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Remnant Vegetation Strategy

for the

Geographe Bay Catchment

Natural Heritage Trust
Helping Communities Helping Australia

Shire of Busselton

Land Conservation
District Committees

GeoCatch

Remnant Vegetation Strategy

ACKNOWLEDGMENTS

This Strategy was prepared for the Capel, Sussex, Vasse-Wonnerup and Yallingup Land Conservations District Committees, by Stephen Connell, Beatrice Franke and Anne Jennings of Edith Cowan University.

A large number of people contributed to this project. In particular the authors would like to thank the members of the project's Steering Committee and those members of the community, who attended the workshops and presentations and provided valuable input. A special thank you is due to the speakers at the public presentations, who freely provided their time and expertise, happily traveling to the different venues. Please refer to Appendix 4 for details.

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EXECUTIVE SUMMARY

This Strategy has been developed to improve local knowledge of the distribution and condition of existing remnant native vegetation, and to provide strategic direction and guidelines to enhance future management of remnant vegetation in the Geographe Bay catchment. Existing vegetation maps and aerial photographs, combined with visual inspections, a literature review and community consultation activities formed the basis for this Strategy. It is supported by a digital database (CD Rom), which incorporates maps of the region's remnant vegetation, and a Remnant Vegetation Handbook for land managers. Use of this Strategy, CD Rom and Handbook is entirely voluntary.

The native vegetation of the Geographe Bay Catchment can be described as consisting of severely dissected sandplain remnants and large contiguous upland blocks. The vegetation complexes in both groups are poorly represented in nature reserves. Of particular concern are the Regional Forest Agreement [RFA] mapped Abba (Aw) community with only 6% of its original area remaining, the RFA Balingup (BLf) community (8% remaining) and the System 6 mapped Abba Complex (7% remaining). Less than 1% of each of these vegetation community types is currently conserved.

The assessment process has added a number of important descriptive fields (e.g. ecological condition, presence of Declared Rare Flora [DRF], vegetation type) in producing a GIS, which can form a basis for the objective management of remnant vegetation in the catchment. The EASY ranking methodology used provides a support system to facilitate the decision making process. Listed below are a number of important remnants in the Geographe Bay catchment, which were identified using this methodology, and their ecological attributes.

REMNANT NAME	AREA (HA)	CONDITION	TENURE	No. OF VEGETATION COMPLEXES	*DRF Present?*
Dawson Gully Riparian	5	Fair	Private	3	No
Evans Road	36	Fair	Private	4	No
Jingarmup Creek	114	Fair	Private	6	No
Kalgup Road	14	Fair	Private	3	Yes
Kaloorup Road	26	Fair	Private	4	Yes
Lyle Road Verge	3	Poor	Private	2	No
Metricup	194	Good	Private	3	Yes
Minninup	614	Good	Private	3	No
Naturaliste Terrace	59	Fair	Private	3	No
North of Adams Road	5	Poor	Private	2	No
Roy Road	321	Good	Private	3	No
Sabina River Riparian	150	Fair	Private	7	Yes
State Forest	5,636	Very Good	Public	9	Yes
State Forest	22,855	Very Good	Public	18	Yes
Tuart Forest National Park	1,079	Fair	Public	5	Yes
Tutunup	634	Fair	Private	2	Yes
Upper Capel Road	2	Poor	Private	2	No
Wonnerup Road	3	Poor	Private	2	No
Yallingup Road	6	Fair	Public	2	Yes

Wildlife corridors have been identified using an approach which identifies links between remnants based on proximity. Critical wildlife corridors link the Leeuwin-Naturaliste Ridge and the south-eastern forests to coastal remnants on the sandplain and along Geographe Bay. These corridors consist of remnants in both private and public ownership, which vary greatly in their ecological condition and area.

Two corridors are associated with river systems – the Capel and the Sabina. A third south-eastern link along Wonnerup Road (Ruabon-Tutunup Railway Reserve) may be re-established after rehabilitation of cleared lands. These corridors essentially consist of a chain of remnants and are thus prone to breakdown should one or more remnants in the chain be cleared. As a priority, management agencies should concentrate on more fully documenting these corridors and determine action plans for their maintenance.

Native vegetation remnants can have high biodiversity value and each remnant contributes to vital but often undervalued ecosystem functions that extend beyond the boundaries of individual properties. The existing reserve system does not yet adequately reflect all vegetation communities present in the Geographe Bay catchment. Therefore, each remnant is of regional importance, whether it is located on private or local government property or on Crown land. Consistent and coordinated management of all native vegetation remnants across all jurisdictions is required to ensure that these important environmental features are conserved.

Community consultation identified a range of environmental, social and economic values of remnant native vegetation. Inadequate planning policies and decisions, which result in long-term environmental degradation, were also of concern. These concerns were linked by economic considerations and difficulties in obtaining adequate funding, in particular for remnants on private property. An effective management response to these concerns therefore has to combine public education with financial incentives and a range of economic instruments to change people's attitudes, reduce the amount of clearing undertaken and ensure environmentally sound land use planning.

The Strategy recommendations reflect a combination of management approaches and highlight areas of concern. Please refer to Section 6.0 for details on each recommendation.

STRATEGY RECOMMENDATIONS

1	Continued public or community education campaigns focusing on the promotion of priority vegetation distribution and remnant vegetation values should be undertaken. (Page 25)
2	Conservation management and funding priority should be given to projects benefiting remnants with native vegetation communities, that are endangered or under-represented in the reserve system. (Page 22)
3	Native vegetation corridors should be established and maintained in several strategic locations. (Page 22)
4	Investigate a range of strategic approaches and instruments in the Geographe Bay catchment. (Page 23)
5	Ongoing support for employment of remnant vegetation officers, eg: Bushcare, Land for Wildlife Officers. (Page 24)
6	Scientific studies of native vegetation remnants and projects trialing different management methods should be encouraged and supported. (Page 25)

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1.0 INTRODUCTION

Increasing knowledge of the ecological processes at work in our environment has highlighted the important role of native vegetation in the landscape. As a result of its large-scale removal for agricultural and residential development we now face serious land degradation problems that affect agricultural production, nature conservation and our quality of life. The protection of the remaining native vegetation as well as the strategic revegetation of cleared land are considered to be the best way of achieving the twin goals of sustainable agricultural production and nature or biodiversity conservation (Hussey and Wallace, 1993).

The role of individual remnants needs to be evaluated in the wider context of the sustainable management of all natural resources (Dore, Binning and Hayes, 1999). Each remnant contributes to several vital but usually undervalued ecosystem functions. These include the protection of water and soil resources, the cycling of nutrients, the provision of carbon sinks absorbing Greenhouse gases, oxygen production, contributions to the maintenance of the local climate and biodiversity maintenance (Biodiversity Unit, 1995).

Native vegetation remnants contain many of south-western Australia's endemic species and vegetation communities, which are not yet fully represented in our reserves and National Parks. Some vegetation communities may only exist as patches of remnant vegetation on private land. In addition to their ecological and economic importance individual native vegetation remnants also have a range of social values including recreational, historical and spiritual values. This means their protection and management are of importance to the entire community and to future generations. When considering native vegetation remnants in this broad context it becomes clear that consistent and coordinated management has to be applied across all boundaries to achieve a collective outcome, the "common good".

The Geographe Bay catchment still retains about 37% of its original vegetation cover, both on private properties and on Crown land. It will require cooperation and careful planning by government and private land managers to allow profitable indutries and biodiversity conservation to coexist sustainably, ensuring that future generations will be able to enjoy the same privileges.

The major objective of this Strategy is to improve local knowledge of the distribution and condition of existing remnant vegetation and to provide strategic direction and guidelines to assist future management of remnant vegetation. It is a non-statutory strategy, accompanied by a digital database and maps of the distribution and condition of remnant vegetation in the Geographe Bay catchment, with potential corridor links highlighted. The Strategy is an information resource that will assist local land managers and management agencies in developing an understanding of remnant vegetation values and attributes and in identifying and assessing vegetation communities as well as to provide appropriate management information and recommendations.

Existing digital information such as vegetation maps and aerial photographs were combined with visual inspections and a literature review to create a CD-ROM of Geographical Information System (GIS) data for the study area. Analysis this data and community consultation activities formed the basis for the Strategy. The field and analytical methodology is detailed in Appendix 1. Remnant Vegetation Handbooks have been produced to assist land managers in identifying, assessing and managing remnant vegetation communities on their land. The CD-ROM is available for public use, and can be accessed at the GeoCatch Network Centre, Shire of Busselton, Capel LCDC and the Toby Inlet Catchment Group. Use of the Strategy, GIS and Handbook is entirely voluntary.

2.0 CURRENT STATE OF REMNANT VEGETATION IN THE GEOGRAPHE BAY CATCHMENT

The main aims in establishing a geographical information system [GIS] on the remnant vegetation in the Geographe Bay Catchment were to determine the current distribution and tenure of remnant vegetation. This information was used to develop the strategy, and will also be helpful to landholders wishing to improve management of remnant vegetation on their land.

Remnant vegetation mapping utilised Landsat image interpretation and intersection with other existing digital mapping (e.g. AgWA, RFA, Beard). The methods employed are detailed in Appendix 1. The resultant maps include attribute linkages to a remnant vegetation database. The attributes within the database are based on physical and ecological features of the remnants as visually assessed during the vegetation survey and include a literature database as well as

Physical features	Area, Area/perimeter ratio (and/or other shape indices), Tenure/ownership, Landform, soils, geomorphology.
Ecological features	Vegetation community types, Presence of declared flora, Corridor information, Ecological value, Vegetation condition, and Potential threats (e.g. weeds, grazing, etc.).

The database is in a generic form, which is easily maintained via commonly used software (e.g. MS Excel, Access) as well as through the GIS software. The GIS is accompanied by a summary and descriptions of the data sets are included in Appendix 8.

2.1 RESULTS OF THE GIS ANALYSIS

2.1.1 Spatial Extent of Remnant Vegetation

The spatial extent of remnant vegetation in the study area is shown in Figure A. The greatest areas of remnant vegetation occur in the south east of the region and along the coast. The coastal plain has been heavily cleared in the east and centre and the remaining remnants are generally small and dispersed. Table 1 indicates that remnant vegetation covers approximately 746 km^2 or 37% of the total area of the study area. Of this 513 km^2 or approximately 69% is retained on public lands.

Table 1 Vegetation coverage in the study area

Study area size	**2,002 km^2**
Coverage of remnant vegetation within the study area (km^2)	746 km^2
Remnant vegetation as a % of study area	37.2%
Coverage of remnant vegetation on public lands within the study area (km^2)	513 km^2
Remnant vegetation on public lands as a % of study area	25.6%
Coverage of remnant vegetation on private lands within the study area (km^2)	233 km^2
Remnant vegetation on private land as a % of study area	11.6%

The vegetation has also been classified according to the size of each remnant (Table 2). There are only a few large remnants (greater than 200 ha). Small remnants make up more than 95% of the total number of remnants, however, they cover less than 25% of the total area of vegetation. The greatest area of vegetation is vested in a few large remnants.

Table 2 Size structure of remnant vegetation within the study area.

REMNANT SIZE (HA)	NUMBER	AREA (km^2)
0 to 10	2177	59
10 to 20	249	36
20 to 50	155	48
50 to 100	60	40
100 to 200	31	43
200 to 500	17	52
500 to 1000	6	51
>1000	6	418
TOTAL	**2,707**	**746**

Remnant vegetation data for other localities in Western Australia is included in Table 3 as a comparison with the status of remnant vegetation in the study area. This table shows that the study area is similar to many other rural areas of Western Australia.

Table 3 Spatial extent of remnant vegetation in other Western Australian localities.

REGION	TOTAL AREA (km^2)	AREA OF REM. VEG. (km^2)	REM. VEG. %
Geographe Bay Catchment	1,995	746	37%
Shire of Augusta-Margaret River	2,425	1,571	65%
Bremer River Catchment	728	167	23%
Perth Metropolitan (1994)	5,323	2,638	50%
City of Armadale	556	422	76%
Shire of Chittering	1,217	419	34%
Shire of Wanneroo (1995)	788	377	48%
Shire of Gingin	3,202	790	25%
Albany Study Region	8,959	3,890	43%

2.1.2 Tenure of Remnant Vegetation

The tenure of remnant vegetation has been divided into private land, reserves and state forest. Private land is any land owned or leased by non-government individuals or organisations, while land administered by government organisations constitutes public land. Often the term "reserved" does not refer to the land's conservation status but to its administrative status. However, it has been assumed that reserved land has a higher degree of protection afforded it than private land. Figure B depicts the spatial distribution of remnant vegetation by tenure. Public remnants occur mostly in the south and south east of the region, with a few larger areas in the north that incorporate the Tuart Forest Reserve. Remnants under private tenure occur mostly on the coastal plain. This data is displayed in Table 4.

Table 4 Tenure of remnant vegetation in the study area.

TENURE	COUNT	AREA (km^2)	PERCENTAGE
Private	2,196	233	31%
Public	511	513	69%
TOTAL	**2,707**	**746**	**100%**

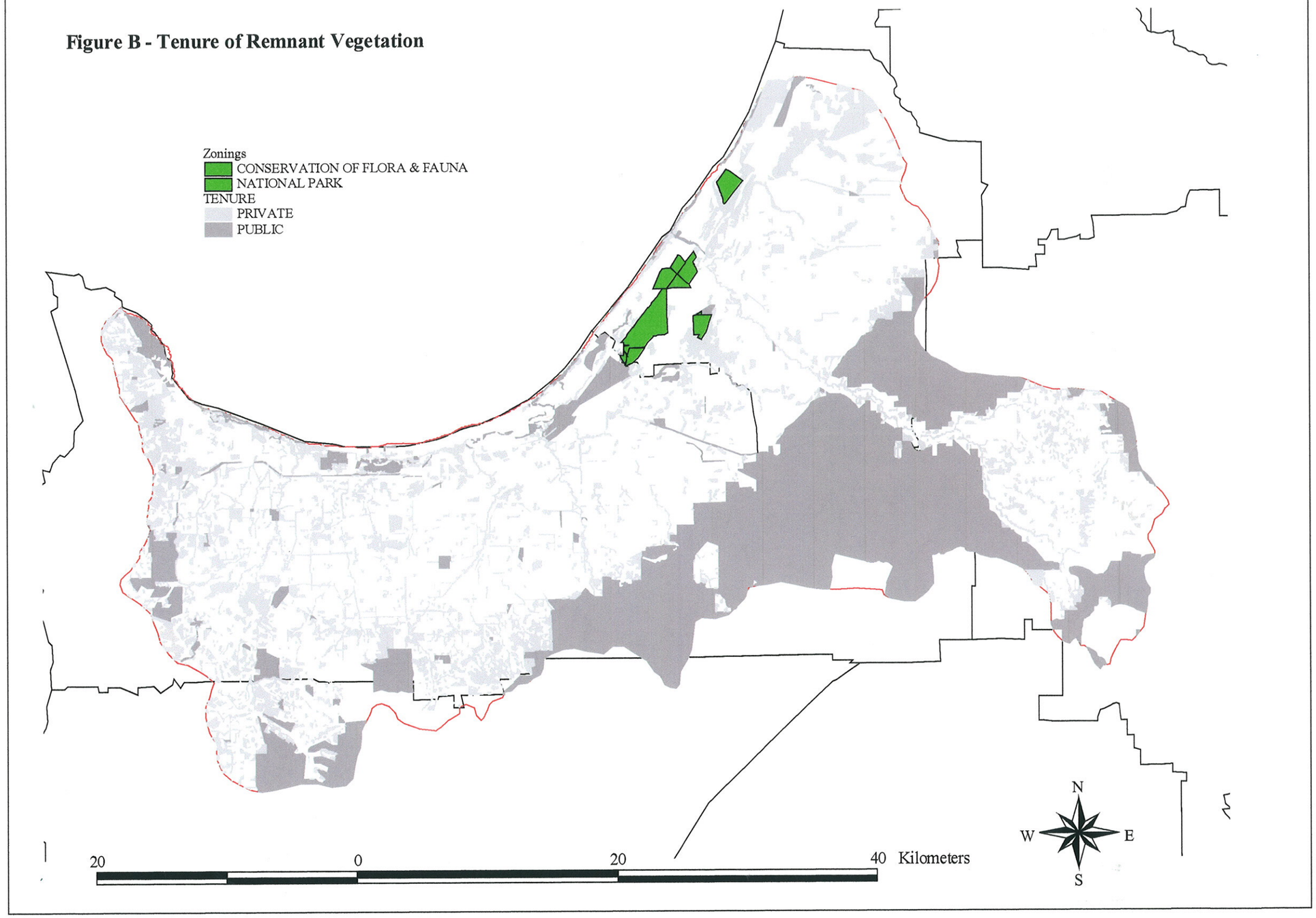
Figure A - Spatial Extent of Remnant Vegetation

Remnant Vegetation

20 0 20 40 Kilometers

N
W E
S

Figure B - Tenure of Remnant Vegetation



Most stands of remnants are on private land, but cover only about one third of the total remnant vegetation area. The majority of remnant vegetation is vested in a small number of public remnants. This is explained further in Table 5, where it can be seen that about 80% of the private remnants are less than 10 hectares in size and cover less than 10% of the total remnant vegetation area. There is only one private remnant greater than 1,000 hectares covering an area of 1,359 hectares, or approximately 2% of the remnant vegetation area. The largest public remnants, on the other hand, while only seven in number, cover over 50% of the total remnant vegetation area.

Table 5 Size class of remnants by tenure.

	PRIVATE		*PUBLIC*	
REMNANT SIZE (ha)	COUNT	AREA km^2	COUNT	AREA km^2
0 to 10	1,770	52	409	7
10 to 20	218	31	31	5
20 to 50	128	39	27	9
50 to 100	46	31	14	9
100 to 200	22	29	10	14
200 to 500	9	25	9	27
500 to 1000	2	12	5	38
>1000	1	14	6	404
TOTAL	2,196	233	511	513

2.1.3 Condition of Remnant Vegetation

The spatial coverage of remnants according to their condition is presented in Figure C. Remnants in very good condition occur mostly in the south east corner of the region on the scarp and in the west of the region on the Leeuwin Ridge. The majority of fair and degraded remnants occur on the coastal plain. The remnants in good condition generally correspond to the large public remnants, while those in poor condition correspond to the small, private remnants found on the heavily cleared coastal plain.

Table 6 shows that the greatest number of remnants in the study area are degraded and the number of remnants decrease as the quality improves so that the remnants in very good condition are the fewest. The reverse is true for the area of remnant vegetation with the most degraded remnants covering the least area and the very good remnants covering the greatest area. This can also be seen in Figure C, where the very large remnants are generally in very good condition.

Table 6 Condition of remnant vegetation in the study area.

CONDITION	COUNT	AREA km^2	PERCENTAGE
Poor	1,480	69	9
Fair	740	106	14
Good	343	137	18
Very Good	144	434	58
TOTAL	2,707	746	100

The condition of remnants divided by tenure is shown in Table 7. The majority of degraded remnants are under private tenure but again cover a relatively small area. The number of private remnants decreases as the quality improves, as does the area they cover. The majority of public remnants are degraded to some extent, however, as indicated by Figure C, the greatest area is in very good condition.

Table 7 Condition of remnant vegetation in the study area divided by tenure.

	PRIVATE		PUBLIC	
CONDITION	COUNT	AREA (km^2)	COUNT	AREA (km^2)
Poor	1,449	67	31	2
Fair	535	70	204	30
Good	184	83	160	60
Very Good	28	13	116	421
TOTAL	2,196	233	511	513

The condition data has been further separated into size class for both private and public tenure and is shown Tables 8 and 9 respectively. The majority of private remnants are less than 10 hectares and in a poor state, but again cover only a small area. There are 34 remnants greater than 100 hectares and the majority of these are fair to good with only 3 rated as in very good condition. The greatest area of privately tenured remnant vegetation is in poor or good condition.

Table 8 Condition of private remnant vegetation by size class.

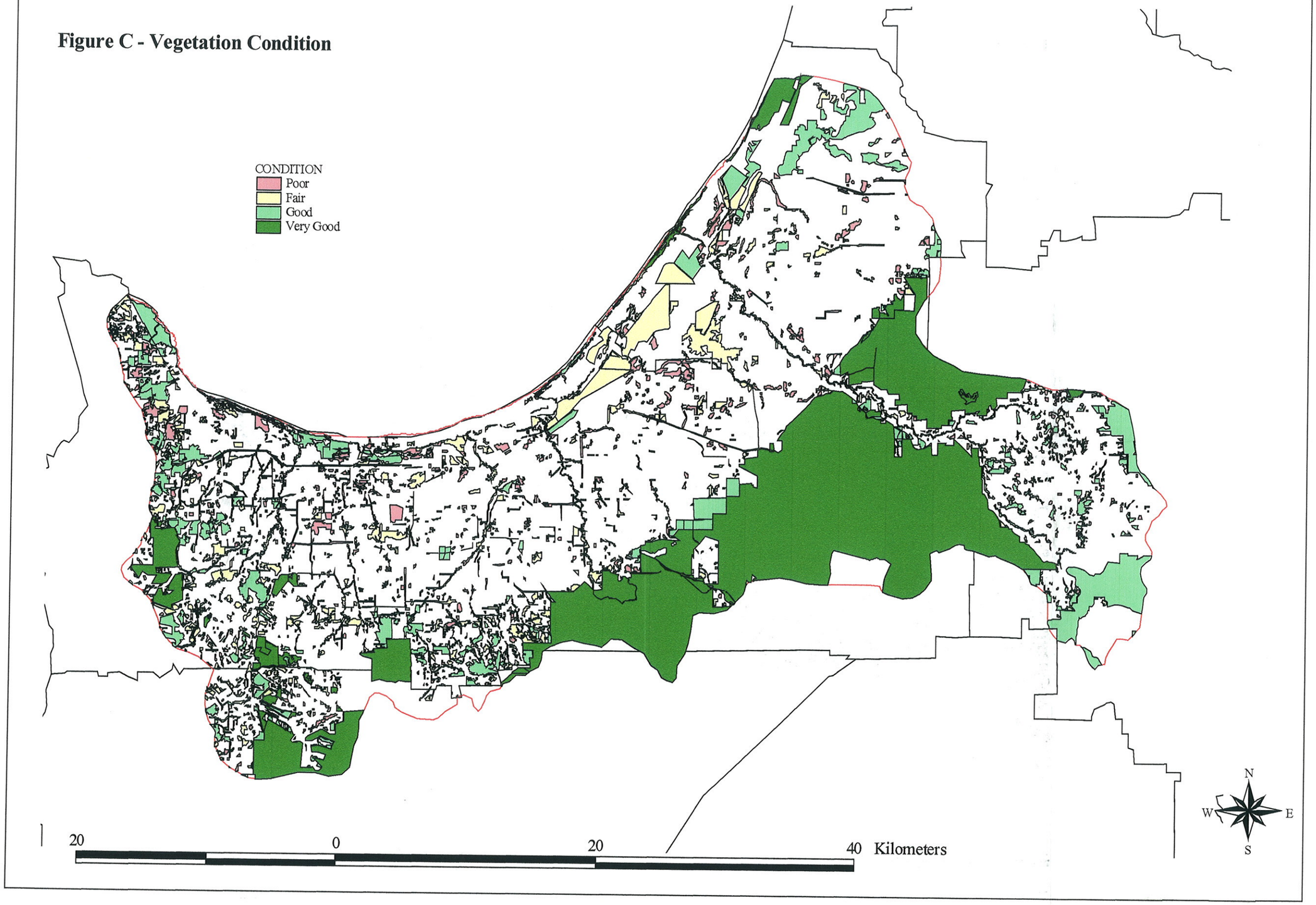
REMNANT SIZE (ha)	POOR		FAIR		GOOD		VERY GOOD	
	COUNT	AREA (km^2)	COUNT	AREA (km^2)	COUNT	AREA (km^2)	COUNT	AREA (km^2)
0 to 10	1,324	34	370	16	59	2	17	1
10 to 20	78	11	84	12	56	8	1	0
20 to 50	33	10	49	15	41	13	4	1
50 to 100	12	8	19	13	12	8	3	2
100 to 200	1	1	10	12	9	13	2	3
200 to 500	1	4	1	3	7	19	0	0
500 to 1000	0	0	1	6	0	0	1	6
>1000	0	0	0	0	1	14	0	0
TOTAL	1,449	68	534	77	185	77	28	13

The majority of public remnants are under 100 hectares and in good and very good condition. The greatest area of public remnants is also in good and very good condition, with the largest area in very good condition vested in a few large remnants. In contrast to privately owned remnants there are only 31 remnants that are degraded and they only cover an area of 1.67 square kilometres. The condition data indicates that small, privately owned remnants are more likely to be degraded to some extent, while larger remnants are likely to be in better condition, especially if they are reserved in some way.

Table 9 Condition of public remnant vegetation by size class.

REMNANT SIZE (ha)	POOR		FAIR		GOOD		VERY GOOD	
	COUNT	AREA (km^2)	COUNT	AREA (km^2)	COUNT	AREA (km^2)	COUNT	AREA (km^2)
0 to 10	29	0.4	183	3	117	2	81	1
10 to 20	0	0	10	1	16	2	5	0.7
20 to 50	1	0.8	5	2	8	2	12	4
50 to 100	1	0.5	1	0.6	7	4	5	4
100 to 200	0	0	1	2	6	8	3	4
200 to 500	0	0	2	5	4	11	3	10
500 to 1000	0	0	1	5	1	7	3	25
>1000	0	0	1	11	1	22	4	372
TOTAL	31	2	204	30	160	59	116	420

Figure C - Vegetation Condition



2.1.4 Current Distribution of Vegetation Complexes

Table 10a RFA Mapping spatial extent of vegetation communities pre- and post-clearing

Vegetation Community	No. of Blocks (1850)	Pre-1850 Area (ha)	No. of Blocks (1999)	Area (ha) Remaining	Area Remaining (%)	Area in Conservation Reserves (% & ha)
Abba (AB)	161	12492	464	1442	12	0
Abba (Ad)	53	3030	124	737	24	0.004ha
Abba (Adw)	3	10	4	3	30	0
Abba (AF)	7	2964	129	525	18	0.05% & 27.4ha
Abba (Af)	22	2909	179	435	15	0
Abba (Aw)	72	15836	565	1028	6	0.09ha
Balingup (BL)	28	5252	188	1012	19	0
Balingup (BLf)	4	126	7	10	8	0
Bidella (BD)	227	7728	78	7026	91	0
Cartis (CSs)	35	1445	41	248	17	0
Catterick (CC1)	16	343	5	219	64	0
Coate (CE)	13	346	11	271	78	0
Cowaramup (C2)	31	2722	167	1514	56	0
Cowaramup (Cd)	10	524	39	237	45	0
Cowaramup (Cw2)	22	1377	141	327	24	0
Darling Scarp (DS)	12	499	22	59	12	0
Donnybrook (DB3)	20	1045	55	179	17	0
Grimwade (GR)	32	2273	83	592	26	0
Hester (HR)	123	3308	73	979	30	0
Jalbaragup (JL)	62	1494	19	1393	93	0
Kilcarnup (kBE)	1	2	0	0	0	0
Kingia (KI)	341	13580	77	12201	90	0
Kirup (KR)	43	4508	35	1536	34	0
Ludlow (Lw)	20	8674	291	2422	28	31% & 748ha
Meerup (My)	14	823	62	605	74	0
Metricup (M)	12	886	81	554	63	0
Preston (PR)	37	2798	81	1314	47	0
QD	4	2397	179	674	28	13% & 91ha
Queenwood (QW)	4	153	4	151	99	0
Quindalup (Qw)	27	4447	305	1227	28	0
Rosa (RO)	194	11388	164	8659	76	0
Telerah (TL)	48	1769	19	1538	87	0
Treeton (T)	16	12959	451	6777	52	1ha
Treeton (Td)	1	18	5	15	83	0
Treeton (Tw)	26	4836	260	1719	36	0.01% & 17ha
Whicher Scarp (WCv)	59	2795	53	2491	89	0
Whicher Scarp (WC)	22	597	31	254	43	0
Wilyabrup (W2)	19	711	85	339	48	0
Wilyabrup (Wd)	6	143	19	86	60	0
Wilyabrup (Wr)	4	435	15	234	54	0
Wilyabrup (Ww2)	10	427	58	185	43	0
Wishart (WS2)	10	602	22	164	27	0
Yelverton (Y)	81	9050	447	3692	41	0
Yelverton (Yd)	44	2216	147	1443	65	4ha
Yelverton (Yf)	2	37	4	10	27	0
Yelverton (Yw)	53	4219	291	1237	29	4ha

Figures D1 and D2 and Tables 10a and b detail the past and present distribution of vegetation communities in the study area (descriptions of the vegetation communities are in Appendix 2). The red numbers in Tables 10a and b indicate communities that have less than 10% of their original area remaining. Some communities, such as the Goonaping Complex (System 6) communities, originally covered a small area of the region and have subsequently been heavily cleared or they could have been fringes of larger areas of that community that border and edge into the study area. If the latter is true, then these communities may be adequately represented outside the study area. However, there are some communities, the Abba (System 6 and RFA-Aw) and Ballingup (BLf) communities for example, that originally covered a significant area and have subsequently had over 90% of that area cleared. The communities that remain best represented occur in the south east of the region along the scarp and correspond to the greatest areas of remnant vegetation coverage, while those with small areas remaining generally occurred on the central coastal plain. The right-most column in Tables 10a and 10b illustrates the dire conservation state with in the catchment. Despite the existence of CALM conservation areas in the region, these areas include few of the vegetation types and those communities, which are included have less than 1% (all values round to zero) of the original area.

Table 10b System 6 Mapping spatial extent of vegetation communities pre and post clearing

Vegetation Community	No. of Blocks (1850)	Pre-1850 Area (ha)	No. of Blocks (1999)	Area (ha) Remaining	Area Remaining (%)	Area in Conservation Reserves (% & ha)
Abba Complex	2	15,164	120	1,032	7	0.03% & 33ha
Bassendean Complex - Central And South	1	4,173	27	1,312	31	0
Cartis Complex	12	126	19	36	29	0
Dwellingup And Hester Complex	3	0	1	0	0	0
Goonaping Complex	1	0	1	0	0	0
Guildford Complex	1	5,021	42	320	6	0
Jarrahwood Complex	3	15	1	1	7	0
Karrakatta Complex-Central And South	3	4,892	56	2,300	47	42% & 958ha
Preston Complex	3	18	2	4	22	0
Quindalup Complex	2	906	24	561	62	0
Serpentine River Complex	1	213	2	42	20	0
Southern River Complex	3	9,016	86	1,694	19	11% & 188ha
Swan Complex	2	1,422	20	241	17	0
Vasse Complex	1	1,327	21	399	30	7% & 29ha
Yoongarillup Complex	2	811	17	258	32	49% & 127ha

2.1.5 Declared Rare Flora

There are 21 Declared Rare Flora [DRF] species and 80 priority species in the study area (see Appendix 3). Figure E maps the general location of each of the DRF and priority species in relation to the spatial distribution and tenure of the remnant vegetation of the region. The majority of DRF species occur on the coastal plain. There are also areas in the west and south of the region and on the fringe of the large remnants in the south east of the region that have concentrations of DRF and priority species.

Figure D1 - Vegetation Complexes (pre 1750)

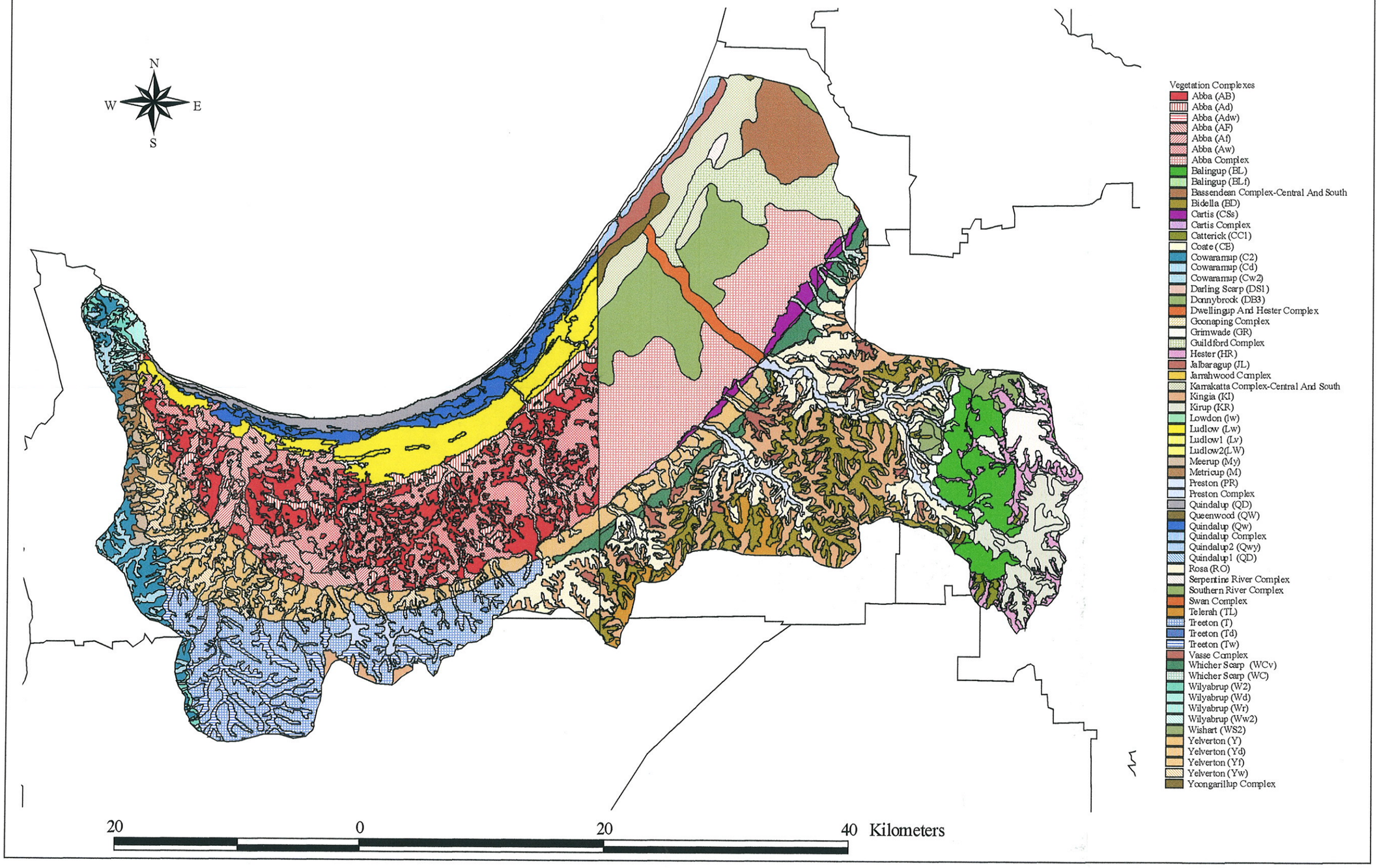


Figure D2 - Remnant Vegetation Complexes

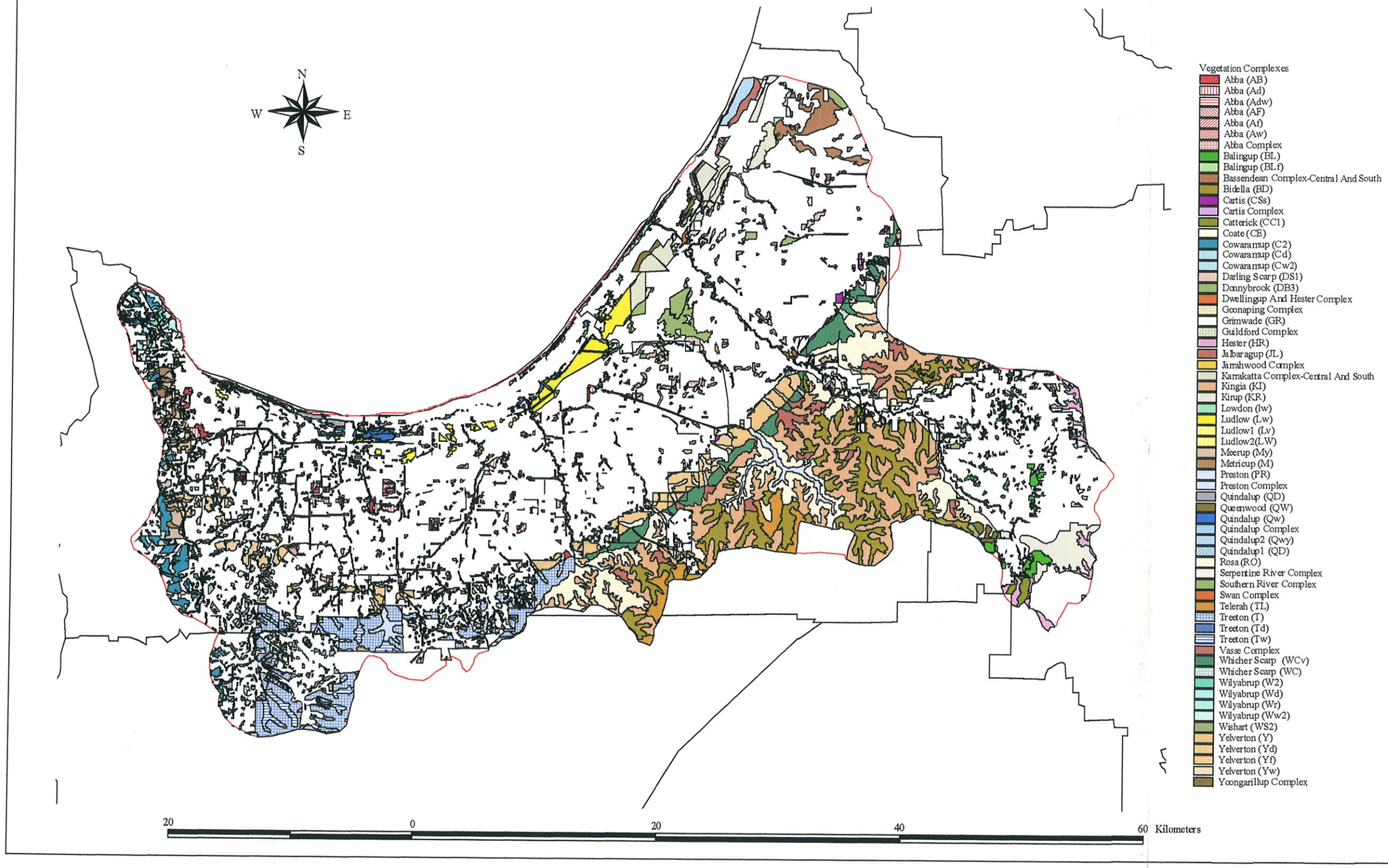
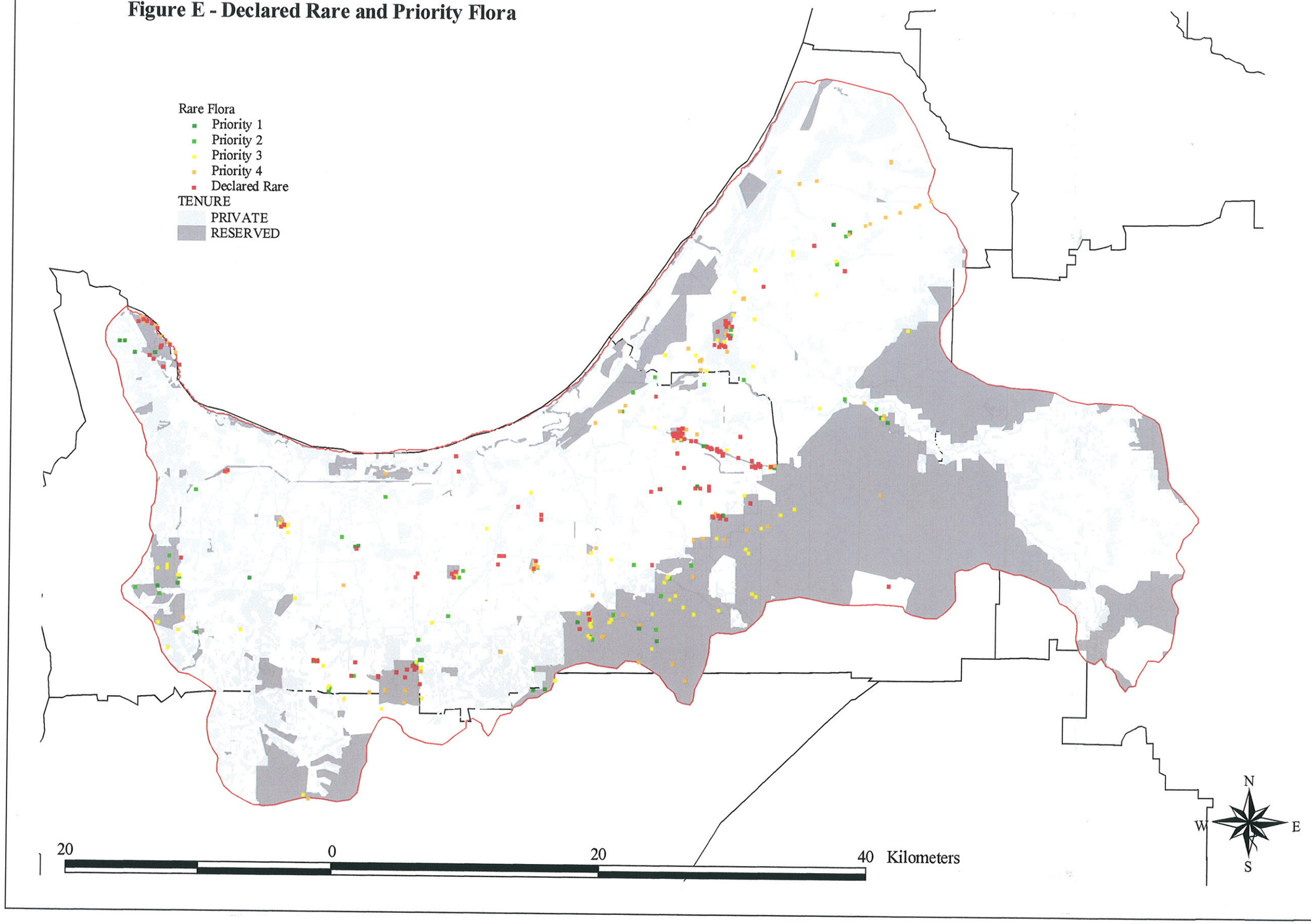


Figure E - Declared Rare and Priority Flora



3.0 REMNANT VEGETATION CORRIDORS IN THE GEOGRAPHE BAY CATCHMENT

Wildlife corridors are important avenues for movement of individuals and populations of both flora and fauna. An ecological corridor is defined as a 'habitat that permits the movement of organisms between ecological isolates' (Newmark, 1993). These corridors can be important for the survival of species as they provide access to feeding and breeding locations as well as access to other populations and therefore to a wider gene pool. However, corridors are difficult to define as each species has its own set of criteria that makes a suitable corridor. As a result the number of wildlife corridors, which could be constructed for a given area could potentially equal the number of species present.

For example, a vegetation corridor suitable for the Splendid Fairy Wren would need to have an understorey of dense shrubs to provide shelter. The Quenda too requires low, dense shrubs to allow it to shelter from predators such as feral cats and foxes, and generally favours riparian or swamp vegetation. The Honey Possum will require food plants (e.g. banksias), that flower at various times of the year, as it is small and unable to move far without a readily available food supply. Bobtails prefer a reasonable amount of bushland leaf litter to burrow and hunt in as well as low, dense shelter plants interspersed with small open patches for sunbathing. The Western Grey Kangaroo on the other hand, being the largest and most mobile of the native terrestrial mammals, can live in and move through a variety of habitats.

3.1. POTENTIAL WILDLIFE CORRIDORS

To produce corridors for a range of flora and fauna, the corridor analysis has used 10, 50, 100, 500 metre gaps between remnants to provide four different corridor scenarios. Figure F shows the corridor maps for 10m through to 500m respectively.

Some of the main considerations in the interpretation of the corridor results include:

1. The nature of the land separating remnants is not considered. Such land will act to filter the species, which can move across it. Roads probably could be considered to act as major barriers to the movement of most ground dwelling animals (but not birds and flying insects), while open fields are probably less restrictive to the movement of most species.

2. The ecology of the remnants is not considered. Some species occur in close relationship with other species (especially plants) or with particular habitats (e.g. amphibians in wetlands, granite outcrop species). The analysis adopted here takes no consideration of such relationships.

The condition and tenure of the remnants in each of the recognised corridors are presented in Tables 11 through 14. Tenure is based on the percentage of the remnant area, which is in public ownership. Condition is based on the percentage of the remnant area, which is in good or very good condition. Therefore, any corridor that has a condition rating of less than 50 could be deemed to be a poor quality corridor or one that requires rehabilitation. All corridors as derived in the analysis are included. Many are small (i.e. < 2 km^2 in area) or consist of only 1 or a few remnants (particularly at the 10m level). These have not been weeded from the analysis as they represent remnants or groups of remnants, which are potentially viable in the long term or which could be used as nuclei for management strategies.

PLEASE NOTE: ***The results in these tables are best interpreted in conjunction with the GIS provided.***

Table 11 10m Corridors in the Geographe Bay catchment.

Corridor	Area	Number	Tenure	Condition	Corridor	Area	Number	Tenure	Condition
2	7.2	10	14	100	483	5.2	33	40	37
4	13.7	2	0	99	508	1.0	1	0	100
5	1.5	1	100	100	525	1.0	1	0	0
14	1.1	1	0	100	595	3.5	62	64	54
15	6.3	5	42	68	612	3.3	16	8	6
18	1.7	1	0	100	615	5.4	25	13	10
19	1.3	1	0	0	719	2.7	13	3	95
30	2.2	15	45	33	833	1.2	8	2	29
53	1.5	4	14	100	843	85.1	48	91	91
85	2.7	2	98	98	869	11.8	22	72	72
96	3.0	1	100	0	987	1.1	1	0	0
101	60.2	22	96	96	1037	1.6	13	5	99
121	18.6	30	91	0	1085	1.2	1	0	0
122	2.7	8	7	7	1175	1.0	1	0	0
131	1.3	8	3	2	1193	22.2	2	99	100
132	9.1	6	28	0	1306	1.3	1	0	0
140	2.4	1	100	100	1321	3.4	5	0	93
161	1.9	4	89	0	1331	1.7	3	66	98
165	1.6	1	100	100	1332	3.5	11	90	95
193	1.2	3	0	61	1470	3.0	40	13	69
219	1.9	1	100	100	1493	1.3	1	0	100
234	7.8	18	11	9	1537	22.3	8	89	99
288	237.9	25	99	99	1667	6.9	16	51	88
312	2.1	43	43	1	1695	3.3	3	15	99
327	7.8	4	97	99	1875	1.7	9	45	97
330	1.2	4	100	100	1882	1.1	8	5	92
386	1.1	1	100	100	1892	26.2	36	94	100

Table 12 50m Corridors in the Geographe Bay catchment.

Corridor	Area	Number	Tenure	Condition	Corridor	Area	Number	Tenure	Condition
2	8.6	11	29	100	616	1.2	10	0	75
5	14.7	3	0	99	649	2.2	8	0	0
15	41.0	109	68	17	710	1.1	1	0	0
18	1.7	1	0	100	738	1.7	14	5	99
46	1.7	6	12	88	816	1.3	5	0	0
57	340.0	185	93	93	857	23.1	9	96	99
84	63.0	32	94	94	911	1.4	4	0	0
104	18.9	71	29	27	931	12.2	39	29	76
105	9.3	9	27	0	937	25.1	44	79	91
127	1.9	4	89	0	1051	1.3	3	0	95
130	1.1	9	0	0	1062	1.0	7	0	0
158	2.1	8	50	0	1075	1.2	8	0	0
204	1.3	16	47	58	1264	2.5	27	40	40
233	51.0	423	40	34	1303	1.5	11	3	90
244	8.4	16	90	95	1313	26.7	48	92	99

Table 13 100m Corridors in the Geographe Bay catchment.

Corridor	Area	Number	Tenure	Condition	Corridor	Area	Number	Tenure	Condition
2	8.6	11	29	100	213	1.2	15	0	51
4	1.0	17	14	32	433	2.2	17	0	21
5	14.7	3	0	99	456	1.4	12	0	79
14	454.0	493	89	85	475	2.7	14	0	0
17	1.7	1	0	100	524	1.1	1	0	0
40	1.8	7	12	84	607	1.6	10	0	11
82	9.6	11	26	0	642	23.2	12	95	98
86	21.3	97	27	25	682	1.6	7	0	0
101	2.0	5	87	0	692	43.9	143	67	67
123	2.1	9	49	0	699	29.0	96	70	87
162	1.4	17	44	55	766	3.4	41	1	0
181	58.2	519	36	30	792	1.2	17	0	0
191	8.5	20	89	94	969	2.1	25	2	63

Table 14 500m Corridors in the Geographe Bay catchment.

Corridor	Area	Number	Tenure	Condition
2	744.9	2,582	70	66
12	1.8	2	0	96
17	1.3	10	0	54
18	2.0	11	0	0
19	1.8	7	12	84

3.1.1 Key Corridors

A key objective of the remnant vegetation strategy was to identify corridors in the study area. The corridors identified provide linkages across the catchment from the hinterlands to the coast. Two wildlife corridors link the south-eastern forest communities to the coast (Figure F). Both corridors are associated with river systems – the Capel and the Sabina. A third south-eastern link along Wonnerup Road (Ruabon-Tutunup Railway Reserve) may be re-established after rehabilitation of cleared lands. These corridors essentially consist of a chain of remnants and are thus prone to breakdown should one or more remnants in the chain be cleared. As a priority, management agencies should concentrate on more fully documenting these corridors and determine action plans for their maintenance.

In the west, a single corridor links the Leeuwin-Naturalist Ridge to Geographe Bay (Figure F). This corridor, unlike the eastern corridors, consists of a network of remnants and may be less prone to disruption from clearing of individual remnants. The opportunity exists to re-establish linkages with other major chains of remnants.

3.1.2 Important Remnants

The EASY system provides a flexible methodology to rank remnant vegetation. It incorporates a number of key attributes such as area, presence of declared flora, vegetation condition, etc. The details of the methodology are presented in Appendix 1. The results of applying the EASY ranking system are displayed in Figures G1 through G3, with Table 15 listing some of the remnants, which the system has highlighted as being ecologically valuable. Figure G1 shows the EASY rank of the remnants in the study area. The raw ranking clearly shows that the larger remnants (mostly on public lands) retain high ecological worth (see also Figure G2). Despite this, when the remnants are standardised (see Appendix 1 for standardisation reasons), many of the smaller remnants are elevated in rank. Standardisation highlights those remnants, which possess a greater rank than

would be expected for remnants of a similar size. Figure G3 illustrates two such remnants. The EASY ranking system provides a useful guide to management of remnant vegetation and gives a relative assessment of remnants within the region. Table 15 lists a number of important remnants and their ecological attributes. The table provides an immediate entry point for targeting environmental projects and seeking additional funding (e.g. weed control activities on road verges).

Table 15 Important remnants in the Geographe Bay catchment.

NAME	GREMVEG -ID	AREA (HA)	CONDITION	TENURE	NO. OF VEGETATION COMPLEXES	DRF	RAW VALUE	STANDARD. VALUE
Dawson Gully Riparian	2330	5	Fair	Private	3	No	8.35	3.80
Evans Road	2051	36	Fair	Private	4	No	8.79	3.43
Jingarmup Creek	196	114	Fair	Private	6	No	8.98	3.13
Kalgup Road	1700	14	Fair	Private	3	Yes	8.54	3.59
Kaloorup Road	1642	26	Fair	Private	4	Yes	8.50	3.28
Lyle Road Verge	1028	3	Poor	Private	2	No	8.01	3.73
Metricup	2209	194	Good	Private	3	Yes	8.94	2.87
Minninup	3	614	Good	Private	3	No	10.37	3.80
Naturaliste Terrace	336	59	Fair	Private	3	No	8.85	3.27
North of Adams Road	2077	5	Poor	Private	2	No	8.25	3.72
Roy Road	1903	321	Good	Private	3	No	8.96	2.67
Sabina River Riparian	1643	150	Fair	Private	7	Yes	8.88	2.91
State Forest	171	5,636	Very Good	Public	9	Yes	9.01	1.50
State Forest	447	22,855	Very Good	Public	18	Yes	11.98	3.87
Tuart Forest National Park	181	1,079	Fair	Public	5	Yes	9.59	2.79
Tutunup	237	634	Fair	Private	2	Yes	8.97	2.39
Upper Capel Road	1600	2	Poor	Private	2	No	7.53	3.46
Wonnerup Road	1402	3	Poor	Private	2	No	7.70	3.45
Yallingup Road	1018	6	Fair	Public	2	Yes	8.2	3.58

Figure F1. Potential Corridors

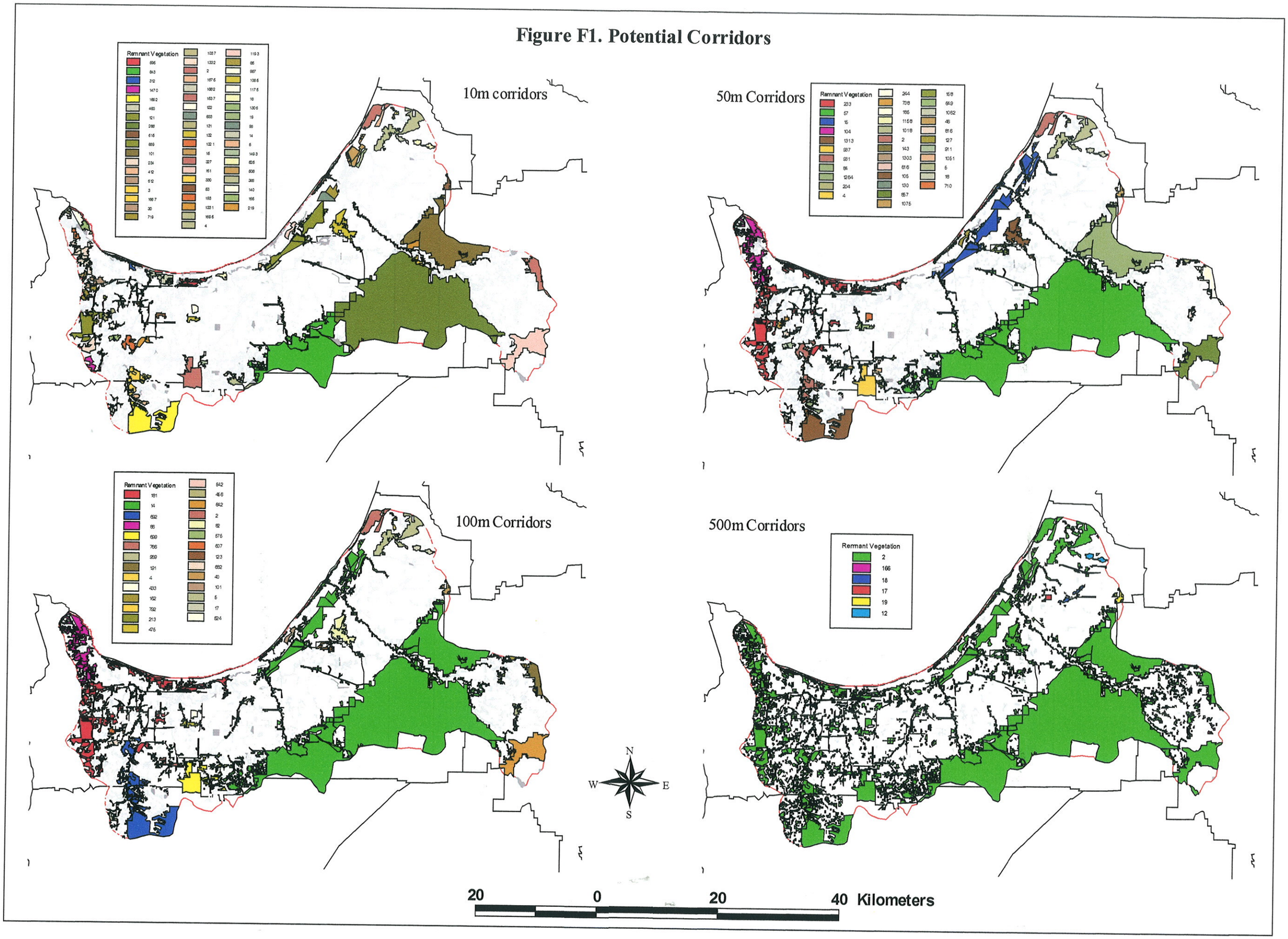
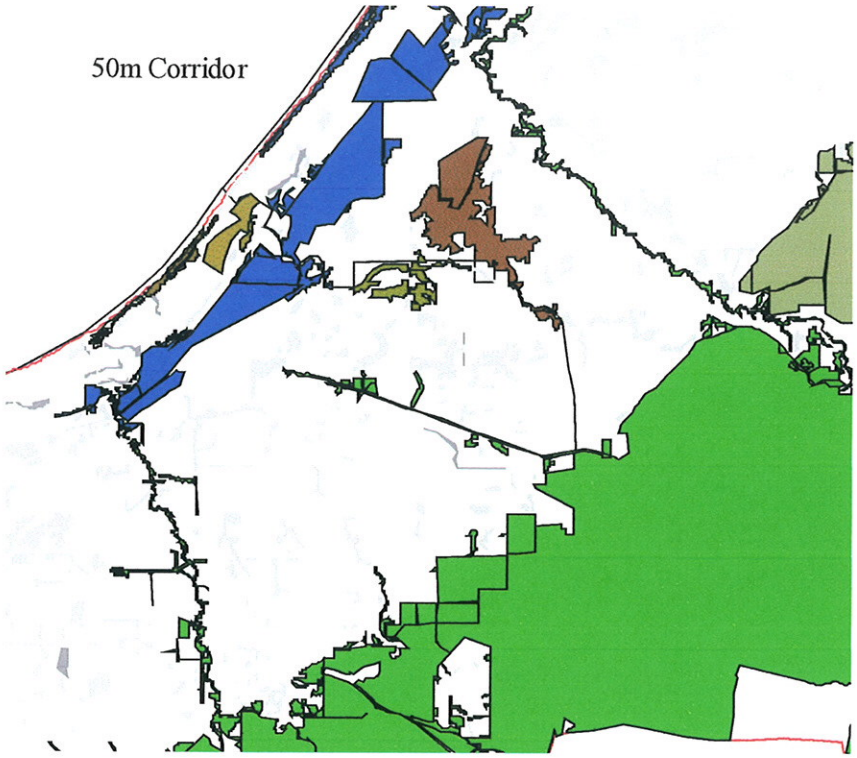
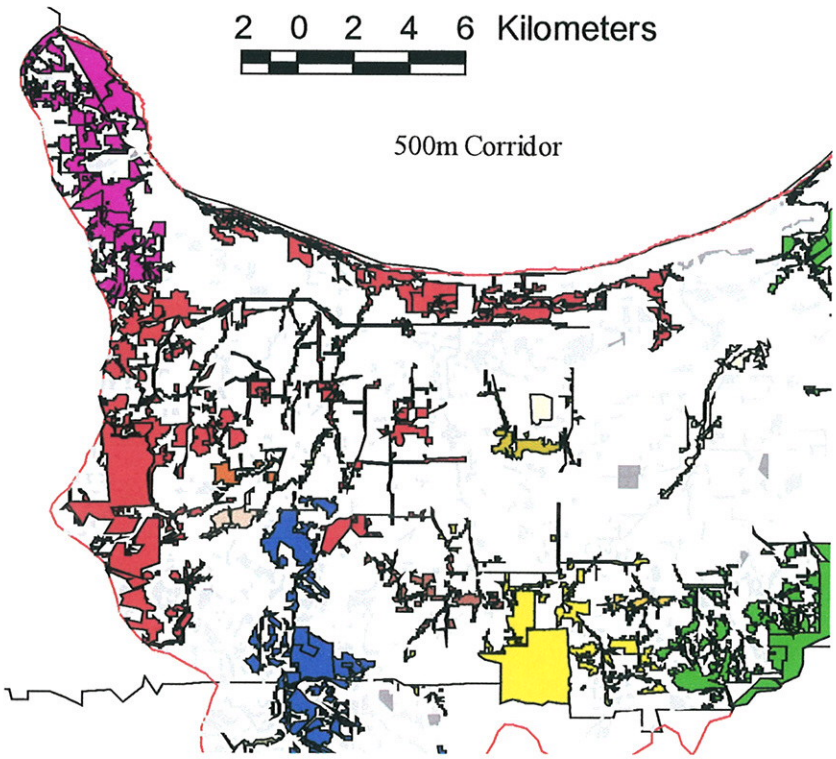


Figure F2 - Key Corridors

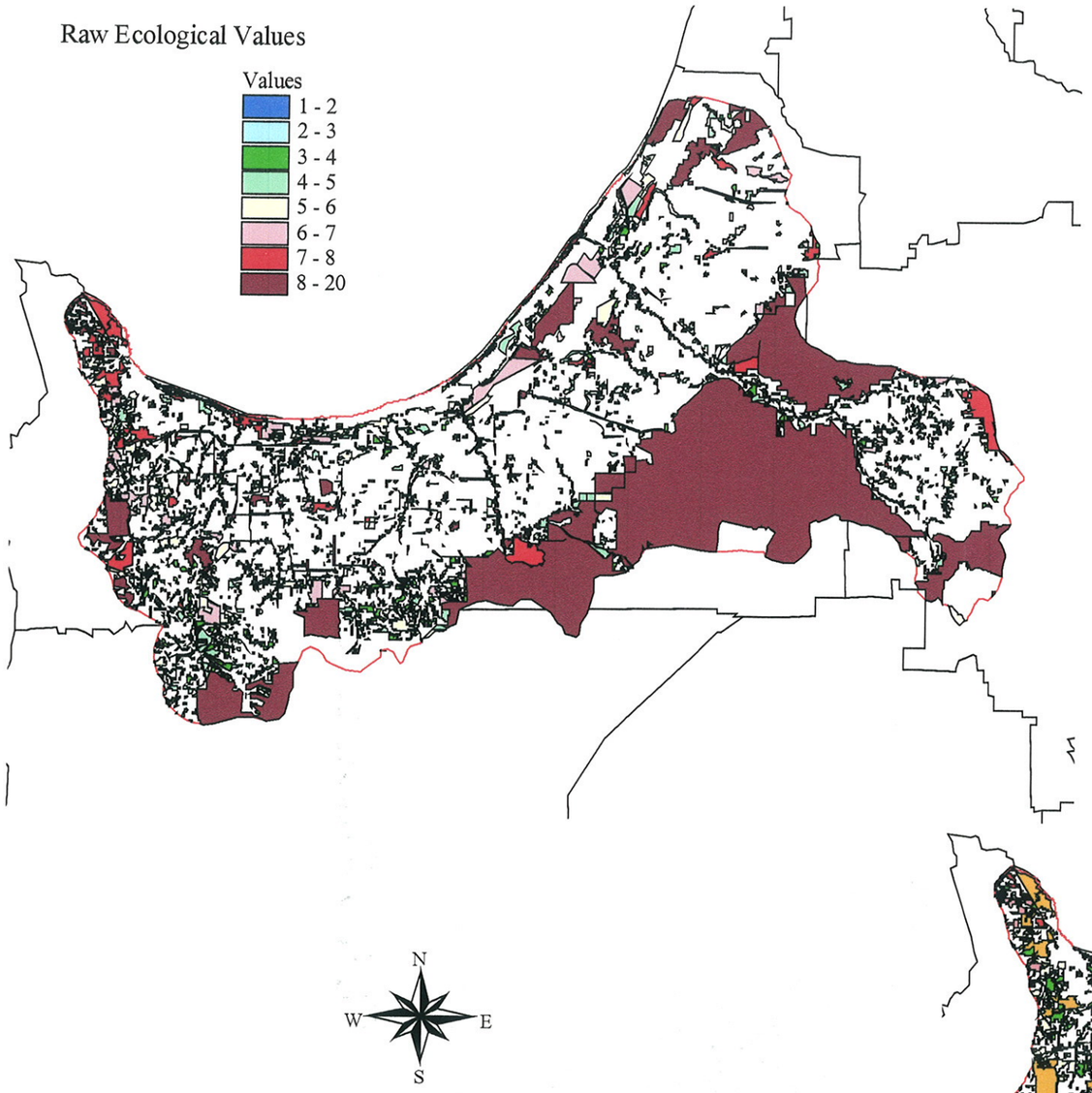


2 0 2 4 6 Kilometers



4 0 4 8 Kilometers

Figure G1. Raw and Standardised Ecological Values of Remnants



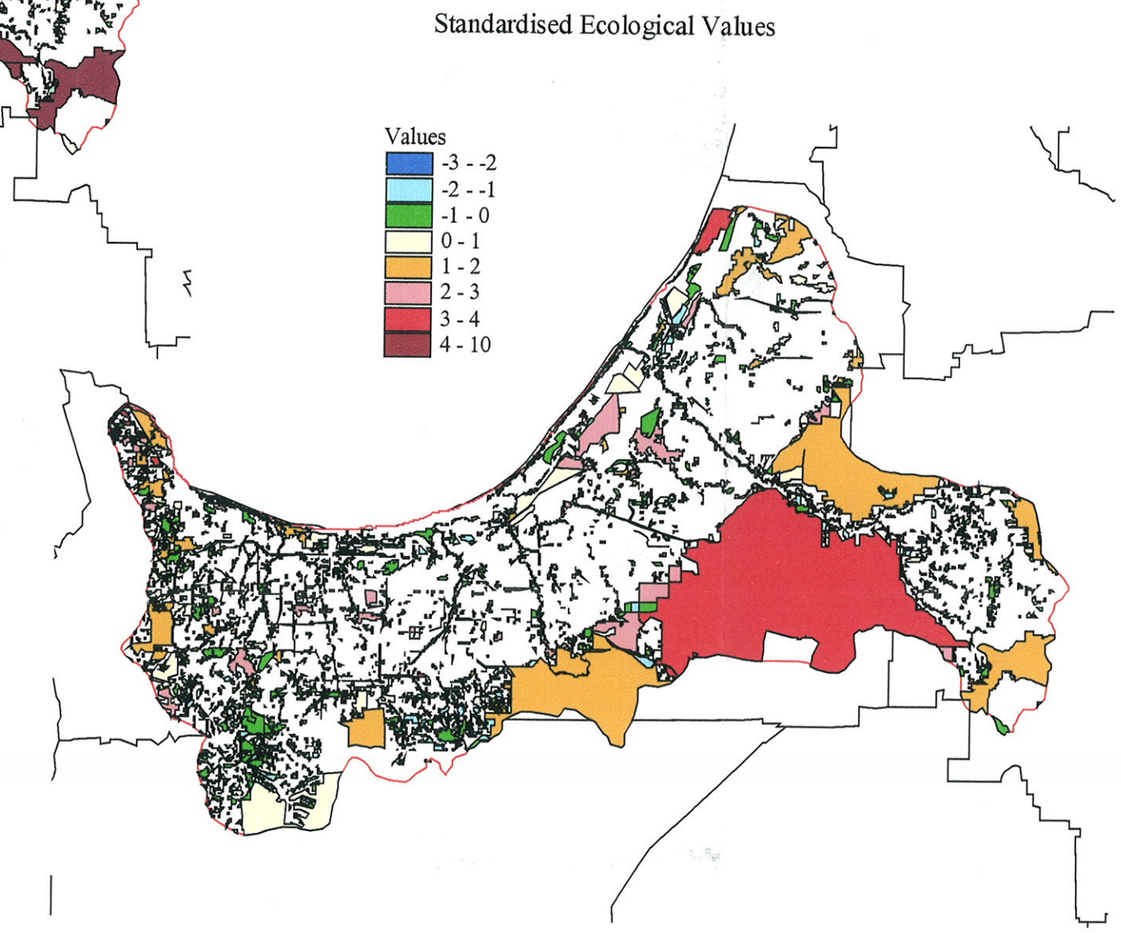
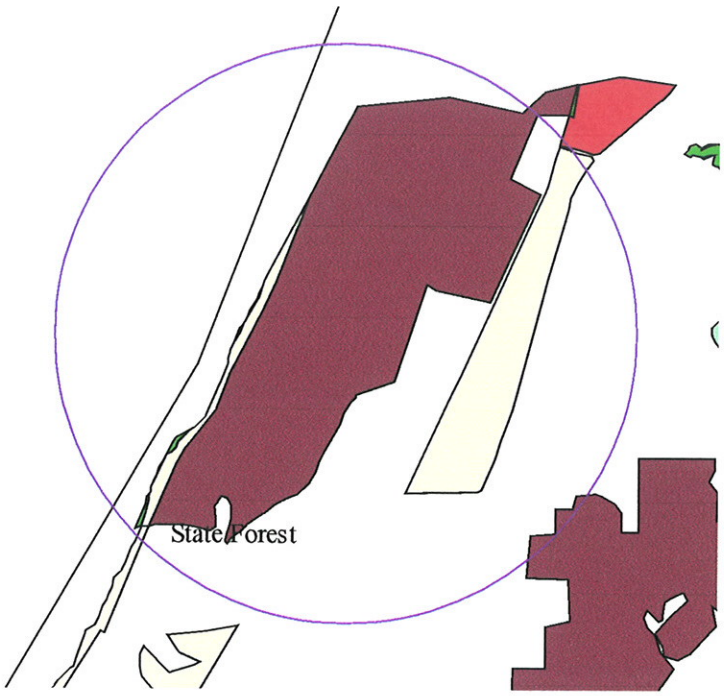
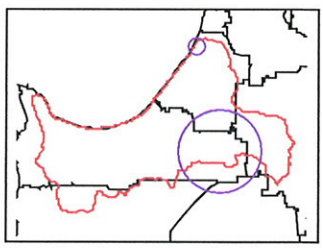
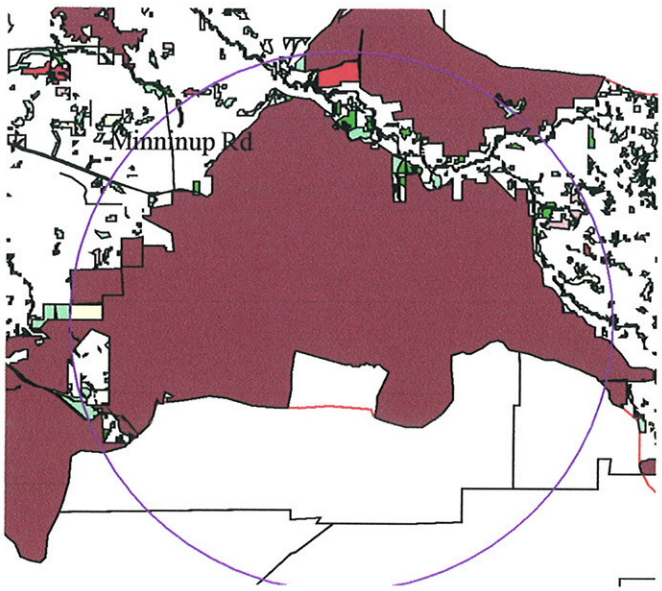


Figure G2 - Remnants with High Ecological Value (Raw)



1 0 1 2 Kilometers



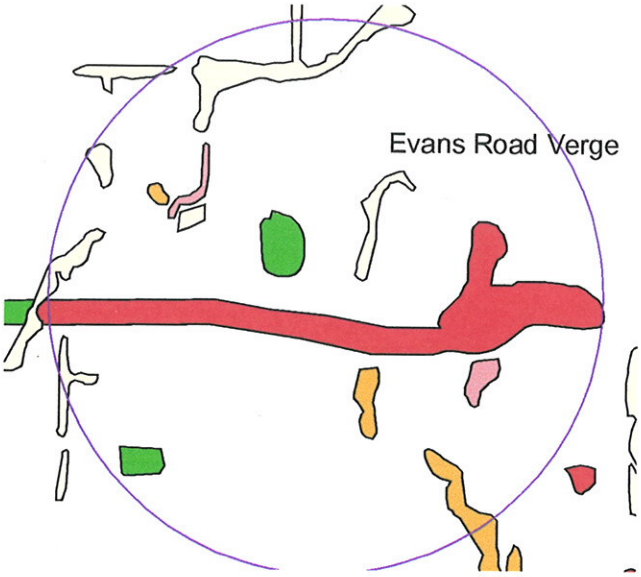


Values
1 - 2
2 - 3
3 - 4
4 - 5
5 - 6
6 - 7
7 - 8
8 - 20

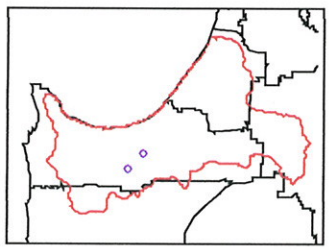
4 0 4 8 Kilometers

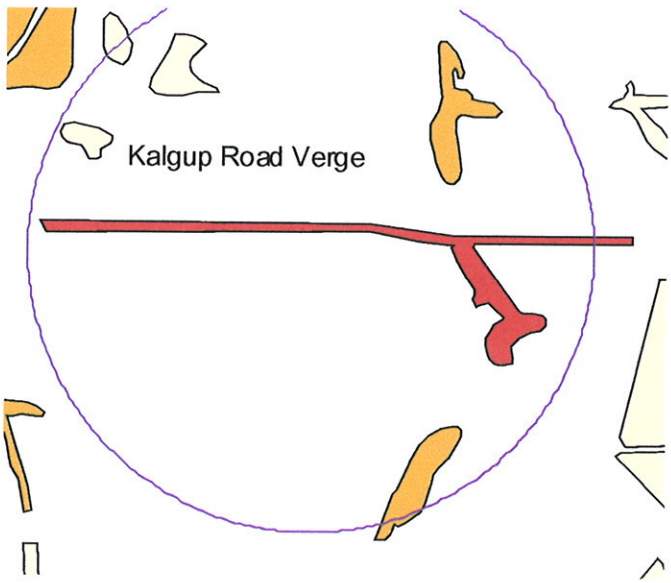
N
W E
S

Figure G3 - Remnants with High Ecological Value (Standardised)



500 0 500 1000 Meters





Values
< -2
-2 - -1
-1 - 0
0 - 1
1 - 2
2 - 3
3 - 4
> 4

N
W E
S

500 0 500 Meters

4.0 COMMUNITY VALUES AND CONCERNS

The values placed on remnant vegetation in a region are as varied as the people living there, but they can generally be grouped into three major categories: environmental, social and economic values. Environmental values include biodiversity and habitat conservation, water quality management and ecosystem maintenance values. Social values include cultural, historical, recreational and spiritual values. Economic values are directly and indirectly obtained economic benefits such as income from wood products (direct) and increases in crop and pasture yields due to the wind shelter effect of remnant vegetation (indirect).

To aid in the development of a regionally relevant Remnant Vegetation Strategy, the remnant vegetation values held by the local community were explored through community consultation activities.

4.1 COMMUNITY CONSULTATION

A series of one-day workshops were organised during the initial round of community consultation activities. These workshops were held on two consecutive weekends in January 1999 in the towns of Capel, Busselton, Margaret River and Karridale. They were publicised through a media release, information notices and more than 200 invitations to government and community organisations and interested individuals. A total of forty-seven people attended the workshops during which a range of values, concerns and management options for remnant vegetation were identified. A summary of the workshop outcomes and a survey form were sent to workshop participants and the organisations and individuals on the mailing list. The survey requested respondents to mark the ten major groupings of concerns about remnant vegetation identified during the workshops in order of priority (high, medium or low).

The final round of community consultation activities was held on two weekends in late June and early July 1999 in Busselton, Margaret River and Karridale. Public presentations by a series of speakers from various organisations involved in remnant vegetation management were held (see Appendix 4). A "Question and Answer" segment followed the presentations to facilitate public comment. The presentations were publicised through a media release, an advertisement in the South-Western Times and the Busselton–Margaret River Times, information notices and invitations to workshop participants, government and community organisations and interested individuals.

4.2 REMNANT VEGETATION VALUES IDENTIFIED THROUGH THE WORKSHOPS

The following section summarises the values of remnant vegetation that were identified by participants at all four workshops.

Environmental Values	These included conservation, habitat and corridor, revegetation/regeneration, climate values and others.
Social Values	These included the 'Common or Public Good', heritage, personal or family history, spiritual values and others.
Economic Values	These included landscape, real estate, potential future uses, sustainable land use, educational values and others.

4.3 COMMUNITY CONCERNS REGARDING REMNANT VEGETATION

Workshop participants identified a range of concerns about remnant vegetation, which were expressed in terms of threats to the continued existence of native forests and bushland. The similarity of the concerns identified at the 4 workshops allowed consolidation into 10 major groups, which illustrate the scope of the issues included under each heading. Please refer to Appendix 5 for a more detailed description of each grouping. They are:

Values, Attitudes and Fears	Different values for remnant vegetation, attitudes of disrespect towards the natural environment, fear of government or community intervention on private properties.
Economics	Pressures to clear native vegetation, which is not considered to have any economic value of its own.
Clearing for Development	Clearing of native vegetation for urban, industrial and horticultural development, land and water degradation as a result of badly designed developments and others.
Planning	Inadequate planning policies and decisions disregarding long-term environmental consequences and related concerns.
Lack of Awareness	A general lack of awareness of the values of remnant vegetation and the environmental consequences of people's own actions.
Lack of Knowledge	Regarding remnant vegetation management techniques, information access, hydrological changes. Also loss of local knowledge.
Introduced Species	The presence of stock, feral animals, weeds, pests and diseases in remnant vegetation.
Current Management (General)	A lack of government accountability, inconsistent and uncoordinated management, short-term staffing appointments, traditional farming methods, recreational over-use and others.
Current Fire Management	A distinct lack of information and an urgent requirement for public education. Are the current practices, burning regimes and legislation appropriate?
Lack of Financial Assistance and Incentives	Private landowners are unpaid land custodians / stewards, who pay rates on land that does not generate a direct income and incur high management costs. Need a low cost economic environment.

Respondents to the survey ranked the ten major groupings of concerns about remnant vegetation in order of priority (high, medium or low). Table 16 lists the concerns, and the percentage of respondents who considered these to be High Priority issues.

Table 16 Major groups of concerns and the percentage of respondents, who considered them to be High Priority issues.

Concern Grouping	% Respondents giving a High Priority Rating
Clearing for Development	65.9%
Values, Attitudes and Fears	61.4%
Planning	56.8%
Lack of Awareness	50.0%
Lack of Financial Assistance and Incentives	47.7%
Introduced Species	47.7%
Lack of Knowledge	40.9%
Economics	38.6%
Current Management (General)	31.8%
Current Fire Management	31.8%

Survey Response Rate: 19.8%

The survey results show that concerns relating to "Clearing for Development", "Values, Attitudes and Fears" and "Planning" were given the highest priority by respondents.

4.4 MANAGEMENT RESPONSES IDENTIFIED THROUGH THE WORKSHOPS

The majority of management responses suggested by workshop participants (listed below) relate to general education, research and innovation and legal management mechanisms. For further details please refer to Appendix 5.

Education

Public or community education campaigns

Aspects and values of remnant vegetation, increase awareness of long-term ramifications of actions taken. Focus on children, industry groups (e.g. nurseries), government agency staff, farmers. Specific recommendations: Bushland Manager's Self-Assessment Tools, Land Management Packs, information databases, Mentor Scheme, demonstration sites, case studies, project signage, oral history record.

Research and Innovation

Increased funding

Research and trial alternative management methods, bushland "inventories". Specific recommendations: economic modelling, community cost-sharing schemes, joined community-agency management, controlling recreational use, regional weeds management coordinator.

Legal Mechanisms

Remnant vegetation protection at ALL levels.

Federal, State and Local Government Level: Increased funding, tax deductable Landcare costs and donations, conservation planning zones, planning processes to incorporate environmental considerations, rate reductions, tradeable Carbon Credits.

Community Level: Levies on the general community to contribute to management, a Community Land Trust.

Individual Property Level: Voluntary covenants on remnant vegetation and revegetated areas, Heritage Agreements, trade Carbon Credits with industry.

5.0 CONSIDERATIONS FOR REMNANT VEGETATION RETENTION

A regional remnant vegetation management strategy needs to take a number of considerations into account. These include regulatory measures, management principles and financial aspects.

The two major strategic approaches to remnant vegetation management on private land are the statutory and the voluntary approach. The statutory or legally based approach obliges landholders to comply with remnant vegetation conservation and management measures set out by either state or local governments. The other approach, which is generally the preferred option, is that of encouraging voluntary, user-driven actions.

Both approaches utilise widely accepted environmental management principles designed to help guide the decision making process. However, the financial aspects of managing remnant vegetation on private land, a key consideration in any management decision, still need to be addressed in more detail.

5.1 STATUTORY OR LEGAL APPROACHES TO REMNANT VEGETATION RETENTION AND MANAGEMENT

State legislation does exist to protect rare and threatened species of flora and fauna, as well as their habitats. The Conservation and Land Management Act (1984) and the Environmental Protection Act (1986) are the two most relevant acts. In addition, Western Australia has the Soil and Land Conservation Act (1945) that can be used to manage the clearing of remnant vegetation. In some instances Commonwealth legislation could also be applied to protect flora and fauna. The use of acts and regulations especially at the Commonwealth and State levels, is not the preferred option for a number of reasons:

- Establishing the occurrence of rare, threatened or endangered flora is time consuming and expensive.
- If such flora is detected, there are generally insufficient resources to manage the area or to enforce the legislation.
- Current political preference is to avoid imposing regulations on the public, but to encourage stakeholders to value their natural resources and take a stewardship role that reflects or maintains those values.

There are other non-statutory actions that the Commonwealth and State governments could take to assist landholders in managing their remnant vegetation. These include the provision of "Custodian Payments" for landholders, who manage and maintain remnant vegetation on their property, and ensuring that costs in maintaining remnant vegetation are tax deductible as are donations to Landcare projects.

At the local or district level available options to compel landholders to manage their remnant vegetation include town planning schemes, which zone land for specific uses. In a town planning scheme private land can be zoned for a range of uses including conservation and the purposes and uses of the land can be specified. Theoretically, this could restrict the range of development options available to landholders. For example, an area could be zoned for conservation with the only allowable purposes and uses being those that can coexist with conservation, such as bee farming or seed collecting. An application to develop the land for other uses (e.g. viticulture) would require rezoning by the local council. The zoning of areas for conservation purposes is generally done in consultation with landholders, who either wish to see their area of land protected for personal reasons or wish to take advantage of incentives offered for having land zoned for conservation.

The Busselton Shire Council has established conservation zones in its District Planning Scheme No. 20. The objective of this zoning is "To restrict the type and scale of development, which will be considered on lands possessing special aesthetic, ecological or conservation values to those compatible with such environments". One of the policy provisions for this conservation zone is the support of subdivisions only where they are consistent with the Leeuwin-Naturaliste Ridge Statement of Planning Policy [SPP] (Ministry for Planning, 1998). The objectives of this SPP range from the conservation of natural, cultural and environmental values to the protection of economic and social values of agricultural land. Please contact the Shire of Busselton for further details.

Recent changes to the Environmental Protection Act (1986) make it a requirement that all new Town and District Planning Schemes and any amendments to existing planning schemes are subject to an environmental assessment. These changes provide an opportunity for managers to consider the environmental consequences of land use change as well as the possibility of retaining or establishing ecological corridors.

Structure plans and rural strategies prepared by local government to specifically manage remnant vegetation within a shire are an alternative to conservation zoning in planning schemes. These plans and strategies can be either a single initiative by a council or part of a wider district or regional plan and may be used to comprehensively plan for remnant vegetation management and initiate studies to determine the significance of local flora and fauna. Since such documents are non-statutory, they may represent a more acceptable management alternative to stakeholders.

The use of planning schemes, council policies and by-laws to manage remnant vegetation must also consider the following:

- Council endorsement or approval for planning zones, by-laws and policies is required, and if the community was not thoroughly consulted or there is opposition to the proposal, such endorsement or approval will be difficult to achieve.
- Council decisions based on town planning schemes, by-laws and policies may be overturned by the Minister for Planning on appeal by the proponents.
- The development and implementation of conservation zones, policies and by-laws generally requires additional local resources and often there are insufficient funds and staff to do so.
- Enforcement of these legal statues, especially if they are viewed by the majority of the community as being unwarranted, may place local government officers in a "watch-dog" role and create a climate of non-cooperation between councils and landholders.

Voluntary agreements and covenants provide an option for landholders, who wish to retain and manage their remnant vegetation. They are negotiated contracts between a landholder and a third party (usually a government department, non-government organisation or Trust), which enable the landholder to retain ownership of the land while gaining assistance in its management (Miles, Lockwood and Walpole, 1998). These include:

Statutory Management Agreements

The land is managed as a conservation reserve by a government agency, but remains in private ownership.

Contract Management Agreements

A government department such as CALM or the Water and Rivers Commission [WRC] and the landowner agree on management regimes. This agreement can be secured through a caveat on the title, however, future owners are not bound by it.

Individual Non-Binding Agreements

An example of these motivational agreements is CALM's "Land for Wildlife" initiative. Management advice, often linked to incentives or grants, is provided to landholders, however, this agreement does not provide long-term security of protection for the area.

Individual Binding Agreements or Covenants

These are voluntary agreements with flexible conditions that are registered against the title, bind future owners and can apply to all or part of a property. Landowners may retain ownership and control of the land and can stipulate conservation values and allowable uses usually in return for management advice and incentives. Voluntary covenants are available through Agriculture WA and the National Trust of Australia. Another covenanting program currently being developed will be administered by CALM.

Heritage Agreements

These are legally binding contracts under the Heritage of Western Australia Act (1990) between a landowner and a public or corporate body. They could form the basis for agreements on the use, development and conservation of land and must be approved by the Minister for Heritage. To successfully apply this agreement to remnant native vegetation conservation, the remnant would have to be judged as having "heritage significance" under the Act.

Financial incentives and project funding can also be used as motivation to remnant vegetation retention and management. The range of available options includes land swaps, planning concessions, rate relief and donations (WAPC, 1998).

Clearly policies, programs and action plans that are user-driven are the preferred option since they avoid many of the constraints councils and state agencies have in managing remnant vegetation. Sound user-driven management of remnant vegetation can provide the balance between development and conservation. In some cases legal mechanisms may be necessary, in other cases options such as good town planning may avoid the need to create laws and regulations. User-driven management measures also have the advantage of meeting stakeholders needs in a cost effective and efficient manner.

5.2 REMNANT VEGETATION MANAGEMENT PRINCIPLES

There are some general management principles to be taken into consideration when deciding on actions to manage remnant vegetation for whatever purpose. The principles listed below provide guidance on what actions to choose and a level of confidence about the decisions to be made. They are derived from a general set of environmental management principles that are used by local and state governments as well as by many community groups. For more specific management information and actions, please refer to the Remnant Vegetation Handbook and other publications.

- Government at all levels and landholders share the role in planning and managing remnant vegetation. This is best shared through a common overall goal and objectives for the entire region.
- Local government, the community and individual landholders acknowledge the benefits of working collectively to maintain remnant vegetation within a region and ultimately the state.
- A holistic view that considers environmental, social and economic needs of the land, the landholder and the region should be foremost in the planning for remnant vegetation on private land.
- When planning remnant vegetation management, it is important to consider the size of the remnant. Larger remnants are more easily and cost-effectively managed to meet management objectives. Smaller remnants require more intensive management such as the establishment of vegetation buffers. The potential for inclusion of individual remnants in the establishment of vegetation corridors should also be a major factor in planning for regional remnant vegetation retention and management.
- Each property differs environmentally as well as socially and economically and therefore management of remnant vegetation on private land should be based on appropriate responses to the distinctive characteristics and needs of the property.

- Vegetation remnants with high biodiversity values (e.g. presence of rare flora or endangered fauna) should be protected. Once the conservation value of the remnant vegetation has been assessed, management should reflect and maintain those values wherever possible.
- The quality of wetlands, groundwater, lakes, estuaries and rivers in a region should be maintained or enhanced through the management of remnant vegetation.
- Landholders must recognise the critical importance of their remnant vegetation to the overall physical and ecological maintenance of the region. The study undertaken during the preparation of this Strategy has identified areas of remnant vegetation that are important to maintaining the floral diversity of the shire. Many of these remnants are on private land, and landholders need to recognise their importance to the region as a whole.
- Landholders should aim to use remnant vegetation in a sustainable manner and any uses should not exceed the capacity of the land to absorb the impacts of the use, or its capacity to function as a viable ecological community.
- Landholders should not compromise the future use of remnant vegetation. Extensive clearing of remnant vegetation, loss of topsoil and alterations to water table regimes threaten the future use of areas once covered by remnant vegetation. All of these impacts should be avoided.
- Ultimately private landholders are the long-term custodians of their remnant vegetation. Current land use and development controls go some way to assisting in the management of remnant vegetation on private land, however, they are not comprehensive or exclusive and therefore landholders themselves must be stewards of the area.
- If remnant vegetation must be used, the areas least valued for conservation should be used first and permanent loss of remnant vegetation should be avoided wherever possible. The use of the area should have scope for rehabilitation or revegetation once the land use is finished. If remnant vegetation is disturbed, steps should be taken to manage the threat posed by exotic plants [weeds] and feral animals that colonise it as a result.

5.3 FINANCIAL ASPECTS OF REMNANT VEGETATION RETENTION AND MANAGEMENT

It is widely acknowledged that private landowners face considerable economic pressures to clear native vegetation, as the prevailing economic world-view does not consider remnant native vegetation cover to be a productive and therefore economically valuable land use. However, the public consultation process identified a range of economic values of remnant vegetation, including landscape, real estate, potential future uses, sustainable land use and educational values.

Community demands to retain remnant vegetation are continually growing louder. Workshop participants were particularly concerned about the general lack of financial assistance and incentives for private landowners to do so. Essentially private landowners are unpaid custodians or stewards of land still covered by native vegetation. They are required to pay rates on that land even though it does not generate a direct income. In addition they incur high initial management costs (e.g. fencing, weed and pest control) if they wish to retain viable remnant vegetation. Once an already degraded remnant has been fenced, management costs will continue to be high until the degradation has been reversed and the remnant has been returned to a good condition.

Several potential management responses to address this problem were put forward (please refer to Section 4.5), which concentrated on the need for both the Government and the community to provide the necessary funds. Specific initiatives identified include:

- Funding to develop an economic model, that allows a monetary value to be assigned to remnant vegetation as part of a "whole property economic plan".
- Community cost-sharing schemes, for example general community levies to finance contributions to the remnant vegetation management costs incurred by landowners, or the establishment of a Community Land Trust, which would purchase and manage remnant vegetation on behalf of the entire community.

- Increased funding for more joint community-agency management projects, which make efficient use of available labour, expertise and equipment.
- Increased funding for effective control of the recreational use of remnant vegetation to avoid degradation issues as a result of over-use.
- Funding to employ a regional weed management coordinator, to ensure that all weed control efforts in the region are undertaken in a systematic and coordinated manner, resulting in a more effective and cost-efficient use of resources.

The majority of initiatives proposed involved increased availability of funds for remnant vegetation management. The key element in achieving native vegetation conservation on private property is economic viability. The long-term survival of privately owned native vegetation remnants depends on their ability to generate an income for the landholder. There are a number of potential income producing activities that have been examined. They include honey, wildflower, seed, essential oil, charcoal and timber production. However, it was found that while these activities do provide some additional income, most do not compare favourably with crops or pastures on a $ per hectare basis. For example, seeds and essential oils can be produced far more economically from purpose-planted orchards than from remnant vegetation. Examination of various farm businesses showed that wildflower collection ($124 to $232/ha) and eco-tourism ($5 to $1,500/ha, depending on the initial investment when setting up eco-tourism ventures, e.g. guided walks or camping grounds) generated the highest income (ACIL, 1993). Eco-tourism operations require a cash investment before income can be generated and rely on personal interactions with visitors. This type of business may not appeal to many farmers. It is also worth noting that these economic activities will put a strain on the vegetation remnants and have the potential to cause degradation, unless they are carefully managed to achieve a sustainable use of this natural resource.

The economic value of the contribution native vegetation remnants make to farm productivity by providing shade and shelter to stock and crops has been examined in several studies. Crop and pasture production may increase by as much as 20%, carrying capacity of ewes by about 15% and lamb and calf survival rates improve markedly in the first few days after birth (Carberry, n.d.). It is more difficult to determine on-farm benefits of native vegetation relating to reduced erosion and salinity risk and improved water quality, for example.

A study carried out by members of the Johnstone Centre at Charles Sturt University (1998) on the economics of remnant native vegetation conservation on private property highlights the difference between market and non-market economic values of remnant vegetation. Market values are the direct on-farm costs and benefits of conserving remnant vegetation, and their dollar value can be estimated. Non-market values are the costs and benefits to the community of retaining remnant vegetation (see Table 17). These values do not relate to tradeable goods and it is therefore extremely difficult to estimate their dollar value (Carberry, n.d.; Miles *et al.*, 1998).

It may be easier to value non-market benefits by estimating the cost to the community of NOT retaining remnant vegetation. The future cost to the community of managing the cumulative effects of degradation as a result of continued clearing of native vegetation is likely to be prohibitively high, possibly running into billions of dollars.

Table 17 Examples of market and non-market values of retaining remnant native vegetation (Miles *et al.*, 1998).

	Benefit	Cost
Market Value	• Increased stock and crop production due to shelter and shade. • Increased agricultural production due to land degradation control and maintenance of localised ecological functions. • Timber yield for firewood and fencing.	• Foregone agricultural production from areas of retained native vegetation. • Management expenses such as fencing materials, weed and pest control, fire management and labour. • Rates and taxes.
Non-Market Value	• Biodiversity conservation (native plant and animal species and communities). • Visual or scenic amenity and landscape character. • Maintenance of regional ecological functions. • Educational, historical and spiritual values.	• Funding of conservation projects.

Generally, the major aim of landholders such as farmers is to earn a living. If the costs of maintaining remnant vegetation on their property are higher than the benefits, landholders will be forced to clear it and put the land to a more productive use. On the other hand the community values remnant native vegetation and faces high costs in the future if it is cleared. Therefore it would make good economic sense for the community to spend a percentage of the projected future costs on preventative measures today, resulting in net savings in the long term. Such funds could be used to finance remnant vegetation management on private properties, an action that could remove some of the remnant vegetation management costs landholders currently have to bear. When combined with other incentives such as rate relief and tax deductibility of additional management costs, the retention of remnant vegetation may become a more economically viable option for landholders.

In some areas of Australia the collection, administration and distribution of such funds is undertaken by local government authorities. An environmental levy is being charged and the resulting funds are being used to finance land management projects within the shire. Many of these Shire Councils are also able to zone land for conservation and offer rate relief schemes. In an effort to protect the investments made by the Councils (foregone rate revenue) and the community (environmental levies), beneficiaries of these schemes are often required to enter into a voluntary management agreement (James, 1997; Bateson, 1999).

6.0 STRATEGY RECOMMENDATIONS

The recommendations made in this Remnant Vegetation Strategy are based on the results of this study, reports on related remnant vegetation studies and existing strategic documents that influence remnant vegetation management in the Geographe Bay catchment. In particular, this Strategy endorses the recommendations made in the *South West Environmental Strategy* (Bradby and Pearce, 1997), the *Leeuwin-Naturaliste Ridge Statement of Planning Policy Report* (Ministry for Planning, 1998) and the *Draft Scott Coastal Plain Vegetation Strategy* (Agriculture WA, in preparation).

The current decline in native vegetation remnants, whether they are forest, bushland or riparian remnants, is of great concern to the community in general. Public consultation identified the following major issues:

- Decision-makers seem to suffer from a general lack of knowledge regarding the regional consequences of native vegetation clearing. This leads to unsustainable land use and developments, as well as uncoordinated management approaches across all management levels.
- A lack of financial resources makes it difficult to carry out effective management actions even with the best of intentions.
- People have different values for, and attitudes to, native vegetation. This combined with a fear of outside interference in property management, leads to conflicts between sections of the community.

Voluntary programs designed to achieve a change in the attitudes, awareness and behaviour of land managers (e.g. Landcare) are not considered to be sufficient to address these issues in the short term and on the necessary scale. On the other hand, some legislative measures appear to encourage clearing of native vegetation (Young *et al.*, 1996, quoted in Miles, Lockwood and Walpole, 1998). Therefore, a mixture of legislative, financial and voluntary strategic approaches and instruments is needed (Miles *et al.*, 1998). These include awareness raising and education, regional coordination of management activities and resources, economic incentives to retain remnant vegetation and legal protection and enforcement where required.

6.1 MECHANISMS TO ENHANCE REMNANT VEGETATION RETENTION AND MANAGEMENT

The mechanisms and activities recommended in this section are aimed at successful long-term management of remnant vegetation in the Geographe Bay catchment. It was not possible to include detailed implementation paths for the Strategy's recommendations, as investigations beyond the scope of this Strategy will be necessary. Funding for these investigations will need to be sourced and this should be done as a matter of urgency.

The recommendations of this Strategy have the potential to form the basis of a remnant vegetation management pilot program with Australia-wide implications. Emphasis has been placed on the use of economic instruments and the integration of a number of existing government initiatives. Both are of utmost importance. Environmental and economic concerns are currently widely considered as being mutually exclusive and a range of federal and state government initiatives are operating independently of one another. However, economic instruments can be used to achieve environmental outcomes and an integration of government initiatives will result in a more effective use of available resources.

Recommendation 1

Continued public or community education campaigns focusing on the promotion of priority vegetation distribution and remnant vegetation values should be undertaken.

Education campaigns should include seminars and printed publications (see below) and should draw on local expertise and knowledge, which could be accessed through the establishment of a "Mentor Scheme", that would allow long-term local landowners to advise new landowners moving to the area.

The following publications could be produced and distributed to landholders and other interested parties:

- Bushland Manager's Self-Assessment Tools (see Appendix 6 for examples).
- Land Management Packs (modelled on the Shire of Augusta-Margaret River Health Promotion Committee's "Welcome Pack").
- Case studies of local Landcare projects on private and shire properties. Project sites should be accessible to the public (demonstration sites) and sign-posted.
- List of local sources of land management information and expertise.

Recommendation 2

Conservation management and funding priority should be given to projects benefiting remnants with native vegetation communities, that are endangered or under-represented in the reserve system.

- The Abba Complex as defined by System 6 and the RFA;
- The Ironstone communities as identified by the Swan Sandplain Survey (Gibson *et al.* 1994);
- The corridors along the Capel and Sabina River systems;
- The corridor connecting the western remnants to remnants along Geographe Bay;
- Remnants identified by the GIS as having high ecological value (this last group is ranked for management attention).

Dawson Gully Riparian	Kaloorup Road	Lyle Road Verge	Metricup
Minninup	Naturaliste Terrace	North of Adams Road	Roy Road
Sabina River Riparian	State Forest	State Forest	Tuart Forest National Park
Tutunup	Upper Capel Road	Wonnerup Road	Yallingup Road

Recommendation 3

Native vegetation corridors should be established and maintained in several strategic locations.

- Capel River - connecting the south-eastern remnants to the coast.
- Sabina River - connecting the south-eastern remnants to the coast.
- Western Corridor - connecting the Naturaliste Ridge remnants to Geographe Bay and includes the Carbanup River.

To aid in the selection of additional areas with corridor potential, the Roadside Conservation Committee should be asked to coordinate a roadside vegetation assessment in the Shire of Busselton and to provide advice on management techniques. Roadsides in the Shire of Capel have already been assessed.

Recommendation 4

Investigate a range of strategic conservation approaches and instruments in the Geographe Bay Catchment.

These approaches and instruments should include the following in addition to existing programs (e.g. Landcare, Bushcare) and existing legislation:

- Undertake a community "Willingness To Pay" survey in the Shires of Capel and Busselton, and depending on the results of this, consider the introduction of an environmental levy.

- In consultation with landholders, introduce conservation zones under the Town and District Planning Schemes for the Shire of Capel, to assist control of land use options in high biodiversity conservation areas (The Shire of Busselton has already incorporated conservation zones into its District Planning Scheme #20).

- The development of a program of financial incentives to retain and manage remnant native vegetation in the Shires of Capel and Busselton based on selected eligibility criteria. Such a program could include rate relief or the provision of grants for fencing and pest control in return for entering into a voluntary management agreement for example.

- Lobby Federal and State Governments to introduce tax-deductibility of remnant vegetation management costs, and provide additional funding for the active monitoring and regulations regarding recreational use of remnant native vegetation.

Recommendation 5

Support for Ongoing Employment of a Remnant Vegetation Officers Eg. Bushcare, Land for Wildlife, etc

The duties of these officers to assist in managing remnant vegetation could include:

- Coordination of the various existing schemes (Landcare, Bushcare, Land for Wildlife, National Trust, etc.), management activities and resources within the catchment, e.g. weed, pest and feral animal control, fire management, threatened and endangered flora and fauna management, monitoring and rehabilitation activities, corridor establishment and maintenance, covenanting and others.

- Provision of assistance to shire councils in regards to planning for remnant vegetation, conservation zoning, planning approval processes, development application assessments and the determination and administration of environmental levies.

- Provision of assistance to landowners and managers as well as community groups and other organisations regarding survey, assessment and management of remnant vegetation and the obtaining of funds to carry out these activities.

- Maintenance of the remnant vegetation GIS and provision of information for State of the Environment reporting.

- Facilitation of voluntary management agreements.

- Community education facilitation and coordination.

Recommendation 6

Scientific studies of native vegetation remnants and projects trialing different management methods should be encouraged and supported.

These studies and trials should include (but not be limited to) flora and fauna surveys (inventories), economic modelling and comparisons between different fire regimes and weed and pest control methods.

7.0 RECOMMENDED STRATEGY EVALUATION PROCESS

This Strategy is a living document that needs to respond to any changes in the environment. How do we know if the Strategy is working or if it needs to be changed? Who should undertake the review and evaluation? When should such a review be undertaken? How should it be done?

7.1 EVALUATION RESPONSIBILITY

A Steering Committee was established to guide the development of this Strategy. Responsibility for carrying out the Strategy evaluation process also rests with the Steering Committee. There are several ways in which this task can be undertaken.

The Steering Committee can act as a coordinating body or appoint another agency to act on its behalf. Potential coordinating agencies are government departments, local government authorities and community organisations. Even though some evaluation activities may be carried out in conjunction with other environmental reporting projects, it may be necessary to obtain funding to undertake the rest.

7.2 EVALUATION ACTIVITIES

It is necessary that the Strategy be reviewed and updated at regular intervals. Some Strategy recommendations may take some time to implement and show an effect, it is recommended that a full evaluation and review be undertaken every 5 years. Recommended key evaluation activities are:

- *For each Strategy recommendation summarise the activities undertaken and their outcomes with the aid of an Evaluation Table.*

The Evaluation Table contains columns on aims, activities and the information required to ascertain whether the activities undertaken have achieved the stated aims. A sample Evaluation Table is included in Appendix 7. Once the information required has been identified and obtained, an evaluation report can be produced. This report can then form the basis of a Strategy review and any amendments, if necessary.

- *Determining the extent and condition of remnant vegetation in the study area and comparing the results with those of previous evaluations.*

  On a regional scale data obtained through biodiversity [flora] condition assessments for State of the Environment reporting projects can be used. Indicators to be examined may include

  - Area (in hectares or as a percentage of the whole) of native vegetation in the study area.
  - Number, size and condition (health) of native vegetation remnants.
  - Area of land affected by weeds.
  - Extent, tenure and protection status of native vegetation remnants and native vegetation communities.
  - Presence of priority and declared rare and endangered flora species.

  (Franke *et al.*, 2000a)

On a local scale data obtained through monitoring surveys of individual remnants and reserves and reviews of any reserve management plans can be used. Where such data is not available surveys may have to be undertaken (please refer to reports such as Franke *et al.*, 2000b, for recommended methodologies). Another acceptable form of monitoring that is low in costs, simple and effective is to keep a photographic record of several selected sites within indicator remnants. Photographs should be taken at regular intervals (e.g. once each season and at the same time each year) and compared. This will highlight whether management actions are working and provide a record of the condition or health of the remnant. Oral histories may also provide important information on plant communities and vegetation condition.

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- APPENDICES -

APPENDIX 1

GIS Methodology

DIGITAL DATA SETS USED

To facilitate the Geographic Information System (GIS) study of the remnant vegetation of the study area existing data was obtained from various Government agencies. These data sets formed the basis of the fieldwork and analysis to produce a current picture of the status of remnant vegetation in the region. Listed below are the data sets used in the study:

- REMNANT VEGETATION DATA: obtained from the Agriculture Department of Western Australia (AgWA).
- DIGITAL AERIAL PHOTOGRAPHS: obtained from the Department of Lands Administration (DOLA) in the form of the Blackwood Compact Disk Set.
- REGIONAL FOREST AGREEMENT (RFA) VEGETATION COMMUNITY MAPPING: obtained from the Department of Conservation and Land Management (CALM). This data set is the best vegetation mapping available, however, it does not provide complete coverage of the study area, being confined to the south-western corner of WA.
- BEARD VEGETATION COMMUNITY MAPPING: obtained from the Agriculture Department of Western Australia (AgWA). This data set is the next best vegetation mapping available and was used to complete the coverage of the region.
- DECLARED RARE FLORA (DRF): obtained from CALM. This data set is randomised (500m) by CALM to offset the actual plant locations, which affords protection from poaching. Accordingly the data has inherent inaccuracies.
- COMPARATIVE REMNANT VEGETATION DATA SETS: Unpublished data from Dr Stephen Connell. Remnant vegetation data for various localities around Western Australia are included to provide comparisons to the study area.
- TENURE: obtained from the Ministry for Planning.

PRE-FIELDWORK DATA MANIPULATION

Prior to the fieldwork occurring, field data sheets for the study area were produced. These were used as a navigation and recording tool for the collection of all information and observations gained in the field. To produce the A4 sized field sheets, each covering an area of 10 x 7.5km, the remnant vegetation, transport and hydrology data sets and the relevant orthophotographs were incorporated into ArcView. Hard copy maps were printed out for use in the field. These maps were used to annotate boundary changes, vegetation condition and vegetation type (see below).

FIELD ASSESSMENT

The fieldwork for the study was completed between October 1998 and March 1999. A visual assessment of the remnant vegetation of the study area was conducted to ascertain the continuing existence of previously mapped remnants, all major changes to remnant boundaries and the current condition of each remnant. The condition of each remnant was visually assessed using the criteria outlined in the table below. Each remnant was given a rating, which was recorded on the field sheets. Any remnants that had been cleared and any boundaries that had changed were also detailed on the field sheets.

Criteria used for the field assessment of remnant vegetation condition.

RATING	CRITERIA
4. Very Good	Natural vegetation in good health. All vegetation layers are intact. Evidence of continuing vegetative and seedling recruitment (esp Banksias). Little damage by galls (on trees and shrubs) or mistletoe (on trees).
3. Good	Evidence of localised low level damage to otherwise healthy bush. Recruitment should be apparent. Weed and grazing damage is confined (<20% of area). Some modification to vegetation structure due to changes in fire regimes may be apparent. Little evidence of logging or fire wood collection.
2. Fair	Evidence of localised high level damage to otherwise low-level damaged bush. Recruitment is localised and the populations of some species may be senescent. Weed and grazing damage is apparent in <50% of the area. Modification to vegetation structure due to changes in fire regimes may be apparent. Gall and mistletoe damage may be apparent. Evidence of logging or fire wood collection.
1. Poor	Widespread high level damage. Recruitment is disrupted and most woody species appear senescent. Weed and grazing damage may be apparent throughout the area. Modification to vegetation structure due to changes in fire regimes may be apparent. Locally some strata may be absent. Gall and mistletoe damage may be apparent. Evidence of logging or fire wood collection.
DAMAGE TYPE	**DESCRIPTION**
High Level	Grazing (domestic and feral), logging, clearing and excavation, die-back, salinisation or other water table modification, road works, flower picking, major structures (eg. managed or fenced areas), mowing, car bodies.
Low Level	Dumping (household, garden etc.), minor structures (eg. sheds), fire wood collection, weed infestation, modified fire regime.

POST-FIELDWORK DATA MANIPULATION

After the fieldwork was completed the AgWA data sets were edited. Remnant vegetation line work was edited and the condition labels for each remnant were added.

The rectified digital aerial photography overlayed with the AgWA data sets was used as the reference for transferring the boundary amendments from the field sheets to the AgWA data sets. Any remnants that had been cleared since the AgWA data was collected were deleted and the data sets were combined to form one data set containing the current spatial distribution of remnant vegetation for the study area. The condition label of each remnant was then added to this data set to produce the initial remnant vegetation data set (REMVEG1) containing both the spatial distribution and condition of each remnant in the study area.

ANALYSIS

The (REMVEG1) data set formed the basis for the analysis of the remnant vegetation of the study area and was used in the construction of the corridor and ecological significance analyses. The data sets produced by these analyses were linked to the (REMVEG1) data set in ArcView appending the following information:

- The spatial extent of remnant vegetation,
- The tenure of remnant vegetation,
- The condition of remnant vegetation,
- The spatial extent of vegetation communities,
- The association of DRF with remnant vegetation,

- The existence of possible wildlife corridors, and
- The ecological values of the remnants.

Extracting the relevant information from the (REMVEG1) data set produced the first three maps. That is, to the spatial extent of remnant vegetation, data concerning the area of each remnant was extracted and so on for the tenure and condition maps.

The spatial extent of vegetation communities prior to clearing is contained in the RFA data set. As discussed in paragraph 2.1.1 this data set does not cover the entire study area. To obtain a complete coverage of the study area a union of the RFA data set and the System 6 data set, which contains similar data, was conducted. This data set was intersected with the REMVEG1 data set to produce a data set depicting the current spatial distribution of the vegetation communities found in the study area.

The DRF data set was mapped to produce a data set containing the approximate location of declared rare and priority species associated with the remnant vegetation of the region. Definitions of the codes used in the DRF data set are included in Appendix 3.

Potential wildlife corridors for the movement of plants and animals were created from the REMVEG1 data set based on the mobility of individuals due to size (the premises used to derive these corridors are discussed below). Corridor maps were produced using a buffering process, which involves the adding, or buffering, of a set distance (e.g. 5m) to each remnant. As a result each remnant grows in size by that distance. When the boundary of the constructed shape contacts the boundary of another constructed shape the two are merged to form one shape with a single unique label (the corridor label). These constructed shapes are then used to determine the existence of linkages between adjacent remnants. Buffering using a 5m value produces a data set where all the remnants that are within 10m of each other are joined; thereby displaying potential corridors for organisms that are capable of moving a distance of 10m to jump (walk, run, fly etc.) from island remnant to island remnant. Clearly this approach has limitations and these are discussed below. Four scenarios were investigated depicting 10, 50, 100 and 500m corridors.

The study region contains approximately 2,700 discrete native vegetation remnants. These vary in size (up to 228 km^2), complexity (1 unique vegetation block to 134) and condition (from very degraded to very good). The ranking system adopted should be considered to be indicative of ecological value. The suggested system is based on provision of very basic information regarding individual remnant polygons in the context of historical and current vegetation status. It requires that each remnant be subdivided into its component vegetation complexes and that these units be measured in terms of area and vegetation condition. The algorithm used combines a number of meaningful ecological attributes. These include: remnant area, remnant diversity in terms of vegetation complexes, vegetation condition, remnant representativeness, scarcity and connectivity. The units for individual attributes vary in type (e.g. binary, continuous, discrete etc.) and in scale (e.g. area from <1 to >220 km^2, condition 1 – 4, etc.). Because of the discrepancies in type and scale between attributes, a standardisation must be included in the calculations to avoid bias in the output. However there are situations when bias may be sought (e.g. to gain insight into vegetation diversity) and the calculations allow interactive modification of weighting factors. Given the degree of complexity in the derivation of the value index, its use should be strictly controlled and the user should be weary of placing too great a reliance on the results of the calculations. The algorithm is the subject of ongoing research.

A remnant polygon's rank is obtained by passing coverage information from ArcView to an external programme. This programme derives the rank according to a set algorithm adjusted by parameters determined by the user. The values of these parameters include a standard set, as well as research sets, which may emphasise certain attributes over others (e.g. connectivity over condition). The standard set will provide the optimal handling of the input data to obtain relative scores. Research sets allow different scenarios to be interrogated.

The technique proceeds as follows:

STEP 1

Provide the external programme with the following coverage data and information:

DATA
- polygon ID,
- number of discrete VEG UNITS in the polygon,
- area of each such unit (in hectares),
- condition of each such unit.

(The above based on the nature of the inquiry)

INFORMATION
- value of Area weighting factor (integer)
- value of Veg Type weighting factor (integer)
- value of Veg condition weighting factor (integer)
- incorporation of CALM rare flora flag (binary)

(The above based on user input)

STEP 2

Obtain original context for the analysis.

STEP 3

Obtain current context for the analysis.
This step accesses the passed data to build a picture of the current state of remnant vegetation. It produces statistics detailing the average size, standard deviation and number of discrete remnant polygons and discrete vegetation units (classified by vegetation type). Total area occupied by vegetation (and types) is also calculated.

STEP 4

Derive polygon ranks.
A second scan through the data file combines the original and current contextual information, the weighting and flagging factors with individual polygons to produce a relative score for the polygon.

STEP 5

Calculate linear regression parameters (area vs rank) and produce standardised polygon ranks based on residuals.

STEP 6

Return ranks to ArcView.

STEP 7

Include CALM rare flora flag in final score.

STEP 8

Interactive interrogation of polygons (on screen maps, tables and figures) and production of paper copy.

Ecological Significance Equation

$$E = \log\left(Connect * Wt_0 * \sum_{i=1}^{j} \left(\frac{Extent}{TOTAL} * Cond * Wt_1 + \frac{Extent}{MEAN} + \frac{1}{NUMB} + \frac{Original}{TOTAL} * Wt_2\right) * \left(Area * Wt_3 + \frac{Complex}{Elements} * Wt_4\right)\right)$$

(over-riding flag CALM-DRF)

where:

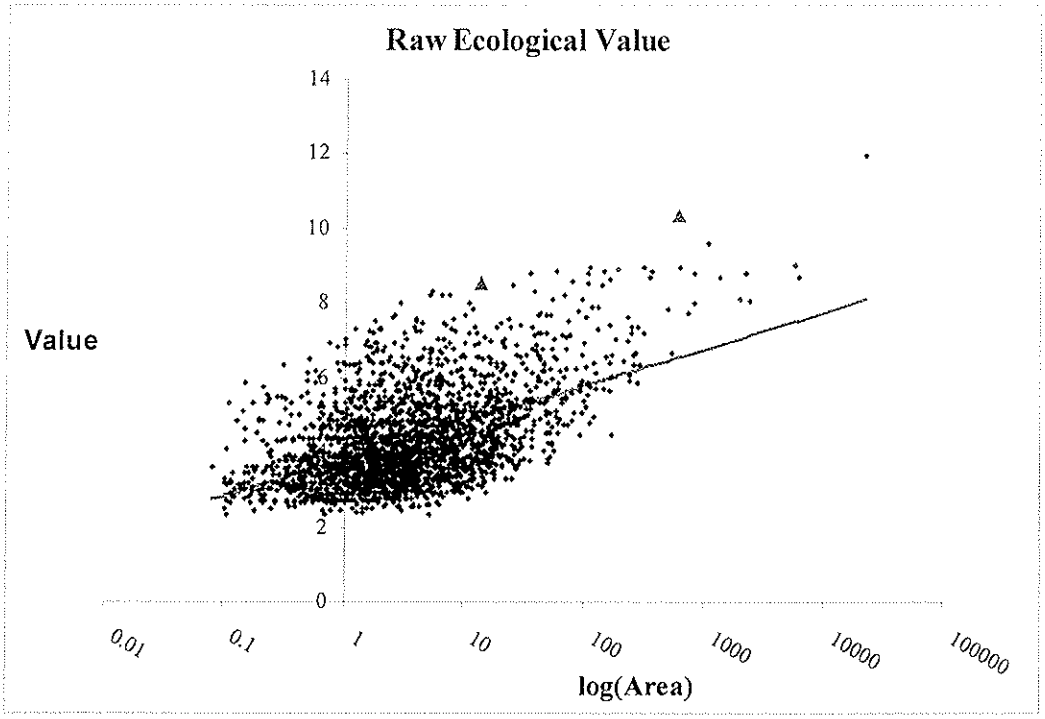
Area	=	the area of the remnant
Complex	=	the number of unique vegetation complexes (following this study) in the remnant
Condit	=	the ecological condition of the remnant (see Table 1)
Connect	=	a score for a remnant's connectivity (see methods for details)
Elements	=	the number of unique vegetation blocks (following this study) in the remnant
Extent	=	the area of the i'th vegetation complex block
i, j	=	j is the number of unique vegetation blocks making the remnant (equal to Elements above) i is unique vegetation block, I of j total blocks, in the remnant
MEAN	=	the average size of all vegetation blocks in the region of the same vegetation complex as i
NUMB	=	the number of vegetation blocks in the region of the same vegetation complex as i
Original	=	the original area occupied by the vegetation complex (i) prior to white settlement in the region
TOTAL	=	the total area of vegetation complex (i) remaining in the region

Wt0, Wt1, Wt2, Wt3, Wt4 = scaling terms for connectivity, condition, rarity, area, and complexity

Ecological Value Methodology

The equation used to calculate ecological value is complex because it must combine a number of different attributes in such a way that no one (or few) attributes contributes disproportionately to the final score. The equation includes scaling factors, which allow the user to investigate the relative impacts of changing the importance of attributes to the overall calculation (e.g. by weighting the corridor term the linkages between remnants is emphasised in the calculation.

Two scores are produced by the calculations. The first score is the Raw, or direct value, which is the output of the equation. The figure below shows the relationship between area and the raw ecological value for the remnants in the study area. Intuitively, the ecological value of a remnant is in part related to area. However larger remnants are more likely to contain rare flora, or possess a number of different vegetation types, or be part of a corridor. Thus the relationship is not strictly linear. The regression line shown on the figure assumes linearity and so the distance that a remnants raw ecological value is away from the predicted value for a remnant of equal size becomes a measure of unexpected value. This, the Standardised ecological value allow detection of remnants which though small, possess a combination of features which may warrant management action (eg to maintain a corridor, to preserve a particular vegetation type etc.)



The two measures of ecological value provide complementary insights into the status and composition of remnant vegetation in the study area.

APPENDIX 2

Vegetation Community Descriptions

SYSTEM 6 MAPPING

Dwellingup/Hester Complex (1)
Open forest in high rainfall zone.

Goonaping Complex (8)
Low open woodland and forest.

Abba Complex (30)
Tall open forest.

Guildford Complex (32)
Open to tall open forest and woodland.

Swan Complex (33)
Fringing woodland with localised occurrences of low open woodland.

Serpentine River Complex (35)
Closed scrub and fringing woodland.

Southern River Complex (42)
Open Woodland.

Bassendean Complex (44)
Woodland and low woodland with sedgelands.

Karrakatta Complex (49)
Open forest and woodland.

Quindalup Complex (55)
Coastal dune complex with low closed forest and closed scrub.

Yoongarillup Complex (56)
Woodland to tall woodland with open forest.

Vasse Complex (57)
Closed scrubland fringing woodlandand open forest.

Preston Complex (73)
Fringing woodland.

Jarrahwood Complex (74)
Open forest and woodland.

Cartis Complex (75)
Low open forest to open woodland.

RFA MAPPING

Abba (AB)
Woodland and open forest of *Corymbia calophylla* on flats and low rises in the humid zone.

Abba (Ad)
Woodland of *Corymbia calophylla-Agonis flexuosa-Allocasuarina fraseriana-Nuytsia floribunda* on mild slopes in the humid zone.

Abba (Adw)
Woodland of *Corymbia calophylla-Agonis flexuosa* on lower slopes and low woodland of *Melaleuca* spp. in depressions in the humid zone.

Abba (Af)
Open forest of *Corymbia calophylla-Agonis flexuosa-Acacia saligna* on lower slopes in the humid zone.

Abba (Aw)
Mosaic of tall shrubland of *Melaleuca viminea* and woodland of *Eucalyptus rudis-Melaleuca rhaphiophylla* with occasional *Corymbia calophylla* on broad depressions in the humid zone.

Blackwood (Bd)
Low open woodland of *Banksia attenuata-Nuytsia floribunda-Eucalyptus marginata* subsp. *marginata* on low dunes in the perhumid zone.

Balingup (BL)
Open forest of *Eucalyptus marginata* subsp. *marginata-Corymbia calophylla* on slopes and woodland of *Eucalyptus rudis* on the valley floor in the humid zone.

Balingup (BLf)
Woodland of *Eucalyptus rudis* on valley floors and woodland of *Eucalyptus patens-Corymbia calophylla* on footslopes with some *Eucalyptus marginata* subsp. *marginata* on lower slopes in the humid zone.

Cowaramup (C2)
Open forest of *Eucalyptus marginata* subsp. *marginata-Corymbia calophylla-Banksia grandis* on lateritic uplands in perhumid and humid zones.

Catterick (CC1)
Open forest of *Eucalyptus marginata* subsp. *marginata-Corymbia calophylla* mixed with *Eucalyptus patens* on slopes, *Eucalyptus rudis* and *Banksia littoralis* on valley floors in the humid zone.

Cowaramup (Cd)
Woodland of *Eucalyptus marginata* subsp. *marginata-Corymbia calophylla-Banksia ilicifolia* on sandy rises and low woodland of *Melaleuca preissiana* on lower slopes in the hyperhumid to humid zones.

Coate (CE)
Low open woodland of *Eucalyptus marginata* subsp. *marginata-Corymbia calophylla-Allocasuarina fraseriana-Banksia ilicifolia* and low open woodland of *Melaleuca preissiana-Banksia littoralis* on broad depressions in upper gullies in perhumid and humid zones.

Cartis (CSs)
Low open forest to open forest of *Eucalyptus marginata* subsp. *marginata-Corymbia calophylla-Corymbia haematoxylon* with some *Banksia attenuata* and *Xylomelum occidentale* on slopes of escarpment in the humid zone.

Cowaramup (Cw2)
Woodland of *Eucalyptus marginata* subsp. *marginata-Corymbia calophylla* on slopes and low woodland of *Melaleuca preissiana-24 Banksia littoralis* on depressions in perhumid and humid zones.

Donnybrook (DB3)
Open forest of *Eucalyptus marginata* subsp. *marginata-Corymbia calophylla-Agonis flexuosa* on slopes of the escarpment in the humid zone.

Darling Scarp (DS)
Mosaic of open forest of *Eucalyptus marginata* subsp. *marginata-Corymbia calophylla*, with some admixtures with *Eucalyptus laeliae* in the north (subhumid zone), with occasional *Eucalyptus marginata* subsp. *elegantella* (mainly in subhumid zone) and *Corymbia haematoxylon* in the south (humid zone) on deeper soils adjacent to outcrops, woodland of *Eucalyptus wandoo* (subhumid and semiarid zones), low woodland of *Allocasuarina huegeliana* on shallow soils over granite outcrops, closed heath of Myrtaceae-Proteaceae species and lithic complex on or near granite outcrops in all climate zones.

Grimwade (GR)
Tall open forest to open forest of *Corymbia calophylla-Eucalyptus marginata* subsp. *marginata* with *Eucalyptus patens* on slopes and *Eucalyptus rudis* over some *Agonis flexuosa* on lower slopes in the humid zone.

Hester (HR)
Tall open forest to open forest of *Eucalyptus marginata* subsp. *marginata-Corymbia calophylla* on lateritic uplands in perhumid and humid zones.

Jalbaragup (JL)
Open forest of *Eucalyptus marginata* subsp. *marginata-Corymbia calophylla-Eucalyptus patens* on slopes with some *Eucalyptus rudis* on broad terraces in perhumid and humid zones.

Kilcarnup (kBE)
Mosaic of coastal complex and closed heath of *Olearia axillaris-Pimelea ferruginea-Melaleuca huegelii* on exposed calcareous dunes on seaward slopes in hyperhumid to humid zones.

Kingia (KI)
Open forest of *Eucalyptus marginata* subsp. *marginata-Corymbia calophylla-Allocasuarina fraseriana-Banksia grandis-Xylomelum occidentale* on lateritic uplands in perhumid and humid zones.

Kilcarnup (Kr)
Tall shrubland of *Agonis flexuosa-Acacia saligna* on leeside of calcareous dunes in hyperhumid to humid zones.

Ludlow (Lw)
Open woodland of *Melaleuca rhaphiophylla* and sedgelands of Cyperaceae-Restionaceae spp. on broad depressions in the subhumid zone.

Metricup (M)
Woodland to open forest of *Eucalyptus marginata* subsp. *marginata-Corymbia calophylla* on escarpment in the humid zone.

Metricup (Mv)
Low woodland of *Eucalyptus marginata* subsp. *marginata* with some *Nuytsia floribunda* on deeply incised valleys in the humid zone.

Preston (PR)
Woodland of *Eucalyptus rudis-Agonis flexuosa-Banksia seminuda* along streams, open forest of *Corymbia calophylla-Eucalyptus patens* on slopes in the humid zone.

Quindalup (Qw)
Tall shrubland of *Acacia saligna-Agonis flexuosa* and open heath on depressions amongst recent dunes in the subhumid zone.

Queenwood (QW)
Open forest of *Eucalyptus marginata* subsp. *marginata-Corymbia calophylla* on slopes in the humid zone.

Rosa (RO)
Woodland to open forest of *Corymbia calophylla-Eucalyptus marginata* subsp. *marginata-Xylomelum occidentale* on slopes and tall shrubland of *Agonis linearifolia* in valley floors in the humid zone.

Treeton (T)
Woodland of *Eucalyptus marginata* subsp. *marginata-Corymbia calophylla* with some *Allocasuarina fraseriana* on mild slopes in the perhumid zone.

Treeton (Td)
Woodland of *Eucalyptus marginata* subsp. *marginata-Corymbia calophylla* on undulating sandy slopes in the perhumid zone.

Telerah (TL)
Low open woodland of *Eucalyptus marginata* subsp. *marginata-Corymbia calophylla-Allocasuarina fraseriana-Xylomelum occidentale-Banksia ilicifolia* on slopes in perhumid and humid zones.

Treeton (Tw)
Open forest of *Eucalyptus patens-Corymbia calophylla-Eucalyptus marginata* subsp. *marginata* on lower slopes and on floors of minor valleys in the perhumid zone.

Wilyabrup (W2)
Open forest of *Corymbia calophylla-Allocasuarina decussata-Agonis flexuosa* on deeply incised valleys in perhumid and humid zones.

Wilyabrup (Wd)
Woodland of *Eucalyptus marginata* subsp. *marginata-Corymbia calophylla* on slight rises on lower slopes in perhumid and humid zones.

Wilyabrup (Wr)
Woodland of *Corymbia calophylla-Eucalyptus marginata* subsp. *marginata* with closed heath of Myrtaceae-Proteaceae-Papilionaceae spp. on steep rocky slopes in the hyperhumid zone.

Wilyabrup (Ww2)
Tall open forest of *Corymbia calophylla-Agonis flexuosa* on flats and valleys in perhumid and humid ones.

Whicher Scarp (WC)
Open forest of *Eucalyptus marginata* subsp. *marginata-Corymbia calophylla* on escarpment with some *Corymbia haematoxylon*, *4 Banksia attenuata* and *Xylomelum occidentale* in the humid zone.

Whicher Scarp (WCv)
Open forest of *Eucalyptus marginata* subsp. *marginata-Corymbia calophylla* with some *Xylomelum occidentale* on valleys dissecting escarpment in the humid zone.

Wishart (WS2)
Tall open forest of *Eucalyptus marginata* subsp. *marginata-Corymbia calophylla-Banksia grandis* with some *Allocasuarina fraseriana* on lower escarpment in hyperhumid to humid zones.

Yelverton (Y)
Woodland of *Eucalyptus marginata* subsp. *marginata-Corymbia calophylla-Allocasuarina fraseriana-Agonis flexuosas*24 and open woodland of *Corymbia calophylla* on low undulating uplands in the humid zone.

Yelverton (Yd)
Woodland of *Allocasuarina fraseriana-Eucalyptus marginata* subsp. *marginata-Xylomelum occidentale-Banksia attenuata* on sandy slopes in the humid zone.

Yelverton (Yf)
Woodland of *Corymbia calophylla-Eucalyptus patens-Agonis flexuosa* on less undulating lower slopes in the humid zone.

Yelverton (Yw)
Woodland of *Allocasuarina fraseriana-Nuytsia floribunda-Agonis flexuosa-Banksia attenuata* on slopes and open forest of *Corymbia calophylla-Eucalyptus patens-Eucalyptus marginata* subsp. *marginata* on the lower slopes and woodland of *Eucalyptus rudis-Melaleuca rhaphiophylla* on valley floors in the humid zone.

APPENDIX 3

Declared Rare and Priority Flora -
Definitions, Codes and Species List

CONSERVATION CODES

R and/or T: Declared Rare Flora - Extant Taxa

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

X: Declared Rare Flora - Presumed Extinct Taxa

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

1: Priority One - Poorly known Taxa

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

2: Priority Two - Poorly Known Taxa

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

3: Priority Three - Poorly Known Taxa

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

4: Priority Four - Rare Taxa

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

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

ms - manuscript names.

These names have not been published and must be indicated as being manuscript names whenever used, either by the standard format of the addition of ms after the name, or the inclusion in inverted commas.

Declared Rare and Priority Flora in the Geographe Bay catchment.

SPECIES	No. of RECORDS	CONSERVATION CODE
Acacia flagelliformis	10	4
Acacia inops	5	3
Acacia mooreana	15	2
Acacia semitrullata	10	3
Acacia subracemosa	6	2
Acacia tayloriana	7	4
Actinotus sp.Walpole (J.R. Wheeler 3786) pn	2	3
Actinotus whicherae ms	2	2
Adenanthos detmoldii	9	4
Amperea protensa	2	2
Andersonia sp. Ironstone (B.J. Keighery & N.Gibson 227) pn	3	1
Anthotium junciforme	1	4
Aotus cordifolia	2	3
Aponogeton hexatepalus	22	4
Astroloma sp. Nannup (R.D. Royce 3978) pn	7	4
Banksia meisneri subsp. ascendens	28	4
Blennospora sp. Ruabon (B.J. Keighery & N.Gibson 20) pn	2	3
Boronia humifusa	1	1
Boronia tenuis	3	4
Bossiaea disticha	4	3
Brachysema modestum	1	T
Brachysema papilio	1	T
Caladenia busselliana ms	1	T
Caladenia caesarea subsp. maritima ms	2	T
Caladenia excelsa ms	10	T
Caladenia harringtoniae ms	5	T
Caladenia huegelii	4	T
Caladenia longicauda subsp. clivicola ms	4	1
Caladenia plicata	1	4
Caladenia speciosa ms	2	4
Caladenia viridescens ms	1	T
Calothamnus graniticus subsp. graniticus	2	4
Calothamnus pallidifolius	7	3
Calothamnus sp. Scott River (R.D. Royce 84) pn	3	2
Calothamnus sp. Whicher (B.J. Keighery & Gibson)	1	1
Carex tereticaulis	1	1
Caustis sp. Boyanup (G.S. McCutcheon 1706) pn	2	1
Chamelaucium erythrochlorum ms	4	4
Chamelaucium roycei ms	15	T
Chordifex gracilior	7	3
Chordifex jacksonii ms	2	1

Declared Rare and Priority Flora in the Geographe Bay catchment - cont.

SPECIES	No. of RECORDS	CONSERVATION CODE
Chorizandra multiarticulata	1	3
Chorizema carinatum	1	3
Chorizema reticulatum	1	3
Conospermum caeruleum subsp. contortum	1	1
Conospermum paniculatum	7	3
Conospermum quadripetalum	1	2
Cyathochaeta stipoides	3	3
Darwinia ferricola ms	7	T
Daviesia elongata subsp. elongata	3	T
Drosera marchantii subsp. marchantii	4	4
Dryandra mimica	1	T
Dryandra nivea subsp. uliginosa	6	T
Dryandra squarrosa subsp. argillacea	6	T
Grevillea brachystylis subsp. brachystylis	5	2
Grevillea cirsiifolia	1	4
Grevillea drummondii	1	4
Grevillea mccutcheonii ms	1	T
Hakea sp. Williamson (B.J. Keighery & N.Gibson 226) pn	3	1
Isopogon formosus subsp. dasylepis	1	3
Jacksonia sparsa ms	3	3
Jansonia formosa	2	3
Kennedia macrophylla	1	T
Lambertia orbifolia	6	T
Lambertia rariflora subsp. rariflora	3	4
Lepyrodia heleocharoides	7	3
Leucopogon gilbertii	5	3
Loxocarya magna	7	3
Melaleuca basicephala	5	4
Melaleuca incana subsp.Gingilup	1	2
Meziella trifida	3	T
Mitreola minima	1	2
Myriophyllum echinatum	3	3
Philydrella pygmaea subsp. minima	1	1
Pterostylis turfosa	1	1
Pultenaea radiata	13	3
Pultenaea skinneri	10	4
Reedia spathacea	5	4
Restio isomorphus	3	2
Rhodanthe pyrethrum	3	3
Schoenus benthamii	1	3
Schoenus loliaceus	2	2
Schoenus natans	21	4
Sphenotoma parviflorum	11	3
Sporadanthus rivularis ms	11	3
Stylidium barleei	9	3
Stylidium leeuwinense	4	3

Declared Rare and Priority Flora in the Geographe Bay catchment - cont.

SPECIES	No. of RECORDS	CONSERVATION CODE
Stylidium mimeticum	3	3
Stylidium rigidifolium	1	2
Synaphea whicherensis	5	3
Thomasia laxiflora	5	1
Thysanotus glaucus	3	4
Trichocline sp. Treeton (B.J. Keighery & N.Gibson 564) pn	2	2
Tripterococcus brachylobus ms	3	4
Tripterococcus sp. Cannington (A.S. George 16201) pn	1	1
Tyrbastes glaucescens	15	4
Verticordia attenuata	10	3
Verticordia densiflora var. pedunculata	4	T
Verticordia lehmannii	5	4
Verticordia plumosa var. ananeotes	2	T
Verticordia plumosa var. vassensis	11	T

APPENDIX 4

LIST OF CONTRIBUTORS

The Steering Committee

Manfred Boldy	Shire of Augusta-Margaret River
Charles Broadbent	Department of Conservation and Land Management
Ted Coulter	South-West Private Property Action Group
Jack Guthrie	Geographe Catchment Council
Cherie Kemp	Land for Wildlife
Bernie Masters	Geographe Bay Advisory Committee
Warwick Rowell	Yallingup Land Conservation District Committee
Cr Bill Shephard	Shire of Augusta-Margaret River
Claire Thorstensen	Geographe Catchment Council
Michael Tichbon	Capel Land Conservation District Committee
Peter Warrilow	Cape to Cape Alliance
Kirrily White	Shire of Busselton
Peter Wren	Lower Blackwood Land Conservation District Committee
Eric Wright	Agriculture Western Australia
Former Members:	Carolyn Switzer (Geographe Catchment Council)
	Sasha Taylor (Cape to Cape Alliance)
	John Wroth (Shire of Busselton)

Workshop Participants

Sheila Bligh
Tom Busby
Jim Challis
Noel Conway
Ted Coulter
Trevor Dennis
Peter Eckersley
Joy Ensor
Genevieve Hanran-Smith
Pat Hatfield
Peter Lane
Suzanne Little
Trevor McDonald
Jen Mitchell
Mal Mortimer
Warwick Rowell
Ken Sharpe
Ann Smith
Alan Standring
Sasha Taylor
Peter Warrilow
Dave Wren
Peter Wren
Barry Young

Evelyn Brand
Cheryl Campbell
Sarah Comer
Peggy Cooper
Gordon Cuthbert
Isabelle Devoy
Ray Ellis
Barry Godley
Bethwyn Hastie
Gwyn Hitchin
Kay Lehman
Bernie Masters
Gary McMahon
Lyn Moorfoot
Neil Pemberton-Ovens
Tony Saw
Bill Shephard
Brian Smith
Carolyn Switzer
Michael Tichbon
Margaret Watson
Manya Wren
John Wroth

PUBLIC PRESENTATIONS

SATURDAY, 3 JULY 1999, Council Chambers, Town View Terrace, Margaret River

Remnant Vegetation - What's left in the Shire of Augusta-Margaret River?
Dr Stephen Connell (Edith Cowan University)
Funding Opportunities for Remnant Vegetation Retention and Management.
Gary McMahon (Bushcare)
Covenants – Legal Mechanisms for Voluntary Remnant Vegetation Protection.
Tom Perrigo (National Trust)
Community Purchase and Management of Remnant Vegetation in the Shire of Kojonup– a Case Study.
Margaret Robertson (Australian Bush Heritage Fund)
Remnant Vegetation and Fire Management.
Neil Pemberton-Ovens (Greening Western Australia)
Protecting Roadside Vegetation to Conserve Biodiversity.
David Lamont (Roadside Conservation Committee)

SUNDAY, 4 JULY 1999, Karridale Hall, Karridale

Remnant Vegetation - What's left in the Shire of Augusta-Margaret River?
Miles Ebert (Edith Cowan University)
Financial Rewards in Conserving Roadside Vegetation.
David Lamont (Roadside Conservation Committee)
Covenants – Legal Mechanisms for Voluntary Remnant Vegetation Protection.
Tom Perrigo (National Trust)
Remnant Bushland on Farms – Do We Need It?
Neil Pemberton-Ovens (Greening Western Australia)
Remnant Bushland and Eco-Tourism.
Denis Norris (Cape to Cape Tours)

SATURDAY, 17 JULY 1999, St. Mary's Family Centre, Cnr Albert St. & Bussell Hwy, Busselton

Remnant Vegetation - What's left in the Geographe Catchment?
Dr Stephen Connell (Edith Cowan University).
Keeping the Bush – Is it worth it? *[TBC]*
Penny Hussey (Land for Wildlife, CALM)
Covenants – Legal Mechanisms for Voluntary Remnant Vegetation Protection.
Tom Perrigo (National Trust).
Local Government Perspective on Conservation Incentives.
Tim Shingles (Shire of Busselton)

APPENDIX 5

Community Consultation Outcomes

Remnant Vegetation Values Identified by the Community

ENVIRONMENTAL VALUES

- Conservation Value: Biodiversity, species yet to be identified, unique plants (e.g. grass trees).
- Habitat and Corridor Value (tree hollows, leaf litter, food sources, genetic diversity).
- Revegetation / Regeneration Value (e.g. seed stores).
- Unexpected Values (i.e. some 'weed' infestations may now serve as wildlife habitats).
- Climate Value: Countering the Enhanced Greenhouse Effect.

SOCIAL VALUES

- 'Common or Public Good' Value (individual properties are part of that), sharing of resources (e.g. knowledge of plants and management).
- Heritage Value: Significant European and Aboriginal sites (sacred sites, place names, old settlements and reserves, Quokka fence remnants, landmark trees; coach routes, plant uses, bush tucker). Oral history and local knowledge. Inheritance for future generations.
- Personal Value: Family or personal history values.
- Spiritual Value: Native bushland is "good for the soul". Inherent value - sacred.
- Sense of place (mosaic of land uses specific to an area), visual amenity.

ECONOMIC VALUES

- Landscape Value: Visual amenity - influences the overall perception of a region (e.g. Shire of Capel slogan "The Natural Choice"). Bush defines local character and identity, distinguishing one region from another. Attracts visitors and new residents.
- Real Estate Value: Good quality native bushland on farm = higher real estate value.
- Potential Future Value: Medicinal uses, eco-tourism attraction, use of native bush for commercial ventures.
- Sustainable Land Use Value: Maintenance of healthy soils, flood and erosion prevention, salinity control, nutrient filtering, water quality and conservation. Enhances farm productivity and quality of products, e.g. through shelter belts, predation of farm pests by native animals, pollination by insects, reduction of local temperature variations.
- Community Value: Education, property owners who manage private bushland (i.e. fire management, fox baiting).

Issues of Concern Identified by the Community

Values, Attitudes and Fears

The concerns in this group include:

- Different people have different values for remnant vegetation (e.g. degree and type of use, biodiversity reserve or fire hazard management). Impacts of changes to the social environment of the area may lead to divisions among residents (e.g. long-term –v- new residents, traditional –v- alternative farming methods).
- Attitudes towards native vegetation such as taking natural bushland for granted, private uses encroaching on reserves and being disrespectful towards our natural heritage; and
- Some residents are believed to fear that changes in community perceptions will result in government or community interference in managing remnant vegetation on private land.

Economics

This group includes concerns regarding:

- The economic pressures to clear native vegetation and put the land to a more productive but often only short-term use;
- Land degradation due to mining activities, excessive tourism and recreational use as well as commercial activities of government agencies; and
- The loss of economic potential of a property due to clearing restrictions.

Clearing for Development

This heading summarises a range of issues related to the continued clearing of native vegetation, such as:

- Clearing to allow urban expansion, industrial development, farm subdivisions and agricultural purposes such as vineyards and intensive horticulture.
- Land and wetland degradation as a result of badly designed and executed urban development.
- Clearing to allow various mining activities.

Planning

Planning policies and decisions were heavily criticised. They were perceived as being inadequate as the long-term environmental consequences of planning decisions do not appear to be considered. Of particular concern were:

- The fragmentation of existing vegetation communities and corridors;
- The environmental impacts of recreational activities and facilities such as golf courses as well as those resulting from the presence of an increasing urban population with domestic animals, exotic garden plants and a variety of polluting substances and road construction techniques;
- The lack of local input into the Planning Department's decision making process, particularly regarding new subdivisions;
- The lack of consideration for the long-term integrity and health (ecological viability) of remnant vegetation.

Lack of Awareness

This heading refers to people's general lack of awareness of the values of remnant vegetation and the environmental consequences of their own actions. Issues characterised by this lack of awareness are:

- Biodiversity conservation;
- Tourism and recreational over-use leading to land degradation;
- Rubbish dumping;
- Spread of dieback and other pathogens;
- Firewood collection; and
- Traditional farming practices.

Lack of Knowledge

The general lack of knowledge identified through the workshops is of particular concern in these areas:

- How to manage remnant vegetation (guidelines and techniques);
- Ecological assumptions (e.g. if it's native bush it has to be burned);
- Loss of local knowledge when people (residents and agency staff) leave the area;
- Changes in groundwater tables due to clearing or replanting; and
- Access to relevant information is often difficult.

Introduced Species

Concerns regarding the presence of stock, feral animals (rabbits, cats, foxes and pigs), weeds, pests (e.g. insects) and diseases (e.g. dieback) in remnant vegetation were included in this grouping. Additional concerns were identified as follows:

- Habitat modifications favouring feral animals or weeds, and impacts of control methods;
- Plants commonly planted in gardens (e.g. palms) becoming weeds that invade remnant vegetation;
- Illicit drug crops; and
- Native animals now occurring in areas where they were previously unknown (e.g. kangaroos in the Tuart Forest).

Current Management (General)

This section includes the most commonly raised concerns about current remnant vegetation management, both on private and Crown land.

- A general lack of state and local government accountability for public land management. Inflexible, inconsistent and uncoordinated management methods resulting in management gaps. A general "roadside vegetation slashing policy", which prevents native vegetation from establishing and allows weeds to take over.
- Agency staffing: short-term agency contractors take their knowledge and expertise with them when they leave. A new contractor may use different methods and management continuity is compromised. No local agency representation means staff are removed from the community and its values and have little local knowledge.
- Increasing management regulation or Government intervention could ultimately result in poorer management practices.
- Farming practices (e.g. active and passive clearing, dam construction, intensive water use, overgrazing, over-use of chemicals, timber plantations).
- Other issues such as dieback, traffic hazards posed by dense roadside vegetation, recreational activities, illicit drug crops (clearing, rubbish, weeds, etc.), lack of long-term impact assessment.

Current Fire Management

This was identified as a complex issue. Fire, intentionally lit or not, is a selective process that destroys some species and encourages others. There is a distinct lack of fire management information and an urgent requirement for public education. Are the current practices, burning regimes and legislation appropriate or not?

Lack of Financial Assistance and Incentives

Private landowners are unpaid custodians or stewards of the land. In addition to rates payable on land that does not generate a direct income, landowners incur high management costs (e.g. for fencing, weed control, bait and time). A low cost economic environment is required to allow landowners to survive AND retain native vegetation.

- There are not enough incentives (e.g. rate reductions) to retain remnant vegetation. The current system provides disincentives rather than support.
- Funding for the present study and for public education in general is lacking.
- Is the retention of remnant vegetation on private properties the responsibility of individual landowners or of the entire community? If it is a community issue, then the community should help fund the cost of retaining and managing the remnants.

Management Responses identified through the Workshops

Education

A public or community education campaign regarding the many aspects and values of remnant vegetation and to increase awareness of the long-term ramifications of actions taken today is urgently required. While children should be a major focus of any campaign, farmers, industry and government agency staff also need to be targeted. Industry groups such as nurseries need to be made aware that they bear an ASSOCIATE RESPONSIBILITY for weed invasions as they continue to sell recognised weeds. Seminars and publications should cover the values and ecological functions of native remnant vegetation, the degradation consequences of actions such as rubbish dumping, recreational activities and over-application of chemicals, environmental best practice and codes of conduct, available expertise and funding sources for environmental projects. Specific public education recommendations made through the workshops include

- The development of a Bushland Manager's Self-Assessment Tool containing a checklist of the resources and skills required to successfully manage remnant vegetation, with information on where or how to obtain the resources and skills that are lacking. Such a self-assessment tool could also contain a table with information on Priority Bushland Management Actions.
- Develop a Land Management Pack (modelled on the Shire of Augusta-Margaret River Health Promotion Committees' 'Welcome Pack').
- Establish a database of general and local knowledge and expertise (central, continuously maintained, user friendly, accessible, with Internet access) as well as updates on the latest Government legislation, acts, regulations and restrictions.
- Initiate a Mentor Scheme, through which local, long-term landowners and managers can share their experience and expertise with, and give advice to, new residents.
- Select farms with well managed remnant vegetation as demonstration sites and publish case studies.
- Place signage on roadsides and publicise environmental projects under way in the region.
- Record oral history and recollections of the environment in the region.

Research and Innovation

Funding should be sought to research and trial alternative management methods, particularly in regards to fire and weed management. Such research could be carried out in the form of cooperative ventures between educational institutions, government agencies and community groups. In many cases this may have to be preceded by an "inventory" - cataloguing the species present at a particular site. Specific research and innovation recommendations made through the workshops include

- The development of economic models that more accurately reflect the value of remnant vegetation in agricultural and tourism related businesses.
- Possible schemes to allow the community to share remnant vegetation management costs and labour with private landholders.
- Government agencies should inventory and assess all reserves vested in them and rate these reserves according to importance. Reserve management plans should then be discussed with the local community and community groups. Joined Shire and community or 'Friends of' groups could manage the reserves.
- Recreational usage of remnant vegetation should be controlled more stringently.
- A regional coordinator should be employed for the management of weeds on private and Crown land.

Legal Mechanisms

The protection of remnant vegetation on private land can be achieved at federal, state and local government level, community level and individual property owner level.

FEDERAL, STATE AND LOCAL GOVERNMENT LEVEL:

- Increased funding for the retention of remnant vegetation or 'Custodian Payments' to landholders who manage and maintain remnant vegetation on their property.
- Landcare and remnant vegetation management costs to be tax deductible.
- Donations given for Landcare purposes to be fully tax deductible.
- District Planning Schemes to incorporate protection of vegetation, e.g. conservation zones.
- Planning processes to incorporate environmental considerations, e.g. when assessing development applications consider corridor retention / establishment.
- Rate reductions for areas of retained bushland, e.g. differential rating to reward retention of remnant vegetation.
- Establish tradeable Carbon Credits - not just for new plantations, but to include retention of remnant vegetation as well.

Community Level:

- Levies on the general community to fund the protection of remnant vegetation in an area. If the community as a whole puts value on remnant vegetation, they should contribute towards its management.
- Forming a genuine community body with the aim of raising and administering funds to purchase and manage land with remnant vegetation (Community Land Trust).

Individual Property Owner Level:

- Landholders can place voluntary covenants on all or part of their properties to protect remnant vegetation and revegetated areas, possibly in conjunction with District Planning Scheme conservation zones or Heritage Agreements.
- Once available, trade Carbon Credits with industry (e.g. BHP) for revegetation and retention of remnant vegetation.

APPENDIX 6

BUSHLAND MANAGER'S SELF-ASSESSMENT TOOLS - EXAMPLES

Bushland Manager's Self-Assessment Tool

Example 1

Checklist of the resources and skills required to successfully manage remnant vegetation:

PRIORITY	Management Action	Resource / Skill	Available on-farm / locally	Not available: see Directory on page .....)
1	Fencing	Identify correct position		
		Materials		
		Labour		
2	Weed Control	Identify weeds		
		Identify management tool and its application		
		Materials		
		Labour		
3	Feral Animal Control	Identify presence and type of animals		
		Identify control tool and its application		
		Materials		
		Labour		
4	Stock Access			
5	Native Flora M'ment			
6	Native Fauna M'ment			
7	Fire Management			
8	Disease Management			
9	Monitoring			
10				

Bushland Manager's Self-Assessment Tool

Example 2

Priority Bushland Management Activities - YEAR 1

	Management Purpose:	Conservation	Heritage	Economic	Recreation	Farm Sustainability
Priority	**Management Activities**					
1	Fencing	××××				
	Assess Remnant Health					
	Weed Control					
	Stock Control					
	Fire Management					
	Disease Management					
	Access Management					
	Monitoring: Observations	×				
	Monitoring: Floristics					
	Monitoring: Fauna Counts					

Key:

×××× Requires maximum time and resources
××× Requires medium time and resources
×× Requires minimum time and resources
× Requires no additional time and resources.

APPENDIX 7

EVALUATION TABLE

Evaluation Table

ISSUE: _____

Aim / What you want to achieve	Activity / The best way to achieve it	How do we know it's working?

APPENDIX 8

GIS DATA SET DESCRIPTIONS

Remnant Vegetation GIS Themes and Attributes

Theme 1. - GREMVEG

The main remnant vegetation theme. Most other themes and tables draw upon or are linked to this theme. The important linkage field is GREMVEG#. Within Arcview, ths field must be used to link tables (eg corridor or Vegetation type tables).

Fields:

Area – remnant area (sq m)
Perimeter – remnant perimeter (m)
Gremveg# - unique identifier
Gremveg-ID – unique identifier
Cond – eological condition
Tenure – tenure as provided by MFP

Theme 2. - VALLRFA

The main remnant vegetation complexes theme.It represents a union of System 6 mapping (as provided by DEP) and RFA mapping (as provided by CALM).

Fields:

Area – remnant area (sq m)
Perimeter – remnant perimeter (m)
Vallrfa# - unique identifier
Vallrfa-ID – unique identifier
Vegclass – vegetation type, numbers indicate System 6 mapping while string codes indicate RFA mapping

Theme 3. – NEWDRF (shape file)

Declared Rare and Priority flora distribution theme (base on data provided by CALM)

Fields:

NEWDRF-ID – series identifier to use with the table below

Table 1. DRFJOIN.TXT

An ascii table which provide species name and conservation code fields to NEWDRF (shape) theme.

Fields:

Species – species name
Spsnum – identifier to link to NEWDRF
Level – the conservation code for the species

Table 2. C5.TXT - 10metre Corridor information

An ascii file which contains the corridor information for linking to GREMVEG.

Fields:

GREMVEG# - unique identifier for linkage
C5# - corridor identifier. All remnants with the same number belong to the same corridor

Table 3. C25.TXT - 50metre Corridor information

An ascii file which contains the corridor information for linking to GREMVEG

Fields:

GREMVEG# - unique identifier for linkage
C25# - corridor identifier. All remnants with the same number belong to the same corridor

Table 4. C50.TXT - 100metre Corridor information

An ascii file which contains the corridor information for linking to GREMVEG.

Fields:

GREMVEG# - unique identifier for linkage
C50# - corridor identifier. All remnants with the same number belong to the same corridor

Table 5. C250.TXT - 500metre Corridor information

An ascii file which contains the corridor information for linking to GREMVEG.

Fields:

GREMVEG# - unique identifier for linkage
C250# - corridor identifier. All remnants with the same number belong to the same corridor

Table 6. EASY.TXT - ecological value results

An ascii file which contains ecological value data to link with GREMVEG.

Fields:

Gremveg# - linking field
Raw – raw ecological value
Standard – standardised ecological value