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Report

Western Australian Planning Commission

Natural Values of 12 Sites of the Greater Bunbury Region Scheme

Tasks 1, 2 and 3

EP027111

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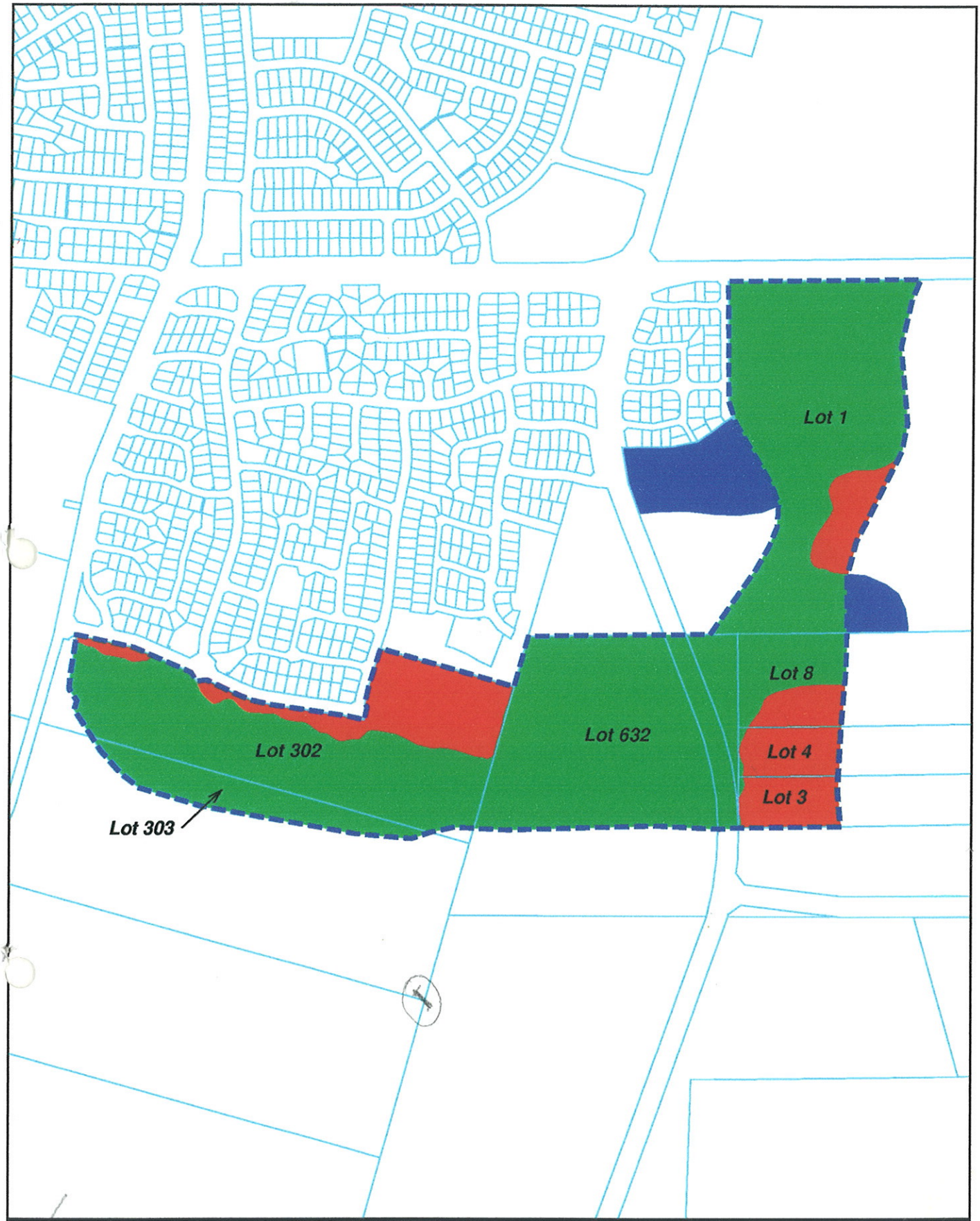

DRAFT GREATER BUNBURY REGION SCHEME - ENVIRONMENTAL SURVEY
REGIONALLY SIGNIFICANT NATURAL VALUES (SITE 10)

Department for Planning and Infrastructure

WESTERN AUSTRALIAN PLANNING COMMISSION

GDA

Filename: Botanist.dgn
Amended: 3 December 2002

Produced By Cartographic Section
Bunbury Office, DPI

LEGEND

- SITE BOUNDARY
- CADASTRE
- R - REGIONALLY SIGNIFICANT NATURAL VALUES
- D- -SUITABLE FOR DEVELOPMENT
- A - ADDITIONAL, MAY HAVE NATURAL VALUES OF REGIONAL SIGNIFICANCE
- E - SUITABLE FOR DEVELOPMENT, EXACT LOCATION NOT DETERMINED
- EXACT LOCATION OF BOUNDARY NOT DETERMINED

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Metres

Figure 5.12

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Appendices

Tables

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1 Introduction

1.1 Background

This report has been prepared in response to a request by the Western Australian Planning Commission (WAPC) to provide environmental consultancy services to progress an environmental assessment of the Greater Bunbury Region Scheme (GBRS).

The WAPC has prepared the GBRS to provide a statutory mechanism to secure land for regional purposes and to include land identified in regional strategies and structure plans for future urban and industrial purposes within appropriate regional zones. To finalise responses to submissions relating to formal assessment by the Environmental Protection Authority (EPA), the WAPC required further information about the natural values of certain sites.

The study is of 12 sites in the Greater Bunbury Region ('the Region') that are proposed to be included in new zonings and reserves.

1.2 Scope of Works

In summary the scope of works comprises the following three tasks:

1. Description of the natural values of 12 sites within the Region nominated by WAPC;
2. Identification and description of the relationship of the sites to regionally significant sequences of ecological communities; and
3. Evaluation of the natural values of the sites and recommendations to protect these values.

This report details the findings of Tasks 1, 2 and 3. Tasks 1 and 2 described the natural values of the sites, in accordance with the study brief:

- detailed vegetation and flora survey of the 12 sites utilising the methodology adopted in *Bush Forever* (Government of Western Australia 2000a and b);
- fauna habitat assessment of the 12 sites utilising desktop and reconnaissance surveys;
- detailed fauna survey of one site (Site 9 Muddy Lakes); and
- description of relationships between the 12 sites and regionally significant ecological communities.

Findings of interest and limitations to the field survey that impact on the study's findings are discussed in Section 6.

Drawing on the findings of Tasks 1 and 2, Task 3 focused on the following in accordance with the study brief:

- evaluate the natural values in a regional context according to EPA (2002b) *A Strategy for the EPA to Identify Regionally Significant Natural Areas in its consideration of the Greater Bunbury Region Scheme portion of the Swan Coastal Plain*; and

- recommend to the Commission whether the sites contain natural values of regional significance and how those values should be protected.

The natural values of the sites were evaluated in a regional context according to EPA (2002b). The EPA's evaluation strategy utilised the selection criteria developed for the Bushplan Project that have been updated to reflect current policy standards and adapted to the specific environment of the GBR (EPA 2002).

It should be noted that the EPA's evaluation strategy (2002b) was written specifically for assessment of the Swan Coastal Plain portion of the GBRS. Several sites in this study occurred beyond the Swan Coastal Plain, and thus the strategy suggested by EPA (2002b) was extended to apply to some areas on the foothills and lateritic uplands of the Blackwood Plateau.

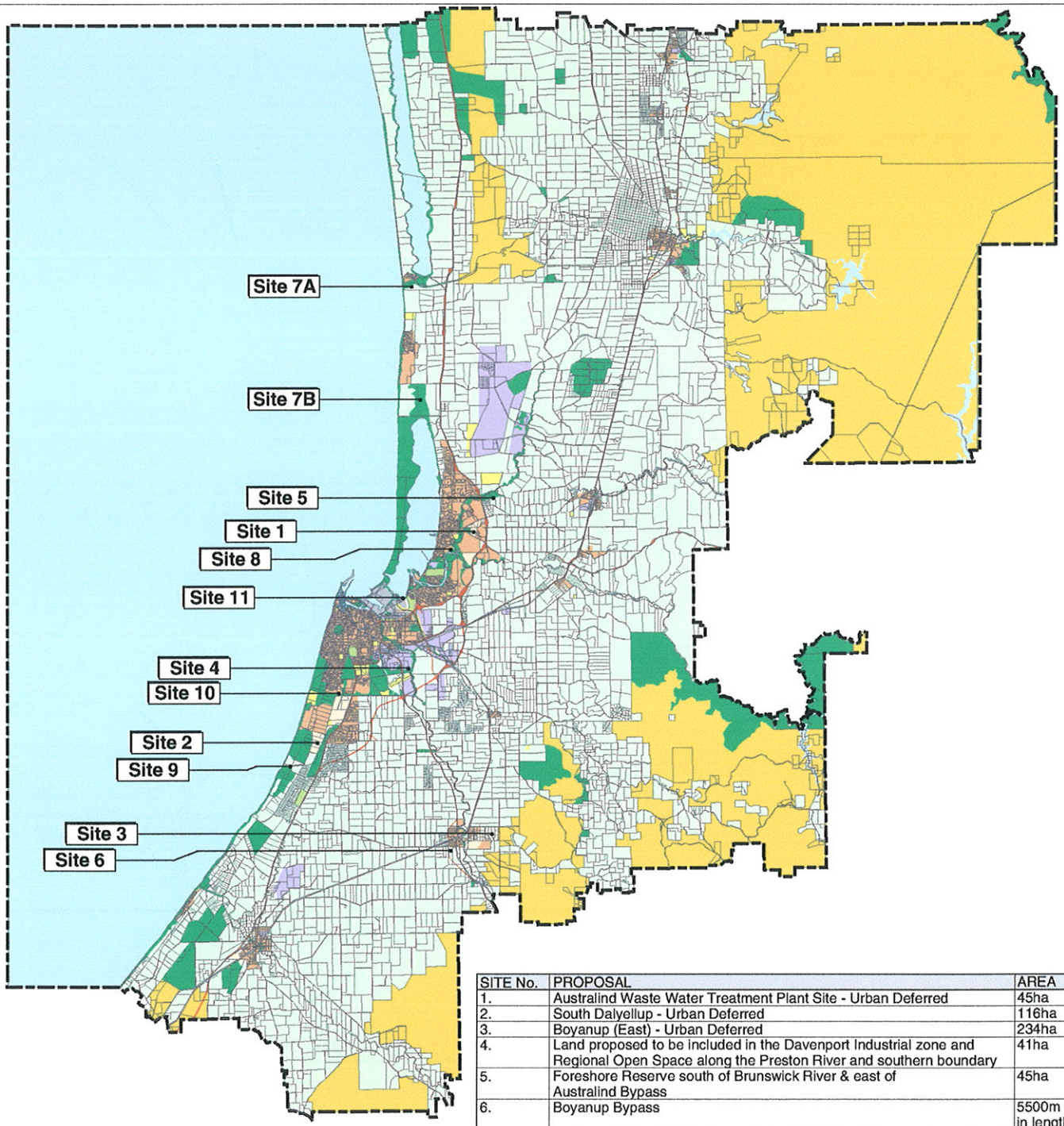
This report also recommends to the Commission the environmental acceptability of the zones and reserves proposed under the GBRS, such as regional open space (ROS). Where the findings suggest that the proposed zones and reserves do not adequately protect regionally significant natural values, recommendations are made to enable the protection of their natural values. Where it was not possible to accurately determine the boundary of protected areas, further survey work is recommended.

1.3 Sites Surveyed

12 sites as listed in Table 1.1 were investigated in accordance with the study brief (Figure 1).

Table 1.1: 12 Sites of the Study

No.	Site Name	Area (ha)	Description
1	Australind Waste Water	44	3 locations E of Australind and W of Australind bypass
2	South Dalyellup	116	Access via Minninup Road
3	Boyanup East	234	E of Boyanup via Hurst Road
4	Davenport Industrial	41	Adjacent to SW Hwy, S of Bunbury
5	Brunswick River	45	Adjacent to Brunswick River E of Australind bypass
6	Boyanup Bypass	5 km	Proposed 50m road reserve bypass west of Boyanup
7A	Myalup	30	S of Myalup townsite & diversion drain
7B	Buffalo Road	165	Between Buffalo & Springhill Roads
8	Twin Rivers	42	Confluence of Collie & Brunswick Rivers
9	Muddy Lakes	285	Access via Minninup Road and coast
10	Parade Road	63	S of housing developments S of Bunbury
11	Estuary Drive	0.5	Estuary Drive, Vittoria Bay



SITE No.	PROPOSAL	AREA
1.	Australind Waste Water Treatment Plant Site - Urban Deferred	45ha
2.	South Dalyellup - Urban Deferred	116ha
3.	Boyanup (East) - Urban Deferred	234ha
4.	Land proposed to be included in the Davenport Industrial zone and Regional Open Space along the Preston River and southern boundary	41ha
5.	Foreshore Reserve south of Brunswick River & east of Australind Bypass	45ha
6.	Boyanup Bypass	5500m in length
7.	Regional Open Space south of the Harvey River diversion drain adjacent to Myalup (refer to submission no. 161 for further details) and Location 7 and 14 Buffalo Road	284ha
8.	Regional Open Space for Twin Rivers Barnes Avenue, Australind (refer to submission no. 232 for further details)	42ha
9.	Regional Open Space for Muddy Lakes and uplands and wetlands associated with the South Dalyellup Muddy Lake wetlands chain	285ha
10.	Regional Open Space over Pt Lot 1 Parade Road & Urban over Pt Lot 302 &303 Ocean Drive, Shearwater (refer to submission 282 & 263 for further details)	63ha
11.	Regional Open Space over Lot 5 & 6 Estuary Drive, Australind (submission 197 & 198)	0.5ha

DRAFT GREATER BUNBURY REGION SCHEME - ENVIRONMENTAL SURVEYS
SELECTED SITES REFERENCE PLAN

PLAN 1

Department for Planning and Infrastructure

WESTERN AUSTRALIAN PLANNING COMMISSION

GDA

Site_Ref_Map.dgn
Amended: 25 October 2002
PRODUCED BY CARTOGRAPHIC SECTION,
BUNBURY OFFICE, DEPARTMENT FOR PLANNING & INFRASTRUCTURE

LEGEND

RESERVED LANDS
- REGIONAL OPEN SPACE
- RAILWAYS
- STATE FORESTS
- WATERWAYS
- PORT INSTALLATIONS

ROADS :
- PRIMARY REGIONAL ROADS
- OTHER REGIONAL ROADS

PUBLIC PURPOSES - DENOTED AS FOLLOWS :
- A AIRPORT
- H HOSPITAL
- HS HIGH SCHOOL
- P PRISON
- PU PUBLIC UTILITIES
- SU SPECIAL USES
- TS TECHNICAL SCHOOL
- U UNIVERSITY

ZONES
- URBAN
- URBAN DEFERRED
- REGIONAL CENTRE
- INDUSTRIAL
- RURAL
- PRIVATE RECREATION

N

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2 Regional Methodology

2.1 Physical Environment

2.1.1 Objectives

The objectives of the desktop review were to undertake a desktop analysis of regional datasets to define the broad physical characteristics of each of the 12 sites.

2.1.2 Background Information

Geology and landforms have been mapped for the Darling System by the Geological Survey of Western Australia (1982a, b; 1987). The Environmental Geology Series has not extended to the sites of this study and therefore only extrapolated information that has not been groundtruthed (Bob Gozzard, Geology Survey of WA, pers. comm.) was available for soils.

Wetland types and consanguineous suites have been defined on the Swan Coastal Plain by Hill *et al.* (1996a) but did not extend south of Bunbury (Table 2.1). While the southern Swan Coastal Plain wetlands have been reviewed by the V and C Semeniuk Research Group (1998), the findings have not been published to date. WRC kindly made these unpublished maps available so that the consanguineous suites and wetland types within each site could be identified.

Table 2.1: Wetland and Estuary definitions (after Semeniuk 1987, and Semeniuk 1996a & b, cited in Government of Western Australia 2000B).

A – Wetland Types

Water Longevity	**Landform**			
	Basin	**Channel**	**Flat**	**Slope**
Permanent inundation	lake*	river	-	-
Seasonal inundation	sumpland	creek	floodplain	-
Seasonal waterlogging	dampland	-	palusplain	paluslope
* Artificial Channels and Artificial Lakes are man-made channels and lakes				

B – Estuaries

Estuary	that part of an estuary which is permanently or seasonally inundated
Estuary	that part of an estuary subject to seasonal waterlogging

Wetland evaluation is the process of assessing the level of significance of a wetland (see Hill *et al.* 1996a and b). An appropriate management category is assigned to the wetland based on the evaluation, which provides guidance on the nature of the management and protection the wetland should be afforded (Table 2.2).

Wetlands that are listed under the *Environmental Protection (Swan Coastal Plain Lakes) 1992 Policy*, referred to as EPP Lakes, have been defined by the Government of Western Australia (1992). Wetlands identified as EPP Lakes are protected from unauthorised filling, mining, effluent disposal and drainage.

Table 2.2: Management Categories and Objectives for wetlands on the Swan Coastal Plain

Management Category	General Description
C - Conservation (incorporates EPA Bulletin 686 categories H and C)	• Wetlands support a high level of ecological attributes and functions.
R - Resource enhancement (incorporates EPA Bulletin 686 categories O and R)	• Wetlands which may have been partially modified but still support substantial ecological attributes and functions.
M - Multiple use (aligned with EPA Bulletin 686 category M)	• Wetlands with few important ecological attributes and functions remaining.

2.1.3 Desktop Survey

A review of all available information relevant to the physical environment of the Sites was conducted and included:

- liaison with the Department for Planning and Infrastructure (DPI) to obtain regional datasets prepared for the GBRS Environmental Review (WAPC 2000);
- liaison with natural resource agencies to ensure regional datasets were current;
- overlaying the site boundaries on the regional datasets.

The digital data of geology and landforms mapped by Geological Surveys of Western Australia was supplied via the Department of Minerals and Petroleum Resources in ArcView shape files. This was converted to MapInfo using the FME Universal Translator and projected in MGS Zone 50. This dataset was then overlaid with site boundaries and the geology and landforms of each site were defined.

The consanguineous groups and wetland types within each site were identified by examining the unpublished maps prepared by the V and C Semeniuk Research Group (1998), held at the WRC.

Wetland management objectives have been mapped by V and C Semeniuk Research Group (1998). The digital data of wetland management objectives mapped by V and C Semeniuk Research Group (1998) within the GBRS was supplied via the DPI in Microstation format. This was converted to MapInfo using the FME Universal Translator and projected in MGS Zone 50. This dataset was then overlaid with site boundaries and the wetland management categories of each site were defined.

The digital data of EPP Lakes within the GBRS was supplied via DPI in Microstation format. This was converted to MapInfo using the FME Universal Translator and projected in MGS Zone 50. This dataset was then overlaid with site boundaries and the EPP lakes that occur within each site was defined.

2.2 Flora and Vegetation

2.2.1 Objectives

The objectives of the desktop review were to undertake a:

- literature review of previous flora and vegetation surveys conducted in the region such as Beard (1:250 000 series), Smith (1973, 1974), Heddle *et al.* (1980) Gibson *et al.* (1994), English and Blyth (1997, 1999), Keighery *et al.* (draft, 2002) and consultant reports such as ATA Environmental (2001a and b) and Bowman Bishaw Gorham (2001);
- desktop search of CALM's database of threatened ecological communities (TECs);
- desktop search of the Department of Conservation and Land Management's (CALM's) database of Declared Rare and Priority Flora; and
- desktop search of the WA Herbarium's database of voucher specimens from the project area.

2.2.2 Background Information

Ecological communities are defined as naturally occurring biological assemblages that occur in a particular type of habitat (Government of Western Australia, 2000a). English and Blyth (1997, 1999) have developed a procedure for identifying and assigning TECs to one of four categories depending on the threat to the community (Table 2.3).

Table 2.3: Conservation categories for Threatened Ecological Communities recognised by CALM and the WA Minister for the Environment (English and Blyth 1997)

Code	Definition
Presumed Totally Destroyed	An ecological community which has been adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future
Critically Endangered	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated.
Endangered	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future.
Vulnerable	An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range.

Commonwealth legislation also protects vegetation communities classified as threatened. Under the *Environmental Protection and Biodiversity Conservation (EPBC) Act 1999*, a person must not take an action that is likely to have a significant impact on a listed threatened ecological community without approval from the Minister for the Environment and Heritage. The definitions of the three categories of threatened communities (TECs) are summarised in Table 2.4.

Table 2.4: Conservation Categories for Threatened Ecological Communities under the *EPBC Act 1999*

Code	Definition
Critically Endangered	A community can be included in the Critically Endangered category if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future.
Endangered	A community can be included in the Endangered category 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	A community can be included in the Vulnerable category 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

While all native flora are protected under the *Wildlife Conservation Act 1950,* a number of plant species are assigned an additional level of conservation significance based on the limited number of known populations and the perceived threats to the locations of these populations. Species of the highest conservation significance are designated Declared Rare Flora (DRF), while species which are believed to warrant a lesser level of additional protection are assigned to one of four Priority flora categories (Table 2.5).

Table 2.5: Categories of Conservation Significance for Flora Species (Atkins, 1999)

Code	Description
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.
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.
P1	Priority 1 - Poorly Known Taxa. Taxa which are known from one or a few (generally <5) populations which are under threat.
P2	Priority 2 - 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.
P3	Priority 3 - Poorly Known Taxa. Taxa which are known from several populations, and the taxa are not believed to be under immediate threat.
P4	Priority 4 - 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.

Flora of the Swan Coastal Plain are also considered to be of conservation significance where they do not occur in reserves (Keighery 1999), appear to be occurrences beyond the known geographical range, or are listed as significant in Bush Forever (Government of WA 2000b).

2.2.3 Desktop Survey

A literature review of all available information relevant to the biological assessment of the project area was conducted and included:

- liaison with DPI to obtain reports prepared for previous biological surveys of similar projects in the vicinity of the study area;
- previous biological surveys (ie flora/vegetation/fauna) undertaken in the region and those undertaken by consultants;
- searches for Rare and Priority Flora (Appendix K), Threatened Ecological Communities (CALM);
- searches for Declared Plants (Department of Agriculture WA); and
- document sourcing from the Department of Conservation and Land Management's Bunbury Regional Office and Woodvale library for information on biological assessments that have been undertaken in the Region.

Information gained during the above investigations aimed to target the search for threatened species and ecological communities, and to provide a setting in which to assess the regional significance of the sites. However, information regarding TECs was not available prior to the field survey (Melissa Hoskins, CALM, pers. comm.).

The location of known TECs within the vicinity of the 12 sites was obtained from CALM and overlaid with site boundaries to examine the extent of TECs adjacent or within each site. The database search area is shown in Figure 4.

Remnant vegetation based on mapping of remnant vegetation undertaken by AgWA derived from Landsat TM satellite imagery dated 1995/1996 was utilised to define the area of remnant bushland within each site. The digital data of remnant vegetation mapped by AgWA was supplied via DPI in Microstation format. This was converted to MapInfo using the FME Universal Translator and projected in MGS Zone 50. This dataset was then overlaid with site boundaries and the remnant vegetation within each site was defined.

While Beard (various dates) and Smith (1973, 1974) have described vegetation on the Swan Coastal Plain in a broad scale, the most comprehensive broad-scale vegetation mapping has been undertaken by Heddle *et al.* (1980). Vegetation Complexes have been defined in relation to the landform-soil units for the Darling System by Heddle *et al.* (1980). The digital data of vegetation complexes mapped by Heddle *et al.* (1980) was supplied via DPI in Microstation format. This was converted to MapInfo using the FME Universal Translator and projected in MGS Zone 50. This dataset was then overlaid with site boundaries and the complexes within each site were defined.

The records of vouchered specimens held at the WA Herbarium were searched to obtain a comparison of flora that has been previously recorded in the vicinity of the study area. The area of Figure 4 defined the search area.

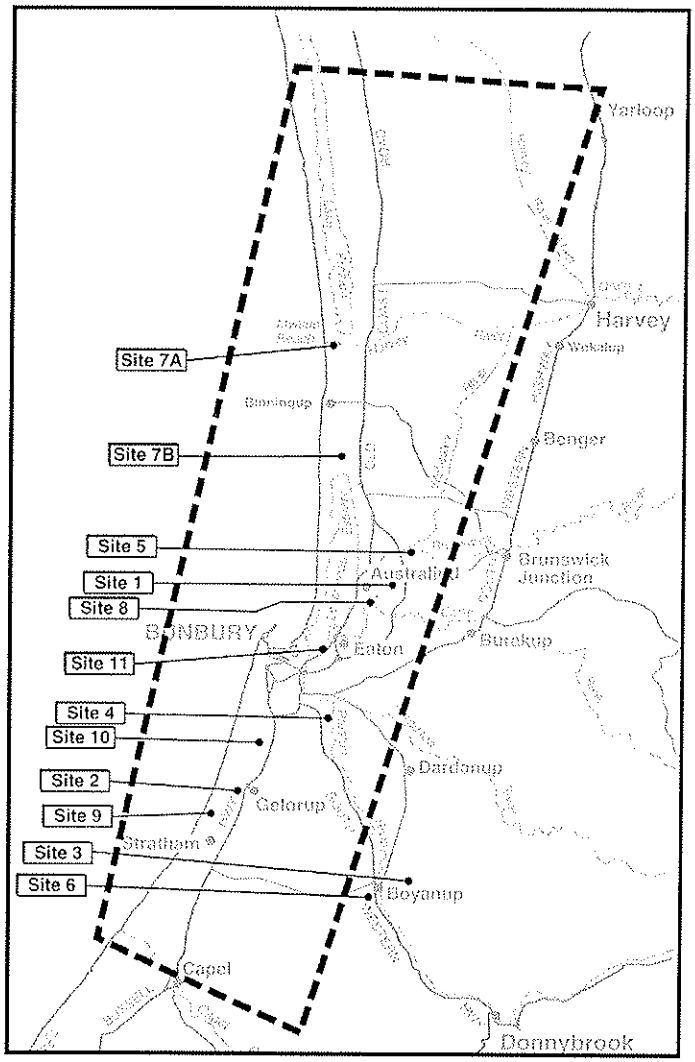


FIGURE 4 - DATABASE SEARCH AREA

2.3 Fauna

2.3.1 Objectives

The objectives of the desktop review were to:

- review available information from the literature, consultant reports, local informants and databases;
- identify and describe fauna habitats within the Region;
- collate available information to facilitate the preparation of lists of vertebrate fauna taxa expected to, or known to, occur in the Region; and
- describe the utilisation of habitats and known presence of Rare and Priority fauna taxa within the Region.

2.3.2 Background Information

Environmental Protection and Biodiversity Conservation Act 1999

Fauna that are considered Rare and Endangered at a national level are listed under Schedule 1 of the *EPBC Act 1999*. Classification of species under the Act is defined in Table 2.6.

Table 2.6: Categories of Threatened Fauna Species under the *EPBC Act 1999*

Code	Category	Criteria
Ex	Extinct	There is no reasonable doubt that the last member of the species has died.
E	Endangered	The species is facing a very high risk of extinction in the wild in the near future.
V	Vulnerable	The species is not considered endangered but is facing a high risk of extinction in the wild in the medium-term future.

Estimates of risk of extinction are based on prescribed criteria that includes an assessment of population size and threatening processes. Additional categories exist under the *EPBC Act 1999* for listed threatened species and ecological communities (critically endangered, conservation dependant and extinct in the wild) but these are not relevant in this case to the fauna of the study area.

Wildlife Conservation Act 1950

Fauna species that are rare, threatened with extinction or considered to have high conservation value are protected in WA under the *Wildlife Conservation Act 1950*. Classification of Rare and Endangered fauna under the *Wildlife Conservation (Specially Protected Fauna) Notice* 2001, recognises four distinct schedules of taxa (Table 2.7).

Table 2.7: WA Threatened Fauna Categories

Code	Category	
S1	Schedule 1	Fauna which is rare or likely to become extinct.
S2	Schedule 2	Fauna which are presumed to be extinct.
S3	Schedule 3	Birds which are subject to an agreement between the governments of Australia and Japan (JAMBA) relating to the protection of migratory birds and birds in danger of extinction.
S4	Schedule 4	Fauna that is otherwise in need of special protection.

In addition to lists of Scheduled Fauna CALM also maintains a list of Priority Fauna. This includes species that have been removed from the Scheduled list and other species that are poorly known or infrequently recorded. Four classifications are recognised (Table 2.8).

Table 2.8: CALM Priority Fauna categories

Code	Category	
P1	Priority 1	Taxa with few, poorly known populations on threatened lands.
P2	Priority 2	Taxa with few, poorly known populations on conservation lands.
P3	Priority 3	Taxa with several, poorly known populations, some on conservation lands.
P4	Priority 4	Taxa in need of monitoring.

Migratory Bird Agreements

At a national level the *EPBC Act 1999* provides for protection of migratory waterbirds through the Convention on Migratory Species (Bonn Convention) and international treaties such as the Japan-Australia and China-Australia Migratory Bird Agreements (JAMBA and CAMBA). In addition, the Ramsar Convention protects wetlands of international importance. Species listed under JAMBA are also protected under Schedule 3 of the *Wildlife Conservation Act 1950* (Table 2.7).

JAMBA and CAMBA cover certain species of avifauna, particularly transequatorial waders. These international agreements are designed for the "protection of migratory birds and birds in danger of extinction and also for the management and protection of their environments".

2.3.3 Desktop Survey

An in depth literature review of all available information relevant to the fauna assessment of the Region was conducted prior to, and following, the field survey. This involved liaison with DPI, CALM, the WA Museum and other interest groups to obtain published and unpublished data from previous survey work on the fauna species known to, or likely to, occur in the study area. In particular, data from previous biological assessment surveys and waterbird surveys carried out in the Kemerton and Leschenault Estuary areas were reviewed (these are discussed in Section 4.4.2 Previous Fauna Studies), as well as systematic surveys undertaken by Environmental Consultants at selected sites. Information from relevant databases and information recorded during the field survey was combined with material obtained during the literature review to gain an appreciation of the variety of vertebrate fauna species present in the Region and their habitat utilisation patterns. The information from the review of fauna studies (Section 4.4.2) was used to characterise the fauna and assemble lists of potential vertebrate fauna species of the Region. In addition to the review of previous fauna studies a search of the following sources of information was made:

- CALM's database of known populations of rare and endangered fauna from the Region, including mammals and birds (Appendix L);

- the WA Museum fauna database for the Region for mammals, frogs and reptiles, performed using the registered FaunaBase online area search (Western Australian Museum 2002). The Region was divided into two query areas; one north and one south of Bunbury. This helped to provide an indication of the variety of species recorded in these sub-areas but also is

indicative of the level of information available concerning the vertebrate fauna. The search area was defined to restrict the query to fauna recorded on the coastal plain portion of the study area, and records of oceanic species were omitted from the lists; and

- the WA Museum fauna database for the south-west mainland for records of the Quokka *Setonix brachyurus*, including locations and collection dates (Appendix M).

In combination with database information specialist fauna reference texts were used to aid in the preparation of lists of species that potentially occur in the Region. These lists were reinterpreted and modified following the field survey based on the series of habitats encountered and the species recorded. Texts used for the relevant taxonomic groups are as follows:

- Mammals — Strahan (1995)
- Bats — Churchill (1998)
- Skinks — Storr *et al.* (1999)
- Monitors — Storr *et al.* (1983)
- Agamids — Storr *et al.* (1983)
- Geckos — Storr *et al.* (1990)
- Pygopods — Storr *et al.* (1990)
- Snakes — Storr *et al.* (2002)
- Reptiles — Cogger (2000)
- Amphibians — Tyler *et al.* (2000)
- Birds — Simpson and Day (1996), Slater *et al.* (1991) Johnstone and Storr (1998), Blakers *et al.* (1984)
- Fish — Allen (1982), Morgan *et al.* (1998)

Taxonomy and nomenclature is based on the WA Museum 'Checklists of the vertebrates of Western Australia' for mammals (How *et al.* 2001), reptiles and frogs (Aplin and Smith 2001), and birds (Christidis and Boles 1994).

2.4 Consultation

A variety of organisations and individuals were consulted during the fauna review process to obtain relevant local information and knowledge of fauna distributions and local populations. This process involved liaison with CALM, Birds Australia, consultants, the WA Museum and the Bunbury Naturalists Club to obtain published and unpublished data from previous survey work on the fauna species known to, or likely to, occur in the study area, particularly waterbirds, shorebirds and rare fauna.

Principal organisations and individuals consulted were as follows:

- CALM Bunbury: Kim Williams
- CALM Wildlife Branch: Peter Orell
- Members of Birds Australia WA group
- Environmental Protection Authority: John Dell
- WA Museum: Norah Cooper, Ric How, Brad Maryan
- Members of Bunbury Naturalists Club

3 Field Methodology

3.1 EPA Requirements

Biological surveys of the natural values of the GBRS sites were conducted in accordance with EPA requirements for the style of terrestrial biological surveys as outlined in Position Statement No. 3 (EPA 2002a). The flora and vegetation survey of the study areas aimed to comply with EPA requirements for a level of survey considered to be appropriate to the Swan Coastal Plain Interim Biogeographic Regionalisation for Australia (IBRA) bioregion (relatively high 'sensitivity') in which the scale of impact is high.

In addition, this survey aimed to utilise the methodology and regional datasets specified by the EPA (2002b) for the GBRS.

3.2 Botanical Survey

The vegetation, flora and weed surveys were conducted concurrently and they are discussed together in this section.

The broad objective of the flora and vegetation survey was to describe and define the botanical values of the 12 sites.

3.2.1 Objectives

Vegetation Survey

- define the vegetation structure present within the study areas according to Keighery (1994), including dominant floristics and key associated species;
- review the ecological significance through a condition assessment of the vegetation (Keighery 1994), recognition of TECs as defined under the *EPBC Act 1999*, identification of communities that may meet the criteria for identification as TECs, and in discussion with CALM; and
- define and map the vegetation community boundaries.

Flora and Weed Survey

- identify all vascular plant species within the study areas;
- collect voucher specimens where identification is uncertain and where species may be confused with Declared Rare, Priority or Significant Flora known from the area;
- review the conservation value of all vascular plant taxa recorded in the study areas on the basis of the CALM Declared Rare and Priority Flora database (2002), threatened species listed under the *EPBC Act 1999* and the experience of the team;
- provide completed CALM rare flora report forms of all Priority and Declared Rare Flora located;
- submit specimens to the WA Herbarium as required under Section 23C licence collecting conditions of the *Wildlife Conservation Act 1950*; and
- identify introduced (weed) taxa or Declared Plants pursuant to Section 37 of the *Agriculture and Related Resources Protection Act 1976* that occur or are likely to occur.

3.2.2 Field Survey

An assessment of the flora and vegetation of the 12 sites was undertaken over a six day period in September 2002. Vegetation associations at each of the 12 sites were estimated prior to field survey through interpretation of digital rectified aerial photographs. During the field survey these associations were investigated by foot traverses within each site. The methodology adopted was consistent with that described in Bush Forever (Government of Western Australia 2000b). Pegged sampling plots were located in each vegetation association described within each of the 12 sites and the following parameters recorded within a 10m x 10m plot:

- location using hand held GPS (MGA (GDA94));
- vegetation community description based on dominant species and strata after Keighery (1994) (Table 3.1);
- landform;
- vascular plant taxa present;
- estimated percentage foliage cover and height of plant taxa present;
- vegetation condition after Keighery (1994) (Table 3.2); and
- evidence of threatening processes such as erosion, fire and proliferation of tracks.

Table 3.1: Vegetation Structural Classes (Keighery, 1994 (adapted from Muir 1977 and Alpin 1979, cited in Government of Western Australia 2002b.)

Life form / height class	Canopy cover (percentage)			
	100-70%	70-30%	30-10%	10-2%
Trees over 30m Trees 10-30m Trees under 10m	Tall Closed Forest Closed Forest Low closed Forest	Tall Open Forest Open Forest Low Open Forest	Tall Woodland Woodland Low Woodland	Tall Open Woodland Open Woodland Low Open Woodland
Tree Mallee	Closed Tree Mallee	Tree Mallee	Open Tree Mallee	Very Open Tree Mallee
Shrub mallee	Closed Shrub Tree Mallee	Shrub Mallee	Open Shrub Mallee	Very Open Shrub Mallee
Shrubs over 2m Shrubs 1-2m Shrubs under 1m	Closed tall Shrub 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
Sedges	Closed Sedgeland	Sedgeland	Open Sedgeland	Very Open Sedgeland

In some cases, corner pegs were removed from the plots where they may pose a danger to the public or to stock. Plots were described within releves (approximately located areas) where surface water was present (plots 5.2, 5.3 and 9.7) or where the vegetation unit was a repeat of an earlier unit (plots 10.4).

A standardised data form was used at each site to maintain consistency (summarised in Appendix C). A colour photograph of the vegetation association was taken from the north-west peg looking south-east, or similar, of each plot (Appendix D). Opportunistic collections were made on an ongoing basis to increase the percentage of species recorded.

Table 3.2: Vegetation Condition Scales commonly used in the Perth Metropolitan Region (Keighery, 1994, cited in Government of Western Australia 2002b).

Pristine (1)	Pristine or nearly so, no obvious signs of disturbance.
Excellent (2)	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
Very Good (3)	Vegetation structure altered, obvious signs of disturbance. For example, disturbance to vegetation structure cause by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
Good (4)	Vegetation structure significantly altered by very obvious signs of multiple disturbance. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.
Degraded (5)	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
Completely Degraded (6)	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated trees or shrubs.

Throughout the survey, where field identification of plant taxa was not possible, collections were made in a systematic manner. Specimens collected were numbered and the location of collection recorded, allowing later identification at the WA Herbarium. All plant specimens collected during the field survey were dried and fumigated in accordance with the requirements of the WA Herbarium. Where appropriate, plant taxonomists with specialist skills were consulted and taxonomic nomenclature updated to comply with that of the WA Herbarium.

Where threatened flora were identified in the field, the coordinates were recorded using a handheld GPS. Populations able to be identified in the field were assessed for extent, size (number of individuals), condition and potential risk of disturbance.

Following the field survey vegetation association descriptions and maps showing distribution of vegetation community types were refined. The conservation significance of vegetation communities and vascular plant taxa recorded during the survey were reviewed.

FloristicCommunities Types (FCT)

The floristic community type (FCT) of each structural vegetation unit was inferred from desktop comparison of survey data to Gibson *et al.* (1994), particularly drawing on the information presented in Table 12 of Gibson *et al.* 1994 (p. 31). The System 6 and Part 1 Update (DEP 1996) identified 15 supplementary groups and extended the known occurrences of the groups identified in Gibson *et al.* 1994 as outlined in BushForever (Government of WA 2000b). As limited published data is available for comparison and time

did not permit further consultation with DEP in regard to this information a comparison was only made with those FCTs in Gibson *et al.* (1994).

Threatened Ecological Communities (TECs)

A search of CALM's database of TECs was requested, however the results were not available prior to the field survey (Melissa Hoskins pers. comm.). As a result, a targeted search of TECs was not possible.

The vegetation structural units recorded in the study were compared to the floristic communities defined in Gibson *et al.* (1994) and English and Blyth (1994), to determine the likelihood of the presence of previously unidentified TECs. However, because of insufficient time for establishment of paired plots in each Floristic Community Type (FCT) recommended in Keighery *et al.* (2002) or for more than 1 visit, the ability to propose additional TEC's was limited.

Weeds

Introduced (weed) species present within the 12 sites were identified during the flora and vegetation survey. Declared Plants pursuant to Section 37 of the *Agriculture and Related Resources Protection Act 1976* that occur or are likely to occur, were identified through database searches and through liaison with staff of the Bunbury office of the WA Department of Agriculture.

Linkage

Linkage with adjacent bushland areas has been identified as a natural attribute of high priority in the assessment of regional significance (EPA 2002b). Two types of regionally significant sequences of ecological communities have been identified within the GBRS (EPA 2002b). Vegetated sequences are predominantly north/south links while river corridors form east/west links between the Darling/Blackwood Plateaus and the coast.

Several of the 12 sites in the present study are related to three areas of regionally significant sequences of ecological communities recognised by the EPA (2002b): the Ocean to Preston River Park (C70), the Dalyellup/Gelorup/Preston River/Plateau Link (C71, C86) and the Brunswick, Collie and Wellesley Rivers Corridor (C67). A forth sequence, the Preston River, while heavily cleared in some sections, still forms a significant corridor between the coast and the Blackwood Plateau.

No formal recognition of linkages or 'greenways' has been undertaken outside the Perth Metropolitan Region, such as those identified in Bush Forever (Government of Western Australia 2000b, p. 73). Greenways are defined as a 'linkage connecting and encompassing conservation areas and landscape features' (Alan Tingay and Associates 1998a). However, such greenways may not be contiguous corridors of bushland and not necessarily of conservation significance.

As a result, the present study has described linkage of each site according to adjacent bushland and contiguous natural areas, particularly where there appears to be a relationship to the four recognised regionally significant sequences of ecological communities documented by the EPA (2002b). This study recognises two additional areas as important linkages where they link

corridors of remnant bushland to System 6 areas and National Parks. This forms Task 2 of the study brief.

The six sequences recognised here as regionally significant sequences of ecological communities are:

1. Ocean to Preston River Park (C70)
2. Dalyellup/Gelorup/Preston River/Plateau Link (C71, C86)
3. Brunswick, Collie and Wellesley Rivers Corridor (C67)
4. Preston River Corridor (while heavily cleared in some sections still forms a significant corridor between the coast and the Blackwood Plateau)
5. Link to National Parks (Yalgorup National Park, C54)
6. Link to other System 6 areas (C 66 Leschenault Estuary)

3.3 Fauna Survey

3.3.1 Objectives

The overall objective of the field survey was to describe the natural values, with emphasis on fauna, of selected sites relevant to the GBRS. A series of 12 sites were surveyed, the specific objectives being to:

- describe the fauna habitats present at each site;
- assess the sites for presence of vertebrate fauna, with special emphasis on Rare and Priority fauna taxa;
- identify regionally significant fauna habitats and ecological linkages; and
- undertake a detailed assessment of the fauna of Site 9.

3.3.2 Field Survey

A field survey of Site 9 and opportunistic surveys of all other sites was undertaken from the 24th September to 1st October 2002. A total of 15 field person days were spent surveying.

The field fauna survey was conducted at the end of September when conditions are generally moderately warm and there is still a fair likelihood of rain. The early part of the survey included overcast conditions and some rain was received at night. The latter part of the survey was fine and warm. The influence of seasons and weather conditions on the survey is discussed in detail in Section 6.2.2.

Prior to commencement of the field work aerial photographic, landform, vegetation and topographic mapping information was reviewed to develop an overview of the study area, define broad habitat units and select potential survey locations.

Habitat Appraisal

Appraisal of habitats at the study sites involved an amalgamation of available information describing landforms and vegetation types, and information obtained during site surveys. Landform and vegetation mapping was matched to the study sites to provide context for the designation of fauna habitats. This information is based primarily on the landform units of Churchward and McArthur (1980) and the vegetation complexes of Heddle *et al.* (1980).

During site surveys a general assessment of fauna habitats was made including description of vegetation types and dominant plant taxa. Information obtained from the concurrent botanical study was used to assist in refining the habitat descriptions and designations.

Opportunistic Site Surveys

A reconnaissance fauna survey was conducted to assess the natural values of selected sites (Table 1.1). This involved a field visit of between one and three hours duration, assessment and description of fauna habitats, and brief investigation of vertebrate fauna species present. Because of the opportunistic nature of these surveys effort was focussed on delineating habitats and assessing the avifauna, with reptiles and mammals recorded only as the opportunity arose.

A census for waterbird species, including ducks, grebes, cormorants, coots, etc. and shorebirds or waders (plovers, sandpipers and related forms) both migratory (as listed under international agreements JAMBA/CAMBA) and resident was conducted where appropriate habitat was present. In the case of shorebirds, muddy shorelines provide the most suitable habitat and the principal area of interest was Site 11.

Point method inventory survey techniques were used at survey sites including avifauna habitat area census and ground fauna microhabitat searching. The objective of avifauna surveys was to document the full range of species present within each area at the time of the survey. Each site was traversed as much as possible in order to provide a comprehensive list of the species present. Searching for reptiles was undertaken where appropriate including searching amongst leaf litter, under bark and logs, investigating burrows and recording opportunistic sightings.

In addition to opportunistic microhabitat searching for reptiles, an aural census was conducted near wetlands and seasonally inundated areas to identify frogs based on species specific calls. Although the surveys were carried out during the day when frogs are generally inactive, some species were detected by this method at opportunistic sites.

The information obtained during the field survey was used in conjunction with data obtained during the desktop review to provide a synopsis of the fauna likely to be present in each area, and determine lists of species that potentially occur in the region but which were not detected during the field survey. This information assists in the assessment of the regional significance of faunal assemblages and the importance of subject sites.

Additional fauna survey activities undertaken at opportunistic sites and throughout the region whilst travelling between sites included:

- identification of road kills and animal remains;
- investigation of burrows and nests;
- recording and identification of animal sign such as tracks, scats, diggings, etc.; and
- assessment of fauna habitat types and broad scale mapping.

Muddy Lakes System

A field fauna survey of Site 9 Muddy Lakes was undertaken from 25 - 30 September 2002. Following a preliminary reconnaissance of the Muddy Lakes

area, detailed survey sites were chosen on the basis that they were representative of the fauna habitats and vegetation associations within the study area, as areas of potential conservation value or ecological sensitivity, and/or as potential habitat for significant fauna taxa.

The fauna survey incorporated description of fauna habitats, detailed assessment of terrestrial vertebrate fauna communities, and inventory of vertebrate fauna species present. The survey of the terrestrial vertebrate fauna present in the Site 9 study area complies with EPA (2002a) requirements for the style of terrestrial biological surveys including reconnaissance survey and trapping. Qualitative data and selected quantitative data were collected for all fauna species occurring within the area. Secondary evidence and opportunistic sightings of all species were also recorded. A variety of groundtruthing, sampling, trapping, opportunistic collecting and observational methods were employed.

The principal component of the fauna survey involved intensive trapping grids allocated to each major habitat within the area (Table 3.3). The trapping grid arrangement within each of the Muddy Lakes north and south sub-areas was appropriate to the survey area, facilitating representation of sites within habitats whilst allowing for a sufficient spread of sites throughout the study area (Figure 2).

Table 3.3: Fauna Survey Grids

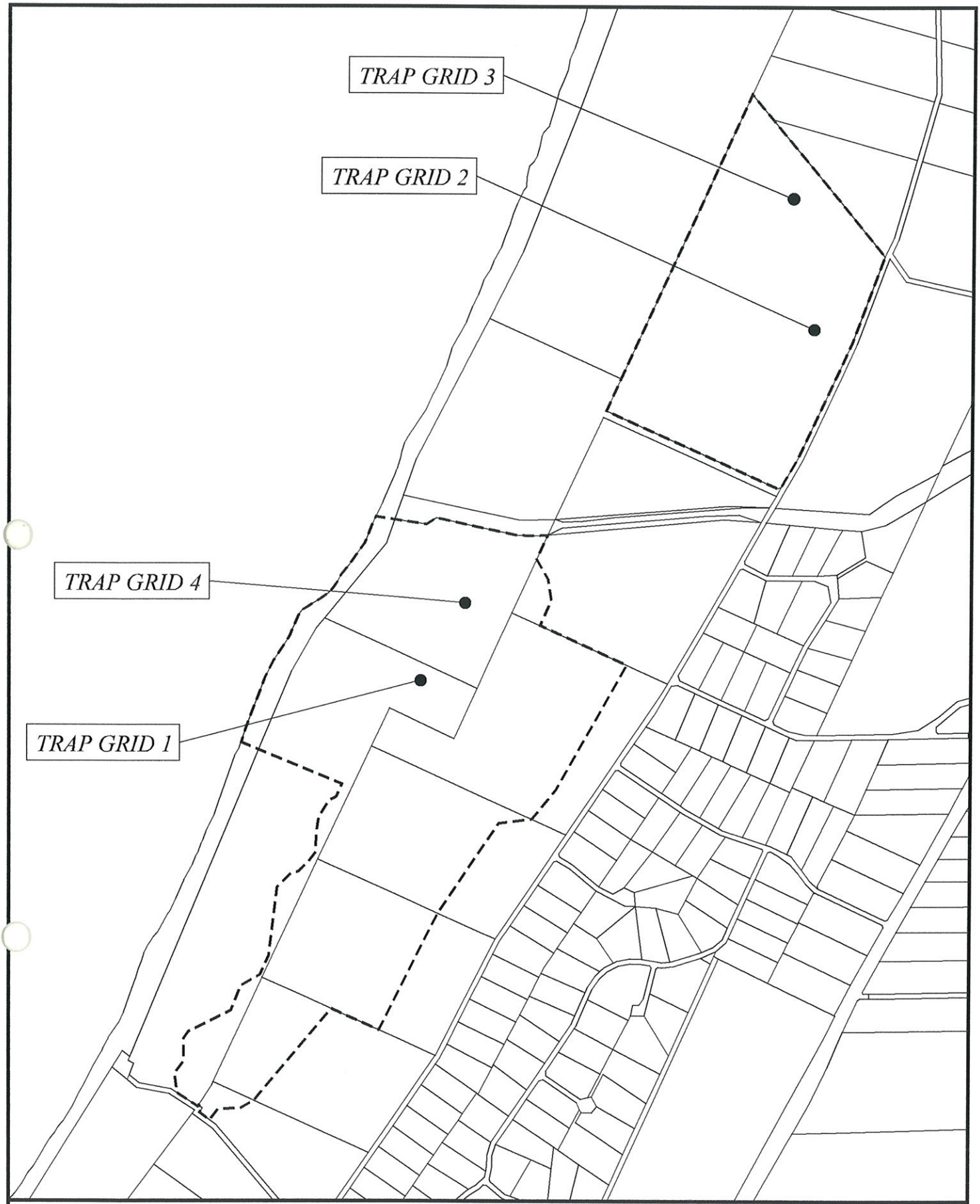
Habitat	Code	Grid	Location	Site Layout
Dune Swale	DS	1	33° 26' 17"S 115° 35' 21"E	5 pits, 20 Elliotts, 4 cage traps
Swamp	SW	2	33° 25' 32"S 115° 36' 22"E	5 pits, 20 Elliotts, 2 cage traps
Tuart Woodland	TW	3	33° 25' 15"S 115° 36' 19"E	5 pits, 20 Elliotts, 2 cage traps
Coastal Dune	CD	4	33° 26' 07"S 115° 35' 28"E	5 pits, 20 Elliotts, 2 cage traps

The trapping array utilised at fauna survey grids involved pits, Elliott and cage traps. Fauna trapping was achieved using a standardised trapping format, with Grids 2 to 4 trapped for four nights and Grid 1 trapped for five nights. An additional area in the northern section (Grid 5) was trapped with 4 cage traps only (Table 3.4). A total of 85 pit trap, 340 Elliott and 44 cage trap nights were undertaken at trapping grids within the Muddy Lakes area.

Each grid consisted of a row of five pitfall traps (20L), each with its own 6m flywire drift fence, 20 Elliott box traps arranged parallel to the pit row, and two cage traps. Elliott traps were placed approximately 20 metres apart and baited with universal bait (a mixture including rolled oats and peanut butter). Cage traps were utilised at trapping grids and in thickly vegetated areas near wetland sites to trap for medium sized mammals that may occur in the area. At systematic sites cage traps were placed at either end of the pit row in suitable microhabitat areas, and baited with apple smeared with peanut butter.

Table 3.4: Trapping at Site 9 Muddy Lakes

	Pits	Elliotts	Cages	Tubes	Arches	Spotlight
Grid 1	25	100	16	8	40	
Grid 2	20	80	8	6	30	
Grid 3	20	80	8			
Grid 4	20	80	8			
Grid 5			4			28/9/02



DRAFT GREATER BUNBURY REGION SCHEME - ENVIRONMENTAL SURVEY
FAUNA TRAP GRID - SITE 9

Department for Planning and Infrastructure

WESTERN AUSTRALIAN PLANNING COMMISSION

GDA

Filename: ...Site9muddylakes_trapsites.dgn
Created: 26 October, 2002
Produced By Cartographic Section
Bunbury Office, DPI

Location of Fauna Trapping Grids at Site 9 Muddy Lakes

Habitat	Code	Grid	Location
Dune Swale	DS	1	33° 26' 17" S 115° 35' 21" E
Swamp	SW	2	33° 25' 32" S 115° 36' 22" E
Tuart Woodland	TW	3	33° 25' 15" S 115° 36' 19" E
Coastal Dune	CD	4	33° 26' 07" S 115° 35' 28" E

N

0 300

Metres

Figure 2

The presence of mammals was also determined by identification of their scats, tracks and characteristic diggings. Baited hair sampling tubes were used to aid in the detection of mammals such as the Quokka *Setonix brachyurus* and Southern Brown Bandicoot *Isoodon obesulus fusciventer* from examination of hair characteristics. Hair sampling involved the use of two baited hair tubes (bait stations) and 10 arches in thickly vegetated areas adjacent to Grids 1 and 2. The tubes and arches were run for four nights at Grid 1 and 3 nights at Grid 2 resulting in a total of 16 tube and 70 arch sampling nights.

The method of hair sampling involves the identification of hair adhering to adhesive tape to establish the occurrence of mammalian species (Suckling 1978; Winnett and Degabriele 1982). The design of the hair tubes used was based on the improved hair-sampling tube of Scotts and Craig (1988). This involves two PVC stormwater adaptors with the bait enclosed in a small piece of piping between. Double-sided adhesive tape was attached inside the top and sides of the adaptors. In addition to the bait stations a series of arches constructed of clear PVC sheeting 30 cm in length and approximately 15cm wide were used, held in place by thin steel rods. Double-sided adhesive tape was also used on arches, which are effective in sampling hair as mammals push their way through the arch. Arches were placed in runnels amongst dense vegetation such as thick Sword Sedge *Lepidosperma gladiatum* and other swamp vegetation. Identification of mammalian hair is based on Brunner and Coman (1974) and comparison with known samples of hair from relevant species.

A census of avifauna species was undertaken at systematic trapping grids to sample bird species composition and abundance, and assess bird habitat utilisation and functional relationships, where evident. A survey of waterbird species was also conducted in the vicinity of the Muddy Lakes wetland system. Waterbirds in the area utilise the open waters of the lakes and associated pools in pasture areas, as well as the heavily vegetated swamps. Fauna survey at designated grids was supplemented by opportunistic avifauna transects and microhabitat searching throughout the Muddy Lakes study area to gain an appreciation of the fauna present and to survey for fauna species not encountered near survey grids. Aural census' were also conducted near Muddy Lakes principally during the day to identify frogs based on species-specific calls.

A general habitat description for each survey grid was made, including topography, landform and soil conditions, GPS fix, dominant vegetation types and survey dates. This allows for greater consistency with other available data for regional comparisons.

Traps on intensive survey grids were checked daily, with vertebrates identified at the point of capture and marked and/or released as appropriate. In certain instances voucher specimens were lodged with the WA Museum for verification of field identifications and to enhance the museum collections where a specimen had not previously been lodged from the study area.

A range of non-systematic fauna survey activities were also undertaken by the survey team to groundtruth the remainder of the Site and provide general coverage of fauna habitats. These included:

- searching of microhabitats for reptile, frog and small mammal species throughout the study area and recording opportunistic sightings;

- spot-lighting for nocturnal species in the northern sub-area of Muddy Lakes in Tuart Woodland habitat adjacent to a swampy area over several hours;
- habitat specific searches and trapping for potential rare and priority fauna species, specifically Quokka *Setonix brachyurus,* Western Ringtail Possum *Pseudocheirus occidentalis* and Southern Brown Bandicoot *Isoodon obesulus fusciventer*; and
- investigation of burrows, runnels, diggings, animal sign and bird nests.

The field fauna survey was conducted toward the end of September when conditions are generally moderately warm and there is still a fair likelihood of rain. The early part of the survey included overcast conditions and some rain was received at night. The latter part of the survey was fine and warm. The influence of seasons and weather conditions on the survey is discussed in detail in Section 6.2.2.

4 Regional Results

4.1 Physical Environment

Climate

The climate of the Region is Mediterranean with two seasons; a hot dry summer extending from October to April and a mild wet Winter from May to September during which the majority of rainfall is received (Seddon, 1972). The seasonal nature of the rainfall in particular is of biological significance. The "dry" period from November to March, during which evaporation exceeds precipitation, is considered to be inadequate for growth of many plants (Bagnouls & Gaussen 1957). Seasonal factors will also influence flowering periods and breeding cycles, and temperature affects fauna activity. For example, reptiles become more active in warm weather and the majority of frogs of the south-est during winter.

Climate data from Bunbury indicates an annual average rainfall of 870mm (Table 4.1). Rainfall predominantly occurs in the months May to September, and is derived from eastwardly moving low pressure systems.

Table 4.1 Climate Averages for Bunbury (Bureau of Meteorology 2002)

Location: 33.33 S, 115.63 E. Elevation: 4.0 m. Recording period: 98 years. Figures rounded to nearest integer. Ann. = annual total (rainfall) or average (temp.)

	J	F	M	A	M	J	J	A	S	O	N	D	Ann.
Rainfall (mm)	11	12	22	46	128	183	171	124	80	54	26	14	871
Daily Max. (°C)	28	28	26	23	20	18	17	17	18	20	23	25	21.8
Daily Min. (°C)	15	15	14	12	10	9	8	8	9	10	12	14	11.6

Surface Hydrology/Wetlands

Wetlands are an important habitat type for a wide range of vertebrate species and are a drastically diminished feature on the Swan Coastal Plain. Wetlands provide a breeding and foraging resource for a wide range of waterbirds, frogs, reptiles, and invertebrates, and support distinct flora and vegetation assemblages unique to wetland habitats (Balla 1995). They also provide an essential water resource for other vertebrates during the summer months.

The Region is relatively similar to other areas on the Swan Coastal Plain south of Perth in that there is considerable development of wetland features, including many that are winter wet areas or seasonally inundated sites (sumplands). Due in part to the higher rainfall received in the Region there has been a greater tendency for the formation of wetlands than in parts of the Swan Coastal Plain to the north.

Three principal types of wetlands can be recognised in the Region, these are the various basin wetlands of the coastal plain, including lakes, sumplands and damplands, the channel wetlands of the area including rivers and creeks, and the marine derived estuaries and near coastal lakes.

Principal wetlands within the Region include Myalup Swamp, Mialla Lagoon and the Kemerton wetlands, Benger Swamp, Muddy Lakes, Marriott Road

Swamp and Australind Egret Swamp (also known as Laporte Swamp and Morangarel Nature Reserve) east of the Leschenault Estuary. Other seasonally inundated areas and pools throughout the Region, many of which have been converted to pastures, also provide feeding areas for waterbirds.

A considerable number of wetlands in the Region are covered by the Environmental Protection Policy (EPP) relating to wetlands on the Swan Coastal Plain (EPA 1993). Under this policy, it is an offence to impact either directly or indirectly on an EPP wetland (EPA 1993).

The major river systems of the Region are the Wellesley, Brunswick and Collie River system in the central portion, and the Preston and Ferguson River system in the south. Both these systems flow into the Leschenault Estuary in the vicinity of Vittoria Bay. Here deposition of sediment has resulted in the formation of extensive deltaic features, including mudflats, islands and shallow pools that are important feeding and roosting areas for waterbirds.

The Leschenault Estuary in the middle portion of the Region and Lake Preston in the north are marine derived, variously saline, permanent water features. The Estuary includes a range of habitats, including the estuarine, tidal main water body, fringing mudflats and samphire areas, and adjacent *Melaleuca* thickets and swamps. It is the most important wetland in the Region for waterbirds, particularly as a summer refuge and as a feeding and roosting area for migratory waders (Ninox 1989). Salinity is influenced by freshwater inflow from river systems and marine ingress from the man made cut which connects the Estuary to the ocean. The Estuary has been significantly modified since settlement, particularly in the area adjacent to the City of Bunbury and along the eastern margins. The western side of the Estuary is relatively intact and conserved in the Leschenault Peninsula Park.

4.2 Swan Coastal Plain Bioregion

The Interim Biogeographic Regionalisation for Australia (IBRA) recognises 85 bioregions across Australia delineated on the basis of factors including climate, geomorphology, landform lithology and characteristic flora and fauna. The study area lies within the southern portion of the Swan Coastal Plain bioregion, which is described by Thackway and Cresswell (1995) as follows:

> 'Low lying coastal plain, mainly covered with woodlands. It is dominated by *Banksia* or Tuart on sandy soils, *Casuarina obesa* on outwash plains, and paperbark in swampy areas. In the east, the plain rises to duricrusted Mesozoic sediments dominated by Jarrah woodland. Warm Mediterranean. Three phases of marine sand dune development provide relief. The outwash plains, once dominated by *C. obesa*-marri woodlands and *Melaleuca* shrublands, are extensive only in the south.'

With an area of 15,181 km^2, the Swan Coastal Plain bioregion is within the smallest area class, other regions varying from 2,000 to over 400,000 km^2 (Thackway & Cresswell 1995) and most being between 14,000 and 200,000 km^2 in size. The Swan Coastal Plain bioregion is smaller than the adjacent Jarrah Forest bioregion (46,078 km^2) but larger than the southern Warren bioregion (10,420 km^2).

Dominant limiting factors and constraints for the Swan Coastal Plain include urbanisation, feral fauna, weeds, clearing of vegetation and agricultural activities. The reservation status of the bioregion is 1 - 5%, which is relatively low (some bioregions have a greater than 10% reservation status).

4.3 Vegetation and Flora

4.3.1 Vegetation

Vegetation complexes have been defined in relation to the landform-soil units for the Swan Coastal Plain by Heddle *et al.* (1980). A total of 29 vegetation complexes defined by Heddle *et al.* (1980) were described in the Greater Bunbury Region (WAPC 2000). Of these, 10 occurred within the sites of this study (Table 4.2). It should be noted that at some sites field observations did not agree with the regional dataset.

Table 4.2: The Total Area of Each Vegetation Complex within the Total Area of the Sites of this Study

Vegetation Complex	Area (ha)
Bassendean Complex - Central and South	54.9
Cartis Complex	80.6
Guildford Complex	153.1
Karrakatta Complex	147.0
Kingia Complex	9.8
Quindalup Complex	172.0
Southern River Complex	26.9
Swan Complex	54.5
Vasse Complex	393.4
Yoongarillup Complex	72.0
Total	1164.2

Within the Figure 4 search area, eight TECs were listed from the database search, listed in Table 4.3 (Melissa Hoskins, CALM, pers. comm.). One of these (type SCP 3c) is also listed as 'endangered' under the *EPBC Act 1999*.

Table 4.3: The threatened ecological communities identified within the vicinity of the 12 sites of this study (after Gibson *et al.* 1994 and DEP 1996; SCP is equivalent to FCT)

TEC No.	Description	Category
14. SCP18	Shrublands on calcareous silts of the Swan Coastal Plain	Vulnerable
17. SCP3c	*Eucalyptus calophylla*^ - *Xanthorrhoea preissii* woodlands and shrublands, Swan Coastal Plain	Critically Endangered
20. SCP20b	*Banksia attenuata* and/or *Eucalyptus marginata* woodlands of the eastern side of the Swan Coastal Plain	Endangered
22. SCP1b	*Eucalyptus calophylla*^ woodlands on heavy soils of the southern Swan Coastal Plain	Vulnerable
23. SCP3b	*Eucalyptus calophylla*^ - *Eucalyptus marginata* woodlands on sandy clay soils of the southern Swan Coastal Plain	Vulnerable
32. SCP07	Herb rich saline shrublands in clay pans	Vulnerable
32. SCP08	Herb rich saline shrublands in clay pans	Vulnerable
34. SCP09	Dense shrublands on clay flats	Vulnerable

^ *Eucalyptus calophylla* is nomenclaturally synonymous with *Corymbia calophylla*, which is the name recognised by the WA Herbarium.

40 structural vegetation units were recorded during the field survey of the 12 study sites (Table 4.4). The floristic composition of these units is presented in Appendix B, and the raw data is presented in Appendix C. A photograph taken at each plot can be viewed in Appendix D.

Table 4.4: The structural vegetation units recorded within the 12 sites of this study (W = wetland, U = upland)

Unit		Structural Vegetation Description
1.1	W	*Kunzea glabrescens* Closed Tall Scrub with emergent *Melaleuca preissiana* and *Corymbia calophylla*
2.2	W	*Melaleuca rhaphiophylla* Open Woodland (scattered native plants)
3.4	W	*Corymbia calophylla* Open Forest over *Agonis flexuosa* var. *flexuosa* Low Open Forest
4.1	W	*Corymbia calophylla* and *Agonis flexuosa* var. *flexuosa* Open Forest
4.2	W	*Eucalyptus rudis* subsp. *rudis* and *Agonis flexuosa* var. *flexuosa* Open Forest
4.3	W	*Agonis flexuosa* var. *flexuosa* Closed Forest
4.4	W	*Melaleuca preissiana* and *Agonis flexuosa* var. *flexuosa* Low Open Forest
4.5	W	*Melaleuca rhaphiophylla* Low Open Forest
4.6	W	*Corymbia calophylla* and *Eucalyptus marginata* subsp. *marginata* Open Woodland over Tall Shrubland dominated by *Melaleuca preissiana, Banksia littoralis, Agonis flexuosa* var. *flexuosa* and *Kunzea glabrescens* and combinations of these
5.1	W	*Eucalyptus rudis* subsp. *rudis* and *Melaleuca rhaphiophylla* Woodland
5.2	W	*Melaleuca rhaphiophylla* Closed Forest
5.3	W	*Eucalyptus rudis* subsp. *rudis* Woodland over *Agonis flexuosa* var. *flexuosa* and *Melaleuca rhaphiophylla* Woodland with occasional *Corymbia calophylla*
7B.1	W	*Melaleuca rhaphiophylla* and *Melaleuca viminea* subsp. *viminea* Low Open Forest
7B.2	W	Closed Sedgeland dominated by *Juncus kraussii* subsp. *australiensis, Triglochin huegelii, Baumea juncea* and **Juncus oxycarpus* and combinations of these
7B.3	W	*Halosarcia lepidosperma, Halosarcia indica* subsp. *bidens* and *Juncus kraussii* subsp. *australiensis* Open Low Heath
8.3	W	*Eucalyptus rudis* subsp. *rudis* and *Melaleuca rhaphiophylla* Open Forest over *Melaleuca incana* subsp. *incana* Tall Open Scrub
8.4	W	*Corymbia calophylla, Eucalyptus rudis* subsp. *rudis* and *Casuarina obesa* Woodland
9.1	W	*Lepidosperma gladiatum* Sedgeland
9.3	W	*Eucalyptus gomphocephala* Closed Forest over *Agonis flexuosa* var. *flexuosa* Low Open Forest
9.6	W	*Banksia littoralis* Low Woodland over Tall Open Scrub dominated by *Xanthorrhoea preissii, Anthocercis littorea* and *Acacia saligna*
9.7	W	Closed Sedgelands dominated by *Lepidosperma gladiatum, Carex appressa, *Typha orientalis* and *Pteridium esculentum* and combinations of these with emergent *Acacia saligna, Banksia littoralis, Agonis flexuosa* var. *flexuosa* and *Melaleuca rhaphiophylla*
9.8	W	Mosaic of units 9.1 and 9.7
9.9	W	*Agonis flexuosa* var. *flexuosa* Low Open Forest
9.10	W	Mosaic of units 9.6 and 9.9

Unit		Structural Vegetation Description
10.3	W	*Melaleuca rhaphiophylla* and *Melaleuca teretifolia* Low Open Forest with emergent *Eucalyptus rudis* subsp. *rudis*
10.4	W	*Melaleuca rhaphiophylla* and *Melaleuca teretifolia* Low Open Forest with emergent *Eucalyptus rudis* subsp. *rudis* (10.3 in better condition)
11.1	W	*Juncus kraussii* subsp. *australiensis* Closed Sedgeland with emergent *Casuarina obesa* and *Eucalyptus rudis* subsp. *rudis*
1.2	U	*Corymbia calophylla, Eucalyptus marginata* subsp. *marginata, Banksia attenuata* and *Banksia ilicifolia* Open Woodland over *Kunzea glabrescens* Tall Open Scrub
1.3	U	*Eucalyptus marginata* subsp. *marginata, Corymbia calophylla, Banksia attenuata* and *Banksia ilicifolia* Woodland over *Allocasuarina humilis* and *Xanthorrhoea brunonis* subsp. *brunonis* Shrubland
2.1	U	*Eucalyptus gomphocephala* and *Agonis flexuosa* var. *flexuosa* Open Forest to Woodland
3.1	U	*Banksia attenuata, Eucalyptus marginata* subsp. *marginata* and *Xylomelum occidentale* Low Open Woodland over *Melaleuca thymoides, Kunzea glabrescens, Hypocalymma robustum* and *Adenanthos meisneri* Shrubland
3.2	U	*Eucalyptus marginata* subsp. *marginata* and *Corymbia calophylla* Woodland over *Banksia grandis* Low Open Woodland
3.3	U	*Eucalyptus marginata* subsp. *marginata* and *Corymbia haematoxylon* Woodland over *Xanthorrhoea preissii* Open Shrubland
6.1	U	*Eucalyptus marginata* subsp. *marginata* and *Corymbia calophylla* Woodland over *Xanthorrhoea preissii, Acacia pulchella* and *Acacia flagelliformis* Open Shrubland
7A.1	U	Very Open Grassland dominated by **Ammophila arenaria, *Pelargonium capitatum* and *Olearia axillaris*
7A.2	U	*Agonis flexuosa* var. *flexuosa* and *Jacksonia furcellata* Tall Shrubland over *Alyxia buxifolia* and *Acanthocarpus preissii* Open Heath
7A.3	U	*Eucalyptus gomphocephala* and *Agonis flexuosa* var. *flexuosa* Low Open Forest over *Spyridium globulosum* and *Alyxia buxifolia* Open Heath
8.1	U	*Corymbia calophylla* and *Eucalyptus marginata* subsp. *marginata* Open Forest to Woodland over *Banksia grandis* and *Agonis flexuosa* var. *flexuosa* Woodland
8.2	U	*Corymbia calophylla* and *Eucalyptus marginata* subsp. *marginata* Woodland over *Jacksonia furcellata, Kunzea glabrescens* and *Agonis flexuosa* var. *flexuosa* Woodland
9.2	U	*Agonis flexuosa* var. *flexuosa* Open Forest
9.4	U	Open Low Heath dominated by *Scaevola crassifolia, *Pelargonium capitatum* and *Olearia axillaris*
9.5	U	Open Low Heath dominated by *Acanthocarpus preissii, Phyllanthus calycinus, Acacia cochlearis* and *Lepidosperma gracile* with emergent *Agonis flexuosa* var. *flexuosa*
10.1	U	*Eucalyptus gomphocephala, Corymbia calophylla* and *Eucalyptus marginata* subsp. *marginata* Open Forest over Low Woodland dominated by *Banksia attenuata, Banksia grandis, Agonis flexuosa* var. *flexuosa* and *Xylomelum occidentale* and combinations of these
10.2	U	*Eucalyptus gomphocephala* Open Forest over *Agonis flexuosa* var. *flexuosa* Low Open Forest

4.3.2 Total Flora

The field survey of September 2002 recorded a total of 424 vascular plant taxa (including incomplete identifications) from 256 genera and 79 families. Of these, 94 were weed taxa. The vascular plant taxa recorded from each family during the field survey are listed in Appendix A. Appendix B lists the taxa recorded in each of the vegetation community units.

The number and range of flora collected during the survey was compared with data from the surveys of ATA Environmental (2001a and b) and the records of the WA Herbarium.

The WA Herbarium holds vouchers of 1,539 flora taxa from the general vicinity of the 12 GBRS sites (Figure 4). ATA Environmental (2001a and b) list 147 and 135 taxa from Sites 8 and 10 respectively. Neither of these collection lists represents the entire flora of the Region, but provide some comparison to the present study. It appears that no taxa recorded during the present survey have not been previously recorded in the area.

4.3.3 Flora of Conservation Significance

81 Priority or Declared Rare Flora were identified in the searches of CALM and WA Herbarium databases (Appendix K). Of these, six were identified in the Spring 2002 survey in 12 of the vegetation units (Table 4.5). A voucher specimen of all priority flora will be submitted to the WA Herbarium. All of the priority taxa recorded during this survey are known to occur in reserves of the Swan Coastal Plain (Keighery 1999). In addition to the priority taxa recorded here, a DRF *Diuris drummondii* which is also listed as Vulnerable under the *EPBC Act 1999* was recorded at Site 8 by ATA Environmental (2001a). This summer flowering DRF was not recorded during the Spring 2002 survey.

Table 4.5: Priority taxa recorded within vegetation units during the Spring 2002 survey, and the number of reserves in which the taxa occur (Keighery 1999).

Species	Status	Reserves	Vegetation Unit											
			1.1	1.2	1.3	3.1	3.2	3.3	3.4	4.4	6.1	8.2	10.1	10.2
Acacia flagelliformis	P4	2		+			+	+			+			
Acacia semitrullata	P3	1	+			+	+							
Caladenia speciosa	P4	1		+				+			+	+	+	+
Drosera ?marchantii subsp. *marchantii*	P4	1							+					
Jacksonia sparsa ms	P4	5	+	+	+	+				+			+	
Lasiopetalum membranaceum	P3	4										+		+

An additional six taxa recorded during the Spring 2002 survey are recognised as significant flora (Table 4.6). These flora are listed as unreserved taxa of the Swan Coastal Plain by Keighery (1999). Flora that are unreserved on the Plain but known to be common in the south-west are not listed here (such as *Leucopogon capitellatus*). Five flora recorded during the Spring 2002 were listed as significant flora in Bush Forever (Government of WA 2000b); *Acacia littorea, Agonis flexuosa, Diplolaena dampieri, Hbbertia cuneiformis* and *Kennedia coccinea*. While these flora were significant in the Perth Metropolitan Region they are not significant within the Greater Bunbury

Region. For example, *Agonis flexuosa* was recognised as being at the northern limit of its known geographic range in the Perth Metropolitan Region (Government of WA 2000b) but this is not the case in the Greater Bunbury Region.

Table 4.6: Taxa recorded within vegetation units during the Spring 2002 survey not know from reserves on the Swan Coastal Plain.

Species	Vegetation Unit											
	1.1	1.2	1.3	3.4	4.1	4.4	4.6	5.3	8.1	9.1	9.7	10.1
Acacia pulchella var. *goadbyi*				+	+	+	+	+				
Acacia urophylla				+								
Calycopeplus oligandrus										+	+	
Drosera nitidula subsp. *nitidula*	+											
Logania serpyllifolia subsp. *angustifolia*		+	+						+			+
Schoenus sublateralis	+											

Of the unreserved taxa, one appears to be of restricted nature. *Calycopopeplus oligandrus* has only been recorded from two wetland localities on the Swan Coastal Plain according to WA Herbarium records and Keighery (1999), Big Swamp and Abba Rivers. This taxa was also identified as significant in Keighery *et al.* (2002).

4.3.4 Weeds

Of the 94 weeds recorded during the Spring 2002 survey, three are Declared Plants pursuant to Section 37 of the *Agriculture and Related Resources Protection Act 1976*:

- **Rubus ulmifolius* (Blackberry);
- **Zantedeschia aethiopica* (Arum Lily); and
- **Solanum linnaeanum* (Apple of Sodom).

Weeds that were recorded during the survey that are not Declared Plants but have significant environmental impact may pose a threat to the bushland and should be controlled are listed in Table 4.7. Table 4.7 also lists other weeds of agricultural or environmental impact that are known from the Region (Brett Vukelic, WA Department of Agriculture, pers. comm.).

Table 4.7: Declared Plants (DP) and weeds identified within the 12 sites of this study or that may pose a threat to the bushland.

Weed	Common name	Recorded during survey	DP	Potential threat
Solanum linnaeanum	Apple of Sodom	+	+	
Zantedeschia aethiopica	Arum Lily	+	+	
Rubus ulmifolius	Blackberry	+	+	
Ammophila arenaria	Maram Grass	+		
Asparagus asparagoides	Bridal Creeper	+		
Cortaderia selloana	Pampas Grass	+		
Erharta calycina	Perennial Veldt Grass	+		
Pelargonium capitatum	Rose Pelargonium	+		
Watsonia mariana subsp.	Watsonia	+		

Weed	Common name	Recorded during survey	DP	Potential threat
bulbillifera				
Chondrilla juncea	Skeleton Weed		+	+
Eichhornia crassipes	Water Hyacinth		+	+
Moraea species	Cape Tulip		+	+
Salvinia molesta	Salvinia		+	+

4.3.5 Regional Linkage

Many sites contribute or were directly linked to remnant bushland recognised as representing regionally significant sequences of ecological communities (EPA 2002b). Others not identified by the EPA (2002b) had direct bushland links to System 6 areas or National Parks so were identified as regionally significant sequences. Table 4.8 summarises the relationship of the 12 sites of this study to regionally significant sequences.

Table 4.8: Regional linkage of the 12 sites of this study.

GBRS Site	Regionally Significant Sequence					
	A	B	C	D	E	F
1			+			
2		+				
3				+		
4	+			+		
5			+			
6						
7A						+
7B					+	
8			+		+	
9		+				
10	+					
11						+

A. Ocean to Preston River Park (C70)
B. Dalyellup/Gelorup/Preston River/Plateau Link (C71, C86)
C. Brunswick, Collie and Wellesley Rivers Corridor (C67)
D. Preston River Corridor
E. Link to other System 6 areas (C 66 Leschenault Estuary)
F. Link to National Parks (Yalgorup)

4.4 Fauna

4.4.1 Zoogeography

The Greater Bunbury Region lies within the boundary of the major zoogeographic region of the mesic South West (Serventy & Whittell 1976), a sub-region of the wider southern Bassian zoogeographic region. At a finer scale, the majority of the area is within the Swan Coastal Plain bioregion (Thackway & Cresswell 1995). There is some separation of species that utilise the coastal plain or the forests of the Darling Range, and some species are almost entirely restricted to the Swan Coastal Plain.

The vertebrate fauna of the Region are attuned to the regular winter rainfall and cool temperatures that prevail in the south-west region through much of the

year, as well as the relatively regular summer drought. Amongst the birds and mammals there is relatively high species richness, whereas reptiles tend to be fairly poorly represented in the south-west in comparison to the arid zone.

The south-west has developed a wide variety of species that are endemic and it is recognised internationally as a biodiversity 'hotspot' (Myers *et al.* 2000). Much of the speciation in vertebrates is thought to have resulted from separation of once widespread species in southern Australia into populations in south-western and south-eastern Australia following development of arid conditions in central Australia during the Pleistocene.

4.4.2 Previous Fauna Studies

Systematic fauna surveys in the area of the southern Swan Coastal Plain south of Mandurah have been relatively limited in comparison to those around Perth. This review relates to the fauna of the Greater Bunbury Region, but some reference has been made to other comprehensive studies on the Swan Coastal Plain where relevant.

Detailed biological surveys of terrestrial vertebrate fauna have been conducted specifically within the study area only at Site 8 (Ecologia 2001) and at Dalyellup Beach Estate adjacent to Sites 2 and 10 (ATA Environmental 1998). These site-specific reports are described Section 5.

Bow (1999) trapped three remnant bushland sites adjacent to Site 10 for ground vertebrate fauna in the vicinity of the City of Bunbury and recorded six frogs and 14 reptile species. Opportunistic records included the Priority species Southern Brown Bandicoot *Isoodon obesulus fusciventer* and Brush Wallaby *Macropus irma* (Appendix E).

The most comprehensive information concerning the range of vertebrate fauna that potentially occurs in the Region is drawn from the Kemerton vertebrate fauna surveys (Nichols 1980, Bamford and Watkins 1983, Watkins 1983 and Ninox 1985). 10 native mammals, eight amphibians (two hylids and six myobatrachids) and 24 reptiles from eight families were recorded from the Kemerton area. More than 80 bird species were recorded during the Kemerton surveys including approximately 30 waterbird species. Some of the wetlands were found to support breeding colonies of waterbirds.

A large and comprehensive biological survey of the Northern Swan Coastal Plain was carried out by the WA Museum in 1977-78 and gives an indication of change in fauna assemblages since settlement. How and Dell (1994) analysed reptile utilisation of bushland remnants in the Perth region and Bush *et al.* (1995) provide general descriptions of the reptiles and frogs that occur.

Dell *et al.* (2002) described the vertebrate fauna of Tuart Woodlands, including three sites in the Bunbury Region; Yalgorup National Park, The Maidens and Ludlow Tuart Forest. A total of 92 species of birds, 16 mammals, 43 reptiles and seven frogs have been recorded from Tuart Woodlands, although not all of these species would be expected to occur in the Region.

As a group, birds are the best studied vertebrate group on the Swan Coastal Plain, with detailed knowledge of local distribution, relative abundance, residency status, habitat preferences and breeding season for most species (Storey *et al.* 1993; Storr *et al.* 1978; Storr & Johnstone 1988). Approximately 180 avifauna species are expected to occur in the habitats of the Greater

Bunbury Region based on the findings of Storr *et al.* (1978) and Storr & Johnstone (1988). Bird surveys within the Region have been undertaken by members of Birds Australia and studies of the flora and fauna of certain sites have been carried out by the Bunbury Naturalists Club.

Storey *et al.* (1993) surveyed waterbird usage on the Swan Coastal Plain from Lancelin to Bunbury. Their survey included a series of 20 sites that lie within the Bunbury Region including Benger Swamp, swamps near the Leschenault Estuary, and the Punchbowl. Sites varied in waterbird species richness from two species to over 20, and a total of 43 waterbird species were recorded from the Region, including ducks, cormorants, egrets, herons, terns and waders.

Ninox (1989) found the Leschenault Estuary is a significant area for waterbirds within a regional context, with 58 waterbird species recorded and 16 waterbird species noted as breeding on the Estuary, and up to four thousand waterbirds being observed at one time. The Estuary supports 15 species of migratory waders, two terns and an egret protected under international agreements. The majority of migratory species were recorded during the months October to March.

4.4.3 Significant Fauna

EPBC Act 1999

Species listed under the *EPBC Act 1999* that were recorded during this survey or are known to occur include Carnaby's Black-Cockatoo *Calyptorhynchus latirostris* which is listed as Endangered, and Baudin's Black-Cockatoo *Calyptorhynchus baudinii,* Chuditch *Dasyurus geoffroii,* Western Ringtail Possum *Pseudocheirus occidentalis* and Quokka *Setonix brachyurus* which are listed as Vulnerable. These species are also listed under the *Wildlife Conservation Act 1950* as Schedule 1 and are discussed below.

Wildlife Conservation Act 1950

10 Scheduled and seven Priority Fauna species were identified in the CALM databases search (Appendix K) that may occur in the study area. A summary of their habitats and status in the Region is provided below.

Schedule 1 (Fauna which is rare or likely to become extinct)

Chuditch *Dasyurus geoffroii*

The Chuditch or Western Quoll is a large dasyurid (predatory marsupial). It is generally uncommon on the coastal plain but is regularly recorded from forested areas in the south-west, particularly where fox baiting has been implemented. Occasional sightings of this species have been made south of Bunbury in near coastal areas (Kim Williams, CALM, pers. comm.). These individuals are likely to be vagrants dispersing through the area, although resident populations may become established.

Western Ringtail Possum *Pseudocheirus occidentalis*

This nocturnal possum is generally associated with groves of Peppermint *Agonis flexuosa* (Strahan 1995), and is likely to use Tuart *Eucalyptus gomphocephala* woodlands in the Bunbury Region, particularly where there is an understorey of Peppermint. Whilst not common in the Region this species is encountered on a regular basis within the coastal strip from Bunbury to

Dunsborough. The known current range of wild populations of this species is from Bunbury to Albany along the coast (Jones *et al.* 1994). The CALM database and ATA Environmental (1998) record this species from Dalyellup Beach. A single individual was observed in a Peppermint adjacent to Grid 1 at Site 9 during the Spring 2002 survey.

Quokka *Setonix brachyurus*

The Quokka was once common in south-western Australia and is still relatively abundant at Rottnest Island. However, mainland populations are principally restricted to the moister forested areas in the extreme south-west of the State, particularly the Walpole-Nannup-Northcliffe area and the Stirling Range National Park (Appendix H). The Quokka appears to have almost completely disappeared from the Swan Coastal Plain, the nearest known records to the Bunbury Region apart from Muddy Lakes are from Collie and Harvey (Sinclair 1998). Quokkas prefer densely vegetated, moist conditions such as swampy thickets, and are mainly nocturnal.

The Muddy Lakes area is one of few remaining places where this species has been reported on the Swan Coastal Plain in the past twenty years. The most recent record on the CALM database is of a sighting and skeletal material in 1974, with earlier records in 1954 and 1926. Records from the WA Museum database indicate a skeletal material record from Muddy Lake again in 1975 (Appendix H). During the current survey skeletal material, including a skull and dentary, was recovered from the western side of Muddy Lakes. This material was confirmed by the WA Museum and subsequently lodged (Museum Accession No. M54132). The skeleton is presumed to be only a few years old, and along with reports of Quokka sightings and records within the past five years at Muddy Lakes, suggests that a population may exist at the site despite frequent fires and grazing.

Remnant mainland populations in dense swampy vegetation often comprise fewer than ten individuals (Sinclair 1998), so it is possible that Quokkas may persist in the area at very low densities and in relatively isolated situations. The most suitable areas of habitat would be along the western side of the southern part of the site (9B) and in the densely vegetated swampy central portion. Potentially suitable habitat also occurs in the northern part of the site (9A).

Carnaby's or Short-billed Black Cockatoo *Calyptorhynchus latirostris*
Baudin's or Long-billed Black Cockatoo *Calyptorhynchus baudinii*

These two large species of Cockatoo are endemic to the south-west, and have diminished in range and population size since European settlement. Baudin's Black Cockatoo breeds in the south-west forests in country with a mean annual rainfall exceeding 750 mm, whereas Carnaby's Black Cockatoo generally breeds in regions with rainfall less than 750 mm (Blakers *et al.* 1984).

Carnaby's Black Cockatoo is a visitor to the Swan Coastal Plain region during spring and is likely to use the Jarrah / Marri woodlands of the Region for foraging but is not likely to breed in the area. Two individuals were recorded during the current survey adjacent to the Australind Bypass on the outskirts of Bunbury and it is likely to occur elsewhere within the study area on the coastal plain.

Baudin's Black Cockatoo generally occurs in the forested parts of the south-west, but also occurs in near coastal areas near Bunbury, and the eastern coastal

plain as far north as Perth. A large flock of this species of more than 80 individuals was recorded from the study area at Site 3 feeding on Marri, and several individuals were heard calling near Site 2.

Australasian Bittern *Botaurus poiciloptilus*

The Australasian Bittern lives in dense reed beds or swamp edges (Blakers *et al.* 1984). This bird is uncommon in the south-west but has been recorded on several occasions at Benger Swamp Nature Reserve in recent times and was observed by Sedgwick (1973). Wetland habitats within the Muddy Lakes area may be suitable for this species.

Schedule 3 (Birds which are subject to an International Agreement)

Refer to the section below "***Migratory Bird Agreements***" for details on migratory bird species.

Schedule 4 (Fauna which is Otherwise Specially Protected)

Peregrine Falcon *Falco peregrinus*

The Peregrine Falcon is uncommon but widespread throughout Australia. It is an uncommon visitor to lightly wooded country on the Swan Coastal Plain from January to July and September to November (Storr & Johnstone 1988). It is likely to be an occasional visitor to the Region.

Carpet Python *Morelia spilota imbricata*

The southern subspecies *M. spilota imbricata* of the Carpet Python is widespread but uncommon in south-west Western Australia. This python is semi-arboreal and is most frequently recorded in woodland and forest areas where it seeks shelter in hollow logs. In recent times it is rarely recorded near population centres but may occur in larger tracts of remnant bushland. The nearest records for the species are from the Margaret River area and the Darling Scarp. Although no specimens were recorded during the survey, certain habitats within the study area, such as the tuart woodlands, provide potential habitat for this species.

Priority 2

Black Bittern *Ixobrychus flavicollis australis*

In the south-west the Black Bittern tends to occur in thick vegetation such as paperbark woodland surrounding swamps (Blakers *et al.* 1984), and previously in fringing woodlands along major rivers such as the Collie, Preston and Capel. The CALM database indicates that the Black Bittern was last recorded in the Bunbury Region at Preston River and along the lower reaches of the Capel River. Both records are old (1931) and Storr and Johnstone (1988) indicate that it is almost extinct on the coastal plain. The isolated south-west population has not been reported breeding since the 1950's and has declined considerably (Blakers *et al.* 1984).

Priority 3

Brush-tailed Phascogale or Wambenger *Phascogale tapoatafa*

The Phascogale is an arboreal, nocturnal predator. Whilst known from the forested south-west and the Margaret River area, the only locations near

Bunbury where this species has been recorded is on the Leschenault Peninsula and at Ludlow Tuart Forest in Tuart / Peppermint woodland and forest (Dell *et al.* 2002). This species potentially occurs in relatively large remnants of woodland (Strahan 1995).

Forest Red-tailed Black-Cockatoo *Calyptorhynchus banksii naso*

The forest subspecies of the widespread Red-tailed Black-Cockatoo is restricted to the Jarrah and Karri forests of the south-west and has declined due to the destruction of forests. It is likely to be present in the eastern portions of the Greater Bunbury Region near the Darling Range. There is potential habitat for this species at Site 3.

Masked Owl *Tyto novaehollandiae novaehollandiae*

The south-west subspecies of the Masked Owl is rarely reported although may be more common than observations indicate because of its secretive nocturnal habits. The CALM database indicates a dead specimen from the Region in 1971 and an extant population is known from the Ludlow Tuart Forest (Kim Williams, CALM, pers. comm.). This species may occur in areas where farmland adjoins forest pockets.

Black-stripe Minnow *Galaxiella nigrostriata*

This native minnow primarily inhabits the coastal peat flats of the south-west but disjunct populations have been discovered near Bunbury (Morgan *et al.* 1998). The CALM database lists four records in the Region in recent years. Morgan *et al.* (1998) suggest that the discontinuity in distribution may be mostly attributable to the loss of habitat caused by widespread urban and rural development.

Priority 4

Southern Brown Bandicoot or Quenda *Isoodon obesulus fusciventer*

Since European settlement, the Southern Brown Bandicoot has undergone a range contraction that is largely thought to be the result of land clearance and introduced predators such as the fox (Strahan 1995). The Southern Brown Bandicoot is nocturnal and prefers to stay close to cover when searching for food, negotiating runnels in dense vegetation and seeking out adjacent open habitat patches. It digs characteristic small conical burrows.

The western subspecies of the Southern Brown Bandicoot *Isoodon obesulus fusciventer* occurs generally in dense vegetation near wetlands. It has been recorded widely but sporadically throughout the southern Swan Coastal Plain from Perth to Busselton. They are relatively common within the Region and are known to occur in areas around Bunbury City. Bandicoots were recorded from three locations at Muddy Lakes during the current survey, and additional populations may exist there. This species has been recorded from Yalgorup National Park, Leschenault Peninsula Park and the Dalyellup Beach Estate (Alan Tingay and Associates 1998b). Loss of habitat significantly affects this species because adults do not tend to move on once established.

Western Brush Wallaby *Macropus irma*

The Brush-tailed Wallaby is a medium sized macropod endemic to south-western Australia. Wallaby numbers have declined significantly in the last 25 years due to predation by foxes and loss of habitat, and consequently there are

few populations remaining in the Bunbury region. This species is likely to occur in Woodland habitat in the study area, particularly areas of Tuart Woodland which provide grassy foraging areas.

This species appears able to persist in moderate sized remnants particularly where there are suitable areas of dense undergrowth. The CALM database lists a record from Muddy Lakes (1975) and one from Manea Park (1999). This species has also been reported from semi-rural blocks immediately to the east of Muddy Lakes and is therefore likely to occur at that site. No Brush Wallabies were observed during the field survey.

Water Rat *Hydromys chrysogaster*

The Water Rat usually lives in the vicinity of permanent water and is semi-aquatic. Its numbers on the Swan Coastal Plain have declined due to clearing and draining of swamps, however, populations still exist in the Region at Leschenault Peninsula. It may occur at Muddy Lakes although no evidence of this species was found during the field survey.

Western False Pipistrelle *Falsistrellus mackenziei*

This small insectivorous bat is endemic to the southern forests where it relies on trees for roost sites (Churchill 1998). It is known from the forests of the Darling Range and the coastal belt, and there is a record for the Ludlow area. This species was captured by Bamford and Watkins (1983) at Kemerton (as *Pipistrellus tasmaniensis*) and is likely to occur at woodland sites in the Region.

Little Bittern *Ixobryxhus minutus*

This small Bittern is only known from the Region at Benger Swamp Nature Reserve. It inhabits the dense vegetation of swamps, lakes and rivers, in the south-west favouring dense, mature sedge beds of *Typha* or *Baumea* (Blakers *et al.* 1984).

Bush Stonecurlew *Burhinus grallarius*

The Bush Stonecurlew is a ground nesting bird that tends to inhabit open woodlands. This species rarely occurs on the coastal plain in the Region.

Eastern Curlew *Numenius madagascariensis*

The Eastern Curlew is a large migratory shorebird (wader) that visits Australia on a seasonal basis where it utilises mudflats for feeding. Whilst more commonly reported from northern Australia some birds reach the south-west and the coastal plain. This species has been recently reported from the region and is known from the Leschenault Estuary (Ninox 1989).

Hooded Plover *Thinornis rubricollis*

The Hooded Plover lives on beaches but also inhabits shorelines of lakes, such as Lake Preston in Yalgorup National Park. There are several records on the CALM database for this species in the region. The principal threat to the Hooded Plover is from disturbance to nests, which consist of a scrape in the sand on beaches.

Crested Shrike-tit *Falcunculus frontatus leucogaster*

The south-western subspecies *leucogaster* of the endemic Crested Shrike-tit is sparsely distributed but is reliably reported from several locations within the south-west, including areas near Margaret River and sites in the forest. There is a record listed in the CALM database from the Region in 1939. It may potentially occur in Tuart forest in the region but was not observed during the field survey.

Migratory Bird Agreements

A total of 66 species are listed in the annex to JAMBA and 81 species under CAMBA. Not all of these species migrate to Australia, and only some are regular visitors to this country. Species that utilise the East Asian-Australasian Flyway (Lane 1987) and that have been recorded from south-west Australia include 22 waders, three egrets and three terns (Table 4.9).

A total of 18 species listed under JAMBA and CAMBA were recorded by Ninox (1989) utilising the Leschenault Estuary, including 15 waders (Table 4.8). Other important sites for migratory species in the Region include the Yalgorup Lakes, Benger Swamp, and coastlines. Storey *et al.* (1993) recorded Great Egret, Caspian Tern, Common Sandpiper and Common Greenshank at coastal plain wetlands within the region.

The only species listed under international agreements and recorded during the September survey were Great Egret, Caspian Tern, Common Greenshank and Common Sandpiper. The principal area likely to support migratory bird species is Site 11 Estuary Drive.

Table 4.9: Species listed under migratory bird agreements (JA = JAMBA, CA = CAMBA, LE = Leschenault Estuary)

Agreement		[1]Species	LE
JA	CA	Cattle Egret *Bubulcus ibis*	
JA	CA	Great Egret *Egretta alba*	✔
	CA	Eastern Reef Egret *Egretta sacra*	
	CA	Glossy Ibis *Plegadis falcinellus*	
	CA	White-bellied Sea-Eagle *Haliaeetus leucogaster*	Y
JA	CA	Greater Sand Plover *Charadrius leschenaultii*	✔
JA	CA	Lesser Sand Plover *Charadrius mongolus*	
JA	CA	[α]Eastern Golden Plover *Pluvialis dominica*	✔
JA	CA	Grey Plover *Pluvialis squatarola*	✔
JA	CA	Ruddy Turnstone *Arenaria interpres*	✔
JA	CA	Red-necked Stint *Calidris ruficollis*	✔
JA	CA	Long-toed Stint *Calidris subminuta*	
JA	CA	Sharp-tailed Sandpiper *Calidris acuminata*	✔
JA	CA	Curlew Sandpiper *Calidris ferruginea*	✔
JA	CA	Great Knot *Calidris tenuirostris*	✔
JA	CA	Red Knot *Calidris canutus*	✔
JA	CA	Sanderling *Calidris alba*	
JA	CA	Common Greenshank *Tringa nebularia*	✔
	CA	Marsh Sandpiper *Tringa stagnatilis*	
JA	CA	Wood Sandpiper *Tringa glareola*	
JA	CA	Grey-tailed Tattler *Tringa brevipes*	✔
JA	CA	Common Sandpiper *Tringa hypoleucos*	✔
JA	CA	Terek Sandpiper *Xenus cinereus*	
JA	CA	Eastern Curlew *Numenius madagascariensis*	✔
JA	CA	Whimbrel *Numenius phaeopus*	✔

Agreement		[1]Species	LE
JA	CA	Bar-tailed Godwit *Limosa lapponica*	✔
JA	CA	Black-tailed Godwit *Limosa limosa*	
JA	CA	White-winged Black Tern *Chlidonias leucoptera*	
	CA	Caspian Tern *Sterna caspia*	✔
JA		Crested Tern *Sterna bergii*	✔
JA	CA	Fork-tailed Swift *Apus pacificus*	

[1] Scientific and common names follow Christidis and Boles (1994).
[a]Eastern Golden Plover *Pluvialis dominica* = Pacific Golden Plover *Pluvialis fulva*. *P. fulva* was previously treated as a subspecies of the Lesser Golden Plover.

Bush Forever Decreaser Species

While not classified as rare, threatened or vulnerable in any State or Commonwealth legislation, a number of species have been listed as significant on the Swan Coastal Plain portion of the Perth Metropolitan Region (Government of Western Australia 1998 and 2000b). The two categories used in Bush Forever are:

- habitat specialists with a reduced distribution on the Swan Coastal Plain (Bh); and
- wide-ranging species with reduced populations on the Swan Coastal Plain (Bp).

With the exception of waterbirds, 21 bird species fall into the first category and 24 into the second. A total of 19 decreaser species were recorded in the Region during the field survey including 13 Bh and six Bp species (Table 4.10).

Some species that are not common around Perth are much more common in the Bunbury region, for example the Splendid Fairy-wren, Common Bronzewing and Golden Whistler, and are probably not as greatly at risk in the Region as they are on the coastal plain near Perth. Scarlet Robin, Yellow-rumped Thornbill and Inland Thornbill were also recorded regularly during the survey (Appendix E). Of the species listed in Table 4.10 Little Eagle, Varied Sittella and Grey Currawong were only recorded on single occasions.

Table 4.10: Bush Forever decreaser species recorded in the Greater Bunbury Region.

Bh species	Bp species
Australasian Shoveller *Anas rhynchotis*	Little Eagle *Hieraaetus morphnoides*
Musk Duck *Biziura lobata*	Whistling Kite *Haliastur sphenurus*
Dusky Moorhen *Gallinula tenebrosa*	Western Rosella *Platycercus icterotis*
Common Bronzewing *Phaps chalcoptera*	New Holland Honeyeater *Phylidonyris novaehollandiae*
Splendid Fairy-wren *Malurus splendens*	Black-faced Woodswallow *Artamus cinereus*
Inland Thornbill *Acanthiza apicalis*	Grey Currawong *Strepera versicolor*
Yellow-rumped Thornbill *Acanthiza chrysorrhoa*	
Weebill *Smicrornis brevirostris*	
White-browed Scrub-wren *Sericornis frontalis*	
Scarlet Robin *Petroica multicolor*	
Varied Sittella *Daphoenositta chrysoptera*	
Grey Shrike-thrush *Colluricincla harmonica*	
Golden Whistler *Pachycephala pectoralis*	

A summary of the significant fauna including those listed in various categories above is provided in Table 4.11.

Table 4.11: Significant fauna of the Greater Bunbury Region.

Species	EPBC	1	2	3	4	5	6	7A	7B	8	9	10	11	^Extant
Schedule 1														
Chuditch *Dasyurus geoffroii*	V										e			Y
Western Ringtail Possum *Pseudocheirus occidentalis*	V				e			e			r			Y
Quokka *Setonix brachyurus*	V										r			Y
Carnaby's Black Cockatoo *Calyptorhynchus latirostris*	E							e		e	e	e		Y
Baudin's Black Cockatoo *Calyptorhynchus baudinii*	V		r	r										Y
Australasian Bittern *Botaurus poiciloptilus*														Y
Schedule 4														
Peregrine Falcon *Falco peregrinus*														Y
Carpet Python *Morelia spilota imbricata*														?
Priority 1														
Bunbury Skink *Glaphyromorphus 'koontoolasi'*														Y
Priority 2														
Black Bittern *Ixobrychus flavicollis*														N
Priority 3														
Brush-tailed Phascogale *Phascogale tapoatafa*														Y
Forest Red-tailed Black-Cockatoo *Calyptorhynchus banksii naso*				e										?
Masked Owl *Tyto novaehollandiae novaehollandiae*														Y
Black-stripe Minnow *Galaxiella nigrostriata*														Y
Priority 4														
Southern Brown Bandicoot *Isoodon obesulus fusciventer*					e	e		e	e	p	r	p		Y
Western Brush Wallaby *Macropus irma*								e			e	e		Y
Water Rat *Hydromys chrysogaster*										e	e			Y
Western False Pipistrelle *Falsistrellus mackenziei*								e		e	e	e		Y
Little Bittern *Ixobrychus minutus*														Y
Bush Stonecurlew *Burhinus grallarius*														Y
Eastern Curlew *Numenius madagascariensis*													e	Y
Hooded Plover *Thinornis rubricollis*														Y
Crested Shrike-tit *Falcunculus frontatus leucogaster*														?
Birds listed under JAMBA and CAMBA										e			r	

r = recorded during survey, e = expected to occur, p = previously reported. ^ - extant in region

5 Area Specific Description

The results are provided as area-specific descriptions, similar to Bush Forever (Government of Western Australia 2000b) as per the brief. This section describes the natural values of each Site determined from desktop studies of regional datasets as described above and from site-specific flora, vegetation and fauna field surveys. It should be noted that a detailed fauna investigation was only carried out at Site 9 as per the brief. A description of common fauna and fauna habitats of each site can be found in Appendices F and G respectively. FCTs at all sites were inferred from Gibson *et al.* (1994) where possible, and are marked with an asterix as per Bush Forever.

The area specific descriptions in Bush Forever summarise the selection criteria and recommendations for each Bush Forever site. This report presents a more detailed explanation of the selection criteria and recommendations than Bush Forever and therefore is provided separately (Sections 7, 8, 9 and 10).

SECTION 5: SELECTION CRITERIA AND RECOMMENDATIONS

5.1 Australind WWTP and Two Adjacent Lots

SECTION 1: LOCAL INFORMATION
Greater Bunbury Region Scheme Site no. 1, A (main area), B (Lots 21, 27) and C (Lot 150)
Area (ha): 28.5 (25.5 remnant vegetation)
Map sheet series ref. no. 2031-III NE
Local Authorities (Suburb): Shire of Harvey (Australind)

SECTION 2: REGIONAL INFORMATION
LANDFORMS AND SOILS
Bassendean Dunes
Bassendean Sands (Qpb: S8)
Pinjarra Plain
Guildford Formation (Qpa: Ms2)
Bassendean Dunes/Pinjarra Plain
Bassendean Sands over Guildford Formation (Qpb/Qpa: S10)

VEGETATION AND FLORA
Vegetation Complexes
Bassendean Dunes
Bassendean Complex – Central and South
Pinjarra Plain
Swan Complex

Floristic Community Types
Supergroup 3: Uplands centred on Bassendean Dunes and Dandaragan Plateau
*21a Central *Banksia attenuata – Eucalyptus marginata* woodlands
*21c Low lying *Banksia attenuata* woodlands or shrublands

WETLANDS
Wetland Types: palusplain
Natural Wetland Groups
Pinjarra Plain

Keysbrook (P.1)
Wetland Management Objective: Multiple Use
Swan Coastal Plain Lakes EPP: none identified

THREATENED ECOLOGICAL COMMUNITIES
Not assessed

SECTION 3: SPECIFIC AREA DETAIL
Landscape Features: vegetated wetland, vegetated upland
Vegetation and Flora: limited survey (HGM 2002)
Structural Units: mapping (HGM 2002)
Uplands: *Corymbia calophylla, Eucalyptus marginata* subsp. *marginata, Banksia attenuata* and *Banksia ilicifolia* Open Woodland over *Kunzea glabrescens* Tall Open Scrub; *Eucalyptus marginata* subsp. *marginata, Corymbia calophylla, Banksia attenuata* and *Banksia ilicifolia* Woodland over *Allocasuarina humilis* and *Xanthorrhoea brunonis* subsp. *brunonis* Shrubland
Wetlands: *Kunzea glabrescens* Closed Tall Scrub with emergent *Melaleuca preissiana* and *Corymbia calophylla*

Scattered Native Plants: not assessed
Vegetation Condition: 25% Excellent, 25% Very Good, 20% Degraded, 30% Completely Degraded
Total Flora: 97 native taxa, 18 weed taxa (HGM 2002) (Estimated >70% expected flora)
Significant Flora: *Acacia flagelliformis* (P4), *Acacia semitrullata* (P3), *Caladenia speciosa* (P4), *Jacksonia sparsa* (P4)

Fauna: limited survey for birds (25 species) (HGM 2002). Significant bird species: Australasian Shoveller, Little Eagle (breeding record), Common Bronzewing, Splendid Fairy-wren, Yellow-rumped Thornbill.

Linkage: good condition vegetation of the site is adjacent to bushland to the west. This site represents an eastern extension of Wardandi Reserve that forms a link to Brunswick River (C67).

Field Comments:
Area immediately to the south and east of the Waste Water Treatment Plant (WWTP) is degraded with a significant area of tree death. The probable cause of tree stress is either dieback disease (caused by the root-rot fungus *Phytophthora* spp.) or water logging caused by seepage from the WWTP. It is recommended that further investigations be conducted to establish the likely cause of tree stress.

SECTION 4: INTERNATIONAL AND NATIONAL SIGNIFICANCE
Not listed

5.2 South Dalyellup

SECTION 1: LOCAL INFORMATION
Greater Bunbury Region Scheme Site No. 2
Area (ha): 116.4 (75.1 remnant vegetation)
Map sheet series ref. no. 2031-III SW
Local Authorities (Suburb): Shire of Capel (Dalyellup)

SECTION 2: REGIONAL INFORMATION
LANDFORMS AND SOILS
Spearwood Dunes
Sands derived from Tamala Limestone (Qts: S7)

VEGETATION AND FLORA
Vegetation Complexes
Spearwood Dunes
Karrakatta Complex – Central and South

Floristic Community Types
Supergroup 2: Seasonal Wetlands
Type not determined
Supergroup 4: Uplands centred on Spearwood and Quindalup Dunes
*25 Southern *Eucalyptus gomphocephala – Agonis flexuosa* woodlands

WETLANDS
Wetland Types: dampland
Natural Wetland Groups
Quindalup Dunes
Big Swamp (Qu.?4)
Wetland Management Objective: Multiple Use
Swan Coastal Plain Lakes EPP: none identified

THREATENED ECOLOGICAL COMMUNITIES
Not assessed

SECTION 3: SPECIFIC AREA DETAIL
Landscape Features: vegetated upland
Vegetation and Flora: limited survey (HGM 2002, Alan Tingay and Associates 1991)
Structural Units: mapping (HGM 2002, Alan Tingay and Associates 1991)
Upland: *Eucalyptus gomphocephala* and *Agonis flexuosa* var. *flexuosa* Open Forest to Woodland (approximately equivalent to Association A - *Eucalyptus gomphocephala/Agonis flexuosa* Forest with *E. Marginata* and *Banksia attentuata* sub-dominant, Alan Tingay and Associates 1991).

Scattered Native Plants: *Melaleuca rhaphiophylla* Open Woodland over pasture on dampland
Vegetation Condition: <40% Very Good, >60% Completely Degraded, with areas of severe localised disturbance
Total Flora: 44 native taxa, 24 weed taxa (HGM 2002) (Estimated >70% expected flora)
Significant Flora: none recorded

Fauna: limited survey for birds (14 species) (HGM 2002). Significant bird species: Splendid Fairy-wren, Yellow-rumped Thornbill.

Linkage: adjacent bushland to the north, west and east; to west is the northern extent of the 'Muddy Lakes' sumpland (ROS); adjacent bushland to east is Dalyellup Reserves, a System 6 area (C71); forms part of the Dalyellup/Gelorup/Preston River/Plateau Link.

Other Special Attributes:
Provides bushland corridor between the coast and the Dalyellup Reserves (C71) (Peter Hanley, pers. comm.).

Field Comments:
The regional dataset for vegetation, landform and soil maps the Vasse Complex within this site but field observations did not concur. It was determined that Vasse Complex occurs immediately to the west of the site.

During the course of the field survey the landowner was engaged in land clearing activities in the northern portion of the site. This activity was reported to the Office of the Commissioner of Soil and Land Conservation (Appendix J). As a result, it is likely that vegetation condition will have deteriorated to Completed Degraded for more than 80% of the site.

SECTION 4: INTERNATIONAL AND NATIONAL SIGNIFICANCE
Not listed

5.3 East Boyanup

SECTION 1: LOCAL INFORMATION
Greater Bunbury Region Scheme Site no. 3
Area (ha): 233.9 (35.5 remnant vegetation)
Map sheet series ref. no. 2031-III SE, 2031-II SW
Local Authorities (Suburb): Shire of Boyanup (Boyanup)

SECTION 2: REGIONAL INFORMATION
LANDFORMS AND SOILS
Blackwood Plateau
Yoganup Formation (Qpry: S12)
Pinjarra Plain
Guildford Formation (Qpa: Msg4 and M)
Colluvial Deposits (Qc: S5)
Alluvial Deposits (Qhao:Sm1)
Whicher Scarp
Whicher Scarp - gravels and laterite (Czll: LA1 and G2)

VEGETATION AND FLORA
Vegetation Complexes
Blackwood Plateau
Kingia Complex
Pinjarra Plain
Swan Complex
Guildford Complex
Whicher Scarp
Cartis Complex

Floristic Community Types
Supergroup1: Foothills/Pinjarra Plain
*1a *Eucalyptus haemotoxylon – E. marginata* woodlands on Whicher foothills
(*Eucalyptus haemotoxylon* is nomenclaturally synonymous with *Corymbia haemotoxylon*, the name recognised by the WA Herbarium)

Supergroup 2: Seasonal Wetlands
Type not inferred
Supergroup 3: Uplands centred on Bassendean Dunes and Dandaragan Plateau
*21b Southern *Banksia attenuata* woodlands

WETLANDS
Wetland Types: palusplain
Natural Wetland Groups
Pinjarra Plain
Keysbrook (P1)
Wetland Management Objective: Conservation (1.5ha), Multiple Use
Swan Coastal Plain Lakes EPP: none identified

THREATENED ECOLOGICAL COMMUNITIES
Not assessed

SECTION 3: SPECIFIC AREA DETAIL
Landscape Features: vegetated wetland, vegetated upland
Vegetation and Flora: limited survey (HGM 2002)
Structural Units: mapping (HGM 2002)
Uplands: *Banksia attenuata, Eucalyptus marginata* subsp. *marginata* and *Xylomelum occidentale* Low Open Woodland over *Melaleuca thymoides, Kunzea glabrescens, Hypocalymma robustum* and *Adenanthos meisneri* Shrubland; *Eucalyptus marginata* subsp. *marginata* and *Corymbia calophylla* Woodland over *Banksia grandis* Low Open Woodland; *Eucalyptus marginata* subsp. *marginata* and *Corymbia haematoxylon* Woodland over *Xanthorrhoea preissii* Open Shrubland
Wetlands: *Corymbia calophylla* Open Forest over *Agonis flexuosa* var. *flexuosa* Low Open Forest

Scattered Native Plants: not assessed
Vegetation Condition: 15% Good, 65% Completely Degraded, 20% rehabilitated
Total Flora: 123 native taxa, 35 weed taxa (HGM 2002) (Estimated >70% expected flora)
Significant Flora: *Acacia flagelliformis* (P4), *Acacia semitrullata* (P3), *Caladenia speciosa* (P4), *Drosera marchantii* subsp. *marchantii* (P4), *Jacksonia sparsa* (P4), only location of *Corymbia haemotoxylon* within the present study sites.

Fauna: limited survey for birds (27 species) (HGM 2002). Significant bird species: Baudin's Black Cockatoo (Schedule 1), Common Bronzewing, Splendid Fairy-wren, Yellow-rumped Thornbill.

Linkage: adjacent to large patch of remnant bushland to the south; potential linkage with State Forest but currently zoned Urban; remnant riparian linkage along Joshua Gully creekline links to the Preston River Corridor.

Other Special Attributes:
Wetland vegetation along Joshua Gully at southern boundary of site is in good condition and continues an important link from the Preston River to the Scarp; large number of priority flora taxa and diversity of floristic community types.

Field Comments:
The majority of the site was not remnant bushland. 65% was cleared for agriculture and 20% was planted as part of Iluka Resources' mineral sands rehabilitation. Only 15% of the site was remnant bushland. However, this small area supported 5 priority taxa and represents 3 floristic community types. Landowners of several lots did not give permission for access during the field survey and therefore the mapping is inferred in these areas.

SECTION 4: INTERNATIONAL AND NATIONAL SIGNIFICANCE
Subject to protection under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999*

5.4 Davenport

SECTION 1: LOCAL INFORMATION
Greater Bunbury Region Scheme Site no. 4
Area (ha): 41.6 (27.9 remnant vegetation)
Map sheet series ref. no. 2031-III NE
Local Authorities (Suburb): City of Bunbury (Davenport)

SECTION 2: REGIONAL INFORMATION
LANDFORMS AND SOILS
Bassendean Dunes
Bassendean Sands (Qpb: S8)
Bassendean Dunes/Pinjarra Plain
Bassendean Sands over Guildford Formation (Qpb/Qpa: S10)
Pinjarra Plain
Guildford Formation (Qpa: Msg4 and M)
Alluvial Deposits (Qhay:Sm1)

VEGETATION AND FLORA
Vegetation Complexes
Combinations of Bassendean Dunes/Pinjarra Plain
Southern River Complex
Pinjarra Plain
Swan Complex

Floristic Community Types
Supergroup 2: Seasonal Wetlands
*4 *Melaleuca preissiana* damplands
Additional type not inferred

WETLANDS
Wetland Types: sumpland, palusplain
Natural Wetland Groups
Bassendean-Pinjarra transition OR Bassendean with fluvial features
Bennet Brook (BP.4)
Wetland Management Objective: Conservation (11.6ha), Multiple Use
Swan Coastal Plain Lakes EPP: none identified

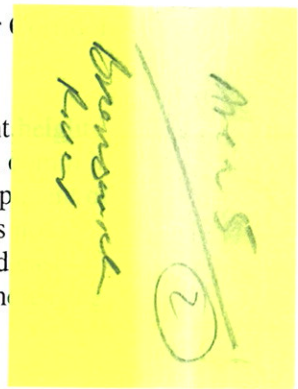
THREATENED ECOLOGICAL COMMUNITIES
Not assessed

SECTION 3: SPECIFIC AREA DETAIL
Landscape Features: vegetated wetland
Vegetation and Flora: limited survey (HGM 2002)
Structural Units: mapping (HGM 2002)
Wetlands: *Corymbia calophylla* Open Forest over *Agonis flexuosa* var. *flexuosa* Low Open Forest; *Corymbia calophylla* and *Agonis flexuosa* var. *flexuosa* Open Forest; *Agonis flexuosa* var. *flexuosa* Closed Forest; *Melaleuca preissiana* and *Agonis flexuosa* var. *flexuosa* Low Open Forest; *Melaleuca rhaphiophylla* Low Open Forest; *Corymbia calophylla* and *Eucalyptus marginata* subsp. *marginata* Open Woodland over Tall Shrubland dominated by *Melaleuca preissiana, Banksia littoralis, Agonis flexuosa* var. *flexuosa* and *Kunzea glabrescens* and combinations of these; *Eucalyptus rudis* subsp. *rudis* and *Agonis flexuosa* var. *flexuosa* Open Forest

Scattered Native Plants: *Melaleuca rhaphiophylla* Open Woodland over pasture on dampland
Vegetation Condition: 100% Degraded to Completely Degraded
Total Flora: 33 native taxa, 60 weed taxa (HGM 2002) (Estimated >70% expected flora)
Significant Flora: *Jacksonia sparsa* (P4);

Fauna: limited survey for birds (28 species) (HGM 2002). Significant bird species: Inland Thornbill, Splendid Fairy-wren, Yellow-rumped Thornbill, Scarlet Robin.

Linkage: adjacent bushland to south-west and north; the southern and eastern portions of this site form part of the riparian corridor of Dalyellup/Gelorup/Preston River/Plateau Link and the Preston River (



Other Special Attributes:
Open water sumpland with *Eucalyptus rudis* subsp. *rudis* of excellent and good condition adjacent to Preston River (Eleanor Bennett, pers. Location 267 to the west of North Boyanup Road is not a major comp the Dalyellup/Gelorup/Preston River/Plateau Link, because it "serves obvious strategic significance in linking areas of ROS to the west and (Grein 2001). However, it does provide canopy connection and by in the width of the corridor it decreases the boundary effects.

Field Comments:
The vegetation associations were observed to be so degraded that they are not considered to be representative of the floristic community types.
There has been commendable effort at control of *Phytolacca octandra* at the northern boundary of the site.
Sheep and horses graze most of site.

SECTION 4: INTERNATIONAL AND NATIONAL SIGNIFICANCE
Not listed

5.5 Brunswick River Foreshore

SECTION 1: LOCAL INFORMATION
Greater Bunbury Region Scheme Site no. 5
Area (ha): 44.8 (22.7 remnant vegetation)
Map sheet series ref. no. 2031-III NE

Local Authorities (Suburb): Shire of Harvey (Australind)

SECTION 2: REGIONAL INFORMATION
LANDFORMS AND SOILS
Bassendean Dunes
Bassendean Sands (Qpb: S8)
Pinjarra Plain
Alluvial Deposits (Qha:Sm1)

VEGETATION AND FLORA
Vegetation Complexes
Bassendean Dunes
Bassendean Complex – Central and South
Pinjarra Plain
Swan Complex

Floristic Community Types
Supergroup 2: Seasonal Wetlands
*13 Deeper wetlands on heavy soils

WETLANDS
Wetland Types: floodplain
Natural Wetland Groups
Coastal Plain Rivers
Brunswick (R.)
Wetland Management Objective: Conservation (11ha), Multiple Use
Swan Coastal Plain Lakes EPP: none identified

THREATENED ECOLOGICAL COMMUNITIES
Not assessed

SECTION 3: SPECIFIC AREA DETAIL
Landscape Features: open water, vegetated wetland
Vegetation and Flora: limited survey (HGM 2002)
Structural Units: mapping (HGM 2002)
Wetlands: *Eucalyptus rudis* subsp. *rudis* and *Melaleuca rhaphiophylla* Woodland; *Melaleuca rhaphiophylla* Closed Forest; *Eucalyptus rudis* subsp. *rudis* Woodland over *Agonis flexuosa* var. *flexuosa* and *Melaleuca rhaphiophylla* Woodland with occasional *Corymbia calophylla*

Scattered Native Plants: not assessed
Vegetation Condition: 25% Degraded, 15% Completely Degraded, 60% cleared for agriculture
Total Flora: 17 native taxa, 14 weed taxa (HGM 2002) (Estimated >70% expected flora)
Significant Flora: none recorded

Fauna: limited survey for birds (26 species) (HGM 2002). Significant bird species: Splendid Fairy-wren, Inland Thornbill, Yellow-rumped Thornbill, Weebil, Grey Shrike-thrush.

Other Special Attributes:
Open water floodplain with outstanding *Melaleuca rhaphiophylla* of excellent density, height and condition adjacent to Brunswick River (Eleanor Bennett, pers. comm.).

Linkage: adjacent bushland to west, south and north; the riparian corridor of this site represents part of the Brunswick, Collie and Wellesley Rivers Corridor.

Field Comments:
There has been commendable effort at control of *Zantedeschia aethiopica* and *Rubus ulmifolius* on the western lot.
Sheep graze all but the western lot. Recommend fencing along creeklines to remove impact of stock grazing.
Vegetation along the north-flowing unnamed creeks that connect to the Brunswick River have hydrological function to impede localised salinity and flooding.

SECTION 4: INTERNATIONAL AND NATIONAL SIGNIFICANCE
Not listed

5.6 Boyanup Bypass Road

SECTION 1: LOCAL INFORMATION
Greater Bunbury Region Scheme Site no. 6 (proposed 50m wide reserve)
Area (ha): 27.7 (2.6 remnant vegetation)
Map sheet series ref. no. 2031-III SE, 2030-IV NE
Local Authorities (Suburb): Shire of Boyanup (Boyanup)

SECTION 2: REGIONAL INFORMATION
LANDFORMS AND SOILS
Whicher Scarp
Colluvial Deposits (Qc: Smg1)
Pinjarra Plain
Guildford Formation (Qpa: Ms2)
Guildford Formation (Qpa: Msg4 and M)
Wetlands
Holocene Swamp Deposits (Qhw: Cps1)

VEGETATION AND FLORA
Vegetation Complexes
Whicher Scarp
Cartis Complex
Pinjarra Plain
Guildford Complex
Swan Complex

Floristic Community Types
Supergroup1: Foothills/Pinjarra Plain
*1a *Eucalyptus haemotoxylon – E. marginata* woodlands on Whicher foothills
(*Eucalyptus haemotoxylon* is nomenclaturally synonymous with *Corymbia haemotoxylon*, the name recognised by the WA Herbarium)

WETLANDS
Wetland Types: sumpland, palusplain
Natural Wetland Groups

Bassendean-Pinjarra transition OR Bassendean with fluvial features
Bennet Brook (BP.4)
Pinjarra Plain
Keysbrook (P1)
Wetland Management Objective: Multiple Use
Swan Coastal Plain Lakes EPP: 0.3ha

THREATENED ECOLOGICAL COMMUNITIES
Not assessed

SECTION 3: SPECIFIC AREA DETAIL
Landscape Features: open water, vegetated wetland, vegetated upland
Vegetation and Flora: limited survey (HGM 2002)
Structural Units: mapping (HGM 2002)
Uplands: *Eucalyptus marginata* subsp. *marginata* and *Corymbia calophylla* Woodland over *Xanthorrhoea preissii, Acacia pulchella* and *Acacia flagelliformis* Open Shrubland

Scattered Native Plants: not assessed
Vegetation Condition: <1% Very Good, 99% Completely Degraded
Total Flora: 72 native taxa, 3 weed taxa (HGM 2002) (Estimated >70% expected flora)
Significant Flora: *Acacia flagelliformis* (P4), *Caladenia speciosa* (P4),

Fauna: limited survey for birds (21 species) (HGM 2002). Significant bird species: Musk Duck, Yellow-rumped Thornbill.

Linkage: adjacent bushland to south.

Field Comments:
Wetlands completely degraded, all sumplands completely degraded. The majority of the Site is grazed. The road verge along South Western Highway is highly degraded. There has been some private effort at rehabilitation of native species at 'Boyanup Billabong' (lake) on private property surrounding open water that is defined as a protected 'Swan Coastal Plain Lake'.
The landowner of lots in the southern portion of the site did not give permission for access during the field survey and therefore the mapping is inferred in this portion. It appeared from a comparison of the photographic textures to those of areas visited, and from field observation adjacent to the restricted access area, that the vegetation structural unit corresponds to that defined in the adjacent portion.
Three vegetation complexes identified in desktop review but only one intact at time of survey and therefore only one floristic community type intact.
The remnant bushland in the south of the site contains the only intact vegetation in the site but is part of a much larger block of remnant bushland to the south of the site.

SECTION 4: INTERNATIONAL AND NATIONAL SIGNIFICANCE
Not listed

5.7 Myalup

SECTION 1: LOCAL INFORMATION
Greater Bunbury Region Scheme Site no. 7A
Area (ha): 28.4 (17.3 remnant vegetation)
Map sheet series ref. no. 2031-IV NE
Local Authorities (Suburb): Shire of Harvey (Myalup)

SECTION 2: REGIONAL INFORMATION
LANDFORMS AND SOILS
Quindalup Dunes
Safety Bay Sands (Qhsm: S1)
Safety Bay Sands (Qhs: S2)

VEGETATION AND FLORA
Vegetation Complexes
Quindalup Dunes
Quindalup Complex
Marine Deposits
Vasse Complex

Floristic Community Types
Supergroup 4: Uplands centred on Spearwood and Quindalup Dunes
*29a Coastal shrublands on shallow soils
*29b *Acacia* shrublands on taller dunes
*30b Quindalup *Eucalyptus gomphocephala* and/or *Agonis flexuosa* woodlands

WETLANDS
No wetlands mapped

THREATENED ECOLOGICAL COMMUNITIES
Not assessed

SECTION 3: SPECIFIC AREA DETAIL
Landscape Features: foredune, tall dunes, vegetated upland
Vegetation and Flora: limited survey (HGM 2002)
Structural Units: mapping (HGM 2002)
Foredune: Very Open Grassland dominated by **Ammophila arenaria*, **Pelargonium capitatum* and *Olearia axillaris*
Tall dunes: *Agonis flexuosa* var. *flexuosa* and *Jacksonia furcellata* Tall Shrubland over *Alyxia buxifolia* and *Acanthocarpus preissii* Open Heath
Uplands: *Eucalyptus gomphocephala* and *Agonis flexuosa* var. *flexuosa* Low Open Forest over *Spyridium globulosum* and *Alyxia buxifolia* Open Heath

Scattered Native Plants: not assessed
Vegetation Condition: 95% Good to Excellent, 5% dune blowout (natural)
Total Flora: 39 native taxa, 23 weed taxa (HGM 2002) (Estimated >70% expected flora)
Significant Flora: none recorded

Fauna: limited survey for birds (21 species) (HGM 2002).

Linkage: adjacent bushland to north, south and east; this site forms a link between the coast and the Yalgorup National Park, a System 6 area (C54);

...on are important waterway linkages to the north-
...the Myalup townsite by vegetated dunes and the
...provide some protection.

...dune vegetation is mostly in excellent
...der Moezel 2001b).

Field Comments:
Less than one hectare of the site at the east of the site is of the Vasse Complex but is an inaccuracy in the regional dataset.
It appears that soils of the Spearwood Dunes are present in the eastern portion of the site and are commonly associated with the Upland vegetation structural unit described above. This concurs with van der Moezel (2001a) but conflicts with the regional dataset.
Three structural and floristic community types represented at this site, indicates excellent diversity.
Dune blowouts are likely to have occurred naturally and are therefore of significance due to landscape value.

SECTION 4: INTERNATIONAL AND NATIONAL SIGNIFICANCE
Not listed

5.8 Buffalo Road

SECTION 1: LOCAL INFORMATION
Greater Bunbury Region Scheme Site no. 7B
Area (ha): 253 (82.5 remnant vegetation)
Map sheet series ref. no. 2031-IV SE
Local Authorities (Suburb): Shire of Harvey (Binningup)

SECTION 2: REGIONAL INFORMATION
LANDFORMS AND SOILS
Lagoonal and Estuarine Deposits
Lagoonal Deposits (Qg: Sm2)
Quindalup Dunes
Safety Bay Sands (Qhs: S2)

VEGETATION AND FLORA
Vegetation Complexes
Marine Deposits
Vasse Complex
Yoongarillup Complex
Quindalup Dunes
Quindalup Complex

Floristic Community Types
Supergroup 2: Seasonal Wetlands
*16 Highly saline seasonal wetlands

WETLANDS
Wetland Types: estuary
Natural Wetland Groups
Estuaries

Leschenault (E.4)
Wetland Management Objective: Conservation (251.5ha)
Swan Coastal Plain Lakes EPP: none identified

THREATENED ECOLOGICAL COMMUNITIES
Not assessed

SECTION 3: SPECIFIC AREA DETAIL
Landscape Features: vegetated wetland
Vegetation and Flora: limited survey (HGM 2002)
Structural Units: mapping (HGM 2002)
Wetlands: *Melaleuca rhaphiophylla* and *Melaleuca viminea* subsp. *viminea* Low Open Forest; Closed Sedgeland dominated by *Juncus kraussii* subsp. *australiensis, Triglochin huegelii, Baumea juncea* and **Juncus oxycarpus* and combinations of these; *Halosarcia lepidosperma, Halosarcia indica* subsp. *bidens* and *Juncus kraussii* subsp. *australiensis* Open Low Heath

Scattered Native Plants: not assessed
Vegetation Condition: 10% Excellent, 90% Degraded to Completely Degraded
Total Flora: 10 native taxa, 34 weed taxa (HGM 2002) (Estimated >70% expected flora)
Significant Flora: none recorded

Fauna: limited survey for birds (29 species) (HGM 2002). Significant bird species: Australasian Shoveller, Whistling Kite, Common Bronzewing, Yellow-rumped Thornbill, Black-faced Woodswallow.

Linkage: adjacent bushland to south and west; direct linkage to the Leschenault Peninsula Conservation Park; forms part of the Leschenault Estuary System 6 area (C66).

Other Special Attributes: the samphire associations are uncommon in the South West Botanical District (Trudgen, 1984).

This site is part of the Leschenault Estuary System 6 area (C66).
The samphire flats area north of Buffalo Road is recognised as an important waterbird habitat (WRC and LIMA 1997, WAPC 2000) and a buffer against lateral movement of nutrients from intensive horticultural areas in to the Parkfield Drain that feeds into the Leschenault Estuary (WAPC 2000).

Field Comments:
The landowner of Location 7 Buffalo Road did not give permission for access to the western portion of the site during the field survey and therefore the mapping is inferred in this portion. It appeared from a comparison of the photographic textures to those of areas visited, and from field observation adjacent to the restricted access area, that the vegetation structural units correspond to those defined in the eastern portion. The exception to this is a small area of Quindalup Complex that appeared to have an *Agonis flexuosa* var. *flexuosa* Woodland to Open Forest that was not encountered elsewhere on the site.

The northern and southern extremes of the site contained well defined structural vegetation units but the centre area was observed to have complexity in units and thus boundaries between units was difficult to map.

The majority of the site was inundated or waterlogged at the time of survey. The eastern portion of the site is subject to summer grazing.

SECTION 4: INTERNATIONAL AND NATIONAL SIGNIFICANCE
Not listed

5.9 Twin Rivers

SECTION 1: LOCAL INFORMATION
Greater Bunbury Region Scheme Site no. 8
Area (ha): 42.2 (37.0 remnant vegetation)
Map sheet series ref. no. 2031-III NE
Local Authorities (Suburb): Shire of Harvey (Australind)

SECTION 2: REGIONAL INFORMATION
LANDFORMS AND SOILS
Spearwood Dunes
Sands derived from Tamala Limestone (Qts: S7)
Pinjarra Plain
Alluvial Deposits (Qhao: Sm1)

VEGETATION AND FLORA
Vegetation Complexes
Spearwood Dunes
Karrakatta Complex
Pinjarra Plain
Swan Complex

Floristic Community Types
Supergroup 2: Seasonal Wetlands
*11 Wet forests and woodlands
Supergroup 4: Uplands centred on Spearwood and Quindalup Dunes
*21a Central *Banksia attenuata – Eucalyptus marginata* woodlands

WETLANDS
Wetland Types: floodplain
Natural Wetland Groups
Coastal Plain Rivers
Brunswick (R.)
Wetland Management Objective: Conservation (0.8ha), Multiple Use
Swan Coastal Plain Lakes EPP: none identified

THREATENED ECOLOGICAL COMMUNITIES
Not assessed

SECTION 3: SPECIFIC AREA DETAIL
Landscape Features: open water, vegetated wetland, vegetated upland
Vegetation and Flora: limited survey (HGM 2002, ATA Environmental 2001a)
Structural Units: mapping (HGM 2002, ATA Environmental 2001a)
Uplands: *Corymbia calophylla* and *Eucalyptus marginata* subsp. *marginata* Open Forest to Woodland over *Banksia grandis* and *Agonis flexuosa* var. *flexuosa* Woodland (approximately equivalent to AfBa, CcEm/AfBa and Cc/AfJf, ATA Environmental 2001a); *Corymbia calophylla* and *Eucalyptus*

9/3

marginata subsp. *marginata* Woodland over *Jacksonia furcellata, Kunzea glabrescens* and *Agonis flexuosa* var. *flexuosa* Woodland (approximately equivalent to CcEm/AfJf, ATA Environmental 2001a)
Wetlands: *Eucalyptus rudis* subsp. *rudis* and *Melaleuca rhaphiophylla* Open Forest over *Melaleuca incana* subsp. *incana* Tall Open Scrub (approximately equivalent to ErMr, MrMv and ErMrCoKe, ATA Environmental 2001a); *Corymbia calophylla, Eucalyptus rudis* subsp. *rudis* and *Casuarina obesa* Woodland (approximately equivalent to CcEr and CoErMr, ATA Environmental 2001a)

Minninup Lake 180. South - Muddy Lakes

Scattered Native Plants: not assessed
Vegetation Condition: 85% Very Good to Good, 5% Degraded, 10% Completely Degraded
Total Flora: 136 native taxa, 53 weed taxa (HGM 2002, ATA Environmental 2001a, van der Moezel 2001b) (Estimated >80% expected flora)
Significant Flora: *Caladenia speciosa* (P4), *Lasiopetalum membranaceum* (P3), Diuris drummondii (DRF)

Fauna: limited survey for birds (26 species HGM 2002; 32 species Ecologia 2001), limited survey for mammals (3 species), reptiles (10 species) and amphibians (4 species) (Ecologia 2001). Significant bird species: Baudin's Black Cockatoo (Schedule 1), Common Greenshank (JAMBA and CAMBA) and Great Egret (JAMBA and CAMBA), Splendid Fairy-wren, Yellow-rumped Thornbill, Grey Currawong. Significant mammal species: Southern Brown Bandicoot (P4)

Linkage: adjacent bushland to south and north is ROS; foreshore is part of the Brunswick, Collie and Wellesley Rivers Corridor, a System 6 area (C67); forms a corridor to the Leschenault Estuary via adjacent bushland of the Australind Primary School.

Field Comments:
Need to preserve river foreshore.
Two structural vegetation units (8.3 and 8.4) are dependent on a high water table, seasonal inundation or permanent water. Another (8.2) that occurs within the area defined as 1 in 100 year flood zone but does not appear to be dependant on a high water table (ATA Environmental 2001a).

SECTION 4: INTERNATIONAL AND NATIONAL SIGNIFICANCE
Subject to protection under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999*

5.10 Muddy Lakes

SECTION 1: LOCAL INFORMATION
Greater Bunbury Region Scheme Site no. 9, separated into two unconnected blocks, where relevant referred to as 9A (north) and 9B (south)
Area (ha): 9A 92.3 (81.4 remnant vegetation); 9B 191.9 (90.3 remnant vegetation)
Map sheet series ref. no. 2031-III SW
Other Names: Minninup Swamp
Local Authorities (Suburb): Shire of Capel (Minninup)

SECTION 2: REGIONAL INFORMATION

LANDFORMS AND SOILS

Marine Deposits
Holocene Swamp Deposits (Qhw: Cps1)
Quindalup Dunes
Safety Bay Sands (Qhsm: S1)
Safety Bay Sands (Qhs: S2)
Spearwood Dunes
Sands derived from Tamala Limestone (Qts: S7)

VEGETATION AND FLORA

Vegetation Complexes

Marine Deposits
Vasse Complex
Quindalup Dunes
Quindalup Complex
Spearwood Dunes
Karrakatta Complex

Floristic Community Types
Supergroup 2: Seasonal Wetlands
*17 *Melaleuca rhaphiophylla – Gahnia trifida* seasonal wetlands
*19 Sedgelands in Holocene dunes swales
Supergroup 4: Uplands centred on Spearwood and Quindalup Dunes
*29a Coastal shrublands on shallow sands
*29b *Acacia* shrublands on taller dunes
*30b Quindalup *Eucalyptus gomphocephala* and/or *Agonis flexuosa* woodlands

WETLANDS

Wetland Types: dampland, sumpland, lake
Natural Wetland Groups

Quindalup Dunes
Big Swamp (Qu.?4)
Marine Deposits
Minninup

Wetland Management Objective: Conservation (66.9ha), Additional Conservation (approx. 25ha additional), Multiple Use
Swan Coastal Plain Lakes EPP: 82.3ha

THREATENED ECOLOGICAL COMMUNITIES

Not assessed, Critically Endangered (floristic community type 19)

SECTION 3: SPECIFIC AREA DETAIL

Landscape Features: open water, vegetated wetland, tall dunes, vegetated upland
Vegetation and Flora: limited survey (HGM 2002, Alan Tingay and Associates 1991, Keighery *et al.* 2002)
Structural Units: mapping (HGM 2002, Alan Tingay and Associates 1991, Keighery *et al.* 2002)
Quindalup Dunes
Uplands: *Agonis flexuosa* var. *flexuosa* Open Forest; *Eucalyptus gomphocephala* Closed Forest over *Agonis flexuosa* var. *flexuosa* Low Open Forest (9.2 approximately equivalent to F, Alan Tingay and Associates 1991); Open Low Heath dominated by *Acanthocarpus preissii, Phyllanthus calycinus, Acacia cochlearis* and *Lepidosperma gracile* with emergent *Agonis flexuosa*

var. flexuosa (9.5; approximately equivalent to N and K, Alan Tingay and Associates 1991)
Strand: Open Low Heath dominated by *Scaevola crassifolia, *Pelargonium capitatum* and *Olearia axillaris*
Wetlands: *Banksia littoralis* Low Woodland over Tall Open Scrub dominated by *Xanthorrhoea preissii, Anthocercis littorea* and *Acacia saligna* (9.6; approximately equivalent to J, Alan Tingay and Associates 1991 and 3D/1, Keighery *et al.* 2002); *Eucalyptus gomphocephala* Closed Forest over *Agonis flexuosa* var. *flexuosa* Low Open Forest (9.3 approximately equivalent to Association F, Alan Tingay and Associates 1991 and 2D and 3D/3, Keighery *et al.* 2002); *Agonis flexuosa* var. *flexuosa* Low Open Forest (9.9, approximately equivalent to Association N, Alan Tingay and Associates 1991 and 5D and 9D, Keighery *et al.* 2002)
Vasse Sumplands
Wetlands: *Lepidosperma gladiatum* Sedgeland; Closed Sedgelands dominated by *Lepidosperma gladiatum, Carex appressa, *Typha orientalis* and *Pteridium esculentum* and combinations of these with emergent *Acacia saligna, Banksia littoralis, Agonis flexuosa* var. *flexuosa* and *Melaleuca rhaphiophylla* (9.1 and 9.7 approximately equivalent to Association P, Alan Tingay and Associates 1991 and 1S, Keighery *et al.* 2002)

Scattered Native Plants: not assessed
Vegetation Condition: 100% Excellent to Good with occasional open areas
Total Flora: 58 native taxa, 74 weed taxa (HGM 2002) (Estimated >70% expected flora)
Significant Flora: *Calycopeplus oligandrus* (HGM 2002, Keighery *et al.* 2002)

Fauna: limited survey for birds (61 species), mammals (5 species), reptiles (10 species) and amphibians (5 species) (HGM 2002). Significant mammals species: Quokka (S1), Western Ringtail Possum (S1) and Southern Brown Bandicoot (P4). Significant bird species (13): Musk Duck, Whistling Kite, Common Bronzewing, Western Rosella, Splendid Fairy-wren, Inland Thornbill, Yellow-rumped Thornbill, Weebill, White-browed Scrubwren, New Holland Honeyeater, Grey Shrike-thrush, Golden Whistler, Black-faced Woodswallow.

Linkage: adjacent bushland to north, south and west ; integral part of the north-west coastal corridor from Bunbury south via Dalyellup Beach, Stirling Beach, Peppermint Grove Beach and Forrest Beach; integral part of the east-west Dalyellup/Gelorup/Preston River/Plateau Link; direct link east-west from coast to the System 6 Dalyellyup Reserves (C71).

Other Special Attributes:
Minninup Swamp is part of the Minninup Consanguineous Suite that is recognised as a wetland of regional significance (V & C Semeniuk Research Group 1998) due to the following attributes:

1. Only wetland in the suite
2. Wetland processes representative of patterns within the suite
3. Coastal evolution
4. Avifauna use

Wetlands of the Upper-Stratham area have relatively high conservation value and should be conserved; Muddy Lakes should be incorporated into open space (Alan Tingay and Associates 1991).

The remnant vegetation of the Vasse Complex has relatively high conservation value to water dependent fauna (Alan Tingay and Associates 1991).

Field Comments:
The damplands and sumplands have values that may contribute to classification as conservation category wetlands.
Are between the north and south segments of this site (9A and 9B) appears to contain Quindalup Dunes and wetlands that are contiguous to those identified within the site.
Protection of the vegetation of the wetlands is important for maintenance of hydrological and ecological function.
During the course of the field survey a landowner was engaged in burning activities in one of the lots at the northern end of portion 9B, which may be construed as land clearing. This activity was reported to the Office of the Commissioner of Soil and Land Conservation. As a result, it is likely that vegetation condition will have deteriorated to Degraded in some areas.

SECTION 4: INTERNATIONAL AND NATIONAL SIGNIFICANCE
Subject to protection under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999*

5.11 Parade Road

SECTION 1: LOCAL INFORMATION
Greater Bunbury Region Scheme Site no. 10
Area (ha): 62.9 (35.8 remnant vegetation)
Map sheet series ref. no. 2031-III SE, SW
Local Authorities (Suburb): City of Bunbury (Shearwater)

SECTION 2: REGIONAL INFORMATION
LANDFORMS AND SOILS
Spearwood Dunes
Sands derived from Tamala Limestone (Qts: S7)
Marine Deposits
Holocene Swamp Deposits (Qhw: Cps1)
Alluvial Deposits (Qha)

VEGETATION AND FLORA
Vegetation Complexes
Spearwood Dunes
Karrakatta Complex
Marine Deposits
Yoongarillup Complex

Floristic Community Types **not sampled, from CALM database
Supergroup 2: Seasonal Wetlands
*11 Wet forests and woodlands
**18 Shrublands on calcareous silts (area within Site boundary degraded, not suitable to be identified as threatened ecological community)
Supergroup 4: Uplands centred on Spearwood and Quindalup Dunes
*25 Southern *Eucalyptus gomphocephala – Agonis flexuosa* woodlands

WETLANDS
Wetland Types: dampland, palusplain

Natural Wetland Groups
Quindalup Dunes
Big Swamp (Qu.4)
Wetland Management Objective: Conservation (10.1ha), Resource Enhancement, Multiple Use
Swan Coastal Plain Lakes EPP: none identified

THREATENED ECOLOGICAL COMMUNITIES
Not assessed

SECTION 3: SPECIFIC AREA DETAIL
Landscape Features: vegetated wetland, vegetated upland
Vegetation and Flora: limited survey (HGM 2002, ATA Environmental 2001b, Ecoscape 2001)
Structural Units: mapping (HGM 2002, ATA Environmental 2001b, Ecoscape 2001)
Uplands: *Eucalyptus gomphocephala, Corymbia calophylla* and *Eucalyptus marginata* subsp. *marginata* Open Forest over Low Woodland dominated by *Banksia attenuata, Banksia grandis, Agonis flexuosa* var. *flexuosa* and *Xylomelum occidentale* and combinations of these (approximately equivalent to EgAfBa, EgBa, EmBaBg, BgCcBa and CcEm, ATA Environmental 2001b; and "Woodland of *Banksia attenuata*, Marri and Tuart", Ecoscape 2001); *Eucalyptus gomphocephala* Open Forest over *Agonis flexuosa* var. *flexuosa* Low Open Forest (approximately equivalent to EgAf, ATA Environmental 2001b; and "Woodland to tall open forest of Tuart and Peppermint with Jarrah and *Banksia attenuata* on Spearwood Dunes", Ecoscape 2001)
Wetlands: *Melaleuca rhaphiophylla* and *Melaleuca teretifolia* Low Open Forest with emergent *Eucalyptus rudis* subsp. *rudis* (approximately equivalent to Mr, ATA Environmental 2001b; and "Woodland of *Melaleuca rhaphiophylla* on poorly drained areas", Ecoscape 2001)

Scattered Native Plants: not assessed
Vegetation Condition: 50% Very Good, 35% Degraded to Completely Degraded, 15% cleared
Total Flora: 146 native taxa, 62 weed taxa (HGM 2002, ATA Environmental 2001b) (Estimated >80% expected flora)
Significant Flora: *Caladenia speciosa* (P4), *Jacksonia sparsa* (P4), *Lasiopetalum membranaceum* (P3) (HGM 2002)

Fauna: limited survey for birds (18 species), and reptiles (1 species) (HGM 2002); limited survey for mammals (2 species) (HGM 2002; ATA Environmental 2001b). Significant bird species: Common Bronzewing, Splendid Fairy-wren, Yellow-rumped Thornbill. Significant mammal species: Southern Brown Bandicoot (P4)

Linkage: adjacent bushland to west, east and south; this site forms part of the Ocean to Preston River Park; linkage to the System 6 area (C70) South Bunbury Coastal Land.

Other Special Attributes:
A small portion (1.5ha) of the extreme northeast corner of the site falls within a known TEC site (myHAY03) of floristic community type 18. This area is less than 2% of the 'zone of influence'. However, the TEC site "myHAY03" is separated from Site 10 by Washington Road and the southern extent that falls

within Site 10 is very degraded, therefore not suitable to be identified as a threatened ecological community.
The Big Swamp Consanguineous Suite is recognised to have regional significance (Semeniuk, V & C Research Group 1998).
The site is part of a series of naturally vegetated areas that extend from the coast and inland to Preston River, and the vegetation is significantly different from that which occurs in other parts of this corridor (ATA Environmental 2001b, p. 14).
The South Bunbury Vegetation Corridor provides a habitat linkage from the coastal dunes inland to Manea Park (Bowman Bishaw Gorham 2001).

Field Comments:
Parts of this site were burnt during a 2001 bushfire and displayed excellent recovery, with floristic and structural diversity maintained and minimal weed invasion.
Evidence of community use of the bushland south of Mosedale Avenue for recreation, including horse trails.
Vegetation along the south-flowing wetland chain east of Parade Road has important hydrological function to impede localised salinity and flooding.

SECTION 4: INTERNATIONAL AND NATIONAL SIGNIFICANCE
Not listed

5.12 Estuary Drive

SECTION 1: LOCAL INFORMATION
Greater Bunbury Region Scheme Site no. 11
Area (ha): 0.5 (0.3 remnant vegetation)
Map sheet series ref. no. 2031-III NE
Local Authorities (Suburb): City of Bunbury (Vittoria Bay)

SECTION 2: REGIONAL INFORMATION
LANDFORMS AND SOILS
Marine Deposits
Alluvial Deposits (Qhao: Sm1)

VEGETATION AND FLORA
Vegetation Complexes
Marine Deposits
Yoongarillup Complex

Floristic Community Types
Supergroup 2: Seasonal Wetlands
Type not inferred

WETLANDS
Wetland Types: estuary
Natural Wetland Groups
Estuaries
Leschenault Estuary (E.4)
Wetland Management Objective: Conservation (0.01ha), Multiple Use
Swan Coastal Plain Lakes EPP: none identified

THREATENED ECOLOGICAL COMMUNITIES

Not assessed

SECTION 3: SPECIFIC AREA DETAIL
Landscape Features: vegetated wetland
Vegetation and Flora: limited survey (HGM 2002)
Structural Units: mapping (HGM 2002)
Wetlands: *Juncus kraussii* subsp. *australiensis* Closed Sedgeland with emergent *Casuarina obesa* and *Eucalyptus rudis* subsp. *rudis*

Scattered Native Plants: not assessed
Vegetation Condition: 100% Good
Total Flora: 9 native taxa, 6 weed taxa (HGM 2002) (Estimated >70% expected flora)
Significant Flora: none recorded

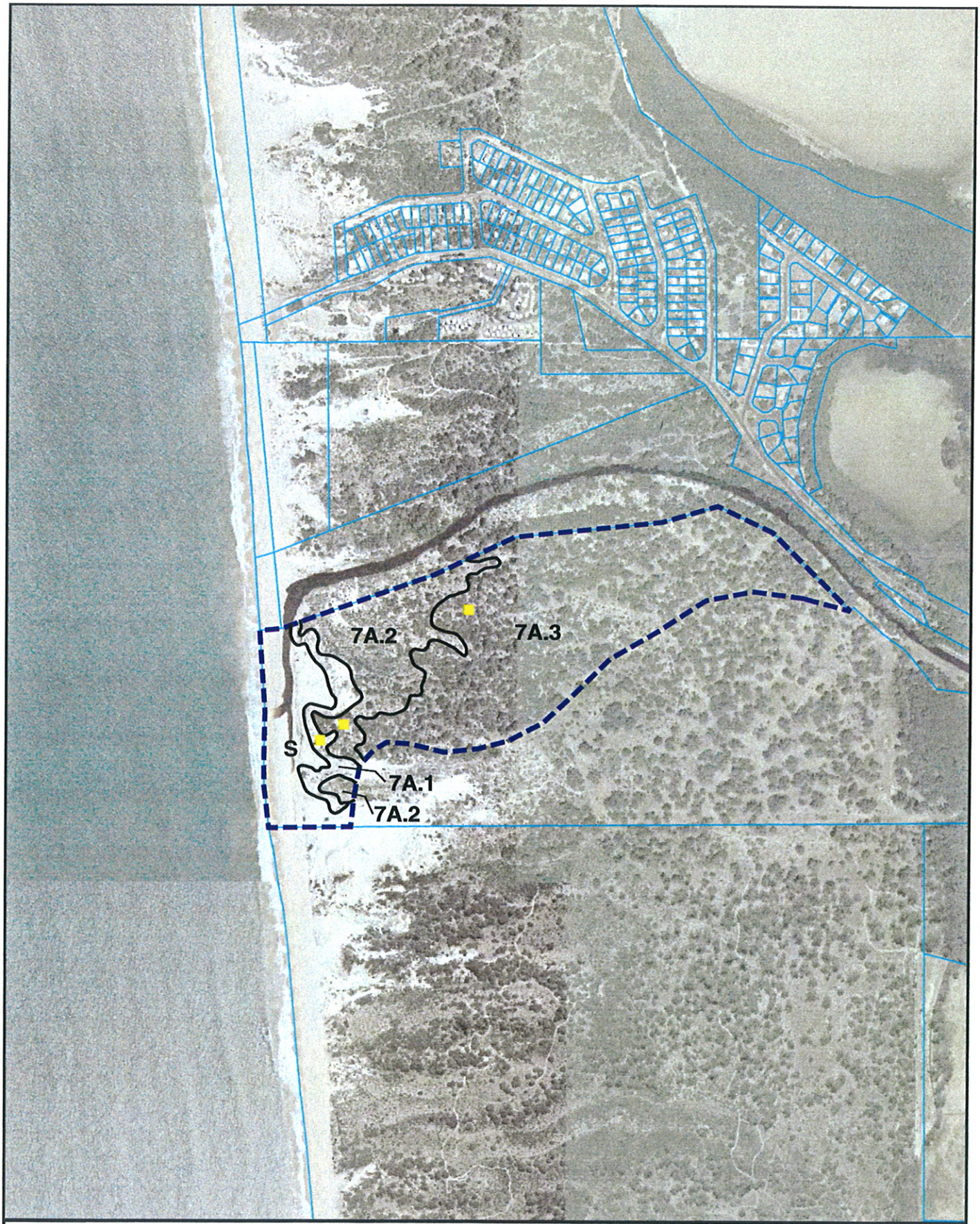
Fauna: limited survey for birds (10 species) (HGM 2002). Significant bird species: Great Egret (JAMBA/CAMBA), Yellow-rumped Thornbill.

Linkage: adjacent bushland to east and west; vegetation fringe along the estuary foreshore of the Estuary and the channel of the Preston River; continuation of the foreshore ROS; the site forms part of the tidal mudflats of the south-east section of the Leschenault Estuary (tidal areas include sandbanks, shallows and mudflats); the Vittoria Bay area is a designated Bird Habitat Area.

Other Special Attributes: the *Juncus* sedgeland association is a floristic community type of Supergroup 2 that appear closest to Type 16 defined in Gibson *et al.* (1994) but may represent a potentially threatened ecological community.
This site is part of the Leschenault Estuary System 6 area (C66).

Field Comments:
Isolated area of *Watsonia meriana* var. *bulbillifera* invasion on private land.

SECTION 4: INTERNATIONAL AND NATIONAL SIGNIFICANCE
Location for JAMBA/CAMBA species; subject to protection under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999*



DRAFT GREATER BUNBURY REGION SCHEME - ENVIRONMENTAL SURVEY
VEGETATION UNITS (SITE 7A)

Department for Planning and Infrastructure

WESTERN AUSTRALIAN PLANNING COMMISSION

GDA

Filename: ....Vegsurveys.dgn
Created: 31 October 2002

Produced By Cartographic Section
Bunbury Office, DPI

Photography: December 2000
Positional Accuracy ±10 metres

LEGEND

- SITE BOUNDARY
- CADASTRE
- 8.2 VEGETATION UNITS
- SURVEY PLOT

SEE LEGEND AT FIGURE 3.0 FOR VEGETATION UNIT DESCRIPTIONS.

N

1:10000 at A4

0 150

Metres

Figure 3.1

DRAFT GREATER BUNBURY REGION SCHEME - ENVIRONMENTAL SURVEY
VEGETATION UNITS (SITE 7B)

Department for Planning and Infrastructure

WESTERN AUSTRALIAN PLANNING COMMISSION

GDA

Filename: ....Vegsurveys.dgn
Created: 31 October 2002

Produced By Cartographic Section
Bunbury Office, DPI

Photography: December 2000
Positional Accuracy ±10 metres

LEGEND

- SITE BOUNDARY
- CADASTRE
- 8.2 VEGETATION UNITS
- SURVEY PLOT

SEE LEGEND AT FIGURE 3.0 FOR VEGETATION UNIT DESCRIPTIONS.

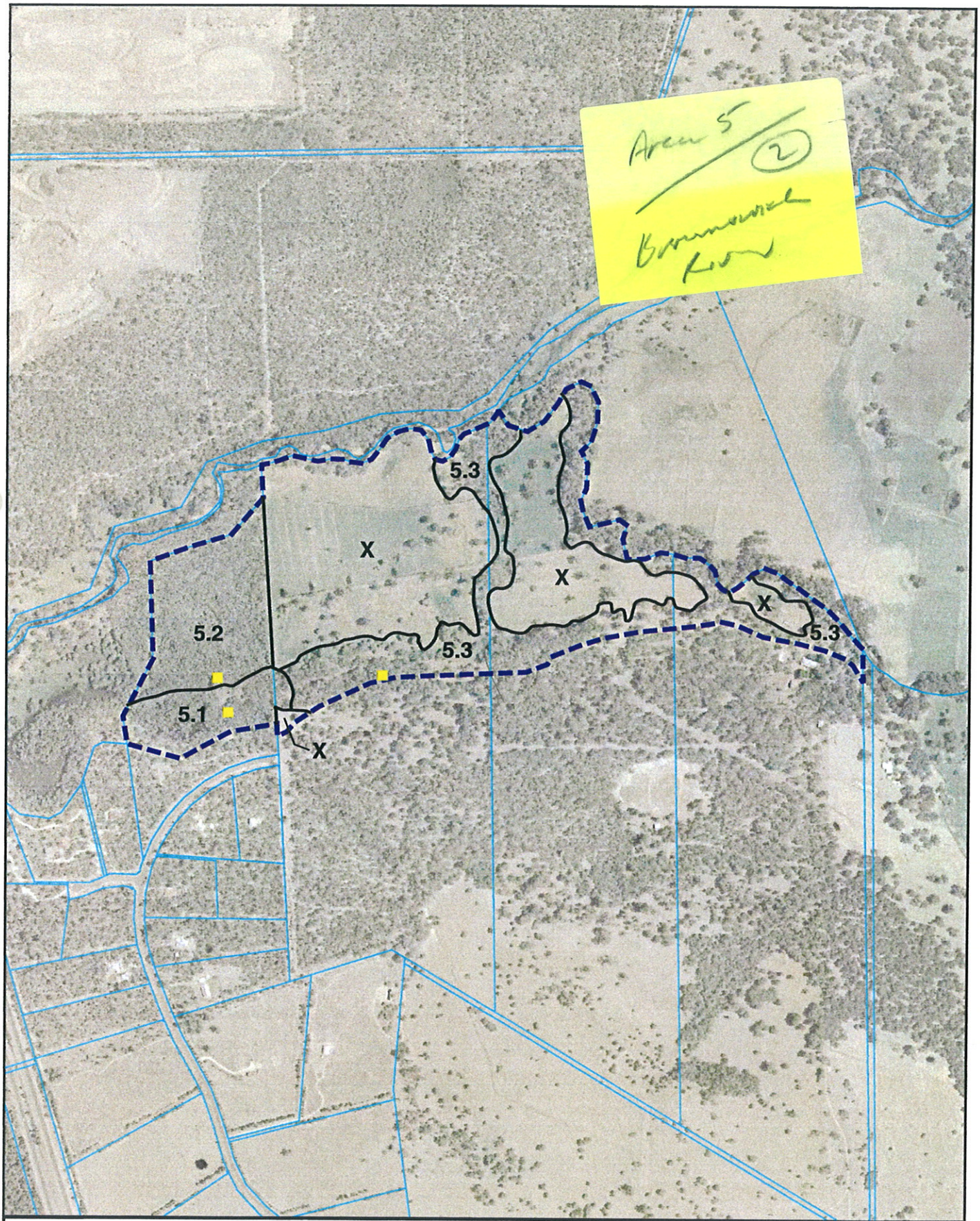
N

1:10000 at A3

0 150

Metres

Figure 3.2



DRAFT GREATER BUNBURY REGION SCHEME - ENVIRONMENTAL SURVEY
VEGETATION UNITS (SITE 5)

Department for Planning and Infrastructure

WESTERN AUSTRALIAN PLANNING COMMISSION

GDA

Filename: ... Vegsurveys.dgn
Amended: 11 November 2002

Produced By Cartographic Section
Bunbury Office, DPI

Photography: December 2000
Positional Accuracy ±10 metres

LEGEND

- SITE BOUNDARY
- CADASTRE
- 8.2 VEGETATION UNITS
- SURVEY PLOT

SEE LEGEND AT FIGURE 3.0 FOR VEGETATION UNIT DESCRIPTIONS.

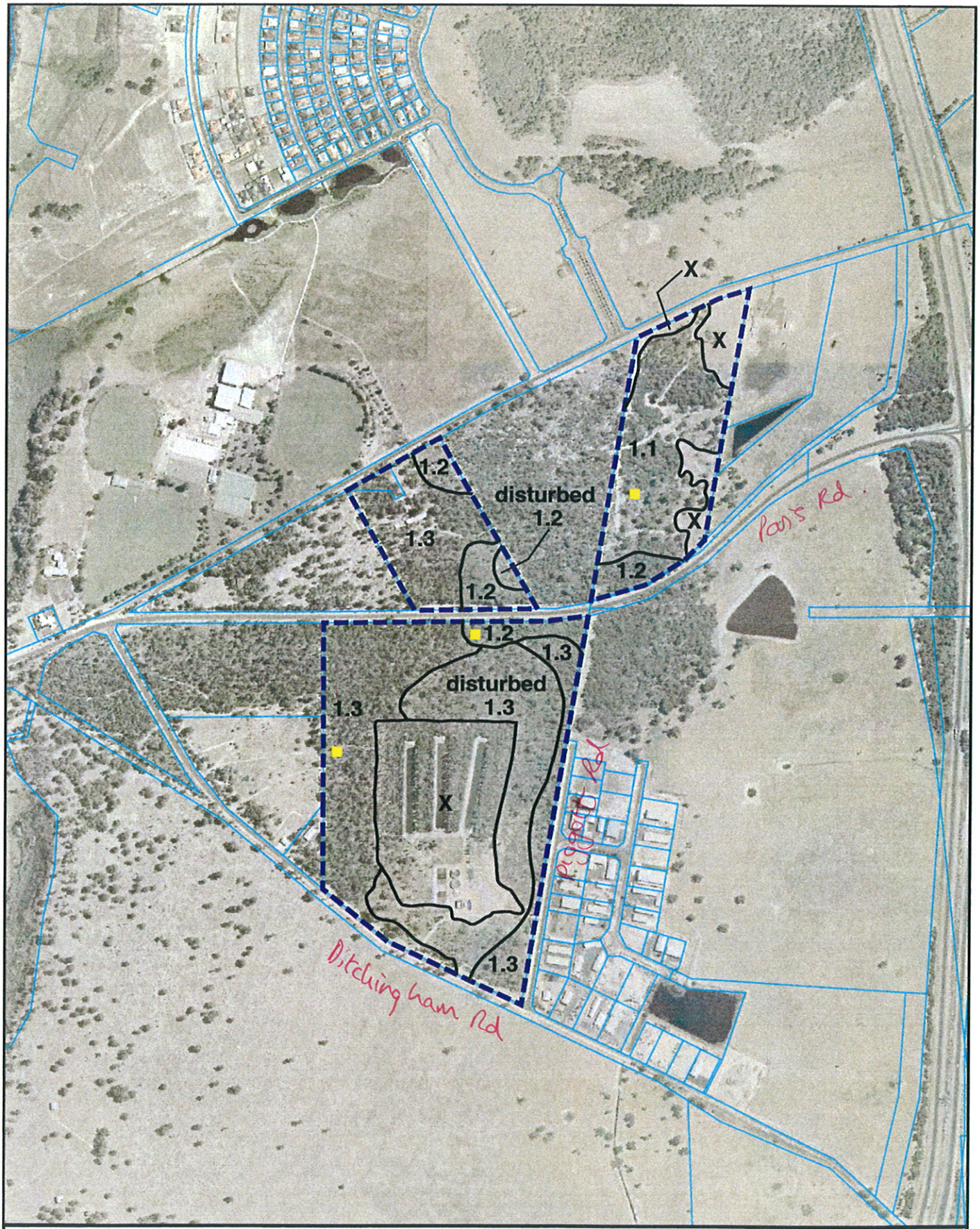
N

1:10000 at A4

0 150

Metres

Figure 3.3



DRAFT GREATER BUNBURY REGION SCHEME - ENVIRONMENTAL SURVEY
VEGETATION UNITS (SITE 1)

Department for Planning and Infrastructure

WESTERN AUSTRALIAN PLANNING COMMISSION

GDA

Filename: ...Vegsurveys.dgn
Amended: 11 November 2002

Produced By Cartographic Section
Bunbury Office, DPI

Photography: December 2000
Positional Accuracy ±10 metres

LEGEND

- SITE BOUNDARY
- CADASTRE
- 8.2 VEGETATION UNITS
- SURVEY PLOT

SEE LEGEND AT FIGURE 3.0 FOR VEGETATION UNIT DESCRIPTIONS.

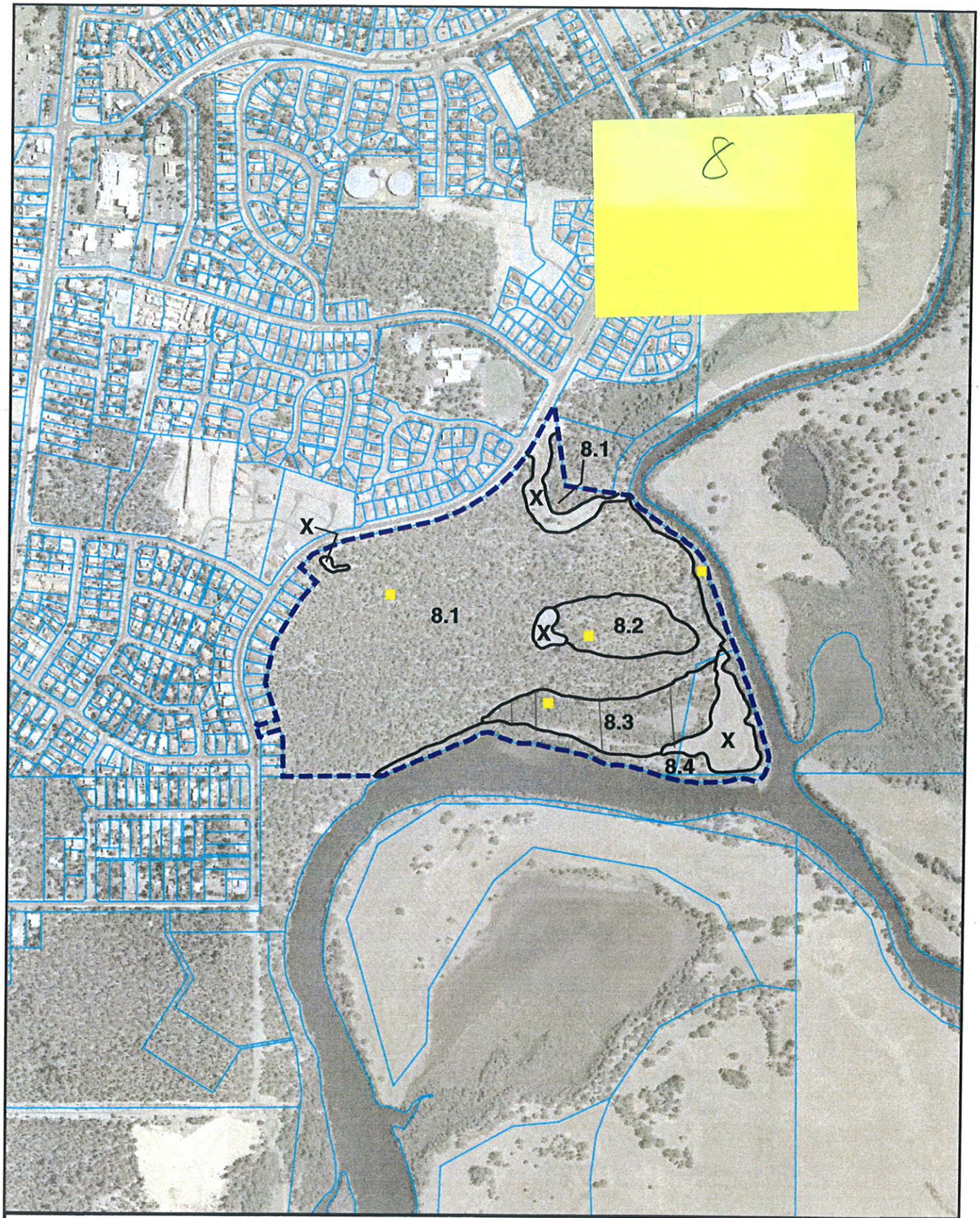
N

1:10000 at A4

0 150

Metres

Figure 3.4



DRAFT GREATER BUNBURY REGION SCHEME - ENVIRONMENTAL SURVEY
VEGETATION UNITS (SITE 8)

Government of Western Australia
Department for Planning and Infrastructure

Western Australian Planning Commission

GDA

Filename: ....Vegsurveys.dgn
Created: 31 October 2002

Produced By Cartographic Section
Bunbury Office, DPI

Photography: December 2000
Positional Accuracy ±10 metres

LEGEND

- SITE BOUNDARY
- CADASTRE
- 8.2 VEGETATION UNITS
- SURVEY PLOT

SEE LEGEND AT FIGURE 3.0 FOR VEGETATION UNIT DESCRIPTIONS.

N

1:10000 at A4

0 150

Metres

Figure 3.5

DRAFT GREATER BUNBURY REGION SCHEME - ENVIRONMENTAL SURVEY
VEGETATION UNITS (SITE 11)

Government of Western Australia
Department for Planning and Infrastructure

Western Australian Planning Commission

GDA

Filename: ....Vegsurveys.dgn
Created: 31 October 2002

Produced By Cartographic Section
Bunbury Office, DPI

Photography: December 2000
Positional Accuracy ±10 metres

LEGEND

- SITE BOUNDARY
- CADASTRE
- 8.2 VEGETATION UNITS
- SURVEY PLOT

SEE LEGEND AT FIGURE 3.0 FOR VEGETATION UNIT DESCRIPTIONS.

N

1:10000 at A4

0 150

Metres

Figure 3.6

Unit	Description
1.1	*Kunzea glabrescens* Closed Tall Scrub with emergent *Melaleuca preissiana* and *Corymbia calophylla*
1.2	*Corymbia calophylla, Eucalyptus marginata* subsp. *marginata, Banksia attenuata* and *Banksia ilicifolia* Open Woodland over *Kunzea glabrescens* Tall Open Scrub
1.3	*Eucalyptus marginata* subsp. *marginata, Corymbia calophylla, Banksia attenuata* and *Banksia ilicifolia* Woodland over *Allocasuarina humilis* and *Xanthorrhoea brunonis* subsp. *brunonis* Shrubland
2.1	*Eucalyptus gomphocephala* and *Agonis flexuosa* var. *flexuosa* Open Forest to Woodland
2.2	*Melaleuca rhapiophylla* Open Woodland
3.1	*Banskia attenuata, Eucalyptus marginata* subsp. *marginata* and *Xylomelum occidentale* Low Open Woodland over *Melaleuca thymoides, Kunzea glabrescens, Hypocalymma robustum* and *Adenanthos meisneri* Shrubland
3.2	*Eucalyptus marginata* subsp. *marginata* and *Corymbia calophylla* Woodland over *Banksia grandis* Low Open Woodland
3.3	*Eucalyptus marginata* subsp. *marginata* and *Corymbia haematoxylon* Woodland over *Xanthorrhoea preissii* Open Shrubland
3.4	*Corymbia calophylla* Open Forest over *Agonis flexuosa* var. *flexuosa* Low Open Forest
4.1	*Corymbia calophylla* and *Agonis flexuosa* var. *flexuosa* Open Forestv
4.2	*Eucalyptus rudis* subsp. *rudis* and *Agonis flexuosa* var. *flexuosa* Open Forestv
4.3	*Agonis flexuosa* var. *flexuosa* Closed Forest
4.4	*Melaleuca preissiana* and *Agonis flexuosa* var. *flexuosa* Low Open Forest
4.5	*Melaleuca rhapiophylla* Low Open Forest
4.6	*Corymbia calophylla* and *Eucalyptus marginata* subsp. *marginata* Open Woodland over Tall Shrubland dominated by *Melaleuca preissiana, Banksia littoralis, Agonis flexuosa* var. *flexuosa* and *Kunzea glabrescens* and combinations of these
5.1	*Eucalyptus rudis* subsp. *rudis* and *Melaleuca rhapiophylla* Woodland
5.2	*Melaleuca rhapiophylla* Closed Forest
5.3	*Eucalyptus rudis* subsp. *rudis* Woodland over *Agonis flexuosa* var. *flexuosa* and *Melaleuca rhapiophylla* Woodland with occasional *Corymbia calophylla*
.1	*Eucalyptus marginata* subsp. *marginata* and *Corymbia calophylla* Woodland over *Xanthorrhoea preissii, Acacia pulchella* and *Acacia flagelliformis* Open Shrubland
7A.1	Very Open Grassland dominated by **Ammophila arenaria, *Pelargonium capitatum* and *Olearia axillaris*
7A.2	*Agonis flexuosa* var. *flexuosa* and *Jacksonia furcellata* Tall Shrubland over *Alyxia buxifolia* and *Acanthocarpus preissii* Open Heath
7A.3	*Eucalyptus gomphocephala* and *Agonis flexuosa* var. *flexuosa* Low Open Forest over *Spyridium globulosum* and *Alyxia buxifolia* Open Heath
7B.1	*Melaleuca rhapiophylla* and *Melaleuca viminea* subsp. *viminea* Low Open Forest
7B.2	Closed Sedgeland dominated by *Juncus kraussii* subsp. *australiensis, Triglochin huegelii, Baumea juncea* and **Juncus oxycarpus* and combinations of these
7B.3	*Halosarcia lepidosperma, Halosarcia indica* subsp. *bidens* and *Juncus kraussii* subsp. *australiensis* Open Low Heath
8.1	*Corymbia calophylla* and *Eucalyptus marginata* subsp. *marginata* Open Forest to Woodland over *Banksia grandis* and *Agonis flexuosa* var. *flexuosa* Woodland
8.2	*Corymbia calophylla* and *Eucalyptus marginata* subsp. *marginata* Woodland over *Jacksonia furcellata, Kunzea glabrescens* and *Agonis flexuosa* var. *flexuosa* Woodland
8.3	*Eucalyptus rudis* subsp. *rudis* and *Melaleuca rhapiophylla* Open Forest over *Melaleuca incana* subsp. *incana* Tall Open Scrub
8.4	*Corymbia calophylla, Eucalyptus rudis* subsp. *rudis* and *Casuarina obesa* Woodland
9.1	*Lepidosperma gladiatum* Sedgeland
9.2	*Agonis flexuosa* var. *flexuosa* Open Forest
9.3	*Eucalyptus gomphocephala* Closed Forest over *Agonis flexuosa* var. *flexuosa* Low Open Forest
9.4	Open Low Heath dominated by *Scaevola crassifolia, *Pelargonium capitatum* and *Olearia axillaris*
5	Open Low Heath dominated by *Acanthocarpus preissii, Phylanthus calucinus, Acacia cochlearis* and *Lepidosperma gracile* with emergent *Agonis flexuosa* var. *flexuosa*
9.6	*Banksia littoralis* Low Woodland over Tall Open Scrub dominated by *Xanthorrhoea preissii, Anthocercis littorea* and *Acacia saligna*
9.7	Closed Sedgelands dominated by *Lepidosperma gladiatum, Carex appressa, *Typha orientalis* and *Pteridium esculentum* and combinations of these with emergent *Acaclia saligna, Banksia littoralis, Agonis flexuosa* var. *flexuosa* and *Melaleuca rhapiophylla*
9.8	Mosaic of units 9.1 and 9.7
9.9	*Agonis flexuosa* var. *flexuosa* Low Open Forest
9.10	Mosaic of units 9.6 and 9.9
10.1	*Eucalyptus gomphocephala, Corymbia calophylla* and *Eucalyptus marginata* subsp. *marginata* Open Forest over Low Woodland dominated by *Banksia attenuata, Banksia grandis, Agonis flexuosa* var. *flexuosa* and *Xylomelum occidentale* and combinations of these
10.2	*Eucalyptus gomphocephala* Open Forest over *Agonis flexuosa* var. *flexuosa* Low Open Forest
10.3	*Melaleuca rhapiophylla* and *Melaleuca teretifolia* Low Open Forest with emergent *Eucalyptus rudis* subsp. *rudis*
11.1	*Juncus kraussii* subsp. *australiensis* Closed Sedgeland with emergent *Casuarina obesa* and *Eucalyptus rudis* subsp. *rudis*
?9.2	Unverified 9.2
S	Sand dunes and foreshore
X	Disturbed

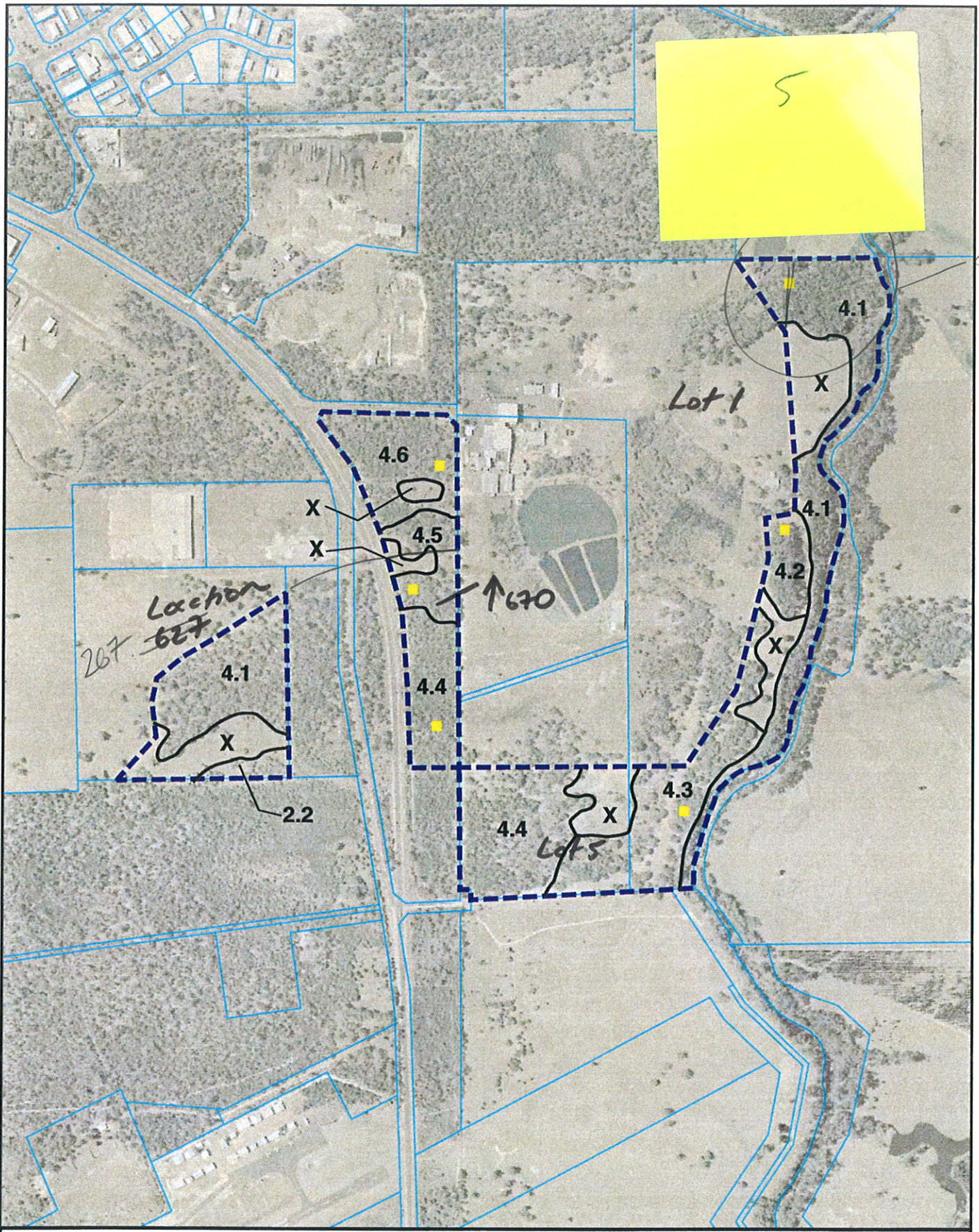
DRAFT GREATER BUNBURY REGION SCHEME - ENVIRONMENTAL SURVEY
VEGETATION UNITS - LEGEND

Department for Planning and Infrastructure

WESTERN AUSTRALIAN PLANNING COMMISSION

Vegetation_Unit_Legend.AI

Figure 3.0



DRAFT GREATER BUNBURY REGION SCHEME - ENVIRONMENTAL SURVEY
VEGETATION UNITS (SITE 4)

Department for Planning and Infrastructure

WESTERN AUSTRALIAN PLANNING COMMISSION

GDA

Filename: ....Vegsurveys.dgn
Created: 31 October 2002

Produced By Cartographic Section
Bunbury Office, DPI

Photography: December 2000
Positional Accuracy ±10 metres

LEGEND

- SITE BOUNDARY
- CADASTRE
- 8.2 VEGETATION UNITS
- SURVEY PLOT

SEE LEGEND AT FIGURE 3.0 FOR VEGETATION UNIT DESCRIPTIONS.

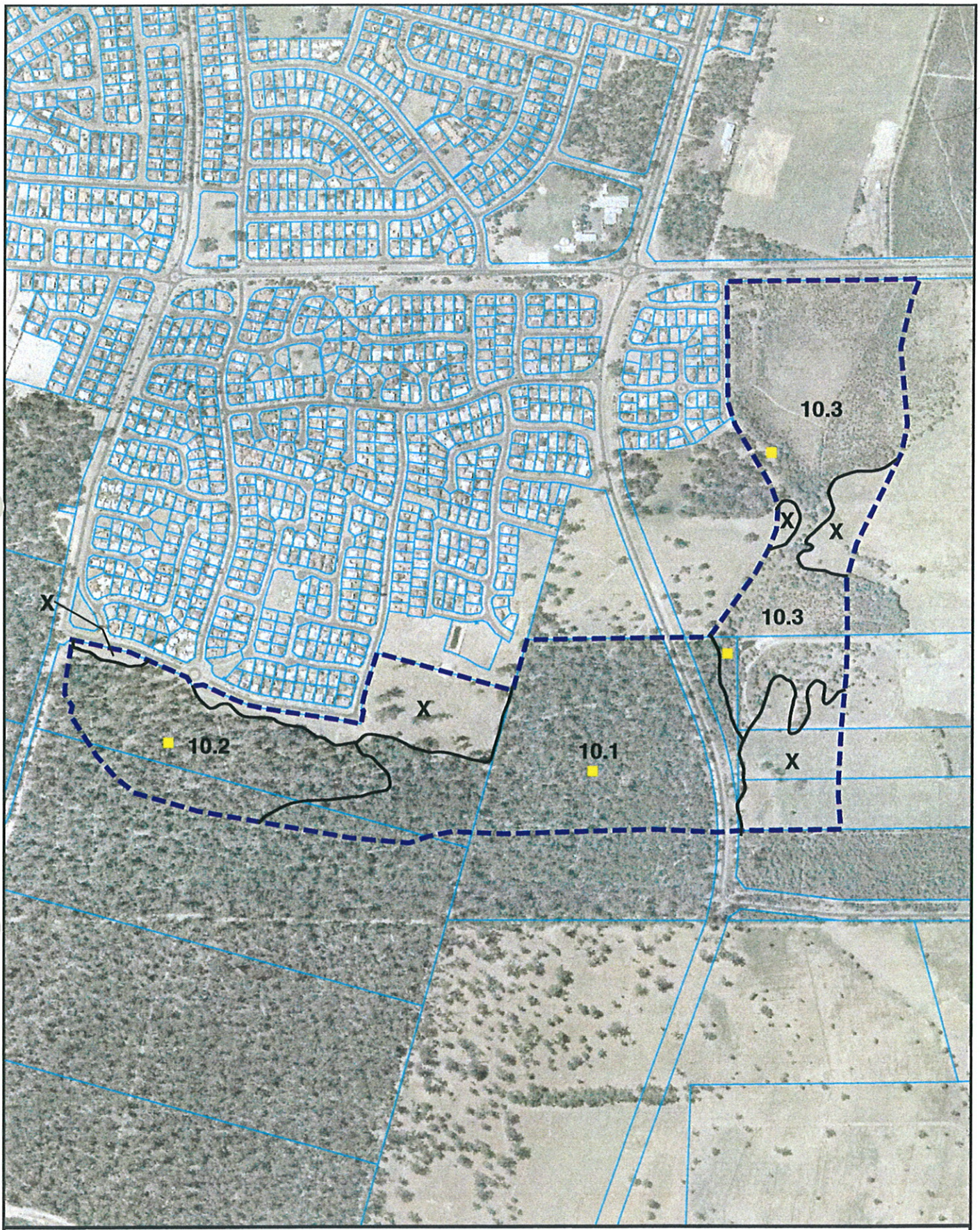
N

1:10000 at A4

0 150

Metres

Figure 3.7



DRAFT GREATER BUNBURY REGION SCHEME - ENVIRONMENTAL SURVEY
VEGETATION UNITS (SITE 10)

Department for Planning and Infrastructure

WESTERN AUSTRALIAN PLANNING COMMISSION

GDA

Filename: ....Vegsurveys.dgn
Created: 31 October 2002

Produced By Cartographic Section
Bunbury Office, DPI

Photography: December 2000
Positional Accuracy 110 metres

LEGEND

- SITE BOUNDARY
- CADASTRE
- 8.2 VEGETATION UNITS
- SURVEY PLOT

SEE LEGEND AT FIGURE 3.0 FOR VEGETATION UNIT DESCRIPTIONS.

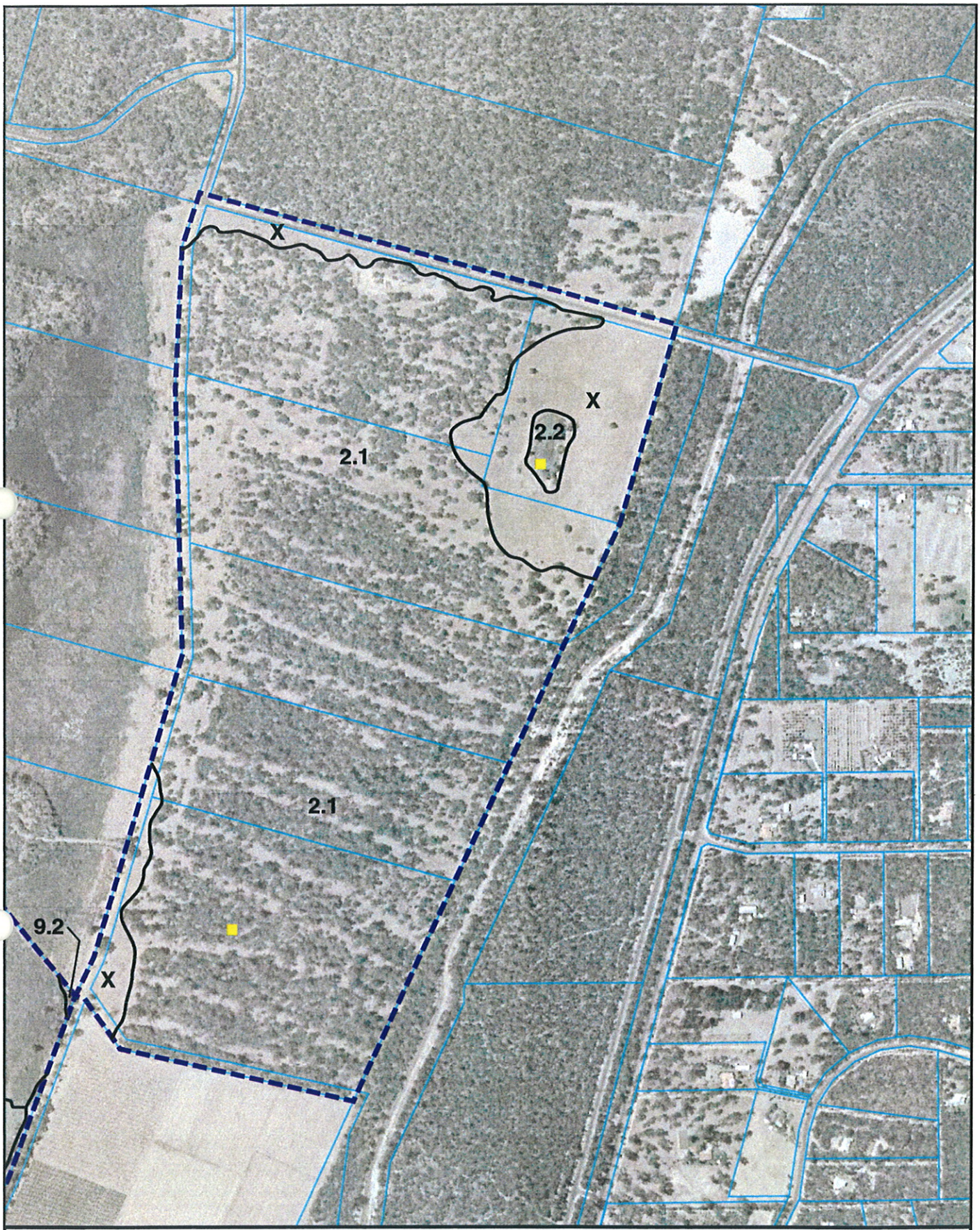
N

1:10000 at A4

0 150

Metres

Figure 3.8



DRAFT GREATER BUNBURY REGION SCHEME - ENVIRONMENTAL SURVEY
VEGETATION UNITS (SITE 2)

Department for Planning and Infrastructure

WESTERN AUSTRALIAN PLANNING COMMISSION

GDA

Filename: ....Vegsurveys.dgn
Created: 31 October 2002
Produced By Cartographic Section
Bunbury Office, DPI

Photography: December 2000
Positional Accuracy ±10 metres

LEGEND

- SITE BOUNDARY
- CADASTRE
- 8.2 VEGETATION UNITS
- SURVEY PLOT

SEE LEGEND AT FIGURE 3.0 FOR VEGETATION UNIT DESCRIPTIONS.

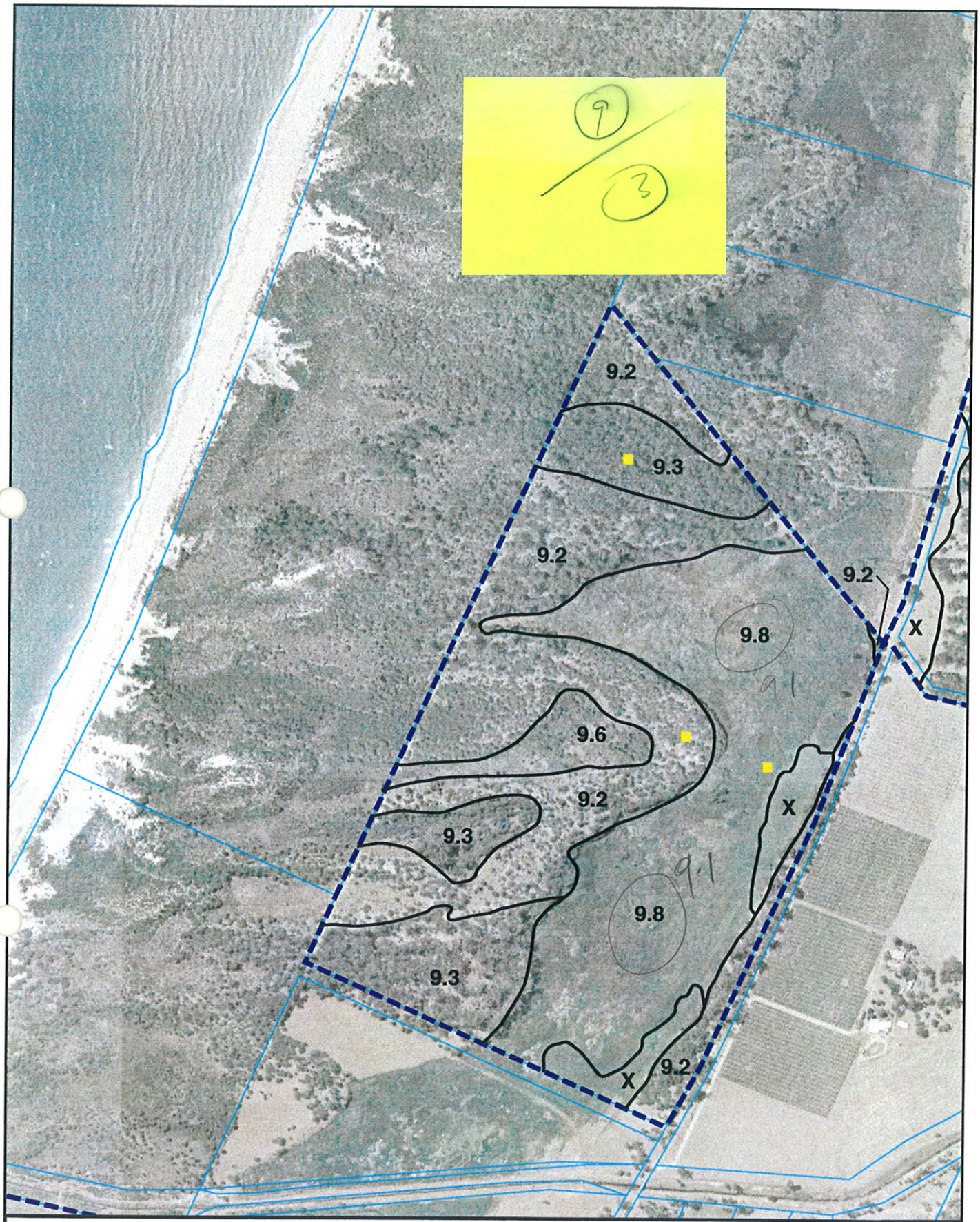
N

1:10000 at A4

0 150

Metres

Figure 3.9



DRAFT GREATER BUNBURY REGION SCHEME - ENVIRONMENTAL SURVEY
VEGETATION UNITS (SITE 9A)

Department for Planning and Infrastructure

WESTERN AUSTRALIAN PLANNING COMMISSION

GDA

Filename: ....Vegsurveys.dgn
Amended: 11 November 2002

Produced By Cartographic Section
Bunbury Office, DPI

Photography: December 2000
Positional Accuracy ±10 metres

LEGEND

- SITE BOUNDARY
- CADASTRE
- 8.2 VEGETATION UNITS
- SURVEY PLOT

SEE LEGEND AT FIGURE 3.0 FOR VEGETATION UNIT DESCRIPTIONS.

N

1:10000 at A4

0 150

Metres

Figure 3.10

DRAFT GREATER BUNBURY REGION SCHEME - ENVIRONMENTAL SURVEY
VEGETATION UNITS (SITE 9B)

Department for Planning and Infrastructure

WESTERN AUSTRALIAN PLANNING COMMISSION

GDA

Filename: ....Vegsurveys.dgn
Created: 31 October 2002

Produced By Cartographic Section
Bunbury Office, DPI

Photography: December 2000
Positional Accuracy ±10 metres

LEGEND

- SITE BOUNDARY
- CADASTRE
- 8.2 VEGETATION UNITS
- SURVEY PLOT

SEE LEGEND AT FIGURE 3.0 FOR VEGETATION UNIT DESCRIPTIONS.

N

1:10000 at A3

0 150

Metres

Figure 3.11

3.3

X

3.1

3.2

3.1

not in survey

X

3.1

3.4

DRAFT GREATER BUNBURY REGION SCHEME - ENVIRONMENTAL SURVEY
VEGETATION UNITS (SITE 3)

Department for Planning and Infrastructure

WESTERN AUSTRALIAN PLANNING COMMISSION

GDA

Filename: ....Vegsurveys.dgn
Created: 31 October 2002

Produced By Cartographic Section
Bunbury Office, DPI

Photography: December 2000
Positional Accuracy ±10 metres

LEGEND

- SITE BOUNDARY
- CADASTRE
- 8.2 VEGETATION UNITS
- SURVEY PLOT

SEE LEGEND AT FIGURE 3.0 FOR VEGETATION UNIT DESCRIPTIONS.

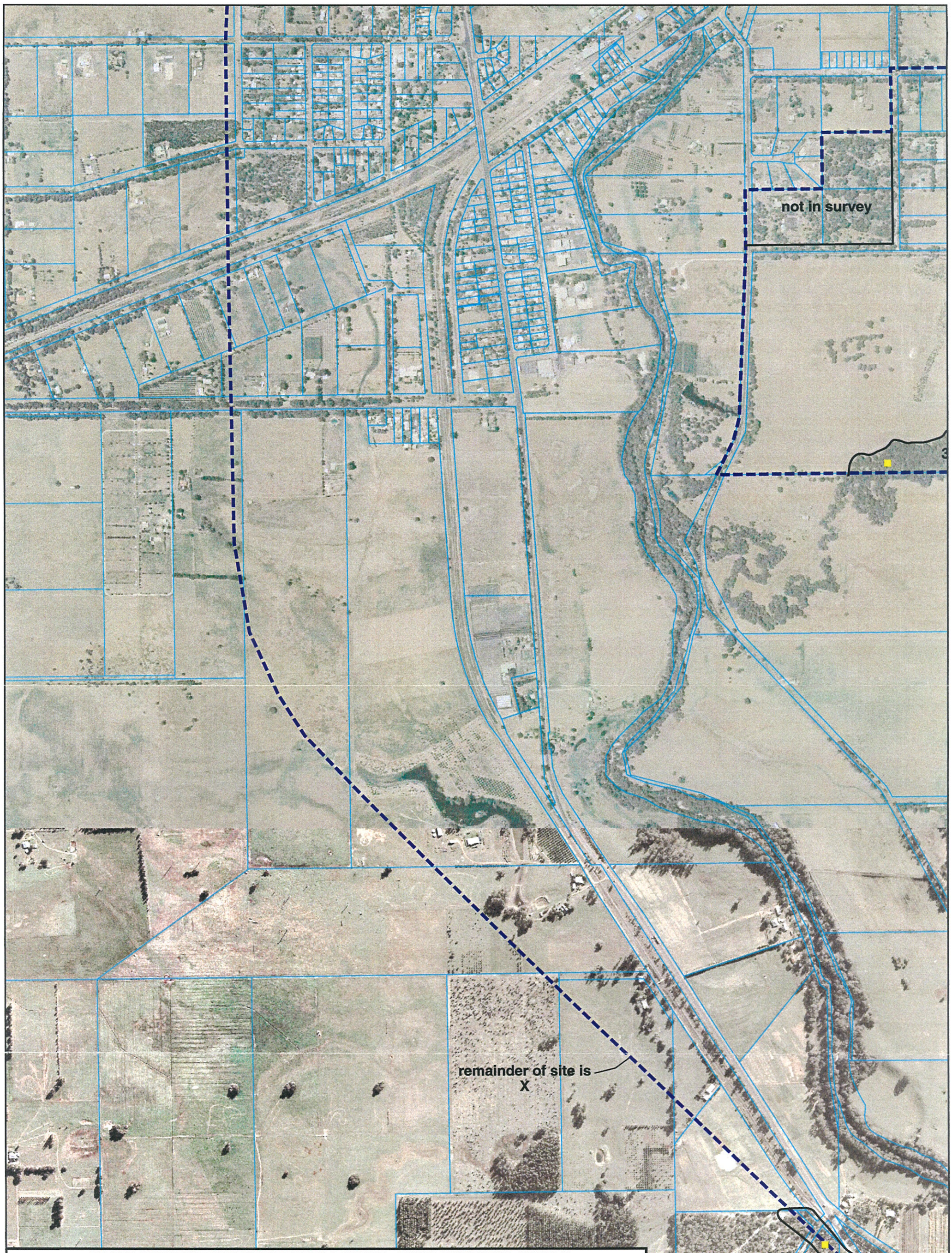
N

1:10000 at A3

0 150

Metres

Figure 3.12



DRAFT GREATER BUNBURY REGION SCHEME - ENVIRONMENTAL SURVEY
VEGETATION UNITS (SITE 6)

Department for Planning and Infrastructure

WESTERN AUSTRALIAN PLANNING COMMISSION

GDA

Filename: ....Vegsurveys.dgn
Created: 31 October 2002

Produced By Cartographic Section
Bunbury Office, DPI

Photography: December 2000
Positional Accuracy ±10 metres

LEGEND

- SITE BOUNDARY
- CADASTRE
- 8.2 VEGETATION UNITS
- SURVEY PLOT

SEE LEGEND AT FIGURE 3.0 FOR VEGETATION UNIT DESCRIPTIONS.

N

1:10000 at A3

0 150

Metres

Figure 3.13

6 Discussion of Field Survey

6.1 Findings of Interest

6.1.1 Diversity of flora

The Spring 2002 survey recorded a total of 424 vascular plant taxa (including incomplete identifications) from 256 genera and 79 families. It appears that all taxa recorded during the present survey have been recorded previously in the Region. It is likely that since this single survey has recorded 70% of the flora likely to occur at the sites, up to 600 taxa may occur across the 12 sites. This diversity of flora is due to the location of the sites on a variety of landforms, from the coast to the foothills, spread over more than 40km.

One taxa that was previously recorded at Site 8 (ATA Environmental 2001a) was not recorded during the Spring 2002 survey, and is listed under the *Wildlife Conservation Act 1950* and the *EPBC Act 1999*. Because this taxa is summer flowering it was unlikely to be recorded during the Spring 2002 survey.

94 taxa recorded during the Spring 2002 survey were weeds, representing over 20% of the flora observed. This was not unexpected given the close proximity of the sites to agricultural and urban environments.

6.1.2 Wetland Area

This study has identified additional areas of dampland at Site 9 than has been mapped to date by V and C Semeniuk Research Group (1998) on behalf of the WRC (Keighery *et al.* 2002). These additional dampland areas occur in Quindalup dune swales to the west of the main wetland chain known as Muddy Lakes or Minninup Swamp. The damplands have values that may contribute to classification as a conservation category wetland, satisfying several of the criteria proposed by V and C Semeniuk Research Group (1998).

The sumpland at Site 9 is vegetated by a mosaic of structural units, the boundaries of which were impossible to define during the course of the field survey. It is recommended that further investigation of this highly complex area is undertaken. In particular, the range of annual and geophytic (underground storage organ with annually renewed aerial shoot) taxa that is expected to occur in seasonally inundated wetlands requires further investigation.

6.1.3 Coastal Salt Marshes

Coastal Salt Marshes are of limited occurrence in the South West Botanical District (Trudgen 1984). The structural vegetation type 7B.3 (*Halosarcia lepidosperma, Halosarcia indica* subsp. *bidens* and *Juncus kraussii* subsp. *australiensis* Open Low Heath) recorded in the south of Site 7B is similar to the salt marsh vegetation recorded on the north-eastern foreshore (Pen 1992) except for the notable absence of *Sarcocornia* species.

Trudgen (1984) recommended that all action possible should be taken to protect Coastal Salt Marshes because of their limited distribution and their importance as feeding habitats for water birds. The importance of this habitat for birds and fish was also highlighted by WRC and LIMA (1997).

6.1.4 Undefined Floristic Community Types and TECs

Three structural vegetation units recorded during this study are of undefined floristic community types or appear to be beyond the comparison with the available regional dataset. In general, further investigation is required to enable a complete analysis of regional floristic affiliations and conservation significance of these three units.

One vegetation unit recorded during the survey could not be assigned to a floristic community type defined by Gibson *et. al.* (1994). *Juncus kraussii* subsp. *australiensis* Closed Sedgeland with emergent *Casuarina obesa* and *Eucalyptus rudis* subsp. *rudis* (unit 11.1) occurred on wetlands of the Yoongarillup Complex along the southern foreshore of the Leschenault Estuary. The field survey conducted for this study is unlikely to be sufficient to determine the regional floristic affiliations and conservation significance of this unit. However, on the results of the present study and that of Trudgen (1984) and Pen (1992) it is proposed that vegetation unit 11.1 has regional significance and may be expected to meet the criteria for identification as a TEC.

The *Eucalyptus rudis* subsp. *rudis* and *Agonis flexuosa* var. *flexuosa* Open Forest (unit 4.2) recorded during this study at Site 4 did not compare to any floristic community type. Community type 17 contains both *Eucalyptus rudis* and *Agonis flexuosa* but was only recorded from swales in the Quindalup and Spearwood dunes or at interfaces with other systems in Gibson *et al.* (1994). It is unlikely that vegetation unit 4.2 is FCT 17. Vegetation unit 4.2 occurred in the Swan Complex, along the Preston River and surrounding an adjacent sumpland that contained open water at the time of survey. Given its restricted nature and uncommon combination of *Eucalyptus rudis* subsp. *rudis* and *Agonis flexuosa* var. *flexuosa,* vegetation unit 4.2 has regional significance and may be expected to meet the criteria for identification as a TEC.

The *Banksia littoralis* Low Woodland (unit 9.6) recorded during this study may represent the most southern occurrence on the Southern Coastal Plain of floristic community type 19. Floristic community type 19 is recognised both at State and Commonwealth level (endorsed by the WA Minister for the Environment and listed as Critically Endangered under the *EPBC Act 1999*).

Keighery *et al.* (2002) suggests that the 'Quindalup Dune Swale Damplands' are the only sequence of this type known on the Swan Coastal Plain, and therefore may constitute a TEC. *Banksia littoralis* Low Woodland (unit 9.6) was not recorded by Trudgen (1984) on the Leschenault Peninsula.

The field survey conducted for this study is unlikely to be sufficient to determine the regional floristic affiliations and conservation significance of the *Banksia littoralis* Low Woodland (unit 9.6). For example, Keighery *et al.* (2002) recommended establishing paired plots in each floristic unit; this level of survey was not possible under the present study. However, on the results of the present study and that of Keighery *et al.* (2002) it is proposed that this vegetation unit has regional significance and is expected to meet the criteria for identification as a TEC.

6.1.5 Disturbance

During the course of the field survey the remnant bushland of several sites was observed to be recently or currently impacted by anthropogenic disturbance. Anthropogenic disturbance included clearing, burning and agricultural activities. Natural disturbance in the form of bushfire was also observed to have occurred at one site.

At Site 2 the landowner was engaged in land clearing activities in the northern portion at the time of survey. It appeared that the mid and understorey was being removed, stockpiled and burnt, resulting in a 'parkland cleared' condition. Furthermore, aerial photographic interpretation suggests that such parkland clearing activities have been ongoing at this site. As a result, it is likely that vegetation condition will have deteriorated to Completely Degraded for more than 80% of the site, seriously degrading its natural values. This activity was reported to the Office of the Commissioner of Soil and Land Conservation (Appendix J). It is recommended that further investigation will be necessary to redefine the vegetation condition of this site post clearing activities.

At Site 9 a landowner was engaged in scrub burning activities in one of the lots at the northern end of portion 9B, which may be construed as land clearing. It appeared that the mid and understorey was being burnt, and that this area was regularly burnt by the landowner. As a result, it is likely that vegetation condition will have deteriorated to Degraded in some areas, including areas of vegetation sumpland that was identified as being of structural and floristic complexity. This activity was reported to the Office of the Commissioner of Soil and Land Conservation. It is recommended that further investigation will be necessary to redefine the vegetation condition of this area of the site post burning activities.

Many creeklines and wetlands within the study areas were fenced from stock during the winter period, thus preventing grazing disturbance. Stock was often permitted into creeklines and wetlands during the summer months, coinciding with the period of recruitment of annual and geophytic taxa that occur as these areas dry. This is likely to have reduced the floristic diversity of the sites.

Parts of Site 10 experienced a bushfire in 2001. These areas were observed to be recovering, with floristic and structural diversity maintained and minimal weed invasion.

Fire regime and associated successional vegetation stages affect certain fauna species. Major portions of the Muddy Lakes site and some other areas had been burnt within the previous few years and this would have resulted in the loss of individuals and possibly local populations of fauna. Ground dwelling species are thought to be particularly at risk from fires, although burrows may provide an escape from less intense fires. Bird species appear to vary in their response to fire; although there is reduced shelter in burnt areas, they may provide foraging opportunities not encountered elsewhere, and some species are more abundant at sites with post-fire regrowth.

6.2 Limitations to Results

6.2.1 Timing of Vegetation Survey

In order to allow information from the surveys to be analysed and the Commission to achieve its timelines in responding to the EPA on submissions, there was a restricted period of time within which the survey was to be conducted and reported on. This has influenced the survey in a number of ways.

Due to time constraints, the study sites were only visited on one occasion. It was expected that increasing visits would increase the number of annual and geophytic taxa recorded, particularly for seasonally wet areas. Gibson *et al.* (1994) visited sites between two and four times to increase the probability of recording the full compliment of flora. For example, a DRF orchid that flowers in summer months and has been previously recorded at Site 8 (ATA Environmental 2001a) could not be expected to be recorded during the present study. Therefore, it is estimated that approximately 70% of the expected flora was recorded during the Spring 2002 survey. The exception to this is where floristic survey by ATA Environmental had also been conducted at the site; this was the case for Sites 8 and 10.

No information on TECs was available prior to the field survey (Melissa Hoskins pers. comm.). As a result, a targeted search of TECs was not possible. A TEC (myHAY03) of floristic community type 18 was identified near Site 10 after the survey had been undertaken. This TEC is listed as 'vulnerable' at a state level. A small portion (1.5ha) of the extreme south-west extent of this TEC falls within Site 10, which is less than 2% of the 'zone of influence' of the TEC. However, since the TEC site "myHAY03" is separated from Site 10 by Washington Road and the southern extent that falls within Site 10 is very degraded, the site should not be classified as a threatened ecological community.

It is possible that vegetation units 9.6 and 11.1 may be expected to meet the criteria for identification as TECs (see section 6.1.4 Undefined Floristic Community Types).

All obvious vegetation changes apparent on the aerial photographs were surveyed. Due to time and access limitations it was not possible to visit the total area. Areas not traversed on foot were assigned to vegetation units on the map by comparing the photographic textures to those of areas groundtruthed.

6.2.2 Timing of Fauna Survey

Limitations on fauna surveys are principally related to timing and duration, because variations in fauna populations over space and time influence the array of species encountered. Some species are nomadic or migratory and may only occur in certain seasons. For example, the arrival of the Rainbow Bee-eater *Merops ornatus* was noted toward the end of the survey, whereas the Shining Bronze-Cuckoo *Chrysococcyx lucidus* was heard calling at several of the survey sites. Fauna populations will tend to fluctuate as a result of the biological and physical factors that form the environment of the organism. Small mammals, for example, may vary radically in numbers both between seasons and annually, and this will influence the likelihood of their being detected during the course of a fauna survey.

Migratory waders or shorebirds are strictly seasonal in their movements. Although it has been documented that in some species a few individuals may overwinter in Australia, in the majority of cases waders will migrate to the Northern Hemisphere (where they breed) in the austral winter. Waders migrate to Australia in spring and usually reach southern Australia in October, building in numbers in late spring. Only two species of migratory waders were observed during the survey but considerable numbers and variety of species are known to occur in the Region over summer. Ninox (1989) noted that larger numbers of waders were recorded on the Leschenault Estuary from October onwards.

In regard to the frogs of the Region it was too late in the season for species of *Heleioporus* to be calling and none were recorded although they would be expected to occur at some sites. The Motorbike Frog *Litoria moorei* was heard calling at the end of the survey; this species commences breeding in late spring and so was not at peak levels of breeding activity. In general the timing of the survey was not optimal for frogs but several species were recorded.

Ambient temperature will greatly influence activity levels of fauna, particularly ectothermic species. Temperatures during the survey were sufficiently warm to encourage some activity in reptiles, but were not ideal. On several days the skinks *Egernia luctuosa* were noted to be active at Muddy Lakes, and Tiger Snakes *Notechis scutatus* were observed basking in the area. Rainfall during the early part of the survey induced activity in some amphibians, and may also have encouraged movement in some nocturnal reptiles and mammals. Warm, humid nights are generally the best times to search for nocturnal snakes, geckos and legless lizards, however, such conditions were not encountered during the current survey.

Whilst common and abundant species or those that are easily observed or recorded (e.g. calling birds) are frequently encountered during fauna surveys, resident species with naturally low population densities or that have secretive habits are often difficult to detect. Surveys incorporating two (or more) phases in different seasons facilitate a more complete inventory of the species present. Long term surveys incorporating several trapping periods over a period of years are ideal for the collection of baseline data and provision of comprehensive species lists (How 1998).

6.2.3 Complexity of Vegetation

Due to the diversity of communities, access restriction and time restrictions in several of the wetland areas (particularly on the wetland of Muddy Lakes), the vegetation map has been simplified by grouping similar communities together in mosaic mapping units. On the Muddy Lakes sumpland the units 9.1 and 9.7 are mapped as a mosaic. This mosaic consists of *Lepidosperma gladiatum* Sedgeland (unit 9.1) interspersed with Closed Sedgelands dominated by *Lepidosperma gladiatum, Carex appressa, *Typha orientalis* and *Pteridium esculentum* and combinations of these with emergent *Acacia saligna, Banksia littoralis, Agonis flexuosa* var. *flexuosa* and *Melaleuca rhaphiophylla* (unit 9.7).

6.2.4 Southern extension beyond Gibson *et al.* (1994)

The detailed floristic survey of Gibson *et al.* (1994) is the most recent regional floristic work over the entire Swan Coastal Plain and was used in this study as

the basis for regional comparison of bushland areas. However, Gibson *et al.* (1994) stated that their survey under-sampled the Pinjarra Plain and Quindalup Dunes and did not fully cover the estuarine and riverine vegetation.

Because the Pinjarra Plain and Quindalup Dunes of the southern Swan Coastal Plain was not well sampled during the Gibson *et al.* (1994) survey, the ability to compare floristic communities from this dataset is limited. For example, only one of the detailed floristic plots was located on the Swan Complex, and this plot was not in the typical watercourse fringing vegetation of the Swan Complex.

Some common flora within the vegetation communities of this study were not listed in Table 12 of Gibson et al (1994) therefore restricting the ability to compare some of the floristic communities from this study with those defined in Gibson et al (1994). Taxa missing from Table 12 include *Banksia littoralis, Casuarina obesa, Xanthorrhoea brunonis* subsp. *brunonis* and *Adenanthos meisneri.*

6.2.5 Limited Fauna Trapping

The fauna survey undertaken in the study area complies with EPA style requirements for terrestrial biological surveys as outlined in Position Statement No. 3. (EPA 2002a). The survey of sites within the Region incorporated a detailed desktop study including a review of available literature and searches of relevant fauna databases prior to commencement of the field work component. Reconnaissance surveys of the Muddy Lakes area and opportunistic sites were undertaken in combination with aerial photographic, landform and topographic information to identify fauna habitats. At Muddy Lakes these habitats were then surveyed through a combination of systematic trapping and transect procedures. Opportunistic field observations were made throughout the study area. The style of survey undertaken at Muddy Lakes is considered by the EPA to be appropriate to environments in the south-west (relatively high 'sensitivity') in which the scale of impact is moderate to high. It should be noted that this level of fauna investigation was only carried out at Site 9 as per the brief.

In reference to fauna surveys in general, it is important that a variety of trapping and survey techniques are utilised. Methods employed during the present study include pit, Elliott and cage trapping, microhabitat searching, avifauna transects, opportunistic observations and nocturnal survey. In addition, hair sampling was used to aid in the detection of medium sized mammals.

It should be noted, however, that although hair sampling and cage traps were used in the survey, it is unlikely that during the course of a brief survey all mammals will be detected, particularly where they occur at low densities. The survey effort at Muddy Lakes was low in comparison to other surveys elsewhere in the state undertaken by CALM, for example in the forests and at Two Peoples Bay, where the emphasis was on medium sized mammals. Despite this, several mammals were trapped in cages and hair samples were collected at these sites. Species recorded using hair sampling techniques were Southern Brown Bandicoot *Isoodon obesulus fusciventer* and *Black Rat *Rattus rattus.* In order to be certain of detecting populations of rare mammals such as the Quokka, however, it would be necessary to undertake a more detailed, focussed survey of the area, involving a sustained period of trapping.

At opportunistic sites relatively brief reconnaissance visits were undertaken in the majority of cases with the principal aim being to describe fauna habitats. The emphasis of the surveys tended to be on avifauna because birds are relatively easily detected and provide a reasonable measure for comparison between sites. Due to the brief period of sampling at these sites and the lack of trapping, reptiles and mammals are poorly documented and species lists are incomplete in probably all cases. Whilst information pertinent to the sites has been obtained from other sources where possible, there is limited or no information concerning the fauna of nearly all sites.

6.2.6 Regional Context

A detailed assessment of natural values and an identification and evaluation of significant bushland areas, similar to the Bush Plan project has not been undertaken in the Greater Bunbury Region. Together with the relatively poor level of knowledge of the composition of the biota within the region, this limits the ability to make a detailed appraisal of natural values within a regional context. The lack of information concerning natural values was apparent in the GBRS Environmental Review (WAPC 2000). For example, no specific information is provided for native terrestrial fauna, and the only reference to habitat is in regard to the value for waterbirds of the Leschenault Estuary. While this study has presented a detailed appraisal of the flora from a site-specific context, detailed investigation of the fauna from a site-specific context is required, and an analysis of the regional natural values is recommended.

In comparison to the Perth region and other parts of the state the information available for fauna in the Region is very limited. There are few studies that have been undertaken with special reference to fauna and basic distributional knowledge for many species is lacking. This deficiency in information concerning the fauna of the Region means that considerable extrapolation has had to be made in the determination of potential species and assessment of their utilisation of habitats.

6.2.7 Incomplete Areas

The 12 Sites of this study were nominated by the WAPC. The sites are not contiguous remnants, discrete occurrences of remnants or complete blocks prosed to be reserved for ROS. This has limited the study's ability to assess the natural values in a regional context.

For example, Site 11 Estuary Road consists of a small part of the ROS proposed for the Leschenault Estuary foreshore. Site 11 contains less than a hectare of remnant bush, but it is an integral part of a substantial corridor of remnant bushland. Considered in isolation, this site does not represent a sufficient size (more than 20 hectares) according to the Urban Bushland Strategy (Government of WA 1995) and is below the preferred lowest area limit (EPA 2002b). However, it is unreasonable to assess this site outside the context of the consolidated ROS that it forms a part of.

7 Regional Selection Criteria

7.1 Regional Context for Natural Values

The Swan Coastal Plain has high natural values, is the most populous and densely settled area of the state, and has been heavily cleared. As a consequence, the Swan Coastal Plain is the focus for the largest number of development proposals submitted to the Environmental Protection Authority for assessment of environmental impacts (EPA 2002b). The continuing pressure of urban development is an ongoing threat to the natural values of remnant bushland of the coastal plain, particularly the diversity of vegetation communities, fauna habitats and rare taxa that occur. In the Greater Bunbury Region, urban expansion (particularly around Bunbury and Australind) and continued rural and industrial development has lead to significant degradation of natural values. This has resulted in an estimated 78% loss of the original native vegetation (EPA 2002b), and loss of condition in many of the remaining remnants.

A detailed assessment of natural values and an identification and evaluation of significant bushland areas within the Perth metropolitan region was facilitated by the Bush Plan project (Government of Western Australia 1998). A similar process of regional evaluation and categorisation has not been undertaken in the Greater Bunbury Region. The relatively poor level of knowledge of the composition of the biota within the region limits the ability to make a detailed appraisal of natural values within a regional context. The lack of information concerning natural values was apparent in the GBRS Environmental Review (WAPC 2000).

The study area of this report focuses primarily on the Swan Coastal Plain portion of the Region as defined by Thackway and Cresswell (1995), largely excluding upland areas to the east on the Blackwood Scarp and Plateau. It is apparent from regional survey information that there are differences in the regional landforms and distribution of vegetation types within the Swan Coastal Plain bioregion, particularly when comparing areas around Bunbury with districts to the north of Perth. This is due to the greater proportion of the Greater Bunbury Region comprising fluviatile (alluvial and colluvial) landform types associated with the eastern coastal plain and changes in vegetation associated with particular landforms over the range of these sequences along the coastal plain. Therefore, it is not unexpected that over a latitudinal gradient there will be significant change in vegetation within what was mapped as a single landform unit over the entire coastal plain by Heddle *et al.* (1980). Some investigations of the vegetation have noted these differences in species composition; for example, Beard (1979) and Smith (1974) have differentiated the Quindalup system into separate units north (Guilderton system) and south (Rockingham system) of the Swan River. The range of small-scale geomorphic units within the Quindalup dunes and their relatively recent development mean that this is an exceedingly diverse landform unit. However, similar local topographic diversity is evident in other landform units to a lesser extent, as for example the interaction of wetland, lake and estuary deposits and Quaternary sedimentary systems.

The overall conclusion is that whilst vegetation corresponds generally to landform units, there is significant sub-(bio)regional variation both in vegetation and the array of fauna species that utilise available habitats over the

latitudinal gradient along the coastal plain. The character of the southern Swan Coastal Plain differs from areas to the north in the relative influence of climatic factors and the relative proportion of underlying geological features (eg. extent of Pinjarra Plain and depth of Tamala limestone) that ultimately dictate the distribution of landforms, soils, vegetation types and fauna habitats.

There has been significant loss and degradation of wetlands in Australia since settlement, and the coastal lowlands of southern Australia have suffered the greatest loss. Estimates of wetland loss on the Swan Coastal Plain are in the order of 70% (Halse 1989) and degradation of wetland values continues to occur. Wetlands are particularly important for waterbirds, frogs, turtles and aquatic invertebrates, and support specific floristic community types. Until wetland mapping and designation of wetland categories for the Region is published, determination of the relative importance of wetlands and wetland systems is limited. As a result, degradation of basin and channel wetlands, their associated riparian vegetation and water dependent fauna communities within the Region may continue.

7.2 Explanation of the Criteria

EPA (2002b) developed a strategy to be adopted for consideration of the regional significance of the GBRS portion of the Swan Coastal Plain. This strategy has been adopted to set the criteria for assessing the natural areas affected by new zones and reserves under the GBRS. The strategy measures an individual area's natural values against the selection criteria for the identification of regionally significant natural areas developed for System 6 and Part System 1 Update and the Bushplan Project to determine regional significance.

The six criteria defined in EPA (2002b) are:

1. representation of ecological communities;
2. diversity;
3. rarity;
4. maintaining ecological processes or natural systems;
5. scientific or evolutionary importance; and
6. protection of vegetation associated with wetlands, streamlines, estuarine and coastal areas.

7.3 Application of the Criteria

The criteria have been broken down into factors and the 12 sites have been assessed against each of these factors, based upon the guidance in the EPA Strategy and on the study team's interpretation of the criteria at each site. This assessment has been used to evaluate the conservation value of each site. Where the objective of satisfying the criteria differs to that of EPA (2002b) it is expressly stated. In total, 27 Factors have been included in the assessment.

7.3.1 Representation of ecological communities

"A number of areas selected to represent the range of ecological communities and the places in which these communities merge" (EPA 2002b).

Total remnant vegetation remaining of vegetation complexes within the Swan Coastal Plain varies between 5 and 47% of their original extent. The standard level of native vegetation retention adopted is 30% of the pre-clearing extent as a target value. These levels are modified for the GBR constrained area, in which there is 'an expectation that development will be able to proceed' (EPA, 2002b).

Where less than 10% of a vegetation complex remains in constrained areas, defined in EPA (2002b) as consolidated Urban, Urban Deferred and Industrial, the objective is to retain all remaining vegetation from that complex (**Factor 1**). Sites 1, 2, 4, 5, 8, 10, and 11 are located within the constrained area. In unconstrained areas, the objective is to retain all remaining vegetation complexes where less than 30% remains (**Factor 2**). Sites 3, 6, 7A, 7B and 9 are located within the unconstrained area.

7.3.2 Diversity

"Areas with a high diversity of flora and/or fauna species or communities in close association" (EPA 2002b).

Number of Vegetation Complexes, Floristic Community Types and Structural Vegetation Units

The EPA recognises that it is important to conserve areas of richness, diversity or complexity for their physical or biological attributes at a community, species or genetic level. The diversity of ecological communities within a site, both at a structural and floristic level, supports other criteria for selection of representative areas. This criterion recognises the diversity of vegetation complexes, inferred floristic community types and structural vegetation units within each site (**Factors 3, 4 and 5** respectively). Only where remnant vegetation occurred within the vegetation complexes defined by Heddle *et al.* (1980) are they recorded for this criterion.

Number of Fauna Habitats

Areas with a high diversity of faunal assemblages have regional significance (**Factor 6**). The variety of fauna species present in an area is often related to the number of habitats. Factor 6 is closely related to the number of vegetation structural units represented at a site.

Native Species Richness Scale

The richness, diversity and complexity of species are another important part of this criterion. Both flora and fauna diversity have been assessed, although the assessment is limited by the constraints of the field survey. Time limitations prevented the field survey recording more than 70% of expected flora taxa occurring within the sites. Where other survey effort has been recorded (eg Sites 8 and 10) it was estimated that 80% of taxa was recorded. Table 7.1 outlines the relative flora richness scale devised to give an indication of the diversity of native flora at each site (**Factor 7**). However, it should be noted that the number of species is commonly a factor of the size of the site.

Table 7.1: The relative scale for native flora richness used to assess native flora species diversity.

Scale	Native flora richness recorded at a site (Number of species)
5	100 or more
4	80-100
3	50-80
2	30-50
1	0-30

To assess fauna diversity, avifauna species richness has been used because this group was the best documented across all 12 sites during the Spring 2002 survey. The variety of species is likely to be indicative of habitat diversity and ecosystem health. A relative avifauna richness scale (Table 7.2) was devised to give an indication of the diversity of avifauna at each site (**Factor 8**).

Table 7.2: The relative scale for avifauna richness used to assess fauna species diversity.

Scale	Avifauna richness recorded at a site (Number of species)
3	40 or more, or 10 or more water birds
2	20-40
1	0-20

7.3.3 Rarity

"Areas containing rare or threatened communities or species, or species of restricted distribution" (EPA 2002b).

Rarity is considered from a community and species perspective. This includes threatened ecological communities and areas supporting threatened species.

No known threatened ecological communities (TECs) occur within the study sites[1]. However three vegetation units recorded during the Spring 2002 survey may be expected to meet the criteria for identification as TECs (**Factor 9**).

Areas that support rare, uncommon or restricted flora are of regional significance. This includes flora listed as Declared Rare or Priority flora under the *Wildlife Conservation Act 1950* and threatened flora under the *EPBC Act 1999* (**Factors 10 and 11**). **Factor 12** also recognises as flora of significance those that were recorded in the Spring 2002 on the Plain and listed by Keighery (1999) as unreserved taxa of the Swan Coastal Plain (Table 4.6).

Factors 13, 14, 15 and 16 recognise sites that support populations of significant fauna. These factors include all rare fauna as listed under the *EPBC Act 1999* and *Wildlife Conservation Act 1950*, CALM Priority Fauna taxa and Birds listed under migratory agreements (**Factors 13, 14 and 15** respectively). Bush Forever decliner species are also listed (**Factor 16**). While not classified as

[1] 1.5ha of TEC site "myHAY03" of floristic community type 18 occurs within the boundary of Site 10 Parade Road, less than 2% of the 'zone of influence'. However, site "myHAY03" is separated from Site 10 by Washington Road and the southern extent that falls within Site 10 is very degraded, therefore not suitable to be identified as threatened ecological community.

rare, threatened or vulnerable in any State or Commonwealth legislation, a number of species have been listed as significant on the Swan Coastal Plain portion of the Perth Metropolitan Region (Government of Western Australia 1998 and 2000). The two categories used in Bush Forever are:

- habitat specialists with a reduced distribution on the Swan Coastal Plain (Bh); and
- wide-ranging species with reduced populations on the Swan Coastal Plain (Bp).

7.3.4 Maintaining ecological processes or natural systems

"Maintenance of ecological processes or natural systems at a regional or national scale" (EPA 2002b).

Size and Condition

It is important that the vegetation to be retained is of suitable condition. This consideration also forms part of Criterion 1. The condition of each site measured during the Spring 2002 survey was based on the condition scale of Keighery (1994). While remnants in largely undisturbed condition are preferred, it is assumed here that Good condition or better, which has the ability to regenerate basic vegetation structure with minimal management, is the objective.

Fauna species vary in their ability to survive in remnants; for example reptiles persist on relatively small remnants (How and Dell 1994) and birds maintain populations in urban areas, whereas native mammals generally disappear. Vegetation condition will to some extent determine the assemblage of fauna species that an area can support, and greater structural diversity generally corresponds to enhanced species diversity. However, whilst areas that retain the overstorey but have little remaining in the ground layer may have little value from a botanical perspective, they may be able to support a moderately diverse avifauna assemblage.

Size is of key importance in determining the viability of natural areas for long term retention. A large sized area is preferred because it is more likely to have a greater variety of vegetation types and therefore fauna habitats, is less prone to edge effects, allows for fauna species that have large home ranges, and supports several territories for less wide ranging species. Island biogeography theory suggests that species richness is a function of area; the larger an area the greater the number of fauna species it will support.

The lower size limit of 20 hectares in the Urban Bushland Strategy was accepted as a preferred lowest area limit (EPA 2002b). Combining these size and condition measures, **Factor 17** includes all sites where the area of remnant bushland in Good or better condition is greater than 20ha.

Shape

A compact or consolidated shape is preferable to irregular or elongate shapes that have increased susceptibility to weed invasion and disturbance (**Factor 18**). Fragmentation of natural areas due to vegetation clearance has lead to a situation where remnants of vegetation are all that survive in many parts of the

Swan Coastal Plain. Areas that retain vegetation act to connect bushland remnants and may be used as corridors by vertebrate fauna. Within the Greater Bunbury Region bushland remnants are often relatively small and tend to be isolated from other such areas. Issues of concern in fragmented ecosystems include:

- many bird and mammal species require a large area for their home range that provides sufficient resources for survival. This is particularly the case for larger species such as the Emu, Grey Kangaroo and Brush Wallaby;
- exchange between populations is important for maintaining genetic diversity; and
- populations that are isolated are susceptible to localised extinction as a consequence of factors such as fire events, climatic fluctuations and predators.

Fauna Habitat Value

Fauna habitats provide functional requirements such as areas for feeding and breeding. Most habitats provide a food and shelter resource of some kind, and emphasis for this criterion is on areas that provide special resources such as mudflats. The floristic character of an area may also be important if flowering or fruiting supports fauna species, and habitat trees will provide shelter in the form of hollows in limbs and trunks. The structure of the vegetation is important as it largely determines bird species diversity. Breeding activity was noted during the field survey but requires more thorough investigation to assess the importance of areas for breeding purposes. **Factor 19** defines the value for fauna habitat into two classes, moderate and high.

Habitats for significant populations of migratory birds contribute to this criterion but have already been acknowledged under Factor 15.

Linkage

Linkage with adjacent bushland areas has been identified as a natural attribute of high priority in the assessment of regional significance (EPA 2002b). Two types of regionally significant sequences of ecological communities have been identified within the Greater Bunbury Region by the EPA (2002b). Vegetated sequences are predominantly north/south links while river corridors form east/west links between the Darling/Blackwood Plateaus and the coast.

Many sites contribute or were directly linked to remnant bushland recognised as regionally significant sequences of ecological communities by the EPA (2002b). Others had direct bushland links to other System 6 areas or National Parks that are recognised as regionally significant sequences in this report (Section 4.3.5). The six sequences included in **Factor 20** are:

1. Ocean to Preston River Park (C70)
2. Dalyellup/Gelorup/Preston River/Plateau Link (C71, C86)
3. Brunswick, Collie and Wellesley Rivers Corridor (C67)
4. Preston River Corridor (while heavily cleared in some sections still forms a significant corridor between the coast and the Blackwood Plateau)
5. Link to National Parks (Yalgorup National Park, C54)
6. Link to other System 6 areas (C 66 Leschenault Estuary)

Factor 21 recognises sites that are directly linked to adjacent remnant bushland, although not as high a priority as areas with linkage or contiguous with regionally significant sequences.

Uplands and Wetlands

Natural areas containing both uplands and wetlands (soils seasonally or intermittently waterlogged and/or inundated) support the highest biodiversity and are a focus for protection (EPA 2002b). **Factor 22** recognises those sites that contain both uplands and wetlands.

7.3.5 Scientific or evolutionary importance

"Areas containing evidence of evolutionary processes either as fossilised material or as relict species and areas containing unusual or important geomorphological or geological sites; Areas of recognised scientific and educational interest as reference sites or as examples of the important environmental processes at work" (EPA 2002b).

Most of the inclusion guidelines in EPA (2002b) are not relevant to the study sites. The unpublished maps associated with evaluation of wetlands on the Southern Swan Coastal Plain by V and C Semeniuk Research Group (1998) identify areas for the conservation of geomorphic processes that include:

- the previous extent of the Leschenault Estuary as shown on Map Sheet 2031 IV SE; and
- significant coastal geomorphology on Map Sheet 2031 III SW.

Factor 23 considers those sites with areas that have been recognised for conservation of geomorphic processes by V and C Semeniuk Research Group (1998).

7.3.6 Protection of vegetation associated with wetlands, streamlines, estuarine and coastal areas

"Conservation category wetland areas including fringing vegetation and associated upland vegetation; Coastal vegetation within the accepted coastal management zone" (EPA 2002b).

Conservation category wetlands associated with regionally significant bushland, their fringing vegetation and associated upland vegetation is assessed for various wetland geomorphic types (**Factors 24, 25 and 26**). **Factor 27** requires consideration of coastal vegetation of regional significance.

8 Evaluation of Selected Sites

The natural values according to the 27 Factors are presented below for each of the 12 sites to establish whether they are regionally significant natural areas. Generally, the assessment was straightforward, however at a few sites some explanation of certain Factors is presented.

8.1 Site 1 Australind WWTP and Two Adjacent Lots

Factor		Natural Values relevant to the Factor
1	Vegetation complex <10% in constrained area	None identified
2	Vegetation complex >10% but <30% in unconstrained area	None identified (Bassendean Complex less than 30% but site in the constrained area)
3	No. of vegetation complexes	1: Bassendean
4	No. of floristic community types	2: 21a and 21c
5	No. of vegetation units	3
6	No. of habitats	2: pools (artificial), Eucalypt woodlands
7	Native flora richness scale	4: 97 native taxa
8	Avifauna richness scale	2: 25 avifauna species
9	Known or potential TECs	None identified
10	Declared Rare Flora	None identified
11	Priority Flora	4: *Acacia flagelliformis* (P4), *Acacia semitrullata* (P3), *Caladenia speciosa* (P4), *Jacksonia sparsa* (P4)
12	Significant/Unreserved Flora	3: *Drosera nitidula subsp. nitidula, Logania serpyllifolia* subsp. *angustifolia, Schoenus sublateralis*
13	Rare Fauna	None identified
14	Priority Fauna	None identified
15	Migratory Birds	None identified
16	Bush Forever Decreaser species	5: Australasian Shoveller, Little Eagle (breeding record), Common Bronzewing, Splendid Fairy-wren, Yellow-rumped Thornbill
17	>20ha of Good or better condition	None identified
18	Remnant of compact shape	No, but one compact remnant of three portions
19	Fauna habitats value	1
20	Linkage to regional or important sequences	Yes, link to Brunswick, Collie and Wellesley Rivers Corridor (C67) via the adjacent bushland at Wardandi Reserve
21	Linkage to adjacent remnant bushland	Yes, adjacent bushland to west at Wardandi Reserve
22	Uplands and Wetlands	Yes
23	Unusual geomorphic processes	None identified
24	Vegetation of channel wetlands	None identified
25	Vegetation of basin wetlands	None identified
26	Vegetation of estuaries	None identified
27	Vegetation of coasts	None identified

8.2 Site 2 South Dalyellup

Factor		Natural Values relevant to the Factor
1	Vegetation complex <10% in constrained area	None identified
2	Vegetation complex >10% but <30% in unconstrained area	None identified (Karrakatta Complex less than 30% but site in the constrained area)
3	No. of vegetation complexes	1: Karrakatta
4	No. of floristic community types	1: 25
5	No. of vegetation units	2
6	No. of habitats	2: Tuart woodland, highly degraded wetland pool
7	Native flora richness scale	2:44 native taxa
8	Avifauna richness scale	1: 12 avifauna species
9	Known or potential TECs	None identified
10	Declared Rare Flora	None identified
11	Priority Flora	None identified
12	Significant/Unreserved Flora	None identified
13	Rare Fauna	None identified
14	Priority Fauna	None identified
15	Migratory Birds	None identified
16	Bush Forever Decreaser species	2: Splendid Fairy-wren, Yellow-rumped Thornbill
17	>20ha of Good or better condition	Yes
18	Remnant of compact shape	Yes
19	Fauna habitats value	1
20	Linkage to regional or important sequences	Yes, adjacent bushland to east is Dalyellup Reserves, a System 6 area (C71); forms part of the Dalyellup/Gelorup/Preston River/Plateau Link; to west is the northern extent of the 'Muddy Lakes' sumpland (ROS)
21	Linkage to adjacent remnant bushland	Yes, adjacent bushland to the north, west and east
22	Uplands and Wetlands	No
23	Unusual geomorphic processes	None identified
24	Vegetation of channel wetlands	None identified
25	Vegetation of basin wetlands	None identified
26	Vegetation of estuaries	None identified
27	Vegetation of coasts	None identified

8.3 Site 3 Boyanup East

Factor		Natural Values relevant to the Factor
1	Vegetation complex <10% in constrained area	None identified
2	Vegetation complex >10% but <30% in unconstrained area	Swan Complex
3	No. of vegetation complexes	3: Swan, Cartis and Kingia
4	No. of floristic community types	3: 1a, 4 and 21b
5	No. of vegetation units	4
6	No. of habitats	3: Eucalypt (Marri) woodlands, artificial wetlands, pastures
7	Native flora richness scale	5: 123 native taxa
8	Avifauna richness scale	2: 27 avifauna species
9	Known or potential TECs	None identified
10	Declared Rare Flora	None identified
11	Priority Flora	5: *Acacia flagelliformis* (P4), *Acacia semitrullata* (P3), *Caladenia speciosa* (P4), *Drosera marchantii* subsp. *marchantii* (P4), *Jacksonia sparsa* (P4)
12	Significant/Unreserved Flora	2: *Acacia pulchella* var. *goadbyi, Acacia urophylla* (also the only location of *Corymbia haemotoxylon* within the study sites)
13	Rare Fauna	1: Baudin's Black Cockatoo (S1)
14	Priority Fauna	None identified
15	Migratory Birds	None identified
16	Bush Forever Decreaser species	3: Common Bronzewing, Splendid Fairy-wren, Yellow-rumped Thornbill
17	>20ha of Good or better condition	Yes
18	Remnant of compact shape	No, but one compact remnant area within the site
19	Fauna habitats value	1
20	Linkage to regional or important sequences	No
21	Linkage to adjacent remnant bushland	Yes, adjacent to large patch of remnant bushland to the south with potential linkage with State Forest but currently zoned Urban; remnant riparian linkage along Joshua Gully creekline links to the Preston River Corridor
22	Uplands and Wetlands	Yes
23	Unusual geomorphic processes	None identified
24	Vegetation of channel wetlands	None identified
25	Vegetation of basin wetlands	None identified
26	Vegetation of estuaries	None identified
27	Vegetation of coasts	None identified

8.4 Site 4 Davenport Industrial

The *Eucalyptus rudis* subsp. *rudis* and *Agonis flexuosa* var. *flexuosa* Open Forest (unit 4.2) is a floristic community type that does not appear to be equivalent to any defined in Gibson *et al.* (1994). Given its restricted nature and uncommon combination of *Eucalyptus rudis* subsp. *rudis* and *Agonis flexuosa* var. *flexuosa,* vegetation unit 4.2 has regional significance and may be expected to meet the criteria for identification as TECs.

Factor		Natural Values relevant to the Factor
1	Vegetation complex <10% in constrained area	None identified
2	Vegetation complex >10% but <30% in unconstrained area	None identified (Southern River and Swan Complexes less than 30% but site in the constrained area)
3	No. of vegetation complexes	1: Southern River and Swan
4	No. of floristic community types	2: 4 and 17
5	No. of vegetation units	6
6	No. of habitats	3: Melaleuca woodland, Eucalypt woodland, river channel
7	Native flora richness scale	2: 33 native taxa
8	Avifauna richness scale	2: 28 avifauna species
9	Known or potential TECs	Yes: proposed new
10	Declared Rare Flora	None identified
11	Priority Flora	1: *Jacksonia sparsa* (P4)
12	Significant/Unreserved Flora	1: *Acacia pulchella* var. *goadbyi*
13	Rare Fauna	None identified
14	Priority Fauna	None identified
15	Migratory Birds	None identified
16	Bush Forever Decreaser species	4: Splendid Fairy-wren, Inland Thornbill, Yellow-rumped Thornbill, Scarlet Robin
17	>20ha of Good or better condition	None identified
18	Remnant of compact shape	No, area split in many sections
19	Fauna habitats value	1
20	Linkage to regional or important sequences	Yes, the southern and eastern portions of this site form part of the Dalyellup/Gelorup/Preston River/Plateau Link and the Preston River Corridor;
21	Linkage to adjacent remnant bushland	Yes, adjacent bushland to south
22	Uplands and Wetlands	No
23	Unusual geomorphic processes	None identified
24	Vegetation of channel wetlands	None identified
25	Vegetation of basin wetlands	None identified
26	Vegetation of estuaries	None identified
27	Vegetation of coasts	None identified

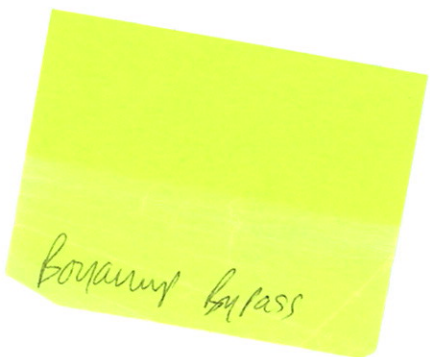
8.5 Site 5 Brunswick River

Factor		Natural Values relevant to the Factor
1	Vegetation complex <10% in constrained area	None identified
2	Vegetation complex >10% but <30% in unconstrained area	Bassendean and Swan Complexes
3	No. of vegetation complexes	2: Bassendean and Swan
4	No. of floristic community types	1: 13
5	No. of vegetation units	3
6	No. of habitats	3: pools, river channel, Eucalypt and Melaleuca woodlands
7	Native flora richness scale	1: 17 native taxa
8	Avifauna richness scale	2: 26 avifauna species
9	Known or potential TECs	None identified
10	Declared Rare Flora	None identified
11	Priority Flora	None identified
12	Significant/Unreserved Flora	1: *Acacia pulchella* var. *goadbyi*
13	Rare Fauna	None identified
14	Priority Fauna	None identified
15	Migratory Birds	None identified
16	Bush Forever Decreaser species	5: Splendid Fairy-wren, Inland Thornbill, Yellow-rumped Thornbill, Weebill, Grey Shrike-thrush
17	>20ha of Good or better condition	None identified
18	Remnant of compact shape	Yes
19	Fauna habitats value	1
20	Linkage to regional or important sequences	Yes, this site represents part of the Brunswick, Collie and Wellesley Rivers Corridor.
21	Linkage to adjacent remnant bushland	Yes, adjacent bushland to west, south and north
22	Uplands and Wetlands	No
23	Unusual geomorphic processes	None identified
24	Vegetation of channel wetlands	Yes, conservation category wetland with regionally significant bushland.
25	Vegetation of basin wetlands	None identified
26	Vegetation of estuaries	None identified
27	Vegetation of coasts	None identified

8.6 Site 6 Boyanup Bypass

This site traverses areas that were mapped by Heddle *et al.* (1980) as Swan, Guildford and Cartis Complexes. While the Swan and Guildford Complexes have less than 30% of their original extent, no remnant bushland remaining within the site is of those complexes. The only remnant bushland remaining within the site is of the Cartis Complex.

Factor		Natural Values relevant to the Factor
1	Vegetation complex <10% in constrained area	None identified
2	Vegetation complex >10% but <30% in unconstrained area	Swan and Guildford Complex
3	No. of vegetation complexes	1: Cartis
4	No. of floristic community types	1: 1a
5	No. of vegetation units	1
6	No. of habitats	2: remnant woodlands, degraded wetlands
7	Native flora richness scale	3: 72 native taxa
8	Avifauna richness scale	2: 21 avifauna species
9	Known or potential TECs	None identified
10	Declared Rare Flora	None identified
11	Priority Flora	2: *Acacia flagelliformis* (P4), *Caladenia speciosa* (P4)
12	Significant/Unreserved Flora	None identified
13	Rare Fauna	None identified
14	Priority Fauna	None identified
15	Migratory Birds	None identified
16	Bush Forever Decreaser species	2: Musk Duck, Yellow-rumped Thornbill
17	>20ha of Good or better condition	None identified
18	Remnant of compact shape	No, elongated road reserve
19	Fauna habitats value	0
20	Linkage to regional or important sequences	None identified
21	Linkage to adjacent remnant bushland	Yes, adjacent bushland to south
22	Uplands and Wetlands	No
23	Unusual geomorphic processes	None identified
24	Vegetation of channel wetlands	None identified
25	Vegetation of basin wetlands	None identified
26	Vegetation of estuaries	None identified
27	Vegetation of coasts	None identified



8.7 Site 7A Myalup

The regional dataset of vegetation complex mapping places Quindalup and Vasse complexes occurring at the site. However, based on field survey, vegetation of the Quindalup and Karrakatta – Central and South complexes occur at the site. Both of these complexes have 30% or more remaining of their original extent on the Swan Coastal Plain.

Factor		Natural Values relevant to the Factor
1	Vegetation complex <10% in constrained area	None identified
2	Vegetation complex >10% but <30% in unconstrained area	None identified
3	No. of vegetation complexes	2: Quindalup and Karrakatta – Central and South
4	No. of floristic community types	3: 29a, 29b and 29c
5	No. of vegetation units	3
6	No. of habitats	3: Tuart woodland, coastal heaths, channel wetland
7	Native flora richness scale	2: 39 native taxa
8	Avifauna richness scale	2: 21 avifauna species
9	Known or potential TECs	None identified
10	Declared Rare Flora	None identified
11	Priority Flora	None identified
12	Significant/Unreserved Flora	None identified
13	Rare Fauna	None identified
14	Priority Fauna	None identified
15	Migratory Birds	None identified
16	Bush Forever Decreaser species	None identified
17	>20ha of Good or better condition	None identified (17.3 ha of Good to excellent remnant bushland)
18	Remnant of compact shape	Yes
19	Fauna habitats value	2
20	Linkage to regional or important sequences	Yes, this site forms a link between the coast and the Yalgorup National Park (C54); Lake Josephine and Lake Preston are important waterway linkages to the north-east;
21	Linkage to adjacent remnant bushland	Yes, adjacent bushland to north, south and east
22	Uplands and Wetlands	No
23	Unusual geomorphic processes	None identified
24	Vegetation of channel wetlands	None identified
25	Vegetation of basin wetlands	None identified
26	Vegetation of estuaries	None identified
27	Vegetation of coasts	Yes

8.8 Site 7B Buffalo Road

7B

Factor		Natural Values relevant to the Factor
1	Vegetation complex <10% in constrained area	None identified
2	Vegetation complex >10% but <30% in unconstrained area	Vasse Complex
3	No. of vegetation complexes	3: Vasse, Yoongarillup and Quindalup
4	No. of floristic community types	1: 16
5	No. of vegetation units	3
6	No. of habitats	2: remnant stands of *Melaleuca,* seasonally inundated areas
7	Native flora richness scale	1: 10 native taxa
8	Avifauna richness scale	2: 29 avifauna species
9	Known or potential TECs	None identified
10	Declared Rare Flora	None identified
11	Priority Flora	None identified
12	Significant/Unreserved Flora	1: *Logania serpyllifolia* subsp. *angustifolia*
13	Rare Fauna	None identified
14	Priority Fauna	None identified
15	Migratory Birds	None identified
16	Bush Forever Decreaser species	5: Australasian Shoveller, Whistling Kite, Common Bronzewing, Yellow-rumped Thornbill, Black-faced Woodswallow
17	>20ha of Good or better condition	None identified
18	Remnant of compact shape	Yes
19	Fauna habitats value	1
20	Linkage to regional or important sequences	Yes, forms part of the Leschenault Estuary System 6 area (C66)
21	Linkage to adjacent remnant bushland	Yes, adjacent bushland to south and west; direct linkage to the Leschenault Peninsular Conservation Park
22	Uplands and Wetlands	Yes
23	Unusual geomorphic processes	Yes, conservation of geomorphology for the previous extent of the Leschenault Estuary
24	Vegetation of channel wetlands	None identified
25	Vegetation of basin wetlands	None identified
26	Vegetation of estuaries	Yes
27	Vegetation of coasts	None identified

8.9 Site 8 Twin Rivers

Factor		Natural Values relevant to the Factor
1	Vegetation complex <10% in constrained area	None identified
2	Vegetation complex >10% but <30% in unconstrained area	None identified (Swan and Karrakatta – Central and South Complexes less than 30% but site in the constrained area)
3	No. of vegetation complexes	2: Swan and Karrakatta – Central and South
4	No. of floristic community types	2: 11 and 21a
5	No. of vegetation units	4
6	No. of habitats	3: Eucalypt Woodland, Melaleuca Woodland, river channel
7	Native flora richness scale	5: 136 native taxa
8	Avifauna richness scale	2: 26 avifauna species
9	Known or potential TECs	None identified
10	Declared Rare Flora	1: *Diuris drummondii*
11	Priority Flora	4: *Caladenia speciosa* (P4), *Lasiopetalum membranaceum* (P3)
12	Significant/Unreserved Flora	None identified
13	Rare Fauna	3: Baudin's Black Cockatoo (S1), Common Greenshank (S3, JAMBA, CAMBA) and Great Egret (S3, JAMBA, CAMBA)
14	Priority Fauna	1: Southern Brown Bandicoot (P4)
15	Migratory Birds	None identified
16	Bush Forever Decreaser species	3: Splendid Fairy-wren, Yellow-rumped Thornbill, Grey Currawong
17	>20ha of Good or better condition	Yes
18	Remnant of compact shape	Yes
19	Fauna habitats value	2
20	Linkage to regional or important sequences	Yes, foreshore is part of the Brunswick, Collie and Wellesley Rivers Corridor, a System 6 area (C67)
21	Linkage to adjacent remnant bushland	Yes, adjacent bushland to south and north is ROS; forms a corridor to the Leschenault Estuary via adjacent bushland of the Australind Primary School
22	Uplands and Wetlands	Yes
23	Unusual geomorphic processes	None identified
24	Vegetation of channel wetlands	Yes
25	Vegetation of basin wetlands	None identified
26	Vegetation of estuaries	None identified
27	Vegetation of coasts	None identified

8.10 Site 9 Muddy Lakes

The *Banksia littoralis* Low Woodland (unit 9.6) recorded during this study may represent the most southern occurrence on the Southern Coastal Plain of floristic community type 19 and is of a sequence of 'Quindalup Dune Swale Damplands' that is the only of this type (Keighery *et al.* 2002). Floristic community type 19 is recognised both at State and Commonwealth level (endorsed by the WA Minister for the Environment and listed as Critically Endangered under the *EPBC Act 1999*). It is proposed that unit 9.6 has regional significance and is expected to meet the criteria for identification as a TEC.

Factor		Natural Values relevant to the Factor
1	Vegetation complex <10% in constrained area	None identified
2	Vegetation complex >10% but <30% in unconstrained area	Vasse and Karrakatta – Central and South Complexes
3	No. of vegetation complexes	3: Vasse, Quindalup and Karrakatta – Central and South
4	No. of floristic community types	5: 17, 19, 29a, 29b and 29c
5	No. of vegetation units	7
6	No. of habitats	3: Swamp, dunes and swales, Tuart woodland
7	Native flora richness scale	3: 58 native taxa
8	Avifauna richness scale	3: 61 avifauna species
9	Known or potential TECs	Yes: 19
10	Declared Rare Flora	None identified
11	Priority Flora	None identified
12	Significant/Unreserved Flora	1: *Calycopeplus oligandrus*
13	Rare Fauna	2: Quokka (S1), Western Ringtail Possum (S1)
14	Priority Fauna	1: Southern Brown Bandicoot (P4)
15	Migratory Birds	None identified
16	Bush Forever Decreaser species	13: Musk Duck, Whistling Kite, Common Bronzewing, Western Rosella, Splendid Fairy-wren, Inland Thornbill, Yellow-rumped Thornbill, Weebill, White-browed Scrubwren, New Holland Honeyeater, Grey Shrike-thrush, Golden Whistler, Black-faced Woodswallow
17	>20ha of Good or better condition	Yes
18	Remnant of compact shape	Yes
19	Fauna habitats value	2
20	Linkage to regional or important sequences	Yes, part of the Dalyellup/Gelorup/Preston River/Plateau Link; direct link east-west from coast to the System 6 Dalyellyup Reserves (C71)
21	Linkage to adjacent remnant bushland	Yes, adjacent bushland to north, south and west; part of the north-west coastal corridor from Bunbury south via Dalyellup Beach, Stirling Beach, Peppermint Grove Beach and Forrest Beach
22	Uplands and Wetlands	Yes
23	Unusual geomorphic processes	Yes, significant coastal geomorphology
24	Vegetation of channel wetlands	None identified
25	Vegetation of basin wetlands	Yes
26	Vegetation of estuaries	None identified
27	Vegetation of coasts	Yes

8.11 Site 10 Parade Road

A small portion (1.5ha) of the extreme northeast corner of the site falls within a known TEC site (myHAY03) of floristic community type 18. This area is less than 2% of the 'zone of influence'. However, the TEC site "myHAY03" is separated from Site 10 by Washington Road and the southern extent that falls within Site 10 is very degraded; therefore Site 10 is not suitable to be identified as threatened ecological community.

Factor		Natural Values relevant to the Factor
1	Vegetation complex <10% in constrained area	None identified
2	Vegetation complex >10% but <30% in unconstrained area	None identified (Karrakatta – Central and South Complex less than 30% but site in the constrained area)
3	No. of vegetation complexes	2: Yoongarillup and Karrakatta – Central and South
4	No. of floristic community types	2: 21a and 21c
5	No. of vegetation units	3
6	No. of habitats	2: Eucalypt woodlands, Melaleuca Woodland
7	Native flora richness scale	5: 146 native taxa
8	Avifauna richness scale	1: 18 avifauna species
9	Known or potential TECs	None identified
10	Declared Rare Flora	None identified
11	Priority Flora	3: *Caladenia speciosa* (P4), *Jacksonia sparsa* (P4), *Lasiopetalum membranaceum* (P3)
12	Significant/Unreserved Flora	1: *Logania serpyllifolia* subsp. *angustifolia*
13	Rare Fauna	None identified
14	Priority Fauna	1: Southern Brown Bandicoot (P4)
15	Migratory Birds	None identified
16	Bush Forever Decreaser species	3: Common Bronzewing, Splendid Fairy-wren, Yellow-rumped Thornbill
17	>20ha of Good or better condition	Yes
18	Remnant of compact shape	Yes
19	Fauna habitats value	1
20	Linkage to regional or important sequences	Yes, this site forms part of the Ocean to Preston River Park; linkage to the System 6 area (C70) South Bunbury Coastal Land
21	Linkage to adjacent remnant bushland	Yes, adjacent bushland to west, east and south
22	Uplands and Wetlands	Yes
23	Unusual geomorphic processes	None identified
24	Vegetation of channel wetlands	None identified
25	Vegetation of basin wetlands	Yes
26	Vegetation of estuaries	None identified
27	Vegetation of coasts	None identified

8.12 Site 11 Estuary Drive

The *Juncus* sedgeland (unit 11.1) is a floristic community type of Supergroup 2 that does not appear to be equivalent to any defined in Gibson *et al.* (1994) and may represent a potentially threatened ecological community.

Factor		Natural Values relevant to the Factor
1	Vegetation complex <10% in constrained area	None identified
2	Vegetation complex >10% but <30% in unconstrained area	None identified
3	No. of vegetation complexes	1: Yoongarillup
4	No. of floristic community types	1: proposed new of Supergroup 2
5	No. of vegetation units	3
6	No. of habitats	2: mudflats, fringing sedgelands
7	Native flora richness scale	2: 33 native taxa
8	Avifauna richness scale	1: 10 avifauna species
9	Known or potential TECs	Yes: proposed new
10	Declared Rare Flora	None identified
11	Priority Flora	None identified
12	Significant/Unreserved Flora	None identified
13	Rare Fauna	None identified
14	Priority Fauna	None identified
15	Migratory Birds	1: Great Egret (JAMBA/CAMBA)
16	Bush Forever Decreaser species	1: Yellow-rumped Thornbill
17	>20ha of Good or better condition	None identified
18	Remnant of compact shape	Yes
19	Fauna habitats value	2
20	Linkage to regional or important sequences	Yes, vegetation fringe along the Leschenault Estuary foreshore and the channel of the Preston River; continuation of the foreshore ROS; the site forms part of the tidal mudflats of the south-east section of the Leschenault Estuary; the Vittoria Bay area is a designated Bird Habitat Area.
21	Linkage to adjacent remnant bushland	Yes, adjacent bushland to east and west
22	Uplands and Wetlands	No
23	Unusual geomorphic processes	None identified
24	Vegetation of channel wetlands	None identified
25	Vegetation of basin wetlands	None identified
26	Vegetation of estuaries	Yes
27	Vegetation of coasts	None identified

9 Comparison of Sites

The Factors of the selection criteria for each site are summarised in Table 9.1. A score was calculated to enable the sites to be ranked according to their capacity to satisfy the criteria. Scoring was based on one point for satisfying a Factor, except for factors 3, 4, 5, 6, 7 and 8 where a number or scale was allocated, as explained in Section 7.3.2, for the number of complexes, floristic community types, vegetation units, fauna habitats and species richness.

The maximum possible score for satisfying all Factors is 34, plus the scores for Factors 3, 4, 5 and 6 for which there is no maximum score stated.

The sites were then ranked in descending score order to establish a broad priority for protection (Table 9.2). It should be noted that most sites scored highly, and may be understood to contain areas of regionally significant natural values. The purpose of ranking was to assist in determining a priority for protection in relation to one another.

Table 9.2: Priority ranking for the sites based on the criteria score

Rank Order	Score	Site
1	40	9
2	32	8
3	29	3
4	26	10
5	25	4
6	21	7B
6	21	1
6	21	7A
9	20	5
10	18	11
10	16	2
12	13	6

Table 9.1: Summary of factors applied to satisfy Regional Significance criteria at each site

No.	Factor	Criteria	1	2	3	4	5	6	7A	7B	8	9	10	11
1	Vegetation complex <10% in constrained area	1,3												
2	Vegetation complex >10% but <30% in unconstrained area	1			+		+			+		+		
3	No. of vegetation complexes	2	1	1	3	2	1	1	2	3	2	3	2	1
4	No. of floristic community types	2	2	1	3	2	1	1	3	1	2	5	2	1
5	No. of vegetation units	2	3	2	4	6	3	1	3	3	4	7	3	1
6	No. of habitats	2	2	2	3	3	3	2	3	2	3	3	2	2
7	Native flora richness scale	2	4	2	5	2	1	3	2	1	5	3	5	1
8	Avifauna richness scale	2	2	1	2	2	2	2	2	2	2	3	1	3
9	Known or potential Threatened Ecological Communities	3				+						+		+
10	Declared Rare Flora	3									1			
11	Priority Flora	3	4		5	1		2			4		3	
12	Significant/Unreserved Flora	3	3		2	1	1				1	1	1	
13	Rare Fauna	3		1	1						3	2		
14	Priority Fauna	3									1	1	1	
15	Migratory Birds	3,4												1
16	Bush Forever Decreaser species	3	5	2	3	4	5	2		5	3	13	3	1
17	>20ha of Good or better condition	4,1		+	+						+	+	+	
18	Remnant of compact shape	4,1		+			+		+	+	+	+	+	+
19	Fauna habitat value	4,1	1	1	1	1	1	0	2	1	2	2	1	2
20	Linkage to regional or important sequences	4	+	+		+	+		+	+	+	+	+	+
21	Linkage to adjacent remnant bushland	4	+	+	+	+	+	+	+	+	+	+	+	+
22	Uplands and Wetlands	4,1	+		+					+	+	+	+	
23	Unusual geomorphic processes	5								+		+		
24	Vegetation of channel wetlands	6				+	+				+			
25	Vegetation of basin wetlands	6					+					+	+	
26	Vegetation of estuaries	6								+				+
27	Vegetation of coasts	6							+			+		
	Score		21	15	29	25	20	13	21	21	32	40	26	18

10 Recommendations for Protection of Regionally Significant Natural Values

10.1 Mechanisms For Protection

Where the findings of the environmental assessment of the 12 selected sites suggest that the proposed zones impact on, or reserves do not adequately protect regionally significant natural values, recommendations are made to enable the protection of their natural values, by either:

- modifying boundaries of proposed zones and reserves; or
- utilising alternative mechanisms under the GBRS to ROS reservation (through liaison with the DPI).

The study team considered protection of the sites identified as regionally significant natural areas in a one-day workshop setting. This allowed a diversity of factors to be considered concurrently, in particular both flora and fauna issues, drawing on the experience of the study team. Each site was considered on its merits as distinct areas. A variety of mechanisms were considered, including:

- ROS reservation, as proposed in the GBRS;
- covenanting for conservation on private lands; and
- modifications of ROS boundaries to include additional regionally significant areas in exchange for exclusion of degraded areas suitable for development.

Conserving vegetation, whether through public or private efforts is necessary for retaining natural values of regional significance. Where regionally significant natural values have been identified on privately owned land, protection may be possible by leaving the land in private ownership. However, private conservation efforts are a *voluntary* mechanism and are only appropriate where the landowner commits to conserving the natural values on their property.

Public Ownership

The GBRS provides a statutory mechanism for the Government to reserve and acquire regionally significant natural areas. However, there are other options available for securing these areas in public ownership. Bush Bank is a revolving fund that provides a mechanism for the purchase, protection and on-selling of areas of land with significant wildlife and habitat conservation values, utilising funding from the Federal and West Australian Governments. To ensure these areas are protected in perpetuity, land purchased by Bush Bank will have a conservation covenant placed on it and this land will then be resold to a purchaser who is aware of the conservation values involved and is prepared to manage the land accordingly. All sites of this study would be expected to meet the Bush Bank's selection criteria.

Another way of ensuring that the land is managed for conservation into the future, at minimal cost, is through gifting the land to an appropriate organisation. Under current tax laws, bushland can be gifted to a registered Deductable Gift Recipient (such as the WA Landcare Trust and the National

Trust). Through the Income Tax Assessment Act 1997, the value of this gift can then be offset against taxable income as a tax deduction, and this benefit can be spread over five years if appropriate.

Private Ownership

Some areas of privately owned bushland of regional significance could be adequately protected by utilising conservation convenants. A covenant is a voluntary agreement between a landowner and a body capable of taking and supervising the covenant. This legal mechanism travels with the land title and can prevent future owners from clearing the bushland but cannot compel undertaking environmental enhancement eg. weed removal. Covenants can be permanent, or for a specified period of time and can be set up to protect the land for many years, even after ownership of the land has changed.

There are three main conservation covenanting programs in WA. These are run by the following government and non-government agencies.

- The Commissioner for Soil and Land Conservation through Agriculture Western Australia;
- The National Trust of Australia (WA); and
- CALM.

Landholders can also obtain funding assistance from a range of programmes to assist with conservation management, including:

- management advice for conservation activities through a variety of funding programmes of the Natural Heritage Trust;
- fencing subsidy available through either the Natural Heritage Trust or the State Landcare program; and
- reducing the rates paid on bushland through property re-evaluation or differential rating.

Where a landholder agrees to the land being covenanted, environmental advice should be provided. In addition to the assistance suggested above, this could include the development of a management plan, guidance with weeds removal and rehabilitation to ensure general environmental enhancement.

However, where a landholder does not volunteer to protect the natural values of regional significance identified in this report, some form of public ownership may be necessary.

10.2 Recommendations for Protection

General Advice

In recognition of the high level (77%) of clearing on the Swan Coastal Plain in the Greater Bunbury Region, the EPA (2002b) indicates that there is a need to preferentially locate developments in cleared areas on the Swan Coastal Plain.

The overriding recommendation of this assessment of certain sites of the GBRS is to preferentially locate developments in cleared areas. Bearing this in mind, the following recommendations for the 12 selected sites are focused on areas

with natural values of regional significance that are of regional priority for conservation. The recommendations refer to areas that are of regional significance according to the criteria that are a priority for protection, illustrated in Figure 5.

Site 1 Australind Waste Water

This site is proposed under the GBRS to be zoned Urban Deferred but the natural values of parts of the site are of regional significance and should be protected for conservation. The north-west portion (Figure 5 shaded green) of Reserve 35061 retains good condition woodlands and forms a link with the Wardandi Flora Reserve. This area supports three Priority and one unreserved flora. Increasing the size of the Wardandi Reserve will enhance the natural values of the region, and could be combined with recreational use of the area.

The southern portion in the area surrounding the tanks (Figure 5 shaded red) is degraded but could be rehabilitated or turned into a recreation area. The ponds currently provide habitat for waterbirds but it is assumed that these would no longer be permanent with removal of the treatment plant. The ponds could be retained and may fill on a seasonal basis.

The lots north of Paris Road (Lots 21, 27 and 150, Figure 5 shaded red) supported two Priority and two unreserved flora but are degraded and not a consolidated area and therefore not a priority for protection.

Site 2 South Dalyellup

This site is proposed under the GBRS to be zoned Urban Deferred but because of its regional significance parts of the site should be protected for conservation. At the time of survey the southern lots of this site (Lots 315, 316 and 317, Figure 5 shaded green) had natural values of regional significance. This site supports a Tuart woodland that provides linkage between the Muddy Lakes area and a System 6 reserve. However as noted elsewhere this site has been subject to recent degradation of its natural values, potentially compromising its regional significance. It is recommended that a revisit be conducted to affirm its condition and status. If condition has degraded since the Spring 2002 survey, it should be reinstated by replanting to enhance the linkage value.

The remainder of the site (Lots 1, 313 and Location 4689, Figure 5 shaded red) are degraded and not of regional significance.

Site 3 Boyanup East

Parts of this site (Lots 1A, 4A, 138, 139 and 66, Figure 5 shaded green) have natural values of regional significance and should be protected for conservation. This remnant bushland should be retained because it is a foraging habitat for a rare fauna, supports three Priority flora and it represents a diversity of floristic and structural vegetation units. It is recommended to include this area in a conservation reserve as part of future planning for the area.

The riparian vegetation of Joshua Gully on Location 4402 (Figure 5 shaded green) is also of regional significance and should also be protected for conservation. It is noted that this vegetation is proposed to be included in a foreshore reserve on the approved structure plan for the area. This area

supports a Priority flora and two unreserved flora, and provides an alternate link from the Preston River to the Scarp. The landowners are to be commended for fencing the remnant vegetation to remove grazing pressure.

The remainder of the site is ficance (Figure 5 shaded red)

Site 4 Davenport Industria

The majority of this site has n ona be protected for conservation.

A riparian corridor of at least 50 ed including trees on the upper banks ng (Figure 5 shaded green). This ripa ion corridor and supports an unreserved flora d ROS over the southern portion of Lot 5 (Figure 5 shade be retained despite its vegetation condition, as it is a v to Preston River Park and supports a Priority flora. The oyanup Road should be retained despite its vegetation also part of this link.

The area to the east of the Boy d in isolation does not contain natural values of regional significance. However, it is of regional significance because it provides an alternate corridor to the Preston River via remnant bushland to the north-east. This portion of the site is proposed under the GBRS to be zoned Industrial but because it forms part of the north-eastern corridor it should be protected for conservation. Future planning for this area should consider retaining the remnant bushland to the north-east that continues this link to the Preston River.

The natural values of some areas within this site are degraded. To improve the condition of these areas and enhance the natural value of these vegetation corridors, rehabilitation is recommended.

Site 5 Brunswick River

Parts of this site (Figure 5 shaded green) have natural values of regional significance and should be protected for conservation.

The western portion (Lot 61, Figure 5 shaded green) should be protected for conservation. It forms part of the Brunswick River Corridor and provides hydrological protection for the Brunswick River floodplain. It also includes an excellent stand of *Melaleuca rhaphiophylla* and provides a habitat for waterbirds. The riparian corridor of fringing vegetation along the Brunswick River (Lots 0, 7 and 9, Figure 5 shaded green) forms part of the regionally significant Brunswick River Corridor and should be protected for conservation.

The majority of the site contains highly degraded pasture areas (central portion of Lots 0 and 7, Figure 5 shaded red) that have no regionally significant natural values and therefore do not need to be retained as ROS. However, stock should be prevented from invading and further degrading riparian habitats.

Vegetation along the southern boundary of the proposed ROS over Lots 0, 7 and 9 has some conservation value because, whilst it is degraded, it supports an unreserved taxa and fauna including arboreal mammals. This vegetation could be retained as part of any future planning for the area. In addition, Eucalypt woodlands immediately south are in relatively good condition and provide

linkage. Future planning for this area should be sensitive to these natural values.

Site 6 Boyanup Bypass

The woodland of unit 6.1 in the extreme south of the road reserve (Figure 5 shaded green) supports two Priority 4 flora and forms part of a large area of remnant bushland to the south of the site. This area should be avoided where possible by the road design.

The natural values at Boyanup Billabong (Part Lot 124) are not considered to be regionally significant. Disturbance to the remnant vegetation along road corridors and in the vicinity of the cemetery should be minimised where possible during the design phase of the road alignment.

Site 7A Myalup

This site has natural values of regional significance and should be protected for conservation. The site is in good condition and supports a diversity of FCTs, vegetation units and fauna habitats. Connections with ROS along the Harvey River Diversion Drain and dune vegetation to the south add to the linkage value of the Site.

The alternative ROS boundary proposed by van der Moezel (2001b) reduces the area protected by ROS. This alternative boundary does not appear to follow topography consistently, increases the perimeter to area ratio thereby the likelihood of adverse edge effects, and does not adequately protect the natural values of regional significance. There appears to be insufficient justification for adoption of this alternative ROS boundary.

Incorporation of some of the adjacent Vasse complex to the east would enhance the regional value by increasing its linkage to Lake Josephine, Lake Preston and Yalgorup National Park. This could be considered as part of future planning in the area.

Site 7B Leschenault Locations

The majority of this site has natural values of regional significance and should be protected for conservation. The southern two thirds of Lots 7 and 14 support remnant stands of *Melaleuca*, shallow inundated sedgelands and samphire and are not significantly degraded. This site is linked to the Leschenault Conservation Park immediately to the south, and is used as additional foraging habitat by bird species associated with wetlands.

The northern third of Lots 7 and 14 are degraded but are part of a System 6 area and represents the previous extent of the Leschenault Estuary. It is noted that this conservation category wetland that represents the previous extent of the Leschenault Estuary continues north of the site boundary.

The area e[illegible] ns degraded pastures. The pasture areas outsi[illegible] to contain natural values of regional significanc[illegible] ervation (Figure 5, approximate location sh[illegible] mended that a further survey be undertaker[illegible] t of the eastern boundary of the ROS.

Boyanup bypass.

Site 8 Twin Rivers

This site contains natural values of regional significance. The site supports a diversity of vegetation typically in Good to Very Good condition, a number of flora and fauna of significance and is likely to support a varied fauna community. However, most of the site has been identified for residential development for some time and the Urban zoning proposed by the GBRS is consistent with the existing Residential zoning in the Shire of Harvey Town Planning Scheme No.1. In this context, these recommendations consider whether the additional area proposed to be included in ROS is regionally significant and whether any of the site outside the proposed ROS should be protected because of its regional conservation significance. The additional area proposed to be included in ROS beyond the area reserved by Shire of Harvey Town Planning Scheme No.1 will serve to:

- widen and increase the functionality of the foreshore corridor along the Brunswick and Collie Rivers;
- increase the amount and diversity of vegetation units, floristic community types and fauna habitats;
- increase the area of upland vegetation thereby increasing the diversity of landform;
- protect the regionally significant vegetation of the conservation category wetland; and
- protects a DRF and two rare birds listed under both State and Commonwealth legislation.

For these reasons the additional area proposed to be reserved ROS under the GBRS is supported.

While the site is one of only a few sizeable remnants in an urban environment in the Region, it is in the constrained area as defined by the EPA (2002b). The proposed ROS contains adequate representation of the significant vegetation, flora and fauna recorded from the site. Based on these considerations, it is recommended that the area of ROS proposed by the GBRS is acceptable. However, the recommended modification to the boundary alignment indicated on Figure 5 would better protect the regionally significant natural values by excluding a large cleared area from the reserve, increasing the corridor width along the foreshore and including more upland vegetation at the west of the site. This modified ROS boundary will maximise the protection of regionally significant values at this site using the advertised area proposed in the GBRS as a guide (shaded green on Figure 5).

For example, Baudin's Black-Cockatoo *Calyptorhynchus baudinii*, a rare bird listed under both State and Commonwealth legislation, occurs primarily in the uplands units. The recommended modified ROS boundary includes more habitat vegetation for this species. It is also recommended that habitat trees such as large Marri or those with hollows be retained where possible within the adjacent development.

In addition to satisfying all of the criteria for regional conservation significance, Site 8 also appears to satisfy an additional criterion that recognises cultural values proposed in EPA (2001) and adopted in Bush Forever (Government of WA 2000) but not listed in EPA (2002b). Site 8 was observed during the survey to provide a bushland setting for recreational use by the community.

Site 9 Muddy Lakes

This site has natural values of outstanding regional significance that should be protected for conservation. The area is part of a coastal corridor that has a unique landscape, forms a unique assemblage of vegetation communities and is one of three known locations of similar sequences of dunes and wetlands associated with the interface of the Quindalup and Spearwood Dunes (Keighery et al. 2002).

The site supports an unreserved flora, rare fauna including Western Ringtail Possum and possibly the only remaining extant population of the Quokka on the Swan Coastal Plain. There are several areas at Muddy Lakes that support the Priority species Southern Brown Bandicoot. The Tuart woodland supports a wide variety of bird species, is in Good condition or better and also has high conservation value. The Muddy Lakes sumpland is a conservation category wetland and EPP lake. The integrity of the wetland system has historically been disrupted to some extent however it retains regional significance as a mosaic of wetland vegetation units and as fauna habitat for waterbirds and other species associated with wetlands.

Within the dunes there are small-scale geomorphic units such as swale damplands and communities that have developed at the Quindalup/Spearwood dune interface (EPA, 2002b). These are poorly represented (or do not occur) elsewhere in the region and should be retained. The damplands have values that may also contribute to classification as conservation category wetlands. The *Banksia littoralis* Low Woodland (unit 9.6) may represent a TEC recognised both at State and Commonwealth level.

Several areas within the site are degraded, including pastured areas on Lots 7 and 17 and parts of Location 41 A, B, C and D. However, they form part of the consolidated area and if excised from ROS may compromise the regionally significant values. It is therefore recommended that these areas be retained in regional open space.

It is recommended that remnant bushland located between the north and south portions of Site 9 should be protected for conservation (Figure 5 shaded blue). Protection of this area would complete the linkage north-south along the dune and wetland vegetation, and east-west along the drain to the Dalyellup Reserves (C71).

The eastern boundary over Lots 6, 7 and 17 and Location 41 B, C and D appears to be arbitrary, based mostly on fenceline locations. This boundary needs to be reviewed to ensure only those areas required to protect regionally significant natural values are included. It is recommended that a further survey be undertaken to determine the exact alignment of the eastern boundary of the ROS.

Site 10 Parade Road

This majority of this site has natural values of regional significance and should be protected for conservation. All remnant bushland of this site should be protected for conservation because it provides a link between bushland at the Maidens (C70) to the west and Manea Park to the east, and is part of the Ocean to Preston River Park.

The portion west of Parade Road is proposed under the GBRS to be zoned Urban but because of its regional significance most of this should be protected for conservation (Figure 5 shaded green). The area shaded green is in good condition, supports a diverse plant community, two Priority 4 flora and one unreserved flora. A variety of fauna species are also expected to occur in the area.

The portion east of Parade Road retains areas of habitat and provides a hydrological function. It is also of regional significance because it provides an alternate corridor for the Ocean to Preston River Park via remnant bushland to the north at Hay Park that links with Manea Park. This portion of the site should be protected for conservation

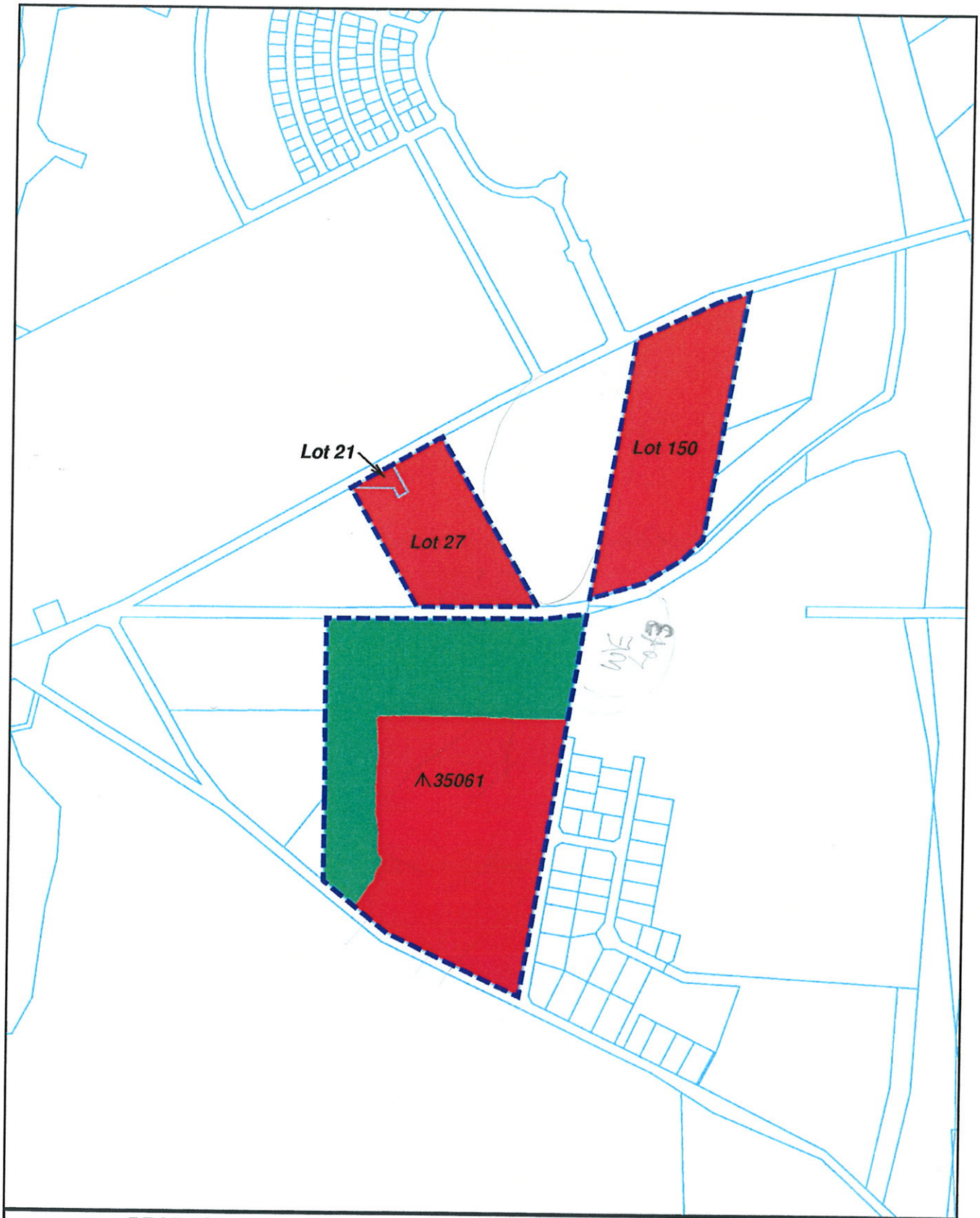
Two disturbed areas east of Parade Road do not currently contribute to the conservation value of the corridor to Hay Park and are therefore not a priority for protection. While the proposed width for the corridor would be beneficial for fauna linkage, substantial rehabilitation effort would be required to reinstate natural values of these disturbed areas.

In comparison, areas east of Parade Road but outside the study area (shaded blue) were observed to contain remnant bushland in Good condition. It is recommended that these areas should be protected for conservation as part of any future planning in the area.

In addition to satisfying five criteria for regional significance, this site is likely to satisfy the criterion that recognises cultural values adopted in Bush Forever (Government of WA 2000). Site 10 was observed during the survey to be providing a bushland setting for recreational use by the community.

Site 11 Estuary Drive

This site has natural values of regional significance and should be protected for conservation. It satisfies five of the criteria for regional significance, and provides habitat for birds listed under State and Commonwealth legislation. The site is vegetated by a *Juncus* sedgeland (unit 11.1) that is not a known floristic community type and may represent a threatened ecological community. This community may occur elsewhere on the estuary foreshore. It is important that a vegetated buffer be retained along the shoreline so as to provide protective cover for waterbird species, including migratory waders, that utilise the adjacent mudflats. Ideally this should be approximately 30 metres in width and would include trees to screen the area. Where possible, other riparian vegetation along the eastern Leschenault Estuary foreshore should also be retained.



DRAFT GREATER BUNBURY REGION SCHEME - ENVIRONMENTAL SURVEY
REGIONALLY SIGNIFICANT NATURAL VALUES (SITE 1)

Department for Planning and Infrastructure

WESTERN AUSTRALIAN PLANNING COMMISSION

GDA

Filename: ...Botanist.dgn
Amended: 3 December 2002

Produced By Cartographic Section
Bunbury Office, DPI

LEGEND

- SITE BOUNDARY
- CADASTRE
- R - REGIONALLY SIGNIFICANT NATURAL VALUES
- D- -SUITABLE FOR DEVELOPMENT
- A - ADDITIONAL, MAY HAVE NATURAL VALUES OF REGIONAL SIGNIFICANCE
- E - SUITABLE FOR DEVELOPMENT, EXACT LOCATION NOT DETERMINED
- EXACT LOCATION OF BOUNDARY NOT DETERMINED

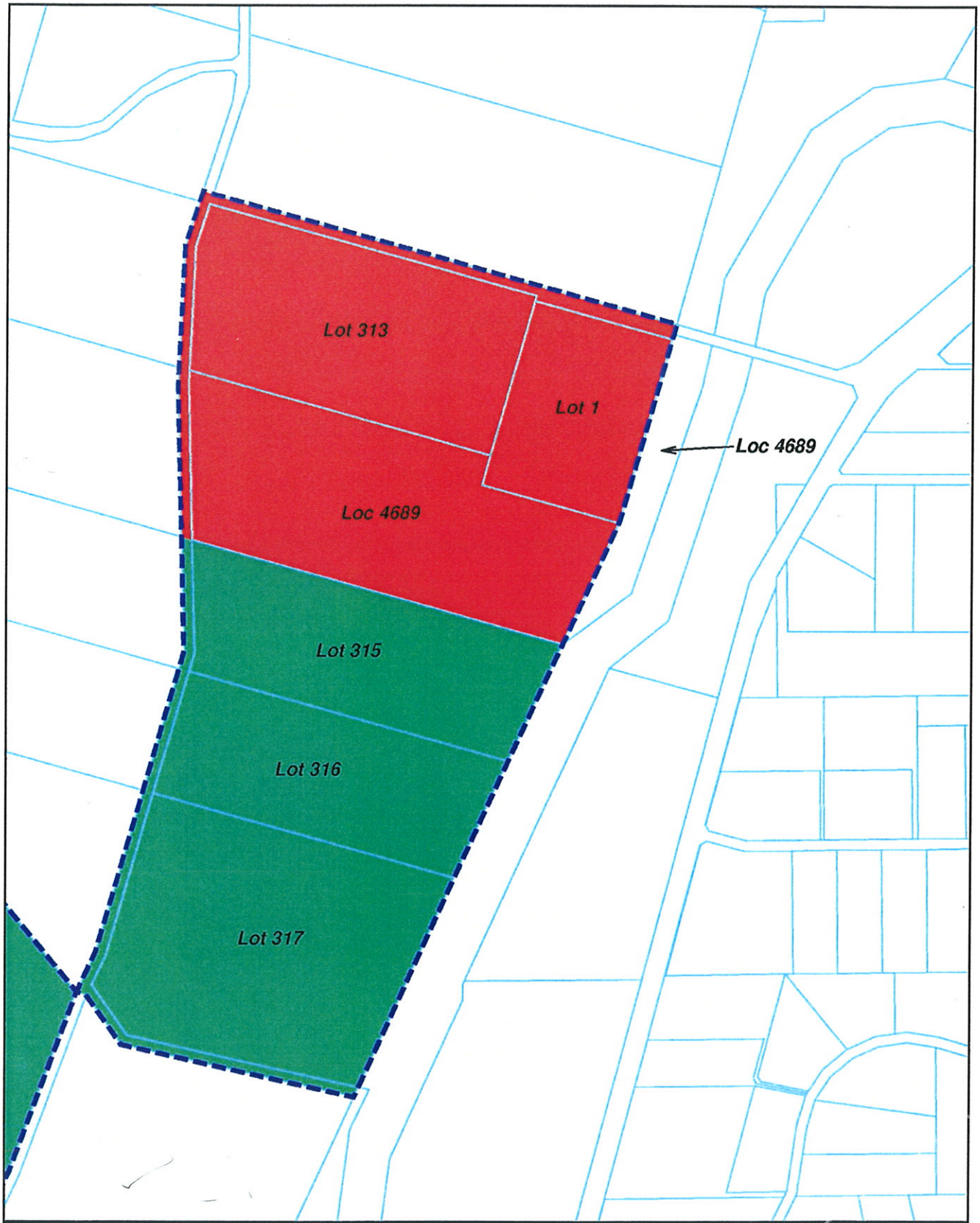
N

1:10000 at A4

0 150

Metres

Figure 5.1



DRAFT GREATER BUNBURY REGION SCHEME - ENVIRONMENTAL SURVEY
REGIONALLY SIGNIFICANT NATURAL VALUES (SITE 2)

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- D- -SUITABLE FOR DEVELOPMENT
- A - ADDITIONAL, MAY HAVE NATURAL VALUES OF REGIONAL SIGNIFICANCE
- E - SUITABLE FOR DEVELOPMENT, EXACT LOCATION NOT DETERMINED
- EXACT LOCATION OF BOUNDARY NOT DETERMINED

N

1:10000 at A4

0 150

Metres

Figure 5.2

Lot 94
Lot 95
Lot 144
Lot 143
Lot 145
24100
Lot 117
Lot 5
Lot 6
Lot 7
Lot 8
Lot 91
Lot 96
Lot 138
Lot 3
Lot 4b
Lot 1b
Lot 2
Lot 90
Lot 97
Lot 139
Lot 66
Lot 1a
Lot 4a
Lot 115
Lot 98
Lot 116
Lot 14
Lot 15
Lot 16
Loc 4402

DRAFT GREATER BUNBURY REGION SCHEME - ENVIRONMENTAL SURVEY
REGIONALLY SIGNIFICANT NATURAL VALUES (SITE 3)

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- D- -SUITABLE FOR DEVELOPMENT
- A - ADDITIONAL, MAY HAVE NATURAL VALUES OF REGIONAL SIGNIFICANCE
- E - SUITABLE FOR DEVELOPMENT, EXACT LOCATION NOT DETERMINED
- EXACT LOCATION OF BOUNDARY NOT DETERMINED

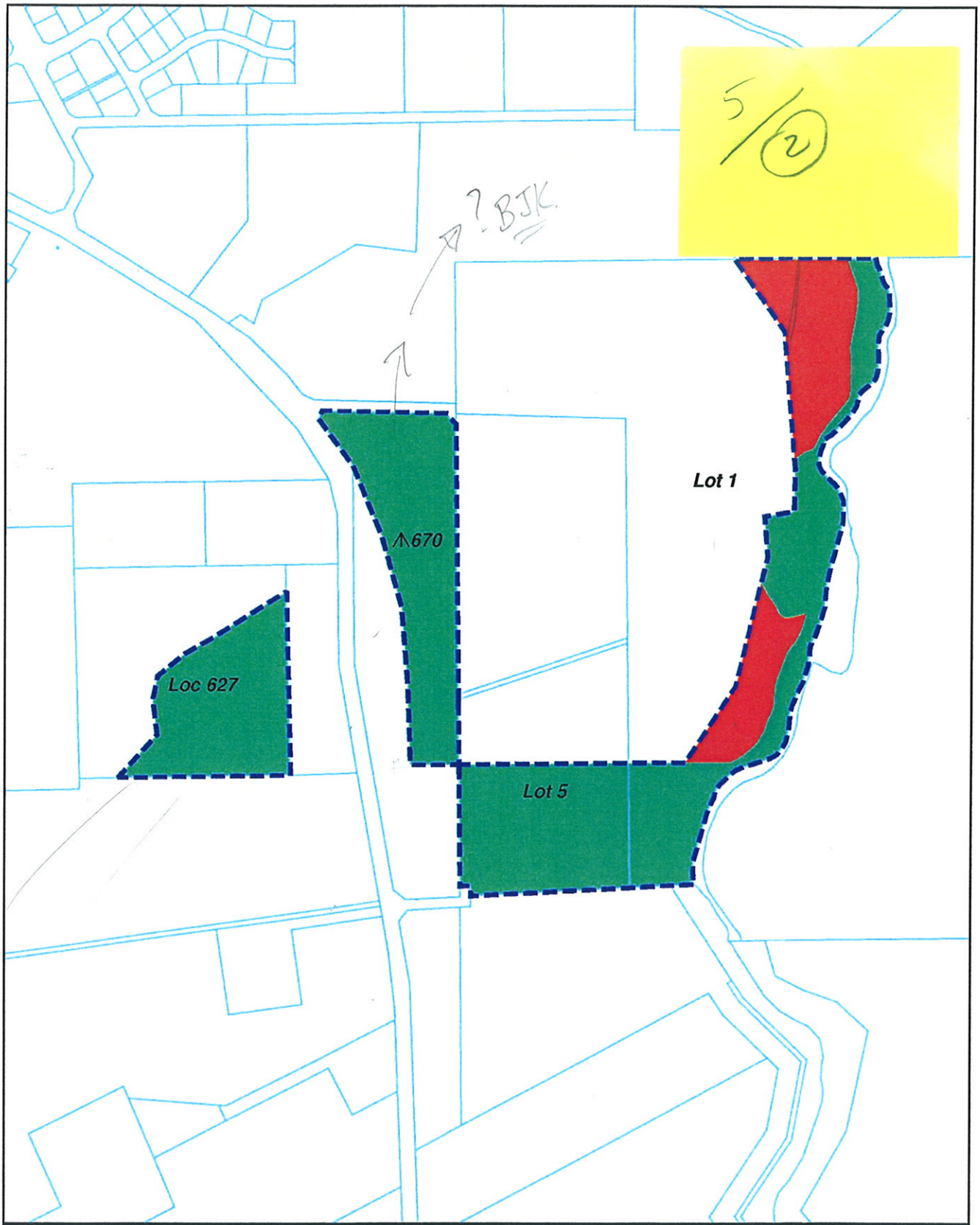
N

1:10000 at A3

0 150

Metres

Figure 5.3



DRAFT GREATER BUNBURY REGION SCHEME - ENVIRONMENTAL SURVEY
REGIONALLY SIGNIFICANT NATURAL VALUES (SITE 4)

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LEGEND

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- A - ADDITIONAL, MAY HAVE NATURAL VALUES OF REGIONAL SIGNIFICANCE
- E - SUITABLE FOR DEVELOPMENT, EXACT LOCATION NOT DETERMINED
- EXACT LOCATION OF BOUNDARY NOT DETERMINED

N

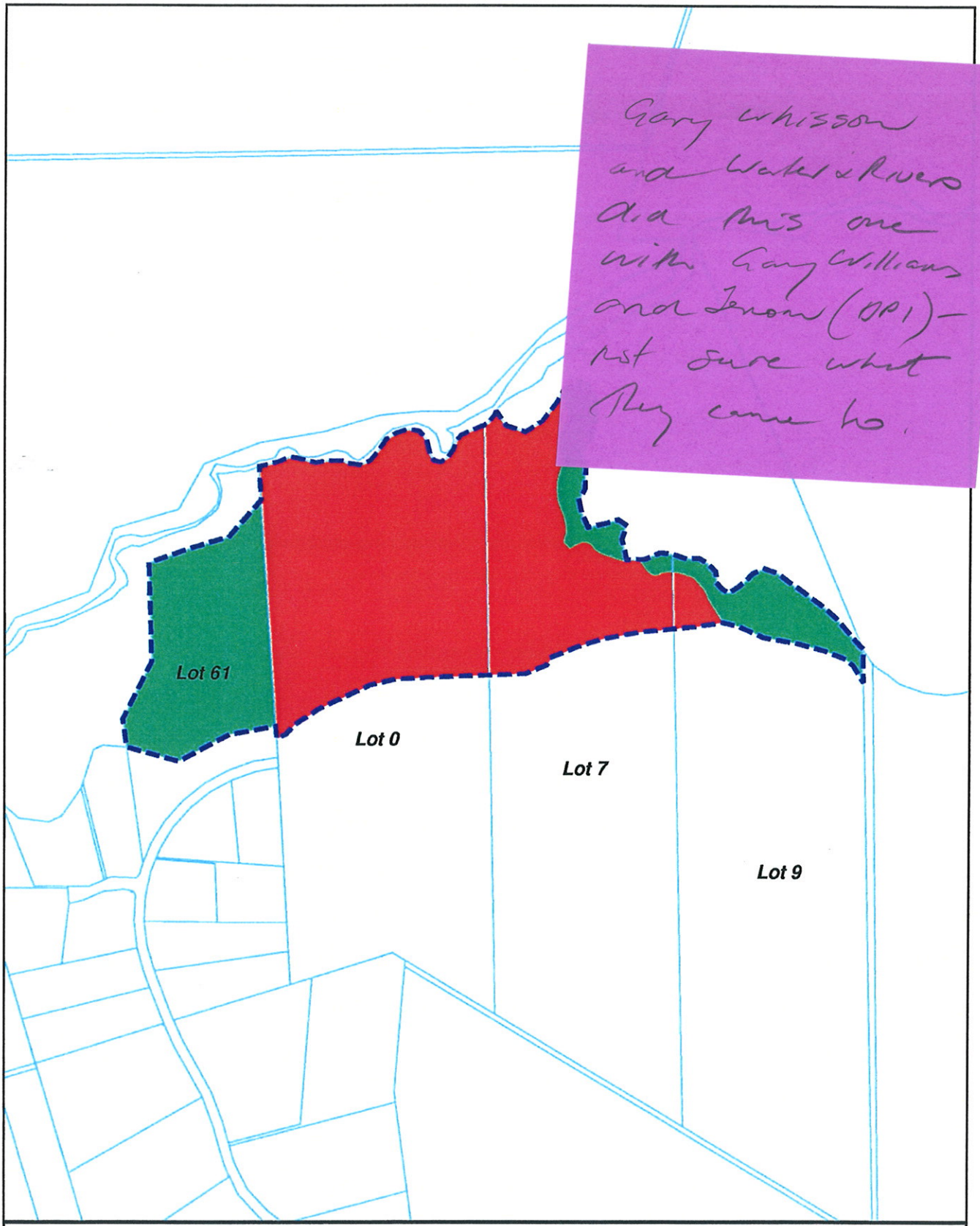
1:10000 at A4

0 150

Metres

Figure 5.4

Gary Whisson and Water & River did this one with Gary Williams and Jerom (DPI) - not sure what they came to.



DRAFT GREATER BUNBURY REGION SCHEME - ENVIRONMENTAL SURVEY
REGIONALLY SIGNIFICANT NATURAL VALUES (SITE 5)

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LEGEND

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- A - ADDITIONAL, MAY HAVE NATURAL VALUES OF REGIONAL SIGNIFICANCE
- E - SUITABLE FOR DEVELOPMENT, EXACT LOCATION NOT DETERMINED
- EXACT LOCATION OF BOUNDARY NOT DETERMINED

Poor description

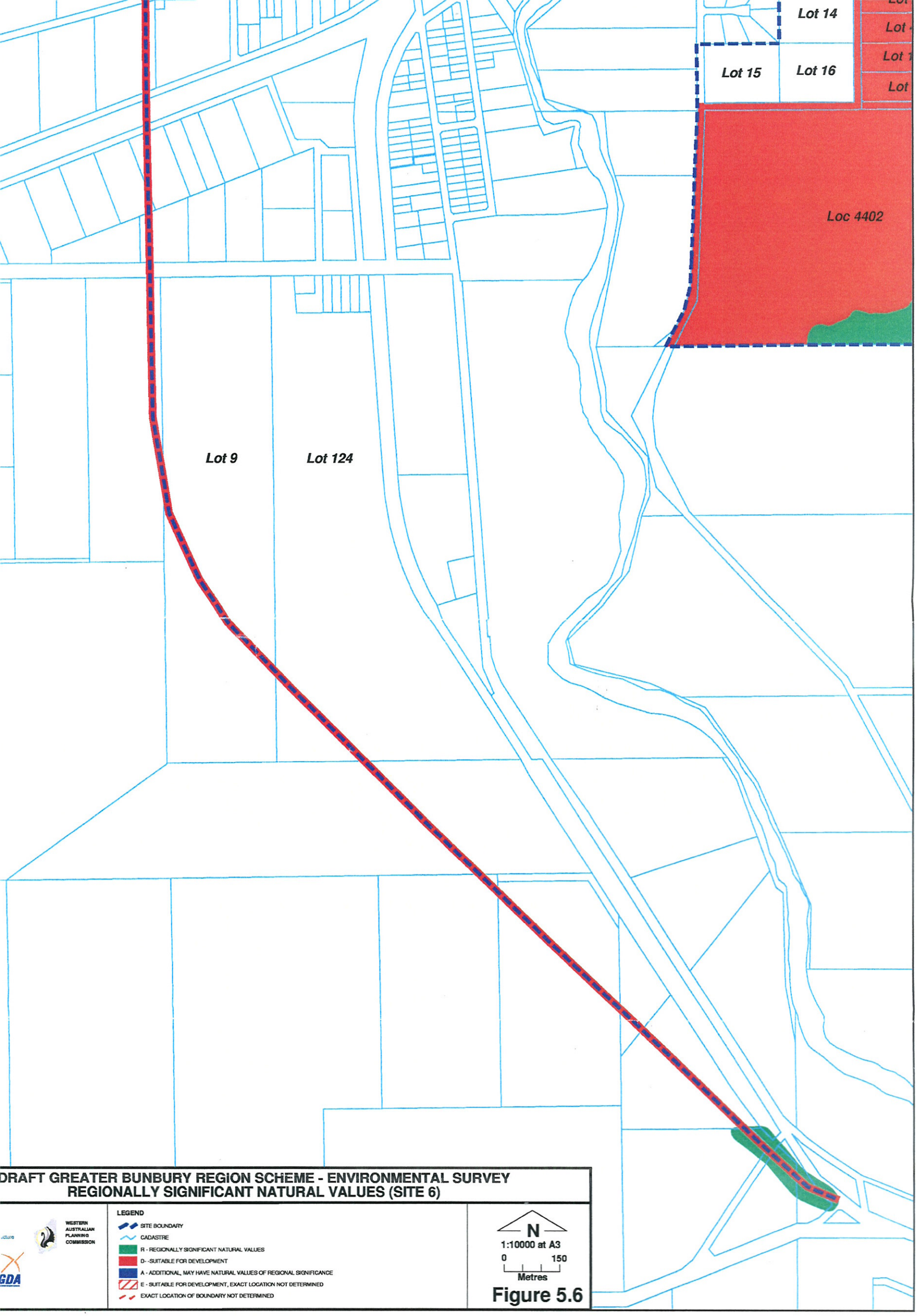
N

1:10000 at A4

0 150

Metres

Figure 5.5



DRAFT GREATER BUNBURY REGION SCHEME - ENVIRONMENTAL SURVEY
REGIONALLY SIGNIFICANT NATURAL VALUES (SITE 6)

WESTERN AUSTRALIAN PLANNING COMMISSION

LEGEND

- SITE BOUNDARY
- CADASTRE
- R - REGIONALLY SIGNIFICANT NATURAL VALUES
- D- -SUITABLE FOR DEVELOPMENT
- A - ADDITIONAL, MAY HAVE NATURAL VALUES OF REGIONAL SIGNIFICANCE
- E - SUITABLE FOR DEVELOPMENT, EXACT LOCATION NOT DETERMINED
- EXACT LOCATION OF BOUNDARY NOT DETERMINED

N

1:10000 at A3

0 150

Metres

Figure 5.6

DRAFT GREATER BUNBURY REGION SCHEME - ENVIRONMENTAL SURVEY
REGIONALLY SIGNIFICANT NATURAL VALUES (SITE 7A)

Department for Planning and Infrastructure

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- E - SUITABLE FOR DEVELOPMENT, EXACT LOCATION NOT DETERMINED
- EXACT LOCATION OF BOUNDARY NOT DETERMINED

N

1:10000 at A4

0 150

Metres

Figure 5.7

Loc 7

Loc 14

DRAFT GREATER BUNBURY REGION SCHEME - ENVIRONMENTAL SURVEY
REGIONALLY SIGNIFICANT NATURAL VALUES (SITE 7B)

Department for Planning and Infrastructure

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LEGEND

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- CADASTRE
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- D- -SUITABLE FOR DEVELOPMENT
- A - ADDITIONAL, MAY HAVE NATURAL VALUES OF REGIONAL SIGNIFICANCE
- E - SUITABLE FOR DEVELOPMENT, EXACT LOCATION NOT DETERMINED
- EXACT LOCATION OF BOUNDARY NOT DETERMINED

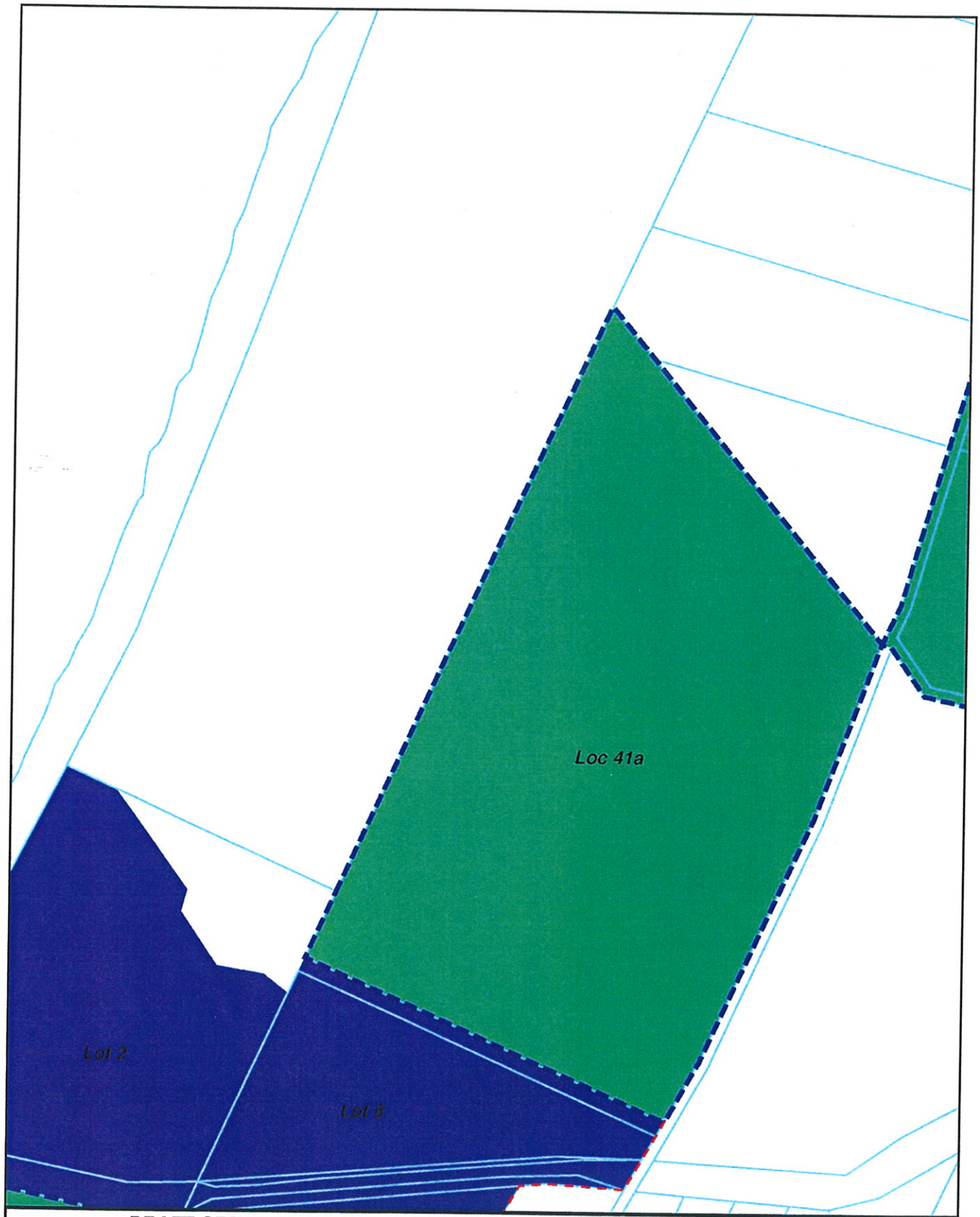
N

1:10000 at A3

0 150

Metres

Figure 5.8



DRAFT GREATER BUNBURY REGION SCHEME - ENVIRONMENTAL SURVEY
REGIONALLY SIGNIFICANT NATURAL VALUES (SITE 9A)

Department for Planning and Infrastructure

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LEGEND

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- A - ADDITIONAL, MAY HAVE NATURAL VALUES OF REGIONAL SIGNIFICANCE
- E - SUITABLE FOR DEVELOPMENT, EXACT LOCATION NOT DETERMINED
- EXACT LOCATION OF BOUNDARY NOT DETERMINED

N

1:10000 at A4

0 150

Metres

Figure 5.10

DRAFT GREATER BUNBURY REGION SCHEME - ENVIRONMENTAL SURVEY
REGIONALLY SIGNIFICANT NATURAL VALUES (SITE 8)

Department for Planning and Infrastructure

WESTERN AUSTRALIAN PLANNING COMMISSION

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LEGEND

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- R - REGIONALLY SIGNIFICANT NATURAL VALUES
- D- -SUITABLE FOR DEVELOPMENT
- A - ADDITIONAL, MAY HAVE NATURAL VALUES OF REGIONAL SIGNIFICANCE
- E - SUITABLE FOR DEVELOPMENT, EXACT LOCATION NOT DETERMINED
- EXACT LOCATION OF BOUNDARY NOT DETERMINED

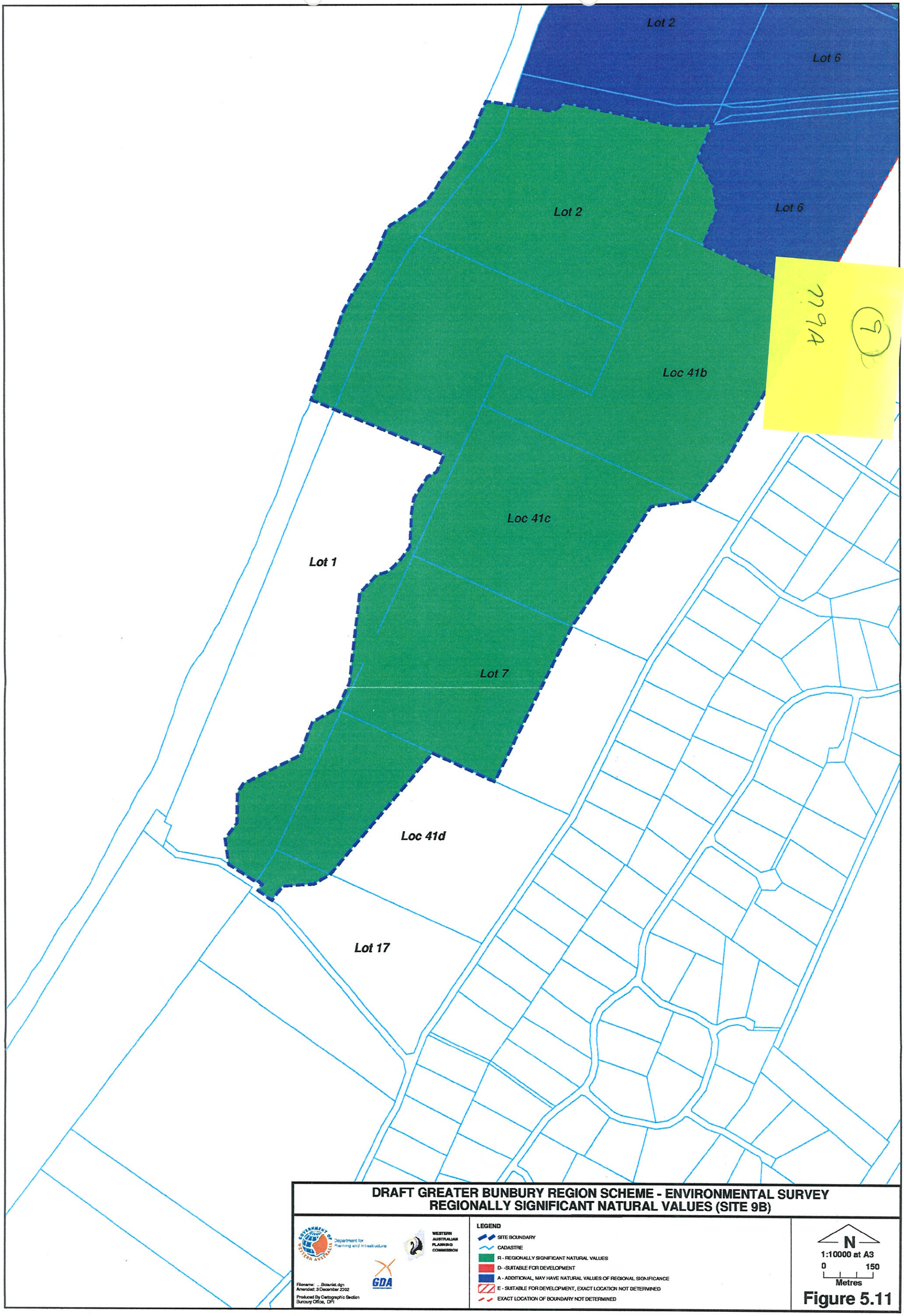
N

1:10000 at A4

0 150

Metres

Figure 5.9


Lot 2
Lot 6
Lot 2
Lot 6
Loc 41b
Loc 41c
Lot 1
Lot 7
Loc 41d
Lot 17
DRAFT GREATER BUNBURY REGION SCHEME - ENVIRONMENTAL SURVEY
REGIONALLY SIGNIFICANT NATURAL VALUES (SITE 9B)
Department for Planning and Infrastructure
WESTERN AUSTRALIAN PLANNING COMMISSION
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Filename: ...Botanist.dgn
Amended: 3 December 2302
Produced By Cartographic Section
Bunbury Office, DPI
LEGEND
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D- -SUITABLE FOR DEVELOPMENT
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E - SUITABLE FOR DEVELOPMENT, EXACT LOCATION NOT DETERMINED
EXACT LOCATION OF BOUNDARY NOT DETERMINED
N
1:10000 at A3
0
150
Metres
Figure 5.11

11 Acknowledgments

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- Dr Eleanor Bennett, Bennett Environmental Consulting
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- Members of Birds Australia WA group
- Members of Bunbury Naturalists Club

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Abbreviations

ANCA	Australian Nature Conservation Agency
ANZAAS	Australian and New Zealand Association for the Advancement of Science
BOM	Bureau of Meteorology
CALM	Department of Conservation and Land Management
CAMBA	China-Australia Migratory Bird Agreement
DPI	Department for Planning and Infrastructure
DRF	Declared Rare Flora
EPBC Act	*Environmental Protection and Biodiversity Conservation Act 1999*
FCT	Floristic community type
GBRS	Greater Bunbury Region Scheme
JAMBA	Japan-Australia Migratory Bird Agreement
LIMA	Leschenault Inlet Management Authority
SCP	Swan Coastal Plain
TEC	Threatened ecological community
WAM	Western Australian Museum
WAPC	Western Australian Planning Commission
WRC	Water and Rivers Commission

Appendix A

Vascular Flora Species List

Appendix A

Family	Species
Adiantaceae	*Adiantum aethiopicum*
Aizoaceae	*Carpobrotus virescens*
	* *Tetragonia decumbens*
Amaranthaceae	*Ptilotus sericostachyus* subsp. *sericostachyus*
Anthericaceae	*Agrostocrinum scabrum*
	Caesia micrantha
	Corynotheca micrantha var. *micrantha*
	Dichopogon capillipes
	Dichopogon preissii
	Johnsonia lupulina
	Sowerbaea laxiflora
	Thysanotus multiflorus
	Thysanotus patersonii
	Thysanotus sparteus
	Tricoryne elatior
Apiaceae	* *Apium graveolens*
	Apium prostratum var. *prostratum*
	Centella asiatica
	Daucus glochidiatus
	Eryngium pinnatifidum subsp. *pinnatifidum* ms
	Hydrocotyle scutellifera
	Hydrocotyle tetragonocarpa
	Trachymene pilosa
	Xanthosia huegelii
Apocynaceae	*Alyxia buxifolia*
Araceae	* *Zantedeschia aethiopica*
Asparagaceae	* *Asparagus asparagoides*
Asphodelaceae	* *Trachyandra divaricata*
Asteraceae	* *Arctotheca calendula*
	Asteraceae sp.
	Asteridea pulverulenta
	* *Cirsium arvense* subsp. *arvense*
	* *Cirsium vulgare*
	Conyza sp.
	Cotula coronopifolia
	* *Cotula turbinata*
	Craspedia variabilis
	* *Hypochaeris glabra*
	Lagenophora huegelii
	Millotia myosotidifolia
	Olearia axillaris
	Ozothamnus cordatus
	Picris squarrosa
	Podotheca angustifolia
	Quinetia urvillei
	Rhodanthe citrina
	Rhodanthe corymbosa
	* *Senecio diaschides*
	Senecio lautus subsp. *maritimus*
	Senecio sp.
	* *Sonchus asper* subsp. *glaucescens*

Appendix A

Family	Species
	Sonchus hydrophilus
	* *Sonchus oleraceus*
	* *Ursinia anthemoides*
	Waitzia suaveolens var. *suaveolens*
Brassicaceae	* *Cakile maritima*
	* *Heliophila pusilla*
Caesalpiniaceae	*Labichea punctata*
Callitrichaceae	* *Callitriche stagnalis*
Campanulaceae	*Wahlenbergia gracilenta*
Caryophyllaceae	* *Petrorhagia dubia*
	* *Sagina apetala*
	* *Silene* sp.
	* *Spergula arvensis*
	* *Stellaria media*
Casuarinaceae	*Allocasuarina humilis*
	Casuarina obesa
Centrolepidaceae	*Centrolepis aristata*
	Centrolepis mutica
Chenopodiaceae	*Chenopodium* sp.
	Halosarcia halocnemoides subsp. *halocnemoides*
	Halosarcia indica subsp. *bidens*
	Halosarcia lepidosperma
	Halosarcia undulata
	Rhagodia baccata subsp. *baccata*
	Threlkeldia diffusa
Colchicaceae	*Burchardia umbellata*
Convolvulaceae	*Dichondra repens*
Crassulaceae	*Crassula colorata* var. *colorata*
	Crassula decumbens var. *decumbens*
Cuscutaceae	* *Cuscuta epithymum*
Cyperaceae	*Baumea articulata*
	Baumea juncea
	Bolboschoenus caldwellii
	Bolboschoenus medianus
	Carex appressa
	* *Carex divisa*
	Carex preissii
	Cyathochaeta avenacea
	* *Cyperus congestus*
	Gahnia trifida
	* *Isolepis marginata*
	Isolepis nodosa
	* *Isolepis prolifera*
	Isolepis setiformis
	Lepidosperma gladiatum
	Lepidosperma gracile
	Lepidosperma longitudinale
	Lepidosperma squamatum
	Lepidosperma tenue
	Mesomelaena graciliceps
	Mesomelaena tetragona

Appendix A

Family	Species
	Schoenus curvifolius
	Schoenus efoliatus
	Schoenus grandiflorus
	Schoenus sublateralis
	Tetraria capillaris
	Tetraria octandra
Dasypogonaceae	*Acanthocarpus preissii*
	Calectasia narragara
	Dasypogon bromeliifolius
	Dasypogon hookeri
	Kingia australis
	Lomandra brittanii
	Lomandra hermaphrodita
	Lomandra micrantha subsp. *micrantha*
	Lomandra nigricans
	Lomandra preissii
	Lomandra ?preissii
	Lomandra purpurea
	Lomandra sericea
	Lomandra sp.
Dennstaedtiaceae	*Pteridium esculentum*
Dilleniaceae	*Hibbertia amplexicaulis*
	Hibbertia cuneiformis
	Hibbertia cunninghamii
	Hibbertia hypericoides
	Hibbertia mylnei
	Hibbertia racemosa
	Hibbertia vaginata
Droseraceae	*Drosera erythrorhiza* subsp. *erythrorhiza*
	Drosera glanduligera
	Drosera macrantha subsp. *macrantha*
	Drosera ?marchantii subsp. *marchantii* (P4)
	Drosera menziesii subsp. *penicillaris*
	Drosera nitidula subsp. *nitidula*
	Drosera pallida
	Drosera stolonifera subsp. *stolonifera*
Epacridaceae	*Astroloma ciliatum*
	Astroloma pallidum
	Astroloma prostratum
	Conostephium pendulum
	Leucopogon capitellatus
	Leucopogon conostephioides
	Leucopogon parviflorus
	Leucopogon polymorphus
	Leucopogon propinquus
	Lysinema ciliatum
	Styphelia tenuiflora
Euphorbiaceae	*Adriana quadripartita*
	Calycopeplus oligandrus
	* *Euphorbia paralias*
	* *Euphorbia peplus*

Appendix A

Family	Species
	* *Euphorbia terracina*
	Monotaxis grandiflora var. *grandiflora*
	Phyllanthus calycinus
Frankeniaceae	*Frankenia pauciflora*
Fumariaceae	* *Fumaria capreolata*
Geraniaceae	* *Erodium cicutarium*
	* *Geranium molle*
	Geranium retrosum
	Geranium solanderi
	* *Pelargonium capitatum*
	Pelargonium littorale subsp. *littorale*
Goodeniaceae	*Dampiera linearis*
	Dampiera trigona
	Lechenaultia biloba
	Scaevola calliptera
	Scaevola crassifolia
	Scaevola lanceolata
Haemodoraceae	*Anigozanthos humilis* subsp. *humilis*
	Anigozanthos mangleisii subsp. *mangleisii*
	Conostylis aculeata subsp. *aculeata*
	Conostylis serrulata
	Conostylis setigera subsp. *setigera*
	Haemodorum paniculatum
	Haemodorum ?paniculatum
	Haemodorum sp.
	Haemodorum spicatum
	Phlebocarya ciliata
Iridaceae	* *Freesia alba x leichtlinii*
	Gladiolus sp.
	Iridaceae sp.
	Orthrosanthus laxus var. *laxus*
	Patersonia umbrosa subsp. *umbrosa*
	Patersonia umbrosa subsp. *xanthina*
	* *Romulea rosea*
	* *Sparaxis bulbifera*
	* *Watsonia meriana* var. *bulbillifera*
Isoetaceae	? *Isoetes drummondii*
Juncaceae	* *Juncus bufonius*
	Juncus kraussii subsp. *australiensis*
	* *Juncus oxycarpus*
	Juncus pallidus
	* *Juncus usitatus*
	Luzula meridionalis
Juncaginaceae	*Triglochin calcitrapa*
	Triglochin huegelii
	Triglochin mucronata
	Triglochin muelleri
Lamiaceae	*Hemiandra pungens*
	* *Mentha x piperita*
Lauraceae	*Cassytha racemosa* forma *racemosa*
Lindsaeaceae	*Lindsaea linearis*

Appendix A

Family	Species
Lobeliaceae	*Lobelia alata*
	Lobelia tenuoir
Loganiaceae	*Logania serpyllifolia* subsp. *angustifolia*
	Phyllangium paradoxum
Loranthaceae	*Nuytsia floribunda*
Mimosaceae	*Acacia applanata*
	Acacia cochlearis
	Acacia cyclops
	Acacia flagelliformis (P4)
	Acacia huegelii
	Acacia littorea
	* *Acacia longifolia* subsp. *longifolia*
	Acacia nervosa
	Acacia pulchella var. *glaberrima*
	Acacia pulchella var. *goadbyi*
	Acacia saligna
	Acacia semitrullata (P3)
	Acacia stenoptera
	Acacia urophylla
Myoporaceae	*Eremophila glabra* subsp. *albicans*
	Myoporum insulare
	Myoporum oppositifolium
Myrtaceae	*Agonis flexuosa* var. *flexuosa*
	Agonis linearifolia
	Astartea affin. *fasicularis*
	Calothamnus sanguineus
	Corymbia calophylla
	Corymbia haematoxylon
	Eremea pauciflora var. *pauciflora*
	Eucalyptus gomphocephala
	Eucalyptus marginata subsp. *marginata*
	Eucalyptus rudis subsp. *rudis*
	Hypocalymma angustifolia
	Hypocalymma robustum
	Kunzea glabrescens
	Kunzea recurva
	* *Leptospermum laevigatum*
	Melaleuca incana subsp. *incana*
	Melaleuca preissiana
	Melaleuca rhaphiophylla
	Melaleuca teretifolia
	Melaleuca thymoides
	Melaleuca viminea subsp. *viminea*
Orchidaceae	*Caladenia flava* subsp. *flava*
	Caladenia georgei
	Caladenia hirta subsp. *hirta*
	Caladenia latifolia
	Caladenia sp.
	Caladenia speciosa (P4)
	Corybas sp.
	* *Disa bracteata*

Appendix A

Family	Species
	Diuris corymbosa
	Elythranthera brunonis
	Leptoceras menziesii
	Microtis media subsp. *media*
	Oligochaetochilus vittatus
	Plumatichilos barbata
	Prasophyllum elatum
	Prasophyllum sp.
	Pterostylis sp. "Slender Snail Orchid" (G.J.Keighery 14516) pn
	Pyrochis nigricans
	Thelymitra pauciflora
	Thelymitra sp.
Orobanchaceae	* *Orobanche minor*
Oxalidaceae	* *Oxalis corniculata*
	* *Oxalis glabra*
	* *Oxalis pes-caprae*
Papilionaceae	*Bossiaea eriocarpa*
	Bossiaea ornata
	Chorizema nanum
	Daviesia divaricata var. *divaricata* ms
	Daviesia physodes
	Eutaxia virgata
	Gompholobium capitatum
	Gompholobium confertum
	Gompholobium marginatum
	Gompholobium polymorphum
	Gompholobium preissii
	Gompholobium tomentosum
	Hardenbergia comptoniana
	Hovea chorizemifolia
	Hovea trisperma
	Isotropis cuneifolia subsp. *cuneifolia*
	Jacksonia furcellata
	Jacksonia horrida
	Jacksonia sparsa ms (P4)
	Kennedia coccinea
	Kennedia prostrata
	* *Lotus suaveolens*
	* *Lupinus angustifolius*
	* *Lupinus cosentinii*
	* *Lupinus luteus*
	* *Melilotus siculus*
	Nemcia capitata
	* *Ornithopus compressus*
	Oxylobium lineare
	Sphaerolobium drummondii
	* *Trifolium campestre* var. *campestre*
	* *Trifolium ?campestre* var. *campestre*
	* *Trifolium* sp.
	* *Trifolium subterraneum*
	* *Vicia sativa* subsp. *nigra*

Appendix A

Family	Species
	Viminaria juncea
Phormiaceae	*Chamaescilla corymbosa* var. *corymbosa*
	Dianella revoluta var. *divaricata*
Phytolaccaceae	* *Phytolacca octandra*
Pittosporaceae	*Billardiera laxiflora*
Plantaginaceae	* *Plantago lanceolata*
Poaceae	*Ammophila arenaria*
	Amphipogon turbinatus
	Austrostipa compressa
	Austrostipa tenuifolia
	* *Avena barbata*
	* *Briza maxima*
	* *Briza minor*
	Bromus arenarius
	* *Bromus diandrus*
	* *Cortaderia selloana*
	* *Cynodon dactylon*
	* *Cynosurus echinatus*
	* *Ehrharta calycina*
	* *Ehrharta longiflora*
	* *Eragrostis curvula*
	* *Holcus lanatus*
	* *Hordeum leporinum*
	* *Lagurus ovatus*
	* *Lolium perenne*
	Microlaena stipoides var. *stipoides*
	Neurachne alopecuroidea
	* *Paspalum vaginatum*
	* *Pennisetum clandestinum*
	* *Piptatherum miliaceum*
	* *Poa annua*
	Poa porphyroclados
	Poaceae sp.
	?* *Rostraria cristata*
	Spinifex hirsutus
	Spinifex longifolius
	Tetrarrhena laevis
	* *Vulpia myuros* var. *myuros*
Polygonaceae	*Persicaria decipiens*
	* *Rumex ?conglomeratus*
	* *Rumex ?cripsis*
	Rumex sp.
Portulacaceae	*Calandrinia liniflora*
Primulaceae	* *Anagallis arvensis* var. *caerulea*
	Samolus junceus
	Samolus repens var. *repens*
Proteaceae	*Adenanthos barbiger* subsp. *intermedius* ms
	Adenanthos meisneri
	Banksia attenuata
	Banksia grandis
	Banksia ilicifolia

Appendix A

Family	Species
	Banksia littoralis
	Conospermum capitatum subsp. *capitatum*
	Dryandra lindeyana var. *lindleyana*
	Hakea amplexicaulis
	Hakea cyclocarpa
	Hakea lissocarpha
	Hakea prostrata
	Hakea varia
	Isopogon sphaerocephalus
	Persoonia longifolia
	Persoonia saccata
	Petrophile linearis
	Stirlingia latifolia
	Synaphea spinulosa subsp. *spinulosa*
	Xylomelum occidentale
Ranunculaceae	*Clematis linearifolia*
	* *Ranunculus muricatus*
Restionaceae	*Anarthria prolifera*
	Desmocladus fasiculatus
	Desmocladus flexuosus
	Hypolaena exsulca
	Loxocarya cinerea
	Lyginia imberbis
	Meeboldina coangustata
	Meeboldina decipiens subsp. *decipiens* ms
Rhamnaceae	*Cryptandra arbutiflora* var. *arbutifloa*
	Spyridium globulosum
	Trymalium floribundum subsp. *floribundum*
Rosaceae	* *Rubus ulmifolius*
Rubiaceae	*Opercularia hispidula* var. *pauciflora*
	Opercularia vaginata
	* *Sherardia arvensis*
Rutaceae	*Boronia spathulata*
	Diplolaena dampieri
	Philotheca spicata
	Rhadinothamnus anceps
Santalaceae	*Exocarpos sparteus*
	Santalum acuminatum
Scrophulariaceae	*Dischisma capitatum*
	* *Parentucellia viscosa*
Solanaceae	*Anthocercis littorea*
	* *Solanum americanum*
	* *Solanum laciniatum*
	* *Solanum linnaeanum*
	* *Solanum nigrum*
Sterculiaceae	*Lasiopetalum membranaceum* (P3)
	Thomasia triphylla
Stylidiaceae	*Stylidium amoenum* var. *amoenum*
	Stylidium brunonianum subsp. *brunonianum*
	Stylidium calcaratum
	Stylidium piliferum subsp. *piliferum*

Appendix A

Family	Species
	Stylidium schoenoides
Thymelaeaceae	*Pimelea rosea* subsp. *rosea*
	Pimelea sp.
Tremandraceae	*Platytheca galioides*
	Tetratheca hirsuta
	Tremandra diffusa
Typhaceae	*Typha ?domingensis*
	* *Typha orientalis*
Urticaceae	*Parietaria debilis*
Violaceae	*Hybanthus calycinus*
	Hybanthus floribundus subsp. *floribundus*
Xanthorrhoeaceae	*Xanthorrhoea brunonis* subsp. *brunonis*
	Xanthorrhoea gracilis
	Xanthorrhoea preissii
Zamiaceae	*Macrozamia riedlei*
Zygophyllaceae	*Zygophyllum simile*

Appendix B

Vascular Flora Recorded within Vegetation Structural Units

Appendix B

	Species	1.1	1.2	1.3	2.1	2.2	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4	4.5	4.6	5.1	5.2	5.3	6.1	7A.1	7A.2	7A.3	7B.1	7B.2	7B.3	8.1	8.2	8.3	8.4	9.1	9.2	9.3	9.4	9.5	9.6	9.7	10.1	10.2	10.3	10.4	11.1
	Acacia applanata								+							+				+																					
	Acacia cochlearis																																									
	Acacia cyclops																				+	+					+				+		+	+	+			+				
	Acacia flagelliformis (P4)		+					+	+											+													+									
	Acacia huegelii						+													+																		+				
	Acacia littorea																					+	+																				
*	*Acacia longifolia* subsp. *longifolia*						+																																			
	Acacia nervosa							+												+																						
	Acacia pulchella var. *glaberrima*			+			+	+												+																						
	Acacia pulchella var. *goadbyi*									+	+			+		+			+										+	+								+	+			
	Acacia saligna				+									+	+	+															+	+	+			+	+	+		+	+	+	
	Acacia semitrullata (P3)	+					+	+																																		
	Acacia stenoptera						+	+	+							+				+																		+				
	Acacia urophylla									+																													+				
	Acanthocarpus preissii				+																	+	+																			
	Adenanthos barbiger subsp. *intermedius* ms							+	+											+													+	+	+	+	+			+			
	Adenanthos meisneri		+	+			+	+								+				+							+															
	Adiantum aethiopicum									+																																
	Adriana quadripartita																																										
	Agonis flexuosa var. *flexuosa*		+	+	+	+				+	+	+	+	+	+	+			+	+		+	+				+	+		+		+	+		+	+	+	+	+			
	Agonis linearifolia																		+																							
	Agrostocrinum scabrum							+	+											+																						
	Allocasuarina humilis			+																																						
	Alyxia buxifolia																					+	+													+						
	Ammophila arenaria																				+																					
	Amphipogon turbinatus						+																																			
*	*Anagallis arvensis* var. *caerulea*				+					+																	+					+				+	+				
	Anarthria prolifera						+	+	+																																	
	Anigozanthos humilis subsp. *humilis*								+																																	
	Anigozanthos mangleisii subsp. *mangleisii*			+			+																				+											+				
	Anthocercis littorea																																									
*	*Apium graveolens*																																									
	Apium prostratum var. *prostratum*																									+			+											+		
*	*Arctotheca calendula*			+	+						+			+									+			+								+			+	+			+
*	*Asparagus asparagoides*						+			+		+		+	+	+																						+	+			
	Astartea affin. *fasicularis*																+		+										+	+											
	Asteraceae sp.									+																																
	Asteridea pulverulenta																										+					+						+				
	Astroloma ciliatum																			+							+											+				
	Astroloma pallidum																											+														
	Astroloma prostratum		+																	+																						
	Austrostipa compressa																																										
	Austrostipa tenuifolia																																										
	Avena barbata			+						+	+					+																										
	Banksia attenuata		+	+	+		+							+		+				+							+	+										+	+			+
	Banksia grandis			+	+			+	+					+		+				+							+											+				
	Banksia ilicifolia	+	+	+									+	+													+											+				
	Banksia littoralis	+											+			+																										
	Baumea articulata																		+																							
	Baumea juncea																									+			+	+										+		
	Billardiera laxiflora		+	+																																			+				
	Bolboschoenus caldwellii																									+	+															
	Bolboschoenus medianus																																										
	Boronia spathulata						+	+	+											+																					+		
	Bossiaea eriocarpa		+	+			+	+												+							+	+										+	+			
	Bossiaea ornata							+												+																						
*	*Briza maxima*			+	+		+	+	+	+																	+	+										+	+		+	
*	*Briza minor*																										+											+	+				
	Bromus arenarius																					+																				
*	*Bromus diandrus*		+			+									+									+														+				
	Burchardia umbellata	+		+			+	+	+					+		+				+							+	+										+	+			
	Caesia micrantha			+						+										+								+										+	+			
*	*Cakile maritima*																																		+								
	Caladenia flava subsp. *flava*	+	+	+	+		+	+	+							+				+							+	+										+	+			
	Caladenia georgei																										+											+	+			
	Caladenia hirta subsp. *hirta*																																						+				

Appendix B

	Species	1.1	1.2	1.3	2.1	2.2	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4	4.5	4.6	5.1	5.2	5.3	6.1	7A.1	7A.2	7A.3	7B.1	7B.2	7B.3	8.1	8.2	8.3	8.4	9.1	9.2	9.3	9.4	9.5	9.6	9.7	10.1	10.2	10.3	10.4	11.1
	Caladenia latifolia															+							+																			
	Caladenia sp.		+																							+			+		+	+		+	+		+	+		+	
	Caladenia speciosa (P4)		+						+											+																					
	Calandrinia liniflora																											+									+	+				
	Calectasia narragara			+																		+	+									+									
*	*Callitriche stagnalis*																																									
	Calothamnus sanguineus						+		+			+					+								+																
	Calycopeplus oligandrus																																									
	Carex appressa																+														+					+					
*	*Carex divisa*																														+					+		+			
	Carex preissii																																						+			
	Carpobrotus virescens																						+									+	+			+					
	Cassytha racemosa forma *racemosa*						+	+									+			+	+	+													+	+					
	Casuarina obesa																+			+		+	+	+							+			+	+	+			+	+	
	Centella asiatica																+							+					+	+											+
	Centrolepis aristata																												+		+	+	+								
	Centrolepis mutica						+																			+																
	Chamaescilla corymbosa var. corymbosa	+	+	+	+		+		+	+											+																	+				
	Chenopodium sp.																										+															
	Chorizema nanum							+		+																																
*	*Cirsium arvense* subsp. *arvense*				+																																					
*	*Cirsium vulgare*																																									
	ematis linearifolia				+					+																																
	Conospermum capitatum subsp. *capitatum*		+																																							
	Conostephium pendulum		+	+	+		+																																			
	Conostylis aculeata subsp. *aculeata*	+			+		+	+	+					+		+				+		+	+				+	+		+		+	+		+	+		+	+		
	Conostylis serrulata		+	+					+											+																						
	Conostylis setigera subsp. *setigera*								+																																	
	Conyza sp.																																									
*	*Cortaderia selloana*																													+												
	Corybas sp.																								+												+					
	Corymbia calophylla	+	+	+	+			+		+	+		+			+			+	+							+	+	+	+								+				
	Corymbia haematoxylon								+																														+				
	Corynotheca micrantha var. *micrantha*																											+									+	+				
	Cotula coronopifolia														+										+	+																
*	*Cotula turbinata*				+									+	+																											
	Craspedia variabilis																																									
	Crassula colorata var. *colorata*	+		+				+														+					+										+				
	Crassula decumbens var. *decumbens*			+				+																			+										+					
	Cryptandra arbutiflora var. *arbutifloa*																										+															
*	*Cuscuta epithymum*																					+																				
	Cyathochaeta avenacea								+																																	
*	*Cynodon dactylon*																																									
	Cynosurus echinatus									+							+	+						+	+	+			+		+								+	+	
*	*Cyperus congestus*																									+																
	Dampiera linearis		+	+				+								+	+			+					+																
	Dampiera trigona																																						+				
	Dasypogon bromeliifolius	+	+	+			+		+					+		+				+								+												+	
	Dasypogon hookeri							+																															+			
	Daucus glochidiatus				+			+																																		
	Daviesia divaricata var. divaricata ms		+	+	+									+									+	+				+	+				+	+		+	+		+	+		
	Daviesia physodes		+	+			+	+								+				+							+											+	+		
	Desmocladus fasiculatus	+	+	+				+	+							+				+							+														
	Desmocladus flexuosus			+																							+											+				
	Dianella revoluta var. *divaricata*																										+															
	Dichondra repens																															+		+				+	+			
	Dichopogon capillipes									+																														+			
	Dichopogon preissii				+																						+															
	Diplolaena dampieri																					+	+																+	+			
*	*Disa bracteata*	+																														+	+		+				+			
	Dischisma capitatum				+																		+																			
	Diuris corymbosa	+		+																												+				+						
	Drosera ?marchantii subsp. *marchantii* (P4)									+																													+	+			
	Drosera erythrorhiza subsp. *erythrorhiza*	+	+	+																+							+															
	Drosera glanduligera						+																																	+			
	Drosera macrantha subsp. *macrantha*						+																																				

Appendix B

	Species	1.1	1.2	1.3	2.1	2.2	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4	4.5	4.6	5.1	5.2	5.3	6.1	7A.1	7A.2	7A.3	7B.1	7B.2	7B.3	8.1	8.2	8.3	8.4	9.1	9.2	9.3	9.4	9.5	9.6	9.7	10.1	10.2	10.3	10.4	11.1
	Drosera menziesii subsp. *penicillaris*		+				+	+								+												+													
	Drosera nitidula subsp. *nitidula*	+																																								
	Drosera pallida		+	+				+																														+				
	Drosera stolonifera subsp. *stolonifera*		+	+	+				+											+																	+	+			
	Dryandra lindeyana var. *lindleyana*								+																																	
*	*Ehrharta calycina*			+			+				+					+				+		+						+		+							+	+		+	
*	*Ehrharta longiflora*	+			+		+		+	+	+	+	+	+	+	+											+	+		+		+	+			+		+			
	Elythranthera brunonis		+				+		+																																
*	*Eragrostis curvula*									+						+										+															
	Eremea pauciflora var. *pauciflora*						+																																			
	Eremophila glabra subsp. *albicans*																																+		+	+						
*	*Erodium cicutarium*																														+					+			+			
	Eryngium pinnatifidum subsp. *pinnatifidum* ms				+																											+			+				+		
	Eucalyptus gomphocephala				+	+																	+									+						+	+		
	Eucalyptus marginata subsp. *marginata*		+	+	+		+	+	+	+			+	+		+				+							+	+									+	+		
	Eucalyptus rudis subsp. *rudis*									+		+	+		+		+	+	+										+	+				+					+	+	+
*	*Euphorbia paralias*																				+												+								
*	*Euphorbia peplus*				+																											+							+		
*	*Euphorbia terracina*																																						+	+		
	Eutaxia virgata																																								+	
	Exocarpos sparteus																					+											+	+	+	+	+					
	Frankenia pauciflora																																									+
	eesia alba x leichtlinii		+																																			+				
*	*Fumaria capreolata*		+								+	+		+																								+				
	Gahnia trifida																							+					+		+									+		
*	*Geranium molle*									+			+				+						+				+														
	Geranium retrosum				+																											+									
	Geranium solanderi				+																						+						+	+							
	Gladiolus sp.															+																										
	Gompholobium capitatum			+																																						
	Gompholobium confertum																			+																						
	Gompholobium marginatum								+											+																						
	Gompholobium polymorphum			+				+																																		
	Gompholobium preissii																			+																						
	Gompholobium tomentosum						+		+											+																	+					
	Haemodorum ?paniculatum								+																																	
	Haemodorum paniculatum							+																																		
	Haemodorum sp.									+										+																						
	Haemodorum spicatum																																							+			
	Hakea amplexicaulis																			+							+															
	Hakea cyclocarpa								+																																		
	Hakea lissocarpha							+																																			
	akea prostrata																										+	+		+												
	akea varia															+																									+		
	Halosarcia halocnemoides subsp. *halocnemoides*																																									+	
	Halosarcia indica subsp. *bidens*																									+																+	
	Halosarcia lepidosperma																									+																+	
	Halosarcia undulata																																									+	
	Hardenbergia comptoniana		+	+	+					+				+					+			+	+				+					+	+	+	+			+	+			
*	*Heliophila pusilla*																					+	+				+						+									
	Hemiandra pungens		+				+		+													+	+					+													
	Hibbertia amplexicaulis									+																																
	Hibbertia cuneiformis				+																	+	+									+	+		+	+			+			
	Hibbertia cunninghamii							+												+																			+			
	Hibbertia hypericoides		+	+	+		+	+	+							+				+							+	+									+	+		
	Hibbertia mylnei																			+																			+			
	Hibbertia racemosa		+	+	+																																		+	+		
	Hibbertia vaginata						+	+	+																																	
*	*Holcus lanatus*																								+						+										
*	*Hordeum leporinum*										+	+	+												+	+					+										
	Hovea chorizemifolia																																						+			
	Hovea trisperma		+	+	+			+																																+		
	Hybanthus calycinus																																						+	+		
	Hybanthus floribundus subsp. *floribundus*			+																																						
	Hydrocotyle scutellifera																															+										
	Hydrocotyle tetragonocarpa																						+								+										

Appendix B

	Species	1.1	1.2	1.3	2.1	2.2	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4	4.5	4.6	5.1	5.2	5.3	6.1	7A.1	7A.2	7A.3	7B.1	7B.2	7B.3	8.1	8.2	8.3	8.4	9.1	9.2	9.3	9.4	9.5	9.6	9.7	10.1	10.2	10.3	10.4	11.1
	Hypocalymma angustifolia	+	+	+				+								+																										
	Hypocalymma robustum						+													+																						
*	*Hypochaeris glabra*	+		+	+		+	+	+					+		+				+							+	+				+		+		+		+		+		
	Hypolaena exsulca	+	+	+			+	+								+				+							+	+														
	Iridaceae sp.																+																									
?	*Isoetes drummondii*																									+																
*	*Isolepis marginata*																								+	+	+											+		+		
	Isolepis nodosa				+																+													+								
*	*Isolepis prolifera*																																					+					
	Isolepis setiformis														+		+								+																	
	Isopogon sphaerocephalus																			+																						
	Isotropis cuneifolia subsp. *cuneifolia*																															+										
	Jacksonia furcellata	+			+									+		+						+						+		+		+			+	+		+	+			
	Jacksonia horrida															+																										
	Jacksonia sparsa ms (P4)	+	+	+			+							+																								+				
	Johnsonia lupulina						+																																			
*	*Juncus bufonius*																														+									+		
	Juncus kraussii subsp. *australiensis*																		+					+	+	+			+													+
*	*Juncus oxycarpus*																							+	+	+																
	Juncus pallidus					+																							+		+						+			+		
*	*Juncus usitatus*									+																																
	Kennedia coccinea							+	+																															+		
	Kennedia prostrata			+	+									+						+							+	+										+				
	Kingia australis								+																																	
	Kunzea glabrescens	+	+				+						+	+		+				+																					
	Kunzea recurva			+																								+													
	Labichea punctata							+	+											+																					
	Lagenophora huegelii		+		+			+	+																		+	+										+	+			
*	*Lagurus ovatus*																																	+	+				+			
	Lasiopetalum membranaceum (P3)																											+											+			
	Lechenaultia biloba							+	+											+																						
	Lepidosperma gladiatum				+																	+	+										+	+	+	+	+					
	Lepidosperma gracile																																			+	+					
	Lepidosperma longitudinale	+	+	+						+						+																									+	
	Lepidosperma squamatum	+	+					+		+										+							+	+				+	+				+	+			
	Lepidosperma tenue									+																													+			
	Leptoceras menziesii																																									
*	*Leptospermum laevigatum*							+																																		
	Leucopogon capitellatus				+																						+	+		+											
	Leucopogon conostephioides						+																																			
	Leucopogon parviflorus																					+	+									+			+							
	Leucopogon polymorphus						+																																			
	Leucopogon propinquus		+	+	+																																		+	+		
	Lindsaea linearis								+																																		
	Lobelia alata																												+													
	Lobelia tenuoir																																						+			
	Logania serpyllifolia subsp. *angustifolia*		+	+					+											+							+											+				
*	*Lolium perenne*																															+										
	Lomandra ?preissii																																						+			
	Lomandra brittanii																																						+	+		
	Lomandra hermaphrodita			+			+	+	+																														+			
	Lomandra micrantha subsp. *micrantha*			+																							+											+				
	Lomandra nigricans				+																																		+			
	Lomandra preissii							+	+																																+		
	Lomandra purpurea			+			+									+											+											+				
	Lomandra sericea								+											+																						
	Lomandra sp.		+																																							
*	*Lotus suaveolens*													+	+																											
	Loxocarya cinerea																			+																						
*	*Lupinus angustifolius*										+																															
*	*Lupinus cosentinii*																																						+			
*	*Lupinus luteus*										+																															
	Luzula meridionalis																										+	+											+			
	Lyginia imberbis	+		+			+		+											+							+														
	Lysinema ciliatum			+			+																																			
	Macrozamia riedlei		+	+	+				+	+				+		+												+											+	+			

Appendix B

	Species	1.1	1.2	1.3	2.1	2.2	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4	4.5	4.6	5.1	5.2	5.3	6.1	7A.1	7A.2	7A.3	7B.1	7B.2	7B.3	8.1	8.2	8.3	8.4	9.1	9.2	9.3	9.4	9.5	9.6	9.7	10.1	10.2	10.3	10.4	11.1
	Meeboldina coangustata																								+																		
	Meeboldina decipiens subsp. *decipiens* ms																																								+	
	Melaleuca incana subsp. *incana*																+												+													
	Melaleuca preissiana	+									+			+		+																										
	Melaleuca rhaphiophylla					+									+		+	+	+					+					+								+			+	+	
	Melaleuca teretifolia																																								+	
	Melaleuca thymoides		+	+			+							+		+				+						+															
	Melaleuca viminea subsp. *viminea*															+								+				+											+		
*	*Melilotus siculus*																							+	+	+			+	+									+		
*	*Mentha x piperita*																+								+																
	Mesomelaena graciliceps								+																																
	Mesomelaena tetragona							+	+																																
	Microlaena stipoides var. *stipoides*																																								
	Microtis media subsp. *media*			+																																		+	+		
	Millotia myosotidifolia																																								
	Monotaxis grandiflora var. *grandiflora*																															+	+			+		+			
	Myoporum insulare																					+	+												+						
	Myoporum oppositifolium																																				+				
	Nemcia capitata															+																									
	Neurachne alopecuroidea			+																																					
	Nuytsia floribunda	+	+	+			+	+	+				+	+		+				+																				
	Olearia axillaris																				+	+	+				+														
	Oligochaetochilus vittatus		+		+		+	+												+						+	+				+	+	+	+	+						
	Opercularia hispidula var. *pauciflora*															+	+			+						+	+										+	+			
	Opercularia vaginata																																+		+			+		+	
*	*Ornithopus compressus*							+																																	
*	*Orobanche minor*																																		+						
	Orthrosanthus laxus var. *laxus*				+																																				
*	*Oxalis corniculata*				+					+												+	+					+											+		
*	*Oxalis glabra*											+																	+	+									+		
*	*Oxalis pes-caprae*			+						+	+	+				+														+											
	Oxylobium lineare																																						+		+
	Ozothamnus cordatus																					+																		+	
*	*Parentucellia viscosa*																								+							+									
	Parietaria debilis																					+	+									+	+		+	+					
*	*Paspalum vaginatum*																																								+
	Patersonia umbrosa subsp. *umbrosa*		+	+			+									+											+											+	+		
	Patersonia umbrosa subsp. *xanthina*							+	+											+																					
*	*Pelargonium capitatum*																				+	+	+																		
	Pelargonium littorale subsp. *littorale*																																	+							
*	*Pennisetum clandestinum*															+													+	+						+				
	Persicaria decipiens																																				+				
	Persoonia longifolia		+	+									+																												
	Persoonia saccata																																								
	Petrophile linearis		+	+			+																					+													
*	*Petrorhagia dubia*			+	+			+																			+												+		
	Philotheca spicata		+	+										+		+										+	+											+	+		
	Phlebocarya ciliata	+	+	+			+									+										+	+											+			
	Phyllangium paradoxum	+																																							
	Phyllanthus calycinus																																				+				
*	*Phytolacca octandra*										+											+	+					+	+												
	Picris squarrosa									+							+								+					+		+			+		+			+	
	Pimelea rosea subsp. rosea						+	+	+											+																						
	Pimelea sp.																																								+	
*	*Piptatherum miliaceum*				+																											+									
*	*Plantago lanceolata*																								+																
	Platytheca galioides															+																									
	Plumatichilos barbata						+																																		
*	*Poa annua*											+			+																										
	Poa porphyroclados																					+	+																		
	Poaceae sp.																											+													
	Podotheca angustifolia																						+																	+	
	Prasophyllum elatum																																								
	Prasophyllum sp.															+																									
	Pteridium esculentum									+								+											+		+						+			
	Pterostylis sp. "Slender Snail Orchid" (G.J.Keighery 14516) pn	+			+																	+	+																		

Appendix B

	Species	1.1	1.2	1.3	2.1	2.2	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4	4.5	4.6	5.1	5.2	5.3	6.1	7A.1	7A.2	7A.3	7B.1	7B.2	7B.3	8.1	8.2	8.3	8.4	9.1	9.2	9.3	9.4	9.5	9.6	9.7	10.1	10.2	10.3	10.4	11.1
	Ptilotus sericostachyus subsp. sericostachyus																														+											
	Pyrochis nigricans		+	+																							+											+				
	Quinetia urvillei						+																				+															
*	*Ranunculus muricatus*														+		+								+																	
	Rhadinothamnus anceps																														+						+					
	Rhagodia baccata subsp. *baccata*				+																	+	+								+	+					+					
	Rhodanthe citrina																						+				+					+										
	Rhodanthe corymbosa																																					+	+				
*	*Romulea rosea*	+					+	+		+	+												+		+	+	+	+			+				+	+		+	+	+	+	
*	*Rostraria cristata*																				+																						
*	*Rubus ulmifolius*																+	+	+																								
*	*Rumex ?conglomeratus*																										+																
*	*Rumex ?cripsis*										+	+	+																														
	Rumex sp.																																				+						
*	*Sagina apetala*				+																	+					+					+				+						
	Samolus junceus																												+													
	Samolus repens var. *repens*																																									+	
	Santalum acuminatum																					+	+																				
	Scaevola calliptera			+				+	+											+																						
	Scaevola crassifolia																				+	+													+								
	Scaevola lanceolata																																		+	+							
	Schoenus curvifolius								+																																		
	choenus efoliatus															+																											
	Schoenus grandiflorus																																										
	Schoenus sublateralis	+																																					+				
*	*Senecio diaschides*																						+																				
	Senecio lautus subsp. *maritimus*																				+	+													+	+	+	+	+				
	Senecio sp.																											+															
*	*Sherardia arvensis*				+																										--											
*	*Silene* sp.		+																																								
*	*Solanum americanum*																																										
*	*Solanum laciniatum*				+						+																																
*	*Solanum linnaeanum*																																										
*	*Solanum nigrum*				+					+	+																																
*	*Sonchus asper* subsp. *glaucescens*																										+																
	Sonchus hydrophilus					+																																					
*	*Sonchus oleraceus*			+	+							+				+						+	+				+	+				+	+						+	+	+	+	
	Sowerbaea laxiflora				+									+		+											+	+									+	+	+	+	+	
*	*Sparaxis bulbifera*									+					+	+																						+	+				
*	*Spergula arvensis*																									+																	
	Sphaerolobium drummondii								+																	+																	
	Spinifex hirsutus																				+																						
	pinifex longifolius																																		+								
	pyridium globulosum				+																	+	+																				
*	*Stellaria media*										+																																
	Stirlingia latifolia			+			+																																				
	Stylidium amoenum var. *amoenum*																			+																							
	Stylidium brunonianum subsp. *brunonianum*		+	+			+	+												+							+															
	Stylidium calcaratum							+																																			
	Stylidium piliferum subsp. *piliferum*	+	+					+																																			
	Stylidium schoenoides																			+																							
	Styphelia tenuiflora							+												+																							
	Synaphea spinulosa subsp. *spinulosa*																										+												+	+			
*	*Tetragonia decumbens*																																	+									
	Tetraria capillaris							+												+																							
	Tetraria octandra			+				+	+											+								+														
	Tetrarrhena laevis							+												+																			+				
	Tetratheca hirsuta		+				+													+																							
	Thelymitra pauciflora	+					+																																				
	Thelymitra sp.						+	+																			+															
	Thomasia triphylla																															+											
	Threlkeldia diffusa																																									+	
	Thysanotus multiflorus			+																								+														
	Thysanotus patersonii			+												+						+	+															+	+			
	Thysanotus sparteus																			+																							
*	*Trachyandra divaricata*				+												+				+	+	+																				

Appendix B

	Species	1.1	1.2	1.3	2.1	2.2	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4	4.5	4.6	5.1	5.2	5.3	6.1	7A.1	7A.2	7A.3	7B.1	7B.2	7B.3	8.1	8.2	8.3	8.4	9.1	9.2	9.3	9.4	9.5	9.6	9.7	10.1	10.2	10.3	10.4	11.1
	Trachymene pilosa		+				+															+	+								+										
	Tremandra diffusa									+																																
	Tricoryne elatior						+	+								+																										
*	*Trifolium ?campestre* var. *campestre*																																									
*	*Trifolium campestre* var. *campestre*				+																						+	+				+						+	+			
*	*Trifolium* sp.							+																			+	+			+									+		
*	*Trifolium subterraneum*	+			+									+																									+		+		
	Triglochin calcitrapa																					+	+										+						+				
	Triglochin huegelii																+		+					+	+																		
	Triglochin mucronata																									+																	
	Triglochin muelleri																									+																	
	Trymalium floribundum subsp. *floribundum*									+																						+	+									
	Typha ?domingensis																		+																								
*	*Typha orientalis*																								+						--					+						
*	*Ursinia anthemoides*	+					+		+					+													+	+										+	+			
*	*Vicia sativa* subsp. *nigra*				+																				+		+				+											
	Viminaria juncea													+		+													+													+
*	*Vulpia myuros* var. *myuros*																													+												
	Wahlenbergia gracilenta																																			+							
	Waitzia suaveolens var. *suaveolens*																																					+					
*	*Watsonia meriana* var. *bulbillifera*										+					+	+			+										+	+							+					
	Xanthorrhoea brunonis subsp. *brunonis*		+	+												+											+	+										+				+
	Xanthorrhoea gracilis	+			+			+	+	+																	+											+				
	Xanthorrhoea preissii				+			+	+											+							+											+				
	Xanthosia huegelii		+	+					+											+								+				+				+					
	Xylomelum occidentale		+	+			+	+	+											+																					
*	*Zantedeschia aethiopica*				+												+	+	+						+						--	+	+			+	+					
	Zygophyllum simile																						+																				

Appendix C

Raw Plot Data

Appendix C

Date	Site	*	Species	Ht (cm)	CA (%)	Status
27/09/2002	1.1		Caladenia flava subsp. flava	5	0.01	
27/09/2002	1.1		Chamaescilla corymbosa var. corymbosa	20	0.01	
27/09/2002	1.1	*	Disa bracteata	5	0.01	
27/09/2002	1.1		Drosera erythrorhiza subsp. erythrorhiza	5	0.01	
27/09/2002	1.1	*	Ehrharta longiflora	30	0.01	
27/09/2002	1.1		Lepidosperma longitudinale	50	0.01	
27/09/2002	1.1		Lepidosperma squamatum	10	0.01	
27/09/2002	1.1		Pterostylis sp. "Slender Snail Orchid" (G.J.Keighery 14516) pn	5	0.01	
27/09/2002	1.1		Schoenus sublateralis	5	0.01	
27/09/2002	1.1		Stylidium piliferum subsp. piliferum	5	0.01	
27/09/2002	1.1	*	Trifolium subterraneum	5	0.01	
27/09/2002	1.1		Desmocladus fasiculatus	40	0.1	
27/09/2002	1.1		Hypocalymma angustifolia	50	0.1	
27/09/2002	1.1		Xanthorrhoea gracilis	60	0.1	
27/09/2002	1.1	*	Hypochaeris glabra	5	0.3	
27/09/2002	1.1		Corymbia calophylla (seedlings)	5	0.5	
27/09/2002	1.1		Acacia semitrullata	20	1	P3
27/09/2002	1.1		Melaleuca preissiana	1000	7	
27/09/2002	1.1		Dasypogon bromeliifolius	40	30	
27/09/2002	1.1		Kunzea glabrescens	400	80	
27/09/2002	1.1		Banksia ilicifolia	opp		
27/09/2002	1.1		Banksia littoralis	opp		
27/09/2002	1.1		Burchardia umbellata	opp		
27/09/2002	1.1		Conostylis aculeata subsp. aculeata	opp		
27/09/2002	1.1		Crassula colorata var. colorata	opp		
27/09/2002	1.1		Diuris corymbosa	opp		
27/09/2002	1.1		Drosera nitidula subsp. nitidula	opp		
27/09/2002	1.1		Hypolaena exsulca	opp		
27/09/2002	1.1		Jacksonia furcellata	opp		
27/09/2002	1.1		Jacksonia sparsa ms	opp		P4
27/09/2002	1.1		Lyginia imberbis	opp		
27/09/2002	1.1		Nuytsia floribunda	opp		
27/09/2002	1.1		Phlebocarya ciliata	opp		
27/09/2002	1.1		Phyllangium paradoxum	opp		
27/09/2002	1.1	*	Romulea rosea	opp		
27/09/2002	1.1		Thelymitra pauciflora	opp		
27/09/2002	1.1	*	Ursinia anthemoides	opp		
27/09/2002	1.2		Billardiera laxiflora	ck	0.01	
27/09/2002	1.2		Caladenia flava subsp. flava	10	0.01	
27/09/2002	1.2		Caladenia sp.	5	0.01	
27/09/2002	1.2		Chamaescilla corymbosa var. corymbosa	20	0.01	
27/09/2002	1.2		Hibbertia racemosa	5	0.01	
27/09/2002	1.2		Lomandra sp.	10	0.01	
27/09/2002	1.2		Oligochaetochilus vittatus	20	0.01	
27/09/2002	1.2		Philotheca spicata	10	0.01	
27/09/2002	1.2		Pyrochis nigricans	10	0.01	
27/09/2002	1.2		Stylidium piliferum subsp. piliferum	10	0.01	
27/09/2002	1.2		Xanthosia huegelii	5	0.01	
27/09/2002	1.2		Xylomelum occidentale	600	0.01	
27/09/2002	1.2		Stylidium brunonianum subsp. brunonianum	20	0.05	
27/09/2002	1.2		Adenanthos meisneri	40	0.1	
27/09/2002	1.2	*	Bromus diandrus	5	0.1	
27/09/2002	1.2		Conostylis serrulata	5	0.1	
27/09/2002	1.2		Desmocladus fasiculatus	10	0.1	
27/09/2002	1.2		Hypolaena exsulca	10	0.1	
27/09/2002	1.2		Lagenophora huegelii	10	0.1	
27/09/2002	1.2		Patersonia umbrosa subsp. umbrosa	30	0.1	
27/09/2002	1.2		Phlebocarya ciliata	20	0.1	
27/09/2002	1.2		Bossiaea eriocarpa	30	0.2	
27/09/2002	1.2		Daviesia divaricata var. divaricata ms	30	0.2	
27/09/2002	1.2		Hemiandra pungens	20	0.2	

Appendix C

Date	Site	*	Species	Ht (cm)	CA (%)	Status
27/09/2002	1.2		Astroloma prostratum	5	0.3	
27/09/2002	1.2		Jacksonia sparsa ms	120	0.3	P4
27/09/2002	1.2		Leucopogon propinquus	40	0.3	
27/09/2002	1.2		Lepidosperma squamatum	50	0.5	
27/09/2002	1.2		Melaleuca thymoides	120	0.5	
27/09/2002	1.2		Hibbertia hypericoides	40	1	
27/09/2002	1.2		Xanthorrhoea brunonis subsp. brunonis	70	1	
27/09/2002	1.2		Drosera stolonifera subsp. stolonifera	10	2	
27/09/2002	1.2		Banksia ilicifolia	600	3	
27/09/2002	1.2		Xanthorrhoea brunonis subsp. brunonis	60	3	
27/09/2002	1.2		Dasypogon bromeliifolius	20	5	
27/09/2002	1.2		Corymbia calophylla	1200	8	
27/09/2002	1.2		Banksia attenuata	800	10	
27/09/2002	1.2		Kunzea glabrescens	600	50	
27/09/2002	1.2		Acacia flagelliformis	opp		P4
27/09/2002	1.2		Agonis flexuosa var. flexuosa	opp		
27/09/2002	1.2		Caladenia speciosa	opp		P4
27/09/2002	1.2		Conospermum capitatum subsp. capitatum	opp		
27/09/2002	1.2		Conostephium pendulum	opp		
27/09/2002	1.2		Dampiera linearis	opp		
27/09/2002	1.2		Daviesia physodes	opp		
27/09/2002	1.2		Drosera erythrorhiza subsp. erythrorhiza	opp		
27/09/2002	1.2		Drosera menziesii subsp. penicillaris	opp		
27/09/2002	1.2		Drosera pallida	opp		
27/09/2002	1.2		Elythranthera brunonis	opp		
27/09/2002	1.2		Eucalyptus marginata subsp. marginata	opp		
27/09/2002	1.2	*	Freesia alba x leichtlinii	opp		
27/09/2002	1.2	*	Fumaria capreolata	opp		
27/09/2002	1.2		Hardenbergia comptoniana	opp		
27/09/2002	1.2		Hovea trisperma	opp		
27/09/2002	1.2		Hypocalymma angustifolia	opp		
27/09/2002	1.2		Lepidosperma longitudinale	opp		
27/09/2002	1.2		Logania serpyllifolia subsp. angustifolia	opp		
27/09/2002	1.2		Macrozamia riedlei	opp		
27/09/2002	1.2		Nuytsia floribunda	opp		
27/09/2002	1.2		Persoonia longifolia	opp		
27/09/2002	1.2		Petrophile linearis	opp		
27/09/2002	1.2	*	Silene sp.	opp		
27/09/2002	1.2		Tetratheca hirsuta	opp		
27/09/2002	1.2		Trachymene pilosa	opp		
27/09/2002	1.2		Trachymene pilosa	opp		
27/09/2002	1.3		Anigozanthos mangleisii subsp. mangleisii	50	0.01	
27/09/2002	1.3		Drosera pallida	ck	0.01	
27/09/2002	1.3		Gompholobium polymorphum	50	0.01	
27/09/2002	1.3	*	Briza maxima	20	0.1	
27/09/2002	1.3		Burchardia umbellata	20	0.1	
27/09/2002	1.3		Dampiera linearis	20	0.1	
27/09/2002	1.3		Daviesia physodes	40	0.1	
27/09/2002	1.3		Desmocladus fasiculatus	20	0.1	
27/09/2002	1.3		Drosera stolonifera subsp. stolonifera	20	0.1	
27/09/2002	1.3		Hardenbergia comptoniana	ck	0.1	
27/09/2002	1.3	*	Hypochaeris glabra	5	0.1	
27/09/2002	1.3		Hypolaena exsulca	20	0.1	
27/09/2002	1.3		Logania serpyllifolia subsp. angustifolia	20	0.1	
27/09/2002	1.3		Melaleuca thymoides	70	0.1	
27/09/2002	1.3	*	Sonchus oleraceus	10	0.1	
27/09/2002	1.3		Xanthosia huegelii	30	0.1	
27/09/2002	1.3		Billardiera laxiflora	ck	0.2	
27/09/2002	1.3		Desmocladus flexuosus	20	0.2	
27/09/2002	1.3		Lomandra hermaphrodita	30	0.2	

Appendix C

Date	Site	*	Species	Ht (cm)	CA (%)	Status
27/09/2002	1.3		Philotheca spicata	40	0.2	
27/09/2002	1.3		Bossiaea eriocarpa	20	0.5	
27/09/2002	1.3		Chamaescilla corymbosa var. corymbosa	20	0.5	
27/09/2002	1.3		Hybanthus floribundus subsp. floribundus	40	0.5	
27/09/2002	1.3		Neurachne alopecuroidea	20	0.5	
27/09/2002	1.3		Stirlingia latifolia	80	0.5	
27/09/2002	1.3		Hibbertia hypericoides	30	1	
27/09/2002	1.3		Lepidosperma longitudinale	40	3	
27/09/2002	1.3		Scaevola calliptera	40	4	
27/09/2002	1.3		Tetraria octandra	50	5	
27/09/2002	1.3		Banksia attenuata	1000	8	
27/09/2002	1.3		Allocasuarina humilis	300	10	
27/09/2002	1.3		Eucalyptus marginata subsp. marginata	1200	10	
27/09/2002	1.3		Xanthorrhoea brunonis subsp. brunonis	0.8	15	
27/09/2002	1.3		Banksia ilicifolia	1200	25	
27/09/2002	1.3		Acacia pulchella var. glaberrima	opp		
27/09/2002	1.3		Adenanthos meisneri	opp		
27/09/2002	1.3		Agonis flexuosa var. flexuosa	opp		
27/09/2002	1.3	*	Arctotheca calendula	opp		
27/09/2002	1.3	*	Avena barbata	opp		
27/09/2002	1.3		Banksia grandis	opp		
27/09/2002	1.3		Caesia micrantha	opp		
27/09/2002	1.3		Caladenia flava subsp. flava	opp		
27/09/2002	1.3		Calectasia narragara	opp		
27/09/2002	1.3		Conostephium pendulum	opp		
27/09/2002	1.3		Conostylis serrulata	opp		
27/09/2002	1.3		Corymbia calophylla	opp		
27/09/2002	1.3		Crassula colorata var. colorata	opp		
27/09/2002	1.3		Crassula decumbens var. decumbens	opp		
27/09/2002	1.3		Dasypogon bromeliifolius	opp		
27/09/2002	1.3		Daviesia divaricata var. divaricata ms	opp		
27/09/2002	1.3		Diuris corymbosa	opp		
27/09/2002	1.3		Drosera erythrorhiza subsp. erythrorhiza	opp		
27/09/2002	1.3	*	Ehrharta calycina	opp		
27/09/2002	1.3		Gompholobium capitatum	opp		
27/09/2002	1.3		Hibbertia racemosa	opp		
27/09/2002	1.3		Hovea trisperma	opp		
27/09/2002	1.3		Hypocalymma angustifolia	opp		
27/09/2002	1.3		Jacksonia sparsa ms	opp		P4
27/09/2002	1.3		Kennedia prostrata	opp		
27/09/2002	1.3		Kunzea recurva	opp		
27/09/2002	1.3		Leucopogon propinquus	opp		
27/09/2002	1.3		Lomandra micrantha subsp. micrantha	opp		
27/09/2002	1.3		Lomandra purpurea	opp		
27/09/2002	1.3		Lyginia imberbis	opp		
27/09/2002	1.3		Lysinema ciliatum	opp		
27/09/2002	1.3		Macrozamia riedlei	opp		
27/09/2002	1.3		Microtis media subsp. media	opp		
27/09/2002	1.3		Nuytsia floribunda	opp		
27/09/2002	1.3	*	Oxalis pes-caprae	opp		
27/09/2002	1.3		Patersonia umbrosa subsp. umbrosa	opp		
27/09/2002	1.3		Persoonia longifolia	opp		
27/09/2002	1.3		Petrophile linearis	opp		
27/09/2002	1.3	*	Petrorhagia dubia	opp		
27/09/2002	1.3		Phlebocarya ciliata	opp		
27/09/2002	1.3		Pyrochis nigricans	opp		
27/09/2002	1.3		Stylidium brunonianum subsp. brunonianum	opp		
27/09/2002	1.3		Thysanotus multiflorus	opp		
27/09/2002	1.3		Thysanotus patersonii	opp		
27/09/2002	1.3		Xylomelum occidentale	opp		

Appendix C

Date	Site	*	Species	Ht (cm)	CA (%)	Status
23/09/2002	2.1	*	Hypochaeris glabra	10	0.01	
23/09/2002	2.1		Oligochaetochilus vittatus	10	0.01	
23/09/2002	2.1	*	Sagina apetala	5	0.01	
23/09/2002	2.1	*	Zantedeschia aethiopica	20	0.01	
23/09/2002	2.1	*	Briza maxima	15	0.1	
23/09/2002	2.1	*	Petrorhagia dubia	15	0.1	
23/09/2002	2.1	*	Piptatherum miliaceum	50	0.1	
23/09/2002	2.1	*	Solanum nigrum	50	0.1	
23/09/2002	2.1	*	Sonchus oleraceus	10	0.1	
23/09/2002	2.1		Acanthocarpus preissii	50	0.3	
23/09/2002	2.1		Pterostylis sp. "Slender Snail Orchid" (G.J.Keighery 14516) pn	10	0.3	
23/09/2002	2.1		Geranium solanderi	40	0.5	
23/09/2002	2.1		Macrozamia riedlei	20	0.5	
23/09/2002	2.1	*	Oxalis corniculata	20	0.5	
23/09/2002	2.1	*	Trifolium campestre var. campestre	10	0.5	
23/09/2002	2.1		Daucus glochidiatus	5	1	
23/09/2002	2.1		Dichopogon preissii	80	1	
23/09/2002	2.1	*	Euphorbia peplus	15	1	
23/09/2002	2.1	*	Ehrharta longiflora	20	2	
23/09/2002	2.1		Hardenbergia comptoniana	ck	5	
23/09/2002	2.1		Hibbertia cuneiformis	250	10	
23/09/2002	2.1	*	Sherardia arvensis	10	20	
23/09/2002	2.1		Agonis flexuosa var. flexuosa	800	30	
23/09/2002	2.1		Eucalyptus gomphocephala	1600	30	
23/09/2002	2.1		Geranium retrosum	5	30	
23/09/2002	2.1		Lepidosperma gladiatum	180	70	
23/09/2002	2.1		Banksia grandis	opp		
23/09/2002	2.1		Acacia saligna	opp		
23/09/2002	2.1	*	Anagallis arvensis var. caerulea	opp		
23/09/2002	2.1	*	Arctotheca calendula	opp		
23/09/2002	2.1		Banksia attenuata	opp		
23/09/2002	2.1	*	Briza maxima	opp		
23/09/2002	2.1		Caladenia flava subsp. flava	opp		
23/09/2002	2.1		Chamaescilla corymbosa var. corymbosa	opp		
23/09/2002	2.1	*	Cirsium arvense subsp. arvense	opp		
23/09/2002	2.1		Clematis linearifolia	opp		
23/09/2002	2.1		Conostephium pendulum	opp		
23/09/2002	2.1		Conostylis aculeata subsp. aculeata	opp		
23/09/2002	2.1		Corymbia calophylla	opp		
23/09/2002	2.1	*	Cotula turbinata	opp		
23/09/2002	2.1		Daviesia divaricata var. divaricata ms	opp		
23/09/2002	2.1		Dischisma capitatum	opp		
23/09/2002	2.1		Drosera stolonifera subsp. stolonifera	opp		
23/09/2002	2.1		*Eryngium pinnatifidum* subsp. *pinnatifidum ms*	opp		
23/09/2002	2.1		Eucalyptus marginata subsp. marginata	opp		
23/09/2002	2.1		Hibbertia hypericoides	opp		
23/09/2002	2.1		Hibbertia racemosa	opp		
23/09/2002	2.1		Hovea trisperma	opp		
23/09/2002	2.1		Isolepis nodosa	opp		
23/09/2002	2.1		Jacksonia furcellata	opp		
23/09/2002	2.1		Kennedia prostrata	opp		
23/09/2002	2.1		Lagenophora huegelii	opp		
23/09/2002	2.1		Leucopogon capitellatus	opp		
23/09/2002	2.1		Leucopogon propinquus	opp		
23/09/2002	2.1		Lomandra nigricans	opp		
23/09/2002	2.1		Orthrosanthus laxus var. laxus	opp		
23/09/2002	2.1		Rhagodia baccata subsp. baccata	opp		
23/09/2002	2.1	*	Solanum laciniatum	opp		
23/09/2002	2.1		Sowerbaea laxiflora	opp		
23/09/2002	2.1		Spyridium globulosum	opp		

Appendix C

Date	Site	*	Species	Ht (cm)	CA (%)	Status
23/09/2002	2.1	*	Trachyandra divaricata	opp		
23/09/2002	2.1	*	Trifolium subterraneum	opp		
23/09/2002	2.1	*	Vicia sativa subsp. nigra	opp		
23/09/2002	2.1		Xanthorrhoea gracilis	opp		
23/09/2002	2.1		Xanthorrhoea preissii	opp		
23/09/2002	2.2		Agonis flexuosa var. flexuosa	opp		
23/09/2002	2.2	*	Bromus diandrus	opp		
23/09/2002	2.2		Eucalyptus gomphocephala	opp		
23/09/2002	2.2		Juncus pallidus	opp		
23/09/2002	2.2		Melaleuca rhaphiophylla	opp		
23/09/2002	2.2		Sonchus hydrophilus	opp		
27/09/2002	3.1		Drosera glanduligera	5	0.01	
27/09/2002	3.1		Quinetia urvillei	10	0.01	
27/09/2002	3.1		Acacia stenoptera	50	0.1	
27/09/2002	3.1	*	Briza maxima	20	0.1	
27/09/2002	3.1		Burchardia umbellata	30	0.1	
27/09/2002	3.1		Caladenia flava subsp. flava	20	0.1	
27/09/2002	3.1		Centrolepis mutica	5	0.1	
27/09/2002	3.1		Chamaescilla corymbosa var. corymbosa	30	0.1	
27/09/2002	3.1		Dasypogon bromeliifolius	40	0.1	
27/09/2002	3.1		Drosera macrantha subsp. macrantha	10	0.1	
27/09/2002	3.1		Drosera menziesii subsp. penicillaris	5	0.1	
27/09/2002	3.1	*	Ehrharta calycina	20	0.1	
27/09/2002	3.1	*	Ehrharta longiflora	20	0.1	
27/09/2002	3.1		Elythranthera brunonis	10	0.1	
27/09/2002	3.1		Hibbertia hypericoides	20	0.1	
27/09/2002	3.1		Hypolaena exsulca		0.1	
27/09/2002	3.1	*	Romulea rosea	10	0.1	
27/09/2002	3.1		Stylidium brunonianum subsp. brunonianum	5	0.1	
27/09/2002	3.1		Thelymitra pauciflora		0.1	
27/09/2002	3.1		Trachymene pilosa	5	0.1	
27/09/2002	3.1		Gompholobium tomentosum	50	0.3	
27/09/2002	3.1		Lyginia imberbis	60	0.3	
27/09/2002	3.1		Conostylis aculeata subsp. aculeata	30	0.5	
27/09/2002	3.1		Hibbertia vaginata	60	0.5	
27/09/2002	3.1	*	Hypochaeris glabra	5	0.5	
27/09/2002	3.1		Jacksonia sparsa ms	100	0.5	P4
27/09/2002	3.1		Phlebocarya ciliata	50	0.5	
27/09/2002	3.1	*	Ursinia anthemoides	20	2	
27/09/2002	3.1		Kunzea glabrescens	200	3	
27/09/2002	3.1		Hypocalymma robustum	160	5	
27/09/2002	3.1		Melaleuca thymoides	200	5	
27/09/2002	3.1		Adenanthos meisneri	60	8	
27/09/2002	3.1		Banksia attenuata	500	8	
27/09/2002	3.1		Patersonia umbrosa subsp. umbrosa	50	8	
27/09/2002	3.1		Acacia huegelii	opp		
27/09/2002	3.1	*	Acacia longifolia subsp. longifolia	opp		
27/09/2002	3.1		Acacia pulchella var. glaberrima	opp		
27/09/2002	3.1		Acacia semitrullata	opp		P3
27/09/2002	3.1		Amphipogon turbinatus	opp		
27/09/2002	3.1		Anarthria prolifera	opp		
27/09/2002	3.1		Anigozanthos mangleisii subsp. mangleisii	opp		
27/09/2002	3.1	*	Asparagus asparagoides	opp		
27/09/2002	3.1		Boronia spathulata	opp		
27/09/2002	3.1		Bossiaea eriocarpa	opp		
27/09/2002	3.1		Calothamnus sanguineus	opp		
27/09/2002	3.1		Cassytha racemosa forma racemosa	opp		
27/09/2002	3.1		Conostephium pendulum	opp		
27/09/2002	3.1		Daviesia physodes	opp		
27/09/2002	3.1		Eremea pauciflora var. pauciflora	opp		

Appendix C

Date	Site	*	Species	Ht (cm)	CA (%)	Status
27/09/2002	3.1		Eucalyptus marginata subsp. marginata	opp		
27/09/2002	3.1		Hemiandra pungens	opp		
27/09/2002	3.1		Johnsonia lupulina	opp		
27/09/2002	3.1		Leucopogon conostephioides	opp		
27/09/2002	3.1		Leucopogon polymorphus	opp		
27/09/2002	3.1		Lomandra hermaphrodita	opp		
27/09/2002	3.1		Lomandra purpurea	opp		
27/09/2002	3.1		Lysinema ciliatum	opp		
27/09/2002	3.1		Nuytsia floribunda	opp		
27/09/2002	3.1		Oligochaetochilus vittatus	opp		
27/09/2002	3.1		Petrophile linearis	opp		
27/09/2002	3.1		Pimelea rosea subsp. rosea	opp		
27/09/2002	3.1		Plumatichilos barbata	opp		
27/09/2002	3.1		Stirlingia latifolia	opp		
27/09/2002	3.1		Stylidium brunonianum subsp. brunonianum	opp		
27/09/2002	3.1		Tetratheca hirsuta	opp		
27/09/2002	3.1		Thelymitra sp.	opp		
27/09/2002	3.1		Tricoryne elatior	opp		
27/09/2002	3.1		Xylomelum occidentale	opp		
27/09/2002	3.2		Acacia nervosa	20	0.01	
27/09/2002	3.2		Lagenophora huegelii	5	0.01	
27/09/2002	3.2	*	Ornithopus compressus	10	0.01	
27/09/2002	3.2		Stylidium calcaratum	10	0.01	
27/09/2002	3.2		Stylidium piliferum subsp. piliferum	5	0.01	
27/09/2002	3.2		Thelymitra sp.	20	0.01	
27/09/2002	3.2		Caladenia flava subsp. flava	15	0.1	
27/09/2002	3.2		Daucus glochidiatus	10	0.1	
27/09/2002	3.2		Drosera menziesii subsp. penicillaris	5	0.1	
27/09/2002	3.2		Drosera pallida	5	0.1	
27/09/2002	3.2		Haemodorum paniculatum	30	0.1	
27/09/2002	3.2		Oligochaetochilus vittatus	20	0.1	
27/09/2002	3.2	*	Trifolium sp.	10	0.1	
27/09/2002	3.2		Boronia spathulata	30	0.2	
27/09/2002	3.2	*	Hypochaeris glabra	5	0.2	
27/09/2002	3.2		Lechenaultia biloba	10	0.2	
27/09/2002	3.2	*	Petrorhagia dubia	10	0.2	
27/09/2002	3.2		Tetraria octandra	20	0.3	
27/09/2002	3.2		Xylomelum occidentale	400	0.3	
27/09/2002	3.2		Bossiaea ornata	20	0.4	
27/09/2002	3.2	*	Briza maxima	20	0.5	
27/09/2002	3.2		Corymbia calophylla (seedlings)	20	0.5	
27/09/2002	3.2		Eucalyptus marginata subsp. marginata (seedlings)	20	0.5	
27/09/2002	3.2		Hakea lissocarpha	140	0.5	
27/09/2002	3.2		Labichea punctata	30	0.5	
27/09/2002	3.2		Lepidosperma squamatum	40	0.5	
27/09/2002	3.2	*	Romulea rosea	10	0.5	
27/09/2002	3.2		Tetrarrhena laevis	30	0.5	
27/09/2002	3.2		Daviesia physodes	60	1	
27/09/2002	3.2		Hibbertia hypericoides	40	1	
27/09/2002	3.2		Hibbertia cunninghamii	60	1.5	
27/09/2002	3.2		Patersonia umbrosa subsp. xanthina		2	
27/09/2002	3.2		Eucalyptus marginata subsp. marginata	2500	3	
27/09/2002	3.2		Tetraria capillaris	80	3	
27/09/2002	3.2		Styphelia tenuiflora	90	4	
27/09/2002	3.2		Xanthorrhoea gracilis	150	5	
27/09/2002	3.2		Banksia grandis	600	8	
27/09/2002	3.2		Xanthorrhoea preissii	180	8	
27/09/2002	3.2		Corymbia calophylla	1600	25	
27/09/2002	3.2		Acacia flagelliformis	opp		P4
27/09/2002	3.2		Acacia pulchella var. glaberrima	opp		

Appendix C

Date	Site	*	Species	Ht (cm)	CA (%)	Status
27/09/2002	3.2		Acacia semitrullata	opp		P3
27/09/2002	3.2		Acacia stenoptera	opp		
27/09/2002	3.2		Adenanthos barbiger subsp. intermedius ms	opp		
27/09/2002	3.2		Adenanthos meisneri	opp		
27/09/2002	3.2		Agrostocrinum scabrum	opp		
27/09/2002	3.2		Anarthria prolifera	opp		
27/09/2002	3.2		Bossiaea eriocarpa	opp		
27/09/2002	3.2		Burchardia umbellata	opp		
27/09/2002	3.2		Cassytha racemosa forma racemosa	opp		
27/09/2002	3.2		Chorizema nanum	opp		
27/09/2002	3.2		Conostylis aculeata subsp. aculeata	opp		
27/09/2002	3.2		Crassula colorata var. colorata	opp		
27/09/2002	3.2		Crassula decumbens var. decumbens	opp		
27/09/2002	3.2		Dampiera linearis	opp		
27/09/2002	3.2		Dasypogon hookeri	opp		
27/09/2002	3.2		Daviesia physodes	opp		
27/09/2002	3.2		Desmocladus fasiculatus	opp		
27/09/2002	3.2		Gompholobium polymorphum	opp		
27/09/2002	3.2		Hibbertia vaginata	opp		
27/09/2002	3.2		Hovea trisperma	opp		
27/09/2002	3.2		Hypocalymma angustifolia	opp		
27/09/2002	3.2		Hypolaena exsulca	opp		
27/09/2002	3.2		Kennedia coccinea	opp		
27/09/2002	3.2	*	Leptospermum laevigatum	opp		
27/09/2002	3.2		Lomandra hermaphrodita	opp		
27/09/2002	3.2		Lomandra preissii	opp		
27/09/2002	3.2		Mesomelaena tetragona	opp		
27/09/2002	3.2		Nuytsia floribunda	opp		
27/09/2002	3.2		Pimelea rosea subsp. rosea	opp		
27/09/2002	3.2		Scaevola calliptera	opp		
27/09/2002	3.2		Stylidium brunonianum subsp. brunonianum	opp		
27/09/2002	3.2		Tricoryne elatior	opp		
27/09/2002	3.3		Lindsaea linearis	5	0.01	
27/09/2002	3.3		Acacia applanata	30	0.1	
27/09/2002	3.3		Adenanthos barbiger subsp. intermedius ms	20	0.1	
27/09/2002	3.3		Boronia spathulata	30	0.1	
27/09/2002	3.3		Caladenia flava subsp. flava	20	0.1	
27/09/2002	3.3		Desmocladus fasiculatus	20	0.1	
27/09/2002	3.3		Drosera stolonifera subsp. stolonifera	5	0.1	
27/09/2002	3.3		Elythranthera brunonis	20	0.1	
27/09/2002	3.3		Gompholobium marginatum	30	0.1	
27/09/2002	3.3		Hemiandra pungens	10	0.1	
27/09/2002	3.3		Hibbertia vaginata	20	0.1	
27/09/2002	3.3	*	Hypochaeris glabra	5	0.1	
27/09/2002	3.3		Labichea punctata	20	0.1	
27/09/2002	3.3		Logania serpyllifolia subsp. angustifolia	20	0.1	
27/09/2002	3.3		Lomandra hermaphrodita	30	0.1	
27/09/2002	3.3		Schoenus curvifolius	40	0.1	
27/09/2002	3.3		Sphaerolobium drummondii	40	0.1	
27/09/2002	3.3		Xanthosia huegelii	10	0.1	
27/09/2002	3.3		Burchardia umbellata	20	0.2	
27/09/2002	3.3		Desmocladus fasiculatus	30	0.2	
27/09/2002	3.3		Lomandra sericea	30	0.2	
27/09/2002	3.3		Scaevola calliptera	30	0.2	
27/09/2002	3.3		Boronia spathulata	40	0.3	
27/09/2002	3.3		Dasypogon bromeliifolius	50	0.3	
27/09/2002	3.3		Mesomelaena graciliceps	70	0.3	
27/09/2002	3.3		Acacia stenoptera	60	0.5	
27/09/2002	3.3		Anarthria prolifera	10	0.5	
27/09/2002	3.3	*	Briza maxima	20	0.5	

Appendix C

Date	Site	*	Species	Ht (cm)	CA (%)	Status
27/09/2002	3.3	*	Bromus diandrus	20	0.5	
27/09/2002	3.3		Calothamnus sanguineus	60	0.5	
27/09/2002	3.3		Chamaescilla corymbosa var. corymbosa	50	0.5	
27/09/2002	3.3		Conostylis setigera subsp. setigera	20	0.5	
27/09/2002	3.3	*	Ehrharta longiflora	20	0.5	
27/09/2002	3.3		Hakea cyclocarpa	30	0.5	
27/09/2002	3.3		Nuytsia floribunda	900	0.5	
27/09/2002	3.3		Dryandra lindeyana var. lindleyana	10	1	
27/09/2002	3.3		Hibbertia hypericoides	30	1	
27/09/2002	3.3		Tetraria octandra	40	1	
27/09/2002	3.3		Mesomelaena tetragona	80	2	
27/09/2002	3.3		Patersonia umbrosa subsp. xanthina	90	3	
27/09/2002	3.3		Xanthorrhoea gracilis	130	3	
27/09/2002	3.3		Corymbia haematoxylon	1200	5	
27/09/2002	3.3		Xanthorrhoea preissii	180	8	
27/09/2002	3.3		Eucalyptus marginata subsp. marginata	1800	20	
27/09/2002	3.3		Acacia flagelliformis	opp		P4
27/09/2002	3.3		Agrostocrinum scabrum	opp		
27/09/2002	3.3		Anigozanthos humilis subsp. humilis	opp		
27/09/2002	3.3		Banksia grandis	opp		
27/09/2002	3.3		Caladenia speciosa	opp		P4
27/09/2002	3.3		Conostylis aculeata subsp. aculeata	opp		
27/09/2002	3.3		Conostylis serrulata	opp		
27/09/2002	3.3		Cyathochaeta avenacea	opp		
27/09/2002	3.3		Gompholobium tomentosum	opp		
27/09/2002	3.3		Haemodorum ?paniculatum	opp		
27/09/2002	3.3		Kennedia coccinea	opp		
27/09/2002	3.3		Kingia australis	opp		
27/09/2002	3.3		Lagenophora huegelii	opp		
27/09/2002	3.3		Lechenaultia biloba	opp		
27/09/2002	3.3		Lomandra preissii	opp		
27/09/2002	3.3		Lyginia imberbis	opp		
27/09/2002	3.3		Macrozamia riedlei	opp		
27/09/2002	3.3		Pimelea rosea subsp. rosea	opp		
27/09/2002	3.3	*	Ursinia anthemoides	opp		
27/09/2002	3.3		Xylomelum occidentale	opp		
27/09/2002	3.4		Chamaescilla corymbosa var. corymbosa	20	0.01	
27/09/2002	3.4		Corymbia calophylla (seedlings)	5	0.01	
27/09/2002	3.4		Haemodorum sp.	30	0.01	
27/09/2002	3.4		Lepidosperma squamatum	20	0.01	
27/09/2002	3.4		Lepidosperma longitudinale	40	0.5	
27/09/2002	3.4		Macrozamia riedlei	30	0.5	
27/09/2002	3.4	*	Oxalis corniculata	5	1	
27/09/2002	3.4		Trymalium floribundum subsp. floribundum	400	2	
27/09/2002	3.4	*	Briza maxima	20	5	
27/09/2002	3.4	*	Ehrharta longiflora	15	5	
27/09/2002	3.4		Agonis flexuosa var. flexuosa	800	50	
27/09/2002	3.4		Corymbia calophylla	1800	60 - 70	
27/09/2002	3.4		Acacia pulchella var. goadbyi	opp		
27/09/2002	3.4		Acacia urophylla	opp		
27/09/2002	3.4		Adiantum aethiopicum	opp		
27/09/2002	3.4	*	Anagallis arvensis var. caerulea	opp		
27/09/2002	3.4	*	Asparagus asparagoides	opp		
27/09/2002	3.4		Asteraceae sp.	opp		
27/09/2002	3.4	*	Avena barbata	opp		
27/09/2002	3.4		Caesia micrantha	opp		
27/09/2002	3.4		Chorizema nanum	opp		
27/09/2002	3.4		Clematis linearifolia	opp		
27/09/2002	3.4		Dichopogon capillipes	opp		
27/09/2002	3.4		Drosera ?marchantii subsp. marchantii	opp		P4

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Date	Site	*	Species	Ht (cm)	CA (%)	Status
27/09/2002	3.4	*	Eragrostis curvula	opp		
27/09/2002	3.4	*	Eragrostis curvula	opp		
27/09/2002	3.4		Eucalyptus marginata subsp. marginata	opp		
27/09/2002	3.4		Eucalyptus rudis subsp. rudis	opp		
27/09/2002	3.4	*	Geranium molle	opp		
27/09/2002	3.4		Hardenbergia comptoniana	opp		
27/09/2002	3.4		Hibbertia amplexicaulis	opp		
27/09/2002	3.4	*	Juncus usitatus	opp		
27/09/2002	3.4		Lepidosperma tenue	opp		
27/09/2002	3.4	*	Oxalis pes-caprae	opp		
27/09/2002	3.4		Picris squarrosa	opp		
27/09/2002	3.4	*	Romulea rosea	opp		
27/09/2002	3.4	*	Romulea rosea	opp		
27/09/2002	3.4	*	Solanum nigrum	opp		
27/09/2002	3.4	*	Sparaxis bulbifera	opp		
27/09/2002	3.4		Tremandra diffusa	opp		
27/09/2002	3.4		Xanthorrhoea gracilis	opp		
26/09/2002	4.1		Melaleuca preissiana	opp	0.01	
26/09/2002	4.1	*	Avena barbata	60	0.1	
26/09/2002	4.1	*	Ehrharta longiflora	40	0.1	
26/09/2002	4.1	*	Fumaria capreolata	20	0.1	
26/09/2002	4.1	*	Oxalis pes-caprae	10	0.1	
26/09/2002	4.1	*	Stellaria media	10	0.1	
26/09/2002	4.1	*	Rumex ?cripsis	0.6	20	
26/09/2002	4.1	*	Hordeum leporinum	40	50	
26/09/2002	4.1		Corymbia calophylla	2000	May-20	
26/09/2002	4.1		Agonis flexuosa var. flexuosa	1000	20 - 60	
26/09/2002	4.1		Acacia pulchella var. goadbyi	opp		
26/09/2002	4.1	*	Arctotheca calendula	opp		
26/09/2002	4.1	*	Cynodon dactylon	opp		
26/09/2002	4.1	*	Ehrharta calycina	opp		
26/09/2002	4.1	*	Lupinus angustifolius	opp		
26/09/2002	4.1	*	Lupinus luteus	opp		
26/09/2002	4.1	*	Phytolacca octandra	opp		
26/09/2002	4.1		Pteridium esculentum	opp		
26/09/2002	4.1	*	Romulea rosea	opp		
26/09/2002	4.1	*	Solanum laciniatum	opp		
26/09/2002	4.1	*	Solanum nigrum	opp		
26/09/2002	4.1	*	Watsonia meriana var. bulbillifera	opp		
26/09/2002	4.2	*	Oxalis glabra	10	0.1	
26/09/2002	4.2	*	Poa annua	10	0.1	
26/09/2002	4.2	*	Sonchus oleraceus	10	0.1	
26/09/2002	4.2	*	Ehrharta longiflora	40	1	
26/09/2002	4.2	*	Oxalis pes-caprae	20	1	
26/09/2002	4.2	*	Rumex ?cripsis	10	1	
26/09/2002	4.2		Agonis flexuosa var. flexuosa	1000	2	
26/09/2002	4.2	*	Fumaria capreolata	60	2	
26/09/2002	4.2	*	Callitriche stagnalis	5	5	
26/09/2002	4.2	*	Hordeum leporinum	50	50	
26/09/2002	4.2		Eucalyptus rudis subsp. rudis	3000	60	
26/09/2002	4.2	*	Asparagus asparagoides	opp		
26/09/2002	4.3		Agonis flexuosa var. flexuosa	1200	90	
26/09/2002	4.3	*	Bromus diandrus	10	90	
26/09/2002	4.3	*	Ehrharta longiflora	50	90	
26/09/2002	4.3		Banksia ilicifolia	opp		
26/09/2002	4.3		Banksia littoralis	opp		
26/09/2002	4.3		Corymbia calophylla	opp		
26/09/2002	4.3		Eucalyptus marginata subsp. marginata	opp		
26/09/2002	4.3		Eucalyptus rudis subsp. rudis	opp		
26/09/2002	4.3	*	Geranium molle	opp		

Appendix C

Date	Site	*	Species	Ht (cm)	CA (%)	Status
26/09/2002	4.3	*	Hordeum leporinum	opp		
26/09/2002	4.3		*Kunzea glabrescens*	opp		
26/09/2002	4.3		Nuytsia floribunda	opp		
26/09/2002	4.3		Persoonia longifolia	opp		
26/09/2002	4.3	*	Rumex ?cripsis	opp		
26/09/2002	4.4	*	Arctotheca calendula	5	0.01	
26/09/2002	4.4	*	Hypochaeris glabra	5	0.01	
26/09/2002	4.4	*	Trifolium subterraneum	5	0.01	
26/09/2002	4.4	*	Lotus suaveolens	5	0.5	
26/09/2002	4.4	*	Fumaria capreolata	20	1	
26/09/2002	4.4		Melaleuca preissiana	700	30	
26/09/2002	4.4		Agonis flexuosa var. flexuosa	800	40	
26/09/2002	4.4	*	Ehrharta longiflora	3	60	
26/09/2002	4.4		Acacia pulchella var. goadbyi	opp		
26/09/2002	4.4		Acacia saligna	opp		
26/09/2002	4.4	*	Asparagus asparagoides	opp		
26/09/2002	4.4		Banksia attenuata	opp		
26/09/2002	4.4		Banksia grandis	opp		
26/09/2002	4.4		Banksia ilicifolia	opp		
26/09/2002	4.4		Burchardia umbellata	opp		
26/09/2002	4.4		Conostylis aculeata subsp. aculeata	opp		
26/09/2002	4.4	*	Cotula turbinata	opp		
26/09/2002	4.4		Dasypogon bromeliifolius	opp		
26/09/2002	4.4		Daviesia divaricata var. divaricata ms	opp		
26/09/2002	4.4		Eucalyptus marginata subsp. marginata	opp		
26/09/2002	4.4		Hardenbergia comptoniana	opp		
26/09/2002	4.4		Jacksonia furcellata	opp		
26/09/2002	4.4		Jacksonia sparsa ms	opp		P4
26/09/2002	4.4		Kennedia prostrata	opp		
26/09/2002	4.4		*Kunzea glabrescens*	opp		
26/09/2002	4.4		Macrozamia riedlei	opp		
26/09/2002	4.4		Melaleuca thymoides	opp		
26/09/2002	4.4		Nuytsia floribunda	opp		
26/09/2002	4.4		Philotheca spicata	opp		
26/09/2002	4.4		Sowerbaea laxiflora	opp		
26/09/2002	4.4	*	Ursinia anthemoides	opp		
26/09/2002	4.4		Viminaria juncea	opp		
27/09/2002	4.5		Isolepis setiformis	5	0.1	
27/09/2002	4.5		Cotula coronopifolia	20	1	
27/09/2002	4.5	*	Cotula turbinata	10	1	
27/09/2002	4.5	*	Ehrharta longiflora	60	1	
27/09/2002	4.5		Eucalyptus rudis subsp. rudis	50	1	
27/09/2002	4.5	*	Poa annua	15	1	
27/09/2002	4.5	*	Asparagus asparagoides	ck	5	
27/09/2002	4.5	*	Lotus suaveolens	5	20	
27/09/2002	4.5	*	Bromus diandrus	10	60	
27/09/2002	4.5		Melaleuca rhaphiophylla	600	70	
27/09/2002	4.5		Acacia saligna	opp		
27/09/2002	4.5		Agonis flexuosa var. flexuosa	opp		
27/09/2002	4.5	*	Ranunculus muricatus	opp		
27/09/2002	4.5	*	Sparaxis bulbifera	opp		
27/09/2002	4.6		Prasophyllum sp.	10	0.01	
27/09/2002	4.6		Acacia aplanata	20	0.1	
27/09/2002	4.6	*	Avena barbata	40	0.1	
27/09/2002	4.6		Desmocladus fasiculatus	40	0.1	
27/09/2002	4.6	*	Ehrharta calycina	40	0.1	
27/09/2002	4.6	*	Hypochaeris glabra	5	0.1	
27/09/2002	4.6		Hypolaena exsulca	20	0.1	
27/09/2002	4.6		Sowerbaea laxiflora	10	0.1	
27/09/2002	4.6		Opercularia hispidula var. pauciflora	20	0.3	

Appendix C

Date	Site	*	Species	Ht (cm)	CA (%)	Status
27/09/2002	4.6		Schoenus efoliatus	10	0.3	
27/09/2002	4.6	*	Asparagus asparagoides	ck	0.5	
27/09/2002	4.6		Dampiera linearis	40	0.5	
27/09/2002	4.6		Patersonia umbrosa subsp. umbrosa	50	0.5	
27/09/2002	4.6		Philotheca spicata	30	0.5	
27/09/2002	4.6		Lepidosperma longitudinale	40	1	
27/09/2002	4.6		Nemcia capitata	30	1	
27/09/2002	4.6		Agonis flexuosa var. flexuosa	350	3	
27/09/2002	4.6		Banksia littoralis	400	3	
27/09/2002	4.6		Melaleuca thymoides	50	3	
27/09/2002	4.6	*	Sparaxis bulbifera	50	3	
27/09/2002	4.6		Corymbia calophylla	1200	5	
27/09/2002	4.6		Kunzea glabrescens	350	15	
27/09/2002	4.6		Dasypogon bromeliifolius	60	20	
27/09/2002	4.6		Phlebocarya ciliata	40	30	
27/09/2002	4.6		Eucalyptus marginata subsp. marginata	o/h	-	
27/09/2002	4.6		Acacia pulchella var. goadbyi	opp		
27/09/2002	4.6		Acacia saligna	opp		
27/09/2002	4.6		Acacia stenoptera	opp		
27/09/2002	4.6		Adenanthos meisneri	opp		
27/09/2002	4.6		Banksia grandis	opp		
27/09/2002	4.6		Burchardia umbellata	opp		
27/09/2002	4.6		Caladenia flava subsp. flava	opp		
27/09/2002	4.6		Caladenia latifolia	opp		
27/09/2002	4.6		Conostylis aculeata subsp. aculeata	opp		
27/09/2002	4.6		Daviesia physodes	opp		
27/09/2002	4.6		Drosera menziesii subsp. penicillaris	opp		
27/09/2002	4.6	*	Ehrharta longiflora	opp		
27/09/2002	4.6	*	Eragrostis curvula	opp		
27/09/2002	4.6		Eucalyptus marginata subsp. marginata	opp		
27/09/2002	4.6		Gladiolus sp.	opp		
27/09/2002	4.6		Hakea varia	opp		
27/09/2002	4.6		Hibbertia hypericoides	opp		
27/09/2002	4.6		Hypocalymma angustifolia	opp		
27/09/2002	4.6		Jacksonia furcellata	opp		
27/09/2002	4.6		Jacksonia horrida	opp		
27/09/2002	4.6		Lomandra purpurea	opp		
27/09/2002	4.6		Macrozamia riedlei	opp		
27/09/2002	4.6		Melaleuca preissiana	opp		
27/09/2002	4.6		Melaleuca viminea subsp. viminea	opp		
27/09/2002	4.6		Nuytsia floribunda	opp		
27/09/2002	4.6	*	Oxalis pes-caprae	opp		
27/09/2002	4.6	*	Pennisetum clandestinum	opp		
27/09/2002	4.6		Platytheca galioides	opp		
27/09/2002	4.6	*	Sonchus oleraceus	opp		
27/09/2002	4.6		Thysanotus patersonii	opp		
27/09/2002	4.6		Tricoryne elatior	opp		
27/09/2002	4.6		Viminaria juncea	opp		
27/09/2002	4.6	*	Watsonia meriana var. bulbillifera	opp		
27/09/2002	4.6		Xanthorrhoea brunonis subsp. brunonis	60		
25/09/2002	5.1	*	Callitriche stagnalis	1	0.01	
25/09/2002	5.1	*	Mentha x piperita	5	0.01	
25/09/2002	5.1	*	Ranunculus muricatus	10	0.01	
25/09/2002	5.1	*	Trachyandra divaricata	30	0.01	
25/09/2002	5.1		Cassytha racemosa forma racemosa	ck	0.1	
25/09/2002	5.1	*	Cyperus congestus	30	0.1	
25/09/2002	5.1	*	Rubus ulmifolius	160	0.1	
25/09/2002	5.1	*	Zantedeschia aethiopica	40	0.5	
25/09/2002	5.1		Melaleuca incana subsp. incana	300	2	
25/09/2002	5.1		Opercularia hispidula var. pauciflora	5	5	

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Date	Site	*	Species	Ht (cm)	CA (%)	Status
25/09/2002	5.1		Eucalyptus rudis subsp. rudis	1200	20	
25/09/2002	5.1		Melaleuca rhaphiophylla	800	20	
25/09/2002	5.1		Astartea affin. fasicularis	opp		
25/09/2002	5.1		Carex appressa	opp		
25/09/2002	5.1		Centella asiatica	opp		
25/09/2002	5.1	*	Cynodon dactylon	opp		
25/09/2002	5.1	*	Cyperus congestus	opp		
25/09/2002	5.1	*	Geranium molle	opp		
25/09/2002	5.1		Iridaceae sp.	opp		
25/09/2002	5.1		Isolepis setiformis	opp		
25/09/2002	5.1		Picris squarrosa	opp		
25/09/2002	5.1		Triglochin huegelii	opp		
25/09/2002	5.1	*	Watsonia meriana var. bulbillifera	opp		
25/09/2002	5.2 releve		Eucalyptus rudis subsp. rudis	1600	1	
25/09/2002	5.2 releve	*	Cynodon dactylon	500	5	
25/09/2002	5.2 releve		Melaleuca rhaphiophylla	1600	70	
25/09/2002	5.2 releve	*	Rubus ulmifolius	opp		
25/09/2002	5.2 releve	*	Zantedeschia aethiopica	opp		
25/09/2002	5.3 releve		Astartea affin. fasicularis	100	0.01	
25/09/2002	5.3 releve		Hardenbergia comptoniana	ck	0.1	
25/09/2002	5.3 releve		Typha ?domingensis	80	0.5	
25/09/2002	5.3 releve		Acacia pulchella var. goadbyi	160	1	
25/09/2002	5.3 releve		Agonis linearifolia	800	1	
25/09/2002	5.3 releve		Corymbia calophylla	2000	1	
25/09/2002	5.3 releve		Pteridium esculentum	60	1	
25/09/2002	5.3 releve	*	Rubus ulmifolius	60	1	
25/09/2002	5.3 releve	*	Zantedeschia aethiopica	50	2	
25/09/2002	5.3 releve		Baumea articulata	60	3	
25/09/2002	5.3 releve		Juncus kraussii subsp. australiensis	60	3	
25/09/2002	5.3 releve		Agonis flexuosa var. flexuosa	1200	5	
25/09/2002	5.3 releve		Melaleuca rhaphiophylla	1600	10	
25/09/2002	5.3 releve		Eucalyptus rudis subsp. rudis	2000	30	
25/09/2002	5.3 releve		Triglochin huegelii	opp		
28/09/2002	6.1		Caesia micrantha	10	0.01	
28/09/2002	6.1		Caladenia flava subsp. flava	10	0.01	
28/09/2002	6.1		Chamaescilla corymbosa var. corymbosa	20	0.01	
28/09/2002	6.1		Oligochaetochilus vittatus	10	0.01	
28/09/2002	6.1		Stylidium amoenum var. amoenum	5	0.01	
28/09/2002	6.1		Stylidium brunonianum subsp. brunonianum	10	0.01	
28/09/2002	6.1	*	Watsonia meriana var. bulbillifera	10	0.01	
28/09/2002	6.1		Drosera stolonifera subsp. stolonifera	20	0.05	
28/09/2002	6.1		Acacia nervosa	20	0.1	
28/09/2002	6.1		Agrostocrinum scabrum	10	0.1	
28/09/2002	6.1		Boronia spathulata	40	0.1	
28/09/2002	6.1		Burchardia umbellata	40	0.1	
28/09/2002	6.1		Cassytha racemosa forma racemosa	ck	0.1	
28/09/2002	6.1		Drosera erythrorhiza subsp. erythrorhiza	10	0.1	
28/09/2002	6.1		Haemodorum sp.	20	0.1	
28/09/2002	6.1		Hibbertia mylnei	30	0.1	
28/09/2002	6.1		Lepidosperma squamatum	30	0.1	
28/09/2002	6.1		Tetratheca hirsuta	20	0.1	
28/09/2002	6.1		Thysanotus sparteus	20	0.1	
28/09/2002	6.1		Dampiera linearis	10	0.2	
28/09/2002	6.1		Daviesia physodes	50	0.2	
28/09/2002	6.1		Hakea amplexicaulis	40	0.2	
28/09/2002	6.1		Kennedia prostrata	ck	0.2	
28/09/2002	6.1		Sowerbaea laxiflora	20	0.2	
28/09/2002	6.1		Tetraria capillaris	30	0.2	
28/09/2002	6.1		Xanthosia huegelii	20	0.2	
28/09/2002	6.1		Acacia aplanata	40	0.3	

Appendix C

Date	Site	*	Species	Ht (cm)	CA (%)	Status
28/09/2002	6.1		Acacia stenoptera	40	0.3	
28/09/2002	6.1		Astroloma ciliatum	10	0.3	
28/09/2002	6.1		Astroloma prostratum	20	0.3	
28/09/2002	6.1		Bossiaea eriocarpa	30	0.3	
28/09/2002	6.1		Conostylis serrulata	20	0.3	
28/09/2002	6.1		Gompholobium preissii	30	0.3	
28/09/2002	6.1		Hibbertia hypericoides	30	0.3	
28/09/2002	6.1		Tetraria octandra	30	0.3	
28/09/2002	6.1		Adenanthos barbiger subsp. intermedius ms	30	0.5	
28/09/2002	6.1		Bossiaea ornata	20	0.5	
28/09/2002	6.1		Daviesia physodes	70	0.5	
28/09/2002	6.1		Styphelia tenuiflora	30	0.5	
28/09/2002	6.1		Tetrarrhena laevis	20	0.5	
28/09/2002	6.1		Gompholobium marginatum	30	1	
28/09/2002	6.1		Gompholobium tomentosum	40	1	
28/09/2002	6.1		Scaevola calliptera	30	1	
28/09/2002	6.1		Isopogon sphaerocephalus	60	1.5	
28/09/2002	6.1		Hypocalymma robustum	60	2	
28/09/2002	6.1		Acacia flagelliformis	180	3	P4
28/09/2002	6.1		Acacia pulchella var. glaberrima	80	3	
28/09/2002	6.1		Xylomelum occidentale	200	4	
28/09/2002	6.1	*	Ehrharta calycina	10	5	
28/09/2002	6.1		Loxocarya cinerea	5	5	
28/09/2002	6.1		Patersonia umbrosa subsp. xanthina	80	5	
28/09/2002	6.1		Xanthorrhoea preissii	160	6	
28/09/2002	6.1		Eucalyptus marginata subsp. marginata	1400	10	
28/09/2002	6.1		Corymbia calophylla	o/h	20	
28/09/2002	6.1		Adenanthos meisneri	opp		
28/09/2002	6.1		Agonis flexuosa var. flexuosa	opp		
28/09/2002	6.1		Banksia attenuata	opp		
28/09/2002	6.1		Banksia grandis	opp		
28/09/2002	6.1		Caladenia speciosa	opp		P4
28/09/2002	6.1		Conostylis aculeata subsp. aculeata	opp		
28/09/2002	6.1		Dasypogon bromeliifolius	opp		
28/09/2002	6.1		Desmocladus fasiculatus	opp		
28/09/2002	6.1		Gompholobium confertum	opp		
28/09/2002	6.1		Hibbertia cunninghamii	opp		
28/09/2002	6.1	*	Hypochaeris glabra	opp		
28/09/2002	6.1		Hypolaena exsulca	opp		
28/09/2002	6.1		*Kunzea glabrescens*	opp		
28/09/2002	6.1		Labichea punctata	opp		
28/09/2002	6.1		Lechenaultia biloba	opp		
28/09/2002	6.1		Logania serpyllifolia subsp. angustifolia	opp		
28/09/2002	6.1		Lomandra sericea	opp		
28/09/2002	6.1		Lyginia imberbis	opp		
28/09/2002	6.1		Melaleuca thymoides	opp		
28/09/2002	6.1		Nuytsia floribunda	opp		
28/09/2002	6.1		Pimelea rosea subsp. rosea	opp		
28/09/2002	6.1		Stylidium schoenoides	opp		
25/09/2002	7A.1		Senecio lautus subsp. maritimus	5	0.01	
25/09/2002	7A.1		Isolepis nodosa	10	0.1	
25/09/2002	7A.1	?*	Rostraria cristata	5	0.1	
25/09/2002	7A.1		Scaevola crassifolia	20	0.5	
25/09/2002	7A.1		Spinifex hirsutus	30	0.5	
25/09/2002	7A.1	*	Trachyandra divaricata	40	0.5	
25/09/2002	7A.1		Carpobrotus virescens	5	1	
25/09/2002	7A.1	*	Euphorbia paralias	40	3	
25/09/2002	7A.1		Olearia axillaris	70	3	
25/09/2002	7A.1	*	Pelargonium capitatum	30	3	
25/09/2002	7A.1		Ammophila arenaria	70	10	

Appendix C

Date	Site	*	Species	Ht (cm)	CA (%)	Status
25/09/2002	7A.1		Acacia cyclops	opp		
25/09/2002	7A.2	*	Avena barbata	20	0.01	
25/09/2002	7A.2		Bromus arenarius Uncommon	20	0.01	
25/09/2002	7A.2	*	Heliophila pusilla	10	0.01	
25/09/2002	7A.2	*	Pelargonium capitatum	10	0.01	
25/09/2002	7A.2	*	Sagina apetala	10	0.01	
25/09/2002	7A.2	*	Sonchus oleraceus	15	0.01	
25/09/2002	7A.2		Triglochin calcitrapa	10	0.01	
25/09/2002	7A.2		Thysanotus patersonii	cr	0.1	
25/09/2002	7A.2		Conostylis aculeata subsp. aculeata	30	0.3	
25/09/2002	7A.2		Daucus glochidiatus	10	0.3	
25/09/2002	7A.2		Senecio lautus subsp. maritimus	20	0.3	
25/09/2002	7A.2		Calandrinia liniflora	10	0.5	
25/09/2002	7A.2	*	Cuscuta epithymum	cr	0.5	
25/09/2002	7A.2		Jacksonia furcellata	200	0.5	
25/09/2002	7A.2		Poa porphyroclados	10	0.5	
25/09/2002	7A.2		Scaevola crassifolia	60	0.5	
25/09/2002	7A.2		Spyridium globulosum	120	0.5	
25/09/2002	7A.2		Carpobrotus virescens	20	1	
25/09/2002	7A.2		Crassula colorata var. colorata	5	1	
25/09/2002	7A.2		Rhagodia baccata subsp. baccata	80	1	
25/09/2002	7A.2		Hardenbergia comptoniana	cr	2	
25/09/2002	7A.2		Parietaria debilis	10	3	
25/09/2002	7A.2	*	Trachyandra divaricata	40	3	
25/09/2002	7A.2		Acacia littorea	80	5	
25/09/2002	7A.2		Agonis flexuosa var. flexuosa	200	8	
25/09/2002	7A.2		Olearia axillaris	200	8	
25/09/2002	7A.2		Acanthocarpus preissii	120	25	
25/09/2002	7A.2		Alyxia buxifolia	150	30	
25/09/2002	7A.2		Acacia cyclops	opp		
25/09/2002	7A.2		Cassytha racemosa forma racemosa	opp		
25/09/2002	7A.2		Diplolaena dampieri	opp		
25/09/2002	7A.2	*	Ehrharta calycina	opp		
25/09/2002	7A.2		Exocarpos sparteus	opp		
25/09/2002	7A.2		Hemiandra pungens	opp		
25/09/2002	7A.2		Hibbertia cuneiformis	opp		
25/09/2002	7A.2		Lepidosperma gladiatum	opp		
25/09/2002	7A.2		Leucopogon parviflorus	opp		
25/09/2002	7A.2		Myoporum insulare	opp		
25/09/2002	7A.2	*	Oxalis corniculata	opp		
25/09/2002	7A.2		Ozothamnus cordatus	opp		
25/09/2002	7A.2		Phyllanthus calycinus	opp		
25/09/2002	7A.2		Pterostylis sp. "Slender Snail Orchid" (G.J.Keighery 14516) pn	opp		
25/09/2002	7A.2		Santalum acuminatum	opp		
25/09/2002	7A.2		Trachymene pilosa	opp		
25/09/2002	7A.3	*	Avena barbata	10	0.01	
25/09/2002	7A.3		Carex preissii	10	0.01	
25/09/2002	7A.3	*	Geranium molle	10	0.01	
25/09/2002	7A.3	*	Heliophila pusilla	5	0.01	
25/09/2002	7A.3	*	Pelargonium capitatum	10	0.01	
25/09/2002	7A.3		Pterostylis sp. "Slender Snail Orchid" (G.J.Keighery 14516) pn	5	0.01	
25/09/2002	7A.3	*	Sonchus oleraceus	5	0.01	
25/09/2002	7A.3		Thysanotus patersonii	cr	0.01	
25/09/2002	7A.3	*	Trachyandra divaricata	30	0.01	
25/09/2002	7A.3		Trachymene pilosa	5	0.01	
25/09/2002	7A.3		Triglochin calcitrapa	5	0.01	
25/09/2002	7A.3		Calandrinia liniflora	5	0.05	
25/09/2002	7A.3		Conostylis aculeata subsp. aculeata	20	0.1	
25/09/2002	7A.3		Daucus glochidiatus	5	0.1	
25/09/2002	7A.3		Hardenbergia comptoniana	cr	0.1	

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Date	Site	*	Species		Ht (cm)	CA (%)	Status
25/09/2002	7A.3		Phyllanthus calycinus		50	0.1	
25/09/2002	7A.3	*	Senecio diaschides		30	0.1	
25/09/2002	7A.3		Leucopogon parviflorus		100	0.5	
25/09/2002	7A.3		Parietaria debilis		5	0.5	
25/09/2002	7A.3	*	Romulea rosea		10	0.5	
25/09/2002	7A.3		Acanthocarpus preissii		30	1	
25/09/2002	7A.3		Caladenia latifolia		20	1	
25/09/2002	7A.3		Myoporum insulare		120	1	
25/09/2002	7A.3		Rhagodia baccata subsp. baccata		100	1	
25/09/2002	7A.3		Diplolaena dampieri		120	2	
25/09/2002	7A.3	*	Oxalis corniculata		5	2	
25/09/2002	7A.3		Hydrocotyle tetragonocarpa		5	4	
25/09/2002	7A.3		Agonis flexuosa var. flexuosa		600	5	
25/09/2002	7A.3		Olearia axillaris		160	5	
25/09/2002	7A.3		Alyxia buxifolia		150	30	
25/09/2002	7A.3		Spyridium globulosum		300	30	
25/09/2002	7A.3		Eucalyptus gomphocephala		1000	60	
25/09/2002	7A.3		Acacia littorea		opp		
25/09/2002	7A.3	*	Arctotheca calendula		opp		
25/09/2002	7A.3		Cassytha racemosa forma racemosa		opp		
25/09/2002	7A.3		Corybas sp.		opp		
25/09/2002	7A.3		Dischisma capitatum		opp		
25/09/2002	7A.3		Hemiandra pungens		opp		
25/09/2002	7A.3		Hibbertia cuneiformis		opp		
25/09/2002	7A.3		Lepidosperma gladiatum		opp		
25/09/2002	7A.3		Poa porphyroclados		opp		
25/09/2002	7A.3		Podotheca angustifolia		opp		
25/09/2002	7A.3		Rhodanthe citrina		opp		
25/09/2002	7A.3		Santalum acuminatum		opp		
25/09/2002	7A.3		Zygophyllum simile uncommon		opp		
25/09/2002	7B.1		Cassytha racemosa forma racemosa	1	cr	0.1	
25/09/2002	7B.1		Gahnia trifida	2	200	1	
25/09/2002	7B.1	*	Juncus oxycarpus		20	1	
25/09/2002	7B.1		Triglochin huegelii	3	20	2	
25/09/2002	7B.1		Centella asiatica	4	5	5	
25/09/2002	7B.1	*	Melilotus siculus		10	5	
25/09/2002	7B.1	*	Cynodon dactylon		20	20	
25/09/2002	7B.1		Melaleuca rhaphiophylla	5	600	30	
25/09/2002	7B.1		Melaleuca viminea subsp. viminea	6	600	30	
25/09/2002	7B.1		Juncus kraussii subsp. australiensis	7	150	70	
25/09/2002	7B.1	*	Bromus diandrus				
25/09/2002	7B.2		Baumea juncea	8	50		
25/09/2002	7B.2		Bolboschoenus caldwellii	9	20		
25/09/2002	7B.2	*	Callitriche stagnalis		opp		
25/09/2002	7B.2	*	Cirsium vulgare		20		
25/09/2002	7B.2	*	Cortaderia selloana		200		
25/09/2002	7B.2		Cotula coronopifolia	10	opp		
25/09/2002	7B.2	*	Cynodon dactylon		20		
25/09/2002	7B.2	*	Cyperus congestus		opp		
25/09/2002	7B.2	*	Holcus lanatus		opp		
25/09/2002	7B.2	*	Hordeum leporinum		opp		
25/09/2002	7B.2	X	Isolepis marginata	11	opp		
25/09/2002	7B.2		Isolepis setiformis		opp		
25/09/2002	7B.2		Juncus kraussii subsp. australiensis	20 24 R	150		
25/09/2002	7B.2	*	Juncus oxycarpus		30		
25/09/2002	7B.2		Meeboldina coangustata	12	opp		
25/09/2002	7B.2	*	Melilotus siculus		5		
25/09/2002	7B.2	*	Mentha x piperita		opp		
25/09/2002	7B.2	*	Parentucellia viscosa		opp		
25/09/2002	7B.2		Picris squarrosa	13	opp		

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Date	Site	*	Species	Ht (cm)	CA (%)	Status
25/09/2002	7B.2	*	Plantago lanceolata	50		
25/09/2002	7B.2	*	Ranunculus muricatus	opp		
25/09/2002	7B.2	*	Romulea rosea	10		
25/09/2002	7B.2		Triglochin huegelii 12	40		
25/09/2002	7B.2	*	Typha orientalis	180		
25/09/2002	7B.2	*	Vicia sativa subsp. nigra	opp		
25/09/2002	7B.2	*	Zantedeschia aethiopica	opp		
25/09/2002	7B.3		Cotula coronopifolia 13	5	0.01	
25/09/2002	7B.3		Triglochin mucronata 14	10	0.01	
25/09/2002	7B.3		Juncus kraussii subsp. australiensis	80	5	
25/09/2002	7B.3		Halosarcia lepidosperma 15	20	70	
25/09/2002	7B.3		Apium prostratum var. prostratum 16	opp		
25/09/2002	7B.3		Bolboschoenus caldwellii	opp		
25/09/2002	7B.3	*	Bromus diandrus	opp		
25/09/2002	7B.3		Centrolepis aristata 17	opp		
25/09/2002	7B.3		Chenopodium sp.	opp		
25/09/2002	7B.3	*	Cynodon dactylon	opp		
25/09/2002	7B.3	*	Cynosurus echinatus	opp		
25/09/2002	7B.3	*	Eragrostis curvula	opp		
25/09/2002	7B.3		Halosarcia indica subsp. bidens ? Dominant in plot. 18	opp		
25/09/2002	7B.3	*	Hordeum leporinum	opp		
25/09/2002	7B.3	?	Isoetes drummondii	opp		
25/09/2002	7B.3	*	Isolepis marginata	opp		
25/09/2002	7B.3	*	Juncus oxycarpus	opp		
25/09/2002	7B.3	*	Melilotus siculus	opp		
25/09/2002	7B.3	*	Melilotus siculus 21 Natives	opp		
25/09/2002	7B.3	*	Romulea rosea	opp		
25/09/2002	7B.3	*	Sparaxis bulbifera	opp		
25/09/2002	7B.3	*	Spergula arvensis	opp		
25/09/2002	7B.3		Triglochin muelleri 19	opp		
24/09/2002	8.1		Caladenia georgei	30	0.01	
24/09/2002	8.1		Astroloma ciliatum	10	0.1	
24/09/2002	8.1	*	Briza minor	15	0.1	
24/09/2002	8.1		Caladenia flava subsp. flava	40	0.1	
24/09/2002	8.1		Caladenia latifolia	35	0.1	
24/09/2002	8.1		Crassula colorata var. colorata	5	0.1	
24/09/2002	8.1		Hardenbergia comptoniana	7	0.1	
24/09/2002	8.1		Lomandra micrantha subsp. micrantha	30	0.1	
24/09/2002	8.1	*	Sagina apetala	10	0.1	
24/09/2002	8.1	*	Sonchus oleraceus	40	0.1	
24/09/2002	8.1	*	Anagallis arvensis var. caerulea	10	0.5	
24/09/2002	8.1		Bossiaea eriocarpa	50	0.5	
24/09/2002	8.1		Conostylis aculeata subsp. aculeata	30	0.5	
24/09/2002	8.1		Daucus glochidiatus	10	0.5	
24/09/2002	8.1		Ehrharta calycina	45	0.5	
24/09/2002	8.1		Geranium solanderi	20	0.5	
24/09/2002	8.1	*	Heliophila pusilla	25	0.5	
24/09/2002	8.1		Lagenophora huegelii	15	0.5	
24/09/2002	8.1		Lepidosperma squamatum	70	0.5	
24/09/2002	8.1		Leucopogon capitellatus	40	0.5	
24/09/2002	8.1	*	Romulea rosea	15	0.5	
24/09/2002	8.1	*	Vicia sativa subsp. nigra	T	0.5	
24/09/2002	8.1	*	Briza maxima	35	1	
24/09/2002	8.1		Dichopogon preissii	15	1	
24/09/2002	8.1	*	Ehrharta longiflora	45	1	
24/09/2002	8.1		Hakea prostrata	400	1	
24/09/2002	8.1	*	Petrorhagia dubia	15	1	
24/09/2002	8.1		Sowerbaea laxiflora	40	1	
24/09/2002	8.1	*	Ursinia anthemoides	50	1	
24/09/2002	8.1		Xanthorrhoea brunonis subsp. brunonis	70	1	

Appendix C

Date	Site	*	Species	Ht (cm)	CA (%)	Status
24/09/2002	8.1		Daviesia divaricata var. divaricata ms	90	2	
24/09/2002	8.1	*	Hypochaeris glabra	5	3	
24/09/2002	8.1		Agonis flexuosa var. flexuosa	1000	5	
24/09/2002	8.1		Xanthorrhoea gracilis	100	8	
24/09/2002	8.1		Banksia grandis	1200	10	
24/09/2002	8.1	*	Trifolium campestre var. campestre	10	10	
24/09/2002	8.1		Corymbia calophylla	1200	40	
24/09/2002	8.1		Hibbertia hypericoides	80	60	
24/09/2002	8.1		Acacia cochlearis	opp		
24/09/2002	8.1		Adenanthos meisneri	opp		
24/09/2002	8.1		Anigozanthos mangleisii subsp. mangleisii	opp		
24/09/2002	8.1	*	Arctotheca calendula	opp		
24/09/2002	8.1		Asteridea pulverulenta	opp		
24/09/2002	8.1		Banksia attenuata	opp		
24/09/2002	8.1		Burchardia umbellata	opp		
24/09/2002	8.1		Conostephium pendulum	opp		
24/09/2002	8.1		Cryptandra arbutiflora var. arbutifloa	opp		
24/09/2002	8.1		Desmocladus fasiculatus	opp		
24/09/2002	8.1		Desmocladus flexuosus	opp		
24/09/2002	8.1		Drosera erythrorhiza subsp. erythrorhiza	opp		
24/09/2002	8.1		Eucalyptus marginata subsp. marginata	opp		
24/09/2002	8.1	*	Geranium molle	opp		
24/09/2002	8.1		Hakea amplexicaulis	opp		
24/09/2002	8.1		Hypolaena exsulca	opp		
24/09/2002	8.1	*	Isolepis marginata	opp		
24/09/2002	8.1		Kennedia prostrata	opp		
24/09/2002	8.1		Logania serpyllifolia subsp. angustifolia	opp		
24/09/2002	8.1		Lomandra purpurea	opp		
24/09/2002	8.1		Luzula meridionalis	opp		
24/09/2002	8.1		Lyginia imberbis	opp		
24/09/2002	8.1		Melaleuca thymoides	opp		
24/09/2002	8.1		Olearia axillaris	opp		
24/09/2002	8.1		Oligochaetochilus vittatus	opp		
24/09/2002	8.1		Phlebocarya ciliata	opp		
24/09/2002	8.1		Pyrochis nigricans	opp		
24/09/2002	8.1		Quinetia urvillei	opp		
24/09/2002	8.1		Rhodanthe citrina	opp		
24/09/2002	8.1	*	Rumex ?conglomeratus	opp		
24/09/2002	8.1	*	Sonchus asper subsp. glaucescens	opp		
24/09/2002	8.1		Thelymitra sp.	opp		
24/09/2002	8.2		Caesia micrantha	10	0.01	
24/09/2002	8.2	*	Oxalis corniculata	10	0.01	
24/09/2002	8.2		Patersonia umbrosa subsp. umbrosa	10	0.01	
24/09/2002	8.2		Persoonia saccata	30	0.01	
24/09/2002	8.2		Senecio sp.	10	0.01	
24/09/2002	8.2		Stylidium brunonianum subsp. brunonianum	5	0.01	
24/09/2002	8.2		Tetraria octandra	20	0.01	
24/09/2002	8.2		Billardiera laxiflora	cr	0.1	
24/09/2002	8.2		Burchardia umbellata	20	0.1	
24/09/2002	8.2		Caladenia flava subsp. flava	30	0.1	
24/09/2002	8.2		Caladenia speciosa	20	0.1	P4
24/09/2002	8.2		Drosera menziesii subsp. penicillaris	5	0.1	
24/09/2002	8.2	*	Ehrharta calycina	40	0.1	
24/09/2002	8.2		Eucalyptus marginata subsp. marginata (seedlings)	5	0.1	
24/09/2002	8.2		Hemiandra pungens	10	0.1	
24/09/2002	8.2		Hypolaena exsulca	10	0.1	
24/09/2002	8.2		Lagenophora huegelii	5	0.1	
24/09/2002	8.2		Luzula meridionalis	20	0.1	
24/09/2002	8.2		Oligochaetochilus vittatus	10	0.1	
24/09/2002	8.2		Phyllanthus calycinus	30	0.1	

Appendix C

Date	Site	*	Species	Ht (cm)	CA (%)	Status
24/09/2002	8.2		Poaceae sp.	20	0.1	
24/09/2002	8.2	*	Romulea rosea	10	0.1	
24/09/2002	8.2		Thysanotus multiflorus	20	0.1	
24/09/2002	8.2		Xanthosia huegelii	10	0.1	
24/09/2002	8.2		Philotheca spicata	30	0.2	
24/09/2002	8.2		Kennedia prostrata	5	0.3	
24/09/2002	8.2		Bossiaea eriocarpa	10	0.5	
24/09/2002	8.2	*	Briza maxima	5	0.5	
24/09/2002	8.2		Daucus glochidiatus	5	0.5	
24/09/2002	8.2		Eucalyptus marginata subsp. marginata	400	0.5	
24/09/2002	8.2	*	Hypochaeris glabra	5	0.5	
24/09/2002	8.2		Lepidosperma squamatum	30	0.5	
24/09/2002	8.2		Leucopogon capitellatus	40	0.5	
24/09/2002	8.2	*	Sonchus oleraceus	5	0.5	
24/09/2002	8.2	*	Ursinia anthemoides	20	0.5	
24/09/2002	8.2		Chamaescilla corymbosa var. corymbosa	30	1	
24/09/2002	8.2		Corymbia calophylla (seedlings)	5	1	
24/09/2002	8.2		Dasypogon bromeliifolius	10	1	
24/09/2002	8.2		Sowerbaea laxiflora	30	1	
24/09/2002	8.2		Conostylis aculeata subsp. aculeata	20	2	
24/09/2002	8.2		Corynotheca micrantha var. micrantha	40	2	
24/09/2002	8.2	*	Ehrharta longiflora	30	2	
24/09/2002	8.2		Agonis flexuosa var. flexuosa	250	3	
24/09/2002	8.2		Hibbertia hypericoides	30	4	
24/09/2002	8.2	*	Avena barbata	20	5	
24/09/2002	8.2		Phlebocarya ciliata	30	5	
24/09/2002	8.2	*	Trifolium campestre var. campestre	10	5	
24/09/2002	8.2		Xanthorrhoea brunonis subsp. brunonis	80	5	
24/09/2002	8.2		Jacksonia furcellata	600	15	
24/09/2002	8.2		*Kunzea glabrescens*	500	25	
24/09/2002	8.2		Corymbia calophylla	1200	30	
24/09/2002	8.2		Astroloma pallidum	opp		
24/09/2002	8.2		Banksia attenuata	opp		
24/09/2002	8.2		Hakea prostrata	opp		
24/09/2002	8.2		Lasiopetalum membranaceum	opp		P3
24/09/2002	8.2		Macrozamia riedlei	opp		
24/09/2002	8.2		Synaphea spinulosa subsp. spinulosa	opp		
24/09/2002	8.3	*	Cynodon dactylon	40	0.01	
24/09/2002	8.3		Juncus kraussii subsp. australiensis	60	0.1	
24/09/2002	8.3		Lobelia alata	30	0.1	
24/09/2002	8.3		Samolus junceus	80	0.1	
24/09/2002	8.3		Apium prostratum var. prostratum	30	1	
24/09/2002	8.3	*	Watsonia meriana var. bulbillifera	60	5	
24/09/2002	8.3		Baumea juncea	60	10	
24/09/2002	8.3		Melaleuca rhaphiophylla	1400	15	
24/09/2002	8.3		Juncus pallidus	100	20	
24/09/2002	8.3		Gahnia trifida	180	40	
24/09/2002	8.3		Melaleuca incana subsp. incana	450	50	
24/09/2002	8.3		Centella asiatica	20	70	
24/09/2002	8.3		Eucalyptus rudis subsp. rudis	1400	70	
24/09/2002	8.3		Acacia pulchella var. glaberrima	opp		
24/09/2002	8.3		Astartea affin. fasicularis	opp		
24/09/2002	8.3		Casuarina obesa	opp		
24/09/2002	8.3		Corymbia calophylla	opp		
24/09/2002	8.3		Melaleuca viminea subsp. viminea	opp		
24/09/2002	8.3	*	Oxalis glabra	opp		
24/09/2002	8.3		Pteridium esculentum	opp		
24/09/2002	8.3		Viminaria juncea	opp		
24/09/2002	8.4		Caladenia latifolia	20	0.01	
24/09/2002	8.4		Conostylis aculeata subsp. aculeata	20	0.1	

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Date	Site	*	Species	Ht (cm)	CA (%)	Status
24/09/2002	8.4	*	Ehrharta longiflora	40	0.1	
24/09/2002	8.4		Leucopogon capitellatus	30	0.1	
24/09/2002	8.4		Astartea affin. fasicularis	300	0.5	
24/09/2002	8.4		Melaleuca viminea subsp. viminea	400	0.5	
24/09/2002	8.4		Acacia pulchella var. glaberrima	150	1	
24/09/2002	8.4		Eucalyptus rudis subsp. rudis	1000	1	
24/09/2002	8.4		Jacksonia furcellata	500	2	
24/09/2002	8.4	*	Oxalis glabra	10	2	
24/09/2002	8.4	*	Oxalis pes-caprae	10	2	
24/09/2002	8.4		Baumea juncea	0.8	5	
24/09/2002	8.4		Casuarina obesa	600	10	
24/09/2002	8.4		Corymbia calophylla	1200	10	
24/09/2002	8.4	*	Watsonia meriana var. bulbillifera	100	90	
24/09/2002	8.4		Acacia saligna	opp		
24/09/2002	8.4		Agonis flexuosa var. flexuosa	opp		
24/09/2002	8.4		Conyza sp.	opp		
24/09/2002	8.4	*	Ehrharta calycina	opp		
24/09/2002	8.4		Hakea prostrata	opp		
24/09/2002	8.4	*	Pennisetum clandestinum	opp		
23/09/2002	9.1	*	Apium graveolens	20	0.01	
23/09/2002	9.1		Conyza sp.	30	0.01	
23/09/2002	9.1	*	Pennisetum clandestinum	10	0.01	
23/09/2002	9.1	*	Sonchus oleraceus	10	0.01	
23/09/2002	9.1	*	Solanum americanum	30	0.05	
23/09/2002	9.1	*	Solanum nigrum	50	0.05	
23/09/2002	9.1	*	Vicia sativa subsp. nigra	10	0.05	
23/09/2002	9.1		Carex appressa	200	0.1	
23/09/2002	9.1		Cassytha racemosa forma racemosa	cr	0.1	
23/09/2002	9.1		Hibbertia cuneiformis	50	0.1	
23/09/2002	9.1	*	Sonchus hydrophilus	20	0.1	
23/09/2002	9.1		Rhadinothamnus anceps	200	0.3	
23/09/2002	9.1	*	Solanum laciniatum	80	0.3	
23/09/2002	9.1	*	Zantedeschia aethiopica	40	0.3	
23/09/2002	9.1		Centella asiatica	15	0.5	
23/09/2002	9.1		Baumea juncea	40	5	
23/09/2002	9.1		Pteridium esculentum	40	5	
23/09/2002	9.1		Rhagodia baccata subsp. baccata	300	5	
23/09/2002	9.1	*	Stellaria media	10	10	
23/09/2002	9.1		Calycopeplus oligandrus	300	15	
23/09/2002	9.1		Gahnia trifida	250	20	
23/09/2002	9.1	*	Holcus lanatus	30	40	
23/09/2002	9.1		Lepidosperma gladiatum	300	50	
23/09/2002	9.1		Acacia saligna	opp		
23/09/2002	9.1		Adriana quadripartita	opp		
23/09/2002	9.1		Banksia littoralis	opp		
23/09/2002	9.1	*	Cirsium vulgare	opp		
23/09/2002	9.1		Cotula coronopifolia	opp		
23/09/2002	9.1	*	Cotula turbinata	opp		
23/09/2002	9.1	*	Cynodon dactylon	opp		
23/09/2002	9.1	*	Cyperus congestus	opp		
23/09/2002	9.1	*	Erodium cicutarium	opp		
23/09/2002	9.1	*	Euphorbia peplus	opp		
23/09/2002	9.1		Geranium retrosum	opp		
23/09/2002	9.1	*	Hordeum leporinum	opp		
23/09/2002	9.1		Hydrocotyle tetragonocarpa	opp		
23/09/2002	9.1		Isolepis nodosa	opp		
23/09/2002	9.1	*	Isolepis prolifera	opp		
23/09/2002	9.1	*	Juncus bufonius	opp		
23/09/2002	9.1		Juncus pallidus	opp		
23/09/2002	9.1		Picris squarrosa	opp		

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Date	Site	*	Species	Ht (cm)	CA (%)	Status
23/09/2002	9.1	*	Poa annua	opp		
23/09/2002	9.1	*	Romulea rosea	opp		
23/09/2002	9.1	*	Sherardia arvensis	opp		
23/09/2002	9.1	*	Solanum linnaeanum	opp		
23/09/2002	9.1		Spyridium globulosum	opp		
23/09/2002	9.1	*	Trachyandra divaricata	opp		
23/09/2002	9.1	*	Trifolium sp.	opp		
23/09/2002	9.1	*	Typha orientalis	opp		
23/09/2002	9.2		Acacia saligna	20	0.1	
23/09/2002	9.2		Carex preissii	10	0.1	
23/09/2002	9.2		Conostylis aculeata subsp. aculeata	10	0.1	
23/09/2002	9.2	*	Heliophila pusilla	15	0.1	
23/09/2002	9.2		Hydrocotyle scutellifera	10	0.1	
23/09/2002	9.2		Lepidosperma squamatum	40	0.1	
23/09/2002	9.2	*	Romulea rosea	10	0.1	
23/09/2002	9.2	*	Sonchus oleraceus	10	0.1	
23/09/2002	9.2	*	Zantedeschia aethiopica	40	0.1	
23/09/2002	9.2		Daucus glochidiatus	5	0.5	
23/09/2002	9.2		Hardenbergia comptoniana	cr	0.5	
23/09/2002	9.2	*	Hypochaeris glabra	5	0.5	
23/09/2002	9.2	*	Oxalis corniculata	5	0.5	
23/09/2002	9.2	*	Sagina apetala	10	0.5	
23/09/2002	9.2		Thysanotus patersonii	cr	0.5	
23/09/2002	9.2		Trachymene pilosa	5	0.5	
23/09/2002	9.2	*	Trifolium campestre var. campestre	10	0.5	
23/09/2002	9.2		Caladenia latifolia	20	1	
23/09/2002	9.2		Rhagodia baccata subsp. baccata	50	1	
23/09/2002	9.2		Centella asiatica	5	5	
23/09/2002	9.2		Geranium solanderi	5	5	
23/09/2002	9.2	*	Piptatherum miliaceum	10	5	
23/09/2002	9.2		Hibbertia cuneiformis	200	30	
23/09/2002	9.2	*	Trachyandra divaricata	40	30	
23/09/2002	9.2		Agonis flexuosa var. flexuosa	1200	40	
23/09/2002	9.2		Acacia cochlearis	opp		
23/09/2002	9.2		Acanthocarpus preissii	opp		
23/09/2002	9.2		Asteridea pulverulenta	opp		
23/09/2002	9.2		Calandrinia liniflora	opp		
23/09/2002	9.2		Clematis linearifolia	opp		
23/09/2002	9.2		Crassula colorata var. colorata	opp		
23/09/2002	9.2		Diplolaena dampieri	opp		
23/09/2002	9.2		Dischisma capitatum	opp		
23/09/2002	9.2	*	Ehrharta longiflora	opp		
23/09/2002	9.2		*Eryngium pinnatifidum* subsp. *pinnatifidum ms*	opp		
23/09/2002	9.2		Exocarpos sparteus	opp		
23/09/2002	9.2		Isotropis cuneifolia subsp. cuneifolia	opp		
23/09/2002	9.2		Jacksonia furcellata	opp		
23/09/2002	9.2		Leucopogon parviflorus	opp		
23/09/2002	9.2	*	Lolium perenne	opp		
23/09/2002	9.2		Millotia myosotidifolia	opp		
23/09/2002	9.2		Olearia axillaris	opp		
23/09/2002	9.2	*	Parentucellia viscosa	opp		
23/09/2002	9.2		Parietaria debilis	opp		
23/09/2002	9.2		Phyllanthus calycinus	opp		
23/09/2002	9.2		Ptilotus sericostachyus subsp. sericostachyus	opp		
23/09/2002	9.2		Rhodanthe citrina	opp		
23/09/2002	9.2		Senecio lautus subsp. maritimus	opp		
23/09/2002	9.2		Spyridium globulosum	opp		
23/09/2002	9.2		Thomasia triphylla	opp		
23/09/2002	9.2		Triglochin muelleri	opp		
23/09/2002	9.2		Xanthorrhoea preissii	opp		

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Date	Site	*	Species	Ht (cm)	CA (%)	Status
23/09/2002	9.3		Conostylis aculeata subsp. aculeata	10	0.1	
23/09/2002	9.3		Acanthocarpus preissii	30	0.5	
23/09/2002	9.3		Daucus glochidiatus	10	0.5	
23/09/2002	9.3		Dianella revoluta var. divaricata	40	0.5	
23/09/2002	9.3		Eremophila glabra subsp. albicans	30	0.5	
23/09/2002	9.3		Hardenbergia comptoniana	cr	0.5	
23/09/2002	9.3	*	Sonchus oleraceus	20	0.5	
23/09/2002	9.3		Thysanotus patersonii	cr	0.5	
23/09/2002	9.3		Lepidosperma squamatum	30	1	
23/09/2002	9.3		Rhagodia baccata subsp. baccata	100	1	
23/09/2002	9.3		Spyridium globulosum	50	2	
23/09/2002	9.3	*	Zantedeschia aethiopica	50	2	
23/09/2002	9.3	*	Anagallis arvensis var. caerulea	20	3	
23/09/2002	9.3		Caladenia latifolia	15	5	
23/09/2002	9.3		Geranium solanderi	20	20	
23/09/2002	9.3	*	Ehrharta longiflora	10	50	
23/09/2002	9.3	*	Trachyandra divaricata	50	50	
23/09/2002	9.3		Agonis flexuosa var. flexuosa	1000	60	
23/09/2002	9.3		Eucalyptus gomphocephala	2200	75	
23/09/2002	9.3		Carex preissii	opp		
23/09/2002	9.3		Centella asiatica	opp		
23/09/2002	9.3		Diplolaena dampieri	opp		
23/09/2002	9.3		Exocarpos sparteus	opp		
23/09/2002	9.3		Lepidosperma gladiatum	opp		
23/09/2002	9.3		Millotia myosotidifolia	opp		
23/09/2002	9.3		Olearia axillaris	opp		
23/09/2002	9.3		Opercularia vaginata	opp		
23/09/2002	9.3		Parietaria debilis	opp		
23/09/2002	9.3		Phyllanthus calycinus	opp		
23/09/2002	9.3		Picris squarrosa	opp		
23/09/2002	9.3		Senecio lautus subsp. maritimus	opp		
23/09/2002	9.3		Triglochin calcitrapa	opp		
23/09/2002	9.3		Triglochin muelleri	opp		
24/09/2002	9.4		Isolepis nodosa	10	0.1	
24/09/2002	9.4	*	Lagurus ovatus	20	0.1	
24/09/2002	9.4		Lepidosperma gladiatum	50	0.1	
24/09/2002	9.4		Senecio lautus subsp. maritimus	10	0.1	
24/09/2002	9.4		Hardenbergia comptoniana	20	0.5	
24/09/2002	9.4	*	Trachyandra divaricata	40	1	
24/09/2002	9.4		Olearia axillaris	50	2	
24/09/2002	9.4	*	Pelargonium capitatum	30	5	
24/09/2002	9.4	?*	Rostraria cristata	10	5	
24/09/2002	9.4	*	Tetragonia decumbens	5	8	
24/09/2002	9.4	*	Euphorbia paralias	20	10	
24/09/2002	9.4		Scaevola crassifolia	40	30	
24/09/2002	9.4		Acacia cyclops	-	-	
24/09/2002	9.4	*	Arctotheca calendula	-	-	
24/09/2002	9.4		Acacia cochlearis	opp		
24/09/2002	9.4		Acanthocarpus preissii	opp		
24/09/2002	9.4		Anthocercis littorea	opp		
24/09/2002	9.4	*	Cakile maritima	opp		
24/09/2002	9.4		Cassytha racemosa forma racemosa	opp		
24/09/2002	9.4		Exocarpos sparteus	opp		
24/09/2002	9.4		Hibbertia cuneiformis	opp		
24/09/2002	9.4	*	Hypochaeris glabra	opp		
24/09/2002	9.4		Rhagodia baccata subsp. baccata	opp		
24/09/2002	9.4		Scaevola lanceolata	opp		
24/09/2002	9.4		Spinifex hirsutus	opp		
24/09/2002	9.4		Spinifex longifolius	opp		
24/09/2002	9.4		Spyridium globulosum	opp		

Appendix C

Date	Site	*	Species	Ht (cm)	CA (%)	Status
24/09/2002	9.5		Crassula colorata var. colorata	10	0.01	
24/09/2002	9.5		Monotaxis grandiflora var. grandiflora	1	0.01	
24/09/2002	9.5		Carpobrotus virescens	5	0.1	
24/09/2002	9.5		Daucus glochidiatus	5	0.1	
24/09/2002	9.5		*Eryngium pinnatifidum* subsp. *pinnatifidum ms*	40	0.1	
24/09/2002	9.5		Hardenbergia comptoniana	cr	0.1	
24/09/2002	9.5		Opercularia vaginata	10	0.1	
24/09/2002	9.5		Rhagodia baccata subsp. baccata	20	0.1	
24/09/2002	9.5	*	Romulea rosea	10	0.1	
24/09/2002	9.5		Exocarpos sparteus	80	0.3	
24/09/2002	9.5	*	Lagurus ovatus	20	0.5	
24/09/2002	9.5		Senecio lautus subsp. maritimus	30	0.5	
24/09/2002	9.5		Cassytha racemosa forma racemosa	cr	1	
24/09/2002	9.5		Gompholobium tomentosum	50	1	
24/09/2002	9.5		Poa porphyroclados	60	1	
24/09/2002	9.5		Scaevola lanceolata	30	1	
24/09/2002	9.5		Diplolaena dampieri	50	1.5	
24/09/2002	9.5		Conostylis aculeata subsp. aculeata	40	2	
24/09/2002	9.5		Leucopogon parviflorus	120	2	
24/09/2002	9.5		Spyridium globulosum	120	2	
24/09/2002	9.5		Agonis flexuosa var. flexuosa	500	5	
24/09/2002	9.5		Acacia cochlearis	100	8	
24/09/2002	9.5		Lepidosperma gracile	40	10	
24/09/2002	9.5		Phyllanthus calycinus	40	10	
24/09/2002	9.5	*	Trachyandra divaricata	50	30	
24/09/2002	9.5		Acanthocarpus preissii	40	50	
24/09/2002	9.5		Acacia saligna	opp		
24/09/2002	9.5		Alyxia buxifolia	opp		
24/09/2002	9.5		Anthocercis littorea	opp		
24/09/2002	9.5		Austrostipa compressa	opp		
24/09/2002	9.5	*	Avena barbata	opp		
24/09/2002	9.5		Caladenia latifolia	opp		
24/09/2002	9.5		Clematis linearifolia	opp		
24/09/2002	9.5		Dianella revoluta var. divaricata	opp		
24/09/2002	9.5		Eremophila glabra subsp. albicans	opp		
24/09/2002	9.5		Hibbertia cuneiformis	opp		
24/09/2002	9.5		Jacksonia furcellata	opp		
24/09/2002	9.5		Lepidosperma gladiatum	opp		
24/09/2002	9.5		Olearia axillaris	opp		
24/09/2002	9.5	*	Orobanche minor	opp		
24/09/2002	9.5		Ozothamnus cordatus	opp		
24/09/2002	9.5		Parietaria debilis	opp		
24/09/2002	9.5		Trachymene pilosa	opp		
24/09/2002	9.5	*	Vulpia myuros var. myuros	opp		
24/09/2002	9.6	*	Avena barbata	30	0.1	
24/09/2002	9.6		Caladenia latifolia	20	0.1	
24/09/2002	9.6		Carex preissii	10	0.1	
24/09/2002	9.6		Crassula colorata var. colorata	5	0.1	
24/09/2002	9.6	*	Erodium cicutarium	5	0.1	
24/09/2002	9.6	*	Hypochaeris glabra	5	0.1	
24/09/2002	9.6		Pelargonium littorale subsp. littorale	5	0.1	
24/09/2002	9.6	*	Sagina apetala	5	0.1	
24/09/2002	9.6		Spyridium globulosum	40	0.1	
24/09/2002	9.6		Trachymene pilosa	5	0.1	
24/09/2002	9.6	*	Zantedeschia aethiopica	5	0.1	
24/09/2002	9.6		Senecio lautus subsp. maritimus	10	0.3	
24/09/2002	9.6		Acacia cochlearis	60	0.5	
24/09/2002	9.6		Exocarpos sparteus	150	0.5	
24/09/2002	9.6		Isolepis nodosa	80	0.5	
24/09/2002	9.6		Olearia axillaris	40	0.5	

Appendix C

Date	Site	*	Species	Ht (cm)	CA (%)	Status
24/09/2002	9.6		Phyllanthus calycinus	30	0.5	
24/09/2002	9.6		Picris squarrosa	10	0.5	
24/09/2002	9.6		Poa porphyroclados	30	0.5	
24/09/2002	9.6		Poa porphyroclados	100	0.5	
24/09/2002	9.6	*	Trachyandra divaricata	40	1	
24/09/2002	9.6		Bromus arenarius	30	2	
24/09/2002	9.6		Lepidosperma squamatum	80	2	
24/09/2002	9.6		Thysanotus patersonii	cr	2	
24/09/2002	9.6		Agonis flexuosa var. flexuosa	200	3	
24/09/2002	9.6		Daucus glochidiatus	5	5	
24/09/2002	9.6		Rhagodia baccata subsp. baccata	60	5	
24/09/2002	9.6		Parietaria debilis	10	10	
24/09/2002	9.6		Clematis linearifolia	cr	15	
24/09/2002	9.6		Acacia saligna	200	20	
24/09/2002	9.6		Xanthorrhoea preissii	250	20	
24/09/2002	9.6		Anthocercis littorea	200	25	
24/09/2002	9.6		Banksia littoralis	800	25	
24/09/2002	9.6		Lepidosperma gracile	0.4	30	
24/09/2002	9.6		Acanthocarpus preissii	opp		
24/09/2002	9.6	*	Avena barbata	opp		
24/09/2002	9.6		Carpobrotus virescens	opp		
24/09/2002	9.6		Cassytha racemosa forma racemosa	opp		
24/09/2002	9.6		Conostylis aculeata subsp. aculeata	opp		
24/09/2002	9.6		Dischisma capitatum	opp		
24/09/2002	9.6		Eremophila glabra subsp. albicans	opp		
24/09/2002	9.6		Jacksonia furcellata	opp		
24/09/2002	9.6		Lepidosperma gladiatum	opp		
24/09/2002	9.6		Millotia myosotidifolia	opp		
24/09/2002	9.6		Phyllangium paradoxum	opp		
24/09/2002	9.6	*	Romulea rosea	opp		
24/09/2002	9.7 Releve		Banksia littoralis	800	0.01	
24/09/2002	9.7 Releve	*	Cortaderia selloana	200	0.01	
24/09/2002	9.7 Releve	*	Ehrharta longiflora	50	0.01	
24/09/2002	9.7 Releve		Persicaria decipiens	20	0.01	
24/09/2002	9.7 Releve		Rhadinothamnus anceps	200	0.01	
24/09/2002	9.7 Releve		Rhagodia baccata subsp. baccata	50	0.01	
24/09/2002	9.7 Releve		Rumex sp.	10	0.01	
24/09/2002	9.7 Releve	*	Sonchus oleraceus	10	0.01	
24/09/2002	9.7 Releve	*	Zantedeschia aethiopica	40	0.01	
24/09/2002	9.7 Releve	*	Isolepis prolifera	40	0.1	
24/09/2002	9.7 Releve		Acacia saligna	250	1	
24/09/2002	9.7 Releve		Agonis flexuosa var. flexuosa	800	1	
24/09/2002	9.7 Releve		Bolboschoenus medianus	180	2	
24/09/2002	9.7 Releve		Juncus pallidus	150	2	
24/09/2002	9.7 Releve		Carex appressa	150	10	
24/09/2002	9.7 Releve	*	Typha orientalis	160	10	
24/09/2002	9.7 Releve		Pteridium esculentum	180	30	
24/09/2002	9.7 Releve		Lepidosperma gladiatum	180	50	
24/09/2002	9.7 Releve		Calycopeplus oligandrus	opp		
24/09/2002	9.7 Releve		Melaleuca rhaphiophylla	opp		
24/09/2002	9.7 Releve		Myoporum oppositifolium	opp		
24/09/2002	9.7 Releve	*	Pennisetum clandestinum	opp		
26/09/2002	10.1		Acacia stenoptera	10	0.01	
26/09/2002	10.1	*	Avena barbata	30	0.01	
26/09/2002	10.1		Caladenia hirta subsp. hirta	20	0.01	
26/09/2002	10.1		Daucus glochidiatus	5	0.01	
26/09/2002	10.1		Drosera pallida	20	0.01	
26/09/2002	10.1		Drosera stolonifera subsp. stolonifera	10	0.01	
26/09/2002	10.1	*	Isolepis marginata	5	0.01	
26/09/2002	10.1		Isotropis cuneifolia subsp. cuneifolia	30	0.01	

Appendix C

Date	Site	*	Species	Ht (cm)	CA (%)	Status
26/09/2002	10.1		Oligochaetochilus vittatus	10	0.01	
26/09/2002	10.1		Thysanotus patersonii	10	0.01	
26/09/2002	10.1		Caladenia flava subsp. flava	20	0.1	
26/09/2002	10.1		Caladenia latifolia	20	0.1	
26/09/2002	10.1		Corynotheca micrantha var. micrantha	10	0.1	
26/09/2002	10.1		Desmocladus fasiculatus	10	0.1	
26/09/2002	10.1		Dichopogon preissii	10	0.1	
26/09/2002	10.1		Diuris corymbosa	10	0.1	
26/09/2002	10.1		Lagenophora huegelii	10	0.1	
26/09/2002	10.1		Microlaena stipoides var. stipoides	40	0.1	
26/09/2002	10.1		Sowerbaea laxiflora	20	0.1	
26/09/2002	10.1		Tetraria octandra	30	0.1	
26/09/2002	10.1	*	Trifolium ?campestre var. campestre	5	0.1	
26/09/2002	10.1		Jacksonia sparsa ms	20	0.2	P4
26/09/2002	10.1		Lomandra ?preissii	40	0.2	
26/09/2002	10.1		Lomandra micrantha subsp. micrantha	20	0.2	
26/09/2002	10.1		Trachymene pilosa	10	0.2	
26/09/2002	10.1		Dianella revoluta var. divaricata	50	0.3	
26/09/2002	10.1		Leucopogon propinquus	30	0.4	
26/09/2002	10.1		Conostylis aculeata subsp. aculeata	20	0.5	
26/09/2002	10.1		Hardenbergia comptoniana	ck	0.5	
26/09/2002	10.1		Lepidosperma squamatum	30	0.5	
26/09/2002	10.1		Austrostipa compressa	40	1	
26/09/2002	10.1		Austrostipa tenuifolia	50	1	
26/09/2002	10.1		Burchardia umbellata	30	1	
26/09/2002	10.1		Kennedia prostrata	5	1	
26/09/2002	10.1		Xylomelum occidentale	800	1	
26/09/2002	10.1	*	Romulea rosea	10	2	
26/09/2002	10.1		Xanthorrhoea gracilis	70	2	
26/09/2002	10.1		Macrozamia riedlei	150	4	
26/09/2002	10.1		Banksia attenuata	600	10	
26/09/2002	10.1		Corymbia calophylla	2000	10	
26/09/2002	10.1		Hibbertia hypericoides	40	10	
26/09/2002	10.1		Eucalyptus gomphocephala	1800	50	
26/09/2002	10.1		Acacia huegelii	opp		
26/09/2002	10.1		Acacia pulchella var. glaberrima	opp		
26/09/2002	10.1		Agonis flexuosa var. flexuosa	opp		
26/09/2002	10.1	*	Anagallis arvensis var. caerulea	opp		
26/09/2002	10.1		Anigozanthos mangleisii subsp. mangleisii	opp		
26/09/2002	10.1	*	Arctotheca calendula	opp		
26/09/2002	10.1		Asteridea pulverulenta	opp		
26/09/2002	10.1		Astroloma ciliatum	opp		
26/09/2002	10.1	*	Avena barbata	opp		
26/09/2002	10.1		Banksia grandis	opp		
26/09/2002	10.1		Billardiera laxiflora	opp		
26/09/2002	10.1		Bossiaea eriocarpa	opp		
26/09/2002	10.1	*	Briza maxima	opp		
26/09/2002	10.1	*	Briza minor	opp		
26/09/2002	10.1		Caesia micrantha	opp		
26/09/2002	10.1		Caladenia georgei	opp		
26/09/2002	10.1		Caladenia speciosa	opp		P4
26/09/2002	10.1		Chamaescilla corymbosa var. corymbosa	opp		
26/09/2002	10.1		Clematis linearifolia	opp		
26/09/2002	10.1		Conostephium pendulum	opp		
26/09/2002	10.1		Craspedia variabilis	opp		
26/09/2002	10.1		Crassula colorata var. colorata	opp		
26/09/2002	10.1		Dampiera linearis	opp		
26/09/2002	10.1		Dasypogon bromeliifolius	opp		
26/09/2002	10.1		Daviesia divaricata var. divaricata ms	opp		
26/09/2002	10.1		Diuris corymbosa	opp		

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Date	Site	*	Species	Ht (cm)	CA (%)	Status
26/09/2002	10.1	*	Ehrharta calycina	opp		
26/09/2002	10.1		Eucalyptus marginata subsp. marginata	opp		
26/09/2002	10.1	*	Euphorbia terracina	opp		
26/09/2002	10.1	*	Freesia alba x leichtlinii	opp		
26/09/2002	10.1	*	Fumaria capreolata	opp		
26/09/2002	10.1		Hibbertia racemosa	opp		
26/09/2002	10.1		Hovea chorizemifolia	opp		
26/09/2002	10.1		Hybanthus calycinus	opp		
26/09/2002	10.1	*	Hypochaeris glabra	opp		
26/09/2002	10.1		Leptoceras menziesii	opp		
26/09/2002	10.1		Lobelia tenuoir	opp		
26/09/2002	10.1		Logania serpyllifolia subsp. angustifolia	opp		
26/09/2002	10.1		Lomandra brittanii	opp		
26/09/2002	10.1		Lomandra hermaphrodita	opp		
26/09/2002	10.1		Lomandra purpurea	opp		
26/09/2002	10.1	*	Lupinus angustifolius	opp		
26/09/2002	10.1	*	Lupinus cosentinii	opp		
26/09/2002	10.1		Luzula meridionalis	opp		
26/09/2002	10.1	*	Melilotus siculus	opp		
26/09/2002	10.1		Millotia myosotidifolia	opp		
26/09/2002	10.1		Opercularia hispidula var. pauciflora	opp		
26/09/2002	10.1		Opercularia vaginata	opp		
26/09/2002	10.1		Orthrosanthus laxus var. laxus	opp		
26/09/2002	10.1	*	Oxalis pes-caprae	opp		
26/09/2002	10.1		Patersonia umbrosa subsp. umbrosa	opp		
26/09/2002	10.1		Petrophile linearis	opp		
26/09/2002	10.1	*	Petrorhagia dubia	opp		
26/09/2002	10.1		Philotheca spicata	opp		
26/09/2002	10.1		Phyllanthus calycinus	opp		
26/09/2002	10.1		Picris squarrosa	opp		
26/09/2002	10.1		Poa porphyroclados	opp		
26/09/2002	10.1		Prasophyllum elatum	opp		
26/09/2002	10.1		Pyrochis nigricans	opp		
26/09/2002	10.1		Rhodanthe corymbosa	opp		
26/09/2002	10.1	*	Sonchus oleraceus	opp		
26/09/2002	10.1		Synaphea spinulosa subsp. spinulosa	opp		
26/09/2002	10.1	*	Trifolium subterraneum	opp		
26/09/2002	10.1	*	Ursinia anthemoides	opp		
26/09/2002	10.1		Wahlenbergia gracilenta	opp		
26/09/2002	10.1		Waitzia suaveolens var. suaveolens	opp		
26/09/2002	10.1		Xanthorrhoea brunonis subsp. brunonis	opp		
26/09/2002	10.2		Acanthocarpus preissii	35	0.1	
26/09/2002	10.2		Bossiaea eriocarpa	35	0.1	
26/09/2002	10.2		Caladenia latifolia	40	0.1	
26/09/2002	10.2		Carex appressa	35	0.1	
26/09/2002	10.2		Dianella revoluta var. divaricata	45	0.1	
26/09/2002	10.2		Diuris corymbosa	40	0.1	
26/09/2002	10.2		Drosera erythrorhiza subsp. erythrorhiza	1	0.1	
26/09/2002	10.2		Drosera pallida	T	0.1	
26/09/2002	10.2		Drosera stolonifera subsp. stolonifera	15	0.1	
26/09/2002	10.2	*	Geranium molle	35	0.1	
26/09/2002	10.2		Lagenophora huegelii	30	0.1	
26/09/2002	10.2		Lasiopetalum membranaceum	30	0.1	P3
26/09/2002	10.2		Macrozamia riedlei	100	0.1	
26/09/2002	10.2		Microlaena stipoides var. stipoides	45	0.1	
26/09/2002	10.2		Patersonia umbrosa subsp. umbrosa	45	0.1	
26/09/2002	10.2		Rhodanthe corymbosa	70	0.1	
26/09/2002	10.2		Synaphea spinulosa subsp. spinulosa	40	0.1	
26/09/2002	10.2		Acacia pulchella var. glaberrima	30	0.5	
26/09/2002	10.2		Corynotheca micrantha var. micrantha	35	0.5	

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Date	Site	*	Species	Ht (cm)	CA (%)	Status
26/09/2002	10.2		Lomandra preissii	35	0.5	
26/09/2002	10.2		Opercularia hispidula var. pauciflora	35	0.5	
26/09/2002	10.2		Orthrosanthus laxus var. laxus	45	0.5	
26/09/2002	10.2	*	Oxalis corniculata	25	0.5	
26/09/2002	10.2		Sowerbaea laxiflora	25	0.5	
26/09/2002	10.2		Clematis linearifolia	T	1	
26/09/2002	10.2		Conostylis aculeata subsp. aculeata	20	1	
26/09/2002	10.2		Daviesia divaricata var. divaricata ms	110	1	
26/09/2002	10.2		Hardenbergia comptoniana	T	1	
26/09/2002	10.2		Lepidosperma squamatum	50	1	
26/09/2002	10.2		Rhagodia baccata subsp. baccata	40	2	
26/09/2002	10.2		Dichopogon preissii	15	4	
26/09/2002	10.2		Daucus glochidiatus	10	5	
26/09/2002	10.2		Hibbertia hypericoides	45	5	
26/09/2002	10.2		Phyllanthus calycinus	40	5	
26/09/2002	10.2	*	Sonchus oleraceus	20	5	
26/09/2002	10.2	*	Trifolium ?campestre var. campestre	35	5	
26/09/2002	10.2	*	Romulea rosea	40	10	
26/09/2002	10.2	*	Anagallis arvensis var. caerulea	15	30	
26/09/2002	10.2		Agonis flexuosa var. flexuosa	800	40	
26/09/2002	10.2	*	Briza maxima	45	40	
26/09/2002	10.2		Eucalyptus gomphocephala	1600	45	
26/09/2002	10.2		Acacia cochlearis	opp		
26/09/2002	10.2		Acacia saligna	opp		
26/09/2002	10.2	*	Arctotheca calendula	opp		
26/09/2002	10.2		Austrostipa tenuifolia	opp		
26/09/2002	10.2	*	Briza minor	opp		
26/09/2002	10.2		Burchardia umbellata	opp		
26/09/2002	10.2		Caesia micrantha	opp		
26/09/2002	10.2		Caladenia flava subsp. flava	opp		
26/09/2002	10.2		Caladenia georgei	opp		
26/09/2002	10.2		Caladenia speciosa	opp		P4
26/09/2002	10.2	*	Cotula turbinata	opp		
26/09/2002	10.2		Dichondra repens	opp		
26/09/2002	10.2		Diplolaena dampieri	opp		
26/09/2002	10.2	*	Ehrharta calycina	opp		
26/09/2002	10.2	*	Ehrharta longiflora	opp		
26/09/2002	10.2		Eremophila glabra subsp. albicans	opp		
26/09/2002	10.2	*	Erodium cicutarium	opp		
26/09/2002	10.2		*Eryngium pinnatifidum* subsp. *pinnatifidum ms*	opp		
26/09/2002	10.2		Eucalyptus marginata subsp. marginata	opp		
26/09/2002	10.2	*	Euphorbia peplus	opp		
26/09/2002	10.2	*	Euphorbia terracina	opp		
26/09/2002	10.2		Haemodorum spicatum	opp		
26/09/2002	10.2		Hibbertia cuneiformis	opp		
26/09/2002	10.2		Hibbertia racemosa	opp		
26/09/2002	10.2		Hovea trisperma	opp		
26/09/2002	10.2		Hybanthus calycinus	opp		
26/09/2002	10.2	*	Hypochaeris glabra	opp		
26/09/2002	10.2		Isolepis nodosa	opp		
26/09/2002	10.2		Isotropis cuneifolia subsp. cuneifolia	opp		
26/09/2002	10.2		Kennedia coccinea	opp		
26/09/2002	10.2		Lagenophora huegelii	opp		
26/09/2002	10.2	*	Lagurus ovatus	opp		
26/09/2002	10.2		Leucopogon propinquus	opp		
26/09/2002	10.2		Lomandra brittanii	opp		
26/09/2002	10.2		Oligochaetochilus vittatus	opp		
26/09/2002	10.2	*	Oxalis pes-caprae	opp		
26/09/2002	10.2	*	Petrorhagia dubia	opp		
26/09/2002	10.2		Prasophyllum elatum	opp		

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Date	Site	*	Species	Ht (cm)	CA (%)	Status
26/09/2002	10.2		Schoenus grandiflorus	opp		
26/09/2002	10.2		Spyridium globulosum	opp		
26/09/2002	10.2		Thysanotus patersonii	opp		
26/09/2002	10.2		Thysanotus sparteus	opp		
26/09/2002	10.2		Trachymene pilosa	opp		
26/09/2002	10.2	*	Ursinia anthemoides	opp		
26/09/2002	10.3	*	Apium graveolens	5	0.01	
26/09/2002	10.3	*	Sonchus oleraceus	5	0.01	
26/09/2002	10.3	*	Cotula turbinata	10	0.1	
26/09/2002	10.3	*	Trifolium sp.	5	0.1	
26/09/2002	10.3		Acacia saligna	400	0.5	
26/09/2002	10.3		Gahnia trifida	70	0.5	
26/09/2002	10.3		Cassytha racemosa forma racemosa	ck	1	
26/09/2002	10.3	*	Romulea rosea	10	1	
26/09/2002	10.3	*	Carex divisa	20	10	
26/09/2002	10.3		Melaleuca teretifolia	400	20	
26/09/2002	10.3		Poaceae sp.	20	35	
26/09/2002	10.3		Melaleuca rhaphiophylla	800	40	
26/09/2002	10.3	*	Cynodon dactylon	10	50	
26/09/2002	10.3		Baumea juncea	opp		
26/09/2002	10.3		Cotula coronopifolia	opp		
26/09/2002	10.3		Eucalyptus rudis subsp. rudis	opp		
26/09/2002	10.3	*	Isolepis marginata	opp		
26/09/2002	10.3	*	Juncus bufonius	opp		
26/09/2002	10.3		Melaleuca viminea subsp. viminea	opp		
26/09/2002	10.3	*	Melilotus siculus	opp		
26/09/2002	10.4 releve		Caladenia latifolia	20	0.01	
26/09/2002	10.4 releve		Cassytha racemosa forma racemosa	ck	0.01	
26/09/2002	10.4 releve	*	Hypochaeris glabra	5	0.01	
26/09/2002	10.4 releve		Picris squarrosa	10	0.01	
26/09/2002	10.4 releve		Pimelea sp.	60	0.01	
26/09/2002	10.4 releve		Sonchus hydrophilus	20	0.01	
26/09/2002	10.4 releve	*	Trifolium campestre var. campestre	10	0.01	
26/09/2002	10.4 releve		Boronia spathulata	60	0.1	
26/09/2002	10.4 releve	*	Briza maxima	20	0.1	
26/09/2002	10.4 releve		Dampiera trigona	40	0.1	
26/09/2002	10.4 releve		Eutaxia virgata	50	0.1	
26/09/2002	10.4 releve		Lyginia imberbis	40	0.1	
26/09/2002	10.4 releve		Meeboldina decipiens subsp. decipiens ms	50	0.1	
26/09/2002	10.4 releve	*	Sonchus oleraceus	10	0.1	
26/09/2002	10.4 releve		Acacia saligna		0.5	
26/09/2002	10.4 releve	*	Ehrharta calycina	50	0.5	
26/09/2002	10.4 releve		Eucalyptus rudis subsp. rudis		0.5	
26/09/2002	10.4 releve		Opercularia hispidula var. pauciflora	10	0.5	
26/09/2002	10.4 releve	*	Romulea rosea	20	0.5	
26/09/2002	10.4 releve		Hakea varia	200	1	
26/09/2002	10.4 releve		Juncus pallidus	60	1	
26/09/2002	10.4 releve		Isolepis nodosa	50	2	
26/09/2002	10.4 releve		Oxylobium lineare	200	3	
26/09/2002	10.4 releve		Lepidosperma longitudinale	60	10	
26/09/2002	10.4 releve	*	Cynodon dactylon	10	30	
26/09/2002	10.4 releve		Melaleuca rhaphiophylla	1000	40	
27/09/2002	11.1	*	Arctotheca calendula	10	0.01	
27/09/2002	11.1	*	Vicia sativa subsp. nigra	10	0.01	
27/09/2002	11.1	*	Avena barbata	40	0.1	
27/09/2002	11.1		Eucalyptus rudis subsp. rudis	800	0.1	
27/09/2002	11.1		Halosarcia halocnemoides subsp. halocnemoides	10	0.5	
27/09/2002	11.1		Halosarcia undulata	10	0.5	
27/09/2002	11.1	*	Oxalis pes-caprae	20	0.5	
27/09/2002	11.1		Threlkeldia diffusa	30	0.5	

Appendix C

Date	Site	*	Species	Ht (cm)	CA (%)	Status
27/09/2002	11.1		Halosarcia lepidosperma	20	1	
27/09/2002	11.1	*	Paspalum vaginatum	5	1	
27/09/2002	11.1		Samolus repens var. repens	10	1	
27/09/2002	11.1		Casuarina obesa	800	3	
27/09/2002	11.1		Frankenia pauciflora	30	3	
27/09/2002	11.1	*	Watsonia meriana var. bulbillifera	60	10	
27/09/2002	11.1		Juncus kraussii subsp. australiensis	120	80	

Appendix D

Photograph of Each Plot

Site 1.1: *Kunzea glabrescens* Closed Tall Scrub with emergent *Melaleuca preissiana* and *Corymbia calophylla*

Site 1.2: *Corymbia calophylla, Eucalyptus marginata* subsp. *marginata, Banksia attenuata* and *Banksia ilicifolia* Open Woodland over *Kunzea glabrescens* Tall Open Scrub

Site 1.3: *Eucalyptus marginata* subsp. *marginata, Corymbia calophylla, Banksia attenuata* and *Banksia ilicifolia* Woodland over *Allocasuarina humilis* and *Xanthorrhoea brunonis* subsp. *brunonis* Shrubland

Site 2.1: *Eucalyptus gomphocephala* and *Agonis flexuosa* var. *flexuosa* Open Forest to Woodland

Site 2.2: *Melaleuca raphiophylla* Open Woodland

Site 3.1: *Banksia attenuata, Eucalyptus marginata* subsp. *marginata* and *Xylomelum occidentale* Low Open Woodland over *Melaleuca thymoides, Kunzea glabrescens, Hypocalymma robustum* and *Adenanthos meisneri* Shrubland

Site 3.2: *Eucalyptus marginata* subsp. *marginata* and *Corymbia calophylla* Woodland over *Banksia grandis* Low Open Woodland

Site 3.3: *Eucalyptus marginata* subsp. *marginata* and *Corymbia haematoxylon* Woodland over *Xanthorrhoea preissii* Open Shrubland

Site 3.4: *Corymbia calophylla* Open Forest over *Agonis flexuosa* var. *flexuosa* Low Open Forest

Site 4.1: *Corymbia calophylla* and *Agonis flexuosa* var. *flexuosa* Open Forest

Site 4.2: *Eucalyptus rudis* subsp. *rudis* and *Agonis flexuosa* var. *flexuosa* Open Forest

Site 4.3: *Agonis flexuosa* var. *flexuosa* Closed Forest

Site 4.4: *Melaleuca preissiana* and *Agonis flexuosa* var. *flexuosa* Low Open Forest

Site 4.5: *Melaleuca raphiophylla* Low Open Forest

Site 4.6: *Corymbia calophylla* and *Eucalyptus marginata* subsp. *marginata* Open Woodland over Tall Shrubland dominated by *Melalecua preissiana, Banksia littoralis, Agonis flexuosa* var. *flexuosa* and *Kunzea glabrescens* and combinations of these

Site 5.1: *Eucalyptus rudis* subsp. *rudis* and *Melaleuca raphiophylla* Woodland

Site 5.2: *Melaleuca raphiophylla* Closed Forest

Site 5.3: *Eucalyptus rudis* subsp. *rudis* Woodland over *Agonis flexuosa* var. *flexuosa* and *Melaleuca raphiophylla* Woodland with occasional *Corymbia calophylla*

Site 6.1: *Eucalyptus marginata* subsp. *marginata* and *Corymbia calophylla* Woodland over *Xanthorrhoea preissii, Acacia pulchella* and *Acacia flagelliformis* Open Shrubland

Site 7A.1: Very Open Grassland dominated by **Ammophila arenaria*, **Pelargonium capitatum* and *Olearia axillaris*

Site 7A.2: *Agonis flexuosa* var. *flexuosa* and *Jacksonia furcellata* Tall Shrubland over *Alyxia buxifolia* and *Acanthocarpus preissii* Open Heath

Site 7A.3: *Eucalyptus gomphocephala* and *Agonis flexuosa* var. *flexuosa* Low Open Forest over *Spyridium globosum* and *Alyxia buxifolia* Open Heath

Site 7B.1: *Melaleuca raphiophylla* and *Melaleuca viminea* subsp. *viminea* Low Open Forest

Site 7B.2: Closed Sedgeland dominated by *Juncus krausii* subsp. *australiensis, Triglochin huegelii, Baumea juncea* and **Juncus oxycarpus* and combinations of these

Site 7B.3: *Halosarcia lepidosperma, Halosarcia indica* subsp. *bidens* and *Juncus krausii* subsp. *australiensis* Open Low Heath

Site 8.1: *Corymbia calophylla* and *Eucalyptus marginata* subsp. *marginata* Open Forest to Woodland over *Banksia grandis* and *Agonis flexuosa* var. *flexuosa* Woodland

Site 8.2: *Corymbia calophylla* and *Eucalyptus marginata* subsp. *marginata* Woodland over *Jacksonia furcellata, Kunzea ericifolia* subsp. *ericifolia* and *Agonis flexuosa* var. *flexuosa* Woodland

Site 8.3: *Eucalyptus rudis* subsp. *rudis* and *Melaleuca raphiophylla* Open Forest over *Melaleuca incana* subsp. *incana* Tall Open Scrub

Site 8.4: *Corymbia calophylla, Eucalyptus rudis* subsp. *rudis* and *Casuarina obesa* Woodland

Site 9.1: *Lepidospermum gladiatum* Sedgeland

Site 9.2: *Agonis flexuosa* var. *flexuosa* Open Forest

Site 9.3: *Eucalyptus gomphocephala* Closed Forest over *Agonis flexuosa* var. *flexuosa* Low Open Forest

Site 9.4: Open Low Heath dominated by *Scaevola crassifolia, *Pelargonium capitatum* and *Olearia axillaris*

Site 9.5: Open Low Heath dominated by *Acanthocarpos preissii, Phyllanthus calycinus, Acacia cochlearis* and *Lepidosperma gracile* with emergent *Agonis flexuosa var. flexuosa*

Site 9.6: *Banksia littoralis* Low Woodland over Tall Open Scrub dominated by *Xanthorrhoea preissii, Anthocercis littorea* and *Acacia saligna*

Site 9.7: Closed Sedgelands dominated by *Lepidosperma gladiatum, Carex appressa, *Typha orientalis* and *Pteridium esculentum* and combinations of these with emergent *Acacia saligna, Banksia littoralis, Agonis flexuosa* var. *flexuosa* and *Melaleuca raphiophylla*

Site 10.1: *Eucalyptus gomphocephala, Corymbia calophylla* and *Eucalyptus marginata* subsp. *marginata* Open Forest over Low Woodland dominated by *Banksia attenuata, Banksia grandis, Agonis flexuosa* var. *flexuosa* and *Xylomelum occidentale* and combinations of these

Site 10.2: *Eucalyptus gomphocephala* Open Forest over *Agonis flexuosa* var. *flexuosa* Low Open Forest

Site 10.3: *Melaleuca raphiophylla* and *Melaleuca teretifolia* Low Open Forest with emergent *Eucalyptus rudis* subsp. *rudis*

Site 10.4: *Melaleuca raphiophylla* and *Melaleuca teretifolia* Low Open Forest with emergent *Eucalyptus rudis* subsp. *rudis* (site 10.3 in better condition)

Site 11.1: *Juncus krausii* subsp. *australiensis* Closed Sedgeland with emergent *Casuarina obesa* and *Eucalyptus rudis* subsp. *rudis*

Appendix E

Fauna Species List

Appendix E

Mammal species recorded or expected to occur in the Bunbury Region.

NATIVE SPECIES

		Sites	Muddy	WAM
Monotremes				
Tachyglossus aculeatus	*Echidna			
Marsupials				
Dasyuridae				
Antechinus flavipes leucogaster	*Mardo or Yellow-footed Antechinus			N
Dasyurus geoffroii	Chuditch or Western Quoll			N S
Phascogale tapoatafa tapoatafa	Wambenger or Brush-tailed Phascogale			N
Sminthopsis gilberti	*Gilbert's Dunnart			N
Myrmecobiidae				
Myrmecobius fasciatus	^Numbat			N
Peramelidae				
Isoodon obesulus fusciventer	Quenda or Southern Brown Bandicoot		N S	N
Burramyidae				
Cercartetus concinnus	Western Pygmy Possum			N
Pseudocheiridae				
Pseudocheirus occidentalis	Western Ringtail Possum		S	N S
Tarsipedidae				
Tarsipes rostratus	Honey Possum			
Phalangeridae				
Trichosurus vulpecula vulpecula	Brushtail Possum			N
Macropodidae				
Macropus irma	Western Brush Wallaby			N
Macropus fuliginosus	Western Grey Kangaroo	1 2 5 7A 8 10	N S	
Setonix brachyurus	Quokka		S	S
Placental Mammals				
Molossidae				
Tadarida australis	White-striped Mastiff Bat		N	
Vespertilionidae				
Chalinolobus gouldii	Gould's Wattled Bat			N
Chalinolobus morio	Chocolate Wattled Bat			
Falsistrellus mackenziei	Western False Pipistrelle			N S
Vespadelus regulus	Southern Forest Bat			N
Muridae				
Hydromys chrysogaster	Water Rat			N S
Rattus fuscipes	*Western Bush Rat			

* although potentially present in the region these species have not been recorded during surveys in the past 20 years.
^ The Numbat record is presumably based on historical data.

Appendix E

INTRODUCED SPECIES

		Sites	Muddy	WAM
Muridae				
Rattus rattus	Black Rat		N	N S
Mus musculus	House Mouse		N S	N
Bovidae				
Bos taurus	Cattle	4 5 6 7B	S	S
Ovis aries	Sheep	4		
Equidae				
Equus caballus	Horse	4 6	S	
Suidae				
Sus scrofa	Feral Pig			N
Canidae				
Vulpes vulpes	Fox			
Felidae				
Felis catus	Feral Cat			N
Leporidae				
Oryctolagus cuniculus	Rabbit	1		

Appendix E

Reptile species recorded or expected to occur in the Bunbury Region.

	Sites	Muddy	WAM
Lizards			
GEKKONIDAE			
Christinus marmoratus	1 8	N	N S
Diplodactylus polyophthalmus			
Strophurus spinigerus			
Underwoodisaurus milii			N
PYGOPODIDAE			
Aprasia repens			N
Aprasia pulchella			
Delma grayii			
Lialis burtonis	8		N S
Pygopus lepidopodus			
AGAMIDAE			
Pogona minor minor	OPP	S	N
Rankinia adelaidensis			
VARANIDAE			
Varanus gouldii			
Varanus rosenbergi			
Varanus tristis	8		
SCINCIDAE			
Acritoscincus trilineatum		N S	N S
Cryptoblepharus plagiocephalus			S
Ctenotus catenifer			
Ctenotus delli			
Ctenotus fallens			N
Ctenotus impar			
Ctenotus labillardieri			
Egernia kingii		N	N S
Egernia luctuosa	8	N	N S
Egernia napoleonis		S	N
Egernia pulchra pulchra			
Glaphyromorphus gracilipes			N
Glaphyromorphus aff. *gracilipes*			
Hemiergis initialis initialis			
Hemiergis peronii			S
Hemiergis quadrilineata	1 8 10		N
Lerista distinguenda			N
Lerista elegans			N S
Lerista lineata			
Lerista microtis microtis			N
Menetia greyii			N
Morethia lineoocellata			N
Morethia obscura			N
Tiliqua occipitalis			
Tiliqua rugosa rugosa	4	S	

Appendix E

	Sites	Muddy	WAM
Snakes			
TYPHLOPIDAE			
Ramphotyphlops australis		N	N S
Ramphotyphlops pinguis			N S
ELAPIDAE			
Demansia psammophis reticulata			N
Echiopsis curta			N
Elapognathus coronatus			N
Neelaps bimaculatus			N
Notechis scutatus	2	N S	N S
Parasuta gouldii			N
Parasuta nigriceps			N
Pseudonaja affinis affinis		N S	N S
Simoselaps bertholdi			N
BOIDAE			
Morelia spilota imbricata			
Turtles			
CHELIDAE			
Chelodina oblonga			N

Notes:
Aprasia pulchella, Diplodactylus polyophthalmus, Underwoodisaurus millii, Ctenotus delli, Egernia pulchra pulchra, Hemiergis initialis initialis and *Lerista microtis microtis* are generally restricted to areas east of the coastal plain. i..e the Darling Scarp and Range.

Appendix E

Frog species recorded or expected to occur in the Bunbury Region.

		Sites	Muddy	WAM
HYLIDAE				
Litoria adelaidensis	Slender Tree Frog	5 7A 7B	S	N
Litoria moorei	Motorbike Frog	7A	N S	N
MYOBATRACHIDAE				
Crinia georgiana	Quacking Frog			N
Crinia glauerti	Glauert's Froglet	5 7A 7B 8	N S	N
Crinia insignifera	Squelching Froglet	1		NS
Geocrinia leai	Lea's Frog	I	S	N
Heleioporus barycragus	Western Marsh Frog			
Heleioporus eyrei	Moaning Frog			NS
Heleioporus inornatus	Plain Frog			N
Heleioporus psammophilus	Sand Frog			
Limnodynastes dorsalis	Banjo Frog		N	NS
Myobatrachus gouldii	Turtle Frog			
Pseudophryne guentheri	Günther's Toadlet			N

Notes:
Heleioporus barycragus occurs along the Darling Scarp. It does not occur on the coastal plain. Similarly *Heleioporus inornatus* occurs in the Darling Range.
Heleioporus eyrei breeds in Autumn hence was not recorded during the September survey.

Appendix E

Species by site table for birds recorded during the field survey.

			Muddy Lakes					Survey Sites													
Species	Common Name	Status	G 1	G 2	G 3	G 4	All	S 1	S 2	S 3	S 4	S 5	S 6	S 7A	S 7B	S 8	S 10	S 11	Lesch	Sum	%
Cygnus atratus	Black Swan						1											1	1	3	25
Anas castanea	Chestnut Teal						1													1	8
Anas gracilis	Grey Teal						1	1			1		1	1		1			1	7	58
Anas rhynchotis	Australasian Shoveller	Bh						1							1					2	17
Anas superciliosa	Pacific Black Duck			1			1	1		1	1	1	1	1	1	1		1	1	11	92
Biziura lobata	Musk Duck	Bh					1						1							2	17
Chenonetta jubata	Maned Duck (Wood)						1	1			1	1		1		1			1	7	58
Tadorna tadornoides	Australian Shelduck						1	1					1		1			1	1	6	50
Poliocephalus poliocephalus	Hoary-headed Grebe							1								1			1	3	25
Tachybaptus novahollandeiae	Australasian Grebe						✓												1	1	8
Anhinga melanogaster	Darter						✓												1	1	8
Phalacrocorax carbo	Great Cormorant													1		1			1	3	25
Phalacrocorax varius	Pied Cormorant													1		1			1	3	25
Phalacrocorax melanoleucos	Little Pied Cormorant						1	1			1	1							1	5	42
Phalacrocorax sulcirostris	Little Black Cormorant													1					1	2	17
Pelecanus conspicillatus	Australian Pelican																	1	1	2	17
Ardea alba	Great Egret						✓											1	1	2	17
Egretta garzetta	Little Egret															1			1	2	17
Ardea pacifica	White-necked Heron						1					1	1		1					4	33
Egretta novaehollandiae	White-faced Heron						1			1	1	1	1			1		1	1	8	67
Platalea flavipes	Yellow-billed Spoonbill						1					1						1	1	4	33
Threskiornis aethiopica	Australian White Ibis						1				1	1	1		1	1			1	7	58
Threskiornis spinicollis	Straw-necked Ibis						✓			1			1		1				1	4	33
Hieraaetus morphnoides	Little Eagle	Bp		stick			✓	1												1	8
Haliaeetus leucogaster	White-bellied Sea Eagle	I																	1	1	8
Circus approximans	Swamp Harrier						1								1				1	3	25
Elanus axillaris	Black-shouldered Kite					1	1				1				1		✓			3	25
Haliastur sphenurus	Whistling Kite	Bp	1			1	1								1				1	3	25
Falco cenchroides	Australian Kestrel						✓					1			1				1	3	25
Falco longipennis	Australian Hobby						1													1	8
Fulica atra	Eurasian Coot						✓						1						1	2	17
Gallinula tenebrosa	Dusky Moorhen	Bh					✓												1	1	8
Porphyrio porphyrio	Purple Swamphen						1													1	8
Actitis hypoleucos	Common Sandpiper	I																	1	1	8
Tringa nebularia	Greenshank	I																	1	1	8
Calidris ferruginea	Curlew Sandpiper	I																	1	1	8
Haematopus longirostris	Pied Oystercatcher																		1	1	8
Himantopus himantopus	Black-winged Stilt																	1	1	2	17
Recurvirostra novaehollandiae	Red-necked Avocet																	1	1	2	17

Painted Button Quail ✓

Appendix E

Species by site table for birds recorded during the field survey.

Species	Common Name	Status	G 1	G 2	G 3	G 4	All	S 1	S 2	S 3	S 4	S 5	S 6	S 7A	S 7B	S 8	S 10	S 11	Lesch	Sum	%
Elseyornis melanops	Black-fronted Dotterel							1		1			1							3	25
Pluvialis squatarola	Grey Plover	I																	1	1	8
Vanellus tricolor	Banded Lapwing														1					1	8
Larus novaehollandiae	Silver Gull					1	1							1				1	1	4	33
Sterna caspia	Caspian Tern	I																	1	1	8
Sterna bergii	Crested Tern	I																	1	1	8
Ocyphaps lophotes	Crested Pigeon						1						1		1					3	25
Phaps chalcoptera	Common Bronzewing	Bh					1	1		1					1		1		1	6	50
Streptopelia senegalensis	Laughing Turtle-dove																		1	1	8
Cacatua roseicapilla	Galah						1	1	✓	1				1			1		1	6	50
Cacatua sanguinea	Corella sp.																1			1	8
Calyptorhynchus baudinii	Long-billed Black Cockatoo	S1, V					✓		1	1										2	17
Calyptorhynchus latirostris	Short-billed Black Cockatoo	S1, E																	1	1	8
Barnardius zonarius	Australian Ringneck				1	1	1	1	1✓	1	1	1	1	1	1	1	1	1	1	13	108
Platycercus icterotis	Western Rosella	Bp			1		1										✓			1	8
Purpureicephalus spurius	Red-capped Parrot						1	1		1	1	1	1			1	✓		1	8	67
Glossopsitta porphyrocephala	Purple-crowned Lorikeet			Elegant			1													1	8
Polytelis anthopeplus	Regent Parrot						1		1								✓			2	17
Cacomantis flabelliformis	Fan-tailed Cuckoo		1		1		1													1	8
Chrysococcyx basalis	Horsfield's Bronze Cuckoo					1	1													1	8
Chrysococcyx lucidus	Shining Bronze-cuckoo		1	Tawny Frogmouth			1				1						1		1	4	33
Cuculus pallidus	Pallid Cuckoo						1	1					1			1			1	5	42
Dacelo novaeguineae	Laughing Kookaburra			Emu wren	1	1	1		1✓		1			1		1	1		1	7	58
Todiramphus sanctus	Sacred Kingfisher						1												1	2	17
Merops ornatus	Rainbow Bee-eater						1												1	2	17
Malurus splendens	Splendid Fairy-wren	Bh	1	1	1	1	1	1	1	1	1	1		1		1	1		1	10	83
Acanthiza apicalis	Inland Thornbill	Bh	1	1	1	1	1			1	1	1		1			✓		1	6	50
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	Bh					1	1	1		1	1	1	1	1	1	1	1	1	12	100
Gerygone fusca	Western Gerygone		1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	13	108
Smicrornis brevirostris	Weebill	Bh			1		1					1		1			✓			3	25
Sericornis frontalis	White-browed Scrub-wren	Bh	1	1	1	1	1										✓			1	8
Pardalotus punctatus	Spotted Pardalote																		1	1	8
Pardalotus striatus	Striated Pardalote				1		1		✓	1	1	1	1	1		1	1		1	9	75
Anthochaera carunculata	Red Wattlebird		1		1	1	1	1	1✓	1	1		1			1	1		1	9	75
Lichenostomus virescens	Singing Honeyeater																		1	1	8
Lichmera indistincta	Brown Honeyeater		1		1	1	1	1		1	1		1	1		1	1	1	1	10	83
Phylidonyris novaehollandiae	New Holland Honeyeater	Bp	1			1	1													1	8
Epthianura albifrons	White-fronted Chat														1					1	8
Petroica multicolor	Scarlet Robin	Bh							1		1				1		✓			3	25
Daphoenositta chrysoptera	Varied Sittella	Bh			1		1													1	8

Boobook ✓

Appendix E

Species by site table for birds recorded during the field survey.

Species	Common Name	Status	G 1	G 2	G 3	G 4	All	S 1	S 2	S 3	S 4	S 5	S 6	S 7A	S 7B	S 8	S 10	S 11	Lesch	Sum	%
Colluricincla harmonica	Grey Shrike-Thrush	Bh	1		1	1	1				1	1		1			✓			4	33
Pachycephala pectoralis	Golden Whistler	Bh	1		1		1								1		✓			2	17
Pachycephala rufiventris	Rufous Whistler		1		1	1	1				1	1				1			1	5	42
Grallina cyanoleuca	Australian Magpie-lark						1	1			1	1	1						1	6	50
Rhipidura fuliginosa	Grey Fantail		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	12	100
Rhipidura leucophrys	Willie Wagtail					1	1		1			1	1	1	1	1		1	1	9	75
Coracina novaehollandiae	Black-faced Cuckoo-shrike				1	1	1			1	1	1	1		1		1		1	8	67
Lalage sueurii	White-winged Triller					1	1													1	8
Artamus cinereus	Black-faced Woodswallow	Bp				1	1								1				1	3	25
Cracticus torquatus	Grey Butcherbird			1	1	1	1		1		1						1			4	33
Gymnorhina tibicen	Australian Magpie					1	1	1	1✓	1		1	1		1	1	1		1	10	83
Strepera versicolor	Grey Currawong	Bp														1				1	8
Corvus coronoides	Australian Raven				1	1	1	1	✓	1	1	1	1		1	1	1		1	10	83
Anthus novaeseelandiae	Richard's Pipit						✓			1					1					2	17
Acrocephalus stentoreus	Clamorous Reed-Warbler						1													1	8
Megalurus gramineus	Little Grassbird			1			1								1				1	3	25
Hirundo neoxena	Welcome Swallow					1	1	1		1	1		1		1				1	7	58
Hirundo nigricans	Tree Martin						1		✓			1			1				1	4	33
Zosterops lateralis	Silvereye		1	1	1	1	1	1	1		1	1	1	1		1	1	1	1	11	92
	Species richness:		15	8	21	25	61	25	14	21	28	26	27	21	29	26	18	16	67		

14
25

50
+ other 2 surveys.

Key: G1 - G4 = Muddy Lake grids
S1, etc. = survey sites
All denotes complete list for Muddy lakes including opportunitic records
Sum is number of records
% = percentage occurrence
Lesch includes survey of Vittoria Bay / Preston river mouth, records from Collie River, caravan park, Egret Swamp, Westgarth, Bar Island, north and east parts of the Estuary and previous surveys (2001) of Bunbury mangroves and Vittoria Bay area

Status codes:
S1 Schedule 1
S4 Schedule 4
P1 etc. Priority species
I International agreements (JAMBA/CAMBA)
V EPBC Vulnerable
E EPBC Endangered
Bh Bushplan habitat specialist
Bp Bushplan reduced population

Appendix F

Common fauna

Site 1: Australind WWTP and Two Adjacent Lots

A total of 22 species of bird, two frogs, two reptiles, one introduced mammal and evidence of one native mammal were recorded in Area A. Ten birds, two mammals and two frog species were recorded in Area C.

Species recorded in the Jarrah woodland at Area A included Red-capped Parrot *Purpureicephalus spurius,* Pallid Cuckoo *Cuculus pallidus,* Red Wattlebird *Anthochaera carunculata*, Splendid Fairy-wren *Malurus splendens*, Yellow-rumped Thornbill *Acanthiza chrysorrhoa* and Little Eagle *Hieraaetus morphnoides.* There are reports of a raptor nest from this Site (Kim Williams, CALM, pers. comm.) and one of the two Eagles observed was clearly a juvenile bird, suggesting that this species breeds at the Site.

Seven waterbird species were recorded utilising the settling ponds including Grey Teal *Anas gracilis* (breeding record), Australian Shelduck *Tadorna tadornoides* (breeding record), Australasian Shoveller *Anas rhynchotis* and Black-fronted Dotterel *Elseyornis melanops*. The frogs *Crinia insignifera* and *Geocrinia leai* were found in shallowly inundated areas adjacent to the ponds. This is the only site at which these species were recorded during the survey.

The skink *Hemiergis quadrilineata* and the Marbled Gecko *Christinus marmoratus* were recorded from under pieces of bark at this Site.

At Area C the *Rabbit *Oryctolagus cuniculus* was relatively abundant based on evidence from scats, tracks and burrows in the sandy white soil. A sump adjacent to the area supports Little Pied Cormorant *Phalacrocorax melanoleucos*, Hoary-headed Grebe *Poliocephalus poliocephalus* and the frogs *Crinia glauerti* and *Litoria adelaidensis.*

The woodland areas of this Site are likely to be used by mammals such as the Brush-tailed Possum *Trichosurus vulpecula* and the introduced *House Mouse *Mus musculus*. Evidence of the Grey Kangaroo *Macropus fuliginosus* was found at the Site.

Site 2: South Dalyellup

A total of 14 bird species were recorded from the Site (Appendix E) and it is likely that a number of additional species occur. Species observed include Regent Parrot *Polytelis anthopeplus*, Splendid Fairy-wren *Malurus splendens*, Western Gerygone *Gerygone fusca*, Yellow-rumped Thornbill *Acanthiza chrysorrhoa* and Scarlet Robin *Petroica multicolor.* The Grey Kangaroo *Macropus fuliginosus* and Tiger Snake *Notechis scutatus* also occur at the Site. Wetland thickets immediately to the west of the Site are likely to be used by the Southern Brown Bandicoot *Isoodon obesulus fusciventer*, which may move onto the Site on occasion. One of the White-tailed Black Cockatoos *Calyptorhynchus* sp. was heard in an area of forest adjacent to the Site and Baudin's Cockatoo has been recorded at nearby Dalyellup Beach Estate (ATA Environmental, 1998).

Site 3: East Boyanup

Species recorded from rehabilitated areas at Site 3 include White-faced Heron *Ardea novaehollandiae*, Black-fronted Dotterel *Elseyornis melanops* and Pacific Black Duck *Anas superciliosa* in wetland areas, Splendid Fairy-wren *Malurus splendens* and Brown Honeyeater *Lichmera indistincta* in denser vegetation and Richard's Pipit *Anthus novaeseelandiae* near the edge of rehabilitated land.

The patch of Marri woodland was found to support Inland Thornbill *Acanthiza apicalis,* Red Wattlebird *Anthochaera carunculata* and Striated Pardalote *Pardalotus striatus*, and the

significant species Baudin's Black Cockatoo *Calyptorhynchus baudinii.* A flock of more than 80 Cockatoos were observed feeding on Marri trees at this Site.

Site 4: Davenport

West of the Highway 19 bird species were recorded in woodland habitat including Shining Bronze-cuckoo *Chysococcyx lucidus,* Inland Thornbill *Acanthiza apicalis*, Western Gerygone *Gerygone fusca*, Scarlet Robin *Petroica multicolor* and Grey Shrike-thrush *Colluricincla harmonica* (Appendix E). Australian Raven *Corvus coronoides* was observed feeding young at the nest.

Species recorded along the Preston River were Pacific Black Duck *Anas superciliosa*, Maned Duck *Chenonetta jubata* and Little Pied Cormorant *Phalacrocorax melanoleucos.* Horses *Equus caballus,* Cattle *Bos taurus* and Sheep *Ovis aries* were observed in paddocks along with White-faced Heron *Ardea novaehollandiae* and Australian White Ibis *Threskiornis molucca.* The only species of reptile recorded was the Bobtail *Tiliqua rugosa.* Inundated areas, flood channels and the banks of the River are potential habitat for frogs, although none were heard.

Site 5: Brunswick River Foreshore

A total of 26 species of bird, two frogs, one introduced mammal and evidence of one native mammal were recorded at this Site (Appendix E).

Large numbers of Cattle *Bos taurus* use the pasture areas of the Site. White-necked Heron *Ardea pacifica* and Australian Kestrel *Falco cenchroides* were observed in these areas, and Maned Duck *Chenonetta jubata* use the pools. Australian Raven *Corvus coronoides* was very common at the Site. The frogs *Crinia glauerti* and *Litoria adelaidensis* were recorded along the minor drainage along the southern side and Australian Ringneck *Barnardius zonarius*, Western Gerygone *Gerygone fusca*, Yellow-rumped Thornbill *Acanthiza chrysorrhoa* Inland Thornbill *Acanthiza apicalis* and Yellow-billed Spoonbill *Platalea flavipes* utilise this habitat.

Waterbird species recorded along the Brunswick River were Little Pied Cormorant *Phalacrocorax melanoleucos*, Pacific Black Duck *Anas superciliosa* and Australian White Ibis *Threskiornis molucca.* Fringing woodland supports species such as Splendid Fairy-wren *Malurus splendens*, Grey Fantail *Rhipidura fuliginosa* and Western Gerygone *Gerygone fusca*, with Weebill *Smicrornis brevirostris* and Striated Pardalote *Pardalotus striatus* using the canopy of *E. rudis.*

There is a Cormorant breeding area in swamp vegetation just west of the Site (Kim Williams, CALM pers. comm.).

Site 6: Boyanup Bypass Road

Birds such as the Australian Magpie *Gymnorhina tibicen*, Magpie-lark *Grallina cyanoleuca,* Australian Raven *Corvus coronoides* and Straw-necked Ibis *Threskiornis spinicollis* utilise these areas.

Species recorded in remnant strips of Marri include Red-capped Parrot *Purpureicephalus spurius,* Western Gerygone *Gerygone fusca*, Yellow-rumped Thornbill *Acanthiza chrysorrhoa* and Red Wattlebird *Anthochaera carunculata.*

Ten waterbird species were observed at the 'Boyanup Billabong', including Black-fronted Dotterel *Elseyornis melanops*, Eurasian Coot *Fulica atra* (breeding record), White-necked Heron *Ardea pacifica,* two species of ibis and Musk Duck *Biziura lobata.* Additional species

are likely to occur here sporadically, but it is not likely to be suitable habitat for many migratory waders. Grey Fantail *Rhipidura fuliginosa*, Black-faced Cuckoo-shrike *Coracina novaehollandiae* and Striated Pardalote *Pardalotus striatus* were found in fringing vegetation. No frogs were heard in this area although they are likely to occur.

Site 7A: Myalup

A total of 21 species of bird, three frogs and evidence of one mammal species were recorded at this Site during the field survey.

The beach area is likely to support several birds of the ocean and coast such as the resident species Pied Oystercatcher *Haematopus longirostris* and Red-capped Plover *Charadrius ruficapillus* as well as some migratory species on a seasonal basis, *e.g.* Sanderling *Calidris alba*. Silver Gull *Larus novaehollandiae* was observed in this area during the survey.

The foredune and primary dune do not support a wide variety of bird species but Splendid Fairy-wren *Malurus splendens* occurs in more thickly vegetated areas and common species such as Silvereye *Zosterops lateralis* and Brown Honeyeater *Lichmera indistincta* utilise this habitat. Reptiles such as small lizards also occur in these areas.

Further inland the taller trees of the Tuart woodland are important habitat for passerines such as the Weebill *Smicrornis brevirostris* and Striated Pardalote *Pardalotus striatus*. Peppermint supports Western Gerygone *Gerygone fusca* and Grey Fantail *Rhipidura fuliginosa*, and Grey Shrike-thrush *Colluricincla harmonica* and Inland Thornbill *Acanthiza apicalis* were also recorded at this Site. Tuart is potential habitat for Brush-tailed Possum *Trichosurus vulpecula* and Western Ringtail Possum *Pseudocheirus occidentalis* where there are thickets of Peppermint. Scats of the Grey Kangaroo *Macropus fuliginosus* were found at this Site.

The drainage channel, although strictly not part of the Site is adjacent to it, and supports species that may utilise the bushland areas. Six waterbird species were observed using the channel including Grey Teal *Anas gracilis* (breeding record), Great Cormorant *Phalacrocorax carbo* and Pied Cormorant *P. varius*. The frog species *Litoria moorei* and *Crinia glauerti* were recorded along the channel. Southern Brown Bandicoot *Isoodon obesulus fusciventer* prefers areas near water and this species may occur at the Site.

Site 7B: Buffalo Road

A total of 30 species of bird were recorded at Site 7B including 14 non-passerines and 16 passerines. Four birds of prey and seven waterbirds were observed. Two frog species were recorded.

Species recorded from samphire and sedge areas include White-fronted Chat *Epthianura albifrons* and Little Grassbird *Megalurus gramineus*. Pastures were heavily grazed by Cattle *Bos taurus* but pools support Australian Shelduck *Tadorna tadornoides* and Straw-necked Ibis *Threskiornis spinicollis* which feed in adjacent grassland areas. Australian Magpie *Gymnorhina tibicen* is also a common open area species, and Yellow-rumped Thornbill *Acanthiza chrysorrhoa* were observed in the area. This is the only Site where Banded Lapwing *Vanellus tricolor* was recorded.

Remnant trees are habitat for Western Gerygone *Gerygone fusca*, Black-faced Cuckoo-shrike *Coracina novaehollandiae* and Grey Fantail *Rhipidura fuliginosa*. Swamp Harrier *Circus approximans* was observed over the inundated sedgeland habitat, and the frogs *Crinia glauerti* and *Litoria adelaidensis* were recorded from this Site.

Site 8: Twin Rivers

Fourteen species of birds were recorded in Marri woodland areas including Red-capped Parrot *Purpureicephalus spurius,* Pallid Cuckoo *Cuculus pallidus,* Western Gerygone *Gerygone fusca*, Striated Pardalote *Pardalotus striatus*, Red Wattlebird *Anthochaera carunculata*, Rufous Whistler *Pachycephala rufiventris* and Grey Currawong *Strepera versicolor.* Reptiles recorded amongst bark and leaf litter were *Lialis burtonis* (grey morph), *Christinus marmoratus* and a species of varanid, possibly *Varanus tristis.* Tracks of the Grey Kangaroo *Macropus fuliginosus* were also observed throughout the Site.

In moister areas the skink *Hemiergis quadrilineata* was fairly common under debris and *Egernia luctuosa* was observed adjacent to water. Birds using the *Melaleuca* forest included Grey Fantail *Rhipidura fuliginosa*, Silvereye *Zosterops lateralis* and Splendid Fairy-wren *Malurus splendens*. Along the River or roosting in fringing vegetation were nine waterbird species, including Grey Teal *Anas gracilis*, Great Cormorant *Phalacrocorax carbo,* Little Egret *Egretta garzetta* and White-faced Heron *Ardea novaehollandiae*. The frog *Crinia glauerti* was heard calling at the Site.

Ecologia (2001) surveyed Site 8 for fauna including trapping and avifauna transects in late spring/summer. They recorded three native and four introduced mammal species, 32 birds including nine waterbirds, two raptors and 15 passerines, ten reptile species and four frogs (including *Crinia georgiana*). Species of interest recorded from the area included Square-tailed Kite *Lophoictinia isura,* Baudin's Black Cockatoo *Calyptorhynchus baudinii*, Common Greenshank *Tringa nebularia* and Great Egret *Egretta alba.* Red-kneed Dotterel was also recorded from the area in Riverine habitat; this species appear to be uncommon in the Bunbury Region. Despite searching the Western Ringtail Possum *Pseudocheirus occidentalis* was not observed in the area.

Site 9: Muddy Lakes

Trapping, avifauna transects and opportunistic collecting throughout the Muddy Lakes study area yielded a total of 86 vertebrate fauna species. The species list comprises five native and four introduced mammals, 61 bird species including 28 passerines and 33 non-passerines, seven lizard species from three families, three species of snake and five frogs (for a detailed description of the fauna habitats and community, refer to Appendix I). The introduced *Mosquitofish *Gambusia holbrooki* was also observed at the edge of shallow channels and pools in the area.

The most common native mammal recorded in the study area was the Western Grey Kangaroo *Macropus fuliginosus* It is anticipated that the Brush-tailed Wallaby *Macropus irma* would also occur at Muddy Lakes as they have been observed in nearby areas. The only bat recorded during the survey was the White-striped Mastiff Bat *Tadarida australis.* Other species expected to occur in woodland habitats of the area include the Western False Pipistrelle *Falsistrellus mackenziei* and Southern Forest Bat *Vespadelus regulus.*

The introduced *House Mouse *Mus musculus* was the most abundant mammal in the area. *Black Rat *Rattus rattus* was captured on two occasions. Other introduced species likely to occur are the *Feral Cat *Felis catus*, *Fox *Vulpes vulpes* and *Rabbit *Oryctolagus cuniculus.*

Birds were found to exist in relatively high numbers at all four survey grids. At the woodland grids there was a good mix of passerines, dominated by members of the family Pardalotidae (pardalotes, gerygones and thornbills) including Inland and Yellow-rumped Thornbills and White-browed Scrubwren *Sericornis frontalis.* Amongst the non-passerines the parrots (Cacatuidae and Psittacidae) dominated in the study area with nine species including the Regent Parrot *Polytelis anthopeplus* and Purple-crowned Lorikeet *Glossopsitta*

porphyrocephala recorded on a single occasion. Birds of prey included Swamp Harrier *Circus approximans* and Australian Hobby *Falco longipennis*. For a more comprehensive description of avifauna recorded in the Muddy Lakes area refer to Appendix I.

Approximately 26 species of reptile would be expected to occur in the study area based on the habitats available. However, extensive trapping over a period of years is normally required before an extensive list of species such as this is built up, since some species are exceedingly sporadic in their occurrence. Species of *Egernia* recorded in the area are endemic to south-western Australia; *E. kingii, E. luctuosa* and *E. napoleonis*. Other reptiles such as the Tiger Snake *Notechis scutatus* and Bobtail *Tiliqua rugosa* are widespread in southern Australia. The gecko *Christinus marmoratus* was found under exfoliating bark on Tuart trees. The Long-necked Tortoise *Chelodina oblonga* may also occur within pools in the wetlands at Muddy Lakes.

Five frog species were recorded from the study area including two hylids and three myobatrachids. *Crinia glauerti* was widespread throughout the Muddy Lakes area and appeared to be the most abundant frog species. An additional species, *Heleioporus eyrei* is expected to occur in the study area, however this species is active earlier in the year and hence was not recorded during the field survey.

Site 10: Parade Road

Shining Bronze-cuckoo *Chrysococcyx lucidus,* Common Bronzewing *Phaps chalcoptera,* Splendid Fairy-wren *Malurus splendens*, Striated Pardalote *Pardalotus striatus* and Red Wattlebird *Anthochaera carunculata* (breeding record) were observed in woodland habitats at the Site. A total of 18 bird species were recorded during the site visit (Appendix E). The Grey Kangaroo *Macropus fuliginosus* and the skink *Hemiergis quadrilineata* were also recorded at the Site.

During a brief site inspection of the area ATA Environmental (2001b) recorded 15 species of birds including Red-capped Parrot *Purpureicephalus spurius,* Splendid Fairy-wren *Malurus splendens,* White-browed Scrubwren *Sericornis frontalis,* Weebill *Smicrornis brevirostris* and Scarlet Robin *Petroica multicolor.* They attributed diggings on the eastern side to the Southern Brown Bandicoot *Isoodon obesulus fusciventer.* Surveys in a nearby area of Tuart Woodland resulted in 52 bird species being recorded and additional species were considered likely to be present in the area (Alan Tingay and Associates 1998b). Other vertebrates recorded at Dalyellup Beach Estate were four species of frogs, 16 reptiles and six native mammals. Significant species recorded from the area were Western Ringtail Possum *Pseudocheirus occidentalis,* Southern Brown Bandicoot *Isoodon obesulus fusciventer* and Baudin's Black Cockatoo *Calyptorhynchus baudinii.* Reptiles of interest included the Bardick *Echiopsis curta* and Gould's Snake *Parasuta gouldii.*

Bow (1999) undertook trapping in a 'remnant bushland corridor' which included part of the western portion of Site 10. He recorded the frogs *Crinia insignifera* and *Heleioporus eyrei* and the lizards *Pogona minor, Cryptoblepharus plagiocephalus, Ctenotus impar, C. labillardieri, Lerista elegans* and *Morethia lineoocellata.* The *House Mouse *Mus musculus* was trapped at the site and Grey Kangaroo *Macropus fuliginosus* was observed.

Site 11: Estuary Drive

This Site supports birds; no reptiles or mammals were recorded during the field survey. The mudflats of the area which adjoins the delta of the Preston River and Vittoria Bay, are important habitat for waterbirds. White-faced Heron *Ardea novaehollandiae*, Black-winged Stilt *Himantopus himantopus* and flocks of Red-necked Avocet *Recurvirostra novaehollandiae* were observed adjacent to the Site feeding on the mudflats. Further out in

the Estuary were Black Swan *Cygnus atratus,* Great Egret *Egretta alba* and Australian Pelican *Pelecanus conspicillatus.* Species recorded using the fringing vegetation were Yellow-rumped Thornbill *Acanthiza chrysorrhoa*, Western Gerygone *Gerygone fusca*, Brown Honeyeater *Lichmera indistincta*, Willie Wagtail *Rhipidura leucophrys* and Silvereye *Zosterops lateralis.*

The mudflats at the Preston River mouth in the vicinity of Vittoria Bay were identified by Ninox (1989) as one of the most important areas on the Leschenault Estuary for waterbirds. The Estuary supports a wide variety of waterbirds and is the most important waterbody in the Bunbury region for waterbirds. A total of 18 species of migratory birds listed under international agreements have been recorded from the Estuary (Ninox, 1989), most of which would be expected to occur on a seasonal basis in the vicinity of Site 11.

The Site may support such species as the skink *Hemiergis quadrilineata* in debris and leaf litter deposited at the high tide mark. Sedgelands may be used as foraging areas by mammals such as the Southern Brown Bandicoot *Isoodon obesulus fusciventer.* No frogs are expected to occur at this Site due to the high salinity.

Appendix G

Fauna Habitat Description

Site No	Site Name	Fauna Habitat Description
1	Australind Waste Water	Around the edge of the main part of this Site (Area A) is a Jarrah *Eucalyptus marginata* dominated woodland with *Banksia ilicifolia* and *B. attenuata,* some Marri *E. calophylla* and a moderately diverse ground layer including *Xanthorrhoea gracilis,* Fabaceae spp., herbs and sedges. Area B immediately to the north appears to have similar habitat. Leaf litter and fallen logs and bark provide refuges for ground dwelling reptiles. The central portion of Area A consists of a revegetated area planted with *Eucalyptus camaldulensis,* cleared areas with tanks and other infrastructure, and settling ponds which although artificial habitat are used by a variety of waterbirds. Area C to the north-west is fairly degraded and is primarily a *Melaleuca* woodland with *Kunzea glabrescens,* but there are areas of Marri woodland.
2	South Dalyellup	The majority of this Site is vegetated with a Tuart Woodland which is fairly degraded due to cattle grazing and clearing of the bushland. During the site visit parts of the areas were actively being cleared with bulldozers. Large old trees were being pushed down, piled into heaps and then burnt. From the appearance of aerial photos of the Site it seems evident that these types of activities have been going on for several years. Despite the ongoing intentional degradation of the Site it supports a woodland of Tuart *Eucalyptus gomphocephala* with Peppermint *Agonis flexuosa* and some patches of Jarrah *E. marginata.* There is the occasional *Banksia grandis, Macrozamia* and Marri tree, but the ground layer now consists principally of grasses and the weed **Trachyandra divaricata.* The small area in the north east corner that appears to once have been a wetland is a small pond with several old *Melaleuca* trees. This area has been intensively grazed and supports a wide variety of weeds.
3	Boyanup East	The open areas that make up much of this Site are pasture areas or areas that have undergone rehabilitation following sand mining by Westralian sands. Rehabilitated areas include three wetland ponds, presumably these were mine pits, and surrounding areas that have been planted with Eucalypts and shrubs. In the eastern central portion of the Site there is a triangle of Marri woodland mixed with Jarrah which includes many mature trees, a midstorey of *Banksia grandis,* and a moderately diverse understorey and some grassed areas. In the south-west corner in the area of Joshua Brook there is some remnant *Melaleuca* along the creekline, but otherwise these areas are pasture.
4	Davenport Industrial	The area to the west of the Highway consists of a Marri *E. calophylla* woodland over Peppermint *Agonis flexuosa,* with a weedy grass layer. Adjacent areas are primarily pastures and paddocks. Adjacent to the abattoir is a seasonally inundated area dominated by *Melaleuca preissiana* with thick sedges and grasses. Upland areas support Marri over Peppermint with *Banksia grandis* and a variety of shrubs including *Jacksonia furcellata* and *Acacia saligna.* The southern part of the Site includes an area of Banksia woodland dominated by *Banksia attenuata,* Peppermint *Agonis flexuosa* and *Nuytsia floribunda,* with scattered *B. ilicifolia* and *Xylomelum occidentale,* and a ground layer dominated by the exotics *Veldt Grass *Erharta longiflora* and **Arctotheca calendula.* Along the banks of the Preston River is a teatree *Melaleuca preissiana* fringe, with Peppermint and tall Marris further up the bank. A variety of species exist in the shrub layer along the banks including *Acacia pulchella* and *Daviesia divaricata,* and some weeds such as *Bridal Creeper *Asparagus asparagoides* and **Watsonia meriana* occur.
5	Brunswick River	The Brunswick River lies adjacent to the north side of the Site and is fringed with *Eucalyptus rudis* and Peppermint *Agonis flexuosa.* There is some invasion of the area by weeds particularly *Blackberry *Rubus ulmifolius* and *Arum Lily *Zantedeschia aethiopica.* Both the stream channel and the fringing woodland provide habitat for fauna. Much of the floodplain area adjacent to the River has been converted to pastures with a few scattered pools. A swampy drainage line runs along the south side of the Site. This area is seasonally inundated and still supports stands of *Melaleuca rhaphiophylla* and wetland plants such as *Astartea fascicularis* and *Centella asiatica,* and some aquatics. The western portion of the Site supports a forest of *E. rudis* over a sedgeland that has largely been replaced by dense growth of the introduced *Arum Lily. Adjacent to the site is an area of woodland dominated by Marri *Eucalyptus calophylla* and *Banksia* spp.

Site No	Site Name	Fauna Habitat Description
6	Boyanup Bypass	The majority of the Boyanup Bypass consists of cleared pastures and paddocks, with only a few small bushland remnants along the proposed alignment. These include strips of vegetation along roadways, principally Marri woodlands, and a patch of Peppermint *Agonis flexuosa* near the cemetery. In the southern part of the alignment there is a wetland area known as the 'Boyanup Billabong' which is fringed by a few remnant Flooded Gums *E. rudis* and revegetation.
7A	Myalup	From the coast inland there are several habitats including the unvegetated beach proper, which is replaced by the low coastal vegetation of the foredune. This habitat includes typical strand species such as *Spinifex hirsutus, Carpobrotus virescens,* the grass *Ammophila arenaria* and the introduced species **Trachyandra divaricata* and **Euphorbia paralias.* Further inland it is replaced by a low scrub which is dominated by coastal plants such as *Acanthocarpos preissii, Diplolaena dampieri, Olearia axillaris, Spyridium globulosum, Acacia littorea,* other low shrubs and the sedge *Lepidosperma gladiatum* on dunes, with thickets of *Agonis flexuosa* and *Acacia saligna* in sheltered swales. In the shelter of the tall dunes in the eastern part of the Site a stand of Tuart *Eucalyptus gomphocephala* has developed with a mid-storey of Peppermint *Agonis flexuosa* and a variety of coastal shrubs in the understorey. The Harvey diversion drain curves around adjacent to the northern portion of the Site. This winter flowing channel passes into the ocean along the west side of the site, with a brackish waterbody forming behind the beach where it is cut off from the ocean in summer.
7B	Leschenault Locations (E)	Four principal habitats were discernible at this Site. In the southern part of the Site (which lies at the northern end of the Leschenault Estuary) an area of samphire includes *Halosarcia lepidosperma* and *H. indica* with the sedge *Juncus krausii.* Much of the site, particularly along the eastern side, consists of pastures dominated by introduced grasses. Some of these areas are seasonally inundated. There are several patches of remnant *Melaleuca rhaphiophylla,* with thick sedges in inundated areas including *Bolboschoenus caldwellii* and *Baumea juncea* and the grass *Cynodon dactylon. Typha* has invaded some parts of the Site.
8	Twin Rivers	The principal fauna habitat at Site 8 is woodland dominated by Marri *E. calophylla* with Peppermint *Agonis flexuosa* forming a second layer, and with *Banksia attenuata,* some Jarrah *E. marginata* and a moderately diverse shrub and ground layer, including species such as *Hibbertia hypericoides, Acacia pulchella, Daviesia divaricata, Hakea prostrata, Jacksonia furcellata* and *Xylomelum occidentale,* herbs and grasses. Wetland areas include the river banks which are fringed by *Casuarina obesa* and *E. rudis,* and floodplain and backwater areas dominated by a low forest of *Melaleuca rhaphiophylla* with dense beds of sedges (*Juncus* spp., *Baumea juncea* and *Gahnia trifida*) and some areas of open water.
9	Muddy Lakes	Refer to Appendix I
10	Parade Road	ATA Environmental (2001b) undertook an assessment of the middle triangle of Site 10 and mapped the vegetation associations in fine detail. In terms of fauna habitats these correspond to Tuart Woodland, Banksia Woodland with emergent Eucalypts, and *Melaleuca rhaphiophylla* low forest. The site largely supports vegetation in good condition with a diverse understorey. Tuart woodland is mixed with Jarrah *E. marginata* and some *Banksia grandis* and Peppermint *Agonis flexuosa* in the second tree layer. Banksia Woodland is dominated by *B. attenuata.* A Range of understorey species were observed at the Site, these include the larger *Xylomelum occidentale* and *Persoonia longifolia,* medium shrubs such as *Hibbertia hypericoides, Macrozamia riedlei* and *Phyllanthus calycinus,* the herbs *Sowerbaea laxiflora, Thysanotus* spp. and *Drosera* spp., the climbers *Hardenbergia comptoniana* and *Clematis linearifolia,* orchids, grasses and sedges.
11	Estuary Drive	Habitats for fauna include the fringing woodland of *Casuarina obesa* with an understorey of sedges, principally *Juncus kraussii,* and the samphire (chenopod) species *Halosarcia lepidosperma* and *Frankenia pauciflora.* The mudflats and open water are important habitat for waterbirds. The area is tidal and is therefore variably inundated.

Appendix H

Quokka Records for the SW Mainland

Appendix H

Quokka records for the SW mainland.

GENUS	Nearest Location	SITE	Latitude	Longitude	Date
North of Bunbury					
Setonix	COOROW	CAVE	29°52`30"S	115°56`00"E	
Setonix	MUNDARING WEIR	MUNDARING FOREST RES	31°57`00"S	116°10`00"E	
Setonix	MUNDARING WEIR	MUNDARING FOREST RES	31°57`00"S	116°10`00"E	
Setonix	MUNDARING WEIR	MUNDARING FOREST RES	31°57`00"S	116°10`00"E	
Setonix	MUNDARING WEIR	MUNDARING FOREST RES	31°57`00"S	116°10`00"E	
Setonix	PERTH	POST OFFICE	31°59`00"S	115°48`00"E	
Setonix	BYFORD	SWAMP (LONG)	32°15`00"S	116°05`00"E	17/05/1957
Setonix	BYFORD	MANJEDAL SWAMP	32°15`00"S	116°05`00"E	20/12/1958
Setonix	BYFORD	MANJEDAL SWAMP	32°15`00"S	116°05`00"E	07/05/1958
Setonix	BYFORD	SWAMP (LONG)	32°15`00"S	116°05`00"E	19/05/1957
Setonix	ARMADALE	ALBANY HIGHWAY	32°15`00"S	116°01`00"E	25/08/1967
Setonix	NORTH DANDALUP	SW HIGHWAY	32°31`S	115°58`E	27/11/1997
Bunbury Region					
Setonix	BUNBURY	MUDDY LAKE	33°25`00"S	115°38`00"E	10/06/1975
Setonix	MUDDY LAKES		33°26`07"	115°35`28"	00/09/2002
Setonix	CAPEL	CAPEL RIVER AREA	33°38`00"S	115°41`00"E	
Setonix	COLLIE	COLLIE BURN,RAILWAY STATION	33°24`00"S	116°11`40"E	
Cape to Cape Region					
Setonix	YALLINGUP CAVE	CLIFF	33°36`50"S	115°01`17"E	24/03/1978
Setonix	WARDANUP HILL	DOLINE	33°38`00"S	115°02`00"E	05/02/1979
Setonix	GRACETOWN	LEEUWIN/NATURALISTE, CAVE	33°53`30"S	115°00`00"E	25/11/1977
Setonix	MARGARET RIVER	POST OFFICE	33°57`00"S	115°04`00"E	12/03/1907
Setonix	MAMMOTH CAVE	CAVE	34°03`00"S	115°01`00"E	
Setonix	MAMMOTH CAVE	CAVE (MAMMOTH)	34°03`30"S	115°01`30"E	
Setonix	FOREST GROVE	LAKE CAVE (NEAR),POST OFFICE	34°05`00"S	115°01`30"E	
Setonix	FOREST GROVE	LAKE CAVE (NEAR),POST OFFICE	34°05`00"S	115°01`30"E	00/01/1963
Setonix	WHEATLEY	TIN MINE GULLY ROAD	34°05`00"S	115°59`00"E	06/05/1976
Setonix	BORANUP HILL	CAVE ENTRANCE	34°06`00"S	115°01`00"E	
Setonix	MOONDYNE CAVE	CAVE	34°16`00"S	115°05`00"E	05/05/1958
Setonix	MOONDYNE CAVE	CAVE	34°16`00"S	115°05`00"E	05/05/1958
Setonix	MOONDYNE CAVE	CAVE	34°16`00"S	115°05`00"E	05/05/1958
Setonix	AUGUSTA	GINGILUP NAT. RES.	34°20`40"S	115°26`E	24/02/1993

Appendix H

Quokka records for the SW mainland.

GENUS	Nearest Location	SITE	Latitude	Longitude	Date
Stirling Range					
Setonix	BLUFF KNOLL	STIRLING RANGE N.P.,ROAD	34°19`00"S	118°11`00"E	17/10/1990
Setonix	ELLEN PEAK	STIRLING RANGE	34°20`35"S	118°20`00"E	04/10/1975
Setonix	BLUFF KNOLL	STIRLING RANGE N.P.	34°22`00"S	118°15`00"E	01/03/1970
Setonix	STIRLING RANGE NP	PYUNGOORUP PEAK	34°22`000"	118°20`000"	01/04/1999
Setonix	BLUFF KNOLL	STIRLING RANGE N.P.	34°22`50"S	118°14`55"E	00/07/1991
Setonix	BLUFF KNOLL	STIRLING RANGE NATIONAL PARK	34°22`S	118°15`E	00/07/1991
Setonix	BLUFF KNOLL	STIRLING RANGE N.P.	34°23`00"S	118°15`00"E	
Deep South					
Setonix	NANNUP	ELLIS CREEK,RAILWAY STATION	33°56`28"S	115°53`05"E	00/01/1963
Setonix	NANNUP	DAVIDSON ROAD, BEFORE AUSTIN ROAD	34°12`S	115°53`E	27/03/1992
Setonix	PEMBERTON	PEMBERTON/NANNUP RD	34°21`S	115°55`E	23/02/1998
Setonix	PEMBERTON	POST OFFICE	34°27`00"S	115°53`00"E	30/04/1980
Setonix	PEMBERTON	POST OFFICE	34°27`00"S	115°53`00"E	30/04/1980
Setonix	PEMBERTON	POST OFFICE	34°30`00"S	115°58`00"E	16/08/1978
Setonix	D`ENTRECASTEAUX NP	2KM FROM TWIN KARRI BEACH. S OF LAKE JASPER	34°27`55"S	115°39`00"E	00/03/2000
Setonix	TONE RIVER	TONE RIVER,APPROX	34°10`00"S	116°40`00"E	03/02/1912
Setonix	TONE RIVER	TONE RIVER	34°10`00"S	116°40`00"E	03/02/1912
Setonix	SHANNON	POST OFFICE	34°29`00"S	116°40`00"E	
Setonix	MANJIMUP	10KM ALONG WHEATLEY COAST RD	34°30`35"S	116°10`47"E	09/11/1998
Setonix	NORTHCLIFFE	WHEATLEY COAST RD	34°37`58"S	116°7`1"E	00/06/1999
Setonix	NORTHCLIFFE	WHEATLEY COAST RD	34°37`58"S	116°7`1"E	00/04/1999
Setonix	NORNALUP	WALPOLE NAT. PARK,POST OFFICE	34°56`40"S	116°51`00"E	00/05/1976
Setonix	NORNALUP	SOUTH WEST HIGHWAY,POST OFFICE	34°59`00"S	116°50`00"E	25/08/1972
Setonix	NORNALUP	ECOPARK, VALLEY OF GIANTS	35°0`0"S	116°50`59"E	26/01/1999
Setonix	WALPOLE	POST OFFICE	34°56`00"S	116°23`00"E	02/05/1973
Setonix	WALPOLE	POST OFFICE	34°57`20"S	116°24`00"E	02/05/1973
Setonix	WALPOLE	VALLEY OF THE GIANTS	34°58`54"S	116°53`02"E	03/12/1997
Setonix	WALPOLE	FISH CREEK ROAD	34°59`00"S	116°44`00"E	04/04/1991
Setonix	WALPOLE	SW HWY APPROX 100m EAST OF TINGLEWOOD DRIVE.	34°59`14"S	116°39`56"E	19/01/1999
Setonix	WALPOLE	SW HWY ADJACENT TO JACK RATE LOOKOUT	34°59`14"S	116°40`36"E	13/10/1998
Setonix	WALPOLE	ADJ. JUNCTION COALMINE BEACH RD & SW HWY.	34°59`23"S	116°44`52"E	28/01/2000
Setonix	WALPOLE	SOUTH COAST HWY	34°59`40"S	116°51`37"E	16/12/1997
Setonix	WALPOLE	SOUTH COAST HWY	34°59`41"S	116°45`48"E	14/03/1999
Setonix	MOUNT HOPKINS	WALPOLE NORNALUP N.P, (SHELLEY BEACH)	35°02`05"S	116°44`30"E	
Setonix	MOUNT HOPKINS	WALPOLE NORNALUP N.P, (SHELLEY BEACH)	35°02`05"S	116°44`30"E	
Setonix	WILLIAM BAY NP	OVERTONE HILL	35°00`S	117°15`E	07/05/2002

Appendix H

Quokka records for the SW mainland.

GENUS	Nearest Location	SITE	Latitude	Longitude	Date
East of Albany					
Setonix	ALBANY	BIG GROVE	35°03`00"S	117°51`00"E	25/03/1905
Setonix	MOUNT GARDNER	TWO PEOPLE BAY RES.	35°00`00"S	118°11`00"E	00/04/1974
Setonix	TWO PEOPLES BAY	ROBINSON GULLY	34°57`S	118°11`E	00/10/1995
Setonix	TWO PEOPLE BAY	TWO PEOPLE BAY RES.	34°58`00"S	118°08`00"E	
Setonix	HUNTER RIVER	HUNTER RIVER	34°21`30"S	119°25`00"E	03/03/1970

Appendix I

Site 10 – Muddy Lakes Fauna Survey

SITE 10 MUDDY LAKES FAUNA SURVEY

Area (ha): 285 - 93 (north), 192 (south) (site includes open water)

Landforms
Quindalup. Dunes and beach ridges.
Vasse. Poorly drained plains.

Vegetation
Quindalup Complex. Coastal dune complex - mobile and stable dune alliance.
Vasse Complex. Closed scrub of *Melaleuca* spp. fringing woodland

1. Fauna Habitats

This Section describes the nature of the habitat in the vicinity of each trapping grid and provides a brief synopsis of the fauna species recorded. Faunal groups are discussed further in the next Section. Habitat utilisation patterns will tend to vary according to the particular faunal group under consideration. In general it can be stated that avifauna respond principally to the structure and composition of the vegetation, whereas herpetofauna (reptiles and amphibians) are influenced primarily by substrate. In mammals, habitat requirements are complicated to a greater degree by foraging patterns, home range size, shelter requirements and seasonal mating activity.

A series of four principal fauna habitats were surveyed within the Muddy Lakes study area, with some variation within each habitat type. (Grid locations are provided in Table 3.3):

(i) Dune Swale
(ii) Swamp
(iii) Tuart Woodland
(iv) Coastal Dune

Dune Swale (Grid 1)

This Grid was located near the west side of the Muddy Lakes wetland area. It consists of a thickly vegetated dune swale with a dense thicket of Peppermint *Agonis flexuosa* and an understorey of dense *Lepidosperma gladiatum, Rhagodia preissii* and tangling plants such as *Cassytha racemosa* and *Hardenbergia comptoniana.* There is some invasion of the area by *Arum Lily *Zantedeschia aethiopica.* Adjacent areas support *Acacia saligna, A. cochlearis,* scattered *Xanthorrhoea preissii* and mixed sedges in the ground layer. The soil is sandy, tending to be darker in thickly vegetated areas, and limestone occurs in the sub-soil at variable depth. Much of the area in this southern section of Muddy Lakes west of the lake has been burnt. It may take some time for ground dwelling fauna in particular to recolonise these areas post fire.

The thick ground layer at this site is habitat for the Southern Brown Bandicoot *Isoodon obesulus fusciventer*, with a well developed system of runnels under the cover of dense vegetation. An individual Western Ringtail Possum *Pseudocheirus occidentalis* was also observed at this Site in a Peppermint. The skull and dentary of a Quokka *Setonix brachyurus* (refer to Section 6.2) was also found adjacent to Grid 1. The close proximity of this Site to the wetland fringe means that some species of frogs move through the area; during the survey *Geocrinia leai* and *Litoria moorei* were trapped at the Site. Birds utilising the thick vegetation include Golden Whistler *Pachycephala pectoralis*, Grey Shrike-thrush *Colluricincla harmonica*, Western Gerygone *Gerygone fusca* and Grey Fantail *Rhipidura fuliginosa* in the *Agonis* dominated tree layer, and Splendid Fairy-wren *Malurus splendens* and White-browed Scrubwren *Sericornis frontalis* in the shrub and sedge layer. Few reptiles

were recorded in this habitat although the skink *Acritoscincus trilineatum* was trapped. This species tends to prefer cool, moist, shaded situations.

Coastal Dune (Grid 4)

Lying within the typical dune formations of the Quindalup landform unit, this habitat includes the slopes and crests of the near coastal dunes. It is dominated by a low mixed shrubland comprising typical coastal dune plants such as *Acanthocarpus preissii, Acacia cochlearis, Diplolaena dampieri, Phyllanthus calycinus, Spyridium globulosum* and a variety of sedges. There are scattered patches of Peppermint *Agonis flexuosa,* and adjacent seasonally moist low lying areas support a *Banksia* woodland dominated by *Banksia littoralis* over thick *Acacia* and sedges. Closer to the beach the foredune supports fewer trees and the mobile dunes carry species such as *Olearia axillaris, Scaevola crassifolia* and *Spinifex longifolius.* The weed **Trachyandra divaricata* is widespread throughout the dune areas.

This site supported few mammals but Grey Kangaroo *Macropus fuliginosus* were common on the dunes, sheltering in woodland areas during the day. The introduced *House Mouse *Mus musculus* was common at this site. A Dugite *Pseudonaja affinis* was observed in the area of the dunes - this species feeds on rodents and may be attracted to the mice in the area. The Bearded Dragon *Pogona minor* was observed to use the open ground of this habitat and perches on tree trunks where it basks in the sun. A specimen of the moderately sized skink *Egernia napoleonis* was extracted from a dead *Xanthorrhoea* stump in this habitat. A small adult of the frog *Litoria moorei* was trapped in this habitat; these animals disperse fairly widely and this individual was presumably seeking out suitable wetland habitat for the breeding season.

The low shrub vegetation of this Site is in general unsuitable for birds and few species were recorded; these included common species such as Silvereye *Zosterops lateralis* (breeding record) and New Holland Honeyeater *Phylidonyris novaehollandiae.* Adjacent Banksia Woodland areas tended to support more species of passerine birds including Red Wattlebird *Anthochaera carunculata,* Inland Thornbill *Acanthiza apicalis* and Rufous Whistler *Pachycephala rufiventris.* Species recorded flying over the general dune area were Black-shouldered Kite *Elanus axillaris,* Whistling Kite *Haliastur sphenurus* and Black-faced Woodswallow *Artamus cinereus.* This was the only area that the White-winged Triller *Lalage sueurii* was recorded during the survey.

Tuart Woodland (Grid 3)

This habitat consists of Tuart *Eucalyptus gomphocephala* tall Woodland to forest over a second strata of Peppermint *Agonis flexuosa.* Several shrub species occur in the midstorey including *Hibbertia cuneiformis* and *Diplolaena dampieri,* and the sedges *Gahnia trifida* and *Lepidosperma gladiatum* form a dense ground layer. Fallen logs and stumps provide additional microhabitat for fauna species. Although mapped as part of the Quindalup system this area is possibly more closely allied to the Yoongarillup Complex.

The deeply shaded habitat of Grid 3 supports reptiles such as the King Skink *Egernia kingii* and *Acritoscincus trilineatum.* The large King Skink is endemic to the south-west and occurs in near coastal areas but also in the Darling Range. A blind snake *Ramphotyphlops australis* was recovered from under a fallen log in this habitat, and a Tiger Snake *Notechis scutatus* was observed. Few mammals were recorded but a Southern Brown Bandicoot *Isoodon obesulus fusciventer* was captured in this habitat and the *House Mouse *Mus musculus* was moderately common. The trees in the area are expected to support both the Brush-tailed Possum *Trichosurus vulpecula* and Western Ringtail Possum *Pseudocheirus occidentalis.* A White-striped Mastiff Bat *Tadarida australis* was heard and observed during nocturnal spotlighting in this habitat.

Tuart Woodland habitat supports a very diverse range of bird species including 21 species recorded during the field survey (Appendix E). Fan-tailed Cuckoo *Cacomantis flabelliformis*, Western Rosella *Platycercus icterotis*, Western Gerygone *Gerygone fusca*, Golden Whistler *Pachycephala pectoralis*, Rufous Whistler *Pachycephala rufiventris*, Grey Shrike-thrush *Colluricincla harmonica*, Weebill *Smicrornis brevirostris*, Striated Pardalote *Pardalotus striatus* and Inland Thornbill Acanthiza apicalis were recorded from this habitat. This was the only area in which the Varied Sittella *Daphoenositta chrysoptera* was recorded during the field survey.

Swamp (Grid 2)

The Muddy Lakes wetland system includes a variety of habitat sub-types that are influenced by degree of inundation and substrate, but also by past history of grazing and fire incidence. Grid 2 was established in the northern sub-area in a seasonally moist site with thick clumps of sedges, prinicipally *Lepidosperma gladiatum* and Sword Sedge amongst seasonally wet pasture. The ground layer is dominated by introduced grasses, which form a dense cover. In wetter parts of the swamp there are a variety of sedges surrounding water including *Baumea juncea, Juncus* spp., *Lepidosperma* spp. and *Typha,* with other wetland plants such as *Centella asiatica* and aquatics. Some seasonally inundated parts of the area support a low woodland of *Melaleuca rhaphiophylla.* Adjacent areas particularly on the eastern side of Muddy Lakes are dominated by pastures that are subject to intensive grazing by Cattle and Horses. There are some seasonal pools amongst the pastures and a channel connecting swamp areas along the western side.

The dense vegetation at this site supports the Southern Brown *Bandicoot Isoodon obesulus fusciventer and the exotic* *Black Rat *Rattus rattus.* The medium sized skink *Egernia luctuosa* was highly abundant in the sedge clumps of swamp habitat, becoming active on warmer days. Throughout much of the Muddy Lakes area the frog *Crinia glauerti* could be heard calling. Few birds were recorded utilising the thick vegetation but Splendid Fairy-wren *Malurus splendens*, Grey Fantail *Rhipidura fuliginosa*, Clamorous Reed-Warbler *Acrocephalus stentoreus* and Little Grassbird *Megalurus gramineus* inhabit these areas. Rainbow Bee-eater *Merops ornatus* was recorded flying over wetland habitat toward the end of the survey period.

Waterbirds recorded at Muddy Lakes included 13 species. Commonly recorded were Pacific Black Duck *Anas superciliosa*, Little Pied Cormorant *Phalacrocorax melanoleucos* and Black Swan *Cygnus atratus* (breeding). Musk Duck *Biziura lobata* was recorded in the open waters of the lake area and Purple Swamphen *Porphyio porphyrio* utilise the reed beds. White-necked Heron *Ardea pacifica* and Yellow-billed Spoonbill *Platalea flavipes* were only recorded on single occasions. Overall there were not a great variety of waterbirds observed in the wetlands but additional species would be expected to visit the area.

2. Vertebrate Fauna Community

Trapping, avifauna transects and opportunistic collecting throughout the Muddy Lakes study area yielded a total of 86 vertebrate fauna species. The species list comprises five native and four introduced mammals, 61 bird species including 28 passerines and 33 non-passerines, seven lizard species from three families, three species of snake and five frogs (Appendix E). The introduced *Mosquitofish *Gambusia holbrooki* was also observed at the edge of shallow channels and pools in the area.

Appendix I

Mammals

The most common native mammal recorded in the study area was the Western Grey Kangaroo *Macropus fuliginosus*. These kangaroos are abundant throughout much of the Bunbury Region and were observed on most days at Muddy Lakes. Kangaroo 'pads' (frequently used paths) traverse the area particularly in the dunes and connect foraging and shelter areas. It is anticipated that the Brush-tailed Wallaby *Macropus irma* would also occur at Muddy Lakes as they have been observed in nearby areas.

Medium sized mammals recorded at Muddy Lakes were the Southern Brown Bandicoot *Isoodon obesulus fusciventer* and evidence of the Quokka *Setonix brachyurus* in the form of skeletal material. The Bandicoot or evidence of the presence of this species in the form of hair samples indicates at least five separate locations where they exist in the area and they are presumed to be fairly abundant in the vicinity of wetlands. Diggings attributable to this species were also observed at other locations in the study area.

The only bat recorded during the survey was the White-striped Mastiff Bat *Tadarida australis*. Other species expected to occur in woodland habitats of the area include the Western False Pipistrelle *Falsistrellus mackenziei* and Southern Forest Bat *Vespadelus regulus*.

The introduced *House Mouse *Mus musculus* was the most abundant mammal in the area based on the numbers captured in Elliott traps and was recorded at all Grids. Mice were particularly common in swale and swamp habitats, which is consistent with their usual preference for mesic habitats. The *Black Rat *Rattus rattus* was captured on two occasions in cage traps at Grid 2. Bamford and Watkins (1983) suggested the possibility that the Black Rat may have displaced native rodents such as the Water Rat *Hydromys chrysogaster* and Bush Rat *Rattus fuscipes* in wetland areas in the vicinity of Bunbury. The Bush Rat would be expected to occur in wetland habitats and is generally common in the south-west. Other introduced species likely to occur are the *Feral Cat *Felis catus*, *Fox *Vulpes vulpes* and *Rabbit *Oryctolagus cuniculus*. Cattle and Horses in particular utilise the paddocks in the area and invade the wetland areas to a varying extent. Evidently seasonally wet areas are important pasture in summer.

Birds

Birds were found to exist in relatively high numbers at all survey sites except Grid 2 with only eight species. Grid 3 Tuart woodland habitat displayed the greatest diversity with 21 bird species. The 25 species recorded from Grid 4 habitat included species recorded in adjacent Banksia Woodland areas, and relatively few species were recorded on the dune proper. The existence of additional waterbirds in the area not recorded at sites increased the overall species list to 61 species. Within the woodland sites there was a good mix of passerines, dominated by members of the the family Pardalotidae (pardalotes, gerygones and thornbills) including Inland and Yellow-rumped Thornbills and White-browed Scrubwren *Sericornis frontalis*. Amongst the non-passerines the parrots (Cacatuidae and Psittacidae) dominated in the study area with nine species including the Regent Parrot *Polytelis anthopeplus* and Purple-crowned Lorikeet *Glossopsitta porphyrocephala* recorded on a single occasion. Birds of prey included Swamp Harrier *Circus approximans* and Australian Hobby *Falco longipennis*.

Species recorded at three or more grids and therefore relatively widespread in the study area were Splendid Fairy-wren *Malurus splendens*, Inland Thornbill *Acanthiza apicalis*, Red Wattlebird *Anthochaera carunculata*, Brown Honeyeater *Lichmera indistincta*, Grey Fantail *Rhipidura fuliginosa* and Silvereye *Zosterops lateralis*. Several bird species characteristic of woodlands were relatively common, including Striated Pardalote *Pardalotus striatus* which tends to occupy the upper and canopy levels, and Golden Whistler *Pachycephala pectoralis*. Weebill *Smicrornis brevirostris*, a leaf gleaning species that passes from tree to tree in small

active groups was recorded on a few occasions, whereas Varied Sittella *Daphoenositta chrysoptera* was only recorded once. Species generally in Peppermint *Agonis flexuosa* were Grey Fantail *Rhipidura fuliginosa* and Western Gerygone *Gerygone fusca.* Both the Fan-tailed Cuckoo *Cacomantis flabelliformis* and Shining Bronze-cuckoo *Chrysococcyx lucidus* were recorded from the study area. The Australian Magpie *Gymnorhina tibicen* was recorded utilising the open pastures and grassed areas, as was Magpie-lark *Grallina cyanoleuca* and Willie Wagtail *Rhipidura leucophrys.*

Species expected to occur in the area but not recorded were Western Spinebill *Acanthorhynchus superciliosus* and Western Thornbill *Acanthiza inornata.* In addition, no nocturnal birds were recorded although Tawny Frogmouth *Podargus strigoides* and Southern Boobook *Ninox novaeseelandiae* are known to occur in the area. The study area supported relatively few Honeyeaters (family Meliphagidae) with only three species and no robins (Family Petroicidae) were observed.

Reptiles

Approximately 26 species of reptile would be expected to occur in the study area based on the habitats available (Appendix E). However, extensive trapping over a period of years is normally required before an extensive list of species such as this is built up, since some species are exceedingly sporadic in their occurrence. Although not recorded in the area, species from the families Pygopodidae (legless lizards) and Varanidae (monitors or goannas) would be expected to occur. Trapping during the summer months would aid in detecting additional species of skinks and other reptiles since warm weather encourages activity in these ectothermic animals.

Three species of *Egernia* recorded in the area are endemic to south-western Australia; *E. kingii, E. luctuosa* and *E. napoleonis.* Other reptiles such as the Tiger Snake *Notechis scutatus* and Bobtail *Tiliqua rugosa* are widespread in southern Australia.

The gecko *Christinus marmoratus* was found under exfoliating bark on Tuart trees. This species is common in near coastal areas throughout the south-west. Species such as the Bobtail *Tiliqua rugosa* would be expected to utilise relatively open areas whereas the Tiger Snake *Notechis scutatus* is a regular inhabitant of wetland areas, and was recorded in areas near swamp vegetation. The Long-necked Tortoise *Chelodina oblonga* may also occur within pools in the wetlands at Muddy Lakes. *Acritoscincus trilineatum,* a skink that usually occupies moist areas or those with a deep litter layer, was recorded from generally shady sites within the study area. Of interest because of their absence were skinks of the genus *Ctenotus,* which are usually an abundant and speciose component of the vertebrate fauna.

Frogs

Five frog species were recorded from the study area including two hylids and three myobatrachids (Appendix E). An additional species, *Heleioporus eyrei* is expected to occur in the study area, however this species is active earlier in the year and hence was not recorded during the field survey.

Crinia glauerti was widespread throughout the Muddy Lakes area and appeared to be the most abundant frog species. This species is favoured by the shallowly inundated areas with emergent semi-aquatic vegetation that occur over much of the wetland area. The Banjo Frog or Pobblebonk *Limnodynastes dorsalis* and Slender Tree Frog *Litoria adelaidensis* were only recorded on single occasions.

Appendix J

Office of the Commissioner of Soil & Land Conservation

Department of Agriculture
Government of Western Australia

OFFICE OF THE COMMISSIONER OF SOIL AND LAND CONSERVATION
3 BARON-HAY COURT SOUTH PERTH WESTERN AUSTRALIA 6151 (POSTAL ADDRESS: LOCKED BAG NO 4 BENTLEY DELIVERY CENTRE WA 6983)
TELEPHONE: (08) 9368 3282 FACSIMILE: (08) 9368 3654

Beck Ryan
PO Box 81
LEEDERVILLE WA 6902

Your Ref:
Our Ref: 000548V01M03
Enquiries: Veronica Newell (9368 3282)
Date: 11 October 2002

Dear Ms Ryan

PORTION WELLINGTON LOCATION 41 – LOTS 313 – 317 ON PLAN 3097
COLIN FIACENTINI

Thank you for your advice, informing us of clearing on the above property.

The Commissioner is currently investigating this matter and will notify you of the outcome in due course.

In the meantime, if you have any queries regarding this matter, please contact me on 9368 3282.

Yours faithfully

Kelly Holyoake
PROJECT OFFICER
SOIL AND LAND CONSERVATION

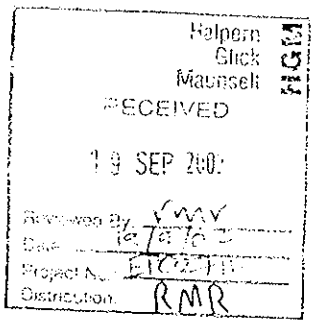
HGM

Appendix K

CALM – Rare and Priority Flora

Your Ref:
Our Ref: 2001F001173VO3
Enquires: John Riley
Phone: (08) 9334 0123
Fax: (08) 9334 0278
Email:

DEPARTMENT OF
Conservation
AND LAND MANAGEMENT



HGM Pty Ltd
PO Box 81
LEEDERVILLE WA 6902

Attention: Rebecca Ryan

Dear Bec

REQUEST FOR RARE FLORA INFORMATION

I refer to your request of 17 September 2002 for information on rare flora in the Bunbury area. The search co-ordinates used were 32^0 55' - 33^0 35' S and 115^0 30' - 115^0 55' E.

A search was undertaken for this area of **(1)** the Department's *Threatened (Declared Rare) Flora* database and (2) the *Western Australian Herbarium Specimen* database for priority species opportunistically collected in the area of interest. The results were emailed to you on 18 September.

Attached also are the conditions under which this information has been supplied. Your attention is specifically drawn to the seventh point which refers to the requirement to undertake field investigations for the accurate determination of rare flora occurrence at a site. *The information supplied should be regarded as an indication only of the rare flora that may be present and may be used as a target list in any surveys undertaken.*

An invoice for $200 (plus GST) to supply this information will be forwarded.

It would be appreciated if any populations of rare flora encountered by you in the area could be reported to this Department to ensure their ongoing management.

If you require any further details, or wish to discuss rare flora management, please contact my Principal Botanist, Dr Ken Atkins, on (08) 9334 0425.

Yours faithfully

J. Riley

.....
for Keiran McNamara
ACTING EXECUTIVE DIRECTOR

18 September, 2002
Attached

Appendix K

Species	Status	Data Source	
		CALM Como	WA Herbarium
Acacia flagelliformis	P4	+	+
Acacia oncinophylla subsp. *patulifolia*	P2		+
Acacia semitrullata	P3	+	+
Amperea micrantha	P2		+
Anthotium junciforme	P4	+	+
Apodasmia ceramophila ms	P2		+
Aponogeton hexatepalus	P4	+	+
Asplenium aethiopicum	P4		+
Boronia capitata subsp. *gracilis*	P2	+	+
Boronia humifusa	P1	+	+
Boronia juncea subsp. *juncea*	P1		+
Boronia tetragona	P3		+
Caladenia busselliana	R	+	+
Caladenia huegelii	R	+	+
Caladenia longicauda subsp. *clivicola*	P4	+	+
Caladenia speciosa	P4	+	+
Caladenia uliginosa subsp. *patulens*	P1	+	+
Calytrix sp. Tutunup (G.J.Keighery & N.Gibson 2953) PN	P2	+	+
Carex tereticaulis	P1	+	+
Caustis sp. Boyanup (G.S.McCutcheon 1706) PN	P1	+	+
Chamaescilla gibsonii	P3		+
Chamelaucium erythrochlorum ms	P4	+	+
Conostylis pauciflora subsp. *pauciflora*	P4		+
Craspedia argillicola ms	P2		+
Dillwynia dillwynioides	P3		+
Diuris drummondii	R	+	+
Diuris micrantha	R	+	+
Diuris purdiei	R	+	
Drakaea elastica	R	+	+
Drakaea micrantha ms	R	+	+
Drosera marchantii subsp. *marchantii*	P4	+	+
Dryandra squarrosa subsp. *argillacea*	R		+
Eleocharis keigheryi	R	+	+
Eryngium ferox ms	P3		+
Eucalyptus macrocarpa subsp. *elachantha*	P4		+
Eucalyptus x *mundijongensis*	P1	+	+
Euphrasia scabra	P2		+
Franklandia triaristata	P4	+	+
Grevillea bipinnatifida subsp. *pagna* ms	P1		+
Grevillea thelemanniana	P4	+	
Haloragis aculeolata	P2	+	+
Haloragis tenuifolia	P3	+	+
Hemigenia microphylla	P3		+
Hibbertia spicata subsp. *leptotheca*	P3		+
Isopogon formosus subsp. *dasylepis*	P3	+	+
Jacksonia sericea	P3	+	+
Jacksonia sparsa ms	P4	+	+
Lasiopetalum membranaceum	P3	+	+
Lepyrodia heleocharoides	P3		+
Meeboldina thysanantha ms	P3		+
Microtis media subsp. quadrata	P4		+
Myriophyllum echinatum	P3	+	
Nemcia cordata ms	P1	+	+
Platysace ramosissima	P3		+

Appendix K

Species	Status	Data Source	
		CALM Como	WA Herbarium
Plumatichilos turfosus	P1		+
Pterostylis sp. Yalgorup (G.Brockman GBB463) PN	P2		+
Pterostylis turfosa	P1	+	
Pultenaea radiata	P3	+	+
Pultenaea skinneri	P4	+	+
Rhodanthe pyrethrum	P3	+	+
Rumex drummondii	P4		+
Scaevola paludosa	P2		+
Schoenus benthamii	P3		+
Schoenus capillifolius	P2		+
Schoenus sp. Waroona (G.J.Keighery 12235) PN	P3		+
Senecio leucoglossus	P4		+
Stylidium longitubum	P3		+
Stylidium rigidifolium	P2	+	+
Synaphea ? stenoloba	R		+
Synaphea aff. *boyaginensis*	P2		+
Synaphea hians	P3		+
Synaphea odocoileops	P1	+	+
Synaphea petiolaris subsp. *simplex*	P2	+	+
Synaphea stenoloba	R	+	+
Tetratheca parvifolia	P3		+
Thomasia laxiflora	P1		+
Thysanotus glaucus	P4	+	+
Trichocline sp. Treeton (B.J.Keighery & N.Gibson 564) PN	P2	+	+
Verticordia attenuata	P3	+	+
Verticordia densiflora var. *pedunculata*	R	+	+
Villarsia submersa	P4	+	+

Appendix L

CALM – Threatened Fauna

Your Ref
Our Ref: 2001F001096V01
Enquires: Peter Orell
Phone: (08) 9334 0454
Fax: (08) 9334 0278
Email: peterO@calm.wa.gov.au

DEPARTMENT OF
Conservation
AND LAND MANAGEMENT

Ms Bec Ryan
Halpern Glick Maunsell Pty Ltd
PO Box 81
LEEDERVILLE WA 6902

Dear Ms Ryan

REQUEST FOR THREATENED FAUNA INFORMATION

I refer to your request of 17 September for information on threatened fauna occurring in the Bunbury area.

A search was undertaken for this area of the Department's Threatened Fauna database, which includes species which are declared as *'Rare or likely to become extinct* (Schedule 1)', *'Birds protected under an international agreement* (Schedule 3)', and *'Other specially protected fauna* (Schedule 4)'. Attached are print outs from these databases where records were found.

Attached also are the conditions under which this information has been supplied. Your attention is specifically drawn to the sixth point that refers to the requirement to undertake field investigations for the accurate determination of threatened fauna occurrence at a site. The information supplied should be regarded as an indication only of the threatened fauna that may be present.

An invoice for $110.00 (includes GST), being the set charge for the supply of this information, will be forwarded.

It would be appreciated if any populations of threatened fauna encountered by you in the area could be reported to this Department to ensure their ongoing management.

If you require any further details, or wish to discuss threatened fauna management, please contact my Senior Zoologist, Dr Peter Mawson on 08 93340421.

Yours sincerely

.....

for Keiran McNamara
ACTING EXECUTIVE DIRECTOR

19 September, 2002

HGM

Appendix M

WA Museum – Quokka Database Search

WESTERN AUSTRALIAN museum

8 October 2002

Halpern Glick Maunsell HGM
Reviewed By: YMY
Date: 9/10/02
Project No.: EP02-111
Distribution:

Ms Rebecca Ryan
Halpern Glick Maunsell
629 Newcastle Street
LEEDERVILLE WA 6007

Dear Ms Ryan

Please find enclosed a computer database search for quokkas on the mainland.

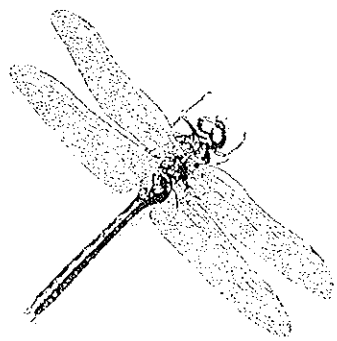
In accordance with the policy of the Trustees of the Museum, these data are provided subject to the following conditions:

- The Western Australian Museum shall at all times retain ownership and copyright over the data supplied.
- None of the data provided may be disposed of in any form to any other individual or institution without prior written consent of the Director of the W.A. Museum;
- The data may not be used for any purpose other than for the project for which they have been provided without the prior written consent of the Director of the W.A. Museum.
- The data must not be placed on any computing network or multi-user system on which its security may be compromised.
- On completion of the project for which the data have been provided, all digital records must be expunged from your computer system.
- Receiving organisations must recognise that while every reasonable effort has been made to prevent errors and omissions in the data set provided, they may be present; the W.A. Museum takes no responsibility for this;
- Receiving organisations must recognise that our data base from which sets have been provided is subject to continual updating and amendment, and such considerations should be taken into account by the user;
- It should be noted that the printout does not necessarily represent a comprehensive listing of the fauna of the area in question. Its comprehensiveness is dependant on the amount of collection that has been done there;
- Acknowledgment of the Western Australian Museum as the source and owner of the data is to be made in any published material using them; copies of all such publications are to be forwarded to the Museum.

On the basis of our standard charge of $96 per hour per data base searched the charge for this database search is $96.00 + GST. An invoice will be forwarded under separate cover.

Yours sincerely

P.F. BERRY
Director, Science and Culture



WESTERN AUSTRALIAN MUSEUM
Perth Cultural Centre, Francis Street, Perth, Western Australia 6000
Telephone: +61 8 9427 2700 • Facsimile: +61 8 9427 2882 • Web: www.museum.wa.gov.au
PERTH • MARITIME • FREMANTLE • GERALDTON • KALGOORLIE-BOULDER • ALBANY

HGM Maunsell

Report

Department for Planning and Infrastructure

Natural Values of 12 Sites of the Greater Bunbury Region Scheme Task 3

EP027111
R001

Halpern Glick Maunsell Pty Ltd
Consulting Engineers &
Environmental Scientists

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Leederville

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Leederville 6902
Western Australia

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AN AECOM COMPANY

October 2002

HGM Maunsell

Department for Planning and Infrastructure

Natural Values of 12 Sites of the Greater Bunbury Region Scheme

Draft of Task 3

EP027111
R001

Consulting
Engineers &
Environmental
Scientists

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Report by: Bec Ryan
Fauna by: Steve Reynolds

Signed:

Reviewed & Approved: I. McCardle

Signed:

Date: 4 November 2002

Distribution: DPI, DEP
Bec Ryan
Steve Reynolds
Eleanor Bennett
HGM Library
HGM File

Contents

Tables

1 Introduction

1.1 Background

This report has been prepared in response to a request by the Department for Planning and Infrastructure (DPI) to provide environmental consultancy services to progress an environmental assessment of the Greater Bunbury Region Scheme (GBRS).

The Western Australian Planning Commission (the Commission) has prepared the GBRS to provide a statutory mechanism to secure land for regional purposes and to include land identified in regional strategies and structure plans for future urban and industrial purposes within appropriate regional zones. To finalise responses to submissions relating to formal assessment by the Environmental Protection Authority (EPA), the DPI required further information about the natural values of nominated sites.

The study is of 12 sites that are proposed to be included in new zonings and reserves.

1.2 Scope of Works

In summary the scope of works comprises the following three tasks:

1. Description of the natural values of 12 GBRS sites nominated by DPI;
2. Identification and description of the relationship of the sites to regionally significant sequences of ecological communities; and
3. Evaluation of the natural values of the sites and recommendations to protect these values.

This report details the findings of Task 3. Tasks 1 and 2 have been previously completed (HGM 2002). The study specifically focuses on the following in accordance with the study brief:

- Evaluate the natural values in a regional context according to EPA (2002); and
- Recommendations for protection of regionally significant values.

The natural values of the sites were evaluated in a regional context according to EPA (2002). The EPA's evaluation strategy utilised the selection criteria developed for the Bushplan Project that have been updated to reflect current policy standards and adapted to the specific environment of the GBR (EPA 2002).

It should be noted that the evaluation strategy by EPA (2002) is extended in this study beyond the Swan Coastal Plain to apply to some areas on the foothills and lateritic uplands of the Blackwood Plateau.

This report is also to recommend to the Commission the environmental acceptability of the zones and reserves proposed under the GBRS. Where the findings suggest that the proposed zones and reserves do not adequately protect

regionally significant natural values, recommendations are made to enable the protection of their natural values.

1.3 12 Sites

12 sites as listed in Table 1.1 were investigated in accordance with the study brief. These sites were from a diverse array of landform, topography and vegetation complex as reported in HGM (2002).

Table 1.1: 12 Sites of the Study

No.	Site Name	Area (ha)	Description
1	Australind Waste Water	44	3 locations E of Australind and W of Australind bypass
2	South Dalyellup	116	Access via Minninup Road
3	Boyanup East	234	E of Boyanup via Hurst Road
4	Davenport Industrial	41	Adjacent to SW Hwy, S of Bunbury
5	Brunswick River	45	Adjacent to Brunswick River E of Australind bypass
6	Boyanup Bypass	5 km	Proposed 50m road reserve bypass west of Boyanup
7A	Myalup	30	S of Myalup townsite & diversion drain
7B	Buffalo Road	165	Between Buffalo & Springhill Roads
8	Twin Rivers	42	Confluence of Collie & Brunswick Rivers
9	Muddy Lakes	285	Access via Minninup Road and coast
10	Parade Road	63	S of housing developments S of Bunbury
11	Estuary Drive	0.5	Estuary Drive, Vittoria Bay

2 Regional Selection Criteria

2.1 Regional Context for natural values

The Swan Coastal Plain has high natural values, is the most populous and densely settled area of the state, and has been heavily cleared. As a consequence, the Swan Coastal Plain is the focus for the largest number of development proposals submitted to the Environmental Protection Authority for the assessment of environmental impacts (EPA 2002). The continuing pressure of urban and suburban development is an ongoing threat to the natural values of the remnant bushland of the coastal plain, particularly the occurrence of diversity of vegetation communities, fauna habitats and rare taxa that occur. In the Bunbury Region, urban expansion (particularly around Bunbury and Australind), continued rural and industrial development has lead to significant degradation of natural values throughout much of the area. This has resulted in an estimated 78% loss of the original native vegetation (EPA 2002), and loss of condition in many of the remaining remnants.

A detailed assessment of natural values and an evaluation and identification of significant bushland areas within the Perth metropolitan region was facilitated by the Bush Plan project (Government of Western Australia 1998). A similar process of evaluation and categorisation has not been undertaken in the Bunbury Region. Together with the relatively poor level of knowledge of the composition of the biota within the region, this limits the ability to make a detailed appraisal of natural values within a regional context. The lack of information concerning natural values was apparent in the GBRS Environmental Review (WAPC 2000) for example no specific information is provided for native terrestrial fauna, and the only reference to habitat is in regard to the value for waterbirds of the Leschenault Estuary. A more detailed appraisal of the fauna and flora from both a site-specific and regional context is required.

The study area of this report focuses primarily on the Swan Coastal Plain portion of the Bunbury Region as defined by Thackway and Cresswell (1995), largely excluding upland areas to the east on the Blackwood Scarp and Plateau. It is apparent from regional survey information that there are differences in the regional landforms and distribution of vegetation types within the Swan Coastal Plain bioregion, particularly when comparing areas around Bunbury with districts to the north of Perth. This is due to the greater proportion of the Bunbury Region comprising fluviatile (alluvial and colluvial) landform types associated with the eastern coastal plain and changes in vegetation associated with particular landforms over the range of these sequences along the coastal plain. Therefore, it is not unexpected that over a latitudinal gradient there will be significant change in vegetation within what was mapped as a single landform unit over the entire coastal plain by Heddle *et al.* (1980). Some investigations of the vegetation have noted these differences in species composition; for example, Beard (1979) and Smith (1974) have differentiated the Quindalup system into separate units north (Guilderton system) and south (Rockingham system) of the Swan River. The range of small-scale geomorphic units within the Quindalup dunes and their relatively recent development mean that this is an exceedingly diverse landform unit. However, similar local topographic diversity is evident in other landform units to a lesser extent, as for example the interaction of wetland, lake and estuary deposits and Quaternary sedimentary systems.

The overall conclusion is that whilst vegetation corresponds generally to landform units, there is significant sub-(bio)regional variation both in vegetation and the array of fauna species that utilise available habitats over the latitudinal gradient along the coastal plain. The character of the southern Swan Coastal Plain differs from areas to the north in the relative influence of climatic factors and the relative proportion of underlying geological features (eg. extent of Pinjarra Plain and depth of Tamala limestone) that ultimately dictate the distribution of landforms, soils, vegetation types and fauna habitats.

Wetland values have not been adequately evaluated in the appraisal of natural values in the GBRS Environmental Review. There has been significant loss and degradation of wetlands in Australia since settlement, and the coastal lowlands of southern Australia have suffered the greatest loss. Estimates of wetland loss on the Swan Coastal Plain are in the order of 70% (Halse 1989) and degradation of wetland values continues to occur. Wetlands are particularly important for waterbirds, frogs, turtles and aquatic invertebrates, and support specific floristic community types. Until wetland mapping and designation of wetland categories for the Region is published, determination of the relative importance of wetlands and wetland systems is limited. As a result, degradation of basin and channel wetlands, their associated riparian vegetation and water dependent fauna communities within the Bunbury Region may continue.

2.2 Explanation of the criteria

EPA (2002) developed a strategy to be adopted for consideration of the regional significance of the GBRS portion of the Swan Coastal Plain. This strategy has been adopted here to assess the natural areas affected by new zones and reserves under the GBRS. The strategy measures an individual area's natural values against the selection criteria for the identification of regionally significant natural areas developed for System 6 and Part System 1 Update and the Bushplan Project to determine regional significance.

The six criteria defined in EPA (2002) are:

1. representation of ecological communities;
2. diversity;
3. rarity;
4. maintaining ecological processes or natural systems;
5. scientific or evolutionary importance; and
6. protection of vegetation associated with wetlands, streamlines, estuarine and coastal areas.

2.3 Application of the criteria

The natural values of the 12 sites of this study were reported in HGM (2002). This study assesses the natural values according to the EPA (2002) criteria defined in the previous section.

One or more factors of the six criteria have been assessed, based upon the guidance in the EPA Strategy and on the study team's interpretation of the criteria at each site. Where the objective of satisfying the criteria differs to that

of EPA (2002) it is expressly stated. In total, 26 factors have been included in the assessment.

2.3.1 Representation of ecological communities

"A number of areas selected to represent the range of ecological communities and the places in which these communities merge" (EPA 2002).

Total remnant vegetation remaining of vegetation complexes within the Swan Coastal Plain varies between 5 and 47% of their original extent. The standard level of native vegetation retention adopted is 30% of the pre-clearing extent as a target value. These levels are modified for the GBR constrained area, in which there is 'an expectation that development will be able to proceed' (EPA, 2002).

Where less than 10% of a vegetation complex remains, the objective is to retain all remaining vegetation complexes in constrained areas, defined in EPA (2002) as consolidated urban, urban deferred and industrial (Factor 1). In unconstrained areas, the objective is to retain all remaining vegetation complexes where less than 30% remains (Factor 2). Sites 1, 2, 4, 5, 8, 10, and 11 are located within the constrained area.

2.3.2 Diversity

"Areas with a high diversity of flora and/or fauna species or communities in close association" (EPA 2002).

Number of Vegetation Complexes, Floristic Community Types and Structural Vegetation Units

The EPA recognises that it is important to conserve areas of richness, diversity or complexity for their physical or biological attributes at a community, species or genetic level. The diversity of ecological communities within a site, both at a structural and floristic level, supports other criteria for selection of representative areas. This criterion recognises the diversity of vegetation complexes, inferred floristic community types and structural vegetation units within each site (Factors 3, 4 and 5 respectively). Only where remnant vegetation occurred within the vegetation complexes defined by Heddle *et al.* (1980) are they recorded for this criterion.

Number of Fauna Habitats

Areas with a high diversity of faunal assemblages have regional significance (Factor 6). The variety of fauna species present in an area is often related to the number of habitats. Factor 6 is closely related to the number of vegetation structural units represented at a site.

Native Species Richness Scale

The richness, diversity and complexity of species is another important part of this criterion (Factor 7). Both flora and fauna diversity have been assessed, although the assessment is limited by the constraints of the field survey. Time limitations prevented the field survey recording more than 70% of expected flora taxa occurring within the sites. Where other survey effort was recorded (eg Sites 8 and 10) it was estimated that 80% of taxa was recorded. Table 2.1 outlines the relative flora richness scale devised to given an indication of the

diversity of native flora at each site (Factor 7a). However, it should be noted that the number of species is commonly a factor of the size of the site.

Table 2.1: The relative scale for native flora richness used to assess native flora species diversity.

Scale	Native flora richness recorded at a site (Number of species)
5	100 or more
4	80-100
3	50-80
2	30-50
1	0-30

To assess fauna diversity, avifauna species richness has been used because this group was the best documented during the field survey. The variety of species is likely to be indicative of habitat diversity and ecosystem health. A relative avifauna richness scale (Table 2.2) was devised to given an indication of the diversity of avifauna at each site (Factor 7b).

Table 2.2: The relative scale for avifauna richness used to assess species diversity.

Scale	Avifauna richness recorded at a site (Number of species)
3	40 or more, or 10 or more water birds
2	20-40
1	0-20

2.3.3 Rarity

"Areas containing rare or threatened communities or species, or species of restricted distribution" (EPA 2002).

Rarity is considered from a community and species perspective. This includes threatened ecological communities and areas supporting threatened species.

No known threatened ecological communities (TECs) occur within the study sites[1]. However, HGM (2002) proposed three vegetation units that may be expected to meet the criteria for identification as TECs (Factor 8).

Areas that support rare, uncommon or restricted flora are of regional significance. This includes flora listed as Declared Rare or Priority flora under *Wildlife Conservation Act 1950* and threatened flora under the *Environmental Protection, Biodiversity and Conservation (EPBC) Act 1999* (Factors 9 and 10). Factor 11 also recognises flora of significance those that were recorded in the Spring 2002 on the Plain and listed by Keighery (1999) as unreserved taxa

[1] 1.5ha of TEC site "myHAY03" of floristic community type 18 occurs within the boundary of Site 10 Parade Road, less than 2% of the 'zone of influence'. However, site "myHAY03" is separated from Site 10 by Washington Road and the southern extent that falls within Site 10 is very degraded, therefore not suitable to be identified as threatened ecological community.

of the Swan Coastal Plain (Table 2.3). Those flora known to be common in the south-west corner are not listed here (such as *Leucopogon capitellatus*).

Table 2.3: Flora recorded during the Spring 2002 survey that are listed by Keighery (1999) as unreserved taxa on the Swan Coastal Plain

Acacia pulchella var. *goadbyi*
Acacia urophylla
Calycopeplus oligandrus
Drosera nitidula subsp. *nitidula*
Logania serpyllifolia subsp. *angustifolia*
Schoenus sublateralis

Factors 12, 13, 14 and 15 recognise sites that support populations of significant fauna. These factors include all rare fauna as listed under the *EPBC Act 1999* and *WA Wildlife Conservation Act 1950*, CALM Priority Fauna taxa and Birds listed under migratory agreements (Factors 12, 13 and 14 respectively). Bush Forever decliner species are also listed (Factor 15). While not classified as rare, threatened or vulnerable in any State or Commonwealth legislation, a number of species have been listed as significant on the Swan Coastal Plain portion of the Perth Metropolitan Region (Government of Western Australia 1998 and 2000). The two categories used in Bush Forever are:

- habitat specialists with a reduced distribution on the Swan Coastal Plain (Bh); and
- wide-ranging species with reduced populations on the Swan Coastal Plain (Bp).

2.3.4 Maintaining ecological processes or natural systems

"Maintenance of ecological processes or natural systems at a regional or national scale" (EPA 2002).

Size and Condition

It is important that the vegetation to be retained is of suitable condition. This consideration also forms part of Criterion 1. The condition of each site measured by HGM (2002) was based on the condition scale of Keighery (1994). While remnants in largely undisturbed condition are preferred, it is assumed here that Good condition or better, which has the ability to regenerate basic vegetation structure with minimal management, is the objective.

Fauna species vary in their ability to survive in remnants; for example reptiles persist on relatively small remnants (How and Dell 1994) and birds maintain populations in urban areas, whereas native mammals generally disappear. Vegetation condition will to some extent determine the assemblage of fauna species that an area can support, and greater structural diversity generally corresponds to enhanced species diversity. However, whilst areas that retain the overstorey but have little remaining in the ground layer may have little value from a botanical perspective, they may be able to support a moderately diverse avifauna assemblage.

Size is of key importance in determining the viability of natural areas for long term retention. A large sized area is preferred because it is more likely to have

a greater variety of vegetation types and therefore fauna habitats, is less prone to edge effects, allows for fauna species that have large home ranges, and supports several territories for less wide ranging species. Island biogeography theory suggests that species richness is a function of area; the larger an area the greater the number of fauna species it will support.

The lower size limit of 20 hectares in the Urban Bushland Strategy was accepted as a preferred lowest area limit (EPA 2002). Combining these size and condition measures, Factor 16 includes all sites where the area of remnant bushland in Good or better condition is greater than 20ha.

Shape

A compact shape is preferable to irregular or elongate shapes that are have increased susceptibility to weed invasion and disturbance (Factor 17). Fragmentation of natural areas due to vegetation clearance has lead to a situation where remnants of vegetation are all that survive in many parts of the Swan Coastal Plain. Areas that retain vegetation act to connect bushland remnants and may be used as corridors by vertebrate fauna. Within the Bunbury region bushland remnants are often relatively small and tend to be isolated from other such areas. Issues of concern in fragmented ecosystems include:

- many bird and mammal species require a large area for their home range that provides sufficient resources for survival. This is particularly the case for larger species such as the Emu, Grey Kangaroo and Brush Wallaby;
- exchange between populations is important for maintaining genetic diversity; and
- populations that are isolated are susceptible to localised extinction as a consequence of factors such as fire events, climatic fluctuations and predators.

Fauna Habitat Value

Fauna habitats provide functional requirements such as areas for feeding and breeding. Most habitats provide a food and shelter resource of some kind, and emphasis for this criterion is on areas that provide special resources such as mudflats. The floristic character of an area may also be important if flowering or fruiting supports fauna species, and habitat trees will provide shelter in the form of hollows in limbs and trunks. The structure of the vegetation is important as it largely determines bird species diversity. Breeding activity was noted during the field survey but requires more thorough investigation to assess the importance of areas for breeding purposes. Factor 18 defines the value for fauna habitat into two classes, moderate and high.

Habitats for significant populations of migratory birds contribute to this criterion but have already been acknowledged under Factor 14.

Linkage

Linkage with adjacent bushland areas has been identified as a natural attribute of high priority in the assessment of regional significance (EPA 2002). Two types of regionally significant sequences of ecological communities have been identified within the GBRS. Vegetated sequences are predominantly

north/south links while river corridors form east/west links between the Darling/Blackwood Plateaus and the coast.

Many sites contribute or were directly linked to remnant bushland recognised as regionally significant sequences of ecological communities by the EPA (2002). Others had direct bushland links to other System 6 areas or National Parks recognised as regionally significant sequences in HGM (2002). The six sequences described in HGM (2002) and included in Factor 19 are:

1. Ocean to Preston River Park (C70)
2. Dalyellup/Gelorup/Preston River/Plateau Link (C71, C86)
3. Brunswick, Collie and Wellesley Rivers Corridor (C67)
4. Preston River Corridor (while heavily cleared in some sections still forms a significant corridor between the coast and the Blackwood Plateau)
5. Link to National Parks (Yalgorup National Park, C54)
6. Link to other System 6 areas (C 66 Leschenault Estuary)

Factor 20 recognises sites that are directly linked to adjacent remnant bushland are also recognised, although not as high a priority as linkage or contiguous with regionally significant sequences.

Uplands and Wetlands

Natural areas containing both uplands and wetlands (soils seasonally or intermittently waterlogged and/or inundated) support the highest biodiversity and are a focus for protection (EPA 2002). Factor 21 recognises those sites that contain both uplands and wetlands.

2.3.5 Scientific or evolutionary importance

"Areas containing evidence of evolutionary processes either as fossilised material or as relict species and areas containing unusual or important geomorphological or geological sites; Areas of recognised scientific and educational interest as reference sites or as examples of the important environmental processes at work" (EPA 2002).

Most of the inclusion guidelines in EPA (2002) are not relevant to the study sites. The unpublished maps associated with evaluation of wetlands on the Southern Swan Coastal Plain by V and C Semeniuk Research Group (1998) indicate areas of conservation of geomorphic processes that include:

- conservation of geomorphology for the previous extent of the Leschenault Estuary for the on Map Sheet 2031 IV SE; and
- significant coastal geomorphology on Map Sheet 2031 III SW.

Factor 22 considers those sites with areas that have been recognised for conservation of geomorphic processes by V and C Semeniuk Research Group (1998).

2.3.6 Protection of vegetation associated with wetlands, streamlines, estuarine and coastal areas

"Conservation category wetland areas including fringing vegetation and associated upland vegetation; Coastal vegetation within the accepted coastal management zone" (EPA 2002).

Conservation category wetlands associated with regionally significant bushland, their fringing vegetation and associated upland vegetation is assessed for various wetland geomorphic types (Factors 23, 24 and 25). Factor 26 considers coastal vegetation with regionally significant vegetation.

Difficult to quantitatively measure these criteria

3 Regionally Significant Sites

The natural values relevant to the 26 Factors to identify regionally significant natural areas are presented for each of the 12 sites. Generally, the assessment was straightforward, however at a few sites some explanation of certain Factors is presented.

3.1 Site 1 Australind WWTP and Two Adjacent Lots

Factor		Natural Values relevant to the Factor
1	Vegetation complex <10% in constrained area	None identified
2	Vegetation complex >10% but <30% in unconstrained area	None identified (Bassendean Complex less than 30% but site in the constrained area)
3	No. of vegetation complexes	1: Bassendean
4	No. of floristic community types	2: 21a and 21c
5	No. of vegetation units	3
6	No. of habitats	2: pools (artificial), Eucalypt woodlands
7a	Native flora richness scale	4: 97 native taxa
7b	Avifauna richness scale	2: 25 avifauna species
8	Known or potential TECs	None identified
9	Declared Rare Flora	None identified
10	Priority Flora	4: *Acacia flagelliformis* (P4), *Acacia semitrullata* (P3), *Caladenia speciosa* (P4), *Jacksonia sparsa* (P4)
11	Significant/Unreserved Flora	3: *Drosera nitidula subsp. nitidula, Logania serpyllifolia* subsp. *angustifolia, Schoenus sublateralis*
12	Rare Fauna	None identified
13	Priority Fauna	None identified
14	Migratory Birds	None identified
15	Bush Forever Decreaser species	5: Australasian Shoveller, Little Eagle (breeding record), Common Bronzewing, Splendid Fairy-wren, Yellow-rumped Thornbill
16	>20ha of Good or better condition	None identified
17	Remnant of compact shape	No, but one compact remnant of three portions
18	Fauna habitats value	1
19	Linkage to regional or important sequences	Yes, link to Brunswick, Collie and Wellesley Rivers Corridor (C67) via the adjacent bushland at Wardandi Reserve
20	Linkage to adjacent remnant bushland	Yes, adjacent bushland to west at Wardandi Reserve
21	Uplands and Wetlands	Yes
22	Unusual geomorphic processes	None identified
23	Vegetation of channel wetlands	None identified
24	Vegetation of basin wetlands	None identified
25	Vegetation of estuaries	None identified
26	Vegetation of coasts	None identified

3.2 Site 2 South Dalyellup

Factor		Natural Values relevant to the Factor
1	Vegetation complex <10% in constrained area	None identified
2	Vegetation complex >10% but <30% in unconstrained area	None identified (Karrakatta Complex less than 30% but site in the constrained area)
3	No. of vegetation complexes	1: Karrakatta
4	No. of floristic community types	1: 25
5	No. of vegetation units	2
6	No. of habitats	2: Tuart woodland, highly degraded wetland pool
7a	Native flora richness scale	2:44 native taxa
7b	Avifauna richness scale	1: 12 avifauna species
8	Known or potential TECs	None identified
9	Declared Rare Flora	None identified
10	Priority Flora	None identified
11	Significant/Unreserved Flora	None identified
12	Rare Fauna	None identified
13	Priority Fauna	None identified
14	Migratory Birds	None identified
15	Bush Forever Decreaser species	2: Splendid Fairy-wren, Yellow-rumped Thornbill
16	>20ha of Good or better condition	Yes
17	Remnant of compact shape	Yes
18	Fauna habitats value	1
19	Linkage to regional or important sequences	Yes, adjacent bushland to east is Dalyellup Reserves, a System 6 area (C71); forms part of the Dalyellup/Gelorup/Preston River/Plateau Link; to west is the northern extent of the 'Muddy Lakes' sumpland (ROS)
20	Linkage to adjacent remnant bushland	Yes, adjacent bushland to the north, west and east
21	Uplands and Wetlands	No
22	Unusual geomorphic processes	None identified
23	Vegetation of channel wetlands	None identified
24	Vegetation of basin wetlands	None identified
25	Vegetation of estuaries	None identified
26	Vegetation of coasts	None identified

3.3 Site 3 Boyanup East (3)

Factor		Natural Values relevant to the Factor
1	Vegetation complex <10% in constrained area	None identified
2	Vegetation complex >10% but <30% in unconstrained area	Swan Complex
3	No. of vegetation complexes	3: Swan, Cartis and Kingia
4	No. of floristic community types	3: 1a, 4 and 21b
5	No. of vegetation units	4
6	No. of habitats	3: Eucalypt (Marri) woodlands, artificial wetlands, pastures
7a	Native flora richness scale	5: 123 native taxa
7b	Avifauna richness scale	2: 27 avifauna species
8	Known or potential TECs	None identified
9	Declared Rare Flora	None identified
10	Priority Flora	5: *Acacia flagelliformis* (P4), *Acacia semitrullata* (P3), *Caladenia speciosa* (P4), *Drosera marchantii* subsp. *marchantii* (P4), *Jacksonia sparsa* (P4)
11	Significant/Unreserved Flora	2: *Acacia pulchella* var. *goadbyi, Acacia urophylla* (also the only location of *Corymbia haemotoxylon* within the study sites)
12	Rare Fauna	1: Baudin's Black Cockatoo (S1)
13	Priority Fauna	
14	Migratory Birds	
15	Bush Forever Decreaser species	3: Common Bronzewing, Splendid Fairy-wren, Yellow-rumped Thornbill
16	>20ha of Good or better condition	Yes
17	Remnant of compact shape	No, but one compact remnant area within the site
18	Fauna habitats value	1
19	Linkage to regional or important sequences	No
20	Linkage to adjacent remnant bushland	Yes, adjacent to large patch of remnant bushland to the south with potential linkage with State Forest but currently zoned Urban; remnant riparian linkage along Joshua Gully creekline links to the Preston River Corridor
21	Uplands and Wetlands	Yes
22	Unusual geomorphic processes	None identified
23	Vegetation of channel wetlands	None identified
24	Vegetation of basin wetlands	None identified
25	Vegetation of estuaries	None identified
26	Vegetation of coasts	None identified

3.4 Site 4 Davenport Industrial

Factor		Natural Values relevant to the Factor
1	Vegetation complex <10% in constrained area	None identified
2	Vegetation complex >10% but <30% in unconstrained area	None identified (Southern River and Swan Complexes less than 30% but site in the constrained area)
3	No. of vegetation complexes	1: Southern River and Swan
4	No. of floristic community types	2: 4 and 17
5	No. of vegetation units	6
6	No. of habitats	3: Melaleuca woodland, Eucalypt woodland, river channel
7a	Native flora richness scale	2: 33 native taxa
7b	Avifauna richness scale	2: 28 avifauna species
8	Known or potential TECs	None identified
9	Declared Rare Flora	None identified
10	Priority Flora	1: *Jacksonia sparsa* (P4)
11	Significant/Unreserved Flora	1: *Acacia pulchella* var. *goadbyi*
12	Rare Fauna	None identified
13	Priority Fauna	None identified
14	Migratory Birds	None identified
15	Bush Forever Decreaser species	4: Splendid Fairy-wren, Inland Thornbill, Yellow-rumped Thornbill, Scarlet Robin
16	>20ha of Good or better condition	None identified
17	Remnant of compact shape	No, area split in many sections
18	Fauna habitats value	1
19	Linkage to regional or important sequences	Yes, the southern and eastern portions of this site form part of the Dalyellup/Gelorup/Preston River/Plateau Link and the Preston River Corridor;
20	Linkage to adjacent remnant bushland	Yes, adjacent bushland to south
21	Uplands and Wetlands	No
22	Unusual geomorphic processes	None identified
23	Vegetation of channel wetlands	None identified
24	Vegetation of basin wetlands	None identified
25	Vegetation of estuaries	None identified
26	Vegetation of coasts	None identified

3.5 Site 5 Brunswick River

Factor		Natural Values relevant to the Factor
1	Vegetation complex <10% in constrained area	None identified
2	Vegetation complex >10% but <30% in unconstrained area	Bassendean and Swan Complexes
3	No. of vegetation complexes	2: Bassendean and Swan
4	No. of floristic community types	1: 13
5	No. of vegetation units	3
6	No. of habitats	3: pools, river channel, Eucalypt and Melaleuca woodlands
7a	Native flora richness scale	1: 17 native taxa
7b	Avifauna richness scale	2: 26 avifauna species
8	Known or potential TECs	None identified
9	Declared Rare Flora	None identified
10	Priority Flora	None identified
11	Significant/Unreserved Flora	1: *Acacia pulchella* var. *goadbyi*
12	Rare Fauna	None identified
13	Priority Fauna	None identified
14	Migratory Birds	None identified
15	Bush Forever Decreaser species	5: Splendid Fairy-wren, Inland Thornbill, Yellow-rumped Thornbill, Weebill, Grey Shrike-thrush
16	>20ha of Good or better condition	None identified
17	Remnant of compact shape	Yes
18	Fauna habitats value	1
19	Linkage to regional or important sequences	Yes, this site represents part of the Brunswick, Collie and Wellesley Rivers Corridor.
20	Linkage to adjacent remnant bushland	Yes, adjacent bushland to west, south and north
21	Uplands and Wetlands	No
22	Unusual geomorphic processes	None identified
23	Vegetation of channel wetlands	Yes, conservation category wetland with regionally significant bushland.
24	Vegetation of basin wetlands	None identified
25	Vegetation of estuaries	None identified
26	Vegetation of coasts	None identified

3.6 Site 6 Boyanup Bypass

This site traverses areas that were mapped by Heddle *et al.* (1980) as Swan, Guildford and Cartis Complexes. While the Swan and Guildford Complexes have less than 30% of their original extent, no remnant bushland remaining within the site is of those complexes. The only remnant bushland remaining within the site is of the Cartis Complex.

Factor		Natural Values relevant to the Factor
1	Vegetation complex <10% in constrained area	None identified
2	Vegetation complex >10% but <30% in unconstrained area	Swan and Guildford Complex
3	No. of vegetation complexes	1: Cartis
4	No. of floristic community types	1: 1a
5	No. of vegetation units	1
6	No. of habitats	2: remnant woodlands, degraded wetlands
7a	Native flora richness scale	3: 72 native taxa
7b	Avifauna richness scale	2: 21 avifauna species
8	Known or potential TECs	None identified
9	Declared Rare Flora	None identified
10	Priority Flora	2: *Acacia flagelliformis* (P4), *Caladenia speciosa* (P4)
11	Significant/Unreserved Flora	None identified
12	Rare Fauna	None identified
13	Priority Fauna	None identified
14	Migratory Birds	None identified
15	Bush Forever Decreaser species	None identified
16	>20ha of Good or better condition	None identified
18	Remnant of compact shape	No, elongated road reserve
18	Fauna habitats value	0
19	Linkage to regional or important sequences	None identified
20	Linkage to adjacent remnant bushland	Yes, adjacent bushland to south
21	Uplands and Wetlands	No
22	Unusual geomorphic processes	None identified
23	Vegetation of channel wetlands	None identified
24	Vegetation of basin wetlands	None identified
25	Vegetation of estuaries	None identified
26	Vegetation of coasts	None identified

3.7 Site 7A Myalup

The regional dataset of vegetation complex mapping places Quindalup and Vasse complexes occurring at the site. However, based on field survey, vegetation of the Quindalup and Karrakatta – Central and South complexes occur at the site. Both of these complexes have 30% or more remaining of their original extent on the Swan Coastal Plain.

Factor		Natural Values relevant to the Factor
1	Vegetation complex <10% in constrained area	None identified
2	Vegetation complex >10% but <30% in unconstrained area	None identified
3	No. of vegetation complexes	2: Quindalup and Karrakatta – Central and South
4	No. of floristic community types	3: 29a, 29b and 29c
5	No. of vegetation units	3
6	No. of habitats	3: Tuart woodland, coastal heaths, channel wetland
7a	Native flora richness scale	2: 39 native taxa
7b	Avifauna richness scale	2: 21 avifauna species
8	Known or potential TECs	None identified
9	Declared Rare Flora	None identified
10	Priority Flora	None identified)
11	Significant/Unreserved Flora	None identified
12	Rare Fauna	None identified
13	Priority Fauna	None identified
14	Migratory Birds	None identified
15	Bush Forever Decreaser species	None identified
16	>20ha of Good or better condition	None identified (17.3 ha of Good to excellent remnant bushland)
17	Remnant of compact shape	Yes
18	Fauna habitats value	2
19	Linkage to regional or important sequences	Yes, this site forms a link between the coast and the Yalgorup National Park (C54); Lake Josephine and Lake Preston are important waterway linkages to the north-east;
20	Linkage to adjacent remnant bushland	Yes, adjacent bushland to north, south and east
21	Uplands and Wetlands	No
22	Unusual geomorphic processes	None identified
23	Vegetation of channel wetlands	None identified
24	Vegetation of basin wetlands	None identified
25	Vegetation of estuaries	None identified
26	Vegetation of coasts	Yes

3.8 Site 7B Buffalo Road

The samphire association (unit 7B.3) is a floristic community type that does not appear to be equivalent to any defined in Gibson *et al.* (1994), are uncommon in the South West Botanical District (Trudgen 1984) and may represent a potentially threatened ecological community.

Factor		Natural Values relevant to the Factor
1	Vegetation complex <10% in constrained area	None identified
2	Vegetation complex >10% but <30% in unconstrained area	Vasse Complex
3	No. of vegetation complexes	3: Vasse, Yoongarillup and Quindalup
4	No. of floristic community types	1: 13
5	No. of vegetation units	3
6	No. of habitats	2: remnant stands of *Melaleuca,* seasonally inundated areas
7a	Native flora richness scale	1: 10 native taxa
7b	Avifauna richness scale	2: 29 avifauna species
8	Known or potential TECs	Yes: proposed new
9	Declared Rare Flora	None identified
10	Priority Flora	None identified
11	Significant/Unreserved Flora	1: *Logania serpyllifolia* subsp. *angustifolia*
12	Rare Fauna	None identified
13	Priority Fauna	None identified
14	Migratory Birds	None identified
15	Bush Forever Decreaser species	5: Australasian Shoveller, Whistling Kite, Common Bronzewing, Yellow-rumped Thornbill, Black-faced Woodswallow
16	>20ha of Good or better condition	None identified
17	Remnant of compact shape	Yes
18	Fauna habitats value	1
19	Linkage to regional or important sequences	Yes, forms part of the Leschenault Estuary System 6 area (C66)
20	Linkage to adjacent remnant bushland	Yes, adjacent bushland to south and west; direct linkage to the Leschenault Peninsular Conservation Park
21	Uplands and Wetlands	Yes
22	Unusual geomorphic processes	Yes, conservation of geomorphology for the previous extent of the Leschenault Estuary
23	Vegetation of channel wetlands	None identified
24	Vegetation of basin wetlands	None identified
25	Vegetation of estuaries	Yes
26	Vegetation of coasts	None identified

3.9 Site 8 Twin Rivers (2)

Factor		Natural Values relevant to the Factor
1	Vegetation complex <10% in constrained area	None identified
2	Vegetation complex >10% but <30% in unconstrained area	None identified (Swan and Karrakatta – Central and South Complexes less than 30% but site in the constrained area)
3	No. of vegetation complexes	2: Swan and Karrakatta – Central and South
4	No. of floristic community types	2: 11 and 21a
5	No. of vegetation units	4
6	No. of habitats	3: Eucalypt Woodland, Melaleuca Woodland, river channel
7a	Native flora richness scale	5: 136 native taxa
7b	Avifauna richness scale	2: 26 avifauna species
8	Known or potential TECs	None identified
9	Declared Rare Flora	1: *Diuris drummondii*
10	Priority Flora	4: *Caladenia speciosa* (P4), *Lasiopetalum membranaceum* (P3)
11	Significant/Unreserved Flora	None identified
12	Rare Fauna	None identified
13	Priority Fauna	1: Southern Brown Bandicoot (P4)
14	Migratory Birds	None identified
15	Bush Forever Decreaser species	3: Splendid Fairy-wren, Yellow-rumped Thornbill, Grey Currawong
16	>20ha of Good or better condition	Yes
17	Remnant of compact shape	Yes
18	Fauna habitats value	2
19	Linkage to regional or important sequences	Yes,; foreshore is part of the Brunswick, Collie and Wellesley Rivers Corridor, a System 6 area (C67);
20	Linkage to adjacent remnant bushland	Yes, adjacent bushland to south and north is ROS; forms a corridor to the Leschenault Estuary via adjacent bushland of the Australind Primary School
21	Uplands and Wetlands	Yes
22	Unusual geomorphic processes	None identified
23	Vegetation of channel wetlands	Yes
24	Vegetation of basin wetlands	None identified
25	Vegetation of estuaries	None identified
26	Vegetation of coasts	None identified

3.10 Site 9 Muddy Lakes

The *Banksia littoralis* Low Woodland (unit 9.6) recorded during this study may represent the most southern occurrence on the Southern Coastal Plain of floristic community type 19 and is of a sequence of 'Quindalup Dune Swale Damplands' that is the only of this type (Keighery *et al.* 2002). Floristic community type 19 is recognised both at State and Commonwealth level (endorsed by the WA Minister for the Environment and listed as Critically Endangered under the *EPBC Act 1999*). It is proposed that unit 9.6 has regional significance and is expected to meet the criteria for identification as a TEC.

Factor		Natural Values relevant to the Factor
1	Vegetation complex <10% in constrained area	None identified
2	Vegetation complex >10% but <30% in unconstrained area	Vasse and Karrakatta – Central and South Complexes
3	No. of vegetation complexes	3: Vasse, Quindalup and Karrakatta – Central and South
4	No. of floristic community types	5: 17, 19, 29a, 29b and 29c
5	No. of vegetation units	7
6	No. of habitats	3: Swamp, dunes and swales, Tuart woodland
7a	Native flora richness scale	3: 58 native taxa
7b	Avifauna richness scale	3: 61 avifauna species
8	Known or potential TECs	Yes: 19
9	Declared Rare Flora	None identified
10	Priority Flora	None identified
11	Significant/Unreserved Flora	1: *Calycopeplus oligandrus*
12	Rare Fauna	2: Quokka (S1), Western Ringtail Possum (S1)
13	Priority Fauna	1: Southern Brown Bandicoot (P4)
14	Migratory Birds	None identified
15	Bush Forever Decreaser species	13: Musk Duck, Whistling Kite, Common Bronzewing, Western Rosella, Splendid Fairy-wren, Inland Thornbill, Yellow-rumped Thornbill, Weebill, White-browed Scrubwren, New Holland Honeyeater, Grey Shrike-thrush, Golden Whistler, Black-faced Woodswallow
16	>20ha of Good or better condition	Yes
17	Remnant of compact shape	Yes
18	Fauna habitats value	2
19	Linkage to regional or important sequences	Yes, part of the Dalyellup/Gelorup/Preston River/Plateau Link; direct link east-west from coast to the System 6 Dalyellyup Reserves (C71)
20	Linkage to adjacent remnant bushland	Yes, adjacent bushland to north, south and west; part of the north-west coastal corridor from Bunbury south via Dalyellup Beach, Stirling Beach, Peppermint Grove Beach and Forrest Beach
21	Uplands and Wetlands	Yes
22	Unusual geomorphic processes	Yes, significant coastal geomorphology
23	Vegetation of channel wetlands	None identified
24	Vegetation of basin wetlands	Yes
25	Vegetation of estuaries	None identified
26	Vegetation of coasts	Yes

3.11 Site 10 Parade Road

A small portion (1.5ha) of the extreme northeast corner of the site falls within a known TEC site (myHAY03) of floristic community type 18. This area is less than 2% of the 'zone of influence'. However, the TEC site "myHAY03" is separated from Site 10 by Washington Road and the southern extent that falls within Site 10 is very degraded; therefore Site 10 is not suitable to be identified as threatened ecological community.

Factor		Natural Values relevant to the Factor
1	Vegetation complex <10% in constrained area	None identified
2	Vegetation complex >10% but <30% in unconstrained area	None identified (Karrakatta – Central and South Complex less than 30% but site in the constrained area)
3	No. of vegetation complexes	2: Yoongarillup and Karrakatta – Central and South
4	No. of floristic community types	2: 21a and 21c
5	No. of vegetation units	3
6	No. of habitats	2: Eucalypt woodlands, Melaleuca Woodland
7a	Native flora richness scale	5: 146 native taxa
7b	Avifauna richness scale	1: 18 avifauna species
8	Known or potential TECs	None identified
9	Declared Rare Flora	None identified
10	Priority Flora	3: *Caladenia speciosa* (P4), *Jacksonia sparsa* (P4), *Lasiopetalum membranaceum* (P3)
11	Significant/Unreserved Flora	1: *Logania serpyllifolia* subsp. *angustifolia*
12	Rare Fauna	None identified
13	Priority Fauna	1: Southern Brown Bandicoot (P4)
14	Migratory Birds	None identified
15	Bush Forever Decreaser species	3: Common Bronzewing, Splendid Fairy-wren, Yellow-rumped Thornbill
16	>20ha of Good or better condition	Yes
17	Remnant of compact shape	Yes
18	Fauna habitats value	1
19	Linkage to regional or important sequences	Yes, this site forms part of the Ocean to Preston River Park; linkage to the System 6 area (C70) South Bunbury Coastal Land
20	Linkage to adjacent remnant bushland	Yes, adjacent bushland to west, east and south
21	Uplands and Wetlands	Yes
22	Unusual geomorphic processes	None identified
23	Vegetation of channel wetlands	None identified
24	Vegetation of basin wetlands	Yes
25	Vegetation of estuaries	None identified
26	Vegetation of coasts	None identified

3.12 Site 11 Estuary Drive

The *Juncus* sedgeland (unit 11.1) is a floristic community type of Supergroup 2 that does not appear to be equivalent to any defined in Gibson *et al.* (1994) and may represent a potentially threatened ecological community.

Factor		Natural Values relevant to the Factor
1	Vegetation complex <10% in constrained area	None identified
2	Vegetation complex >10% but <30% in unconstrained area	None identified
3	No. of vegetation complexes	1: Yoongarillup
4	No. of floristic community types	1: proposed new of Supergroup 2
5	No. of vegetation units	3
6	No. of habitats	2: mudflats, fringing sedgelands
7a	Native flora richness scale	2: 33 native taxa
7b	Avifauna richness scale	1: 10 avifauna species
8	Known or potential TECs	Yes: proposed new
9	Declared Rare Flora	None identified
10	Priority Flora	None identified
11	Significant/Unreserved Flora	None identified
12	Rare Fauna	None identified
13	Priority Fauna	None identified
14	Migratory Birds	1: Great Egret (JAMBA/CAMBA)
15	Bush Forever Decreaser species	1: Yellow-rumped Thornbill
16	>20ha of Good or better condition	None identified
17	Remnant of compact shape	Yes
18	Fauna habitats value	2
19	Linkage to regional or important sequences	Yes, vegetation fringe along the Leschenault Estuary foreshore and the channel of the Preston River; continuation of the foreshore ROS; the site forms part of the tidal mudflats of the south-east section of the Leschenault Estuary; the Vittoria Bay area is a designated Bird Habitat Area.
20	Linkage to adjacent remnant bushland	Yes, adjacent bushland to east and west
21	Uplands and Wetlands	No
22	Unusual geomorphic processes	None identified
23	Vegetation of channel wetlands	None identified
24	Vegetation of basin wetlands	None identified
25	Vegetation of estuaries	Yes
26	Vegetation of coasts	None identified

4 Score For Satisfying Criteria

The Factors for each site are summarised in Table 4.1. A score was calculated to enable the sites to be ranked according to their capacity to satisfy all of the criteria. Scoring was based on one point for satisfying a Factor, except for factors 3, 4, 5, 6 and 7 where a the number or scale was allocated, as explained in Section 2.3, for the number of complexes, floristic community types, vegetation units, fauna habitats and species richness.

The maximum possible score for satsifying all Factors is 34, plus the scores for Factors 3, 4, 5 and 6 for which there is no maximum score stated.

The sites were then ranked in descending score order to establish a broad priority for protection (Table 4.2). It should be noted that most sites scored highly, and may be understood to contain areas of regionally significant natural values. The purpose of ranking was to assign a priority for protection.

Table 4.2: Priority ranking for the sites based on the criteria score

Rank Order	Score	Site
1	40	9
2	31	8
3	29	3
4	26	10
5	24	4
6	23	7B
7	21	1
7	21	7A
9	20	5
10	18	11
10	16	2
12	12	6

Table 4.1: Summary of factors applied to satisfy Regional Significance criteria at each site

No.	Factor	Criteria	1	2	3	4	5	6	7A	7B	8	9	10	11
1	Vegetation complex <10% in constrained area	1,3												
2	Vegetation complex >10% but <30% in unconstrained area	1			+		+			+		+		
3	No. of vegetation complexes	2	1	1	3	2	1	1	2	3	2	3	2	1
4	No. of floristic community types	2	2	1	3	2	1	1	3	2	2	5	2	1
5	No. of vegetation units	2	3	2	4	6	3	1	3	3	4	7	3	1
6	No. of habitats	2	2	2	3	3	3	2	3	2	3	3	2	2
7a	Native flora richness scale	2	4	2	5	2	1	3	2	1	5	3	5	1
7b	Avifauna richness scale	2	2	1	2	2	2	2	2	2	2	3	1	3
8	Known or potential Threatened Ecological Communities	3								+		+		+
9	Declared Rare Flora	3									1			
10	Priority Flora	3	4		5	1		2			4		3	
11	Significant/Unreserved Flora	3	3		2	1	1				1	1	1	
12	Rare Fauna	3		1	1							2		
13	Priority Fauna	3									1	1	1	
14	Migratory Birds	3,4												1
15	Bush Forever Decreaser species	3	5	2	3	4	5			5	3	13	3	1
16	>20ha of Good or better condition	4,1		+	+						+	+	+	
17	Remnant of compact shape	4,1		+			+		+	+	+	+	+	+
18	Fauna habitat value	4,1	1	1	1	1	1	0	2	1	2	2	1	2
19	Linkage to regional or important sequences	4	+	+		+	+		+	+	+	+	+	+
20	Linkage to adjacent remnant bushland	4	+	+	+	+	+	+	+	+	+	+	+	+
21	Uplands and Wetlands	4,1	+		+					+	+	+	+	
22	Unusual geomorphic processes	5								+		+		
23	Vegetation of channel wetlands	6				+	+				+			
24	Vegetation of basin wetlands	6					+					+	+	
25	Vegetation of estuaries	6								+				+
26	Vegetation of coasts	6							+			+		
	Score		21	15	29	24	20	12	21	23	31	40	26	18

5 Recommendations for Protection of Regionally Significant Natural Areas

5.1 Mechanisms For Protection

Where the findings of the environmental assessment suggest that the proposed zones and reserves do not adequately protect regionally significant natural values, recommendations are made to enable the protection of their natural values, by either:

- modifying boundaries of proposed zones and reserves; or
- utilising alternative mechanisms under the GBRS to Regional Open Space reservation (through liaison with the Commission).

The study team considered protection of the sites identified as regionally significant natural areas in a one-day workshop setting. This allowed a diversity of factors to be considered concurrently, in particular both flora and fauna issues, drawing on the experience of the study team. Each site was considered on its merits as distinct areas. A variety of mechanisms were considered, including:

- ROS zoning, as proposed in the GBRS;
- covenanting for conservation on private lands; and
- tradeoff between regionally significant areas and degraded areas suitable for development.

Conserving vegetation, whether through public or private efforts is necessary for retaining natural values of regional significance. However, private conservation efforts are a *voluntary* mechanism and only appropriate where the landowner commits to conserving the natural values on their property. Where regionally significant natural values have been identified on privately owned lands, protection may be possible by remaining in private ownership or pubic ownership may be necessary.

Public Ownership

Bush Bank is a revolving fund that provides a mechanism for the purchase, protection and on-selling of areas of land with significant wildlife and habitat conservation values, utilising funding from the Federal and West Australian Governments. To ensure these areas are protected in perpetuity, land purchased by Bush Bank will have a conservation covenant placed on it and this land will then be resold to a purchaser who is aware of the conservation values involved and is prepared to manage the land accordingly. All sites of this study would be expected to meet the Bush Bank's selection criteria.

Another way of ensuring that the land is managed for conservation into the future, at minimal cost, is through gifting the land to an appropriate organisation. Under current tax laws, bushland can be gifted to a registered Deductable Gift Recipient (such as the WA Landcare Trust and the National Trust). Through the Income Tax Assessment Act 1997, the value of this gift can then be offset against taxable income as a tax deduction, and this benefit can be spread over five years if appropriate.

Private Ownership

Some areas of privately owned bushland of regional significance could be adequately protected by utilising conservation convenants. A covenant is a voluntary agreement between a landowner and a body capable of taking and supervising the covenant. This legal mechanism travels with the land title and can prevent future owners from clearing the bushland but cannot compel undertaking environmental enhancement eg. weed removal. Land ownership is not transferred and remains the property of the owner at all times. Covenants can be permanent, or for a specified period and of time and can be set up to protect the land for many years, even after ownership of the land has changed.

There are three main conservation covenanting programs in WA. These are run by the following government and non-government agencies.

- The Commissioner for Soil and Land Conservation through Agriculture Western Australia;
- The National Trust of Australia (WA); and
- CALM.

Landholders can also obtain funding assistance from a range of programmes to assist with conservation management, including:

- management advice for conservation activities through a variety of finding programmes of the Natural Heritage Trust;
- fencing subsidy available through either the Natural Heritage Trust or the State Landcare program; and
- reducing the rates paid on bushland through property re-evaluation or differential rating.

Where a landholder agrees to the land being covenanted, environmental advice should be provided. This could include in additional to the physical assistance suggested above, development of a management plan, guidance with weeds removal and rehabilitation to ensure general environmental enhancement.

However, where a landholder does not volunteer to protect the natural values of regional significance identified in this report, some form of public ownership may be necessary.

5.2 Recommendations for protection

General Advice

In recognition of the high level (77%) of clearing on the Swan Coastal Plain in the Greater Bunbury Region, the EPA (2002) indicates that there is a need to preferentially locate developments in cleared areas on the Swan Coastal Plain.

The overriding recommendation of this assessment of certain sites of the GBRS is to preferentially locate developments in cleared areas. Bearing this in mind, the following recommendations for the 12 sites are focused on areas that are of regional priority for conservation.

Site 1 Australind Waste Water

The north/west portion of Reserve 35061 retains good condition woodlands and forms a link with the Wardandi Flora Reserve. This area supported three Priority *Acacia flagelliformis* (P4), *Caladenia speciosa* (P4) and *Jacksonia sparsa* (P4) and one unreserved flora. Increasing the size of the Wardandi Reserve is seen as a positive step in enhancing the natural values of the region, and could be combined with recreational use of the area. The southern portion in the area surrounding the tanks is degraded but could be rehabilitated or turned into a recreation area. The ponds currently provide habitat for waterbirds but would presumably no longer be permanent with removal of the treatment plant. The ponds could be retained and may fill on a seasonal basis.

The two lots north of Paris Road (Lots 21, 27 and 150) are degraded and therefore not a priority for protection, despite supporting 2 Priority and 2 unreserved flora.

Site 2 South Dalyellup

At the time of survey the southern lots of site were of regional significance. However as noted elsewhere this Site has been subject to intentional degradation of its natural values, compromising its regional significance. It is recommended that a revisit be conducted to affirm its condition and status. This site supports a Tuart woodland, with value for fauna and linkage to the nearby Muddy Lakes area. Lots 315, 316 and 317 should be protected for conservation, but Lots 1, 313 and Location are not a priority for protection.

Site 3 Boyanup East

Lots 138, 139 and 66 should be protected for conservation. The remnants of Marri woodland should be retained because they are a foraging habitat for the rare Baudin's Cockatoo and represent a diversity of floristic and structural vegetation units. This area supported three Priority *Acacia flagelliformis* (P4), *Acacia semitrullata* (P3) and *Jacksonia sparsa* (P4). It is recommended to zone these Lots as ROS under any future structure plan for development.

The riparian vegetation of Joshua Gully on Location 4402 should also be protected for conservation. This area supports a Priority flora *Drosera ?marchantii* subsp. *marchantii* (P4) and two unreserved flora. The landowners are to be commended for fencing the remnant vegetation to remove grazing pressure.

A change of zoning should be arranged so that the adjacent area to the south of Site 3 currently zoned Urban that supports bushland becomes ROS. This patch of bushland would link the other fragments in the area to nearby State Forest. As noted by the EPA (2002) preference should be given to development in areas that have already been cleared. Much of Site 3 has been previously disturbed by sand mining and would accomodate urban development without the requirement for further clearing of native vegetation. The recreated wetlands in the area would serve as recreational sites.

Site 4 Davenport Industrial

Portions of this Site are relatively degraded, particularly in the ground layer, and some parts have been cleared. Although it supports some bird species, the

area west of the road would have to be actively managed, including fencing and rehabilitation, to have much value for fauna. The area to the west of the abattoir includes a moderate diversity of vegetation.

On Lot 1 a riparian corridor of 50m should be retained along the Preston River, including trees on the upper banks, and also including vegetation unit 4.2. This riparian area supported an unreserved flora taxa. Lot 5 should also be protected for conservation despite its vegetation condition, as it is a vital part of the Ocean to Preston River Park and supports the Priority flora *Jacksonia sparsa* ms (P4).

Site 5 Brunswick River

Lot 61 should be protected for conservation. It includes an excellent stand of *Melaleuca rhaphiophylla,* waterbirds utilise the area, it provides hydrological protection for the Brunswick River floodplain and forms part of the Brunswick River Corridor. A riparian corridor of fringing vegetation along the Brunswick River on Lots 0, 7 and 9 should be protected for conservation because it forms part of the Brunswick River Corridor.

The southern boundary of Lots 0, 7 and 9 should be protected for conservation because it supports a Eucalypt woodland and although degraded the area supports an unreserved taxa and fauna including arboreal mammals.

There are no obvious reasons for retaining highly degraded pasture areas (central portion) of Lots 0 and 7 as ROS, particularly as they provide summer forage for stock. However, stock should be prevented from invading and further degrading riparian habitats. Adjacent areas zoned rural have Eucalypt woodlands in relatively good condition and provide linkage.

Site 6 Boyanup Bypass

Disturbance to the remnants of vegetation along road corridors and in the vicinity of the cemetery should be minimised during the design phase of the road alignment. The lower portion of the alignment could be moved slightly west so as to minimise disturbance to the Boyanup Billabong on Part Lot 54 but this is not a priority for protection.

The woodland of unit 6.1 in the extreme south of the road reserve supports two Priority 4 taxa *Acacia flagelliformis* and *Caladenia speciosa* and should be avoided where possible.

Site 7A Myalup

This area is in relatively good condition, supports Tuart woodland and component fauna species and is priority for protection. The site should be extended to the Harvey Diversion Drain as this acts both as a border and a protective barrier. Connections with ROS along drain and dune vegetation to the south add to the linkage value of the Site. Ideally the Site should also include some of the adjacent Vasse unit to the east. The area provides a recreation resource for people using the nearby Myalup area.

Site 7A is less than the 20ha of bushland as part of Factor 16 but is of compact shape. It could be expanded to the south to increase its size, delimited by the fenceline and natural boundaries within the Quindalup dunes. This would

include most of Lot 148. Incorporation of portion of Vasse system into the Site would enhance its regional value.

Site 7B Leschenault Locations

The southern two thirds of Lots 7 and 14 support remnant stands of *Melaleuca,* shallow inundated sedgelands and samphire in the southern part of the Site and are not significantly degraded. This area is linked to the Leschenault Conservation Park immediately to the south, and is used as additional foraging habitat by bird species associated with wetlands. The samphire association (unit 7B.3) may represent a potentially threatened ecological community. This area should be protected for conservation.

The area east of the fence on Lot 14 is degraded pastures and is not a priority for protection. The northern third of Lots 7 and 14 are part of a System 6 area but are severely degraded and therefore there is little regional value remaining.

Site 8 Twin Rivers

This Site supports a variety of vegetation associations, most of which are in good to very good condition. There are a few small cleared patches on Lot 3 but overall the Site is likely to support a varied fauna community and is one of only a few sizeable remnants in the area. The wetland area (lagoon) is consistent with a conservation category wetland and supports waterbirds. This site supports a Declared Rare Flora *Diuris drummondii* and two Priority flora *Caladenia speciosa* (P4) and *Lasiopetalum membranaceum* (P3) are relatively common throughout the site. If managed appropriately this Site, including wetlands and riparian zones, would be a useful conservation and recreation resource for the people of Australind and would retain representative examples of vegetation types and fauna habitats, whilst also being an important link in the river corridor system.

The majority of the site should be protected for conservation. Development is recommended to a single row of houses along Barnes Avenue. Allowing pedestrian access via the drainage area would facilitate recreational use of the cleared area adjacent to the river whilst retaining the natural values of the majority of the Site. No vehicle access should be permitted in the conservation area.

In addition to satisfying the criteria and associated Factors considered to lend regional significance, Site 8 also satisfies an additional criterion not listed in EPA (2002) but was proposed in EPA (2001) and adopted in Bush Forever (Government of WA 2000). This criterion recognises cultural values. Site 8 was observed during the survey to be providing a bushland setting for recreational use by the community.

Site 9 Muddy Lakes

Within the dunes there are small-scale geomorphic units such as swale damplands and communities that have developed at the Quindalup/Spearwood dune interface (EPA, 2002). These are poorly represented (or do not occur) elsewhere in the region and should be preserved. The *Banksia littoralis* Low Woodland (unit 9.6) may represent a potentially threatened ecological community recognised both at State and Commonwealth level.

The area supports an unreserved flora, rare fauna including Western Ringtail Possum and possibly the only remaining extant population of the Quokka on the Swan Coastal Plain. There are several areas at Muddy Lakes that support the Priority species Southern Brown Bandicoot. The Tuart woodland in the northeast corner of Lot 41 supports a wide variety of bird species, is in Good condition or better and also has high conservation value.

The Muddy Lakes area is a conservation category and EPP wetland and the lake and associated fringing vegetation should be zoned ROS. The integrity of the wetland system has historically been disrupted however it retains value as fauna habitat for waterbirds and other species associated with wetlands (eg. Clamorous Reed Warbler and Little Grassbird).

All remaining remnant vegetation on Lots 1, 2, 6, 7 and 17 and Location 41B, C and D should be protected for conservation. An area of degraded pasture on Lots 7 and 17 and Location 41C and D are not a priority for protection. However, it is difficult to foresee how development could occur in this area without degrading the natural values of regional significance elsewhere on those properties.

A small area (less than 5%) along the eastern boundary of Lot 41 has been degraded and is not a priority for protection.

A potential mechanism for protection of the natural values of regional significance may allow an increased density of semi-rural development of the properties along the west side of Minninup Road similar to that found on the east side of Minninup Road, with conservation covenants placed on the remaining area. The eastern boundary of the wetland system needs to be clearly defined so as to preserve the values of the area, and fenced to protect it from stock grazing.

It is also recommended that remnant bushland between the north and south portions of Site 9 of this site should be protected for conservation. This includes Lot 6 and the Lots directly north of the drain. Protection of this area would complete the linkage north-south between the sites and along the dune vegetation, and east-west along the drain to the Dalyellup Reserves (C71).

Site 10 Parade Road

The western parts of this Site are in good condition and support a diverse plant community. This area supports two Priority 4 flora *Caladenia speciosa* and *Jacksonia sparsa* (ms) and one unreserved flora. A variety of fauna species are also expected to occur in the area. The eastern area is not as valuable but does retain areas of habitat and provides a hydrological function. The bushland at this Site provides a link between bushland at The Maidens to the west and Manea Park to the east, and is part of the Ocean to Preston River Park.

All remnant bushland of this Site should be protected for conservation, particularly as nearby areas are under intense pressure for housing developments.

Three disturbed areas that are not a priority for protection can be excised for development as a tradeoff with an additional area east of Parade Road that was observed to be remnant bushland in Good condition that may meet the definition of a natural value of regional significance.

In addition to satisfying the criteria and associated Factors considered to lend regional significance, Site 10 also satisfies the criterion that recognises cultural values adopted in Bush Forever (Government of WA 2000). Site 10 was observed during the survey to be providing a bushland setting for recreational use by the community.

Site 11 Estuary Drive

This site is vegetated by a *Juncus* sedgeland (unit 11.1) that may represent a potentially threatened ecological community. It is important that a vegetated buffer be retained along the shoreline so as to provide protective cover for the variety of waterbird species, including migratory waders that utilise the adjacent mudflats. Ideally this would be approximately 30 metres in width and would include trees to screen the area. Similarly, vegetation should be retained along other parts of the eastern side of the Leschenault Estuary.

The area defined within Site 11, including a portion of Lots 5 and 6 should be protected for conservation.

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