will group together the most closely.

This is the most quantitative method currently available to identify significant vegetation, as within the southern Swan Coastal Plain, TEC and PEC definitions are largely based on Gibson *et al.* (1994) Floristic Community Types. The nearest neighbour results were also used to aid vegetation community mapping.

Results are presented in Appendix 4.

4.0 RESULTS

4.1 Flora

4.1.1 Statistics

A total of 229 taxa were recorded from the survey area, of which 155 or 68% were native. The 155 native species recorded represents 5% of the native taxa known from the Swan Coastal Plain and 2% of the native taxa known from the South West of Western Australia (Western Australian Herbarium, 2008).

The 229 species represented 72 families and 168 genera. The number of species recorded within each Family is shown in Table 9. The number of species recorded within each Genera is shown in Table 10. See Appendix 1 for a full species list recorded for the survey area.

Table 9: Dominant Vascular Plant Families Present in the Study Area

Family	Common Name	Native	Introduced	Total Species
MYRTACEAE	Myrtles	18	5	23
POACEAE	Grasses	4	16	20
PAPILLIONACEAE	Peas	12	7	19
ASTERACEAE	Daisies	6	12	18
CYPERACEAE	Sedges	10	4	14
ORCHIDACEAE	Orchids	8	1	9
ANTHERICACEAE	Lillies	8	0	8
PROTEACEAE	Banksia, Hakea	7	0	7

Table 10: Dominant Vascular Plant Genera Present in the Study Area

Genus	Common Name	Native	Introduced	Total Species
Acacia	Wattles	5	2	7
Eucalyptus	Gum Trees	4	3	7
Melaleuca	Paperbarks, Bottlebrush	5	0	5
Drosera	Sundew	4	0	4
Banksia	Banksia	4	0	4
Sonchus	Thistles	2	1	3
Pterostylis	Greenhood Orchid	3	0	3
Kunzea	Kunzea	3	0	3
Hibbertia	Guinea Flower	3	0	3
Cyperus	Sedge	0	3	3
Cassytha	Dodder Laurels	3	0	3

4.1.2 Flora of Conservation Significance

4.1.2.1 Declared Rare Flora

No DRF species protected under the *Wildlife Conservation Act, 1950* were recorded within the survey area. No species protected under the *Environmental Protection Biodiversity Conservation Act, 1999* were recorded within the survey area.

There were five DRF species identified in the DEC database rare flora search of a 10km radius of the survey area. Four were orchids; *Caladenia huegelii, Diuris purdiei, Drakaea elastica* and *Drakaea micrantha.* There was one perennial shrub, *Verticordia plumosa* var. *ananeotes.* There was suitable habitat present within the survey area for these species, however they were not seen during the 2007 survey(s) of the study area.

4.1.2.2 Priority Flora

One Priority 2, *?Byblis gigantea and* two Priority 4, *Dodonaea hackettiana* and *Eucalyptus rudis* subsp. *cratyantha* were recorded from within the survey area (Figure 2).

?Byblis gigantea **Priority 2**

This species is a insectivorous perennial herb that grows to 45cm tall that is known from peaty sand in seasonally wet areas.

B. gigantea is known from 37 records from approximately 21 populations between Guildford and Boddington. Nine of these known populations appear to have been cleared. The record from the survey area would represent population 22.

Plate 1: **Habitat of *Byblis gigantea* (P2). August 2007**

Plate 2: ***Byblis gigantea* (P2). Scanned specimen**

Within the survey area, this species was growing in a low lying dampland, which had *Eucalyptus rudis* subsp. *rudis* over *Astartea scoparia* over weeds (Plate 1). Seedlings of this species were observed during the first season visit in August 2007, growing on a windrow in the north (Figure 2). A specimen was collected and it was intended that better material would be collected in the follow up survey. However, the plants were

not detected in October, and it was assumed that they had dried off. Due to the immaturity of the material collected, it could not be unequivocally determined to be *B. gigantea* through the usual flora identification methods. However, due to the distinctiveness of carnivorous plants, and the lack of any other option as to its identity, the material collected is likely to be this species.

Dodonaea hackettiana **Priority 4**

This species is a woody shrub to small tree, to five metres in height (Plates 3 and 4), that is typically known from areas of limestone outcropping (Western Australian Herbarium, 2008).

It is known from 28 records in the Western Australian Herbarium, from what appears to be 18 populations between Nilgen in the north and Casuarina in the south. Thirteen of these known populations appear to have been cleared. It has a known range of approximately 135km and is restricted to the Swan Coastal Plain.

Plate 3: Habit of *Dodonaea hackettiana* (P4).

Plate 4: Fruit of *Dodonaea hackettiana* (P4).

Within the survey area, 20 individuals were recorded from a disturbed edge of vegetation in the central survey area (Figure 2). The habitat would have originally been vegetation type 2a. (Figure 2), which is *Banksia* Woodland on white sand.

Eucalyptus rudis* var. *cratyantha **Priority 4**

This species is a tree to 20m (Plate 5) with rough, grey bark (Western Australian Herbarium, 2008). It differs from the more common *E. rudis* var. *rudis* by having fruit that are nearly twice as large (Plate 6).

According to specimen data from the Western Australian Herbarium, this taxa is known from 15 records from near coastal areas between Yallingup, and the Serpentine River, east of Rockingham. It is difficult to determine how many populations remain, as this species can still be present as an overstorey species in an otherwise cleared landscape. The record from the survey area represents a 23km North West range extension for this species.

Plate 5: Habit of *Eucalyptus rudis* subsp. *cratyantha* (P4).

Plate 6: Fruit of *Eucalyptus rudis* subsp. *cratyantha* (P4).

A single specimen was recorded on the corner of Branch Circus and Gadd Street (Figure 2). *Eucalyptus rudis* is widespread in the survey area and it is possible that other specimens are present. The fruit are required for positive identification, and due to the size of this species, these are not easily seen and/or able to be collected.

See Appendix C for detailed location and habitat details. See Appendix E for Rare Flora Report Forms.

4.1.2.3 Other Flora of Conservation Significance

Other taxa recorded from the survey area that have conservation significance, as defined by the EPA (2004) (Section 3.4.1.4) include the range representations shown in Table 11. Ranges were determined from coordinates in specimen records from the WAH (2008).

Endemic refers to those species that are known from a discrete area only e.g. a Swan Coastal Plain endemic is only known from the Swan Coastal Plain, and nowhere else. Short range endemism is an arbitrary measure (Paul Gioia, Research Scientist Western Australian Herbarium, DEC pers. comm., Jan 2008) of species with a limited range. Here, it has been defined as species with a range of less than 200 km and those with a range of less than 50km.

Table 11: Other Flora of Conservation Significance

Taxa	Significance
?Byblis gigantea	Short range endemic (range of <200km). At SW extent of known range (Boddington to Perth).
Conostylis festucacea subsp. *festucacea*	10km range extension to the SW. At SW extent of known range (Perth to Cervantes).
Diuris magnifica	Short range endemic (range of <200km) SCP endemic.

Taxa	Significance
Dodonaea hackettiana	Short range endemic (range of <200km). SCP endemic.
Melaleuca thymoides	At N extent of known range (Forrestdale, Perth to Esperance).
Pterostylis sanguinea	Only seven collections in the WAH.
Pterostylis sp. Cauline Leaves (N. Gibson & M.N. Lyons 1490)	Only seven collections in the WAH.
Senecio condylus	Short range endemic (main range <50km) (Herdsman Lake to Rockingham). Short range endemic (outlier range of <200km) (Herdsman Lake to Busselton). SCP endemic.

In addition, Bush Forever (WAPC, 2000) identifies *Byblis gigantea, Dodonaea hackettiana* and *Pterostylis* sp. Cauline Leaves (N. Gibson & M.N. Lyons 1490) as significant within the PMR, due to their range implications and/or Priority flora status.

4.1.3 Introduced Flora

Eighty introduced (weed) flora were recorded from the survey site, which represented 35% of the total flora recorded.

Naturalised bushland weeds were recorded at low to moderate densities within intact vegetation (Good to Excellent areas) (Figure 2). The most widespread weeds in the plots (i.e. native vegetation) included **Zantedeschia aethiopica* (ten out of ten detailed flora sites), **Briza maxima* and **Hypochaeris glabra* (nine sites), **Isolepis marginata* and **Briza minor* (eight sites) and **Ehrharta longiflora, *Acacia longifolia* and **Lotus angustissimus* (seven sites each).

Overall, the most extensively weed infested areas were along tracks, in pasture, firebreaks and areas that had been historically cleared or disturbed (Degraded to Completely Degraded areas) (Figure 2) (Plates 16 to 19).

4.1.3.1 Agricultural Weeds

Two declared weeds (agricultural weeds) listed for the Shire of Cockburn under the *Agricultural Protection Board Act, 1950* were recorded within the survey area: Arum Lily **Zantedeschia aethiopica* and Bridal Creeper **Asparagus asparagoides.* See http://www.agric.wa.gov.au/ for further information. Both of these species are widespread on the Swan Coastal Plain.

4.1.3.2 Environmental Weeds

The Environmental Weeds Strategy for Western Australia (CALM, 1999) was developed to identify those weed species that have the most serious implications for conservation. It classifies 1350 weed species into four categories of High, Moderate, Mild and Low.

Species in the High category are those that rate for all three criteria of Invasiveness, Distribution and Environmental Impacts, Moderate rate two criteria, Mild one with Low nil for all criteria but which will require future monitoring.

A list of the Moderate (25 species) to High (13 species) category weed species recorded from the survey area is given in Table 12. These categories can aid in identifying serious weeds and also aid in establishing priorities for any future weed management required.

Table 12: Environmental Weeds (High to Moderate Rating) Recorded from the Survey Area

Species	**Common Name**	**WA Weed Strategy Rating** (CALM, 1999)
* *Asparagus asparagoides*	Bridal Creeper	High
* *Brassica tournefortii*	Wild Radish	High
* *Bromus diandrus*	Great Brome	High
**Cortaderia selloana*	Pampas Grass	High
**Ehrharta calycinus*	Perennial Veldt Grass	High
**Euphorbia terracina*	Geraldton Carnation Weed	High
* *Lagurus ovatus*	Hare's Tail Grass	High
* *Leptospermum laevigatum*	Eastern States Teatree	High
**Lupinus cosentinii*	Blue Lupin	High
* *Pelargonium capitatum*	Rose Geranium	High
* *Romulea rosea*	Guildford Grass	High
**Watsonia bulbillifera*	Watsonia	High
* *Zantedeschia aethiopica*	Arum Lily	High
* *Aira caryophyllea*	Silvery Hair Grass	Moderate
* *Anagallis arvensis* var. *arvensis*	Orange Pimpernel	Moderate
* *Anagallis arvensis* var. *caerulea*	Blue Pimpernel	Moderate
* *Arctotheca calendula*	Capeweed	Moderate
* *Avena barbata*	Wild Oats	Moderate
**Briza maxima*	Blowfly Grass	Moderate
**Briza minor*	Shivery Blowfly Grass	Moderate
**Carpobrotus edulis*	Pigface	Moderate
**Cynodon dactylon*	Couch	Moderate
**Cyperus tenellus*	(Sedge)	Moderate
**Dischisma arenarium*	(Herb)	Moderate
**Ehrharta longiflora*	Annual Veldt Grass	Moderate
**Euphorbia peplus*	Petty Spurge	Moderate
**Galium murale*	Small Goosegrass	Moderate
**Hypochaeris glabra*	Flatweed	Moderate

Species	Common Name	WA Weed Strategy Rating (CALM, 1999)
**Rostraria cristata*	(Grass)	Moderate
**Schinus terebinthifolia*	Japanese Pepper	Moderate
**Solanum nigrum*	Blackberry Nightshade	Moderate
**Sonchus asper*	(Herb)	Moderate
**Sonchus oleraceus*	Common Sowthistle	Moderate
Stenotaphrum secundatum	Buffalo Grass	Moderate
**Urospermum picroides*	False Hawkbit	Moderate
**Ursinia anthemoides*	Ursinia	Moderate
**Vulpia myuros*	(Grass)	Moderate
**Wahlenbergia capensis*	Cape Bluebell	Moderate

4.2 Vegetation

The vegetation types within the survey area were defined as:

Bassendean Dunes/Spearwood Dunes Interface

1. Wetlands & Damplands

1a. Low Open Forest dominated by Moondah *Melaleuca preissiana* with scattered Flooded Gum *Eucalyptus rudis*.

1b. Low Open Forest dominated by Flooded Gum *Eucalyptus rudis* subsp. *rudis* with Freshwater Paperbark *Melaleuca rhaphiophylla* and *M. teretifolia*.

1c. Closed Tall Scrub of Spearwood *Kunzea glabrescens* over a Claypan.

1d. Closed Tall Scrub of Spearwood *Kunzea glabrescens* over species rich understorey.

2. Dunes (Low Lying)

2a. Emergent Jarrah *Eucalyptus marginata* over Woodland of *Eucalyptus todtiana*, *Banksia attenuata, B. menziesii* with scattered *B. ilicifolia*.

3. Cleared Areas

See Figure 2 for vegetation types and vegetation condition mapping, Section 5.2.1 for full description of vegetation units, Appendix 2 for Species by Site table and Appendix 3 for detailed vegetation plot descriptions.

Bassendean Dunes/Spearwood Dunes Interface

1. Wetlands & Damplands

Equivalent to FCT11 (Gibson *et al.*, 1994)

1a. Low Open Forest dominated by Moondah *Melaleuca preissiana* with scattered Flooded Gum *Eucalyptus rudis*.

Understorey very variable due to disturbance, with Degraded areas of Open Grassland Buffalo Grass **Stenotaphrum secundatum*, with other areas in Good or better condition including transitional vegetation, with species rich Low Shrubland dominated by *Hypocalymma angustifolium* and Herbland including *Dasypogon bromeliifolius* and Very Open Sedgeland typically of *Lepidosperma longitudinale*.

1b. Low Open Forest dominated by Flooded Gum *Eucalyptus rudis* subsp. *rudis* with Freshwater Paperbark *Melaleuca rhaphiophylla* and *M. teretifolia*.

With Tall Open to Open Shrubland of *Kunzea glabrescens, Acacia saligna, Viminaria juncea, Acacia pulchella var. glaberrima* and/or *Astartea affinis*. Very Open Sedgeland of *Juncus pallidus, Lepidosperma longitudinale* and *Isolepis stellata* and Very Open Herbland of *Centella asiatica, Isotoma pusilla* and *Lobelia alata*.

1c. Closed Tall Scrub of Spearwood *Kunzea glabrescens* over a Claypan.

Understorey consists of Very Open Herbland typically of *Chamaescilla corymbosa* var. *corymbosa, Drosera glanduligera, Cotula australis* and Orchidaceae species.

1d. Closed Tall Scrub of Spearwood *Kunzea glabrescens* over species rich understorey.

Understorey typically a Low Shrubland dominated by *Hypocalymma angustifolia*, Herbland of *Dasypogon bromeliifolius, Phlebocarya ciliata* and annual herbs and Sedgeland of *Schoenus efoliatus, Hypolaena exsulca and Lepidosperma longitudinale*.

2. Dunes (Low Lying)

Equivalent to FCT28 (Gibson *et al.*, 1994)

2a. Emergent Jarrah *Eucalyptus marginata* over Woodland of *Eucalyptus todtiana, Banksia attenuata, B. menziesii* with scattered *B. ilicifolia*

With an Open Shrubland typically of *Allocasuarina humilis, Xanthorrhoea preissii* and *Macrozamia riedlei* over a species rich Low Shrubland dominated by *Hibbertia hypericoides*, mixed Open Herbland and mixed Very Open Sedgeland dominated by *Lepidosperma pubisquameum* and *Desmocladus asper*.

3. Cleared Areas

3a. Remnant overstorey species and/or introduced trees over cleared ground, pasture or urban development.

Byblis gigantea	Priority 2
Dodonaea hackettiana	Priority 4
Eucalyptus rudis subsp. *cratyantha*	Priority 4

Caveat: This map constitutes broad scale vegetation mapping with boundaries drawn from aerial photography. Boundaries are indicative.

Datum: WGS84/GDA94.

Vegetation Condition Scale (WAPC, 2000)

	Condition	Definition
P	Pristine	No obvious signs of disturbance.
E	Excellent	Vegetation structure intact, disturbance affecting individual species ; weeds are non-aggressive species
VG	Very Good	Vegetation structure altered; obvious signs of disturbance
G	Good	Vegetation structure significantly altered by very obvious signs of multiple disturbance; basic vegetation structure or ability to regenerate it is retained
D	Degraded	Basic vegetation structure severely impacted by disturbance; scope for regeneration but not to a state approaching good (sic) condition without intensive management
CD	Completely Degraded	Vegetation structure not intact; the area completely or almost completely without native species ('parkland cleared')

Site Boundary
Cadastre
Vegetation Type Boundary
Bush Forever Boundary - Site 391
BC02 Detailed Flora Site

0 50 150 250m
Scale 1:5000

BUSH FOREVER SITE 391
ORIGINALLY 2a
ORIGINALLY 1d
ORIGINALLY 1a
ORIGINALLY 2a
BRANCH CIRCUS
GADD STREET
HAMMOND ROAD
BARTRAM ROAD
BC01 BC02 BC03 BC04 BC05 BC06 BC07 BC08 BC09 BC10

Figure 2

Vegetation Type and Condition

L07263 03.06.08

RPS

1a. Low Open Forest dominated by Moondah *Melaleuca preissiana* with scattered Flooded Gum *Eucalyptus rudis*.

This vegetation type was on seasonally inundated peaty dark grey sand in the southern half of the survey area (Figure 2).

The understorey in this vegetation type was very variable due to disturbance. Good to Degraded areas generally had an Open Grassland of Buffalo Grass **Stenotaphrum secundatum*, with scattered native species including shrubs *Melaleuca lateritia, Astartea scoparia* and *Eutaxia virgata* and sedges *Juncus pallidus, Lepidosperma longitudinale* and *Schoenus efoliatus*.

Areas in Good or better condition largely consisted of transitional vegetation between this vegetation type and Vegetation Type 2a (Figure 2). As a result of this, there was a mix of wetland and upland species in these areas. There was a Tall Open to Open Shrubland of *Acacia saligna*, *A. pulchella* var. *glaberrima*, *Jacksonia furcellata*, *Astartea scoparia* over a species rich Shrubland including *Hypocalymma angustifolium*, *Boronia fastigiata*, a Herbland dominated by *Dasypogon bromeliifolius* and Very Open Sedgeland typically of *Lepidosperma longitudinale* (Plates 7 and 8).

This vegetation type was mainly in Good to Degraded condition, with a small area in Very Good condition (Figure 2).

There were two detailed flora sites established within this vegetation type (BC01 and BC02). The average species richness of the two sites was 40 ± 11 with a mean weed frequency of 19 ± 1 species. Even though both sites had a similar number of weeds, these figures do not take into account weed density and BC02 had a much higher cover of weeds than BC01.

This vegetation type represents FCT11 (Gibson *et al.,* 1994), which has a Reservation Status: Well Reserved and Conservation Status: Low Risk. This FCT had a mean species richness of 27.2 species per sites with a mean weed frequency of 6.9.

Plate 7: **Vegetation Type 1a at BC01 (Very Good condition) (October 2007).**

Plate 8: **Vegetation Type 1a at BC02 (Good to Degraded condition) (August 2007).**

1b. Low Open Forest dominated by Flooded Gum *Eucalyptus rudis* with Freshwater Paperbark *Melaleuca rhaphiophylla* and *M. teretifolia*.

This vegetation type was on seasonally inundated peaty dark grey sand throughout the survey area (Figure 2).

The understorey in this vegetation type was very variable due to disturbance. Good to Degraded areas (Figure 2) generally had a Low Open Forest of Flooded Gum *Eucalyptus rudis* over scattered native species and a Herbland dominated by weeds such as **Zantedeschia aethiopica* and **Lotus angustissimus* and Grassland of **Briza maxima* and **Ehrharta longifolia*.

Areas in Good or better condition had a Low Open Forest of Flooded Gum *Eucalyptus rudis* and *Melaleuca rhaphiophylla* over Tall Open to Open Shrubland of *Astartea scoparia, Acacia saligna*, *Exocarpos sparteus*, *Kunzea glabrescens* and/or *Viminaria juncea*. There was a Very Open Herbland typically of *Centella asiatica*, *Isotoma pusilla*, *Lobelia alata*, *Sonchus hydrophilus* and *Microtis media* subsp. *media*, as well as the introduced herbs **Zantedeschia aethiopica*, **Lotus angustissimus*, **Sonchus asper*, **S. oleraceous* and **Hypochaeris glabra*. There was an Open Sedgeland of *Baumea juncea, B. articulata*, *Juncus pallidus*, *Lepidosperma longitudinale*, *Isolepis stellata* and the weeds **Isolepis marginata* and **Cyperus polystachyos*, and a Very Open Grassland predominantly of weed species such as **Briza maxima*, but also the native species *Deyeuxia quadriseta* in patches (Plates 9 and 10).

This vegetation type was in variable condition, ranging from Degraded to Very Good condition (Figure 2).

There were three detailed flora sites within this vegetation type (BC04, BC06 and BC09). The average species richness of the three sites was 29 ± 8 with a mean weed frequency of 17 ± 15. This variability is due to the varying condition across this type.

This vegetation type represents FCT11 (Gibson *et al.,* 1994), which has a Reservation Status: Well Reserved and Conservation Status: Low Risk. This FCT has a mean species richness of 27.2 species per sites with a mean weed frequency of 6.9.

Plate 9: Vegetation type 1b (Good to Degraded) BC04 (August 2007)

Plate 10: Vegetation type 1b, BC06 (Very Good) (October 2007)

1c. Closed Tall Scrub of Spearwood *Kunzea glabrescens* over a Claypan.

This vegetation type was on seasonally inundated light grey sandy clay in the north of the survey area (Figure 2).

It was a Tall Closed Scrub of *Kunzea glabrescens* over a naturally species poor understorey of Very Open Herbland typically of *Chamaescilla corymbosa*, *Cotula australis*, *Drosera glanduligera*, *Pterostylis nana* and *Caladenia flava*, as well as the introduced flora **Lotus angustissimus* and **Hypochaeris glabra*. There were scattered weedy grasses, **Ehrharta longifolia* and **Briza maxima*.

This vegetation type was mainly in Good to Very Good condition (Figure 2).

There was one detailed flora site within this vegetation type (BC05). The species richness for this site was 16 with a mean weed frequency of 10 species. Despite the dominance of weed species, their overall density was low.

This vegetation type represents FCT11 (Gibson *et al.,* 1994), which has a Reservation Status: Well Reserved and Conservation Status: Low Risk. This FCT has a mean species richness of 27.2 species per sites with a mean weed frequency of 6.9.

Plate 11: Vegetation type 1c at BC05 (August 2007).

Plate 12: Vegetation type 1c typical understorey at BC05 (August 2007).

1d. Closed Tall Scrub of Spearwood Kunzea glabrescens over species rich understorey.

This vegetation type was on seasonally damp dark peaty white sand, in the north east portion of the survey area (Figure 2).

This vegetation type was a Closed Tall Scrub dominated by *Kunzea glabrescens*, with scattered *Jacksonia furcellata* and *Exocarpos sparteus* over Low Shrubland dominated by *Hypocalymma angustifolium*, but also including *Xanthorrhoea preissii*, *Boronia fastigiata*, *Gompholobium tomentosum* and the woody creeper *Hardenbergia comptoniana*. There was a species rich Open Herbland to Herbland, dominated by *Phlebocarya ciliata* and

Dasypogon bromeliifolius, but also included *Dampiera linearis*, *Conostylis festucacea*, *Lobelia tenuior, Dianella revoluta* var. *divaricata, Phyllangium paradoxum*, *Centrolepis drummondiana*, *Homalosciadium homalocarpum*, *Poranthera microphylla*, *Trachymene pilosa*, *Levenhookia stipitata* and *Drosera glanduligera* and *Pterostylis* species. There was an Open Sedgeland dominated by *Schoenus efoliatus*, *Desmocladus asper*, *Hypolaena exsulca*, *Lepidosperma longitudinale* and *L. pubisquameum*.

This vegetation type was in predominantly Excellent condition, with Good to Degraded in a small area (Figure 2).

There was one detailed flora site within this vegetation type (BC07). The species richness for this site was 49 with a mean weed frequency of 18 species, although overall weed density was low.

This vegetation type represents a transition between FCT28 and FCT11 (Gibson *et al.,* 1994. Both have a Reservation Status: Well Reserved and Conservation Status: Low Risk. FCT11 has a mean species richness of 27.2 species per sites with a mean weed frequency of 6.9. FCT28 has a mean species richness of 55.2, with a mean weed frequency of 8.

Plate 13: Vegetation Type 1d at BC07 (August 2007)

2a. Emergent Jarrah *Eucalyptus marginata* over Woodland of *Eucalyptus todtiana*, *Banksia attenuata*, *B. menziesii* with scattered *B. ilicifolia*.

This vegetation type was on white sand on the lower slopes of consolidated dunes, in small pockets throughout the survey area (Figure 2).

Other scattered trees within this vegetation type included *Nuytsia floribunda* and *Allocasuarina fraseriana*. There was an Open Shrubland of *Allocasuarina humilis*, *Adenanthos cygnorum*, *Xanthorrhoea preissii*, *Macrozamia riedlei*, *Acacia pulchella* var. *glaberrima* and/or *Jacksonia furcellata*. There was a species rich Open Low Heath dominated by *Hibbertia hypericoides* but also typically included *H. racemosa*, *Calytrix flavescens*, *Scholtzia involucrata*, *Stirlingia latifolia*, *Bossiaea eriocarpa*, *Conostephium pendulum*, *Eremaea pauciflora*, *Gompholobium tomentosum*, *Hovea trisperma*, *Hypocalymma*

robustum and the woody creepers *Hardenbergia comptoniana* and *Kennedia prostrata*. There was a species rich Herbland, which was not dominated by any one species, but typically included *Dasypogon bromeliifolius*, *Anigozanthos humilis, A. manglesii*, *Burchardia congesta*, *Caladenia flava*, *Microtis media*, *Chamaescilla corymbosa*, *Conostylis* spp., *Drosera* spp., *Stylidium* spp., *Dampiera linearis*, *Lomandra caespitosa*, *Thysanotus manglesianus*, *Trachymene pilosa*, as well as the weeds **Arctotheca calendula*, **Ursinia anthemoides* and **Gladiolus caryophyllaceus*. There was an Open Sedgeland typically of *Lepidosperma pubisquameum*, *Desmocladus asper*, *Mesomelaena pseudostygia*, *Hypolaena exsulca* and/or *Schoenus curvifolius* (Plates 14 and 15).

This vegetation type was predominantly in Good to Very Good condition, with some areas in Good to Degraded condition (Figure 2).

There were three detailed flora sites within this vegetation type (BC03, BC08 and BC10). The average species richness of the three sites was 49 ± 5 with a mean weed frequency of 15 ± 4 species.

This vegetation type represents FCT28, which has a Reservation Status: Well Reserved and Conservation Status: Low Risk. FCT28 has a mean species richness of 55.2, with a mean weed frequency of 8.

Plate 14: Vegetation type 2a, understorey at BC10 (August 2007).

Plate 15: Vegetation type 2a at BC08 (August 2007).

3a. Remnant overstorey species and/or introduced trees over cleared ground, pasture or urban development.

The survey area has a history of use, including for agricultural activities such as grazing and horse husbandry and training. There has been drains put through the area and extensive clearing for infrastructure, such as fences, houses, pasture, firebreaks and tracks (Plates 16 to 18).

Vegetated remnants were very exposed due to the fragmentation caused by historical clearing, and because of this, the edges had varying degrees of degradation caused by exposure and weed invasion (Plate 19).

Plate 16: Historical clearing for fencing and firebreaks along western boundary of site (August 2007)

Plate 17: Area historically cleared for grazing, adjacent to Branch Circus (August 2007)

Plate 18: Drainage channel, adjacent to Branch Circus (August 2007)

Plate 19: 'Edge effect' on remnant vegetation, showing weedy understorey (October 2007)

4.2.1 Statistical Analysis of Floristic Community Types

See Appendix 4 for 'R' multivariate analysis result – 'R' Hierarchical Cluster Dendrogram.

At a broad level, the vegetation of the survey area came out in two separate groups within the 'R' analysis (Appendix 4). These were split into seasonal wetlands and uplands (Spearwood Dunes). There were also two sites that were transitional between wetland and upland vegetation. The two main groupings are equivalent to FCT11 and FCT 28.

FCT 11 Wet Forests and Woodlands

Reservation Status: Well reserved Conservation Status: Low risk

FCT 11 is found on both Bassendean Dunes and the Pinjarra Plain from Bullsbrook to Pinjarra. This community type is generally dominated by *Eucalyptus rudis* and/or

Melaleuca rhaphiophylla with other common species; *Astartea* aff. *fascicularis*, *Lepidosperma longitudinale* and *Pericalymma elliptica* (Gibson *et al.,* 1994).

FCT 28 Spearwood Banksia attenuata or Banksia attenuata-Eucalyptus Woodlands

Reservation Status: Well reserved Conservation Status: Low risk

FCT 28 is wide spread on the Swan Coastal Plain, from Thompson Lake to Seabird on Spearwood Dunes. This community type is largely made up of Jarrah, Marri Banksia attenuata Woodlands. Typical species for this FCT include *Banksia attenuata, Xanthorrhoea preissii, and Hibbertia hypericoides* (Gibson *et al.,* 1994).

Seasonal Wetlands

Sites BC02, BC04, BC05, BC06 and BC09 from the survey area were plotted in the 'R' Hierarchical Cluster Dendrogram, in a group with eight Gibson *et al.* (1994) sites, of which the closest three were FCT 11; Rowe-01, Hymus01 and Harry06. Of the remaining eight, 3 were FCT11, 1 was FCT14 and 1 was FCT25.

Seasonal Wetlands/Uplands Transitional

Sites BC01 and BC07 were placed in the transitional zone between wetlands and uplands. Sites are not usually located in transitional vegetation, however due to the fragmented vegetation present in the survey area, these sites were chosen because they were the best areas available to sample.

While these sites were grouped in the 'R' analysis with upland sites (BC03, BC08 and BC10) (FCT28), these were mapped and described in this report as Wetlands and Damplands (Figure 2). As there was a higher species diversity of upland species compared to wetland species, the upland species 'out weighted' the wetland species (as the analysis is based on species presence/absence only). However as there was a dense coverage of wetland indicator species these sites were described and mapped as wetlands.

The conclusion for these sites therefore, is that they are most likely a transitional Vegetation Type between FCT28 and FCT11.

Uplands

Sites BC03, BC08 and BC10 from the survey were grouped in the 'R' analysis results with 39 Gibson *et al,* (1994) plots, of which 34 were FCT28.

Even though the grouping with FCT28 was very strong, the closest Gibson *et al.*(1994) site in the 'R' analysis to the survey area was THOM-02, which was determined to be FCT24 by Gibson et al. (1994). THOM-02 is located less than one kilometre from the survey area, within Bush Forever Site 391. This grouping may be due to a number of factors, including proximity and also the methods used to classify the original groups by Gibson *et al.* (1994). However, because the grouping of FCT28 sites was so strong, and amongst other factors such as locality, floristics and habitat, this vegetation type was determined to be equal to FCT28.

5.0 DISCUSSION

5.1 Flora

5.1.1 Conservation Significance

The individual plants of *?Byblis gigantea* (P2) and *Eucalyptus rudis* subsp. *cratyantha* (P4) recorded within the survey area, represent range extremities for these species. In addition to these, there were six species recorded that were either at the extent of their known range, had a known range of less than 200km or 50km, were endemic to the Swan Coastal Plain and/or were poorly known, with less than 10 collections within the Western Australian Herbarium (as presented in Table 13).

The importance of identifying range representations, particularly extremities, is that they define the full and original extent of a species. Additionally, the genetics of a species can vary a great deal across a species range and it is likely that specific genetic strains are present at range extremities. Some of these genetic varieties may undergo taxonomic review, and be determined as new taxa in their own right. These new taxa may be relatively rare. Unlike most developed regions, taxonomy within Western Australia is still very active, due to the diversity of the flora and a lack of resources.

Dodonaea hackettiana appears to be less secure than its Priority 4 status indicates. Most of the populations represented by collections in the Western Australian Herbarium, have been cleared, particularly those within the Perth Metropolitan Region. Its range has been severely impacted by urban development. There is one population which is presumably secure, within the vicinity of the survey area, from Bush Forever Site 391: *'Thomsons Lake Nature Reserve and Adjacent Bushland'*. From Western Australian Herbarium records, this population is approximately 2.5km to the north west of the survey area. The 20 individuals within the survey area are not likely to have long term viability, as they are growing in an otherwise degraded habitat.

Table 13: Summary of known Priority Flora Populations.

Species	Collections (WA Herbarium)	No. of Known Populations	Populations likely to be remaining*	Survey Area Records	Known Range
?Byblis gigantean (P2)	37	21	12	New Population No. 22. At SW of known range.	125km linear from Guildford to Boddington.
Dodonaea hackettiana (P4)	29	18	5	New Population No. 19.	135km linear range between Nilgen and Casuarina.

Species	Collections (WA Herbarium)	No. of Known Populations	Populations likely to be remaining*	Survey Area Records	Known Range
Eucalyptus rudis subsp. *cratyantha* (P4)	15	11 (two location details questionable)	Unknown due to species ability to persist in disturbed landscapes.	New Population No. 12. Range extension of 23km to North.	200km linear along coast between Yallingup and east of Rockingham.

* Population coordinates plotting on residential developments and other cleared land such as quarries assumed to be destroyed. There is some ambiguity with cleared road verges and paddocks, as some flora can survive in these areas. Factors taken into account when deciding this included the species involved and the likelihood of long term viability in a highly disturbed landscape.
**Population defined as individual or clusters of records at least approximately 1km from another record or cluster of records.

5.2 Vegetation

5.2.1 Representation

This section discusses the amount of native vegetation thought to remain. This is expressed as a percentage remaining of the pre-European extent of a defined area or type of vegetation (Table 14).

The bioregion (Section 6.2.1.1) is the broadest scale for vegetation assessment. A bioregion contains a number of vegetation complexes (Section 6.2.1.2). Within, or even across vegetation complexes there are numerous FCTs (Section 6.2.1.3). FCTs may then contain a number of related plant communities. Trudgen (1996) defines a FCT as *'groups of flora species that consistently occur together to form an abstract community, which should not be confused with the traditional plant community'*. A plant community is a more detailed level of classification again, and there will be multiple plant communities within a FCT. The vegetation types described within this report (Section 5.2.1) fall between a FCT and a plant community in their level of detail.

5.2.1.1 Bioregional

The IBRA (Thackway and Cresswell, 1995 as amended) bioregion of SCP (SWA2) was described in an assessment of landscape health across Australia, as being 1,128,926 hectares in size with 37% of native vegetation remaining (974,699 hectares) (Commonwealth of Australia, 2000). This figure for the entire Swan Coastal Plain has been described as inaccurate and likely to be less than 30% (CALM, 2002).

Within the PMR portion of the Swan Coastal Plain (approximately 20%), Bush Forever states that there is 28% of native vegetation remaining (1998 data). The Western Australian State of the Environment Report states that within the PMR, an average of 850 hectares of vegetation was cleared each year between 1998 and 2004 (EPA, 2007). At that rate, a conservative estimate of vegetation remaining in the PMR portion of the Swan Coastal Plain in 2008, is approximately 24.8%.

See Table 14 for a summary of bioregional and other representation.

5.2.1.2 Vegetation Complexes

Within the Swan Coastal Plain (SWA2) bioregion (Section 6.2.1.1), the survey area is mapped within the *'Bassendean Dunes: Central and South'* (Heddle *et al*., 1980). However, it is on the very western extremity of this complex. The adjoining complexes are the '*Spearwood Dunes: Karrakatta Central and South'* and the wetlands suite of *'Spearwood: Herdsman Complex'*. Additionally, the multivariate analysis indicated that the vegetation in the survey area was more similar to the Spearwood Dunes than the Bassendean Dunes.

'Bassendean Dunes: Central and South' in the PMR portion of the Swan Coastal Plain is described as having 24% or 10,919 hectares of the original 46,220 hectares remaining, with 5,883 hectares (13%) to be protected under existing reserves and/or Bush Forever sites (WAPC, 2000).

'Spearwood Dunes: Karrakatta Central and South' in the PMR portion of the Swan Coastal Plain is described as having 18% or 6,275 hectares of the original 34,532 hectares remaining, with 2,590 hectares (8%) to be protected under existing reserves and/or Bush Forever sites (WAPC, 2000).

'Spearwood: Herdsman Complex' in the PMR portion of the Swan Coastal Plain is described as having 31% or 2,017 hectares of the original 6,509 hectares remaining, with 1,567 hectares (24%) to be protected under existing reserves and/or Bush Forever sites (WAPC, 2000).

All of these percentage figures are best case scenario based on the limitations discussed in Section 6.3.

See Table 14 for a summary of Vegetation Complexes and other representation of vegetation. The Vegetation Units of the survey area and the Vegetation Complexes they represent is listed. Vegetation Unit 2a is a mixture/at the interface of *'Bassendean Dunes: Central and South'* and *'Spearwood Dunes: Karrakatta Central and South.*

5.2.1.3 Floristic Community Types

There were two FCTs recorded for the survey area; FCT11: *'Wet Forests and Woodlands'* and FCT28: *'Spearwood Banksia attenuata or Banksia attenuata – Eucalyptus woodlands'*. FCT11 included the wetland vegetation (vegetation types 1a to 1d) and FCT28 included the upland dune vegetation (vegetation type 2)(Figure 2)(Section 5.2).

It is unknown how much of each of these FCTs remain as a percentage, as this data is not available. However, Gibson *et al.* (1994) allocated a Conservation Status and Reservation Status (Section 3.4.2.1) for each FCT, based on how much of each was remaining and how well it was protected (Table 14).

FCTs still represent a broad grouping of floristic communities, as is illustrated by the fact that from these two FCTs, there were five vegetation types described for the survey area (Figure 2) (Section 5.2).

See Table 14 for a summary of FCTs and other representation.

Table 14: Summary of Native Vegetation Representation and Conservation Significance in the Survey Area

IBRA Bioregion**		**Vegetation Complex****			**Branch Circus Vegetation**			**Floristic Community Types** (Gibson, 1994)				**TEC** (*Wildlife Cons. Act*,	**PEC** (DEC, 2007)	**TEC** (*EPBC Act, 1999*)
Region	**% Remaining in PMR**	**Complex**	**% Remaining in PMR**	**Proposed for Protection in PMR^**	**Vegetation Type** (Section 5.2)	**Sites**	**% Remaining in PMR**	**FCT***	**Reservation Status**	**Conservation Status**	**% Remaining in the PMR**			
Swan Coastal Plain 2	28% (24.8%)	**Bassendean** Central and South	24%	13%	2a	3, 8, 10.	Unknown	28	Well Reserved	Low Risk	Unknown	-	-	-
		Spearwood Karrakatta Central and South	18%	8%										
		Spearwood Herdsman	31%	24%	1a	1, 2.	Unknown	11	Well Reserved	Low Risk	Unknown	-	-	-
					1b	4, 6, 9.	Unknown							
					1c	5	Unknown							
					1d	7	Unknown							

** See Section 6.2 for limitations to these figures. Figures calculated from 1997 aerial photography (WAPC, 2000).
❖ This figure takes into account the rate of clearing of approximately 850 hectares per year on the SCP between 1997 and 2004 (EPA, 2007).
^ Proposed protection within Bush Forever sites in the Perth Metropolitan Region.
* Determined using results of 'R' multivariate analysis and inferred information from Gibson *et al.* (1994).

5.2.1.4 Representation in Protected Areas

This section assesses whether the flora and vegetation within the survey area is represented elsewhere within protected areas. Protected areas may include Bush Forever sites or DEC managed lands such as Nature Reserves.

Bush Forever Site 391: *'Thomson's Lake Nature Reserve and Adjacent Bushland, Beeliar'* is immediately to the west and the north of the survey area. The vegetation is described as representing FCT11, FCT12, FCT24 and FCT28 (WAPC, 2000), and is described as consisting of:

- Uplands: *Eucalyptus marginata* Low Open Forest; *Banksia attenuata* and *B. menziesii* Low Open Forest and Low Woodland with *Eucalyptus marginata* and *E. todtiana* and mixed Low Heath.

- Wetlands: *Eucalyptus rudis*, *Melaleuca preissiana* and *M. rhaphiophylla* Open Forests to Low Woodland; *Eucalyptus todtiana* and *Melaleuca preissiana* Low Open Forest to Low Woodland; *Melaleuca teretifolia* Low Open Forest; *Baumea articulata* and *Typha* sp. Closed Sedgelands.

Bush Forever Site 392: '*Harry Waring Marsupial Reserve, Wattleup'* is approximately four kilometres to the south west of the survey area. The vegetation is described as representing FCT05, FCT11, FCT21a, FCT23a and FCT 28, and is described of consisting of:

- Uplands: Bassendean and Spearwood Dunes not distinguished: *Eucalyptus marginata* Open Woodland; *Banksia attenuata* and *B. menziesii* Low Open Woodland to Low Closed Forest.

- Wetlands: *Eucalyptus rudis*, *Melaleuca preissiana* and *Banksia littoralis* Low Woodland to Low Closed Forest; *Banksia attenuata* and *B. ilicifolia* Low Woodland; *Baumea articulata* Sedgeland to Closed Sedgeland.

The multivariate analysis (Appendix 4) (Section 5.2.1) showed that the plot data from vegetation type 2 (Figure 2) in the survey area, was most closely related to one Gibson *et al.* (1994) plot (THOM-02), within Bush Forever Site 391.

The multivariate analysis (Appendix 4) (Section 5.2.1) showed that the plot data from the wetland communities, vegetation types 1a to 1d (Figure 2) in the survey area were closely related to one Gibson *et al.* (1994) plot (HARRY-06), within Bush Forever Site 392.

5.2.2 Regional Significance

The survey area is not identified in Bush Forever as Regionally Significant Bushland. It does not contain a vegetation complex with less than 10% or 400ha remaining on the Swan Coastal Plain. There are no DRF or TECs located within the survey area.

5.2.3 Locally Significant Natural Areas

The survey area meets eight of the criteria in Table 15 for significance, Del Marco *et al.* (2004).

Table 15: Assessment of the Survey Area against the Ecological Criteria to identify Locally Significant Natural Areas (Del Marco *et al.*, 2004)

1. REPRESENTATION	
1a. Regional Representation	
i) Any natural area with recognised International, National, State or Regional Conservation Value (outside Bush Forever Sites and Department of Conservation and Land Management [CALM] Managed Estate) that is not yet protected and/ or managed for conservation (Essential).	**No** The survey area is part of a interconnected wetland that also includes a RAMSAR Site 35: *'Forrestdale and Thomsons Lakes'*.
ii) Natural areas of an ecological community with only 1500 ha or 30% or less (whichever is greater) of their pre-European extent remaining in the Interim Biogeographically Regionalisation of Australia (IBRA) subregion (Essential – Jarrah Forest, Desirable – SCP).	**Yes** For the SCP south of Moore River, based on 1997 levels of clearing (Del Marco *et al.,* 2004), there is: 27% of Bassendean Central and South Complex; 28.7% of Spearwood, Karrakatta Central and South Complex; and 34.6% of Spearwood, Herdsman Complex.
iii) Large (greater than 20 ha), viable natural area in good or better condition of an ecological community with over 30% of its pre-European extent remaining in the IBRA subregion (Desirable).	**No** Vegetated areas in Good or better condition within the survey area are all less than 20 hectares.
iv) of an ecological community with only 1500 ha or 15% or less (whichever is the greater) protected for conservation in the Jarrah Forest IBRA subregion (Desirable - Jarrah Forest Only)	**N/A**
v) Natural area of an ecological community with only 400 ha or 10% or less (whichever is greater) protected for conservation in the Bush Forever Study Area (Essential).	**Yes** 13% (5,883ha) of Bassendean Central and South Complex; 8% (2,590ha) of Spearwood, Karrakatta Central and South Complex; and 24% (1,567ha) of Spearwood, Herdsman Complex proposed for protection under Bush Forever.

1b. Local Representation	
i) Natural area of an ecological community with 10% or less of its pre-European extent remaining within the Local Government area (Essential).	**No** In the City of Cockburn there is: 39% (2680ha) of the original extent of Bassendean Central and South Complex; 19% (269ha) of Spearwood, Karrakatta Central and South Complex; and 36% (442ha) of Spearwood, Herdsman Complex (Del Marco *et al.,* 2004)(2001 level of clearing).
ii) Natural area of an ecological community with 30% or less of its pre-European extent remaining within the Local Government area (Essential – Jarrah Forest, Desirable SCP).	**Yes** In the City of Cockburn there is: 39% (2680ha) of the original extent of Bassendean Central and South Complex; 19% (269ha) of Spearwood, Karrakatta Central and South Complex; and 36% (442ha) of Spearwood, Herdsman Complex (Del Marco *et al.,* 2004)(2001 level of clearing).
1b. Local Representation	
iii) Large (greater than 10 ha), viable natural areas in good or better condition of an ecological community with more than 30% of its pre-European extent remaining within the Local Government area (Desirable).	**No** Vegetated areas in Good or better condition within the survey area are all less than 10 hectares.
2. DIVERSITY	
i) Natural areas in good or better condition that contain both upland and wetland structural plant communities (Essential).	**Yes** The survey area includes natural areas in Good or better condition, of both upland and wetland plant communities.
3. RARITY	
i) Natural areas of an ecological community with only 1500 ha or 10% or less (whichever is the greater) of their pre-European extent remaining in the IBRA subregion (Essential).	**No**
ii) Natural areas of an ecological community with only 400ha or 10% or less (whichever is the greater) of their pre- European extent remaining in the Bush Forever Study Area (Essential).	**No**
iii) areas classified by CALM as containing Threatened Ecological Communities (TEC's) (English & Blyth 1997, 1999; CALM TEC GIS database, undated) (Essential).	**No** No TECs recorded within the survey area.
iv) Natural areas containing Declared Rare Flora (DRF), Specially Protected Fauna (SPF) or significant habitat for Specially Protected Fauna (Essential).	**No** No DRF recorded within the survey area. Suitable habitat is present for *Caladenia huegelii, Diuris purdiei, Drakaea elastica and Drakaea micrantha*.
v) Natural areas containing Priority or other significant flora or fauna or significant habitat for these fauna (Essential).	**Yes** Three Priority flora were recorded: *?Byblis gigantea* (P2), *Dodonaea hackettiana* (P4) and *Eucalyptus rudis* subsp. *cratyantha* (P4).

4. MAINTAINING ECOLOGICAL PROCESSES OR NATURAL SYSTEMS – CONNECTIVITY	
i) Natural areas acting as stepping stones within a Regional Ecological Linkage (Essential).	**No** Part of a linkage (Bush Forever Site 391), however the survey area is not a linkage corridor to other vegetated areas in itself.
ii) Natural areas acting as stepping stones within a within a local ecological linkage determined by a Local Government (Essential).	**No** City of Cockburn has no publicly listed ecological linkages.
5. PROTECTION OF WETLAND, STREAMLINE AND ESTUARINE FRINGING VEGETATION AND COASTAL VEGETATION	
i) Wetlands meeting the criteria for listing as Conservation Category or Resource Enhancement Wetlands plus an appropriate buffer (minimum 50m) in addition to the wetland dependant vegetation (Essential)	**Yes** There is a Conservation Category at the southern end of the survey area, and a Resource Enhancement Wetland in the northern survey area (see RPS Environment, 2008).
5. PROTECTION OF WETLAND, STREAMLINE AND ESTUARINE FRINGING VEGETATION AND COASTAL VEGETATION	
ii) Riparian vegetation along rivers, creeklines and other channel wetlands plus an appropriate buffer (minimum 50m) in addition to the riparian (wetland dependant) vegetation (Essential).	**Yes** Wetland dependant vegetation present in the survey area as per vegetation types 1a to 1d (Figure 2).
iii) Floodplains delineated on the basis of ecological and geomorphic features plus an appropriate buffer (minimum 50m) in addition to the floodplain area (Essential).	**Yes** Relevant to survey area. See RPS Environment (2008).
iv) Estuarine fringing vegetation plus an appropriate buffer (minimum 50m) of non-estuarine vegetation (Essential).	**N/A**.
v) Coastal vegetation on the foredunes and secondary dunes (Essential).	**N/A**.

5.3 Survey Limitations

A two-season survey in peak flowering times was completed in accordance with the EPA's Guidance Statement 51 (EPA, 2004). It is estimated that the flora inventory obtained for the survey area represents >70% of its expected flora.

Rainfall was 14% below the long term average for the five months leading up to the surveys.

Due to the complexity and diversity of natural systems, surveys are necessarily a random sampling exercise and localised populations of flora may have been missed. Additionally, many species are dormant or only emerge after certain events such as fire. Many species do not flower every year while a proportion flower in non-peak times and may have been inconspicuous or dormant at the time of the survey.

Random sampling means that not every individual significant flora species may have been recorded. The locations in Figure 2 are an indication only of their general distribution, and assumptions can only be made of how widespread they are in the survey area, based on habitat preference etc. This is particularly valid of *Eucalyptus rudis* subsp. *cratyantha* (P4), because it is a large tree, and the defining taxonomic feature of this taxa are its large nuts. Because of its size, these cannot necessarily be seen from the ground. *Eucalyptus rudis* was widespread in the survey area.

Taxonomy in Western Australia is limited by a lack of resources. At least 10% of the flora are undescribed, with new species being identified regularly. The flora identifications were completed to a standard limited by the technical resources available at the time. Specialist taxonomists were consulted where appropriate and/or possible. The overall accuracy of botanical identifications may be affected by many factors, including poor plant material being available at the time of collection, in addition to the factors listed above. It is estimated that the identifications have greater than 90% accuracy.
The assignment of FCTs based on comparison to Gibson *et al.* (1994) using a multivariate analysis, is the most quantitative method currently available to assess vegetation community representation on the SCP (Val English, Threatened Species and Communities Branch, DEC pers. comm., 2007). However, there are still limitations to this method. Gibson *et al.* (1994) FCT groupings are often broad, and many of them are a 'complex' of floristic communities that are similar to each other, but contain significant variation within them. The survey area for instance had five floristic communities, whereas these were only definitively represented by two known FCT groups.

Percentage figures of vegetation complexes or other vegetation remaining that are given in Section 3.3.2.2 and 6.2.1 are not necessarily accurate (Shaun Molloy, Ecologist, South West Biodiversity Project, DEC pers. comm., Jan 2008), or a useful figure for determining how much of an area remains. The reasons for this include that:

- Figures are determined using historical clearing levels or historical aerial photography. This is most relevant in areas of rapid development like the Perth Metropolitan Region. These figures can only be used as a 'best case scenario'.

- Vegetation complexes contain numerous floristic communities, some of which are likely to be less well represented than the overall figure indicates.

- They do not take vegetation condition into account and therefore the long term viability of remaining vegetation. It is highly likely that a large proportion of fragile ecosystems in a fragmented landscape would be degraded beyond the threshold for long term viability.

- They do not take into account the size, shape and continuity of vegetation, or the ongoing secondary threats and therefore the long-term viability of remaining vegetation.

6.0 RECOMMENDATIONS

As the survey area is identified as a Locally Significant Natural Area, there is the case for conservation of such values as part of the proposed development.

It is recommended that consideration be given to the retention of bushland containing the three identified priority flora species and regionally significant representation of Karrakatta Central and South (Vegetation Unit 2a) onsite, as part of the proposed subdivision. These values may be considered for inclusion within proposed conservation areas and/or POS as part of the planned subdivision.

It is pertinent to successful conservation efforts to assess the suitability of areas for retention. In such consideration, any reservation would have to be of a critical size (>4-10ha, Del Marco et *al*., 2004) to withstand disturbance within the urban environment, and commitment to long term management of degrading factors undertaken. In this case, the remnant bushland across the site is highly fragmented and the locations of priority flora onsite are currently degraded.

Therefore, it is acknowledged that such retention and management may be prohibitive and unsuitable for POS in a small subdivision. Conservation efforts may be better directed to mitigation/management of the potential impact of the development on the surrounding Bush Forever Site 391, which contains an extensive, viable reservation of Karrakatta Central and South within the local area.

The Priority 4 (P4) *Eucalyptus rudis* subsp. *cratyantha* could be quite easily retained and conserved onsite, as a feature tree in any POS/conservation area it happens to occur within. The long term protection of the *Dodonaea hackettiana* (P4) and *?Byblis gigantea* (P2) may be more effectively achieved through managing the interface with the Bush Forever Site 391. (A dedicated survey to locate these flora/or suitable habitat for these flora in Bush Forever Site 391 would be required in the first instance).

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APPENDIX I

Flora Inventory by Family

APPENDIX 1

FAMILY			SPECIES
015	Azollaceae		*Azolla filiculoides*
018	Zamiaceae		*Macrozamia riedlei*
020	Typhaceae	*	*Typha orientalis*
026	Juncaginaceae		*Triglochin linearis*
031	Poaceae	*	*Aira caryophyllea*
			Amphipogon turbinatus
			Austrostipa compressa
		*	*Avena* barbata
		*	*Briza maxima*
		*	*Briza minor*
		*	*Bromus diandrus*
		*	*Cortaderia selloana*
		*	*Cynodon dactylon*
		*	*Desmazeria rigida*
			Deyeuxia quadriseta
		*	*Ehrharta calycina*
		*	*Ehrharta longiflora*
		*	*Lagurus ovatus*
		*	*Lolium perenne*
			Microlaena stipoides
		*	*Poa annua*
		*	*Rostraria cristata*
		*	*Stenotaphrum secundatum*
		*	*Vulpia myuros*

FAMILY			SPECIES
032	Cyperaceae		*Baumea articulata*
			Baumea juncea
		*	*Cyperus laevigatus*
		*	*Cyperus polystachyos*
		*	*Cyperus tenellus*
			Isolepis cyperoides
		*	*Isolepis marginata*
			Isolepis stellata
			Lepidosperma longitudinale
			Lepidosperma pubisquameum
			Mesomelaena pseudostygia
			Schoenus curvifolius
			Schoenus efoliatus
			Tricostularia neesii var. *neesii*
035	Araceae	*	*Zantedeschia aethiopica*
036	Lemnaceae		*Lemna disperma*
039	Restionaceae		*Desmocladus asper*
			Desmocladus flexuosus
			Hypolaena exsulca
040	Centrolepidaceae		*Aphelia cyperoides*
			Centrolepis drummondiana
047	Commelinaceae		*Cartonema philydroides*
052	Juncaceae		*Juncus pallidus*
054B	Asparagaceae	*	*Asparagus asparagoides*
054C	Dasypogonaceae		*Calectasia narragara*
			Dasypogon bromeliifolius
			Lomandra caespitosa
			Lomandra preissii

FAMILY			SPECIES
054D	Xanthorrhoeaceae		*Xanthorrhoea preissii*
054E	Phormiaceae		*Dianella revoluta* var. *divaricata*
054F	Anthericaceae		*Arnocrinum preissii*
			Chamaescilla corymbosa var. *corymbosa*
			Corynotheca micrantha var. *micrantha*
			Laxmannia squarrosa
			Thysanotus manglesianus
			Thysanotus multiflorus
			Thysanotus sparteus
			Tricoryne elatior
054J	Colchicaceae		*Burchardia congesta*
055	Haemodoraceae		*Anigozanthos humilis* subsp. *humilis*
			Anigozanthos manglesii
			Conostylis aculeata subsp. *aculeata*
			Conostylis festucacea
			Phlebocarya ciliata
060	Iridaceae		*Gladiolus caryophyllaceus*
			Patersonia occidentalis
		*	*Romulea flava* var. *minor*
		*	*Romulea rosea*
		*	*Watsonia bulbillifera*
066	Orchidaceae		*Caladenia arenicola*
			Caladenia flava subsp. *flava*
		*	*Disa bracteata*
			Diuris magnifica
			Microtis media subsp. *media*
			Pterostylis sanguinea

FAMILY			SPECIES
066	Orchidaceae *(cont')*		*Pterostylis* sp. cauline leaves (N. Gibson & M.N. Lyons 1490)
			Pterostylis vittata
			Thelymitra sp.
070	Casuarinaceae		*Allocasuarina fraseriana*
			Allocasuarina humilis
090	Proteaceae		*Adenanthos cygnorum* subsp. *cygnorum*
			Banksia attenuata
			Banksia ilicifolia
			Banksia littoralis
			Banksia menziesii
			Petrophile linearis
			Stirlingia latifolia
092	Santalaceae		*Exocarpos sparteus*
097	Loranthaceae		*Nuytsia floribunda*
103	Polygonaceae	*	*Acetosella vulgaris*
		*	*Rumex pulcher*
109	Phytolaccaceae	*	*Phytolacca octandra*
110	Aizoaceae	*	*Carpobrotus edulis*
111	Portulacaceae		*Calandrinia corrigioloides*
113	Caryophyllaceae		*Cerastium glomeratum*
		*	*Stellaria media*
119	Ranunculaceae	*	*Ranunculus muricatus*
131	Lauraceae		*Cassytha pomiformis*
			Cassytha racemosa forma *pilosa*
			Cassytha racemosa forma *racemosa*
136	Fumariaceae	*	*Fumaria capreolata*
138	Brassicaceae	*	*Brassica tournefortii*

FAMILY			SPECIES
143	Droseraceae		*Drosera erythrorhiza*
			Drosera glanduligera
			Drosera menziesii subsp. *penicillaris*
			Drosera pallida
149	Crassulaceae		*Crassula colorata* var. *colorata*
		*	*Crassula decumbens*
154	Byblidaceae		*?Byblis gigantea* (P2)
163	Mimosaceae		*Acacia huegelii*
		*	*Acacia iteaphylla*
		*	*Acacia longifolia*
			Acacia pulchella var. *glaberrima*
			Acacia pulchella var. *pulchella*
			Acacia saligna
			Acacia stenoptera
165	Papilionaceae		*Bossiaea eriocarpa*
			Chamaecytisus prolifer
			Daviesia triflora
			Eutaxia virgata
			Gastrolobium capitatum
			Gompholobium tomentosum
			Hardenbergia comptoniana
			Hovea pungens
			Hovea trisperma var. *trisperma*
			Jacksonia furcellata
			Kennedia prostrata
		*	*Lotus angustissimus*
		*	*Lupinus cosentinii*

FAMILY			SPECIES
165	Papilionaceae	*	*Lupinus luteus*
	(cont')	*	*Medicago polymorpha*
			Pultenaea reticulata
		*	*Trifolium cernuum*
		*	*Vicia sativa*
			Viminaria juncea
167	Geraniaceae	*	*Erodium botrys*
		*	*Geranium molle*
			Pelargonium capitatum
168	Oxalidaceae	*	*Oxalis pes-caprae*
215	Rutaceae		*Boronia fastigiata*
			Philotheca spicata
178	Meliaceae	*	*Melia azedarach*
185	Euphorbiaceae	*	*Euphorbia peplus*
		*	*Euphorbia terracina*
			Poranthera microphylla
		*	*Ricinus communis*
194	Anacardiaceae	*	*Schinus terebinthifolia*
207	Sapindaceae		*Dodonaea hackettiana* (P4)
226	Dilleniaceae		*Hibbertia hypericoides*
			Hibbertia racemosa
			Hibbertia subvaginata
263	Thymelaeaceae		*Pimelea rosea*
273	Myrtaceae		*Astartea scoparia*
			Calytrix angulata
			Calytrix flavescens
			Corymbia calophylla

FAMILY			SPECIES
273	Myrtaceae (cont')		*Eremaea pauciflora*
		*	*Eucalyptus camaldulensis*
		*	*Eucalyptus citriodora*
		*	*Eucalyptus erythrocorys*
			Eucalyptus marginata subsp. *marginata*
			Eucalyptus rudis subsp. *cratyantha* (P4)
			Eucalyptus rudis subsp. *rudis*
			Hypocalymma angustifolium
			Hypocalymma robustum
		*	*Kunzea baxteri*
			Kunzea glabrescens
			Kunzea micrantha
		*	*Leptospermum laevigatum*
			Melaleuca lateritia
			Melaleuca preissiana
			Melaleuca rhaphiophylla
			Melaleuca teretifolia
			Melaleuca thymoides
			Scholtzia involucrata
281	Apiaceae		*Centella asiatica*
			Homalosciadium homalocarpum
			Trachymene pilosa
288	Epacridaceae		*Astroloma pallidum*
			Conostephium pendulum
			Leucopogon australis
			Leucopogon conostephioides
			Lysinema ciliatum

FAMILY			SPECIES
263	Primulaceae		*Anagallis arvensis* var. *arvensis*
		*	*Anagallis arvensis* var. *caerulea*
302	Loganiaceae		*Phyllangium paradoxum*
303A	Menyanthaceae		*Villarsia albiflora*
313	Lamiaceae		*Hemiandra pungens*
315	Solanaceae	*	*Solanum nigrum*
316	Scrophulariaceae		*Dischisma arenarium*
		*	*Veronica arvensis*
331	Rubiaceae	*	*Galium murale*
			Opercularia vaginata
339	Campanulaceae	*	*Wahlenbergia capensis*
			Wahlenbergia multicaulis
340	Lobeliaceae		*Isotoma pusilla*
			Lobelia alata
			Lobelia tenuior
341	Goodeniaceae		*Dampiera linearis*
			Goodenia pulchella subsp. Coastal Plain B
			Lechenaultia floribunda
343	Stylidiaceae		*Levenhookia stipitata*
			Stylidium piliferum
			Stylidium repens
345	Asteraceae	*	*Arctotheca calendula*
		*	*Conyza bonariensis*
			Cotula australis
			Cotula coronopifolia
		*	*Gamochaeta calviceps*
		*	*Hypochaeris glabra*

FAMILY			SPECIES
345	Asteraceae (cont')		*Lagenifera huegelii*
			Quinetia urvillei
			Senecio condylus
			Siloxerus filifolius
		*	*Sonchus asper*
			Sonchus hydrophilus
		*	*Sonchus oleraceus*
		*	*Symphyotrichum subulatum*
		*	*Taraxacum officinale*
		*	*Urospermum picroides*
		*	*Ursinia anthemoides*
		*	*Vellereophyton dealbatum*

APPENDIX 2

Species by Site Table

	NAME	BC01	BC02	BC03	BC04	BC05	BC06	BC07	BC08	BC09	BC10	OPPORTUNISTIC
	Acacia huegelii											Opp
*	*Acacia iteaphylla*											Opp X 08
*	*Acacia longifolia*	<1	1	1				<1				
	Acacia pulchella var. *glaberrima*	3							2	<1	<1	2
	Acacia pulchella var. *pulchella*											Opp X 10
	Acacia saligna						2			1		
	Acacia stenoptera											Opp X 01
*	*Acetosella vulgaris*											Opp
	Adenanthos cygnorum subsp. *cygnorum*											Opp X 10
*	*Aira caryophyllea*	<1		<1		<1		<1			<1	
	Allocasuarina fraseriana											1
	Allocasuarina humilis								3		12	15
	Amphipogon turbinatus										<1	Opp
*	*Anagallis arvensis* var. *arvensis*		1							<1		
*	*Anagallis arvensis* var. *caerulea*											
	Anigozanthos humilis subsp. *humilis*								<1		<1	Opp
	Anigozanthos manglesii											Opp
	Aphelia cyperoides											Opp X 06
*	*Arctotheca calendula*	3	1	<1		<1		<1	2			-
	Arnocrinum preissii								<1		<1	
*	*Asparagus asparagoides*							<1				
	Astartea scoparia	2	1		4		5			5		
	Astroloma pallidum										<1	
	Austrostipa compressa			<1				<1	<1		<1	
*	*Avena barbata*	<1		<1								
	Azolla filiculoides											Opp X 02
	Banksia attenuata			<1					10		15	15
	Banksia ilicifolia	0		2					1			2
	Banksia littoralis											Opp
	Banksia menziesii			10					15		15	15
	Baumea articulata											Opp X 06
	Baumea juncea											Opp
	Boronia fastigiata	8		1								
	Bossiaea eriocarpa	5		<1					<1		<1	
*	*Brassica tournefortii*										1	
*	*Briza maxima*	6		2	12	<1	2	1	<1	2	1	15
*	*Briza minor*	0	<1		<1		<1	<1	1	1		
*	*Bromus diandrus*	<1	<1		<1				<1			
	Burchardia congesta			<1					<1		<1	Opp
	Byblis gigantea											Opp
	Caladenia arenicola										<1	
	Caladenia flava subsp. *flava*			<1		<1		<1			<1	
	Calandrinia corrigioloides											Opp
	Calectasia narragara										1	
	Calytrix angulata								2			
	Calytrix flavescens			<1					<1			
*	*Carpobrotus edulis*	5		<1			1		5	<1		10
	Cartonema philydroides											Opp
	Cassytha pomiformis	<1										
	Cassytha racemosa forma *pilosa*		5				5			3		
	Cassytha racemosa forma *racemosa*											Opp X 04
	Centella asiatica		5		1		2			1		1
	Centrolepis drummondiana	<1						<1				
*	*Cerastium glomeratum*				<1			<1				
	Chamaecytisus prolifer											Opp
	Chamaescilla corymbosa var. *corymbosa*			<1		<1					5	
	Conostephium pendulum								<1		<1	Opp
	Conostylis aculeata subsp. *aculeata*								1		1	Opp
	Conostylis festucacea			<1				1	<1			
*	*Conyza bonariensis*									<1		
*	*Cortaderia selloana*									<1		Opp
	Corymbia calophylla											Opp
	Corynotheca micrantha var. *micrantha*											Opp

	NAME	BC01	BC02	BC03	BC04	BC05	BC06	BC07	BC08	BC09	BC10	OPPORTUNISTIC
	Cotula australis	<1			2			<1				
	Cotula coronopifolia											Opp X 02
	Crassula colorata var. *colorata*			<1				<1				3
*	*Crassula decumbens*					<1						
*	*Cynodon dactylon*		4									Opp
*	*Cyperus laevigatus*	<1			<1							
*	*Cyperus polystachyos*		1				<1			<1		
*	*Cyperus tenellus*											Opp X 02
	Dampiera linearis	1		<1				<1	1		1	Opp
	Dasypogon bromeliifolius	15		15				2	<1			Opp
	Daviesia triflora										<1	
*	*Desmazeria rigida*							<1				
	Desmocladus asper							5	<1		8	5
	Desmocladus flexuosus			7								
	Deyeuxia quadriseta						30			<1		
	Dianella revoluta var. *divaricata*	1		<1	<1			<1			<1	Opp
*	*Disa bracteata*			<1		<1		<1	<1		<1	
*	*Dischisma arenarium*											Opp X 08
	Diuris magnifica											Opp X 10
	Dodonaea hackettiana											Opp
	Drosera erythrorhiza											Opp X 10
	Drosera glanduligera					<1						1
	Drosera menziesii subsp. *penicillaris*			<1								
	Drosera pallida								<1		1	
*	*Ehrharta calycina*	1		<1					10		1	15
*	*Ehrharta longiflora*		<1		<1	<1			<1	<1	<1	
	Eremaea pauciflora			<1								Opp
*	*Erodium botrys*											Opp
*	*Eucalyptus camaldulensis*											Opp
*	*Eucalyptus citriodora*											Opp
*	*Eucalyptus erythrocorys*											Opp
	Eucalyptus marginata subsp. *marginata*										8	2
	Eucalyptus rudis subsp. *cratyantha*											Opp
	Eucalyptus rudis subsp. *rudis*				65		30			5		10
*	*Euphorbia peplus*				<1				<1			Opp
*	*Euphorbia terracina*											Opp
	Eutaxia virgata		<1									Opp
	Exocarpos sparteus				nc							
*	*Fumaria capreolata*		<1									
*	*Galium murale*				1							
*	*Gamochaeta calviceps*							<1				
	Gastrolobium capitatum										<1	
*	*Geranium molle*											Opp
*	*Gladiolus caryophyllaceus*			<1					1		1	Opp
	Gompholobium tomentosum							<1	<1		<1	Opp
	Goodenia pulchella subsp. Coastal Plain B (L.W. Sage 2336)											Opp
	Hardenbergia comptoniana								1		<1	Opp
	Hemiandra pungens											Opp X 10
	Hibbertia hypericoides								5		20	15
	Hibbertia racemosa			<1								
	Hibbertia subvaginata								<1			
	Homalosciadium homalocarpum	<1						<1			<1	
	Hovea pungens										1	Opp
	Hovea trisperma var. *trisperma*	<1		<1					<1			
	Hypocalymma angustifolium	20			2			15	<1			2
	Hypocalymma robustum			<1								Opp
*	*Hypochaeris glabra*	1		<1	<1	<1	<1	<1	2	1	1	3
	Hypolaena exsulca			<1				3				
	Isolepis cyperoides						<1					
*	*Isolepis marginata*	<1	<1		<1		<1	<1	<1	<1		+
	Isolepis stellata				<1					<1		
	Isotoma pusilla						<1			<1		
	Jacksonia furcellata	<1						1				Opp

	NAME	BC01	BC02	BC03	BC04	BC05	BC06	BC07	BC08	BC09	BC10	OPPORTUNISTIC
	Juncus pallidus		2		<1		1			1		1
	Kennedia prostrata											
*	*Kunzea baxteri*											Opp
	Kunzea glabrescens					75		70	<1	1		Opp
	Kunzea micrantha											Opp X 10
	Lagenifera huegelii										1	
*	*Lagurus ovatus*							<1		<1		
	Laxmannia squarrosa										<1	
	Lechenaultia floribunda								<1			
	Lemna disperma											Opp X 02
	Lepidosperma longitudinale	1						2		<1		
	Lepidosperma pubisquameum	10		4				<1			<1	Opp
*	*Leptospermum laevigatum*					3						20
	Leucopogon australis											Opp X 04
	Leucopogon conostephioides											Opp X 10
	Levenhookia stipitata							<1			<1	
	Lobelia alata		<1				1			<1		Opp
	Lobelia tenuior	<1						<1				
*	*Lolium perenne*	<1							<1			
	Lomandra caespitosa			<1					<1		<1	
	Lomandra preissii			<1								
*	*Lotus angustissimus*		<1		1	<1	<1	<1	<1	1		Opp
*	*Lupinus cosentinii*											Opp
*	*Lupinus luteus*											Opp
	Lysinema ciliatum											Opp X 10
	Macrozamia riedlei	<1								<1	1	Opp
*	*Medicago polymorpha*											Opp X 02
	Melaleuca lateritia		<1									
	Melaleuca preissiana	60	30									
	Melaleuca rhaphiophylla						15			30		Opp
	Melaleuca teretifolia		20				5			2		1
	Melaleuca thymoides											Opp
*	*Melia azedarach*		<1			<1				<1		
	Mesomelaena pseudostygia										5	
	Microlaena stipoides	<1							<1			
	Microtis media subsp. *media*	<1				<1	<1			<1		
	Microtis media subsp. *quadrata*			<1				<1	<1		<1	
*	*Myrsiphyllum asparagoides*											Opp X 08
	Nuytsia floribunda											Opp
	Opercularia vaginata	<1										
*	*Oxalis pes-caprae*											Opp X 08
	Patersonia occidentalis			<1					<1		<1	Opp
*	*Pelargonium capitatum*	<1							<1			Opp
	Petrophile linearis			<1					<1			Opp
	Philotheca spicata											
	Phlebocarya ciliata	5		15				8				
	Phyllangium paradoxum							<1				
*	*Phytolacca octandra*		1									
	Pimelea rosea			1								Opp
*	*Poa annua*				<1							
	Poranthera microphylla	<1						<1			<1	
	Pterostylis sanguinea							<1				
	Pterostylis sp. cauline leaves (N. Gibson & M.N. Lyons 1490)							<1				
	Pterostylis vittata											Opp X 10
	Pultenaea reticulata											Opp X 07
	Quinetia urvillei											Opp X 01
*	*Ranunculus muricatus*		<1									
*	*Ricinus communis*							<1				Opp
*	*Romulea flava* var. *minor*											Opp X 03
*	*Romulea rosea*									<1		
*	*Rostraria cristata*									<1		
*	*Rumex pulcher*		<1							<1		
*	*Schinus terebinthifolia*		25									

	NAME	BC01	BC02	BC03	BC04	BC05	BC06	BC07	BC08	BC09	BC10	OPPORTUNISTIC
	Schoenus curvifolius			<1							1	
	Schoenus efoliatus	2						8				
	Scholtzia involucrata											4
	Senecio condylus			<1								
	Siloxerus filifolius										<1	
*	*Solanum nigrum*						<1	<1				
*	*Sonchus asper*				<1					<1		
	Sonchus hydrophilus		<1		<1					1		
*	*Sonchus oleraceus*	<1	<1	<1			<1		<1	<1		
*	*Stellaria media*		<1		1							
*	*Stenotaphrum secundatum*		35									3
	Stirlingia latifolia								3			2
	Stylidium piliferum										<1	
	Stylidium repens										<1	
*	*Symphyotrichum subulatum*		2									
*	*Taraxacum officinale*	1										
	Thelymitra sp.							<1				
	Thysanotus manglesianus	nc		<1				<1	<1		<1	Opp
	Thysanotus multiflorus											Opp X 04
	Thysanotus sparteus								<1			
	Trachymene pilosa			<1				<1			1	
	Tricoryne elatior	<1										
	Tricostularia neesii var. *neesii*								<1			
*	*Trifolium cernuum*											Opp X 07
	Triglochin linearis											Opp X 06
*	*Typha orientalis*											Opp X 02
*	*Urospermum picroides*			<1								
*	*Ursinia anthemoides*			<1					1		<1	
*	*Vellereophyton dealbatum*											Opp X 09
*	*Veronica arvensis*				<1							
*	*Vicia sativa*											Opp X 07
	Villarsia albiflora											Opp X 06
	Viminaria juncea											Opp
*	*Vulpia myuros*	1			<1				<1	<1	<1	
*	*Wahlenbergia capensis*							<1	<1		<1	
	Wahlenbergia multicaulis										<1	
*	*Watsonia bulbillifera*											Opp
	Xanthorrhoea preissii	30		10				2				5
*	*Zantedeschia aethiopica*	1	20	<1	<1	<1	<1	<1	1	5	<1	1

APPENDIX 3

Detailed Flora Site Descriptions

APPENDIX 3

SITE BC01

Described by: Angela Mercier (13/08/2007) and Kelli McCreery (26/10/2007).
Type: 10m by 10m Quadrat.
MGA Zone: (WGS84) 50 6442987S, 390825E.
Habitat: Wetland.
Soil: Dark brown loamy sand.
Rock Type: Limestone.
Vegetation: *Melaleuca* preissiana, *Banksia ilicifolia* Low Woodland over *Xanthorrhoea preissii* and *Hypocalymma angustifolium* Closed Heath over *Dasypogon bromeliifolius* and *Lepidosperma longitudinale* Herbland.
Condition: Excellent to Very Good, Low disturbance- weeds.
Fire Age: More than five years.
Notes: Bareground: 0% Litter: 10% Aspect: Slightly SE. This community was very narrow and as a result, the floristics were affected by adjoining *Banksia* woodland.

Plot Species List

*Melaleuca preissiana, Banksia ilicifolia, Hypocalymma angustifolium, Xanthorrhoea preissii, Bossiaea eriocarpa, Dasypogon bromeliifolius, Boronia fastigiata, Dampiera linearis, Lepidosperma pubisquameum, *Zantedeschia aethiopica, *Hypochaeris glabra, Jacksonia furcellata, Phlebocarya ciliata, Dianella revoluta* var. *divaricata, Astartea scoparia, *Acacia longifolia, *Pelargonium capitatum, Hovea trisperma* var. *trisperma, Schoenus efoliatus, *Carpobrotus edulis, *Arctotheca calendula, Lepidosperma longitudinale, Acacia pulchella* var. *glaberrima, *Briza minor, *Cyperus laevigatus, Conostylis festucacea, Banksia littoralis, *Ehrharta longiflora, Pimelea rosea, Petrophile linearis, Desmocladus flexuosus, Burchardia congesta, Hibbertia subvaginata, Hypocalymma robustum, Acacia stenoptera, Allocasuarina fraseriana, Eremaea pauciflora, *Briza maxima, *Bromus diandrus, *Ehrharta longiflora, *Vulpia myuros, *Aira caryophyllea, *Lolium perenne, *Ehrharta calycina, *Sonchus oleraceus, Schoenus efoliatus, *Taraxacum officinale, Cassytha pomiformis, Microtis media* subsp. *media, Burchardia congesta, Acacia stenoptera, Burchardia congesta, Allocasuarina fraseriana, Opercularia vaginata, Lobelia tenuior, Microlaena stipoides, Tricoryne elatior, Poranthera microphylla, Lepidosperma longitudinale, Homalosciadium homalocarpum, Cotula australis, *Avena barbata, Lepidosperma pubisquameum, Thysanotus manglesianus, Centrolepis drummondiana, Macrozamia riedlei.*

Outside Plot

Eucalyptus rudis subsp. *rudis, Trachymene pilosa, Philotheca spicata, Quinetia urvillei, Petrophile linearis, Lechenaultia floribunda, Hibbertia racemosa, Austrostipa compressa, Stylidium piliferum, Siloxerus filifolius, Melaleuca thymoides,* Isolepis marginata, Pimelea rosea.*

SITE BC02

Described by: Angela Mercier (14/08/2007) and Kelli McCreery (25/10/2007).
Type: 10m by 10m Quadrat.
Location: (WGS84) 50 6443156S, 390776E.
Habitat: Wetland.
Soil: Black to brown loamy sand. Wet but not inundated.
Rock Type: None.
Vegetation: Scattered **Schinus terebinthifolia* with *Melaleuca preissiana* and *Melaleuca teretifolia* Low Open Forest over *Astartea affinis* Tall Shrubland over *Juncus pallidus* Very Open Sedgeland with *Zantedeschia aethiopica* Herbland and Poaceae sp. Grassland.

Condition: Good, with high disturbance: weeds.
Fire Age: More than five years.
Notes: Bare ground: 0% Litter: 60% Aspect: Flat.

Species List

**Schinus terebinthifolia, Melaleuca teretifolia, Melaleuca preissiana, Astartea scoparia, Juncus pallidus, Cassytha racemosa* forma *pilosa, *Acacia longifolia, *Zantedeschia aethiopica, *Stenotaphrum secundatum, *Symphyotrichum subulatum, *Phytolacca octandra, *Centella asiatica, *Arctotheca calendula, *Melia azedarach, *Sonchus oleraceus, *Anagallis arvensis* var. *arvensis, *Fumaria capreolata, *Cyperus polystachyos.*

Outside Plot

Acacia saligna, Eucalyptus rudis subsp. *rudis, *Conyza bonariensis, *Solanum nigrum, Lemna disperma, *Ranunculus muricatus, *Melia azedarach, *Anagallis arvensis* var. *arvensis, *Stellaria media, Sonchus hydrophilus, *Briza minor, Lobelia alata, *Cynodon dactylon, *Conyza bonariensis, *Solanum nigrum, *Isolepis marginata, *Bromus diandrus, *Ehrharta longiflora, Melaleuca lateritia, *Lotus angustissimus, Eutaxia virgata, *Cotula coronopifolia, *Typha orientalis, *Anagallis arvensis* var. *caerulea, *Ricinus communis, *Cyperus tenellus, *Medicago polymorpha, *Lolium perenne, *Lupinus cosentinii, Crassula colorata* var. *colorata, Lepidosperma longitudinale, *Rostraria cristata, *Azolla filiculoides, *Lolium perenne, Goodenia pulchella* subsp. Coastal Plain B (L.W. Sage 2336)*, *Rumex pulcher.*

SITE BC03

Described by: Kelli McCreery (13/08/2007) and Angela Mercier(26/10/2007).
Type: 10m by 10m Quadrat.
Location: (WGS84) 50 6442958S, 390806E.
Habitat: Lower Slope.
Soil: White Sand.
Rock Type: Limestone.
Vegetation: *Banksia attenuata, B. menziesii* and *B. ilicifolia* Low Woodland over *Xanthorrhoea preissii*, *Jacksonia furcellata* Shrubland over *Phlebocarya ciliata* and *Dasypogon bromeliifolius* Closed Herbland with *Lepidosperma* sp. Open to Very Open Sedgeland.
Condition: Excellent to Very Good, Low to Medium disturbance.
Fire Age: Greater than five years.
Notes: Bareground: 2% Litter: 25% (dead Dasypogon) Aspect: SE.

Species List

*Banksia menziesii, Banksia ilicifolia, Banksia attenuata, *Acacia longifolia, Xanthorrhoea preissii, Pimelea rosea, Hibbertia racemosa, Petrophile linearis, Eremaea pauciflora, Bossiaea eriocarpa, Boronia fastigiata, Dampiera linearis, Hovea trisperma* var. *trisperma, Caladenia flava* subsp. *flava, Hypocalymma robustum, Dasypogon bromeliifolius, Burchardia congesta, *Gladiolus caryophyllaceus, *Ursinia anthemoides, Drosera menziesii* subsp.. *penicillaris, Patersonia occidentalis, Dianella revoluta* var. *divaricata, Chamaescilla corymbosa* var. *corymbosa, Thysanotus manglesianus, *Briza maxima, *Ehrharta calycina, Trachymene pilosa, Lomandra preissii, *Zantedeschia aethiopica, Hypolaena exsulca, Lepidosperma pubisquameum, Desmocladus flexuosus, *Sonchus oleraceus, *Urospermum picroides,* Unknown sp., *Conostylis festucacea, Phlebocarya ciliata, Schoenus curvifolius, Carpobrotus edulis, *Hypochaeris glabra, *Arctotheca calendula.*

Outside Plot

Jacksonia furcellata, Macrozamia riedlei, Stylidium piliferum, Gompholobium tomentosum, Scholtzia involucrata, Allocasuarina fraseriana, Philotheca spicata, Tricoryne elatior, Conostylis aculeata subsp. *aculeata, *Pelargonium capitatum, *Romulea flava* var. *minor, *Avena barbata, *Aira caryophyllea, Senecio condylus, *Disa bracteata, Microtis media* subsp. *media, Crassula colorata* var. *colorata, Lomandra caespitosa, Calytrix flavescens, Austrostipa compressa, *Pelargonium capitatum, *Briza minor, *Galium murale.*

SITE BC04

Described by: Kelli McCreery (13/08/2007) Angela Mercier (25/10/2007).
Type: 10m by 10m quadrat.
Location: (WGS84) 50 6442990S, 390873E.
Habitat: Valley Floor.
Soil: Black from peat over sand.
Rock Type: Limestone.
Vegetation: Open Forest *Eucalyptus rudis* over Open Shrubland of *Astartea scoparia.*
Condition: Good to Degraded, disturbance is high due to weeds and grazing.
Fire Age: Greater than five years.
Notes: Bareground: 1%. Litter: 95%. Aspect: Flat.

Species List

Eucalyptus rudis subsp. *rudis, Astartea scoparia, Dianella revoluta* var. *divaricata,* Cyperus laevigatus, Hypocalymma angustifolium, *Zantedeschia aethiopica, Centella asiatica, *Hypochaeris glabra, *Briza maxima, *Poa annua, Juncus pallidus, Cotula australis, *Stellaria media, *Lotus angustissimus, *Briza minor, *Ehrharta longiflora, Cerastium glomeratum, *Isolepis marginata, *Bromus diandrus, *Veronica arvensis, *Euphorbia peplus, *Vulpia myuros, Isolepis stellata, Sonchus hydrophilus, *Galium murale, *Sonchus asper.*

Outside Plot

Leucopogon australis, Cassytha racemosa forma *racemosa, Lepidosperma longitudinale, Hypocalymma angustifolium, *Acacia longifolia, *Cortaderia selloana, Viminaria juncea, Leucopogon australis, Baumea juncea, Lepidosperma longitudinale, Thysanotus multiflorus, Patersonia occidentalis, Isotoma pusilla, Corynotheca micrantha* var. *micrantha, Exocarpos sparteus.*

SITE BC05

Described by: Kelli McCreery (14/08/2007) Angela Mercier (25/10/2007).
Type: Quadrat.
Location: (WGS84) 50 6443637S, 390449E.
Habitat: Dampland.
Soil: Sandy white with black peat.
Rock Type: None.
Vegetation: *Kunzea glabrescens* Closed Tall Scrub over *Drosera glanduligera*, moss, Orchidaceae spp. and lichen Very Open Herbland.
Condition: Very Good with Low disturbance due to weeds and some old tracks
Fire Age: Greater than five years.
Notes: Bareground: 25%. Litter: 70%. Aspect: Flat.

Species List

*Kunzea glabrescens, *Leptospermum laevigatum, Chamaescilla corymbosa* var. *corymbosa, Drosera glanduligera, *Hypochaeris glabra, Caladenia flava* subsp. *flava, *Crassula decumbens, *Lotus angustissimus, *Arctotheca calendula, *Zantedeschia aethiopica, Unknown, *Briza maxima, *Aira caryophyllea, *Ehrharta longiflora, Jacksonia furcellata, *Melia azedarach, *Disa bracteata, *Aira caryophyllea, Microtis media* subsp. *media.*

Outside Plot

Jacksonia furcellata, Eucalyptus rudis subsp. *rudis, Pterostylis sp*. cauline leaves (N. Gibson & M.N. Lyons 1490), *Isolepis marginata, Astartea scoparia, Crassula colorata* var. *colorata, Cotula australis, Thelymitra sp (Sterile)., Austrostipa compressa.*

SITE BC06

Described by: Angela Mercier (14/08/2007) and Kelli McCreery (25/10/2007).
Type: 10m by 10m quadrat.
Location: 50 6443544 degrees S, 390414 degrees E.
Habitat: Wetland.
Soil: Black and brown loamy sand, with peat.
Rock Type: None.
Vegetation: Open Forest to Low Open Forest *Eucalyptus rudis* subsp. *rudis* and *Melaleuca rhaphiophylla* over Open Shrubland *Astartea scoparia* with Herbland *Cassytha racemosa* over Deyeuxia quadriseta, Grassland and Open Herbland *Centella asiatica* and Very Open Sedgeland *Juncus pallidus*.
Condition: Excellent to Very Good, disturbance is Low.
Fire Age: Greater than five years.
Notes: Water: 2%. Litter: 5%. Aspect: N/A.

Species List

Melaleuca rhaphiophylla, Eucalyptus rudis subsp. *rudis, Astartea scoparia, Acacia saligna, Cassytha racemosa* forma *pilosa, Melaleuca teretifolia, Centella asiatica, Juncus pallidus, Deyeuxia quadriseta, *Carpobrotus edulis, *Zantedeschia aethiopica, *Lotus angustissimus, *Hypochaeris glabra, Isolepis cyperoides, *Briza maxima, Lobelia alata, *Briza minor, Acacia pulchella* var. *glaberrima, Deyeuxia quadriseta, Microtis media* subsp. *media, *Sonchus oleraceus, *Cyperus polystachyos, *Isolepis marginata, Isotoma pusilla, *Hypochaeris glabra, *Solanum nigrum.*

Outside Plot

**Cortaderia selloana, Acacia pulchella* var. *glaberrima, Eutaxia virgata, Baumea articulata, Kunzea glabrescens, Baumea juncea, Triglochin linearis, Villarsia albiflora, Schoenus efoliatus, Viminaria juncea, Exocarpos sparteus, *Rostraria cristata, Isolepis stellata, Phyllangium paradoxum, Aphelia cyperoides, *Aira caryophyllea.*

SITE BC07

Described by: Kelli McCreery (14/08/2007) and Angela Mercier and Kelli McCreery (25/10/2007).
Type: 10m by 10m quadrat.
Location: (WGS84) 50 6443624S, 390687E.
Habitat: Dampland.
Soil: White sand with black peat.
Rock Type: Limestone.

Vegetation: *Kunzea glabrescens* Closed Tall Scrub over *Xanthorrhoea preissii, Hypocalymma angustifolium* Open Shrubland over *Schoenus* sp and Lepidosperma longitudinal Open Sedgeland over scattered herbs and grasses.
Condition: Excellent, disturbance is Low with some weeds and rabbits.
Fire Age: Greater than five years.
Notes: Bareground: 5%. Litter: 60%. Aspect: Flat.

Species List

*Kunzea glabrescens, Hypocalymma angustifolium, Xanthorrhoea preissii, Jacksonia furcellata, Gompholobium tomentosum, Dasypogon bromeliifolius, Phlebocarya ciliata, Thysanotus manglesianus, *Hypochaeris glabra, Dianella revoluta* var. *divaricata, Pterostylis sanguinea, Pterostylis* sp. cauline leaves (N. Gibson & M.N. Lyons 1490), *Caladenia flava* subsp. *flava, *Asparagus asparagoides, Poranthera microphylla, *Gamochaeta calviceps, Conostylis festucacea, Trachymene pilosa, Lepidosperma longitudinale, Hypolaena exsulca, Schoenus efoliatus, Desmocladus asper, Lepidosperma pubisquameum, *Zantedeschia aethiopica, *Briza maxima, *Solanum nigrum, Cotula australis, Poranthera microphylla, *Aira caryophyllea, *Lotus angustissimus, Thelymitra* sp., *Disa bracteata, Microtis media* subsp. *media, *Arctotheca calendula, Thelymitra* sp., *Phyllangium paradoxum, *Isolepis marginata, Austrostipa compressa, Levenhookia stipitata, *Briza minor, *Carpobrotus edulis, *Acacia longifolia, *Lagurus ovatus, Lomandra caespitosa, Homalosciadium homalocarpum, Levenhookia stipitata, Centrolepis drummondiana, *Desmazeria rigida, Crassula colorata* var. *colorata, *Wahlenbergia capensis, *Ricinus communis, Thysanotus manglesianus, Cerastium glomeratum, Lobelia tenuior, Dampiera linearis.*

Outside Plot

Lomandra caespitosa, Boronia fastigiata, Eucalyptus rudis subsp. *rudis, *Carpobrotus edulis, Hardenbergia comptoniana, *Ehrharta calycina, *Ursinia anthemoides, Drosera glanduligera, Astartea scoparia, Exocarpos sparteus, Pultenaea reticulata, Boronia fastigiata, *Trifolium cernuum, *Vicia sativa, *Vulpia myuros,*

SITE BC08

Described by: Angela Mercier (14/08/2007) Angela Mercier and Kelli McCreery (26/10/2007).
Type: 10m by 10m quadrat.
Location: (WGS84) 50 6443399S, 390620E.
Habitat: Flat.
Soil: Light grey sand.
Rock Type: Limestone.
Vegetation: Scattered *Eucalyptus marginata* over Low Woodland *Banksia menziesii* and *B. attenuata* over *Allocasuarina humilis*, *Hibbertia hypericoides*, *Acacia pulchella*, *Stirlingia latifolia* Open Heath over mixed Herbland and Grassland.
Condition: Good, disturbance is medium with some weeds.
Fire Age: More than five years.
Notes: Bareground: 10% Litter: 20% Aspect: N/A.

Species List

Banksia menziesii, Banksia ilicifolia, Banksia attenuata, Allocasuarina humilis, Hibbertia hypericoides, Acacia pulchella var. *glaberrima, Conostephium pendulum, *Ehrharta calycina, Stirlingia latifolia, Conostylis aculeata* subsp. *aculeata, Drosera pallida, *Gladiolus caryophyllaceus, *Hypochaeris glabra, *Arctotheca calendula, Hardenbergia comptoniana, Calytrix angulata, *Pelargonium capitatum, *Carpobrotus edulis, Thysanotus manglesianus, Conostylis festucacea, *Zantedeschia aethiopica, Patersonia occidentalis, Desmocladus asper, Dampiera linearis, Gompholobium tomentosum, Hovea trisperma* var. *trisperma, Burchardia congesta, Bossiaea eriocarpa, *Briza minor, *Briza maxima,*

*Burchardia congesta, Hypocalymma angustifolium, *Ursinia anthemoides, Petrophile linearis, Anigozanthos humilis* subsp. *humilis, *Lotus angustissimus, Patersonia occidentalis, *Euphorbia peplus, Dasypogon bromeliifolius, Lomandra caespitosa, Tricostularia neesii* var. *neesii, Lepidosperma pubisquameum, Lechenaultia floribunda, *Sonchus oleraceus, *Disa bracteata, *Ehrharta longiflora, *Bromus diandrus, Kunzea glabrescens, *Wahlenbergia capensis, Microtis media* subsp. *media, *Vulpia myuros, *Asparagus asparagoides, *Isolepis marginata, Calytrix flavescens, Austrostipa compressa, Thysanotus sparteus, Microlaena stipoides, *Lolium perenne, Arnocrinum preissii, Hibbertia subvaginata.*

Outside Plot

Hypocalymma robustum, Lepidosperma pubisquameum, Scholtzia involucrata, Kennedia prostrata, Patersonia occidentalis, Eucalyptus marginata subsp. *marginata, *Schinus terebinthifolia, Nuytsia floribunda, *Asparagus asparagoides, Jacksonia furcellata, *Acacia iteaphylla, Macrozamia riedlei, Dodonaea hackettiana, Scholtzia involucrata, *Dischisma arenarium, *Erodium botrys, *Leptospermum laevigatum, *Pelargonium capitatum, *Zantedeschia aethiopica, *Acacia longifolia, *Asparagus asparagoides, *Briza maxima, *Gladiolus caryophyllaceus, *Oxalis pes-caprae, *Hypochaeris glabra, *Arctotheca calendula.*

SITE BC09

Described by: Angela Mercier (14/08/2007) and Angela Mercier (25/10/2007).
Type: 10m by 10m Quadrat.
Location: (WGS84) 50 6443579S, 390322E.
Habitat: Wetland.
Soil: Black brown sandy loam with peat.
Rock Type: None.
Vegetation: *Eucalyptus rudis* subsp. *rudis* and *Melaleuca rhaphiophylla* Low Open Forest over *Astartea scoparia* and *Melaleuca teretifolia* Tall Open Scrub over **Zantedeschia aethiopica* and mixed herbs Open Herbland with Poaceae spp. Very Open Grassland.
Condition: Very Good, disturbance is low.
Fire Age: More than five years.
Notes: Bareground: 1%. Litter: 40% Aspect: Flat.

Plot Species List

Melaleuca rhaphiophylla, Eucalyptus rudis subsp. *rudis, Astartea scoparia, Acacia saligna, *Zantedeschia aethiopica, Centella asiatica, Melaleuca teretifolia,* Lotus angustissimus, *Hypochaeris glabra, Juncus pallidus, Sonchus hydrophilus, *Sonchus oleraceus, Cassytha racemosa* forma *pilosa, *Melia azedarach, *Briza minor, *Anagallis arvensis* var. *arvensis, *Briza maxima, Isolepis stellata, *Romulea rosea, *Cortaderia selloana, *Sonchus asper, Kunzea glabrescens, *Carpobrotus edulis, Lobelia alata, *Ehrharta longiflora, *Lagurus ovatus, Acacia pulchella* var. *glaberrima, *Cyperus polystachyos, *Rostraria cristata, Isotoma pusilla, Deyeuxia quadriseta, Lepidosperma longitudinale, *Rumex pulcher, *Isolepis marginata, *Conyza bonariensis, *Vulpia myuros, Macrozamia riedlei, Microtis media* subsp. *media, Microtis media* subsp. *media.*

Outside Plot

**Fumaria capreolata, *Asparagus asparagoides, *Acacia longifolia, *Anagallis arvensis* var. *caerulea, Vellereophyton dealbatum, *Avena barbata, *Bromus diandrus.*

SITE BC10

Described by: Kelli McCreery (15/08/2007) and Kelli McCreery and Angela Mercier (26/10/2007).
Type: 10m by 10m Quadrat.
Location: (WGS84) 50 6443466S, 390802E.
Habitat: Mid Slope.
Soil: White sand.
Rock Type: Limestone.
Vegetation: Low Open Forest of Jarrah *Eucalyptus marginata*, *Banksia attenuata* and *B. menziesii* over Low Open Heath dominated by *Hibbertia hypericoides*, Open Sedgeland dominated by *Mesomelaena pseudostygia* and *Lepidosperma pubisquameum* and Open Herbland (mixed).
Condition: Excellent to Very Good, disturbance is Low with weeds.
Fire Age: More than five years.
Notes: Bareground: 10% Litter: 80% Aspect: West.

Species List

Eucalyptus marginata subsp. *marginata, Banksia attenuata, Banksia menziesii, Allocasuarina humilis, Gompholobium tomentosum, Hibbertia hypericoides, Hovea pungens, Bossiaea eriocarpa, Gastrolobium capitatum, Acacia pulchella* var. *glaberrima, Conostephium pendulum, Daviesia triflora, Calectasia narragara, Mesomelaena pseudostygia, Schoenus curvifolius, Dampiera linearis, Trachymene pilosa, Macrozamia riedlei, *Gladiolus caryophyllaceus, *Hypochaeris glabra, *Brassica tournefortii, Conostylis aculeata* subsp. *aculeata, Drosera pallida, Lagenifera huegelii, Chamaescilla corymbosa* var. *corymbosa, *Ursinia anthemoides, Burchardia congesta, Caladenia flava* subsp. *flava, Stylidium piliferum, Stylidium repens, Homalosciadium homalocarpum, Thysanotus manglesianus, Hardenbergia comptoniana, Patersonia occidentalis, *Ehrharta calycina, Laxmannia squarrosa, Poranthera microphylla, Amphipogon turbinatus, *Disa bracteata, Astroloma pallidum, *Wahlenbergia capensis, *Aira caryophyllea, Anigozanthos humilis* subsp. *humilis, Microtis media* subsp. *media, Wahlenbergia multicaulis, Siloxerus filifolius, *Ehrharta longiflora, *Vulpia myuros, Austrostipa compressa, Levenhookia stipitata, Arnocrinum preissii, Caladenia arenicola, Desmocladus asper, *Briza maxima, Dianella revoluta* var. *divaricata, *Zantedeschia aethiopica, Lepidosperma pubisquameum, Lomandra caespitosa.*

Outside Plot

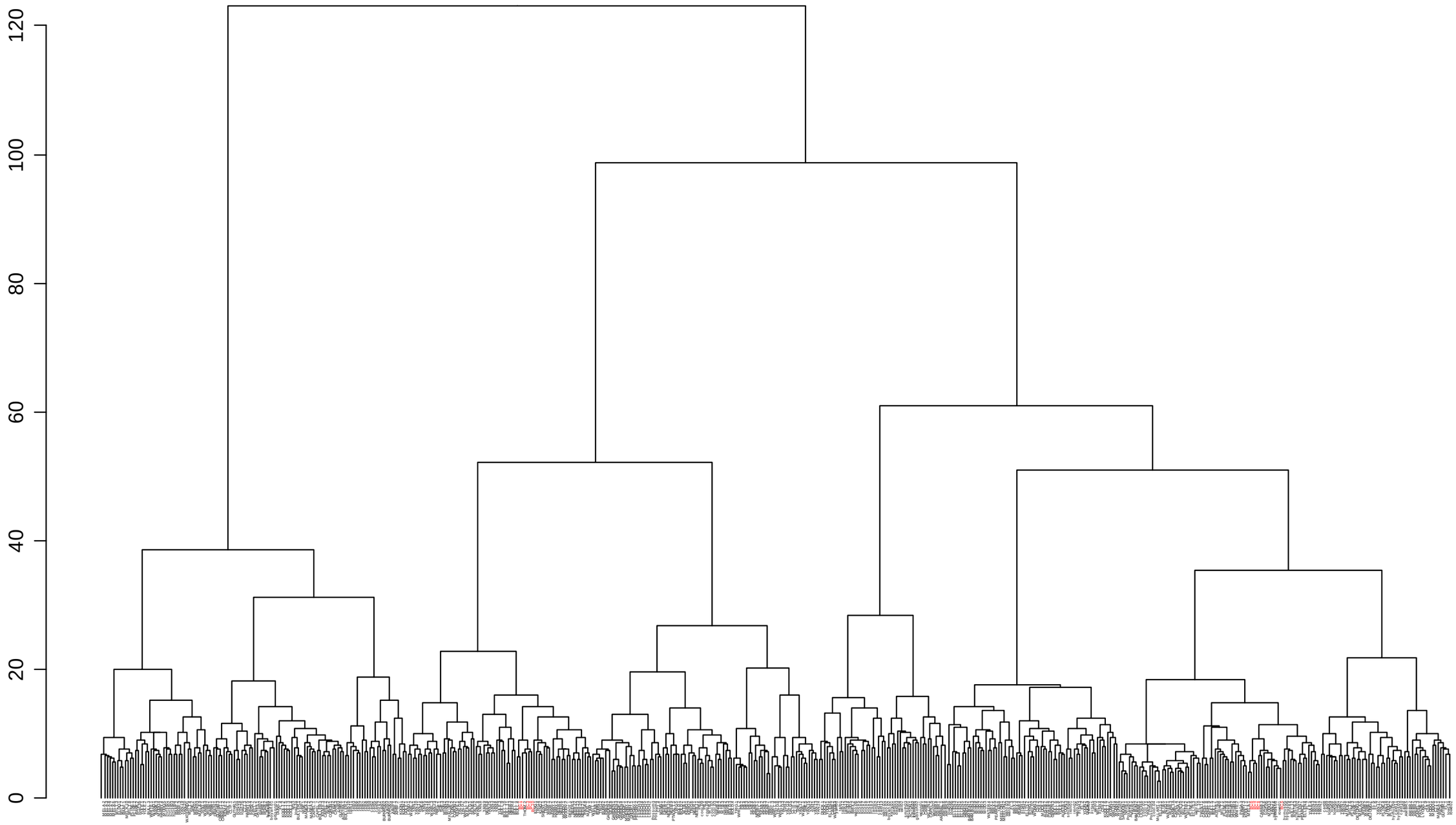
Petrophile linearis, Stirlingia latifolia, Diuris magnifica, Philotheca spicata, Xanthorrhoea preissii, Drosera erythrorhiza, Hibbertia racemosa, Kennedia prostrata, Leucopogon conostephioides, Eremaea pauciflora, Hemiandra pungens, Lysinema ciliatum, Conostylis festucacea, Pterostylis vittata, Hibbertia racemosa, Opercularia vaginata, Kunzea micrantha, Hypocalymma robustum, Leucopogon conostephioides, Acacia pulchella var. *pulchella, Crassula colorata* var. *colorata, Stirlingia latifolia, Anigozanthos manglesii, *Romulea rosea, Nuytsia floribunda, Hypolaena exsulca, Adenanthos cygnorum* subsp. *cygnorum.*

RPS

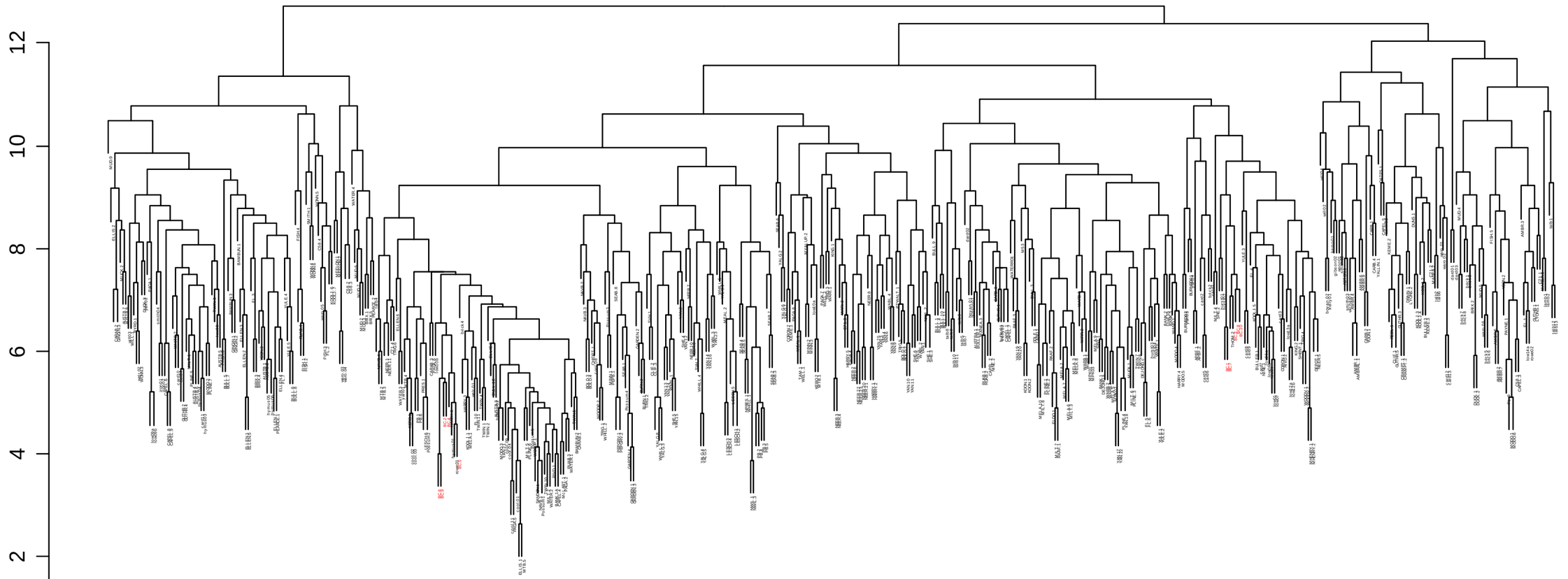
APPENDIX 4

'R' Multivariate Analysis Results

APPENDIX 4: **Ward Linkage Method (survey area sites in red, Gibson *et al.*, 1994 sites in black)**



Complete Linkage Method (survey area sites in red, Gibson *et al.*, 1994 sites in black)



APPENDIX 5

Rare Flora Report Forms

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

RARE FLORA REPORT FORM

TAXON: _?Byblis gigantea _____ POPULATION No: _____

DRF ❒ Priority Species ❒ P2 Partial Survey ❒ Full Survey ❒ New Population ❒

FROM: _K. McCreery, A. Mercier (RPS) TITLE: _____ SURVEY DATE: __14/08/2007___

REGION: __Swan_____ DISTRICT: __Swan Coastal_____ SHIRE: __City of Cockburn_____

File Ref.: _____ Map/Site Ref.: _____ Reserve No.: _____

LOCATION: __Between Branch Circus and Hammond Road, Success._____

_____

_____

LATITUDE: _See attachment _″S LONGITUDE: ____°____′____″E G.P.S. USED: ❒ ASPECT: _____

LAND STATUS:	Nature Reserve ❒	Private ❒	Gravel Res. MRD ❒	Gravel Res. Shire ❒	
National Park ❒	Pastoral Lease ❒	Rd. Verge MRD ❒	Rd. Verge Shire ❒	State Forest ❒	
VCL ❒	Rail Reserve ❒	Other Shire Res. ❒	Water Reserve ❒	Other ❒	

Specify:_____SLK____to____

LANDFORM:	Hilltop ❒	Cliff ❒	Slope ❒	Valley ❒	Swamp ❒
Outcrop ❒	Breakaway ❒	Low Plain ❒	Gully ❒	Riverbank ❒	Ridge ❒
Sand Dune ❒	Flat ❒	Drainageline ❒	Lake Edge ❒	Firebreak ❒	

Other ❒ _Edge of dampland, growing on windrow of track through dampland_____

ROCK TYPE:	Laterite ❒	Granite ❒	Dolerite ❒	Limestone ❒

Other:_____

ROCK FORM:	Sheet ❒	Boulder ❒	Fluviatile Gravel ❒	Concretionary Gravel ❒	
SOIL TYPE:	Sand ❒	Loam ❒	Clay ❒	Peat ❒	Gravel ❒
SOIL COLOUR:	Red ❒	Brown ❒	Yellow ❒	White ❒	Grey ❒
SOIL CONDITION:	Inundated ❒	Moist ❒	Dry ❒	Saline ❒	Other: _____

VEGETATION CLASSIFICATION (Muir's): __See attached Figure 2 for vegetation descriptions_____

ASSOCIATED SPECIES: _ See attached Figure 2 for vegetation descriptions _____

_____

No. of PLANTS:	Mature: ____	Seedlings: _10___	Dead: ____	Actual ❒	Estimate ❒	Area Occupied:__
REPRODUCTIVE STATE:	Flower bud ❒	Flower ❒	Immat. fruit ❒	Fruit ❒	Fruit Dehisced ❒	Vegetative ❒
POLLINATORS:	Native bees ❒	Honey bees ❒	Other insects ❒	Birds ❒	Mammals ❒	

Other observations: _____

CONDITION OF POPULATION:	Healthy ❒	Moderate ❒	Poor ❒	Disturbed ❒	

Comment: _See attached Figure 2 for Vegetation Condition Map _____

POTENTIAL THREATS:	Firebreaks ❒	Mining ❒	Recreational ❒	Roadworks ❒	Grazing ❒	Weeds ❒
Prescribed Burning ❒	Disease ❒	Other ❒	Comment:__Proposed housing subdivision _____			
FIRE HISTORY:	Not known ❒	Burnt in 19____	Summer ❒	Autumn ❒	Winter ❒	Spring ❒
FENCING:	Not Required ❒	Fenced ❒	Required ❒	Replace/Repair ❒		
ROADSIDE MARKERS:	Not Required ❒	Present ❒	Required ❒	Replace ❒	Reposition ❒	

OTHER COMMENTS (include action taken/required):__These were seedlings 3cm tall, therefore the query mark on their identity. However, due to the distinctiveness of this carnivorous species, there is nothing else that these seedlings were likely to be, other than Drosera, however there are no Drosera with the same form as a Bylbis._____

_____

_____

VOUCHER SPECIMEN:	Regional Herb. ❒	District Herb. ❒	WA Herb. ❒	Other ❒ _____
ATTACHED:	Map ❒	Mudmap ❒	Illustration ❒	Photo ❒ Field Notes ❒
COPY SENT TO:	Regional Office ❒	District Office ❒	Other ❒	Specify:_____

Signed: _____ Date:__18___/__04___/_2008__

NOTE: More than one box, in any section may be ticked. Map or further information may be given on the back of this form.

Please return completed form to Executive Director, CALM, Locked Bag 104, BENTLEY DELIVERY CENTRE, WA 6983

RECORDS: PLEASE FORWARD TO ADMINISTRATIVE OFFICER, FLORA, WILDLIFE BRANCH

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

RARE FLORA REPORT FORM

TAXON: _*Dodonaea hackettiana* _____ POPULATION No: _____

DRF ❒ Priority Species ❒ P4 Partial Survey ❒ Full Survey ❒ New Population ❒

FROM: _K. McCreery, A. Mercier (RPS) TITLE: _____ SURVEY DATE: __25/10/2007___

REGION: __Swan_____ DISTRICT: __Swan Coastal_____ SHIRE: __City of Cockburn_____

File Ref.: _____ Map/Site Ref.: _____ Reserve No.: _____

LOCATION: __Between Branch Circus and Hammond Road, Success._____

_____

_____

LATITUDE: _See attachment _″S LONGITUDE: ____°____′____″E G.P.S. USED: ❒ ASPECT: _____

LAND STATUS:	Nature Reserve ❒	Private ❒	Gravel Res. MRD ❒	Gravel Res. Shire ❒	
National Park ❒	Pastoral Lease ❒	Rd. Verge MRD ❒	Rd. Verge Shire ❒	State Forest ❒	
VCL ❒	Rail Reserve ❒	Other Shire Res. ❒	Water Reserve ❒	Other ❒	

Specify:_____SLK____to____

LANDFORM:	Hilltop ❒	Cliff ❒	Slope ❒	Valley ❒	Swamp ❒
Outcrop ❒	Breakaway ❒	Low Plain ❒	Gully ❒	Riverbank ❒	Ridge ❒
Sand Dune ❒	Flat ❒	Drainageline ❒	Lake Edge ❒	Firebreak ❒	

Other ❒ _____

ROCK TYPE:	Laterite ❒	Granite ❒	Dolerite ❒	Limestone ❒

Other:_____

ROCK FORM:	Sheet ❒	Boulder ❒	Fluviatile Gravel ❒	Concretionary Gravel ❒	
SOIL TYPE:	Sand ❒	Loam ❒	Clay ❒	Peat ❒	Gravel ❒
SOIL COLOUR:	Red ❒	Brown ❒	Yellow ❒	White ❒	Grey ❒
SOIL CONDITION:	Inundated ❒	Moist ❒	Dry ❒	Saline ❒	Other: _____

VEGETATION CLASSIFICATION (Muir's): __See attached Figure 2 for vegetation descriptions_____

ASSOCIATED SPECIES: _ See attached Figure 2 for vegetation descriptions _____

_____

No. of PLANTS:	Mature: __20__	Seedlings: _____	Dead: ____	Actual ❒	Estimate ❒	Area Occupied:__
REPRODUCTIVE STATE:	Flower bud ❒	Flower ❒	Immat. fruit ❒	Fruit ❒	Fruit Dehisced ❒	Vegetative ❒
POLLINATORS:	Native bees ❒	Honey bees ❒	Other insects ❒	Birds ❒	Mammals ❒	

Other observations: _____

CONDITION OF POPULATION:	Healthy ❒	Moderate ❒	Poor ❒	Disturbed ❒	
Comment: _See attached Figure 2 for Vegetation Condition Map _____					
POTENTIAL THREATS:	Firebreaks ❒	Mining ❒	Recreational ❒	Roadworks ❒	Grazing ❒ Weeds ❒
Prescribed Burning ❒	Disease ❒	Other ❒	Comment:__Proposed housing subdivision _____		
FIRE HISTORY:	Not known ❒	Burnt in 19____	Summer ❒	Autumn ❒	Winter ❒ Spring ❒
FENCING:	Not Required ❒	Fenced ❒	Required ❒	Replace/Repair ❒	
ROADSIDE MARKERS:	Not Required ❒	Present ❒	Required ❒	Replace ❒	Reposition ❒

OTHER COMMENTS (include action taken/required):_____

_____

_____

_____

VOUCHER SPECIMEN:	Regional Herb. ❒	District Herb. ❒	WA Herb. ❒	Other ❒ _____
ATTACHED:	Map ❒	Mudmap ❒	Illustration ❒	Photo ❒ Field Notes ❒
COPY SENT TO:	Regional Office ❒	District Office ❒	Other ❒	Specify:_____

Signed: _____ Date:__28___/__02___/_2008__

NOTE: More than one box, in any section may be ticked. Map or further information may be given on the back of this form.

Please return completed form to Executive Director, CALM, Locked Bag 104, BENTLEY DELIVERY CENTRE, WA 6983

RECORDS: PLEASE FORWARD TO ADMINISTRATIVE OFFICER, FLORA, WILDLIFE BRANCH

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

RARE FLORA REPORT FORM

TAXON: _*Eucalyptus rudis* subsp. *cratyantha* _____ POPULATION No: _____

DRF ❒ Priority Species ❒ P4 Partial Survey ❒ Full Survey ❒ New Population ❒

FROM: _K. McCreery, A. Mercier (RPS) TITLE: _____ SURVEY DATE: __14/08/2007___

REGION: __Swan_____ DISTRICT: __Swan Coastal_____ SHIRE: __City of Cockburn_____

File Ref.: _____ Map/Site Ref.: _____ Reserve No.: _____

LOCATION: __Corner of Branch Circus and Gadd Street, Success._____

_____

_____

LATITUDE: _See attachment_″S LONGITUDE: ____°____′____″E G.P.S. USED: ❒ ASPECT: _____

LAND STATUS:	Nature Reserve ❒	Private ❒	Gravel Res. MRD ❒	Gravel Res. Shire ❒	
National Park ❒	Pastoral Lease ❒	Rd. Verge MRD ❒	Rd. Verge Shire ❒	State Forest ❒	
VCL ❒	Rail Reserve ❒	Other Shire Res. ❒	Water Reserve ❒	Other ❒	

Specify:_____SLK____to____

LANDFORM:	Hilltop ❒	Cliff ❒	Slope ❒	Valley ❒	Swamp ❒
Outcrop ❒	Breakaway ❒	Low Plain ❒	Gully ❒	Riverbank ❒	Ridge ❒
Sand Dune ❒	Flat ❒	Drainageline ❒	Lake Edge ❒	Firebreak ❒	

Other ❒ _____

ROCK TYPE:	Laterite ❒	Granite ❒	Dolerite ❒	Limestone ❒

Other:_____

ROCK FORM:	Sheet ❒	Boulder ❒	Fluviatile Gravel ❒	Concretionary Gravel ❒	
SOIL TYPE:	Sand ❒	Loam ❒	Clay ❒	Peat ❒	Gravel ❒
SOIL COLOUR:	Red ❒	Brown ❒	Yellow ❒	White ❒	Grey ❒
SOIL CONDITION:	Inundated ❒	Moist ❒	Dry ❒	Saline ❒	Other: _____

VEGETATION CLASSIFICATION (Muir's): __See attached Figure 2 for vegetation descriptions_____

ASSOCIATED SPECIES: _ See attached Figure 2 for vegetation descriptions _____

_____

No. of PLANTS:	Mature: __1__	Seedlings: _____	Dead: ____	Actual ❒	Estimate ❒	Area Occupied:__
REPRODUCTIVE STATE:	Flower bud ❒	Flower ❒	Immat. fruit ❒	Fruit ❒	Fruit Dehisced ❒	Vegetative ❒
POLLINATORS:	Native bees ❒	Honey bees ❒	Other insects ❒	Birds ❒	Mammals ❒	

Other observations: _____

CONDITION OF POPULATION:	Healthy ❒	Moderate ❒	Poor ❒	Disturbed ❒	
Comment: _See attached Figure 2 for Vegetation Condition Map _____					
POTENTIAL THREATS:	Firebreaks ❒	Mining ❒	Recreational ❒	Roadworks ❒	Grazing ❒ Weeds ❒
Prescribed Burning ❒	Disease ❒	Other ❒	Comment:__Proposed housing subdivision _____		
FIRE HISTORY:	Not known ❒	Burnt in 19____	Summer ❒	Autumn ❒	Winter ❒ Spring ❒
FENCING:	Not Required ❒	Fenced ❒	Required ❒	Replace/Repair ❒	
ROADSIDE MARKERS:	Not Required ❒	Present ❒	Required ❒	Replace ❒	Reposition ❒

OTHER COMMENTS (include action taken/required):_____

_____

_____

_____

VOUCHER SPECIMEN:	Regional Herb. ❒	District Herb. ❒	WA Herb. ❒	Other ❒ _____
ATTACHED:	Map ❒	Mudmap ❒	Illustration ❒	Photo ❒ Field Notes ❒
COPY SENT TO:	Regional Office ❒	District Office ❒	Other ❒	Specify:_____

Signed: _____ Date:__18___/__04___/_2008__

NOTE: More than one box, in any section may be ticked. Map or further information may be given on the back of this form.

Please return completed form to Executive Director, CALM, Locked Bag 104, BENTLEY DELIVERY CENTRE, WA 6983

RECORDS: PLEASE FORWARD TO ADMINISTRATIVE OFFICER, FLORA, WILDLIFE BRANCH