Groundwater – Biodiversity – Land use

FIELD SURVEY OF THREATENED FLORA POPULATIONS AND THREATENED ECOLOGICAL COMMUNITIES FOR THE GNANGARA SUSTAINABILITY STRATEGY

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Field Survey of Threatened Flora Populations and Threatened Ecological Communities for the Gnangara Sustainability Strategy

Unpublished Report to the Department of Environment and Conservation and Gnangara Sustainability Strategy

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Gnangara Sustainability Strategy

This document has been commissioned/produced as part of the Gnangara Sustainability Strategy (GSS). The GSS is a State Government initiative which aims to provide a framework for a whole of government approach to address land use and water planning issues associated with the Gnangara groundwater system. For more information go to www.gnangara.water.wa.gov.au

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Introduction

In Western Australia, threatened flora is assigned conservation codes based on their level of rarity and risk of extinction. Declared Rare Flora (DRF) are taxa which have been adequately searched for and are deemed to be either rare or in danger of extinction, and have been gazetted under Western Australia's *Wildlife Conservation Act 1950*. The Western Australian Department of Environment and Conservation (DEC) also assigns priority rankings for taxa that do not qualify as DRF but are considered to be rare or poorly known, with a priority code ranging from P1 to P4 (Appendix 1). Within the Gnangara Sustainability Strategy (GSS) study area, 47 'threatened' plant species were known to be extant in 2008 (Atkins 2008). Ten of these are DRF, with the remaining 37 classified as priority flora.

An ecological community is a naturally occurring biological assemblage of plants and/or animals. Floristic community types defined by floristic-based studies (e.g. Gibson *et al.* 1994) can be used as a basis to delineate ecological plant communities. Inferred floristic community types require floristic analyses of 10x10 m quadrats in order to confirm that it belongs to a threatened ecological community (TEC). A TEC can be a floristic community type that has been assessed based on its geographic extent and degree of threatening processes that affect it, and can be defined as Presumed Destroyed, Critically Endangered, Endangered or Vulnerable (English and Blyth 1999). Within the GSS study area, nine floristic community types and one plant/invertebrate assemblage have been identified as a TEC, four are listed as Critically Endangered, three as Endangered and three as Vulnerable. There is currently no legislation in Western Australia that specifically covers threatened ecological communities, however they are indirectly protected under the *Environmental Protection Act 1986* and *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*. TECs that occur in Western Australia may be listed as nationally threatened under the Commonwealth's *Environmental Protection and Biodiversity Conservation Act 1999*.

This report presents data collected during a number of surveys of threatened flora and 10x10 m floristic quadrat assessments of inferred floristic community types that were carried out in the GSS study area and within DEC's Swan Coastal District during 2006-2008.

Methodology

Staff from the Department of Environment and Conservation led field surveys for threatened flora and TECs between August 2006 and October 2008.

Threatened flora

DEC's Swan Coastal District conducts a threatened flora program, which regularly monitors existing populations of declared rare flora (DRF), with priority flora being monitored when resources are available. For this project, existing populations of threatened flora (DRF and priority) that required monitoring were selected for re-surveying. One species (*Calectasia* sp. Pinjar) was known from only one population comprising two plants and therefore required a complete survey to map the extent of the new population.

High resolution locality information was collected for threatened flora using a differential GPS. Depending on the size of the population, either each individual plant, a group of plants in close proximity to each other or the known extent (boundary) of a large number of plants was mapped. The two individuals comprising the *Eucalyptus x mundijongensis* population were individually mapped, whereas the extents of plants in close proximity were mapped for populations of *Isotropis cunefolia* subsp. *glabra, Acacia bethamnii* and *Eleocharis keigheryi*. The previously un-surveyed population of *Calectasia* sp. Pinjar was surveyed by DEC staff and volunteers traversing transects through *Banksia* woodland at a distance of 20 m apart. This provided 100% survey coverage of the area and established the likely extent of the population. Each plant was individually mapped.

Threatened ecological communities

Threatened ecological communities (TECs) occurring in localities which were considered to be possibly threatened by impacts from urban development, mining, prescribed fire or a combination of threats were selected for floristic quadrat assessments. Floristic quadrat assessments consisted of a 10x10 m quadrat at each inferred community type location and were based upon methods described in Keighery (1994). Although floristic data was collected at these sties and is reported here (Appendix 3), the analysis required to confirm the community type, and thus confirm whether the community type is a TEC, will not be able to be completed within the lifetime of the GSS due to cost and time constraints. Therefore, this report will present the floristic data, vegetation condition and potential threat information of the 10 inferred TECs.

Survey results

Threatened flora

Two populations of the priority 2 species *Isotropis cuneifolia* subsp. *glabra* (Papilionaceae), one population of the priority 1 species *Eucalyptus x mundijongensis*, three populations of the priority 2 species *Acacia benthamii* and three populations of the declared rare flora *Eleocharis keigheryi* were monitored during this study (Table 1). A new population of the priority 1 species *Calectasia* sp. Pinjar was mapped during a targeted survey in Melaleuca Park (Figure 1).

Rare flora report forms and high resolution distribution maps were produced for each population. Specific locality information for Declared Rare Flora and priority flora is regarded as confidential and therefore cannot be reproduced in this report. Rare flora report forms, distribution maps and high resolution point data shapefiles can be requested from DEC's Species and Communities Branch (data custodian Ken Atkins). A summary of the data contained in the rare flora report forms is summarised below.

Table 1: Threatened flora survey information with population identification number, species name, conservation code (see Appendix 1), current survey dates and date of previous survey.

Population ID	Flora	Conservation Code	This Survey	Previous / Last Survey
1	*Acacia benthamii*	P2	Aug 2007	Sept 1975
4	*Acacia benthamii*	P2	Aug 2007	June 2000
Translocated	*Acacia benthamii*	P2	Nov 2007	Translocated in 2001
New	*Calectasia* sp. Pinjar	P1	Sept 2007	N/A
1	*Eleocharis keigheryi*	R	Oct/Nov 2007	Oct 1978
7	*Eleocharis keigheryi*	R	Sept 2007	Sept 1994
8	*Eleocharis keigheryi*	R	Sept 2007	Sept 1992
1	*Eucalyptus x mundjongensis*	P1	Oct 2008	March 1990
1	*Isotropis cunefolia* subsp. *glabra*	P2	Sept 2007	Sept 1987
2	*Isotropis cunefolia* subsp. *glabra*	P2	Sept 2007	June 1994

Acacia benthamii

Three populations of *Acacia benthamii* (priority 2) were monitored including a translocated population. Population 1 was located on the western edge of Lake Goollelal on land vested in the WAPC (WA Planning Commission). The previous survey was conducted in September 1975. The area was re-surveyed in August 2007 without locating any plants. The land was highly degraded and threatened by invasive weeds, and is now unlikely to be suitable habitat for this species.

Population 4 was located within the Main Roads Department road verge adjacent to Neerabup National Park, where there were originally four sub-populations located in the area. The population was last monitored in June 2000 and has since been cleared. There is no longer any suitable habitat remaining where the original population was located.

In 2001 Kings Park undertook a translocation using cuttings taken from population 4 which was due to be cleared for railway alignment. This translocated population is located

within Neerabup National Park and consists of nine mature, healthy plants. It is not known how many propagated plants were translocated to this site. Potential threats include invasive weeds.

Calectasia sp. Pinjar

A new population of the priority 1 species *Calectasia* sp. Pinjar was identified in the proposed Melaleuca Nature Reserve (Melaleuca Park) during a two week survey in September 2007. The healthy population was found scattered throughout approximately 140 hectares of *Banksia* woodland. Potential threats to this species include firebreak construction and maintenance, grazing and prescribed burning.

Eucalyptus x mundijongensis

Population 1 was monitored in October 2008. The population consists of one mature tree and possibly one juvenile plant within *Banksia* woodland. The trees are located on a Shire of Gingin road verge within state forest. Upgrading and widening of the limestone track was identified as a potential threat to this population.

Eleocharis keigheryi

Three populations of the declared rare flora *Eleocharis keigheryi* were monitored between September and November 2007.

Population 1 occurs in Ellen Brook Nature Reserve in seasonally inundated clay pans scattered throughout the southern portion of the reserve. The open inundated clay flats are populated exclusively by *Eleocharis keigheryi*, transitioning into vegetated claypans of scrub over sedges and herbs. Weed invasion in and around the claypans was identified as a potential threat for this population, as were altered hydrology and firebreak construction and maintenance. Some plants occur within the threatened ecological community known as 'Herb rich saline shrublands in claypans' (community type 7).

Population 7 is located in a low-lying inundated clay pan in the south-western area of the RAAF Pearce Aerodrome. Weeds were identified as a potential threat. In the recent past, flowering may have been reduced or prevented by regular mowing by the RAAF, which

has now ceased. The long-term effect of mowing on this otherwise healthy population is unknown.

Population 8 occurs in the central-southern portion of the Shire of Gingin Reserve 22831 and appears to be restricted to a low-lying, seasonally inundated flat. The population is associated with the threatened ecological community type 'Forests and woodlands of deep seasonal wetlands' (community type 15). Invasive weeds and altered hydrology have been identified as potential threats for this population.

Isotropis cuneifolia subsp. *glabra*

Two populations of the priority 2 species *Isotropis cuneifolia* subsp. *glabra* were monitored in September 2007. Both populations are associated with the 'Herb rich saline shrublands in clay pans' (Community type 7 described by Gibson *et al.* 1994) within areas of low-lying seasonally inundated flats.

Population 1 was found to occur throughout the southern portion of the Gingin shire reserve (Reserve 22831). Potential threats to this species include firebreak construction and maintenance, recreation, grazing by kangaroos and weed invasion.

Population 2 was surveyed in Nullila Nature Reserve, Gingin and was found throughout the northern and southern portions of the reserve. Potential threats include changes in hydrology and weed invasion.

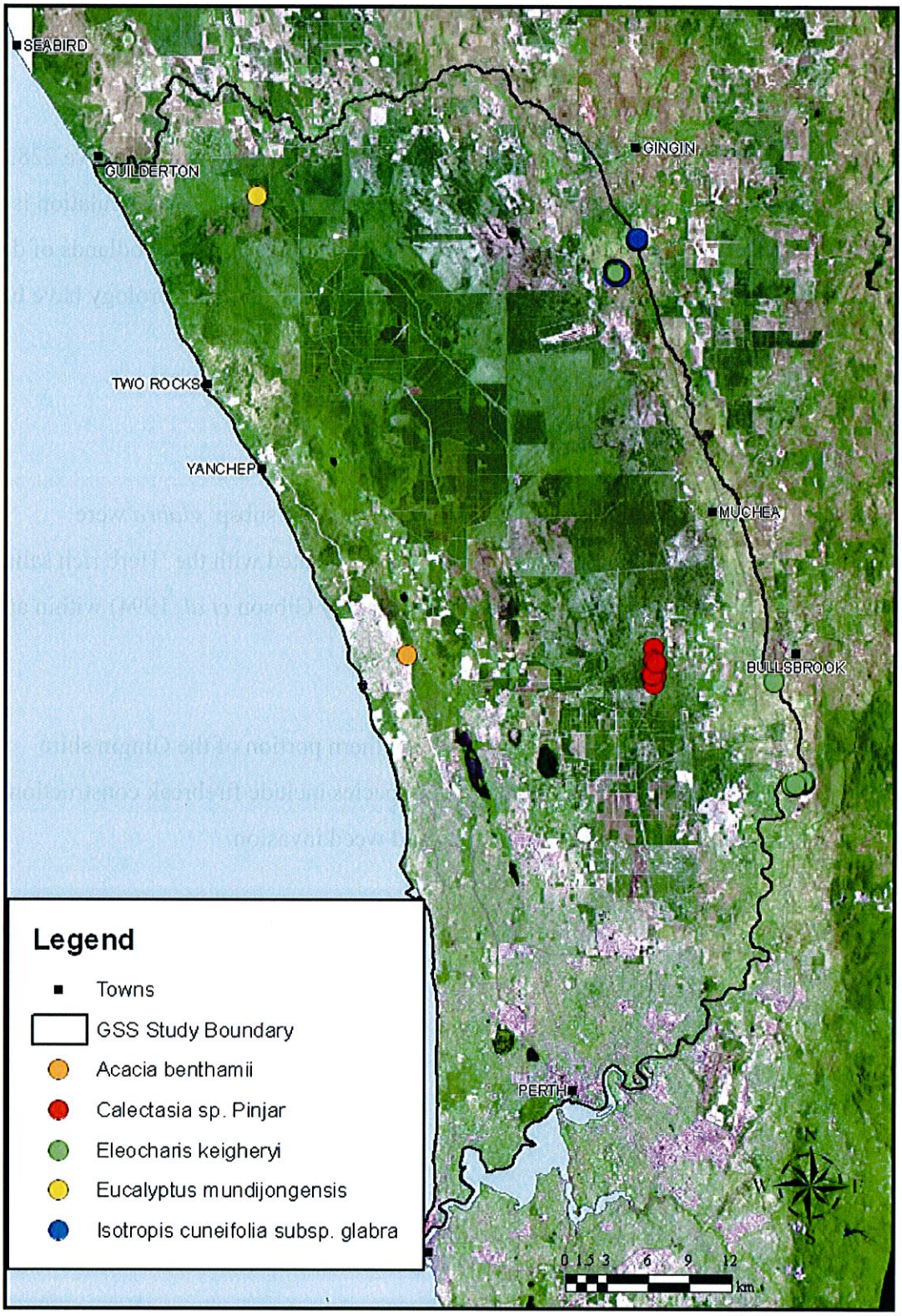

Figure 1: Location of threatened flora populations surveyed for the GSS.

Threatened ecological communities

Two inferred occurrences of *Corymbia calophylla - Xanthorrhoea preissii* woodlands and shrublands, Swan Coastal Plain (Gibson *et al.* 1994 community type 3c) located within the Ellen Brook Nature reserve were surveyed, as were four of *Melaleuca huegelii - Melaleuca acerosa* (currently *M. systena*) shrublands on limestone ridges (Gibson *et al.* 1994 community type 26a), three of *Banksia attenuata* woodland over species rich dense shrublands (Gibson *et al.* 1994 community type 20a) and one inferred occurrence of Southern wet shrublands, Swan Coastal Plain (Gibson *et al.* 1994 community type 2). A total of 10 inferred TEC occurrences were assessed using 10x10 m floristic quadrats (Table 2 and Figure 2). Full species lists for each quadrat are provided in Appendix 2.

Table 2: Floristic quadrat assessments were carried out for ten inferred TEC occurrences in the GSS study area.

Inferred Community Type	Conservation Code	Occurrence ID	Survey Dates
Banksia attenuata woodland over species rich dense shrublands (Gibson *et al.* 1994 community type 20a)	Endangered	SULT01	07/09/2007 & 15/11/2007
		ALEX01	04/08/2006 & 26/10/2006
		ERRINAN01	04/10/2007 & 6/11/2007
Melaleuca huegelii – M. acerosa (currently *M. systena*) shrublands on limestone ridges (Gibson *et al.* 1994 community type 26a)	Endangered	MYWAN03	11/09/2007 & 21/11/2007
		MYYAN03	27/09/2007 & 21/11/2007
		MYYEAL04	25/09/2007 & 21/11/2007
		ONETREEHILL01	13/09/2007 & 21/11/2007
Corymbia calophylla - Xanthorrhoea preissii woodlands and shrublands (Gibson *et al.* 1994 community type 3c)	Critically Endangered	ELLEN07	26/09/2007 & 09/11/2007
		ELLEN09	26/09/2007 & 09/11/2007
Southern wet shrublands (Gibson *et al*. 1994 community type 2).	Endangered	BEDFORD01	10/09/2007 & 15/11/2007

Banksia woodlands (community type 20a) quadrats generally contained a higher number of species and fewer introduced taxa than the other quadrats surveyed (Table 3). 'ErrinaN01' (74 species) and 'Sultana01' (60 species) were identified with the highest species richness, a documented characteristic of this community type 20a (Gibson *et al.* 1994). Quadrats 'Myyan03' and 'Myyeal04' contained the largest number of introduced taxa (15 and 14 species, respectively).

Table 3: Species counts for 10 floristic quadrats surveyed for ten inferred TEC occurrences in the GSS study area.

Community Type	Occurrence	# Alien taxa	# Native taxa	Total # Taxa
SCP02	Bedford01	4	44	48
SCP03c	Ellen07	13	23	36
	Ellen09	12	30	42
SCP20a	Alex01	2	40	42
	ErrinaN01	6	68	74
	Sultana01	1	59	60
SCP26a	Mywan03	7	50	57
	Myyan03	15	38	53
	Myyeal04	14	39	53
	Onetree01	6	44	50

Thirty six introduced plant species were identified from the floristic quadrat assessments (Appendix 3). Some introduced plant species may potentially threaten the plant communities discussed in this report. The most widespread introduced species were *Aira cupaniana* and *Hypochaeris glabra* (found in six of the ten quadrats) and *Gladiolus caryophyllaceus* and *Sonchus oleraceus* (found in five of the ten quadrats). Another potential threat identified was grazing by introduced (e.g. rabbits) and native fauna (e.g. kangaroos; Table 4).

Table 4: Potential threats and vegetation condition of the ten quadrats surveyed.

Site	Vegetation Condition	Potential Threats
Alex01		Invasive weeds, *P. cinnamomi*, illegal rubbish dumping
Bedford01	Excellent	N/A
Ellen07	Excellent	Invasive weeds, Inappropriate fire regime, Impacts of feral animals
Ellen09	Good - very good	Invasive weeds, Grazing (introduced fauna), Inappropriate fire regime
ErrinaN01	Excellent	Grazing (introduced fauna)
Mywan03	Excellent	Invasive weeds, Grazing (Native fauna), Mining activities, Inappropriate fire regime
Myyan03	Very Good	Invasive weeds, Grazing (Native fauna), Mining activities, Inappropriate fire regime
Myyeal04	Very Good	Invasive weeds, Mining activities, Inappropriate fire regime
Onetree01	Good-very good	Invasive weeds, grazing (introduced fauna), inappropriate fire regime
Sultana01	excellent	Grazing (introduced fauna)

Summary

- Populations of threatened flora including *Acacia benthamii, Eleocharis keigheryi, Eucalyptus x mundigonensis* and *Isotropis cunefolia* subsp. *glabra* were monitored, and one new population of *Calectasia* sp. Pinjar was surveyed.
- High resolution locality information was collected for the threatened flora populations. Either each individual plant, a group of plants in close proximity or the known extent (boundary) of a large number of plants was mapped.
- A total of 10 inferred threatened ecological community occurrences were assessed using 10x10 m floristic quadrats, including inferred communities of *Banksia attenuata* woodland over species rich dense shrublands (community type 20a), *Corymbia calophylla - Xanthorrhoea preissii* woodlands and shrublands, Swan Coastal Plain (community type 3c), *Melaleuca huegelii - Melaleuca acerosa* (currently *M. systena*) shrublands on limestone ridges (community type 26a) and Southern wet shrublands, Swan Coastal Plain (community type 2).
- The analysis of the floristic quadrats required to confirm the community type, and thus confirm the threatened ecological community occurrence, is not likely to be completed within the lifetime of the GSS due to cost and time constraints

References

Atkins K. J. (2008) Declared Rare and Priority Flora List for Western Australia, 6th October 2008. WA Department of Environment and Conservation, Perth.

English V. & Blyth J. (1999) Development and application of procedures to identify and conserve threatened ecological communities in the South-west Botanical Province of Western Australia. *Pacific Conservation Biology* **5**, 124 - 38.

Gibson N., Keighery B. J., Keighery G. J., Burbidge A. H. & Lyons M. N. (1994) A floristic survey of the southern Swan Coastal Plain. Unpublished report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia Perth, Western Australia.

Keighery B. J. (1994) Bushland plant survey: A guide to plant community survey for the community. Wildflower Society of WA (Inc.), Nedlands, Western Australia.

Appendix 1: The Department of Environment and Conservation Declared Rare and Priority Flora Conservation Codes for Western Australia

R: Declared Rare Flora - Extant Taxa

Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such.

X: Declared Rare Flora - Presumed Extinct Taxa

Taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently, and have been gazetted as such.

1: Priority One - Poorly known Taxa

Taxa which are known from one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat, e.g. road verges, urban areas, farmland, active mineral leases, etc., or the plants are under threat, e.g. from disease, grazing by feral animals, etc. May include taxa with threatened populations on protected lands. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.

2: Priority Two - Poorly Known Taxa

Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.

3: Priority Three - Poorly Known Taxa

Taxa which are known from several populations, and the taxa are not believed to be under immediate threat (i.e. not currently endangered), either due to the number of known populations (generally >5), or known populations being large, and either widespread or protected. Such taxa are under consideration for declaration as 'rare flora' but are in need of further survey.

4: Priority Four - Rare Taxa

Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5-10 years.

Note, the need for further survey of poorly known taxa is prioritised into the three categories depending on the perceived urgency for determining the conservation status of those taxa, as indicated by the apparent degree of threat to the taxa based on the current information.

Appendix 2: Floristic results of 10x10 m quadrat assessments

Inferred Community Type: 'Southern wet shrublands, Swan Coastal Plain' (Community type 2 as described in Gibson *et al.* 1994). * denotes introduced plant taxa.

Bedford01
Acacia applanata
**Aira cupaniana*
Alexgeorgea nitens
Allocasuarina humilis
Arnocrinum preissii
Austrostipa flavescens
Banksia dallanneyi
Banksia telmatiaea
Burchardia congesta
Calytrix ? aurea
Calytrix aurea
Cassytha
Conostylis aculeata
Conostylis juncea
Corymbia calophylla
Cytogonidium leptocarpoides
Dasypogon sp.
Desmocladus fasciculatus
Eutaxia virgata
**Gladiolus caryophyllaceus*
Gompholobium confertum
Hakea varia
Hovea trisperma
**Hypochaeris glabra*
Hypolaena exsulca
**Isolepis ? marginata*
Kingia australis
Lyginia imberbis
Melaleuca preissiana
Mesomelaena graciliceps
Mesomelaena tetragona
Patersonia occidentalis
Pelargonium littorale
Pericalymma ellipticum
Philotheca spicata
Phlebocarya ciliata
Pimelea angustifolia
Schoenus efoliatus
? Schoenus sp.
Siloxerus humifusus
Stirlingia latifolia
Stylidium brunonianum
Thysanotus sp.
Tricoryne elatior
Verticordia lindleyi subsp. *lindleyi*
Verticordia spl (bedford)
Verticordia sp2 (bedford)
Xanthorrhoea preissii

Inferred Community Type: 'Corymbia calophylla - Xanthorrhoea preissii woodlands and shrublands' (Community type 3c described by Gibson *et al.* 1994). * denotes introduced plant taxa.

Ellen07

Acacia saligna
**Aira cupaniana*
**Anagallis arvensis*
Aphelia brizula
Austrodanthonia caespitosa
**Briza maxima*
**Briza minor*
Centrolepis aristata
**Cicendia filiformis*
Corymbia calophylla
Cyathochaeta ? avenacea
Cyathochaeta sp.
Cyathochaeta sp.
Dampiera alata
**Echium plantagineum*
Eucalyptus rudis
Gompholobium marginatum
**Hesperantha falcata*
Hibbertia commutata
Hypocalymma angustifolium
**Hypochaeris glabra*
**Isolepis marginata*
**Juncus capitatus*
Lepidosperma pubisquameum
Lepidosperma sp.
Lomandra sp.
Melaleuca lateritia
Microtis media
**Monopsis debilis*
**Moraea* sp.
Neurachne alopecuroidea
Pterostylis sp.
Schoenus variicellae
**Sonchus oleraceus*
Verticordia huegelii
Xanthorrhoea preissii

Ellen09

Acacia saligna
**Aira cupaniana*
*? *Apium annuum*
**Arctotheca calendula*
**Avena fatua*
Borya sphaerocephala
**Briza maxima*
**Briza minor*
Burchardia ? bairdiae
Calothamnus quadrifidus
Centrolepis aristata
Chorizandra enodis
Cryptandra arbutiflora
Cryptandra sp.
Drosera erythrogyne
Drosera macrantha
Eriochilus dilatatus
Eucalyptus rudis
Gonocarpus nodulosus
Goodenia micrantha
Hakea lissocarpha
Hibbertia hypericoides
Hypocalymma angustifolium
Kunzea micrantha
**Moraea* sp.
Neurachne alopecuroidea
**Parentucellia latifolia*
**Parentucellia viscosa*
Philydrella pygmaea
**Romulea rosea*
Schoenus nanus
Schoenus sp.
Stylidium bulbiferum
Stylidium petiolare
Thysanotus manglesianus
Utricularia multifida
Verticordia densiflora
Verticordia huegelii
Verticordia pennigera
**Vulpia* sp.
**Watsonia* sp.

Inferred Community Type: '*Banksia attenuata* woodland over species rich dense shrublands' (community type 20a as described in Gibson *et al.* 1994). * denotes introduced plant taxa.

Alex01
Acacia pulchella
Acacia oswaldii
Acacia sessilis
Alexgeorgea nitens
Allocasuarina humilis
Amphipogon turbinatus
Banksia attenuata
Banksia dallanneyi
Banksia menziesii
Bossiaea eriocarpa
Burchardia congesta
Calectasia narragara
Caustis dioica
Conostylis aculeata
Dampiera lindleyi
Dasypogon bromeliifolius
Desmocladus flexuosus
Eremaea pauciflora
Gastrolobium capitatum
**Gladiolus cardinalis*
**Gladiolus* sp.
Hibbertia huegelii
Hibbertia hypericoides
Hovea trisperma
Hybanthus calycinus
Hypocalymma robustum
Hypolaena exsulca
Lepidosperma tenue
Leucopogon conostephioides
Lomandra hermaphrodita
Lyginia barbata
Mesomelaena pseudostygia
Patersonia occidentalis
Petrophile linearis
Philotheca spicata
Ptilotus sp.
Scaevola repens
Schoenus curvifolius
Stirlingia latifolia
Tetraria octandra
Tricoryne elatior
Xanthorrhoea preissii

ErrinaN01
Acacia sessilis
**Aira cupaniana*
Alexgeorgea nitens
Amphipogon turbinatus
Anigozanthos manglesii
Astroloma pallidum
Austrodanthonia caespitosa
Banksia attenuata
Banksia dallanneyi
Banksia menziesii
Bossiaea eriocarpa
**Briza maxima*
Burchardia congesta
Caladenia flava
Calytrix ? flavescens
Chamaescilla corymbosa
Conostephium pendulum
Conostylis aculeata subsp. *cygnorum*
Conostylis setigera
Cyperaceae sp.
Dampiera linearis
Daviesia divaricata
Daviesia nudiflora
Daviesia triflora
Desmocladus flexuosus
Drosera erythrogyne
Drosera menziesii
**Ehrharta calycina*
Eremaea pauciflora
Eucalyptus todtiana
Gastrolobium capitatum
**Gladiolus caryophyllaceus*
Gompholobium marginatum
Gompholobium tomentosum
Haemodorum laxum
Hibbertia huegelii
Hibbertia hypericoides
Hibbertia racemosa
Hovea trisperma
Hybanthus calycinus
Hypocalymma robustum
**Hypochaeris glabra*
Hypolaena exsulca
Jacksonia floribunda
Lepidosperma sp.
Lepidosperma squamatum
Levenhookia stipitata
Lomandra caespitosa
Lomandra hermaphrodita
Lomandra suaveolens
Lyginia imberbis
Mesomelaena ? stygia
Mesomelaena pseudostygia
Monotaxis grandiflora var. *grandiflora*
Neurachne alopecuroidea
Patersonia occidentalis
Petrophile linearis
Petrophile macrostachya
Philotheca spicata
Pimelea sulphurea
Pronaya sp.
Pterostylis sp.
Scaevola repens
Schoenus curvifolius
Stirlingia latifolia
Stylidium piliferum
Stylidium repens
Thysanotus patersonii
Trachymene pilosa
Tricoryne elatior
**Ursinia anthemoides*
Waitzia suaveolens var. *suaveolens*
Xanthorrhoea preissii
Xanthosia huegelii

Sultana01
Acacia applanata
Alexgeorgea nitens
Allocasuarina humilis
Amphipogon turbinatus
Banksia attenuata
Banksia dallanneyi
Banksia menziesii
Bossiaea eriocarpa
Caesia micrantha
Caesia sp.
Calytrix sp.
Conospermum undulatum
Conostylis aurea
Cyathochaeta avenacea
Dampiera linearis
Dasypogon bromeliifolius
Dasypogon obliquifolius
Desmocladus fasciculatus
Drosera erythrogyne
Eremaea fimbriata
Eremaea pauciflora
Eucalyptus marginata
**Gladiolus caryophyllaceus*
Haemodorum sp.
Hemiandra pungens
Hibbertia huegelii
Hibbertia hypericoides
Hovea trisperma
Hypolaena exsulca
Isopogon drummondii
Johnsonia pubescens
Labichea punctata
Lambertia multiflora
Lepidosperma sp.
Lomandra preissii
Lomandra sericea
Lomandra sp.
Melaleuca sp.
Mesomelaena graciliceps
Monotaxis grandiflora
Patersonia occidentalis
Philotheca spicata
Phlebocarya ciliata
Pimelea sulphurea
Scaevola repens
Schoenus pedicellatus
Schoenus sp.
Stirlingia latifolia
Stylidium araeophyllum
Stylidium repens
Stylidium schoenoides
Styphelia tenuiflora
? Tetraria capillaris
Thysanotus sp.
Thysanotus sparteus
Thysanotus triandrus
Tricoryne elatior
Tricostularia neesii
Xanthorrhoea preissii

Inferred Community Type: 'Melaleuca huegelii - Melaleuca acerosa (currently *M. systena*) shrublands on limestone ridges' (community type 26a as described in Gibson *et al*.1994). * denotes introduced plant taxa.

Mywan03
Acacia lasiocarpa
**Anagallis arvensis*
Anigozanthos humilis
Austrostipa compressa
**Avellinia michelii*
Banksia dallanneyi
Brachyscome iberidifolia
Burchardia congesta
Caladenia flava
Caladenia longicauda
Calytrix strigosa
Cassytha pomiformis
Centrolepis drummondiana
Comesperma integerrimum
Conospermum stoechadis
Conostylis setosa
Crassula colorata
Cryptandra pungens
Cyrtostylis huegelii
Desmocladus asper
Drosera erythrogyne
Gompholobium tomentosum
Grevillea thelemanniana
Hakea trifurcata
**Heliophila pusilla*
Hibbertia hypericoides
Hyalosperma cotula
**Hypochaeris glabra*
**Isolepis marginata*
Isotropis cuneifolia
Jacksonia calcicola
Lagenophora huegelii
Laxmannia sp.
Lechenaultia linarioides
Lepidobolus preissianus subsp. *preissianus*
Lepidosperma sp.
Lepidosperma sp.
Lobelia heterophylla
Melaleuca systena
Millotia myosotidifolia
Opercularia vaginata
Pelargonium littorale subsp. *littorale*
Petrophile axillaris
Phyllanthus calycinus
Podotheca gnaphalioides
Poranthera microphylla
Quinetia urvillei
Rhodanthe citrina
**Sonchus oleraceus*
Stackhousia monogyna
Serichonus gracilipes
Stylidium rigidulum
Thysanotus patersonii
Trachymene pilbarensis
Triglochin nana
Triglochin isingiana
**Ursinia anthemoides*

Myyan03
**Aira cupaniana*
**Anagallis arvensis* var. *caerulea*
**Avellinia michelii*
Banksia dallanneyi
Banksia sessilis
**Briza maxima*
Caladenia sp.
Calothamnus quadrifidus
Cassytha pomiformis
**Cerastium balearicum*
**Crassula glomerata*
**Daucus glochidiatus*
**Desmazeria rigida*
Desmocladus asper
Desmocladus flexuosus
Drosera erythrogyne
**Ehrharta longiflora*
Eriochilus dilatatus
**Galium murale*
Geranium ? solanderi
Gompholobium tomentosum
Grevillea thelemanniana
**Heliophila pusilla*
Hibbertia hypericoides
Hibbertia racemosa
Hydrocotyle hispidula
**Hypochaeris glabra*
**Isolepis marginata*
Leucopogon parviflorus
Lomandra maritima
Melaleuca huegelii
Melaleuca systena
Millotia myosotidifolia
Gastrolobium capitatum
Opercularia vaginata
Parietaria debilis
Pelargonium littorale
Petrophile axillaris
Philotheca spicata
Poa drummondiana
Poa sp.
Pterostylis sp.
**Romulea rosea*
**Sonchus oleraceus*
Spyridium globulosum
Stylidium maritimum
Thysanotus patersonii
Trachymene pilosa
Tricoryne elatior
Tricoryne sp.
Triglochin isingiana
Trymalium ledifolium
Waitzia nitida

Myyeal04
Acacia lasiocarpa
Acacia sp.
**Aira cupaniana*
**Anagallis arvensis var. caerulea*
Apium annuum
**Avellinia michelii*
Banksia dallanneyi
Banksia sessilis
Bossiaea eriocarpa
Brachyscome iberidifolia
Caladenia flava
Cassytha pomiformis
**Cerastium glomeratum*
Conostylis pauciflora
Conostylis setosa
Crassula colorata
**Daucus glochidiatus*
Desmocladus asper
Desmocladus flexuosus
Diplolaena angustifolia
**Dischisma arenarium*
Drosera erythrogyne
**Gladiolus caryophyllaceus*
Grevillea thelemanniana
Hakea trifurcata
**Heliophila pusilla*
Hibbertia hypericoides
Hibbertia subvaginata
Hyalosperma cotula
Hybanthus calycinus
Hydrocotyle hispidula
**Hypochaeris glabra*
**Isolepis marginata*
Leucopogon parviflorus
Leucopogon sp. Yanchep (M. Hislop 1986)
Melaleuca huegelii
Melaleuca systena
Mirbelia spinosa
Opercularia vaginata
Phyllanthus calycinus
Poranthera microphylla
Pterostylis sp.
**Sonchus oleraceus*
Stylidium maritimum
Templetonia retusa
Thysanotus patersonii
Trachymene pilosa
**Trifolium campestre*
Triglochin isingiana
**Ursinia anthemoides*
**Vulpia myuros*
Wahlenbergia gracilenta
Xanthorrhoea preissii

Onetree01
Acacia lasiocarpa
Acacia truncata
**Anagallis arvensis* var. *caerulea*
Astroloma microcalyx
**Avellinia michelii*
Banksia dallanneyi
Banksia sessilis
Bossiaea eriocarpa
Caladenia arenicola
Calothamnus quadrifidus
Cassytha ? pomiformis
Conostylis aculeata
Crassula colorata
Cyrtostylis huegelii
Dampiera linearis
**Daucus glochidiatus*
Daviesia
Desmocladus asper
Desmocladus flexuosus
Dianella revoluta
Drosera erythrogyne
Eriochilus dilatatus
**Gladiolus caryophyllaceus*
Gompholobium tomentosum
Grevillea thelemanniana
Hakea trifurcata
Hardenbergia comptoniana
Hibbertia hypericoides
Hibbertia racemosa
Hovea trisperma
Hydrocotyle hispidula
Lepidosperma sp.
Leucopogon parviflorus
Leucopogon parviflorus
Lomandra maritima
Lomandra suaveolens
Lysinema ciliatum
Melaleuca huegelii
Melaleuca systena
Opercularia vaginata
Poa drummondiana
Prasophyllum ? calcicola
Pteridium sp.
Schoenus nanus
**Sonchus oleraceus*
Stylidium maritimum
Thysanotus patersonii
Trachymene pilbarensis
Triglochin isingiana
**Ursinia anthemoides*
Xanthorrhoea preissii

Appendix 3: Introduced floral species identified from 10x10 m floristic quadrat assessments

Aira cupaniana
Anagallis arvensis
Anagallis arvensis var. *caerulea*
Arctotheca calendula
Avellinia michelii
Avena fatua
Briza maxima
Briza minor
Cerastium balearicum
Cerastium glomeratum
Cicendia filiformis
Crassula glomerata
Daucus glochidiatus
Desmazeria rigida
Dischisma arenarium
Echium plantagineum
Ehrharta calycina
Ehrharta longiflora
Galium murale
Gladiolus cardinalis
Gladiolus caryophyllaceus
Heliophila pusilla
Hesperantha falcata
Hypochaeris glabra
Isolepis marginata
Juncus capitatus
Monopsis debilis
Moraea sp.
Parentucellia latifolia
Parentucellia viscosa
Romulea rosea
Sonchus oleraceus
Trifolium campestre
Ursinia anthemoides
Vulpia myuros
Watsonia sp.