Water Authority
of Western Australia

Channel Wetlands

An Investigation of the Application of Simple Evaluation Procedures

Report No. WP 153
March 1992

Water Authority
of Western Australia

WATER RESOURCES DIRECTORATE
Water Resources Planning Branch
Strategic Water Planning Section

Channel Wetlands

An Investigation of the Application of Simple Evaluation Procedures

Liz Thorburn

Report No. WP 153
March 1992

RIPARIAN INFLUENCE ON STREAM ECOSYSTEMS

Kenneth W. Cummins
University of Maryland, USA

An Ode To Riparian Protection

I entreat we extol,
Riparian control

'Though many riparian,
Is largely agrarian -
Or removed by the axe,
To save corporate tax.
Inputs from this zone,
May suffice all alone -
As the energy drivers
of stream bio-survivers.

Leaves in the stream,
Are the substrate supreme.
"With microbes they're better,"
Says an invertebrate shredder -
They're ever so munchy,
With hyphomycete fungi.

And, so I emplore,
Let's work to restore -
Our riparian green,
To conditions once seen.

This is the correction
The real Stream Protection.

From Cummins 1986

CONTENTS

TABLES

FIGURES

1.0 SUMMARY

The essence of this study was to investigate methods of evaluating channel wetlands. This assessment has produced some management recommendations and has identified areas that require further research.

It is important when assessing channel wetlands to view them as natural corridors and to evaluate their attributes according to abiotic, biotic and catchment features, as well as their natural and social significance. An effective method of assessment is to define fifty and two hundred metre corridors alongside the wetland to describe the condition of the corridor vegetation. Retaining, restoring and revegetating wetland vegetation is important when considering wetland management. The erection and maintenance of fences should be of primary concern in the headwaters of channel wetlands and where temporary and permanent pools exist. Fencing wetlands allows the native fringing vegetation to grow undisturbed and prevents the intrusion of stock, weeds and pollutants. Native vegetation buffers of a minimal fifty metres from the wetland edge should be encouraged.

The long term future of channel wetlands depends upon the planning strategies that are implemented and their effectiveness in maintaining, conserving and enhancing the wetlands' natural and social values.

2.0 INTRODUCTION

The aim of this study is to investigate the application of simple evaluation procedures to assess channel wetlands. The procedures investigated involved firstly a desk study and secondly, a more detailed field assessment of the channels.

The method is as follows:

Desk Study

(i) Divide wetland into segments and define zones

(ii) Devise a simple procedure for evaluating segments of channel wetlands based on vegetation status and identified attributes of natural and social significance

(iii) Implement the procedure using aerial photographs, orthophotos and existing reference material and refine if necessary

(iv) Determine preliminary management categories for segments of channel wetlands

Field Study

(i) Describe a field evaluation process to complement the desk study

(ii) Implement the procedure on a field trial and refine if necessary (see Figure 1)

(iii) Modify the management categories (if necessary) according to the field results

The study will:

Propose recommendations for the management of channel wetlands on the Swan Coastal Plain and the Darling Plateau based on desk and field assessment; and

Identify requirements for future work

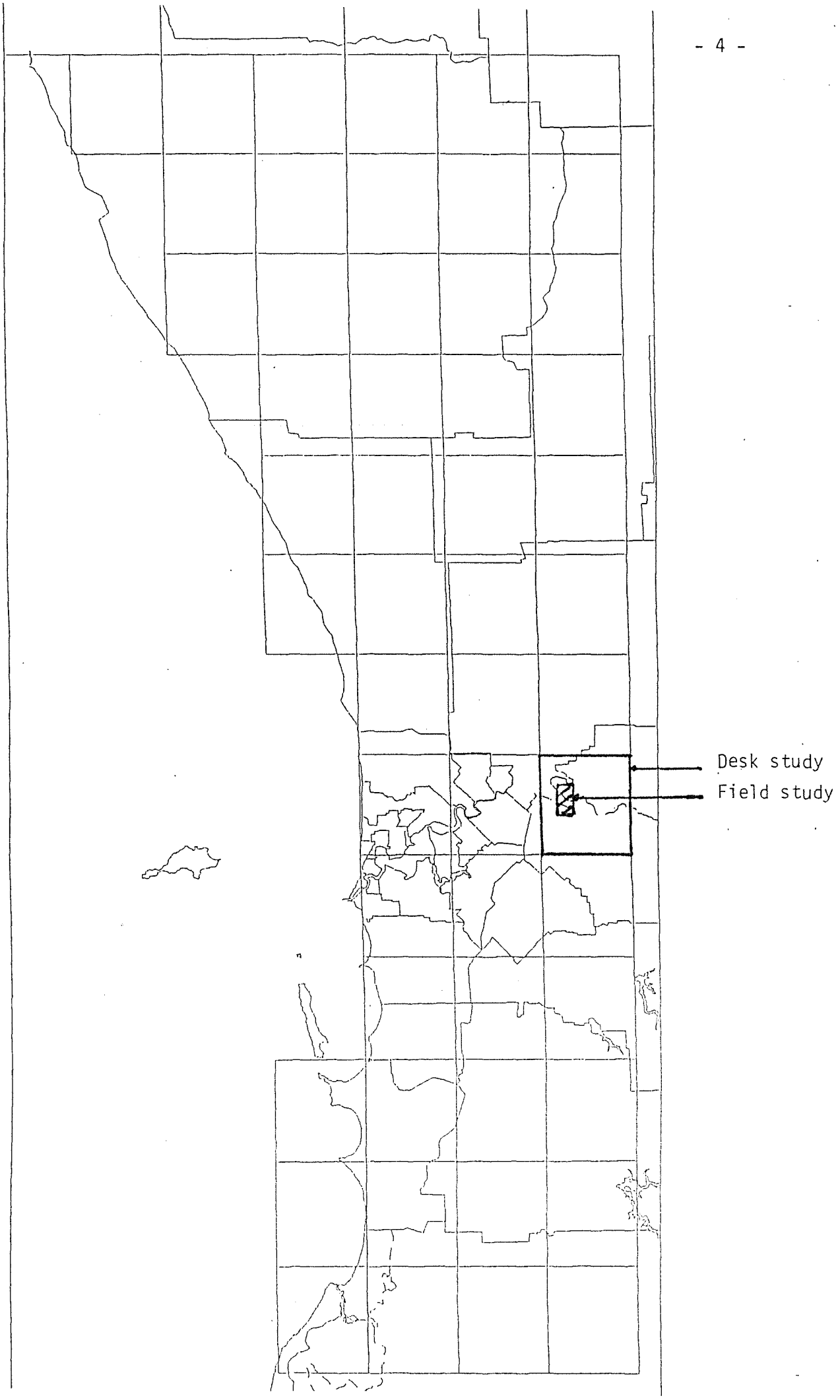


Figure 1

3.0 CHANNEL WETLANDS LITERATURE REVIEW

3.1 Types of Channel Wetlands

The wetland classification system developed by Semeniuk(1987), identifies three basic landforms: basin, channel and flat, and then further classifies the wetlands according to water longevity. A permanently inundated channel is defined as a river and a seasonally (or intermittently) inundated channel is termed a creek. Drains are described as artificial channels. Department of Land Information topographic maps are used as a source for linework and other hydrographic information in this study.

3.2 Previous Wetland Evaluation Studies

A number of studies have been performed in Australia to assess the environmental, conservation and recreational value of channels. Each study uses a different approach, some with more merit than others. A review of the approaches and their applicability to Western Australian conditions is as follows.

A study by Blyth (1984) describes a rapid stream survey technique for assessing the physical and botanical features of small streams and their catchments. The method was tested on streams of the Errinundra Plateau in Victoria using a set of seven criteria. These criteria were based on Morgan (1982) and adopted to suit Australian conditions.

A scoring system was devised for diversity, naturalness and rarity, and four other criteria; scientific and educational value, representativeness, aesthetic, wilderness and scenic values and effectiveness as a conservation unit. These last four criteria were used as qualifiers and given ratings of high, moderate or low. The simple procedure provides baseline information for use in management however it is most applicable in streams of fourth order and less in south eastern Australia.

Macmillan (1984) developed a method for identifying small streams of high conservation status. Streams were first classified on catchment features; climate, physiography and geology, to identify streams of order 3 or less. High conservation status streams were identified using a filter system with the preliminary filter being the natural vegetation cover of a catchment. This gives a rapid method of recognising high value catchments. The subsequent filters were: impoundment and river works, mining, logging, road crossings, grazing and exotic species. The system of identification was then applied to streams in the East Gippsland Plateau.

A study conducted by Mitchell (1990) for the Department of Water Resources Victoria dealt with the Environmental Condition of Victorian Streams. The streams were categorised initially on the basis of catchment area and then further according to the degree of clearing in the catchment. Streams with cleared catchments were further categorised according to land types. As a result of this, forty three stream categories were defined across the state. Assessment of the environmental condition of the streams was determined by looking at 10 environmental factors.

The criteria are as follows; bed composition, proportion of pools and riffles, bank vegetation, verge vegetation, cover for fish, average flow velocity, water depth, underwater vegetation, organic debris, and erosion/sedimentation. Not all of the criteria were given equal weighting, with bed composition, bank and verge vegetation and the amount of cover for fish being given the most weight. The other factors were all given low weighting from the results of the environmental ratings, the sites were rated as very poor, poor, moderate, good or excellent. The length of stream in each environmental rating category was then calculated so that a comparison between each basin could be produced. This method of assessment is time consuming due to the amount of factors that are to be identified and evaluated in the field. It is however, worthwhile to note that the study is thorough and detailed and provides an accurate account of the condition of the streams in each basin.

LeProvost, Semeniuk and Chalmer (1987) for the Western Australian Water Resources Council carried out a study to identify procedures for wetland classification and evaluation in the Perth to Bunbury Region. The work in this paper on channel wetlands is principally based on modifications of the methods proposed by Leprovost, Semeniuk and Chalmer in 1987.

The above descriptions of past studies are just a few examples of methods of evaluating channels, and in particular, streams. The examples show some of the methods that have been used in Australia and more commonly, eastern Australia. The studies also indicate the variety of features that can be used to evaluate a wetland.

The problem of determining which variables to consider stems largely from the fact that channels are integrated systems that interact with the surrounding environment. Thus, assessing the channel and excluding the riparian environment would not accurately describe the channel ecosystem. What is needed is an overall assessment of the abiotic, biotic, natural and social features of the channel with an emphasis on catchment activities.

3.2 Channel Wetlands - Natural Corridors

3.2.1 Definition of Corridors

Corridors as described by Forman and Godron (1986) in A.F.Bennett's Habitat Corridors, can be divided into five categories according to their origin.

* Stream corridors are considered natural corridors as they follow topographic or environmental contours and are the result of natural environmental processes.
* Remnant corridors are strips of remnant vegetation resulting from alteration or disturbance to the surrounding environment.
* Regenerated corridors occur as the result of regrowth of a strip of vegetation that was formerly cleared or disturbed.
* Planted corridors include windbreaks, or farm plantations which have been established by humans.
* Disturbance corridors include railway reserves and roads and result from disturbance within the corridor strip.

Loney and Hobbs (1991) recognise three distinct corridor types based on their mode of origin: natural, remnant and cultural. These 3 classes are similar to those proposed by Forman and Godron (1986), although slight differences are evident.

The corridor definitions as described by Loney and Hobbs(1991) are as follows.

Natural Corridors - which are present in unfragmented landscapes and may be retained following fragmentation. These include streams and rivers, riparian vegetation strips and topographic features such as mountain passes, isthmuses and narrow straits which may channel faunal movement.

Remnant Corridors - which are strips of natural vegetation left following the clearing or alteration of the surrounding landscape. These include roadsides and railway edges. Natural corridors may also become remnants following landscape fragmentation.

Cultural Corridors - which are strips of artificial vegetation created specifically for a primarily utilitarian use. These include shelterbelts, hedgerows, ditches and clearings cut through forest for power lines or rights of way.

3.2.2 Corridor Functions

Corridors are an important part of an ecosystem, providing habitat for native flora and fauna and permitting the movement of species along and between them. The linking of corridors is essential for maintaining diversity and for encouraging interactions between populations. Corridors serve other purposes which relate to the condition of the landscape and the enhancement of its appearance.

Vegetation corridors help to combat land degradation by contributing to the prevention of wind and water erosion and to the control of dryland salinity (Hussey et al, 1991). Corridors are also valuable for aesthetic purposes as they provide an attractive focal point for travellers and for local residents. The native vegetation and fauna is also an important scientific and educational source that can arouse interest whilst travelling.

3.4 The Importance of Riparian Vegetation to Creeks

From the above descriptions it is evident that rivers and their associated floodplains are natural corridors which have developed as a result of climatic, hydrologic and geomorphic processes. Hydrologic factors significantly determine the physical and biotic features of riparian ecosystems (Cross et al, 1991). The vegetation corridor surrounding a stream or river plays a vital role in maintaining the integrity of the river ecosystem.

The riparian vegetation performs many important functions relating to the physical, chemical, biotic and abiotic features of a wetland. Figure 2 shows the influences of stream side vegetation on a channel wetland. The plant communities of a wetland provide a food source in the form of organic matter such as fallen leaves, branches and logs. The productivity of the ecosystem is vital for the survival of aquatic and terrestrial fauna which inhabit the stream zone.

The vegetation also provides shelter and a habitat for an array of avian, terrestrial and amphibian fauna which use the stream ecosystem for feeding and breeding, including insects, frogs, tortoises, and birds (Olsen and Skitmore, 1991).

Another function of the fringing vegetation is to stabilize and aerate the sediment and provide a filtering mechanism for material passing into the wetland (Chambers and Davis, 1988). Riparian vegetation buffers the river or stream from the surrounding land use by intercepting sediment and pollutants carried by runoff from agricultural, urban or industrial areas and preventing their entrance into the wetland ecosystem.

Possibly the most important function of the fringing vegetation is to stabilize the channel and its banks by binding the soil together with plant roots (Olsen and Skitmore, 1991). Erosion by stock, vehicles, water, wind and humans is reduced if fringing vegetation is left intact.

Shading the water surface and lowering the water temperature is another function of the riparian vegetation. Algal growth is reduced by the lower surface temperature and light intensity and native aquatic fauna (lampreys) are favoured under these conditions (Hilliard, 1989). Higher temperatures and light intensity resulting from the removal of vegetation, increases the suitability of the wetland for introduced species such as Gambusia (mosquito fish), (Hilliard, 1989).

Fringing vegetation provides a source of colour to a wetland with the breakdown of plant material into dissolved humic substances. Recent invertebrate research has shown that coloured wetlands do not generally experience algal blooms, even though nutrient levels may be excessive (Davis, 1991). Wetlands that exhibit these features are termed dystrophic. It is likely that the number of coloured wetlands on the Swan Coastal Plain has been reduced due to the removal of native fringing vegetation for landscaping and recreational purposes. It is evident then, that riparian vegetation plays a major role in the functioning of a wetland ecosystem and is vital for maintaining and enhancing its natural qualities.

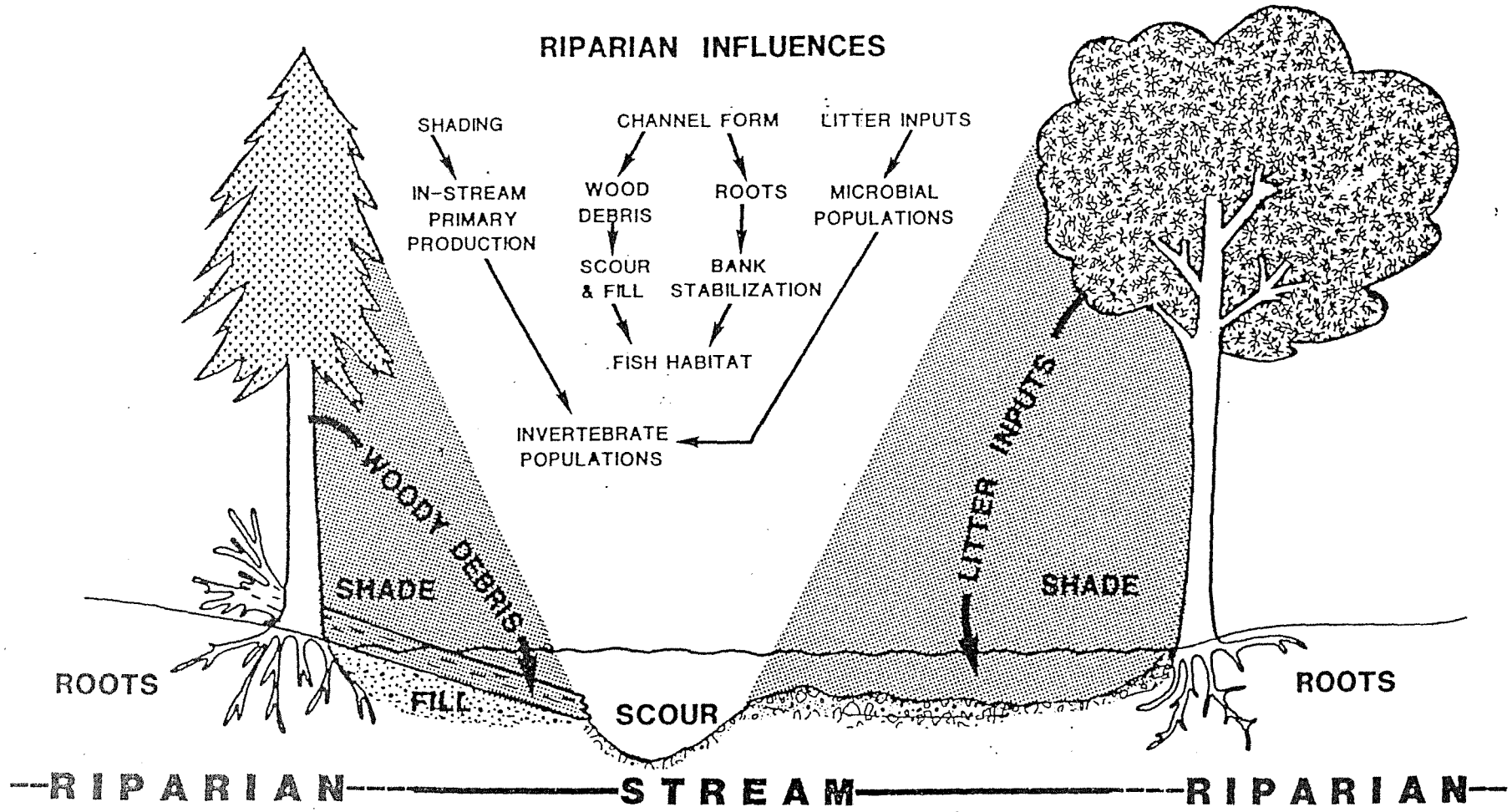


Figure 2. A diagrammatic summary of the influences exerted by the riparian zone on the physical characteristics and biological components of the associated stream ecosystem.

From Cummins 1986

4.0 DESK EVALUATION

4.1 Principal Issues

The two principal issues addressed in the desk evaluation are the assessment of the wetland vegetation status and the identification of areas of natural and social significance. Other issues include the presence or absence of drains, and the principal land use surrounding the wetland. The two principal issues will be discussed in the following sections.

4.1.1 Vegetation Description

A method for describing the status of corridor vegetation based on LeProvost, Semeniuk and Chalmer (1987), is proposed as follows. Arbitrary widths of zones are set for rivers, creeks and artificial channels at 50m and 200m. The first zone named the wetland zone (<50m), contains principally wetland vegetation and the second named the upland vegetation zone is the surrounding vegetation (>50m and <200m). An overlay of the 50m and 200m zones of the watercourse corridor is placed over the 1:25 000 orthophotos. The channels are divided into segments as defined by bifurcations, and estimates of the percentage of vegetation in each of the zones is noted.

A category is then assigned from this raw score according to the following three categories:

V - vegetated:	50% or more of the buffer is vegetated
P - partly vegetated:	greater than 10% and less than 50% of the buffer is vegetated
C - cleared:	less than 10% of the buffer is vegetated

Each segment will have a V,P, or C assigned for the two parts of the corridor. For example, a creek that is classified as vegetated in the 0-50m wetland zones and partly vegetated in the 50-200m upland zone would be referred to as VP.

4.1.2 Features of Natural and Social Significance

Features of natural and social significance are identified using a system based on LeProvost, Semeniuk and Chalmer (1987), Alan Hill (in prep.). The function of the natural and social significance component is to address factors which are concerned with the outstanding natural and social attributes of the wetland. Ecosystem, species, culture and recreation are the essential attributes that will be the focus of the study.

The final stage of evaluation is to assign a management category which reflects the state of the wetland vegetation corridors and the significance of features in the wetland (LeProvost, Semeniuk and Chalmer (1987), Alan Hill (in prep.). Figure 3 shows the criteria used to evaluate channels in the desk study.

A : WETLAND VEGETATION AND LAND USE SURVEY:DESK STUDY

1 Map Sheet Name

2 Wetland Name\Number

3 Wetland Identification Number

4 Wetland Type

5 Geomorphology Unit

6 Geomorphology map used

7 Vegetation Unit

8 Vegetation map used

9 Vegetation Status

*Left	Right	*Left (%)		Right (%)	
V,P or C	V,P or C	200-50m	50-0m	0-50m	50-200m

V : Vegetation >50% of zone
P : Vegetation >10% and <50% of zone
C : Vegetation <10% of zone

10 Drain Status

O:Drains Out I:Drains In N:No drains

11 Principle Land Uses (50-200m)

*Left	Right

V : Predominantly uncleared native vegetation
P : Pine Plantation
A : Agriculture
H : Horticulture
U : Urban
I : Mining/Industry
O : Other (Please specify) _____

* Facing Downstream
Basin and flat wetlands use 'left' column only

12 Assessor

13 Survey Date

B : WETLAND FEATURES OF NATURAL AND SOCIAL SIGNIFICANCE

Ecosystem

15 Is the wetland a prime example or representative of the area's wetland ecosystems?

16 Is the wetland of a type that is limited in distribution?

17 Is the wetland part of a linked, natural system where destroying or degrading one wetland would affect others in the system?

Species

18 Is the wetland an important sanctuary for flora or fauna?

19 Is the wetland a habitat for rare and endangered species?

20 Does the wetland function as either a seasonal or temporary habitat or breeding ground for large numbers of migratory or nomadic animals?

Culture

21 Does the wetland function as an important educational resource?

22 Does the wetland have importance as an historic or Aboriginal site or does it hold unusual features of special scientific significance?

23 Is the wetland part of a linked network of cultural resources significant for aesthetic or heritage purposes?

Recreation

24 Does the wetland serve as an important recreation resource?

25 Is the wetland a site for recreational activities which are restricted at other wetlands?

26 Is the wetland part of a linked network of recreational resources?

Key:

Significance: I:International N:National S:State R:Regional L:Local P:Parochial

References:

1.
2.
3.
4.

4.2 Explanatory Notes for Survey Sheet

Question 1: Map Sheet Name

The 1:25 000 Map Sheet Name
eg: 21343SW

Question 2: Wetland Name/Number

The name or number assigned to that wetland

Question 3: Wetland Identification Number

The Wetland Identification Number comprises the first four digits of the easting and the last five digits of the northing of the wetland centroid to the nearest 100m.

Question 4: Wetland Type

Type of wetland classified according to Semeniuk (1987) Wetland Classification System eg: dampland

Question 5: Geomorphology Unit

The unit of geomorphology that describes the area containing the wetland. The unit should be obtained from reference literature. System 6 landform and soils mapping (Department of Conservation and Environment, 1980), and Semeniuk (1987) consanguineous wetland suites mapping are useful references for the Darling System.

Question 6: Geomorphology map used

The map used to provide the above geomorphology unit.

Question 7: Vegetation Unit

The unit of vegetation that describes the area containing the wetland. For the Swan Coastal Plain, System 6 vegetation mapping is useful and outside this area Beard (1990) vegetation descriptions for Western Australia are recommended (1:250 000 in the South West and 1:1 000 000 elsewhere).

Question 8: Vegetation map used

The map used to provide the vegetation unit for the above question.

Question 9: Vegetation Status

The vegetation status of a wetland can be described as the percentage of the wetland that is vegetated. The raw scores are stored in the set of four boxes marked with the 0-50m and 50-200m corridors. The average of the 0-50m corridors and the 50-200m corridors respectively are then converted to a V,P or C status, and recorded in the first two boxes.

Question 10: Drain Status

The presence of drains with flow in or out of the wetland or their absence is noted here.

Question 11: Principle Land Use

The principle land use on the left and right hand side of the wetland (or surrounding the wetland if a basin or flat) is to be recorded in the two boxes provided.

Question 12:Aerial Photos

The job number, run number, photo number and the date of the aerial photos is to be recorded in the boxes provided.

Question 13:Assessor

The person who assessed the wetland.

Question 14:Survey Date

The date the desk survey of the wetland was performed.

4.3 Results of the Desk Evaluation

Table 1 : Desk Evaluation Results

	VV	VP	VC	PP	PV	PC	CC	CV	CP
340	212	22	4	39	22	15	15	4	7
%	62.3	6.5	1.2	11.5	6.5	4.4	4.4	1.2	2.0

The results of the desk study, as seen in Table 1, showed that of the wetlands assessed, approximately 62% were evaluated as being VV. That is, 62% of the wetlands of map sheet 21343SW are 50% or more vegetated in the 200m zone from the wetland. This is not surprising considering that approximately 50% of the map sheet area is System 6 reserve or part of the C.A.L.M. Estate. Partly vegetated wetlands PP comprised 11.5% of the total number of wetlands assessed and PV and VP wetlands represented 6.5% of the total. All other categories each recorded less than 5% of the total number of wetlands assessed. These marginal categories are dominated by wetlands with cleared wetland zone vegetation (0-50m) or cleared upland zone vegetation (50-200m). It is essential to note that these vegetated or partly vegetated wetlands arise from urban or semi-urban areas where a well vegetated 50m corridor remains, and a partly cleared 50-200m corridor exists. Although the 50-200m corridor may be cleared or partly cleared, it is vital that the extent of vegetation in the 0-50m zone be noted. This zone is important to the functioning of the wetland as well as buffering it from the surrounding land use. A matrix as shown in Table 2 has been proposed to provide management categories from the vegetation status.

Table 2 : Wetland Vegetation and Land Use Survey

Vegetation Status	*Bulletin 374 Management Category		
	River	Creek	Artificial Channel
VV	C	C	O
VP	C	C	O
VC	C	C	O
PV	C	C	O
PP	O	O	R
PC	O	O	R
CV	O	O	R
CP	O	O	R
CC	R	R	M

* Refer to Table 6 for definitions of Bulletin 374 management categories.

Table 3 shows the Bulletin 374 management category that should be given to a wetland with natural or social significance. The management categories in this table override those shown in Table 2. For instance, if a wetland is given a C for Conservation from Table 2, but is listed in the Register of the National Estate, then it qualifies under national significance and as such is an H, high conservation wetland.

Table 3 : Wetland Features of Natural and Social Significance

Level of Significance	*Bulletin 374 Management Category		
	Code	Natural	Social
International	I	H	H
National	N	H	H
State	S	H	H
Regional	R	H	H
Local	L	N/A	O
Parochial	P	N/A	N/A

Table 4 shows the results of the desk study and the percentage of wetlands in each category. The table is divided into two sections with the first being the results from the vegetation status assessment. The second section is the percentage of wetlands in each management category after the features of significance has been applied. It is evident from Table 4 that many of the conservation wetlands were assessed as high conservation after the significant features assessment. This is true for wetlands in the John Forrest National Park and in other well vegetated areas, such as System 6 reserves, which were altered from conservation to high conservation due to regional or state significance.

Table 4 : Management Categories Derived from Desk and Field Studies

*Bulletin 374 Management Category	Percentage of total number of wetlands	
	From vegetation status (See Table 2)	From features of Significance (See Table 3)
H	0	57.1
C	76.5	23.5
O	19.1	16.5
R	4.4	2.9
M	0	0

* Refer to Table 6 for descriptions of management categories

Table 5 : Preliminary Identification of Management Issues by Management Category

	Retain Restore Reveg.	Fences	Pools	Weeds/ Intro. Flora	Fire
H	High	High	High	High	High
C	High	High	High	High	High
O	Medium	High	High	Medium	Medium
R	Medium	High	High	Medium	Low
M	Medium	Medium	Medium	Medium	Low

Table 5 identifies management issues and relates the issues to management categories using a rating of high medium or low. When analyzing this table it is important to perceive the management categories as the potential category of the wetland and to assume that all wetlands can be enhanced through proper management.

Table 6 : E.P.A. Bulletin 374 Management Categories

*** H : High Conservation**

Management objectives : Active management to maintain and enhance the wetland attributes, particularly natural attributes. Where there is no active management at present it should be put in place as a matter of highest priority.

*** C : Conservation**

Management objectives : To maintain and enhance natural attributes and functions.

*** O : Conservation and recreation**

Management objectives : To provide for human uses whilst maintaining and enhancing the existing natural attributes.

*** R : Resource enhancement**

Management objectives : To maintain and enhance the existing ecological functions.

*** M : Multiple Use**

Management objectives : Should be considered in the context of catchment and land use planning (especially drainage, nutrient enrichment, surface and groundwater pollution), in terms of the current value of the wetland and the potential value to the community if rehabilitated.

5.0 FIELD EVALUATION

5.1 Principle Issues

The field evaluation is aimed at testing the effectiveness of the desk study in providing a rapid assessment of the corridor vegetation and in producing a preliminary management category. As it is a more detailed survey designed for use in the field, the evaluation provides information that could not be obtained from using orthophotos or aerial photos. The field evaluation is divided into sections entitled Wetland Details, Abiotic and Biotic Wetland Information, Management Issues and a Wetland Site Description. The field evaluation sheet is shown in Figure 8.

The essence of the field evaluation is to use the abiotic and biotic wetland information determined from the field study, coupled with the natural and social significance of the wetland determined from the desk study to produce a refined preliminary management category. A second function of the field evaluation is to identify management issues. The two fundamental issues that have been included on the sheet for evaluation are the presence and condition of fences and pools. Sections 5.1.1 and 5.1.2 discuss these two issues in detail. Management options can then be formulated according to the objectives described for each category in Bulletin 374 as shown in Table 6.

The study area comprised of the map sheet 21343SW which is situated primarily in the Shire of Kalamunda with the Shires of Swan and Mundaring adjoining.

The area is interesting for testing the process as it contains the Helena River and its associated tributaries flowing through the following land uses: urban, recreational, agricultural, horticultural, mining, industry, National Park and nature reserves. This spectrum of land uses should assess the effectiveness of the survey and identify any faults in the system.

The creek chosen for the field survey flows through many land uses and is subjected to most of the land use impacts described in the survey sheet. The upstream section of the creek is situated in the System 6 M34 reserve and then flows downstream through the various land uses and System 6 M33 reserve to the Helena River. Figure 4 shows the position of the trial creek with the overlay of the 50m and 200m corridors. Figures 5, 6 and 7 are photos of the trial creek from upstream, through M34 reserve and into pastureland.

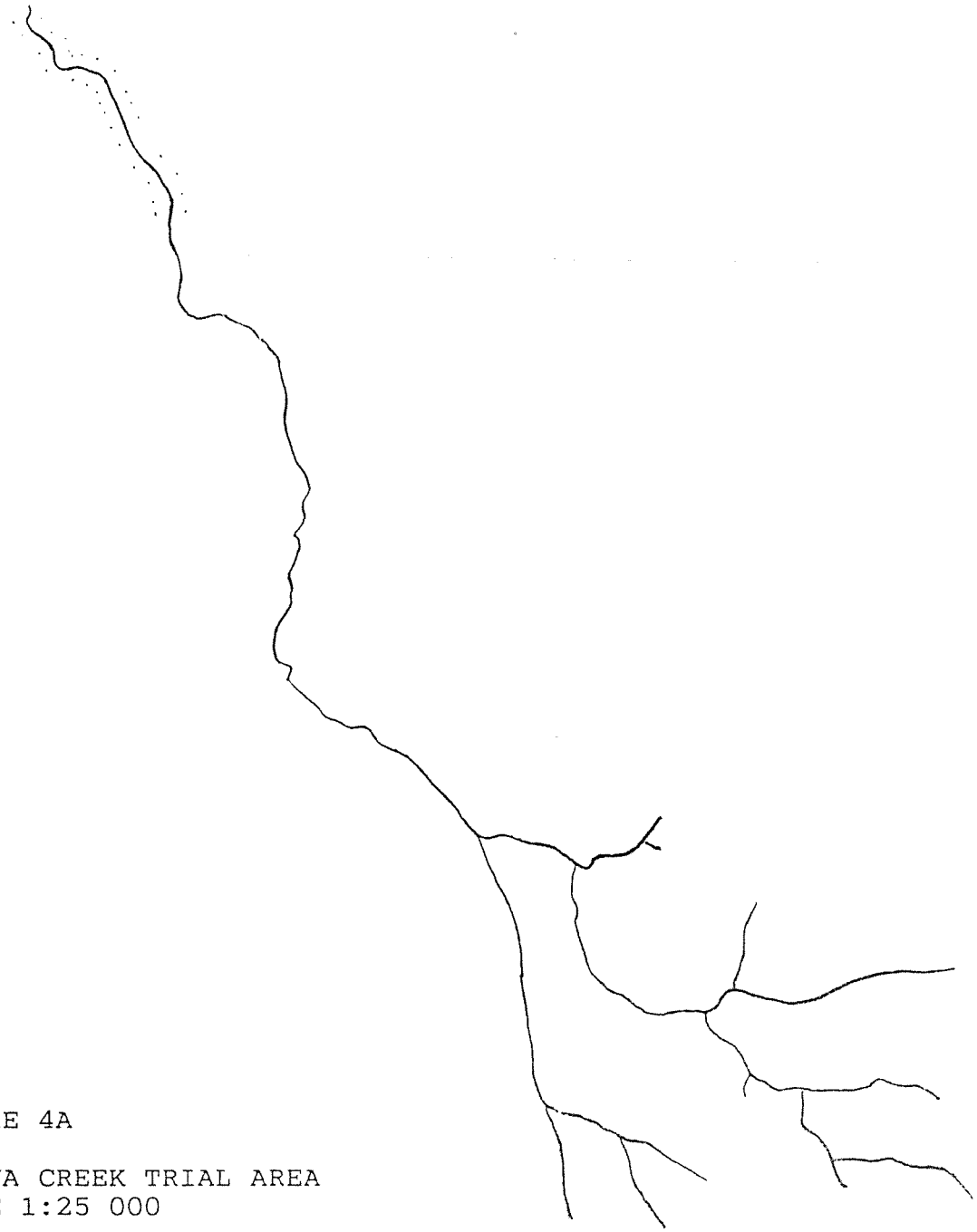


FIGURE 4A

KADINA CREEK TRIAL AREA
SCALE 1:25 000

FIGURE 4B

KADINA CREEK TRIAL AREA OVERLAY ON 1991 ORTHOPHOTO
SCALE 1:25 000

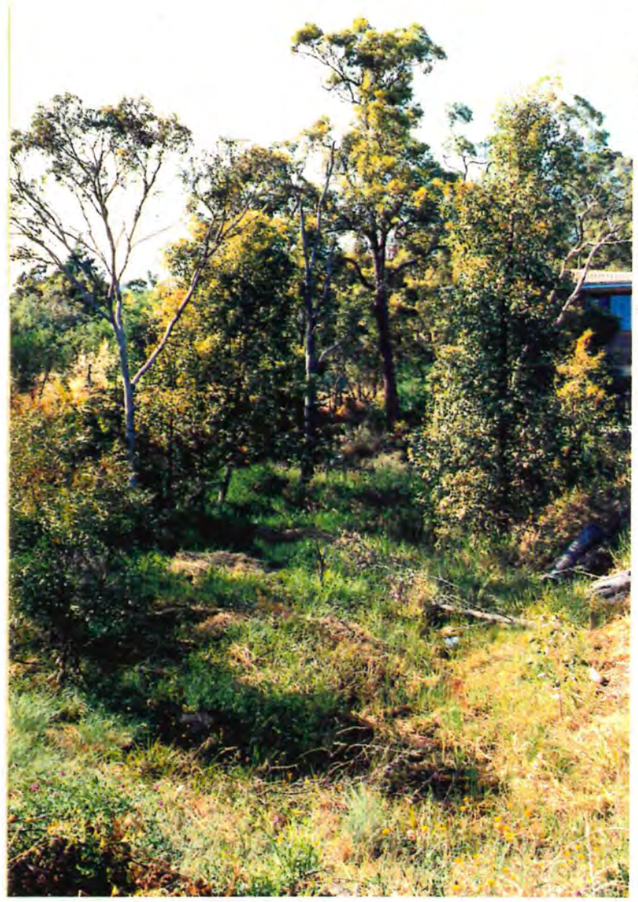


FIGURE 5A

PHOTOGRAPH TAKEN
OF CREEK HEADWATERS
LOOKING SOUTH FROM
GIRRAWHEEN DRIVE
GOOSEBERRY HILL

FIGURE 5B

PHOTOGRAPH TAKEN
OF CREEK HEADWATERS
LOOKING NORTH FROM
GIRRAWHEEN DRIVE
GOOSEBERRY HILL

FIGURE 7

PHOTOGRAPH TAKEN OF
CREEK BELOW M34 IN
FARMLAND, UNDERSTORY
GRAZED BUT REGENERATION
OCCURRING

FIGURE 6

PHOTOGRAPH TAKEN
OF CREEK IN SYSTEM 6
RESERVE M34, NOTE
WATSONIA INFESTATION

5.1.1 Fences

Fences are essential for the protection of riparian vegetation. Erosion of river and stream banks is common in the absence of fencing, leading to an increase in the turbidity of the water and a general lowering of the water quality. Nutrients are added by stock and by the release of nutrients previously trapped in the sediments by the root systems of the riparian vegetation. The removal of vegetation also accelerates the runoff of nutrient rich waters from crops and pastures or point sources such as piggeries and dairies. The increase in nutrient concentrations in the water column may lead to eutrophication, algal blooms and the stagnation of river pools.

5.1.2 River Pools

River pools are vital to the survival of many aquatic species, especially in times of high temperatures and low rainfall. As the riffle zones dry up, the pools provide refuge for aquatic animals and are filled with many different species competing for resources. The pools also provide the essential supply of water so vital for the development of dormant eggs and larvae. Animals appear from the bottom mud as desiccation resistant eggs, dormant larvae, or adults and are reactivated as they take up water (McComb and Lake, 1990). Temporary pools also provide a source of food for fauna, particularly birds, which feed on the crustaceans and tadpoles.

WETLAND VEGETATION AND LAND USE SURVEY:FIELD STUDY

A : WETLAND DETAILS

1 Map Sheet Name

2 Wetland Name/Number

3 Wetland Identification Number

4 Wetland Type

5 Assessor

6 Survey Date

7 Survey Time

8 Principle Land Uses (50-200m)

*Left	Right

V:Predominantly uncleared native vegetation
vegetation P:Pine plantation A:Agriculture
H:Horticulture U:Urban I:Mining/Industry
O:Other

* Facing downstream
Basin and flat wetlands use 'left' column only

9 Land use impacts on segment

G:Grazing W:Weeds F:Fire S:Salinity
T:Transport M:Mining L:Logging D:Drains out
I:Drains in O:Obstructions/Dams R:Recreation

10 Wetland Condition

P:Pristine N:Near pristine S:Slightly modified
M:Moderately modified H:Heavily modified
D:Degraded

B : ABIOTIC WETLAND INFORMATION

11 Substrate

F:Fine gravelly; small pebbles	2-6mm
M:Medium gravelly; medium pebbles	6-20mm
G:Coarse gravelly; large pebbles	20-60mm
C:Cobbly; or cobbles	60-200mm
S:Stony; stones	200-600mm
B:Bouldery; or boulders	600mm-2m

12 Origin of Bed Materials

R:Recent alluvial P:Parent M:Parent and alluvial

13 Stage (at established sample site)

14 Temperature (at established sample site)

15 Conductivity (at established sample site)

C : BIOTIC WETLAND INFORMATION

Native Flora

16 Type of dominant native vegetation remaining in 'immediate' zone of wetland edge (0-50m) (%)

	Left	Right
Tree layer		
Shrub layer		
Ground layer		

17 Extent of vegetation from wetland edge (%)

	Left	Right
0-50m		
50-200m		

18 Extent of native vegetation along the length of the wetland edge (%)

	Left	Right
0-50m		
50-200m		

Figure 8

BIOTIC WETLAND INFORMATION (CONT.)

19 Introduced Flora : Terrestrial/Aquatic

Name	Observation	Abundance

20 Native Fauna : Mammals/Birds/Reptiles/Amphibians/Fish

Name	Observation	Abundance

21 Introduced Fauna : Mammals/Birds/Fish

Name	Observation	Abundance

22 Rare Species Identified : Plants/Animals

Name	Observation	Abundance

23 Wetland Interspersion

Vegetation Cover [ ] C:Complete M:Mosaic P:Peripheral

Vegetation Organisation [ ] O:Homogeneous Z:Zoned E:Heterogeneous

D : Management Issues

24 Proportion of wetland edge fenced (%)
*Left Right

[ ] [ ]

25 Average distance of fence from wetland edge (m)
*Left Right

[ ] [ ]

* Facing downstream
Basin and flat wetlands use 'left' column only

26 Number of pools in segment (channel wetlands only) [ ]

27 Area of pools in segment (channel wetlands only) [ ]

E : Wetland Site Diagram

Key information to be included is : wetland boundary, wetland size and shape, vegetation types, introduced flora/weeds, native fauna, introduced fauna/feral animals, rare species, fences, access, drains/pumps, dams, gauges or other structures and any other relevant information. Mark photo sites on sketch and using an arrow indicate direction of photo.

Photographs:

Roll No.	Negative No.	Description

Additional notes or comments:

Figure 8 (Cont'd)

5.3 Explanatory Notes for Wetland Field Study

Question 1: Map Sheet Name

The 1:25 000 Map Sheet Name

eg: 21343SW

Question 2: Wetland Name/Number

The name or number assigned to that wetland

Question 3: Wetland Identification Number

The wetland identification number comprises the first four digits of the easting and the last five digits of the northing of the wetland centroid to the nearest 100m.

Question 4: Wetland Type

Type of wetland classified according to C.A. Semeniuk (1987) Wetland Classification System.

Question 5: Assessor

The person who assessed the wetland

Question 6: Survey Date

The date the desk survey of the wetland was performed

Question 7: Survey Time

The time of day the field survey was conducted

Question 8: Principle Land Uses (50-200m)

The principle land uses in the 50-200m corridor are to be recorded in the two boxes provided for the left and right hand sides of the wetland (use left box for basin and flat wetlands).

Question 9: Land use impacts on wetland

List the land use impacts on the wetland in order of their impact from highest to lowest.

Question 10: Wetland Condition

Record the condition of the wetland in the box provided according to which describes the wetland most accurately.

Question 11: Substrate

The wetland substrate is to be recorded in the boxes provided according to the soil size that is present. If there is a combination of two types than record the scores in the two boxes. The particle sizes shown on the sheet are meant as a guide only and no precise measurements are expected. The substrate categories are from McDonald et al (1990).

Question 12: Origin of Bed Materials

The origin of the bed materials is determined by analysing the surrounding soil. If the substrate is similar to the surrounding soil then it is likely to be of parent origin, if it is different then it is alluvial and if it is a combination of both then it is assessed as parent and alluvial.

Question 13: Stage

The stage of a wetland is defined as the flow of water in a channel in cubic metres per second, and the depth in a basin or flat wetland measured from a known reference point.

Question 14: Temperature

The temperature of the wetland is to be measured at an established sample site and the measurement and the appropriate units should be recorded in the boxes provided on the sheet.

Question 15: Conductivity

The conductivity of the wetland is to be measured at an established sample site and the measurement and the units recorded in the boxes provided.

Question 16: Type of dominant native vegetation remaining in the 0-50m zone of the wetland edge

Score, as a percentage, the amount of native vegetation in the 0-50m zone from the wetland. Record the amount for the tree, shrub and ground layer and for both the left and right hand sides of the wetland.

Question 17: Extent of native vegetation from the wetland edge

Determine the extent of the vegetation from the wetland edge and record it as a percentage for 0-50m and 50-200m for the left and right hand sides of the wetland.

Question 18: Extent of native vegetation along the length of the wetland edge

Determine the extent of native vegetation along the length of the wetland edge for the left and right hand sides and record it as a percentage.

Question 19: Introduced Flora:Terrestrial/Aquatic

Record any observations of terrestrial or aquatic introduced flora and the abundance of the species.

Question 20: Native Fauna:Mammals/Birds/Reptiles/Amphibians/Fish

Record any observations of native fauna and their abundance. Note the nature of the observation, whether nests, droppings and so on.

Question 21:Introduced Fauna:Mammals/Birds/Fish

Record any observations of introduced fauna and their abundance, including the nature of the observation such as burrows, droppings etc.

Question 22:Rare Species Identified

Record any rare species that are identified and the nature of the observation such as the species itself, droppings, scats etc.

Question 23:Wetland Interspersion

Refer to Figure 9 from Semeniuk et al (1990) for descriptions of wetland cover and organisation.

Question 24:Proportion of the wetland fenced

Record the proportion of the wetland edge fenced on both the left and right sides of the wetland.

Question 25:Average distance of fence from the wetland edge

Record the average distance of the fence from the wetland edge on the left and right sides of the wetland.

Question 26:Number of pools in segment

Record the number of pools in the segment

Question 27:Area of pools in segment

Record the area of pools in the segment in relation to the total area of the segment.

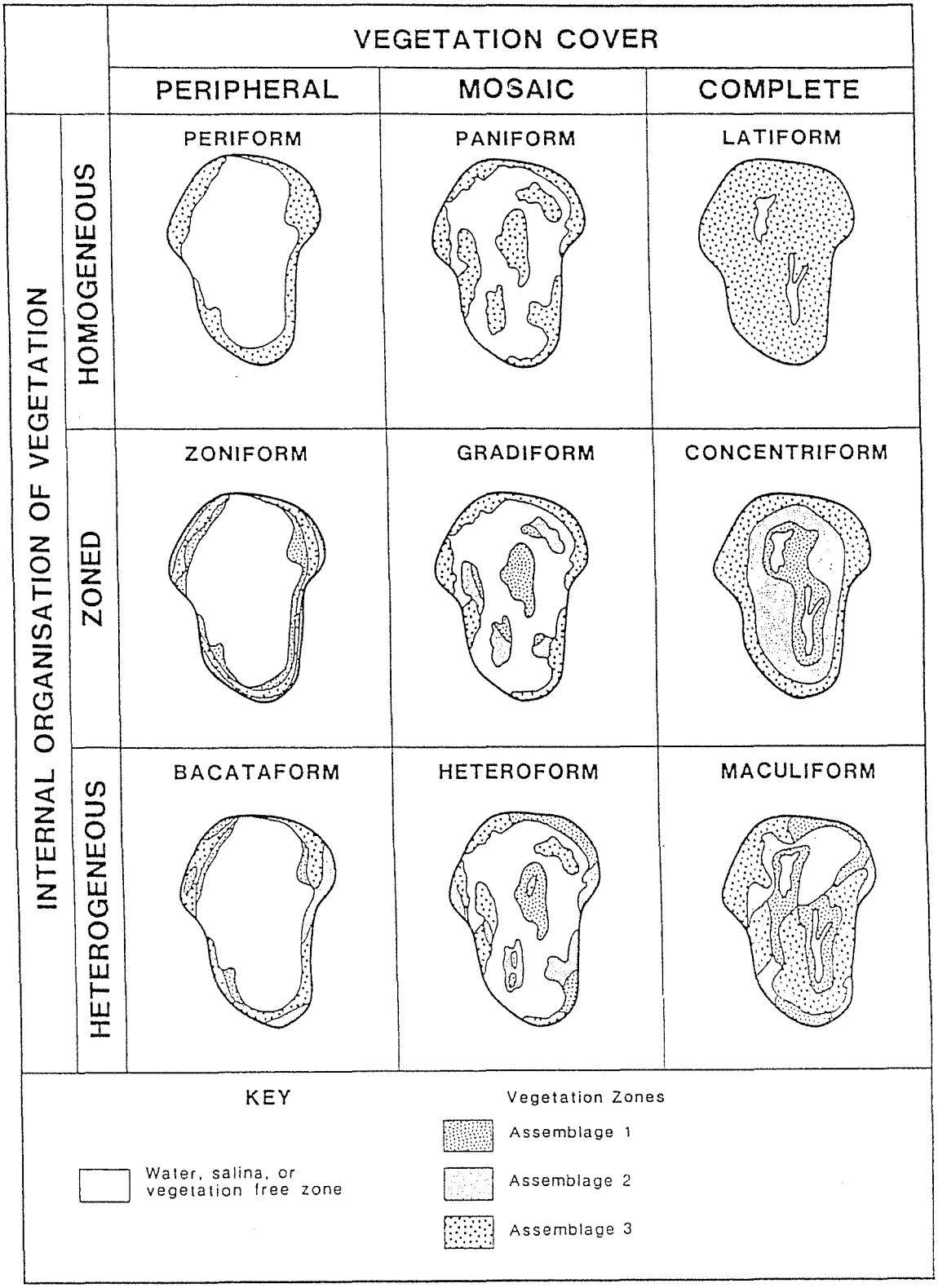

VEGETATION COVER
PERIPHERAL
MOSAIC
COMPLETE
INTERNAL ORGANISATION OF VEGETATION
HOMOGENEOUS
ZONED
HETEROGENEOUS
PERIFORM
PANIFORM
LATIFORM
ZONIFORM
GRADIFORM
CONCENTRIFORM
BACATAFORM
HETEROFORM
MACULIFORM
KEY
Water, salina, or vegetation free zone
Vegetation Zones
Assemblage 1
Assemblage 2
Assemblage 3

Figure 9

5.3 Results of Field Evaluation

The field evaluation was a valuable test of the survey sheet design and of the variables being assessed. Changes to the sheet include the addition of a land use impact descriptor, urban encroachment, identified by the letter U, and the inclusion of the substrate types, sand, silt and clay. The assessor is then given the choice of describing the substrate with one or two substrate types, such as L,S representing a clay and stone combination. The wetland site diagram proved useful for noting the shape and length of the wetland, as well as the position of fences, roads and photo sites. A feature of the survey that was identified as necessary to provide a measure of diversity is the degree of interspersion in the wetland. A method of assessing this feature based on Semeniuk et al (1990) is included in the modified field evaluation sheet (Figure 8) under question 23.

6.0 Management Implications of this Evaluation

Management issues include:

- retention, restoration and revegetation of riparian zone
- erection and maintenance of fences
- protection of pools
- preventative erosion practices
- dams/obstructions
- weed management
- fire management

6.1 Protection of Riparian Zone

To protect the integrity of a stream system, it is important to maintain riparian vegetation and where necessary implement revegetation programmes in degraded areas. Restoration of catchments affected by activities such as clearing, grazing and logging should be accompanied by effective riparian zone revegetation to ensure maximum protection of the stream. Stream management should be concerned primarily with the physical and ecological condition of the riparian zone vegetation. The protection and maintenance of the vegetation should be of highest importance in areas of first and second order streams.

6.2 Fences

An important management consideration for riparian and corridor vegetation is to restrict access of stock by fencing off the wetland. Maintenance of existing fences and the erection of new fences is vital to the protection of the native vegetation. Stock eat and trample the vegetation and prevent the growth of seedlings by degrading the soil structure such that the immature root systems cannot survive. Grazing animals can also break down the banks, accelerating bank erosion and sediment movement (Olsen and Skitmore, 1991).

To fence off stock would serve two purposes in that it would prevent the removal of vegetation by stock and would allow the vegetation corridor to grow undisturbed. Unfortunately, some land owners view water courses as private watering holes for stock and so are reluctant to lose this valuable resource (Pen and Hilliard, 1988). As a result, in some areas the maintenance of fences along pools is neglected and stock control is limited. Limiting access of stock to a number of watering sites is one solution to this problem.

6.3 River Pools

The presence of pools is an important management consideration due to the large extent of species diversity they support. It is essential to protect both permanent and temporary pools from sources of degradation such as runoff containing nutrients, salt and heavy metals and erosion from stock, vehicles and human disturbance.

6.4 Dams/Obstructions

Since European settlement, the natural hydraulic patterns of streams and rivers have been modified to meet the demands of water distribution and supply. A major part of water resource development is the damming of rivers. Water flow is reduced downstream of the dam, affecting the physical, biological and chemical characteristics of the stream system.

Changes include the loss of seasonal flow patterns, altered oxygen levels and temperature regime, and a decline in the abundance of native fish species (Department of Resources and Energy, 1983). The formation of a large, deep lake replacing small, permanent pools may discourage the survival of species adapted to the existing pools (Olsen and Skitmore, 1991). These large, deep reservoirs favour introduced fish such as trout, red-fin perch and carp which may then compete with and displace native fish. The introduced Gambusia thrive in still or gently moving water and their reproductive rate increases with higher water temperatures (Olsen and Skitmore, 1991). The construction of dams also alters the downstream movement of organic matter, nutrients and biota (Lake and Marchant, 1990).

Privately owned dams are numerous and widespread in the south west of Western Australia and are also poorly regulated (Olsen and Skitmore, 1991). The farm dams alter the hydrological patterns of streams and further affect the already cleared or degraded riparian vegetation.

Further studies are required to assist in developing appropriate Western Australian responses to proposals for small private and larger public dams which consider biota requirements.

Gauging weirs have been constructed to measure the flow along rivers and streams. These structures have shown to be an obstacle to certain fish species which cannot migrate past them, thus affecting spawning and local fish populations. Possible solutions to the problem include improving the design of the weir, reducing the number of weirs and removing them after adequate data has been collected.

6.5 Weeds/Introduced Flora

The close proximity of agricultural and urban areas to the riverine environment has led to an invasion of weeds and grasses. Two introduced plants which have invaded watercourses and which require management are the blackberry (Rubus sp.) and the Watsonia sp. (Olsen and Skitmore, 1991). The bulrush, Typha orientalis, is an aquatic plant which has established itself in many disturbed waterways, including parts of the Swan-Canning estuary. The systematic mapping of weed outbreaks in a field assessment process will help to manage weed invasion along channels.

6.6 Fire

Stream zones can be affected by either deliberately lit 'prescribed' fires or by wildfires, started by lightning, arsonists or human carelessness (Olsen and Skitmore, 1991). Fire causes drastic temporary changes in the terrestrial habitat along watercourses (Olsen and Skitmore, 1991). These changes include a loss of leaf litter, flora and fauna. As a consequence of these changes, there is increased light penetration, increased temperature, reduced leaf litter and increased nutrient and sediment input (Olsen and Skitmore, 1991).

The effect of fire on riparian zones is considered temporary due to regeneration alongside the river and streams. It is important to note that some riparian habitats may be too moist to burn and so are not directly affected by fire.

7.0 Conclusions

Evaluation Procedures

1. The use of fifty and two hundred metre corridors is useful when evaluating the status of vegetation surrounding channel wetlands.

Management

1. Programmes concerned with retaining, restoring and revegetating native fringing vegetation around wetlands should be implemented. Restoring and revegetating with the appropriate native species should occur where vegetation has been removed, and the removal of remnant native fringing vegetation should not be permitted.

2. First order tributaries should be given the most protection from impacts such as weeds, pollutants and erosion. It is these upstream areas which determine the condition of the channel downstream.

3. A suggested minimum buffer width of fifty metres from the wetland edge would protect the wetland from degradation and help to preserve its natural qualities. The buffer width should be increased according to the steepness of the stream valley or creek gully, as well as the gradient of the stream (Hilliard et al, 1987).

4. The buffer width should increase, where necessary, to incorporate the visual corridor and the environmental sequence from wetland to upland vegetation (Land Conservation Council, 1986). The zone should also be wider to accommodate natural or cultural features such as historic sites or recreational areas.

5. Channel wetlands should be viewed as natural corridors linked by the natural watercourse, and as complex systems influenced by its catchment, fringing vegetation and interactions within the stream ecosystem.

6. Fences should be erected alongside channel wetlands where they are absent, and those that exist should be maintained. There is no set width from the wetland that the fence should be placed, however corridor research has suggested that the wider the corridor the better.

7. Fencelines should be on both sides of the wetland to be most effective. Limited access watering points should be used to reduce the effects of stock on the wetland.

8. River pools are important conservation areas and their protection should be of highest priority. Maintaining fences along streams and rivers would protect the pools from erosion and degradation.

9. Planning for the expected increase in recreational demands on channel wetlands in or near urban areas is essential.

10. The application of this assessment provides the opportunity for community involvement.

8.0 References

Beard, J.S.(1990) Plant Life of Western Australia Kangaroo Press, N.S.W., Australia.

Bennett, A.F. (1990) Habitat Corridors - Their Role in Wildlife Management and Conservation Department of Conservation and Environment, Melbourne, Australia.

Blyth, J.D.(1984) 'Rapid Stream Survey to Assess Conservation Value and Habitats Available for Invertebrates' In:Survey Methods for Nature Conservation (Eds. K.Meyers et al) Canberra:C.S.I.R.O. Division of Water and Land Resources. Vol. 1, pp. 343-375.

Chambers, J.M. and Davis, J.A. (1988) 'How Wetlands Work'. Proceedings of the Swan Coastal Plain Groundwater Management Conference. pp. 91-103, Western Australian Water Resources Council.

Cross, H.C., Wettin, P.D. and Keenan, F.M. (1991) 'Corridors for wetland conservation and management? Room for conjecture.' In:Nature Conservation 2: The Role of Corridors (Eds. Saunders, D.A. and Hobbs, R.J.) pp.159-165. Surrey Beatty and Sons Pty. Limited, N.S.W., Australia.

Cummins, K.W.(1986) 'Riparian Influence on Stream Ecosystems' In: Campbell, I.C.(Ed). The Management of Rivers for Instream Uses, Water Studies Centre, Chisholm Institute of Technology, Victoria, Australia.

Davis,J.(1991) Draft report on :'Wetland Classification on the Basis of Water Quality and Invertebrate Community Data'

Department of Conservation and Environment (1980) Atlas of Natural Resources : Darling System, Western Australia Department of Conservation and Environment, Perth, Western Australia.

Department of Conservation and Environment (1983) Conservation Reserves for Western Australia as recommended by the Environmental Protection Authority 1983. The Darling System - System 6 Department of Conservation and Environment, Perth, Western Australia. Report 13, October 1983.

Department of Resources and Energy (1983) Water 2000 Consultants Report No. 9.In-Stream and Environmental Issues Australian Government Publishing Service, Canberra.

Environmental Protection Authority (1990) A Guide to Wetland Management in Perth Bulletin 374.

Feilman Planning Consultants (1987) Recreational Opportunities of Rivers and Wetlands in the Perth to Bunbury Region Western Australian Water Resource Council, Water Authority of Western Australia, December, 1987.

Forman, R.T.T. and Godron, M.(1986). Landscape Ecology. John Wiley and Sons:New York.

Hilliard, R.W., Pen, L. and Potter, I.(1987) 'An Appraisal of the south-west rivers and their fish fauna'. A submission to the Department of Conservation and Land Management Draft Regional Management Plans for the Forest Regions of Western Australia. School of Biological and Environmental Sciences, Murdoch University, Western Australia.

Hilliard, R.W. (1989) 'Aspects of Stream Degradation Influencing the Distribution of Native and Introduced Fishes - A South-west Australian Perspective'. Paper delivered at the 'State of our Rivers' conference. Issues in Water Management 2. Australian National University, Canberra, A.C.T. September, 1989.

Hussey, B.M.J., Hobbs, R.J. and Saunders, D.A.(1991) Guidelines for Bush Corridors From the workshop/conference on "Nature Conservation:the Role of Corridors" held in Western Australia in September 1989.

Lake, P.S. and Marchant, R. (1990) 'Australian Upland Streams : ecological degradation and possible restoration'
Proc. Ecol. Soc. Aust. 16 : 79-91.

Land Conservation Council (1986) East Gippsland Area Review - Proposed Recommendations Land Conservation Council, Melbourne, Victoria.

LeProvost, Semeniuk and Chalmer (1987) Environmental Significance of Wetlands in the Perth to Bunbury Region , Western Australian Water Resources Council, Water Authority of Western Australia, December, 1987.

Loney, B. and Hobbs, R.J. (1991) 'Management of vegetation corridors : maintenance, rehabilitation and establishment' In: Nature Conservation 2: The Role of Corridors (Eds. Saunders, D.A. and Hobbs, R.J.) pp. 299-311. Surrey Beatty and Sons Pty. Limited, N.S.W. Australia.

Macmillan, L.A. (1984) 'A method for identifying small streams of high conservation status' In: Survey methods for nature conservation (Eds. K.Meyers et al) Canberra:C.S.I.R.O. Division of Water and Land Research. Vol.1 pp.319-342.

McComb,A.J. and Lake,P.S.(1990) Australian Wetlands Collins/Angus and Robertson, North Ryde, N.S.W., Australia.

McDonald,R.C.,Isbell,R.F.,Speight, J.G., Walker,J. and Hopkins,M.S. (1990) Australian Soil and Land Survey - Field Handbook. Second Edition.Inkata Press, Melbourne.

Michaelis,F.B. and O'Brien,M (1988) 'Preservation of Australia's Wetlands : A Commonwealth Approach'. In: Eds: A.J.McComb and P.S.Lake. The Conservation Of Australian Wetlands Surrey Beatty and Sons Pty. Limited, N.S.W., Australia.

Mitchell, P.(1990) The Environmental Condition of Victorian Streams Department of Water Resources, Victoria, Australia.

Morgan, N.C. (1982) 'An ecological survey of standing waters in North West Africa:2. Site Descriptions for Tunisia and Algeria. Biological Conservation 24:83-113.

Olsen, G. and Skitmore, E. (1991) State of the Rivers of the South West Drainage Division. Western Australian Water Resources Council, Western Australia.

Pen,L.J. and Hilliard,R.W. (1988) 'Conserving permanent streamline pools - the importance of maintaining adequate buffer strips and fencelines'. Submission to Western Australian Water Resources Council on Draft Management Plans for Water Allocation in the Perth-Bunbury region. School of Biological and Environmental Sciences, Murdoch University.

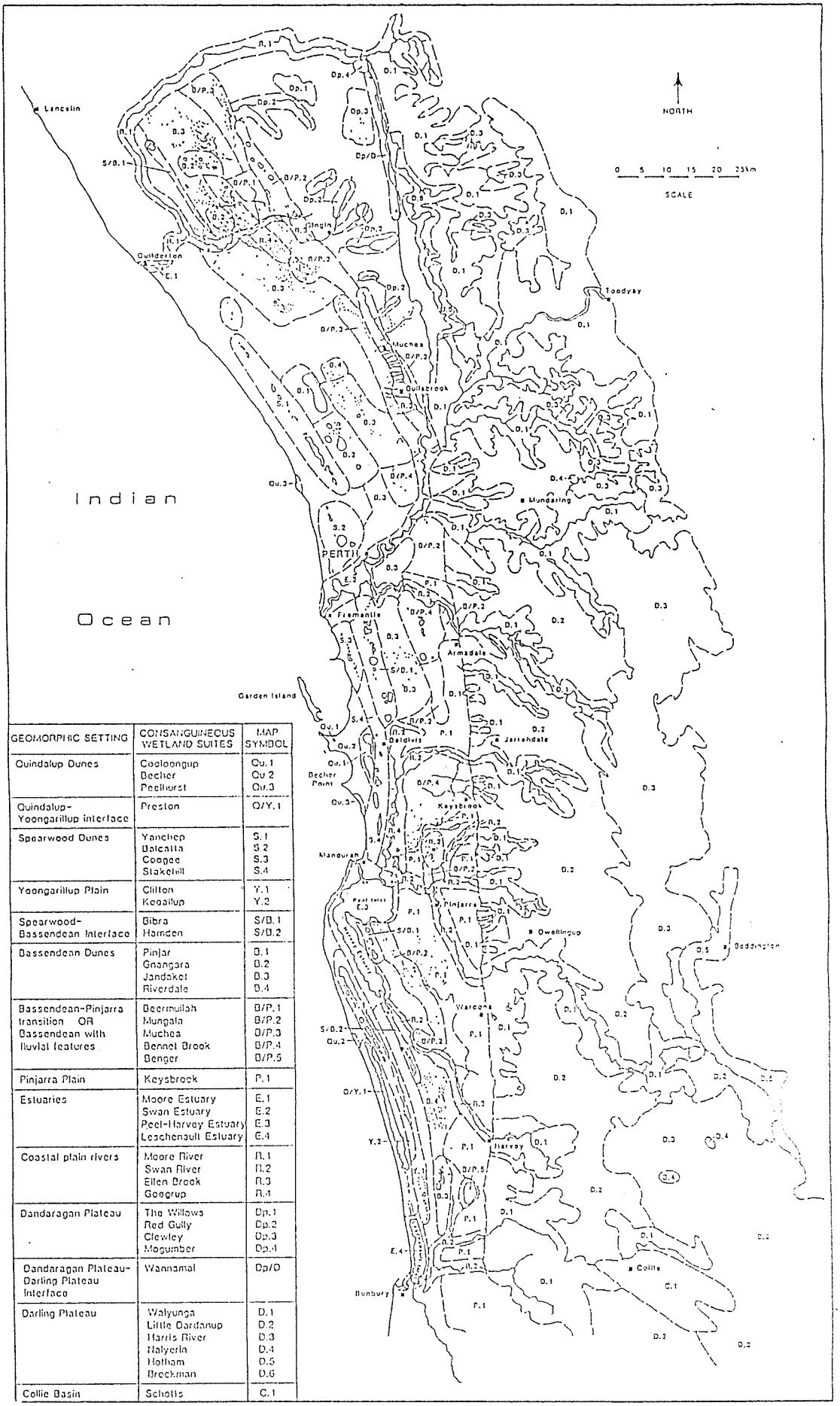
Semeniuk, C.A. (1987) 'Wetlands of the Darling System - a geomorphic approach to habitat classification'. Journal of the Royal Society of Western Australia.69 : 95-112.

Semeniuk V & C Research Group (1989) Assessment of Wetland Classification and Mapping in the Jumperkine SW and Mundaring NW Sheet Areas Report to the Water Authority of Western Australia. No. WP 87, December 1989.

Semeniuk, C.A., Semeniuk, V., Cresswell, I.D., Marchant, N.G. (1990) 'Wetlands of the Darling System, Southwestern Australia : a descriptive classification using vegetation pattern and form'. Journal of the Royal Society of Western Australia 72: 109-121.

APPENDIX 1

MAP OF WETLAND DOMAINS FOR USE IN DETERMINING REPRESENTATIVENESS



GEOMORPHIC SETTING	CONSANGUINEOUS WETLAND SUITES	MAP SYMBOL
Quindalup Dunes	Cooloongup Becher Peelhurst	Qu.1 Qu.2 Qu.3
Quindalup-Yoongarillup interface	Preston	Q/Y.1
Spearwood Dunes	Yanchep Balcatta Coogee Stakehill	S.1 S.2 S.3 S.4
Yoongarillup Plain	Clifton Keogillup	Y.1 Y.2
Spearwood-Bassendean Interface	Bibra Herndon	S/B.1 S/B.2
Bassendean Dunes	Pinjar Gnangara Jandakot Riverdale	B.1 B.2 B.3 B.4
Bassendean-Pinjarra transition OR Bassendean with fluvial features	Beermullah Mungala Muchea Bennet Brook Benger	B/P.1 B/P.2 B/P.3 B/P.4 B/P.5
Pinjarra Plain	Keysbrook	P.1
Estuaries	Moore Estuary Swan Estuary Peel-Harvey Estuary Leschenault Estuary	E.1 E.2 E.3 E.4
Coastal plain rivers	Moore River Swan River Ellen Brook Geegrup	R.1 R.2 R.3 R.4
Dandaragan Plateau	The Willows Red Gully Clewley Mogumber	Dp.1 Dp.2 Dp.3 Dp.4
Dandaragan Plateau-Darling Plateau Interface	Wannamal	Dp/D
Darling Plateau	Walyunga Little Darkan up Harris River Nalyerin Hotham Breckman	D.1 D.2 D.3 D.4 D.5 D.6
Collie Basin	Schotts	C.1

Figure 3: Distribution of the consanguineous wetland suites in domains throughout the Darling System (after C.A. Semeniuk, 1987a)

P89/299
11/9/89

Nine areas in Western Australia, totalling nearly half a million hectares, are to be listed as wetlands of International Importance to help ensure their protection for future generations.

Premier Peter Dowding today said the areas had special value for flora and fauna and were important to the public and scientific community.

"The listing means the nine areas will be internationally recognised as a vital resource which human activity cannot be allowed to endanger.

"The move is part of the Government's commitment to nature conservation in general and in particular the protection of wetlands.

"It has been a time-consuming and delicate task to ensure that the nominations were soundly based before listing and it is unfortunate there has been some grandstanding over the issue in a way which could have jeopardized these arrangements," Mr Dowding said.

The areas to be listed are:

+ Peel-Yalgorup System -- about 21,000 ha and in terms of the total numbers, it is the most important area for waterbirds in the south west of the State. Lake Clifton is one of only three areas in the State where stromatolites occur (these are thought to be the earliest form of life on earth).

+ Forrestdale and Thomsons Lakes -- both are A class reserves which total about 750 ha. They support 70 species of waterbirds including many species such as the Long-toed Stint from Siberia and a great diversity of invertebrates.

+ The Ord River floodplain -- an area of about 102,000 ha which supports some of the most impressive mangrove communities in Australia including large numbers of waterbirds and a substantial number of salt water crocodiles.

+ Lake Argyle and Kununurra -- about 150,000 ha has large populations of ducks, geese and coot, considerable numbers of two gazetted rare species (Radjah Shelduck and Comb-crested Jacana) and more than 25,000 fresh water crocodiles.

+ Roebuck Bay -- the proposed area is about 55,000 ha and supports a population of more than 100,000 migratory waders. The number of Great Knot counted recently exceeded the previous estimate of the total world population. The area is critical as feeding grounds and departure point for trans-equatorial migratory birds, including some groups from as far away as Siberia.

+ Eighty Mile Beach -- about 125,000 ha and is similar in importance to Roebuck Bay.

+ Lake Toolibin -- The 437 ha is of special value for maintaining ecological diversity with the highest number of breeding species of waterbirds recorded in the Southwest. It is the oly large freshwater lake of its type remaining in the wheatbelt.

+ Vasse-Wonnerup Wetlands -- the 590 ha supports 300,000 waterbirds each year, including thousands of ducks, Avocets, Black-winged stilts and WA's largest colony of black swans.

+ Lake Warden System -- the 2,300 ha supports 10,000 ducks and hundreds of Hooded Plovers, a species which is under serious threat of extinction in Eastern Australia.

The proposed boundaries for the wetland areas do not involve any private property.

APPENDIX 2

PREMIER DOWDING'S PRESS RELEASE ON WETLANDS OF INTERNATIONAL

APPENDIX 3

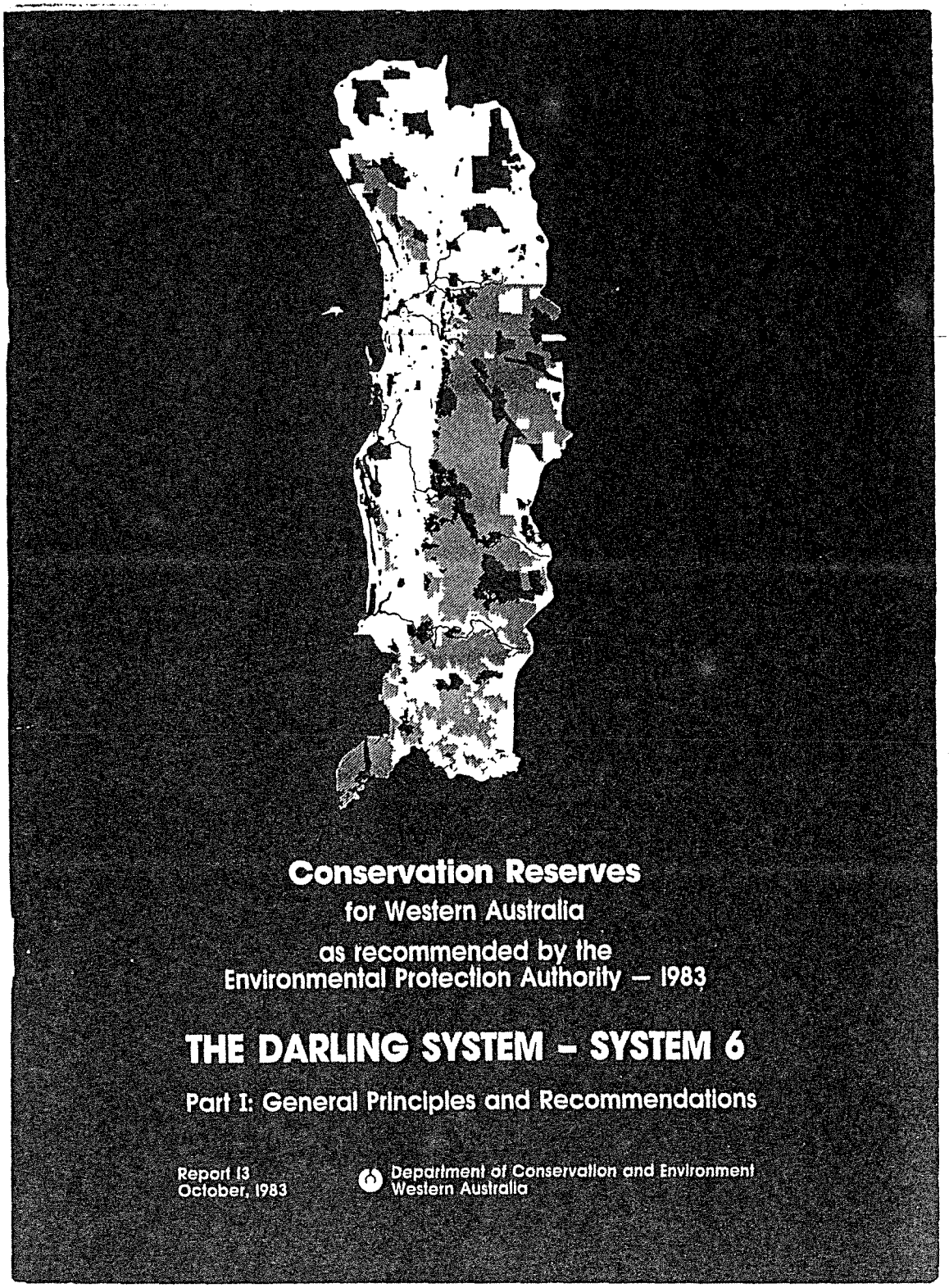
EXTRACT FROM MCCOMB & LAKE (1988) OF WETLANDS ENTERED ON THE REGISTER OF THE NATIONAL ESTATE - NATIONAL SIGNIFICANCE

Table 8.2. Wetlands entered in the Register of the National Estate under the Australian Heritage Commission Act.

Name	Nearest Town
WESTERN AUSTRALIA	
Millbrook Reserve (C18739)	Albany
Torndirrup National Park	Albany
Two Peoples Bay Wildlife Sanctuary	Albany
Tone-Perup River Area	Manjimup
Fitzgerald River National Park	Ravensthorpe
Ludlow Wonnerup Area	Busselton
The Broadwater Reserve	Busselton
Reserve 12049	Yarloop
Cathedral Avenue and Wetlands	Bunbury
Lake Muir Area	Manjimup
Proposed South Coast National Park	Walpole
Karri Management Priority Areas	Walpole
Lake Indoon Reserve	Eneabba
Arrowsmith Lake Area	Eneabba
Esperance Lakes Reserves	Esperance
Mungilli Clay Pan	Warburton Mission
Lake Magenta Nature Reserve	Pingrup
Lake Grace — Lake Chinocup Area	Lake Grace
L. Pallurup One Mile Rocks National Reserve	Ravensthorpe
Lake Cronin Area	Hyden
Palm Springs Reserve	Wyndham
Parry Lagoon Reserves	Wyndham
Bindoon and Chittering Lakes	Gingin
Bambun, Nambung and Mungala Lakes	Gingin
Lake Wannamal	Gingin
Bootine Reserve 9676	Gingin
Reserve C31241	Gingin
Gingin Brook	Gingin
Star Swamp	Stirling
Herdsman Lake	Perth
Thompson (Jilbup) Lake Reserve	Wattleup
Reserve 7756	Jandakot
Blue Gum Swamp	Melville
Lake Forrestdale (Jandakot)	Forrestdale
Banksia Road Nature Reserve No 28167	Wellard
Yanchep National Park	Yanchep
Lake Joondalup Reserves	Wanneroo
Jandabup Lake Nature Reserve	Wanneroo
Nowergup Lake Fauna Reserve	Quinn's Rock
Harvey Estuary Nature Reserve	Pinjarra
Austin Bay Nature Reserve	Pinjarra
Lake Macleod Area	Carnarvon

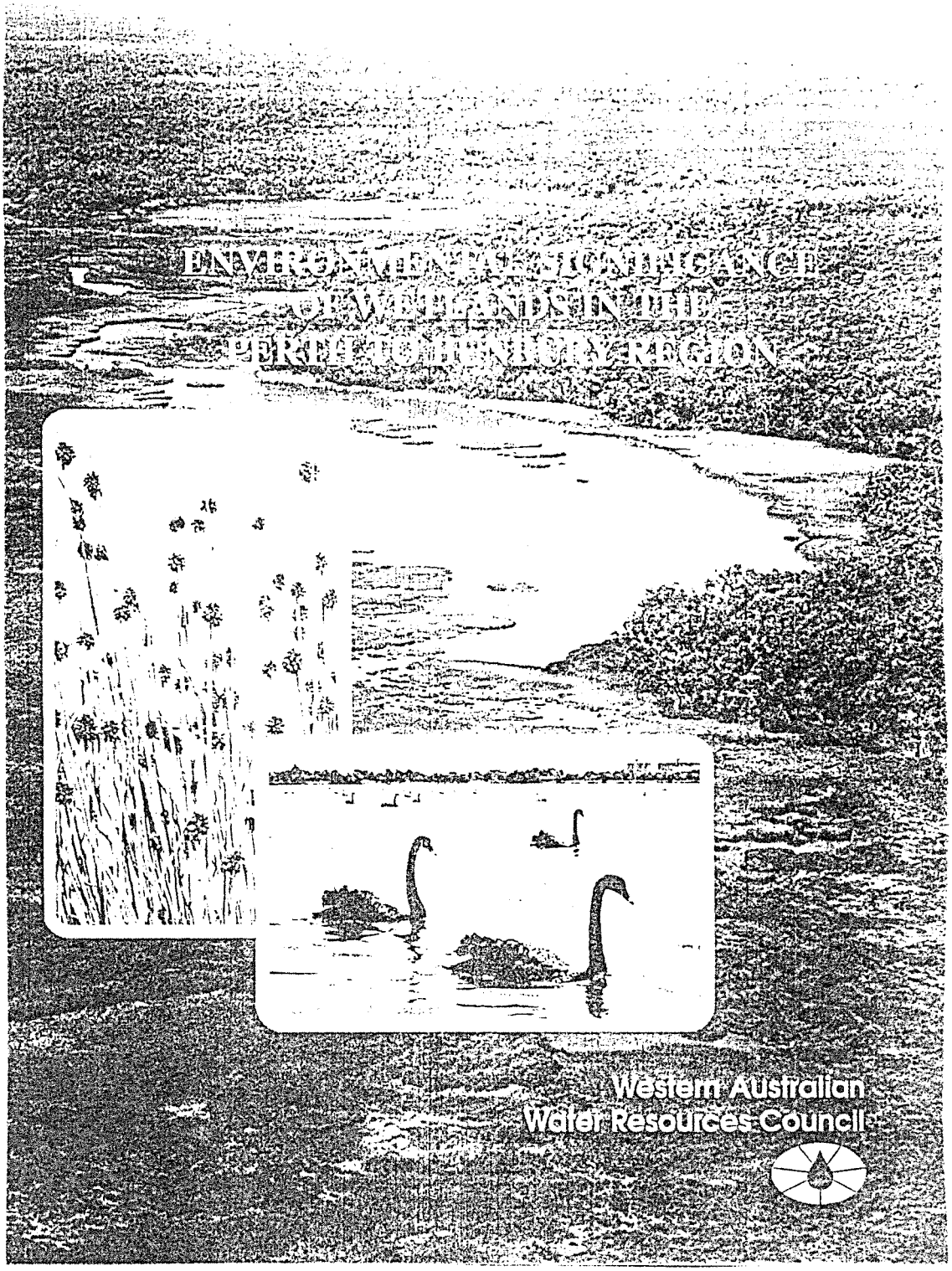
APPENDIX 4

DCE (1983) "SYSTEM 6" REGIONAL STUDY OF CONSERVATION RESERVES PROVIDES "REGIONAL SIGNIFICANCE" INFORMATION



APPENDIX 5

LEPROVOST SEMENIUK & CHALMER (1987) PROVIDES A PRELIMINARY LIST OF WETLANDS OF REGIONAL ENVIRONMENTAL SIGNIFICANCE



WILDLIFE CONSERVATION ACT 1950

CALM 016707F3807.

Pursuant to the powers conferred by Section 14 (2) (ba) of the Act, I hereby cancel the notice published in *Government Gazette* No. 116 of 2 December 1988 and declare that the fauna described in Schedule 1 hereunder is for the purpose of the Act, fauna that is likely to become extinct, or is rare; and the fauna described in Schedule 2 hereunder is for the purpose of the Act, fauna that is otherwise in need of special protection.

BOB PEARCE, Minister for the Environment.

Schedule 1

Mammals

Scientific Name	*Common Name*
Dasyurus geoffroii	Chuditch or Western Quoll
Dasycercus cristicauda	Mulgara or Minyi-minyi
Parantechinus apicalis	Dibbler
Phascogale calura	Red-tailed Phascogale
Sminthopsis psammophila	Sandhill Dunnart
Myrmecobius fasciatus	Numbat or Walpurti
Isoodon obesulus	Southern Brown Bandicoot or Quenda
Isoodon auratus	Golden Bandicoot or Wintarru
Perameles bougainville	Western Barred Bandicoot
Perameles eremiana	Desert Bandicoot or Walilya
Chaeropus ecaudatus	Pig-footed Bandicoot or Kantjilpa
Macrotis lagotis	Dalgyte or Bilby or Ninu
Macrotis leucura	Lesser Bilby or Tjunpi
Pseudocheirus occidentalis	Western Ringtail Possum
Potorous tridactylus gilberti	Gilbert's Potoroo
Potorous platyops	Broad-faced Potoroo
Bettongia penicillata	Brush-tailed Bettong or Woylie
Bettongia lesueur	Burrowing Bettong or Boodie
Lagorchestes conspicillatus	Spectacled Hare-wallaby or Wampana
Lagorchestes hirsutus	Rufous Hare-wallaby or Mala
Lagorchestes asomatus	Central Hare-wallaby or Kuluwarri
Lagostrophus fasciatus	Banded Hare-wallaby or Munning
Onychogalea lunata	Crescent Nailtail Wallaby or Tjawalpa
Petrogale lateralis	Black-footed Rock-wallaby or Warru
Macropus eugenii	Tammar
Macropus robustus isabellinus	Barrow Island Euro
Mesembriomys gouldii	Black-footed Tree-rat
Pseudomys praeconis	Shark Bay Mouse
Pseudomys gouldii	Gould's Mouse
Pseudomys australis	Plains Rat
Pseudomys shortridgei	Heath Rat
Pseudomys occidentalis	Western Mouse
Pseudomys chapmani	Pebble-mound Mouse
Leporillus conditor	Greater Stick-nest Rat
Leporillus apicalis	Lesser Stick-nest Rat
Notomys fuscus	Dusky Hopping-mouse
Notomys macrotis	Big-eared Hopping-mouse
Notomys longicaudatus	Long-tailed hopping-mouse
Balaenoptera musculus	Blue Whale
Megaptera novaeangliae	Humpback Whale
Eubalaena australis	Southern Right Whale

Birds

Scientific Name	*Common Name*
Phaethon rubricauda	Red-tailed Tropic-bird
Dupetor flavicollis	Black Bittern (south-west population)
Botaurus poiciloptilus	Australasian Bittern
Stictonetta naevosa	Freckled Duck
Cereopsis novaehollandiae grisea	Recherche Cape Barren Goose
Aviceda subcristata	Crested Hawk or Pacific Baza
Erythrotriorchis radiatus	Red Goshawk
Falco hypoleucos	Grey Falcon
Megapodius reinwardt	Orange-footed Scrubfowl
Turnix varia scintillans	Abrolhos Painted Button-quail
Rallus pectoralis clelandi	Lewin's Water Rail
Anous tenuirostris	Lesser Noddy
Petrophassa smithii smithii	Partridge Pigeon
Cacatua pastinator pastinator	Western Long-billed Corella
Polytelis alexandrae	Princess or Alexandra's Parrot
Pezoporus wallicus	Ground Parrot
Geopsittacus occidentalis	Night Parrot
Neophema splendida	Scarlet-chested Parrot
Ninox rufa	Rufous Owl
Ninox connivens	Barking Owl (south-west population)
Tyto longimembris	Eastern Grass Owl
Atrichornis clamosus	Noisy Scrub-bird or Tjimiluk
Coracina tenuirostris melvillensis	Cicadabird
Poecilodryas superciliosa	White-browed Robin
Falcunculus frontatus	Crested Shrike-tit
Psophodes nigrogularis	Western Whipbird
Cinclosoma alisteri	Nullarbor Quail-thrush
Malurus coronatus	Purple-crowned Fairy-wren
Malurus leucopterus leucopterus	Dirk Hartog Black-and-white Fairy-wren
Malurus leucopterus edouardi	Barrow Is Black-and-white Fairy-wren
Amytornis textilis	Thick-billed Grass-wren
Dasyornis longirostris	Western Bristlebird
Dasyornis broadbenti litoralis	Rufous Bristlebird
Conopophila whitei	Grey Honeyeater
Lonchura flaviprymna	Yellow-rumped Mannikin
Erythrura gouldiae	Gouldian Finch

Birds required to be given special protective measures under Article III of the Agreement between the Government of Australia and the Government of Japan for the Protection of Migratory Birds and Birds in Danger of Extinction and Their Environment.

Scientific Name	*Common Name*
Pterodroma leucoptera leucoptera	Gould's Petrel
Pterodroma solandri	Providence Petrel
Sula abbotti	Abbott's Booby
Fregata andrewsi	Christmas Island Frigate-bird
Pedionomus torquatus	Plains Wanderer
Tricholimnas sylvestris	Lord Howe Island Woodhen
Cyanoramphus novaezelandiae cookii	Norfolk Island Parrot
Cyclopsitta diophthalma coxeni	Coxen's Fig Parrot
Neophema chrysogaster	Orange-bellied Parrot
Psephotus chrysopterygius	Golden-shouldered Parrot
Psephotus dissimilis	Hooded Parrot
Psephotus pulcherrimus	Paradise Parrot
Ninox novaeseelandiae rayana	Norfolk Island Boobook Owl
Ninox squamipila natalis	Christmas Island Owl
Podargus ocellatus plumiferus	Plumed Frogmouth
Amytornis dorotheae	Carpentarian Grass-wren
Strepera graculina crissalis	Lord Howe Island Currawong
Pardalotus quadragintus	Forty-spotted Pardalote
Zosterops albogularis	Norfolk Island Silvereye
Lichenostomus melanops cassidix	Helmeted Honeyeater
Manorina flavigula melanotis	Black-eared Miner
Drymodes superciliaris colcloughi	Northern Scrub-robin

Reptiles

Scientific Name	*Common Name*
Dermochelys coriacea	Leathery Turtle or Luth
Pseudemydura umbrina	Western Swamp Tortoise
Ctenophorus yinnietharra	Yinnietharra Rock-dragon
Ctenotus angusticeps	Airlie Island Ctenotus
Ctenotus lancelini	Lancelin Island Skink
Egernia stokesii aethiops	Baudin Island Spiny-tailed Skink
Morelia carinata	Rough-scaled Python

Schedule 2

Mammals

Scientific Name	*Common Name*
Arctocephalus forsteri	New Zealand Fur-seal
Neophoca cinerea	Australian Sealion
Dugong dugon	Dugong

Birds

Scientific Name	*Common Name*
Tadorna radjah	Burdekin Duck or Radjah Shelduck
Falco peregrinus	Peregrine Falcon
Calyptorhynchus funereus latirostris	Carnaby's Black-Cockatoo
Calyptorhynchus baudinii	Baudin's Black-Cockatoo
Cacatua leadbeateri	Pink or Major Mitchell's Cockatoo
Northiella haematogaster narethae	Naretha Blue Bonnet
Stagonopleura oculata	Red-eared Firetail

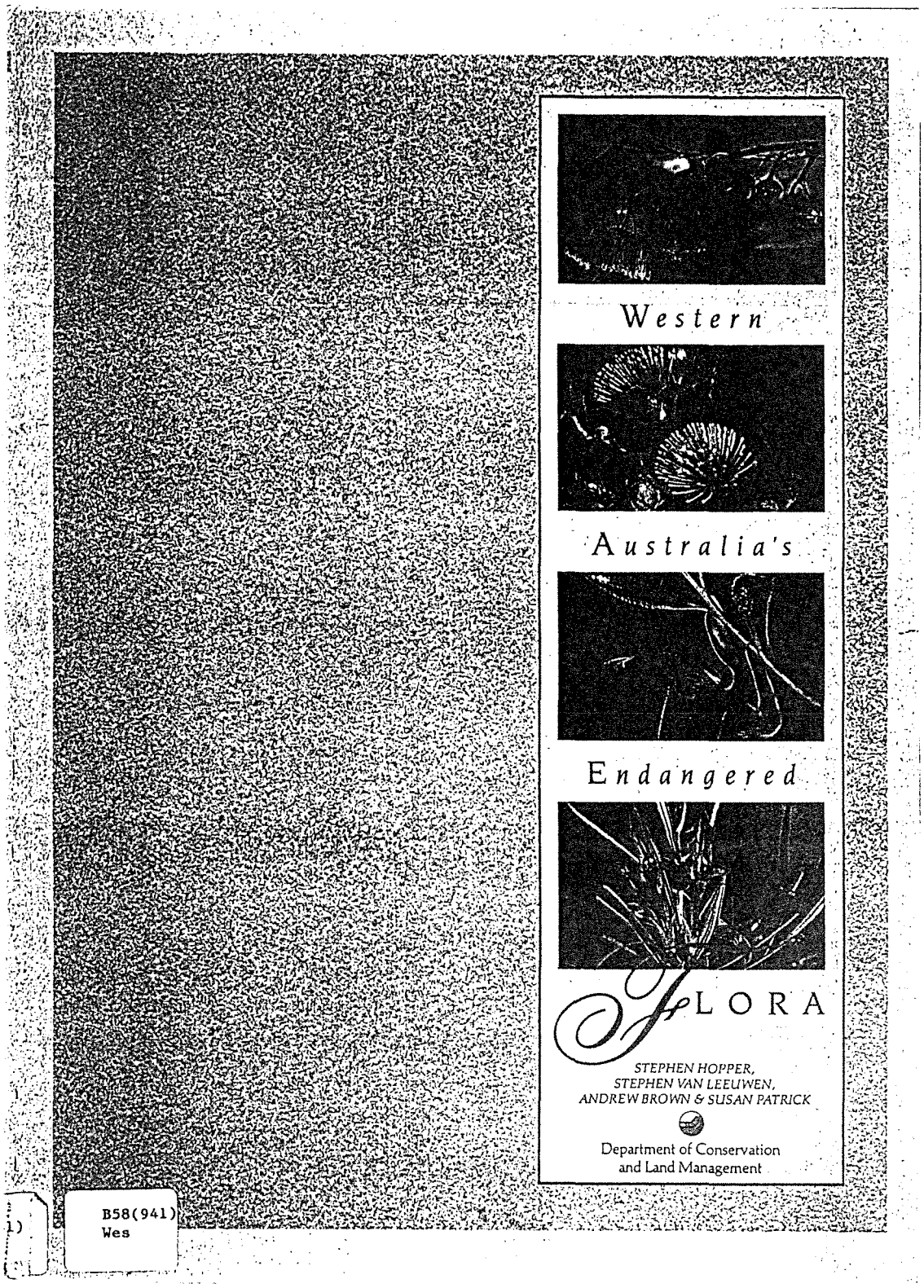
Reptiles

Scientific Name	*Common Name*
Crocodylus porosus	Saltwater Crocodile
Crocodylus johnstoni	Australian Freshwater Crocodile
Aspidites ramsayi	Woma or Ramsay's Python
Morelia spilota imbricata	Carpet Python
Morelia olivacea barroni	Pilbara Olive Python

CURRENT SCHEDULE (FEB 1992) OF RARE, LIKELY TO BECOME EXTINCT, OR ANIMALS IN SPECIAL NEED OF PROTECTION

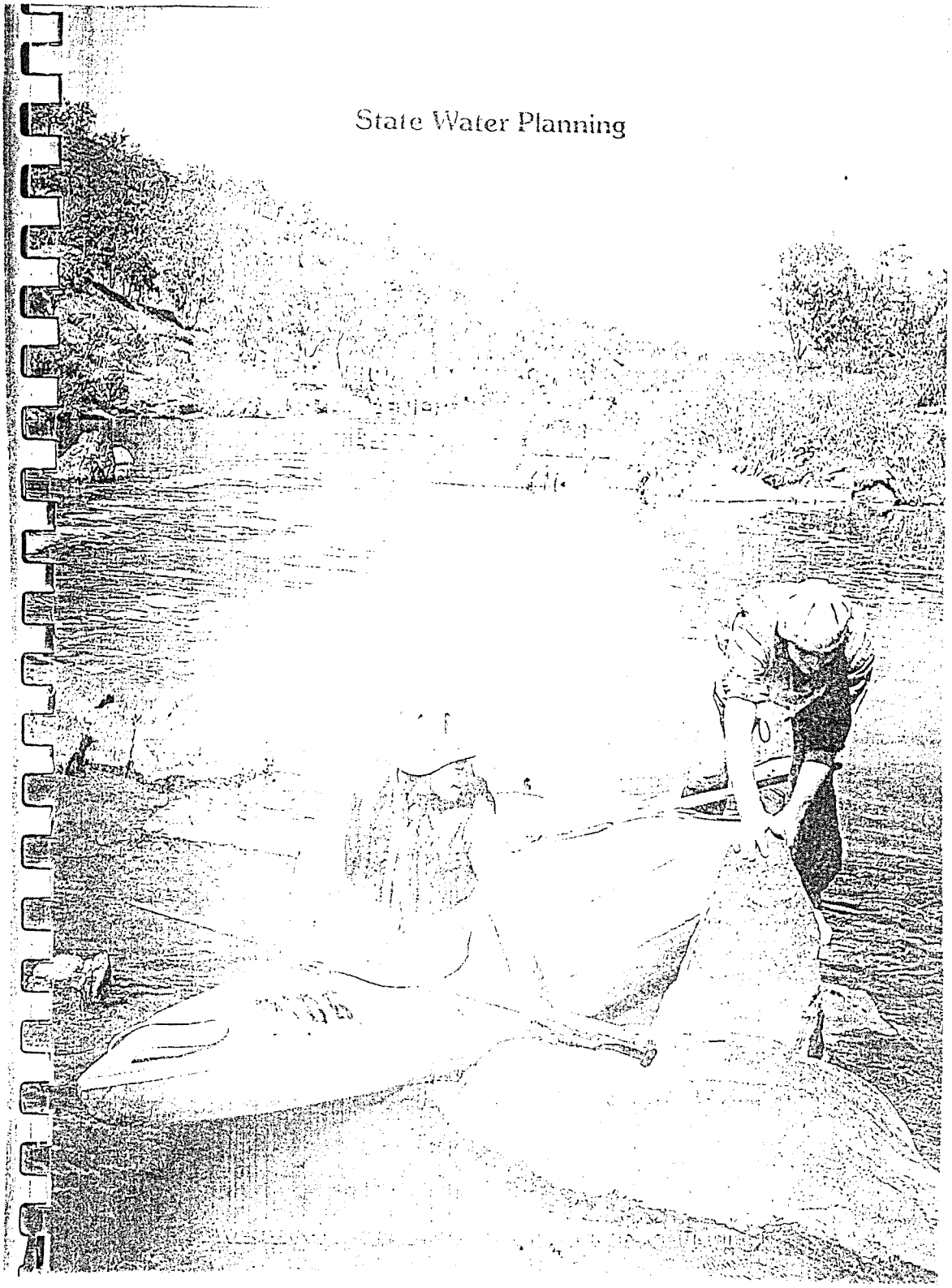
APPENDIX 7

RECENT LIST OF WESTERN AUSTRALIA'S ENDANGERED FLORA AND OTHER PLANTS UNDER CONSIDERATION FOR DECLARATION PREPARED BY HOPPER, VAN LEEUWEN, BROWN & PATRICK (1990)



APPENDIX 8

REGIONAL AND LOCAL SIGNIFICANCE FOR RECREATION WERE ADDRESSED BY FEILMAN PLANNERS (1987)



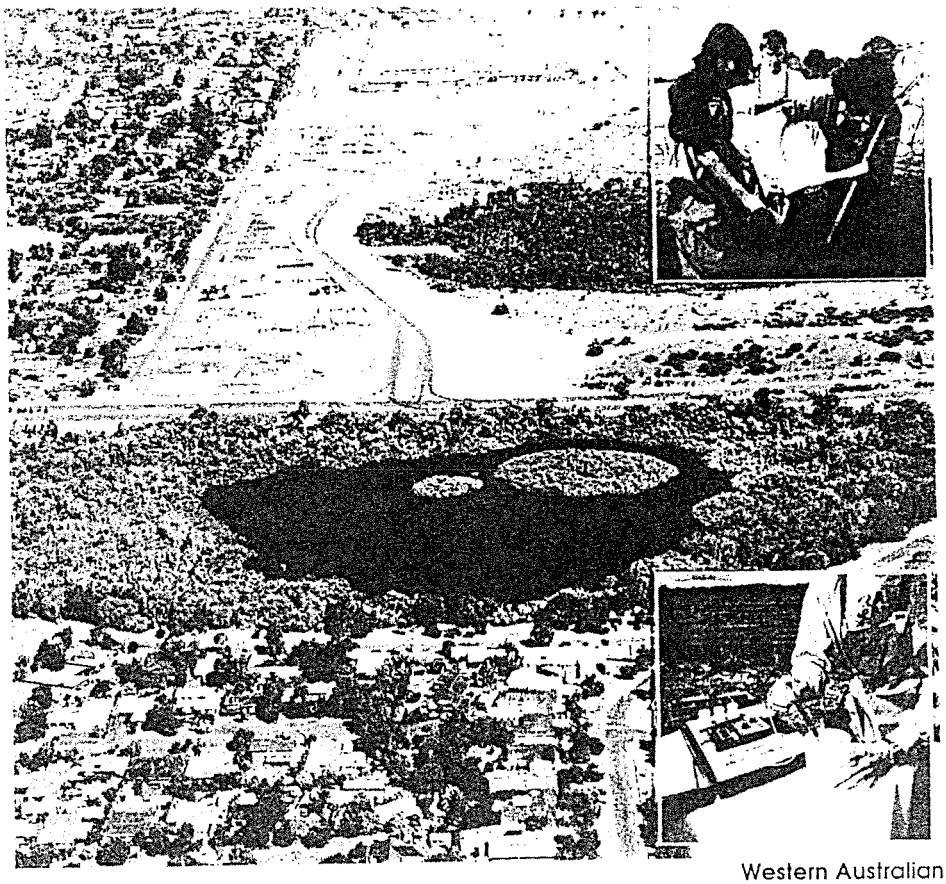
APPENDIX 9

REGIONAL AND LOCAL SIGNIFICANCE FOR EDUCATION WAS INVESTIGATED BY PATRICK COFFEY OF MITCHELL MCCOTTER & ASSOCIATES (1990)

State Water Planning

Report on an Investigation into Scientific and Educational Values of Wetlands and Rivers in the Perth-Bunbury Region

Patrick Coffey of
Mitchell McCotter and Associates



Western Australian
Water Resources Council

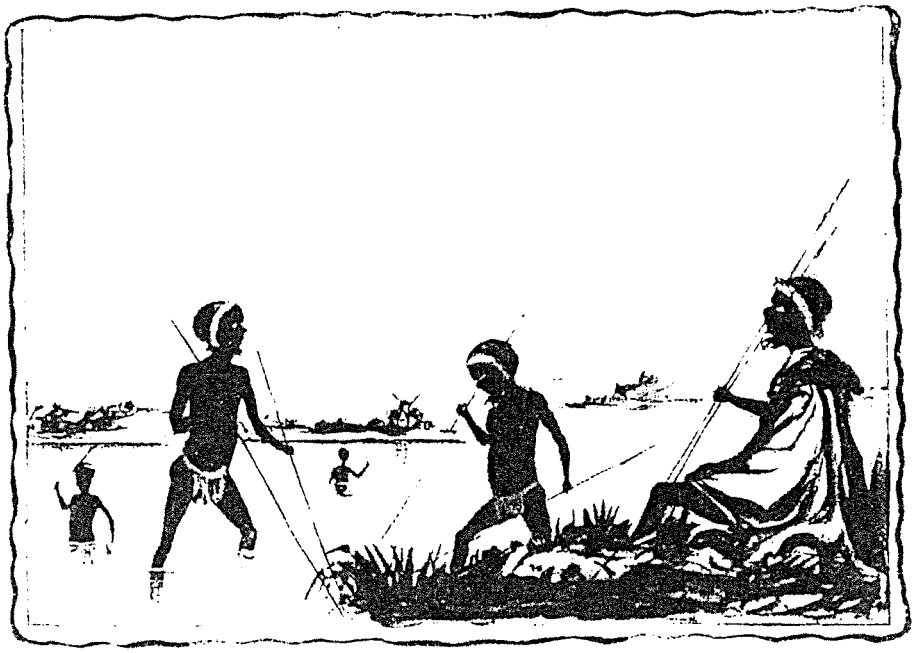
APPENDIX 10

REGIONAL ABORIGINAL SIGNIFICANCE WAS REPORTED BY OCCONNOR, QUATERMAINE & BODNEY

State Water Planning

Report on an Investigation into Aboriginal Significance of Wetlands and Rivers in the Perth–Bunbury Region

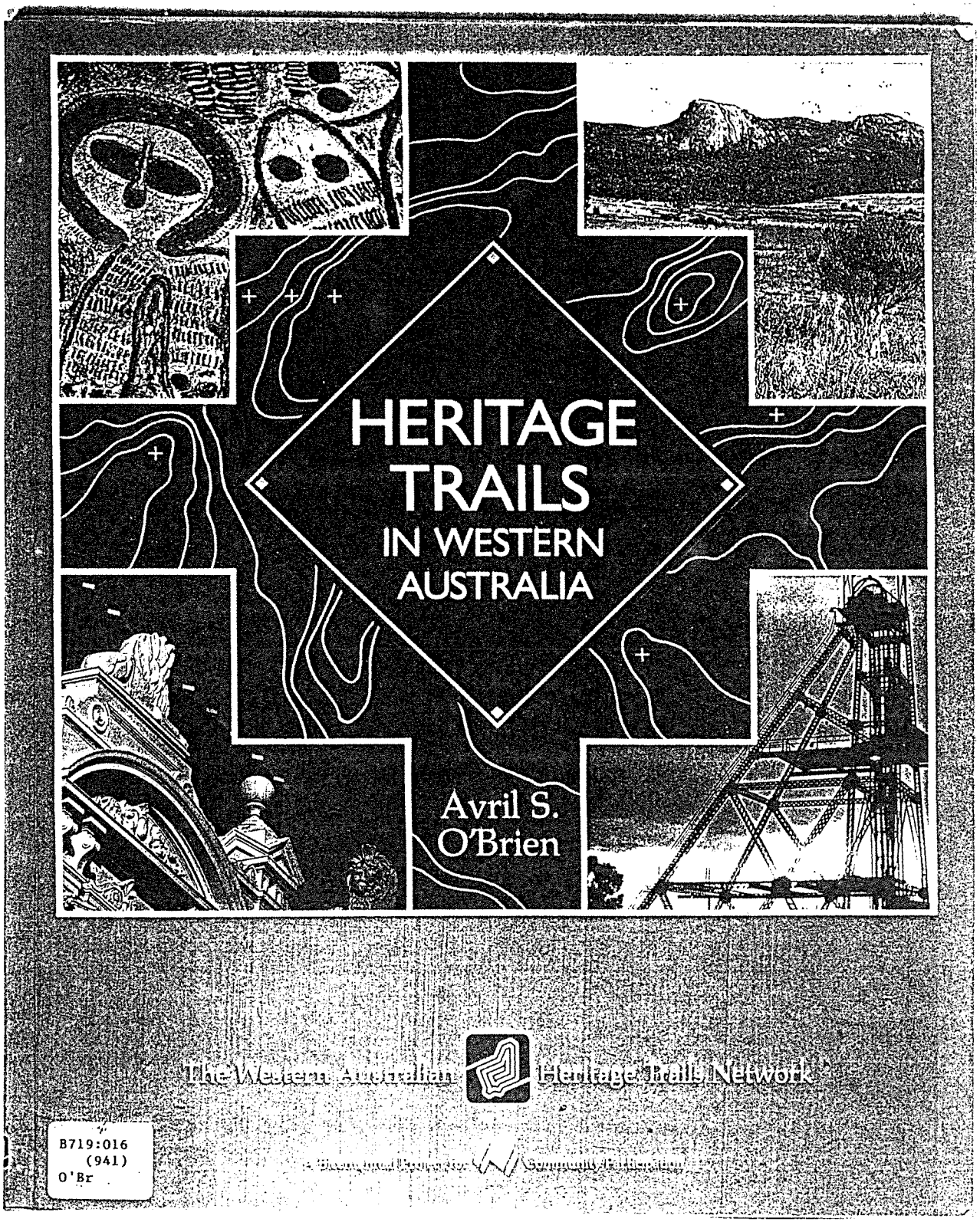
Rory O'Connor, Gary Quartermaine
and Corrie Bodney



Western Australian
Water Resources Council

APPENDIX 11

STATE HERITAGE TRAILS HAVE BEEN DESCRIBED BY O'BRIEN (1988)



APPENDIX 12

DESK SURVEY SHEETS FOR KADINA CREEK TRIAL

A : WETLAND VEGETATION AND LAND USE SURVEY:DESK STUDY

1 Map Sheet Name

2134 3 SW

2 Wetland Name\Number

12d

3 Wetland Identification Number

4 Wetland Type

CREEK

5 Geomorphology Unit

WALYUNGA

6 Geomorphology map used

SEMENIUK

7 Vegetation Unit

HELENA

8 Vegetation map used

SYSTEM 6

9 Vegetation Status

*Left	Right	*Left (%)		Right (%)	
V	V	80	90	90	50
V,P or C	V,P or C	200-50m	50-0m	0-50m	50-200m

V : Vegetation >50% of zone
P : Vegetation >10% and <50% of zone
C : Vegetation <10% of zone

10 Drain Status

N O:Drains Out I:Drains In N:No drains

11 Principle Land Uses (50-200m)

*Left	Right
V	U

V : Predominantly uncleared native vegetation
P : Pine Plantation
A : Agriculture
H : Horticulture
U : Urban
I : Mining/Industry
O : Other (Please specify) RESERVE

* Facing Downstream
Basin and flat wetlands use 'left' column only

12 Assessor

LIZ

13 Survey Date

12 02 1992

B : WETLAND FEATURES OF NATURAL AND SOCIAL SIGNIFICANCE

Ecosystem

14 Is the wetland a prime example or representative of the area's wetland ecosystems? R3

15 Is the wetland of a type that is limited in distribution?

16 Is the wetland part of a linked, natural system where destroying or degrading one wetland would affect others in the system? R3

Species

17 Is the wetland an important sanctuary for flora or fauna?

18 Is the wetland a habitat for rare and endangered species? S1

19 Does the wetland function as either a seasonal or temporary habitat or breeding ground for large numbers of migratory or nomadic animals?

Culture

20 Does the wetland function as an important educational resource?

21 Does the wetland have importance as an historic or Aboriginal site or does it hold unusual features of special scientific significance?

22 Is the wetland part of a linked network of cultural resources significant for aesthetic or heritage purposes?

Recreation

23 Does the wetland serve as an important recreation resource?

24 Is the wetland a site for recreational activities which are restricted at other wetlands?

25 Is the wetland part of a linked network of recreational resources?

Key:

Significance:
I:International N:National S:State
R:Regional L:Local P:Parochial

References:

1. BANDKOOTS (HILL PERS COM)
2.
3. DCE (1983) SYSTEM 6 RED BOOK M34
4.

A : WETLAND VEGETATION AND LAND USE SURVEY:DESK STUDY

1 Map Sheet Name

2134 3SW

2 Wetland Name\Number

119

3 Wetland Identification Number

4 Wetland Type

CREEK

5 Geomorphology Unit

WALYUNGA

6 Geomorphology map used

SEMENIUK

7 Vegetation Unit

HELENA

8 Vegetation map used

SYSTEM 6

9 Vegetation Status

*Left	Right	*Left (%)		Right (%)	
V	V	60	80	80	50
V,P or C	V,P or C	200-50m	50-0m	0-50m	50-200m

V : Vegetation >50% of zone
P : Vegetation >10% and <50% of zone
C : Vegetation <10% of zone

10 Drain Status

N O:Drains Out I:Drains In N:No drains

11 Principle Land Uses (50-200m)

*Left	Right
V	V

V : Predominantly uncleared native vegetation
P : Pine Plantation
A : Agriculture
H : Horticulture
U : Urban
I : Mining/Industry
O : Other (Please specify) RESERVE

* Facing Downstream
Basin and flat wetlands use 'left' column only

12 Assessor

LIZ

13 Survey Date

12021992

B : WETLAND FEATURES OF NATURAL AND SOCIAL SIGNIFICANCE

Ecosystem

14 Is the wetland a prime example or representative of the area's wetland ecosystems? R3

15 Is the wetland of a type that is limited in distribution?

16 Is the wetland part of a linked, natural system where destroying or degrading one wetland would affect others in the system? R3

Species

17 Is the wetland an important sanctuary for flora or fauna?

18 Is the wetland a habitat for rare and endangered species? S1

19 Does the wetland function as either a seasonal or temporary habitat or breeding ground for large numbers of migratory or nomadic animals?

Culture

20 Does the wetland function as an important educational resource?

21 Does the wetland have importance as an historic or Aboriginal site or does it hold unusual features of special scientific significance?

22 Is the wetland part of a linked network of cultural resources significant for aesthetic or heritage purposes? R3

Recreation

23 Does the wetland serve as an important recreation resource?

24 Is the wetland a site for recreational activities which are restricted at other wetlands?

25 Is the wetland part of a linked network of recreational resources?

Key:

Significance:

I:International N:National S:State
R:Regional L:Local P:Parochial

References:

1. BANDICOOTS (HILL PERS COM) (BUSHMEAD EIA)
2.
3. DCE (1983) SYSTEM 6 RED BOOK M34
4.

A : WETLAND VEGETATION AND LAND USE SURVEY:DESK STUDY

1 Map Sheet Name

2	1	3	4	3	S	W				

2 Wetland Name\Number

1	03	W	I	L	L	O	W	C	K											

3 Wetland Identification Number

4 Wetland Type

C	R	E	E	K					

5 Geomorphology Unit

W	A	L	Y	U	P	G	A				

6 Geomorphology map used

S	E	M	E	N	1	J	K					

7 Vegetation Unit

D	A	R	L	I	N	G		S	C	A	R	P

8 Vegetation map used

S	Y	S	T	E	M		6					

9 Vegetation Status

*Left	Right	*Left (%)		Right (%)	
P	P	50	30	30	20
V,P or C	V,P or C	200-50m	50-0m	0-50m	50-200m

V : Vegetation >50% of zone
P : Vegetation >10% and <50% of zone
C : Vegetation <10% of zone

10 Drain Status

N

O:Drains Out I:Drains In N:No drains

11 Principle Land Uses (50-200m)

*Left	Right
U	G

V : Predominantly uncleared native vegetation
P : Pine Plantation
A : Agriculture
H : Horticulture
U : Urban
I : Mining/Industry
O : Other (Please specify) _____

* Facing Downstream
Basin and flat wetlands use 'left' column only

12 Assessor

L	I	Z							

13 Survey Date

1	2	0	2	1	9	9	2

B : WETLAND FEATURES OF NATURAL AND SOCIAL SIGNIFICANCE

Ecosystem

14 Is the wetland a prime example or representative of the area's wetland ecosystems? [ ]

15 Is the wetland of a type that is limited in distribution? [ ]

16 Is the wetland part of a linked, natural system where destroying or degrading one wetland would affect others in the system? [ ]

Species

17 Is the wetland an important sanctuary for flora or fauna? [ ]

18 Is the wetland a habitat for rare and endangered species? [ ]

19 Does the wetland function as either a seasonal or temporary habitat or breeding ground for large numbers of migratory or nomadic animals? [ ]

Culture

20 Does the wetland function as an important educational resource? [ ]

21 Does the wetland have importance as an historic or Aboriginal site or does it hold unusual features of special scientific significance? [ ]

22 Is the wetland part of a linked network of cultural resources significant for aesthetic or heritage purposes? [ ]

Recreation

23 Does the wetland serve as an important recreation resource? [ ]

24 Is the wetland a site for recreational activities which are restricted at other wetlands? [ ]

25 Is the wetland part of a linked network of recreational resources? [ ]

Key:

Significance: [ ] I:International N:National S:State R:Regional L:Local P:Parochial

References:

1.
2.
3.
4.

A : WETLAND VEGETATION AND LAND USE SURVEY:DESK STUDY

1 Map Sheet Name

2134 3SW

2 Wetland Name\Number

WADINA BK

3 Wetland Identification Number

4 Wetland Type

CREEK

5 Geomorphology Unit

WALYUNGA

6 Geomorphology map used

SEMENIUC

7 Vegetation Unit

DARLING SCARP

8 Vegetation map used

SYSTEM 6

9 Vegetation Status

*Left	Right	*Left (%)		Right (%)	
P	V	30	20	70	70
V,P or C	V,P or C	200-50m	50-0m	0-50m	50-200m

V : Vegetation >50% of zone
P : Vegetation >10% and <50% of zone
C : Vegetation <10% of zone

10 Drain Status

N O:Drains Out I:Drains In N:No drains

11 Principle Land Uses (50-200m)

*Left	Right
G	V

V : Predominantly uncleared native vegetation
P : Pine Plantation
A : Agriculture
H : Horticulture
U : Urban
I : Mining/Industry
O : Other (Please specify) _____

* Facing Downstream
Basin and flat wetlands use 'left' column only

12 Assessor

LIZ

13 Survey Date

12021992

B : WETLAND FEATURES OF NATURAL AND SOCIAL SIGNIFICANCE

Ecosystem

14 Is the wetland a prime example or representative of the area's wetland ecosystems? R3

15 Is the wetland of a type that is limited in distribution?

16 Is the wetland part of a linked, natural system where destroying or degrading one wetland would affect others in the system? R3

Species

17 Is the wetland an important sanctuary for flora or fauna?

18 Is the wetland a habitat for rare and endangered species?

19 Does the wetland function as either a seasonal or temporary habitat or breeding ground for large numbers of migratory or nomadic animals?

Culture

20 Does the wetland function as an important educational resource?

21 Does the wetland have importance as an historic or Aboriginal site or does it hold unusual features of special scientific significance?

22 Is the wetland part of a linked network of cultural resources significant for aesthetic or heritage purposes?

Recreation

23 Does the wetland serve as an important recreation resource?

24 Is the wetland a site for recreational activities which are restricted at other wetlands?

25 Is the wetland part of a linked network of recreational resources?

Key:

Significance:

I:International N:National S:State
R:Regional L:Local P:Parochial

References:

1.
2.
3. DCE (1983) SYSTEM 6 RED BOOK M34
4.

A : WETLAND VEGETATION AND LAND USE SURVEY:DESK STUDY

1 Map Sheet Name

2133436W

2 Wetland Name\Number

100 KADINA BK

3 Wetland Identification Number

4 Wetland Type

CREEK

5 Geomorphology Unit

WALYUNGA

6 Geomorphology map used

SEMENIUK

7 Vegetation Unit

FORRESTFIELD

8 Vegetation map used

SYSTEM 6

9 Vegetation Status

*Left	Right	*Left (%)		Right (%)	
V	P	40	60	50	30
V,P or C	V,P or C	200-50m	50-0m	0-50m	50-200m

V : Vegetation >50% of zone
P : Vegetation >10% and <50% of zone
C : Vegetation <10% of zone

10 Drain Status

N O:Drains Out I:Drains In N:No drains

11 Principle Land Uses (50-200m)

*Left	Right
	G

V : Predominantly uncleared native vegetation
P : Pine Plantation
A : Agriculture
H : Horticulture
U : Urban
I : Mining/Industry
O : Other (Please specify) RESERVE

* Facing Downstream
Basin and flat wetlands use 'left' column only

12 Assessor

KJ2

13 Survey Date

12/02/1992

B : WETLAND FEATURES OF NATURAL AND SOCIAL SIGNIFICANCE

Ecosystem

14 Is the wetland a prime example or representative of the area's wetland ecosystems?

15 Is the wetland of a type that is limited in distribution?

16 Is the wetland part of a linked, natural system where destroying or degrading one wetland would affect others in the system? R3

Species

17 Is the wetland an important sanctuary for flora or fauna?

18 Is the wetland a habitat for rare and endangered species? S1

19 Does the wetland function as either a seasonal or temporary habitat or breeding ground for large numbers of migratory or nomadic animals?

Culture

20 Does the wetland function as an important educational resource?

21 Does the wetland have importance as an historic or Aboriginal site or does it hold unusual features of special scientific significance?

22 Is the wetland part of a linked network of cultural resources significant for aesthetic or heritage purposes?

Recreation

23 Does the wetland serve as an important recreation resource?

24 Is the wetland a site for recreational activities which are restricted at other wetlands?

25 Is the wetland part of a linked network of recreational resources?

Key:

Significance:

References:

I:International N:National S:State
R:Regional L:Local P:Parochial

1. BUSHMEAD RIFLE RANGE EIS-BANDICOOTS
2.
3. LINK OF M33 HELENA VALLEY, M34 DARLING
4. RANGE DCE(1983) SYSTEM 6 RED BOOK

APPENDIX 13

FIELD SURVEY SHEETS FROM KADINA CREEK TRIAL

WETLAND VEGETATION AND LAND USE SURVEY:FIELD STUDY

A : WETLAND DETAILS

1 Map Sheet Name

2	1	3	4	3	S	W				

2 Wetland Name/Number

	1	2	C																					

3 Wetland Identification Number

4 Wetland Type

C	R	E	E	K					

5 Assessor

L	I	Z		T	H	E	[illegible]		

6 Survey Date

0	7	0	2	1	9	9	2

7 Survey Time

1	0	0	0

8 Principle Land Uses (50-200m)

*Left	Right
V	V

V:Predominantly uncleared native vegetation vegetation P:Pine plantation A:Agriculture H:Horticulture U:Urban I:Mining/Industry O:Other

* Facing downstream
Basin and flat wetlands use 'left' column only

9 Land use impacts on segment

W	U							

G:Grazing W:Weeds F:Fire S:Salinity
T:Transport M:Mining L:Logging D:Drains out
I:Drains in O:Obstructions/Dams R:Recreation
U: urban encroachment.

10 Wetland Condition

S

P:Pristine N:Near pristine S:Slightly modified
M:Moderately modified H:Heavily modified
D:Degraded

B : ABIOTIC WETLAND INFORMATION

1 Sand
2 Silt
3 Clay

11 Substrate

S

3

F:Fine gravelly; small pebbles 2-6mm
M:Medium gravelly; medium pebbles 6-20mm
G:Coarse gravelly; large pebbles 20-60mm
C:Cobbly; or cobbles 60-200mm
S:Stony; stones 200-600mm
B:Bouldery; or boulders 600mm-2m

12 Origin of Bed Materials

M

R:Recent alluvial P:Parent M:Parent and alluvial

13 Stage (at established sample site)

0								

14 Temperature (at established sample site)

15 Conductivity (at established sample site)

C : BIOTIC WETLAND INFORMATION

Native Flora

16 Type of dominant native vegetation remaining in 'immediate' zone of wetland edge (0-50m) (%)

	Left	Right
Tree layer	50	50
Shrub layer	50	50
Ground layer		

17 Extent of vegetation from wetland edge (%)

	Left	Right
0-50m	90	40
50-200m	60	70

18 Extent of native vegetation along the length of the wetland edge (%)

	Left	Right
0-50m	100	100
50-200m	70	80

BIOTIC WETLAND INFORMATION (CONT.)

19 Introduced Flora : Terrestrial/Aquatic

Name	Observation	Abundance
Blackeyed Susan *See Diagram		

20 Native Fauna : Mammals/Birds/Reptiles/Amphibians/Fish

Name	Observation	Abundance
Bandicoots		

21 Introduced Fauna : Mammals/Birds/Fish

Name	Observation	Abundance
Dogs		

22 Rare Species Identified : Plants/Animals

Name	Observation	Abundance
See Wildflower Society and System 6 Red Book		

D : Management Issues

1. Proportion of wetland edge fenced (%)
   *Left Right

2	2

2. Average distance of fence from wetland edge (m)
   *Left Right

60	60

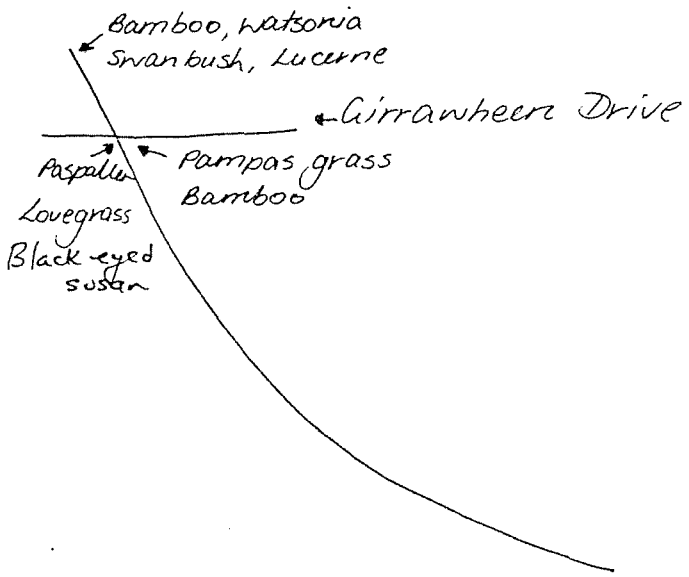
* Facing downstream
Basin and flat wetlands use 'left' column only

3. Number of pools in segment (channel wetlands only) –

4. Area of pools in segment (channel wetlands only) –

E : Wetland Site Diagram

Key information to be included is : wetland boundary, wetland size and shape, vegetation types, introduced flora/weeds, native fauna, introduced fauna/feral animals, rare species, fences, access, drains/pumps, dams, gauges or other structures and any other relevant information.
Mark photo sites on sketch and using an arrow indicate direction of photo.



Photographs:

Roll No.	Negative No.	Description

Additional notes or comments:

WETLAND VEGETATION AND LAND USE SURVEY:FIELD STUDY

A : WETLAND DETAILS

1 Map Sheet Name

2134 3SW

2 Wetland Name/Number

11-37

3 Wetland Identification Number

4 Wetland Type

CREEK

5 Assessor

LIZ THOMSEN

6 Survey Date

07021992

7 Survey Time

1050

8 Principle Land Uses (50-200m)

*Left	Right
V	V

V:Predominantly uncleared native vegetation vegetation P:Pine plantation A:Agriculture
H:Horticulture U:Urban I:Mining/Industry
O:Other

* Facing downstream
Basin and flat wetlands use 'left' column only

9 Land use impacts on segment

W

G:Grazing W:Weeds F:Fire S:Salinity
T:Transport M:Mining L:Logging D:Drains out
I:Drains in O:Obstructions/Dams R:Recreation

10 Wetland Condition

N

P:Pristine N:Near pristine S:Slightly modified
M:Moderately modified H:Heavily modified
D:Degraded

B : ABIOTIC WETLAND INFORMATION

11 Substrate

S

3

F:Fine gravelly; small pebbles	2-6mm
M:Medium gravelly; medium pebbles	6-20mm
G:Coarse gravelly; large pebbles	20-60mm
C:Cobbly; or cobbles	60-200mm
S:Stony; stones	200-600mm
B:Bouldery; or boulders	600mm-2m

12 Origin of Bed Materials

M

R:Recent alluvial P:Parent M:Parent and alluvial

13 Stage (at established sample site)

0

14 Temperature (at established sample site)

15 Conductivity (at established sample site)

C : BIOTIC WETLAND INFORMATION

Native Flora

16 Type of dominant native vegetation remaining in 'immediate' zone of wetland edge (0-50m) (%)

	Left	Right
Tree layer		
Shrub layer	100	100
Ground layer		

17 Extent of vegetation from wetland edge (%)

	Left	Right
0-50m	100	100
50-200m	90	90

18 Extent of native vegetation along the length of the wetland edge (%)

	Left	Right
0-50m	100	100
50-200m	100	100

BIOTIC WETLAND INFORMATION (CONT.)

19 Introduced Flora : Terrestrial/Aquatic

Name	Observation	Abundance
Watsonia Veldt Grass		numerous slight

20 Native Fauna : Mammals/Birds/Reptiles/Amphibians/Fish

Name	Observation	Abundance

21 Introduced Fauna : Mammals/Birds/Fish

Name	Observation	Abundance

22 Rare Species Identified : Plants/Animals

Name	Observation	Abundance
System 6 - Wildflower Society	M34	

D : Management Issues

1. Proportion of wetland edge fenced (%)

*Left	Right
0	0

2. Average distance of fence from wetland edge (m)

*Left	Right
0	0

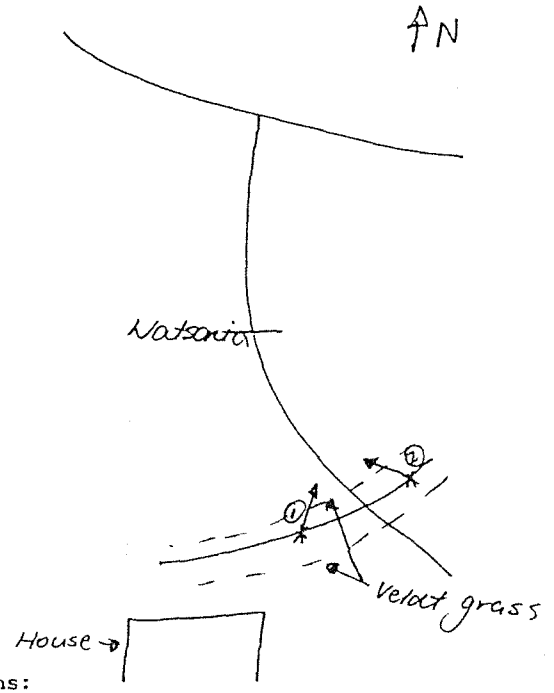
* Facing downstream
Basin and flat wetlands use 'left' column only

3. Number of pools in segment (channel wetlands only) 0

4. Area of pools in segment (channel wetlands only) 0

E : Wetland Site Diagram

Key information to be included is : wetland boundary, wetland size and shape, vegetation types, introduced flora/weeds, native fauna, introduced fauna/feral animals, rare species, fences, access, drains/pumps, dams, gauges or other structures and any other relevant information.
Mark photo sites on sketch and using an arrow indicate direction of photo.



Photographs:

Roll No.	Negative No.	Description
1	1	N direction
	2	NW - along creek.

Additional notes or comments:

Closed heathland
scenic views of scarp

WETLAND VEGETATION AND LAND USE SURVEY:FIELD STUDY

A : WETLAND DETAILS

1 Map Sheet Name

2	1	3	4	3	5	W				

2 Wetland Name/Number

C	S	W	I	L	L	O	W		C	K												

3 Wetland Identification Number

4 Wetland Type

C	R	E	E	K					

5 Assessor

L	I	Z		T	H	O	R	S	O	R	N	

6 Survey Date

0	7	0	2	1	9	9	2

7 Survey Time

1	1	3	0

8 Principle Land Uses (50-200m)

*Left	Right
A	A

V:Predominantly uncleared native vegetation vegetation P:Pine plantation A:Agriculture
H:Horticulture U:Urban I:Mining/Industry
O:Other

* Facing downstream
Basin and flat wetlands use 'left' column only

9 Land use impacts on segment

G	W	T	U					

G:Grazing W:Weeds F:Fire S:Salinity
T:Transport M:Mining L:Logging D:Drains out
I:Drains in O:Obstructions/Dams R:Recreation

10 Wetland Condition

H

P:Pristine N:Near pristine S:Slightly modified
M:Moderately modified H:Heavily modified
D:Degraded

B : ABIOTIC WETLAND INFORMATION

11 Substrate

F
1

F:Fine gravelly; small pebbles 2-6mm
M:Medium gravelly; medium pebbles 6-20mm
G:Coarse gravelly; large pebbles 20-60mm
C:Cobbly; or cobbles 60-200mm
S:Stony; stones 200-600mm
B:Bouldery; or boulders 600mm-2m

12 Origin of Bed Materials

R

R:Recent alluvial P:Parent M:Parent and alluvial

13 Stage (at established sample site)

0								

14 Temperature (at established sample site)

15 Conductivity (at established sample site)

C : BIOTIC WETLAND INFORMATION

Native Flora

16 Type of dominant native vegetation remaining in 'immediate' zone of wetland edge (0-50m) (%)

	Left	Right
Tree layer	70	70
Shrub layer	5	5
Ground layer	0	0

17 Extent of vegetation from wetland edge (%)

	Left	Right
0-50m	25	25
50-200m	25	25

18 Extent of native vegetation along the length of the wetland edge (%)

	Left	Right
0-50m		
50-200m		

BIOTIC WETLAND INFORMATION (CONT.)

19 Introduced Flora : Terrestrial/Aquatic

Name	Observation	Abundance
paspallen Tasmanian Bluegum		

20 Native Fauna : Mammals/Birds/Reptiles/Amphibians/Fish

Name	Observation	Abundance

21 Introduced Fauna : Mammals/Birds/Fish

Name	Observation	Abundance

22 Rare Species Identified : Plants/Animals

Name	Observation	Abundance

D : Management Issues

1. Proportion of wetland edge fenced (%)

*Left	Right
0	50

2. Average distance of fence from wetland edge (m)

*Left	Right
0	20

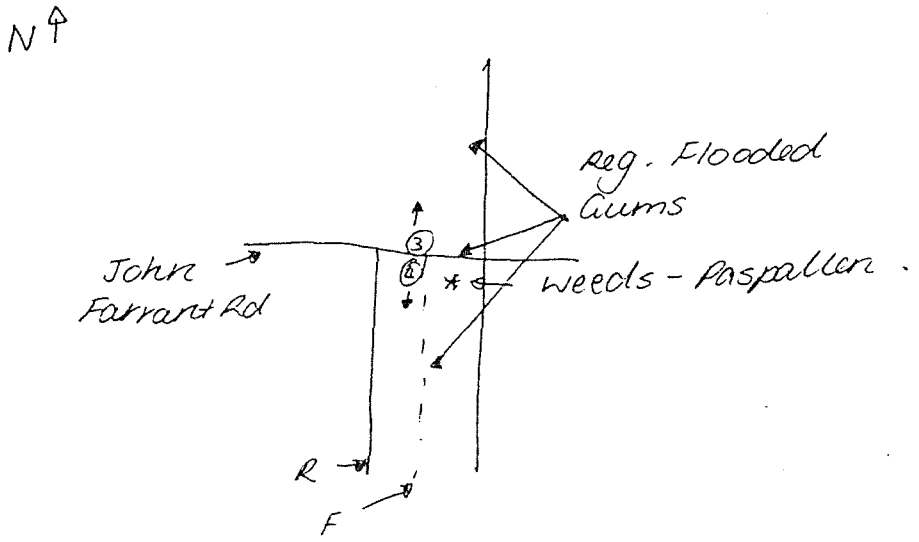
* Facing downstream
Basin and flat wetlands use 'left' column only

3. Number of pools in segment (channel wetlands only) -

4. Area of pools in segment (channel wetlands only) -

E : Wetland Site Diagram

Key information to be included is : wetland boundary, wetland size and shape, vegetation types, introduced flora/weeds, native fauna, introduced fauna/feral animals, rare species, fences, access, drains/pumps, dams, gauges or other structures and any other relevant information.
Mark photo sites on sketch and using an arrow indicate direction of photo.



Photographs:

Roll No.	Negative No.	Description
1	3	North - cleared area
	4	south along creek.

Additional notes or comments:

Regenerating Flooded Gums.

BIOTIC WETLAND INFORMATION (CONT.)

19 Introduced Flora : Terrestrial/Aquatic

Name	Observation	Abundance
Watsonia		

20 Native Fauna : Mammals/Birds/Reptiles/Amphibians/Fish

Name	Observation	Abundance
Wrens		

21 Introduced Fauna : Mammals/Birds/Fish

Name	Observation	Abundance
Rabbits		2
Cows	Pats	

22 Rare Species Identified : Plants/Animals

Name	Observation	Abundance

D : Management Issues

1. Proportion of wetland edge fenced (%)
   *Left Right

50	75

2. Average distance of fence from wetland edge (m)
   *Left Right

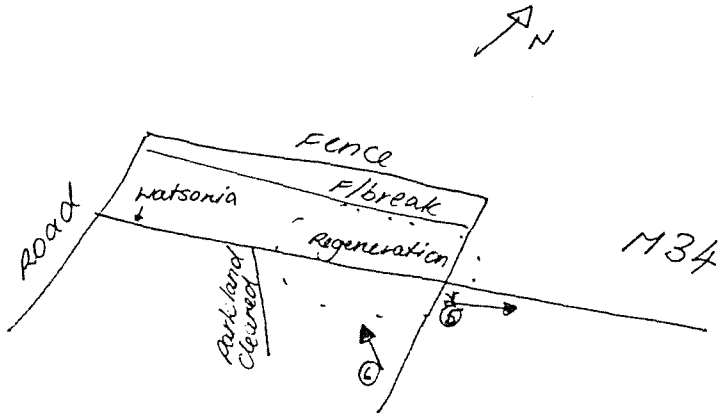
* Facing downstream
Basin and flat wetlands use 'left' column only

3. Number of pools in segment (channel wetlands only) —

4. Area of pools in segment (channel wetlands only) —

E : Wetland Site Diagram

Key information to be included is : wetland boundary, wetland size and shape, vegetation types, introduced flora/weeds, native fauna, introduced fauna/feral animals, rare species, fences, access, drains/pumps, dams, gauges or other structures and any other relevant information.
Mark photo sites on sketch and using an arrow indicate direction of photo.



Photographs:

Roll No.	Negative No.	Description
1	5	From fence into M34
	6	Cleared area (grazed

Additional notes or comments:

WETLAND VEGETATION AND LAND USE SURVEY:FIELD STUDY

A : WETLAND DETAILS

1 Map Sheet Name

2	1	3	4	3	S	W				

2 Wetland Name/Number

N		C	R	E	E	K		2		F	L	O	O	D	P	L	A	I	N	(S	E	M)

3 Wetland Identification Number

4 Wetland Type

F	L	O	O	D	P	L	A	I	N

5 Assessor

L		E		T	W	C	R	S	C	N

6 Survey Date

7 Survey Time

	1	0	0

8 Principle Land Uses (50-200m)

*Left	Right
A, U	

V:Predominantly uncleared native vegetation vegetation P:Pine plantation A:Agriculture
H:Horticulture U:Urban I:Mining/Industry
O:Other

* Facing downstream
Basin and flat wetlands use 'left' column only

9 Land use impacts on segment

G	W	T	O	U				

G:Grazing W:Weeds F:Fire S:Salinity
T:Transport M:Mining L:Logging D:Drains out
I:Drains in O:Obstructions/Dams R:Recreation

10 Wetland Condition

M

P:Pristine N:Near pristine S:Slightly modified
M:Moderately modified H:Heavily modified
D:Degraded

3 sand
2 silt
1 clay

B : ABIOTIC WETLAND INFORMATION

11 Substrate

1

F:Fine gravelly; small pebbles 2-6mm
M:Medium gravelly; medium pebbles 6-20mm
G:Coarse gravelly; large pebbles 20-60mm
C:Cobbly; or cobbles 60-200mm
S:Stony; stones 200-600mm
B:Bouldery; or boulders 600mm-2m

12 Origin of Bed Materials

R

R:Recent alluvial P:Parent M:Parent and alluvial

13 Stage (at established sample site)

O								

14 Temperature (at established sample site)

-			

15 Conductivity (at established sample site)

-							

C : BIOTIC WETLAND INFORMATION

Native Flora

16 Type of dominant native vegetation remaining in 'immediate' zone of wetland edge (0-50m) (%)

	Left	Right
Tree layer	20	
Shrub layer	0	
Ground layer	60-70*	

+reeds

17 Extent of vegetation from wetland edge (%)

	Left	Right
0-50m	15	
50-200m	25	

18 Extent of native vegetation along the length of the wetland edge (%)

	Left	Right
0-50m	15	
50-200m	25	

BIOTIC WETLAND INFORMATION (CONT.)

19 Introduced Flora : Terrestrial/Aquatic

Name	Observation	Abundance
Kikuyu Willows		

20 Native Fauna : Mammals/Birds/Reptiles/Amphibians/Fish

Name	Observation	Abundance
-		

21 Introduced Fauna : Mammals/Birds/Fish

Name	Observation	Abundance
Sheep		

22 Rare Species Identified : Plants/Animals

Name	Observation	Abundance
none known not attempted		

D : Management Issues

1. Proportion of wetland edge fenced (%)

*Left	Right
30	

2. Average distance of fence from wetland edge (m)

*Left	Right
0-10m on edge of floodplain	

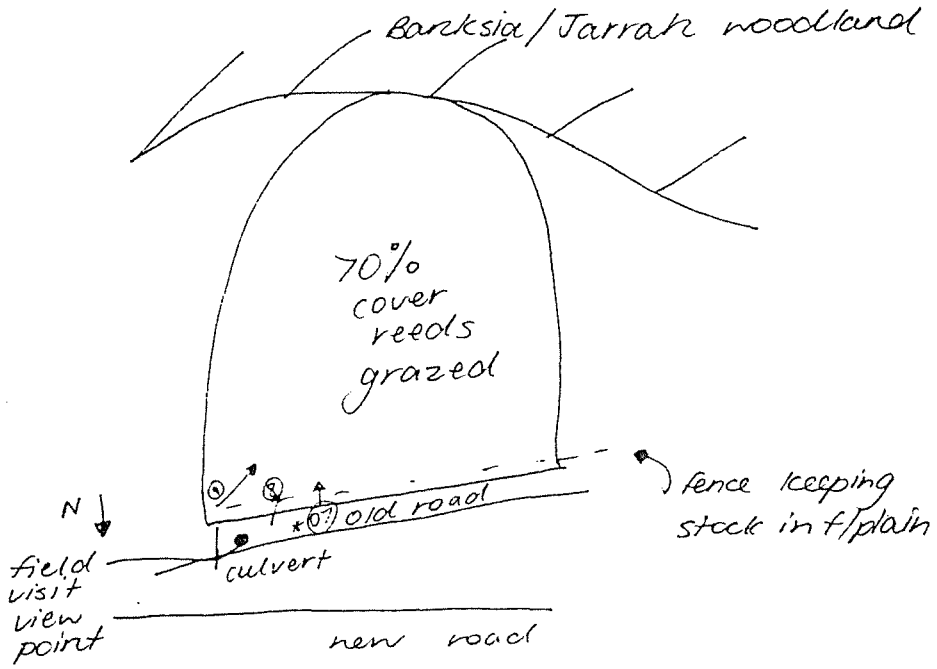
* Facing downstream
Basin and flat wetlands use 'left' column only

3. Number of pools in segment (channel wetlands only) -

4. Area of pools in segment (channel wetlands only) -

E : Wetland Site Diagram

Key information to be included is : wetland boundary, wetland size and shape, vegetation types, introduced flora/weeds, native fauna, introduced fauna/feral animals, rare species, fences, access, drains/pumps, dams, gauges or other structures and any other relevant information.
Mark photo sites on sketch and using an arrow indicate direction of photo.



Photographs:

Roll No.	Negative No.	Description
01	7	
	8	main channel
	9	sideways down f/plain

Additional notes or comments:

Reach of 100 only