BUSH AND BIODIVERSITY

A Preliminary Assessment of Biodiversity Values in the South West Catchments Natural Resource Management Region

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November 2000

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Acknowledgments

This report is a compilation and analysis of data from diverse sources. We thank the many people who assisted by supplying data and providing advice. In particular, we thank Ken Atkins and Michael Meffert (CALM Wildlife Conservation Section) for their assistance in identifying rare and priority plant species in the study area, John Blyth, Val English and Sheila Hamilton Brown (WA Threatened Species & Communities Unit, CALM) for supplying information about Threatened Ecological Communities in the study area, Kim Williams (CALM Central Forest Region) for threatened fauna mapping and general advice, and Mark Cowan (Western Australian Museum) for supplying records of fauna occurring in the study area. We also thank Chris Portlock (CALM Central Forest Region) for his assistance in managing the project. CALM staff from the Central Forest and Wheatbelt Regions and Dr Geoff Stoneman, Sustainable Forest Management Division, made helpful comments on an earlier draft of this report. And Stefano Mazzilli (CALMScience Division) prepared some of the data sets that we used for this project, and assisted with the data analyses. Finally, we thank Greg Beeston (Agriculture WA Spatial Resource Information Group) for his continuing support for our work.

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Summary

This report presents the results of a preliminary assessment of the biodiversity values of the South West Catchments Natural Resource Management (NRM) Region. The Region includes six major catchments in the south west of Western Australia: Peel-Harvey, Leschenault, Geocatch, Cape to Cape, Warren and Blackwood, a total area of 514,507 ha. This study was commissioned by the South West Catchments Council as a precursor to the development of a Natural Resource Management Strategy for the Region. The study was conducted under constraints of time and money and should, therefore, be regarded as a preliminary assessment only.

The biodiversity assessment involved a compilation of spatial data sets and an analysis of those data sets in a GIS environment. Lists of fauna, rare flora and threatened ecological communities were compiled from available data.

The study found that one hundred and sixteen vegetation associations (mapped at the 1:250,000 scale) were originally present in the South West Catchments NRM Region. Ten vegetation associations have ≤10% of their original areal extent remaining, including one that is apparently extinct. A further 33 associations have only 10-30% remaining. Fifty-eight of the 116 vegetation associations are limited in distribution, with ≤2000 hectares remaining.

The reservation status of the vegetation associations was assessed. Twenty vegetation associations are completely unrepresented in any CALM-managed lands in the South West Catchments NRM Region. Five of these are also unrepresented in CALM-managed lands anywhere in the South West Agricultural Region. An additional 38 vegetation associations are poorly reserved, with >0% but less than 15% of their pre-European extent in CALM-managed lands in the NRM Region, of which 33 are also poorly represented in CALM-managed lands in the whole South West Agricultural Region.

Fifty-one vegetation associations are not represented in conservation reserves that fall into IUCN Reserve Categories I – IV and that occur in the South West Catchments NRM Region. Thirty-three of these are also unrepresented in conservation reserves in IUCN Categories I-IV in the whole South West Agricultural Region. An additional 16 vegetation associations are poorly reserved, with >0% but <15% of their pre-European extent in IUCN I – IV conservation reserves in the NRM Region; all of these are poorly reserved in the whole South West Agricultural Region. Some additional vegetation associations are not included in the above analysis as they are within the area covered by the Regional Forest Agreement (RFA) and so have been dealt with through the RFA process.

The data on extent remaining and conservation status were amalgamated to produce a list of vegetation associations that should be given priority for a more detailed assessment prior to instituting conservation management programs. Forty-three vegetation associations are both of limited extent, and are either not reserved or are poorly represented in the conservation reserve system. These vegetation associations should be the subjects of detailed, on-ground survey.

The fauna and flora of the Region was also investigated. Three hundred and twenty-nine known species of Rare and Priority Flora occur in the South West Catchments NRM Region. The Region also has a rich fauna: 46 known species of terrestrial mammals, 137 species of reptiles and amphibians, and 376 species of birds are listed in this report. Although the fauna and flora lists are comprehensive, it is likely that

they are not complete as there was not sufficient time to consult all available documentary sources. The most up-to-date information on the conservation status of each species, and some initial mapping of habitats of special significance for fauna, are also included here.

The South West Catchments NRM Region contains 23 Threatened Ecological Communities (TECs), according to the TECs database being developed by the Department of Conservation and Land Management. These include entities such as floristic communities, invertebrate communities restricted to root mats in caves and microbial communities forming stromatolites and related structures. It is highly probable that additional TECs will be identified with further survey.

The data sets brought together for this project have been compiled on a CD ROM which can be used for on-going planning and management within the Region. In particular, the data can be interrogated to provide assessments at the individual catchment level.

The South West Catchments NRM Region is a very important part of the State from a nature conservation point of view. This preliminary assessment has highlighted some of the special values, including some areas that should be given priority for management to protect those values. We recommend the on-going development of these data sets and their use in the planning and management of the South West Catchments NRM Region.

1. General Introduction – Biodiversity in the South West Catchments NRM Region

The South West Botanical Province of Western Australia is described as a centre of megadiversity on a global scale due to the exceptionally high number of species and high rate of endemism of its flora, and some aspects of the fauna (*eg.* Myers 1988). The remarkable richness, degree of speciation and endemism in the flora of the area has been attributed to a range of factors including (Hopper *et al.* 1996 and papers therein):

- the history of the evolution of the Western Shield first as a part of Pangea and then as the last part of Gondwana to separate off from the Antarctic continent about 65M years ago;
- the complete absence of glaciation over the past 200 m years, so that the biota has evolved *in situ* in parallel with the landscape weathering processes since that time;
- the absence of significant volcanism or mountain-building events, so that the soils and landscapes have evolved with erosion and weathering as the dominant processes. The particular processes of weathering that have occurred have resulted in the deep lateritic soil profiles with nutrient-poor soils that that are prevalent throughout the south west today;
- the climatic changes that the landscape has experienced, especially over the past 5M years, that have lead to a change from a predominantly mesic (rainforest) biota to predominantly sclerophyllous vegetation and associated semi-arid biota, while the major flucutuations in rainfall have caused the biota to migrate in a concertina-like fashion, into and out from the south west corner.

Within the vascular flora, more than 7000 species have been described in almost 140 families and almost 700 genera, and many more remain to be described. Woody and herbaceous perennials in families such as the Myrtaceae, Proteaceae, Fabaceae, Mimosaceae, Epacridaceae, Orchidaceae, and Restionaceae dominate. The rate of endemism has been estimated at up to 79% (Beard *et al.* in press).

The South West Catchments Natural Resource Management Region encompasses a large part of this megadiversity hot-spot. The Region includes part of the Swan Coastal Plain, part of the South Coast with its associated dune fields, native forests of jarrah, marri, karri and tuart and various mixes of these, as well as a large part of the wheatbelt, formerly supporting extensive woodlands but now substantially cleared. The area has a rich biota, although some elements have declined over the last 100 years or so, largely through loss, degradation and fragmentation of habitat due to clearing and grazing, predation by foxes and feral cats and alterations to fire regimes. It is probable too that the dieback fungus *Phytophthora cinnamomi* has had a severe impact on nature conservation values, but this is not well documented. The decline of the biota is expected to continue, exacerbated by the additional pressures of rising groundwaters and salinisation.

It is in the context of concern about the biota of the Region, and the need to develop a Natural Resource Management Strategy for the Region, that the South West Catchments Council requested this assessment. The study was conducted under constraints of time and money, and should therefore be regarded as a preliminary assessment only.

It should be noted that a substantial part of the South West Catchments NRM Region is forested land that has recently been assessed comprehensively through the Regional Forest Agreement Process (CoA&SoWA 1999). It is not the intention of this study to undermine the work of the Western Australian RFA; rather the intention is to provide a whole-of-catchments assessment using common data sets and a standardised approach as the starting point for further work in the catchments. The South West Catchments Council may well chose to incorporate the results of the Comprehensive Regional Assessment in its Natural Resource Management Strategy at some future time.

2. Methodology

2.1 The data sets

The project drew on a number of data sets, which are outlined below:

Pre-European Vegetation Type and Extent
The vegetation map database for Western Australia developed over the past 14 years is described in Hopkins *et al.* (1996), Hopkins *et al.* (in press), and Beard *et al.* (in press). In summary, the data set is based on the 1:250,000 scale mapping by J.S. Beard for the State, except the south west corner which was mapped by A.J.M. Hopkins in 1998/99. The primary vegetation units are vegetation associations *sensu* Beard and Webb (1974), but are equivalent to the sub-associations of the National Vegetation Information System (ERIN 1999). The individual polygons of each vegetation association have been captured digitally and attributed with data characterising the vegetation. The database of spatial information and tabular data can be interrogated in a Geographic Information System (GIS) environment.

Remnant Vegetation Type and Extent
Since European settlement, much of the original vegetation of the south west of Western Australia has been cleared for agriculture, resulting in a loss of biodiversity. Within the Agricultural Region, most of the native vegetation now exists only as isolated remnants, many of which occur on privately-owned land. A spatial database of present vegetation extent in the South West is currently being developed for National Land and Water Resources Audit project DAW27 (Land-use and vegetation mapping: Western Australia). The data set builds on the work done for the Australian Land Cover Change Project (Barson *et al.* 1999) using the recent aerial photo coverage converted to digital orthophoto coverage (Beeston, Hopkins and Shepherd in preparation). The polygons of remnant vegetation are attributed with vegetation type data derived from the pre-European vegetation map coverage described above.

South West Catchment Boundaries
South West Catchment boundaries shape files were provided by the Water and Rivers Commission. Staff at the Spatial Resource Information Group at Agriculture WA then prepared these boundaries for GIS analyses. Catchment boundaries included in this data set are those of the Warren, Blackwood, Leschenault, Cape to Cape, Geocatch and Peel-Harvey caychments.

Conservation Estate
The Department of Conservation and Land Management holds an up-to-date set of cadastral data for all lands and waters managed by the Department (see Bowen 1995). The cadastral data are attributed with information on classification, vesting and purpose. Each parcel of land can thereby be assigned an IUCN Protected Area Management Category (IUCN 1994), which reflects the type of the reserve and its purpose with respect to nature conservation.

The part of the study area that overlaps the Regional Forest Agreement (RFA) area contains a number of yet-to-be-implemented conservation reserve proposals. These are formally committed-to by the Western Australian Government through the RFA. The set of reserve cadasta used for this project is that agreed to under the RFA with the individual parcels of land classified as if the RFA had been fully implemented. Those parcels of land that are designated to become Forest Conservation Zones under section 62 of the Conservation and Land Management Act 1984 have been

categorised as IUCN Category IV: Habitat/species Management Area - protected areas managed mainly for conservation through management intervention.

Declared Rare and Priority Flora

Records of Declared Rare and Priority Flora were obtained from a database maintained by the Department of Conservation and Land Management (Dr Ken Atkins, personal communication 2000).

Fauna

The majority of the fauna records are taken from a database of fauna maintained by the Western Australian Museum (Mark Cowan, personal communication 2000). The list of fauna was cross-checked with fauna lists from Grein (1995), Weaving (1998) and Weaving (1999).

Threatened Ecological Communities

An ecological community is defined as "a naturally occurring biological assemblage that occurs in a particular type of habitat" (English and Blyth 1997, 1999). Ecosystems and their biological component, ecological communities, are now widely recognised as integral parts of biodiversity and deserving of similar conservation standards to those applied to the conservation of species of plants and animals. The Department of CALM has identified a number of ecological communities in Western Australia that are subject to threatening processes that may destroy or significantly modify the communities. Although there is no provision for the protection of threatened communities under present State legislation, CALM keeps a database of threatened ecological communities (TECs), which have been rigorously assessed and identified as either 'presumed totally destroyed', 'critically endangered', 'endangered', 'vulnerable', 'data deficient' or 'lower risk' (English and Blyth 1997, 1999). Threatened Ecological Communities are included within the Commonwealth Environmental Protection and Biodiversity Conservation Act 1999.

2.2 Analyses

Vegetation

The vegetation types and extent, and CALM-managed lands data are held as vector data, feature coded and attributed to a database within a GIS Environment (MGE) at Agriculture Western Australia. In order to facilitate large-scale analyses, some data were converted to raster format at a resolution of one hectare.

Raster layers were created for several themes. These are pre-European vegetation, present vegetation extent and CALM-managed estate. These themes were overlaid and intersected in pairs, using the Modular GIS Grid Analyst (MGA) module of MGE. Reports were generated directly from these overlays. The data from these reports were imported to a spreadsheet program for further sorting and computation.

The vegetation associations found in the South West Catchments Region prior to European settlement were determined by intersecting Pre-European vegatation with the catchment boundaries. The remnant vegetation database was intersected with the results of the first analysis to determine the present extent of the vegetation types in the Region. The current vegetation associations in the Region were intersected with cadastral data of the CALM-managed estate to determine the conservation status of each association.

Other data sets were maintained in vector format. These are rare flora sites, threatened ecological community sites and catchment boundaries. These data sets were analysed using Intergraph Geomedia and reports were generated as for the raster data sets.

Vegetation criteria

For the purposes of this preliminary assessment, we have use the native vegetation clearing criteria recently adopted by the Western Australian Environmental Protection Authority (EPA 2000), and drawn from the Australian and New Zealand Environment and Conservation Council's *National Framework for thje Management and Monitoring of Australia's Native Vegetation* (ANZEEC 2000):

> From a purely biodiversity perspective and taking no account of any other land degradation issues, there are several key criteria now being applied where clearing is still occuring:
>
> i) the threshold level below which species loss appears to accelerate exponentially at an ecosystem level is regarded as being at a level of 30% of the pre-clearing extent of the vegetation type;
>
> ii) a level of 10% of the original extent is regarded as being a level representing "endangered"...(EPA 2000 p 6)

Similar criteria were applied in the Western Australian Comprehensive Regional Assessment for the south western forests (C&WARFASC 1998, JANIS 1997), with the ≤ 30% of original extent remaining vegetation type being referred to as vulnerable, and the ≤ 10% of original extent remaining vegetation type being referred to as endangered. The recent conservation assessment of Queensland's bioregional ecosystems (Slater and Williams 1999) has also used the 10% and 30% criteria, and the terminology of 'endangered' and 'of concern'. It is anticipated that the 10% and 30% threshold levels will be applied in developing criteria for nation-wide assessment when the Environmental Protection and Biodiversity Conservation Act 1999 (Cwlth) becomes fully operational.

We have also used the general reservation target developed for the Comprehansive Regional Assessments of Australia's production forests (JANIS 1997):

> As a general criterion, 15% of the pre-1750 distribution of each forest ecosystem should be protected in the CAR[1] reserve system...(JANIS 1997 p12)

It should be noted, however, that there are specific JANIS criteria for the protection of vulnerable forest ecosystems (60% of the remaining extent), and rare and endangered forest ecosystems (100% of the remaining extent).

Rare and Priority Flora

Declared Rare and Priority Flora in the South West Catchments NRM Region were determined by intersection of the catchment boundaries and flora locations from a database of rare and priority flora maintained by the Department of CALM.

Fauna

Fauna occurring in the South West Catchments NRM Region were identified by intersecting point locations for fauna records with catchment boundaries using GIS.

Threatened Ecological Communities

TECs within the South West Catchments NRM Region were identified by intersecting catchment boundaries with point locations of TECs using GIS.

[1] CAR: Comprehensive, Adequate and Representative, and refers to an ideal conservation system

3. Results

3.1 Vegetation

Vegetation types and extent within catchments

One hundred and sixteen (116) vegetation associations were originally present within the South West Catchments Natural Resource Management Region which comprises the Peel-Harvey, Leschenault, Blackwood, Geographe, Cape to Cape, Blackwood and Warren catchments. The vegetation associations and their pre-European extent within the total area encompassed by the catchments are listed in Table1. Map1 displays the original vegetation types at a scale of 1:3,000,000 as a detailed map at a scale of 1:250,000 could not be produced at not available. The vegetation associations that are restricted to the NRM Region are highlighted in the table. Figures showing the pre-European and current extent of the vegetation associations in the whole South West Agricultural Region are also included for comparison.

Table1 is arranged according to the Vegetation Association Code Number, a coding number assigned to each vegetation association for the purpose of identification and database management by Hopkins *et al.* (1996). The triplet map codes developed by J.S. Beard are also shown. Included in the list are a number of sparsely vegetated units such as bare ground and granite rock that are considered to support unique vegetation but in relatively limited amounts. The sparsely vegetated units are also referred to as vegetation associations for ease of discussion.

Table 1 also shows the current extent of each of the vegetation associations in the NRM Region. All but one vegetation association (Vegetation Code No. 511, Medium woodland; York gum) are still present, although many others remain only as isolated and fragmented remnants. Map 2 shows the distribution of remnant vegetation in the Region.

Ten vegetation associations have ≤10% of their original areal extent remaining, including one which is apparently extinct. A further 33 vegetation associations have only 10 – 30% of their original areal extent remaining in the catchments. These are listed in Table 2. Map 3 shows the present distribution of vegetation associations with less than 30% of their original extent remaining in the catchments.

Fifty-eight of the 116 vegetation associations originally present in the catchments now have < 2000ha remaining. These are listed in Table 3 and mapped in Map 4. Those that are naturally limited in extent (ie. less than 2000ha pre-European area) are shaded in Table 3.

Appendix 1 (on CD ROM) contains data on the pre-European and present extent of each of these vegetation associations in each of the six catchments that make up the South West Catchments NRM Region. The data on extent of remnant native vegetation are summarised in Table 4, and displayed graphically in Figure 1, to show the proportion of native vegetation cover for each catchment. At this scale of analysis, all but the Blackwood Catchment are reasonably well vegetated (the Blackwood Catchment has only 27.33% of native vegetation remaining).

Table 1 . Vegetation associations in the South West Catchments NRM Region, derived from 1:250,000 scale vegetation mapping by J.S. Beard and A.J.M. Hopkins. The Table shows the pre-European and current extent of each vegetation association, and the current extent expressed as a percentage of its original extent, within the South West Catchments Region, and in the whole South West Agricultural Region. The final column is included to give an indication of the extent to which each of the vegetation associations occurs outside the South West Catchments Region. Rows in the table that are shaded indicate associations that are restricted to the South West Catchments Region.

Veg Assoc Code No	Beard Code	Vegetation Association Description	Current Extent in SW Catchments (ha)	Total Current Extent-SW Agric Region (ha)	Pre-European Extent in SW Catchments (ha)	Total Pre-European Extent-SW Agric Region (ha)	% of original remaining in catchments	% of original in SW Agric Region	% current total extent occurring in catchments
1	E1Tc	Tall forest; karri (Eucalyptus diverscolor)	46029	56299	54799	71121	84	79.2	81.8
2	E4Ti	Tall woodland; tuart (E. gomphocephala)	2436	2436	3155	3155	77.21	77.2	100.0
3	E2,3Mc	Medium forest; jarrah-marri	1459993	1849205	1869561	2523870	78.09	73.3	79.0
4	E3,5Mi	Medium woodland; marri & wandoo	98107	175524	590449	880016	16.62	19.9	55.9
5	E5,45Mi	Medium woodland; wandoo & powderbark (E. accedens)	17212	27216	35560	52137	48.4	52.2	63.2
6	E2,4Mi	Medium woodland; tuart & jarrah	12620	22962	18582	63474	67.92	36.2	55.0
7	E5,6Mi	Medium woodland; York gum (E. loxophleba) & wandoo	1681	27044	11235	244397	14.96	11.1	6.2
8	E8,34Mi	Medium woodland; salmon gum & gimlet	5	29135	39	464860	12.82	6.3	0.02
13	e5Mr	Medium open woodland; wandoo	127	4488	741	6541	17.14	68.6	2.8
14	e2Lc	Low forest; jarrah	980	72709	1228	94214	79.8	77.2	1.3
22	AgLi	Low woodland; Agonis flexuosa	2137	2864	2626	3706	81.38	77.3	74.6
23	e2bLi	Low woodland; jarrah-banksia	27287	30753	37263	40830	73.23	75.3	88.7
25	c5e6Li	Low woodland; Allocasuarina huegeliana & York gum	292	1404	681	9021	42.88	15.6	20.8
27	Mli	Low woodland; paperbark (Melaleuca sp.)	64179	97881	91441	133124	70.19	73.5	65.6
37	MSc	Shrublands; teatree thicket	3168	46032	7127	79754	44.45	57.7	6.9
38	XSc	Shrublands; thicket, mixed	29	2353	29	2353	100	100.0	1.2
48	XSZc	Shrublands; scrub-heath	1924	3665	4921	16012	39.1	22.9	52.5
49	XZc	Shrublands; mixed heath	114	20866	512	48653	22.27	42.9	0.5
51	XGc	Sedgeland; reed swamps, occasionally with heath	24902	34790	34011	57660	73.22	60.3	71.6
125	Sl	Bare areas; salt lakes	3176	16755	18352	211357	17.31	7.9	19.0
126	Fl	Bare areas; freshwater lakes	2535	5749	9010	20182	28.14	28.5	44.1
128	R	Bare areas; rock outcrops	1302	36005	1838	82914	70.84	43.4	3.6
129	Ds	Bare areas; drift sand	2349	12323	12371	42752	18.99	28.8	19.1
131	e8,34Mi/e10,27Si	Mosaic: Medium woodland; salmon gum & gimlet / Shrublands; mallee scrub, redwood & black marlock	915	11420	9470	197202	9.66	5.8	8.0
142	e6,8Mi	Medium woodland; York gum & salmon gum	694	38085	12897	690360	5.38	5.5	1.8

Table 1. Vegatation associations in the South West Catchments NRM Region continued.

352	e6Mi	Medium woodland; York gum	2175	53256	17558	741258	12.39	7.2	4.1
511	e8,9Mi	Medium woodland; salmon gum & morrel	0	28031	7	188237	0	14.9	0.0
676	k3Ci	Succulent steppe; samphire	393	936	1280	11038	30.7	8.5	42.0
929	e33Lc	Low forest; moort (E. platypus)	111	2739	301	4411	36.88	62.1	4.1
931	e7Mi	Medium woodland; yate	51	12616	96	30083	53.13	41.9	0.4
938	e6,7Mi	Medium woodland; York gum & yate	426	16670	1221	76416	34.89	21.8	2.6
946	e5Mi	Medium woodland; wandoo	5328	15057	30661	80570	17.38	18.7	35.4
947	e64,45Mi	Medium woodland; powderbark & mallet	8321	11528	18952	31955	43.91	36.1	72.2
949	Bli	Low woodland; banksia	2158	88857	6205	164658	34.78	54.0	2.4
952	DZc	Shrublands; dryandra heath	5390	9963	18835	59125	28.62	16.9	54.1
953	MSc k3Ci	Succulent steppe with thicket; teatree over samphire (m5?)	206	918	476	9976	43.28	9.2	22.4
955	x10SZc/c3Sc	Mosaic: Shrublands; scrub-heath (SE Avon)/ Shrublands; Allocasuarina campestris thicket	1030	10434	7456	137417	13.81	7.6	9.9
961	x10SZc/c4Sc	Mosaic: Shrublands; scrub-heath (SE Avon)/ Shrublands; Allocasuarina acutivalvis thicket	169	4315	683	24918	24.74	17.3	3.9
962	e64Mi	Medium woodland; mallet (E. astringens)	230	232	1144	1206	20.1	19.2	99.1
963	e7mMi	Medium woodland; yate & paperbark (Melaleuca spp)	1401	1774	4569	6119	30.66	29.0	79.0
965	e2,3Mi	Medium woodland; jarrah & marri	516	5017	516	9163	100	54.8	10.3
967	e5,7Mi	Medium woodland; wandoo & yate	3378	36001	21726	216697	15.55	16.6	9.4
968	e2,3,5Mi	Medium woodland; jarrah, marri & wandoo	8671	72374	56906	184182	15.24	39.3	12.0
973	MLc	Low forest; paperbark (Melaleuca rhaphiophylla)	283	83422	2428	168900	11.66	49.4	0.3
975	e2Li	Low woodland; jarrah	3676	15454	4343	17122	84.64	90.3	23.8
987	e2,5Mi	Medium woodland; jarrah & wandoo	566	1381	2572	3619	22.01	38.2	41.0
990	AgLc	Low forest: peppermint (Agonis flexuosa)	12357	13301	16006	17504	77.2	76.0	92.9
992	e2,5Mc	Medium forest; jarrah & wandoo (E. wandoo)	30138	30815	121178	121855	24.87	25.3	97.8
997	m4Zc	Shrublands; melaleuca heath	1225	1290	2352	2404	52.08	53.7	95.0
998	e4Mi	Medium woodland; tuart	6696	16033	14997	41235	44.65	38.9	41.8
999	e3Mi	Medium woodland; marri	11769	26771	98417	217348	11.96	12.3	44.0
1000	e2,3Mi/bLi/mLc	Mosaic: Medium forest; jarrah-marri / Low woodland; banksia / Low forest; teatree (Melaleuca Spp.)	29509	30522	96440	99495	30.6	30.7	96.7
1001	e2Mb cbLi	Medium very sparse woodland; jarrah, with low woodland; banksia & casuarina	2944	17313	6697	57615	43.96	30.0	17.0
1002	e2Mr	Medium open woodland; jarrah	15084	15389	15647	15956	96.4	96.4	98.0
1003	e2,3,5Mc	Medium forest; jarrah, marri & wandoo	17296	55075	34467	82666	50.18	66.6	31.4
1005	c5Li	Low woodland; Allocasuarina huegeliana	203	226	554	777	36.64	29.1	89.8

Table 1. Vegatation associations in the South West Catchments NRM Region continued.

1006	e2,5,45Mi	Medium woodland; jarrah, wandoo & powderbark	2519	23178	9025	44969	27.91	51.5	10.9
1008	e3Mr	Medium open woodland; marri	6	931	77	4585	7.79	20.3	0.6
1009	e3,18Mr	Medium woodland; marri & river gum	24	2366	24	7474	100	31.7	1.0
1017	e2,3Mr bLi	Medium open woodland; jarrah & marri, with low woodland; banksia	9010	11083	11262	17092	80	64.8	81.3
1023	e5,6,8Mi	Medium woodland; York gum, wandoo & salmon gum (E. salmonophloia)	66740	96905	718110	1343995	9.29	7.2	68.9
1026	a23,32m3Sc /a26m4Zc	Mosaic: Shrublands; Acacia rostellifera, A. cyclops (S) & Melaleuca cardiophylla (N) thicket / Shrublands; Acacia lasiocarpa & Melaleuca acerosa heath	1052	69609	3830	95502	27.47	72.9	1.5
1030	b1,2Li	Low woodland; Banksia attenuata & B. menziesii	108	90011	143	138818	75.52	64.8	0.1
1031	HSZc/dZc	Mosaic: Shrublands; hakea scrub-heath / Shrublands; dryandra heath	96	95287	409	269304	23.47	35.4	0.1
1034	e3,5,45Mi	Medium woodland; marri, wandoo & powderbark	36	1085	64	1830	56.25	59.3	3.3
1036	b3Li	Low woodland; Banksia prionotes	91	31965	468	86267	19.44	37.1	0.3
1040	C6e6Mi	Medium woodland; York gum & Casuarina obesa	7	526	35	2821	20	18.6	1.3
1051	E5,7Mr mSc	Shrublands; teatree thicket with scattered wandoo & yate	4347	4573	14113	14864	30.8	30.8	95.1
1053	E6Mr m6Sc	Shrublands; Melaleuca uncinata thicket with scattered York gum	545	1168	1140	13833	47.81	8.4	46.7
1073	E5,64Mi	Medium woodland; wandoo & mallet	6524	6712	16787	17629	38.86	38.1	97.2
1074	E5c6Mr mSc k3Ci	Succulent steppe with open woodland & thicket; wandoo & Allocasuarina obesa over teatree & samphire	1463	1463	4598	4598	31.82	31.8	100.0
1075	E15,27Si	Shrublands; mallee scrub, Eucalyptus eremophila & black marlock (E.redunca)	15998	29714	176809	336072	9.05	8.8	53.8
1083	E5,8c6Mr mSi k3Ci	Succulent steppe with open woodland & scrub; wandoo, salmon gum & Allocasuarina obesa over teatree & samphire	2470	2470	10663	10663	23.16	23.2	100.0
1085	E5,69Mi	Medium woodland; wandoo & blue mallet (E. gardneri)	4456	5371	41848	51817	10.65	10.4	83.0
1087	E5,9,69Mi	Medium woodland; wandoo, morrell & blue mallet	261	261	743	743	35.13	35.1	100.0
1088	E64,69 Mi	Medium woodland; mallet & blue mallet	134	150	197	392	68.02	38.3	89.3
1091	B3c5Li	Low woodland; Banksia prionotes & Allocasuarina huegelianna	266	266	719	719	37	37.0	100.0
1092	E5,6,9 Mi	Medium woodland; wandoo, York gum & morrell	5674	5674	78065	78065	7.27	7.3	100.0
1093	Ec6Mr mSc k3Ci	Succulent steppe with open woodland & thicket; eucalypts & Allocasuarina obesa over teatree & samphire	742	742	8265	8265	8.98	9.0	100.0
1094	E6,8Mi/e15, 27Si	Mosaic: Medium woodland; York gum & salmon gum / Shrublands; mallee scrub Eucalyptus eremophila & black marlock	4434	4479	70144	72717	6.32	6.2	99.0
1096	E7,8Mi	Medium woodland; yate & salmon gum	180	180	347	347	51.87	51.9	100.0
1103	aISc	Shrublands; Acacia & lamarchea thicket	37	37	38	38	97.37	97.4	100.0

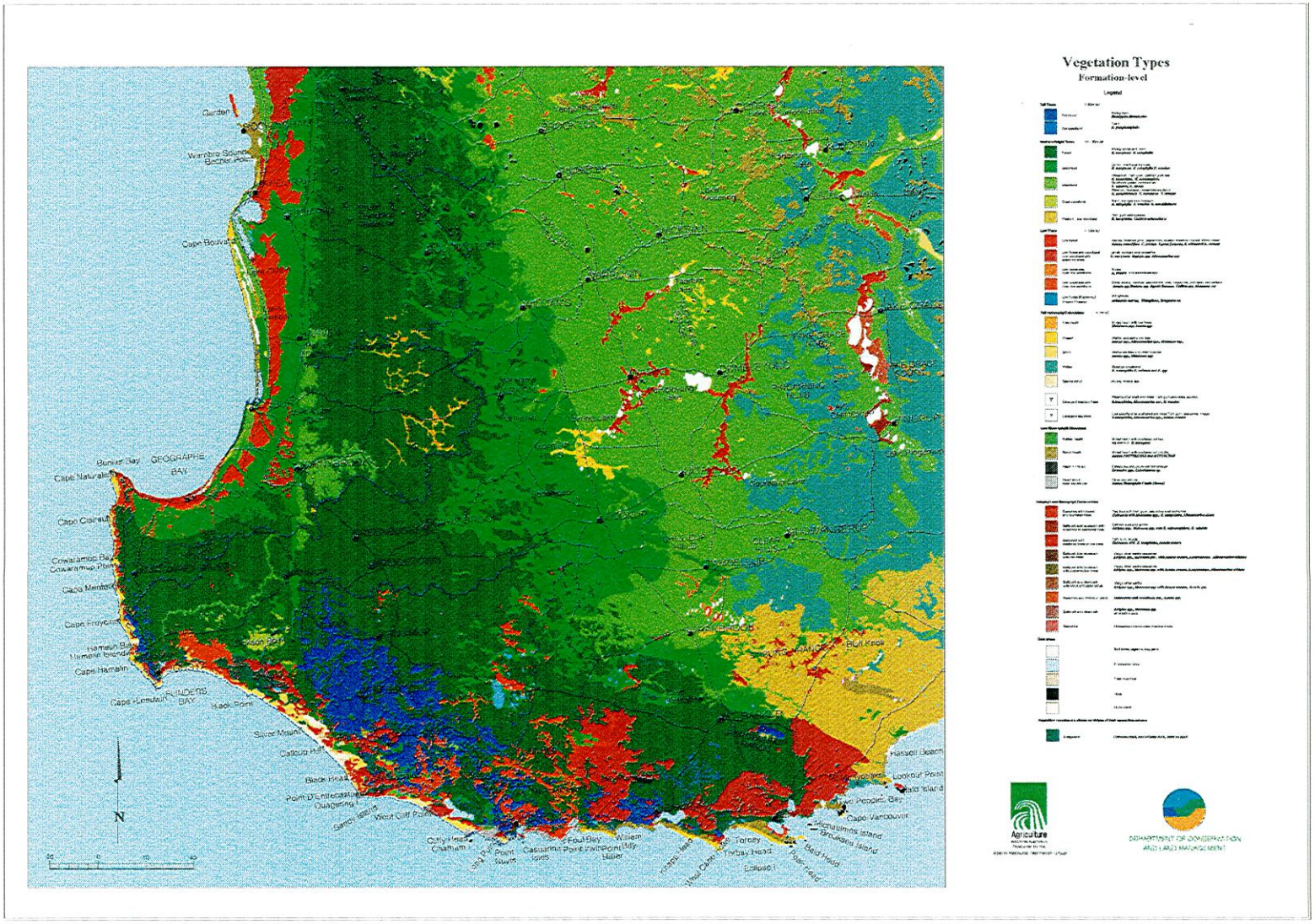
Table 1. Vegatation associations in the South West Catchments NRM Region continued.

1104	XSZc/a23m 3Sc	Mosaic: Shrublands; scrub-heath / Shrublands; Acacia rostellifera & Melaleuca cardiophylla thickets	140	140	173	173	80.92	80.9	100.0
1108	A31Sc	Shrublands; Acacia decipiens	7004	7212	8460	8789	82.79	82.1	97.1
1109	AgSi	Shrublands; peppermint scrub, Agonis flexuosa	27884	27935	33933	32846	82.17	85.0	99.8
1111	E37Mi	Medium woodland; yate (E. occidentalis)	653	653	802	802	81.42	81.4	100.0
1112	E1Tc/e2,3Tc	Mosaic: Tall forest; karri / Tall forest; jarrah & marri	10094	10094	10676	10676	94.55	94.5	100.0
1113	JZc	Shrublands; Jacksonia horrida heath	3564	4952	5236	5975	68.07	82.9	72.0
1114	MLSi	Shrublands tree-heath; paperbark over teatree thickets	13469	13469	19846	19846	67.87	67.9	100.0
1115	E3,37Mi	Medium woodland; marri & yate	1251	1251	1273	1273	98.27	98.3	100.0
1116	E2Tc	Tall forest; jarrah (E. marginata)	4229	4229	4628	4628	91.38	91.4	100.0
1130	E1,68Tc	Tall forest; karri & red tingle (E. jacksonii)	924	993	999	1079	92.49	92.0	93.1
1131	E37Mc	Medium forest; bushy yate (E. cornuta)	276	276	284	284	97.18	97.2	100.0
1132	E3Mc	Medium forest; marri	245	245	274	274	89.42	89.4	100.0
1134	E2Mi	Medium woodland; jarrah (south coast)	30710	32909	35482	38106	86.55	86.4	93.3
1136	E3Mi (e2,5,18,c)	Medium woodland; marri with some jarrah, wandoo, river gum and casuarina	6106	6122	57060	57006	10.7	10.7	99.7
1137	Xsi	Shrublands; Melaueca incana, Hakea tuberculata, Viminaria juncea scrub on ironstone, south coast.	299	299	1081	1081	27.66	27.7	100.0
1138	E2,3Lc	Low forest; jarrah & marri	490	490	660	660	74.24	74.2	100.0
1139	E1,74Tc	Tall forest; karri & yellow tingle (E. guilfoyleii)	12327	14053	13320	15056	92.55	93.3	87.7
1144	E1,3Tc	Tall forest; karri & marri (E. calophylla)	131838	131866	165458	165486	79.68	79.7	100.0
1147	X10SZc	Shrublands; scrub-heath in the south-east Avon-Wheatbelt Region	32	2244	1452	43302	2.2	5.2	1.4
1150	E1,68,74Tc	Tall forest; karri, red tingle & yellow tingle	49	5200	52	5435	94.23	95.7	0.9
1151	E2,68Mc	Medium forest; jarrah & red tingle	183	1992	269	2173	68.03	91.7	9.2
1152	E2,74Mc	Medium forest; jarrah & yellow tingle	4684	7258	4763	7350	98.34	98.7	64.5
1157	E2,3,Tc	Tall forest; jarrah & marri	1171	1171	1237	1237	94.66	94.7	100.0
1180	ChSc	Shrublands; Calothamnus quadrifidis & Hakea trifircata (Cape Naturaliste)	1990	2165	2622	2536	75.9	85.4	91.9
1181	E2,63Mi	Medium woodland, jarrah & Eucalyptus haematoxylon (Whicher Ra.)	9846	9846	19318	19318	50.97	51.0	100.0
1182	E18mMi	Medium woodland; Eucalyptus rudis & Melaleuca rhaphiophylla	7400	7400	23357	23357	31.68	31.7	100.0
1183	E18,72Mi	Medium woodland; Eucalyptus rudis & blackbutt with some bullich, jarrah & marri (fringing Blackwood R.)	7891	7891	9065	9065	87.05	87.0	100.0
1184	E2,3,18,agM i	Medium woodland-fringing; jarrah, marri, Eucalyptus rudis & Agonis flexuosa	34465	34465	63414	63414	54.35	54.3	100.0

Table 1. Vegatation associations in the South West Catchments NRM Region continued.

1185	E2,3,72Mi	Medium woodland; jarrah, marri & blackbutt	14153	14153	15175	15175	93.27	93.3	100.0
1200	E8,9Mi/e15, 27Si	Mosaic: Medium woodland; salmon gum & morrel / Shrublands; mallee scrub Eucalyptus eremophila & black marlock (E. redunca)	2694	10213	21782	124521	12.37	8.2	26.4
2048	X13SZc	Shrublands; scrub-heath in the Mallee Region	1185	38971	5859	207543	20.23	18.8	3.0
2093	E7Mi mSi k3Ci	Succulent steppe with open woodland & scrub; yate over teatree & samphire	2946	2946	9253	9253	31.84	31.8	100.0
3041	A19c5Li/roc k	Mosaic: Low woodland; Allocasuarina huegeliana & jam around granite rocks	467	1487	2262	6027	20.65	24.7	31.4
3048	X14SZc	Shrublands; scrub-heath on the Swan Coastal Plain	46	2432	369	9599	12.47	25.3	1.9

Map 1. Pre-European vegetation in the South West Catchments NRM Region (simplified for the 1:3,000,000 scale map for the whole State.



Map 2. Present extent of native vegetation in the South West Catchments NRM Region

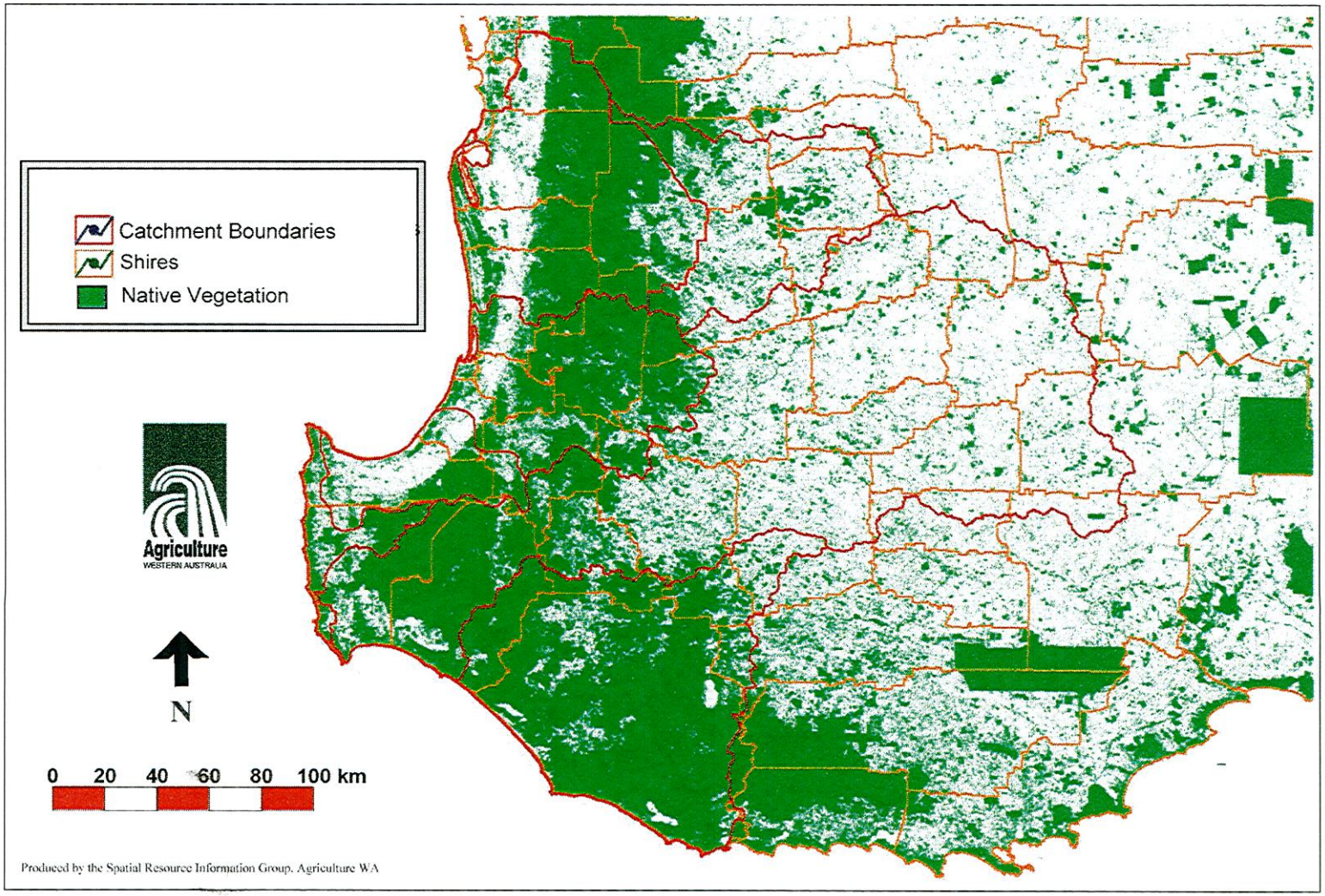


Table 2. Vegetation associations in the South West Catchments NRM Region that are 70% or more cleared (ie. ≤30% of their original areal extent). Vegetation associations that are 90% or more cleared (ie. ≤10% of their original areal extent remaining) are shaded.

Veg Assoc No.	Beard Code	Vegetation Association Description	% original remaining in catchments
4	e3,5Mi	Medium woodland; marri & wandoo	16.62
7	e5,6Mi	Medium woodland; York gum (E. loxophleba) & wandoo	14.96
8	e8,34Mi	Medium woodland; salmon gum & gimlet	12.82
13	e5Mr	Medium open woodland; wandoo	17.14
49	XZc	Shrublands; mixed heath	22.27
125	Si	Bare areas; salt lakes	17.31
126	FI	Bare areas; freshwater lakes	28.14
129	Ds	Bare areas; drift sand	18.99
131	e8,34Mi/e10,27Si	Mosaic: Medium woodland; salmon gum & gimlet / Shrublands; mallee scrub, redwood & black marlock	9.66
142	e6,8Mi	Medium woodland; York gum & salmon gum	5.38
352	e6Mi	Medium woodland; York gum	12.39
511	e8,9Mi	Medium woodland; salmon gum & morrel	0.00
946	e5Mi	Medium woodland; wandoo	17.38
952	dZc	Shrublands; dryandra heath	28.62
955	x10SZc/c3Sc	Mosaic: Shrublands; scrub-heath (SE Avon)/ Shrublands; Allocasuarina campestris thicket	13.81
961	x10SZc/c4Sc	Mosaic: Shrublands; scrub-heath (SE Avon)/ Shrublands; Allocasuarina acutivalvis thicket	24.74
962	e64Mi	Medium woodland; mallet (E. astringens)	20.10
967	e5,7Mi	Medium woodland; wandoo & yate	15.55
968	e2,3,5Mi	Medium woodland; jarrah, marri & wandoo	15.24
973	MLc	Low forest; paperbark (Melaleuca rhaphiophylla)	11.66
987	e2,5Mi	Medium woodland; jarrah & wandoo	22.01
992	e2,5Mc	Medium forest; jarrah & wandoo (E. wandoo)	24.87
999	e3Mi	Medium woodland; marri	11.96
1006	e2,5,45Mi	Medium woodland; jarrah, wandoo & powderbark	27.91
1008	e3Mr	Medium open woodland; marri	7.79
1023	e5,6,8MI	Medium woodland; York gum, wandoo & salmon gum (E. salmonophloia)	9.29
1026	a23,32m3Sc/a26m4Zc	Mosaic: Shrublands; Acacia rostellifera, A. cyclops (S) & Melaleuca cardiophylla (N) thicket / Shrublands; Acacia lasiocarpa & Melaleuca acerosa heath	27.47
1031	hSZc/dZc	Mosaic: Shrublands; hakea scrub-heath / Shrublands; dryandra heath	23.47
1036	b3Li	Low woodland; Banksia prionotes	19.44
1040	c6e6Mi	Medium woodland; York gum & Casuarina obesa	20.00
1075	e15,27Si	Shrublands; mallee scrub, Eucalyptus eremophila & black marlock (E.redunca)	9.05
1083	e5,8c6Mr mSi k3Ci	Succulent steppe with open woodland & scrub; wandoo, salmon gum & Allocasuarina obesa over teatree & samphire	23.16
1085	e5,69Mi	Medium woodland; wandoo & blue mallet (E. gardneri)	10.65
1092	e5,6,9 Mi	Medium woodland; wandoo, York gum & morrell	7.27
1093	ec6Mr mSc k3Ci	Succulent steppe with open woodland & thicket; eucalypts & Allocasuarina obesa over teatree & samphire	8.98
1094	e6,8Mi/e15,27Si	Mosaic: Medium woodland; York gum & salmon gum / Shrublands; mallee scrub Eucalyptus eremophila & black marlock	6.32
1136	e3Mi (e2,5,18,c)	Medium woodland; marri with some jarrah, wandoo, river gum and casuarina	10.70
1137	XSi	Shrublands; Melaueca incana, Hakea tuberculata, Viminaria juncea scrub on ironstone, south coast.	27.66
1147	x10SZc	Shrublands; scrub-heath in the south-east Avon-Wheatbelt Region	2.20
1200	e8,9Mi/e15,27Si	Mosaic: Medium woodland; salmon gum & morrel / Shrublands; mallee scrub Eucalyptus eremophila & black marlock (E. redunca)	12.37

Table 2. Extensively cleared vegetation associations continued.

2048	x13SZc	Shrublands; scrub-heath in the Mallee Region	20.23
3041	a19c5Li/rock	Mosaic: Low woodland; Allocasuarina huegeliana & jam around granite rocks	20.65
3048	x14SZc	Shrublands; scrub-heath on the Swan Coastal Plain	12.47

Map 3. Distribution of vegetation associations in the South West Catchments NRM Region with <10% and <30% of their original extent remaining

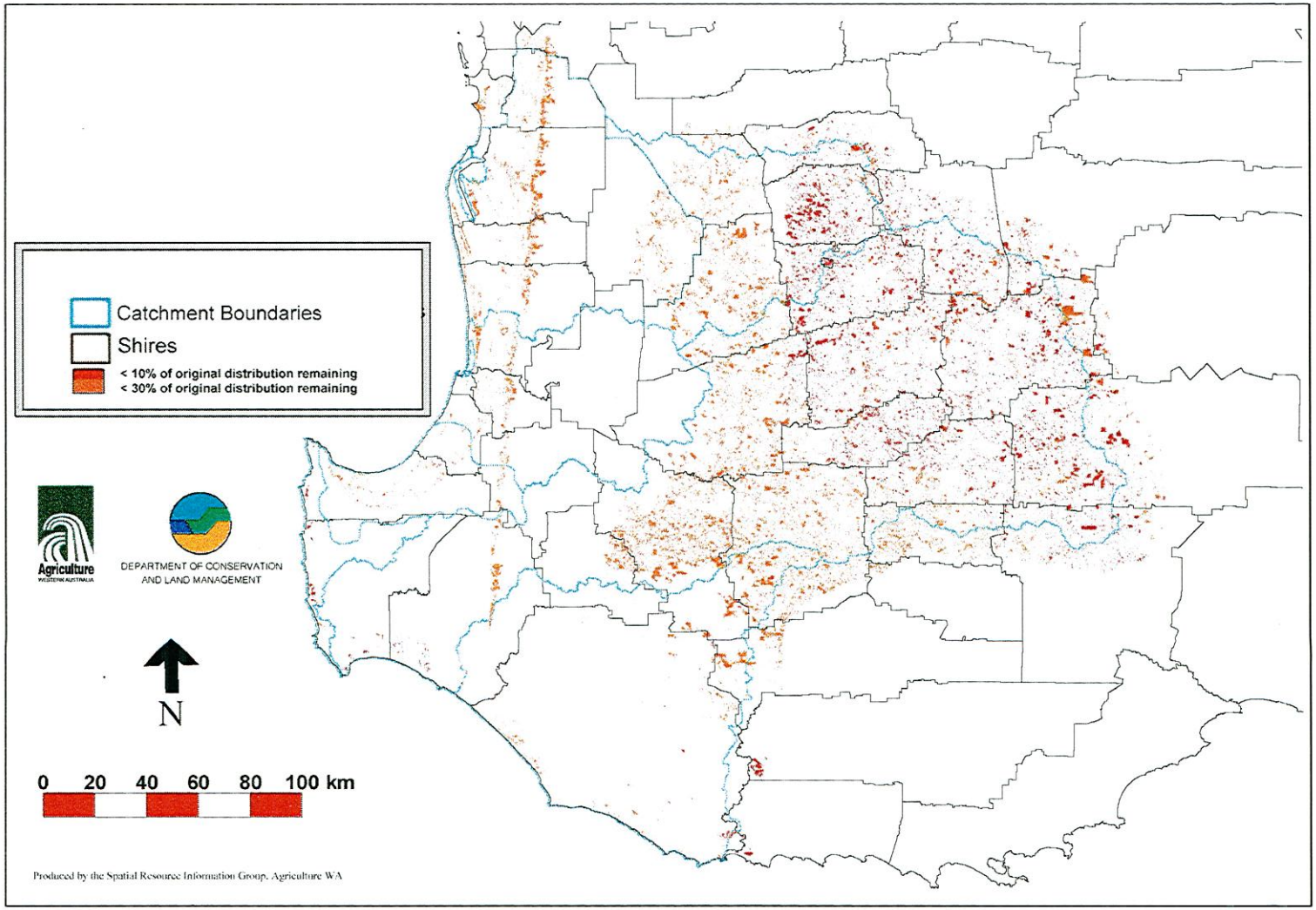


Table 3. Vegetation associations of limited current extent (ie. <2,000 ha) in the South West Catchments NRM Region. Vegetation associations also with a total area <2,000 ha in the whole South West Agricultural Region are highlighted.

Veg Assoc	Beard Code	Vegetation Association Description
7	e5,6Mi	Medium woodland; York gum (E. loxophleba) & wandoo
8	e8,34Mi	Medium woodland; salmon gum & gimlet
13	e5Mr	Medium open woodland; wandoo
14	e2Lc	Low forest; jarrah
25	c5e6Li	Low woodland; Allocasuarina huegeliana & York gum
38	XSc	Shrublands; thicket, mixed
48	XSZc	Shrublands; scrub-heath
49	XZc	Shrublands; mixed heath
128	R	Bare areas; rock outcrops
131	e8,34Mi/e10,27Si	Mosaic: Medium woodland; salmon gum & gimlet / Shrublands; mallee scrub, redwood & black marlock
142	e6,8Mi	Medium woodland; York gum & salmon gum
511	e8,9Mi	Medium woodland; salmon gum & morrel
676	k3Ci	Succulent steppe; samphire
929	e33Lc	Low forest; moort (E. platypus)
931	e7Mi	Medium woodland; yate
938	e6,7Mi	Medium woodland; York gum & yate
953	mSc k3Ci	Succulent steppe with thicket; teatree over samphire (m5?)
955	x10SZc/c3Sc	Mosaic: Shrublands; scrub-heath (SE Avon)/ Shrublands; Allocasuarina campestris thicket
961	x10SZc/c4Sc	Mosaic: Shrublands; scrub-heath (SE Avon)/ Shrublands; Allocasuarina acutivalvis thicket
962	e64Mi	Medium woodland; mallet (E. astringens)
963	e7mMi	Medium woodland; yate & paperbark (Melaleuca spp)
965	e2,3Mi	Medium woodland; jarrah & marri
973	MLc	Low forest; paperbark (Melaleuca rhaphiophylla)
987	e2,5Mi	Medium woodland; jarrah & wandoo
997	m4Zc	Shrublands; melaleuca heath
1005	c5Li	Low woodland; Allocasuarina huegeliana
1008	e3Mr	Medium open woodland; marri
1009	e3,18Mr	Medium woodland; marri & river gum
1026	a23,32m3Sc/a26m4 Zc	Mosaic: Shrublands; Acacia rostellifera, A. cyclops (S) & Melaleuca cardiophylla (N) thicket / Shrublands; Acacia lasiocarpa & Melaleuca acerosa heath
1030	b1,2Li	Low woodland; Banksia attenuata & B. menziesii
1031	hSZc/dZc	Mosaic: Shrublands; hakea scrub-heath / Shrublands; dryandra heath
1034	e3,5,45Mi	Medium woodland; marri, wandoo & powderbark
1036	b3Li	Low woodland; Banksia prionotes
1040	c6e6Mi	Medium woodland; York gum & Casuarina obesa
1053	e6Mr m6Sc	Shrublands; Melaleuca uncinata thicket with scattered York gum
1074	e5c6Mr mSc k3Ci	Succulent steppe with open woodland & thicket; wandoo & Allocasuarina obesa over teatree & samphire
1087	e5,9,69Mi	Medium woodland; wandoo, morrell & blue mallet
1088	e64,69 Mi	Medium woodland; mallet & blue mallet
1091	b3c5Li	Low woodland; Banksia prionotes & Allocasuarina huegelianna

Table 3. Vegetation associations of limited current extent continued.

1093	ec6Mr mSc k3Ci	Succulent steppe with open woodland & thicket; eucalypts & Allocasuarina obesa over teatree & samphire
1096	e7,8Mi	Medium woodland; yate & salmon gum
1103	alSc	Shrublands; Acacia & lamarchea thicket
1104	xSZc/a23m3Sc	Mosaic: Shrublands; scrub-heath / Shrublands; Acacia rostellifera & Melaleuca cardiophylla thickets
1111	e37Mi	Medium woodland; yate (E. occidentalis)
1115	e3,37Mi	Medium woodland; marri & yate
1130	e1,68Tc	Tall forest; karri & red tingle (E. jacksonii)
1131	e37Mc	Medium forest; bushy yate (E. cornuta)
1132	e3Mc	Medium forest; marri
1137	Xsi	Shrublands; Melaueca incana, Hakea tuberculata, Viminaria juncea scrub on ironstone, south coast.
1138	e2,3Lc	Low forest; jarrah & marri
1147	x10SZc	Shrublands; scrub-heath in the south-east Avon-Wheatbelt Region
1150	e1,68,74Tc	Tall forest; karri, red tingle & yellow tingle
1151	e2,68Mc	Medium forest; jarrah & red tingle
1157	e2,3,Tc	Tall forest; jarrah & marri
1180	ChSc	Shrublands; Calothamnus quadrifidis & Hakea trifircata (Cape Naturaliste)
2048	x13SZc	Shrublands; scrub-heath in the Mallee Region
3041	a19c5Li/rock	Mosaic: Low woodland; Allocasuarina huegeliana & jam around granite rocks
3048	x14SZc	Shrublands; scrub-heath on the Swan Coastal Plain

Map 4. Vegetation associations of limited present extent (<2000 ha) in the South West Catchments NRM Region

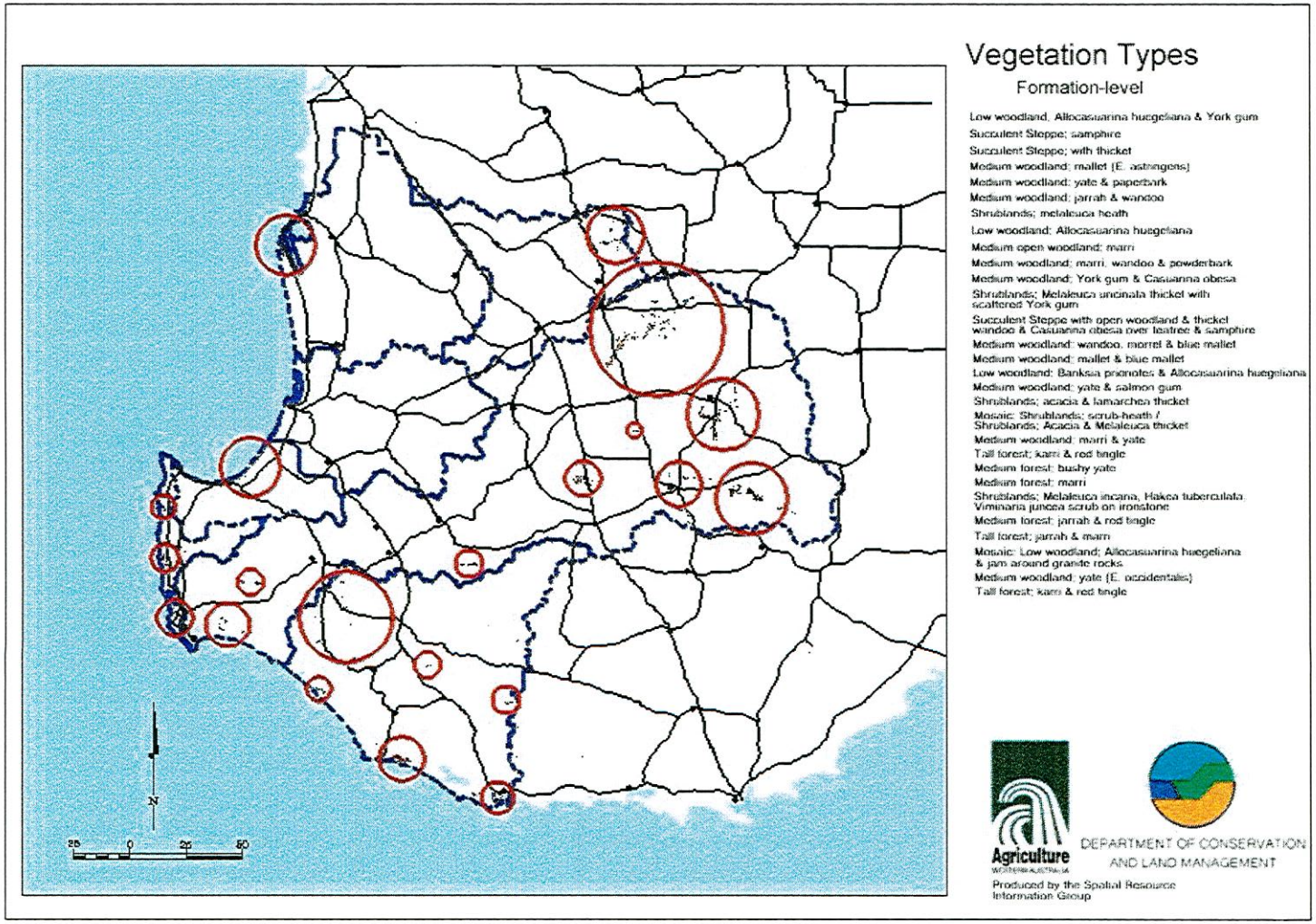


Table 4. Extent of native vegetation remaining in each of the catchments comprising the South West Catchments NRM Region (summarised from Appendix 1. 1999 data).

Catchment	Area of catchment (ha)	Area remnant vegetation (ha)	% Rem Veg
Peel Harvey	1147374	555897	48.45
Leschenault	502486	341507	67.96
Geocatch	197400	88230	44.70
Cape to Cape	97118	64535	66.45
Warren	956843	751591	78.55
Blackwood	2239356	612093	27.33
Total (average%)	5140577	2413853	46.96

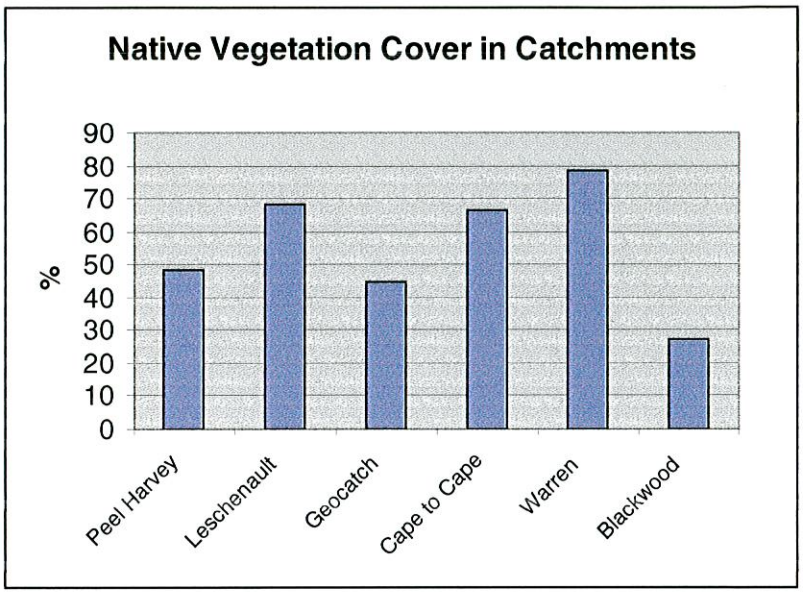


Figure 1. Bar chart showing the proportion of each catchment in the South West Catchments NRM Region covered by native vegetation.

Reservation Status of Vegetation Associations

The reservation status of each of the vegetation associations occurring in the South West Catchments NRM Region are shown in Table 5. Map 5 shows the present extent of native vegetation in the catchments, colour coded by tenure type (conservation reserves in IUCN Reserve Categories I-IV; other CALM-managed lands; private land). Some vegetation associations, although poorly reserved in the catchments, are well-represented in reserves in the rest of the Agricultural Region. The reservation status in the whole South West Agricultural Region is given for each of the vegetation associations in Appendix 2 (on CD ROM) for comparison.

Twenty vegetation associations are completely unreserved in any CALM-managed lands in the South West Catchments Region (Table 6). Five of these are also unreserved in CALM-managed lands anywhere in the South West Agricultural Region. Fifty-two vegetation associations are not reserved in IUCN reserves of management categories I – IV in the south west catchments (Table 7). These are shown in Map 6. Thirty-four of these are also unrepresented in IUCN I-IV reserves outside the catchments.

An additional 38 vegetation associations have more than 0 but less than 15% of their pre-European extent in CALM-managed lands in the catchments (Table 8). Thirty-three of these also have >0 but <15% of their pre-European extent in CALM-managed lands in the South West Agricultural Region. Sixteen vegetation associations have more than 0 but less than 15% of their pre-European extent in the catchments reserved in IUCN I – IV reserves, and all of these also have >0 but <15% of the pre-European extent reserved in IUCN I – IV in the South West Agricultural Region (Table 9).

Appendix 3 (on CD ROM) provides details for each catchment, showing the amount of each vegetation association reserved in comparison to the original extent in the catchment.

Table 5. Reservation status of vegetation associations occurring in the South West Catchments NRM Region. IUCN Reserve Categories I-IV include National Parks, Nature Reserves, Conservation Parks and Forest Conservation Zones to be classified under section 62 of the CALM Act.

Veg Assoc	Beard Code	Vegetation Association Description	IUCN I-IV (inc. RFA)	% total in IUCN I-IV	all CALM-managed land	% total in all CALM	Pre-European in SWCC (ha)
1	E1Tc	Tall forest; karri (Eucalyptus diverscolor)	18449.0	33.7	40784	74.4	54799
2	E4Ti	Tall woodland; tuart (E. gomphocephala)	1394.0	44.2	2073	65.7	3155
3	E2,3Mc	Medium forest; jarrah-marri	217053.0	11.6	1183253	63.3	1869561
4	E3,5Mi	Medium woodland; marri & wandoo	5591.0	0.9	10222	1.7	590449
5	E5,45Mi	Medium woodland; wandoo & powderbark (E. accedens)	0.0	0.0	12715	35.8	35560
6	E2,4Mi	Medium woodland; tuart & jarrah	1352.0	7.3	6779	36.5	18582
7	E5,6Mi	Medium woodland; York gum (E. loxophleba) & wandoo	0.0	0.0	89	0.8	11235
8	E8,34Mi	Medium woodland; salmon gum & gimlet	0.0	0.0	4	10.3	39
13	E5Mr	Medium open woodland; wandoo	0.0	0.0	0	0.0	741
14	E2Lc	Low forest; jarrah	747.0	60.8	756	61.6	1228
22	AgLi	Low woodland; Agonis flexuosa	748.0	28.5	967	36.8	2626
23	E2bLi	Low woodland; jarrah-banksia	16348.0	43.9	18157	48.7	37263
25	C5e6Li	Low woodland; Allocasuarina huegeliana & York gum	0.0	0.0	33	4.8	681
27	MLi	Low woodland; paperbark (Melaleuca sp.)	31307.0	34.2	47566	52.0	91441
37	MSc	Shrublands; teatree thicket	456.0	6.4	1562	21.9	7127
38	XSc	Shrublands; thicket, mixed	0.0	0.0	27	93.1	29
48	XSZc	Shrublands; scrub-heath	195.0	4.0	729	14.8	4921
49	XZc	Shrublands; mixed heath	0.0	0.0	28	5.5	512
51	XGc	Sedgeland; reed swamps, occasionally with heath	15752.0	46.3	19416	57.1	34011
125	Sl	Bare areas; salt lakes	1242.0	6.8	1784	9.7	18352
126	Fl	Bare areas; freshwater lakes	1725.0	19.1	2009	22.3	9010
128	R	Bare areas; rock outcrops	482.0	26.2	642	34.9	1838
129	Ds	Bare areas; drift sand	2075.0	16.8	2061	16.7	12371

Table 5. Reservation status continued.

131	E8,34Mi/e10,27Si	Mosaic: Medium woodland; salmon gum & gimlet / Shrublands; mallee scrub, redwood & black marlock	0.0	0.0	4	0.0	9470
142	E6,8Mi	Medium woodland; York gum & salmon gum	0.0	0.0	57	0.4	12897
352	E6Mi	Medium woodland; York gum	0.0	0.0	517	2.9	17558
511	E8,9Mi	Medium woodland; salmon gum & morrel	0.0	0.0	0	0.0	7
676	k3Ci	Succulent steppe; samphire	2.0	0.2	7	0.5	1280
929	E33Lc	Low forest; moort (E. platypus)	0.0	0.0	2	0.7	301
931	E7Mi	Medium woodland; yate	0.0	0.0	0	0.0	96
938	E6,7Mi	Medium woodland; York gum & yate	0.0	0.0	34	2.8	1221
946	E5Mi	Medium woodland; wandoo	0.0	0.0	2972	9.7	30661
947	E64,45Mi	Medium woodland; powderbark & mallet	0.0	0.0	4086	21.6	18952
949	BLi	Low woodland; banksia	748.0	12.1	854	13.8	6205
952	DZc	Shrublands; dryandra heath	0.0	0.0	3141	16.7	18835
953	MSc k3Ci	Succulent steppe with thicket; teatree over samphire (m5?)	0.0	0.0	85	17.9	476
955	X10SZc/c3Sc	Mosaic: Shrublands; scrub-heath (SE Avon)/ Shrublands; Allocasuarina campestris thicket	0.0	0.0	0	0.0	7456
961	X10SZc/c4Sc	Mosaic: Shrublands; scrub-heath (SE Avon)/ Shrublands; Allocasuarina acutivalvis thicket	0.0	0.0	115	16.8	683
962	E64Mi	Medium woodland; mallet (E. astringens)	0.0	0.0	0	0.0	1144
963	E7mMi	Medium woodland; yate & paperbark (Melaleuca spp)	12.0	0.3	373	8.2	4569
965	E2,3Mi	Medium woodland; jarrah & marri	469.0	90.9	516	100.0	516
967	E5,7Mi	Medium woodland; wandoo & yate	0.0	0.0	146	0.7	21726
968	E2,3,5Mi	Medium woodland; jarrah, marri & wandoo	428.0	0.8	1136	2.0	56906
973	MLc	Low forest; paperbark (Melaleuca rhaphiophylla)	72.0	3.0	97	4.0	2428
975	E2Li	Low woodland; jarrah	1696.0	39.1	3056	70.4	4343
987	E2,5Mi	Medium woodland; jarrah & wandoo	0.0	0.0	0	0.0	2572
990	AgLc	Low forest: peppermint (Agonis flexuosa)	8498.0	53.1	8317	52.0	16006
992	E2,5Mc	Medium forest; jarrah & wandoo (E. wandoo)	2150.0	1.8	1982	1.6	121178

Table 5. Reservation status continued.

997	M4Zc	Shrublands; melaleuca heath	694.0	29.5	694	29.5	2352
998	E4Mi	Medium woodland; tuart	2455.0	16.4	3256	21.7	14997
999	E3Mi	Medium woodland; marri	1974.0	2.0	3836	3.9	98417
1000	E2,3Mi/bLi/ mLc	Mosaic: Medium forest; jarrah-marri / Low woodland; banksia / Low forest; teatree (Melaleuca Spp.)	1629.0	1.7	5518	5.7	96440
1001	E2Mb cbLi	Medium very sparse woodland; jarrah, with low woodland; banksia & casuarina	152.0	2.3	184	2.7	6697
1002	E2Mr	Medium open woodland; jarrah	8191.0	52.3	14408	92.1	15647
1003	E2,3,5Mc	Medium forest; jarrah, marri & wandoo	914.0	2.7	6415	18.6	34467
1005	C5Li	Low woodland; Allocasuarina huegeliana	0.0	0.0	0	0.0	554
1006	E2,5,45Mi	Medium woodland; jarrah, wandoo & powderbark	0.0	0.0	875	9.7	9025
1008	E3Mr	Medium open woodland; marri	0.0	0.0	0	0.0	77
1009	E3,18Mr	Medium woodland; marri & river gum	0.0	0.0	0	0.0	24
1017	E2,3Mr bLi	Medium open woodland; jarrah & marri, with low woodland; banksia	0.0	0.0	7917	70.3	11262
1023	E5,6,8Mi	Medium woodland; York gum, wandoo & salmon gum (E. salmonophloia)	0.0	0.0	9749	1.4	718110
1026	A23,32m3Sc/a26m4Zc	Mosaic: Shrublands; Acacia rostellifera, A. cyclops (S) & Melaleuca cardiophylla (N) thicket / Shrublands; Acacia lasiocarpa & Melaleuca acerosa heath	0.0	0.0	0	0.0	3830
1030	B1,2Li	Low woodland; Banksia attenuata & B. menziesii	34.0	23.8	34	23.8	143
1031	HSZc/dZc	Mosaic: Shrublands; hakea scrub-heath / Shrublands; dryandra heath	0.0	0.0	0	0.0	409
1034	E3,5,45Mi	Medium woodland; marri, wandoo & powderbark	0.0	0.0	0	0.0	64
1036	B3Li	Low woodland; Banksia prionotes	0.0	0.0	2	0.4	468
1040	C6e6Mi	Medium woodland; York gum & Casuarina obesa	0.0	0.0	0	0.0	35
1051	E5,7Mr mSc	Shrublands; teatree thicket with scattered wandoo & yate	0.0	0.0	58	0.4	14113
1053	E6Mr m6Sc	Shrublands; Melaleuca uncinata thicket with scattered York gum	0.0	0.0	417	36.6	1140
1073	E5,64Mi	Medium woodland; wandoo & mallet	0.0	0.0	2685	16.0	16787
1074	E5c6Mr mSc k3Ci	Succulent steppe with open woodland & thicket; wandoo & Allocasuarina obesa over teatree & samphire	0.0	0.0	773	16.8	4598

Table 5. Reservation status continued.

1075	E15,27Si	Shrublands; mallee scrub, Eucalyptus eremophila & black marlock (E.redunca)	0.0	0.0	2380	1.3	176809
1083	E5,8c6Mr mSi k3Ci	Succulent steppe with open woodland & scrub; wandoo, salmon gum & Allocasuarina obesa over teatree & samphire	0.0	0.0	570	5.3	10663
1085	E5,69Mi	Medium woodland; wandoo & blue mallet (E. gardneri)	0.0	0.0	0	0.0	41848
1087	E5,9,69Mi	Medium woodland; wandoo, morrell & blue mallet	0.0	0.0	48	6.5	743
1088	E64,69 Mi	Medium woodland; mallet & blue mallet	0.0	0.0	0	0.0	197
1091	B3c5Li	Low woodland; Banksia prionotes & Allocasuarina huegeliana	0.0	0.0	17	2.4	719
1092	E5,6,9 Mi	Medium woodland; wandoo, York gum & morrell	0.0	0.0	140	0.2	78065
1093	Ec6Mr mSc k3Ci	Succulent steppe with open woodland & thicket; eucalypts & Allocasuarina obesa over teatree & samphire	0.0	0.0	300	3.6	8265
1094	E6,8Mi/e15, 27Si	Mosaic: Medium woodland; York gum & salmon gum / Shrublands; mallee scrub Eucalyptus eremophila & black marlock	0.0	0.0	51	0.1	70144
1096	E7,8Mi	Medium woodland; yate & salmon gum	0.0	0.0	0	0.0	347
1103	aISc	Shrublands; Acacia & lamarchea thicket	15.0	39.5	15	39.5	38
1104	XSZc/a23m 3Sc	Mosaic: Shrublands; scrub-heath / Shrublands; Acacia rostellifera & Melaleuca cardiophylla thickets	80.0	46.2	81	46.8	173
1108	A31Sc	Shrublands; Acacia decipiens	4662.0	55.1	4659	55.1	8460
1109	AgSi	Shrublands; peppermint scrub, Agonis flexuosa	22023.0	64.9	20084	59.2	33933
1111	E37Mi	Medium woodland; yate (E. occidentalis)	629.0	78.4	629	78.4	802
1112	E1Tc/e2,3T c	Mosaic: Tall forest; karri / Tall forest; jarrah & marri	2372.0	22.2	9653	90.4	10676
1113	JZc	Shrublands; Jacksonia horrida heath	3107.0	59.3	3110	59.4	5236
1114	MLSi	Shrublands tree-heath; paperbark over teatree thickets	1505.0	7.6	9308	46.9	19846
1115	E3,37Mi	Medium woodland; marri & yate	1209.0	95.0	1209	95.0	1273
1116	E2Tc	Tall forest; jarrah (E. marginata)	0.0	0.0	3615	78.1	4628
1130	E1,68Tc	Tall forest; karri & red tingle (E. jacksonii)	821.0	82.2	821	82.2	999
1131	E37Mc	Medium forest; bushy yate (E. cornuta)	276.0	97.2	276	97.2	284
1132	E3Mc	Medium forest; marri	132.0	48.2	177	64.6	274
1134	E2Mi	Medium woodland; jarrah (south coast)	9881.0	27.8	24451	68.9	35482

Table 5. Reservation status continued.

1136	E3Mi (e2,5,18,c)	Medium woodland; marri with some jarrah, wandoo, river gum and casuarina	36.0	0.1	862	1.5	57060
1137	XSi	Shrublands; Melaueca incana, Hakea tuberculata, Viminaria juncea scrub on ironstone, south coast.	120.0	11.1	134	12.4	1081
1138	E2,3Lc	Low forest; jarrah & marri	55.0	8.3	27	4.1	660
1139	E1,74Tc	Tall forest; karri & yellow tingle (E. guilfoyleii)	2416.0	18.1	11188	84.0	13320
1144	E1,3Tc	Tall forest; karri & marri (E. calophylla)	30847.0	18.6	117666	71.1	165458
1147	X10SZc	Shrublands; scrub-heath in the south-east Avon-Wheatbelt Region	0.0	0.0	0	0.0	1452
1150	E1,68,74Tc	Tall forest; karri, red tingle & yellow tingle	30.0	57.7	30	57.7	52
1151	E2,68Mc	Medium forest; jarrah & red tingle	153.0	56.9	183	68.0	269
1152	E2,74Mc	Medium forest; jarrah & yellow tingle	1308.0	27.5	4518	94.9	4763
1157	E2,3,Tc	Tall forest; jarrah & marri	172.0	13.9	970	78.4	1237
1180	ChSc	Shrublands; Calothamnus quadrifidis & Hakea trifircata (Cape Naturaliste)	1634.0	62.3	1624	61.9	2622
1181	E2,63Mi	Medium woodland, jarrah & Eucalyptus haematoxylon (Whicher Ra.)	642.0	3.3	5519	28.6	19318
1182	E18mMi	Medium woodland; Eucalyptus rudis & Melaleuca rhaphiophylla	159.0	0.7	3597	15.4	23357
1183	E18,72Mi	Medium woodland; Eucalyptus rudis & blackbutt with some bullich, jarrah & marri (fringing Blackwood R.)	3197.0	35.3	6204	68.4	9065
1184	E2,3,18,ag Mi	Medium woodland-fringing; jarrah, marri, Eucalyptus rudis & Agonis flexuosa	2881.0	4.5	16562	26.1	63414
1185	E2,3,72Mi	Medium woodland; jarrah, marri & blackbutt	2817.0	18.6	12768	84.1	15175
1200	E8,9Mi/e15, 27Si	Mosaic: Medium woodland; salmon gum & morrel / Shrublands; mallee scrub Eucalyptus eremophila & black marlock (E. redunca)	0.0	0.0	101	0.5	21782
2048	X13SZc	Shrublands; scrub-heath in the Mallee Region	0.0	0.0	124	2.1	5859
2093	E7Mi mSi k3Ci	Succulent steppe with open woodland & scrub; yate over teatree & samphire	0.0	0.0	1463	15.8	9253
3041	A19c5Li/roc k	Mosaic: Low woodland; Allocasuarina huegeliana & jam around granite rocks	0.0	0.0	1	0.0	2262
3048	X14SZc	Shrublands; scrub-heath on the Swan Coastal Plain	0.0	0.0	0	0.0	369

Map 5. Conservation reserves and other CALM-managed lands in the South West Catchments NRM Region

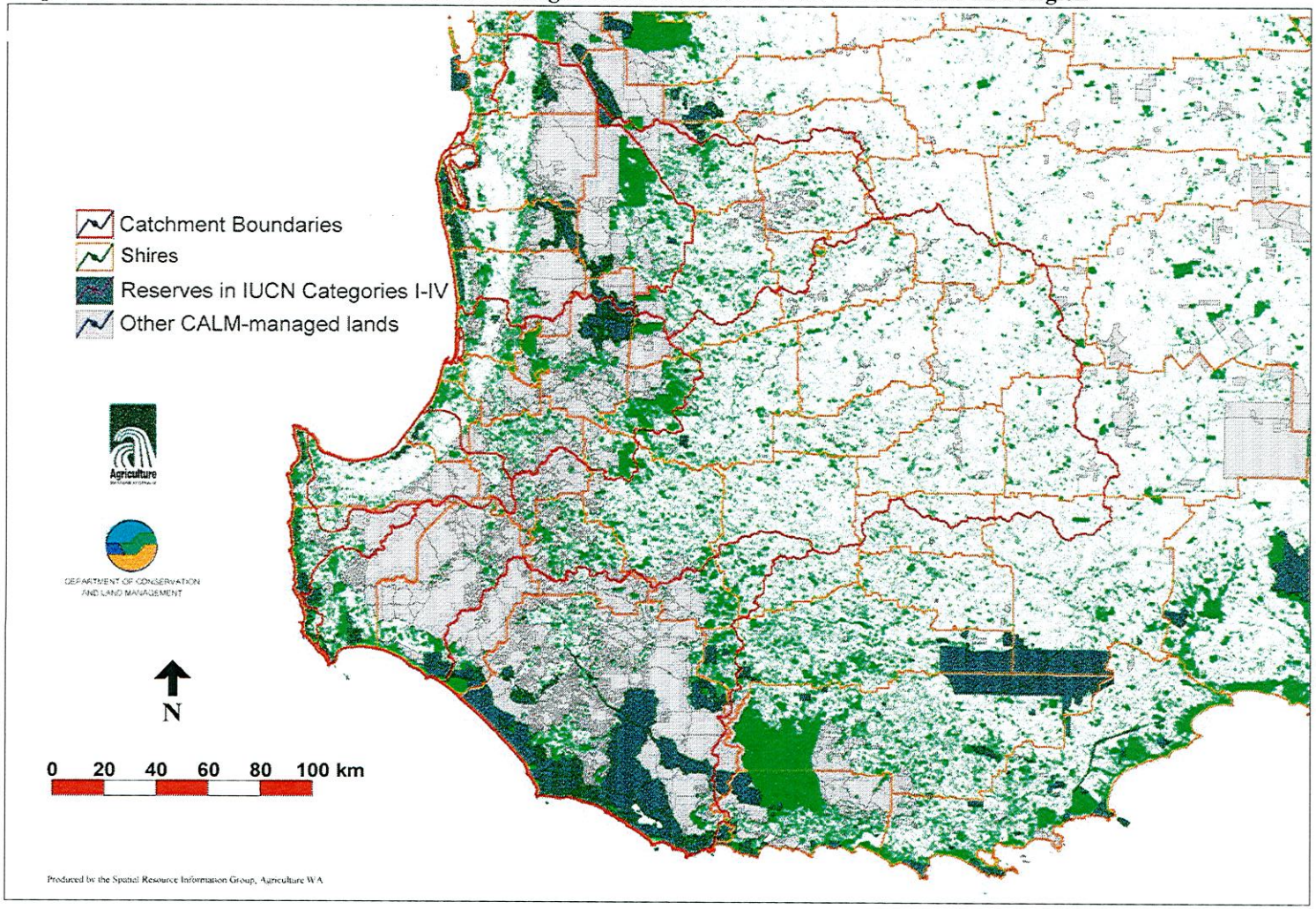


Table 6. Unreserved vegetation associations: vegetation associations not represented in any CALM-managed land within the South West Catchments NRM Region. Those that are also unreserved outside the Region are shaded.

Veg Assoc	Beard Code	Vegetation Association Description
13	e5Mr	Medium open woodland; wandoo
131	e8,34Mi/e10,27Si	Mosaic: Medium woodland; salmon gum & gimlet / Shrublands; mallee scrub, redwood & black marlock
511	e8,9Mi	Medium woodland; salmon gum & morrel
931	e7Mi	Medium woodland; yate
955	x10SZc/c3Sc	Mosaic: Shrublands; scrub-heath (SE Avon)/ Shrublands; Allocasuarina campestris thicket
962	e64Mi	Medium woodland; mallet (E. astringens)
987	e2,5Mi	Medium woodland; jarrah & wandoo
1005	c5Li	Low woodland; Allocasuarina huegeliana
1008	e3Mr	Medium open woodland; marri
1009	e3,18Mr	Medium woodland; marri & river gum
1026	a23,32m3Sc/a26m4Zc	Mosaic: Shrublands; Acacia rostellifera, A. cyclops (S) & Melaleuca cardiophylla (N) thicket / Shrublands; Acacia lasiocarpa & Melaleuca acerosa heath
1031	hSZc/dZc	Mosaic: Shrublands; hakea scrub-heath / Shrublands; dryandra heath
1034	e3,5,45Mi	Medium woodland; marri, wandoo & powderbark
1040	c6e6Mi	Medium woodland; York gum & Casuarina obesa
1085	e5,69Mi	Medium woodland; wandoo & blue mallet (E. gardneri)
1088	e64,69 Mi	Medium woodland; mallet & blue mallet
1096	e7,8Mi	Medium woodland; yate & salmon gum
1147	x10SZc	Shrublands; scrub-heath in the south-east Avon-Wheatbelt Region
3041	a19c5Li/rock	Mosaic: Low woodland; Allocasuarina huegeliana & jam around granite rocks
3048	x14SZc	Shrublands; scrub-heath on the Swan Coastal Plain

Table 7. Unreserved vegetation associations: vegetation associations not represented in conservation reserves that meet criteria for IUCN Reserve Categories I-IV within the South West Catchments NRM Region. Vegetation associations that are completely unrepresented in reserves in IUCN Categories I-IV within the whole South West Agricultural Region are shaded.

Veg Assoc No.	Beard Code	Vegetation Association Description
5	e5,45Mi	Medium woodland; wandoo & powderbark (E. accedens)
7	e5,6Mi	Medium woodland; York gum (E. loxophleba) & wandoo
8	e8,34Mi	Medium woodland; salmon gum & gimlet
13	e5Mr	Medium open woodland; wandoo
25	c5e6Ll	Low woodland; Allocasuarina huegeliana & York gum
38	xSc	Shrublands; thicket, mixed
49	xZc	Shrublands; mixed heath
131	e8,34Ml/e10,27 Sl	Mosaic: Medium woodland; salmon gum & gimlet / Shrublands; mallee scrub, redwood & black marlock
142	e6,8Mi	Medium woodland; York gum & salmon gum
352	e6Mi	Medium woodland; York gum
511	e8,9Mi	Medium woodland; salmon gum & morrel
929	e33Lc	Low forest; moort (E. platypus)
931	e7Mi	Medium woodland; yate
938	e6,7Mi	Medium woodland; York gum & yate
946	e5Mi	Medium woodland; wandoo
947	e64,45Mi	Medium woodland; powderbark & mallet
952	dZc	Shrublands; dryandra heath
953	mSc k3Ci	Succulent steppe with thicket; teatree over samphire (m5?)
955	x10SZc/c3Sc	Mosaic: Shrublands; scrub-heath (SE Avon)/ Shrublands; Allocasuarina campestris thicket
961	x10SZc/c4Sc	Mosaic: Shrublands; scrub-heath (SE Avon)/ Shrublands; Allocasuarina acutivalvis thicket
962	e64Mi	Medium woodland; mallet (E. astringens)
967	e5,7Mi	Medium woodland; wandoo & yate
987	e2,5Mi	Medium woodland; jarrah & wandoo
1005	c5Ll	Low woodland; Allocasuarina huegeliana
1006	e2,5,45Mi	Medium woodland; jarrah, wandoo & powderbark
1023	e5,6,8Ml	Medium woodland; York gum, wandoo & salmon gum (E. salmonophloia)
1026	a23,32m3Sc/a 26m4Zc	Mosaic: Shrublands; Acacia rostellifera, A. cyclops (S) & Melaleuca cardiophylla (N) thicket / Shrublands; Acacia lasiocarpa & Melaleuca acerosa heath
1031	hSZc/dZc	Mosaic: Shrublands; hakea scrub-heath / Shrublands; dryandra heath
1034	e3,5,45Mi	Medium woodland; marri, wandoo & powderbark
1036	b3Li	Low woodland; Banksia prionotes
1040	c6e6Ml	Medium woodland; York gum & Casuarina obesa
1051	e5,7Mr mSc	Shrublands; teatree thicket with scattered wandoo & yate
1053	e6Mr m6Sc	Shrublands; Melaleuca uncinata thicket with scattered York gum
1073	e5,64Mi	Medium woodland; wandoo & mallet
1074	e5c6Mr mSc k3Ci	Succulent steppe with open woodland & thicket; wandoo & Allocasuarina obesa over teatree & samphire
1075	e15,27Sl	Shrublands; mallee scrub, Eucalyptus eremophila & black marlock (E.redunca)

Table 7. Vegetation associations not represented in reserves in IUCN Categories I – IV continued.

1083	e5,8c6Mr mSi k3Cl	Succulent steppe with open woodland & scrub; wandoo, salmon gum & Allocasuarina obesa over teatree & samphire
1085	e5,69Mi	Medium woodland; wandoo & blue mallet (E. gardneri)
1087	e5,9,69Mi	Medium woodland; wandoo, morrell & blue mallet
1088	e64,69 Mi	Medium woodland; mallet & blue mallet
1091	b3c5Li	Low woodland; Banksia prionotes & Allocasuarina huegelianna
1092	e5,6,9 Mi	Medium woodland; wandoo, York gum & morrell
1093	ec6Mr mSc k3Cl	Succulent steppe with open woodland & thicket; eucalypts & Allocasuarina obesa over teatree & samphire
1094	e6,8Mi/e15,27 Si	Mosaic: Medium woodland; York gum & salmon gum / Shrublands; mallee scrub Eucalyptus eremophila & black marlock
1096	e7,8Mi	Medium woodland; yate & salmon gum
1147	x10SZc	Shrublands; scrub-heath in the south-east Avon-Wheatbelt Region
1200	e8,9Mi/e15,27 Si	Mosaic: Medium woodland; salmon gum & morrel / Shrublands; mallee scrub Eucalyptus eremophila & black marlock (E. redunca)
2048	x13SZc	Shrublands; scrub-heath in the Mallee Region
2093	e7Mi mSi k3Cl	Succulent steppe with open woodland & scrub; yate over teatree & samphire
3041	a19c5Li/rock	Mosaic: Low woodland; Allocasuarina huegeliana & jam around granite rocks
3048	x14SZc	Shrublands; scrub-heath on the Swan Coastal Plain

* Some additional types occurring within the RFA area have not been included here as they have been dealt with under the RFA process.

Map 6. Vegetation associations completely unrepresented in conservation reserves in IUCN Categories I-IV or in other CALM-manged lands within the South West Catchments NRM Region

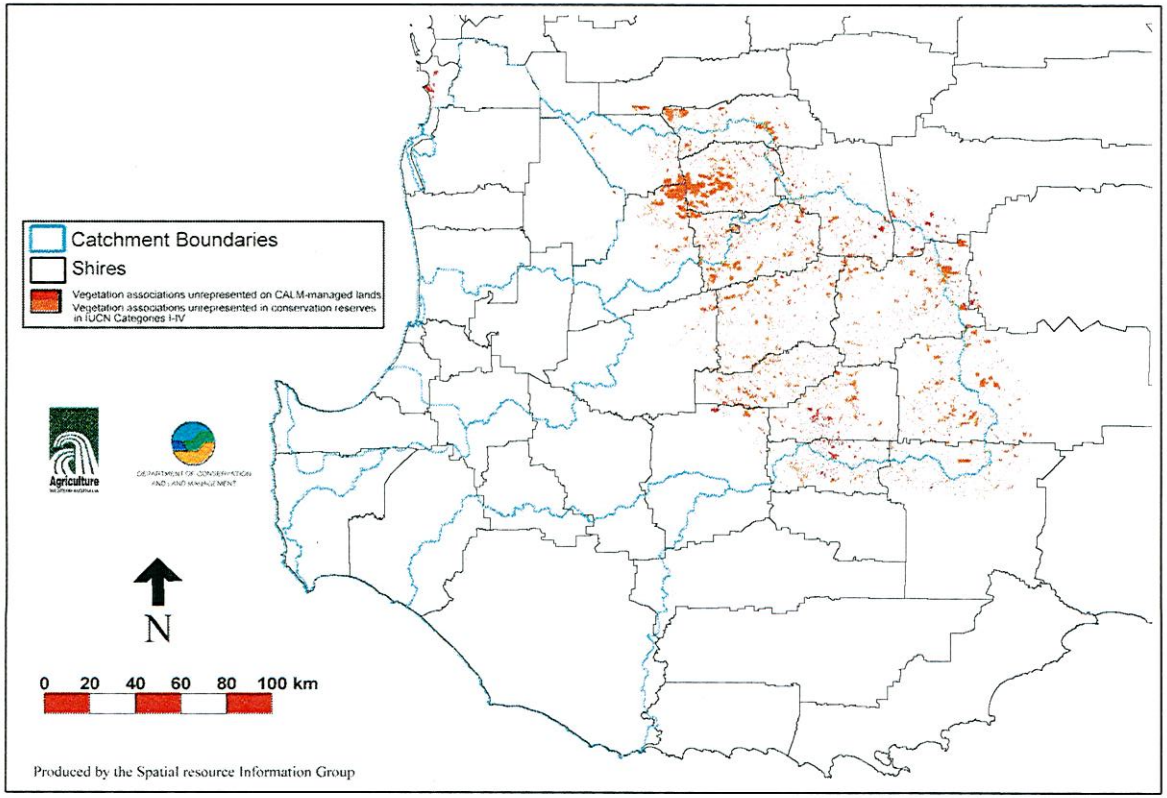


Table 8. Poorly reserved vegetation associations: vegetation associations with >0% but <15% of their pre-European vegetation extent in CALM-managed lands within the South West Catchments NRM Region. Vegetation associations also with >0% but <15% of the pre-European vegetation in CALM-managed lands within the SW Agricultural Region are shaded.

Veg Assoc	Beard Code	Vegetation Association Description
4	e3,5Mi	Medium woodland; marri & wandoo
7	e5,6Mi	Medium woodland; York gum (E. loxophleba) & wandoo
8	e8,34Mi	Medium woodland; salmon gum & gimlet
25	c5e6Li	Low woodland; Allocasuarina huegeliana & York gum
48	XSZc	Shrublands; scrub-heath
49	XZc	Shrublands; mixed heath
125	SI	Bare areas; salt lakes
142	e6,8Mi	Medium woodland; York gum & salmon gum
352	e6Mi	Medium woodland; York gum
676	k3Ci	Succulent steppe; samphire
929	e33Lc	Low forest; moort (E. platypus)
938	e6,7Mi	Medium woodland; York gum & yate
946	e5Mi	Medium woodland; wandoo
949	Bli	Low woodland; banksia
963	e7mMi	Medium woodland; yate & paperbark (Melaleuca spp)
967	e5,7Mi	Medium woodland; wandoo & yate
968	e2,3,5Mi	Medium woodland; jarrah, marri & wandoo
973	MLc	Low forest; paperbark (Melaleuca rhaphiophylla)
992	e2,5Mc	Medium forest; jarrah & wandoo (E. wandoo)
999	e3Mi	Medium woodland; marri
1000	e2,3Mi/bLi/mLc	Mosaic: Medium forest; jarrah-marri / Low woodland; banksia / Low forest; teatree (Melaleuca spp.)
1001	e2Mb cbLi	Medium very sparse woodland; jarrah, with low woodland; banksia & casuarina
1006	e2,5,45Mi	Medium woodland; jarrah, wandoo & powderbark
1023	e5,6,8Mi	Medium woodland; York gum, wandoo & salmon gum (E. salmonophloia)
1036	b3Li	Low woodland; Banksia prionotes
1051	e5,7Mr mSc	Shrublands; teatree thicket with scattered wandoo & yate
1075	e15,27Si	Shrublands; mallee scrub, Eucalyptus eremophila & black marlock (E.redunca)
1083	e5,8c6Mr mSi k3Ci	Succulent steppe with open woodland & scrub; wandoo, salmon gum & Allocasuarina obesa over teatree & samphire
1087	e5,9,69Mi	Medium woodland; wandoo, morrell & blue mallet
1091	b3c5Li	Low woodland; Banksia prionotes & Allocasuarina huegelianna
1092	e5,6,9 Mi	Medium woodland; wandoo, York gum & morrell
1093	ec6Mr mSc k3Ci	Succulent steppe with open woodland & thicket; eucalypts & Allocasuarina obesa over teatree & samphire
1094	e6,8Mi/e15,27 SI	Mosaic: Medium woodland; York gum & salmon gum / Shrublands; mallee scrub Eucalyptus eremophila & black marlock
1136	e3Mi (e2,5,18,c)	Medium woodland; marri with some jarrah, wandoo, river gum and casuarina
1137	Xsi	Shrublands; Melaueca incana, Hakea tuberculata, Viminaria juncea scrub on ironstone, south coast.
1138	e2,3Lc	Low forest; jarrah & marri
1200	e8,9Mi/e15,27 SI	Mosaic: Medium woodland; salmon gum & morrel / Shrublands; mallee scrub Eucalyptus eremophila & black marlock (E. redunca)
2048	x13SZc	Shrublands; scrub-heath in the Mallee Region

Table 9. Poorly reserved vegetation associations: Vegetation associations with >0 but <15% of their pre-European extent in conservation reserves that meet criteria for IUCN Reserve Categories I–IV within the South West Catchments Region. Vegetation associations also with >0 but <15% of their pre-European vegetation in reserves in IUCN Categories I - IV within the whole South West Agricultural Region are shaded.

Veg Assoc No.	Beard Code	Vegetation Association Description
4	e3,5Mi	Medium woodland; marri & wandoo
6	e2,4Mi	Medium woodland; tuart & jarrah
37	MSc	Shrublands; teatree thicket
48	XSZc	Shrublands; scrub-heath
125	SI	Bare areas; salt lakes
676	k3Ci	Succulent steppe; samphire
949	Bli	Low woodland; banksia
963	e7mMi	Medium woodland; yate & paperbark (Melaleuca spp)
968	e2,3,5Mi	Medium woodland; jarrah, marri & wandoo
973	MLc	Low forest; paperbark (Melaleuca rhaphiophylla)
1000	e2,3Mi/bLi/mLc	Mosaic: Medium forest; jarrah-marri / Low woodland; banksia / Low forest; teatree (Melaleuca Spp.)
1001	e2Mb cbLi	Medium very sparse woodland; jarrah, with low woodland; banksia & casuarina
1114	mLSi	Shrublands tree-heath; paperbark over teatree thickets
1136	e3Mi (e2,5,18,c)	Medium woodland; marri with some jarrah, wandoo, river gum and casuarina
1137	xSi	Shrublands; Melaueca incana, Hakea tuberculata, Viminaria juncea scrub on ironstone, south coast.
1182	e18mMi	Medium woodland; Eucalyptus rudis & Melaleuca rhaphiophylla

* Some additional types occurring within the RFA area have not been included here as they have been dealt with under the RFA process.

Vegetation associations both limited in extent and poorly reserved

Table 10 represents a distillation of the data in Tables 2, 3, 6,7 and 9. Forty-three vegetation associations are both extremely limited in extent and completely unrepresented in the present conservation reserve system or completely inadequately reserved. These vegetation associations are considered to be the types most in need of further attention in order to ensure their conservation within the South West Catchments NRM Region. The criteria within each of the two main categories of 'limited extent' and 'poor reservation' that were used to develop the list are shown as fields in Table 10. Vegetation associations that meet one or more of the criteria in both these categories are included in the list.

It would be possible to prioritise the vegetation associations in Table 10 by further interrogating the individual tables in earlier parts of this report.

The distribution of these vegetation associations is illustrated in Map 7.

Table 10. Vegetation associations that are extremely limited in their present extent and poorly represented in the present conservation reserve system.

			Limited Extent				Poorly Reserved			
Veg Assoc No.	Beard Code	Description	<2000ha in SW Catchments	<2000ha in SW Agric Region	<10% remaining in Catchments	<10% remaining in SW Agric Region	unreserved in IUCN in SW Catchments	<15% reserved in IUCN in SW Catchments	unreserved in IUCN in SW Agric Region	<15% reserved in IUCN in SW Agric Region
7	E5,6Mi	Medium woodland; York gum (E. loxophleba) & wandoo	X				x	x		x
8	E8,34Mi	Medium woodland; salmon gum & gimlet	X			x	x	x	x	x
13	E5Mr	Medium open woodland; wandoo	X				x	x		
25	C5e6Li	Low woodland; Allocasuarina huegeliana & York gum	X	x			x	x	x	x
38	XSc	Shrublands; thicket, mixed	X				x	x		
48	XSZc	Shrublands; scrub-heath	X					x		x
49	XZc	Shrublands; mixed heath	X				x	x		x
131	E8,34Mi/e1 0,27Si	Mosaic: Medium woodland; salmon gum & gimlet / Shrublands; mallee scrub, redwood & black marlock	X		x	x	x	x	x	x
142	E6,8Mi	Medium woodland; York gum & salmon gum	X		x	x	x	x		x
511	E8,9Mi	Medium woodland; salmon gum & morrel	X		x		x	x	x	x
676	K3Ci	Succulent steppe; samphire	X	x		x		x		x
929	E33Lc	Low forest; moort (E. platypus)	X				x	x	x	x
931	E7Mi	Medium woodland; yate	X				x	x		x
938	E6,7Mi	Medium woodland; York gum & yate	X				x	x		x
953	MSc k3Ci	Succulent steppe with thicket; teatree over samphire (m5?)	X	x		x	x	x	x	x
955	X10SZc/c3 Sc	Mosaic: Shrublands; scrub-heath (SE Avon)/ Shrublands; Allocasuarina campestris thicket	X			x	x	x	x	x
961	X10SZc/c4 Sc	Mosaic: Shrublands; scrub-heath (SE Avon)/ Shrublands; Allocasuarina acutivalvis thicket	X				x	x	x	x
962	E64Mi	Medium woodland; mallet (E. astringens)	X	x			x	x	x	x
963	E7mMi	Medium woodland; yate & paperbark (Melaleuca spp)	X	x				x		x

Table 10. Vegetation associations both limited in extent and poorly reserved continued.

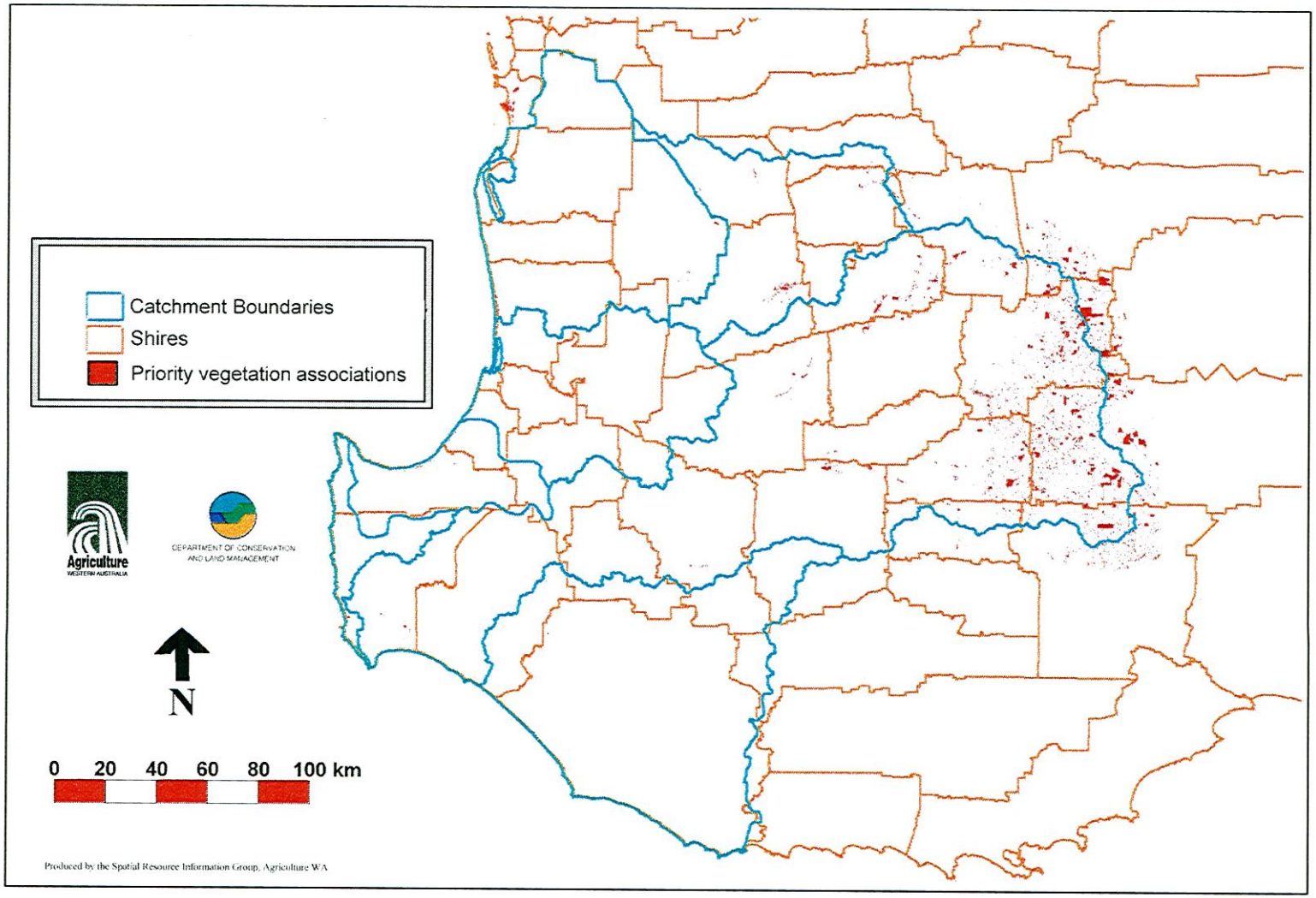
973	MLc	Low forest; paperbark (Melaleuca rhaphiophylla)	X					x		x
987	E2,5Mi	Medium woodland; jarrah & wandoo	X	x			x	x		
1005	C5Li	Low woodland; Allocasuarina huegeliana	X	x			x	x	x	x
1023	E5,6,8Mi	Medium woodland; York gum, wandoo & salmon gum (E. salmonophloia)			x	x	x	x	x	x
1026	A23,32m3Sc/a26m4Zc	Mosaic: Shrublands; Acacia rostellifera, A. cyclops (S) & Melaleuca cardiophylla (N) thicket / Shrublands; Acacia lasiocarpa & Melaleuca acerosa heath	X				x	x		
1031	HSZc/dZc	Mosaic: Shrublands; hakea scrub-heath / Shrublands; dryandra heath	X				x	x		x
1034	E3,5,45Mi	Medium woodland; marri, wandoo & powderbark	X	x			x	x		
1036	B3Li	Low woodland; Banksia prionotes	X				x	x		
1040	C6e6Mi	Medium woodland; York gum & Casuarina obesa	X	x			x	x	x	x
1053	E6Mr m6Sc	Shrublands; Melaleuca uncinata thicket with scattered York gum	X	x		x	x	x	x	x
1074	E5c6Mr mSc k3Ci	Succulent steppe with open woodland & thicket; wandoo & Allocasuarina obesa over teatree & samphire	X	x			x	x	x	x
1075	E15,27Si	Shrublands; mallee scrub, Eucalyptus eremophila & black marlock (E.redunca)			x	x	x	x	x	x
1087	E5,9,69Mi	Medium woodland; wandoo, morrell & blue mallet	X	x			x	x	x	x
1088	E64,69 Mi	Medium woodland; mallet & blue mallet	X	x			x	x	x	x
1091	B3c5Li	Low woodland; Banksia prionotes & Allocasuarina huegelianna	X	x			x	x	x	x
1092	E5,6,9 Mi	Medium woodland; wandoo, York gum & morrell			x	x	x	x	x	x
1093	Ec6Mr mSc k3Ci	Succulent steppe with open woodland & thicket; eucalypts & Allocasuarina obesa over teatree & samphire	X	x	x	x	x	x	x	x
1094	E6,8Mi/e15,27Si	Mosaic: Medium woodland; York gum & salmon gum / Shrublands; mallee scrub Eucalyptus eremophila & black marlock			x	x	x	x	x	x
1096	E7,8Mi	Medium woodland; yate & salmon gum	X	x			x	x	x	x
1137	XSi	Shrublands; Melaueca incana, Hakea tuberculata, Viminaria juncea scrub on ironstone, south coast.	X	x				x		x

Table 10. Vegetation associations both limited in extent and poorly reserved continued.

1147	X10SZc	Shrublands; scrub-heath in the south-east Avon-Wheatbelt Region	X		x	x	x	x	X	X
2048	X13SZc	Shrublands; scrub-heath in the Mallee Region	X				x	x	X	X
3041	A19c5Li/rock	Mosaic: Low woodland; Allocasuarina huegeliana & jam around granite rocks	X	x			x	x	X	X
3048	X14SZc	Shrublands; scrub-heath on the Swan Coastal Plain	X				x	x	X	X

* Some additional types occurring within the RFA area have not been included here as they have been dealt with under the RFA process.

Map 7. Priority vegetation associations in the South West Catchments NRM Region.



3.2 Rare and Priority Flora

The Rare and Priority Flora found in the South West Catchments NRM Region, and the catchments in which they occur, are listed in Appendix 4 (on CD ROM). The flora are ranked as Extinct (Ex), Critically Endangered (CR), Endangered (EN), Vulnerable (VU), or Priority flora (P1 – P4). The ranking for each species is determined by the Threatened Species Scientific Committee (TSSC).

There are 24 species listed as critically endangered, 24 species listed as endangered, 24 species listed as vulnerable, and one species is extinct. There are also 52 Priority One species, 72 Priority Two species, 74 Priority Three species and 57 Priority Four species.

3.3 Fauna

Appendix 5 (on CD ROM) lists the vertebrate fauna known from the South West Catchments NRM Region, including introduced animals. The Region has a rich fauna, with 49 known species of terrestrial mammals, approximately 137 species of reptiles and amphibians, and more than 350 known species of birds. The lists include threatened and priority fauna, which are ranked as Extinct (Ex), Critically Endangered (CR), Endangered (EN), Vulnerable (VU), or Priority fauna (P1 – P4). The ranking for each species is determined by the Threatened Species Scientific Committee (TSSC). Sixteen mammal species, 7 reptiles and amphibians, and 28 birds occurring in the Region are listed as either threatened or Priority species. Two mammal species and one bird species are extinct in the Region.

Appendix 5 also includes other fauna from the list of threatened and priority fauna that occur in the Region, including marine mammals, fish and invertebrates. Invertebrates make an important contribution to biodiversity in the south west but are poorly known and too numerous to document. However, records for specific habitats are available in many cases and should be considered in any assessment of the biodiversity of a localised area.

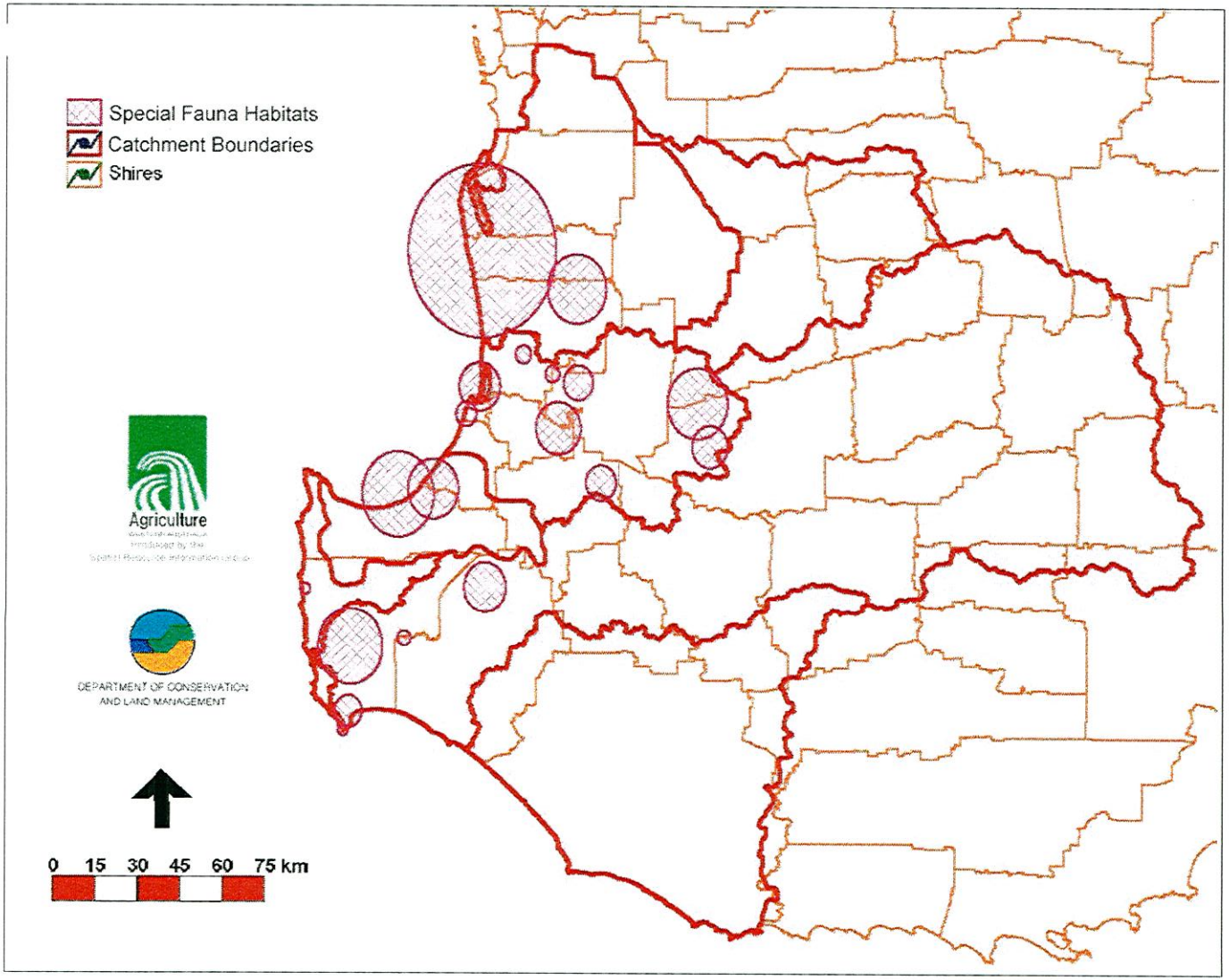
Although habitat information is available for many species in the south west, the time constraints of this project did not permit the inclusion of habitat data. However, as a preliminary means of identifying areas of importance to fauna conservation a judgement based on scientific opinion was made as to the general location of some of these areas (Kim Williams, personal communication 2000). Areas of importance to several threatened species and to waterbirds are shown in Map 8. It would be useful to obtain this information for more species in the Region, along with specific habitat details, in order to identify 'hotspots' for biodiversity.

3.4 Threatened Ecological Communities

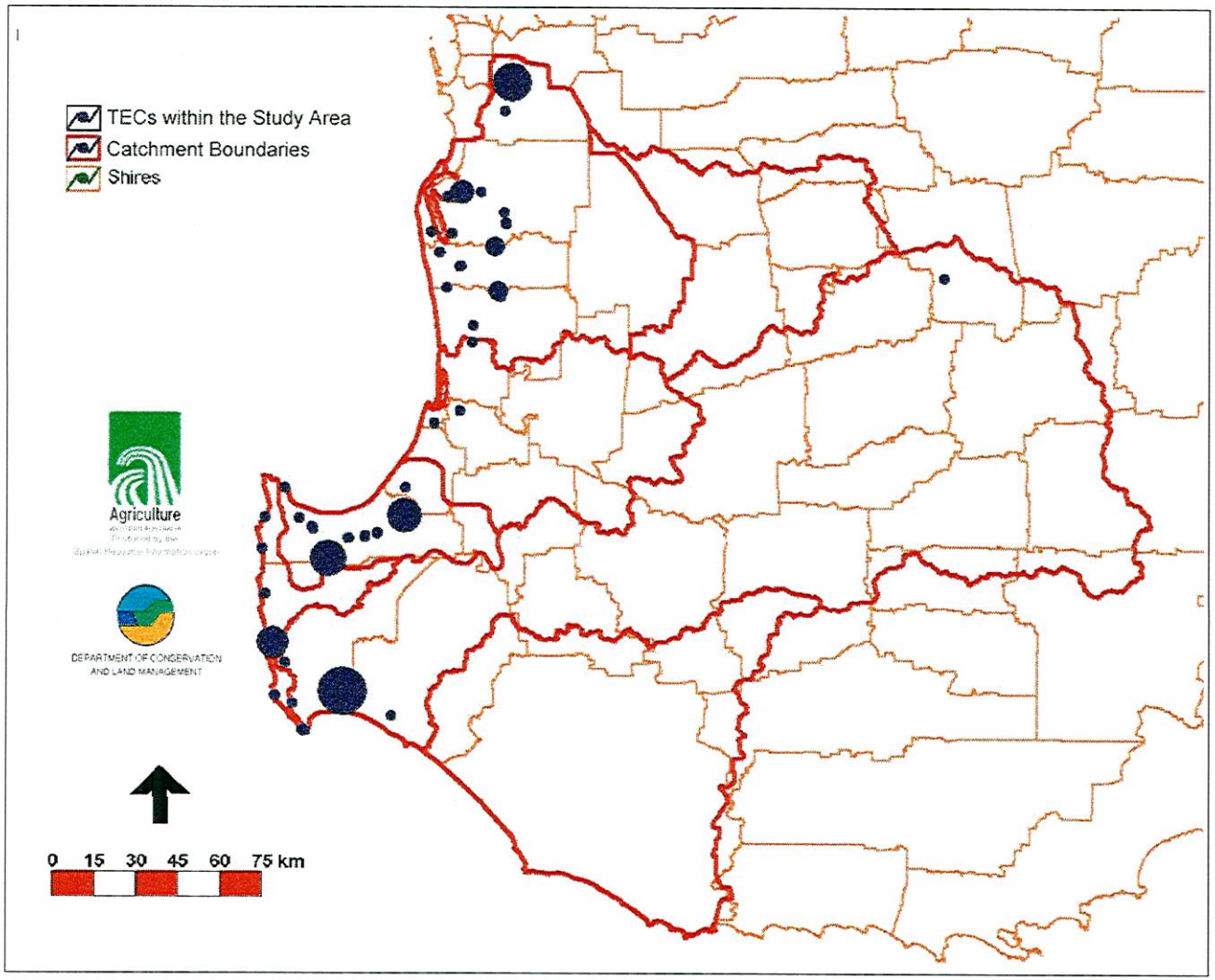
The South West Catchments NRM Region contains twenty known Threatened Ecological Communities (TECs) identified by the Department of Conservation and Land Management (Appendix 6 on CD ROM). The approximate distribution of TECs is shown on Map 9. TECs have been identified on the basis of available information, including aerial photographs and soil maps. Map 9 shows that most of the known TECs are concentrated along coastal sections of the Region. Many other ecosystems and communities, both on the coast and inland areas, have been reduced greatly in area and are likely to be vulnerable to threatening processes in the catchments. Some TECs are likely to occur on private land, and so partnerships between CALM and landholders are therefore needed to identify and manage TECs in a manner beneficial to all stakeholders. More specific information concerning TECs and measures currently being undertaken for their protection and/or rehabilitation is available from

the Western Australian Threatened Species and Communities Unit (WATSCU), Department of CALM.

Map 8. Areas of importance to some threatened species and to waterbirds in the South West Catchments NRM Region



Map 9. Threatened Ecological Communities in the South West Catchments NRM Region



4. Discussion and Conclusions

The South West Catchments NRM Region is a very important part of the State from a nature conservation point of view. It is diverse: its environments range from the only remaining example of wet sclerophyll forest with its associated Gondwanan invertebrate faunas, through to dry sclerophyll forests, coastal woodlands and scrub, several major river systems, lakes and swamps, to remnants of the biologically important woodlands and shrublands of the wheatbelt. The region ranks among the most important areas for plant biodiversity in the world, with a rich flora with a high level of endemism. The flora includes numerous rare and threatened plant species, many which are poorly known. The vertebrate and invertebrate faunas are also rich; the invertebrates are very poorly known.

The area encompassed by the catchments is subject to many of the pressures common to the larger South West Agricultural Region. Within the area known as the wheatbelt, and on the Swan Coastal Plain particularly, extensive clearing of native vegetation and modification of the environment have resulted in highly fragmented landscapes. The effects of the subsequent losses of biodiversity are compounded by threats associated with rising groundwater and consequent salinisation, grazing and soil erosion. In fragmented landscapes, remnant vegetation such as that on farms and undisturbed roadside areas becomes important habitat for plants and animals, and may constitute the only remaining examples of some ecosystems.

The Region also retains substantial areas of State forest and relatively undisturbed vegetation along the South Coast. Such areas are extremely important to the overall biodiversity of the Region. Large areas of forest and natural bushland in the South West are also important as places for recreation and education, and thus have an intrinsic value cannot be measured in the same way as biodiversity. Although the forests are extensive and relatively intact, they too are subject to numerous threats including *Phytophthora* infection, the presence of foxes and feral cats, and the effects of adjacent land uses.

Data on the 116 vegetation associations originally present in the South West Catchments NRM Region are provided. Half of these are endangered or vulnerable. More than half of the vegetation associations are completely unrepresented, or very poorly represented, in the present conservation reserve system. Forty-three vegetation associations are both endangered, and are either not reserved or poorly represented in the conservation reserve system. These 43 vegetation associations should be the subject of detailed, on-ground survey as a matter of priority. They may qualify for classification as Threatened Ecological Communities (English and Blyth 1999). It is probable that other vegetation associations will qualify for entry in the TECs database as lower priority conservation entities.

Vegetation associations in the whole of the Western Australian wheatbelt have been evaluated recently for their potential to be seriously at risk as a consequence of rising watertables and associated salinisation (Hopkins 2000). The evaluation was based on the intersection of the present vegetation type and extent data set with a data set of soil landscapes containing a high proportion of saline or potentially saline soils. A similar analysis was not employed in this project because the salinity assessment in the South West Cacthments NRM Region was undertaken by separate consultants.

The fauna and flora of the Region was assessed. Of the guestimated 3,500 species of vascular plant species thought to occur in the Region (cf. C&WARFASC 1998), 339 are Rare and Priority Flora. The Region also has a rich fauna: 46 known species of

terrestrial mammals, 137 species of reptiles and amphibians, and 376 species of birds are listed in this report. The most up-to-date information on the conservation status of each species, and some initial mapping of habitats of special significance for fauna are also given. Although the fauna and flora lists are comprehensive, it is likely that they are not complete as there was not sufficient time to consult all available documentary sources. For example, we are aware of the study by Horwitz (1994) which identified areas of high local endemism for freshwater invertebrates in the South West: we have not used these data at all in this preliminary assessment.

The South West Catchments NRM Region contains 23 Threatened Ecological Communities (TECs). These include entities such as floristic communities, invertebrate communities restricted to root mats in caves and microbial communities forming stromatolites and related structures. However, development of the TECs database is in its infancy, so it highly probable that additional TECs will be identified with further survey. As noted above, some of the vegetation associations found in the South West Catchments NRM Region are potential candidates for the TECs database. Some TECs are likely to occur on private land, and so partnerships between CALM and landholders will be needed to identify and manage TECs in a manner beneficial to all stakeholders. More specific information concerning TECs and measures currently being undertaken for their protection and/or rehabilitation is available from the Western Australian Threatened Species and Communities Unit (WATSCU), Department of CALM.

The South West Catchments NRM Region is a very important part of the State from a nature conservation point of view. This preliminary assessment has highlighted some of the special values, including some areas that should be given priority for management to protect those values. We recommend the on-going development of these data sets and their use in the planning and management of the South West Catchments NRM Region. For example, although habitat information is available for many species in the South West, the time constraints of this project did not permit its inclusion. Here we have merely presented a preliminary assessment of areas of importance to fauna conservation based on scientific opinion (Kim Williams, personal communication 2000). The more detailed habitat data should be compiled for more species in the Region, as this would enhance our ability to map out biodiversity hotspots, if indeed such things occur at the local scale (cf. Myers 1988).

The diversity of environments in the South West, the species richness and the endemism, the high turnover of species across the landscape, and large number of poorly known species, communities and ecosystems highlights the importance of managing all remaining areas of native vegetation for their nature conservation values. This preliminary assessment has highlighted some of the special values of the South West Catchments NRM Region, including some areas that should be given immediate priority for management. However, it is also important to note that there are significant gaps in the information, and that much more work needs to be done. A sound knowledge of the natural resources of the Region, including the biological diversity, should be considered an essential foundation for on-going natural resources management within the Region. We also recommend ongoing development of procedures for monitoring and evaluation of the biodiversity of the South West Catchments NRM Region, and their application to planning for the effective management of biodiversity.

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