PAGANONI SWAMP AND ADJACENT BUSHLAND, KARNUP

Boundary Definition: protected area/bushland (part taken to cadastre) boundary (Boundary adjusted after vegetation survey and negotiations with land owner(s) in response to a submission to draft *Perth's Bushplan*.)

SECTION 1: LOCATION INFORMATION

Bush Forever Site no. 395 **Area (ha):** bushland 705.5 (Site also includes open water.)
Map no. 79, 80 **Map sheet series ref. no.** 2033–II SW
Other Names: part of Rockingham Lakes Regional Park, Submission Area 266 and Submission Area 151, Lot 1 cnr Paganoni and Mandurah Rds
Local Authorities (Suburb): City of Rockingham (Karnup)

SECTION 2: REGIONAL INFORMATION

LANDFORMS AND SOILS
Pinjarra Plain
Guildford Formation (Qha: Cp) (associated with Serpentine River)
Bassendean Dunes
Bassendean Sands (Qpb: S8)
Spearwood Dunes
Sands derived from Tamala Limestone (Qts: S7)
Tamala Limestone (Qtl: LS1)
Wetlands (within the Spearwood Dunes)
Holocene Swamp Deposits (Qhw: Scp, Cps)

VEGETATION AND FLORA
Vegetation Complexes
Spearwood Dunes
Karrakatta Complex — Central and South
Cottesloe Complex — Central and South
Wetlands
Herdsman Complex
Floristic Community Types: *not sampled, types inferred
Supergroup 2: Seasonal Wetlands
17 *Melaleuca rhaphiophylla — Gahnia trifida* seasonal wetlands
Supergroup 3: Uplands centred on Bassendean Dunes and Dandaragan Plateau
21a Central *Banksia attenuata — Eucalyptus marginata* woodlands
Supergroup 4: Uplands centred on Spearwood and Quindalup Dunes
*24 Northern Spearwood shrublands and woodlands
25 Southern *Eucalyptus gomphocephala — Agonis flexuosa* woodlands

WETLANDS
Wetland Types: sumpland, dampland
Natural Wetland Groups
Bassendean Dunes
Gnangara (B.2)
Spearwood Dunes
Stakehill (S.4)
Coastal Plain Rivers
Goegrup (R.4)
Wetland Management Objectives: Conservation (107.8ha)
Swan Coastal Plain Lakes EPP: 4.5ha + 9.6ha + 4.1ha + 0.3ha = 18.5ha (total)

THREATENED ECOLOGICAL COMMUNITIES
Not assessed

SECTION 3: SPECIFIC SITE DETAIL

Landscape Features: open water, vegetated uplands, dune crest, limestone ridge
Vegetation and Flora: limited survey (DEP roadside survey 1998, DEP 1999, Gibson *et al.* 1994 (Paga 01–08)); detailed survey (Keighery, GJ, 1996, Semeniuk, V&C Research Group 1991d, part Site — Tingay 1999c)
Structural Units: mapping (Semeniuk, V&C Research Group 1991d)
Uplands — Sands derived from Tamala Limestone: *Eucalyptus gomphocephala* Forest to Woodland; Woodlands dominated by *Banksia attenuata* with scattered emergent *Eucalyptus marginata* and *E. gomphocephala* mixed with varying proportions of *Banksia ilicifolia, B. grandis, B. menziesii, Allocasuarina fraseriana* and *Xylomelum*

occidentale; *Eucalyptus decipiens* Shrub Mallee; Mixed Low Heaths with a variety of dominants such as *Melaleuca huegelii, Grevillea preissii* and *Hakea trifurcata*
Uplands — Tamala Limestone: Low heath dominated by *Olearia axillaris*, *Melaleuca systena*, *Acacia truncata*, *A. cyclops* and *A. saligna*
Wetlands: Woodlands to Forests dominated by *Eucalyptus rudis*, *E. calophylla* or *E. gomphocephala*; *Melaleuca preissiana*, *Banksia littoralis* and *Acacia saligna* Low Woodland; *Melaleuca rhaphiophylla* Low Forest; Closed Scrub to Open Scrub dominated by *Melaleuca teretifolia* or *M. viminea*; Closed to Open Heath dominated by *Pericalymma ellipticum* alone or in combination with *Hakea varia*, *Calothamnus lateralis* and *Aotus* species; *Astartea* aff. *fascicularis* Heath; Sedgelands dominated by *Lepidosperma longitudinale*, *Baumea articulata*, *B. juncea* or *Gahnia trifida*
Vegetation Condition: >75% Excellent to Very Good, <25% Good to Degraded
Total Flora: 305 native taxa, 45 weed taxa (Keighery, GJ, 1996, Semeniuk, V&C Research Group 1991d) (estimated >80% expected flora)
Significant Flora: *Lasiopetalum membranaceum* (2) (Tingay 1999), *Hibbertia spicata* subsp. *leptotheca* (3), *Acacia benthamii* (3) (Keighery, GJ, 1999), *Dillwynia dillwynioides* (3); *Jacksonia calcicola* (most southern population), *Trachymene coerulea*, *Mesomelaena tetragona* (most western record, generally associated with eastern side of the Swan Coastal Plain), *Senecio ramosissimus* (one of two populations known in the PMR, Keighery, GJ, 1996), *Pterostylis* sp. cauline leaves (NG & ML 1490), *Pterostylis* sp. crinkled leaf (GJK 13426); typical Tamala Limestone taxa (DEP 1999 and Tingay 1999) — *Melaleuca huegelii Grevillea preissii*, *Trymalium ledifolium* subsp. *ledifolium*, *Diplopeltis huegelii* subsp. *huegelii*, *Eucalyptus foecunda, Jacksonia calcicola*

Fauna: Significant mammal species: Quenda (Friend 1996 D)
Linkage: adjacent bushland to the north (Site 379, across road), east (to Serpentine River) and west; part of Greenways 89, 123 (Tingay, Alan & Associates 1998a); part of a regionally significant contiguous bushland/wetland linkage (Part A, Map 7)
Other Special Attributes: Paganoni wetland is the largest in the Stakehill Suite; wetland of 'regional to international significance' (Semeniuk, V&C Research Group 1991e); majority of Site included in Port Kennedy and Rockingham Parks proposal (Tingay, Alan & Associates 1997b)

SECTION 4: INTERNATIONAL AND NATIONAL SIGNIFICANCE

Entered in the Interim List of the Register of the National Estate

SECTION 5: SELECTION CRITERIA AND RECOMMENDATIONS

Criteria: Representation of ecological communities, Diversity, Rarity, Maintaining ecological processes or natural systems, Scientific or evolutionary importance, General criteria for the protection of wetland, streamline and estuarine fringing and coastal vegetation
Recommendation: Part A: Site with Some Existing Protection; the care, control and management of this Site for conservation purposes within Rockingham Lakes Regional Park is endorsed. Part B: Urban Negotiated Planning Solution (see Table 3, Volume 1).

PAGANONI SWAMP AND ADJACENT BUSHLAND, KARNUP

Boundary Definition: protected area/bushland taken to cadastre boundary

SECTION 1: CADASTRAL INFORMATION

(Lots, locations and derived information to be updated in the public submission period)

Bushplan Site no. 395 **Map no.** 99, 103 **Map sheet series ref. no.** 2033–II SW

Other Names
Submission Area 266 and Submission Area 151, Lot 1 cnr Paganoni and Mandurah Rds

Local Authorities (Suburb)
City of Rockingham (Karnup)

Ownership Categories
State Government, Private (commercial organisation)

Area (ha): total 751.0 (includes open water); bushland 740.2

Zoning
MRS: Parks and Recreation, Urban Deferred, Railways
TPS: Rural, Landscape, No Zone

Lot/Location/Reserve numbers (Purpose), Street name
1, 4, 14 Mandurah Rd; 2 Paganoni Rd

SECTION 2: REGIONAL INFORMATION

LANDFORMS AND SOILS

Pinjarra Plain
Guildford Formation (Qha: Cp) (associated with Serpentine River)
Bassendean Dunes
Bassendean Sands (Qpb: S8)
Spearwood Dunes
Sands derived from Tamala Limestone (Qts: S7)
Tamala Limestone (Qtl: LS1)
Wetlands (within the Spearwood Dunes)
Holocene Swamp Deposits (Qhw: Scp, Cps)

VEGETATION AND FLORA

Vegetation Complexes
Spearwood Dunes
Karrakatta Complex — Central and South
Cottesloe Complex — Central and South
Wetlands
Herdsman Complex
Marine (lagoonal and estuarine) Deposits
Yoongarillup Complex (most northern occurrence)

Floristic Community Types: *not sampled, types inferred
Supergroup 2: Seasonal Wetlands
17 *Melaleuca rhaphiophylla — Gahnia trifida* seasonal wetlands
Supergroup 3: Uplands centred on Bassendean Dunes and Dandaragan Plateau
21a Central *Banksia attenuata — Eucalyptus marginata* woodlands
Supergroup 4: Uplands centred on Spearwood and Quindalup Dunes
*24 Northern Spearwood shrublands and woodlands
25 Southern *Eucalyptus gomphocephala — Agonis flexuosa* woodlands

WETLANDS

Wetland Types: sumpland, dampland
Natural Wetland Groups
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Gnangara (B.2)
Spearwood Dunes
Stakehill (S.4)
Coastal Plain Rivers
Goegrup (R.4)
Wetland Management Objectives: Conservation (107.8ha)
Swan Coastal Plain Lakes EPP: 4.5ha + 9.6ha + 4.1ha + 0.3 = 18.5ha (total)

THREATENED ECOLOGICAL COMMUNITIES

Not assessed

SECTION 3: SPECIFIC SITE DETAIL

Landscape Features: open water, vegetated uplands, dune crest, limestone ridge

Vegetation and Flora: detailed survey (Keighery, GJ, 1996, Semeniuk, V&C Research Group 1991d); limited survey (DEP roadside survey, Gibson *et al.* 1994 (Paga 01–08))

Structural Units: mapping (Semeniuk, V&C Research Group 1991d)
Uplands — Sands derived from Tamala Limestone: *Eucalyptus gomphocephala* Forest to Woodland; Woodlands dominated by *Banksia attenuata* with scattered emergent *Eucalyptus marginata* and *E. gomphocephala* mixed with varying proportions of *Banksia ilicifolia, B. grandis, B. menziesii, Allocasuarina fraseriana* and *Xylomelum occidentale*
Uplands — Tamala Limestone: Low heath dominated by *Olearia axillaris, Melaleuca acerosa, Acacia truncata, A. cyclops* and *A. saligna*
Wetlands: Woodlands to Forests dominated by *Eucalyptus rudis, E. calophylla* or *E. gomphocephala*; *Melaleuca preissiana, Banksia littoralis* and *Acacia saligna* Low Woodland; *Melaleuca rhaphiophylla* Low Forest; Closed Scrub to Open Scrub dominated by *Melaleuca teretifolia* or *M. viminea*; Closed to Open Heath dominated by *Pericalymma ellipticum* alone or in combination with *Hakea varia, Calothamnus lateralis* and *Aotus* species; *Astartea* aff. *fascicularis* Heath; Sedgelands dominated by *Lepidosperma longitudinale, Baumea articulata, B. juncea* or *Gahnia trifida*
Vegetation Condition: >75% Excellent to Very Good, <25% Good to Degraded
Total Flora: 305 native taxa, 45 weeds (Keighery, GJ, 1996, Semeniuk, V&C Research Group 1991d) (estimated >80% expected flora)
Significant Flora: Keighery, GJ, 1996 — *Acacia benthamii* (3), *Dillwynia dillwynioides* (3), *Jacksonia sericea* (3) (in the area of most southern population); *Trachymene coerulea, Mesomelaena tetragona* (most western record known, generally associated with eastern side of the Swan Coastal Plain), *Senecio ramosissimus* (one of two populations known in the PMR); typical Tamala Limestone taxa — *Melaleuca huegelii, Grevillea preissii, Trymalium ledifolium* subsp. *ledifolium*

Fauna: no systematic survey. Significant mammal species: Quenda (Friend 1996 D)
Linkage: adjacent bushland to the north (BS379, across road), east (to Serpentine River) and west; part of proposed Greenways 102, 139 (Tingay, Alan & Associates 1997a); part of a regionally significant contiguous bushland/wetland linkage (Volume 2A, Map 8)

Other Special Attributes: Paganoni wetland is the largest in the Stakehill Suite; wetland of 'regional to international significance' (Semeniuk, V&C Research Group 1991e); majority of Bushplan Site included in Port Kennedy and Rockingham Parks proposal (Tingay, Alan & Associates 1997b)

SECTION 4: INTERNATIONAL AND NATIONAL SIGNIFICANCE

Interim List of the Register of the National Estate

SECTION 5: SELECTION CRITERIA AND RECOMMENDATIONS

Criteria: Representation of ecological communities, Diversity, Rarity, Maintaining ecological processes or natural systems, Scientific or evolutionary importance, General criteria for the protection of wetland, streamline and estuarine fringing and coastal vegetation

Opportunities and/or Constraints

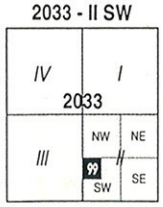
Opportunities: Bushplan Site/part Bushplan Site subject to Swan Coastal Plain Lakes EPP, Peel-Harvey Estuary EPP/SPP; location of conservation category wetlands; under MRS Parks and Recreation Reservation and TPS Landscape Zoning
Constraints: private land; under MRS Urban Deferred Zoning, General Mineral Resource Area (limestone), mining tenement (Main Roads Western Australia) for limestone and mining tenement 28/667 (Readymix Pty Ltd) for limestone

Recommendation: The care, control and management of parts of this area for conservation purposes within Rockingham Lakes Regional Park is endorsed. The most appropriate mechanism for the protection of the remainder of this Bushplan Site be considered through the public comment period in consultation with the land owner(s).

LEGEND

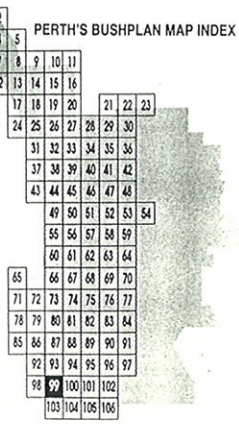
- 472 — Bushplan Sites With Regionally Significant Bushland
- Other Native Vegetation
- Conservation Category Wetlands
- Bushplan Sites With Some Existing Protection
- 696 — Lot Number, Location Number
- Channel Wetlands
- Local Government Boundary

2033 - II SW



1 : 25 000 AMG Reference Grid showing Perth's Bushplan Map Sheet Breakdown

PERTH'S BUSHPLAN MAP INDEX



N

SCALE

0 500 1000

Metres

Produced by Project Mapping Section
Land Information Branch, Ministry for Planning, Perth W.A. November 1998

ntw-map17//environ/bushplan//bushv2_99.dgn

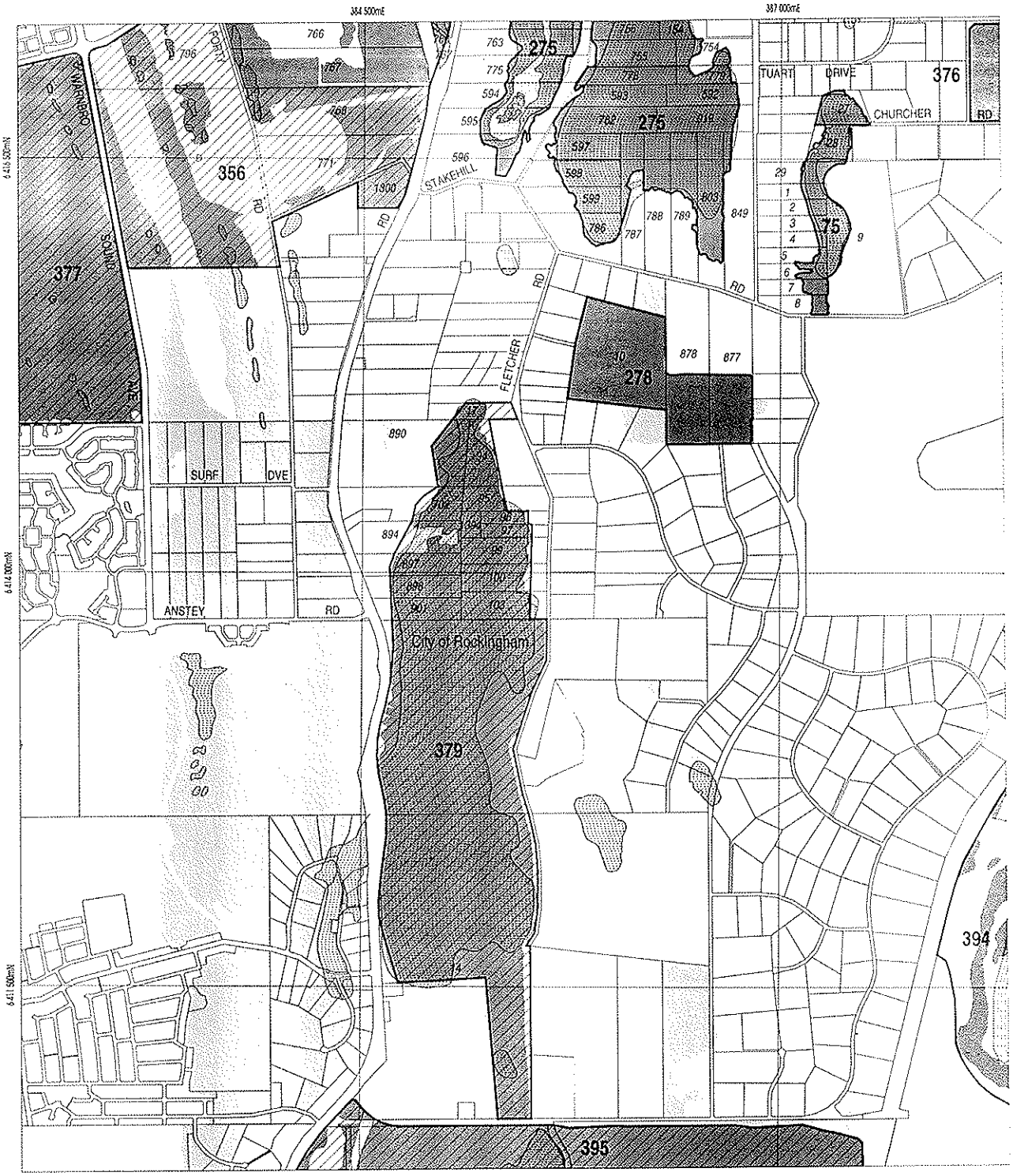
Cadastral Data supplied by Department of Land Administration, W.A.

Wetlands Data supplied by Water and Rivers Commission

Native Vegetation Extent for Study Area supplied by Agriculture Western Australia

Bushplan Site Map

Map 99



LEGEND

- 472 — Bushplan Sites With Regionally Significant Bushland
- Other Native Vegetation
- Conservation Category Wetlands
- Bushplan Sites With Some Existing Protection
- 696 — Lot Number, Location Number
- Channel Wetlands
- Local Government Boundary

2033 - II SW

IV | I
2033
III | II
NW | NE
99
SW | SE

1 : 25 000 AMG Reference Grid showing Perth's Bushplan Map Sheet Breakdown

PERTH'S BUSHPLAN MAP INDEX

N

SCALE

0 500 1000
Metres

Produced by Project Mapping Section
Land Information Branch, Ministry for Planning, Perth W.A. November 1998

ntw-map17//environ/bushplan//bushv2_99.dgn

Cadastral Data supplied by Department of Land Administration, W.A.

Wetlands Data supplied by Water and Rivers Commission

Native Vegetation Extent for Study Area supplied by Agriculture Western Australia

Bushplan Site Map

Map 99

LEGEND

472 Bushplan Sites With Regionally Significant Bushland

Other Native Vegetation

Conservation Category Wetlands

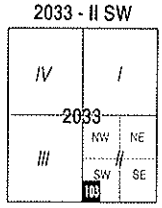
Bushplan Sites With Some Existing Protection

696 Lot Number, Location Number

Channel Wetlands

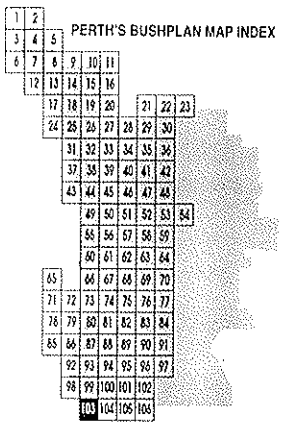
Local Government Boundary

2033 - II SW



1 : 25 000 AMG Reference Grid showing Perth's Bushplan Map Sheet Breakdown

PERTH'S BUSHPLAN MAP INDEX



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SCALE

0 500 1000

Metres

Produced by Project Mapping Section Land Information Branch, Ministry for Planning, Perth W.A. November 1998

ntw_map17//environ/bushplan/bushv2_103.dgn

Cadastral Data supplied by Department of Land Administration, W.A.

Wetlands Data supplied by Water and Rivers Commission

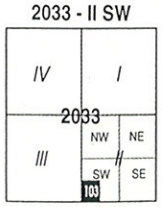
Native Vegetation Extent for Study Area supplied by Agriculture Western Australia

Bushplan Site Map

LEGEND

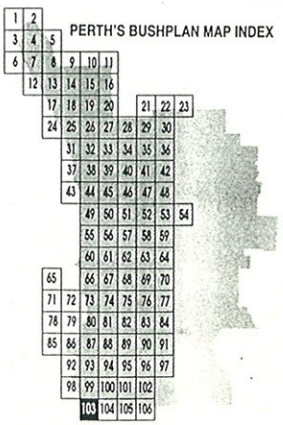
- 472 — Bushplan Sites With Regionally Significant Bushland
- Other Native Vegetation
- Conservation Category Wetlands
- Bushplan Sites With Some Existing Protection
- 696 — Lot Number, Location Number
- Channel Wetlands
- Local Government Boundary

2033 - II SW



1 : 25 000 AMG Reference Grid showing Perth's Bushplan Map Sheet Breakdown

PERTH'S BUSHPLAN MAP INDEX



N

SCALE

0 500 1000

Metres

Produced by Project Mapping Section
Land Information Branch, Ministry for Planning, Perth W.A. November 1998

ntw_map17//environ/bushplan//bushv2_103.dgn

Cadastral Data supplied by Department of Land Administration, W.A.

Wetlands Data supplied by Water and Rivers Commission

Native Vegetation Extent for Study Area supplied by Agriculture Western Australia

Bushplan Site Map

Map 103

BUSHPLAN SITES CORRECTED

THE GOVERNMENT OF WESTERN AUSTRALIA

WESTERN AUSTRALIAN PLANNING COMMISSION

CUSTOMER FOCUS WESTERN AUSTRALIA

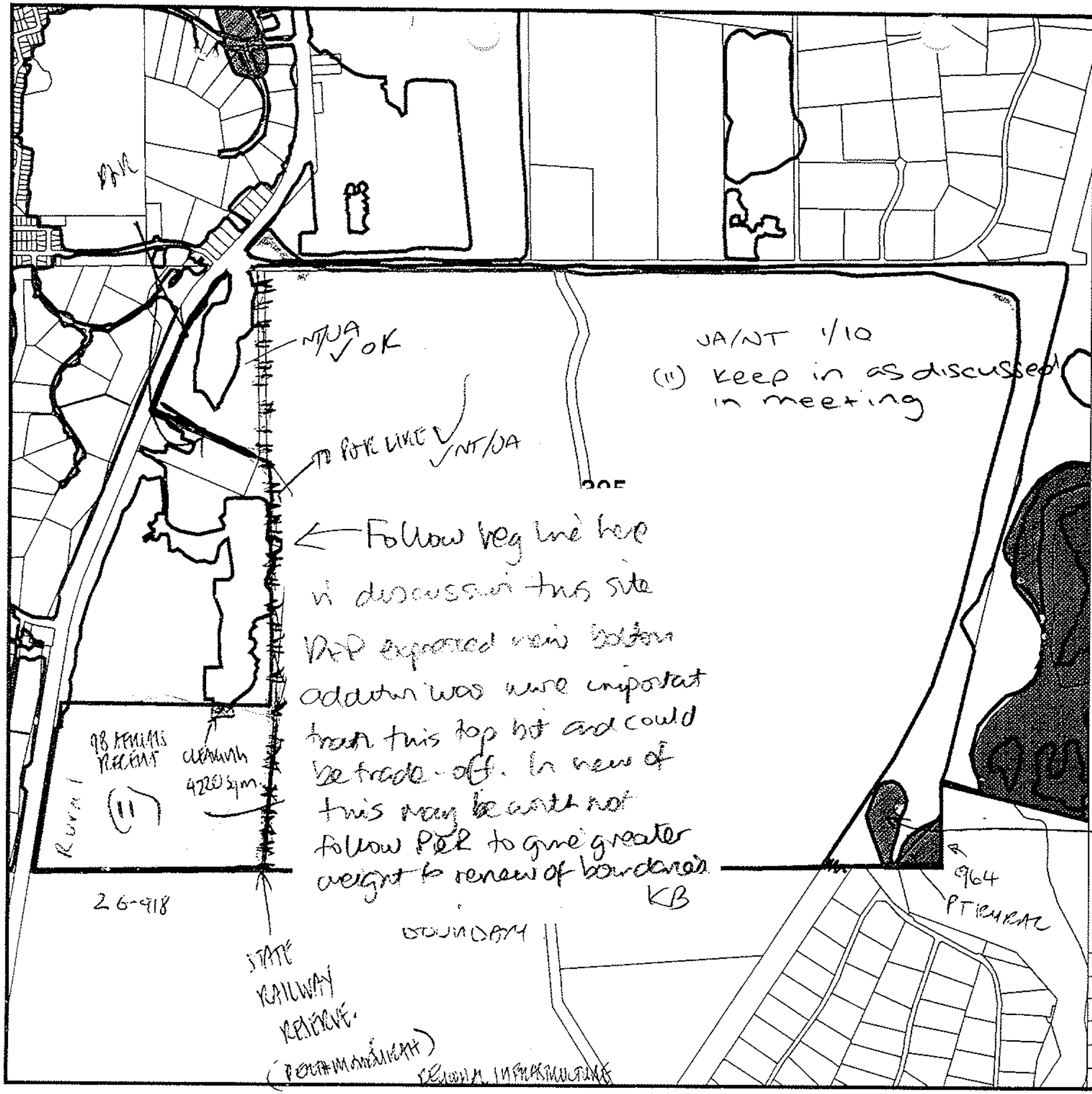
BTh 28/10/98

N

bp site 395

SINGLETON

	Cadastre
	Bushplan sites refno 1-500 SCP BOUNDARY
	cons category wetlands
	Verified CCWs
	AG VEG 1998 BOUNDARY THEME



(i) Follow PER line not rail as C-C-S not worth trouble

(ii) FULL JUSTIFICATION PREFER LEAVE OUT

* SHOWN AS IN VERY POOR CONDITION C-C-SOUTH ADDED IN BY B/K FAIRLY RECENTLY 52HA

UA/NT 1/10 (is shown on July 97 map - so not a new edition!!!

C4H NOT VEGETATED

MFP INTERNAL USE ONLY

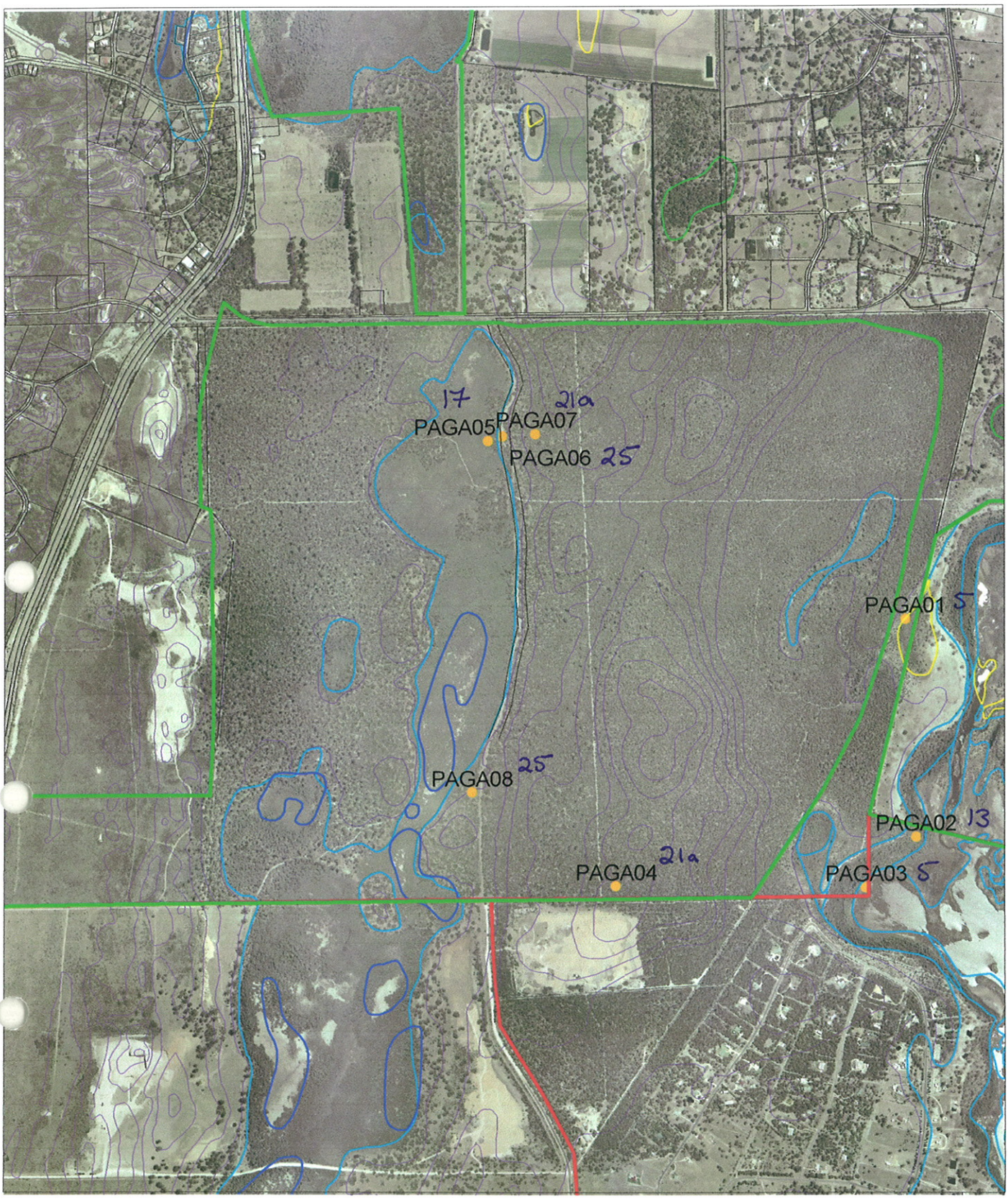
Prepared By: Andrea Zappacosta

Prepared For:

Map Ident: plot980605_2

Date: 05 Jun 98

Scale 1: 22931



Bush Forever Sites
Local Government Authority Boundaries
Lakes EPP
Geomorphic Wetlands Feb04 by Evaluation
Conservation
Resource Enhancement
Multiple Use
Floristic Survey Sites of the Southern Swan Coastal Plain
GJKENV (Keighery 1996)
GRIFFIN (Griffen 1994)
SCP (Gibson et al 1994)
SYS6ENV (DEP 1996 and Trudgen & Keighery 1995)
SYS6ENV2 (DEP 1996 and Trudgen & Keighery 1995)
CALM Threatened Ecological Communities 2002
Roads - Perth Metropolitan
5 Metre, South West WA

Bush Forever Site 395: Paganoni Swamp and Adjacent Bushland, Karnup

0 500 1000 1500 Meters

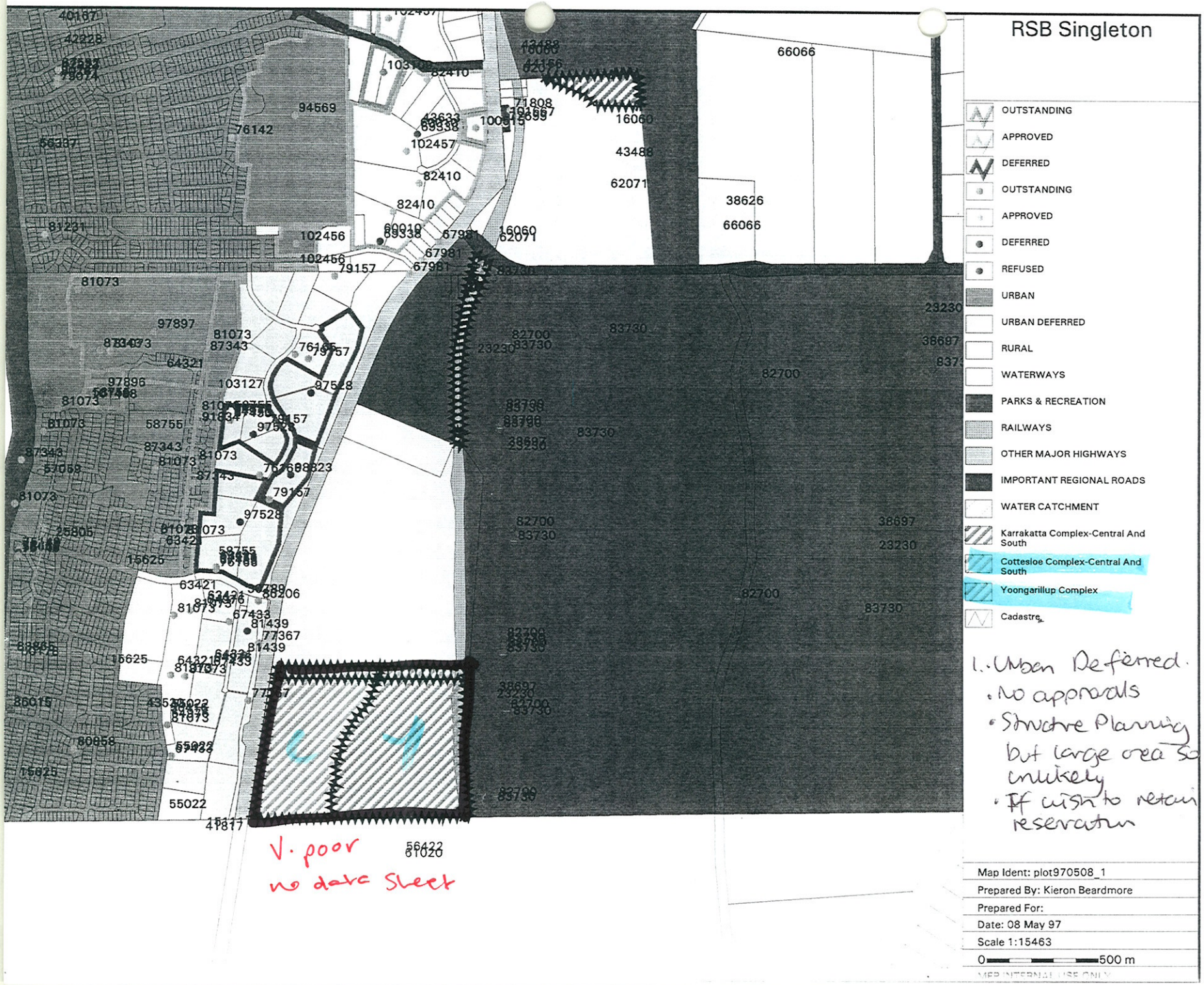
N

1:22500

Datum: GDA - Projection: MGA Zone 50

Department of Environment

Data Sources:
Cadastre DLI
Aerial Phototography : Skyview DLI



21

1. Urban Deferred.
   - No approvals
   - Structure Planning needs examination? But large area so POS contribution unlikely
   - If wish to retain will require PeR reservation

V. poor
no data sheet

N
BS 395 1998 Paganoni Swamp

- SURVEY RECORDING SHEET Please use pencil

QUADRAT No. ______ VEGETATION TYPE ______

DATE FIRST TRIP ______ VOLUNTEERS ______

DATE SECOND TRIP ______ VOLUNTEERS ______

BOTANIST ______

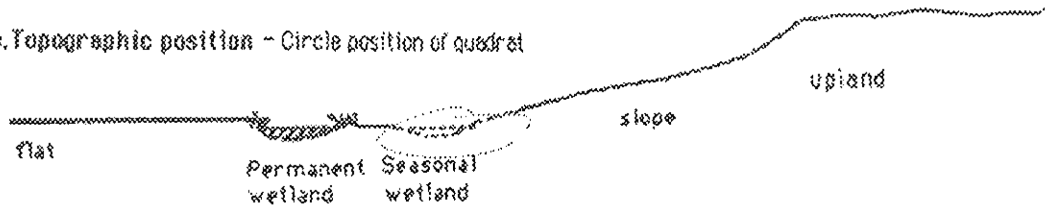
Keighery and Keighery, 1990
Adapted from Griffin and Keighery, 1989
MOORE RIVER to JURIEN SANDPLAIN SURVEY. WILDFLOWER SOCIETY of WA

1. LOCATION of the QUADRAT

a. Mud Map Drew a sketch of the location of the quadrat the back of this sheet

b. Photograph Photographer's name M L

c. Topographic position - Circle position of quadrat



2. SITE DATA - Circle the correct response

Slope flat gentle steep Aspect N NE E SE S SW W NW

% Bare ground 60% Drainage well mod poor Wet All year winter/spring

Litter (% cover) ______ Surface soil ______ Sub-surface soil ______

3. VEGETATION STRUCTURE AND COVER. Record appropriate cover class

	TREES		MALLEES	
LIFE FORM	>15 m 5-15m	under 5m	MALLEE SHRUB less than 8m	MALLEE TREE 8m or more
COVER CLASS (%)	≥15m 5-15m			

15m, 10m, 5m

	SHRUBS				
LIFE FORM	over 2m	2.0-1.5m	1.5-1.0m	1.0m - .5m	under .5m
COVER CLASS (%)			30-50		

3m, 2m, 1m

	BUNCH GRASSES	HERBS	SEDGES	
LIFE FORM	under .5m	under .5m (except creepers)	over .5m	under .5m
COVER CLASS (%)		<2	20-30	

2.0m, 1.5m, 1.0m, .5m

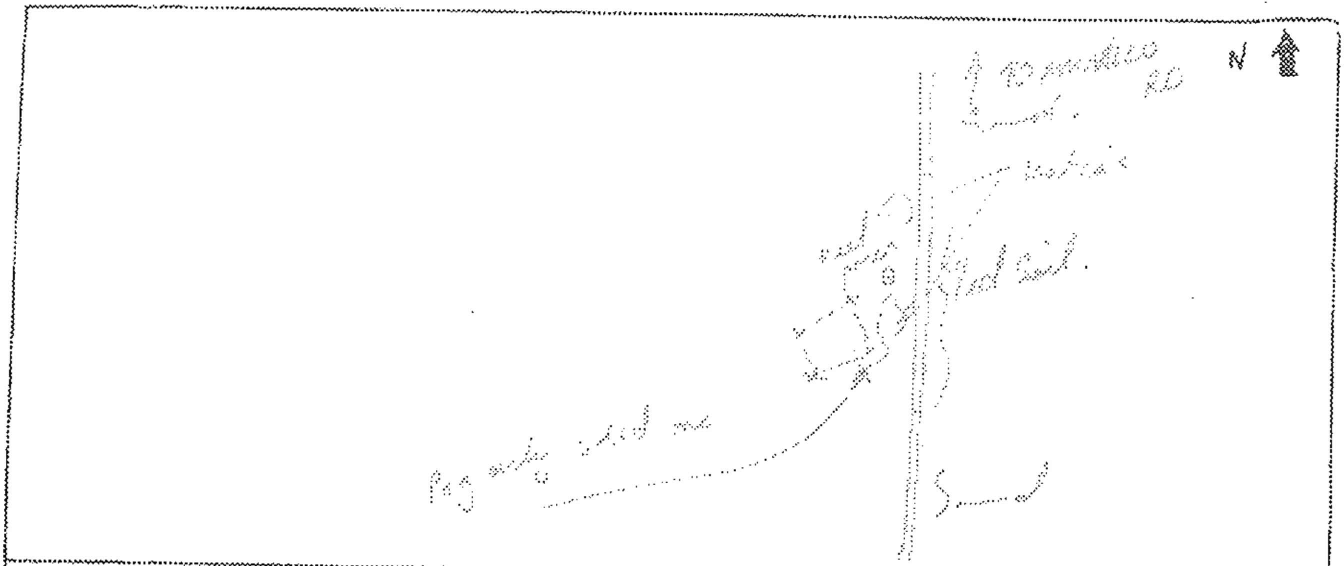
Height (metres)

Cover Class - percentage classes: 0% | under 2% | 2-10% | 10-20% | 20-30% | 30-50% | 50-70% | over 70%

PAGA 01

1. LOCATION of the QUADRAT

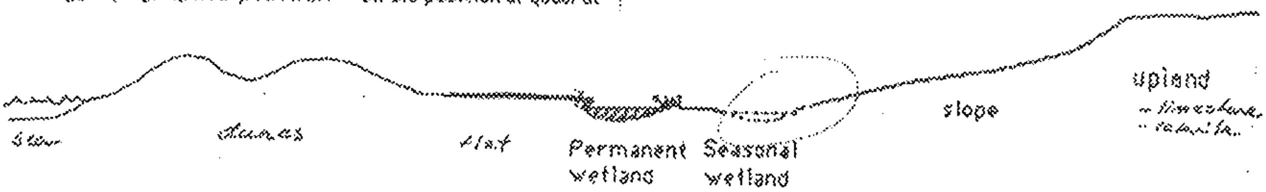
a. Mud Map Draw a sketch of the location of the quadrat :



b Road Location	c. Latitude	Longitude
	32 26 07.4	115 46 05.9
		Altitude

d. Photograph Photographer's name Photo No

e. Topographic position – Circle position of quadrat :



2. SITE DATA – Circle the correct response

Slope flat gentle steep

Aspect N NE E SE S SW W NW

Surface soil Red Clay / loam

Sub-surface soil Clay / Hardpan / Limestone

Drainage well mod poor

Wet All year winter/spring

Litter (% cover) 40%

% Bare ground 60%

4. VEGETATION CONDITION

EXCELLENT		COMMENTS
VERY GOOD		
GOOD		
POOR		
VERY POOR		

SPECIES PRESENCE

[illegible date]

QUADRAT No. [illegible]

- **work systematically through the vegetation**, start with the tallest stratum, i.e. trees
- within each stratum try to record the **most common species first** and the most uncommon last.
- as each species is collected **label** it with a numbered tag and use this number on your recording sheet
- indicate if the species is in **flower**

Keighery and Keighery, 1990
Adapted from Griffin and Keighery, 1989
MOORE RIVER to JURIEN SANDPLAIN SURVEY. WILDFLOWER SOCIETY of WA

Trees	No	ID

Mallees		

SHRUBS		
[illegible handwritten entries]		

SHRUBS	No	ID
[illegible handwritten entries]		

Bunch Grasses		
[illegible handwritten entries]		

Herbs		
[illegible handwritten entries]		

Herbs	No	ID
[illegible handwritten entries]		

Sedges		
[illegible handwritten entries]		

- SURVEY RECORDING SHEET - Please use pencil

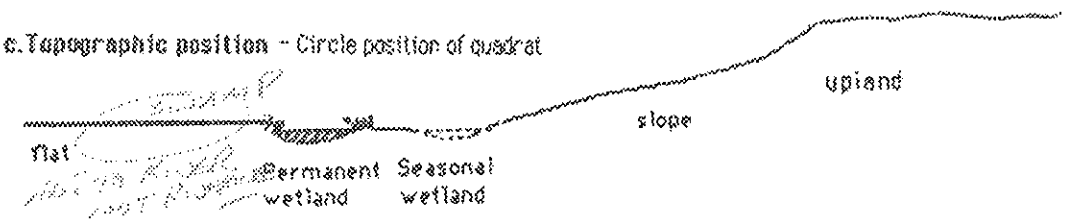
QUADRAT No. _____ VEGETATION TYPE _____
DATE FIRST TRIP _____ VOLUNTEERS _____
DATE SECOND TRIP _____ VOLUNTEERS _____
BOTANIST _____

1. LOCATION of the QUADRAT

a. Mud Map Draw a sketch of the location of the quadrat the back of this sheet →

b. Photograph Photographer's name _____

c. Topographic position - Circle position of quadrat



Keighery and Keighery, 1990
Adapted from Griffin and Keighery, 1985
MOORE RIVER to JARRAH SANDPLAIN SURVEY. WILDFLOWER SOCIETY of WA

2. SITE DATA - Circle the correct response

Slope flat gentle steep Aspect N NE E SE S SW W NW

% Bare ground _____ Drainage well mod poor Wet All year winter/spring

Litter (% cover) _____ Surface soil _____ Sub-surface soil _____

3. VEGETATION STRUCTURE AND COVER. Record appropriate cover class

Cover Class - percentage classes: 0% | under 2% | 2-10% | 10-20% | 20-30% | 30-50% | 50-70% | over 70%

LIFE FORM					
TREES	over 15m, 5-15m	under 5m	MALLEES	MALLEE SHRUBS less than 8m	MALLEE TREE 8m or more
SHRUBS	over 2m	2.0-1.5m	1.5-1.0m	1.0m - .5m	under .5m
BUNCH GRASSES	under .5m		HERBS	under .5m (except creepers)	
SEDGES	over .5m	under .5m			

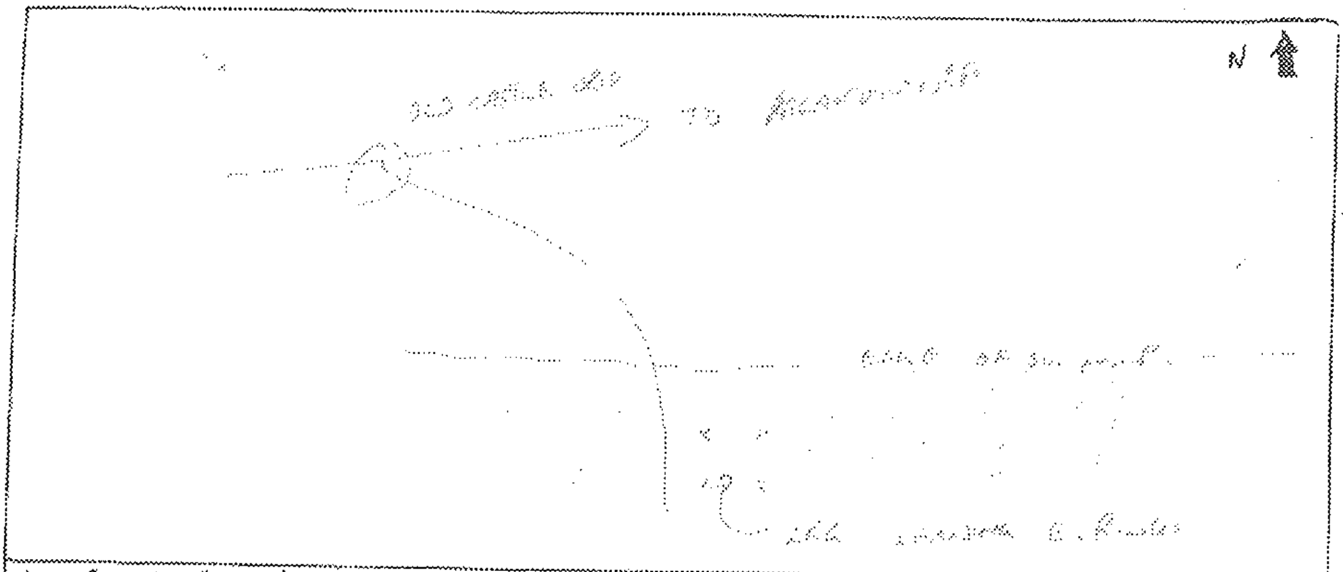
Heights (metres)

COVER CLASS (%)					
TREES	over 15m	5-15m	under 5m		
SHRUBS	over 2m	2.0-1.5m	1.5-1.0m	1.0m - .5m	under .5m
BUNCH GRASSES, HERBS, SEDGES					

PAGA 02

1. LOCATION of the QUADRAT

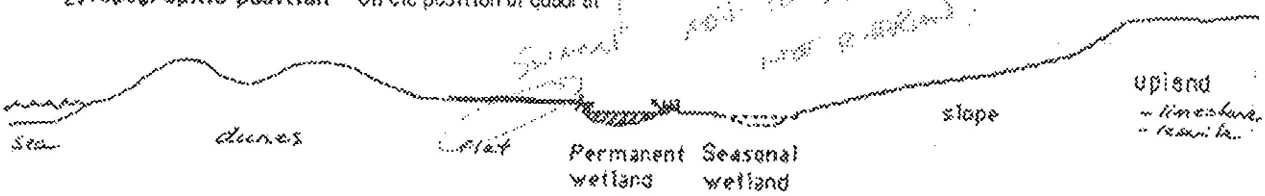
a. Mud Map Draw a sketch of the location of the quadrat



b Road Location	c. Latitude	Longitude
	32 27 15.8	115 48 7.2
		Altitude

d. Photograph Photographer's name NG Photo No

e. Topographic position – Circle position of quadrat



2. SITE DATA – Circle the correct response

Slope flat gentle steep

Aspect N NE E SE S SW W NW

Surface soil Peaty sand dark brown

Sub-surface soil " "

Drainage well mod poor

Wet All year winter/spring

Litter (% cover) 90%

% Bare ground < 10%

4. VEGETATION CONDITION

EXCELLENT	✓✓	Comments
VERY GOOD		
GOOD		
POOR		
VERY POOR		

SPECIES PRESENCE

- **work systematically through the vegetation**; start with the tallest sratum, i.e. trees
- within each stratum try to record the **most common species first** and the most uncommon last.
- as each species is collected **label** it with a numbered tag and use this number on your recording sheet
- indicate if the species is in **flower**

QUADRAT No. [illegible]

Keighery and Keighery, 1990
Adapted from Griffin and Keighery, 1989
MOORE RIVER to JURIEN SANDPLAIN
SURVEY. WILDFLOWER SOCIETY of WA

Trees	No	ID
[illegible]		
[illegible]		

Mallees	No	ID

SHRUBS	No	ID
[illegible]		X
[illegible]		
[illegible]		

SHRUBS	No	ID
[illegible]		
[illegible]		
[illegible]	[illegible]	[illegible]

Bunch Grasses	No	ID

Herbs	No	ID
[illegible]		
[illegible]		X
[illegible]	[illegible]	X
[illegible]		✓

Herbs	No	ID

Sedges	No	ID
[illegible]	[illegible]	✓
[illegible]	[illegible]	✓
[illegible]		X
[illegible]		✓
[illegible]		
[illegible]		

- SURVEY RECORDING SHEET Please use pencil

QUADRAT No. _____ VEGETATION TYPE _____

DATE FIRST TRIP _____ VOLUNTEERS _____

DATE SECOND TRIP _____ VOLUNTEERS _____

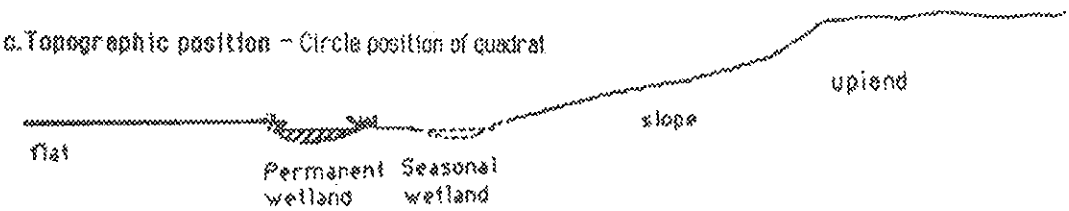
BOTANIST _____

1. LOCATION of the QUADRAT

a. Mud Map Draw a sketch of the location of the quadrat the back of this sheet

b. Photograph Photographer's name _____

c. Topographic position – Circle position of quadrat



Kenneary and Kenneary, 1990
Adapted from Griffin and Kenneary, 1989
MOORE RIVER to JURIEN SAND PLAIN
SURVEY, WILDFLOWER SOCIETY of WA

2. SITE DATA – Circle the correct response

Slope flat gentle steep Aspect N NE E SE S SW W NW

% Bare ground..... Drainage well mod poor Wet All year winter/spring

Litter (% cover)..... Surface soil..... Sub-surface soil _____

3. VEGETATION STRUCTURE AND COVER. Record appropriate cover class

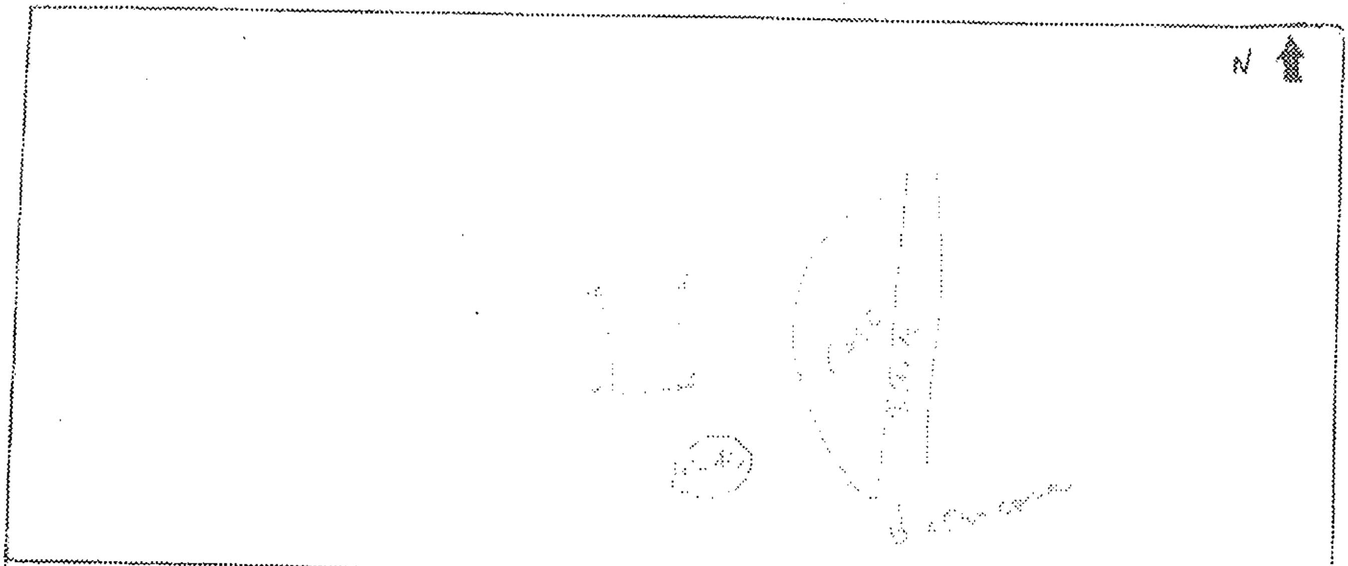
Cover Class = percentage classes: 0% | under 2% | 2-10% | 10-20% | 20-30% | 30-50% | 50-70% | over 70%

LIFE FORM					Height (metres)
TREES	2-15m 5-15m	under 5m	MALLEES: MALLEE SHRUB less than 8m	MALLEES: MALLEE TREE 8m or more	15m 10m 5m
COVER CLASS (%)	2-15m 5-15m				
SHRUBS	over 2m	2.0-1.5m	1.5-1.0m	1.0m-.5m	under .5m
COVER CLASS (%)					3m 2m 1m .5m
BUNCH GRASSES	under .5m	HERBS: under .5m (except creepers)	SEDGES: over .5m	SEDGES: under .5m	2.0m 1.5m 1.0m .5m
COVER					

PAGA 03

1. LOCATION of the QUADRAT

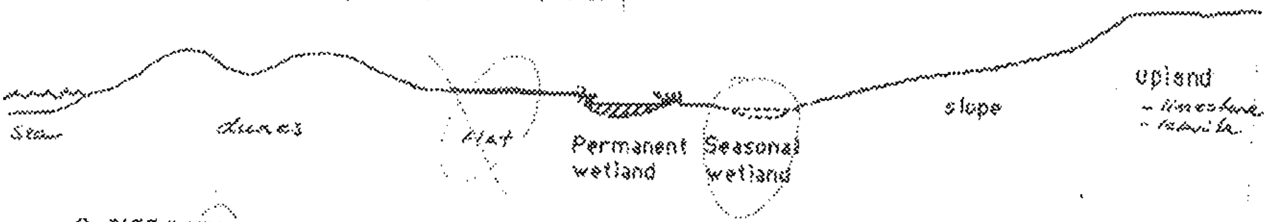
a. Mud Map Draw a sketch of the location of the quadrat :



b. Road Location	c. Latitude	Longitude
	32 27 13.5	115 42 51.9
		Altitude

d. Photograph Photographer's name ______ Photo No ______

e. Topographic position – Circle position of quadrat



2. SITE DATA – Circle the correct response

Slope (flat) gentle steep

Aspect N NE E SE S SW W NW

Surface soil ______

Sub-surface soil ______

Drainage well (mod) poor

Wet All year (Winter/spring)

Litter (% cover) ______

% Bare ground ______

4. VEGETATION CONDITION

		Comments
EXCELLENT	✓	
VERY GOOD		
GOOD		
POOR		
VERY POOR		

SPECIES PRESENCE

- work systematically through the vegetation, start with the tallest stratum, i.e. trees
- within each stratum try to record the **most common species first** and the most uncommon last.
- as each species is collected **label** it with a numbered tag and use this number on your recording sheet
- indicate if the species is in **flower**

QUADRAT No. [illegible]

Keighery and Keighery, 1990
Adapted from Griffin and Keighery, 1989
MOORE RIVER to JURIEN SANDPLAIN SURVEY. WILDFLOWER SOCIETY of WA

Trees	No	ID
[illegible]		

Mallees	No	ID

SHRUBS	No	ID
[illegible]	X	[illegible]
[illegible]		
[illegible]	X	[illegible]
[illegible]	X	[illegible]
[illegible]		
[illegible]	X	[illegible]
[illegible]	X	
[illegible]		
[illegible]		
[illegible]		

SHRUBS	No	ID
[illegible]		
[illegible]		
[illegible]		
[illegible]		X
[illegible]	X	[illegible]
[illegible]		
[illegible]	X	[illegible]
[illegible]		
[illegible]		
[illegible]		
[illegible]		
[illegible]		
[illegible]		
[illegible]	X	[illegible]
[illegible]		

Bunch Grasses	No	ID
[illegible]		

Herbs	No	ID
[illegible]		
[illegible]		
[illegible]		X
[illegible]		
[illegible]		
[illegible]		
[illegible]		
[illegible]		X

Herbs	No	ID
[illegible]		
[illegible]		
[illegible]		
[illegible]		X
[illegible]		

Sedges	No	ID
[illegible]		X
[illegible]		X
[illegible]		
[illegible]		

- SURVEY RECORDING SHEET **Please use pencil**

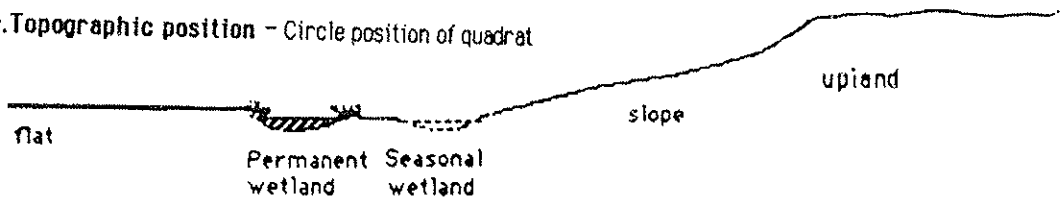
QUADRAT No. PKSF 04 **VEGETATION TYPE** Banksia - Jarrah Woodland
DATE FIRST TRIP 2/10/92 **VOLUNTEERS** NC, DL
DATE SECOND TRIP 4/11/92 **VOLUNTEERS** BJK, NG
BOTANIST NS/MC

1. LOCATION of the QUADRAT

a. Mud Map Draw a sketch of the location of the quadrat the back of this sheet →

b. Photograph Photographer's name _____

c. Topographic position – Circle position of quadrat



Keighery and Keighery, 1990
Adapted from Griffin and Keighery, 1989
MOORE RIVER to JURIEN SANDPLAIN
SURVEY. WILDFLOWER SOCIETY of WA

2. SITE DATA – Circle the correct response

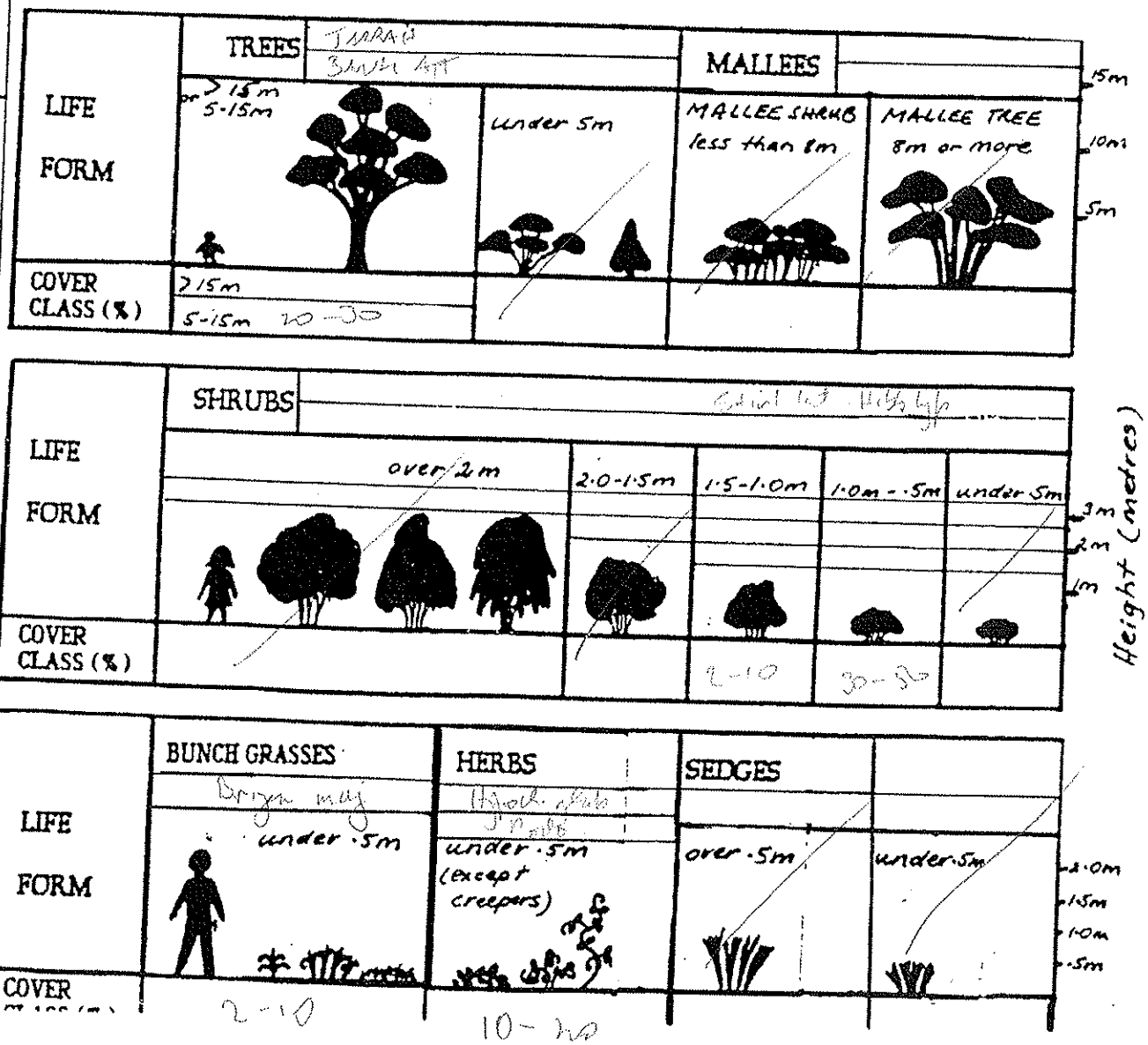
Slope flat gentle steep **Aspect** N NE E SE S SW W NW

% Bare ground____ **Drainage** well mod poor **Wet** All year winter/spring

Litter (% cover)____ **Surface soil**_____ **Sub-surface soil** _____

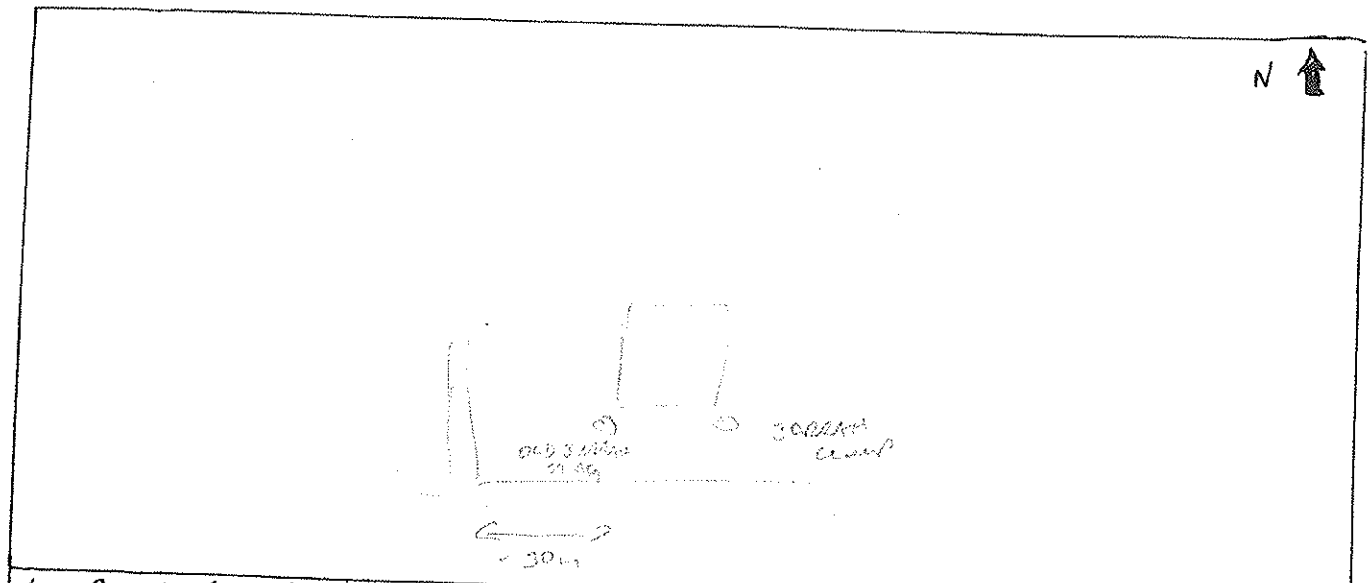
3. VEGETATION STRUCTURE AND COVER Record appropriate cover class

Cover Class – percentage classes: 0% | under 2% | 2-10% | 10-20% | 20-30% | 30-50% | 50-70% | over 70%



a. **Mud Map** Draw a sketch of the location of the quadrat :

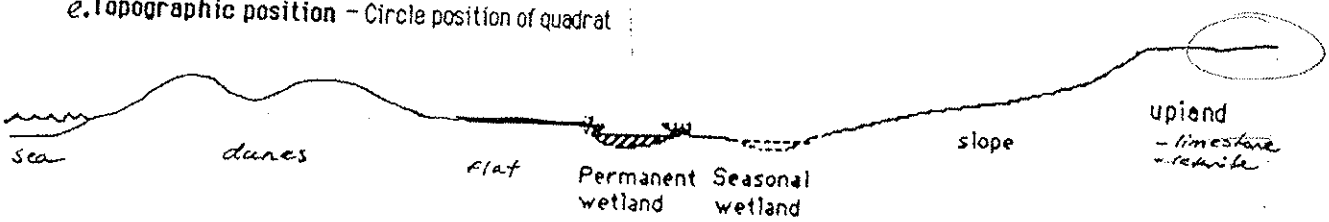
PAGA-4



b Road Location	c. Latitude	Longitude
	32 27 22.9	115 41 49.5

d. **Photograph** Photographer's name NG Photo No 34 — Altitude 30m ± 10m

e. **Topographic position** – Circle position of quadrat



2. SITE DATA – Circle the correct response

Slope flat (gentle) steep

Aspect (N) NE E SE S SW W NW

Surface soil SAND

Sub-surface soil ORANGE AT DEPTH

Drainage (well) mod poor

Wet All year winter/spring

Litter (% cover) 5%

% Bare ground 10%

4. VEGETATION CONDITION

EXCELLENT		Comments
VERY GOOD	? ✓	Few weeds
GOOD		Dominated by Nuts
POOR		
VERY POOR		

SPECIES PRESENCE

- **work systematically through the vegetation**; start with the tallest sratum, i.e. trees
- within each stratum try to record the **most common species first** and the most uncommon last.
- as each species is collected **label** it with a numbered tag and use this number on your recording sheet
- indicate if the species is in **flower**

Keighery and Keighery, 1990
Adapted from Griffin and Keighery, 1989
MOORE RIVER to JURIEN SANDPLAIN SURVEY. WILDFLOWER SOCIETY of WA

QUADRAT No.
PHGA 04

Trees

	Trees	No	ID
/	JARRAH		
/	B. ATT		
/	B. MENZ		

Mallees

SHRUBS

	SHRUBS	No	ID
/	HIBB HYP		
/	MACRO RED		
/	STIRL LAT		
/	DAVIES TRIFL		
/	GOMPH TOM		X
/	BOSS ERIO		
/	HOVEA TRIS		
/	DESMO LIN		X
/	HIBB HUME		
/	~~[illegible]~~ = [illegible]		X

SHRUBS

	SHRUBS	No	ID
	[illegible]		
X	[illegible]		
X	G [illegible]		
X	[illegible]		
/	[illegible]		
X	[illegible]		
X	[illegible]		X
X	[illegible]		
X	[illegible] ERICIFOLIA		X
X	[illegible] pallida		
X	[illegible]		
X	[illegible]		X
	G [illegible]		
	G [illegible]		
	G [illegible]		

Bunch Grasses

	Bunch Grasses	No	ID
/	* BRIZ MAJ MAX		
/	STIPA FLAV		
/	X ARIA [illegible]		
/	[illegible]		X
			X

Herbs

	Herbs	No	ID
X	SOW ARM		
X	HYLO SUR		
X	DROS BRO		
X	TRICH PILO		
X	PAMP LIN		
X	PODO GRAC		
X	* URSIN ANTH		X
X	BURCH UMB		
X	LASIN HUEG		
X	~~[illegible]~~ CURV		
X	HAEM SP		
X	CHAM CORY		
X	CONO AUL		
X	[illegible]		
X	CALA [illegible]		
X	STYL PILF		
X	PTERO aff nana	X	KH
	[illegible]		

Herbs

	Herbs	No	ID
/	DAUC GLOC		
/	* TRIF SP STERILE		X
/	LEVENH FIN		
/	LOMANDRA SP [illegible]		
/	HYBAN CALY		X
/	PTERO aff sanguineus	KH	
/	STY SCHO		
/	LOMANDRA caespitosa		KH
	[illegible]		
/	[illegible]		
/	[illegible]		
	G [illegible]		

Sedges

	Sedges	No	ID
/	LEPIDO FLEX		
/	HYPO BXEU		
/	[illegible]		

(N)

- SURVEY RECORDING SHEET Please use pencil

QUADRAT No. PARA 5 VEGETATION TYPE

DATE FIRST TRIP 2/10/92 VOLUNTEERS ML NG

DATE SECOND TRIP 4/11/94 VOLUNTEERS CDK NG

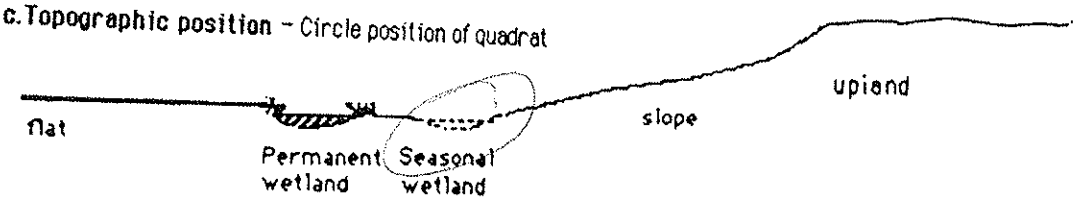
BOTANIST ML & NG.

1. LOCATION of the QUADRAT

a. Mud Map Draw a sketch of the location of the quadrat the back of this sheet →

b. Photograph Photographer's name N. GIBSON

c. Topographic position – Circle position of quadrat



Keighery and Keighery, 1990
Adapted from Griffin and Keighery, 1989
MOORE RIVER to JURIEN SANDPLAIN SURVEY. WILDFLOWER SOCIETY of WA

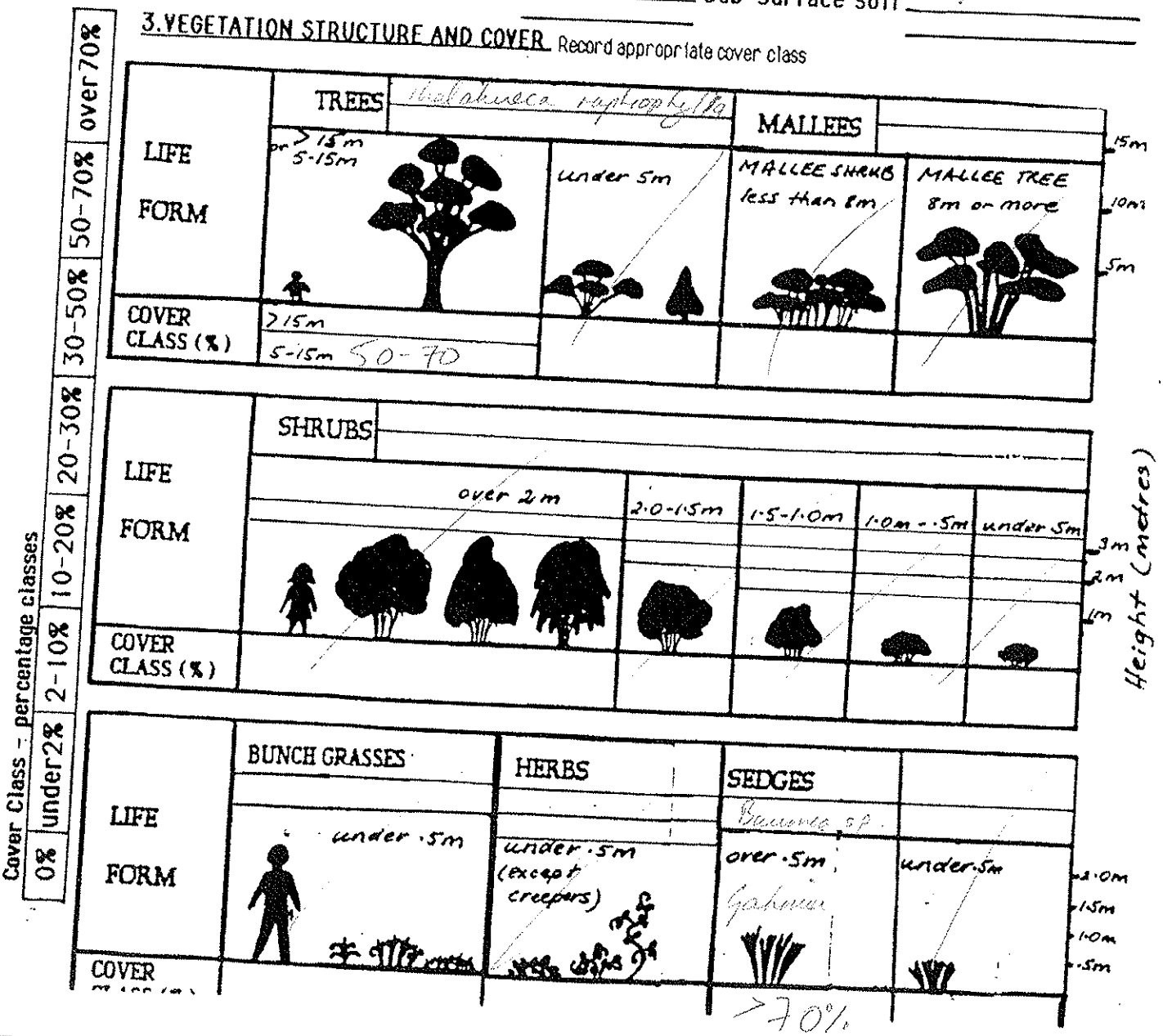
2. SITE DATA – Circle the correct response

Slope flat gentle steep Aspect N NE E SE S SW W NW

% Bare ground ? Drainage well mod poor Wet All year winter/spring

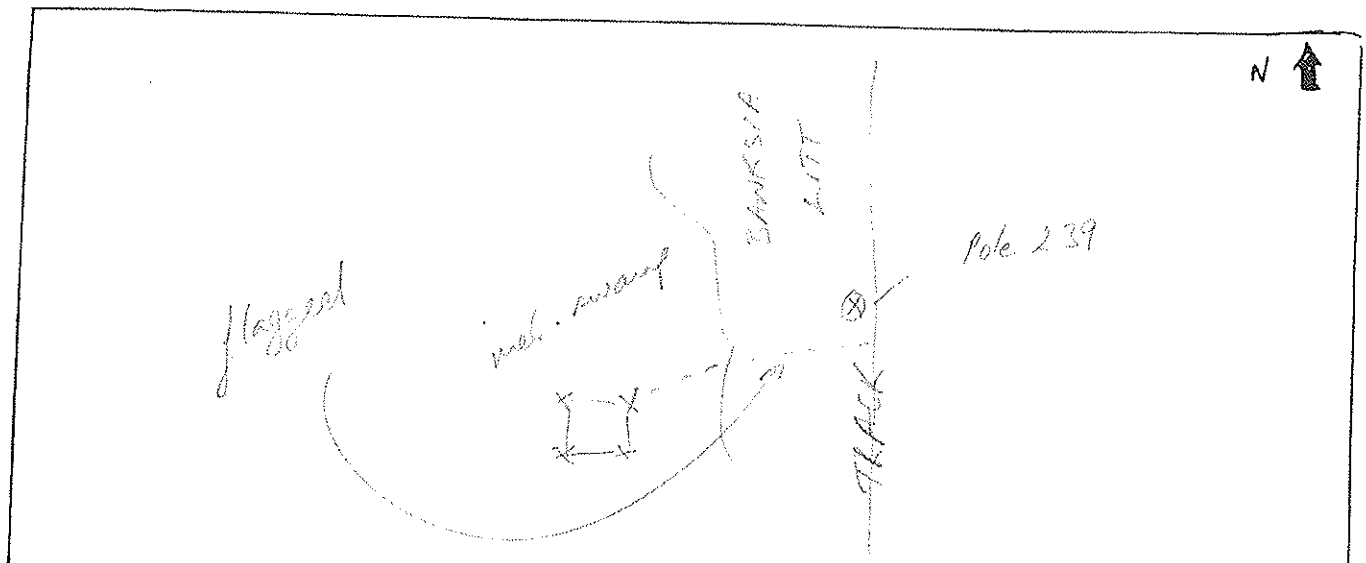
Litter (% cover) ? Surface soil ? Sub-surface soil ?

3. VEGETATION STRUCTURE AND COVER Record appropriate cover class



a. **Mud Map** Draw a sketch of the location of the quadrat :

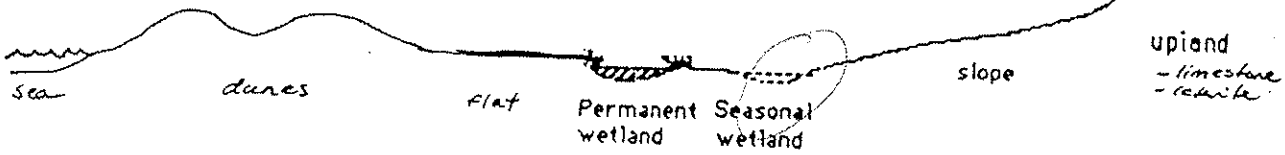
PAGA-5



b Road Location	c. Latitude	Longitude
	32 26 22.6	115 46 59.9

d. **Photograph** Photographer's name _____ Photo No 36 — Altitude 10m

e. **Topographic position** – Circle position of quadrat ± 100m



2. SITE DATA – Circle the correct response

Slope flat gentle steep

Aspect N NE E SE S SW W NW

Surface soil _____

Sub-surface soil _____

Drainage well mod poor ?

Wet All year winter/spring ?

Litter (% cover) _____

% Bare ground _____

4. VEGETATION CONDITION

		Comments
EXCELLENT		
VERY GOOD		
GOOD		
POOR		
VERY POOR		

SPECIES PRESENCE - **work systematically through the vegetation**, start with the tallest sratum, i.e. trees
- within each stratum try to record the **most common species first** and the most uncommon last.
- as each species is collected **label** it with a numbered tag and use this number on your recording sheet
- indicate if the species is in **flower**

QUADRAT No. MACA 5

2/10/92

Keighery and Keighery, 1990
Adapted from Griffin and Keighery, 1989
MOORE RIVER to JURIEN SANDPLAIN SURVEY. WILDFLOWER SOCIETY of WA

Trees

	No	ID
/ Melaleuca rhaphiophylla		

Mallees

	No	ID

SHRUBS

	No	ID
/ Acacia saligna		

SHRUBS

4/10/92

	No	ID
/ Samolus junceus		
~~Baumea articulata~~		
~~[illegible]~~		
/ Baumea juncea	X	
/ Lepidosperma longitudinale	X	

Bunch Grasses

	No	ID

Herbs

	No	ID
/ Lobelia alata		
~~Serrated leaf herb~~		
/ Myoporum caprarioides	X	X
/ Apium ?? prost	X	
/ Villarsia [illegible]	X	
/ Agrostis ?? inflorescence	X	
/ Juncus [illegible]		
/ Prasophyllum sp.	X	X

Herbs

	No	ID

Sedges

	No	ID
/ Baumea & juncea	X	
~~Baumea [illegible]~~		
/ Gahnia trifida		
Dominant		

(N)

– SURVEY RECORDING SHEET   Please use pencil

QUADRAT No. PAGA 6   **VEGETATION TYPE**
DATE FIRST TRIP 2/10/92   **VOLUNTEERS**
DATE SECOND TRIP   **VOLUNTEERS**
BOTANIST

Keighery and Keighery, 1990. Adapted from Griffin and Keighery, 1989 MOORE RIVER to JURIEN SANDPLAIN SURVEY. WILDFLOWER SOCIETY of WA

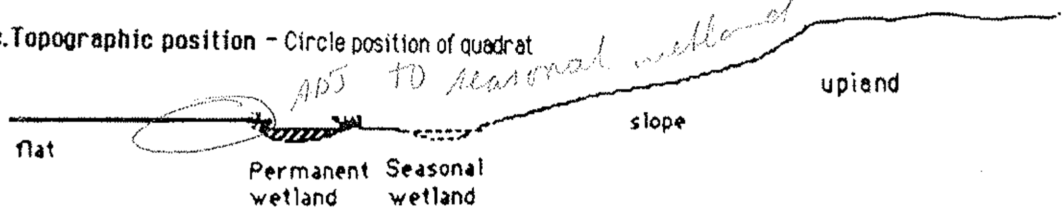
1. LOCATION of the QUADRAT

a. **Mud Map** Draw a sketch of the location of the quadrat the back of this sheet

b. **Photograph** Photographer's name N. GIBSON #1

c. **Topographic position** – Circle position of quadrat

ADJ TO seasonal wetland



2. SITE DATA – Circle the correct response

Slope (flat) gentle steep   Aspect N NE E SE S SW W NW

% Bare ground <2%   Drainage well (mod) poor   Wet All year (winter/spring) DAMP

Litter (% cover) >70%   Surface soil DARK GREY SAND   Sub-surface soil "

3. VEGETATION STRUCTURE AND COVER. Record appropriate cover class

Cover Class – percentage classes: over 70% | 50-70% | 30-50% | 20-30% | 10-20% | 2-10% | under 2% | 0%

LIFE FORM	TREES: 1) Eucalyptus gomphocephala (10m) 2) Banksia littoralis (6m)		MALLEES	
	>15m / 5-15m	under 5m	MALLEE SHRUB less than 8m	MALLEE TREE 8m or more
COVER CLASS (%)	>15m / 5-15m: (1) 30-50 / (2) 50-70%			

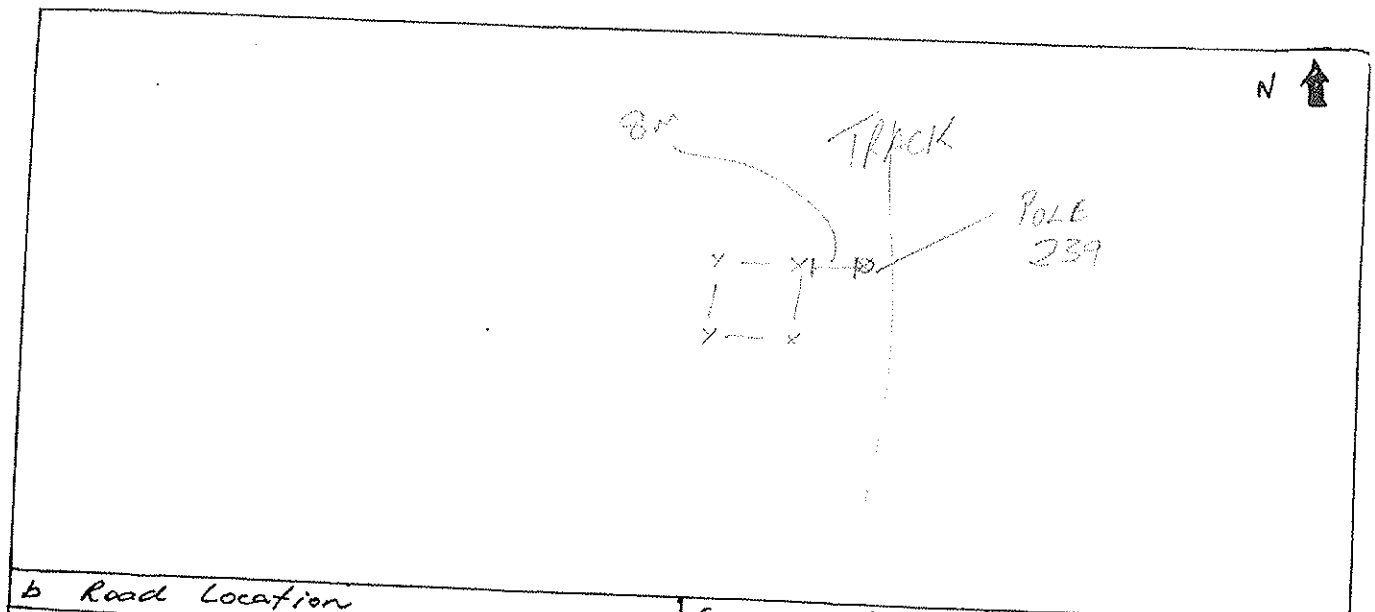
LIFE FORM	SHRUBS				
	over 2m	2.0-1.5m	1.5-1.0m	1.0m-.5m	under .5m
COVER CLASS (%)					

Height (metres): 15m, 10m, 5m, 3m, 2m, 1m, 2.0m, 1.5m, 1.0m, .5m

LIFE FORM	BUNCH GRASSES	HERBS: Opercularia vaginata	SEDGES: Lepidosperma longitudinale	
	under .5m	under .5m (except creepers)	over .5m	under .5m
COVER CLASS (%)		<2% - 10%	>70%	

a. **Mud Map** Draw a sketch of the location of the quadrat

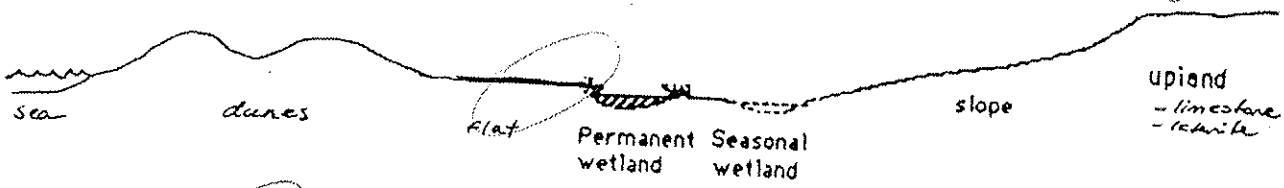
PAGA-6



b Road Location	c. Latitude	Longitude
	32 26 22.0	115 47 02.1

d. **Photograph** Photographer's name _____ Photo No _____ Altitude 10m

e. **Topographic position** – Circle position of quadrat ± 100



2. SITE DATA – Circle the correct response

Slope flat gentle steep

Aspect N NE E SE S SW W NW

Surface soil Dark grey sand

Sub-surface soil Cream Sand

Drainage well mod poor

Wet All year winter/spring

Litter (% cover) >20%

% Bare ground ~2%

4. VEGETATION CONDITION

EXCELLANT	
VERY GOOD	✓
GOOD	
POOR	
VERY POOR	

Comments

22/4/94

SPECIES PRESENCE

- **work systematically through the vegetation**; start with the tallest sratum, i.e. trees
- within each stratum try to record the **most common species first** and the most uncommon last.
- as each species is collected **label** it with a numbered tag and use this number on your recording sheet
- indicate if the species is in **flower**

QUADRAT No. 7/10/92
VAGA 6

Keighery and Keighery, 1990
Adapted from Griffin and Keighery, 1989
MOORE RIVER to JURIEN SANDPLAIN
SURVEY. WILDFLOWER SOCIETY of WA

Trees

	No	ID
/ Eucalyptus gompho		
/ Banksia attenuata		X

Mallees

SHRUBS

	No	ID
/ Myoporum capparoides		X
~~Conostylis ...~~		
/ Macrozamia riedlei		
Leucopogon propinquus		

SHRUBS

4/11/92

	No	ID
/ ~~Microlaena stipoides~~		
/ Grass = Ehrharta setigera	✓	KH
/ Eryngium pinnat		
/ ×Hypochaeris glabra		
/ Thelwa / tenuior = PAKA ∅		
/ Trachymene pilosa		
/ Stipa (?) flavescens.		X
/ Oxalis ? pernambucensis	✓	
/ Acacia? ...		

Bunch Grasses

	No	ID
/ Perth Grass =		
/ Microlaena stipoides		X

Herbs

	No	ID
/ Conostylis juncea		
/ Opercularia hispidula.		
/ Sowerbaea lax		
/ Trachymene ~~pilosa~~ coerulea		X
/ Conostylis aculeata		
/ Tribonanthes sp		
/ ~~...~~		
/ Hypocalymma ...		
/ Drosera glanduligera		
* Stellaria media		X
/ Hyalosperma ...		
/ ~~...~~		
/ Drosera erythrorhiza		
// → Caladenia latifolia		
/ Tricoryne sp (hisp.)		

= Trycomba ... X

Herbs

	No	ID
/ Podolepis ? gracilis		X

Sedges

	No	ID
~~Lepidosperma ...~~	(KH)	
= ~~Baumea ...~~		
= ~~Baumea ...~~		
/ Lepidosperma angustatum.		
→ VSH ... from PPS		VSH 4/1/93
→ Lepidosperma longitudinale		X

- SURVEY RECORDING SHEET **Please use pencil**

QUADRAT No. PAGA 7 **VEGETATION TYPE** ______

DATE FIRST TRIP 2/10/92 **VOLUNTEERS** ML NG

DATE SECOND TRIP 4/11/92 **VOLUNTEERS** BJK NG

BOTANIST NG & ML

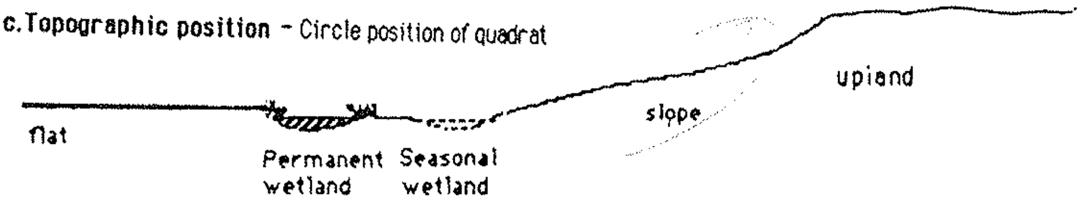
Keighery and Keighery, 1990
Adapted from Griffin and Keighery, 1989
MOORE RIVER to JURIEN SANDPLAIN SURVEY. WILDFLOWER SOCIETY of WA

1. LOCATION of the QUADRAT

a. **Mud Map** Draw a sketch of the location of the quadrat the back of this sheet ➔

b. **Photograph** Photographer's name N. GIBSON #3

c. **Topographic position** - Circle position of quadrat



2. SITE DATA - Circle the correct response

Slope flat (gentle) steep **Aspect** N NE E SE S SW (W) NW

% Bare ground____ **Drainage** well mod poor **Wet** All year winter/spring

Litter (% cover)____ **Surface soil**________ **Sub-surface soil**________

3. VEGETATION STRUCTURE AND COVER Record appropriate cover class

Cover Class - percentage classes: 0% | under 2% | 2-10% | 10-20% | 20-30% | 30-50% | 50-70% | over 70%

Height (metres): 15m, 10m, 5m

	TREES: Euc. gomphocephala (1); Banksia attenuata (2)		MALLEES	
LIFE FORM	>15m / 5-15m	under 5m	MALLEE SHRUB less than 8m	MALLEE TREE 8m or more
COVER CLASS (%)	>15m (1) 10-20%; 5-15m (2) 10-20%			

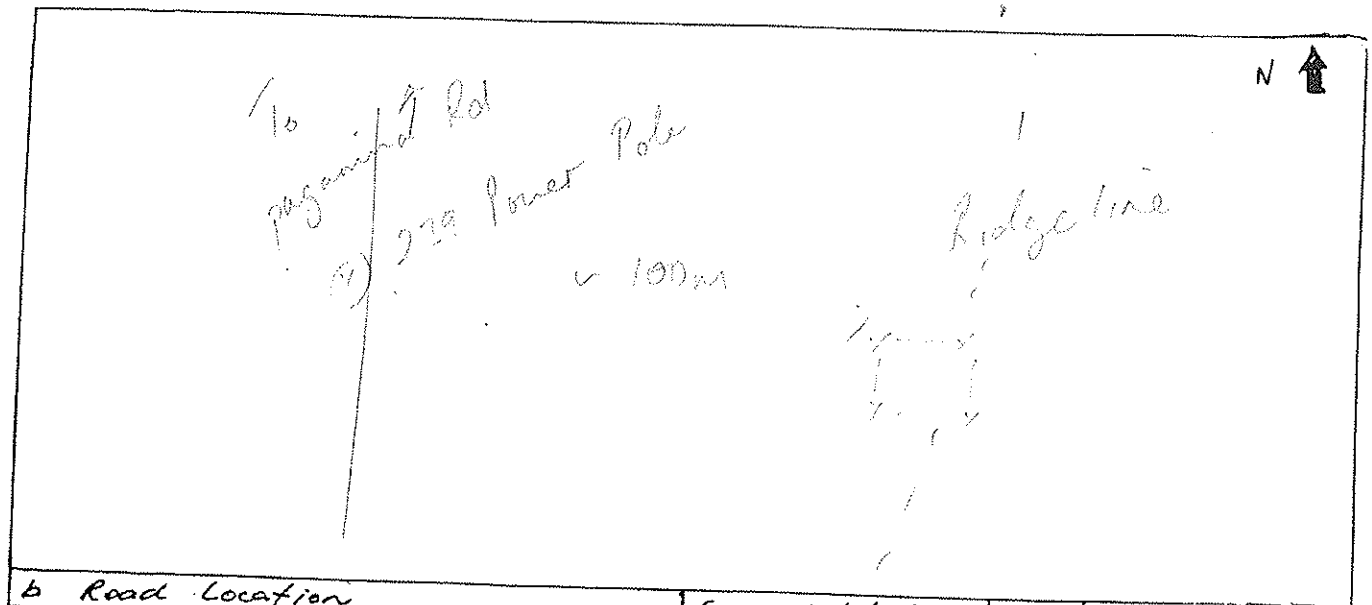
Height (metres): 3m, 2m, 1m

	SHRUBS				
LIFE FORM	over 2m	2.0-1.5m	1.5-1.0m	1.0m-.5m (Hibb hyp)	under .5m
COVER CLASS (%)				50-70%	

Height (metres): 2.0m, 1.5m, 1.0m, .5m

	BUNCH GRASSES	HERBS: Trifolium; [illegible]	SEDGES	
LIFE FORM	under .5m	under .5m (except creepers)	over .5m	under .5m
COVER CLASS (%)		30-50%		

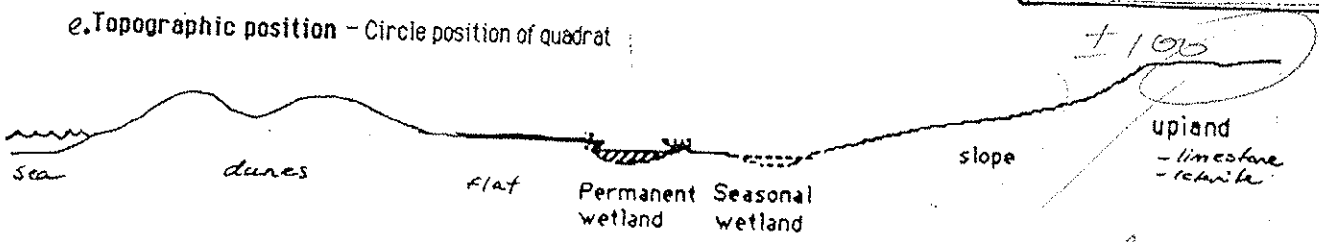
a. **Mud Map** Draw a sketch of the location of the quadrat : PAGA-7



b Road Location	c. Latitude	Longitude
	32 26 21.8	115 47 07.04

d. **Photograph** Photographer's name _____ Photo # No _____ Altitude 20m

e. **Topographic position** – Circle position of quadrat



2. SITE DATA – Circle the correct response

2° Ridge

Slope flat gentle steep

Aspect N NE E SE S SW W NW

Surface soil Orange Brown Sand

Sub-surface soil " " / " / Limestone ? at depth

Drainage well mod poor

Wet All year winter/spring

Litter (% cover) 60%

% Bare ground ± 10%

4. VEGETATION CONDITION

EXCELLANT	
VERY GOOD	(✓)
GOOD	✓
POOR	
VERY POOR	

Comments

Some erosion

Structure good.

SPECIES PRESENCE — **work systematically through the vegetation**; start with the tallest sratum, i.e. trees
- within each stratum try to record the **most common species first** and the most uncommon last.
- as each species is collected **label** it with a numbered tag and use this number on your recording sheet
- indicate if the species is in **flower**

QUADRAT No.
PAGA 7

2/10/92

Keighery and Keighery, 1990
Adapted from Griffin and Keighery, 1989
MOORE RIVER to JURIEN SANDPLAIN
SURVEY. WILDFLOWER SOCIETY of WA

Trees

Species	No	ID
/ Euc ~~[illegible]~~ gompho		
/ Banksia attenuata		
/ Allo fraseriana		
/ Banksia menziesii		

Mallees

Species	No	ID

SHRUBS

Species	No	ID
X Hibbertia hypericoides		
X Grevillea crithmifolia		X
X Acacia cochlearis		
~~[illegible]~~		
X Pimelea rosea		
X Daviesia triflora		
X Hibbertia racemosa		X
X Hovea trisperma		X
X Dryandra linea		
X Melaleuca [illegible]		
X Hardenbergia comptoniana		
X Dryandra ericoides		
? Hovea trisperma		
(Scaevola paludosa = ? Scaevola canescens)		
X Conostephium preissii		
X Astroloma pallidum		

SHRUBS

Species	No	ID
/ * Silene gallica		
X 4/11/92 ** Bromus diandrus		
X * Vulpia myuros		
X Synaphea spinulosa		X
X * Aira caryo		X
X Danthonia occidentalis		X
X * Dichelachne crinita		X
X Fat woody grass Dielsia setigera		X
/ Stylidium / ?		
/ * Trifolium campestre		
~~[illegible]~~		
X Scaevola canescens		
X Lobelia tenuior		
X Orobanche minor		
X Anigozanthos [illegible]		
X Petrophile [illegible]		

Bunch Grasses

Species	No	ID
~~* Aira~~		
X * Briza minor		
X Poa drummondii		X

Herbs

Species	No	ID
/ ~~[illegible]~~ Lomandra sericea		X
X Lomandra caespitosa		X
/ Helichrysum [illegible]		
X Lyginia [illegible]		X
X Trifolium campestre		X
X Trachymene pilosa		
X * Hypochaeris glabra		
X Podolepis gracilis		X
X Sowerbaea laxiflora		
X Caesia parviflora		X
X Xanthosia huegelii		
X Drosera [illegible]		
X Laxmannia [illegible]		
X [illegible]		X
X * Ursinia anthemoides		
X * Petrorhagia velutina		
~~[illegible]~~		
X Luzula meridionalis		

Herbs

Species	No	ID
X Drosera erythrorhiza		
X Caustis acuta		
X * Stellaria media		X
~~[illegible]~~		
X Drosera [illegible]		X
/ Chamaescilla corymbosa		
/ * [illegible]		
X Arthropodium [illegible] cap		X
X Quinetia urvillei		X
X Stylidium schoenoides		
/ Opercularia [illegible]		
X [illegible]		X

Sedges

Species	No	ID
X Loxocarya flexuosa		
X Isolepis [illegible]		X
X Lepidosperma angust.		
4/11/92		
/ Lomandra ~~[illegible]~~ (grey [illegible])		
/ Podolepis gracilis white		
X * [illegible]		
~~[illegible]~~		
/ Daucus glochidiatus		
/ Trichocline [illegible]		
/ [illegible]		

- SURVEY RECORDING SHEET **Please use pencil**

QUADRAT No. PAGA 08 **VEGETATION TYPE** Marri on B[illegible]

DATE FIRST TRIP 2/10/92 **VOLUNTEERS** NG [illegible]

DATE SECOND TRIP 4/11/92 **VOLUNTEERS** BJK NG

BOTANIST [illegible]

Keighery and Keighery, 1990
Adapted from Griffin and Keighery, 1989
MOORE RIVER to JURIEN SANDPLAIN
SURVEY. WILDFLOWER SOCIETY of WA

1. LOCATION of the QUADRAT

a. Mud Map Draw a sketch of the location of the quadrat the back of this sheet

b. Photograph Photographer's name ____________

c. Topographic position – Circle position of quadrat

flat — Permanent wetland — Seasonal wetland — slope — upland

2. SITE DATA – Circle the correct response

Slope flat gentle steep **Aspect** N NE E SE S SW W NW

% Bare ground ____ **Drainage** well mod poor **Wet** All year winter/spring

Litter (% cover) ____ **Surface soil** ____________ **Sub-surface soil** ____________

3. VEGETATION STRUCTURE AND COVER Record appropriate cover class

Cover Class – percentage classes: 0% | under 2% | 2-10% | 10-20% | 20-30% | 30-50% | 50-70% | over 70%

	TREES: Marri		MALLEES	
LIFE FORM	>15m / 5-15m	under 5m	MALLEE SHRUB less than 8m	MALLEE TREE 8m or more
COVER CLASS (%)	>15m Marri 10-20; 5-15m B[illegible] 1-10			

Height: 15m, 10m, 5m

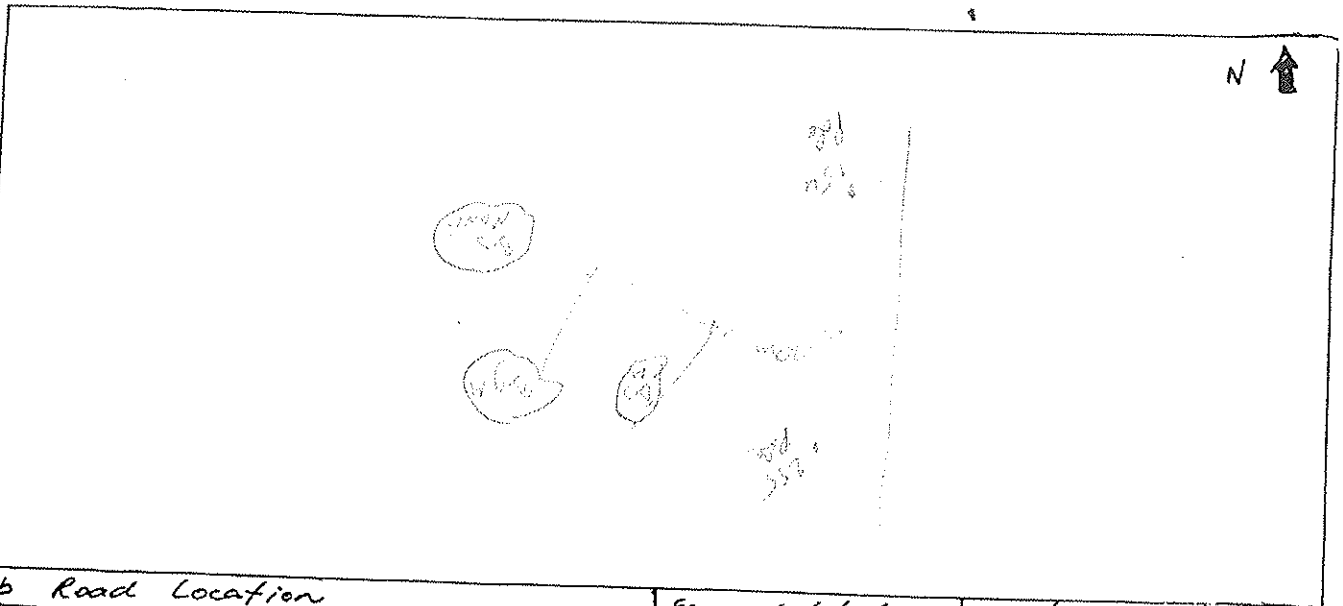
	SHRUBS: (1) [illegible] (2) [illegible] (3) [illegible]				
LIFE FORM	over 2m	2.0-1.5m	1.5-1.0m	1.0m-.5m	under .5m
COVER CLASS (%)			30-50		

Height (metres): 3m, 2m, 1m

	BUNCH GRASSES: [illegible]	HERBS: [illegible]	SEDGES	
LIFE FORM	under .5m	under .5m (except creepers)	over .5m	under .5m
COVER CLASS (%)	10-30	10-20		

Height: 2.0m, 1.5m, 1.0m, .5m

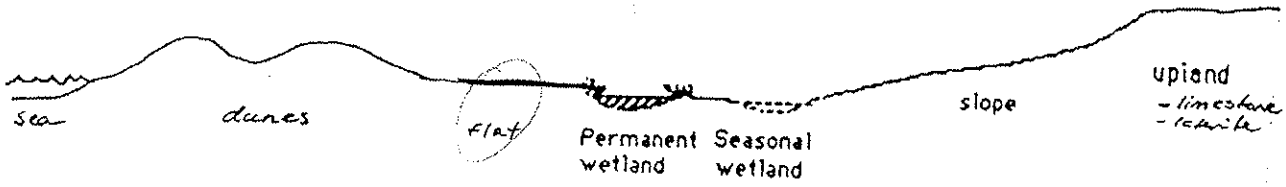
a. **Mud Map** Draw a sketch of the location of the quadrat : PAGA-8



b Road Location	c. Latitude	Longitude
	32 25 10.1	115 46 56.8

d. **Photograph** Photographer's name _____ Photo No _____ Altitude 10 m ± 100

e. **Topographic position** – Circle position of quadrat



2. SITE DATA – Circle the correct response

Slope flat gentle steep

Aspect N NE E SE S SW W NW

Surface soil Red-Br sand

Sub-surface soil Red-Br Sand

Drainage well mod poor

Wet All year winter/spring

Litter (% cover) 50

% Bare ground 10

4. VEGETATION CONDITION

		Comments
EXCELLANT		Lots of weeds
VERY GOOD		
GOOD		
POOR		
VERY POOR		

SPECIES PRESENCE

- **work systematically through the vegetation**; start with the tallest sratum, i.e. trees
- within each stratum try to record the **most common species first** and the most uncommon last.
- as each species is collected **label** it with a numbered tag and use this number on your recording sheet
- indicate if the species is in **flower**

Keighery and Keighery, 1990
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MOORE RIVER to JURIEN SANDPLAIN
SURVEY. WILDFLOWER SOCIETY of WA

QUADRAT No.
PASA 05

Trees

	Trees	No	ID
/	[illegible]		
/	[illegible]		

Mallees

SHRUBS

	SHRUBS	No	ID
/	[illegible]		
/	[illegible]		
/	[illegible]		
/	[illegible]		
/	[illegible]		
/	BOSS [illegible]		
/	~~[illegible]~~		
/	[illegible]		
/	[illegible]		X

SHRUBS

4/11/92

	SHRUBS	No	ID
/	* [illegible] myuros.		RH
/	* Dichelachne crinita	X	
/	* Bromus diandrus		X
/	* Stick weed = Conyza sp	✓	RH
/	[illegible]		
/	[illegible]		
/	Cerastium glom		
/	[illegible]		
/	[illegible]		
/	Astroloma pallida		X
/	Acanthocarpus preiss		
/	Eryngium [illegible]		
/	Poa porphyroclados		

Bunch Grasses

	Bunch Grasses	No	ID
/	* BRIZA MAX		X
	~~[illegible]~~		
/	* [illegible] CALY		
/	* BRIZA MINOR		X
/	~~[illegible]~~ = Vulpia brom		RH

Herbs

	Herbs	No	ID
X	[illegible] CAPILLARIS		
X	[illegible]		
X	[illegible]		
X	* TRIFOL (PASA 07) STERILE	(WHITE)	
X	[illegible]		
X	* URSIN ANTH		
X	PELARGON SP? FWR = MOLLE	RH	✓
X	* PETROR VEL		
X	* Stellaria media		X
X	[illegible]	RH	X
X	[illegible]		
X	* [illegible]		
X	[illegible]		
X	[illegible]		
X	[illegible] SP [illegible]		
X	~~[illegible]~~	=	
X	PELARGON SP? [illegible]		
	[illegible]	RH	

= LITTORALIS ?

Herbs

	Herbs	No	ID
X	* ARCTOTHECA CALENDULA		X
X	CARDAMINE PAUC?		X
/	[illegible]		
X	[illegible]		
/	HELIO PUS		
X	MELILOTUS INDICA		X
	~~[illegible]~~		
X	CONYZA SP (STERILE)		
X	Cerastium [illegible]		X

Sedges

	Sedges	No	ID
X	[illegible]		
X	[illegible]		
X	[illegible]		
X	[illegible]		
	* Erodium botrys X		

Plotorsource	Family	N	Genus	Species	InfraspRank	InfraspName	Informal	ConsvCode
PAGA-7	Mimosaceae		Acacia	cochlearis				
PAGA-8	Mimosaceae		Acacia	pulchella				
PAGA-1	Mimosaceae		Acacia	saligna				
PAGA-2	Mimosaceae		Acacia	saligna				
PAGA-3	Mimosaceae		Acacia	saligna				
PAGA-5	Mimosaceae		Acacia	saligna				
PAGA-3	Mimosaceae		Acacia	stenoptera				
PAGA-6	Mimosaceae		Acacia	willdenowiana				
PAGA-8	Dasypogonaceae		Acanthocarpus	preissii				
PAGA-1	Poaceae	*	Aira	caryophyllea				
PAGA-4	Poaceae	*	Aira	caryophyllea				
PAGA-7	Poaceae	*	Aira	caryophyllea				
PAGA-7	Casuarinaceae		Allocasuarina	fraseriana				
PAGA-7	Primulaceae	*	Anagallis	arvensis				
PAGA-8	Primulaceae	*	Anagallis	arvensis				
PAGA-4	Haemodoraceae		Anigozanthos	humilis	subsp.	humilis		
PAGA-1	Centrolepidaceae		Aphelia	cyperoides				
PAGA-5	Apiaceae		Apium	prostratum	var.	prostratum		
PAGA-8	Asteraceae	*	Arctotheca	calendula				
PAGA-4	Epacridaceae		Astroloma	pallidum				
PAGA-7	Epacridaceae		Astroloma	pallidum				
PAGA-8	Epacridaceae		Astroloma	pallidum				
PAGA-4	Poaceae		Austrodanthonia	occidentalis				
PAGA-7	Poaceae		Austrodanthonia	occidentalis				
PAGA-4	Poaceae		Austrostipa	flavescens				
PAGA-6	Poaceae		Austrostipa	flavescens				
PAGA-4	Proteaceae		Banksia	attenuata				
PAGA-7	Proteaceae		Banksia	attenuata				
PAGA-8	Proteaceae		Banksia	grandis				
PAGA-6	Proteaceae		Banksia	littoralis				
PAGA-4	Proteaceae		Banksia	menziesii				
PAGA-7	Proteaceae		Banksia	menziesii				
PAGA-2	Cyperaceae		Baumea	juncea				
PAGA-5	Cyperaceae		Baumea	juncea				
PAGA-8	Cyperaceae		Baumea	juncea				
PAGA-5	Cyperaceae		Baumea	vaginalis				
PAGA-4	Papilionaceae		Bossiaea	eriocarpa				
PAGA-7	Papilionaceae		Bossiaea	eriocarpa				
PAGA-8	Papilionaceae		Bossiaea	eriocarpa				
PAGA-4	Epacridaceae		Brachyloma	preissii				
PAGA-1	Asteraceae		Brachyscome	iberidifolia				
PAGA-1	Poaceae	*	Briza	maxima				
PAGA-4	Poaceae	*	Briza	maxima				
PAGA-7	Poaceae	*	Briza	maxima				
PAGA-8	Poaceae	*	Briza	maxima				
PAGA-1	Poaceae	*	Briza	minor				
PAGA-3	Poaceae	*	Briza	minor				
PAGA-7	Poaceae	*	Briza	minor				
PAGA-8	Poaceae	*	Briza	minor				
PAGA-7	Poaceae	*	Bromus	diandrus				
PAGA-8	Poaceae	*	Bromus	diandrus				
PAGA-4	Colchicaceae		Burchardia	congesta				
PAGA-1	Colchicaceae		Burchardia	multiflora				
PAGA-1	Anthericaceae		Caesia	micrantha				
PAGA-4	Anthericaceae		Caesia	micrantha				
PAGA-7	Anthericaceae		Caesia	micrantha				
PAGA-8	Anthericaceae		Caesia	micrantha				
PAGA-4	Orchidaceae		Caladenia	flava	subsp.	flava		
PAGA-3	Orchidaceae		Caladenia	latifolia				
PAGA-6	Orchidaceae		Caladenia	latifolia				
PAGA-8	Orchidaceae		Caladenia	latifolia				
PAGA-8	Orchidaceae		Caladenia	longicauda	subsp.	calcigena		
PAGA-2	Lauraceae		Cassytha	racemosa				
PAGA-1	Centrolepidaceae		Centrolepis	alepyroides				
PAGA-1	Centrolepidaceae		Centrolepis	aristata				
PAGA-8	Caryophyllaceae	*	Cerastium	glomeratum				
PAGA-1	Anthericaceae		Chamaescilla	corymbosa	var.	corymbosa		
PAGA-3	Anthericaceae		Chamaescilla	corymbosa	var.	corymbosa		

Plotorsource	Family	N	Genus	Species	InfraspRank	InfraspName	Informal	ConsvCode
PAGA-4	Anthericaceae		Chamaescilla	corymbosa	var.	corymbosa		
PAGA-7	Anthericaceae		Chamaescilla	corymbosa	var.	corymbosa		
PAGA-8	Anthericaceae		Chamaescilla	corymbosa	var.	corymbosa		
PAGA-4	Epacridaceae		Conostephium	preissii				
PAGA-7	Epacridaceae		Conostephium	preissii				
PAGA-4	Haemodoraceae		Conostylis	aculeata				
PAGA-6	Haemodoraceae		Conostylis	aculeata				
PAGA-7	Haemodoraceae		Conostylis	aculeata				
PAGA-8	Haemodoraceae		Conostylis	aculeata				
PAGA-6	Haemodoraceae		Conostylis	juncea				
PAGA-8	Asteraceae	*	Conyza	sumatrensis				
PAGA-8	Crassulaceae		Crassula	colorata	var.	colorata		
PAGA-1	Cyperaceae		Cyathochaeta	avenacea				
PAGA-1	Goodeniaceae		Dampiera	linearis				
PAGA-4	Goodeniaceae		Dampiera	linearis				
PAGA-4	Apiaceae		Daucus	glochidiatus				
PAGA-6	Apiaceae		Daucus	glochidiatus				
PAGA-7	Apiaceae		Daucus	glochidiatus				
PAGA-8	Apiaceae		Daucus	glochidiatus				
PAGA-4	Papilionaceae		Daviesia	triflora				
PAGA-7	Papilionaceae		Daviesia	triflora				
PAGA-4	Restionaceae		Desmocladus	fasciculatus				
PAGA-7	Restionaceae		Desmocladus	fasciculatus				
PAGA-8	Restionaceae		Desmocladus	fasciculatus				
PAGA-7	Poaceae		Dichelachne	crinita				
PAGA-8	Poaceae		Dichelachne	crinita				
PAGA-7	Anthericaceae		Dichopogon	capillipes				
PAGA-8	Anthericaceae		Dichopogon	capillipes				
PAGA-3	Papilionaceae		Dillwynia	dillwynioides				P3
PAGA-4	Droseraceae		Drosera	erythrorhiza	subsp.	erythrorhiza		
PAGA-6	Droseraceae		Drosera	erythrorhiza	subsp.	erythrorhiza		
PAGA-7	Droseraceae		Drosera	erythrorhiza	subsp.	erythrorhiza		
PAGA-8	Droseraceae		Drosera	erythrorhiza	subsp.	erythrorhiza		
PAGA-1	Droseraceae		Drosera	gigantea	subsp.	gigantea		
PAGA-1	Droseraceae		Drosera	glanduligera				
PAGA-4	Droseraceae		Drosera	menziesii	subsp.	penicillaris		
PAGA-7	Droseraceae		Drosera	menziesii	subsp.	penicillaris		
PAGA-1	Droseraceae		Drosera	neesii	subsp.	neesii		
PAGA-3	Droseraceae		Drosera	nitidula	subsp.	nitidula		
PAGA-7	Droseraceae		Drosera	pallida				
PAGA-7	Proteaceae		Dryandra	lindleyana				
PAGA-8	Poaceae	*	Ehrharta	calycina				
PAGA-8	Onagraceae		Epilobium	hirtigerum				
PAGA-8	Geraniaceae	*	Erodium	botrys				
PAGA-6	Apiaceae		Eryngium	pinnatifidum	subsp.	pinnatifidum	MS	
PAGA-7	Apiaceae		Eryngium	pinnatifidum	subsp.	pinnatifidum	MS	
PAGA-8	Apiaceae		Eryngium	pinnatifidum	subsp.	pinnatifidum	MS	
PAGA-8	Myrtaceae		Eucalyptus	calophylla				
PAGA-6	Myrtaceae		Eucalyptus	gomphocephala	var.	gomphocephala		
PAGA-7	Myrtaceae		Eucalyptus	gomphocephala	var.	gomphocephala		
PAGA-8	Myrtaceae		Eucalyptus	gomphocephala	var.	gomphocephala		
PAGA-4	Myrtaceae		Eucalyptus	marginata	subsp.	marginata		
PAGA-1	Myrtaceae		Eucalyptus	rudis	subsp.	rudis		
PAGA-2	Myrtaceae		Eucalyptus	rudis	subsp.	rudis		
PAGA-3	Myrtaceae		Eucalyptus	rudis	subsp.	rudis		
PAGA-1	Papilionaceae		Eutaxia	virgata				
PAGA-3	Papilionaceae		Eutaxia	virgata				
PAGA-5	Cyperaceae		Gahnia	trifida				
PAGA-8	Geraniaceae	*	Geranium	molle				
PAGA-4	Papilionaceae		Gompholobium	tomentosum				
PAGA-7	Papilionaceae		Gompholobium	tomentosum				
PAGA-1	Goodeniaceae		Goodenia	pulchella				
PAGA-3	Goodeniaceae		Goodenia	pulchella				
PAGA-7	Proteaceae		Grevillea	crithmifolia				
PAGA-1	Haemodoraceae		Haemodorum	laxum				
PAGA-1	Proteaceae		Hakea	varia				
PAGA-2	Proteaceae		Hakea	varia				
PAGA-3	Proteaceae		Hakea	varia				

Plotorsource	Family	N	Genus	Species	InfraspRank	InfraspName	Informal	ConsvCode
PAGA-7	Papilionaceae		Hardenbergia	comptoniana				
PAGA-7	Brassicaceae	*	Heliophila	pusilla				
PAGA-8	Brassicaceae	*	Heliophila	pusilla				
PAGA-4	Dilleniaceae		Hibbertia	hypericoides				
PAGA-7	Dilleniaceae		Hibbertia	hypericoides				
PAGA-8	Dilleniaceae		Hibbertia	hypericoides				
PAGA-4	Dilleniaceae		Hibbertia	racemosa				
PAGA-7	Dilleniaceae		Hibbertia	racemosa				
PAGA-8	Dilleniaceae		Hibbertia	racemosa				
PAGA-1	Dilleniaceae		Hibbertia	stellaris				
PAGA-3	Dilleniaceae		Hibbertia	stellaris				
PAGA-6	Poaceae	*	Holcus	setiger				
PAGA-7	Poaceae	*	Holcus	setiger				
PAGA-8	Apiaceae		Homalosciadium	homalocarpum				
PAGA-1	Papilionaceae		Hovea	trisperma	var.	trisperma		
PAGA-4	Papilionaceae		Hovea	trisperma	var.	trisperma		
PAGA-7	Papilionaceae		Hovea	trisperma	var.	trisperma		
PAGA-4	Violaceae		Hybanthus	calycinus				
PAGA-7	Violaceae		Hybanthus	calycinus				
PAGA-1	Apiaceae		Hydrocotyle	diantha				
PAGA-1	Asteraceae	*	Hypochaeris	glabra				
PAGA-3	Asteraceae	*	Hypochaeris	glabra				
PAGA-4	Asteraceae	*	Hypochaeris	glabra				
PAGA-6	Asteraceae	*	Hypochaeris	glabra				
PAGA-7	Asteraceae	*	Hypochaeris	glabra				
PAGA-8	Asteraceae	*	Hypochaeris	glabra				
PAGA-1	Restionaceae		Hypolaena	exsulca				
PAGA-3	Restionaceae		Hypolaena	exsulca				
PAGA-4	Restionaceae		Hypolaena	exsulca				
PAGA-1	Restionaceae		Hypolaena	pubescens				
PAGA-7	Cyperaceae	*	Isolepis	marginata				
PAGA-4	Papilionaceae		Isotropis	cuneifolia	subsp.	cuneifolia		
PAGA-7	Papilionaceae		Isotropis	cuneifolia	subsp.	cuneifolia		
PAGA-3	Papilionaceae		Jacksonia	furcellata				
PAGA-1	Juncaceae	*	Juncus	bufonius				
PAGA-2	Juncaceae		Juncus	pallidus				
PAGA-1	Myrtaceae		Kunzea	glabrescens				
PAGA-4	Asteraceae		Lagenophora	huegelii				
PAGA-6	Asteraceae		Lagenophora	huegelii				
PAGA-7	Asteraceae		Lagenophora	huegelii				
PAGA-8	Asteraceae		Lagenophora	huegelii				
PAGA-3	Goodeniaceae		Lechenaultia	expansa				
PAGA-3	Cyperaceae		Lepidosperma	longitudinale				
PAGA-5	Cyperaceae		Lepidosperma	longitudinale				
PAGA-6	Cyperaceae		Lepidosperma	longitudinale				
PAGA-4	Cyperaceae		Lepidosperma	squamatum				
PAGA-6	Cyperaceae		Lepidosperma	squamatum				
PAGA-7	Cyperaceae		Lepidosperma	squamatum				
PAGA-8	Cyperaceae		Lepidosperma	squamatum				
PAGA-4	Orchidaceae		Leporella	fimbriata				
PAGA-2	Restionaceae		Lepyrodia	glauca				
PAGA-2	Restionaceae		Lepyrodia	muirii				
PAGA-6	Epacridaceae		Leucopogon	propinquus				
PAGA-8	Epacridaceae		Leucopogon	propinquus				
PAGA-1	Stylidiaceae		Levenhookia	stipitata				
PAGA-4	Stylidiaceae		Levenhookia	stipitata				
PAGA-5	Lobeliaceae		Lobelia	alata				
PAGA-4	Lobeliaceae		Lobelia	tenuior				
PAGA-6	Lobeliaceae		Lobelia	tenuior				
PAGA-7	Lobeliaceae		Lobelia	tenuior				
PAGA-3	Dasypogonaceae		Lomandra	caespitosa				
PAGA-4	Dasypogonaceae		Lomandra	caespitosa				
PAGA-7	Dasypogonaceae		Lomandra	caespitosa				
PAGA-8	Dasypogonaceae		Lomandra	caespitosa				
PAGA-4	Dasypogonaceae		Lomandra	hermaphrodita				
PAGA-4	Dasypogonaceae		Lomandra	sericea				
PAGA-7	Dasypogonaceae		Lomandra	sericea				
PAGA-7	Dasypogonaceae		Lomandra	suaveolens				

Plotorsource	Family	N	Genus	Species	InfraspRank	InfraspName	Informal	ConsvCode
PAGA-7	Juncaceae		Luzula	meridionalis				
PAGA-1	Restionaceae		Lyginia	barbata				
PAGA-4	Zamiaceae		Macrozamia	riedlei				
PAGA-6	Zamiaceae		Macrozamia	riedlei				
PAGA-7	Zamiaceae		Macrozamia	riedlei				
PAGA-8	Zamiaceae		Macrozamia	riedlei				
PAGA-2	Restionaceae		Meeboldina	roycei			MS	
PAGA-3	Restionaceae		Meeboldina	roycei			MS	
PAGA-3	Myrtaceae		Melaleuca	preissiana				
PAGA-2	Myrtaceae		Melaleuca	rhaphiophylla				
PAGA-5	Myrtaceae		Melaleuca	rhaphiophylla				
PAGA-1	Cyperaceae		Mesomelaena	tetragona				
PAGA-6	Poaceae		Microlaena	stipoides				
PAGA-2	Orchidaceae		Microtis	media				
PAGA-3	Orchidaceae		Microtis	media				
PAGA-8	Asteraceae		Millotia	myosotidifolia				
PAGA-5	Myoporaceae		Myoporum	caprarioides				
PAGA-6	Myoporaceae		Myoporum	caprarioides				
PAGA-1	Papilionaceae		Nemcia	capitata				
PAGA-1	Papilionaceae		Nemcia	reticulata				
PAGA-1	Loranthaceae		Nuytsia	floribunda				
PAGA-6	Rubiaceae		Opercularia	hispidula				
PAGA-7	Rubiaceae		Opercularia	vaginata				
PAGA-7	Orobanchaceae	*	Orobanche	minor				
PAGA-6	Oxalidaceae		Oxalis	perennans				
PAGA-8	Oxalidaceae		Oxalis	perennans				
PAGA-1	Iridaceae		Patersonia	occidentalis				
PAGA-3	Iridaceae		Patersonia	occidentalis				
PAGA-8	Geraniaceae		Pelargonium	littorale	subsp.	littorale		
PAGA-1	Myrtaceae		Pericalymma	ellipticum	var.	floridum		
PAGA-3	Myrtaceae		Pericalymma	ellipticum	var.	floridum		
PAGA-4	Proteaceae		Petrophile	linearis				
PAGA-7	Caryophyllaceae	*	Petrorhagia	dubia				
PAGA-8	Caryophyllaceae	*	Petrorhagia	dubia				
PAGA-8	Euphorbiaceae		Phyllanthus	calycinus				
PAGA-1	Lycopodiaceae		Phylloglossum	drummondii				
PAGA-7	Thymelaeaceae		Pimelea	rosea	subsp.	rosea		
PAGA-8	Thymelaeaceae		Pimelea	rosea	subsp.	rosea		
PAGA-2	Poaceae	*	Poa	annua				
PAGA-7	Poaceae		Poa	drummondiana				
PAGA-8	Poaceae		Poa	poiformis				
PAGA-4	Asteraceae		Podolepis	gracilis				
PAGA-7	Asteraceae		Podolepis	gracilis				
PAGA-3	Asteraceae		Podolepis	gracilis (Swamp form) (GJ Keighery 13126)				
PAGA-7	Asteraceae		Podolepis	gracilis (Swamp form) (GJ Keighery 13126)				
PAGA-4	Asteraceae		Podotheca	chrysantha				
PAGA-1	Orchidaceae		Prasophyllum	brownii				
PAGA-4	Orchidaceae		Pterostylis	sanguinea				
PAGA-2	Orchidaceae		Pterostylis	sp.cauline leaves(N.Gibson & M.N.Lyons 1490)			PN	
PAGA-3	Orchidaceae		Pterostylis	sp.Slender Snail Orchid(G.J.Keighery 14516)			PN	
PAGA-4	Orchidaceae		Pterostylis	sp.Slender Snail Orchid(G.J.Keighery 14516)			PN	
PAGA-8	Orchidaceae		Pterostylis	sp.Slender Snail Orchid(G.J.Keighery 14516)			PN	
PAGA-6	Orchidaceae		Pyrorchis	nigricans				
PAGA-1	Asteraceae		Quinetia	urvillei				
PAGA-4	Asteraceae		Quinetia	urvillei				
PAGA-7	Asteraceae		Quinetia	urvillei				
PAGA-5	Primulaceae		Samolus	junceus				
PAGA-7	Goodeniaceae		Scaevola	canescens				
PAGA-1	Cyperaceae		Schoenus	brevisetis				
PAGA-3	Cyperaceae		Schoenus	efoliatus				
PAGA-1	Cyperaceae		Schoenus	odontocarpus				
PAGA-1	Selaginellaceae		Selaginella	gracillima				
PAGA-3	Selaginellaceae		Selaginella	gracillima				
PAGA-7	Caryophyllaceae	*	Silene	gallica				
PAGA-1	Asteraceae		Siloxerus	humifusus				
PAGA-3	Asteraceae		Siloxerus	humifusus				
PAGA-1	Asteraceae		Siloxerus	multiflorus				
PAGA-5	Asteraceae	*	Sonchus	oleraceus				

Plotorsource	Family	N	Genus	Species	InfraspRank	InfraspName	Informal	ConsvCode
PAGA-7	Asteraceae	*	Sonchus	oleraceus				
PAGA-4	Anthericaceae		Sowerbaea	laxiflora				
PAGA-6	Anthericaceae		Sowerbaea	laxiflora				
PAGA-7	Anthericaceae		Sowerbaea	laxiflora				
PAGA-1	Stackhousiaceae		Stackhousia	monogyna				
PAGA-4	Stackhousiaceae		Stackhousia	monogyna				
PAGA-6	Caryophyllaceae	*	Stellaria	media				
PAGA-7	Caryophyllaceae	*	Stellaria	media				
PAGA-8	Caryophyllaceae	*	Stellaria	media				
PAGA-4	Proteaceae		Stirlingia	latifolia				
PAGA-1	Stylidiaceae		Stylidium	brunonianum	subsp.	brunonianum		
PAGA-4	Stylidiaceae		Stylidium	brunonianum	subsp.	brunonianum		
PAGA-1	Stylidiaceae		Stylidium	calcaratum				
PAGA-3	Stylidiaceae		Stylidium	dichotomum				
PAGA-4	Stylidiaceae		Stylidium	piliferum	subsp.	piliferum		
PAGA-7	Stylidiaceae		Stylidium	piliferum	subsp.	piliferum		
PAGA-3	Stylidiaceae		Stylidium	repens				
PAGA-4	Stylidiaceae		Stylidium	schoenoides				
PAGA-7	Stylidiaceae		Stylidium	schoenoides				
PAGA-2	Asteraceae	*	Symphyotrichum	subulatum				
PAGA-7	Proteaceae		Synaphea	spinulosa	subsp.	spinulosa		
PAGA-1	Orchidaceae		Thelymitra	aff. pauciflora scps				
PAGA-1	Orchidaceae		Thelymitra	antennifera				
PAGA-1	Orchidaceae		Thelymitra	benthamiana				
PAGA-3	Orchidaceae		Thelymitra	flexuosa				
PAGA-6	Anthericaceae		Thysanotus	arenarius				
PAGA-1	Anthericaceae		Thysanotus	multiflorus				
PAGA-6	Apiaceae		Trachymene	coerulea	subsp.	coerulea		
PAGA-4	Apiaceae		Trachymene	pilosa				
PAGA-6	Apiaceae		Trachymene	pilosa				
PAGA-7	Apiaceae		Trachymene	pilosa				
PAGA-1	Haemodoraceae		Tribonanthes	australis				
PAGA-8	Papilionaceae	*	Trifolium	arvense	var.	arvense		
PAGA-7	Papilionaceae	*	Trifolium	campestre	var.	campestre		
PAGA-8	Papilionaceae	*	Trifolium	campestre	var.	campestre		
PAGA-2	Juncaginaceae		Triglochin	linearis				
PAGA-4	Asteraceae	*	Ursinia	anthemoides				
PAGA-7	Asteraceae	*	Ursinia	anthemoides				
PAGA-8	Asteraceae	*	Ursinia	anthemoides				
PAGA-5	Menyanthaceae		Villarsia	albiflora				
PAGA-8	Poaceae	*	Vulpia	bromoides				
PAGA-1	Poaceae	*	Vulpia	myuros				
PAGA-7	Poaceae	*	Vulpia	myuros				
PAGA-8	Poaceae	*	Vulpia	myuros				
PAGA-1	Poaceae	*	Vulpia	sp. scps				
PAGA-4	Poaceae	*	Vulpia	sp. scps				
PAGA-7	Apiaceae		Xanthosia	huegelii	subsp.	huegelii	MS	

Plotorsource	Family	N	Genus	Species	InfraspRank	InfraspName	Informal	ConsvCode
PAGA-1	Mimosaceae		Acacia	saligna				
PAGA-1	Poaceae	*	Aira	caryophyllea				
PAGA-1	Centrolepidaceae		Aphelia	cyperoides				
PAGA-1	Asteraceae		Brachyscome	iberidifolia				
PAGA-1	Poaceae	*	Briza	maxima				
PAGA-1	Poaceae	*	Briza	minor				
PAGA-1	Colchicaceae		Burchardia	multiflora				
PAGA-1	Anthericaceae		Caesia	micrantha				
PAGA-1	Centrolepidaceae		Centrolepis	alepyroides				
PAGA-1	Centrolepidaceae		Centrolepis	aristata				
PAGA-1	Anthericaceae		Chamaescilla	corymbosa	var.	corymbosa		
PAGA-1	Cyperaceae		Cyathochaeta	avenacea				
PAGA-1	Goodeniaceae		Dampiera	linearis				
PAGA-1	Droseraceae		Drosera	gigantea	subsp.	gigantea		
PAGA-1	Droseraceae		Drosera	glanduligera				
PAGA-1	Droseraceae		Drosera	neesii	subsp.	neesii		
PAGA-1	Myrtaceae		Eucalyptus	rudis	subsp.	rudis		
PAGA-1	Papilionaceae		Eutaxia	virgata				
PAGA-1	Goodeniaceae		Goodenia	pulchella				
PAGA-1	Haemodoraceae		Haemodorum	laxum				
PAGA-1	Proteaceae		Hakea	varia				
PAGA-1	Dilleniaceae		Hibbertia	stellaris				
PAGA-1	Papilionaceae		Hovea	trisperma	var.	trisperma		
PAGA-1	Apiaceae		Hydrocotyle	diantha				
PAGA-1	Asteraceae	*	Hypochaeris	glabra				
PAGA-1	Restionaceae		Hypolaena	exsulca				
PAGA-1	Restionaceae		Hypolaena	pubescens				
PAGA-1	Juncaceae	*	Juncus	bufonius				
PAGA-1	Myrtaceae		Kunzea	glabrescens				
PAGA-1	Stylidiaceae		Levenhookia	stipitata				
PAGA-1	Restionaceae		Lyginia	barbata				
PAGA-1	Cyperaceae		Mesomelaena	tetragona				
PAGA-1	Papilionaceae		Nemcia	capitata				
PAGA-1	Papilionaceae		Nemcia	reticulata				
PAGA-1	Loranthaceae		Nuytsia	floribunda				
PAGA-1	Iridaceae		Patersonia	occidentalis				
PAGA-1	Myrtaceae		Pericalymma	ellipticum	var.	floridum		
PAGA-1	Lycopodiaceae		Phyiloglossum	drummondii				
PAGA-1	Orchidaceae		Prasophyllum	brownii				
PAGA-1	Asteraceae		Quinetia	urvillei				
PAGA-1	Cyperaceae		Schoenus	brevisetis				
PAGA-1	Cyperaceae		Schoenus	odontocarpus				
PAGA-1	Selaginellaceae		Selaginella	gracillima				
PAGA-1	Asteraceae		Siloxerus	humifusus				
PAGA-1	Asteraceae		Siloxerus	multiflorus				
PAGA-1	Stackhousiaceae		Stackhousia	monogyna				
PAGA-1	Stylidiaceae		Stylidium	brunonianum	subsp.	brunonianum		
PAGA-1	Stylidiaceae		Stylidium	calcaratum				
PAGA-1	Orchidaceae		Thelymitra	aff. pauciflora scps				
PAGA-1	Orchidaceae		Thelymitra	antennifera				
PAGA-1	Orchidaceae		Thelymitra	benthamiana				
PAGA-1	Anthericaceae		Thysanotus	multiflorus				
PAGA-1	Haemodoraceae		Tribonanthes	australis				
PAGA-1	Poaceae	*	Vulpia	myuros				
PAGA-1	Poaceae	*	Vulpia	sp. scps				

Plotorsource	Family	N	Genus	Species	InfraspRank	InfraspName	Informal	ConsvCode
PAGA-2	Mimosaceae		Acacia	saligna				
PAGA-2	Cyperaceae		Baumea	juncea				
PAGA-2	Lauraceae		Cassytha	racemosa				
PAGA-2	Myrtaceae		Eucalyptus	rudis	subsp.	rudis		
PAGA-2	Proteaceae		Hakea	varia				
PAGA-2	Juncaceae		Juncus	pallidus				
PAGA-2	Restionaceae		Lepyrodia	glauca				
PAGA-2	Restionaceae		Lepyrodia	muirii				
PAGA-2	Restionaceae		Meeboldina	roycei			MS	
PAGA-2	Myrtaceae		Melaleuca	rhaphiophylla				
PAGA-2	Orchidaceae		Microtis	media				
PAGA-2	Poaceae	*	Poa	annua				
PAGA-2	Orchidaceae		Pterostylis	sp.cauline leaves(N.Gibson & M.N.Lyons 1490)			PN	
PAGA-2	Asteraceae	*	Symphyotrichum	subulatum				
PAGA-2	Juncaginaceae		Triglochin	linearis				

Plotorsource	Family	N	Genus	Species	InfraspRank	InfraspName	Informal	ConsvCode
PAGA-3	Mimosaceae		Acacia	saligna				
PAGA-3	Mimosaceae		Acacia	stenoptera				
PAGA-3	Poaceae	*	Briza	minor				
PAGA-3	Orchidaceae		Caladenia	latifolia				
PAGA-3	Anthericaceae		Chamaescilla	corymbosa	var.	corymbosa		
PAGA-3	Papilionaceae		Dillwynia	dillwynioides				P3
PAGA-3	Droseraceae		Drosera	nitidula	subsp.	nitidula		
PAGA-3	Myrtaceae		Eucalyptus	rudis	subsp.	rudis		
PAGA-3	Papilionaceae		Eutaxia	virgata				
PAGA-3	Goodeniaceae		Goodenia	pulchella				
PAGA-3	Proteaceae		Hakea	varia				
PAGA-3	Dilleniaceae		Hibbertia	stellaris				
PAGA-3	Asteraceae	*	Hypochaeris	glabra				
PAGA-3	Restionaceae		Hypolaena	exsulca				
PAGA-3	Papilionaceae		Jacksonia	furcellata				
PAGA-3	Goodeniaceae		Lechenaultia	expansa				
PAGA-3	Cyperaceae		Lepidosperma	longitudinale				
PAGA-3	Dasypogonaceae		Lomandra	caespitosa				
PAGA-3	Restionaceae		Meeboldina	roycei			MS	
PAGA-3	Myrtaceae		Melaleuca	preissiana				
PAGA-3	Orchidaceae		Microtis	media				
PAGA-3	Iridaceae		Patersonia	occidentalis				
PAGA-3	Myrtaceae		Pericalymma	ellipticum	var.	floridum		
PAGA-3	Asteraceae		Podolepis	gracilis (Swamp form) (GJ Keighery 13126)				
PAGA-3	Orchidaceae		Pterostylis	sp.Slender Snail Orchid(G.J.Keighery 14516)			PN	
PAGA-3	Cyperaceae		Schoenus	efoliatus				
PAGA-3	Selaginellaceae		Selaginella	gracillima				
PAGA-3	Asteraceae		Siloxerus	humifusus				
PAGA-3	Stylidiaceae		Stylidium	dichotomum				
PAGA-3	Stylidiaceae		Stylidium	repens				
PAGA-3	Orchidaceae		Thelymitra	flexuosa				

Plotorsource	Family	N	Genus	Species	InfraspRank	InfraspName	Informal	ConsvCode
PAGA-4	Poaceae	*	Aira	caryophyllea				
PAGA-4	Haemodoraceae		Anigozanthos	humilis	subsp.	humilis		
PAGA-4	Epacridaceae		Astroloma	pallidum				
PAGA-4	Poaceae		Austrodanthonia	occidentalis				
PAGA-4	Poaceae		Austrostipa	flavescens				
PAGA-4	Proteaceae		Banksia	attenuata				
PAGA-4	Proteaceae		Banksia	menziesii				
PAGA-4	Papilionaceae		Bossiaea	eriocarpa				
PAGA-4	Epacridaceae		Brachyloma	preissii				
PAGA-4	Poaceae	*	Briza	maxima				
PAGA-4	Colchicaceae		Burchardia	congesta				
PAGA-4	Anthericaceae		Caesia	micrantha				
PAGA-4	Orchidaceae		Caladenia	flava	subsp.	flava		
PAGA-4	Anthericaceae		Chamaescilla	corymbosa	var.	corymbosa		
PAGA-4	Epacridaceae		Conostephium	preissii				
PAGA-4	Haemodoraceae		Conostylis	aculeata				
PAGA-4	Goodeniaceae		Dampiera	linearis				
PAGA-4	Apiaceae		Daucus	glochidiatus				
PAGA-4	Papilionaceae		Daviesia	triflora				
PAGA-4	Restionaceae		Desmocladus	fasciculatus				
PAGA-4	Droseraceae		Drosera	erythrorhiza	subsp.	erythrorhiza		
PAGA-4	Droseraceae		Drosera	menziesii	subsp.	penicillaris		
PAGA-4	Myrtaceae		Eucalyptus	marginata	subsp.	marginata		
PAGA-4	Papilionaceae		Gompholobium	tomentosum				
PAGA-4	Dilleniaceae		Hibbertia	hypericoides				
PAGA-4	Dilleniaceae		Hibbertia	racemosa				
PAGA-4	Papilionaceae		Hovea	trisperma	var.	trisperma		
PAGA-4	Violaceae		Hybanthus	calycinus				
PAGA-4	Asteraceae	*	Hypochaeris	glabra				
PAGA-4	Restionaceae		Hypolaena	exsulca				
PAGA-4	Papilionaceae		Isotropis	cuneifolia	subsp.	cuneifolia		
PAGA-4	Asteraceae		Lagenophora	huegelii				
PAGA-4	Cyperaceae		Lepidosperma	squamatum				
PAGA-4	Orchidaceae		Leporella	fimbriata				
PAGA-4	Stylidiaceae		Levenhookia	stipitata				
PAGA-4	Lobeliaceae		Lobelia	tenuior				
PAGA-4	Dasypogonaceae		Lomandra	caespitosa				
PAGA-4	Dasypogonaceae		Lomandra	hermaphrodita				
PAGA-4	Dasypogonaceae		Lomandra	sericea				
PAGA-4	Zamiaceae		Macrozamia	riedlei				
PAGA-4	Proteaceae		Petrophile	linearis				
PAGA-4	Asteraceae		Podolepis	gracilis				
PAGA-4	Asteraceae		Podotheca	chrysantha				
PAGA-4	Orchidaceae		Pterostylis	sanguinea				
PAGA-4	Orchidaceae		Pterostylis	sp.Slender Snail Orchid(G.J.Keighery 14516)			PN	
PAGA-4	Asteraceae		Quinetia	urvillei				
PAGA-4	Anthericaceae		Sowerbaea	laxiflora				
PAGA-4	Stackhousiaceae		Stackhousia	monogyna				
PAGA-4	Proteaceae		Stirlingia	latifolia				
PAGA-4	Stylidiaceae		Stylidium	brunonianum	subsp.	brunonianum		
PAGA-4	Stylidiaceae		Stylidium	piliferum	subsp.	piliferum		
PAGA-4	Stylidiaceae		Stylidium	schoenoides				
PAGA-4	Apiaceae		Trachymene	pilosa				
PAGA-4	Asteraceae	*	Ursinia	anthemoides				
PAGA-4	Poaceae	*	Vulpia	sp. scps				

Plotorsource	Family	N	Genus	Species	InfraspRank	InfraspName	Informal	ConsvCode
PAGA-5	Mimosaceae		Acacia	saligna				
PAGA-5	Apiaceae		Apium	prostratum	var.	prostratum		
PAGA-5	Cyperaceae		Baumea	juncea				
PAGA-5	Cyperaceae		Baumea	vaginalis				
PAGA-5	Cyperaceae		Gahnia	trifida				
PAGA-5	Cyperaceae		Lepidosperma	longitudinale				
PAGA-5	Lobeliaceae		Lobelia	alata				
PAGA-5	Myrtaceae		Melaleuca	rhaphiophylla				
PAGA-5	Myoporaceae		Myoporum	caprarioides				
PAGA-5	Primulaceae		Samolus	junceus				
PAGA-5	Asteraceae	*	Sonchus	oleraceus				
PAGA-5	Menyanthaceae		Villarsia	albiflora				

Plotorsource	Family	N	Genus	Species	InfraspRank	InfraspName	Informal	ConsvCode
PAGA-6	Mimosaceae		Acacia	willdenowiana				
PAGA-6	Poaceae		Austrostipa	flavescens				
PAGA-6	Proteaceae		Banksia	littoralis				
PAGA-6	Orchidaceae		Caladenia	latifolia				
PAGA-6	Haemodoraceae		Conostylis	aculeata				
PAGA-6	Haemodoraceae		Conostylis	juncea				
PAGA-6	Apiaceae		Daucus	glochidiatus				
PAGA-6	Droseraceae		Drosera	erythrorhiza	subsp.	erythrorhiza		
PAGA-6	Apiaceae		Eryngium	pinnatifidum	subsp.	pinnatifidum	MS	
PAGA-6	Myrtaceae		Eucalyptus	gomphocephala	var.	gomphocephala		
PAGA-6	Poaceae	*	Holcus	setiger				
PAGA-6	Asteraceae	*	Hypochaeris	glabra				
PAGA-6	Asteraceae		Lagenophora	huegelii				
PAGA-6	Cyperaceae		Lepidosperma	longitudinale				
PAGA-6	Cyperaceae		Lepidosperma	squamatum				
PAGA-6	Epacridaceae		Leucopogon	propinquus				
PAGA-6	Lobeliaceae		Lobelia	tenuior				
PAGA-6	Zamiaceae		Macrozamia	riedlei				
PAGA-6	Poaceae		Microlaena	stipoides				
PAGA-6	Myoporaceae		Myoporum	caprarioides				
PAGA-6	Rubiaceae		Opercularia	hispidula				
PAGA-6	Oxalidaceae		Oxalis	perennans				
PAGA-6	Orchidaceae		Pyrorchis	nigricans				
PAGA-6	Anthericaceae		Sowerbaea	laxiflora				
PAGA-6	Caryophyllaceae	*	Stellaria	media				
PAGA-6	Anthericaceae		Thysanotus	arenarius				
PAGA-6	Apiaceae		Trachymene	coerulea	subsp.	coerulea		
PAGA-6	Apiaceae		Trachymene	pilosa				

Plotorsource	Family	N	Genus	Species	InfraspRank	InfraspName	Informal	ConsvCode
PAGA-7	Mimosaceae		Acacia	cochlearis				
PAGA-7	Poaceae	*	Aira	caryophyllea				
PAGA-7	Casuarinaceae		Allocasuarina	fraseriana				
PAGA-7	Primulaceae	*	Anagallis	arvensis				
PAGA-7	Epacridaceae		Astroloma	pallidum				
PAGA-7	Poaceae		Austrodanthonia	occidentalis				
PAGA-7	Proteaceae		Banksia	attenuata				
PAGA-7	Proteaceae		Banksia	menziesii				
PAGA-7	Papilionaceae		Bossiaea	eriocarpa				
PAGA-7	Poaceae	*	Briza	maxima				
PAGA-7	Poaceae	*	Briza	minor				
PAGA-7	Poaceae	*	Bromus	diandrus				
PAGA-7	Anthericaceae		Caesia	micrantha				
PAGA-7	Anthericaceae		Chamaescilla	corymbosa	var.	corymbosa		
PAGA-7	Epacridaceae		Conostephium	preissii				
PAGA-7	Haemodoraceae		Conostylis	aculeata				
PAGA-7	Apiaceae		Daucus	glochidiatus				
PAGA-7	Papilionaceae		Daviesia	triflora				
PAGA-7	Restionaceae		Desmocladus	fasciculatus				
PAGA-7	Poaceae		Dichelachne	crinita				
PAGA-7	Anthericaceae		Dichopogon	capillipes				
PAGA-7	Droseraceae		Drosera	erythrorhiza	subsp.	erythrorhiza		
PAGA-7	Droseraceae		Drosera	menziesii	subsp.	penicillaris		
PAGA-7	Droseraceae		Drosera	pallida				
PAGA-7	Proteaceae		Dryandra	lindleyana				
PAGA-7	Apiaceae		Eryngium	pinnatifidum	subsp.	pinnatifidum	MS	
PAGA-7	Myrtaceae		Eucalyptus	gomphocephala	var.	gomphocephala		
PAGA-7	Papilionaceae		Gompholobium	tomentosum				
PAGA-7	Proteaceae		Grevillea	crithmifolia				
PAGA-7	Papilionaceae		Hardenbergia	comptoniana				
PAGA-7	Brassicaceae	*	Heliophila	pusilla				
PAGA-7	Dilleniaceae		Hibbertia	hypericoides				
PAGA-7	Dilleniaceae		Hibbertia	racemosa				
PAGA-7	Poaceae	*	Holcus	setiger				
PAGA-7	Papilionaceae		Hovea	trisperma	var.	trisperma		
PAGA-7	Violaceae		Hybanthus	calycinus				
PAGA-7	Asteraceae	*	Hypochaeris	glabra				
PAGA-7	Cyperaceae	*	Isolepis	marginata				
PAGA-7	Papilionaceae		Isotropis	cuneifolia	subsp.	cuneifolia		
PAGA-7	Asteraceae		Lagenophora	huegelii				
PAGA-7	Cyperaceae		Lepidosperma	squamatum				
PAGA-7	Lobeliaceae		Lobelia	tenuior				
PAGA-7	Dasypogonaceae		Lomandra	caespitosa				
PAGA-7	Dasypogonaceae		Lomandra	sericea				
PAGA-7	Dasypogonaceae		Lomandra	suaveolens				
PAGA-7	Juncaceae		Luzula	meridionalis				
PAGA-7	Zamiaceae		Macrozamia	riedlei				
PAGA-7	Rubiaceae		Opercularia	vaginata				
PAGA-7	Orobanchaceae	*	Orobanche	minor				
PAGA-7	Caryophyllaceae	*	Petrorhagia	dubia				
PAGA-7	Thymelaeaceae		Pimelea	rosea	subsp.	rosea		
PAGA-7	Poaceae		Poa	drummondiana				
PAGA-7	Asteraceae		Podolepis	gracilis				
PAGA-7	Asteraceae		Podolepis	gracilis (Swamp form) (GJ Keighery 13126)				
PAGA-7	Asteraceae		Quinetia	urvillei				
PAGA-7	Goodeniaceae		Scaevola	canescens				
PAGA-7	Caryophyllaceae	*	Silene	gallica				
PAGA-7	Asteraceae	*	Sonchus	oleraceus				
PAGA-7	Anthericaceae		Sowerbaea	laxiflora				
PAGA-7	Caryophyllaceae	*	Stellaria	media				
PAGA-7	Stylidiaceae		Stylidium	piliferum	subsp.	piliferum		
PAGA-7	Stylidiaceae		Stylidium	schoenoides				
PAGA-7	Proteaceae		Synaphea	spinulosa	subsp.	spinulosa		
PAGA-7	Apiaceae		Trachymene	pilosa				
PAGA-7	Papilionaceae	*	Trifolium	campestre	var.	campestre		
PAGA-7	Asteraceae	*	Ursinia	anthemoides				
PAGA-7	Poaceae	*	Vulpia	myuros				
PAGA-7	Apiaceae		Xanthosia	huegelii	subsp.	huegelii	MS	

Plotorsource	Family	N	Genus	Species	InfraspRank	InfraspName	Informal	ConsvCode
PAGA-8	Mimosaceae		Acacia	pulchella				
PAGA-8	Dasypogonaceae		Acanthocarpus	preissii				
PAGA-8	Primulaceae	*	Anagallis	arvensis				
PAGA-8	Asteraceae	*	Arctotheca	calendula				
PAGA-8	Epacridaceae		Astroloma	pallidum				
PAGA-8	Proteaceae		Banksia	grandis				
PAGA-8	Cyperaceae		Baumea	juncea				
PAGA-8	Papilionaceae		Bossiaea	eriocarpa				
PAGA-8	Poaceae	*	Briza	maxima				
PAGA-8	Poaceae	*	Briza	minor				
PAGA-8	Poaceae	*	Bromus	diandrus				
PAGA-8	Anthericaceae		Caesia	micrantha				
PAGA-8	Orchidaceae		Caladenia	latifolia				
PAGA-8	Orchidaceae		Caladenia	longicauda	subsp.	calcigena		
PAGA-8	Caryophyllaceae	*	Cerastium	glomeratum				
PAGA-8	Anthericaceae		Chamaescilla	corymbosa	var.	corymbosa		
PAGA-8	Haemodoraceae		Conostylis	aculeata				
PAGA-8	Asteraceae	*	Conyza	sumatrensis				
PAGA-8	Crassulaceae		Crassula	colorata	var.	colorata		
PAGA-8	Apiaceae		Daucus	glochidiatus				
PAGA-8	Restionaceae		Desmocladus	fasciculatus				
PAGA-8	Poaceae		Dichelachne	crinita				
PAGA-8	Anthericaceae		Dichopogon	capillipes				
PAGA-8	Droseraceae		Drosera	erythrorhiza	subsp.	erythrorhiza		
PAGA-8	Poaceae	*	Ehrharta	calycina				
PAGA-8	Onagraceae		Epilobium	hirtigerum				
PAGA-8	Geraniaceae	*	Erodium	botrys				
PAGA-8	Apiaceae		Eryngium	pinnatifidum	subsp.	pinnatifidum	MS	
PAGA-8	Myrtaceae		Eucalyptus	calophylla				
PAGA-8	Myrtaceae		Eucalyptus	gomphocephala	var.	gomphocephala		
PAGA-8	Geraniaceae	*	Geranium	molle				
PAGA-8	Brassicaceae	*	Heliophila	pusilla				
PAGA-8	Dilleniaceae		Hibbertia	hypericoides				
PAGA-8	Dilleniaceae		Hibbertia	racemosa				
PAGA-8	Apiaceae		Homalosciadium	homalocarpum				
PAGA-8	Asteraceae	*	Hypochaeris	glabra				
PAGA-8	Asteraceae		Lagenophora	huegelii				
PAGA-8	Cyperaceae		Lepidosperma	squamatum				
PAGA-8	Epacridaceae		Leucopogon	propinquus				
PAGA-8	Dasypogonaceae		Lomandra	caespitosa				
PAGA-8	Zamiaceae		Macrozamia	riedlei				
PAGA-8	Asteraceae		Millotia	myosotidifolia				
PAGA-8	Oxalidaceae		Oxalis	perennans				
PAGA-8	Geraniaceae		Pelargonium	littorale	subsp.	littorale		
PAGA-8	Caryophyllaceae	*	Petrorhagia	dubia				
PAGA-8	Euphorbiaceae		Phyllanthus	calycinus				
PAGA-8	Thymelaeaceae		Pimelea	rosea	subsp.	rosea		
PAGA-8	Poaceae		Poa	poiformis				
PAGA-8	Orchidaceae		Pterostylis	sp.Slender Snail Orchid(G.J.Keighery 14516)			PN	
PAGA-8	Caryophyllaceae	*	Stellaria	media				
PAGA-8	Papilionaceae	*	Trifolium	arvense	var.	arvense		
PAGA-8	Papilionaceae	*	Trifolium	campestre	var.	campestre		
PAGA-8	Asteraceae	*	Ursinia	anthemoides				
PAGA-8	Poaceae	*	Vulpia	bromoides				
PAGA-8	Poaceae	*	Vulpia	myuros				

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SYSTEM 6 BUSHLAND SUBMISSION FORM
FOR CONSIDERATION IN THE UPDATE PROGRAMME

If you wish to submit more than one area for consideration in the System 6 update, please use a separate form for each area.

Please fill in each section giving as much information as possible.

LOCATION, OWNERSHIP AND ZONING OF THE AREA

1. Location Kamup.

Please give as accurate and detailed a description as possible of the site location

Please include either a hand drawn or copied map showing the area of the area

a) Bordering Roads: .....

b) Nearest Corner: Cnr. Mandurah + Paganoni Rds.

c) Lot Number: 1 Street Number: .....

d) Town/Suburb/Location: .....

e) Local Council: .....

f) Site Name (if any): .....

g) Approximate size of the area (ha): .....

h) Please locate the area on a map and give us map references if possible:

.....

i) Map: ..... Streetsmart /UBD/Other: .....

j) Map no.: .....

k) Grid Ref: .....

l) Please give any other information that may help us to find the location:

Adjacent to Lot 2, Paganoni Road.

m) Are you aware of any development proposals that are likely to affect the area?

MRD - Quarry site.

.....

NOTE: Areas that have already been given development APPROVAL should not be nominated

Please fill out those questions that you can answer

2. Who owns the area? (If owned by the person/s making the nomination please indicate) Govt - MRD Quarry

3. If you own the area, and may be interested in participating in conservation on private land initiatives please indicate (and leave your name and address at the end of this submission form)

4 .What is the area zoned? (please indicate whether zoning is Town Planning Scheme or Metropolitan Region Scheme) Public Purposes (?)

CAN YOU TELL US A LITTLE ABOUT THE PHYSICAL CHARACTERISTICS OF THE AREA

5. Why do you consider this area important? (Refer to Guiding Issues paper) (1) Would enhance Paganoni Reserve by add'g a different habitat type (2) Provide a connecting link + enable an east-west transect of ROS to proposed Serpentine Regional Pk (through southern end of Rockingham Lakes Reg Pk + Pt Kennedy)

6. What is/are the soil type/s and colours ?

Type: Sand/Clay/Gravel/Loam/Silt

Colour: White/Grey/Brown/Orange/Yellow/Red/Black

7. Does the area have any special features such as unusual landforms / landscapes that still retain their natural vegetation? Yes/No

If yes, what are they? Limestone heath ridge

8. Is the area a wetland or does it include a wetland?

If yes, what kind of a wetlands is it?

a) lake

b) river

c) stream

d) swamp

e) estuary

f) seasonally wet

g) other

9. What percentage of the wetland is open water in summer? .....

CAN YOU TELL US A LITTLE ABOUT THE VEGETATION /FAUNA ON THE NOMINATED AREA.

10. What percentage of the area is indigenous vegetation? .....

11. If the area includes regions cleared of native bushland please indicate reasons for the inclusion. .....

.....

12. Has any previous flora or fauna survey work been done on the area?
.....no -

If yes, please give details of the work .....

.....

.....

13. How would you rate the condition of the native bushland? (see attached table)

a) pristine
b) excellent
c) very good
d) good
e) degraded
f) completely degraded
g) don't know

14. Please indicate the disturbances affecting the area and where appropriate the percentage of the area disturbed.

a) Partial clearing
b) fragmentation
c) Selective removal of species: timber cutting, wildflower picking, mowing dieback and other plant diseases
d) Fire regime, including intensity, season and frequency
e) 'Enrichment plantings' that is plantings of species not found in that community
f) Weed invasion
g) Animal impact: horses, foxes, rabbits, cats, dogs, camels, goats etc
h) Soil movement, both removal and dumping
i) Changes in water regimes; flooding, drainage and watering
j) Salinity
k) Fertiliser drift and along waterways nutrient influx
l) Mining, including that for road works

Quarrying

m) Grazing: stock, overgrazing by feral or native mammals

n) Proliferation of tracks, fire breaks and walk trails

o) Off-road vehicle use

p) Use as service corridors by the SEC, Main Roads, Water Authority.

(Source: B Keighery. Bushland Plant Survey, September 1994)

15. Does the area contain any plant species of special interest that you know of?
(eg. declared rare flora, priority taxa, outlier populations) ...Very likely......

Do you know what they are? ......Limestone ridge - Leschenault.

....

16. Do you know of any native animals that use the area? ....

Can you list those you know of? (birds, mammals, reptiles, amphibians etc)

....

17. Is the area used by any native animals of special interest? (eg. endangered species, large/important populations)....................................

If yes, please name them and indicate source of information

....

....

CAN YOU TELL US A LITTLE ABOUT THE SURROUNDING AREA

18. Are there any bushland areas (including wetlands) near to this area?
..............Paganoni........

If yes, how close are they ? ......immediately adjacent......

....

....

Are they already conservation reserves? ......Yes.......

What is their approximate size? ......100 ha......

19. Does the submitted area link other bushland areas? ......Yes - above

....

....

Please attach any additional information about the area which may be of use when assessing it.

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Perth's Bushplan
Ministry for Planning
Albert Facey house
469 Wellington Street
Perth WA 6000

CSR Readymix Quarries

Bs 395

PBI 94

25 March, 1999

Dear Sir,

SUBMISSION ON PERTH'S BUSHPLAN.

Singleton Limestone Quarry: Portion site [redacted].

CSR owns the above property in fee simple. The northern half of the property is excluded from Bushplan and the southern half included.
This submission by CSR contends that the nominated portion of the specified lot should be **excluded** from Bushplan for the reasons detailed below:

1. Existing Approved Use.

The property is the site of an operating limestone quarry which obtained a 10 year development approval in 1997. Current quarrying operations on the site have degraded portions of the property with future activities having the potential to increase the area of disturbance.

2. Conflicts with current MRS Zonings.

There are a number of issues within this section;

2.1. The reservation of the rapid transit route (railway) between Mandurah, Rockingham and Perth, lies on the eastern edge of the lot and provides a barrier to an effective link between the existing P&R area and Lot 4. In fact, lot 4 is sandwiched between Mandurah Road to the west and the railway reserve to the east.

No areas are proposed for inclusion in Bushplan in Singleton, to the west of Mandurah Road, which would create an east-west corridor from the coast to the Paganoni wetlands (albeit severed by major transport routes).

SUBMISSION NO. 388

MINISTRY FOR PLANNING
30 MAR 1999
805-2-1-32 pt 12
FILE

CSR Limited A.C.N. 000 001 276. Cockram Road, Gosnells, Western Australia 6110
PO Box 138, Gosnells, Western Australia 6110. Phone (09) 391 6434 Fax (09) 391 6442

CSRWA022

Arguably, with the existing quarry use of the lot and only half of the lot proposed for inclusion in Bushplan, this creates a property which will ultimately have more commonality with the developing coastal urban cell of Singleton, Golden Bay and Secret Harbour than the inland Paganoni wetlands. This has been recognised, prior to Bushplan, with the zoning of Urban Deferred in the MRS. CSR contends that the planning principles are unchanged over the site.

2.2. The property abuts (but is not an integral part of) the Paganoni wetland chain, located to the east of the lot and already zoned Parks and Recreation in the MRS. CSR contends that the reservation of sufficient area to protect the significant conservation attributes of the region has already occurred.

2.3. The lot is currently not in the 'conservation estate' (Parks and Recreation in the MRS). Indeed the current zoning is Urban Deferred, which implies that ,until the release of Bushplan, there has been a presumption of urbanisation in the longer term. The private property status of the land and its current use as a quarry would be contributing factors in this view.

3. Interaction between the MRS and the Peel Region Structure Plan.

This point is extremely important to CSR's case for exclusion of lot 4 from Bushplan.

Lot 4 is located on the southern extremity of the MRS. The Perth's Bushplan document, page 25, acknowledges the administrative nature of this line and more specifically, that the Peel and Bunbury regional planning processes must also be considered.

This is explained by analysis of the data presented in the Bushplan document and the Peel Region Structure Plan December 1997. The conclusion is that from a landform complex perspective, the Yoongarillup Complex is mostly located in the Peel Region. Only the very northern extremity enters the MRS, as shown in Map 1(page 77 of the Bushplan document) and of this total area, **58%** is currently protected in the existing P&R reservation of the Paganoni wetlands.

Extracts from the Peel Region Structure Plan are attached as Appendix 1 which shows;

- Landform units
- Structure plan
- Open space and Crown reserves
- Peel region park

This information supports the points made above that:

i. The Yoongarillup complex is a landform unit essentially located in the Peel Region.
ii. The small proportion of the complex extending into the MRS is already well protected.

iii. Within the Peel Region Structure Plan, adequate protection of the complex either already exists, in existing CALM estate and Crown reserves or is planned.

4. Analysis of data presented in Perth's Bushplan.

Table 1 is a duplication of Appendix Six in the Perth's Bushplan document (page 76), with the insertion of one extra column, shaded, which shows the **percentage** of the various landform units **already protected** in the Bushplan area.

Lot 4 has a combination of the Yoongarillup and Cottesloe- Central and South landform units. Table 1 shows that for the Yoongarillup landform, **58% is already protected, almost six times the minimum criteria of 10%.** The proportion of the area of lot 4 nominated in Bushplan consisting of the Cottesloe landform unit is very small. Table 1 shows this unit is **already 15% protected.**

5. Submission by the Chamber of Commerce and Industry.

CSR is part of the Extractive Industries Committee with the Chamber of Commerce and Industry. This group has provided a submission specifically focused on the impact of Bushplan on the current and future quarrying of Basic Raw Materials in the study area.

CSR understands this detailed submission is to be forwarded to the Ministry for Planning under separate cover. Among its many points for consideration is information, provided in Table 3 of the submission, which finds that exclusion of the basic raw materials areas from Bushplan will have an insignificant effect on the percentage of protection of landform units, as outlined in Appendix Six of the Bushplan document.

CSR contends that on the basis of the above evidence, the nominated portion of the specified lot should be **excluded** from Bushplan.

Yours faithfully,

Paul Rokich
Development Manager
CSR Readymix.

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APPENDIX SIX - PERTH'S BUSHPLAN DOCUMENT.								
	Original area in SCP (96)	Remaining area in SCP/PMR (ha)	% remaining	Currently protected*(ha)	currently protected * (%)	bushplan area recommended for protection (ha)	bushplan area total (ha)	proposed protection %
Foothills								
forrestfield	11328	1020	9	219	2	375	594	5
coonambidgee	40	3	7	0	0	3	3	7
Pinjarra Plain								
guildford	24513	1369	6	384	2	488	872	4
swan	5962	682	11	287	5	252	538	9
dardanup	1992	309	15	0	0	211	211	11
serpentine river	4445	398	9	40	1	129	169	4
beermullah	6707	433	6	139	2	216	355	5
yanga	5775	1058	18	267	5	309	576	10
Bassendean Dunes								
north	22933	12390	54	6771	30	3994	10765	47
central and south	46220	10919	24	2830	6	3093	5923	13
north transition	3116	2238	72	1473	47	612	2085	67
central and south transition	623	622	100	0	0	622	622	100
Bassendean and Pinjarra Plain								
cannington	601	4	1	0	0	0	0	1
southern river	31148	5370	17	1786	6	1493	3279	11
Spearwood								
karrakatta north	5155	1027	20	348	7	679	1027	20
karakatta north transition	2344	1849	79	16	1	1833	1849	79
karrakatta central and south	34532	6275	18	1933	6	828	2761	8
cottesloe north	8670	6082	70	5547	64	42	5589	64
cottesloe central and south	34439	12362	36	5205	15	1237	6442	19
Wetlands								
herdsman	6509	2017	31	1423	22	147	1570	24
pinjar	4893	1200	25	618	13	313	932	19
Quindalup								
quindalup	24381	11598	48	3536	15	1512	5049	21
Marine								
yoongarillup	684	478	72	387	58	38	424	64
vasse	751	9	1	6	1	0	6	1
Dandaragan Plateau								
mogumber	866	347	40	0	0	287	287	33
reagan	1655	396	24	33	2	297	330	20
TOTALS	290262	80455		33248	11	19010	52258	18

APPENDIX 1

APPROXIMATE LOCATION OF SINGLETON QUARRY.

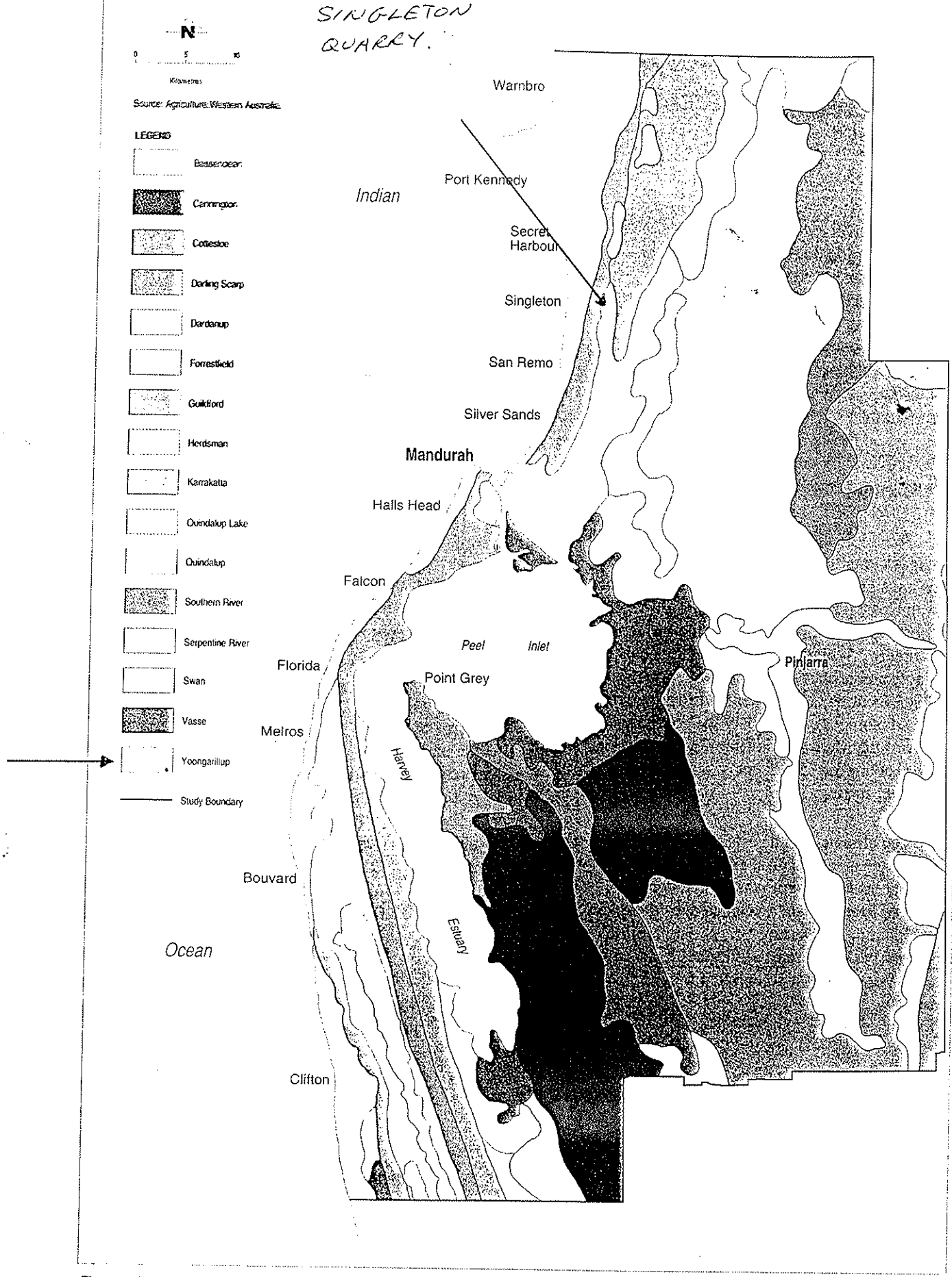
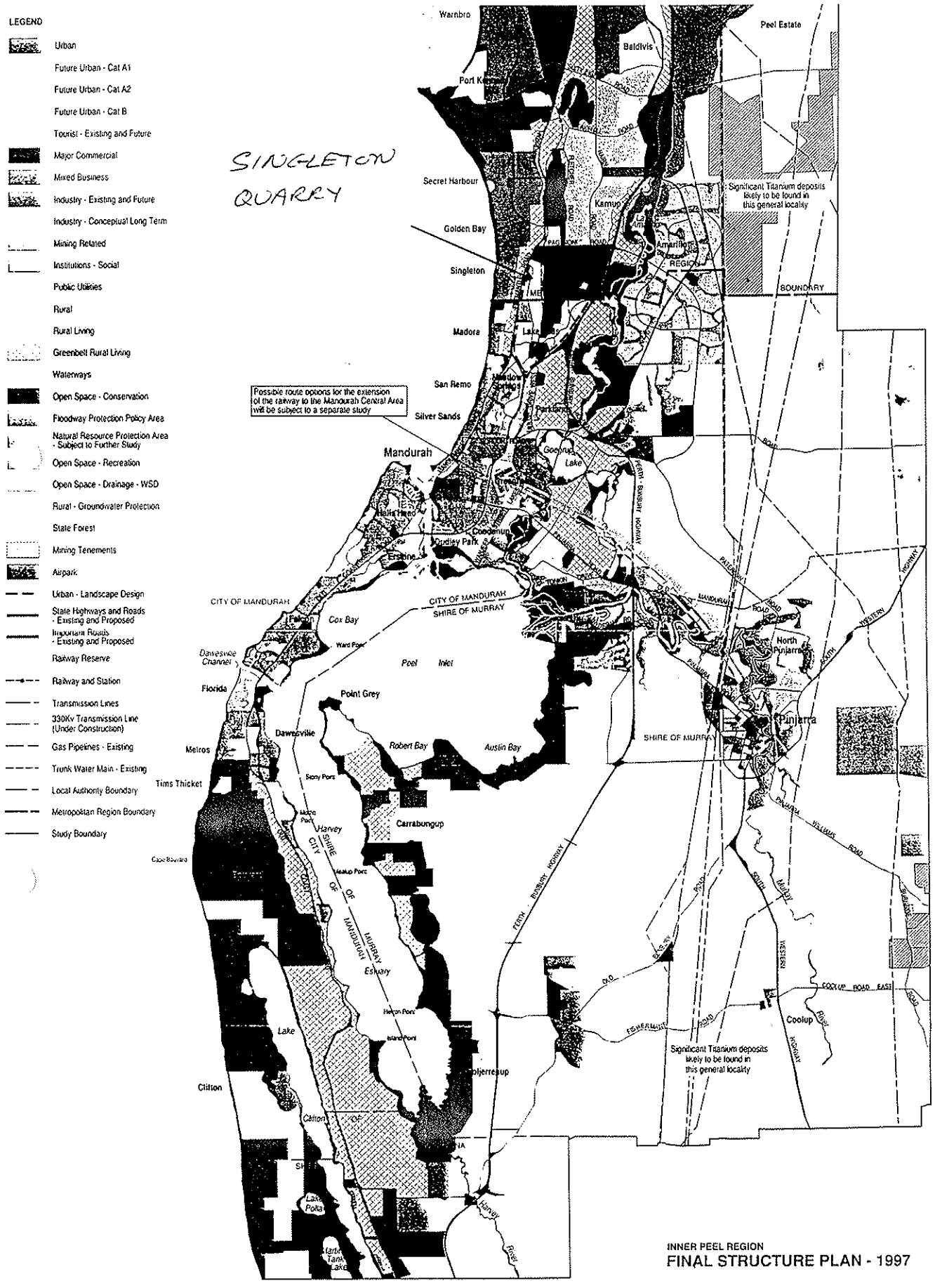


Figure 4: Regional Soil Associations in the Study Area



INNER PEEL REGION
FINAL STRUCTURE PLAN - 1997

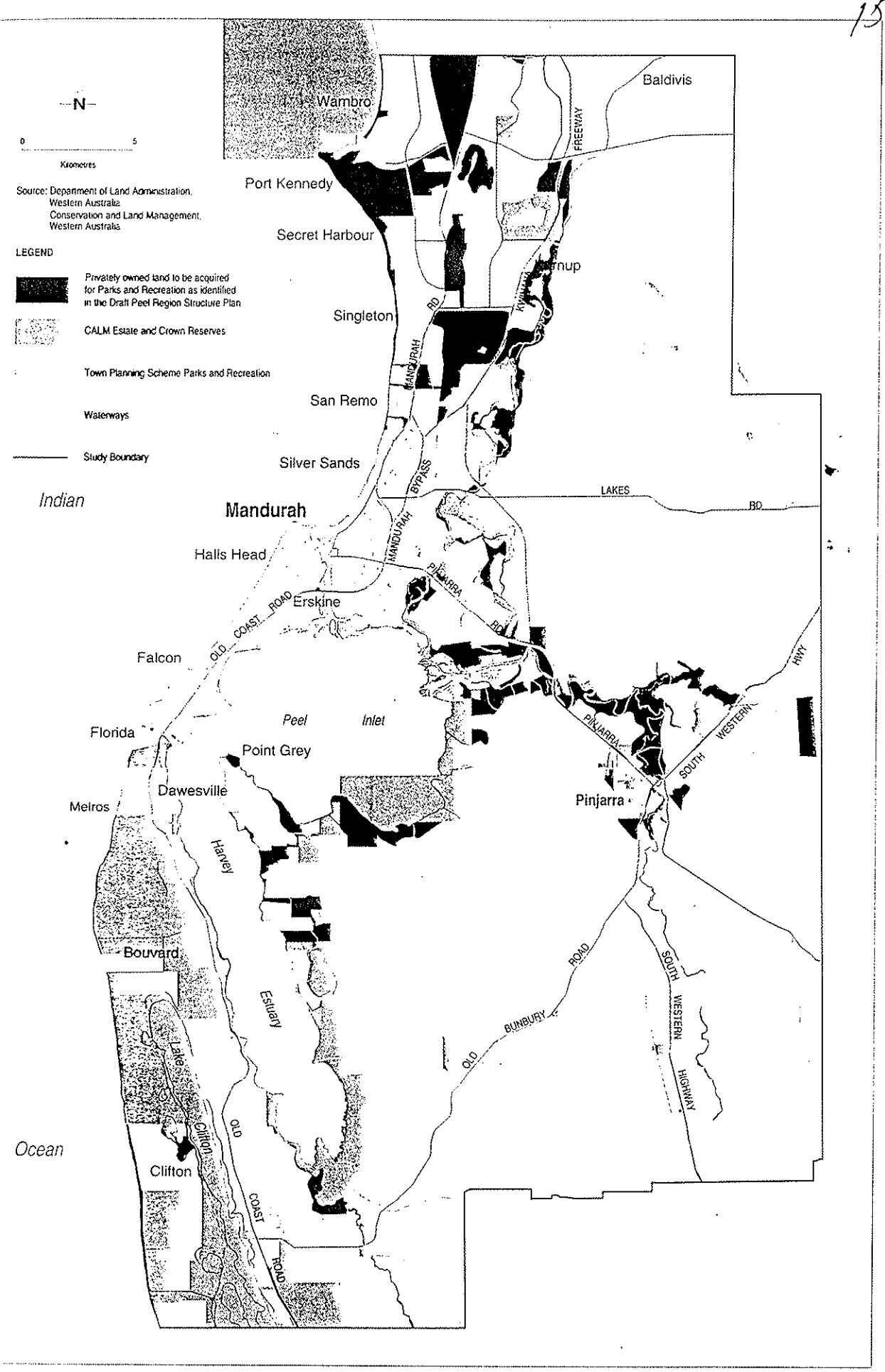


Figure A23: Existing Open Space and Crown Reserves

BUSHPLAN SITE LOT SURVEY SHEET 2 - ADDITIONAL VEGETATION UNITS

BS 395

For each additional vegetation unit observed describe
- *each layer in the unit according to height and cover*
- *dominant species*
- *associated significant species*
- *condition of each unit.*

Indicate location of sample/description point for each units described on the map.

Unit 1
Trees and/or Mallees adj Euc decipiens (outside BS)
Hak prost
Shrubs Hak tri, Grev prei, Rhag: bac & Gryn, Temp ret, Mel acu,
Allo hum, Hib sub-veg, Melan lan / 30-70% Pim, Jacksor
Herbs Daucus glochid, Opercularia vag, Senecio lautus & Dry lina
Dros erythr, Trach pilosa, Hyb ciliy, Eryng pinnat, Pat
Sedges Lox Grex, Conostylis set, Conost Tenuis
Grasses
Significant Flora Grev preissii, Jacksonia calcicola
Shrubs (cont) Hibb spicata
Vegetation Condition 1 (2) (3) 4 5
Comment Exposed limestone patches - poor sand
ridge top

Unit 2
Trees and/or Mallees
Shrubs Ac rost / Olea axil 1.5-2m 10-30% to
30-70% patchy // Grev crith
Herbs
Sedges
Grasses
Significant Flora Jack calcicola
Vegetation Condition 1 2 (3)—(4) 5
Comment 'Swale' deeper soil on ridge

Clements

Unit 3
Trees and/or Mallees
Shrubs
Herbs
Sedges
Grasses
Significant Flora
Condition 1 2 3 4 5
Comment

GENERAL CONDITION of LOT

Vegetation Condition - Keighery 1994 (Trudgen 1993) *Indicate range and %* in each class
1 = 'Pristine' (Excellent)
2 = Excellent (Very Good) – Excellent patches on ridges
3 = Very Good (Good) ✓
4 = Good (Poor)
5 = Degraded (Very Poor)
6 = Completely Degraded

Disturbance Describe observed disturbance eg partial clearing, weeds, soil movement, changes in water regimes etc

overall above, tracks running
scraps for soil, [illegible] [illegible] on
soil patches, along road 'hill/dyke' of
debris to [illegible] site
LOCATION – 32° 27' 006"
115° 46 210"

OTHER COMMENT.

Lam. [illegible], Ac lasio, Tersonia
Phyl caly, Hib [illegible]
Acr [illegible]
Red [illegible], Ac coch, Dip [illegible]
Red [illegible], Hak [illegible], Lepid [illegible]
[illegible] [illegible] [illegible]
SUMMARY Response to [illegible] [illegible]
– negotiation
– not urgent
– currently of [illegible]

CONSERVATION BRANCH
DEPARTMENT of ENVIRONMENTAL PROTECTION
ADVICE

TO: Valerie Thompson, Ministry for Planning
SUBJECT: Lot 4 Mandurah Road, Bushplan Site 395
FROM: Bronwen Keighery/Gary Whisson
DATE: 23/8/99

Copy for file
(to provide to consultant (Tingay))

Background
Lot 4 was included in Bushplan as

• Together with vegetation units in the Paganoni block to the east it contains the typical Spearwood Dunes units in the area, that is the following floristic community types (*not sampled, types inferred)

Supergroup 2: Seasonal Wetlands
17 *Melaleuca rhaphiophylla — Gahnia trifida* seasonal wetlands
Supergroup 3: Uplands centred on Bassendean Dunes and Dandaragan Plateau units
21a Central *Banksia attenuata — Eucalyptus marginata* woodlands
Supergroup 4: Uplands centred on Spearwood Dunes
*24 Northern Spearwood shrublands and woodlands
25 Southern *Eucalyptus gomphocephala — Agonis flexuosa* woodlands.
That is the block would has a high diversity of Spearwood Dune taxa, vegetation associations and floristic community types.

• Considered to contain floristic community type 24 which is typical of shallow soils over Tamala Limestone (Spearwood Dune community - Cottesloe Complex - Central South). This is the most southern of these limestone ridges in the Metropolitan Area and the most substantial between here and Yalgorup NP, south of Mandurah.

• The ridge is a significant landscape feature.

• System 6 Recommendation area M107 as currently recommended to be implemented (area to the immediate south of the PMR west of Mandurah Road to the coast) is contiguous with Lot 4. From aerial photograph interpretation and edge inspection Lot 4 offered the best opportunity to link with M107 and together with the remainder of BS 395 link to the Serpentine River.

That is the relevant selection criteria in relation to Lot 4 were: Representation of ecological communities/Diversity/Maintaining ecological processes or natural systems.

Site Inspection/Comments
As this lot had not been inspected before the release of the draft Perth's Bushplan (edge inspection only) its condition and the presence of Yoongarillup Complex were questionable.

A field inspection of Lot 4 Mandurah Road Bushplan Site 395 was made by Bronwen Keighery, Bridget Hyder- Giffiths (DEP) and Valerie Thompson (MfP) on 30/5/99. Paul Rokich attended for CSR.

From this inspection and consideration of Tingay 1999 the following were determined:

- Lot 4 is not considered to contain the Yoongarillup Complex as argued in Tingay (1999) but is typical of Cottesloe Complex - Central South. The twin span analysis in Tingay (1999) identified two clear groupings the Karrakatta Complex — Central and South (floristic community type 25) vegetation of the deeper soils of the east of Lot 4 (and the majority of the Bushplan Site) and Cottesloe Complex - Central South on the shallow soils of the ridge (floristic community type 24). The majority of the vegetation in Lot 4 is from Cottesloe Complex - Central South. That is as outlined in the Bushplan Site description Lot 4 contributes to the values of the Bushplan Site by substantially increasing the diversity and representation of ecological communities.
- Vegetation in Lot 4 was in Very Good (to Good Condition) with patches in Excellent condition. South of the river areas of floristic community type 24 occur in Bushplan Sites 247, 346, 349, 379 and 356. Only two of these areas contain similar substantial ridges (247 and 346). The area of floristic community type 24 in Lot 4 is of equal, and generally better condition, than the areas.
- The diversity of taxa typically encountered in floristic community type 24 were present in Lot 4, including *Eucalyptus decipiens* Shrub Mallee to Mixed Low Heaths with a variety of dominants (*Melaleuca huegelii, Grevillea preissii, Hakea trifurcata*).
- A series of significant taxa occur in the Lot
  - Taxa typical of Tamala Limestone: *Grevillea preissii, Melaleuca huegelii, Diplopeltis huegelii, Eucalyptus foecunda, Trymalium ledifolium* subsp *ledifolium, Hibbertia spicata* subsp. *leptotheca, Jacksonia calcicola*
  - *Jacksonia calcicola* is disjunct from its more northern distribution (Trigg Dune area) and is the most southern known population. This record reinforces the value of the area as a significant area of Tamala Limestone vegetation. Detailed survey of Lot 4 and consideration of the distributions of further taxa may identify other taxa at their southern limit.
  - *Hibbertia spicata* subsp. *leptotheca* (not listed by Tingay 1999) is a priority taxon as is *Lasiopetalum membranaceum* (listed in Tingay 1999); both are additional to the Site description.
- Similar vegetation occurs over Mandurah Road as described by Tingay (1999) but NOT of the same complexity (variety of vegetation units in association) as in BS395 or with the same linkage and landscape values as Lot 4. Also, there are no proposals to protect areas of this vegetation.
- The value of Lot 4 as part of corridor from the coast to the Serpentine River is reduced by the presence of roads but most areas have these problems and it does not negate its high value as part of a corridor. An area of housing on Lot 4 will be a greater impediment to linkage values.

That is the Site inspection confirmed and reinforced the values attributed to Lot 4 in Bushplan Site 395.

Conclusion

Lot 4 continues to be worthy of inclusion in Bushplan and is an important section of Bushplan Site 395.

PB194

Lot 4 Mandurah Road Bushplan Site 395 - Field inspection 30/5/99

Background
Lot 4 was included in Bushplan as
- contained floristic community type 24 which is typical of shallow soils over Tamala Limestone (Spearwood Dune community - Cottesloe Complex - Central South); this is the most southern of these limestone ridges in the Metropolitan Area and the most substantial between here and Yalgorup NP, south of Mandurah.
- significant landscape feature
- together with vegetation units in the Pagononi block to east shows all units typical of Spearwood Dunes in the area.

As this lot had not been visited for Bushplan (edge inspection only) its condition and the presence of Yoongarillup Complex were questionable.

Inspection

- Area does not contain Yoongarillup complex (i.e. agree Tingay 1999)
- Vegetation in Lot 4 was in Very Good (to Good Condition) with patches in Excellent condition (better than expected).
- Lot 4 contains a diversity of units typical of these soils from Eucalyptus decipiens Shrub Mallee to Mixed Low Heaths with a variety of dominants (Melaleuca huegelii, Grevillea preissii, Hakea trifurcata - additional to site description)
- A series of significant taxa occur in the Lot

- Taxa typical of Tamala Limestone: *Grevillea preissii*, *Melaleuca huegelii, Diplopettis huegelii*, *Eucalyptus foecunda*, *Trymalium ledifolium* subsp *ledifolium*, *Hibbertia spicata* subsp. *leptotheca*, *Jacksonia calcicola*
- *Jacksonia calcicola* is disjunct from its more northern distribution and is the most southern known population
- *Hibbertia spicata* subsp. *leptotheca* (not found by Tingay 1999) is a priority taxon as is *Lasiopetalum membranaceum* (found by Tingay 1999); both are additional to the site description.

Discussion

- Lot 4 continues to be worthy of inclusion in Bushplan
- Similar vegetation occurs over Mandurah Road as described by Tingay 1999 but NOT of the same complexity (variety of vegetation units in association) as in BS395. All are worthy of retention and it is important to retain this central portion of the transect.
- The roads do divide the units but most areas have these problems

Lot 4 Mandurah Road, Bushplan Site 395
Field Inspection 30/6/99

Background
Lot 4 was included in Bushplan as
- contained Floristic community type 24 which is typical of shallow soils over Tamala Limestone (Spearwood Dune community - Cottesloe Complex - Central South); this is the most southern of these limestone ridges in the Metropolitan Area and the most substantial between here and Yalgorup NP, south of Mandurah.
- significant landscape feature
- together with Vegetation Units in the Agonis block to east shows all units typical of Spearwood Dunes in the area.

As this lot had not been visited for Bushplan (edge inspection only) its condition and the presence of Yoongarillup Complex were questionable.

Inspection
- Area does not contain Yoongarillup complex (ie agree Tingay 1999)
- Vegetation in Lot 4 was in Very Good (to Good Condition) with patches in Excellent condition (better than expected)
- Lot 4 contains a diversity of units typical of these soils from

Eucalyptus decipiens Shrub Mallee to Mixed Low Heaths with a variety of dominants (Melaleuca huegelii, Grevillea preissii, Hakea trifurcata - additional to site description)
- A series of significant taxa occur in the Lot
  - Taxa typical of Tamala Limestones; Grevillea preissii, Melaleuca huegelii, Diplolaena huegelii, Eucalyptus foecunda, Trymalium ledifolium subsp ledifolium, Hibbertia spicata subsp. leptotheca, Jacksonia calcicola.
  - Jacksonia calcicola is disjunct from its more northern distribution and is the most southern known population.
  - Hibbertia spicata subsp. leptotheca (not found by Tingay 1999) is a priority taxon as is Lasiopetalum membranaceum (found by Tingay 1999); both are additional to the site description.

Discussion
- Lot 4 continues to worthy of inclusion in Bushplan.
- Similar vegetation occurs over Mandurah Road as described by Tingay 1999 but NOT of the same complexity (Variety of vegetation units in association) as in BS 395. All are worthy of retention and it is important to retain this central portion of the transect.
- The roads do divide the units <u>but</u> most areas have these problems.

N

BS 395 Paganoni Swamp 1998

Run on 17-SEP-98 DEPARTMENT OF PLANNING AND URBAN DEVELOPMENT
APPLICATION DETAILS REPORT

FILE NUMBER 28-667-3 - (This File Is Currently Marked To - Records)

Status	:	APPROVED
Type	:	DEVELOPMENT
Application Date	:	20-MAY-97
Receipt Date	:	04-JUL-97
Planning Officer	:	S Chong
Local Authority	:	City Of Rockingham
Applicant(s)	:	C S R Readymix Quarries Ltd P O Box 138 GOSNELLS WA 6110
Owner(s)	:	C S R Readymix Quarries Ltd 75 Canning Highway VICTORIA PARK WA 6100
Sketch Date	:	04-JUL-97 Grid : CCD :
Subject	:	
Location	:	MANDURAH ROAD, KARNUP
Purpose	:	LIMESTONE EXTRACTION
LA Recommendation	:	CONDITIONAL APPROVAL
LA Zone Text	:	RURAL,NO ZONE
LA Zone Code	:	
MRS Zone Text	:	ADJOINS OTHER MAJOR HIGHWAYS,PARKS & RECREATION,RAILWAYS,URBAN DEFERRED
MRS Zone Code	:	
Land Description	:	Lots : 4 loc No : 16 Diagram : 41254 C/T : 1353/084
Related Files	:	
Decision	:	APPROVED- DAUT Date : 20-OCT-97
Allocate To Agenda	:	NOT ALLOCATED
Map Reference	:	PEEL 08.10
Carto Office Date	:	

CONSULTANTS

DEPT OF TRANS - COUNTRY REGION Area : STATE
Date Sent : 25-JUL-97 Date Reply :

RELATED L.A.

City Of Rockingham Reference : 28/667.MW
Date Sent : 29-JUL-97 Date Reply :

BOARD NOTES/CONDITIONS

The application for approval to commence development is granted subject to the following condition(s):

1.^I^Access to the subject land to be to the satisfaction and specification of Main Roads Western Australia.

2.^I^The excavation, management and rehabilitation of the subject land shall be to the satisfaction of the City of Rockingham.

3.^I^Compliance with the Mines Act and the Extractive Industry By-Laws.

4.^I^The applicant making satisfactory arrangements with the Commissioner of Soil Conservation for compliance with the Land Clearing Regulations administered under the Soil and Land Conservation Act 1945 (as amended).

5.^I^The excavation operations hereby granted are for a limited period, namely for a period of 5 years from the date of this approval.

If the development the subject of this approval is not substantially commenced within a period of two years from the date of this letter, the approval shall lapse and be of no further effect. Where an approval has so lapsed, no development shall be carried out without the further approval of the responsible authority having first been sought and obtained.

COMMITTEE NOTES

^B^NOTES TO COMMITTEE:^B^^C^^C^1.^I^This application seeks approval to extend existing limestone extraction operations over an area of approximately 2ha within the 140ha lot (refer to Attachments 1 and 2). The landowner (CSR Readymix) has extracted limestone from the subject land and rehabilitated affected areas accordingly over the last 10 years (previous approvals by the Commission in April 1986 and June 1992 - 28-667-1/2). ^C^^C^2.^I^The Commission's determination is required as portions of the subject land are reserved for Railways (Perth to Mandurah railway line), and Parks and Recreation under the MRS. The 2ha si) the subject of this application is partially within the Railways reservation and not on land reserved for Parks and Recreation. ^C^^C^3.^I^Council does not object to the proposal and has granted approval (extension to Extractive Industries Licence) subject to conditions. ^C^^C^4.^I^The Department of Transport does not object to the proposal and has suggested that it would be desirable to establish appropriate final contouring with the proponent at this stage to facilitate future construction of the railway line. ^C^^C^5.^I^Approval is recommended.

REPORT BODY

APPROVAL: with conditions (letter f)^C^^C^CONDITIONS:^C^^C^1.^I^Access to the subject land to be to the satisfaction and specification of Main Roads Western Australia.^C^^C^2.^I^The excavation, management and rehabilitation of the subject land shall be to the satisfaction of the City of Rockingham. ^C^^C^3.^I^Compliance with the Mines Act and the Extractive Industry By-Laws.^C^^C^4.^I^The applicant making satisfactory arrangements with the Commissioner of Soil

Conservation for compliance with the Land Clearing Regulations administered under the Soil and Land Conservation Act 1945 (as amended). ^C^^C^5.^I^The excavation operations hereby granted are for a limited period, namely for a period of 5 years from the date of this approval. ^C^^C^ADVICE TO APPLICANT:^C^^C^1.^I^#MTPS^C^^C^2.^I^The proponent is advised to liaise with the Department of Transport with respect to appropriate final contouring to facilitate the future construction of the proposed Perth to Mandurah railway line.

FOOTNOTE TO APPLICANT

A copy of this decision has been forwarded to the Local Government for information.

You are advised of the need to consult with the Local Government with regard to the gaining of all necessary approvals and the issuing of the requisite building licence.

This decision is issued pursuant to the provisions of the Metropolitan Region Scheme, and has been made by the Commission after due consideration of the regional planning implications of the proposal. The development must also comply with the requirements of Council's Town Planning Scheme(s) and any determination in this regard must be made by Council. The Commission's decision, therefore, is made without prejudice to any others that may be separately required from Council.

The proponent is advised to liaise with the Department of Transport with respect to appropriate final contouring to facilitate the future construction of the proposed Perth to Mandurah railway line.

It is advised that should the applicant be aggrieved by this decision there is a right of appeal pursuant to the provisions of section 8A of the Town Planning and Development Act 1928. Such an appeal must be submitted in accordance with Part V of the Act.

Lot Size	Zone	Lots Produced
	**********	
sum		

FINAL APPROVAL STATISTICS

=== E N D O F R E P O R T ===

41

BS 395

PB194

CITY OF ROCKINGHAM

Civic Boulevard, Rockingham
Western Australia

OUR REF: TP11-2-44 PM.mw
YOUR REF:

ENQUIRIES TO: Mr Monks

23rd April 1999

Manager
Environmental Planning Branch
Ministry for Planning
469 Wellington Street
PERTH WA 6000

Dear Sir

Re: Submission on the Draft Perth's Bushplan

I refer to your letter dated the 27th November 1998 inviting comment on the draft Perth's Bushplan. The report and plans were presented to Council at its ordinary Meeting held on the 23rd March 1999, where it was resolved to submit the following comments, which are divided into four sections:-

1. Principles and Recommendations.
2. Comments on specific sites nominated in the City of Rockingham.
3. General Comments.
4. Implementation.

1. PRINCIPLES AND RECOMMENDATIONS

The retention of regionally and locally significant bushland is an important measure that has the support of the City of Rockingham, and the draft Perth Bushplan provides important information and recommendations to achieve this objective.

The methodology used to establish which sites are of regional significance is clear, once the reporting structure of the various volumes of the documents is understood.

Council has attended a number of briefing sessions organised by the Ministry for Planning and WAMA and these sessions have played a very important role in understanding both the implications of the recommendations of Perth Bushplan, and the views of the various parties that are affected by the Report.

SUBMISSION NO. 501

(viii) Bushplan Site No 294 - Lake Amarillo, Serpentine River and Adjacent Bushland, Karnup

Council has previously supported the inclusion of the Serpentine River and its environs, in the locality of Amarillo, as a 'Parks and Recreation' reserve in the MRS. Future structure planning for the area should be consistent with the proposed status of the reserve as a Bushplan site.

(ix) Bushplan Site No [redacted] - Paganoni Swamp and Adjacent Bushland, Karnup

This site includes a portion of privately owned bushland west of Paganoni Swamp on the southern side of the CSR Quarry on Mandurah Road. This portion of the site is zoned 'Urban Deferred' and it is queried why this land is included as a Bushplan site, given its approval for extractive industries and its location adjacent to the Paganoni Swamp reserve, which would contain similar examples of the same vegetation complexes.

(x) Bushplan Site No [redacted] - Garden Island

Garden Island is reserved as 'Public Purposes - Commonwealth Government and Special Use' in the Metropolitan Region Scheme. The island comprises a significant parcel of remnant bushland and accordingly should be protected against any development that may threaten its current condition.

(xi) Bushplan Site No [redacted] - Serpentine River, Stakehill and Harvey Roads Bushland, Karnup

This site is adjacent to the Serpentine River, is a low lying well vegetated fringe area of the Serpentine River which is reserved in the MRS as 'Parks and Recreation', is an EPP wetland and is a Conservation status floodplain. It is appropriate that this site is included in Perth's Bushplan.

(xii) Bushplan Site No [redacted] - Point Peron and Adjacent Bushland, Peron/Shoalwater Bay

The majority of this area is reserved as 'Parks and Recreation' and, although portions of the area have been degraded through human activity, it comprises a regional recreation, tourist and conservation focus for the City. The site is included within the Rockingham Lakes Regional Park and CALM is currently preparing a Management Plan for this area. It is appropriate that it is included in Bushplan.

Subm 225 BS 395

93

Bushplan Site [redacted]:

I recommend extension of this site to include Part Lot 21 and Part Lot 60 on the Norman Road Bushland.

Bushplan Site [redacted]:

Wetland type bushland on the adjoining Lot 4 is threatened and should be included in that site.

Bushplan Site [redacted]:

This site includes the Modong Nature Reserve at Oakford and I recommend that it be extended to include good quality bush on Lots 22 and 23.

Bushplan Site [redacted]:

This site includes Sandy Lake and Bushland at Anketell. I particularly suggest inclusion of Lots 5. 12, 13 & 14 adjacent to this site (good quality Banksia Woodland).

Bushplan Site [redacted]:

I recommend the inclusion of the vegetated north east corner of part lot 40 Taylor Road. Forrestdale (near the corner of Armadale and Taylor Roads).

I thank you for the opportunity to comment on the Bushplan strategy.

Yours faithfully

JEFF A SPENCER.

104a

from Sam

~~CONFIDENTIAL~~

NATIONAL TRUST OF AUSTRALIA (WA)
LANDSCAPE ASSESSMENT FORM
NATURAL AND CULTURAL LANDSCAPES

1. IDENTIFICATION AND LOCATION

Current Name of Place: **Paganoni**

Other Names:

Location: The Paganoni area lies between Perth and Mandurah along the Mandurah Road about 10km north of Mandurah and about 50km south of Perth. It is 2km inland from the coast in the locality of Karnup, east of Singleton. The area is bounded by Paganoni Road in the north, Mandurah Road in the west, private agricultural land in the south and east, and the Serpentine River also to the east. It includes the whole of lot 2 Paganoni Road which has been acquired by the State government as a regional reserve on the southern boundary of the metropolitan region (as defined in the Perth Metropolitan Region Scheme).

The boundaries also include a southerly extension of the Paganoni wetland which stretches into the City of Mandurah and is outside the current boundaries of the Perth metropolitan region. The quarries in lots 1, 3 and 4 Paganoni Road are excluded from the area and the surrounding coastal heath within these lots is included.

Local Government Authority: City of Rockingham; City of Mandurah.
(Note: Notify Shire of Murray as Paganoni in on border of Shire of Murray.)

Map Reference Peel 10 000 BG 33/2.2 & /2.3. Scale 1:10,000

Property details
City of Rockingham:

1. Cockburn Sound Loc. 16, Lot 2 Paganoni Road is freehold land owned by the State Planning Commission (SPC) and is managed as a Reserve for the conservation of flora and fauna, currently being rezoned to "Parks and Recreation" in the Perth Metropolitan Region Scheme.
   (SPC, Albert Facey House, 469–489 Wellington Street Perth 6000.
   Tel: 264 7777; contact Marie Ward or Neil Robinson)
   Title No 1353/85 Plan 21 Lot 2 PT
2. Cockburn Sound Loc. 16, Lot 1 corner Paganoni Road and Mandurah Road is freehold land owned by Main Roads WA.
   (Waterloo Crescent, East Perth 6004 Tel: 323 4111)
   Title No. 1253/731 Diagram 27004
3. Cockburn Sound Loc. 16, Lot 3 near corner Paganoni Road and Mandurah Road is freehold land owned by the City of Rockingham.
   (PO Nox 42 Rockingham 6168 Tel: 528 0333)
   Title No. 1260/678 Diagram 27691
4. Cockburn Sound Loc. 16, Lot 4 Mandurah Road, is freehold land owned by CSR Ltd.
   (75 Canning Highway, Victoria Park 6100)
   Title No. 1353/84 Diagram 41254

City of Mandurah:

5. Cockburn Sound Loc. 16, Part Lot 1, Stock Route Road, is freehold land owned by Danchill Nominees P/L.
   (C/– M. Franconi & Assoc. 26 Milligan St, Perth.)
   Title No. 1905/779 Plan 12382
6. Cockburn Sound Loc. 16, Part Lot 41, Stock Route Road, is freehold land owned by Peet Mandurah Syndicate Pty Ltd. (7th Floor, 200 St. George's Terrace, Perth.)
   Title No. 1942/622 Plan 8813

3. ASSESSMENT

Type of Assessment (geological monument, natural landscape, cultural landscape): Natural environment.

Assessment Team:

Mary Gray, 24 Hillview Road, Mt Lawley 6050 Tel: 271 5707
Bronwen Keighery, 224 Hamersley Road, Subiaco 6008 Tel: 381 4062

Date assessed: April 1994

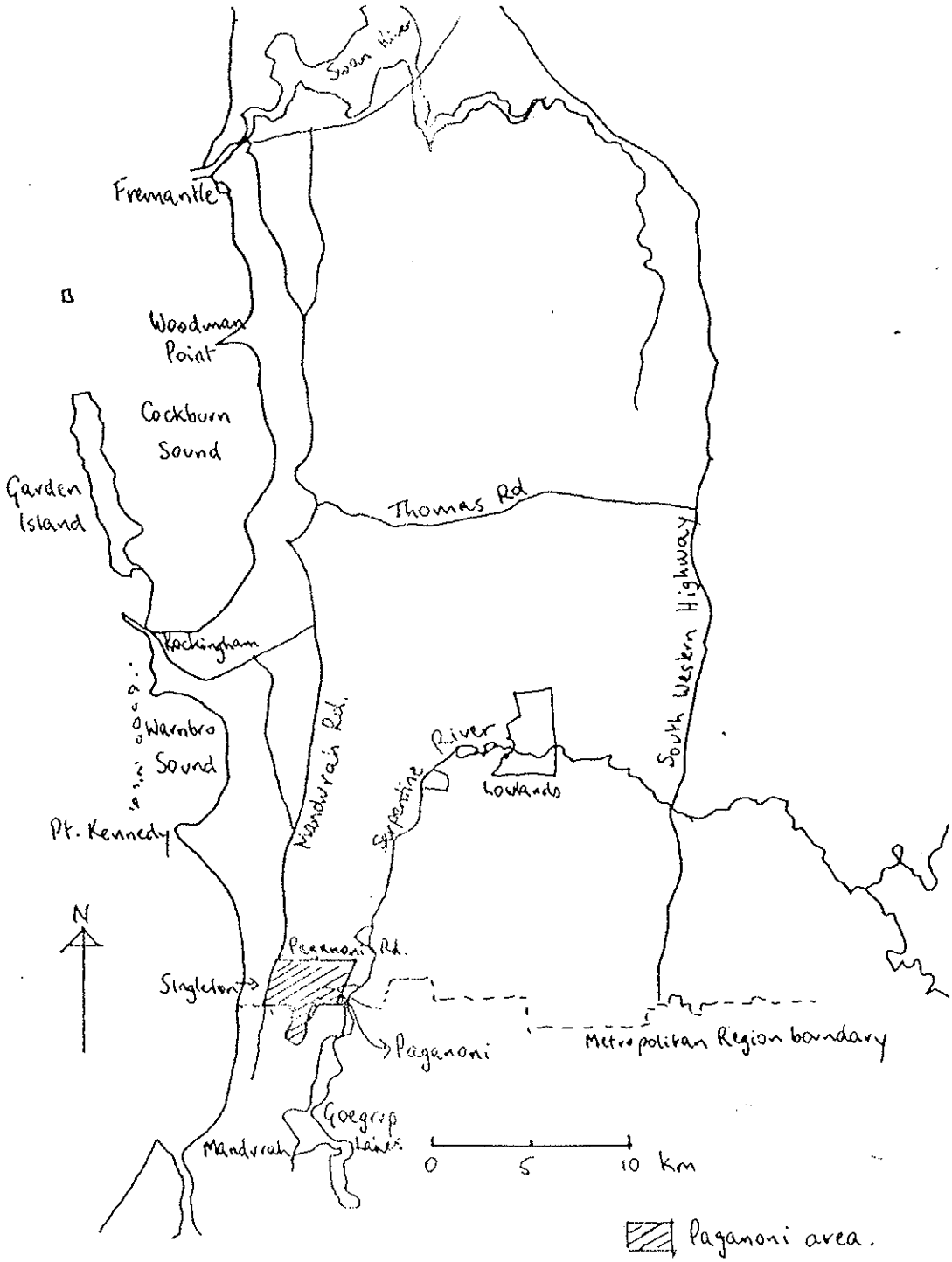
Note: This assessment is based on the nomination prepared by the Wildflower Society fo WA for the Register of the National Estate, natural environment section.

Previous Assessments:

1. "Environmental/Ecological Assessment of wetlands and uplands of the Paganoni area" by V & C Semeniuk Research Group, April 1991 was the subject of a report to the Department of Planning and Urban Development.

2. "Wetlands of the City of Rockingham, their classification, significance, and management" was prepared by V&C Semeniuk Research Group in December 1991, with funding from the NEGP. High conservation value of Paganoni area recognised in the report.

LOCATION MAP SHOWING PAGANONI



4. DESCRIPTION

The area comprises a range of Spearwood Dune landforms with a rich array of relatively undisturbed vegetation types typical of the central region of the Swan Coastal Plain. There are 4 wetlands and uplands present together with well developed transition zones from 4 different landforms which are described moving from west to east across the area.

Firstly the Cottesloe unit nearest the coast consists of low hilly landscapes with exposed limestone. A north south ridge system rises gently from the east to a peak at 30-40 m AHD and drops away more suddenly over 50 - 100 metres on the western slope. This limestone zone has relatively flat swales to 10 m AHD. The vegetation consists of a mosaic of low limestone heath assemblages of 50 different plant species. Dominant species include *Olearia Axillaris, Melaleuca acerosa, Acacia truncata, A. saligna,* and *A. cyclops.* There are a number of active limestone quarries in this zone which make a dramatic change to the morphology of the landscape.

Secondly moving east, a sudden change in the vegetation marks the change to the Yoongarillup landform. It consists of a similar pattern of lower ridges and swales and soils are shallow sands over limestone. The upland vegetation changes to a variety of woodlands consisting of various combinations of Banksia, Tuart, Marri, Jarrah, and Sheoak, identified in 5 different woodland communities. (1) In swales Tuart *Eucalyptus gomphocephala* grows with *Banksia attenuata, B. ilicifolia*; (2) on upper slopes of ridges there is low Banksia Woodland of *B. attenuata,* with Sheoak *Allocasuarina fraseriana*; (3) in the small depressions there is Mixed Woodland of Tuart, Jarrah *E. marginata, B. attenuata, B. grandis, B. menziesii,* Sheoak, Woody Pear *Xylomelum occidentale;* (4) on lower slopes is a woodland of Jarrah, *B. attenuata, B. menziesii;* and (5) in the wetter zone around the wetland is a Marri [illegible] *calophylla* Woodland.
The vegetated wetland itself covers about 8 ha and is either seasonally inundated or waterlogged depending on rainfall. It is similar to a Bassendean wetland of the Jandakot suite, and notably this wetland is mapped as a Bassendean landform by van Gool. The wetland vegetation consists of 3 communities: (1) heath dominated by *Pericalymma ellipticum* with *Calothamnus lateralis* and *Aotus* species; (2) woodland of *M. preissiana* and *B. littoralis* with an *Acacia saligna* understorey; (3) forest of *M. rhaphiophylla* with sedge understorey.

Thirdly the Karrakatta land unit is an undulating landscape with deep yellow sands over limestone. Uplands support open Tuart forest with *B. littoralis* and mixed sedge understorey of *Lepidosperma* and *Baumea* species in a narrow band around the Paganoni wetland and in the western side of the study area. The large Paganoni wetland (wetland no 1 by VCSRG) covers about 190 ha in a sumpland (seasonally inundated wetland although some surface water usually persists through summer) which is part of the linear chain known as the Stakehill Suite of wetlands. Its vegetation consists of zones with 3 communities. The outer zone is woodland of *B. littoralis* with *Acacia saligna* and sedge understorey. Then there is forest of *M. rhaphiophylla* with sedges. The central area consists of open heath of *M. teretefolia* and *Lepyrodia tenax* sedgeland, and also a low heath of *M. humulosa, M. teretifolia,* with sedgeland of *Gahnia trifida, Baumea juncea* and others. Only small areas (up to 10%) of open water occur.

Fourthly the Herdsman unit consists of low lying peaty swamps and floodplains comprising 2 interesting wetlands belonging to the Goegrup Suite. The first wetland covers some 6 ha and has an unusual ironstone organic hardpan up to 2 metres below the surface but ironstone sands are evident also in patches of surface soil. It supports (1) heath of *Pericalymma ellipticum, Scholtzia involucrata* and *Calytrix fraseri;* (2) open woodland of *Melaleuca preissiana* and *Eucalyptus rudis;* and (3) heath of *Astartea fascicularis.*
The second wetland covering some 4 ha has dampland with open flooded gum *E. rudis* and Melaleuca woodland with a *Pericalymma ellipticum* heath understorey.
Both of these Goegrup wetlands have floodplains which are associated with and are hydrologically part of the adjacent Serpentine River system, . The latter is the subject of System 6 recommendation M108 Goegrup Lakes and is a proposed Regional Park.

There is a population of about 60 Western Grey kangaroos that move through the area from the Serpentine River to the limestone heathlands on a regular basis for feeding and watering. Kangaroo gates constructed in the fencelines assist the passage of kangaroos. Other native fauna exists in the area but no survey work has been done to date.

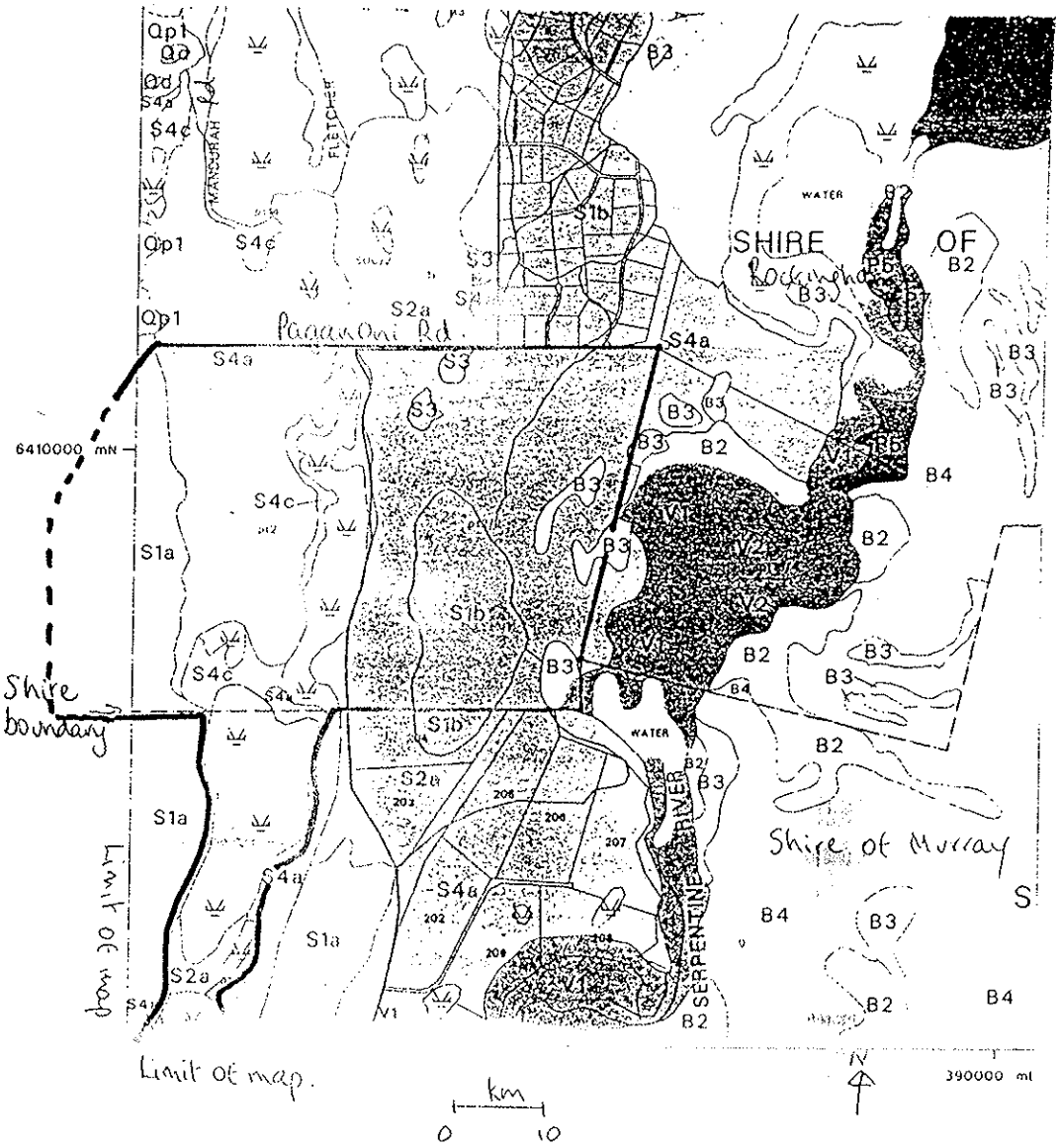
Stock Route Road, which traverses the area from north to south, is used for recreational horse-riding according to guidelines established between users and the Department of Planning and Urban Development (DPUD).

LANDFORMS AND SOILS OF THE PAGANONI AREA

Source: D. van Gool 1990, Land resources in the northern section of the Peel-Harvey Catchment, Swan Coastal Plain WA. WA Department of Agriculture.

Note: Below is a photocopy of the relevant section of the above colour map by van Gool. Unfortunately the area lies in the extreme south west corner of the area mapped. Thus the extreme west of the area adjacent to Mandurah Road [illegible]ern limit of the Paganoni wetland are beyond the limits of the map.

Refer legend on opposite page. Soils present in the area are mostly Spearwood units: S1a, S4a, S4c, S3, S1b, S2a; with small areas of Bassendean units: B3 in the location of wetlands no 2, 3, and 4. Wetland no 4 in the far south east corner of the area includes a small area mapped as Vasse V1 which is part of the Serpentine River floodplain. Ironstone is evident at the B3 area of wetland no 3 & 2. The Paganoni wetland, wetland no 1, is marked with \ 4



Bassendean Dune and Sandplain System: – Very low relief, leached, grey siliceous Pleistocene sand dunes, intervening sandy and clayey swamps and gently undulating plains. These occur immediately west of, and partly overlie, the Pinjarra Plain. Topography becomes more subdued from west to east.

B1 Extremely low to very low relief dunes, undulating sandplain and discrete sand rises with deep bleached grey sands sometimes with a pale yellow B horizon or a weak iron–organic hardpan at depths generally greater than 2 metres; banksia dominant

B1a As for B1, but with a more intensely coloured yellow B horizon occurring within 1 metre of the surface; marri and jarrah dominant (redgum rises)

B2 Flat to very gently undulating sandplain with well to moderately well drained deep bleached grey sands with a pale yellow B horizon or a weak iron organic hardpan at 1–2 metres

B2a As for B2, but with a more intensely coloured yellow B horizon usually well within 1 metre of the surface

B3 Closed depressions and poorly defined stream channels with moderately deep, poorly to very poorly drained bleached sands with an iron–organic pan, or clay at generally less than 1 metre depth; surfaces are dark grey sand or sandy loam

B4 Broad poorly drained sandplain with deep grey siliceous sands or bleached sands, underlain at depths generally greater than 1.5 metres by clay or less frequently a strong iron–organic pan

B5 Shallowly incised stream channels of minor creeks and rivers with soils similar to B4 (and B6)

B6 Sand plain similar to B4 with imperfectly drained soils

Spearwood Dune and Sandplain System: – Gently to moderately inclined low hills and gently undulating plain located west of the Bassendean System and associated with Pleistocene, Tamala Limestone. Hills consist of a core of friable aeolianite, capped by secondary calcite and overlain by variable depths of rapidly drained siliceous yellow–brown sands. The gently undulating plain is the surface expression of the consolidated marine limestone component of the Tamala Limestone.

S1 Dune ridges with:

a. shallow to moderately deep siliceous yellow–brown sands, very common limestone outcrop and slopes 5 to 15%

b. deep siliceous yellow brown sands or pale sands with yellow–brown subsoil, and slopes 5 to 15%

*c. deep bleached grey sands with yellow–brown subsoils, and slopes 5 to 15%

*d. moderately deep to deep siliceous yellow–brown sands, rare limestone outcrop and slopes 15 to 25% occurring on the eastern slipface

S2 Lower slopes (1 to 5%) of dune ridge with:

a. moderately deep to deep siliceous yellow–brown sands or pale sands with yellow–brown subsoils, and minor limestone outcrop

*b. shallow to moderately deep siliceous yellow–brown sands and common limestone outcrop

S3 Inter dunal swales and depressions with gently inclined sideslopes and deep rapidly drained siliceous yellow–brown sands

S4 Flat to gently undulating sandplain with:

a. deep, pale and sometimes bleached, sands with yellow–brown subsoils

*b. shallow to moderately deep siliceous yellow–brown and grey–brown sands with minor limestone outcrop

c. deep, yellow–brown or dark brown siliceous sands that are seasonally inundated

Quindalup Dune System: –Coastal dune formations of unconsolidated Holocene aeolian deposits, occurring to the west of the Spearwood Dunes. The major formations are moderately inclined to steep sided, low relief complex parabolic dunes fronted by foredunes. The soils are rapidly drained, uniform pale calcareous sands.

* Qf2 Relict foredunes and gently undulating beach ridge plain with deep uniform calcareous sands.

* Qf2a More prominent relict foredune ridges which occur within unit Qf2.

* Qf3 Relict foredunes forming a plain which is topographically lower than Qf2 with prominent ridges and swales. Swamps frequently occupy the swales

* Qp1 Complex of nested low relief parabolic dunes with moderate to steep slopes and uniform calcareous sands showing variable depths of surface darkening

* Qp2 Long walled discrete parabolic dunes with similar slopes and soils to Qp1

* Qd Small gently undulating plains (deflation basins) enclosed by discrete parabolic dunes with moderately deep to deep calcareous sands over limestone

Vasse Estuarine and Lagoonal deposits: —Low lying poorly drained terraces, flats and beach ridges fringing the Peel–Harvey estuarine system, the coastal lakes and major river mouths. Soils are extremely variable, being formed on unconsolidated Holocene estuarine alluvium and lagoonal deposits, and are often highly saline and subject to periodic inundation.

V1 Saline tidal flats composed of grey, black and brown fluvial muds and humic sandy clays with locally common shell and limestone fragments

V2 Samphire covered sand and mud flats marginally higher than V1 and frequently inundated; with deep alkaline alluvial sands and clayey sands

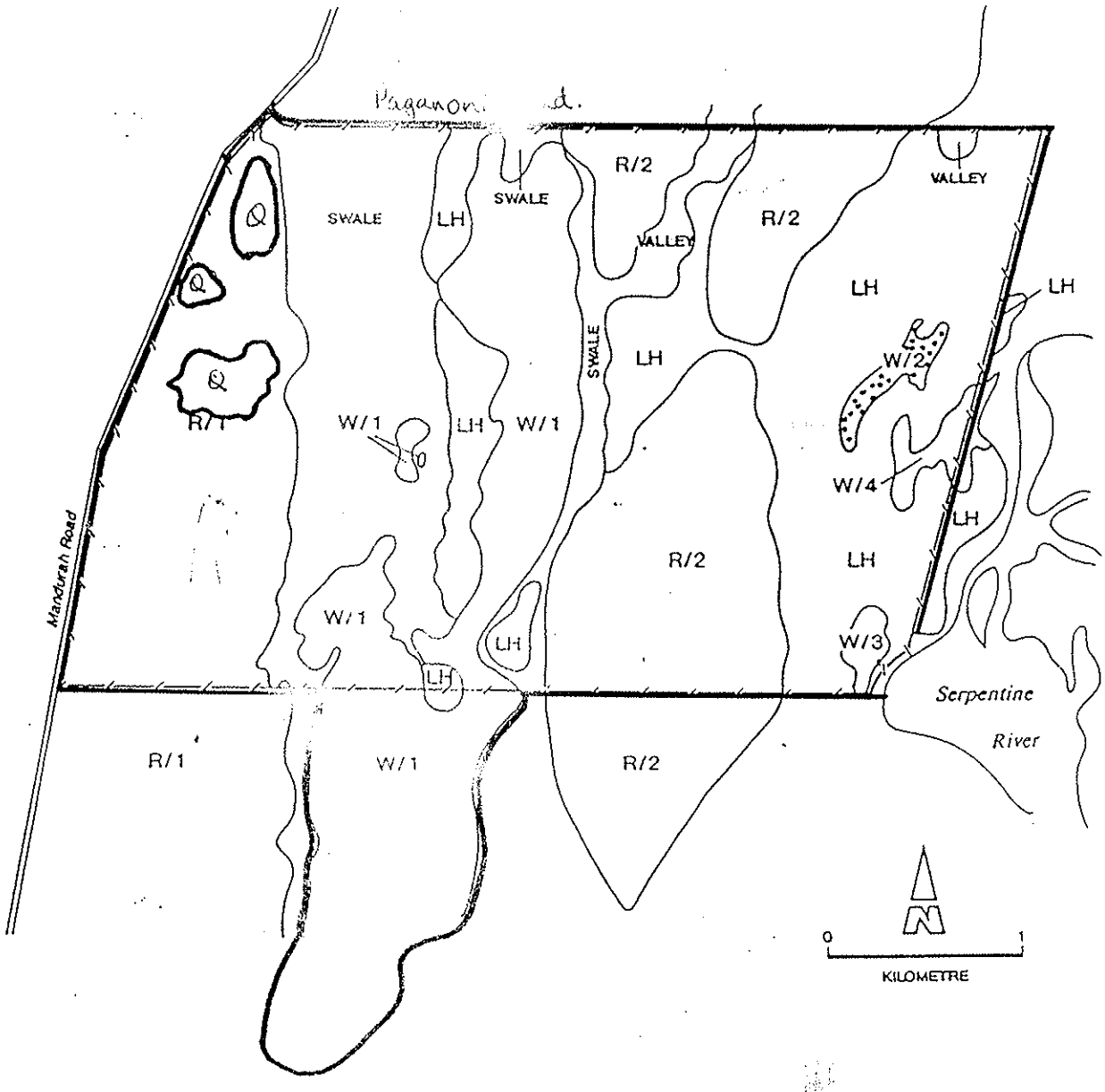
* V4a Intermediate level terrace fringing lakes. The deep calcareous soils comprise black loams overlying brown to grey silty clay and muddy sands at depth

* V6 Upper level sandy terrace and gently undulating beach ridges with deep grey or bleached pale brown siliceous sands overlying soft shelly limestone

V9 Areas of former swamps which have been artificially drained, with uniform loamy or peaty soils

MEDIUM SCALE
GEOMORPHIC UNITS IN THE PAGANONI AREA AND SURROUNDS

Source: VCSRG 1991



WETLANDS

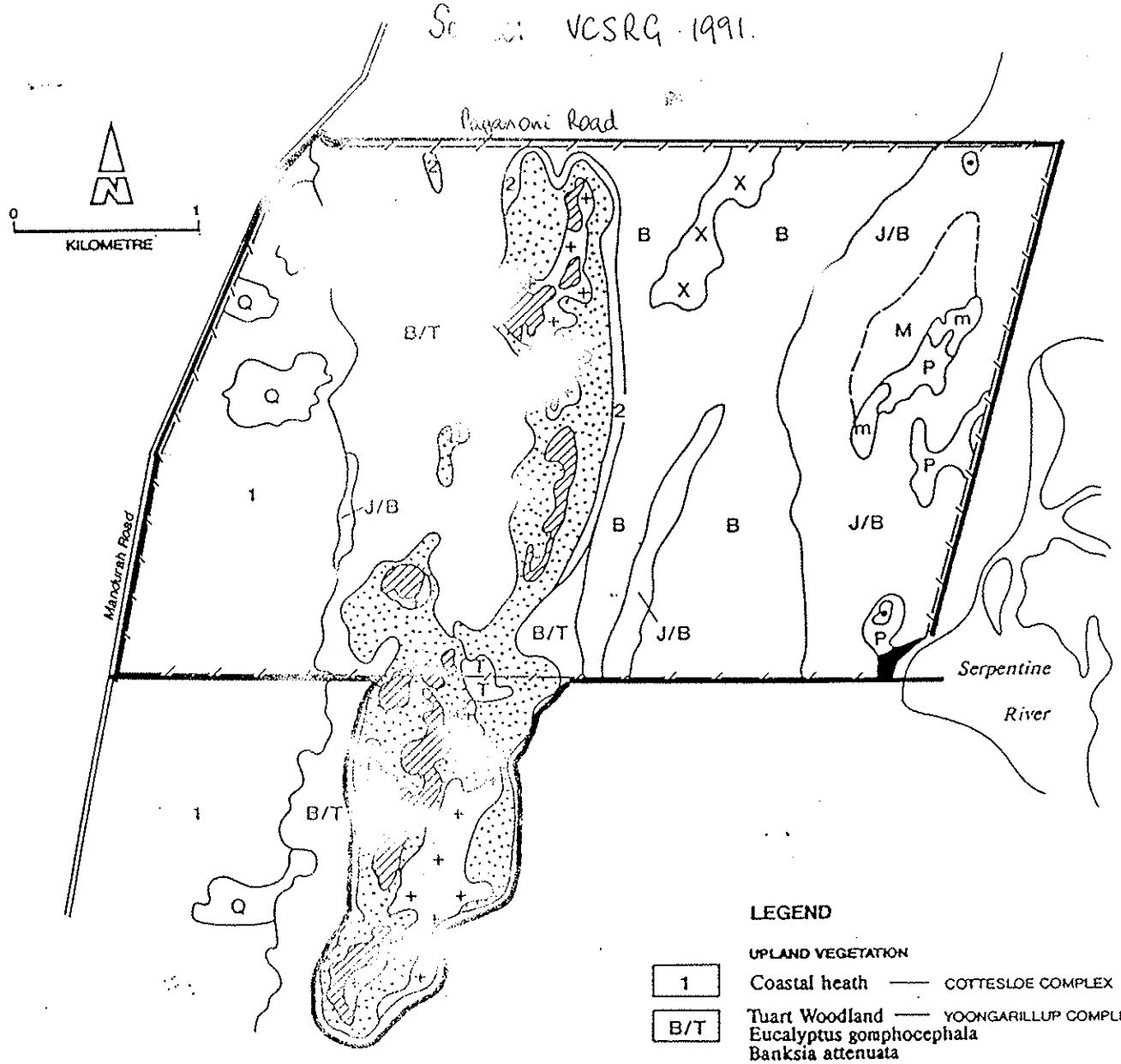
W/1	Sumpland, Paganoni wetland
W/2	Dampland/sumpland-Yoongarillup unit
W/3	Dampland and Floodplain
W/4	Dampland and Floodplain

LEGEND

—/—/—	Boundary of Paganoni Area Studied by VCSRG for DPUD 1991.
R/1	Limestone ridge - COTTESLOE UNIT
R/2	Older limestone and yellow sand ridge - YOONGARILLUP UNIT
LH	Low hills forming part of the main ridge system
VALLEY	Small scale depressions within the main system
SWALE	Swale between two main ridges
Q	quarry (excluded)
———	Boundary of area nominated.

SMALL SCALE
VEGETATION ASSEMBLAGES IN THE PAGANONI AREA

Source: VCSRG 1991.



LEGEND

WETLAND VEGETATION

- Melaleuca rhaphiophylla forest
- \+ Baumea juncea and Baumea articulata sedgeland with patches of Melaleuca hamulosa heath
- Melaleuca teretifolia low heath
- P Perycalymma ellipticum heath
- • Melaleuca preissiana open woodland
- Astartea fascicularis heath
- m Melaleuca rhaphiophylla and Banksia littoralis

Boundary of area nominated

UPLAND VEGETATION

- 1 Coastal heath — COTTESLOE COMPLEX
- B/T Tuart Woodland — YOONGARILLUP COMPLEX
  Eucalyptus gomphocephala
  Banksia attenuata
  Banksia illicifolia
- 2 Tuart Woodland — KARRAKATTA COMPLEX
  E. gomphocephala
  Banksia littoralis
- B Banksia Woodland — YOONGARILLUP COMPLEX
  B. attenuata
  Allocasuarina fraseriana
- X Mixed Woodland — YOONGARILLUP COMPLEX
  B. attenuata
  Banksia menziesii
  Banksia grandis
  A. fraseriana
  Eucalyptus marginata
  E. gomphocephala
  Xylomeleum occidentalis
- J/B Jarrah Banksia Woodland — YOONGARILLUP COMPLEX
  A. attenuata
  B. menziesii
  E. marginata
- M Marri Woodland — YOONGARILLUP COMPLEX
  Eucalyptus calophylla
- Q Quarry for limestone and sand
- T Tuart Woodland — KARRAKATTA COMPLEX
  E. gomphocephala

5. STATEMENT OF SIGNIFICANCE

+ 0 presence of endangered species, communities
+ 1 scientific importance
+ 2 educational importance
3 social importance
+ 4 aesthetic importance
5 historic importance
+ 6 recreational importance
+ 7 diversity of species, communities
+ 8 'naturalness'
+ 9 rarity
+ 10 fragility
+ 11 position in an ecological or geographic unit

The wetland and upland ecosystems in the area are intact and in a relatively undisturbed and unbroken contiguous system making it an area of outstanding biological integrity on the Swan Coastal Plain south of the Swan River. The relatively undisturbed vegetation associations present in the area are representative of a wide range of vegetation complexes historically present in the central part of the Swan Coastal Plain. This is the best remnant in the south west corridor region and in the metropolitan region south of the Swan River, with particularly well developed transition zones between wetland and upland vegetation and between successive vegetation complexes. The variety of habitats enables fauna such as kangaroos to move regularly between various feeding, watering and shelter areas. The vegetated uplands also act as a buffer against disturbance of the groundwater system.

The diversity of 4 different landform and soil units (Cottesloe, Yoongarillup, Karrakatta, and Herdsman units); 3 wetland types (sumplands, damplands and floodplains); and 3 Wetland Suites (Stakehill, Yoongarillup, and Goegrup Suites) contribute to a diverse assemblage of 15 plant communites in Paganoni. The vegetation of wetlands, uplands and transition zones are well represented, with most major forest and woodland species of the Swan Coastal Plain being present.

The Paganoni Wetland is the largest in the linked system of Stakehill Wetlands and is the only one with its upland vegetation complexes still intact (in its northern half only).

There are two of the extremely rare (on the Swan Coastal Plain) floodplain wetlands present in the area. On the Swan Coastal Plain, floodplains are restricted to narrow fringing zones beside Goegrup Lake and Yalbanerup Pool and to a small extent wetlands in the Jandakot area. The floodplains at Paganoni act as flowthrough areas to the Serpentine River and are crucial in maintaining water quality and quantity in the adjacent river system.

The vegetated Yoongarillup Wetland and associated upland plant communities represent an important intact example of this now uncommon community due to land clearing and filling for development. The diverse communities comprise three wetland types: *Pericalymma ellipticum* heath, *Melaleuca preissiana-Banksia littoralis* woodland and *M. rhaphiophylla* forest communities; and five types of upland woodlands of Jarrah, Low Banksia, Mixed Woodland, Marri-Banksia, and Marri Woodland.

The Paganoni area provides the largest remaining example of the limestone heath vegetation of the Cottesloe - Central and South complex. The other three being at Leda, Tamworth Hill, and in a linear strip along Mandurah Road from Peel Forest to Madora

The diversity of vegetation in the seasonal wetlands in the area provides a wide range of habitats for aquatic invertebrates which are thus likely to be diverse in terms of species represented. In addition to aquatic invertebrates, Paganoni provides a wildlife refuge to mammals, birds, reptiles, insects and spiders. All these natural features, including the meandering Serpentine River on the eastern side of Paganoni, provide aesthetic relief in a contrasting cultural landscape of agricultural, industrial and urban land uses in the surrounding area.

Paganoni provides a valuable educational and scientific resource contributing to a better understanding of the distribution of plant communities, transition zones between different plant communities, and in ecological [illegible]

6. CONDITION

The general condition of Lot 2 is excellent, with disturbance limited to Stock Route Road and firebreaks. Lot 2 is fully fenced with special 'gates' for horse-riders and others for kangaroos. Stock Route Road is unsealed sand track and transects the area north to south, is a gazetted road and has a SECWA easement along it with a power line. Horse-riding is permitted in Lot 2 only along Stock Route Road and there is also a track outside the fenceline along the firebreak available for horse-riding. Firebreaks within Lot 2 are not open to riders although there is some illegal use.

There is little to no aggressive weed invasion along tracks and firebreaks in Lot 2. Invasion of weeds is mostly via seed dispersed from cleared land to the south of the area, with Apple of Sodom being the worst in the south east of the area. It is controlled by spraying. There are 12 weed species recorded in the area, many of which are widespread in particular plant communities but are never common or dominant. In the coastal heath there are weeds such as *Diplotaxis muralis, Euphorbia terac, Romulea rosea,* and *Trachyandra divaricata*
Grazing in the past by cattle on Lot 2 has had little impact on most of the area being largely impenetrable and unpalatable to stock.

There has been no fire in Lot 2 for at least 7 years, but the limestone heath has been burnt often and is in poorer condition with more weed invasion as a result. The limestone ridge on the eastern side of the Cottesloe unit is a critical geomorphological feature which protects the habitats on its western side from frequent fires, winds and winter storms. It is therefore important that its shape and stability be maintained.

The major disturbance factor in the area is quarrying for limestone within the Cottesloe unit. There are established quarries in Lots 1 and 3, and there is a large quarry currently being mined in the north of Lot 4. The main limestone ridgeline on the east remains intact and there does not appear to be any quarry rehabilitation after mining. There is also a large limestone and sand quarry adjacent to the area in the south east and straddling both Cottesloe and Yoongarillup units which must have at least some impact on the water table and groundwater hydrology of the Paganoni wetland (wetland no 1). The extent of groundwater perturbations are not known although the Water Authority has pisometers in the area to study groundwater movements.

7. RATIONALE FOR PROPOSED BOUNDARIES

The whole of Lot 2 is included because it is in exceptionally good condition and has high natural heritage values for wetlands, uplands and transition zones which are all intact. On the western border of Lot 2 is the Cottesloe unit, little of which remains in its natural state on the Swan Coastal Plain. While its condition is variable due to fires and quarrying in the Paganoni area, it is an integral part of the linked landscape system with important values as representation of the increasingly rare Cottesloe- central and South complex. It also provides important feeding habitat for kangaroos which move in and out of the coastal heath on a regular sometimes daily basis. The quarries themselves are omitted from the area as they are not vegetated and the surface landform has been removed leaving large holes in the ground. It is recognised that some of the quarries are actively being mined at present (1994).

The southern part of the Paganoni wetland which lies in the Shire of Murray is also included as its wetland vegetation is still relatively intact . The boundary includes the wetland vegetation and an upland zone, albeit in poor condition, outside this to an arbitrary distance of 50 metres. There is a large quarry which may threaten the Paganoni wetland if it comes too close.

The south east corner of the area adjoins the Serpentine River where wetland no 3 is an integral part of the river system. Indeed anecdotal evidence suggests that all the 4 wetlands in the area are part of the Serpentine River System and that subsurface flow of fresh water through the wetlands is quite rapid, being part of the greater river flow. It has also been noticed that the water in the wetlands is relatively cold, whereas if it were stationary or almost so, the water would warm up considerably in summer. The Serpentine River in this region is the subject of System 6 recommendation M108, also an area of natural heritage value, but which is not the subject of this nomination. Thus it is difficult to draw a boundary on ecological grounds as both areas merge into each other. The boundary drawn is arbitrary, and recognises the interlinking of the Serpentine floodplain and the Paganoni area by including the contiguous section of the river. The Serpentine River floodplain deserves consideration for evaluation of National Estate values in its own right.

8. CONSERVATION RECOMMENDATION

A natural heritage conservation plan (or management plan) be prepared and implemented for the area.

9. PERSONAL CONTACTS

1. Christine Semeniuk, V&C Semeniuk Research Group, 21 Glenmore Rd Warwick 6024. Telephone 09 447 3708.
2. Matthew Stafford, DPUD Ranger responsible for management of Paganoni, Albert Facey House 469-489 Wellington St Perth 6000. Telephone 09 264 7777.
2. Greg J. Keighery, Department of Conservation and Land Management (CALM) botanist, Woodvale Research Centre, Ocean Reef Rd., Woodvale. Telephone 09 405 5100.
3. Bronwen J. Keighery, Consulting Botanist, Swan Coastal Plain Survey, 224 Hamersley Rd., Subiaco. Telephone 09 381 4062.
5. Shirley Balla, aquatic invertebrates, series of publications on Wetlands of the Swan Coastal Plain, Water Authority of WA, PO Box 100 Leederville 6007. Telephone 09 420 2420.
6. Kim Taylor, Manager Groundwater Branch, Water Authority of WA PO Box 100 Leederville 6007. Telephone 09 420 2420. Also Tim Katsavounidis, same section.
7. Joan Payne, Wetlands Conservation Society, telephone 09 397 6380.

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11. ATTACHMENTS

Plant species found in the Paganoni area by VCSRG 1991

Paganoni — area classified. — AREA SUBMITTED FOR SYSTEM 6 INCLUSION

Need IP address for 427277 Telstra Margaret Downer

PT. PEEL 10000 BG 33/2.3

TOWNSITE (L.G.A.)

LOT 1 53 ACRS

LOT 3 19 ACRS

LOT 4 140.62 HECTS

LOT 2 699.2639 HECT

LOT 1 25 HECTS

496.04 HECT

PT. PEEL 10000 BG 33/2.2

Area

PA

Refe
of
of

BS 3/15 Spearwood S4W

FOR INTERNAL USE ONLY **from Gibson *et.al* 1994**

CONTACT DR N. GIBSON CALM WOODVALE for further information.
Flora list for Paganoni Swamp (extracted from Swan Coastal Plain database, Paga 1-8, 196 taxa, 9/5/1995).

Department of Environmental Protection System 6 Update: Site Based Flora List Paganoni Swamp
(extracted from the CALM Swan Coastal Plain database, Paga 1-8, 196 taxa, 9/5/95)

Anthericaceae
Caesia micrantha
Chamaescilla corymbosa
Dichopogon capillipes
Sowerbaea laxiflora
Thysanotus arenarius
Thysanotus multiflorus
Thysanotus sp. scps

Apiaceae
Apium prostratum
Daucus glochidiatus
Eryngium pinnatifidum subsp. pinnatifidum scps
Homalosciadium homalocarpum
Hydrocotyle diantha
Trachymene coerulea
Trachymene pilosa
Xanthosia huegelii

Asteraceae
* Arctotheca calendula
* Aster subulatus
Brachyscome iberidifolia
* Conyza albida
* Hypochaeris glabra
Lagenifera huegelii
Millotia myosotidifolia
Podolepis gracilis
Podolepis gracilis swamp (GJK 13126)
Podotheca chrysantha
Quinetia urvillei
Rutidosis multiflora
Siloxerus humifusus
* Sonchus oleraceus
* Ursinia anthemoides

Brassicaceae
* Heliophila pusilla

Caryophyllaceae
* Cerastium glomeratum
* Petrorhagia velutina
* Silene gallica
* Stellaria media

Casuarinaceae
Allocasuarina fraseriana

Centrolepidaceae
Aphelia cyperoides
Centrolepis alepyroides
Centrolepis aristata

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Flora list for Paganoni Swamp (extracted from Swan Coastal Plain database, Paga 1-8, 196 taxa, 9/5/1995).

Colchicaceae
- Burchardia multiflora
- Burchardia umbellata

Crassulaceae
- Crassula colorata

Cyperaceae
- Baumea juncea
- Baumea vaginalis
- Cyathochaeta avenacea
- Gahnia trifida
- * Isolepis marginata
- Lepidosperma angustatum
- Lepidosperma longitudinale
- Mesomelaena tetragona
- Schoenus brevisetis
- Schoenus odontocarpus
- Schoenus rodwayanus

Dasypogonaceae
- Acanthocarpus preissii
- Lomandra caespitosa
- Lomandra hermaphrodita
- Lomandra sericea
- Lomandra suaveolens

Dilleniaceae
- Hibbertia hypericoides
- Hibbertia racemosa
- Hibbertia stellaris

Droseraceae
- Drosera erythrorhiza
- Drosera gigantea
- Drosera glanduligera
- Drosera menziesii
- Drosera menziesii subsp. penicillaris
- Drosera neesii
- Drosera nitidula
- Drosera pallida

Epacridaceae
- Astroloma pallidum
- Brachyloma preissii
- Conostephium preissii
- Leucopogon propinquus

Euphorbiaceae
- Phyllanthus calycinus

Geraniaceae
- * Erodium botrys
- * Geranium molle
- Pelargonium littorale

CONTACT DR N. GIBSON CALM WOODVALE for further information.
Flora list for Paganoni Swamp (extracted from Swan Coastal Plain database, Paga 1-8, 196 taxa, 9/5/1995).

Goodeniaceae
- Dampiera linearis
- Goodenia pulchella
- Lechenaultia expansa
- Scaevola canescens

Haemodoraceae
- Anigozanthos humilis
- Conostylis aculeata
- Conostylis juncea
- Haemodorum laxum
- Haemodorum sp. scps
- Tribonanthes australis

Iridaceae
- Patersonia occidentalis

Juncaceae
- * Juncus bufonius
- Juncus pallidus
- Luzula meridionalis

Juncaginaceae
- Triglochin procerum

Lauraceae
- Cassytha racemosa

Lobeliaceae
- Lobelia alata
- Lobelia tenuior

Loranthaceae
- Nuytsia floribunda

Lycopodiaceae
- Phylloglossum drummondii

Menyanthaceae
- Villarsia albiflora

Mimosaceae
- Acacia cochlearis
- Acacia pulchella
- Acacia saligna
- Acacia stenoptera
- Acacia willdenowiana

Myoporaceae
- Myoporum caprarioides

Myrtaceae
- Eucalyptus calophylla
- Eucalyptus gomphocephala
- Eucalyptus marginata

Flora list for Paganoni Swamp (extracted from Swan Coastal Plain database, Paga 1-8, 196 taxa, 9/5/1995).

Eucalyptus rudis
Kunzea ericifolia
Melaleuca preissiana
Melaleuca rhaphiophylla
Pericalymma "floridum" scps

Onagraceae
Epilobium hirtigerum

Orchidaceae
Caladenia flava
Caladenia latifolia
Caladenia longicauda subsp. calcigena ms scps map
Leporella fimbriata
Lyperanthus nigricans
Microtis aff. media scps
Microtis media warr subsp. media
Prasophyllum brownii
Prasophyllum sp. scps
Pterostylis aff. nana scps
Pterostylis aff. sanguinea scps
Pterostylis sp. nov. "paganoni" scps
Pterostylis sp. scps
Thelymitra aff. pauciflora scps
Thelymitra antennifera
Thelymitra benthamiana
Thelymitra flexuosa

Orobanchaceae
* Orobanche minor

Oxalidaceae
Oxalis perennans

Papilionaceae
Bossiaea eriocarpa
Daviesia triflora
Dillwynia dillwynioides
Eutaxia virgata
Gompholobium tomentosum
Hardenbergia comptoniana
Hovea trisperma var. trisperma
Isotropis cuneifolia
Jacksonia furcellata
* Lotus sp. scps
Nemcia capitata
Nemcia reticulata
* Trifolium arvense
* Trifolium campestre
* Trifolium sp. scps

Poaceae
* Aira caryophyllea
* Briza maxima
* Briza minor
* Bromus diandrus

Flora list for Paganoni Swamp (extracted from Swan Coastal Plain database, Paga 1-8, 196 taxa, 9/5/1995).

Danthonia occidentalis
Dichelachne crinita
* Ehrharta calycina
* Holcus setiger
Microlaena stipoides
* Poa annua
Poa drummondiana
Poa poiformis
Stipa flavescens
* Vulpia bromoides
* Vulpia myuros
* Vulpia sp. scps

Primulaceae
* Anagallis arvensis
Samolus junceus

Proteaceae
Banksia attenuata
Banksia grandis
Banksia littoralis
Banksia menziesii
Dryandra nivea
Grevillea crithmifolia
Hakea varia
Petrophile linearis
Stirlingia latifolia
Synaphea spinulosa

Restionaceae
Hypolaena exsulca
Leptocarpus roycei ms sthcst
Lepyrodia glauca
Lepyrodia muirii
Loxocarya flexuosa
Loxocarya pubescens
Lyginia barbata

Rubiaceae
Opercularia hispidula
Opercularia vaginata

Selaginellaceae
Selaginella gracillima

Stackhousiaceae
Stackhousia monogyna

Stylidiaceae
Levenhookia stipitata
Stylidium brunonianum
Stylidium calcaratum
Stylidium dichotomum
Stylidium piliferum
Stylidium repens
Stylidium schoenoides

CONTACT DR N. GIBSON CALM WOODVALE for further information.

Flora list for Paganoni Swamp (extracted from Swan Coastal Plain database, Paga 1-8, 196 taxa, 9/5/1995).

Thymelaeaceae
Pimelea rosea

Violaceae
Hybanthus calycinus

Zamiaceae
Macrozamia riedlei

Spearwoods Submn 11 (197)

CITY OF ROCKINGHAM

Civic Boulevard, Rockingham,
Western Australia

OUR REF: TP11-2-11 PM.mw
YOUR REF:

ENQUIRIES TO: Mr Monks

3rd October 1995

The System Six Study Team
Department of Environmental Protection
141 St George's Terrace
PERTH WA 6000

ATT: Mr K McAlpine

Dear Sir

Re: System Six Update

The current review of the System Six recommendations were considered by Council at its ordinary Meeting held on the 26th September 1995. Council resolved that the following modifications and additions to the System Six Areas be submitted for consideration:-

1. Modification of Existing System Six Areas

   (i) M107 - Peelhurst, Singleton and Madora

   The recommendations of the System Six Report have in part been overturned by the EPA and the Minister for the Environment in approving urban development at Singleton and Golden Bay.

   It is recommended that the boundaries of this recommendation should be modified to exclude the east-west transects where urban development has been approved. It is desirable, however, that the System Six recommendations remain over the land currently zoned Rural in the Metropolitan Region Scheme and Special Rural under Town Planning Scheme No.1, this being the Peelhurst and Singleton Special Rural Zones (see attached plan).

   (ii) Similarly M103 should be modified to delete the area between Green Meadows and the Port Kennedy Business Park recently rezoned to Urban and Industrial under the Metropolitan Region Scheme, a portion of which is currently being rezoned to Development Zone under Town Planning Scheme No.1. M103 should, however, be extended to take into account the MRS Parks and Recreation Reserve around Tamworth Swamp (see attached plan).

   (iii) M106 at Port Kennedy should be modified to exclude that portion of Secret Harbour approved for urban development and to rationalise the boundaries to coincide with the boundaries of the 'Scientific Park' to the west of the Warnbro Sound Avenue extension (see attached plan).

The recommendations applicable to Garden Island, Cape Peron, Lake Richmond and the Serpentine River remain relevant and should remain.

2. Additional Areas to Be Included in System Six

(i) An additional area within the City that should be investigated for possible inclusion within the System Six Report is the Paganoni and Anstey Swamp area which is a Regional Reserve for Parks and Recreation under the Metropolitan Region Scheme and classified by the National Trust.

The above wetland is currently protected by an Environmental Protection Policy, however, incorporating it into a System Six recommendation may provide additional benefits in terms of its protection.

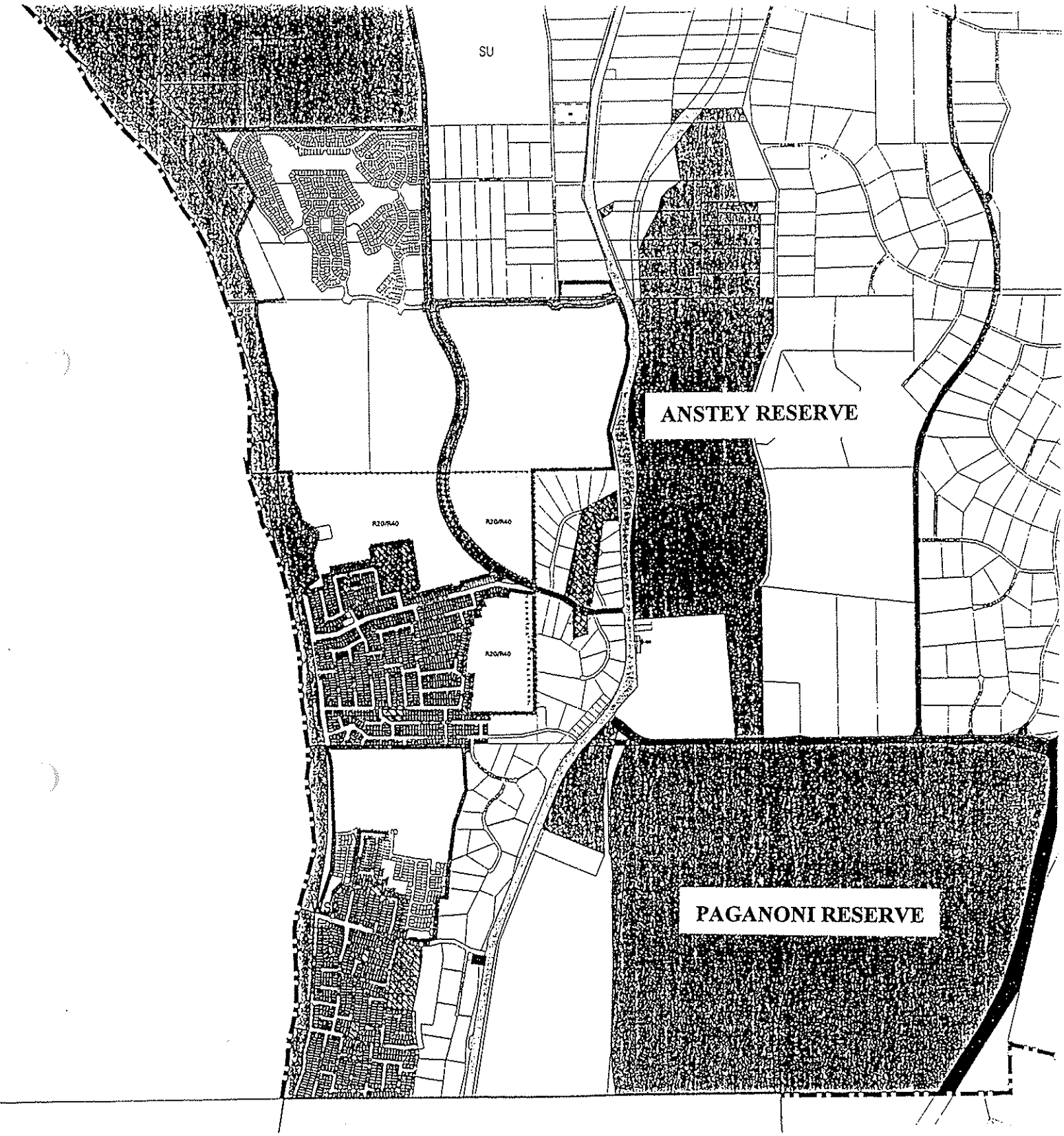
Council also resolved to consider the recommendations contained within the Red Book (Status Report 1993) for System Six with the view towards pursuing those recommendations that remain outstanding. A submission on Council's approach to implementing the recommendations will be forwarded to you following consideration of the Report.

As Council does not have a copy of the above Report, could a copy be forwarded to Council so that this matter can be progressed.

Should you have any enquiries with respect to this advice please do not hesitate to contact Mr Peter Monks on 528 0330.

Yours faithfully

G G HOLLAND
CHIEF EXECUTIVE OFFICER



ANSTEY & PAGANONI RESERVES TO BE INCLUDED

ENVIRONMENTAL/ECOLOGICAL ASSESSMENT OF WETLANDS AND UPLAND OF PAGANONI AREA

Report to : Department of Planning and Urban Development
Albert Facey House
469 Wellington St.,
PERTH WA 6000

Report by : VCSRG
21 Glenmere Rd.,
WARWICK WA 6024

3rd April, 1991

ENVIRONMENTAL/ECOLOGICAL ASSESSMENT OF WETLANDS AND UPLAND OF PAGANONI AREA

Table of Contents

1.0 INTRODUCTION

Urbanisation of the South West Corridor of Metropolitan Perth has proceeded very rapidly in the past decade, and as a consequence, it has been necessary for planners to revise Concept plans for the landuses and location of infrastructures necessary to support an increasingly large population. In conjunction with this revision, DPUD invited V & C Semeniuk Research Group [VCSRG] to carry out an environmental audit of the South West Corridor, and to "make initial determination on areas within the corridors suitable for the conservation of environmental and wildlife values only". One such area, referred to as the Paganoni Area (Fig. 1), was highlighted in preliminary surveys, and subsequently became the focus of a more detailed appraisal to determine the extent of regional and local conservation values in order to evaluate its environmental significance. This report presents the results of that appraisal. The contents of this report are as follows:

Section 2 outlines the regional setting of the Paganoni Area.
Section 3 describes the wetland environment of the Paganoni Area.
Section 4 describes the upland environment of the Paganoni Area.
Section 5 presents an assessment of the area.
Section 6 presents a summary and discussion of the significance of the Paganoni Area within the context of the South West Corridor.

2.0 REGIONAL SETTING

The Paganoni area lies within the Rockingham Shire precincts, south of Paganoni Rd., west of Mandurah Rd., east of Serpentine River, encompassing an area of approximately 780 hectares.
The Paganoni area covers four separate landform/soil units as defined by Churchwood & McArthur (1978) in their mapping series, Landforms and Soils of the Darling System (1978). The landform/soil units represented within the region are west to east (Fig.1):

COTTESLOE - a low hilly landscape with much exposed limestone
YOONGARILLUP - low ridges and swales with shallow sands over limestone
KARRAKATTA - undulating landscape with deep yellow sands over limestone
HERDSMAN - peaty swamps and floodplain areas

These landform/soil units occur within the traditionally recognised geomorphic units of Spearwood Dunes of McArthur & Bettenay (1960). The Spearwood Dune Unit is a large scale ridge and swale complex of Pleistocene dunes.

[The concept that there is a unit of low ridges and swales with shallow sands over Limestone, that is distinct from the Cottesloe and Karrakatta units, is accepted here, but the term "Yoongarillup" as used in the geomorphic sense of Churchwood & McArthur (1978) and in the vegetation complex of Heddle, Loneragan & Havel (1978) is used in this document only for purposes of reporting. Semeniuk (1989) recently discussed the problems of the nomenclature of the Yoongarillup Plain, and recommended excising the term from any of the geomorphic systems to the north of Mandurah. Nevertheless, until this recommendation is more widely accepted by scientist, the original term "Yoongarillup" is used herein provisionally.]

The Herdsman unit comprising two wetlands, has only small scale representation in this area, but is considered environmentally significant in regional context. Two other wetlands occur within the study area; one within the Karrakatta Unit (Paganoni Wetland) and another within the Yoongarillup Unit (Wetland #2, Fig. 1). The large scale vegetation complexes as defined by Heddle, Loneragan &Havel (1978) are associated with these landforms as follows:

COTTESLOE COMPLEX - Central and South: This complex is a mosaic of assemblages comprising a closed heath.
YOONGARILLUP COMPLEX: This complex is a mosaic of woodland assemblages represented by dominant species of one or more of the following trees: Eucalyptus gomphocephala, Eucalytus marginata, Eucalyptus calophylla.
KARRAKATTA COMPLEX - Central and South: In this area the Karrakatta complex is a very open woodland of Eucalyptus gomphocephala, with a lower storey woodland of Eucalyptus marginata and Banksia spp.
HERDSMAN COMPLEX: This complex comprises sedgelands, heath and fringing woodland of Eucalyptus rudis and Melaleuca spp.

3.0 WETLAND ENVIRONMENT

There are four wetlands in the Paganoni Area and each is of a different type and consanguineous (genetic) setting (C. A. Semeniuk, 1988). The wetlands are classified according to the geomorphic system of C. A. Semeniuk (1987) as sumplands, damplands or floodplains. Sumplands are basin wetlands that are seasonally flooded, damplands are basin wetlands that are seasonally waterlogged, and floodplains are wetland flats that are seasonally flooded. The wetlands are:

1. Paganoni Wetland or Wetland #1 (W/1 on Fig. 1)
2. Wetland #2 (W/2 on Fig. 1)
3. Wetland #3 (W/3 on Fig. 1)
4. Wetland #4 (W/4 on Fig. 1)

The wetlands are described below in terms of their size, general features, and vegetation patterns. Their vegetation is also classified according to C. A. Semeniuk et al (1990). Fig. 5

The main wetland basin referred to as Paganoni wetland is a macroscale sumpland of some 190ha, the northern sector of which comprising approximately 95 ha occurs within the study area. This wetland forms part of a linked system of linear wetlands known collectively as the Stakehill Suite (C. A. Semeniuk, 1998). It is the largest of the wetlands in the Stakehill Suite wetland chain and in contrast to other representatives of the Suite is undisturbed by the clearing of peripheral vegetation or the addition of nutrients from local agricultural landuse.

The wetland vegetation pattern is maculiform and exhibits mosaics similar to all Stakehill wetlands but in contrast to the other wetlands in this suite, also exhibits zonation with respect to water depth (Fig. 2). A small area of open water occurs in the wetland interior (not within the study area). The vegetation assemblages within the Paganoni Wetland are:

1) woodland of Banksia littoralis with an understorey of Acacia saligna and sedges.
2) forest of Melaleuca rhaphiophylla with an understorey of sedges.
3) open heath of Melaleuca teretifolia with a sedgeland of Lepirodia tenax.
4) low heath of Melaleuca hamulosa/Melaleuca teretifolia with a sedgeland of Gahnia trifida, Baumea juncea and others.

The second wetland (W/2) is microscale (about 8 ha in size) and alternates between a shallow sumpland and a dampland from year to year (dependent on rainfall amount). It is similar in type to Bassendean wetlands found in the Jandakot Suite and is incomparable to wetlands in the Stakehill Suite. The wetland vegetation is zoned (concentriform) and comprises 3 distinct assemblages:

1) heath dominated by Pericalymma ellipticum, but rich in other wetland species such as Calothamnus lateralis and Aotus sp.
2) woodland of Melaleuca preissiana and Banksia littoralis with an understorey of Acacia saligna.
3) forest of Melaleuca rhaphiophylla with an understorey of assorted sedges.

The third wetland (W/3) belongs to the Goegrup Suite and is a shallow dampland basin which coalesces into a small area of floodplain linked to the Serpentine River. In association these components comprise a microscale area (approximately 6 ha.). The basin and floodplain areas exhibit a mosaic of vegetation patterns (maculiform) including:

1) heath of Pericalymma ellipticum/Sholtzia involucrata and Calytrix fraseri.
2) open woodland of Melaleuca preissiana and Eucalyptus rudis
3) heath of Astartea fascicularis.

The fourth wetland also belonging to the Goegrup Suite is a small scale (approximately 4ha) dampland/floodplain area similar in character to wetland #3 and borders the study area.

The floodplain area has been cleared for agricultural purposes. The dampland is still completely vegetated by a multi-layered assemblage of very open woodland of Eucalyptus rudis and Melaleuca preissiana with an understorey heath of Pericalymma ellipticum (latiform organisation).

Each of the wetlands described above are freshwater, inundated for short periods every year and rich in diversity of formation, structure, wetland vegetation pattern and species representation.

3.1 Fauna of Wetlands

The present literature available on the use of wetlands by fauna within this municipality is limited to studies of individual wetlands eg. Cooloongup, Richmond, and sections of environmental reviews prepared for a specific development area within a defined strategy. More recent work by VCSRG (1991), Shappelle McNee (1990) and Water Authority of Western Australia (1991) has been designed to distinguish types of wetland habitats which reflect the variety of uses of a wetland required by avifauna, and it is this approach which is adopted here.

The Paganoni Wetland is recognised as a sumpland defined by a zone of Melaleuca rhaphiophylla closed forest and reedbed understorey with a central mosaic of low heath/sedgeland covering the entire wetland. Small isolated areas of open water exist, however cover is usually greater than 90%. The Water Authority of Western Australia (1991) habitat classification with respect to waterbird usage (Table 1) recognises the following elements in the Paganoni Wetland suitable for avifauna:

1) open forest and woodland of Tuart
2) low open forest, woodlands of Banksia spp. and Jarrah on moister slopes
3) fringing woodlands of paperbarks, flooded gums and Banksia littoralis
4) fringing and intrusive wet sedgelands and reedbeds
and 5) inundated woodlands of Melaleuca rhaphiophylla and shrubs

Thus such a vegetated wetland could provide excellent sedge habitat for the more cryptic species of waterfowl i.e. Rallidae spp (including 3 species of Crake, Rails, Dusky Moorhen, Purple Swamphen), Eurasian Coot, and perhaps Little Bittern, and there is also a high potential that the Melaleuca forests would be utilised by colonial species including cormorants, herons and egrets for breeding and roosting. The presence of surrounding woodland could also encourage nesting waterfowl which prefer hollow nesting sites such as Pacific Black Duck, however these species are more likely to nest in areas where more open water is available. The presence of submergent Melaleuca teretifolia shrubs increase the likelihood of a rarer species of waterfowl known to breed in the area (RAOU reference), such as the Freckled Duck.

4.0 UPLAND ENVIRONMENT

The upland environment exhibits variable vegetation assemblages in response to landform/soil changes and gradient. The terrain comprises two major North-South ridge systems AHD 30-40 m (Cottesloe unit and Yoongarillup unit) with a relatively flat swale area AHD 10 m between. East of the second ridge the terrain slopes towards the Serpentine River. The various vegetation complexes that occur in this terrain correspond to these large scale features. Thus, for instance, Cottesloe Central and South (vegetation Complexes occur on the Cottesloe landform/soil unit of Churchwood & McArthur (1978), and so on. There are three upland vegetation complexes (Heddle, Loneragan & Havel, 1978) represented in the Paganoni Area, these are:

1) Cottesloe -Central and South
2) Yoongarillup
3) Karrakatta -Central and South

However within each of these broader scale vegetation complexes a large number of smaller scale assemblages can be recognised, as will be detailed below.
The Cottesloe Complex -Central and South, comprises a closed low heath of 50 different species (see Table 2) typically found on limestone ridges of moderate relief. The Cottesloe complex is typified by mixed assemblages of coastal heaths with dominant species Olearia axillaris, Melaleuca acerosa, Acacia truncata, Acacia saligna and Acacia cyclops

The change from Cottesloe Complex to Yoongarillup Complex is abrupt and correlates with landform and soil changes. The Yoongarillup Complex is typified by woodlands of Banksia, tuart, marri, jarrah and sheoak. However, in detail, the Yoongarillup Complex exhibits a variety of vegetation types, and thus it can be further subdivided into five smaller scale assemblages based on both variation in dominant species and understorey composition. They are as follows:

1) Tuart Woodland - dominant species are Eucalyptus gomphocephala, Banksia attenuata, Banksia illicifolia; This occurs in the swales.
2) Low Banksia Woodland - dominant species are Banksia attenuata and Allocasuarina fraseriana; This occurs on the upper slopes of the Yoongarillup ridge.
3) Mixed Woodland - dominant species are Eucalyptus gomphocephala, Eucalyptus marginata, Banksia attenuata, Banksia grandis, Banksia menziesii, Allocasuarina fraseriana and Xylomelum occidentale; This occurs in the small scale depression hollows of the Yoongarillup ridge.
4) Jarrah/Banksia Woodland - dominant species are Eucalyptus marginata, Banksia attenuata and Banksia menziesii; This occurs on the lower slopes of the Yoongarillup ridge.
and 5) Marri Woodland - dominant species is Eucalyptus calophylla. This occurs in the gradational zone surrounding wetland #2.

The Karlakarta complex is typified by Eucalyptus gomphocephala open forest with Banksia littoralis. The upland vegetation complex is restricted to a narrow band of vegetation surrounding the Paganoni wetland and to one small stand on the western side of the study area. The assemblage exhibits transitional features of both wetland and upland communities dominated by Eucalyptus gomphocephala, Banksia littoralis and an understorey of variable sedges such as Lepidosperma sp., Baumea juncea and Baumea preissii.

From the surveys conducted in this study, it appears that there are no rare and endangered plants species that are endemic to the area. However the vegetation associations are representative of a wide range of complexes historically present in the central part of the Swan Coastal Plain. Additionally, the area is significant in that the relatively undisturbed vegetation is the best developed and largest remnant of such vegetation in the South West Corridor region, and in the metropolitan area south of the Swan River generally.

5.0 ASSESSMENT OF WETLANDS AND UPLANDS

The assessments of wetlands and the upland area were carried out using a variety of schemes or evaluation procedures. The wetlands were evaluated using two systems designed for Western Australian situations; these are: 1) the EPA system (Bulletin 374, 1990) and 2) the procedure adopted by the Water Resources Council 1987 (W.R.C.) using a set of internationally recognised evaluation principles (Table 3). The upland environment was evaluated using the main elements of internationally recognised procedures implemented and modified by V. Semeniuk (1985), in which the attribute of naturalness, representativeness, wildlife sanctuary, research resource, etc. are evaluated and given a weighting. Regional significance of the area was evaluated in the context of the region south of the Swan River and north of Mandurah in which similar and comparable landform/soil units occur.

5.1 Assessment of wetlands

The EPA System was used to evaluate the natural attributes and human uses of the wetlands. The results are presented in Fig.3, which shows that all the wetlands have a high natural value score, thus placing them in a category for recommendation for conservation. The evaluation of wetlands using the W.R.C. Scheme results in a series of histographs, one histograph for each wetland; within the histograph, each evaluation criterion of the W.R.C. Scheme is given a ranking on a scale from 1-5, and these rankings indicate the significance of each of the evaluation criteria for that wetland. The W.R.C. Scheme is not intended to provide a cumulative assessment, but rather to highlight the significance of a given criterion for that particular wetland. The results of assessment of the wetlands using the W.R.C. Scheme are presented in Fig.4.

The assessment results for the wetlands using both the EPA (1987) and W.R.C. (1987) Schemes, clearly show that wetlands in the Paganoni Area are important and significant. Some are of regional significance, others are significant in the context of the Southwest Corridor, and some are significant because they have become relatively uncommon on the Swan Coastal Plain generally.

It can be seen for instance, that Paganoni Wetland within the Karrakatta Complex is a wetland of regional significance with high priority as an integral part in the linked system of Stakehill wetlands. It is an important resource for maintaining environmental stability and quality, and as such, is therefore important to educationalists, researchers and naturalists. Wetland #2 in the Yoongarillup complex is a wetland type which is rapidly disappearing from the Swan Coastal Plain as development continues, and as such it becomes a significant representative example of the type of wetland which occurs in this geomorphic setting. The flora found in this wetland once was widespread but is becoming less common and even restricted. Wetlands #3 and #4 are wetlands within the Herdsman complex. However they differ significantly from other wetlands also in the Herdsman complex (such as those of the Stakehill Suite). On the Swan Coastal Plain, small scale remnant areas of floodplain wetlands are now restricted to narrow fringing zones beside Goegrup Lake and Yalbanberup Pool and to a small extent wetlands in the Jandakot area. As a comparatively rare wetland type it is of primary importance that it be conserved. These wetlands act as through flow areas for water draining to the Serpentine River and maintain the quality and quanitity of this resource and its dependent ecological biocoenose.

5.2 Assessment of Upland

As previously stated, the Paganoni area comprises 3 large scale vegetation complexes.

In general, south of the Swan River, the Cottesloe-Central and South Complex covers a zone of approximately 1-4 km in width and extends from Fremantle to Mandurah adjacent to and inland of the Quindalup Complex on the coastal dunes. Much of this vegetation complex throughout its extent in the Southwest Corridor has been cleared. Remnant areas of this complex are located at 1) Leda, 2) Tamworth Hill, 3) in a linear strip along Mandurah Rd. from Peelhurst to Madora, 4) Paganoni site.

In this region, the Yoongarillup Complex is restricted to a zone 2-3 km wide located west of the Serpentine River extending from Paganoni Rd. in the north to Mandurah. The majority of the area has been cleared for urbanisation. Thus remnant areas remain 1) on the Paganoni site and 2) on the point bar of the Serpentine River south of Yalbanberup Pool. However recent detailed mapping of soils and landform (VCSRG, 1986) shows that the area of the point bar is not comparable to the Yoongarillup Complex, because it is part of a riverine/estuarine system, and not a landform developed on limestone as is the Yoongarillup system.

Neither of these sites are at present secured in reserves, although Yalbanberup Pool was recommended for inclusion in System 6 reserve M108.

In this region the Karrakatta Complex covers a zone of variable width between 2-4 km lying to the west of the Beeliar wetlands and east of the Stakehill wetlands. Remnants of this complex are situated now only northwest of Lake Thomson, and on the western shores of 3 other wetlands - the Spectacles, Bollard Bullrush (near Leda) and Tamworth Hill wetland. Within the Paganoni study area, the Karrakatta complex largely comprises wetland assemblages,and important transitional zones between wetland and upland forests.

The Yoongarillup, Cottesloe-Central and South, and Karrakatta-Central and South vegetation complexes occurring on the upland sites of the Paganoni area are now restricted in distribution between Perth and Mandurah. They represent four ecological communities which were once widespread throughout the region; Banksia Woodland, Jarrah/Banksia Woodland, Tuart forest and Marri Woodland, and include many species of plants in a living herbarium. The vegetation is largely undisturbed by fire, rubbish dumping, clearing, logging, grazing and weed invasion, except for the northern section of the Cottesloe ridge which is currently being mined for limestone and sand (several quarries). Vegetation is regenerating on cleared abandoned areas and here Olearia axillaris and Acacia truncata form an open heath.

The transition of vegetation between wetland forests to upland woodlands/forests in the Paganoni Area is important and significant because it is not well represented generally elsewhere on the Swan Coastal Plain. Such a transition is well developed only in three other areas in the Urban Coastal Corridors i.e., at Thomsons Lake, Yanchep National Park and the UWA property incorporating Lake Banganup. In these areas the transition is between vegetation systems of a different vegetaion complex and so are not strictly comparable. These types of wetland to upland transitions are important and significant because there is an interdependence between upland communities and wetland communities and because fauna move between the two landscapes as they pursue different functions. Uncleared, i.e., naturally vegetated upland environments act as a buffer against alteration and contamination of the wetland hydrologies so that the natural system is maintained. The preservation of a well developed wetland to upland transition is also important in that it provides scientists, educationalists, and naturalists with an example of a wetland/upland contact in its entirety. However the upland vegetation systems are important in their own right, even if they are not functioning as a buffer to a wetland.

6.0 DISCUSSION OF SIGNIFICANCE

Factors used to determine significance of a system include features of its: 1)representativeness, 2)research resource, 3) wildlife sanctuary, 4) aesthetics, 5) linkages to adjoining systems, 6) rare and endangered species, 7) endemic species and 8) management potential.

In this regard the vegetation and landform system within the Paganoni Area is significant on the basis of its:

1) Representativesness: The Paganoni Area includes many examples of natural features:
i four landform/soil units
ii three upland vegetation complexes incorporating eight plant communities
iii three wetland geomorphic types
iv representatives of three wetland Suites, and
v three wetland vegetation patterns incorporating a further seven plant communities.

Together these represent a variety of habitats found on the Swan Coastal Plain. One of these wetland types i.e., the Floodplain is considered extremely rare on the Swan Coastal Plain and warrants recognition on this basis alone. Variability also occurs in the upland vegetation complexes which in response to landform, soil and water availibility patterns exhibit a gradation of communities from wetland to upland ridge and includes most major forest and woodland species.

2) Status as a wildlife sanctuary: The Paganoni Area is located in a setting of cleared rural land and urban development. It is therefore acts as a regional wildlife sanctuary to mammals, avifauna, reptiles and invertebrates.

3) Aesthetics: Within the context of rural settlement and high density urban and industrial development, the Paganoni Area provides an important contrast in landuse and environment. It is a natural feature in the midst of a cultural landscape.

4) Linkages to adjoining systems: The Paganoni Area represents an area of reasonable size where both wetland and upland communities and habitats are represented together in an unbroken and undisturbed contiguous and interdependent system. In terms of wetland systems, the Paganoni Area contains the only example of a Stakehill wetland type that has its surrounding upland vegetation intact.

The development of the South West Corridor will result in a more urgent need for retaining representative remnants of natural environments for biological purposes, aesthetic purposes and research purposes. The Paganoni Area thus represents one of the last areas between Perth and Mandurah where natural forest and woodland remain integral and functional in the long term.

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Table 1

No.	Class	Description
1		Open forest and woodlands of Tuart (*Eucalyptus gomphocephala*)
2		Low open forest, woodlands of *Banksia attenuata* and B. *menziesii*. B. *ilicifolia* and Jarrah on moister lower slopes
3		Fringing woodlands of paperbarks, flooded gums and B. *littoralis*
4		Low open woodlands of *Melaleuca preissiana* with a very dense shrub-layer of seasonally inundated heath species, ie dampland or sumpland
5	II	Fringing and intrusive wet sedgelands and reedbeds
6	I	Bare shorelines and mudflats with up to 0.15 m of water
7	II	Inundated woodlands of *Melaleuca rhaphiophylla* and shrubs
8	II	Open shallow expanses of water (< 0.5 m deep)
9	III	Open deep expanses of water (> 0.5 m deep)
10	IV	Pastures, grassed areas and farmland with relic stands of paperbarks (*Melaleuca* spp.) and eucalypts (*Eucalyptus* spp.)
11	I	Water pastures and flooded grasslands
12	III	Non living roosts
13	IV	Non living nest sites

Habitats used by waterbirds in the Jandakot Area. (Class represents a habitat grouping).

Table 2: Plant Species found in the Pagamini Area

SPECIES	HABITAT LISTING A	B	D	F	G	J	K	M	L	W	DISTRIBUTION (in SW.Aust.)
Upper level											
Allocasuarina fraseriana	X	X	X	X		X	X	X	X		widespread
Banksia attenuata	X	X	X				X	X			widespread
grandis	X	X			X	X	X				widespread
ilicifolia	X	X			X	X	X				widespread
littoralis					X					X	restricted
menziesii	X	X	X		X		X				widespread
Eucalyptus calophylla				X	X						widespread
gomphocephala	X	X	X					X	X	X	restricted
marginata	X	X	X	X			X	X			widespread
rudis	X					X				X	restricted
Melaleuca preissiana					X	X	X				restricted
rhaphiophylla					X					X	restricted
Nuytsia floribunda					X	X					widespread
Xylomelum occidentale	X	X		X			X				widespread
Lower level											
Acacia alata									X		widespread
cochlearis	X	X	X								widespread
cyclops								X	X		widespread
huegelii								X			widespread
lasiocarpa									X		widespread
pulchella	X	X						X	X	X	widespread
saligna	X				X	X		X	X	X	widespread
stenoptera		X				X		X			widespread
truncata									X		widespread
Acanthocarpus preissii	X		X					X	X		widespread
Adenanthos cygnorum				X							widespread
Allocasuarina humulis								X	X		widespread
Aotus sp.					X						widespread
Anigozanthus manlesii									X		widespread
Anthropodium preissii										X	widespread
Apium prostratum										X	widespread
Arnocrinum preissii						X				X	widespread

SPECIES	HABITAT LISTING A	B	E	F	G	J	K	H	L	W	DISTRIBUTION
Arthropodium preissii	X		X					X			widespread
Astartea fascicularis				X	X						widespread
Astroloma pallidum	X							X	X		widespread
Ameyma sp.				X		X					widespread
*Avena sp.	X									X	widespread
Baumea arthrophylla										X	widespread
articulata					X					X	widespread
juncea		X			X					X	widespread
preissii										X	widespread
Bossiaea eriocarpa	X	X	X	X				X	X		widespread
*Briza maxima	X		X	X							widespread
Burtonia scabra				X							widespread
Calothamnus lateralis					X	X					restricted
Calytrix flavescens		X			X	X					widespread
fraserii						X	X				widespread
Carpobrotus virescens						X		X	X		widespread
Cartonema philydroides						X					widespread
Cassytha racemosa					X						widespread
sp.	X								X		widespread
Centella asiatica					X					X	widespread
Comesperma calymega										X	widespread
Conostephium pendulum	X	X	X					X			widespread
Conostylis aculeata	X	X	X	X		X	X	X			widespread
candicans									X		widespread
*Conyza bonariensis	X										widespread
Corynotheca micrantha	X							X	X		widespread
Crassula sp.	X										widespread
Dasypogon bromeliifolius	X	X			X	X	X				widespread
Daviesia triflora	X	X	X	X							widespread
incrassata?	X								X		widespread
Dianella revoluta	X	X						X			widespread

SPECIES	HABITAT LISTING A	B	D	F	G	J	F	M	L	W		DISTRIBUTION
Baeckea diosmifolia					X	X						widespread
*Briza maxima									X			widespread
Bryandra nivea	X							X	X			widespread
*Eragrostis curvula	X											widespread
Eriostemon spicatus	X	X		X				X				widespread
Eryngium rostratum	X	X	X	X	X	X	X	X				widespread
*Euphorbia terac									X			widespread
Exocarpos spartens									X			widespread
Gahnia trifida										X		widespread
Gompholobium tomentosum		X				X		X				widespread
Grevillea erithmifolia	X							X				widespread
thelemaniana									X			widespread
vestita	X											widespread
Hardenbergia comptoniana								X				widespread
Hakea lissocarpha		X										widespread
prostrata	X						X		X			widespread
trifurcata									X			widespread
varia					X	X						widespread
Hemiandra pungens					X	X						widespread
Hibbertia hypericoides	X	X	X	X			X	X	X			widespread
racemosa	X	X	X	X				X				widespread
stellaris					X	X						widespread
Hovea trisperma	X							X				widespread
*Hypochaeris glabra	X				X	X						widespread
Isolepis nodosus										X		widespread
Jacksonia furcellata	X					X		X				widespread
sternbergiana	X				X	X						widespread
sp.								X	X		?	widespread
Juncus pallidus										X		widespread
sp.					X						?	widespread
Kennedia prostrata								X	X			widespread
Kunzea ericifolia	X	X	X			X						widespread
*Lagurus ovatus	X							X				widespread

SPECIES	HABITAT LISTING A	B	C	E	G	I	F	M	L	T		DISTRIBUTION
Leucophyllia												
elatioides						X						widespread
Lepidosperma												
angustatum	X	X			X	X	X	X				widespread
aff. drummondii					X	X	X			X		widespread
sp										X	?	widespread
Lepirodia												
tenax										X		widespread
Leptocarpus												
aristatus					X	X						widespread
scariosus					X	X				X		widespread
Leptomeria												
empt									X			widepread
sp.									X			widespread
Leucopogon												
parviflorus	X		X			X		X				widespread
propinquus	X	X						X	X			widespread
Lobelia												
alata										X		widespread
sp.									X			widespread
Logonia												
vaginalis										X		widespread
Lomandra												
caespitosa	X	X						X				widespread
integra	X	X	X	X								widespread
Loxocarya												
fasciculata	X	X				X						widespread
flexuosa	X		X	X	X	X	X	X	X			widespread
Lyginia												
barbata		X		X	X							widespread
Lythrum												
hyssopifolia					X							widespread
Macrozamia												
riedlei	X	X	X	X		X	X	X				widespread
Melaleuca												
acerosa									X			widespread
hamulosa										X		widespread
huegelii									X			widespread
lateritia					X							widespread
scabra								X				widespread
teretifolia										X		widespread
thymoides				X								widespread
Mesomelaena												
stygia								X				widespread
Muehlenbeckia												
adpressa								X		X		widespread
Myoporum												
capraioides										X		widespread
Nemeia												
capitulatum									X			widespread
Olearia												
axillaris	X							X	X			widespread
Opercularia												
spermacosa									X			widespread
Orobanche												
minor	X		X			X	X	X	X			widespread

SPECIES	HABITAT UNITS A	B	C	F	G	I	F	M	L	U	DISTRIBUTION
Euphorbia lanceolata					X						widespread
Gompholobium grandiflorum	X				X	X		X	X	X	widespread
*Pelargonium capitatum	X							X			widespread
Pericalymma ellipticium					X	X	X				widespread
Persoonia saccata				X				X			widespread
Petrophile linearis	X	X	X	X				X			widepsread
serrulea	X								X		widespread
Phlebocarya ciliata						X					widespread
Phyllanthus calycinus	X								X		widespread
Pimelea rosea	X	X			X		X	X	X		widespread
Restio sp.	X										? widespread
Rhagodia baccata	X							X	X		widespread
*Romulea rosea					X	X		X	X		widespread
Samolus junceus										X	widespread
Scaevola canescens	X		X					X			widespread
paludosa	X										widespread
thesoides									X		widespread
Schoenus grandiflorus								X	X	X	widespread
Scholtzia involucrata	X					X					widespread
Senecio sp.	X				X						? widespread
*Solanum nigram	X										widespread
sodomaeum								X			widespread
Spyridium ledifolia	X								X		widespread
Stirlingia latifolia				X							widespread
Stylidium repens					X	X					widespread
sp.	X				X	X			X		widespread
Synephea spinulosa	X								X		widespread
Templetonia retusa									X		widespread
Tersoonia brevipes									X		widespread
*Trachyandra divaricata									X		widespread

SPECIES	HABITAT LISTING A	B	D	F	G	J	K	M	L	W	DISTRIBUTION
Stirlingia latifolia							X			X	widespread
Tetraria octandra									X		widespread
*Ursinia anthemoides	X	X	X	X	X	X	X	X			widespread
Villarsia sp.					X	X					widespread
Viminea juncea						X				X	widespread
Xanthorrhoea brunonis	X	X	X				X	X			widespread

* = Introduced Species

KEY TO HABITAT CODE

A = BANKSIA WOODLAND
B = MIXED WOODLAND
D = JARRAH/BANKSIA WOODLAND
F = MARRI WOODLAND
G = WETLAND #2
J = WETLAND #3 & #4
K = Melaleuca preissiana OPEN WOODLAND
M = TUART WOODLAND WITH BANKSIA
L = COASTAL HEATH
W = PAGANONI WETLAND (WETLAND #1)

Table 3

CRITERIA FOR ASSESSING CONSERVATION VALUE OF A WETLAND
("First Tier" Assessment)

* (1) Is the wetland type regionally widespread or is it restricted in distribution? If the latter, then it may warrant conservation. (If the former, it may still be significant for conservation purposes - see below).

Having identified why a given wetland is regionally significant and thus requires conservation and management, it would then be necessary to identify the range of conservation values which apply to specific resources within the wetland. To do this, one needs to resolve the various other conservation criteria listed below. These criteria would require input from a range of natural history scientists but would mainly draw on the experience of geomorphologists and biologists.

(2) Is the wetland type representative of the region in that it provides an example of typical features of the natural systems.

This factor would ensure conservation of some typical wetlands even though they may be regionally widespread, given that other examples of similar wetlands elsewhere are degraded.

(3) Is the wetland important as a productive area upon which depend such commercial endeavours as fisheries (e.g. in coastal areas mangroves function as nursery areas for fisheries)?

For terrestrial wetlands of the Swan Coastal Plain this may not be relevant but may be relevant for the estuarine flats adjoining the river systems.

*(4) Is the wetland important to maintain the quality of human or animal and plant life (e.g. vegetation to arrest soil erosion)?

For wetlands on the Swan Coastal Plain and Darling Plateau this aspect would involve water quality relevant for the resident animal/plant population, maintenance of habitats for the migratory, nomadic or resident wildlife, and natural recharge/discharge processes. This criterion also incorporates the aspect of 'diversity' of habitat in which there is also a diversity of vegetation floristics and structure, and consequent diversity of fauna.

*(5) Does the wetland have important ecological or geological features of national or international significance (comparable to the significance of the Shark Bay stromatolites, Pinnacles at Cervantes)?

For wetlands this includes landforms, vegetation assemblages and other examples of regionally unique ecological and geological features. Some wetlands in Western Australia have international significance under the Ramsar Treaty.

*(6) Is the wetland important in providing relatively pristine or little modified environments or habitats (or system of these units) which are a research resource (comparable to the corals of the Ningaloo Reef; terrestrial vegetation of the Mitchell Plateau; strandplain of the Gascoyne delta)?

For wetlands this includes the range of interactions between landforms and habitats, the evolution of landforms, stratigraphic history of wetlands, ecological relationship between the above and population dynamics of various species of flora, aquatic fauna and other vertebrate fauna such as tortoises, avifauna.

*(7) Could the wetland function as an important pristine to semi-pristine or even altered environment for use by primary, secondary or tertiary educationalists because of scientific features and accessibility (e.g. geological localities for illustrating earth science principles, wetland localities for illustrating ecological principles)?

For wetlands this would include any of the suite of landforms, their associated biota, interdependence and evolution.

[Note: In Western Australia, there is inadequate reservation for scientific/educational purposes of the various types of wetland which occur within or close to the Metropolitan Area. These areas are under intense pressure for recreational and other development. This trend has been identified by numerous authors and must be expected to continue to grow as population pressures increase.]

Table 3

*(8) Does the wetland function as the habitat of rare and endangered species?

For example, Bullsbrook swamps for the Short-necked Tortoise.

*(9) Does the wetland function as an important regional wildlife sanctuary, even if the flora/fauna are not rare or endangered?

For wetlands this would include those areas that provide water, refuge or breeding grounds for a variety of reptiles, avifauna, mammals, etc., and should include the aspect of habitat diversity, or vegetation diversity and interspersion, with its consequential implication of diverse faunal usage.

*(10) Is the wetland important as either a seasonal or temporary habitat or breeding ground of large numbers of migratory or nomadic animals, particularly waterbirds?

For wetlands in general this factor is likely to be important.

*(11) Can the wetland function as a semi-pristine to pristine area or wilderness for use by naturalists, bush-walkers, etc. (e.g. Kakadu National Park in the Northern Territory or Herdsman Lake in the Perth Metropolitan Area)?

Wetlands close to the population centre of Perth have special value to naturalists, professional ornithologists, amateur bird observers, outdoor enthusiasts, etc.

(12) Does the wetland have importance from the point of view of aesthetics?

Well-vegetated and/or water-filled wetlands provide a contrast to the adjacent, heavily-developed residential areas.

(13) Does the wetland have importance as an historic or actively-utilised Aboriginal heritage site?

There are some recorded Aboriginal sites at wetlands and therefore this factor has to be assessed for each site.

(14) Does the wetland have value for active water-based recreation?

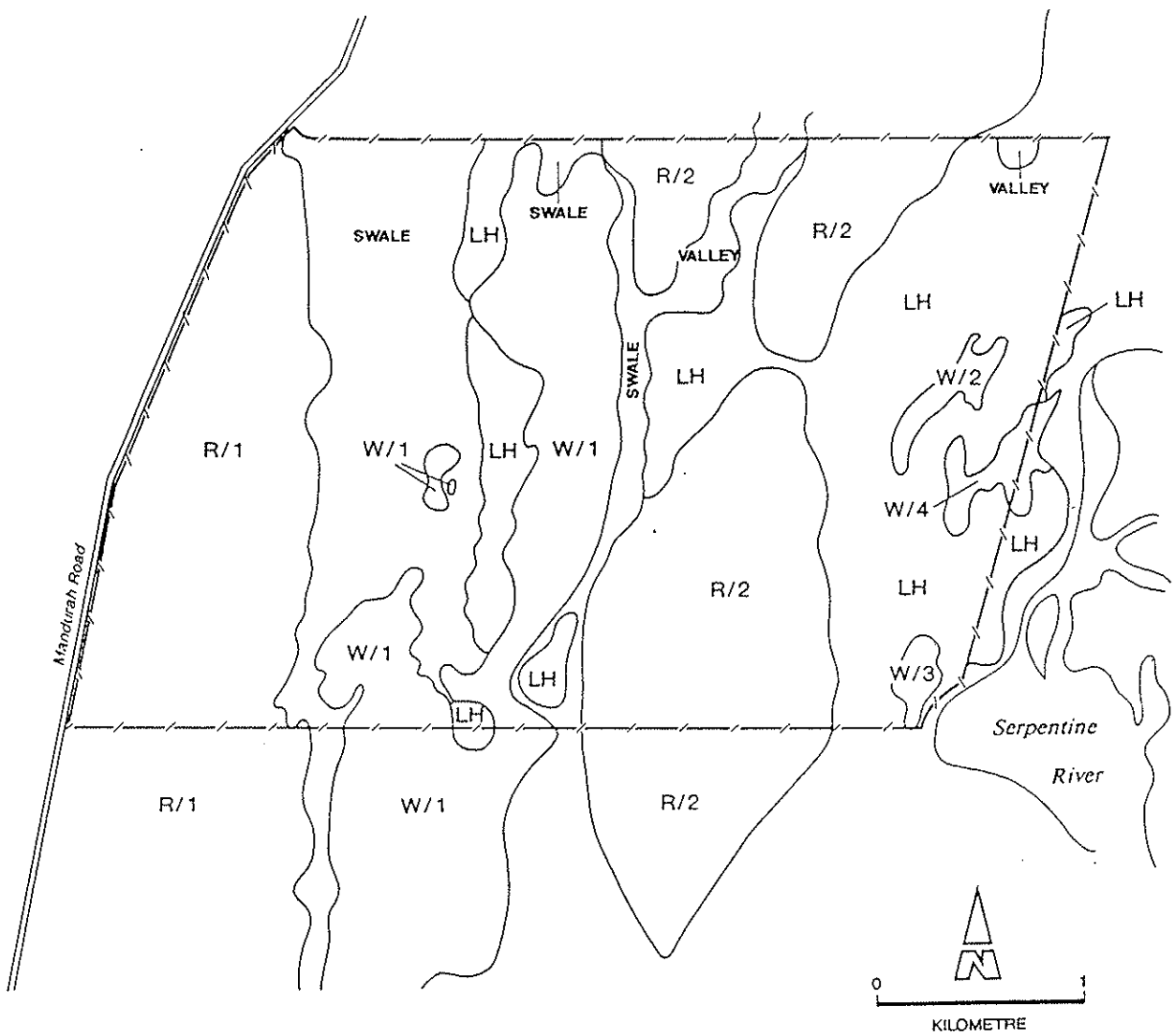
There is increasing pressure for use of wetlands for boating and other water sports, including duck hunting.

*(15) Does the wetland, regardless of whether it is pristine or degraded, constitute part of a linked natural system, either physical or biological (biological: in terms of usage by waterbirds, particularly migrating or nomadic species) such that its destruction or alternate use would result in disturbance/alteration to adjoining wetlands or to fauna species using the system?

(16) Does the wetland have social values evidenced by community concern for its conservation, regardless of scientific values?

* indicates criteria used to evaluate the wetlands in the Lake Joondalup-Walyunga transect.

Fig.1 MEDIUM SCALE GEOMORPHIC UNITS WITHIN THE PAGANONI AREA AND SURROUNDS



LEGEND

—/——/—	Boundary of Paganoni Area
R/1	Limestone ridge - COTTESLOE UNIT
R/2	Older limestone and yellow sand ridge - YOONGARILLUP UNIT
LH	Low hills forming part of the main ridge system
VALLEY	Small scale depressions within the main system
SWALE	Swale between two main ridges

WETLANDS

W/1	Sumpland
W/2	Dampland/sumpland
W/3	Dampland and Floodplain
W/4	Dampland and Floodplain

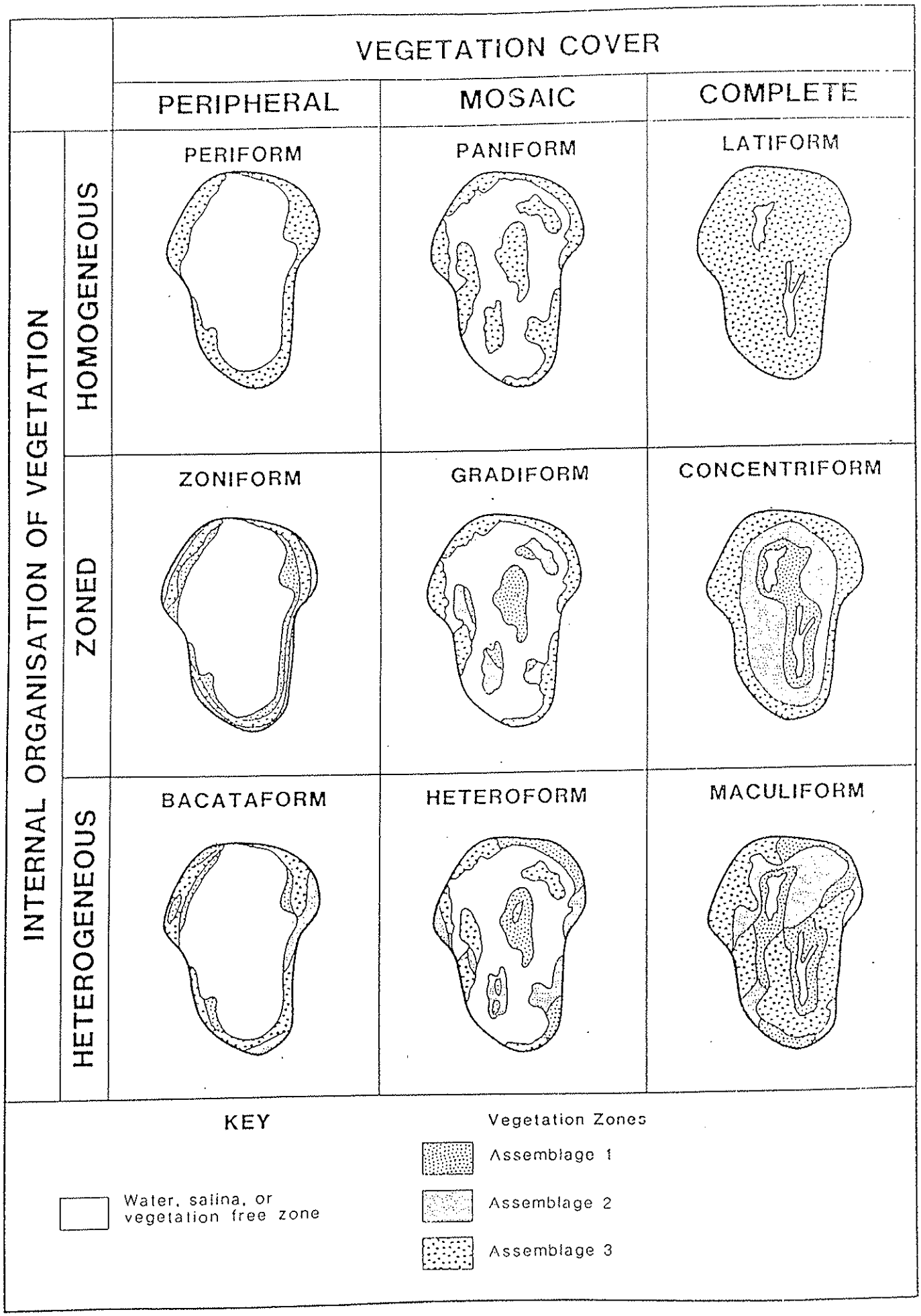


Figure 5 The nine categories of vegetation organization of wetlands

Fig.3 EVALUATION OF PAGANONI WETLANDS #1, #2, #3, #4, USING
EPA BULLETIN 374 – NATURAL ATTRIBUTES CRITERIA
– HUMAN USE CRITERIA

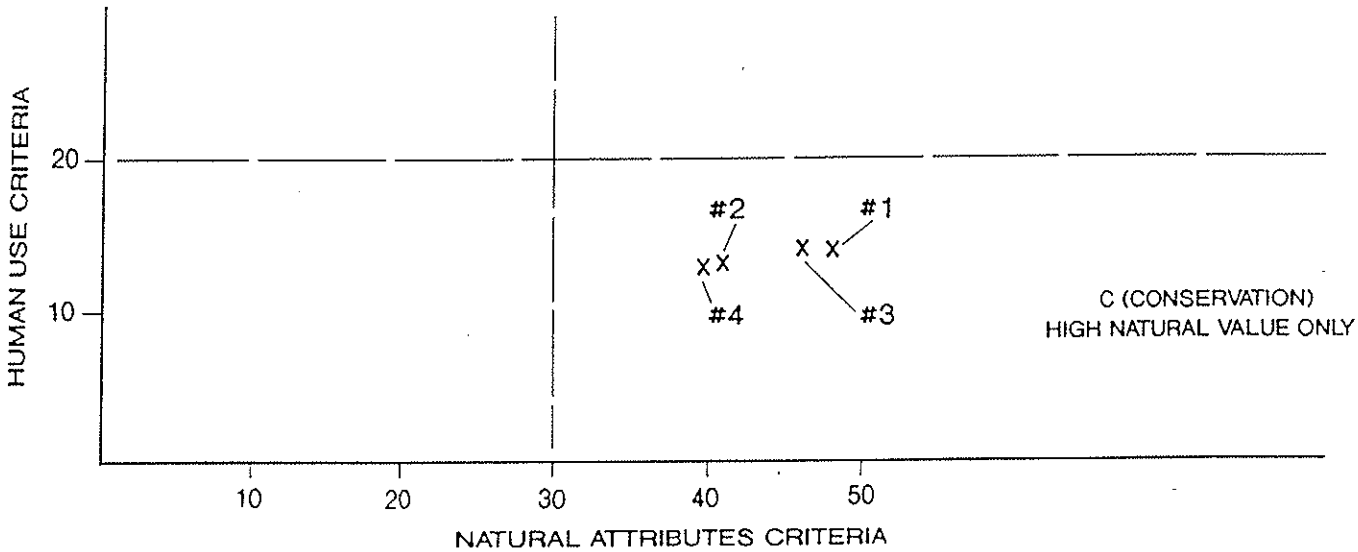


Fig.4 EVALUATION OF PAGANONI WETLANDS #1, #2, #3, #4, USING
CRITERIA DEVELOPED FOR WATER RESOURCES COUNCIL 1987

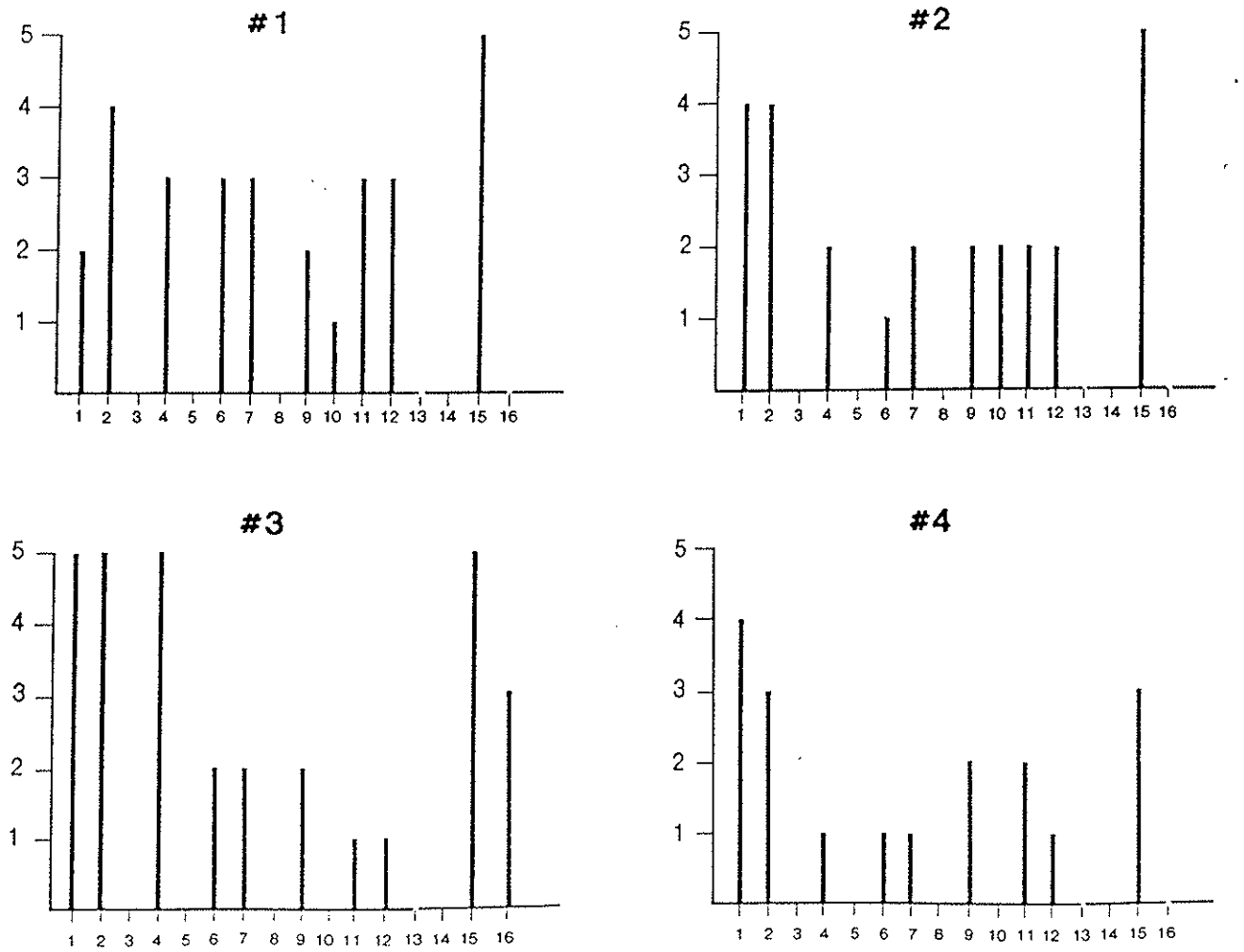
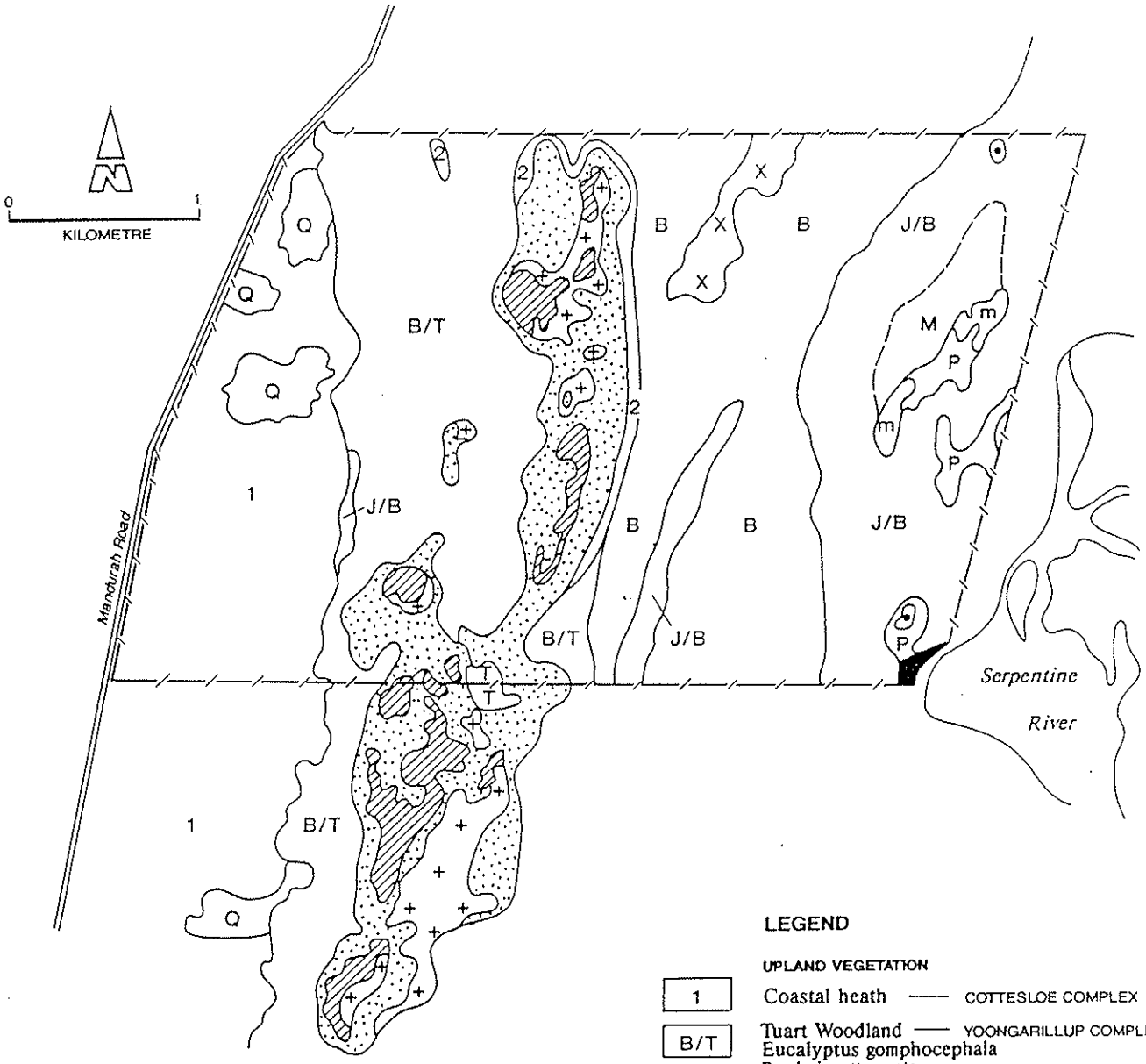


Fig.2 SMALL SCALE VEGETATION ASSEMBLAGES IN THE PAGANONI AREA



LEGEND

UPLAND VEGETATION

- 1 — Coastal heath — COTTESLOE COMPLEX
- B/T — Tuart Woodland — YOONGARILLUP COMPLEX
  Eucalyptus gomphocephala
  Banksia attenuata
  Banksia illicifolia
- 2 — Tuart Woodland — KARRAKATTA COMPLEX
  E. gomphocephala
  Banksia littoralis
- B — Banksia Woodland — YOONGARILLUP COMPLEX
  B. attenuata
  Allocasuarina fraseriana
- X — Mixed Woodland — YOONGARILLUP COMPLEX
  B. attenuata
  Banksia menziesii
  Banksia grandis
  A. fraseriana
  Eucalyptus marginata
  E. gomphocephala
  Xylomeleum occidentalis
- J/B — Jarrah Banksia Woodland — YOONGARILLUP COMPLEX
  A. attenuata
  B. menziesii
  E. marginata
- M — Marri Woodland — YOONGARILLUP COMPLEX
  Eucalyptus calophylla
- Q — Quarry for limestone and sand
- T — Tuart Woodland — KARRAKATTA COMPLEX
  E. gomphocephala

WETLAND VEGETATION

- Melaleuca rhaphiophylla forest
- \+ — Baumea juncea and Baumea articulata sedgeland with patches of Melaleuca hamulosa heath
- Melaleuca teretifolia low heath
- P — Perycalymma ellipticum heath
- • — Melaleuca preissiana open woodland
- Astartea fascicularis heath
- m — Melaleuca rhaphiophylla and Banksia littoralis forest

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File BS 375

CSR

ENVIRONMENTAL REPORT
BUSHPLAN SUBMISSION

LOT 4 MANDURAH ROAD, SINGLETON

SUBMISSION NO 382

ALAN TINGAY & ASSOCIATES

APRIL 1999

REPORT NO: 99/29

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1. INTRODUCTION

1.1 Background

Alan Tingay and Associates has been engaged by CSR to determine whether the inclusion of a part of their landholding, Lot 4 Mandurah Road Singleton, in the draft Perth's Bushplan as regionally significant is warranted.

This report provides a brief description of the existing biophysical environment of the site and the findings of flora and vegetation surveys conducted in 1997 and 1999. The criteria for inclusion of Lot 4 in Bushplan are discussed in Section 4. The information provides a strong case to delete the site from Bushplan.

1.2 Land Use and Zoning

The site is currently zoned 'Urban Deferred' under the Metropolitan Region Scheme and 'Rural' under the City of Rockingham's District Zoning Scheme. An extractive mining program (limestone) is currently in operation in the northern half of Lot 4 with the remaining area of limestone ridge to the south licensed to be mined over the next three years.

1.3 Surrounding Land Use

Lot 4 is bounded to the west by Mandurah Road and the Singleton coastal townsite. Additional quarry sites are located to the north of Lot 4. Pt Lot 3 is similarly zoned Urban Deferred, whereas the remainder of the land to Paganoni Road is classified as Parks and Recreation Reservation. Lot 4 abuts the Paganoni Swamp Parks and Recreation Reservation to the east. Paganoni Swamp forms a component of the Rockingham Lakes Regional Park. The property to the south (Lot 42) is located in the City of Mandurah and therefore is outside the Metropolitan Region. Lot 42 is currently being used for limestone extraction and is a comparatively cleared site.

The regional location of Lot 4 Mandurah Road, Singleton is shown in Figure 1.

2. PHYSICAL ENVIRONMENT

2.1 Climate

The Mandurah region experiences a Mediterranean climate with hot, dry summers and mild, wet winters. Mean temperatures range between 18.2°C and 30.1°C in summer and from 9.6°C to 17.8°C in winter. The average annual rainfall in the region is 884mm, 75% of which falls between May and August.

During summer, winds in the morning are generally from the south to east, while in the afternoon and evening, sea breezes from the south to south-west dominate the wind pattern. In winter, winds are largely controlled by the movement of low pressure systems with wind directions changing as the system moves east (Riedel and Byrne, 1987). During this time, the wind pattern is dominated by winds from the north-west to south-west sector through the day. Morning easterlies in summer are typically less than 20km/h, although wind speeds in excess of this are occasionally experienced. Afternoon sea breezes are generally between 10km/h and 20km/h, but may reach speeds up to 30km/h. Wind speeds in winter are generally between 10km/h and 20km/h, however, higher wind speeds are experienced more frequently at this time of year than in summer. Winter squalls can produce winds of up to 50km/h (Koltasz Smith & Partners, 1993).

2.2 Geology and Geomorphology

The geology of the site is described by Gozzard (1983) as principally comprising of limestone (Ls_1) overlain by a pale yellowish brown, fine to coarse grained sub-angular quartz, trace of feldspar, shell debris, variably lithified, surface kankar, of aeolian origin.

The substrate has a variable bearing capacity, depending upon cementation. Solution cavities and fissures (karstic phenomenon) are common and could result in severe settlement under load and may offer an easy path for pollutants to reach the groundwater table (Gozzard, 1983).

The easternmost 100m of the property varies slightly to that described above and is characterised by a pale yellowish brown, medium to coarse-grained, sub-angular quartz sand containing traces of feldspar which are moderately sorted of residual origin.

The soil associations in the area are categorised by the V&C Semeniuk Research Group (1991) as belonging to the Cottesloe Unit. The Cottesloe Unit is often considered to be a transitory soil association describing the change from coastal sands to the inland wetland complexes.

2.3 Topography

The major landscape feature of Lot 4 Mandurah Road is a ridge which runs north-south, 200m from and parallel to the eastern property boundary (Figure 2). The ridge attains a height of 28m adjacent to the quarry in the north. It continues to the south between 22m and 26m AHD. The topography of the study site is shown in Figure 2.

The terrain on the remainder of the site undulates, moving from the Mandurah Road to reveal an 8m swale which then rises gradually to form the ridge. The relief then falls sharply to the eastern property boundary.

A large limestone quarry currently dominates the northern portion of the lot. However, this will be recontoured and remediated to the satisfaction of the relevant authorities prior to any development of the site.

2.4 Hydrogeology

The limestone substrate of Lot 4 comprises part of a shallow unconfined aquifer known as the Stakehill Mound. The highest point of the Stakehill Mound is relatively shallow (2.3m AHD) and occurs to the north of Singleton. The entire aquifer is approximately 15m to 20m thick with salinity generally less than 1000mg/L TDS (Davidson, 1984). Recharge to the aquifer is by rainfall infiltration.

Examination of the groundwater contours would tend to indicate that groundwater from the property would generally flow towards the coast.

While urban development usually results in a raising of groundwater tables, this effect is likely to be reduced at Singleton due to the pre-existing level of clearing from quarrying, the absence of deep-rooted trees and domestic groundwater use following development.

Consequently, residential development on Lot 4 is unlikely to have any significant impact on groundwater levels or groundwater quality. Accordingly, the proposal will not adversely affect the adjoining Paganoni wetland system.

3. BIOLOGICAL ENVIRONMENT

3.1 Vegetation and Flora

3.1.1 Methodology

A detailed flora and vegetation survey of the site was undertaken in December 1996 and January 1997 (Alan Tingay & Associates, 1997). The initial site inspection in 1997 provided an overview of vegetation types with reference to aerial photographs and maps. Observations of the vegetation within the survey area and comparisons between it and portions of vegetation in the adjoining land areas allowed an appraisal of the major vegetation types and of the relative degree of disturbance on the site. Four sites were selected which were representative of the principal vegetation types. Floral examinations were conducted at these locations and a species list was complied. Although these sites were all located close to the boundaries of the surveyed area, the area was extensively surveyed on foot to confirm that significantly different vegetation types were not represented outside the sampled areas. The Department of Conservation and Land Management (CALM) Reference Herbarium was used to verify the identities of plant specimens collected.

A second survey was conducted in March 1999 to determine the significance of the vegetation and flora of the site in terms of the criteria used to incorporate the southern portion of Lot 4 Mandurah Road in Bushplan Site 395. A further seven sites were selected based on aerial photographs and the delineation of vegetation complexes at the site in accordance with the mapping prepared by Heddle *et al.* (1980) which forms the basis of the vegetation complex mapping in Bushplan. The sample site locations for the 1997 and 1999 surveys are shown in Figure 3.

Statistical analyses of the flora recorded at 11 locations over the site during the 1997 and 1999 surveys (Appendix 1 includes sample site descriptions) were undertaken using the classification programs TWINSPAN and SYSTAT, as shown in Appendix 2. The dendrogram produced as a result of the SYSTAT analysis determined quantitative differences and similarities between the various locations with TWINSPAN identifying indicator species for each grouping. The statistical analysis is discussed in more detail in Section 4.3.

3.1.2 Communities

The vegetation types found on Lot 4 are determined chiefly by differences in topography and soil type. Associated with the north-south limestone ridge system, and with the limestone sands to the west of the ridge system, is a scrub-heath vegetation, where, apart from scattered clumps of a few taller species (see below), the tallest species are generally multi-stemmed shrubs less than two metres in height. The floristic composition within this area, which accounts for over two-thirds of the area of Lot 4, varies somewhat with topography, i.e. the ridge-tops, with outcropping limestone (Site 1/97, Site 4/99, Site 5/99), are somewhat different from the lower and more gently-sloping areas to the west (Site 4/97, Site 3/99, Site 6/99) and the flat low lying area at the western boundary (Site 1/99, Site 2/99, Site 7/99).

The other main vegetation types are the Tuart and Jarrah/Tuart woodlands, which together account for a relatively small area of Lot 4, close to the eastern boundary, and are represented in Site 2/97 and Site 3/97.

The following section provides a brief description of the sites examined during the 1997 and 1999 surveys. The flora list for each site is contained in Appendix 1.

Site 1/97, Site 4/99 and Site 5/99 - Limestone ridge areas

The limestone ridge system supports a scrub-heath association dominated by *Melaleuca huegelii* on the summits of the ridges, with *Templetonia retusa*, *Olearia axillaris* and *Hakea trifurcata* scattered or forming thickets on the slopes. There are no tree species, and the maximum height of these shrubs is approximately 1.5m. Commonly associated with these species are *Allocasuarina humilis*, *Melaleuca acerosa*, with many other species of low shrubs and herbs.

Site 2/97 - Tuart woodland

The floristic composition of Site 2/97, which represents a relatively small area in the north-east of Lot 4, suggests a transition between that of the limestone ridge areas and of the Jarrah/Tuart woodland which occurs mainly to the east of Lot 4, and is represented at Site 3/97. The dominant tree species is Tuart (*Eucalyptus gomphocephala*), growing to 15m, with a mid-storey of *Banksia attenuata* and *Allocasuarina huegelii*, growing to 7m. A dense and varied understorey of shrubs and herbs includes many species also collected at the limestone ridge and in the Jarrah/Tuart Woodland.

Site 3/97 - Jarrah/Tuart woodland

Site 3/97 represents a section of Tuart/Jarrah woodland which is common immediately outside the eastern boundary of Lot 4, and is represented in some parts of a narrow strip between the limestone ridge system and the eastern boundary fence. Jarrah (*E. marginata*) is the most common tree species, growing to 7m, and is associated with Tuart, growing to 10m. Other trees include *Allocasuarina huegelii*, to 7m, and *Banksia attenuata* to 6m. There is a relatively dense understorey of shrubs and herbs. Only ten of the 28 species collected at this site were also collected at Site 1, which suggests that Sites 1 and 3 represent the most different associations in the area.

Site 4/97, Site 3/99 and Site 6/99 - Limestone scrub-heathland

Site 4/97 and Site 3/99 represent the vegetation types common to much of the area to the south of the quarry, and to the east of the main limestone ridge system. Most of this area is relatively flat and low-lying, and appears to support a less diverse floristic pattern than the ridge system, and the Tuart and Jarrah/Tuart woodland areas. In general, the tallest plants present in this region consist of shrubs of *Melaleuca huegelii* (on ridge-tops, as in Site 1), *M. acerosa* and *Templetonia retusa*, rarely exceeding 1.5m in height.

Site 6/99 provided a slight variation in species composition from the heathland typical over much of the site. This site is composed of an isolated patch of *Eucalyptus foecunda* closed heath to thicket with minimal understorey. The species composition increases at the periphery to include species such as *Melelauca. huegelii, Grevillea thelemaniana, Lomandra maritima* and *Hakea trifurcata* typical of the surrounding heathland.

Site 1/99, Site 2/99 and Site 7/99 – Heath and Shrubland

The large area of shrub-heathland to the west of the main limestone ridge system shows a relatively uniform floristic composition. In this area, relatively few plant species were observed which were not collected at either the ridgetops and slopes. In general, these sites consisted of an *Acacia truncata, Templetonia retusa* and *Grevillea thelemanniana* Shrubland (Site 1/99 and Site 2/99) with species generally associated with the slopes of the limestone ridge to the east. In addition, pockets of *Acacia rostellifera* Heath (Site 7/99) over *Acacia pulchella* and *Hakea trifurcata* occur along the western boundary of the site.

3.1.3 Vegetation Condition

The majority of the vegetation communities at the site have remained comparatively intact except for the quarry area and the southern and western extremities of the site. The principal forms of disturbance to native communities include weed invasion, rehabilitation plantings, fire and vehicular tracks. No evidence of recent clearing or agricultural grazing was observed apart from an area near the south-western corner of the site which has been subject to a recent burn. The greatest degree of weed invasion occurs along the southern boundary, where seeds of grasses such as *Avena sativa, Ehrhardta calycina* and *Lagurus ovatus*, and of the thorny shrub *Solanum sodomeum* (a declared noxious weed with poisonous berries), have been carried in by wind from the adjacent area of pasture. The first two of these species are present in most parts of Lot 4, in varying densities, and are least abundant near the northern and north-eastern boundaries, where the density and diversity of native species are greatest.

Revegetation has been carried out along the 'bund-wall' which runs the length of the western boundary, and also near the northern edge of the quarried area, close to Site 1/97. It appears that some, but not all, of the species selected are native to the region (including Tuart, and some *Acacia* species). There also appear to be some plantings of an (unidentified) *Acacia* species along some of the major tracks associated with the quarry.

The condition of the vegetation across the site is shown in Figure 4. The disturbance rating applied to the site defines categories ranging from 'Pristine' (vegetation showing no signs of damage caused by the activities of humans) to 'Degraded' (areas that are completely without native species in the structure of the vegetation.

3.1.4 Flora

A total of 82 native and 19 introduced plant species was observed on Lot 4 during the 1997 and 1999 surveys, as shown in Appendix 3.

The Department of Conservation and Land Management's Threatened Flora Database contains four Declared Rare or Priority plant taxa which have been collected in the region.

No Declared Rare Flora (DRF) were observed on the site during the field surveys. However, one Priority Two (2) species, *Lasiopetalum membranaceum* was found. This species is a multi-stemmed shrub, to 0.65m tall, with densely hairy branchlets, hairy, heart-shaped leaves, and small pink or mauve flowers. It is known to occur on coastal sandy soils in Tuart woodland, and has been previously collected from between Yalgorup

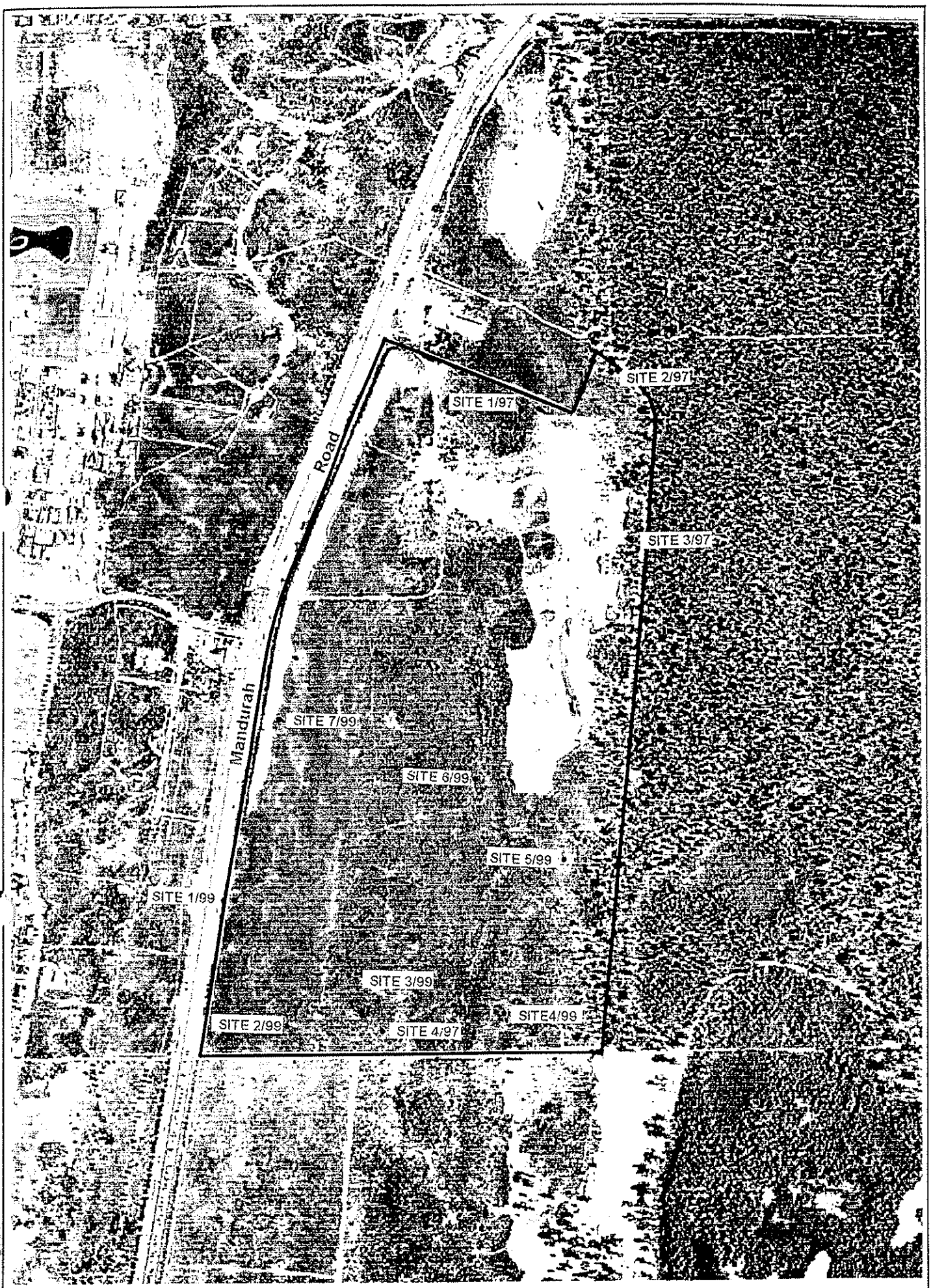
and Capel. On Lot 4 it occurs at Site 3/97, close to the eastern boundary, in association with Tuart and Jarrah.

Priority Two (2) species are categorised as poorly known taxa. They are plants which are known from one or a few (generally five) populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as "rare flora" but are in urgent need of further survey. There is no legal obligation for landowners to protect priority species.

3.2 Fauna

A detailed vertebrate fauna survey of the site has not been undertaken. However, a number of kangaroos were observed feeding on the property during the vegetation survey. It is believed that the kangaroos are from the neighbouring Regional Open Space where Paganoni Swamp offers fresh water and more abundant food and shelter.

Vertebrate fauna surveys in similar heath associations such as at Alkimos have revealed that woodlands possess a significantly larger vertebrate fauna diversity in comparison to limestone heath communities. This is most probably due to the woodland's greater vertical complexity. Nevertheless, a limestone heath community of approximately 100ha would support a diverse assemblage of reptiles and birds. The vertebrate fauna expected to occur at Lot 4 are shown in Appendix 4.



LOT 4 MANDURAH ROAD, SINGLETON
FLORA SURVEY SITES
FIGURE 3

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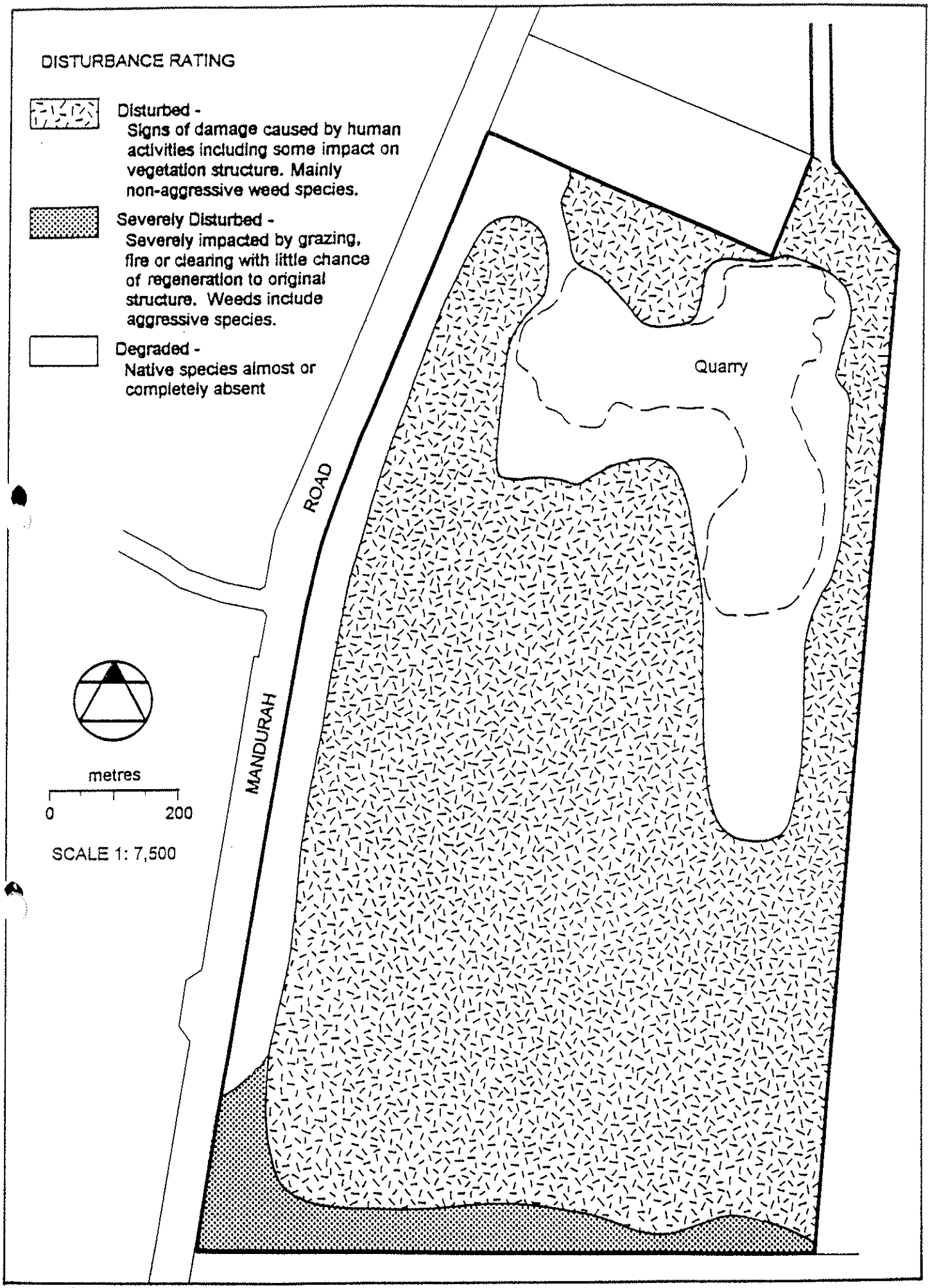

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LOT 4 MANDURAH ROAD SINGLETON
VEGETATION CONDITION
FIGURE 4

4. DRAFT PERTH'S BUSHPLAN

The draft Perth's Bushplan (Bushplan) was released for public comment in November 1998. The plan identifies areas of bushland within the Perth Metropolitan area which are deemed to be of regional significance, and therefore in need of protection.

In seeking to protect areas deemed to be regionally significant, Perth's Bushplan presents a range of approaches including State ownership, reservation and management (ie. conservation reserves) and land clearing controls including direct legal controls. Complementary controls include using information and educational incentives, voluntary measures such as the Land for Wildlife scheme, applying various incentives (eg. taxation rebates, grants or technical assistance), legally constructed management arrangements (eg. covenants), and negotiated planning solutions.

4.1 Bushplan Site 395

The southern portion of Lot 4 Mandurah Road has been identified in the draft Perth's Bushplan as Site 395 and forms part of a larger area (751ha) which incorporates Paganoni Swamp and adjoining bushland. Lot 4 Mandurah Road comprises approximately 140ha of which the Bushplan listing proposes to reserve 65.5ha or 47% of the total landholding.

Listing of the site in Bushplan implies that the whole site is of regional significance and needs to be protected to achieve the state government's objectives with regard to nature conservation. The documentation for Bushplan, however, is quite general in stating the reasons why each site has been considered to be of regional significance. For example, the selection criteria relates to the whole site and are very general in nature, as follows: "*the site contains a representation of ecological communities, diversity, rarity, maintaining ecological processes or natural systems, scientific or evolutionary importance, general criteria for the protection of wetland, streamline and estuarine fringing and coastal vegetation*".

Under Bushplan, Site 395 is recognised as containing an area of Cottesloe-Central and South Complex and the northern most extent of the Yoongarillup Complex not currently reserved for conservation purposes.

4.2 Vegetation Mapping

The vegetation complex is the basic unit used in Bushplan to determine protection of biodiversity and representation of ecological communities. Bushplan aims to protect at least 10% or a minimum of 400ha of each vegetation complex on the Swan Coastal Plain within the Perth Metropolitan Area. Other criteria such as size of remnant, condition of the vegetation, linkage value and fauna habitats are also considered important.

The mapping of vegetation complexes in the Darling region by Heddle (*et al.*, 1980) and the Perth Environment Project has been used for the delineation of vegetation complexes in Bushplan. This mapping has determined that the site lies within the Cottesloe-Central and South Complex (western half of the site) and the Yoongarillup Complex (eastern half) as shown in Table 1 and illustrated in Figure 2.

TABLE 1

VEGETATION COMPLEXES - LOT 4 MANDURAH ROAD
(As per Heddle et al, 1980)

VEGETATION COMPLEX	LOT 4 TOTAL (ha)	LOT 4 BUSHPLAN (ha)
Cottesloe-Central & South Complex	56.36	26.27
Yoongarillup Complex	62.17	39.32
Cleared	19.97	-
TOTAL	138.5	65.6

4.2.1 Cottesloe-Central and South Complex Reservation

The Cottesloe-Central and South Complex is one of the largest vegetation complexes reserved on the Swan Coastal Plain both in terms of area and percentage remaining. This complex is generally composed of a mosaic of Tuart Woodland and Open Forest of Tuart, Jarrah and Marri with Closed Heath on limestone outcrops. Presently, 12,362ha or 36% remains of the original extent of this complex. Of this, 5,205ha is currently reserved and a further 1,237ha is proposed for reservation under Bushplan. The total area of Cottesloe-Central and South Complex proposed for reservation therefore is 6,442ha or 19% of the original extent, as shown in Table 2. According to vegetation mapping prepared by Heddle *et al.*, (1980) the area of Cottesloe-Central and South Complex on Lot 4 within Bushplan Site 395 is 26.27ha which represents 0.4% of the total area in existing or proposed reserves.

Nearby areas of reserved Cottesloe-Central and South Complex vegetation include Henderson bushland, Leda bushland and parcels within the Port Kennedy Scientific Park and Rockingham Lakes Regional Park.

Therefore, it could be considered that the component of the Cottesloe-Central and South Complex vegetation on Lot 4 is not critical to the protection of a representative portion of this vegetation type in the Perth Metropolitan Area.

4.2.2 Yoongarillup Complex Reservation

The Yoongarillup Complex is, in contrast, one of the smallest vegetation complexes in the Perth Metropolitan Area and is composed of Tuart with Peppermint Woodlands and occasionally Open Forests of Tuart, Jarrah and Marri. Of the 664ha of this complex originally in the metropolitan area, 478ha remains, as shown in Table 2. Most of this is currently protected (387ha or 58% of the original extent). The 39.3ha of Yoongarillup Complex on Lot 4, as per the vegetation mapping undertaken by Heddle *et al,* (1980), is the only additional area of this complex proposed for reservation under Bushplan.

The distribution of the Yoongarillup Complex is actually much larger than the Perth Metropolitan Area. The complex extends from the Paganoni Swamp area along the coast to south of Bunbury.

Significant areas of reservation are included in Yalgorup National Park and State Forest between Mandurah and Bunbury. The area of Yoongarillup Complex currently protected in the Metropolitan Area (387ha) is in the Rockingham Lakes Regional Park located immediately to the east of Lot 4. This area within the Regional Park could be considered adequate to protect an example of the northern extremity of this widely distributed complex.

TABLE 2

RESERVATION OF VEGETATION COMPLEXES UNDER BUSHPLAN

	COTTESLOE COMPLEX - CENTRAL & SOUTH (ha)	YOONGARILLUP COMPLEX (ha)
Original Area in SCP	34,439	664
Remaining Area in SCP/PMR	12,362	478
% of Original Area Remaining in SCP/PMR	36%	72%
Currently Protected	5,205	387
Recommended for Protection under Bushplan	1,237	38
TOTAL	6,442	424
% of Original Area Protected	19%	64%

Note: SCP - Swan Coastal Plain, PMR - Perth Metropolitan Region.

4.3 Significance of Bushplan Criteria

Flora surveys conducted in July 1997 and March 1999 were consolidated to substantiate the base vegetation complex mapping used in Bushplan and to determine the significance of the vegetation at the site in terms of the criteria used to incorporate Lot 4 in Bushplan Site 395. The location of sample sites is shown in Figure 1.

The criteria for including this part of Lot 4 in the larger Bushplan site are not specifically stated in the Bushplan documents. The selection criteria relate to the whole site and are very general in nature, as follows: "the site contains a representation of ecological communities, diversity, rarity, maintaining ecological processes or natural systems, scientific or evolutionary importance, general criteria for the protection of wetland, streamline and estuarine fringing and coastal vegetation".

Clarification of the criteria used for Lot 4 were discussed with the Conservation Branch of the Department of Environmental Protection (DEP). Although not recognised in the Bushplan document, it was identified that the southern portion of Lot 4 has unique floristic attributes associated with the underlying limestone ridge (mapped as part of the Yoongarillup Complex (Heddle *et al.*, 1980)) not present in the eastern area of Bushplan site 395. In addition, the site was selected to consolidate the Rockingham Lakes Regional Park (Keighery, B. Feb 1999, pers com).

Aerial photograph interpretation and site investigations determined that the area mapped as Yoongarillup Complex vegetation on Lot 4 is significantly different from that in the Regional Park and nearby reservations. The flora surveys conducted in 1997 and 1999

provided statistical data to justify the lack of floristic variation across the site and the consequent inappropriate delineation of the vegetation complexes.

The statistical analyses using the classification programs TWINSPAN and SYSTAT determined an immediate variation between the vegetation of the Tuart/Jarrah Woodland at the eastern boundary of the site and the Scrub-Heath vegetation located over the remaining portion of the site. In particular, the analysis did not distinguish significant floristical variation from east to west with the vegetation of the limestone ridge statistically indifferent from the vegetation of lower lying areas to the west of the site. Furthermore, the sample sites located directly on the limestone ridge did not form a distinct grouping but correlated with other sites.

On this basis, the delineation of two distinct vegetation complexes at Lot 4 distinguished by a limestone ridge of unique flora is erroneous. The floristic composition of Lot 4 (excluding the Woodland at the eastern boundary) has been identified as a collective unit across the site and should be considered as part of one and the same complex, specifically the Cottesloe-Central and South Complex.

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5. DEVELOPMENT PROPOSAL AND PLANNING IMPLICATIONS

5.1 Urban Development

Lot 4 Mandurah Road, Singleton has been held for many years by CSR Construction Materials with the principal objective of urban development succeeding site re-contouring and rehabilitation as a result of the extractive program. The development potential of the property has been recognised in an Outline Development Plan (ODP) prepared on behalf of CSR by Chappell and Lambert and subsequently by Council who endorsed the ODP prior to the release of Bushplan.

The development area (140ha) represents an ideal neighbourhood size, with enough critical mass in the form of potential dwellings and population to support a primary school and an economically sustainable local centre. The reduction in the area of the proposed development and extractive area as a result of Bushplan would have a major impact on the function of this neighbourhood and the type and level of services expected by future residents.

The nomination of the southern portion of the site for conservation purposes under Bushplan would therefore have a major impact on the existing extractive program, the feasibility of a long-term proposal for urban development and consequently financial implications for CSR.

5.2 Rapid Transit Railway

In addition to the potential development of the site for residential purposes, the future Perth to Mandurah Railway route is gazetted along and partly through the eastern boundary of the site.

Populations of the Priority Two (2) species, *Lasiopetalum membranaceum* found in association with the Tuart and Jarrah Woodlands (Site 3/97), will be disturbed by the construction of the rapid transit railway.

The railway corridor will effectively sever any opportunity for an environmental linkage through to Paganoni Swamp and associated bushland. In addition, land on the western side of Mandurah Road comprises Special Rural and urban development. A contiguous linkage from east to west is therefore not achievable. Once the railway line is developed, the current relationship that exists between the Bushplan site and Paganoni Swamp will disappear, significantly reducing the environmental value of the land.

6. CONCLUSIONS

The criteria for the inclusion of Lot 4 Mandurah Road, Singleton in Bushplan are not substantiated as a result of the findings of this assessment. The vegetation at Lot 4 Mandurah Road is considered to have only local environmental significance. Whilst the floristic composition and condition of the vegetation may be considered of a high standard, the representation of this type of vegetation, locally and regionally, is adequate in terms of existing reservations of the Cottesloe-Central and South Complex in the Perth Metropolitan Region.

The results have also determined that the vegetation of the site is not representative of the Yoongarillup Complex, with this complex commencing to the east of Lot 4 where a significant portion is already reserved for conservation purposes under the MRS. Nevertheless, it has been demonstrated that the Yoongarillup Complex is adequately reserved to the south of the PMR in National Parks and Conservation Reserves.

These conclusions are based on the following considerations:

- The vegetation types which cover most of the Lot are protected in the adjacent Paganoni reserve and are present on the western side of Mandurah Road in a section of System 6 Area M107 which is likely to be protected for "landscape" purposes. The vegetation types are also represented in the conservation reserve at Leda and Henderson to the north of Lot 4.

- The floristic composition of Lot 4 has been identified as a collective unit, excluding the Woodland at the eastern boundary of the site, with flora and vegetation types representative of the Cottesloe-Central and South Complex.

- All of the vegetation has been classified as disturbed or severely disturbed in condition mainly as a result of past use of the area for agricultural purposes including stock grazing which has lead to considerable weed invasion.

- The Tuart Woodland and the Tuart/Jarrah Woodland in the easternmost sector of the Lot is on the alignment of the proposed rapid transit railway to Mandurah. In addition, this vegetation type has been identified as supporting the Priority 2 flora species, *Lasiopetalum membranaceum*, will be disturbed as a result of the railway alignment.

The implications of including a portion of Lot 4 do not seem to have been considered in terms of the current land use approved for the site. The operation of an extractive industry over the northern portion of the site with mining expected to continue along the southern extent of the limestone ridge significantly negates any of the criteria used to select the land for conservation purposes. In addition, the railway proposed to follow the alignment of the eastern boundary of Lot 4 will sever any opportunity of a linkage to Paganoni Swamp and consolidation of the Regional Park.

On this basis, Alan Tingay and Associates on behalf of CRS recommends the deletion of Lot 4 Mandurah Road, Singleton from Perth's Bushplan.

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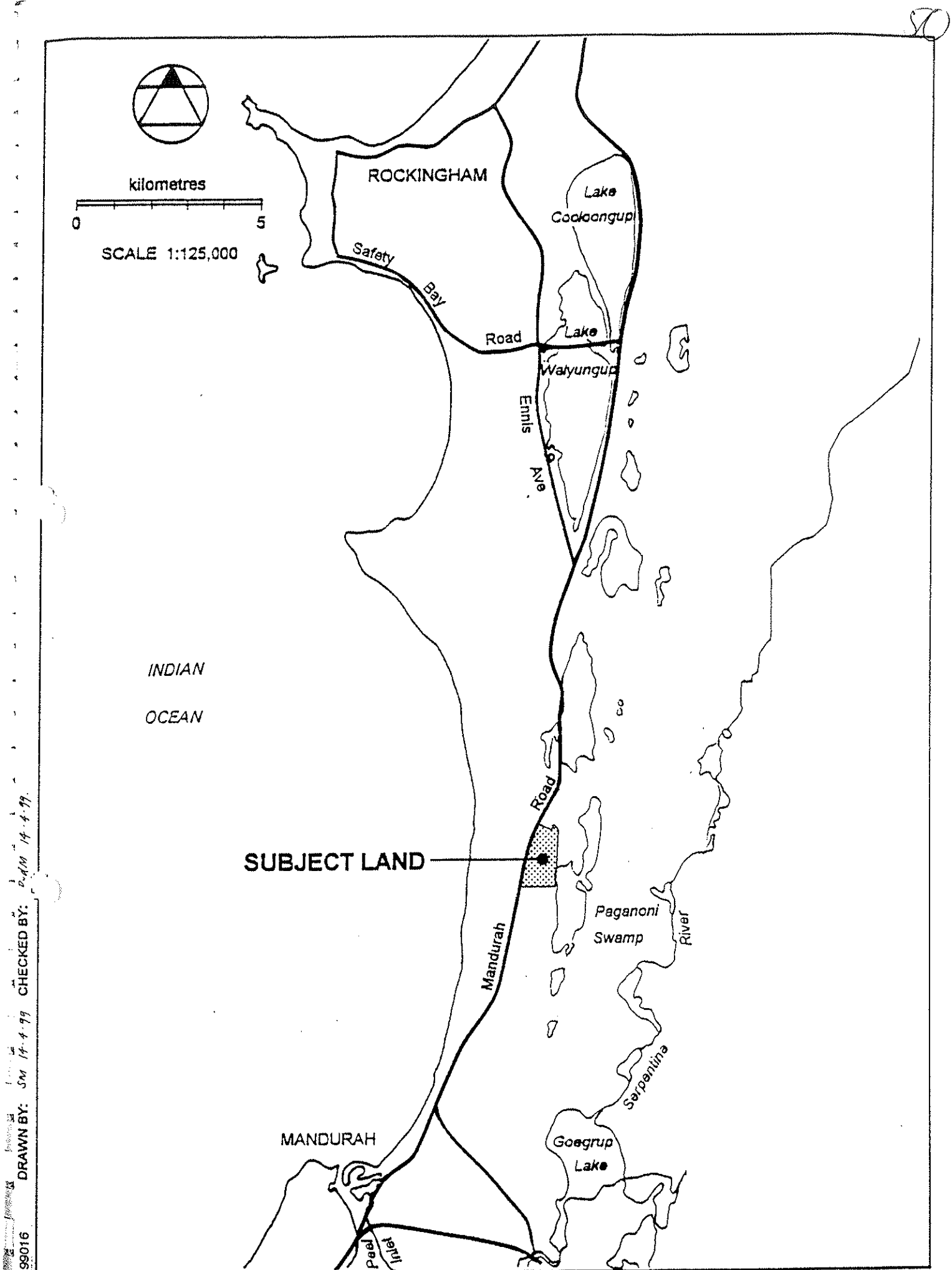

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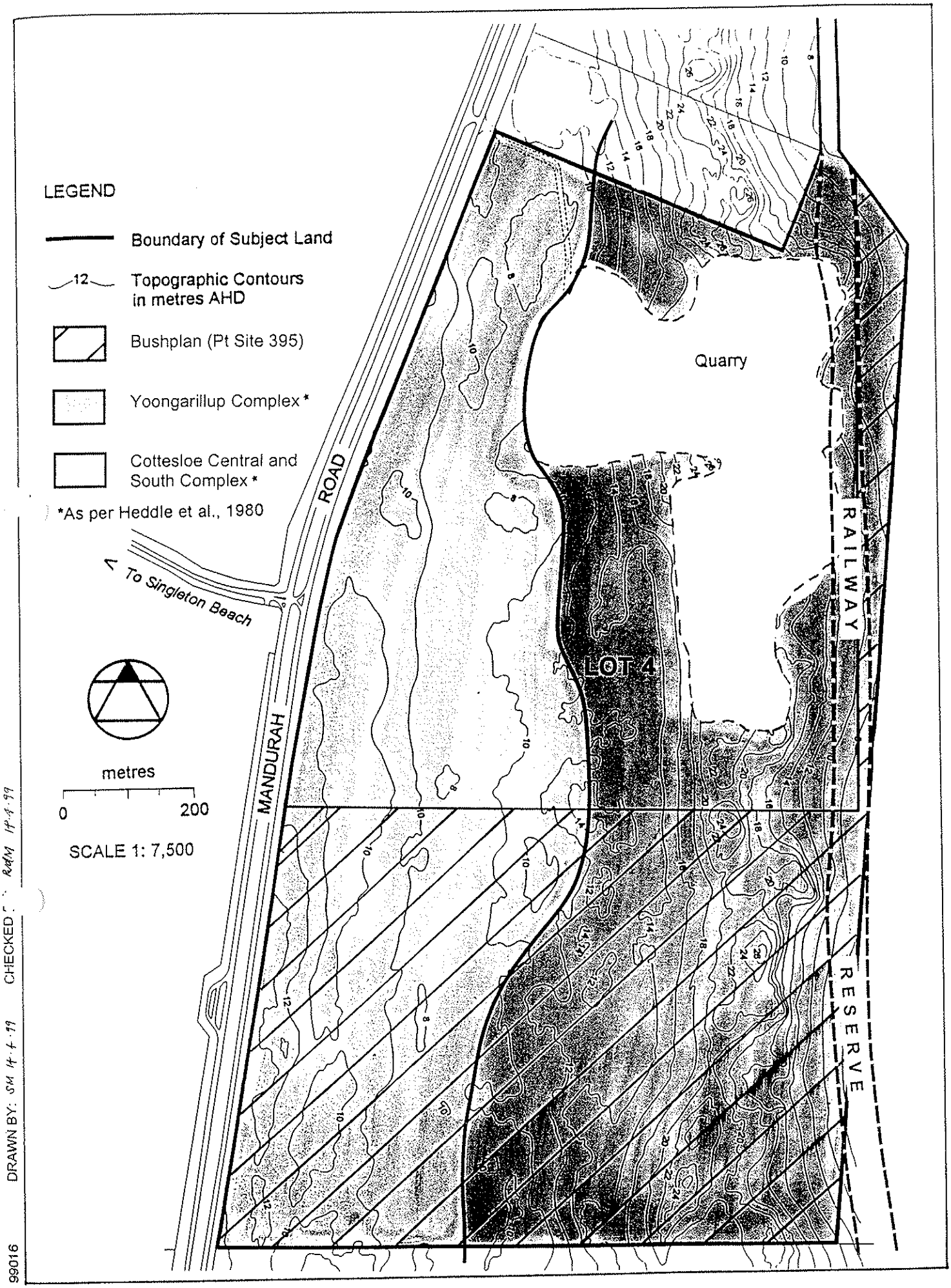
ALAN TINGAY & ASSOCIATES

LOT 4 MANDURAH ROAD SINGLETON
REGIONAL LOCATION
FIGURE 1



DRAWN BY: SM 14-4-99 CHECKED: RAM 19-4-99

99016

ALAN TINGAY & ASSOCIATES

LOT 4 MANDURAH ROAD SINGLETON
TOPOGRAPHY & VEGETATION COMPLEXES
FIGURE 2

APPENDIX 1

FLORA LIST FOR 1997 AND 1999 SURVEY SITES AT LOT 4 MANDURAH ROAD, SINGLETON

APPENDIX 1

FLORA LIST & SAMPLE SITE DESCRIPTIONS
(As per survey conducted July 1997 (Alan Tingay & Associates, 1997) and March 1999)

Survey Date:	July 1997				March 1999						
Site No. / Species	SITE 1/97	SITE 2/97	SITE 3/97	SITE 4/97	SITE 1/99	SITE 2 /99	SITE 3/99	SITE 4/99	SITE 5/99	SITE 6/99	SITE 7/99
Acacia cochlearis	1			1	1	1					
Acacia lasiocarpa	1										
Acacia pulchella		1		1		1	1		1	1	1
Acacia rostellifera			1								1
Acacia saligna	1										
Acacia stenoptera		1									
Acacia truncata				1	1			1		1	
Acanthocarpus preissii	1	1									
Adriana quadripartita			1								
Allocasuarina huegelii		1	1								
Allocasuarina humilis	1	1	1	1	1	1	1	1			1
Astroloma (toothed)								1			
Banksia attenuata		1	1								
Banksia grandis			1								
Beyeria cinerea	1								1		
Bossiaea eriocarpa		1									
Brachyloma preissii				1							
Caesia micrantha		1	1								
Cassytha flava	1								1		
Comesperma confertum	1										
Conostylis aculeata					1	1	1				
Conostylis candicans	1	1						1			1
Conostylis setigera				1							
Corynotheca micrantha		1									
Cryptandra mutila									1		
Desmocladus flexuosus	1				1	1	1	1	1	1	1
Dianella revoluta	1										
Dryandra lindleyana	1	1		1	1	1	1	1			1
Ecalyptus foecunda										1	
Eucalyptus gomphocephala		1	1								
Eucalyptus marginata			1								
Gompholobium tomentosum	1	1			1	1			1		1
Grevillea crithmifolia		1									
Grevillea preissii	1		1				1				
Grevillea thelemanniana					1	1	1	1	1	1	1
Gyrostemon ramulosus									1		
Hakea lissocarpha			1								
Hakea prostrata	1		1	1	1		1	1			1
Hakea trifurcata	1	1	1	1		1		1		1	1
Hardenbergia comptoniana		1	1								
Hemiandra pungens			1								
Hibbertia hypericoides	1	1	1					1			
Hibbertia racemosa					1		1	1			1
Jacksonia calcicola		1									
Jacksonia furcellata			1								

Survey Date:	July 1997				March 1999						
Site No. / Species	SITE 1/97	SITE 2/97	SITE 3/97	SITE 4/97	SITE 1/99	SITE 2 /99	SITE 3/99	SITE 4/99	SITE 5/99	SITE 6/99	SITE 7/99
Jacksonia stricta							1	1			
Lasiopetalum membranaceum			1								
Lepidosperma angustatum					1	1	1		1	1	1
Leucopogon parviflorus					1	1	1			1	
Lomandra maritima	1				1	1	1	1	1	1	1
Macrozamia reidlei		1	1								
Melaleuca acerosa	1	1	1	1	1	1		1	1	1	1
Melaleuca huegelii	1			1					1	1	
Mesomelaena pseudostygia		1	1								
Nemcia reticulata						1	1				1
Olearia axillaris	1	1					1				
Opercularia vaginata	1					1				1	1
Patersonia occidentalis		1	1								
Persoonia saccata		1									
Petrophile serruriae	1		1	.	1	1	1	1			
Phyllanthus calycinus	1		1		1			1	1		
Pimelea calcicola	1			1		1					
Podolepis gracilis			1								
Rhagodia baccata		1				1	1	1	1	1	
Santalum acuminatum						1	1				
Scaevola thesioides				1	1				1		1
Scaevola canescens										1	
Sphaerolobium medium	1					1					
Stipa flavescens											1
Templetonia retusa	1			1	1	1	1	1	1		
Thysanotus thyrsoides	1		1								
Trymalium ledifolium	1										
Adriana sp.					1				1		
Tetraria octandra						1					
Rhamnaceae sp.					1		1	1		1	1
TOTAL	29	25	26	14	20	22	20	19	17	15	19

SAMPLE SITE DESCRIPTIONS

JULY 1997 SURVEY

SITE 1/1997 *Melaleuca huegelii* Scrub-Heath on the limestone ridge with *Templetonia retusa, Olearia axillaris* and *Hakea trifurcata.* Commonly associated with these species is *Allocasuarina humilis* and *M. acerosa* and numerous other species of low shrubs and herbs.

SITE 2/1997 Tuart (*Eucalyptus gomphocephala)* Woodland with *Banksia attenuata* and *A. huegelii* with a dense understorey of shrubs and herbs.

SITE 3/1997 Jarrah (*E. marginata)* and Tuart Woodland with *A. huegelii, B. attenuata* with a dense understorey of shrubs and herbs.

SITE 4/1997 Limestone Scrub-Heath of *M. huegelii, M. acerosa* and *T. retusa.*

MARCH 1999 SURVEY

SITE 1/1999 *Acacia truncata* Shrubland over *Grevillea thelemanniana, T. retusa* and *Lomandra maritima.*

SITE 2/1999 *T. retusa, G.thelemanniana* Low Shrubland

SITE 3/1999 *Santalum acuminatum* Shrubland with *A. humilis.*

SITE 4/1999 *Hakea trifurcata* Heath with *A. humilis* and *M.acerosa*

SITE 5/1999 *M. huegelii* and *T. retusa* Open Heath

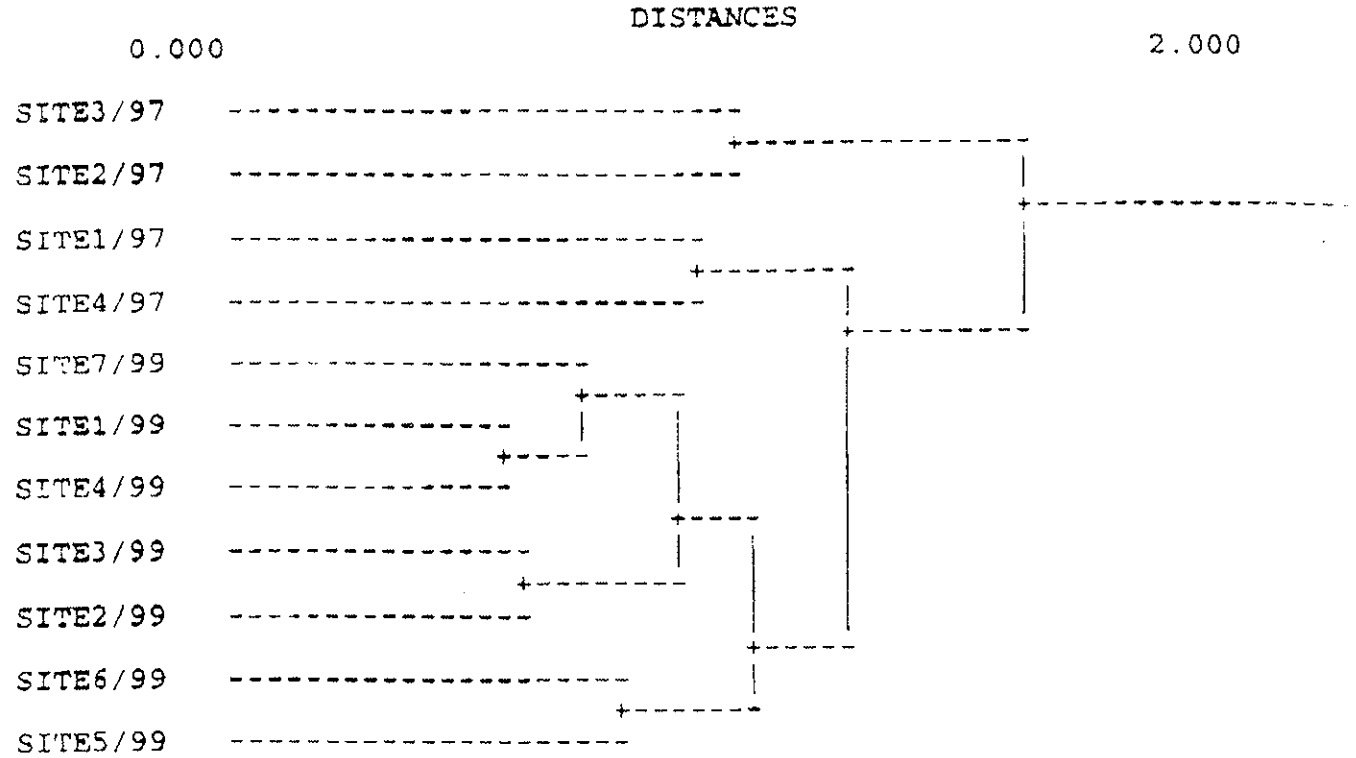
SITE 6/1999 *Eucalyptus foecunda* Closed Heath to Thicket over *M. huegelii, G. thelemanniana, L. maritima* and *H. trifurcata* at the periphery.

SITE 7/1999 *Acacia rostellifera* Heath over *A. pulchella* and *H. trifucata.*

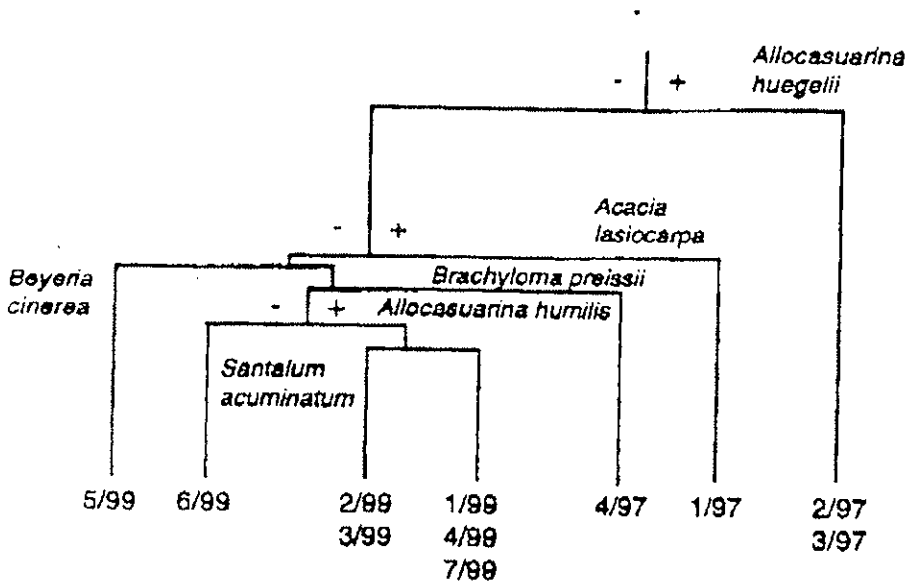
APPENDIX 2

CLASSIFICATION DIAGRAMS

DISTANCE METRIC IS 1-PEARSON CORRELATION COEFFICIENT
COMPLETE LINKAGE METHOD (FARTHEST NEIGHBOR)
TINGAY DATA



TWINSPAN Analysis



APPENDIX 3

CONSOLIDATED FLORA LIST FOR LOT 4 MANDURAH ROAD

APPENDIX 3 - CONSOLIDATED FLORA LIST

NATIVE SPECIES

Acacia cochlearis
Acacia lasiocarpa
Acacia pulchella
Acacia rostellifera
Acacia saligna
Acacia stenoptera
Acacia truncata
Acanthocarpus preissii
Adriana quadripartita
Allocasuarina huegelii
Allocasuarina humilis
Anigozanthos humilis
Astroloma sp.
Banksia attenuata
Banksia grandis
Beyeria cinerea
Bossiaea eriocarpa
Brachycome iberidifolia
Brachyloma preissii
Caesia micrantha
Cassytha flava
Comesperma confertum
Conostylis aculeata
Conostylis candicans
Conostylis setigera
Corynotheca micrantha
Cryptandra mutila
Cuscuta epithymum
Daviesia physodes
Desmocladus flexuosus
Dianella revoluta
Dryandra lindleyana
Eucalyptus decipiens
Eucalyptus foecunda
Eucalyptus gomphocephala
Eucalyptus marginata
Gompholobium tomentosum
Grevillea crithmifolia
Grevillea preissii
Grevillea thelemanniana
Gyrostemon ramulosus
Hakea lissocarpha
Hakea prostrata
Hakea trifurcata
Hardenbergia comptoniana
Hemiandra pungens
Hibbertia hypericoides
Hibbertia racemosa
Jacksonia calcicola
Jacksonia furcellata
Jacksonia stricta
Lasiopetalum membranaceum
Lepidosperma angustatum
Lepidosperma sp. D
Leucopogon parviflorus
Lobelia tenuior
Lomandra maritima
Macrozamia reidlei
Melaleuca acerosa
Melaleuca huegelii
Mesomelaena pseudostygia
Nemcia reticulata
Olearia axillaris
Opercularia vaginata
Patersonia occidentalis
Persoonia saccata
Petrophile serruriae
Phyllanthus calycinus
Pimelea calcicola
Podolepis gracilis
Rhagodia baccata
Santalum acuminata
Scaevola canescens
Scaevola thesioides
Senecio lautus
Sphaerolobium medium
Stipa flavescens
Templetonia retusa
Tersonia cyathiflora
Thysanotus thyrsoides
Tricoryne elatior
Trymalium ledifolium

INTRODUCED SPECIES

Anagallis arvensis (pimpernel)
Arctotheca calendula (capeweed)
Avena sativa (common oat)
Carpobrotus edulis (pigface)
Centaurea melitensis
Dichanthium sericeum
Ehrharta calycina (veldtgrass)
Euphorbia terracina
Heliophila pusilla
Lagurus ovatus (hare's tail grass)
Lupinus cosentinii (lupin)
Orobanche minor
Pelargonium capitatum
Romulea rosea (Guildford grass)
Scabiosa atropurpurea
Solanum nigrum (nightshade)
Solanum sodomeum
Taraxacum officinale (dandelion)
Ursinia anthemoides

APPENDIX 4

ANTICIPATED FAUNA LIST FOR LOT 4 MANDURAH ROAD

APPENDIX 4

Anticipated Vertebrate Fauna List for Lot 4 Mandurah Road, Singleton

Typical reptile species which may occur in the Singleton region include:

GEKKONIDAE	
Diplodactylus alboguttatus	White-spotted Ground Gecko
Phyllodactylus marmoratus	Marbled Gecko
Strophurus spinigerus	South-western Spiny-tailed Gecko
PYGOPODIDAE	
Aprasia repens	South-western Sandplain Worm Lizard
Delma fraseri	Fraser's Legless Lizard
Lialis burtonis	Burton's Legless Lizard
SCINCIDAE	
Cryptoblepharus plagiocephalus	Snake-eyed, Fence or Sun Skink
Egernia kingii	King's Skink
Lerista elegans	West Coast Four-toed Lerista
Lerista praepedita	Western Worm Lerista
Menetia greyii	Common Dwarf Skink
Morethia lineoocellata	Western Pale-flecked Morethia
Tiliqua occipitalis	Western Bluetongue
Tiliqua rugosa	Shingleback or Bobtail
TYPHLOPIDAE	
Ramphotyphlops australis	Southern Blind Snake
ELAPIDAE	
Pseudonaja affinis	Dugite or Spotted Brown Snake

Birds in the area may include the following:

ACCIPITRIDAE	
Elanus axillaris	Black-shouldered Kite
FALCONIDAE	
Falco cenchroides	Nankeen Kestrel
COLUMBIDAE	
Phaps chalcoptera	Common Bronzewing
PSITTACIDAE	
Barnardius zonarius	Australian Ringneck
CUCULIDAE	
Cacomantis flabelliformis	Fan-tailed Cuckoo

MEROPIDAE	
Merops ornatus	Rainbow Bee-eater
MALURIDAE	
Malurus splendens	Splendid Fairy-wren
PARDALOTIDAE	
Sericornis frontalis	White-browed Scrubwren
Gerygone fusca	Western Gerygone
Acanthiza apicalis	Inland Thornbill
Acanthiza chrysorrhoa	Yellow-rumped Thornbill
MELIPHAGIDAE	
Anthochaera carunculata	Red Wattlebird
Lichenostomus virescens	Singing Honeyeater
Lichmera indistincta	Brown Honeyeater
Phylidonyris novaehollandiae	New Holland Honeyeater
Acanthorhynchus superciliosus	Western Spinebill
PETROICIDAE	
Petroica multicolor	Scarlet Robin
PACHYCEPHALIDAE	
Pachycephala pectoralis	Golden Whistler
DICRURIDAE	
Grallina cyanoleuca	Magpie-Lark
Rhipidura fuliginosa	Grey Fantail
Rhipidura leucophrys	Willie Wagtail
CAMPEPHAGIDAE	
Coracina novaehollandiae	Black-faced Cuckoo-shrike
ARTAMIDAE	
Cracticus torquatus	Grey Butcherbird
Gymnorhina tibicen	Australian Magpie
CORVIDAE	
Corvus coronoides	Australian Raven
MOTACILLIDAE	
Anthus novaeseelandiae	Richard's Pipit
HIRUNDINIDAE	
Hirundo neoxena	Welcome Swallow
Hirundo nigricans	Tree Martin
ZOSTEROPIDAE	
Zosterops lateralis	Silvereye

PORT KENNEDY Q
BS377
ANSTEY Q SWAMP
BS 379

Proposed Port Kennedy and Rockingham Parks Management Framework

Includes the Port Kennedy Scientific Park, Lake Richmond, Anstey Swamp, Paganoni Swamp, Tamworth Hill Swamp, Lake Cooloongup and Lake Walyungup

PAGANONI SWAMP Q
BS395
LAKES Q COOLOONGUP + WALYUNG
BS 356

Prepared for

CITY OF ROCKINGHAM

WESTERN AUSTRALIAN PLANNING COMMISSION

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

PORT KENNEDY BOARD OF MANAGEMENT

LAKE Q RICHMOND
BS 358
TAMWORTH HILL SWAMP Q

By

Alan Tingay & Associates
environmental scientists

August 1997

BP 395 (6) Paganoni – eastern boundary

5099 WA 3165 (C) METRO REGIONAL AREA & EXT. RUN 8 (5079-5160) 1:20000 11-DEC-92 920676

5100 WA 3165 (C) METRO REGIONAL AREA & EXT. RUN 8 (5079-5160) 1:20000 11-DEC-92 920676

5101 WA 3165 (C) METRO REGIONAL AREA & EXT. RUN 8 (5079-5160) 1:20000 11-DEC-92 920676

5183 WA 3165 (C) METRO REGIONAL AREA & EXT. RUN 9 (5161-5244) 1:20000 11-DEC-92 920676