Department of
Environment and Conservation

Our environment, our future

Resource Condition Report for Significant Western Australian Wetland

Vasse Estuary

2008

Figure 1 –A view across the shallow water body at Vasse Estuary.

This report was prepared by:

Anna Nowicki, Technical Officer, Department of Environment and Conservation, PO Box 51, Wanneroo 6946

Stephen Kern, Botanist, Department of Environment and Conservation, Locked Bag 104 Bentley Delivery Centre 6983

Adrian Pinder, Senior Research Scientist, Department of Environment and Conservation, PO Box 51, Wanneroo 6946

Glen Daniel, Environmental Officer, Department of Environment and Conservation, Locked Bag 104 Bentley Delivery Centre 6983

Invertebrate sorting and identification was undertaken by:

Nadine Guthrie, Research Scientist, Department of Environment and Conservation, PO

Box 51, Wanneroo 6946

Ross Gordon, Technical Officer, Department of Environment and Conservation, PO Box

51, Wanneroo 6946

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1. Introduction

The current report considers the ecological character and condition of Vasse Estuary, part of the Vasse-Wonnerup Wetland System immediately east of the town of Busselton (Fig. 2). A natural sand bar across the mouth of Wonnerup Inlet closes the system to the sea for much of the year and floodgates on the exit channels connect Vasse and Wonnerup estuaries to the narrow Wonnerup Inlet. The floodgates were installed in the early 1900s with the aim of minimising flooding of adjoining lands and largely excluding seawater. This effectively transformed the estuaries into shallow, winter-fresh/summer-saline lagoons (Wetland Research & Management 2007). The Estuaries now act as compensating basins for water discharging from the Ludlow, Sabina, Abba and Vasse Rivers. When the water level in the Estuaries rises above sea level, hydrostatic pressure opens the floodgates and allows water to flow out to Wonnerup Inlet and the sea. When the level drops the gates close, thereby preventing ingress of seawater (Jaensch 1992).

Vasse Estuary was selected as a study site in the current project due to the Vasse-Wonnerup Wetland System's status as a Ramsar Convention on Wetlands (Ramsar) listed and a Directory of Important Wetlands in Australia (DIWA) listed wetland (Environment Australia 2001). Specifically, the Vasse-Wonnerup Wetland System is an example of a system of formerly estuarine basins now functioning as seasonal brackish lakes, which is unique in Western Australia. The system is also important to waterbirds, as it regularly supports peak numbers of 25,000 – 35,000 waterbirds in most years, and provides the most significant regular breeding habitat for the Black Swan (*Cygnus atratus*) in WA (Wetland Research & Management 2007). The Vasse-Wonnerup Wetland System regularly supports at least 1% of the populations of Black-winged Stilt, Red-necked Avocet, Australian Shelduck and Australasian Shoveler (Jaensch 1992).

1.1. Site Code

Ramsar Site Number: 38.

Directory of Important Wetlands in Australia: WA093.

Register of the National Estate Place ID: 18101.

Inland Aquatic Integrity Resource Condition Monitoring Project: RCM043.

1.2. Purpose of Resource Condition Report

This Resource Condition Report (RCR) was prepared by the Inland Aquatic Integrity Resource Condition Monitoring project (IAI RCM). The objective of the RCR is to supplement the Vasse-Wonnerup Wetlands Ecological Character Description (ECD) (Wetland Research & Management 2007) by providing the results of the survey undertaken by the IAI RCM project. While a brief description of the wetland is provided here, it is intended that reference is made to the Vasse-Wonnerup Wetlands ECD for further information and for data collected as part of previous studies.

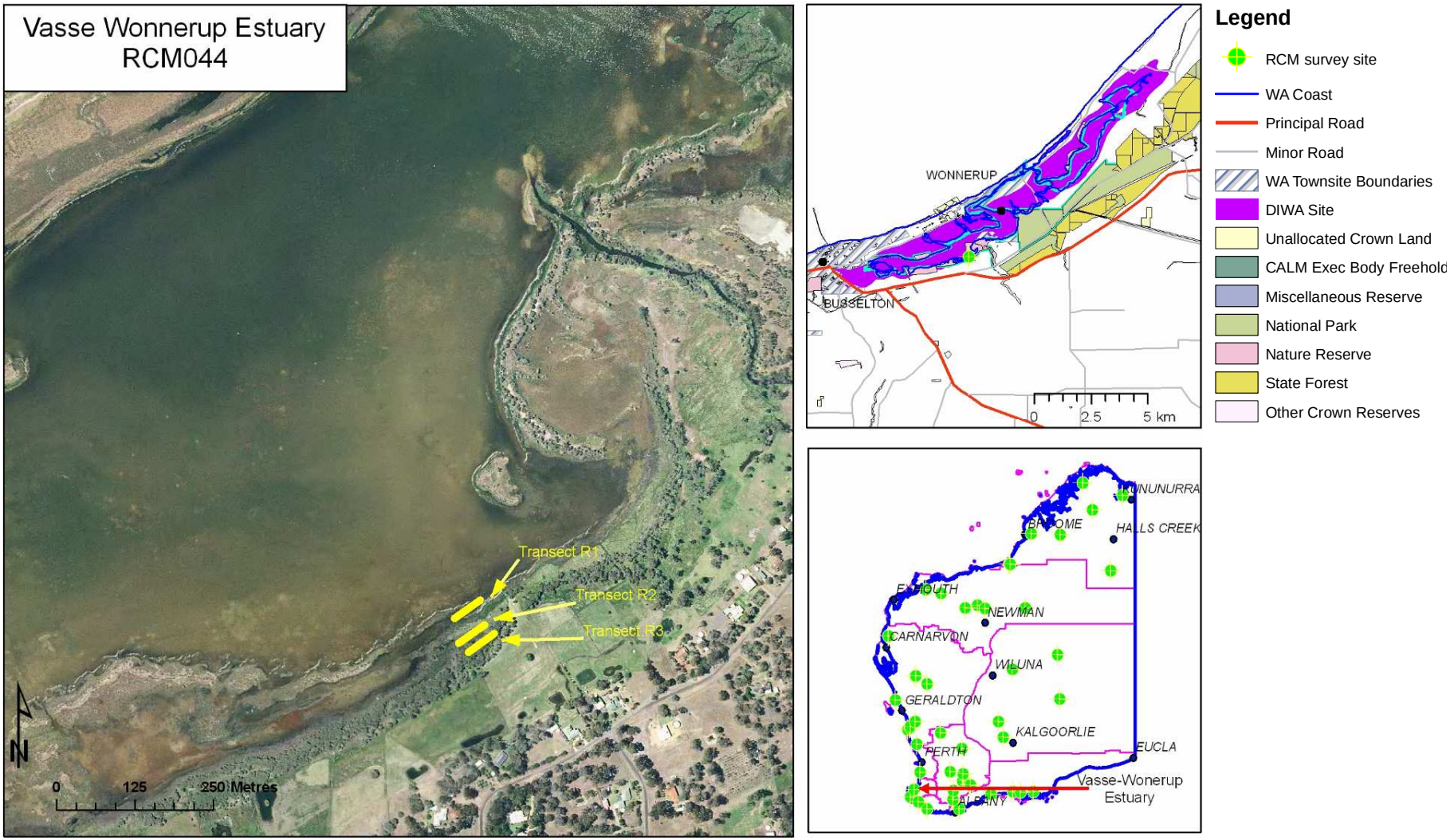

Figure 2 – Aerial photograph showing the location of the vegetation transects at Vasse Estuary. Aquatic invertebrates and water quality were sampled adjacent to the transects. The upper insert shows the location of the sampling site relative to the Vasse-Wonnerup Wetland System. The lower insert shows the location of the lake in the state of Western Australia and in relation to other RCM sampling sites.

2. Summary of IAI RCM survey findings at Vasse Estuary

Vasse Estuary was sampled by the IAI RCM project on 16th November 2008 to collect information on vegetation, water quality, aquatic fauna and threats. The methodology used for the RCM survey was as described by DEC (2008). The results of this sampling are presented below. For information on any previous studies that may have occurred at Vasse Estuary, it is advised to refer to the Vasse Estuary ECD (Wetland Research & Management 2007).

2.1. Water Quality

Nitrogen and chlorophyll concentrations were high at the sampled site (Table 1), indicating nutrient enrichment and raised algal growth. However, most of the nitrogen is in the soluble fraction and phosphorus concentration is very low, so the latter may be limiting more excessive algal growth.

Table 1 – Water quality parameters at Vasse Estuary.

pH	8.9
Alkalinity (mg/L)	115
TDS (g/L)	13
Turbidity (NTU)	0.25
Colour (TCU)	33
Total nitrogen (ug/L)	2,300
Total phosphorus (ug/L)	10
Total soluble nitrogen (ug/L)	2,100
Total soluble phosphorus (ug/L)	10
Chlorophyll (ug/L)	49.5
Na (mg/L)	4,200
Mg (mg/L)	472
Ca (mg/L)	206
K (mg/L)	156
Cl (mg/L)	7,490
SO_4 (mg/L)	985
HCO_3 (mg/L)	55
CO_3 (mg/L)	42

2.2. Littoral Vegetation

The vegetation of the Vasse Wonnerup Wetland System has previously been described as open-scrub, grassland/sedgeland and low shrubland (samphire), mainly in zoniform arrangement (Jaensch 1992). The samphire is dominated by *Sarcocornia blackiana* and *Halosarcia pergranulata*. Sedgeland commonly consists of *Juncus kraussii* or *Bolboschoenus caldwellii*, and *Lepidosperma leptostachyum* and *Carex divisa* also occur. Couch grass grows thickly in central Vasse Estuary and at river mouths. Open-scrub comprises *Melaleuca cuticularis*, *M. hamulosa* and *M. rhaphiophylla*. Tall samphire, seasonally covered by dense *Bolboschoenus caldwellii*, occurs extensively at Vasse River deltaic marshes and in smaller areas around Vasse Estuary. The site supports probably the largest area of this community in WA (Jaensch 1992).

Three transects were established by the IAI RCM project within vegetation fringing the southeastern side of Vasse Estuary (Table 2).

Table 2 – Site attributes of the Vasse Estuary vegetation transects.

Transect		R1	R2	R3
Datum		WGS84	WGS84	WGS84
Zone		50	50	50
Easting		351694	351713	351736
Northing		6275699	6275668	6275652
Length (m)		30	30	30
Bearing		340	240	240
Wetland state		Drying	Drying	Drying
Soil state (%)	Dry	0	0	0
	Waterlogged	100	100	100
	Inundated	0	0	0
Substrate (%)	Bare	30	0	20
	Rock	0	0	0
	Cryptogam	0	0	0
	Litter	5	0	20
	Trash	0	0	1
	Logs	0	0	0
Time since last fire		vegetation not fire prone	no evidence	no evidence
Community condition		Natural	Impacted	Impacted
Upper Stratum	Cover (%)	-	-	100
	Height (m)	-	-	<8
Mid Stratum	Cover (%)	-	-	-
	Height (m)	-	-	-
Ground Cover	Cover (%)	56.5667	100	60
	Height (m)	<0.4	<1	<0.8

Transect RCM043-R1

Transect RCM043-R1 was established approximately 15 m from the water's edge. The black, muddy substrate was completely waterlogged at the time of survey. Vegetation was comprised of a single stratum dominated by *Sarcocornia quinqueflora* and *Tecticornia pergranulata* low samphire shrubland with scattered grasses and herbs including *Paspalum vaginatum*, *Triglochin mucronata* and *Cotula coronopifolia* (56.6% cover, <0.4 m tall). Table 3 provides a complete list of taxa recorded on transect RCM043-R1.

There was an abundance of recently germinated samphire seedlings along the transect (Figure 3). Two of the species recorded on the transect were weeds (*P. vaginatum*, *C. coronopifolia*). The overall community condition was considered 'natural' (Table 8 in Appendix 1).

Figure 3 – Vasse Estuary vegetation transect RCM043-R1.

Table 3 – Plant taxa recorded along Vasse Estuary vegetation transect RCM043-R1 (in order of dominance).

Genus	Species	Height (m)	Stratum[1]	Form
Sarcocornia	*quinqueflora*	0.3	G1	Chenopod
Tecticornia	*?pergranulata*	0.3	G1	Chenopod
**Paspalum*	*vaginatum*	0.2	G1	Grass
Triglochin	*mucronata*	0.2	G1	Forb
**Cotula*	*coronopifolia*	0.1	G1	Forb
Suaeda	*australis*	0.1	G1	Chenopod

1 In an NVIS description, 'U' denotes the upper storey, 'M' the mid storey and 'G' the under storey (ground cover). Numerals to denote substrata from tallest (ESCAVI 2003).
* Introduced species.
? Limited confidence in identification.

According to the National Vegetation Information System (NVIS), the vegetation community may be described as (ESCAVI 2003):

G1+ ^*Sarcocornia quinqueflora*, *Tecticornia ?pergranulata*, **Paspalum vaginatum*, *Triglochin mucronata*, **Cotula coronopifolia*\chenopod shrub, grass, forb\1\c.

Transect RCM043-R2

Transect RCM004-R2 was established approximately 30 m from the water's edge. The substrate was completely waterlogged at the time of survey. The vegetation was comprised of a single stratum of *Juncus kraussii* subsp. *australiensis*, *Carex divisa*, *Paspalum vaginatum* mid-high closed rushes/sedges/grasses (100% cover, <1 m tall) (Figure 4). Table 4 provides a complete list of taxa recorded along the transect RCM043-R2.

Two of the four species recorded on the transect were weeds (*C. divisa* and *P. vaginatum*), totalling approximately 50% of the vegetative cover. The overall community condition was considered 'impacted' (Table 8 in Appendix 1).

Figure 4 – Vasse Estuary vegetation transect RCM043-R2.

Table 4 – Plant taxa recorded along Vasse Estuary vegetation transect RCM043-R2 (in order of dominance).

Genus	Species	Height (m)	Stratum[1]	Form
Juncus	*kraussii* subsp. *australiensis*	1.3	G1	Rush
**Carex*	*divisa*	0.8	G1	Sedge
**Paspalum*	*vaginatum*	0.6	G1	Grass
Bolboschoenus	*caldwellii*	0.6	G1	Sedge

1 In an NVIS description, 'U' denotes the upper storey, 'M' the mid storey and 'G' the under storey (ground cover). Numerals to denote substrata from tallest (ESCAVI 2003).
* Introduced species.

According to the National Vegetation Information System (NVIS), the vegetation community may be described as (ESCAVI 2003):

G1+ ^*Juncus kraussii* subsp. *australiensis*, **Carex divisa*, **Paspalum vaginatum*, *Bolboschoenus caldwellii*\rush, sedge, grass\2\d.

Transect RCM043-R3

Transect RCM043-R3 was established approximately 50 m from the water's edge. The soil was peaty, with a high organic content, and waterlogged at the time of survey. Vegetation was dominated by *Melaleuca cuticularis*, *M. viminea* subsp. *viminea* low closed forest (100% cover, <8 m tall) over *Carex divisa*, *Juncus kraussii* subsp. *australiensis* mid-high sedges and rushes (60% cover, <0.8 m tall). Table 5 provides a complete list of taxa recorded along the transect RCM043-R3.

Three species of weed were recorded on the transect contributing to the majority of vegetative cover in the understorey (Figure 5). The overall community condition was considered 'impacted' (Table 8 in Appendix 1).

Figure 5 – Vasse Estuary vegetation transect RCM043-R3.

Table 5 – Plant taxa recorded along Vasse Estuary vegetation transect RCM043-R3 (in order of stratum then dominance).

Genus	Species	Height (m)	Stratum[1]	Form
Melaleuca	*cuticularis*	8	U1	Tree
Melaleuca	*viminea* subsp. *viminea*	6	U1	Tree
**Carex*	*divisa*	0.6	G1	Sedge
Juncus	*kraussii* subsp. *australiensis*	0.8	G1	Rush
**Paspalum*	*vaginatum*	0.3	G1	Grass
Baumea	*juncea*	0.8	G1	Sedge
Centella	*asiatica*	0.2	G1	Forb
Centella	*aethiopica*	0.4	G1	Forb

1 In an NVIS description, 'U' denotes the upper storey, 'M' the mid storey and 'G' the under storey (ground cover). Numerals to denote substrata from tallest (ESCAVI 2003).
* Introduced species.

According to the National Vegetation Information System (NVIS), the vegetation community may be described as (ESCAVI 2003):

U1+ ^*Melaleuca cuticularis*, *Melaleuca viminea* subsp. *viminea*\tree\6\d; G1 ^**Carex divisa*, *Juncus kraussii* subsp. *australiensis*, **Paspalum vaginatum*, *Baumea juncea*, *Centella asiatica*\sedge, rush, grass, herb\2\c.

2.3. Benthic Plants

No benthic vegetation was recorded from the area sampled, as the water had receded a large distance from the littoral vegetation. However, the inundated areas of Vasse Estuary were densely covered with *Ruppia sp*. (Figure 6).

Figure 6 – Aquatic vegetation of Vasse Estuary.

2.4. Aquatic Invertebrates

Twelve aquatic macroinvertebrate species belonging to ten families were collected from Vasse Estuary (Table 6). The richness and composition of macroinvertebrates corresponds to expectations of an estuary with this level of salinity. All of these species are widespread and moderately to highly salt tolerant.

Table 6 – Aquatic invertebrate composition at Vasse Estuary.

Class	Order	Family	Lowest ID	Sample *
Oligochaeta	Tubificida	Enchytraeidae	Enchytraeidae	2,3
Gastropoda	Neotaeniglossa	Pomatiopsidae	*Coxiella* sp.	1,2,3
Crustacea	Amphipoda	Ceinidae	*Austrochiltonia subtenuis*	1,2,3
	Decapoda	Palaemonidae	*Palaemonetes australis*	1,2,3
Insecta	Coleoptera	Dytiscidae	*Necterosoma penicillatus*	1
		Haliplidae	*Haliplus* sp.	1,2,3
		Hydrophilidae	*Berosus discolor*	1,2,3
	Diptera	Chironomidae	*Procladius paludicola*	1,2,3
			Tanytarsus fuscithorax/semibarbitarsus	1,2,3
			Cladopelma curtivalva	1,2,3
	Hemiptera	Corixidae	*Micronecta* sp.	2
	Lepidoptera	Pyralidae	Pyralidae nr. sp. 39/40 of JHH	3

* Numbers in the last column indicate presence in the samples:

1. Shallow vegetated edge 1
2. Deeper vegetated area
3. Shallow vegetated edge 2

2.5. Waterbirds

Several birds were observed utilising Vasse Estuary (Table 7). All four of the waterbird species sighted in 2008 (Australian Shelduck, Red-capped Plover, Black Swan and Silver Gull) have previously been recorded at Vasse Estuary and the wetland is used as a breeding grounds by all except Silver Gulls (Wetland Research & Management 2007). The Vasse-Wonnerup wetlands provide the most significant regular breeding habitat for Black Swans in Western Australia and regularly support at least 1% of the Ramsar populations of Australian Shelduck (Wetland Research & Management 2007).

Table 7 – Waterbirds observed on Vasse Estuary during the IAI RCM survey in 2008.

Common name	Scientific name	Abundance
Australian Shelduck	*Tadorna tadornoides*	Approx. 200
Silver Gull	*Larus novaehollandiae*	6
Red-capped Plover	*Charadrius ruficapillus*	5
Black Swan	*Cygnus atratus*	23 adults, 5 cygnets

2.6. Other Fauna

Fish were observed in Vasse Estuary at low abundance. The species of fish were not identified in keeping with the rapid assessment methodology employed (DEC 2008). At least twenty-nine species of fish, including freshwater, estuarine and marine fish, are known to occur within the Vasse-Wonnerup Wetland System (Wetland Research & Management 2007).

There was no evidence of other terrestrial vertebrate fauna within the wetland. However, horse faeces were sighted in a paddock adjacent to Vasse Estuary.

2.7. Threats to the Ecology of Vasse Estuary

The Vasse-Wonnerup Wetland System is situated on the Swan Coastal Plain - a highly cleared area with extensive urban development. Vasse Estuary itself is closely bordered by semi-rural development with a narrow buffer of native vegetation. The wetland therefore faces potential threats of eutrophication and introduced flora.

The effect of eutrophication was evident across the entire waterbody from the presence of an algal mat on the sediment. Large amounts of faeces were also observed on the adjacent paddock and this nutrient input may have contributed to eutrophication of the Vasse estuary. It is likely that runoff from the surrounding cleared areas contains fertilisers, contributing to the problem. These observations are confirmed by previous threat analyses conducted at the site. The Vasse-Wonnerup Wetland System has been described as highly nutrient-enriched (eutrophic) due to catchment input from several diffuse and point sources, including agricultural fertilisers, stock wastes, urban and industrial drains and unsewered areas of the Busselton township (Wetland Research & Management 2007).Following grazing, the next largest contributor of phosphorus and nitrogen to both catchments is point sources. The majority of point sources are derived from the numerous dairy sheds that exist throughout the catchment (DoW, 2009).

Not surprisingly, considering the Vasse Estuary's close proximity to grassed paddocks and residential gardens, weeds were present at the site (Figure 7). An estimated five percent of the site was impacted by weeds. Pasture grasses (Kikuyu & Couch) have been identified as impacting the Vasse-Wonnerup Wetland System, as well as Bridal Creeper, Arum Lilies and *Typha* (Wetland Research & Management 2007).

Figure 7 – The change from exotic, urban influenced vegetation to the samphire dominated riparian vegetation to the south of Vasse Estuary.

References

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Appendix 1

Table 8 – Overall Vegetation Community Condition Rating as adapted from Thackway and Lesslie (2005). Shading indicates the condition of Spearwood Creek.

Overall Community Condition Rating					
	0	**1**	**2**	**3**	**4**
Community Condition Class	**RESIDUAL BARE**	**NATURAL**	**IMPACTED**	**DEGRADED**	**REMOVED / REPLACED**
	Areas where native vegetation does not naturally persist	Native vegetation community structure, composition and regenerative capacity intact - no significant perturbation from land management practices	Native vegetation community structure, composition and regenerative capacity intact but perturbed by land management practices	Native vegetation community structure, composition and regenerative capacity significantly altered by land management practices	Species present are alien to the locality and either spontaneous in occurrence or cultivated. Alternatively, vegetation may have been removed entirely
Regenerative Capacity	Natural regenerative capacity unmodified - ephemerals and lower plants	Regenerative capacity intact. All species expected to show regeneration are doing so	Natural regenerative capacity somewhat reduced, but endures under current/past land management practices	Natural regenerative capacity limited and at risk due to land management practices. Rehabilitation and restoration possible through removal of threats	Regenerative potential of native vegetation has been suppressed by ongoing disturbances. There is little potential for restoration
Vegetation Structure	Nil or minimal	Structural integrity of native vegetation is very high. All expected strata, growth forms and age classes are present	Structure is altered but persists, i.e. some elements of a stratum are missing	Structure of native vegetation is significantly altered, i.e. one or more strata are missing entirely	All structural elements of native vegetation are missing or highly degraded
Vegetation Composition	Nil or minimal	Compositional integrity of native vegetation is very high. All species expected at the site are present	Composition of native vegetation is altered. All major species are present, although proportions may have changed. Some minor species may be missing	Significant species are missing from the site and may have been replaced by opportunistic species. Loss of species affects structure of vegetation	Native vegetation removed entirely +/- replaced with introduced species

Appendix 2

Table 9 – Herbarium Records for Spearwood Creek.

Search Coordinates: NW corner 33.6272°S, 115.3582° E; SE corner 33.6543°S, 115.4227°E

Family	Species	Alien	Cons. Status
Amaranthaceae	*Alternanthera denticulata*		
Apiaceae	*Apium prostratum* var. *prostratum*		
Apocynaceae	*Alyxia buxifolia.*		
Asteraceae	*Senecio quadridentatus*		
Brassicaceae	*Cardamine hirsuta*	Y	
Brassicaceae	*Cardamine paucijuga*		P2
Brassicaceae	*Sisymbrium orientale*	Y	
Chenopodiaceae	*Atriplex hypoleuca*		
Chenopodiaceae	*Suaeda australis*		
Colchicaceae	*Burchardia multiflora*		
Collemataceae	*Collema leucocarpon*		
Collemataceae	*Collema subconveniens*		
Collemataceae	*Leptogium menziesii*		
Crassulaceae	*Crassula alata* var. *alata*	Y	
Crassulaceae	*Crassula decumbens* var. *decumbens*		
Crassulaceae	*Crassula thunbergiana* subsp. *thunbergiana*	Y	
Cyperaceae	*Baumea preissii*		
Cyperaceae	*Isolepis oldfieldiana*		
Cyperaceae	*Isolepis* sp.		
Cyperaceae	*Schoenoplectus validus*		
Dasypogonaceae	*Lomandra purpurea*		
Dilleniaceae	*Hibbertia commutata*		
Dilleniaceae	*Hibbertia ferruginea*		
Dilleniaceae	*Hibbertia hypericoides*		
Dilleniaceae	*Hibbertia stellaris*		
Dilleniaceae	*Hibbertia vaginata*		
Epacridaceae	*Andersonia* aff. *caerulea*		
Epacridaceae	*Conostephium pendulum*		
Epacridaceae	*Leucopogon conostephioides*		
Epacridaceae	*Lysinema ciliatum*		
Euphorbiaceae	*Euphorbia peplus*	Y	
Gentianaceae	*Centaurium erythraea*	Y	
Gentianaceae	*Centaurium spicatum*		
Goodeniaceae	*Dampiera linearis*		
Haemodoraceae	*Conostylis aculeata* subsp. *aculeata*		
Hyacinthaceae	*Albuca canadensis*	Y	
Iridaceae	*Watsonia meriana* var. *meriana*	Y	

Family	Species	Alien	Cons. Status
Lamiaceae	*Lavandula stoechas*	Y	
Lemnaceae	*Lemna disperma*		
Lobeliaceae	*Lobelia tenuior*		
Malvaceae	*Malva multiflora*	Y	
Mimosaceae	*Acacia cyclops*		
Mimosaceae	*Acacia extensa*		
Mimosaceae	*Acacia pulchella* var. *glaberrima*		
Moraceae	*Ficus carica*	Y	
Myrtaceae	*Agonis flexuosa*		
Myrtaceae	*Astartea leptophylla*		
Myrtaceae	*Eucalyptus cornuta*		
Myrtaceae	*Eucalyptus cornuta x gomphocephala*		
Myrtaceae	*Eucalyptus rudis*		
Myrtaceae	*Melaleuca pauciflora*		
Myrtaceae	*Melaleuca rhaphiophylla*		
Oleaceae	*Olea europaea* subsp. *europaea*	Y	
Onagraceae	*Epilobium billardiereanum*		
Orchidaceae	*Prasophyllum hians*		
Papilionaceae	*Gastrolobium praemorsum*		
Papilionaceae	*Hardenbergia comptoniana*		
Papilionaceae	*Hovea stricta*		
Papilionaceae	*Kennedia coccinea*		
Papilionaceae	*Lessertia frutescens*	Y	
Parmeliaceae	*Parmelina labrosa*		
Phormiaceae	*Stypandra glauca*		
Physciaceae	*Rinodina conradii*		
Plantaginaceae	*Plantago debilis*		
Poaceae	*Avena barbata*	Y	
Poaceae	*Bromus* sp.		
Poaceae	*Deyeuxia quadriseta*		
Poaceae	*Hemarthria uncinata*		
Poaceae	*Hordeum marinum*	Y	
Poaceae	*Phalaris paradoxa*	Y	
Polygonaceae	*Emex australis*	Y	
Polygonaceae	*Polygonum arenastrum*	Y	
Proteaceae	*Conospermum caeruleum* subsp. *marginatum*		
Proteaceae	*Grevillea vestita* subsp. *vestita*		
Proteaceae	*Synaphea petiolaris* subsp. *triloba*		
Ranunculaceae	*Ranunculus colonorum*		
Rutaceae	*Philotheca spicata*		
Scrophulariaceae	*Linaria maroccana*	Y	

Family	Species	Alien	Cons. Status
Solanaceae	*Solanum americanum*	Y	
Solanaceae	*Solanum symonii*		
Thymelaeaceae	*Pimelea argentea*		
Tremandraceae	*Platytheca galioides*		