Swan Coastal Plain 2 *(SWA2 – Swan Coastal Plain subregion)*

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Subregional description and biodiversity values

Description and area

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

The Perth subregion is composed of colluvial and aeolian sands, alluvial river flats, coastal limestone. Heath and / or Tuart woodlands on limestone, *Banksia* and Jarrah-*Banksia* woodlands on Quaternary marine dunes of various ages, Marri on colluvial and alluvials. Includes a complex series of seasonal wetlands and also includes Rottnest, Carnac and Garden Islands etc. Rainfall ranges between 600 and 1000 mm annually and the climate is Mediterranean. The subregional area is 1, 333, 901 ha.

Dominant land use

Mainly (iv) Cultivation – dry land agriculture (see Appendix B, key b), (xiii) Conservation, (xi) UCL and Crown reserves, (i) Urban, (ii) Rural residential, (iii) Cultivation – irrigated horticulture, agriculture and plantations, (v) Forestry-plantations, (xiv) Other – roads and other easements and infrastructure, and (viii) Grazing – Improved pastures. There are smaller areas of (vii) Mining, and (xii) Defence lands.

Continental Stress Class

The Continental Stress Class for SWA2 is as 3, however, the southern half of the region is cleared to a similar degree to the Avon Wheatbelt (although there is a greater proportion of remnant vegetation in the northern third of the subregion). The value should be at least 2, or even 1.

Known special values in relation to landscape, ecosystem, species and genetic values

Rare Features: There are Landscape features, such as Holocene dunes and wetlands. Several of the Threatened Ecological Communities, for example tumulus springs etc. are considered rare features. There are a large number of rare and threatened species and Ecological Communities – see listing later in Synopsis.

Refugia:
Caves, tumulus springs, and thrombolite communities provide refugia for relictual species. Off-shore islands provide refugia for mammals, reptiles and sea birds from feral predators.

High Species and Ecosystem Diversity:
The Swan Coastal Plain Subregion is part of the South West Botanical Province which has a very high degree of species diversity. Within the subregion there are areas of relatively high ecosystem or species diversity, notably on the eastern side of the coastal plain. For example, the Brixton Street Bushland has over 555 plant species recorded within it's 126 ha.

Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats

In 1974 the Conservation Through Reserves Committee (CTRC) made recommendations for reserves within the System Six - Swan Coastal Plain in the CTRC Green Book (Environmental Protection Authority 1974), and then Red Book (Department of Conservation and Environment 1983). Some, but not all, of these recommendations (with modification) were implemented over the following ten years.

All but the northern quarter of the subregion is covered by a CALM Regional Management Plan published in 1987 and updated in 1994 (Department of Conservation and Land Management 1994a). These documents provide an overview of biota, addresses land and wildlife conservation issues, but are generalised in attention to detail. The reviews and strategies therein (for reserve system development or management of weeds, fire, feral animals, mining, ecosystem rehabilitation & disease quarantine) do not necessarily address the specific needs of the subregion.

The Perth Metropolitan Area portion of the Swan Coastal Plain (approximately 20% of the whole subregion) has had a comprehensive study of the reservation status and protection requirements in the Perth's Bushplan / Bush Forever project (Western Australian Planning Commission 2000). This has identified regionally significant bushland for protection by reservation or within the statutory planning framework. This study was based on representation of vegetation complexes mapped by Heddle *et al.* (1980) which is at a finer scale than the Beard Vegetation Associations used in this state wide audit. There are proposals for a similar project to Bush Forever to be applied to other areas of the Swan Coastal Plain south of the Perth metropolitan region (System 6 / part 1 update).

The South West Catchment Council's, South West Regional Strategy for Natural Resource Management working (2001) Bush & Biodiversity section identified poorly conserved vegetation associations and nodes of high value fauna conservation within the lower half of the SWA2 subregion. Other sections of the document deal with Waterways and Wetlands, Land Resources and Coastal Environs. Strategic targets for implementation are yet to be developed.

Similar draft Natural Resource Management Strategy has been prepared (Swan Catchment), or is being prepared (Moore River as part of Northern Agricultural Catchment) for the central and northern areas of the subregion respectively.

Wetlands

Wetlands of National significance (DIWA listings)

Name and Code	Description[1]	Condition[2]	Trend[3]	Reliability[4]	Threatening Processes[5]
Barraghup Swamp, SWA001WA	B14	iii	iii	iii	ix, x
Becher Point Wetlands, SWA002WA	B10, B14	iii	iv	iii	vi
Benger Swamp, SWA003WA	B10, B14	iii	iv	iii	vi (typha), v (pig, fox, cat, rat), xii (eutrophication, illegal harvesting, urban development), vii
Booragoon Lake, SWA004WA	B5, B14	iii	iv	iii	xii (eutrophication), x
Brixton Street Swamps, SWA005WA	B13	iii	iv	iii	vi, x vii
Chandala Swamp, SWA006WA	B14	iii	iii	iii	ix, xii (eutrophication), iv
Ellen Brook Swamps System, SWA007WA	B13	iii	iv	iii	v (fox), vii
Forrestdale Lake, SWA008WA	B8	iii	iii	iii	xii (eutrophication), x, vi (typha), xi
Gibbs Road Swamp System, SWA009WA	B14, B13	iii	iv	iii	xii (eutrophication), i, x, xi
Gugura Lake, SWA010WA	B7, B12	iii	iv	iii	x, ix, xi
Herdsman Lake, SWA011WA	B5, B10, B15, B14	ii	iii	iii	xii (eutrophication), xi, vi (typha), v,
Joondalup Lake, SWA012WA	B5	iii	iii	iii	xii (eutrophication), vi (typha), xi, v,
Karakin Lakes, SWA013WA	B10	ii	iv	iii	iv, xii (eutrophication),
Lake McLarty System, SWA014WA	B12, B13, B14	iii	iv	iii	xii (eutrophication), vi (typha),
Lake Thetis, SWA015WA	B7	iii	iv	iii	xii (crushing stromatolites), x
Loch McNess System, SWA016WA	B5, B9, B15, B14, B19	iii	iv	iii	vi
McCarleys Swamp (Ludlow Swamp), SWA017WA	B14	iii	iii	iii	xi, x, xii (eutrophication),
Peel-Harvey Estuary, SWA018WA	A6, A7, A8	iii	iii	iii	xii (eutrophication), x (artificial outlet to sea), xii (urban and canal development, modification of tidal flats)
Perth Airport Woodland Swamps, SWA019WA	B10, B14, C5	iii	iv	iii	vii, vi, v, xi, i
Rottnest Island Lakes, SWA020WA	B7, B8, B12	iii	iii	iii	x, xii (eutrophication, disturbance to birds),
Spectacles Swamp, SWA021WA	B14, B10	iii	iv	iii	x, vi (typha),
Swan-Canning Estuary, SWA022WA	A6, A7, A8	iii	iii	iii	xii (eutrophication), xi, xii (urban development on shore, erosion of shore by boat wake/waves)
Thompsons Lake, SWA023WA	B8	iii	iv	iii	x, xii (eutrophication), vi, v (fox, cat)

Name and Code	Description[1]	Condition[2]	Trend[3]	Reliability[4]	Threatening Processes[5]
Vasse-Wonnerup Wetland System, SWA024WA	B8, B11, A10	iii	iv	iii	x (flood gate management), vi (kikuyu, typha), xii (eutrophication, urban and canal development), v (fox, cat, rabbit)
Yalgorup Lakes System, SWA026WA	B7	iii	iv	iii	xii (eutrophication), x

[1]Appendix B, key d; [2]Appendix C, rank 2; [3]Appendix C, rank 3; [4]Appendix C, rank 1; [5]Appendix B, key e

Wetlands of Subregional significance (in addition to the DIWA listed wetlands)

Over a quarter of the Swan Coastal Plain land area from Wedge Island to Dunsborough is wetland. The Western Australian Water and Rivers Commission have prepared a comprehensive wetland atlas for the Swan Coastal Plain from Wedge Island to Dunsborough, including assessment of the preliminary management categories (into 3 categories: Conservation, Resource Enhancement and Multiple Use Wetland) for 4 700 basin and flat wetlands in the Wedge Island to Mandurah area (Hill *et al.* 1996a and Hill *et al.* 1996b).

Most of those wetlands described as Conservation Wetlands category and many in the Resource Enhancement category would warrant inclusion in this section as Wetlands of Subregional Significance. However the number of wetlands involved makes it impractical to include them all in this synopsis, and the wetland atlas should be used (Hill *et al.* 1996a and Hill *et al.* 1996b).

Riparian zone vegetation

Most rivers in this subregion have the majority of their catchments in subregions to the east. They pass through the subregion on their way to the ocean.

Name	Condition[1]	Trend[2]	Reliability[3]	Threatening Processes[4]
Hill River	i	iii	ii	i, ii, ix, x, iv, vi, v, xi
Moore River/Gingin Brook	i	iii	ii	i, ii, ix, x, iv, vi, v, xi
Swan River	ii	iii	ii	i, ii, ix, x, iv, vi, v, xi
Serpentine River	ii	iii	ii	i, ii, ix, x, iv, vi, v, xi
Murray River	ii	iii	ii	i, ii, ix, x, iv, vi, v, xi
Harvey River	i	iii	ii	i, ii, ix, x, iv, vi, v, xi
Collie River	ii	iii	ii	i, ii, ix, x, iv, vi, v, xi
Preston River	ii	iii	ii	i, ii, ix, x, iv, vi, v, xi
Capel River	ii	iii	ii	i, ii, ix, x, iv, vi, v, xi
Wellesley River	ii	iii	ii	i, ii, ix, x, iv, vi, v, xi

[1]Appendix C, rank 2; [2]Appendix C, rank 3; [3]Appendix C, rank 1; [4]Appendix B, key e

Ecosystems at risk

Threatened ecological communities (TECs)

In general, plant communities comprising of susceptible plant species are threatened by dieback (*Phytopthora cinnamomi*) and can be considered as ecosystems at risk.

These fungi eliminate numerous species of structurally and floristically dominant plant families such as the Proteaceae and Myrtaceae from ecosystems.

Community	Status	NVIS[1]	Condition[2]	Trend[3]	Reliability[4]	Threatening Processes[5]
Aquatic root mat community number 1 of caves of the Swan Coastal Plain	CR	N/A	iii	ii	iii	x (declining groundwater levels – rainfall, extraction)
Communities of Tumulus Springs (Organic Mound Springs, Swan Coastal Plain)	CR	32 wetland	iii	iii	iii	x (declining groundwater levels – rainfall), ii, vii
Eucalyptus calophylla - Kingia australis woodlands on heavy soils, Swan Coastal Plain (Gibson *et al.* 1994: type 3a)	CR	8	ii	iv	iv	ii, v (rabbits), vi (grasses, Watsonia, bridle creeper), vii, viii
Eucalyptus calophylla - Xanthorrhoea preissii woodlands and shrublands, Swan Coastal Plain (Gibson *et al.* 1994: type 3c)	CR	8	ii	iv	iii	ii, v (rabbits, pigs), vi (Watsonia, bridle creeper, introduced monocots), vii, viii, xii (physical disturbance – vehicles)
Community	Status	NVIS[1]	Condition[2]	Trend[3]	Reliability[4]	Threatening Processes[5]
Perth to Gingin Ironstone Association	CR	32	ii	iv	iii	ii, v (rabbits), vi (grasses, Watsonia, bridle creeper), vii, viii
Sedgelands in Holocene dune swales of the southern Swan Coastal Plain (Gibson *et al.* 1994: type 19)	CR	32 wetland	iii	iv	iv	ii, vi (grasses, Watsonia, bridle creeper), vii, v (rabbits), viii
Shrublands and Woodlands of the eastern side of the Swan Coastal Plain (Gibson *et al.* 1994: type 20c)	CR	8	ii	iv	iv	ii, v (rabbits), vi (grasses, Watsonia, bridle creeper), vii, viii

Shrublands and Woodlands on Muchea Limestone	CR	32 wetland	ii	iv	iii	ii, v (rabbits), vi (grasses, Watsonia, bridle creeper), vii, viii
Shrublands on southern Swan Coastal Plain Ironstones (Busselton area) (Community 10b, Gibson *et al*. 1994)	CR	32	ii	iii	iv	ii, iv, v (rabbits), vi (pasture grasses, Watsonia), vii, viii, x, xii (sand mining)
Stromatolite like community of coastal freshwater lakes (Lake Richmond)	CR	42	ii	iv	iii	ix, xi (increased nutrients)
Stromatolite-like microbialite community dependent on fresh ground water of coastal brackish lakes (Extant thrombolitic aragonite community of coastal brackish lakes formed by biologically influenced precipitation of a mineral phase and dominated by *Scytonema* and other cyanobacteria, and diatoms: Lake Clifton, Yalgorup) (Moore 1993)	CR	8	ii	iii	iii	ix, xi (increased nutrients)
Banksia attenuata and/or *Eucalyptus marginata* woodlands of the eastern side of the Swan Coastal Plain (Gibson *et al*. 1994: type 20b)	E	30	ii	iii	iv	i., ii, v (rabbits), vi (grasses, Watsonia, bridle creeper, numerous other garden species resulting from rubbish dumping), vii, viii, x, xii (sand mining)
Banksia attenuata woodland over species rich shrublands (Gibson *et al.* 1994: type 20a)	E	32	iii	iii	iv	ii, v (rabbits), vi (grasses, vii, viii
Melaleuca huegelii – M. acerosa shrublands of limestone ridges (Gibson *et al.* 1994: type 26a)	E	32 wetland	ii	iii	iv	xii (limestone mining), ii
Shrublands on dry clay flats (Gibson *et al.* 1994: type 10a)	E	32 wetland	ii	iv	iv	v (rabbits), vi (pasture grass)
Southern wet shrublands, Swan Coastal Plain (Community 2, Gibson *et al*. 1994)	E	12	ii	iv	iv	v (rabbits), vi (pasture grass), viii
Callitris preissii (or *Melaleuca lanceolata*) forests and woodlands Swan Coastal Plain (Gibson *et al*. 1994: type 30a)	V	32 wetland	iii	iii	iv	ii, vii, vi (Watsonia, bridle creeper), v (rabbits), viii
Dense shrublands on clay flats (Gibson *et al*. 1994: type 9)	V	8	ii	v	iv	v (rabbits, pigs), vi (Watsonia, pasture grasses), vii, viii
Eucalyptus calophylla - Eucalyptus marginata woodlands on sandy clay soils of the southern Swan Coastal Plain (Gibson *et al*. 1994: type 3b)	V	9	ii	iii	iv	i., ii, v (rabbits), vi (grasses, Watsonia, bridle creeper), vii, viii, x, xii (sand mining)
Forests and woodlands of deep seasonal wetlands of the Swan Coastal Plain (Gibson *et al.* 1994: type 15)	V	32 wetland	ii	iii	iv	ii, v (rabbits), vi (grasses, Watsonia, bridle creeper), vii, viii
Herb rich saline shrublands in clay pans (Gibson *et al.* 1994: type 7)	V	32 wetland	ii	iv	iv	iv, v (rabbits), vi (pasture grasses), vii
Herb rich shrublands in freshwater clay pans (Gibson *et al.* 1994: type 8)	V	32 wetland	ii	v	iv	ii, v (rabbits, pigs), vi (Watsonia, introduced monocots), vii, viii, xii (physical disturbance – vehicles)
Shrublands on calcareous silts of the Swan Coastal Plain (Gibson *et al.* 1994: community type 18)	V	32 wetland	iii	iv	iv	ii, v (rabbits), vii
Community	Status	NVIS[1]	Condition[2]	Trend[3]	Reliability[4]	Threatening Processes[5]
Stromatolite community of stratified hypersaline coastal lakes (Stromatolitic aragonite communities formed by *Glaeocapsa* and diatoms in stratified coastal hypersaline lakes) (Lake Thetis, 3 km SE of Cervantes) (Moore 1993)	V	N/A	iii	iv	iii	ix, xi (increased nutrients)
Eucalyptus calophylla woodlands on heavy soils of the southern Swan Coastal Plain	V	8	iii	iii	iii	i, vi, vii, viii (*Phytophthora*), v (rabbits), iv, xii (recreation)

[1]Appendix B, key f; [2]Appendix C, rank 2; [3]Appendix C, rank 3; [4]Appendix C, rank 1; [5]Appendix B, key e

Other ecosystems at risk

In general, plant communities comprising of susceptible plant species are threatened by dieback (*Phytopthora cinnamomi*) and can be considered as ecosystems at risk. These fungi eliminate numerous species of structurally and floristically dominant plant families such as the Proteaceae and Myrtaceae from ecosystems.

Beard Veg Assoc	Name and Description	Status	NVIS[1]	Condition[2]	Trend[3]	Reliability[4]	Threatening Processes[5]
	Southern Swan Coastal Plain *Eucalyptus calophylla* woodlands on heavy soils	V	8	ii	iii	iv	v (rabbits), vi (pasture grass), vii, viii

	(Community 1b, Gibson *et al*. 1994)						
	Callitris preissii/*Melaleuca lanceolata* woodlands on saline soils (Rottnest) (B. Keighery pers comm.;)	P1	12	iii	iv	iii	vii, v (rabbits), vi (grasses, viii
	Casuarina obesa association (Thomas Rd to Serpentine River, Swan Coastal Plain; No detailed information to assess if distinct community) (Gibson *et al*. 1994); A. Brown pers comm.)	P1	26	i	iii	ii	ii, ix, xii (ecosystem is almost all destroyed)
	Fairbridge Ironstone community (cemetery – Fairbridge Farm) (G. Keighery pers. comm.)	P1	32	unknown	vi	ii	xii (very little information on the ecosystem)
	Relictual mangrove community (Bunbury) (may not be considered a separate community type as is a possibly a geographic outlier) (J. Lane pers. comm.)	P1	40	iii	iv	ii	xii (edge of range), no known threatening processes
	Banksia ilicifolia woodlands (Community 22, Gibson *et al*. 1994)	P2	30	iii	iii	iv	ii, vii, vi (grasses, v (rabbits), viii (*Phytophthora*)
	Deeper seasonal wetlands on sandy soils (Swan Coastal Plain) (Community 14, Gibson *et al*. 1994)	P2	32 wetland	iii	iii	iv	ii, vii, vi (grasses, Watsonia, bridle creeper), v (rabbits), viii
	Hypersaline microbial community 1 (Extant coastal hypersaline lakes microbialite community formed by *Apanothecae halophitica*, *Oscillatoria* sp./*Spirulina* sp., *Botrycoccus* and diatoms) (Government House Lake, Rottnest) (Moore 1993)	P2	N/A	iii	iv	iii	No known threatening processes
	Living microbial mats in hypersaline ponds (Extant hypersaline pond stromatolitic "Conophyton" like unlithified communities formed with little sediment incorporation by (?) *Phormidium hypersalinum*) (Pamelup Pond, Lake Preston, Yalgorup) (Moore 1993)	P2	N/A	iii	ii	iii	x, i, ii
	Acacia shrublands on taller dunes (Community 29b, Gibson *et al*. 1994)	P3	32	iii	iii	iv	ii, vii, vi (grasses, Watsonia, bridle creeper), v (rabbits), viii

Beard Veg Assoc	Name and Description	Status	NVIS[1]	Condition[2]	Trend[3]	Reliability[4]	Threatening Processes[5]
	Coastal shrublands on shallow sands (Community 29a, Gibson *et al*. 1994)	P3	32	iii	iv	iv	ii, vii, vi (grasses, Watsonia, bridle creeper), v (rabbits), viii
	Eucalyptus haemotoxylon - Eucalyptus marginata woodlands on Whicher foothills (Community 1a, Gibson *et al*. 1994)	P3	8	ii	ii	iv	ii, v (rabbits), vi (pasture grass), xii (occurs in very small areas)
	Low lying *Banksia attenuata* woodlands or shrublands (Community 21c, Gibson *et al*. 1994)	P3	30	iii	iv	iv	v (rabbits), viii
	Northern Spearwood shrublands and woodlands (Community 24, Gibson *et al*. 1994)	P3	28	iii	iii	iv	ii, vii, vi (grasses, bridle creeper), v (rabbits), viii
	Northern Swan Coastal Plain *Banksia attenuata - Banksia menziesii* woodlands (Community 23b, Gibson *et al*. 1994)	P3	30	iii	iv	iv	ii, vii, vi (grasses, v (rabbits), viii, xii (ecosystem is not currently represented in reserve system)
	Quindalup *Eucalyptus gomphocephala* and/or *Agonis flexuosa* woodlands (Community 30b, Gibson *et al*. 1994)	P3	8		iii	iv	ii, v (rabbits), vi (bridle creeper, arum, pasture grass), vii, viii (borers, Armillaria), x (ecosystem is not currently represented in reserve system)
	Southern Swan Coastal Plain *Eucalyptus gomphocephala - Agonis flexuosa* woodlands (Community 25, Gibson *et al*. 1994)	P3	8		iii	iv	ii, v (rabbits), vi (bridle creeper, arum, pasture grass), vii, viii (borers, Armillaria), x, xii (mining)
999	Medium woodland; marri	E	8		iii	ii	i, ii, iv, vi (pasture grasses) vii, x, xii (intensive agriculture; horticulture; urban & semi rural developments)
1136	Medium woodland; marri with some jarrah, wandoo, river gum and casuarina	E	8		iii	ii	i, ii, iv, vi (pasture grasses) vii, x, xii (intensive agriculture; horticulture; urban & semi rural developments)
968	Medium woodland; jarrah, marri & wandoo	E	8		iii	ii	i, ii, iv, vi (pasture grasses) vii, x, xii (intensive agriculture; horticulture; urban & semi rural developments)
1182	Medium woodland; *Eucalyptus rudis* & *Melaleuca rhaphiophylla*	E	8		iii	ii	i, ii, iv, vi (pasture grasses) vii, x, xii (intensive agriculture; horticulture; urban & semi rural developments)
973	Low forest; paperbark (*Melaleuca rhaphiophylla*)	E	15		iii	ii	i, ii, iv, v (rabbits), vi (pasture grasses), vii, xi, xii (intensive agriculture, horticulture, urban & semi rural developments)
15	Low forest; cypress pine	E	12		iii	ii	i, ii, iv, vi (pasture grasses) vii, x, xii (intensive agriculture; horticulture; urban & semi rural developments)
1010	Medium open woodland; marri & tuart	E	8		iii	ii	i, ii, iv, vi (pasture grasses) vii, x, xii (intensive agriculture; horticulture; urban & semi rural developments)

[1]Appendix B, key f; [2]Appendix C, rank 2; [3]Appendix C, rank 3; [4]Appendix C, rank 1; [5]Appendix B, key e

Analysis of the pre-european and remaining extent of Beard's vegetation associations, shows that of the 41 vegetation associations that covered greater than 0.1% (i.e. 1 334 ha) of the subregion in pre-european times (i.e. covering in total over 99.6% of original area):

- Seven have less than 10% of the original area remaining, and so could be considered threatened. None of these have greater than 3.4% of the subregion pre-European area in CALM estate. These seven are listed at the end of the table above.
- The sum of the original area of these 7 vegetation associations was 257 655 ha. That is 19.3 % of the original vegetation in IBRA Subregion. Thus they were significant components of the original vegetation.
- The sum of the remaining area of these 7 vegetation associations = 19 334 ha (3.5 % of the remaining vegetation in IBRA Subregion)
- 2 of the 7 are mostly found in SWA2 (>70% of the remnants of this vegetation association are in SWA2). So conservation of these associations needs to be carried out in this subregion.
- 4 of the 7 are mostly found outside SWA2 (>70% of the remnants of this vegetation association are found in other subregions SWA2), and so there may be options for reservation and conservation in other subregions. However note that features, including floristics, of a Beard vegetation association may differ in different subregions, and so representation

of these in Swan Coastal Plain Subregion may be unique.

- There are 18 vegetation associations that have between 10% and 30% of the original area remaining, and so could be considered in the next threatened group. Only 4 of these have >10% of the subregion pre-European area in CALM reserves. Nine of the 18 are mostly found in SWA2, only 1 of these has >10% in CALM reserves.

Species at risk

Fauna

Species	Status	Condition[1]	Trend[2]	Reliability[3]	Threatening Processes[4]
SCHEDULE 1; RARE/LIKELY TO BECOME EXTINCT, DIV 1 (MAMMALS)					
Dasyurus geoffroii	V	ii	v	iii	v (fox)
Myrmecobius fasciatus	V	i	iv	iii	v (fox)
Pseudocheirus occidentalis	V	ii	iii	iii	ii, v (fox), vii
Setonix brachyurus	V	i	v	iii	v (fox), vii
SCHEDULE 1; RARE/LIKELY TO BECOME EXTINCT, DIV 2 (BIRDS)					
Calyptorhynchus latirostris	E	ii	iii	iii	i, ii, vii
Leipoa ocellata	V	i	iv	iii	v (fox)
Botaurus poiciloptilus	V	i	iii	iii	i, ii, v, vii, ix, x
Calyptorhynchus baudinii	V	ii	iii	iii	i, ii, vii
SCHEDULE 1; RARE/LIKELY TO BECOME EXTINCT, DIV 3 (REPTILES)					
Pseudemydura umbrina	CR	i	v	iii	v (fox), ii, vii, vi, x
Ctenotus lancelini	V	iii	iv	iii	v (mice), xii (human disturbance)
SCHEDULE 1; RARE/LIKELY TO BECOME EXTINCT, DIV 8 (CRUSTACEANS)					
Hurleya sp. (WAM#642-97)	CR	Unknown	ii	iii	x (declining groundwater – rainfall)
SCHEDULE 1; RARE/LIKELY TO BECOME EXTINCT, DIV 11 (NATIVE BEES)					
Leioproctus douglasiellus	E	Unknown	vi	ii	ii, vii, vi
Neopasiphae simplicior	E	Unknown	vi	ii	ii, vii, vi
Schedule 1; Rare/likely to become extinct, Div 13 (Moths)					
Synemon gratiosa	E	Unknown	vi	ii	ii, vii, vi
OTHER SPECIES AT RISK WITHIN THE SUBREGION					
Arbanitis inornatus	1	Unknown	vi	ii	ii, vii, vi
Throscodectes xiphos	1	Unknown	vi	ii	ii, vii, vi
Ixobrychus flavicollis	2	i	i	ii	i., ii, vii, ix (salinisation of streams has lead to lack of food source), x
Ninox connivens connivens	2	i	i	iii	i, ii, xii (logging practices, reduction in tree hollows)
Tiliqua rugosa konowi	2	iv	iv	ii	xii (human disturbance)
Pseudonaja affinis exilis	2	iv	iv	ii	xii (human disturbance)
Leioproctus bilobatus	2	Unknown	vi	ii	ii, vii, vi
Austromerope poultoni	2	Unknown	vi	ii	Unknown threatening processes
Dasyornis broadbenti litoralis	EX	i	i	i	Last record was approx 100 years ago.

[1]Appendix C, rank 2; [2]Appendix C, rank 3; [3]Appendix C, rank 1; [4]Appendix B, key e

Declared rare and priority flora

In general, plant communities comprising of susceptible plant species are threatened by dieback (*Phytopthora cinnamomi*) and can be considered as ecosystems at risk. These fungi eliminate numerous species of structurally and floristically dominant plant families such as the Proteaceae and Myrtaceae from ecosystems.

Species Name	Status	Condition[1]	Trend[2]	Reliability[3]	Threatening Processes[4]
DECLARED RARE FLORA					
Brachysema papilio	CR	ii	ii	iii	i, ii, v, vi, vii, viii, xii (roads; mining), iv
Caladenia procera ms	CR	iii	ii	iii	i, vii,
Calytrix breviseta subsp. *breviseta*	CR	ii-iii	v	iii	i, ii, iv, vi, vii, x, xii (roads; one population only)
Darwinia sp. Williamson (GJ Keighery 12717) [*aff. apiculata*]	CR	ii-iii	iii	iii	i, vii, viii, xii (mining)
Epiblema grandiflorum var. *cyaneum* ms	CR	iii	ii	iii	i, ii, iv, v, vi, vii, viii, ix, x, xi, xii (roads; recreation use)
Grevillea althoferorum	CR	iii	iv	iii	i, ii, vi, vii, viii, xii (roads)
Grevillea curviloba subsp. *curviloba*	CR	iii	iii	iii	i, ii (no recruitment), iv, v, vi, vii, viii, xi, xii (roads; small population size)
Grevillea curviloba subsp. *incurva*	CR	iii	iii	iii	i, ii (no recruitment), iv, v, vi, vii, viii, xi, xii

					(roads; small population size)
Grevillea elongata	CR	iii	v	iii	i, ii, v (rabbit), vi (pasture grasses), vii, viii
Grevillea maccutcheonii	CR	i	v	iv	i, v (rabbit), viii
Hemigenia ramosissima	CR	ii	iv	iii	x, i, ii
Lambertia echinata subsp. occidentalis	CR	ii	ii	iv	i, v (rabbit), viii (*Phytophthora* sp.)
Petrophile latericola ms	CR	iii	ii	iii	viii (*Phytophthora* sp.), ii (no recruitment), vii
Synaphea sp. Pinjarra (R Davis 6578)	CR	ii	iii	iii	i, ii, iv, vi, vii, viii, x, xii (roads)
Synaphea stenoloba	CR	ii	iii	iii	i, ii, iv, vi, vii, viii, x, xii (roads)
Verticordia plumosa var. *ananeotes*	CR	ii	iii	iii	i, ii, iv, v, vi, vii, viii (*Phytophthora* sp.), x, xii (roads)
Caladenia huegelii	E	iii	iii	iii	i, ii, v, vi, vii, x, xii (roads etc, recreation and rubbish dumping)
Centrolepis caespitosa	E	iii	iii	iii	i, ii, vi, xii (recreation; species is very hard to locate)
Chorizema varium	E	iii	ii-iii	iii	iv, v, vii, xii (roads, recreation; species is not reserved), ii
Darwinia sp. Muchea	E	ii-iii	iii	iii	ii, iv, vi, vii, x
Diuris purdiei	E	iii	ii-iii	iii	i, ii, v, vi, vii, x, xii (roads; recreation use; species is naturally uncommon)
Drakaea elastica	E	ii-iii	iii	iii	i, ii, iv, vi, vii, xii (roads)
Dryandra mimica	E	iii	v	iii	viii (*Phytophthora* sp.), i, ii, vi, vii, xii (roads)
Dryandra nivea subsp. *uliginosa*	E	iii	iii	iii	viii (*Phytophthora* sp.), i., ii, v (rabbit), vi, vii, viii
Hydatella dioica	E	iii	iv	iii	i, ii, vi, ix, x, xii (small population size)
Lepidosperma rostratum	E	iii	iii	iii	i, ii, vi, vii, viii, x, xii (roads; found in area with high rate of bushland clearance for urbanisation)
Macarthuria keigheryi	E	iii	iv	iii	i, ii, vi, xii (roads)
Paracaleana dixonii ms	E	iii	ii	iii	i, ii, vii, xii (roads, powerlines)
Thelymitra stellata	E	iii	ii	iii	i, ii, vi, vii, xii (roads; gravel and other mining; small population size)
Verticordia densiflora var. *pedunculata*	E	ii	iv	iii	i., ii, v (rabbit), vi, vii, viii, xii (harvesting)
Verticordia plumosa var. *pleiobotrya*	E	ii	iii	iii	i, ii, iv, v, vi, vii, x, xii (roads; illegal harvesting)
Species Name	Status	Condition[1]	Trend[2]	Reliability[3]	Threatening Processes[4]
Verticordia plumosa var. *vassensis*	E	iii	iii	iii	i., ii, v (rabbit), vi, vii, viii, xii (harvesting)
Andersonia gracilis	V	iii	iii	iii	ii, vi, viii, xii (roads etc. mining)
Anigozanthos humilis subsp. *chrysanthus*	V	iii	v	iii	vi, ix, xii (roads etc)
Anigozanthos viridis subsp. *terraspectans*	V	iii	iv	iii	xii (small populations; sandmining)
Chamelaucium roycei ms	V	iii	iv	iii	ii, v (rabbit), vi (pasture grass), vii, viii, xii (small population)
Conospermum undulatum	V	iii	iv	iii	i, ii, vi, vii, xii (roads etc)
Diuris drummondii	V	iii	iii	iii	ii, vi, vii, xii (recreation use)
Diuris micrantha	V	ii	iii	iii	v, vi, x, xii (roads; recreation use; species is very hard to locate)
Drakaea micrantha ms	V	iii	iii	iii	i, ii, vi, vii, x, xii (roads; small populations)
Dryandra squarrosa subsp. *argillacea*	V	ii	ii	iii	viii (*Phytophthora* sp.), i, ii, v (rabbit), vi, vii
Eleocharis keigheryi	V	iii	iv	iii	i, ii, iv, v, vi, ix, x, xii (roads, mowing of airfield)
Eucalyptus argutifolia	V	iii	iv	ii	i, ii, vii, xii (roads, mining)
Ptychosema pusillum	V	ii	ii	ii	vii, i, ii, vi, xii (roads)
Tetraria australiensis	V	iii	v	iii	i, ii, vi, vii, xii (roads, gravel and other mining)
PRIORITY 1					
Acacia lasiocarpa var. *bracteolata* long peduncle variant (GJ Keighery 5026)	1	iii	iv	ii	i, ii, vi, x, xii (roads etc)
Amphibromus vickeryae	1	iii	iv	iii	i, ii
Andersonia ferricola ms	1	iii	iv	ii	viii (*Phytophthora* sp.), ii, v (rabbit), vii
Billardiera sp. Seabird (GJ Keighery 12977)	1	iii	iii	ii	i, ii, xii (roads; recreation; species is not

					found in current reserve system)
Brachyscias verecundus	1	iii	v	iii	vii, i, vi, viii
Calandrinia sp. Kenwick (GJ Keighery 10905) *[aff. composita]*	1	ii	iii	ii	i, ii, vi, viii, ix, x, xii (roads; species is very hard to locate)
Calothamnus sp. Whicher (BJ Keighery & N Gibson 230)	1	iii	iv	ii	vii
Carex tereticaulis	1	unknown	vi	ii	xii (very little is known about the species)
Dampiera tephrea	1	iii	iv	ii	i, ii, vi, xii (roads etc)
Eucalyptus mundijongensis x	1	iii	iii	ii	i, ii, vi, xii (roads)
Grevillea evanescens	1	iii	v	ii	i, ii, vi, viii, xii (roads)
Hakea oldfieldii	1	iii	iv	iii	vii
Malleostemon sp. Cooljarloo (B Backhouse s.n. 16.11.88)	1	iii	iv	iii	xii (mining)
Schoenus pennisetis	1	iii	iv	ii	i, vi, x, xii (roads)
Synaphea odocoileops	1	iii	iv	iii	xii (species is not found in current reserve system)
Tripterococcus paniculatus ms	1	iii	iv	ii	i, ii, vi, xii (roads)
PRIORITY 2					
Acacia benthamii	2	iii	iv	ii	i, ii, viii, xii (roads etc)
Amperea micrantha	2	iii	iv	ii	xii (species is not found in current reserve system)
Boronia capitata subsp. *gracilis*	2	iii	iv	iii	i, ii, vii,
Comesperma rhadinocarpum	2	iii	iv	ii	i, ii, viii, ix, x, xii (roads, gravel extraction)
Eucalyptus marginata subsp. *elegantella*	2	iii	iv	ii	i, ii, vi, xii (roads)
Grevillea manglesii subsp. *ornithopoda*	2	iii	iv	ii	i, ii, vi, xii (recreation)
Haloragis aculeolata	2	iii	iv	ii	i, ii, vi, xii (roads)
Isotropis cuneifolia subsp. *glabra*	2	ii	iv	ii	i, ii, x, xii (roads)
Species Name	Status	Condition[1]	Trend[2]	Reliability[3]	Threatening Processes[4]
Mitreola minima	2	iii	iv	ii	xii (edge of range)
Phyllangium palustre	2	iii	iv	ii	i, ii, ix, x,
Schoenus capillifolius	2	iii	iv	ii	i, ii, vi, ix, x,
Schoenus loliaceus	2	iii	iv	ii	No known threatening processes
Stylidium rigidifolium	2	iii	iv	ii	No known threatening processes
Synaphea petiolaris subsp. *simplex*	2	iii	iv	ii	No known threatening processes
Trichocline sp. Treeton (BJ Keighery & N Gibson 564)	2	iii	iv	ii	No known threatening processes

[1]Appendix C, rank 2; [2]Appendix C, rank 3; [3]Appendix C, rank 1; [4]Appendix B, key e

Analysis of appropriate management scenarios

Reservation priorities of ecosystems

Reserves are needed to protect most of the occurrences of the listed TECs.

Analysis of the tables of SWA Beard vegetation associations provides the following:

Of the 53 vegetation associations that occurred in SWA2 subregion in pre-european times:

- 33 have less than 10% of the original area in CALM managed reserves, and so could be considered poorly reserved.
- 15 of these are mostly found outside SWA2 (>70% of the remnants of this vegetation association are found in other subregions), so there may be options for reservation in other subregions. However, Beard's vegetation mapping includes a degree of heterogeneity within single units, especially floristic differences. The same Beard vegetation association may be different in another region. Therefore reserves in another region may not be fully representative of the variation within the unit.
- This leaves 18 poorly reserved vegetation associations that are mostly found in SWA2. These are shown in the table below.

Beard Veg Assoc	Veg Assoc description	Total current extent per Veg Assoc (ha)	% of total extent in IBRA Subregion	Pre-European Area (ha) in Subregion	Current Area in IBRA Subregion	% of pre-European Area remaining in Subregion	Area in IUCN Reserve	Area in IUCN Reserve %	Total Area in CALM Estate	Total Area in CALM Estate %	% of subregion pre-European area in CALM estate

6	Low forest; cypress pine	0.0	0.0	2,786.7	0.0	0.0					0.0
1016	Mosaic: Low woodland; banksia/Shrublands; dryandra heath	595.1	100.0	1,789.0	595.1	33.3	0.0	0.0	0.0	0.0	0.0
1010	Medium open woodland; marri & tuart	93.2	100.0	1,423.3	93.2	6.5	0.0	0.0	0.0	0.0	0.0
1012	Mosaic: Medium open woodland; tuart / Low woodland; banksia	169.8	100.0	598.1	169.8	28.4	0.0	0.0	0.0	0.0	0.0
1013	Mosaic: Medium open woodland; marri / Shrublands; teatree thicket	114.3	100.0	547.0	114.3	20.9	0.0	0.0	0.0	0.0	0.0
1007	Medium woodland	4,976.3	100.0	4,976.3	4,976.3	100.0	0.0	0.0	2.1	0.0	0.0
1018	Mosaic: Medium forest; jarrah-marri/Low woodland; banksia/Low forest; teatree/Low woodland; *Casuarina obesa*	3,743.5	100.0	16,611.6	3,743.5	22.5	16.4	0.4	16.4	0.4	0.1
1008	Medium open woodland; marri	968.9	99.4	5,330.8	963.0	18.1	0.0	0.0	7.8	0.8	0.1
965	Medium woodland; jarrah & marri	6,071.2	30.2	2,121.4	1,836.4	86.6	21.6	1.2	21.6	1.2	1.0
1136	Medium woodland; marri with some jarrah, wandoo, river gum and casuarina	7,297.9	83.2	68,761.7	6,048.1	8.8	816.4	13.5	982.4	16.2	1.4

Beard Veg Assoc	Veg Assoc description	Total current extent per Veg Assoc (ha)	% of total extent in IBRA Subregion	Pre-European Area (ha) in Subregion	Current Area in IBRA Subregion	% of pre-European Area remaining in Subregion	Area in IUCN Reserve	Area in IUCN Reserve %	Total Area in CALM Estate	Total Area in CALM Estate %	% of subregion pre-European area in CALM estate
1001	Medium very sparse woodland; jarrah, with low woodland; banksia & casuarina	19,006.2	99.6	68,475.2	18,906.8	27.6	797.5	4.2	1,039.2	5.5	1.5
1009	Medium woodland; marri & river gum	2,678.0	99.0	8,764.5	2,650.5	30.2	2.8	0.1	139.9	5.3	1.6
1000	Mosaic: Medium forest; jarrah-marri/Low woodland; banksia/Low forest; teatree (*Melaleuca Spp*.)	34,462.3	75.3	112,487.1	25,418.8	22.6	3,274.5	12.9	5,877.8	23.1	5.2
3048	Shrublands; scrub-heath on the Swan Coastal Plain	4,183.9	100.0	14,575.0	4,183.9	28.7	804.6	19.2	804.6	19.2	5.5
1949	Low woodland	38,686.2	100.0	132,945.8	34,011.7	25.6	8,302.1	24.4	8,302.1	24.4	6.2
1028	Medium woodland; river gum	358.4	100.0	1,309.9	358.4	27.4	114.6	32.0	114.6	32.0	8.7
6	Medium woodland; tuart & jarrah	26,364.9	90.5	76,214.5	18,397.7	24.1	2,662.5	14.5	6,936.7	37.7	9.1
1030	Low woodland; *Banksia attenuata & B. menziesii*	103,177.3	93.5	136,951.8	96,459.1	70.4	12,972.9	13.4	12,972.9	13.4	9.5

Subregional constraints in order of priority

(see Appendix B, key g)

Irreplacibility and Economic Constraints: High economic value of land close to cities and coast for urban and semi-rural subdivision has lead to a high degree of land speculation.

Competing Land Uses: Major components of the landscape are covered by mines, mining tenements, exploration leases and to a lesser extent grazing.

Bioregional and subregional priority for reserve consolidation

SWA is reservation Class 4d (see Appendix D, and Appendix C, rank 4) because 10 - 15% of its area reserved (any tenure). SWA1 has 6.78% of the subregion in conservation reserves. SWA2 has 10.74% of the subregion in conservation reserves. However, there are threatening processes including continuing land clearing, and impacts on small fragmented remnants which predominate in the central and southern zone of the subregion. There is also some bias in the reserve system in that 62% of vegetation associations have <10% in reserves, including several that covered significant area (>10%) of the pre-european vegetation. The distribution of remnant vegetation is uneven with the greatest clearing having occurred in the central and southern zone of the subregion. In particular the eastern side of the coastal plain has been extensively cleared.

Therefore, SWA2 warrants a higher Rank than 4d#, and a rank of 2 would probably be the most appropriate.

Reserve management standard

Within SWA2 there are 65 nature reserves, 8 national parks and 2 conservation parks.

Nature Reserves: Reserve management standards is (i) Poor to (ii) Fair (see Appendix C, rank 5) for majority of small reserves in the southern and central zone, (iii) Good, for larger reserves and those in the northern zone.

Approximately half of the nature reserves in this subregion are small (<100 ha), with 10 reserves being very small (< 10 ha) and only 8 reserves being greater than 1000 ha. In the southern and central zones of the subregion, the areas highly disturbed by urban development and intensive agricultural activities, nature reserves are frequently associated with protection of coastal plain wetlands or a small vegetated remnants surrounded by urban and semi rural land uses. The largest reserves are found in the northern zone, with all but two being greater than 700 ha. These reserves contain coastal and northern Sand Plain vegetation communities grading to low eucalypt woodlands which in season are used by commercial apiarists.

There are no resident staff for these reserves, management visitation varies greatly with urban wetland reserves often frequently visited and others restricted to a minimum of once per year. Only a small number of the nature reserves in this subregion have formal approved management plans or interim management guidelines. In the southern and central zone, because of their small size and wetland protection function most reserves have significant weed invasion especially watsonia, arum, bridle creeper, kikuyu as well as annual and perennial grasses.

Feral animals (foxes, rabbits and increasingly in the southern zone, pigs) in all but the largest reserves are not controlled. Significant problems impede the agency's ability to undertake control programs in urban and semi-urban environments. Across all areas of the subregion, *Phytophthora* disease is impacting on vegetation communities in the reserves.

In many of the smaller reserves understorey species composition is often depauperate and in a degraded state resulting from grass and other weed invasion (however some small reserves, including those on the heavy soils of the eastern coastal plain are able to retain the majority of the original species), grazing impacts (including from

kangaroos) and too frequent fires. Fire regimes based on biodiversity outcomes are generally absent, deliberately lit wildfires can and do occur frequently depending on the proximity of the reserve to urbanisation. Formalised biodiversity monitoring programs are absent.

National Parks: Reserve management standards range from (ii) Fair to (iii) Good for the majority of the parks, though a Tuart decline (which appears to be climate driven, but includes a very high impact from native borer infestation) has left significant parts of one national park and small areas in a further two of the 8 national parks in this subregion in a poor state. (Rank is (i) Poor, indicating that threatening processes are leading to permanent resource degradation)

Five of the eight parks have management plans which are being implemented, though targeted ecological monitoring programs are either absent or inadequate. Size ranges from 1059 ha to 26 965 ha, with 2 of the 8 parks primarily servicing the recreation and day visitor requirements of the Perth metropolitan area. Three parks have staff in residence. All but two (Lesueur National Park and Moore River National Park) are sited on the coastal or near coastal (within 3 km) zone of the subregion. Thus the overall diversity of vegetation communities contained within these reserves is limited.

Feral animal control (fox, rabbit) is undertaken but is hampered by their close proximity to urban areas. Salinity issues are generally not evident on the western side of the subregion but extensive use of ground and surface water resources may be impacting of the overall health of the vegetation in a number of these parks. Fungal diseases (*Phytophthora* sp, *Armillaria* sp) are present in all of the parks and Tuart decline (Borer *Phorocantha* spp) are currently significantly affecting much of Yalgorup National Park, as well as impacting on Neerabup and Yanchep National Parks. The southern and central zone parks often have high weed loads especially Arum lilies, bridle creeper and pasture grass species, often associated with riparian and moisture gaining sites.

Fire regimes are often dominated by the requirement to protect adjoining land values. In most parks formalised biodiversity monitoring programs are absent.

Conservation Parks: Reserve management standard is (ii) Fair, biodiversity values and issues are poorly identified, degradation is retrievable. Two Conservation Parks occur within the subregion.

A Management Plan is available for Leschenault Peninsula Conservation Park (Department of Conservation and Land Management 1998b). Neither of the Conservation Parks have resident staff. Size ranges from 27 ha to approx 1000 ha. Weed invasion along riparian habitats and pasture grass invasion along the boundaries is of concern. Fox and rabbit control is undertaken. Fire regimes, currently set at exclusion, are yet to be optimised for biodiversity outcomes. Formalised biodiversity monitoring programs are absent but vegetation assessment plots were established during the Swan Coastal Plain Vegetation project and could form the basis of a permanent monitoring program.

Off reserve conservation

Priority species or groups and existing recovery plans

Species	Specific Recovery Plans	General Recovery Plans
Threatened flora species of highly cleared areas of the swan coastal plain (SWA2) subregion (majority of species are off reserve)	Recovery Plans or Interim Recovery Plans exist for all CR ranked flora. RPs and IRPs do not exist for all non-critically endangered flora.	Draft Swan Region Threatened Flora Management Plan provides recovery actions for all DRF flora within the Department of Conservation and Land Management's Swan Region (covering the central zone of SWA2.)
Threatened invertebrate species (bees and moth species) are only known from non-reserved land in the highly cleared areas of the swan coastal plain (SWA2) subregion	No RPs or IRPs exist for any of the ranked invertebrate fauna.	No

Appropriate species recovery actions

Species	Recovery Actions[1]	Recovery Descriptions
Threatened flora species of highly cleared areas of the swan coastal plain (SWA2) subregion (majority of species are off reserve)	i, ii, iii, vi, ix, v, vii, viii	Habitat retention and protection through reserves, on private lands and on other state lands (especially rail and road reserves). Weed control. Reinstatement of hydrology. Fencing. Control of rabbits. Revegetation.
Threatened invertebrate species (bees and moth species) are only known from non-reserved land in the highly cleared areas of the swan coastal plain (SWA2) subregion	i, ii, iii, ix, vi	Habitat retention and protection through reserves, on private lands and on other state lands (especially rail and road reserves). Regrowth retention. Weed control.

[1]Appendix B, key h.

Ecosystems and existing recovery plans

Ecosystem	Specific Recovery Plans	General Recovery Plans
Remnant vegetation complexes on the Abba Plains, including but not limited to the Busselton Ironstone TEC east of Busselton and subjected to extensive clearing for agriculture	Yes – IRP for Shrubland Association on Southern Swan Coastal Plain Ironstone (Busselton area) (Southern Ironstone Association); RPs and IRPs exist for flora and fauna species ranked CR	No
Agonis and/or tuart woodlands along coastal wetlands supporting populations of Western Ringtail Possum in the Busselton to Bunbury area threatened by urbanisation	Yes – IRP for *Pseudocheirus occidentalis*; RPs and IRPs exist for flora and fauna species ranked CR	No
Upland Vegetation Communities (TECs)	Yes – IRP for Shrublands and Woodlands on Muchea Limestone; IRP for Eastern shrublands and woodlands (Swan Coastal Plain community 20c); IRP for *Eucalyptus calophylla - Kingia australis* woodlands on heavy soils; IRP for *Eucalyptus calophylla - Xanthorrhoea preissii* woodlands and shrublands.	Draft Swan Region Threatened Flora Management Plan provides recovery actions for all DRF flora within the Department of Conservation and Land Management's Swan Region (covering the central zone of SWA2)
Wetland Vegetation Communities (TECs)	Yes – IRP for Community of Tumulus Springs (organic mound springs) of the Swan Coastal Plain; IRP for Shrublands and woodlands on Perth to Gingin ironstone.	Draft Swan Region Threatened Flora Management Plan provides recovery actions for all DRF flora within the Department of Conservation and Land Management's Swan Region (covering the central zone of SWA2)
Stromatolite Communities (TECs)	Yes – Draft IRPs for Lake Clifton and Lake Richmond Thrombolite Communities.	No
Cave Communities (TECs)	Yes – Draft IRP for Aquatic Root Mat Community and the Crystal Cave Crangonycoid of Caves of the Swan Coastal Plain	No
Sedgeland Community (TEC)	Yes – IRP for Sedgelands and Holocene Dune Swales	No

Appropriate ecosystem recovery actions

Ecosystem	Recovery Actions[1]	Recovery Descriptions
Remnant vegetation complexes on the Abba Plains, including but not limited to the Busselton Ironstone TEC east of Busselton and subjected to extensive clearing for agriculture.	i, ii, iii, v, vii, viii, ix, xiv	Habitat retention and protection through reserves, on private lands and on other state lands (especially rail and road reserves). Fencing. Control of rabbits. Revegetation. Fire Management. Other - minimise sand mining impacts.
Agonis and/or tuart woodlands along coastal wetlands supporting populations of Western Ringtail Possum in the Busselton to Bunbury area threatened by urbanisation.	i, ii, iii, vii, viii	Habitat retention and protection through reserves, on private lands and on other state lands. Feral animal control. Revegetation.

Ecosystem	Recovery Actions[1]	Recovery Descriptions
Upland Vegetation Communities (TECs)	i, ii, iii, vi, ix, v, viii, xiii, vii	Habitat retention and protection through reserves, on private lands and on other state lands (especially rail and road reserves and Commonwealth lands). Weed control. Fire Management. Fencing. Revegetation. Capacity building with friends groups, and Green Corps teams. Control of rabbits.
Wetland Vegetation Communities (TECs)	i, ii, iii, vi, xi, viii, xiii	Habitat retention and protection through reserves, on private lands and on other state lands (especially rail and road reserves and Commonwealth lands). Weed control. Reinstatement of hydrology. Revegetation. Capacity building with friends groups, and Green Corps teams.
Stromatolite Communities (TECs)	i, xi, xiii	Habitat retention through reserves. Reinstatement of hydrology. Capacity building with friends groups, and Green Corps teams.
Cave Communities (TECs)	i, xi, xii, xiv	Habitat retention through reserves. Reinstatement of hydrology. Research. Other – Emergency artificial watering of root mats.

[1]Appendix B, key h.

Subregion priority for off reserve conservation

On average the subregion would rank (ii) (see Appendix C, rank 6), however areas of the south and east of the subregion would rank (i), and areas in the central zone could rank (iii) as there is a large population base and so there a large potential capacity to carry out off reserve works.

Conservation actions as an integral part of NRM

Existing NRM actions

Incentives:
There are incentives for a range of on-ground actions through State, Commonwealth and some other programs. These incentives generally involve remnant vegetation fencing under various programs; or provision of advice or assistance (Land for Wildlife, covenant program, and some NHT funded community projects).

Incentives for conservation on private property (such as rate rebates) are available through some Local Governments, as well as limited State and Commonwealth government rate and tax relief.

Legislation:
Existing legislation includes Wildlife Conservation Act, Conservation and Land Management Act and Environmental Protection Act.

Water use and conservation legislation has benefit to wetland and riparian biodiversity values. Soil conservation and land clearing legislation has influence on the retention of remnant vegetation and protection of biodiversity assets.

Statutory land planning legislation and policies, while designed to facilitate orderly development, is taking increased consideration of biodiversity values during that process, and is increasingly used to protect biodiversity assets (for example the Bush Forever project for the Perth metropolitan area).

Institutional Reform:
As noted above, statutory land planning is increasingly used to protect biodiversity assets, for example, State planning policy now requires Rural Planning Strategies and Schemes to address NRM issues.

Operation of regional NRM groups, and interactions with State and Commonwealth agencies, is currently in a state of evolution, but represents an on-going case of institutional reform. Some State agencies in NRM area have been restructured and re-oriented over the past 12 months, and this is continuing.

Increasing activity of some Local Governments in biodiversity management, including employment of specialist biodiversity and bushland management staff. However, not all councils involved and level of activity varies.

Valuing Ecosystem Services and Tradable Rights:
Limited application to date in Swan Coastal Plain Subregion. The aesthetic and social values of native vegetation and biodiversity are used to promote bush blocks in populated, coastal areas. Programs such as "Bush Brokers" deal with these values.

Similarly some semi-rural subdivisions in bushland areas use the same promotion. However poorly designed, or inappropriate subdivision of remnant vegetation, which may be promoted as protecting bushland, in fact results in decline in the values due to increased fragmentation and disturbance to bushland from fencing, firebreaks, building envelopes, grazing, and inappropriate bushland management.

Bushland is often retained as a visual or spatial buffer between land uses, including buffering noxious industry. This can result in retention of bushland that would otherwise be cleared. However, the usual situation is that due to the size, shape and configuration of these buffers some biodiversity values are lost.

Threat Abatement Planning as Part of NRM:
Several programs coordinated through CALM, and there are internal reports and policies relating to management of threats such as dieback, feral animal control, fire, etc. on lands managed by the Department. Some of this practice (e.g. dieback management) is taken up by industry, local government, and others.

Major programs include: feral animal control programs (Western Shield – limited cooperative participation by landholders); Also State government, multi-agency programs such as State Salinity Strategy; and State Weed Strategy.

Vegetation management plans are often required as condition of development through the statutory planning

or environmental assessment processes. However these are site based plans. Given that land clearing for development is a major threatening process on the swan coastal plain, more strategic, broad scale vegetation management planning is required to address this threat. The Bush Forever project (covering the swan coastal plain portion of the Perth metropolitan area, i.e. the central portion of the subregion) is an attempt to address this through the existing statutory planning and environmental assessment processes (Western Australian Planning Commission 2000).

Industry Codes of Practice
Some codes of practice and documentation of "best practice" exist that include consideration of biodiversity assets. Some of these are enforced through licensing or statutory processes. For example, codes of practice relating to mining and extractive industry, plantation management, as well as agricultural and development industries are relevant to the subregion.

Capacity Building:
There is significant interaction between State agencies, regional NRM groups, and other agencies and groups such as Greening Australia (WA) and Worldwide Fund for Nature. These groups are also interacting jointly and independently to contribute to capacity building amongst landholders and community groups. For example, the Skills for Nature Conservation training carried out by the Ecoplan project in conjunction with Greening Australia (WA) and the Swan Catchment Centre provide capacity building opportunities to community groups. Other groups such as the Threatened Species Network also make significant contributions to capacity building in the community.

The Department of Agriculture, Department of Conservation and Land Management and Water and Rivers Commission all contribute to community forums, workshops and education as part of increasing understanding processes and management actions available to landowners and community in relation to biodiversity issues; Weed action groups are supported by CALM and AgWA.

Other Planning Opportunities:
Local Government Rural Strategies and Town Planning schemes (for controlling development and assessing proposals) can now address biodiversity and environmental issues within an NRM context as a result of Western Australian Planning Commission requirements.

The Western Australian Planning Commission have several final and draft Statement of Planning Policies (SPPs) that provide for consideration of biodiversity issues in the statutory land use planning process. These include (but are not limited to): The Peel-Harvey Coastal Plain Catchment Policy (SPP No. 2); State Coastal Planning Policy (SPP No. 2.6); Gnangara Mound Crown Land Policy (SPP No. 3); Basic Raw Materials (SPP No. 10); Agriculture and Rural Land Use Planning (SPP No. 11); and Environment and Natural Resources Policy (draft SPP).

Regional NRM strategies developed through the NHT2 (and National Action Plan for Salinity and Water Quality) process will include Biodiversity issues.

Integration With Property and Catchment Management Planning:
There are three Regional NRM groups covering the Swan Coastal Plain subregion (Northern Agricultural Catchment Council, Swan Catchment Council, and Southwest Catchment Council). These include a number of subregional NRM groups and Land Conservation District Committees within their boundaries. These groups have varying access to biodiversity expertise. Regional NRM groups are not fully representative and with limited capacity currently.

Integration occurring in various ways, examples include:
- Contribution to property planning by Land for Wildlife, and similar programs;
- Advice from other State agencies, for example Department of Agriculture advice on soil survey, land capability assessment and farm planning etc.
- Regional planning through State agency plans, NRM regional group plans
- Department for Planning and Infrastructure rural land use planning.

Feasible opportunities for NRM

Incentives:
There are opportunities to extend the availability of incentives for conservation on private property through rate and tax rebates or relief, additional subdivision rights, and assistance or advice programs (for example, rate relief is only available in a few local governments). Potential exists for changes in the taxation laws for philanthropy.

Similarly many incentive programs are "opt-in" - participants include only those who contact the program and volunteer to join. There is a potential for these programs to be more strategic and targeted, to the degree of lobbying or approaching owners of high conservation value lands.

Some potential for protection of remnant vegetation through marketing as conservation properties close to major city centres, however the high level of property speculation with expectation for maximum yield will limit uptake.

Legislation:
Proposed amendments in 2003 to State Environmental Protection Act relating to land clearing and environmental harm.
Proposed new State Biodiversity Conservation Act to replace the existing Wildlife Conservation Act. Consultation process commenced in late 2002.

Also more thorough and effective enforcement of all existing legislation is required.

Institutional Reform:
Some incentive options, such as tax incentives, rate relief, trading of development rights, require legislative or policy change to become fully effective.

Development of the emerging paradigm of regional delivery of NRM, facilitated through the NHT2 and NAPSWQ, may result in changes to the involvement of State agencies, community groups and the wider community in decision making, and implementation in relation to biodiversity conservation (including through development of Regional NRM Strategies).

While institutional reform is an issue, opportunities for progress lie in improving existing institutions and ensuring that they carry out their responsibilities effectively and are resourced at a sufficient level and staffed with appropriate people.

Some Local Governments are taking on an increased role in biodiversity management, including employment of specialist biodiversity and bushland management staff. Greater uptake by other Local Governments (and State agencies who manage lands with biodiversity values) is required.

Valuing Ecosystem Services and Tradable Rights:
Development of tradable development rights within the statutory land planning process, may provide options for conserving biodiversity values within the areas of the subregion with high property values and high levels of property speculation that might not otherwise be available.

Threat Abatement Planning as Part of NRM:
There is a need for the recognition of land clearing for urban development as a significant threatening process, followed by coordinated, biodiversity conservation focused, threat abatement planning.

There is a need for the extension of some State agency threat abatement programs (for example Western Shield) beyond lands under the immediate control of the agencies.

The state weed strategy needs to be resourced and implemented.

Industry Codes of Practice:
Increased development and adoption of codes of practice, and best practice, that benefits biodiversity conservation.

Capacity Building:
Facilitate greater community education / involvement in a range of areas in biodiversity conservation and NRM. This should be aimed at increasing the amount and effectiveness of on-ground effort by the community, as well as development of a constituency of support for biodiversity conservation in the wider community.

Other Planning Opportunities:
Some Local Governments have had improved inclusion of biodiversity issues in their statutory land planning processes, as well in management of land under their control. Greater uptake by other Local Governments is required.

There is potential for greater uniformity across councils, as well as for strategic pre-planning.

Integration with Property Management Planning, Catchment Planning and Landcare:
Increased or improved integration with property and catchment management planning.

Increased activity and influence of Regional NRM groups arising from new NHT2 and NAPSWQ arrangements, and increased focus by these groups on biodiversity issues.

Impediments or constraints to opportunities

A number of impediments exist including;

- Need to increase awareness of conservation values through education of public in general;
- Limited financial resources for agencies to effectively manage the range of issues within the subregion; high level of property speculation for assumed future urban or rural subdivision inflates land prices, a large part of this speculation is on bush blocks.

Subregions where specific NRM actions are a priority to pursue

SWA2 has an NRM priority of (i) (see Appendix C, rank 7), which indicates that there are major constraints to implement effective NRM actions due to the extent of past degradation, competing land uses, high property values, and urbanisation pressures.

Data gaps

Gaps in data needed for the identification of biodiversity values and management responses

Vegetation and Regional Ecosystem Mapping: There is no regolith mapping available and vegetation map resolution is 1:250 000 at best. Existing vegetation mapping (Beard) does not cover most southern ¼ of subregion. Few reserves have detailed vegetation mapping available.

Systematic Fauna Survey: Data is mainly confined to vertebrates and selected invertebrate taxa. There is not uniform coverage of survey and while there is some existing survey of invertebrate across subregion most of this has not been sorted identified or analysed yet. The existing invertebrate data indicates that there are significant species and groups of species within the subregion. Most reserves don't have long-term survey data on species presence or absence, even for vertebrates.
Floristic Data: There has been plot based floristic survey throughout the subregion. However this has been based on specific projects and is uneven in coverage, with the southern half of the subregion having better coverage. This has provided valuable information on Threatened Ecological Communities. However floristics in the northern half has not been as well surveyed, there may be other areas requiring additional survey, and a systematic and consolidated analysis of floristic data is required throughout.

Ecological and Life History Data: There few data on habitat requirements of virtually all invertebrate species,

most ephemeral plants, persisting CWR mammals, and uncommon vertebrate and plant species. There are no data to provide a regional context on life-history (including population-trend) of most species, including introduced or pest species.

Other Priority Data Gaps Include:

- No quantitative data on the effect of exotic predators, weed colonisation, fragmentation, fire, mineral-extraction.

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