WHITEMAN PARK, WHITEMAN/WEST SWAN

Boundary Definition: protected area/proposed protected area boundary (Areas of bushland within the boundaries of the Site are not accurately mapped. The boundary has been drawn to include any unmapped bushland. Boundary adjusted from that in draft *Perth's Bushplan*.)

SECTION 1: LOCATION INFORMATION

Bush Forever Site no. 304
Area (ha): bushland 1547.9
Map no. 35, 36, 37, 42
Map sheet series ref. no. 2034–II NE
Other Names: Mussel Pool
Local Authorities (Suburb): Shire of Swan (Whiteman, West Swan)
System 6 (1983): M13, part M41 part System area bushland, only bushland described

SECTION 2: REGIONAL INFORMATION

LANDFORMS AND SOILS
Pinjarra Plain
Guildford Formation (Qpa: Mgs1) (Qha: Mc1)
Bassendean Dunes
Bassendean Sands (Qpb: S8)
Bassendean Dunes/Pinjarra Plain
Bassendean Sands over Guildford Formation (Qpb/Qpa: S10)
Wetlands (within the Bassendean Dunes/Pinjarra Plain)
Holocene Swamp Deposits (Qhw: Cps)

VEGETATION AND FLORA
Vegetation Complexes
Bassendean Dunes
Bassendean Complex — Central and South
Combinations of Bassendean Dunes/Pinjarra Plain
Southern River Complex
Floristic Community Types
Supergroup 2: Seasonal Wetlands
4 *Melaleuca preissiana* damplands
S17 *Eucalyptus rudis/Agonis linearifolia* wetlands in Bassendean Dunes
Supergroup 3: Uplands centred on Bassendean Dunes and Dandaragan Plateau
21c Low-lying *Banksia attenuata* woodlands or shrublands
22 *Banksia ilicifolia* woodlands
23a Central *Banksia attenuata* — *B. menziesii* woodlands

WETLANDS
Wetland Types: dampland, floodplain, palusplain, sumpland, artificial channel, creek
Natural Wetland Groups
Bassendean—Pinjarra transition OR Bassendean with fluvial features
Bennett Brook (B/P.4)
Wetland Management Objectives: Conservation (336.5ha), Resource Enhancement, Multiple Use
Swan Coastal Plain Lakes EPP: none identified

THREATENED ECOLOGICAL COMMUNITIES
Not assessed, Not determined

SECTION 3: SPECIFIC SITE DETAIL

Landscape Features: vegetated wetland, creek, vegetated uplands
Vegetation and Flora: limited survey (DEP 1996 (White 03–08), Gibson *et al.* 1994 (White 01–02), Griffin 1994 (WIS 01–02)); detailed survey (part Site — Arnold *et al.* 1991, Jackson *et al.* 1975, Mattiske & Associates 1989)
Structural Units: mapping (part Site — Arnold *et al.* 1991, Jackson *et al.* 1975, Mattiske & Associates 1989)
Uplands (mainly Bassendean Sands): *Eucalyptus calophylla* Woodland to Low Open Woodland, often with *E. marginata*, *Melaleuca preissiana*, *Banksia ilicifolia* or *B. grandis* and combinations of these, and generally over *Verticordia nitens* or mixed Open Low Heath to Low Shrubland; Low Open Forest to Low Open Woodland dominated by *Banksia attenuata*, *B. menziesii*, *B. ilicifolia*, *Allocasuarina fraseriana* or *Eucalyptus todtiana* and combinations of these
Wetlands: Open Forest to Low Open Forest of *Eucalyptus rudis*, *Melaleuca preissiana*, *M. rhaphiophylla* or *Banksia littoralis* and combinations; Heaths and Shrublands of *Melaleuca lateritia*, *Astartea* aff. *fascicularis*,

Pericalymma ellipticum and others; Sedgelands of *Baumea ?vaginata*, *Lepidosperma longitudinale*, *Cyathochaeta teretifolia* and other species

Scattered Native Plants: not assessed

Vegetation Condition: >70% Very Good to Excellent, <30% Good to Degraded, with areas of severe localised disturbance

Total Flora: 340 native taxa, 76 weed taxa (Mattiske & Associates 1989; with additions from DEP 1996 (White 03–08), Gibson *et al.* 1994 (WHITE 01–02) and pers. comm. D. Bright, H. Gratte, J. Wann, T. Comber, A. Brown, WA Native Orchid Study and Conservation Group, Wildflower Society of WA) (estimated >85% expected flora)

Significant Flora: *Cyathochaeta teretifolia* (3), *Aotus cordifolia* (3), *Isopogon drummondii* (3) (Mattiske & Associates 1989), *Stachystemon axillaris* (4), *Conostephium minus* (4), *Verticordia lindleyi* subsp. *lindleyi* (4); *Astroloma xerophyllum*, *Eremaea fimbriata, Verticordia nitens*, *Conospermum triplinervium*, *Boronia purdieana*, *Burchardia bairdiae*, *Drosera macrantha* (swamp form)

Fauna: structured survey for birds (103 species), native mammals (6 species), reptiles (30 species) and amphibians (8 species) (Jackson *et al.* 1975 and Arnold *et al.* 1991). Rich assemblage of insectivorous and nectarivorous birds. Significant bird species: category 1 (2), category 3 (13) and category 4 (13). Significant mammal species: Ash Grey Mouse, Honey Possum, Quenda and Western Brush Wallaby. Rich reptile assemblage including a dragon (*Tympanocryptis adelaidensis*), Black-headed Snake (*Parasuta gouldii*), a gecko (*Diplodactylus alboguttatus*), skink lizards (*Acritoscincus trilineatum* and *Ctenotus gemmula*), Rosenberg's Monitor (*Varanus rosenbergi*) and Black-striped Snake (*Simoselaps calonotos*)

Linkage: adjacent native vegetation to the south (Site 305) and west (Site 198 across road); part of Greenways 32, 39, 21, 40, 38 (Tingay, Alan & Associates 1998a); part of a regionally significant fragmented bushland/wetland linkage (Part A, Map 7)

Other Special Attributes: rich and diverse flora and fauna, with a relatively large number of significant species, including the largest known stands of the significant sedge *Cyathochaeta teretifolia*; contains part of the channel (Bennett Brook) recommended for conservation by Semeniuk, V&C Research Group (1992); contains area of significant undeveloped remnant vegetation and/or regional open space identified by Semeniuk, V&C Research Group (1992); contains 956m of regionally significant river (WRC 1996a GIS)

SECTION 4: INTERNATIONAL AND NATIONAL SIGNIFICANCE

Subject to protection under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*

SECTION 5: SELECTION CRITERIA AND RECOMMENDATIONS

Criteria: Representation of ecological communities, Diversity, Rarity, Scientific or evolutionary importance, General criteria for the protection of wetland, streamline and estuarine fringing vegetation and coastal vegetation, Criteria not relevant to determination of regional significance, but which may be applied when evaluating areas having similar values

Recommendation: Part A: Site with Some Existing Protection; the existing purpose, care, control and management of this Site is endorsed. Part B: Proposed Parks and Recreation Reservation (see Table 3, Volume 1).

WHITEMAN PARK, WHITEMAN/WEST SWAN

Boundary Definition: protected area/bushland boundary (Areas of bushland within the boundaries of the Bushplan Site are not accurately mapped. The boundary has been drawn to include any unmapped bushland.)

SECTION 1: CADASTRAL INFORMATION

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

Bushplan Site no. 304 **Map no.** 40, 41, 46, 47 **Map sheet series ref. no.** 2034–II NE

System 6 (1983): M13, part M41 part System area bushland, only bushland described

Other Names
Mussel Pool

Local Authorities (Suburb)
Shire of Swan (Whiteman, West Swan)

Ownership Categories
State Government, Private

Area (ha): total 2514.9; bushland 1416.2

Zoning
MRS: Parks and Recreation, Rural
TPS: Landscape, General Rural

Lot/Location/Reserve numbers (Purpose), Street name
2, 3 Woollcott Ave; 3 Dulwich St; 54, 626 Cranleigh St; 1, 20 Harrow St; 20 Gnangara Rd; 11, 21, 22, 58 Park St; 1, 99 street not identified

SECTION 2: REGIONAL INFORMATION

LANDFORMS AND SOILS

Pinjarra Plain
Guildford Formation (Qpa: Mgs1) (Qha: Mc1)

Bassendean Dunes
Bassendean Sands (Qpb: S8)

Bassendean Dunes/Pinjarra Plain
Bassendean Sands over Guildford Formation (Qpb/Qpa:S10)

Wetlands (within the Bassendean Dunes/Pinjarra Plain)
Holocene Swamp Deposits (Qhw: Cps)

VEGETATION AND FLORA

Vegetation Complexes

Bassendean Dunes
Bassendean Complex — Central and South

Combinations of Bassendean Dunes/Pinjarra Plain
Southern River Complex

Floristic Community Types

Supergroup 2: Seasonal Wetlands
4 *Melaleuca preissiana* damplands
S17 *Eucalyptus rudis/Agonis linearifolia* wetlands in Bassendean Dunes

Supergroup 3: Uplands centred on Bassendean Dunes and Dandaragan Plateau
21c Low lying *Banksia attenuata* woodlands or shrublands
22 *Banksia ilicifolia* woodlands
23a Central *Banksia attenuata* — *B. menziesii* woodlands

WETLANDS

Wetland Types: dampland, floodplain, palusplain, sumpland, lake, creek, artificial channel

Natural Wetland Groups

Bassendean—Pinjarra transition OR Bassendean with fluvial features
Bennett Brook (B/P.4)

Wetland Management Objectives: Conservation (336.5ha), Resource Enhancement, Multiple Use

Swan Coastal Plain Lakes EPP: none identified

THREATENED ECOLOGICAL COMMUNITIES

Not assessed, Not determined

SECTION 3: SPECIFIC SITE DETAIL

Landscape Features: vegetated wetland, creek, vegetated uplands

Vegetation and Flora: detailed survey (Arnold *et al.* 1991, part Bushplan Site — Jackson *et al.* 1975), Mattiske & Associates 1989; limited survey (DEP 1996 (White 03–08), Gibson *et al.* 1994 (White 01–02), Griffin 1994 (WIS 01–02))

Structural Units: mapping (Arnold *et al.* 1991, Jackson *et al.* 1975; Mattiske & Associates 1989)

Uplands (mainly Bassendean Sands): *Eucalyptus calophylla* Woodland to Low Open Woodland, often with *E. marginata*, *Melaleuca preissiana*, *Banksia ilicifolia* or *B. grandis* and combinations of these, and generally over *Verticordia nitens* or mixed Open Low Heath to Low Shrubland; Low Open Forest to Low Open Woodland

dominated by *Banksia attenuata, B. menziesii, B. ilicifolia, Allocasuarina fraseriana* or *Eucalyptus todtiana* and combinations of these

Wetlands: Open Forest to Low Open Forest of *Eucalyptus rudis, Melaleuca preissiana, M. rhaphiophylla* or *Banksia littoralis* and combinations; Heaths and Shrublands of *Melaleuca lateritia, Astartea* aff. *fascicularis, Pericalymma ellipticum* and others; Sedgelands of *Baumea ?vaginata, Lepidosperma longitudinale, Cyathochaeta teretifolia* and other species

Scattered Native Plants: not assessed

Vegetation Condition: >70% Very Good to Excellent, <30% Good to Degraded, with areas of severe localised disturbance

Total Flora: 340 native taxa, 76 weeds (Mattiske & Associates 1989; with additions from DEP 1996 (White 03–08), Gibson *et al.* 1994 (WHITE 01–02); and pers. comm. D. Bright, H. Gratte, J. Wann, T. Comber, A. Brown, Native Orchid Group, WA Wildflower Society) (estimated >85% expected flora)

Significant Flora: *Cyathochaeta teretifolia* (3), *Aotus cordifolia* (3), *Isopogon drummondii* (3) (Mattiske & Associates 1989), *Stachystemon axillaris* (4), *Conostephium minus* (4), *Verticordia lindleyi* subsp. *lindleyi* (4); *Astroloma xerophyllum, Eremaea fimbriata, Verticordia nitens, Conospermum triplinervium, Boronia purdieana, Burchardia bairdiae, Drosera macrantha* (swamp form)

Fauna: multiple and structured surveys by Jackson *et al.* (1975) and Arnold *et al.* (1991) for birds (103), native mammals (6), reptiles (30) and amphibians (8). Rich assemblage of insectivorous and nectarivorous birds. Significant bird species: category 1 (2), category 3 (13) and category 4 (13). Significant mammal species: Ash-grey Mouse, Honey Possum, Quenda and Western Brush Wallaby. Rich reptile assemblage including a dragon (*Tympanocryptis adelaidensis*), Black-headed Snake (*Rhinoplocephalus gouldii*), a gecko (*Diplodactylus alboguttatus*), skink lizards (*Bassiana trilineata* and *Ctenotus gemmula*) and Rosenberg's Monitor (*Varanus rosenbergii*). Significant reptile species: Black-striped Snake (*Simoselaps calonotos*)

Linkage: adjacent native vegetation to the south (BS305) and west; part of proposed Greenway 41, 22, 39, 21, 40, 33 (Tingay, Alan & Associates 1997a); part of a regionally significant fragmented bushland/wetland linkage (Volume 2A, Map 8)

Other Special Attributes: rich and diverse flora and fauna, with a relatively large number of significant species, including the largest known stands of the significant sedge *Cyathochaeta teretifolia*; contains part of the channel (Bennett Brook) recommended for conservation by Semeniuk, V&C Research Group (1992); contains area of significant undeveloped remnant vegetation and/or regional open space identified by Semeniuk, V&C Research Group (1992); contains 956m of regionally significant river (WRC 1996a GIS)

SECTION 4: INTERNATIONAL AND NATIONAL SIGNIFICANCE

Not listed

SECTION 5: SELECTION CRITERIA AND RECOMMENDATIONS

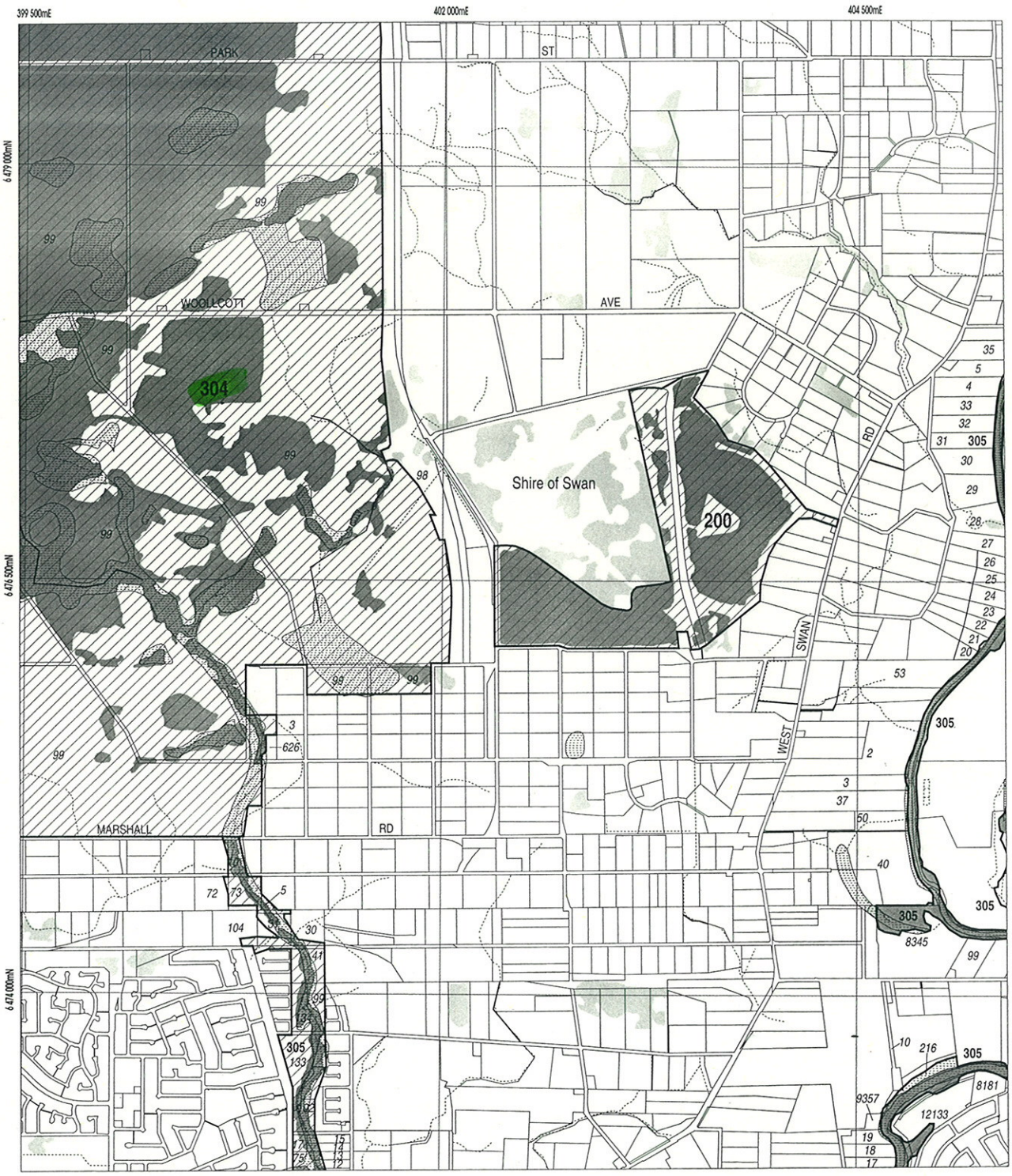
Criteria: Representation of ecological communities, Diversity, Rarity, Scientific or evolutionary importance, General criteria for the protection of wetland, streamline and estuarine fringing and coastal vegetation, Criteria not relevant to determination of conservation value, but which may be applied when evaluating areas having similar values

Opportunities and/or Constraints

Opportunities: Bushplan Site/part Bushplan Site subject to Swan and Canning Rivers EPP, Gnangara Mound Crown Land EPP; location of Scheduled Fauna, conservation category wetlands; under MRS Parks and Recreation Reservation and TPS Landscape Zoning

Constraints: under General Mineral Resource Area (sand)

Recommendation: The existing purpose, care, control and management of this Bushplan Site is endorsed.



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

2034 - II NE

IV	I
III	II (NW, NE, SW, SE)

2034 — II NE = 47

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

PERTH'S BUSHPLAN MAP INDEX

1 2 | 3 4 5 | 6 7 8 9 10 11 | 12 13 14 15 16 | 17 18 19 20 21 22 23 | 24 25 26 27 28 29 30 | 31 32 33 34 35 36 | 37 38 39 40 41 42 | 43 44 45 46 47 48 | 49 50 51 52 53 54 | 55 56 57 58 59 | 60 61 62 63 64 | 65 66 67 68 69 70 | 71 72 73 74 75 76 77 | 78 79 80 81 82 83 84 | 85 86 87 88 89 90 91 | 92 93 94 95 96 97 | 98 99 100 101 102 | 103 104 105 106

N

SCALE

0 — 500 — 1000 Metres

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

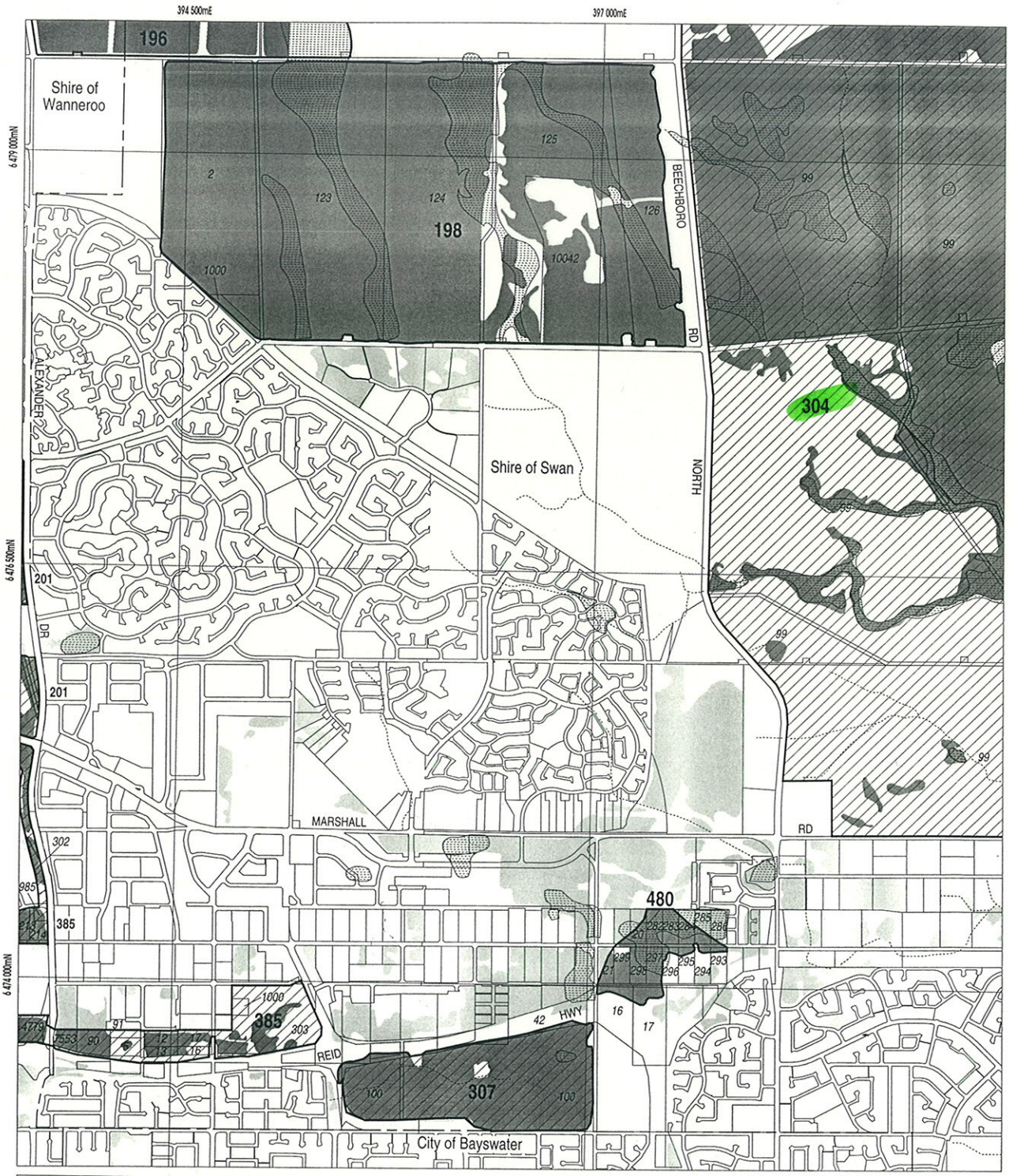
ntw-map11//environ/bushplan//bushv2_47.dgn

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

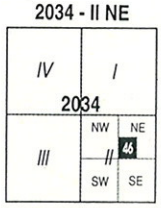
Bushplan Site Map



LEGEND

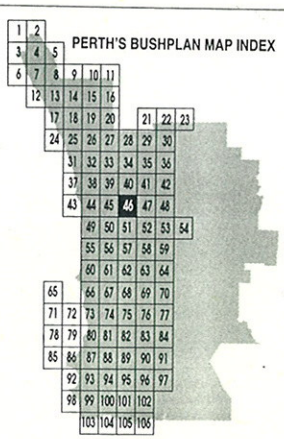
- 472 — Bushplan Sites With Regionally Significant Bushland
- Other Native Vegetation
- Conservation Category Wetlands
- Bushplan Sites With Some Existing Protection
- 696 — Lot Number, Location Number
- Channel Wetlands
- Local Government Boundary

2034 - II NE



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

PERTH'S BUSHPLAN MAP INDEX



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SCALE

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Metres

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

ntw-map11//environ/bushplan//bushv2_46.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 46

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

2034 - II NE

IV | I
2034
III | NW 40 NE / SW SE

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

PERTH'S BUSHPLAN MAP INDEX

1 2
3 4 5
6 7 8 9 10 11
12 13 14 15 16
17 18 19 20 21 22 23
24 25 26 27 28 29 30
31 32 33 34 35 36
37 38 39 40 41 42
43 44 45 46 47 48
49 50 51 52 53 54
55 56 57 58 59
60 61 62 63 64
65 66 67 68 69 70
71 72 73 74 75 76 77
78 79 80 81 82 83 84
85 86 87 88 89 90 91
92 93 94 95 96 97
98 99 100 101 102
103 104 105 106

N

SCALE
0 500 1000
Metres

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

ntw-map11//environ/bushplan//bushv2_40.dgn

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

Wetlands Data supplied by Water and Rivers Commission

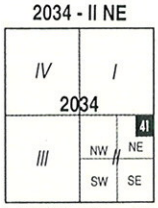
Native Vegetation Extent for Study Area supplied by Agriculture Western Australia

Bushplan Site Map

LEGEND

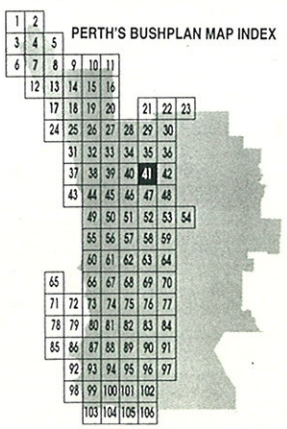
- 472 — Bushplan Sites With Regionally Significant Bushland
- Other Native Vegetation
- Conservation Category Wetlands
- Bushplan Sites With Some Existing Protection
- 696 — Lot Number, Location Number
- Channel Wetlands
- Local Government Boundary

2034 - II NE



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

PERTH'S BUSHPLAN MAP INDEX



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SCALE

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Metres

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

ntw-map11//environ/bushplan/bushv2_41.dgn

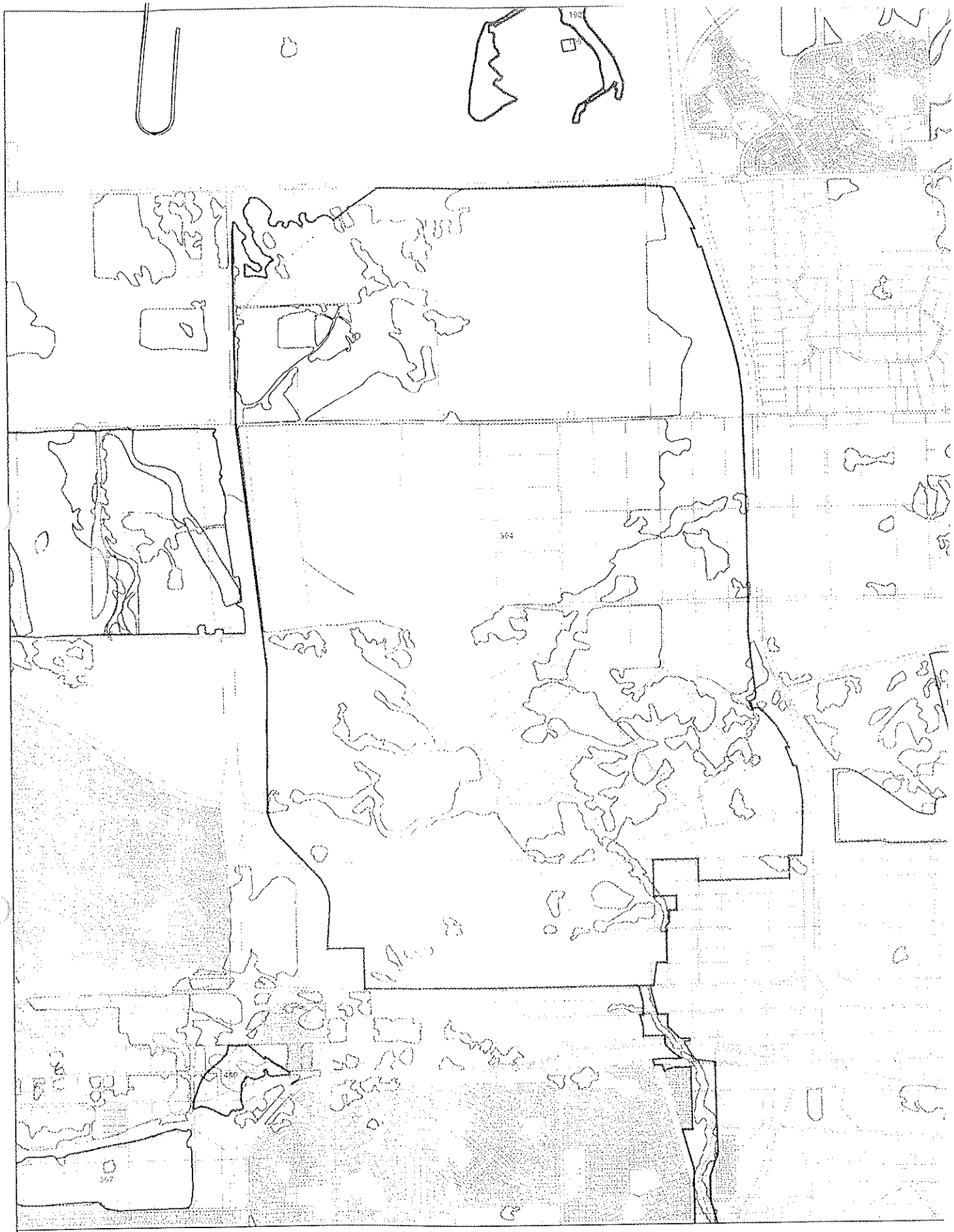
Cadastral Data supplied by Department of Land Administration, W.A.

Wetlands Data supplied by Water and Rivers Commission

Native Vegetation Extent for Study Area supplied by Agriculture Western Australia

Bushplan Site Map

Map 41



304

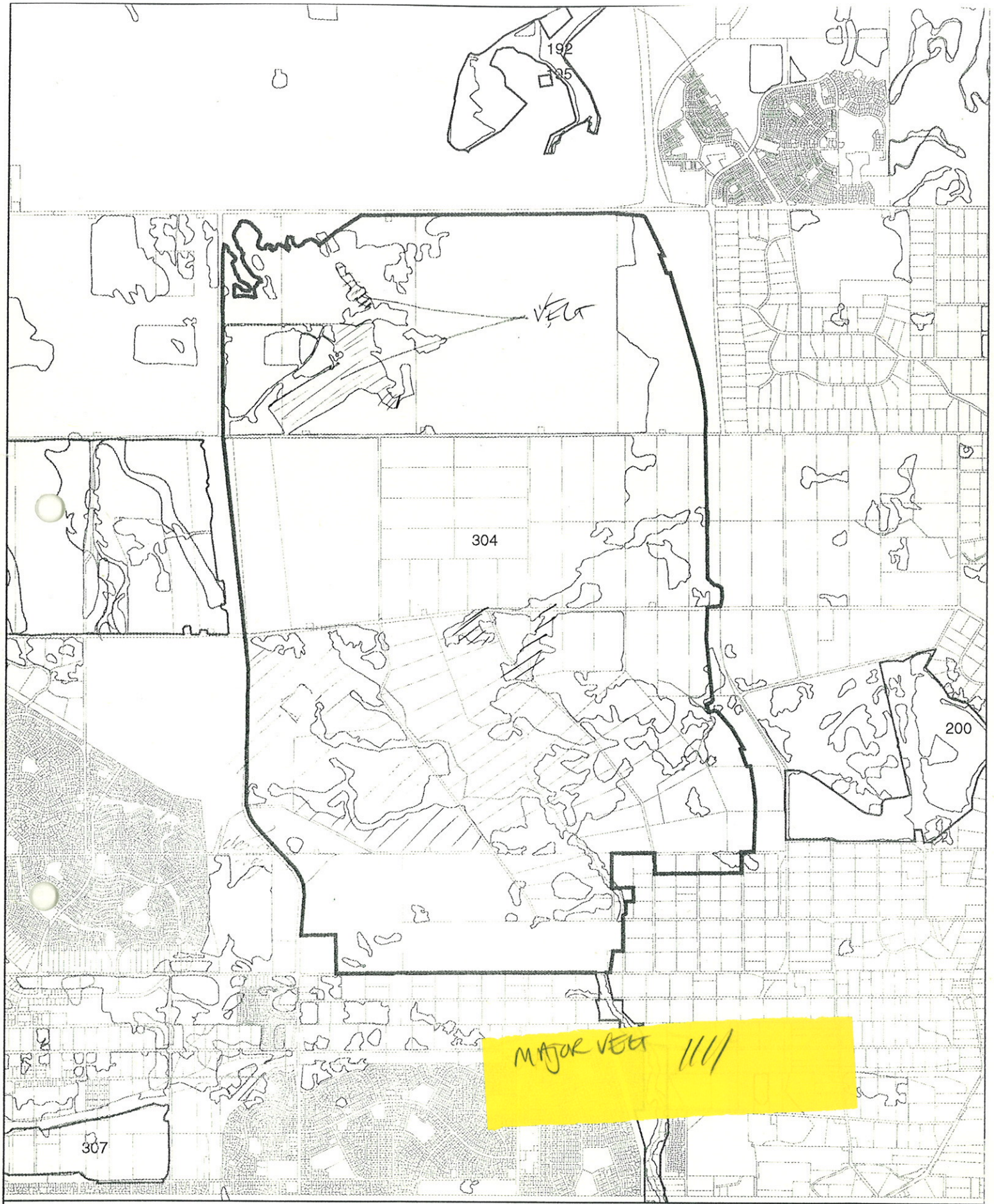
BUSHPLAN SITES CORRECTED

6 BK/TC 22/4/88

WESTERN AUSTRALIAN PLANNING COMMISSION

CUSTOMER FOCUS

N



BUSHPLAN SITES CORRECTED

THE GOVERNMENT OF WESTERN AUSTRALIA

WESTERN AUSTRALIAN PLANNING COMMISSION

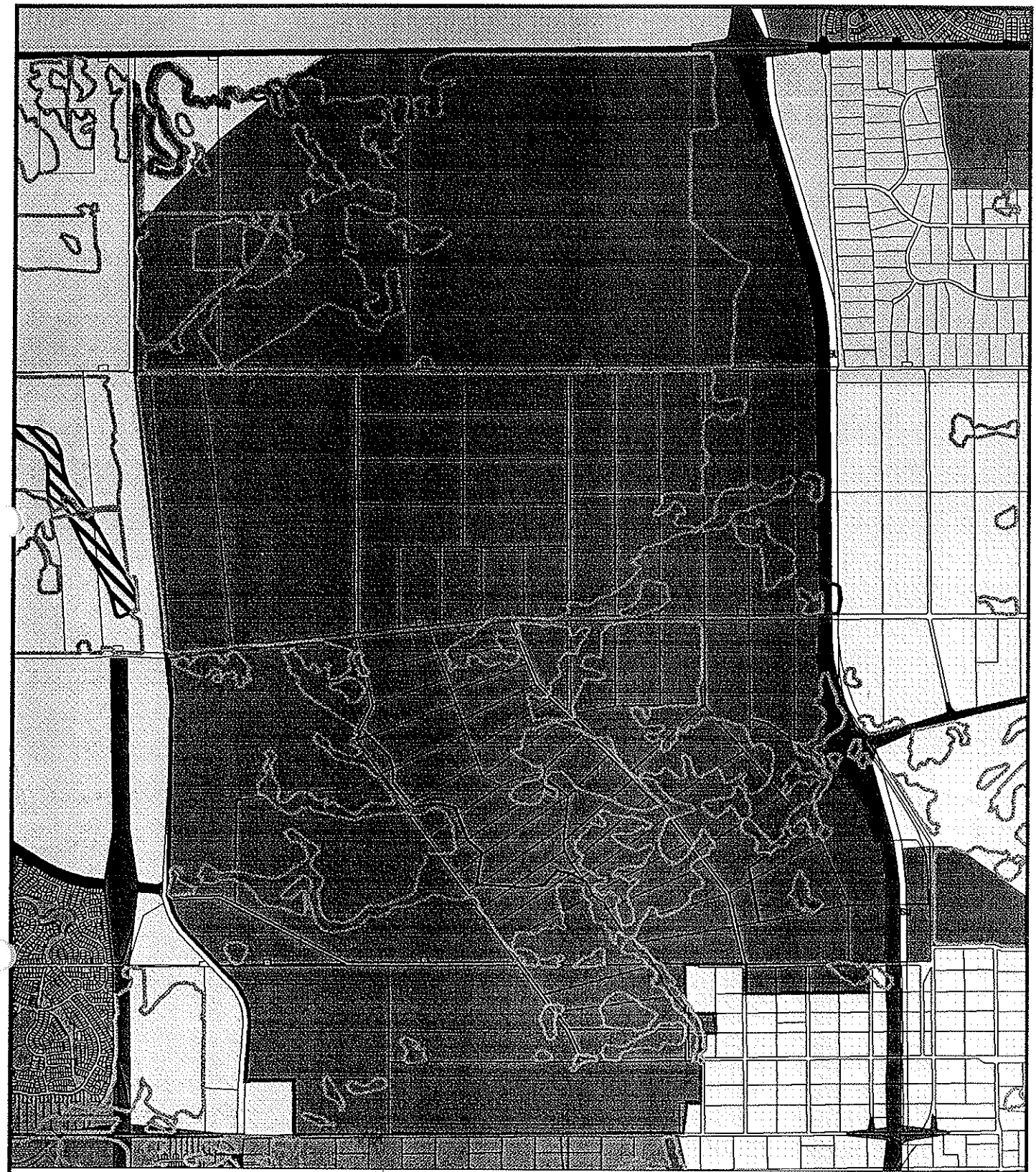
CUSTOMER FOCUS WESTERN AUSTRALIA

NOTE: old veg mapping more accurate ////
= VEG

N

BOUNDARY FINE

CK/NT
29/9/93



bp site 304

MFP INTERNAL USE ONLY	
Prepared By: Andrea Zappacosta	
Prepared For:	
Map Ident: plot980908_1	
Date: 08 Sep 98	
Scale 1:33158	

- Bushplan sites refno 1-500 SCP BOUNDARY THEME
- Cadastre
- AG VEG 1998 - BOUNDARIES SCP
- URBAN
- URBAN DEFERRED
- INDUSTRIAL
- RURAL
- PARKS & RECREATIO
- STATE FORESTS
- CONTROLLED ACCES
- IMPORTANT REGION
- PP - SPECIAL USES
- Verified CCWs
- cons category wetlan

Figure 4.1 overlay

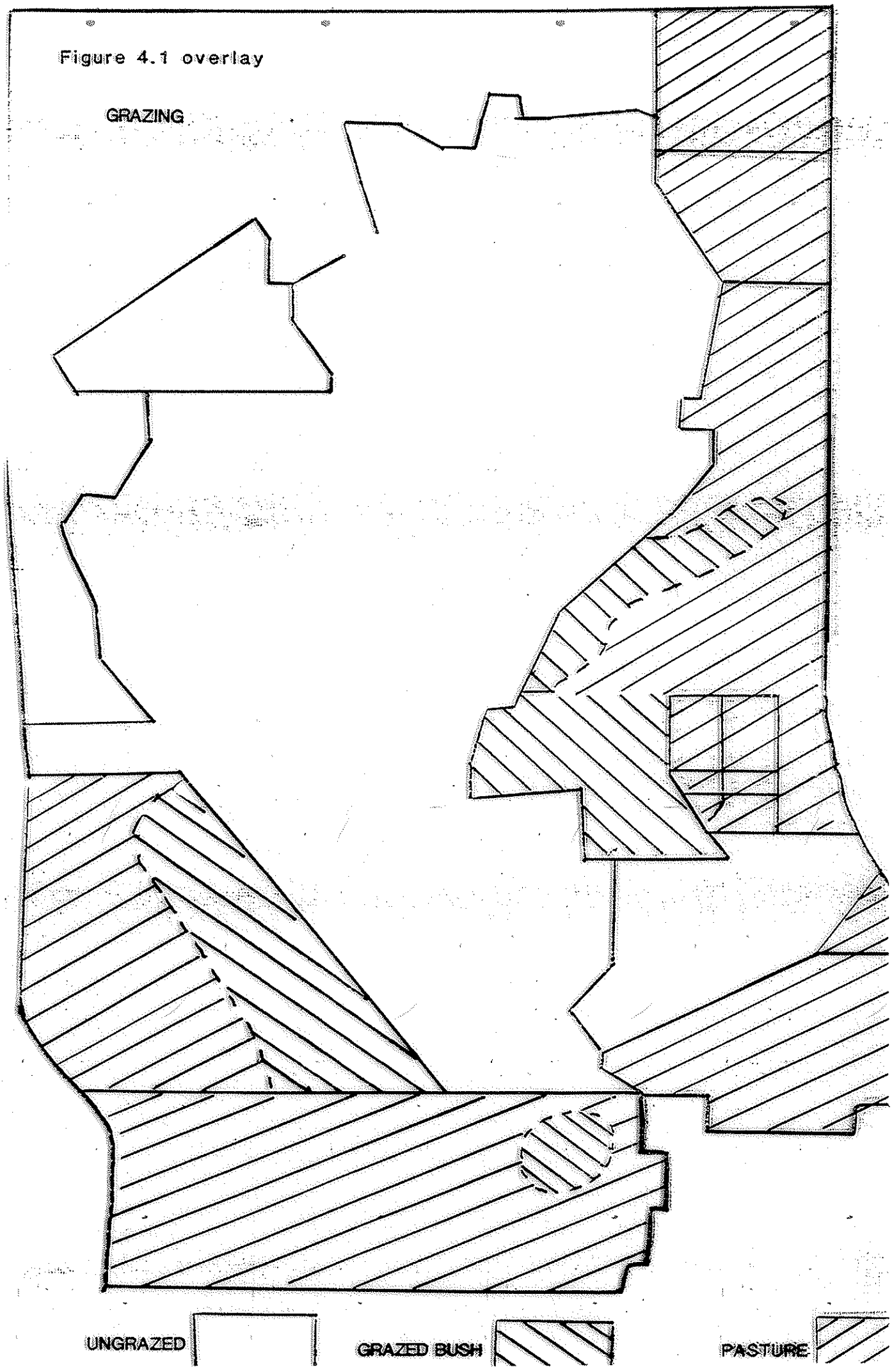


Fig 6.6 overlay to Fig 6.2

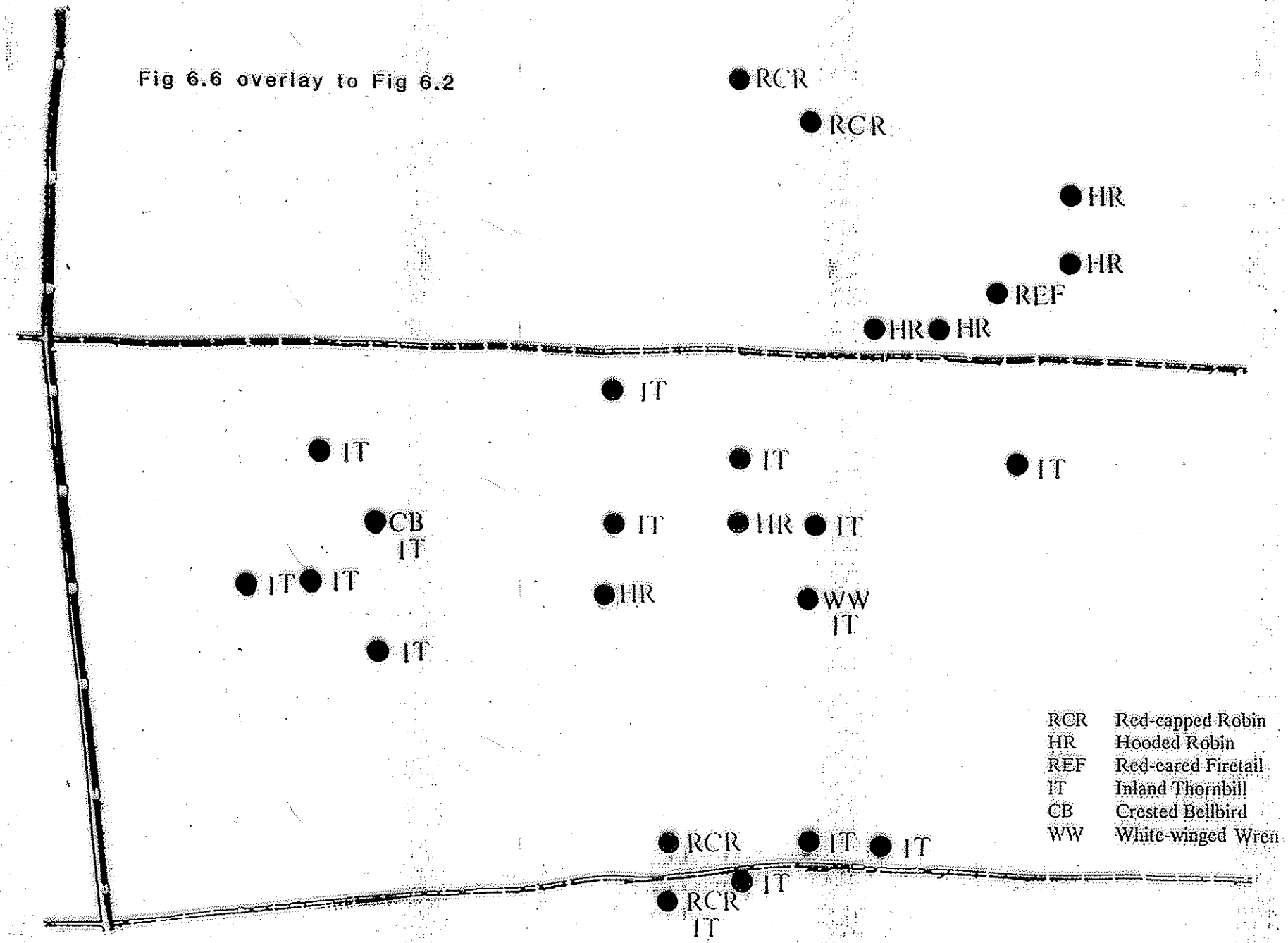


Figure 6.4 overlay to Fig 6.2

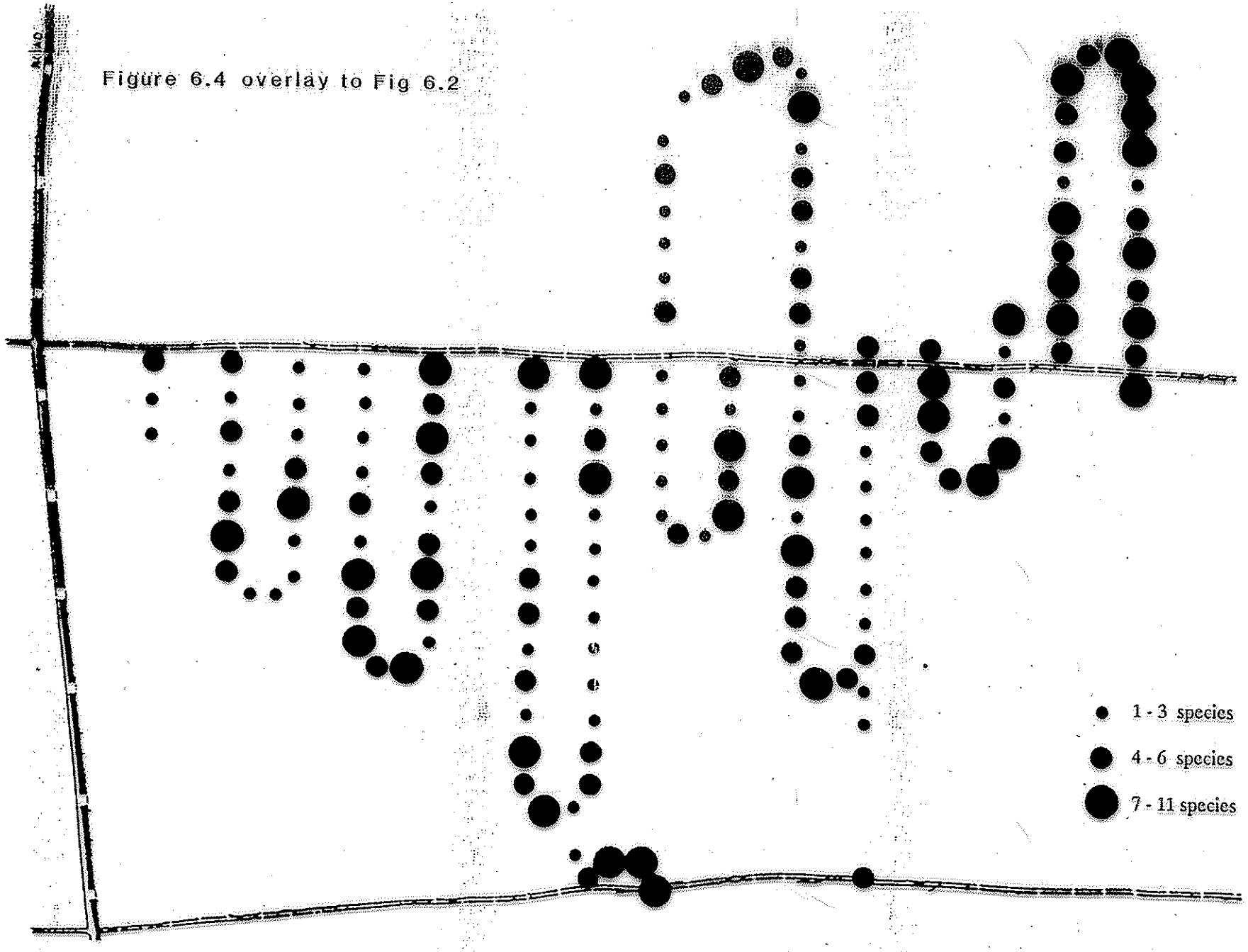


Fig 6.5 overlay to Fig 6.2

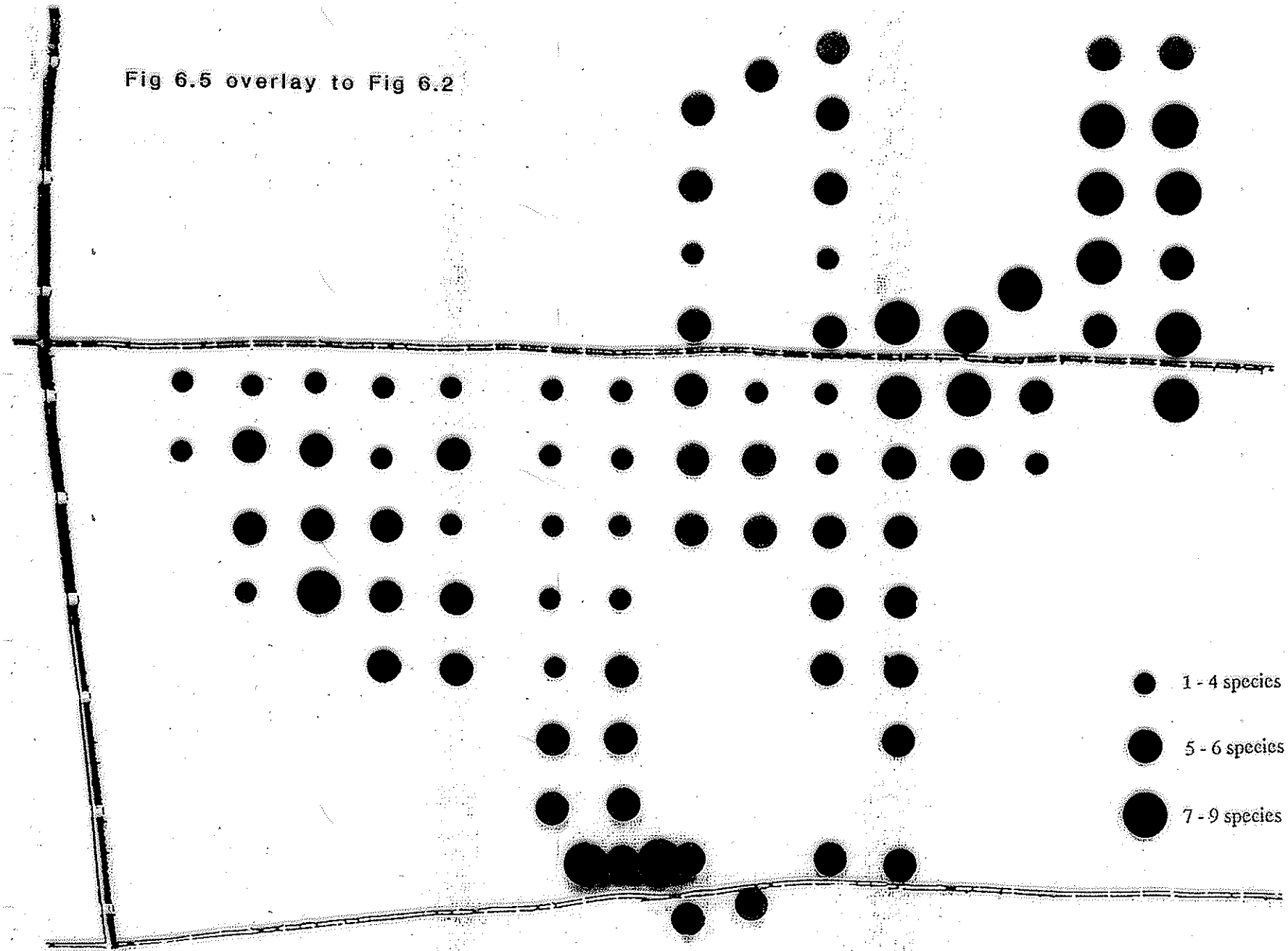
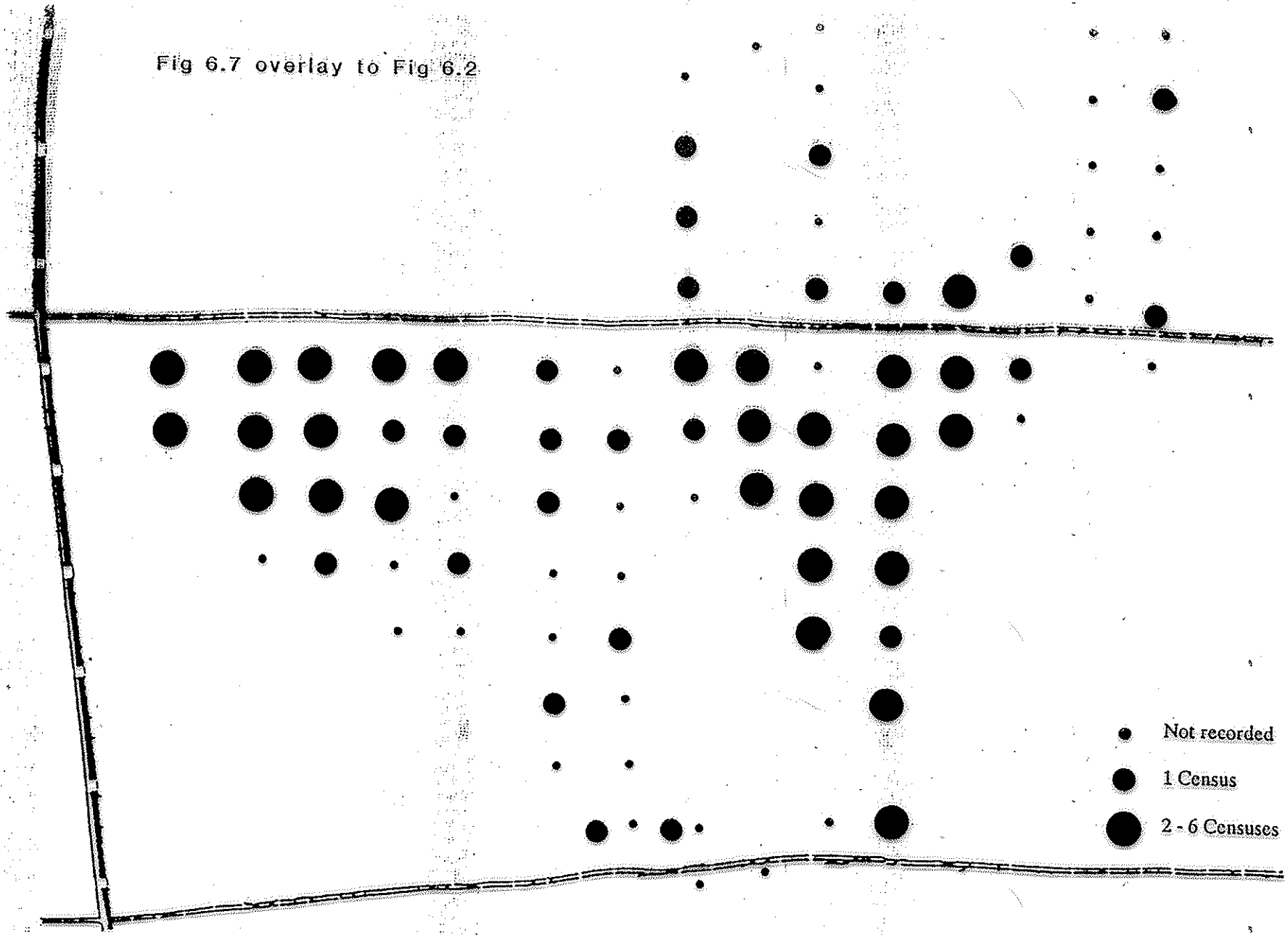


Fig 6.7 overlay to Fig 6.2



PONY CLUB

STABLES

HIGHWAY

GERALDTON

PROPOSED

INDOOR ARCHERY

ADMINISTRATION

GATEHOUSE

PARK

STREET

WOOLCOTT ROAD

STATION

CENTRAL STATION

RAILWAY MUSEUM

LAKE

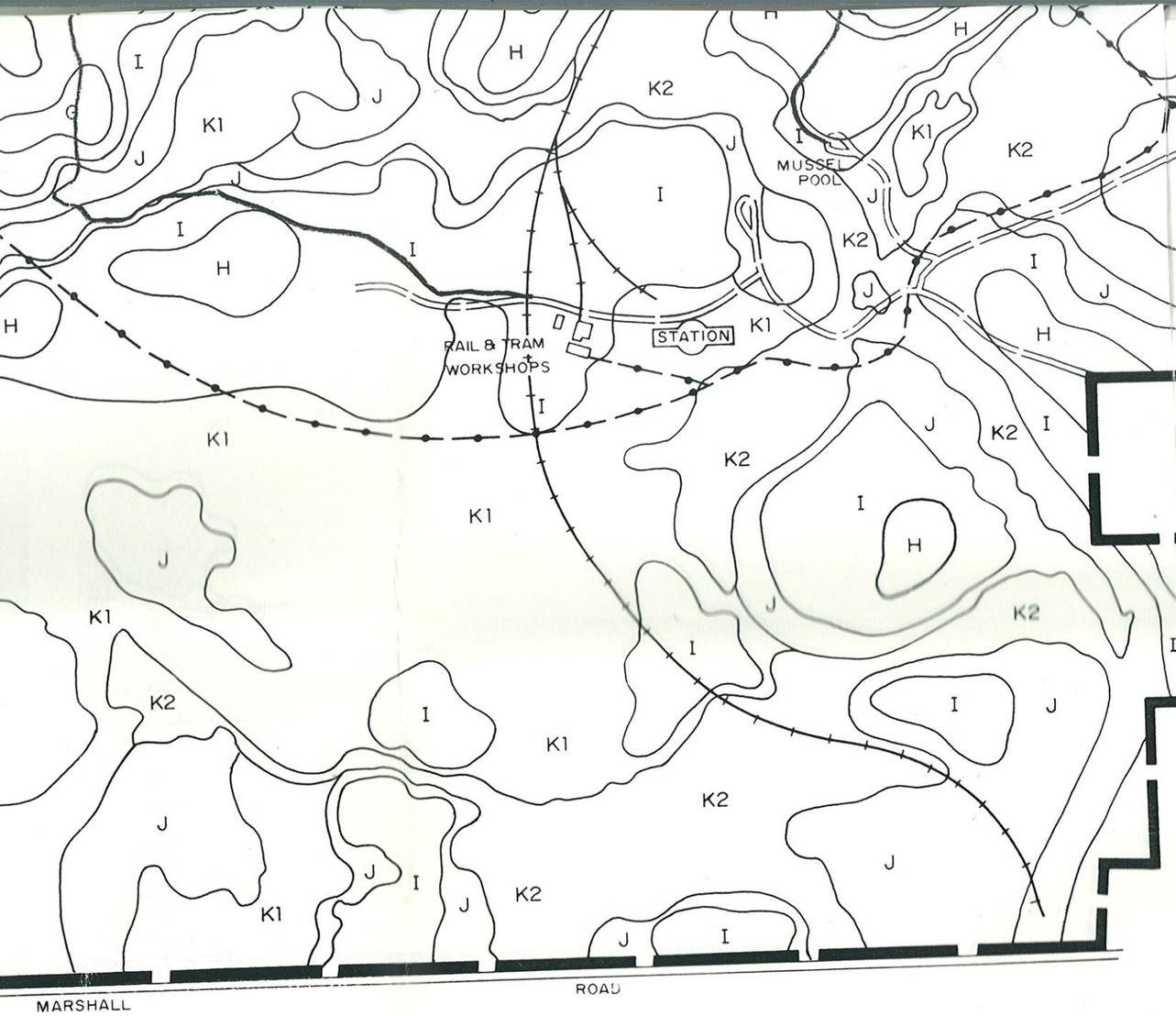
TRADE VILLAGE

HOMESTEAD

BUS MUSEUM

TRAM STATION

YOULF-DEAN



LEGEND

Site-Vegetation Types (G to K based on Havel, 1968)

G – Low woodland of Banksia attenuata – Banksia menziesii – Eucalyptus todtiana on dry pale grey sands on slopes and dune crests.

H – Low woodland to low open forest of Banksia attenuata – Banksia menziesii – Banksia ilicifolia on deep pale grey sands, dry at surface and moist at depth on dune slopes.

I – Open woodland of Eucalyptus marginata – Eucalyptus calophylla – Banksia ilicifolia and occasionally Banksia grandis on moist sandy soils with dark grey humusoid surface on lower slopes.

J – Open woodland of Eucalyptus calophylla on moister dark grey humusoid soils on flatter lower areas; with local additional species reflecting moister (Melaleuca preissiana) or sandier (Banksia ilicifolia and Banksia menziesii) soils.

K1 – Ranging from low open forest of Melaleuca preissiana – Banksia littoralis (very occasional Eucalyptus rudis on old flow lines), to closed heath of Myrtaceae species on seasonally water saturated sands and peats of swamp areas.

K2 – Low open forest to open forest of Eucalyptus rudis – Melaleuca rhaphiophylla on sands and organic silty clays along water-courses or seasonally flooded areas.

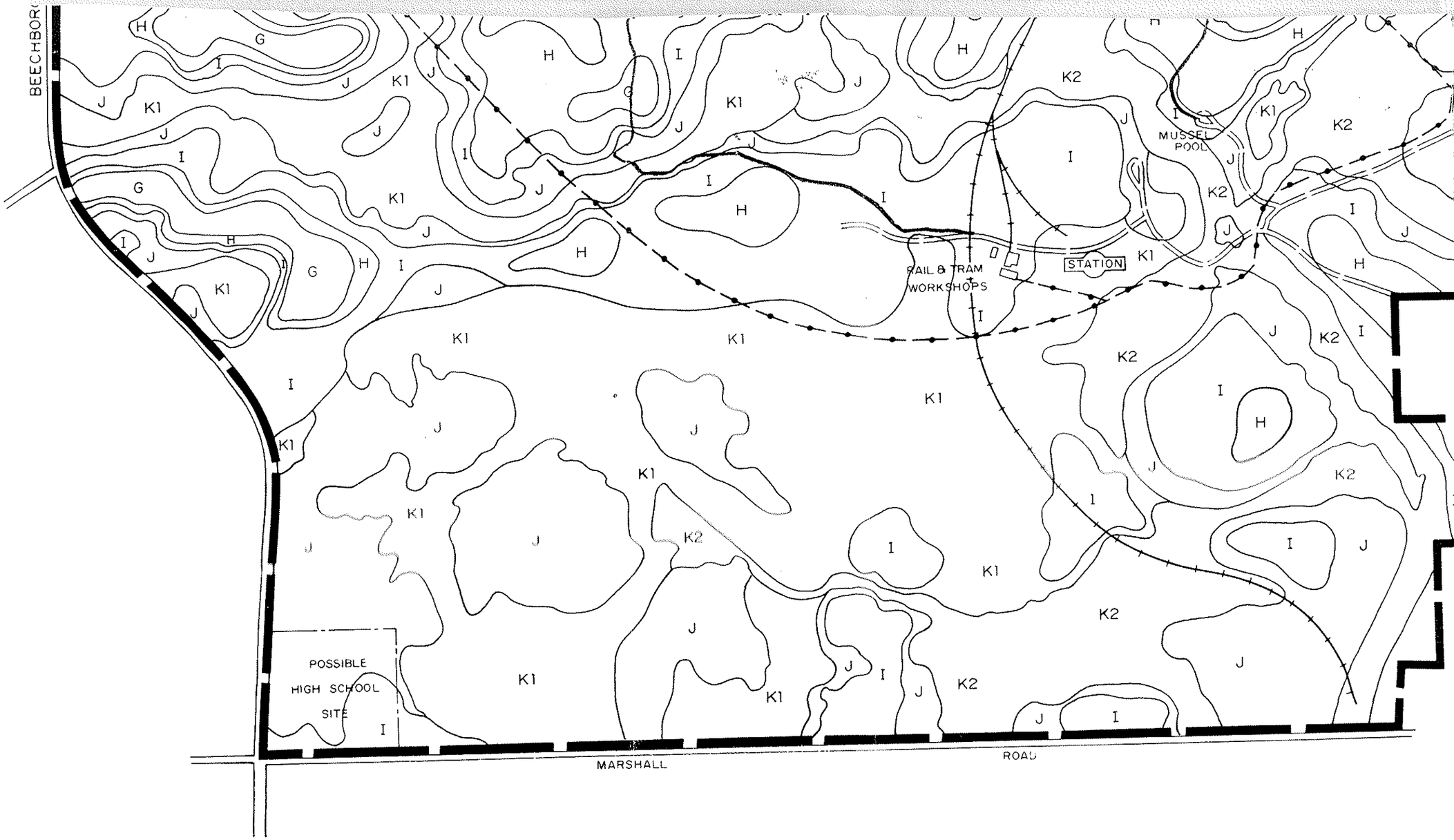
Scale

0·5 1km

NORTH

WHITEMAN PARK

VEGETATION MAP



LEGEND

- PARK BOUNDARY
- RAILWAY LINE
- TRAMWAY
- MAJOR ROAD
- MANAGEMENT ROAD

Scale

0 0.5 1km

NORTH

GNANGARA ROAD

PARK STREET

NGANGARA ROAD

GYOR ROAD

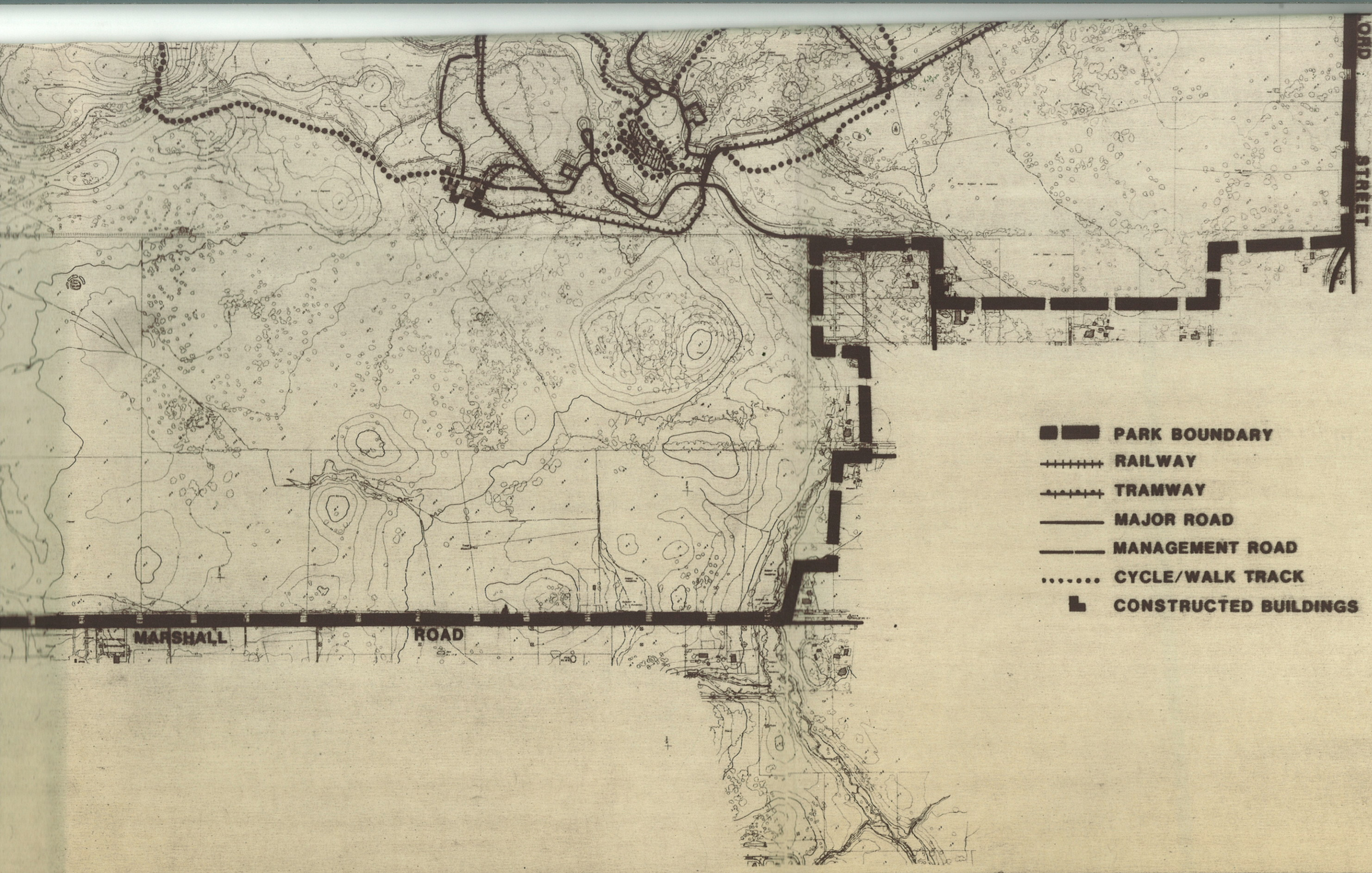
WOOLCOTT ROAD

LORD

ROAD

BEECHBORO

NORTH



WHITEMAN PARK

OVERALL PLAN

DRAFTSMAN	C.Marcelino
EXAMINED	Alan Brien
REVISED	
AUTHORISED	
EXAMINED	
APPROVED	
DATE	August 88

NORTH

SCALE 10 000

FILE REF :

PLAN REF :

PLAN No 1·2513

MARSHALL ROAD

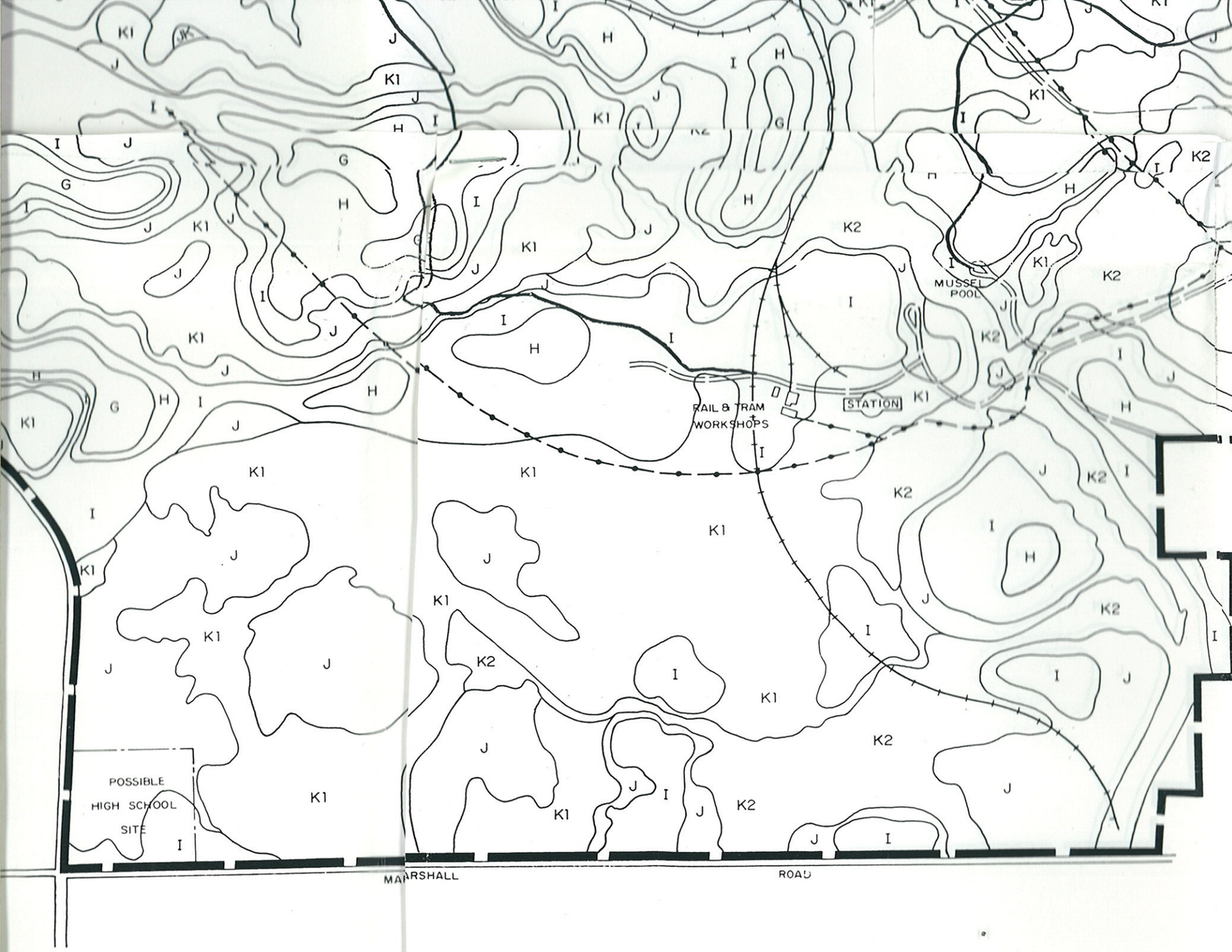
STATE PLANNING COMMISSION WESTERN AUSTRALIA

WHITEMAN PARK

OVERALL PLAN

DRAFTSMAN
EXAMINED
REVISED

AUTHORISED
EXAMINED
APPROVED
DATE



LEGEND

Site-Vegetation Types (G to K based on Havel, 1968)

G – Low woodland of Banksia attenuata–Banksia menziesii–Eucalyptus todtiana on dry pale grey sands on slopes and dune crests.

H – Low woodland to low open forest of Banksia attenuata – Banksia menziesii – Banksia ilicifolia on deep pale grey sands, dry at surface and moist at depth on dune slopes.

I – Open woodland of Eucalyptus marginata–Eucalyptus calophylla–Banksia ilicifolia and occasionally Banksia grandis on moist sandy soils with dark grey humusoid surface on lower slopes.

J – Open woodland of Eucalyptus calophylla on moister dark grey humusoid soils on flatter lower areas; with local additional species reflecting moister (Melaleuca preissiana) or sandier (Banksia ilicifolia and Banksia menziesii) soils.

K1 – Ranging from low open forest of Melaleuca preissiana – Banksia littoralis (very occasional Eucalyptus rudis on old flow lines), to closed heath of Myrtaceae species on seasonally water saturated sands and peats of swamp areas.

K2 – Low open forest to open forest of Eucalyptus rudis – Melaleuca rhaphiophylla on sands and organic silty clays along water-courses or seasonally flooded areas.

Mattiske & Associates 1989

Scale

0 0.5 1km

NORTH

WHITEMAN PARK

VEGETATION MAP

PARK

STREET G

WOOLCOTT

ROAD

KEITH MAINE YOUTH CAMP

STATION

RAILWAY MUSEUM

LAKE

CENTRAL STATION

TRADE VILLAGE

HOMESTEAD

BUS MUSEUM

TRAM STATION

KOULE-DEAU

PROPOSED GERALDTON HIGHWAY

PONY CLUB

STABLES

INDOOR ARCHERY

ADMINISTRATION

GATEHOUSE

PARK STREET

ROAD

bp site 304

Map Ident: plot980528_1	DATE: 28 May 98
Prepared By: Andrea Zappacosta	Prepared For:
Scale 1:AUTO	MFP INTERNAL USE ONLY

0 — 1.25 Km

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

MKS - FOK + KUKAL PORTION (VEGETATED AREA.

SEE OFFER MAP FOR CHANGES DEP 29/9

AREA INFORMATION

System 6 Area (C or M) or Update Area (Update)

Conservation Area	
	Nature Reserve M13 - Whiteman Park
	Reserve No
	National Park
	Reserve No
	Local Government
	Reserve No
	Other
Proposed Conservation Areas	
	Local Government
	Reserve No
	Other

Conservation Area

	Nature Reserve
	Reserve No
	National Park
	Reserve No
	Local Government
	Reserve No
	Other

AREA

Total Area	hectares
Completely Degraded	hectares
comments:	

AREA MAPPED FLORISTIC UNITS

Boundaries: System6 CALM

Units	Site (Condition) Code	Bound	Area (ha)	Area(ha)

Boundaries determined by use of

	aerial photograph RIB, Metro Regional Area (1992) 5097
	orthophoto
	vegetation map
	soil map

M13 Whiteman Park (Mussel Pool)

Friends Advocate Management

Other Names:

Specific Study/studies **Miscellaneous studies**

Flora

Vegetation Map 1 2 3

Flora list 1 2 3 4

Significant Taxa done / **suitable** doubtful

Fauna

Mammals	?1	2	
Birds	?1	2	RAOU
Reptiles and Amphibia	1	2	
Invertebrates	1	2	

Vegetation Condition Map **Sites** Comment

Disturbance Factors **Comment** Management

Swan Coastal Plain Floristic Survey

AHC: National Estate- Listed / Interim / Notified National Trust: Heritage Classification

M13 Whiteman Park (Mussel Pool)		
M13.1 Regional park recommendations be applied to this area.	Implemented	DPUD manages the area as a regional park.
M13.2 DPUD's Management Plan is endorsed.	Implemented	Endorsement.

SHEET 1: System 6 - REPORT Information Search Date 3/5/94 RH

Please circle the appropriate response or respond in the space provided.

Area M/3 Name	Whiteman Park
Title	Whiteman Park Fauna Survey
Published/Unpublished	Date 1991
Author/s	Arnold Smith & Brookes M.
Location of Publication	? DPUD Library
Purpose (why was the report prepared?)	
Government	DPUD
Corporate	
Community Group	
Management Plan	

Soils			
Units	mapped	described	referenced

Landscape		
Features	described	referenced

Flora							
Vegetation Map							
Units				Site based (no)			
Mapped							
Veg Units	Comparable Heddle *et al*			Compared Heddle *et al.*		Unit not mapped by Heddle *et al.*	
Flora list							
Timing	%completion					Significant Taxa	
	Trees	Shrubs	Herbs	Sedges	Weeds	DRF	CALM Priority Other

Fauna			
Timing	%completion		Significant Taxa
	Mammals	Birds	Sched1 Sched2 Other
	Reptiles	Invertebrates	

Vegatation Condition		
Site based	Mapped	Units

Disturbance Factors				
Phytophthora	observed	Other	incidental	
	tested		itemised	

Notes

SHEET 1: System 6 - REPORT Information Search Date 3/6/94

Please circle the appropriate response or respond in the space provided.

Area M/3	Name Whiteman Park (Mussel Pool)
Title	① Whiteman Park ② Biological survey of the Proposed Mussel Pool Complex & ①+② Recommendations for its Future Development
Published/Unpublished	Date ① commissioned January 1978 ② Spring 1975
Author/s	① Maunsell + Partners (Landscape Consultants) ② WA Museum, J Johnson, Morris, Harold, Kitchener
Location of Publication	① SRC ② WA Museum + SPC.
Purpose (why was the report prepared?)	① A plan to develop area ② Survey.
Government	① + ②
Corporate	
Community Group	
Management Plan	

Soils	① See Figure 4. Bassendean / some clay on SE/EAST corner. Bassendean Dune System		
Units	mapped	described	referenced

Landscape Features	described	referenced

① Generally flat, 3 sand ridges pass through area generally from Southwest to North-East. Depressions - seasonal wet lands

Refer Appendix III P59 of WHITEMAN PARK

Flora						
Vegetation Map						
Units				Site based (no)		
Mapped						
Veg Units	Comparable Heddle *et al*		Compared Heddle *et al.*		Unit not mapped by Heddle *et al.*	
Flora list						
Timing	%completion				Significant Taxa	
	Trees	Shrubs Herbs	Sedges	Weeds	DRF	CALM Priority Other

Fauna			
Timing	%completion		Significant Taxa
	Mammals	Birds	Sched1 Sched2 Other
	Reptiles	Invertebrates	

Vegatation Condition		
Site based	Mapped	Units
Disturbance Factors		
Phytophthora	observed	Other incidental
	tested	itemised

Notes

not at EIA 3-10-96

SHEET 1: System 6 - REPORT Information Search Date 3/5/94 RH

Please circle the appropriate response or respond in the space provided.

Area M13 Name	Whiteman Park
Title	Spring 1975 Biological Survey of the Proposed Mussel Pool (complex) and Recomend. Future Devel.
Published/(Unpublished)	Date 1975
Author/s	Jackson Morris & Kitchener D.
Location of Publication	Museum
Purpose (why was the report prepared?)	
Government	
Corporate	
Community Group	
Management Plan	

Soils			
Units	mapped	described	referenced

Landscape		
Features	described	referenced

Flora	as relates (veg. fauna sites)		
Vegetation Map			
Units		Site based (no)	
Mapped			
Veg Units	Comparable Heddle *et al*	Compared Heddle *et al.*	Unit not mapped by Heddle *et al.*
Flora list			
Timing	%completion		Significant Taxa
	Trees Shrubs Herbs Sedges	Weeds	DRF CALM Priority Other

Fauna	area based. (used with other by H&D)		
Timing	%completion		Significant Taxa
	(Mammals)	(Birds)	Sched1 Sched2 Other
	(Reptiles)	Invertebrates	

Vegatation Condition		
Site based	Mapped	Units
Disturbance Factors		
Phytophthora	observed	Other incidental
	tested	itemised

Notes

SHEET 2: System 6 - VERBAL Information Search Date 5/5/94

Area M13 Name	Whiteman Park				
Source	David Bright				
Purpose (why was the study done?)	Updating flora list - Management				
Government	DPUD - Whiteman Park Staff				
Corporate					
Community Group	Wildflower Society - Northern Suburbs				
Management Plan					
Publication Planned ?	Yes	No	Date		
Planned Location					

Soils		
Units	described	referenced

Landscape		
Features	described	referenced

Flora						
Vegetation Map						
Units				Site based (no)		
Mapped						
Veg Units	Comparable Heddle *et al*		Compared Heddle *et al*		Unit not mapped by Heddle et *al*	
Flora list	updating flora list from Marchiske 1989					
Timing	%completion				Significant Taxa	
	Trees	Shrubs Herbs	Sedges	Weeds	DRF	CALM Priority Other

Fauna			
Timing	%completion		Significant Taxa
	Mammals	Birds	Sched1 Sched2 Other
	Reptiles	Invertebrates	

Vegetation Condition				
Site based	Mapped	Units		
Disturbance Factors				
Phytophthora	observed		Other	Incidental
	tested			Itemised

Notes

SHEET 1: System 6 - REPORT Information Search Date 6/94

Please circle the appropriate response or respond in the space provided.

Area M 13 Name	Whiteman Park
Title	"Whiteman Park"
Published/(Unpublished)	Date 1978
Author/s	Maunsell and Partners Pty Ltd
Location of Publication	
Purpose (why was the report prepared?)	Planning
Government	Metropolitan Region Planning Authority
Corporate	
Community Group	
Management Plan	

Soils			
Units	mapped	described	referenced

Landscape		
Features	described	referenced

Flora	brief descriptions Bushland Appendix III (A. Tingay)					
Vegetation Map						
Units				Site based (no)		
Mapped	very broad map (two units (4))					
Veg Units	Comparable Heddle *et al*		Compared Heddle *et al.*		Unit not mapped by Heddle *et al.*	
Flora list						
Timing	%completion				Significant Taxa	
	Trees	Shrubs Herbs	Sedges	Weeds	DRF	CALM Priority Other

Fauna			
Timing	%completion		Significant Taxa
	Mammals	Birds	Sched1 Sched2 Other
	Reptiles	Invertebrates	

Vegatation Condition				
Site based	Mapped	Units		
Disturbance Factors				
Phytophthora	observed		Other	incidental
	tested			itemised

Notes

System 6 - REPORT Information Search Date 5/94

Please circle the appropriate response or respond in the space provided.

Area M 13 Name Whiteman Park
Title

Author: Jackson M. Morris K. Harold G. Kitchner D.
Date: 1975
Title: Mammals In: A spring, 1975, biological survey of the proposed Mussel Pool complex and recommendations for its future management
Source: Western Australian Museum, Perth Unpublished Report to M.R.P.A.

Author: Morris K.D. Muir B.G.
Date: 1975
Title: Vegetation In: A spring, 1975, biological survey of the proposed Mussel Pool complex and recommendations for its future management
Source: Western Australian Museum, Perth Unpublished Report to M.R.P.A.

Soils			
Units	mapped	described	referenced

Landscape		
Features	described	referenced

Flora							
Vegetation Map							
Units				Site based (no)			
Mapped							
Veg Units	Comparable Heddle *et al*			Compared Heddle *et al*		Unit not mapped by Heddle *et al*	
Flora list							
Timing	%completion					Significant Taxa	
	Trees	Shrubs	Herbs	Sedges	Weeds	DRF	CALM Prority Other

Fauna			
Timing	%completion		Significant Taxa
	Mammals	Birds	Sched1 Sched2 Other
	Reptiles	Invertebrates	

Vegatation Condition		
Site based	Mapped	Units
Disturbance Factors		
Phytophthora	observed	Other Incidental
	tested	itemised

Notes

BS304

R. A. O. U. T R A C K I N G D A T A B A S E

23/06/96 PARK SIGHTINGS REPORT Page No. 1

Whiteman Park (M13)

ORDER:	REF:	BIRD NAME	NO. SIGHTINGS
0012	0903	Indian Peafowl	1
0022	0203	Black Swan	1
0025	0207	Australian Shelduck	1
0028	0202	Australian Wood Duck	3
0032	0208	Pacific Black Duck	4
0033	0212	Australasian Shoveler 3	1
0035	0211	Grey Teal	2
0039	0213	Pink-eared Duck 3	1
0061	0061	Australasian Grebe	2
0129	0100	Little Pied Cormorant	1
0132	0097	Little Black Cormorant	1
0139	0188	White-faced Heron	2
0142	0189	White-necked Heron	1
0157	0179	Australian White Ibis	1
0158	0180	Straw-necked Ibis	2
0160	0182	Yellow-billed Spoonbill	1
0165	0232	Black-shouldered Kite	2
0175	0221	Brown Goshawk 4	1
0180	0224	Wedge-tailed Eagle	2
0181	0225	Little Eagle 4	1
0183	0235	Australian Hobby	1
0187	0240	Nankeen Kestrel	2
0204	0058	Purple Swamphen	1
0208	0059	Eurasian Coot	1
0267	0146	Black-winged Stilt	1
0282	0144	Black-fronted Dotterel	1
0326	0988	Laughing Turtle-Dove	1
0327	0989	Spotted Turtle-Dove	1
0333	0043	Crested Pigeon	4
0356	0794	Short-billed Black-Cockatoo 1	1
0359	0273	Galah	5
0362	0271	Little Corella	2
0386	0294	Australian Ringneck	5
0387	0290	Red-capped Parrot	3
0397	0307	Elegant Parrot	2
0411	0344	Shining Bronze-Cuckoo	1
0446	0322	Laughing Kookaburra	5
0451	0326	Sacred Kingfisher	2
0453	0329	Rainbow Bee-eater	1
0471	0532	Splendid Fairy-wren 3	5
0489	0565	Spotted Pardalote	1
0492	0976	Striated Pardalote	1
0512	0465	Weebill 3	2

0517	0463	Western Gerygone		5
0524	0476	Inland Thornbill	3	1
0531	0486	Yellow-rumped Thornbill	3	5
0537	0638	Red Wattlebird		5
0539	0637	Little Wattlebird	4	3
0550	0635	Yellow-throated Miner		1
0561	0608	Singing Honeyeater		2
0583	0597	Brown Honeyeater		3
0587	0631	New Holland Honeyeater	4	2
0588	0632	White-cheeked Honeyeater	4	1
0590	0593	Tawny-crowned Honeyeater	4	1
0597	0592	Western Spinebill		3
0613	0380	Scarlet Robin	3	3
0614	0381	Red-capped Robin		1
0644	0549	Varied Sittella	3	1
0650	0398	Golden Whistler	3	1
0653	0401	Rufous Whistler		4
0658	0408	Grey Shrike-thrush	3	2
0671	0415	Magpie-Lark		5
0673	0361	Grey Fantail		4
0676	0364	Willie Wagtail		4
0678	0424	Black-faced Cuckoo-shrike		4
0691	0546	Black-faced Woodswallow	4	3
0695	0702	Grey Butcherbird		5
0698	0705	Australian Magpie		5
0706	0930	Australian Raven		4
0763	0357	Welcome Swallow		1
0765	0359	Tree Martin		5
0781	0574	Silvereye		3

*** END OF REPORT ***

(1) 1

(2)

(3) 10

(4) 7

SUMMARY REPORT

TOTAL BIRDS SIGHTED	:	72
TOTAL NUMBER OF CARDS	:	5

*** END OF SUMMARY ***

Additions from sites 03 - 08 BJK 2/2/96.

Vascular Species list for Whiteman Park - Natives

	Family	Genus	Species	Common name	
FILICOPSIDA - True Ferns					
1	CYATHEACEAE	Cyathea	cooperii	Scaly Tree Fern	DB **
2	DENNSTAEDTIACEAE	Pteridium	esculentum	Bracken	LM
CYCADOPSIDA - Cycads					
3	ZAMIACEAE	Macrozamia	riedlei	Zamia Palm	LM
4		Macrozamia	?riedlei	Zamia Palm with trunk	DB
MAGNOLIOPSIDA (Angiosperms) - Dicotyledons					
5	AMARANTHACEAE	Alternanthera	nodiflora	Common Joyweed	LM
6		Ptylotis	polystachyus	Prince of Wales Feather	DB
7		Ptylotis	sp.	Mulla Mulla	DB
8	APIACEAE	Actinotus	glomeratus		LM
9		Centrella	cordifolia	Gotu Kola	WS
10		Homalosciadium	homalocarpum		LM
11		Platysace	compressa	Tapeworm Plant	LM
12		Schoenolaena	juncea		BK
13		Trachymene	pilosa	Native Parsnip	LM
14		Xanthosia	atkinsoniana		LM
15		Xanthosia	huegelii		LM
16	ASTERACEAE	Brachyscome	pussila		LM
17		Gnaphalium	sphaericum		LM
18		Hyalosperma	cotula		LM
19		Lagenifera	huegelii		LM
20		Millotia	tenuifolia		BK
21		Olearia	paucidentata		LM
22		Podolepis	gracilis	Slender Podolepis	LM
23		Podotheca	angustifolia		BK
24		Podotheca	gnaphalioides		LM
25		Siloxerus	humifusus		LM
26		Waitzia	citrina		LM
27		Waitzia	paniculata		LM
28		Waitzia	podolepis	Fragrant Waitzia	LM
29		Waitzia	suaveolens		LM
30	CASUARINACEAE	Allocasuarina	?humilis	Dwarf Sheoak	LM
31		Allocasuarina	humilis	Dwarf Sheoak	LM
32		Allocasuarina	fraseriana	Fraser's Sheoak	LM
33	DILLENIACEAE	Hibbertia	acerosa		LM
34		Hibbertia	helianthemoides		LM
35		Hibbertia	huegelii		LM
36		Hibbertia	hypericoides	Yellow Buttercups	LM
37		Hibbertia	pachyrrhiza		LM
38		Hibbertia	racemosa	Stalked Guinea Flower	LM
39		Hibbertia	stellaris	Orange Stars	LM
40		Hibbertia	subvaginata		LM
41		Hibbertia	vaginata		LM
42	DROSERACEAE	Drosera	erythrorhiza		LM
43		Drosera	gigantea		LM
44		Drosera	glanduligera		BK
45		Drosera	macrantha		JW
46		Drosera	menziesii ssp. penicillaris		BK

Drosera pallida

CAMPANULACEAE
Wahlenbergia preissii
DILLENIACEAE
Hibbertia cuneiformis

ASTERACEAE
* Arctotheca calendula
* Hypochaeris glabra
Quinetia urvillei
Senecio hispidulus

Weeds but none on list so left out of this.

47		Drosera	palacea		LM
48	EPACRIDACEAE	Astroloma	pallidum		LM
49		Astroloma	xerophyllum		LM
50		Conostephium	minus		LM
51		Conostephium	pendulum		LM
52		Leucopogon	aff. polymorphous		LM
53		Leucopogon	australis		LM
54		Leucopogon	conostephioides		LM
55		Leucopogon	polymorphous		LM
56		Leucopogon	propinquus		LM
57		Leucopogon	sprengelioides		LM
58		Lysinema	ciliatum		LM
59		Styphelia	sp.		LM
60	EUPHORBIACEAE	Monotaxis	occidentalis		LM
61		Phyllanthus	calycinus	False Boronia	LM
62		Poranthera	microphylla		LM
63	FABACEAE	Aotus	cordifolia		LM
64	(PAPILIONACEAE)	Aotus	gracillima		LM
65		Bossiaea	eriocarpa	Common Brown Pea	LM
66		Daviesia	divaricata		LM
67		Daviesia	physodes		LM
68		Daviesia	triflora		LM
69		Euchilopsis	linearis		LM
70		Eutaxia	virgata		LM
71		Gompholobium	confertum		LM
72		Gompholobium	scabrum	Painted Lady	LM
73		Gompholobium	tomentosum	Hairy Yellow Pea	LM
74		Hardenbergia	comptoniana	Wild Sarsparilla	LM
75		Hovea	pungens	Devils Pins	LM
76		Hovea	trisperma	Common Hovea	LM
77		Isotropis	cuneifolia	Granny Bonnets	DB
78		Jacksonia	densiflora		LM
79		Jacksonia	floribunda		JW
80		Jacksonia	furcellata	Grey Stinkwood	LM
81		Jacksonia	sternbergiana	Green Stinkwood	LM
82		Kennedia	prostrata	Running Postman/Red Runne	LM
83		Mirbelia	sp.		BK
84		Nemcia	capitata		LM
85		Oxylobium	capitatum	Bacon and Eggs	LM
86		Oxylobium	lanceolatum	Greenbush/Native Willow	LM
87		Oxylobium	lineare		LM
88		Pultenaea	reticulata		LM
89		Viminaria	juncea	Swishbush	LM
90	GOODENIACEAE	Dampiera	linearis		LM
91		Lechenaultia	floribunda		LM
92		Scaevola	crassifolia		DB
93		Scaevola	paludosa		LM
94		Velleia	trinervis		LM
95	HALORAGACEAE	Glischrocaryon	flavescens		LM
96		Gonocarpus	cordiger		LM
97		Gonocarpus	pithyoides		LM
98		Gonocarpus	sp.		LM
99	LAMIACEAE	Hemiandra	linearis		LM
100		Hemiandra	pungens	Snake Bush	JW
101	LAURACEAE	Cassytha	racemosa	Dodder Laurel	LM
102		Cassytha	sp.		LM
103	LENTIBULARIACEAE	Polypompholyx	multifida	Pink Petticoats	DB
104	LOBELIACEAE	Lobelia	alata		LM
105		Lobelia	sp.		LM

Lechenaultia expansa

FABACEAE
Sphaerolobium vimineum
EPACRIDACEAE
Leucopogon squarrosus
EUPHORBIACEAE
Stachystemon axillaris (PRIORITY TAXON)
ADW 25.5.97

Note: the P3 species Jacksonia sericea has been brought in to the park, inadvertently in soil. If it becomes established it does so as a weed

106		Lobelia	tenuior		LM	
107	LOGANIACEAE	Mitrasacme	paradoxa		LM	
108	LORANTHACEAE	Nuytsia	floribunda	Christmas Tree	LM	
109	MENYANTHACEAE	Villarsia	albiflora		LM	
110	MIMOSACEAE	Acacia	huegelii		LM	
111		Acacia	pulchella var.pulchella	Prickly Moses	LM	
112		Acacia	saligna	Golden Wreath Wattle	LM	
113		Acacia	sessilis		LM	
114		Acacia	spathulifolia		LM	
115		Acacia	stenoptera		LM	
116		Acacia	willdenowiana	Grass Wattle	WS	
117		Paraserianthes	lophantha	Albizia	TC	**
118	MOLLUGINACEA	Macarthuria	australis		LM	
119	MYRTACEAE	Agonis	linearifolius		LM	
120		Astartea aff.	fascicularis		LM	
121		Beaufortia	elegans		LM	
122		Calothamnus	lateralis		LM	
123		Calothamnus	sanguineus		BK	
124		Calothamnus	sp.		LM	
125		Calytrix	angulata	Yellow Star Flower	LM	
126		Calytrix	flavescens	Summer Starflower	LM	
127		Calytrix	fraseri	Pink Summer Starflower	LM	
128		Chamelaucium	uncinatum	Geraldton Wax	DB	**
129		Eremaea	fimbriata		LM	
130		Eremaea	pauciflora		LM	
131		Eremaea	sp. A = asterocarpa ssp. asterocarpa		LM	
132		Eucalyptus	calophylla	Marri or Red Gum	LM	
133		Eucalyptus	calophylla rosea	Marri or Red Gum	LM	
134		Eucalyptus	gomphocephala	Tuart	HG	**
135		Eucalyptus	marginata	Jarrah	LM	
136		Eucalyptus	rudis	Flooded Gum	LM	
137		Eucalyptus	todtiana	Coastal Blackbutt	LM	
138		Hypocalymma	angustifolium	White Myrtle	LM	
139		Hypocalymma	robustum	Swan River Myrtle	LM	
140		Kunzea	ericifolia	Spearwood	LM	
141		Kunzea	recurva		LM	
142		Leptospermum	spinescens		WS	
143		Melaleuca	lateritia	Robin Redbreast	LM	
144		Melaleuca	preissiana	Stout Paperbark/Modong	LM	
145		Melaleuca	rhaphiophylla	Freshwater Paperbark	LM	
146		Melaleuca	scabra	Rough Honeymyrtle	LM	
147		Melaleuca	seriata		LM	
148		Melaleuca	viminea		LM	
149		Pericalymma	ellipticum		LM	
150		Regelia	ciliata		LM	
151		Scholtzia	involucrata	Spiked Scholtzia	LM	
152		Verticordia	densiflora		LM	
153		Verticordia	drummondii		LM	
154		Verticordia	nitens	Yellow Morrison	LM	
155	ONAGRACEAE	Epilobium	billardierianum		LM	
156	PITTOSPORACEAE	Billardiera	coeruleo-punctata		LM	
157		Sollya	heterophylla	Bluebell	LM	
158	POLYGALACEAE	Comesperma	calymega	Blue-spike Milkwort	LM	
159		Comesperma	flavum		LM	
160		Comesperma	virgatum		LM	
161	PRIMULACEAE	Samolus	repens	Creeping Brookweed	WS	
162	PROTEACEAE	Adenanthos	cygnorum	Woolly Bush	LM	
163		Adenanthos	obovatus	Basket Flower	LM	

Melaleuca sp B (Perth Flora)

(P4) Verticordia lindleyi ssp lindleyi (PRIORITY TAXON)

164		Banksia	attenuata	Candle Banksia	LM
165		Banksia	grandis	Bull Banksia	LM
166		Banksia	ilicifolia	Holly Banksia	LM
167		Banksia	littoralis	Swamp Banksia	LM
168		Banksia	menziesii	Firewood Banksia	LM
169		Conospermum	stoechadis	Common Smokebush	LM
170		Conospermum	triplinervium	Tree Smokebush	DB
171		Dryandra	?carduacea	Pingle	WS
172		Dryandra	sessilis	Parrot Bush	DB
173		Dryandra	nivea	Couch Honeypot	LM
174		Hakea	prostrata	Harsh Hakea	WS
175		Hakea	varia		LM
176		Isopogon	drummondii		LM
177		Persoonia	saccata	Snottygobble	LM
178		Petrophile	linearis	Pixie Mops	LM
179		Stirlingia	latifolia	Blue Boy	LM
180		Synaphea	spinulosa		LM
181	RUTACEAE	Boronia	crenulata var. gracilis		LM
182		Boronia	purdieana		LM
183		Eriostemon	spicatus	Salt and Pepper	LM
184	SANTALACEAE	Leptomeria	cunninghamii		LM
185		Leptomeria	preissiana		LM
186	SCROPHULARIACEAE	Gratiola	peruviana		LM
187	STACKHOUSIACEAE	Tripterococcus	brunonis	Winged Stackhousia	LM
188	STYLIDIACEAE	Levenhookia	stipitata	Common Styewort	LM
189		Stylidium	amoenum	Lovely Triggerplant	LM
190		Stylidium	brunonianum	Pink Fountain Triggerplan	LM
191		Stylidium	calcaratum	Book Triggerplant	LM
192		Stylidium	guttatum	Dotted Triggerplant	BK
193		Stylidium	junceum	Reed Triggerplant	LM
194		Stylidium	piliferum	Common Butterfly Triggerp	LM
195		Stylidium	repens	Matted Triggerplant	LM
196		Stylidium	schoenoides	Cow Kicks	LM
197	TREMANDRACEAE	Platytheca	galioides		BK
198	THYMELAEACEAE	Pimelea	sulphurea	Yellow Banjine	LM
199	VIOLACEAE	Hybanthus	calycinus	Wild Violet	DB
200		Hybanthus	floribundus		LM

MAGNOLIOPSIDA (Angiosperms) - Monocotyledons

201	ANTHERICACEAE	Arnocrinum	preissii		LM
202		Arthropodium	capillipes		WS
203		Chamaescilla	corymbosa	Blue Squill	LM
204		Corynotheca	micrantha		LM
205		Hensmania	turbinata		LM
206		Johnsonia	acaulis		LM
207		Johnsonia	pubescens	Pipe Lily	BK
208		Laxmannia	ramosa		LM
209		Laxmannia	squarrosa		LM
210		Sowerbaea	laxiflora	Purple Tassels/Vanilla Li	DB
211		Thysanotus	arenarius	Fringe Lily	LM
212		Thysanotus	sparteus	- " -	LM
213		Thysanotus	multiflorus	- " -	LM
214		Thysanotus	thyrsoideus	- " -	LM
215		Thysanotus	dichotomus	- " -	LM
216		Thysanotus	patersonii	- " -	LM
217		Thysanotus	?triandrus	- " -	DB
218		Tricoryne	elatior	Yellow Autumn Lily	LM
219	CENTROLEPIDACEAE	Centrolepis	aristata		BK

Thysanotus arbuscula
Tricoryne tenella
STYLIDIACEAE
Stylidium dichotomum

Burchardia bairdiae

220		Centrolepis	drummondiana		BK
221	COLCHICACEAE	Burchardia	?multiflora		BK
222		Burchardia	umbellata	Milkmaids	LM
223		Wurmbea	dioica	Early Nancy	BK
224	CYPERACEAE	Baumea	arthrophylla		LM
225		Baumea	articulata	Jointed Twig-rush	LM
226		Baumea	juncea	Bare Twig-rush	LM
227		Baumea	preissii		LM
228		Carex	fascicularis	Tassel Sedge	LM
229		Cyathochaeta	avenacea		LM
230		Cyperus	rotundus	Nut Grass	LM *?
231		Gahnia	decomposita		LM
232		Isolepis	marginata	Coarse Club Rush	BK
233		Lepidosperma	angustatum		LM
234		Lepidosperma	gladiatum	Coast Sword-sedge	LM
235		Lepidosperma	longitudinale	Pithy Sword-sedge	LM
236		Lepidosperma	scabrum		LM
237		Lepidosperma	sp. E		LM
238		Lepidosperma	tenue		LM
239		Lepidosperma	tetraquetrum		LM
240		Mesomelaena	pseudostygia		LM
241		Mesomelaena	stygia		LM
242		Mesomelaena	tetragona		LM
243		Schoenoplectus	?validus	Lake Club-rush	LM
244		Schoenus	bifidus		LM
245		Schoenus	curvifolius		LM
246		Schoenus	rodwayanus		LM
247		Tetraria	capillaris	Hair Sedge	LM
248	DASYPOGONACEAE	Calectasia	cyanea	Blue Tinsel Lily	LM
249		Dasypogon	bromeliifolius	Pineapple Bush	LM
250		Lomandra	caespitosa	Tufted Mat Rush	BK
251		Lomandra	hermaphrodita		LM
252		Lomandra	?integra		LM
253		Lomandra	?pauciflora		LM
254		Lomandra	purpurea		LM
255		Lomandra	sericea		LM
256		Lomandra	?sonderi		LM
257		Lomandra	sp.		LM
258		Lomandra	suaveolens		LM
259	HAEMODORACEAE	Anigozanthos	humilis	Cats Paw	LM
260		Anigozanthos	manglesii	Mangles Kangaroo Paw	TC
261		Anigozanthos	viridis	Green Kangaroo Paw	DB
262		Conostylis	aculeata ssp. aculeata	Prickly Conostylis	LM
263		Conostylis	aculeata ssp. bromeliodes	Prickly Conostylis	LM
264		Conostylis	aurea		BK
265		Conostylis	juncea		LM
266		Conostylis	setigera	Bristly Conostylis	LM
267		Haemodorum	laxum	Bloodroot	LM
268		Haemodorum	spicatum	Bloodroot	LM
269		Phlebocarya	ciliata		LM
270	IRIDACEAE	Patersonia	occidentalis		LM
271	JUNCACEAE	Juncus	kraussii	Sea Rush	GK
272		Juncus	pallidus	Pale Rush	LM
273	JUNCAGINACEAE	Triglochin	procera	Water Ribbons	LM
274	ORCHIDACEAE	Burnettia	nigricans	Red Beaks Orchid	LM
275		Caladenia	arenicola	Carousel Spider Orchid	AB
276		Caladenia	flava	Cowslip Orchid	DB

no Cyathochaeta teretifolia listed →

Add: Cyathochaeta teretifolia

CRASSULACEAE
Crassula colorata

Mesomelaena graciliceps

ORCHIDACEAE
Hyperanthes sororia
Prasophyllum regium
Thelymitra carnea

277		Caladenia	latifolia	Pink Fairy Orchid	DB
278		Caladenia	longicauda	White Spider Orchid	DB
279		Caladenia	paludosa	Swamp Spider Orchid	AB
280		Cyanicula	deformis	Blue Fairy Orchid	DB
281		Diuris	corymbosa	Common Donkey Orchid	AB
282		Diuris	laxiflora	Bee Orchid	AB
283		Diuris	magnifica	Pansy Orchid	DB
284		Elythranthera	brunonis	Purple Enamel Orchid	DB
285		Elythranthera	emarginata	Pink Enamel Orchid	DB
286		Epiblema	grandiflorum ssp. grandiflorum	Babe-in-a-Cradle Orchid	OS
287		Eriochilus	dilatatus	Common Bunny Orchid	DB
288		Leporella	fimbriata	Hare Orchid	DB
289		Leptoceras	menziesii	Rabbit Orchid	DB
290		Microtis	brownii	Sweet Mignonette Orchid	DB
291		Microtis	media	Common Mignonette Orchid	LM
292		Prasophyllum	drummondii	Swamp Leek Orchid	DB
293		Prasophyllum	?giganteum	Bronze Leek Orchid	DB
294		Prasophyllum	regium	King Leek Orchid	AB
295		Pterostylis	aff. nana A	Snail Orchid	DB
296		Pterostylis	aff. nana B	Snail Orchid	DB
297		Pterostylis	sanguinea	Dark Banded Greenhood	DB
298		Pterostylis	vittata	Banded Greenhood	DB
299		Thelymitra	aff. holmesii	Scented Swamp Sun Orchid	DB
300		Thelymitra	?flexuosa	Twisted Sun Orchid	OS
301		Thelymitra	?pauciflora	Slender Sun Orchid	OS
302		Thelymitra	sp.	Sun Orchid	DB
303	PHORMIACEAE	Dianella	revoluta	Flax Lily	LM
304	POACEAE	Amphipogon	turbinatus		LM
305		Danthonia	setacea	Smallflower Wallaby Grass	LM
306		Neurachne	alopecuroidea	Foxtail Mulga Grass	LM
307		Paspalidium	sp.		LM
308		Stipa	campylachne		LM
309		Stipa	compressa		LM
310	RESTIONACEAE	Alexgeorgea	nitens		LM
311		Hypolaena	exsulca		LM
312		Leptocarpus	scariosus		LM
313		Leptocarpus	sp. B		LM
314		Lepyrodia	glauca		LM
315		Loxocarya	fasciculata		LM
316		Loxocarya	flexuosa		LM
317		Lyginia	barbata		LM
318		Restio	leptocarpoides		LM
319		Restio	stenostachyus		LM
320	XANTHORRHOEACEAE	Xanthorrhoea	brunonis	Blackboy	DB
321		Xanthorrhoea	preissii	Blackboy	LM

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JW	Joanne Wann
LM	Dr Libby Mattiske
OS	WA Native Orchid Study and Conservation Group
TC	Tim Comber
WS	Wildflower Society of WA (Northern Suburbs Branch)

** = Native but possibly not endemic to Whiteman Park

Draft list - total number of indigenous species estimated to be in excess of 400
Updated 5 July 1994 by D. Bright (PL_LIST1.WK1)

Vascular Species list for Whiteman Park - Exotics

	Family	Genus	Species	Common name	
FILICOPSIDA - True Ferns					
1	DENNSTAEDTIACEAE	Cyrtomium	falcatum	Japanese Holly fern	DB *
CONIFEROPSIDA - Conifers					
2	PINACEAE	Pinus	pinaster		LM *
MAGNOLIOPSIDA (Angiosperms) - Dicotyledons					
3	AIZOACEAE	Carpobrotus	edulis	Pigface	LM *
4	ASTERACEAE	Arctotheca	calendula	Cape Weed	LM *
5		Centaurea	melitensis	Maltese Cockspur	LM *
6		Conyza	albida	Tall Fleabane	LM *
7		Conyza	bonariensis	Flaxleaf Fleabane	LM *
8		Dittrichia	graveolens	Stinkwort	LM *
9		Hypochaeris	glabra	Flat Weed	LM *
10		Lactuca	?saligna		LM *
11		Osteospermum	clandestinum	Stinking Rogor	LM *
12		Sonchus	oleraceus	Common Sowthistle	DB *
13		Ursinia	anthemoides	Ursinia	LM *
14		Vellereophyton	dealbatum		LM *
15	BORAGINACEAE	Echium	lycopsis	Pattersons Curse/Salvatio	DB *
16	BRASSICACEAE	Rorippa	?nasturtium-aquatic	Watercress	DB ?*
17	CAMPANULACEAE	Wahlenbergia	capensis	Cape Bluebell	LM *
18	CANNABACEAE	Cannabis	sativa	Marijuana	BK *
19	CARYOPHYLLACEAE	Corrigiola	litoralis	Strapwort	GK *
20		Petrorhagia	velutina		LM *
21		Silene	gallica	French Catchfly	DB *
22	CUCURBITACEAE	Cucumis	myriocarpus		LM *
23	EUPHORBIACEAE	Ricinus	communis	Caster Oil Plant	DB *
24	FABACEAE	Lotus	suaveolens	Birdsfoot Trefoil	LM *
25	(PAPILIONACEAE)	Lupinus	consentinii	Sandplain Lupin	LM *
26		Lupinus	mutabilis	Pearl Lupin	DB *
27		Lupinus	luteus	Yellow Lupin	DB *
28		Medicago	sp.		DB *
29		Trifolium	campestre	Hop Clover	LM *
30		Trifolium	glomeratum	Cluster Clover	LM *
31		Trifolium	sp.		LM *
32		Trifolium	subterraneum	Subterraneum Clover	DB *
33	FUMARIACEAE	Fumaria	capreolata	Whiteflower Fumitory	DB *
34	GERANIACEAE	Erodium	moschatum	Musky Crowfoot	DB *
35		Pelargonium	capitatum	Rose Pelargonium	DB *
36	LAMIACEAE	Mentha	Puligium		LM *
37	MYRTACEAE	Leptospermum	?laevigatum	Coastal Tea-tree	DB *
38	OLEACEAE	Olea	europaea	Olive	DB *
39	ORCHIDACEAE	Monadenia	bracteata	South African Orchid	LM *
40	OROBANCHACEAE	Orobanche	minor	Lesser Broomrape	LM *
41	OXALIDACEAE	Oxalis	pes-caprae	Soursob	DB *
42		Oxalis	glabra		DB *
43		Oxalis	corniculata	Yellow Wood Sorrel	DB *
44	PHYTOLACCACEAE	Phytolacca	octandra	Ink weed	DB *
45	POLYGONACEAE	Rumex	acetosella	Sorrel	LM *
46		Rumex	crispus	Curled Dock	LM *
47	PRIMULACEAE	Anagallis	arvensis	Blue Pimpernel	DB *

** Jacksonia sericea - apparently introduced in soil/gravel brought in to park.

48	ROSACEAE	Acaena	echinata		LM *
49	SOLANACEAE	Nicotiana	glauca	Tree Tobacco	DB *
50		Solanum	nigrum	Black Berry Nightshade	LM *
51		Solanum	sodomaeum	Apple of Sodom	LM *

MAGNOLIOPSIDA (Angiosperms) - Monocotyledons

52	ARACEAE	Colocasia	esculenta	Elephants Ears, Taro	DB **
53		Zantedeschia	aethiopica	Arum Lily	LM *
54	CYPERACEAE	Cyperus	brevifolius	Kyllinga Weed	LM *
55		Cyperus	congestus	Dense Flat-sedge	LM *
56	IRIDACEAE	Gladiolus	caryophyllaceus	Gladiolus	LM *
57		Homeria	flaccida	Cape Tulip	LM *
58		Romulea	rosea	Guildford Grass	LM *
59		Sparaxis	bulbiferum	Harlequin Flower	DB *
60	JUNCACEAE	Juncus	acutus		LM *
61	POACEAE	Aira	caryophyllea	Silvery Hair Grass	LM *
62		Briza	maxima	Blowfly Grass	LM *
63		Briza	minor	Shivery Grass	LM *
64		Cortaderia	selloana	Pampas Grass	LM *
65		Ehrharta	calycina	Perennial Veldgrass	DB *
66		Ehrharta	longiflora	Annual Veldgrass	LM *
67		Holcus	lanatus	Yorkshire Fog	LM *
68		Hordeum	?leporinum	Barley Grass	LM *
69		Lagurus	ovatus	Hare's Tail Grass	LM *
70		Lolium	perenne	Perennial Ryegrass	LM *
71		Paspalum	dilatatum	Paspalum	DB *
72		Pennisetum	macrourum	African Feather Grass	LM *
73		Phalaris	sp.	Canary Grass	LM *
74		Polypogon	monspeliensis	Annual Beardgrass	LM *
75		Vulpia	myuros	Rat's Tail Fescue	LM *
76	TYPHACEAE	Typha	orientalis	Bulrush	LM ***

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Draft list - updated 5 July 1994 by D. Bright (PL_LIST1.WK1)

CONTACT DR N. GIBSON CALM WOODVALE for further information.

Flora list for M13 Whiteman Park (Mussel Pool) (extracted from Swan Coastal Plain database, White01-02 and from BJ Keighery, White03-08, 24/1/96).

Department of Environmental Protection System 6 Update: Site Based Flora List for M13 Whiteman Park (Mussel Pool)
(extracted from the CALM Swan Coastal Plain database, White01-02, and from BJ Keighery, White03-08, 24/1/96)

Anthericaceae

Johnsonia acaulis
Johnsonia pubescens
Laxmannia ramosa
Thysanotus arbuscula
Thysanotus multiflorus
Thysanotus thyrsoideus
Thysanotus triandrus
Tricoryne tenella

Apiaceae

Homalosciadium homalocarpum
Schoenolaena juncea
Trachymene pilosa
Xanthosia huegelii

Asteraceae

* Arctotheca calendula
* Hypochaeris glabra
Lagenifera huegelii
Millotia tenuifolia
Podotheca angustifolia
Quinetia urvillei
Senecio hispidulus
Siloxerus humifusus
* Sonchus oleraceus
* Ursinia anthemoides
Waitzia suaveolens

Campanulaceae

* Wahlenbergia capensis
Wahlenbergia preissii

Casuarinaceae

Allocasuarina fraseriana

Centrolepidaceae

Centrolepis aristata
Centrolepis drummondiana

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Colchicaceae

Burchardia bairdiae
Burchardia umbellata
Wurmbea dioica

Crassulaceae

Crassula colorata

Cyperaceae

Baumea arthrophylla
Baumea articulata
Baumea juncea
Cyathochaeta avenacea
Gahnia decomposita
Isolepis marginata
Lepidosperma angustatum
Lepidosperma longitudinale
Lepidosperma sp. E FPR
Lepidosperma tetraquetrum
Mesomelaena graciliceps
Schoenus aff. rodwayanus
Schoenus curvifolius

Dasypogonaceae

Dasypogon bromeliifolius
Lomandra caespitosa
Lomandra hermaphrodita

Dilleniaceae

Hibbertia aurea
Hibbertia huegelii
Hibbertia hypericoides
Hibbertia racemosa
Hibbertia subvaginata

Droseraceae

Drosera erythrorhiza
Drosera glanduligera
Drosera menziesii
Drosera pallida
Drosera sp. scps

Epacridaceae

Andersonia heterophylla

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Astroloma xerophyllum
Conostephium pendulum
Leucopogon conostephioides
Leucopogon squarrosus
Lysinema ciliatum

Euphorbiaceae

Stachystemon axillaris

Goodeniaceae

Dampiera linearis
Lechenaultia expansa

Haemodoraceae

Conostylis aculeata
Conostylis aurea
Conostylis juncea
Haemodorum laxum
Haemodorum spicatum
Phlebocarya ciliata

Haloragaceae

Gonocarpus pithyoides

Iridaceae

* Gladiolus caryophyllaceus
Patersonia occidentalis

Lamiaceae

Hemiandra pungens

Lauraceae

Cassytha racemosa

Lobeliaceae

Lobelia tenuior

Loganiaceae

Mitrasacme paradoxa

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Mimosaceae

- Acacia pulchella
- Acacia saligna
- Acacia stenoptera
- Acacia willdenowiana

Molluginaceae

- Macarthuria australis

Myrtaceae

- Agonis linearifolia
- Astartea aff. fascicularis sthcst
- Calothamnus sanguineus
- Calytrix angulata
- Calytrix fraseri
- Eremaea asterocarpa subsp. asterocarpa
- Eremaea ~~purpurea~~ imbricata.
- Eucalyptus calophylla
- Eucalyptus rudis
- Eucalyptus todtiana
- Hypocalymma angustifolium
- Kunzea recurva
- Melaleuca lateritia
- Melaleuca preissiana
- Melaleuca rhaphiophylla
- Melaleuca sp. B FPR (BJK&NG 054)
- Pericalymma ellipticum
- Scholtzia involucrata
- Verticordia lindleyi subsp. lindleyi scps map
- Verticordia nitens

Orchidaceae

- Caladenia flava
- Lyperanthus nigricans
- Lyperanthus serratus
- Prasophyllum regium
- Thelymitra crinita
- Thelymitra sp. scps

Papilionaceae

- Aotus cordifolia
- Bossiaea eriocarpa
- Daviesia physodes
- Euchilopsis linearis
- Eutaxia virgata
- Gompholobium confertum

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Gompholobium tomentosum
Hovea trisperma var. trisperma
Jacksonia densiflora
Nemcia capitata
Sphaerolobium sp. scps
Sphaerolobium vimineum

Poaceae

* Aira caryophyllea
* Aira sp. scps
Amphipogon turbinatus
* Briza maxima
* Briza minor
* Ehrharta longiflora
Stipa compressa
* Vulpia sp. scps

Proteaceae

Adenanthos cygnorum
Adenanthos obovatus
Banksia attenuata
Banksia ilicifolia
Banksia littoralis
Banksia menziesii
Dryandra nivea
Hakea varia
Persoonia saccata
Petrophile linearis
Stirlingia latifolia

Restionaceae

Alexgeorgea nitens
Hypolaena exsulca
Leptocarpus sp. scps
Loxocarya fasciculata
Loxocarya flexuosa
Lyginia barbata

Rutaceae

Eriostemon spicatus

Stylidiaceae

Levenhookia stipitata
Stylidium brunonianum
Stylidium calcaratum
Stylidium dichotomum

CONTACT DR N. GIBSON CALM WOODVALE for further information.
Flora list for M13 Whiteman Park (Mussel Pool) (extracted from Swan Coastal Plain database, White01-02 and from BJ Keighery, White03-08, 24/1/96).

Stylidium guttatum
Stylidium piliferum
Stylidium repens

Xanthorrhoeaceae

Xanthorrhoea preissii

BS 304
BASS. N.
WHITEMAN

WHITEMAN PARK FAUNA SURVEY

GW Arnold + GT Smith + MG Brooker

CSIRO
Division of Wildlife and Ecology
Perth, Western Australia

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1 SUMMARY AND RECOMMENDATIONS

This report presents the results of surveys made of the vertebrate fauna of Whiteman Park in 1990 and gives assessments of the conservation status of a number of locally endangered species. Recommendations are made for the development of a wildlife management plan and for further research on the wildlife in the Park.

1. Whiteman Park is considered to be a very important area for the conservation of fauna representative of the Bassendean dune system of the Swan Coastal Plain, as it is large in area and has the management personnel and structures available for its proper maintenance. Future urban development on the Swan Coastal Plain will increase the conservation and educational values of the Park, provided its present integrity is maintained. This integrity depends on the maintenance of a buffer zone around the core Conservation Area so that the impacts of suburbia are filtered. Because the Park will be completely isolated by urban development in a few years time, the persistence of many of the species in the Park will depend on self-sustaining populations. Any reduction in the size of the Park would reduce the size of these populations and endanger the persistence of the rarer species.

RECOMMENDATION That the Park be retained at its current size and with its current physical structure of a core Conservation Area surrounded by a buffer zone for recreational and grazing activities.

2. Tree dieback is present, especially in areas dominated by vegetation types I, J and K1 (Mattiske 1989) but the cause of this physiological stress has not been established. As all the wildlife in the Park is influenced by the vegetation, it is apparent that tree dieback poses the most immediate risk to wildlife conservation in the Park and needs urgent

investigation.

RECOMMENDATION That the factors responsible for tree dieback and stress be urgently investigated and management implemented to prevent further losses.

3. The buffer zone and the Conservation Area both require ongoing management of the vegetation to maintain their conservation value.

RECOMMENDATION That an integrated management plan be developed incorporating revegetation, fire management and water extraction. This plan should include research involving key wildlife species and their relationships with the vegetation.

4. At least six species of amphibians, 26 species of reptiles, 95 species of birds and five species of native mammals exist in the Park. Three of the mammals are of particular interest from a wildlife conservation viewpoint, because they are likely to become endangered with the spread of urban development and Dieback Disease in the south-west of the State. These are the Black-gloved Wallaby, the Honey-Possum and the Southern Brown Bandicoot. It seems likely that the Park could sustain viable populations of these species but further research on them is needed so that management plans can include the maintenance of their habitats within the Park.

RECOMMENDATION That the populations of Black-gloved Wallaby, Honey-Possum and Southern Brown Bandicoot be maintained on a long-term basis and that research into their habitat requirements be commissioned.

5. The Park contains most of the species of birds expected on the northern part of the Swan Coastal Plain, including several whose numbers have declined since European settlement. Retention of this suite of species requires that fire be minimized and that the vegetation be retained in a healthy state.

RECOMMENDATION That bird species in the Conservation Area and selected wetlands be monitored at least annually so that the effects of any management plans can be monitored.

6. Kangaroo densities in the Park appear to be high. It is important to assess population trends and the impact they are having on both the native vegetation and cattle carrying capacity of the Park.

RECOMMENDATION That kangaroo distribution and abundance be monitored and their impact on the vegetation assessed. Should this be found to be serious and the numbers increasing, then benign control measures should be instituted.

2 INTRODUCTION

Whiteman Park, 20 km north-east of Perth, is on the Bassendean soil association of the Bassendean dune system (Bettenay *et al.* 1960) This soil association covers an extensive area of the Swan Coastal Plain including much of the area northwards from the Swan River to Gingin Brook. Its topography is characterised by low sand dunes with intervening depressions which are usually either permanently or seasonally wet due to the presence of a shallow aquifer known as the Gnangara Mound.

In the higher areas of the association the vegetation comprises a complex mosaic of formations (Havel 1968) principally low Open Woodland dominated by eucalypts or banksias. In the wet depressions the seasonal wetlands usually support *Melaleuca priessiana* Open Woodland while the permanently moist areas support *Melaleuca rhaphiophylla* Open Woodland. Heathlands of variable floristic composition are also common.

Most of the area of the soil association is being subjected to increasing human pressures which are having deleterious effects on the vegetation and the wildlife which it supports. The principals pressures are the clearing of land for urban development and the extraction of groundwater from shallow unconfined aquifers. The extraction of groundwater in Whiteman Park and its impact on the vegetation has been discussed by Mattiske (1989).

Whiteman Park is important from a conservation viewpoint because of its size and because it represents an ecosystem that is rapidly being eliminated as the Perth Metropolitan Region expands. Also, from a conservation viewpoint, the Park is an island which, with the exception of some bird species, cannot be recolonised. As urban development around the Park increases, the isolation of the Park will increase and no species will be able to recolonize the Park unless they are deliberately re-introduced. Thus

it is imperative that the management strategy aims to minimise the risk of species extinctions.

Previous reports on the flora and fauna of Whiteman Park (Jackson *et al.* 1975, Maunsell 1978) emphasised the importance of restricting access to the 700 hectares of relatively undisturbed woodland. The current Park management plan adopts this policy. However, the management of the rest of the Park can impinge on the flora and fauna in this bushland Conservation Area. It is widely accepted that a buffer zone around such an area, within which human activities are restricted, is highly desirable. The buffer zone is used to "filter out" any undesirable impacts from activities in the surrounding urban and rural areas.

Since the establishment of the Park, there has been progressive development of recreational activities. The Water Authority has developed a network of bores and is extracting underground water. A recent flora survey showed that physiological damage to the trees and shrubs is extensive throughout the Park. Any changes in the vegetation due to man's activities may well affect the fauna. A brief spring survey of the Park's fauna by the Western Australian Museum (Jackson *et al.* 1975) indicated the presence of 7 species of amphibia, 25 species of reptiles, 70 species of birds and 5 species of native mammals. Another six mammal species were thought likely to be in the Park.

The management of the undisturbed bushland Conservation Area has been to restrict access, to control rabbits and to burn. The disturbed areas of bushland are grazed by cattle and are also burnt periodically. The Museum survey report recommended that fire management in the Conservation Area should aim to:-

1. ensure that the entire reserve is never burnt,
2. maintain ground litter at a level where wildlife is maintained but below a level where wildfire gets so hot that the vegetation in any sector is completely devastated,
3. maintain floristic diversity.

A 12 year cycle for rotating burning at three year intervals was proposed. The Museum

report also recommended that biological surveys be conducted in the future to monitor the effects of urban impact on the conditions of the Park.

When more is known about the fauna and its habitat requirements, management may be targeted better to enhance fauna conservation. Of particular concern is the population of Western Grey Kangaroos and their interaction with cattle grazing.

3. OBJECTIVES

1. To survey the distribution and, where possible, estimate the abundance of the vertebrate fauna species in Whiteman Park.

2. To indicate the appropriate strategies to conserve and maintain viable wildlife numbers in the Park.

3. To recommend a policy for the management of the kangaroo population in relation to the cattle grazing usage of the Park.

4 LARGE MAMMALS

4.1 METHODS

The whole of the Park was surveyed for Western Grey Kangaroos *Macropus fuliginosus* in March and November 1990. The objective was to estimate densities in various parts of the Park in two seasons and relate densities to vegetation attributes. The 32 km of transect lines shown on Figure 4.1 were walked slowly and the number of faecal pellets in a 1 metre strip counted. The counts were kept separate for each vegetation type along the transect. The counts were converted to numbers per 100 metres and written onto a large scale vegetation map. Densities of kangaroos were estimated from the densities of faecal pellets (Arnold *et al.* 1991). The densities of kangaroos within the various vegetation associations were then used to calculate the total population.

The survey for Black-gloved Wallabies *Macropus irma* was restricted to the Conservation Area. In autumn and spring 1990, this area was surveyed by three people on horseback, the three riders keeping 100 m apart. Each wallaby seen was mapped.

4.2 RESULTS

4.2.1. Western Grey Kangaroo

The counts of kangaroo pellets per 100 metres were classified into four densities: low (0 - 0.09 kangaroos per hectare), medium (0.09 - 0.156), high (0.156 to 0.29) and very high (more than 0.29 kangaroos per hectare). The maps were then coloured to show zones of different densities. Figures 4.2, 4.3 and 4.4 show the distributions of densities separately for autumn, spring and the seasons combined.

There were very high densities in the cattle-grazed woodland in the south east of the Park in both autumn and spring. Mobs of up to 70 animals were counted. In this area, the

KANGAROO FAECAL TRANSECTS

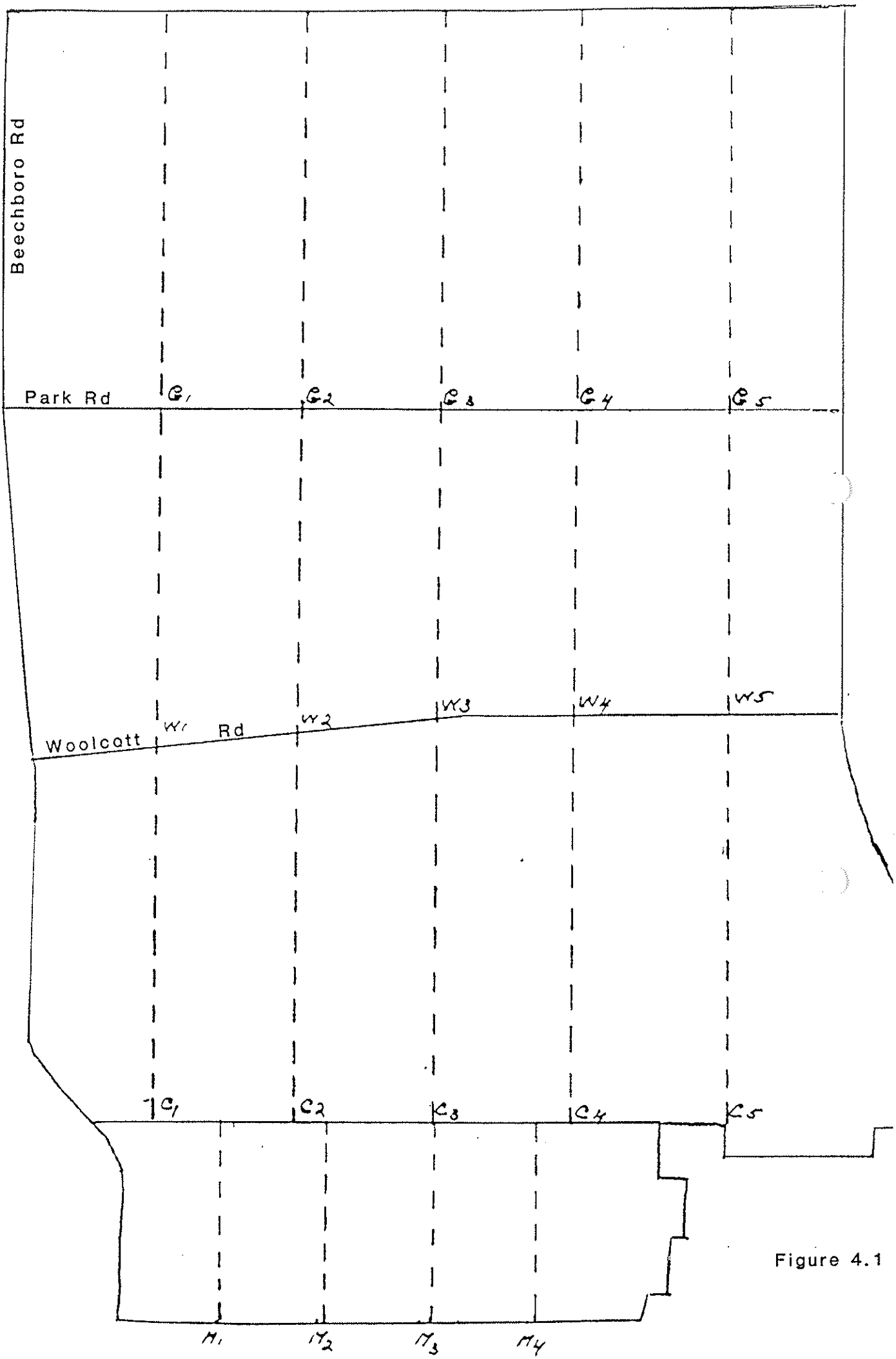


Figure 4.1

RELATIVE KANGAROO DENSITY MAY 1990

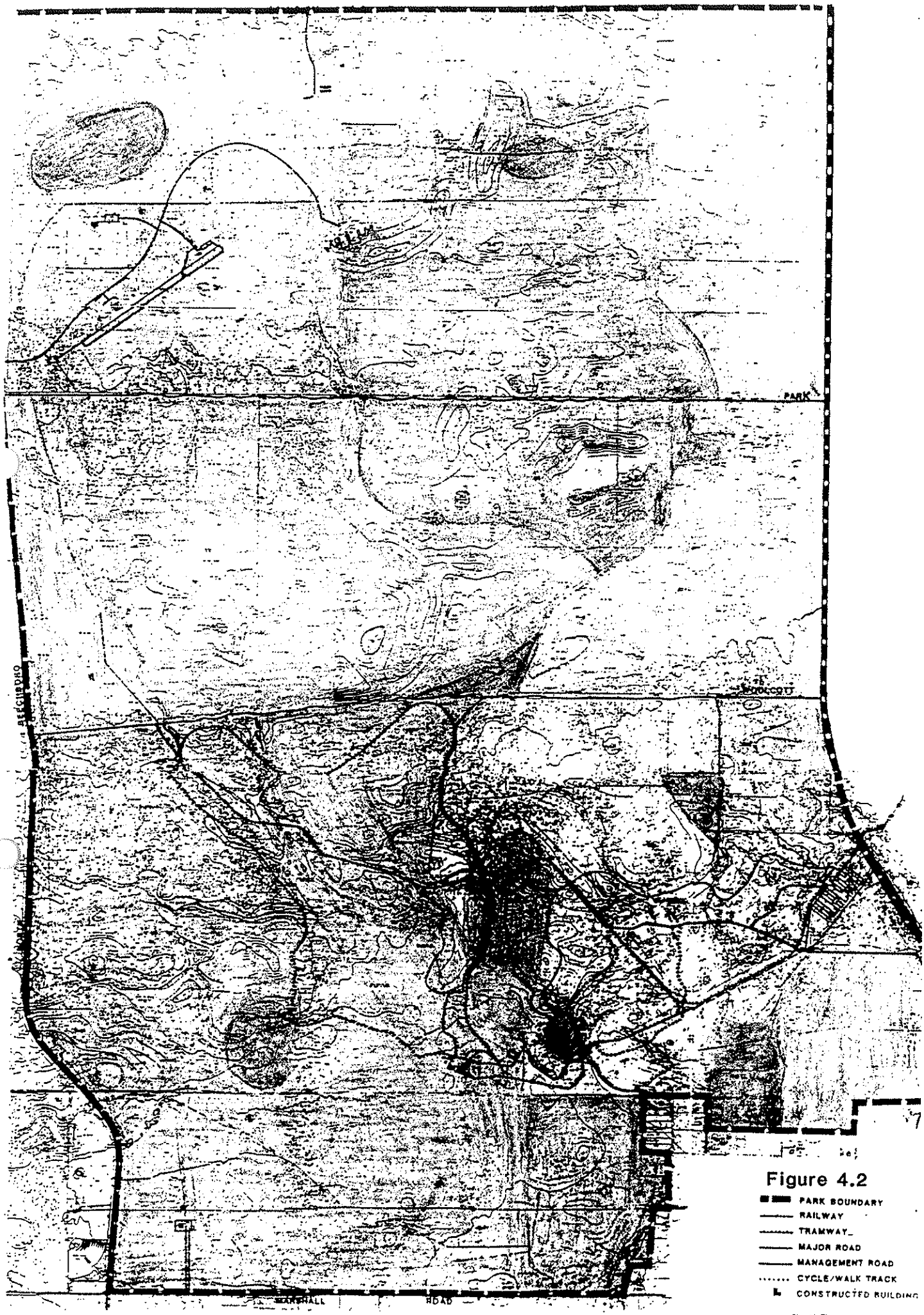
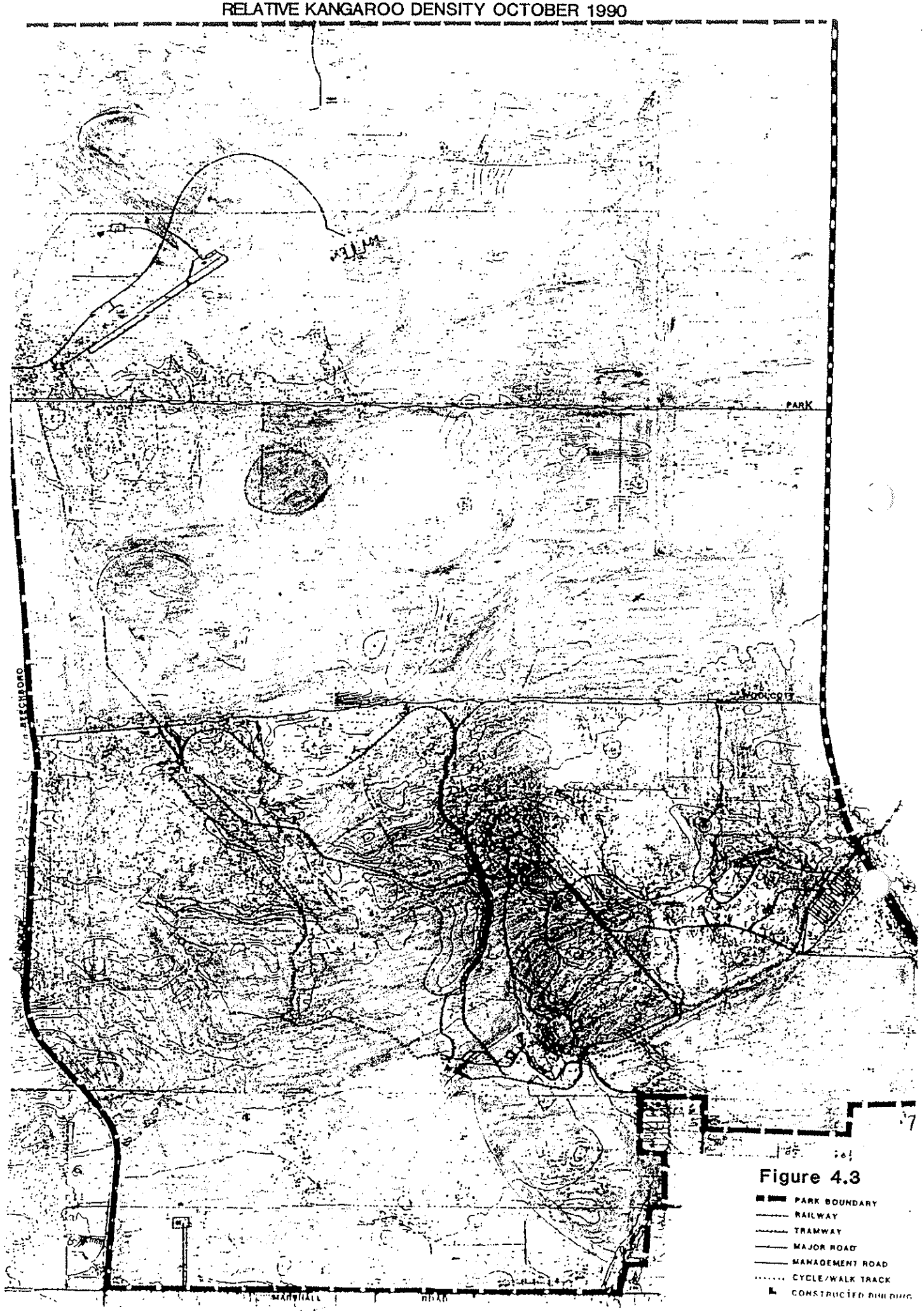


Figure 4.2

RELATIVE KANGAROO DENSITY OCTOBER 1990



RELATIVE KANGAROO DENSITY 1990

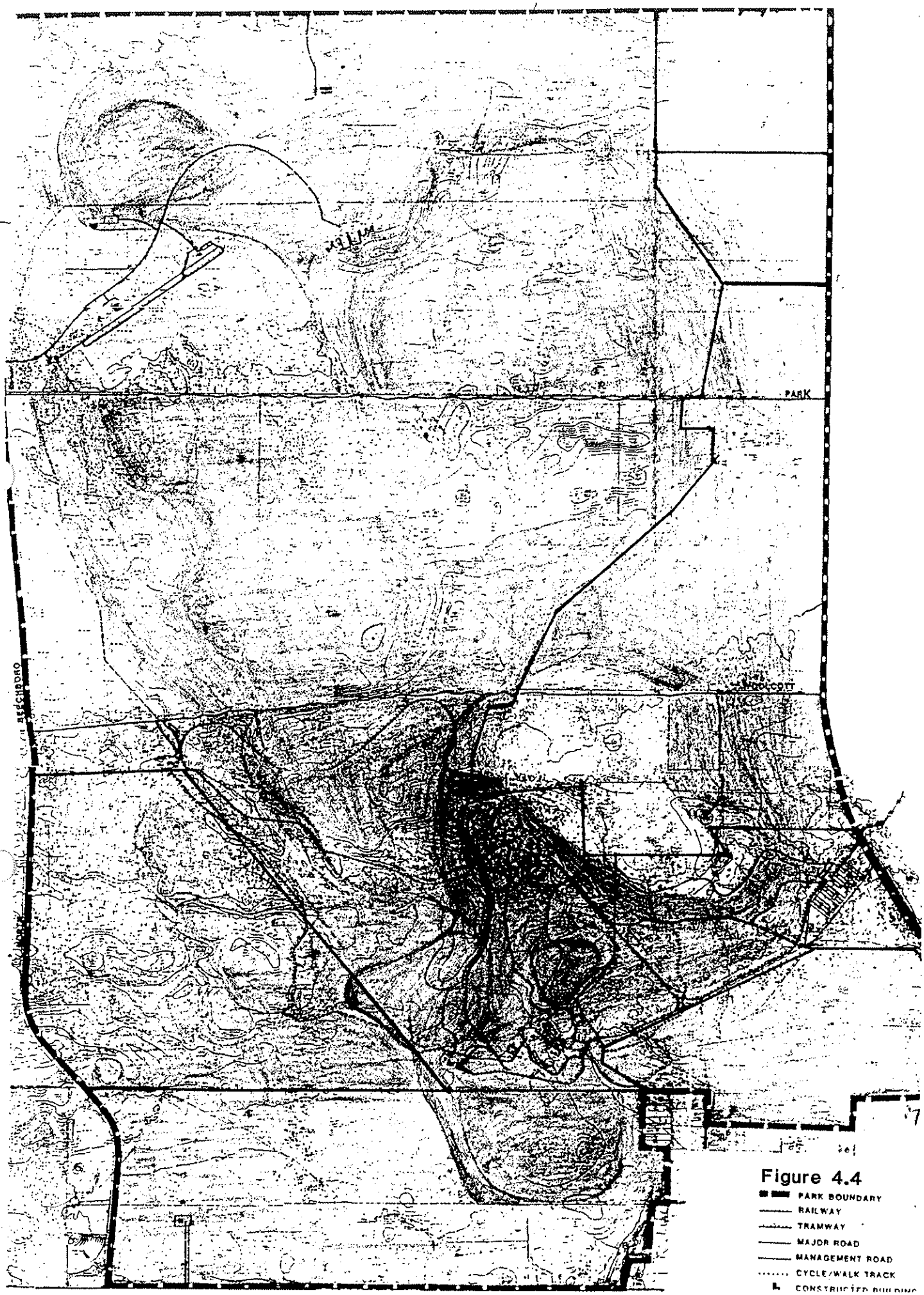


Figure 4.4

PARK BOUNDARY
RAILWAY
TRAMWAY
MAJOR ROAD
MANAGEMENT ROAD
CYCLE/WALK TRACK
CONSTRUCTED BUILDING

ground cover has been changed by cattle grazing and the invasion of annual pasture plants which kangaroos have readily adapted to feeding upon. The low density of trees allows a good growth of pasture and still provides shade and shelter for the kangaroos.

Medium to high densities occurred on much of the woodland in the Conservation Area in both seasons, with several areas of very high density in the Conservation Area in spring. The overall pattern, seen in Figure 4.4, is that densities decreased away from the woodland vegetation and were low in the open pasture areas. The hectares of grazed land and bushland in each density class is given in Table 4.1. Within the areas of natural or near natural vegetation, there was no clear relationship between kangaroo density and vegetation types as classified by Mattiske (1989).

Whilst the percentages of cattle grazed areas and ungrazed bushland areas with very high densities were small, 41% of the bush areas had high densities and this may be significant in terms of grazing pressure on the native vegetation.

The total population of kangaroos was estimated to be 550, of which around 180 are competing with cattle.

Table 4.1 Areas (hectares) of Whiteman Park subject to different densities of kangaroos. Values in parenthesis are percentages.

	Low	Medium	High	Very high	Total
Cattle grazing	680 (64)	264 (25)	56 (5)	71 (7)	1071
Restricted access bush	459 (28)	458 (28)	679 (41)	57 (4)	1653
Total	1139 (42)	722 (27)	735 (27)	128 (5)	2724

4.2.2 Black-gloved Wallaby

The sightings of 18 Black-gloved Wallabies shown in Figure 4.5 demonstrate a clear relationship with vegetation type. There were single sightings in vegetation types G and H of Mattiske (1989), two in type I, six in type J and nine in type JK (see Appendix A for a description of Mattiske's vegetation types). These were daytime sightings when the wallabies would be resting. They may feed in these vegetation types and in adjacent types, although we have no information on this. The resting habitat is in *Eucalyptus calophylla* open woodland with areas of *Melaleuca preissiana*, *Banksia ilicifolia* and *B. menziesii*, low open forest of *M. preissiana - B. littoralis*, ranging to closed heath of Myrtaceae species. Wallabies are seen regularly grazing on open grassland areas around the shooting complex to the north.

4.3 DISCUSSION

It is not possible to compare the densities of Western Grey Kangaroos in the Conservation Area of the Park with densities in other locations of similar habitat since no estimates of density have been made elsewhere. Certainly, the densities are much higher than in Jarrah forest (Arnold, unpublished data) but this is probably due to the availability of herbaceous material in disturbed areas of bushland and the use of pasture land. The key question is whether this density is adversely affecting the native ground flora and low shrubs in the conservation area. This is important since any reduction in cover could have an effect on the wallabies. The second important question is whether the population is growing or is in equilibrium with the resources available. Neither question can be answered without further research.

It is recommended that monitoring be established to answer these questions. This monitoring can be done by Park staff with specialist supervision by scientists in Government Agencies or Universities. Monitoring vegetation changes would be done by establishing a series of matched pairs of vegetation patches (100 sq metres), one of each pair being fenced to keep kangaroos out. The pairs should be set up in the 18 locations marked in Figure 4.6. These give three replications in each major type of vegetation. The

● BLACKGLOVED WALLABY SIGHTINGS

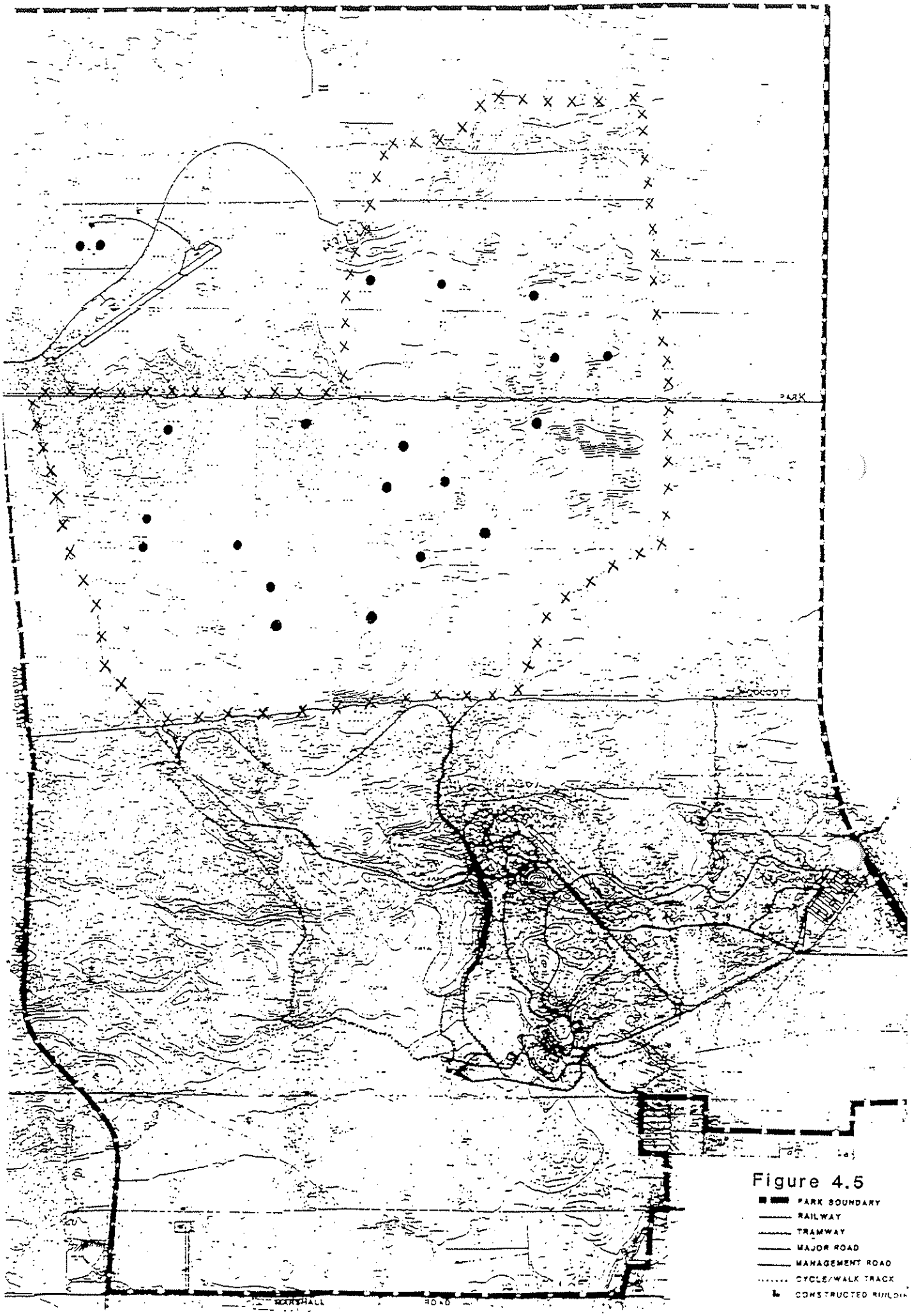


Figure 4.5

PARK BOUNDARY
RAILWAY
TRAMWAY
MAJOR ROAD
MANAGEMENT ROAD
CYCLE/WALK TRACK
CONSTRUCTED BUILDIN

XXXX BOUNDARY OF SEARCHED AREA

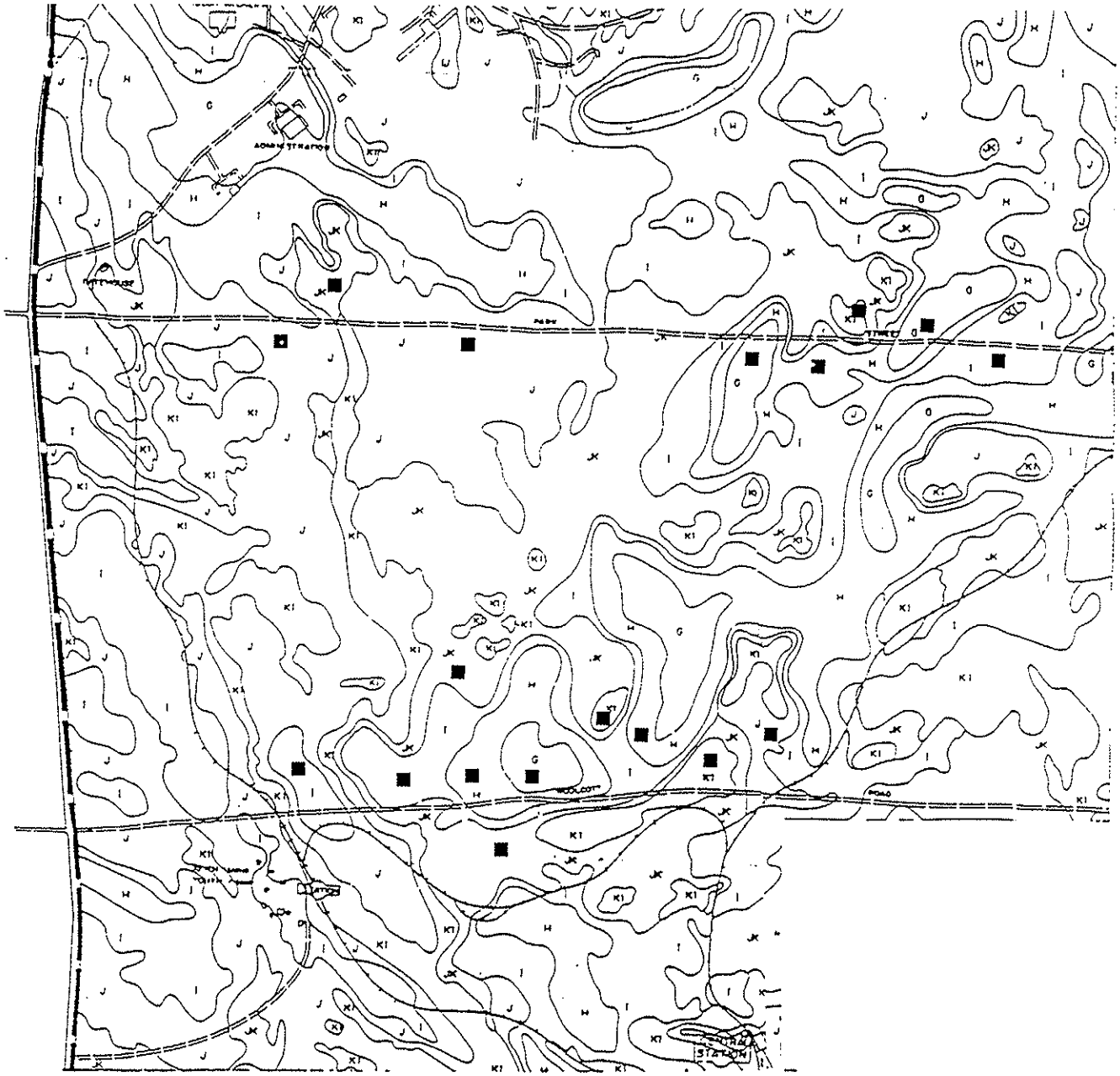


Figure 4.6 Suggested locations of paired sites for the monitoring vegetation changes due to kangaroo grazing.

vegetation in the patches would be measured once a year for at least 5 years. Estimates of numbers of kangaroos should be made each autumn and spring from faecal pellet counts made along the 32 km of transects that were used in this study. Changes in kangaroo distribution should be monitored from these transect counts.

In the open areas of pasture, kangaroos are at low density, and would have little effect on the cattle carrying capacity of the pastures. In the wooded areas, kangaroos are at high densities and must be reducing the cattle carrying capacity. Allowing that eight kangaroos eat the equivalent of one cow, the current reduction is about 20 cows. It is doubtful whether food quantity is limiting the kangaroo population, which could increase at a rate of 30 - 50% per year. An increase in the kangaroo population will force more kangaroos to utilise the open pasture areas and will increase the grazing pressure in the Conservation Area. The biannual faecal pellet counts should detect any changes in distribution and abundance of kangaroos in the park.

Any large increase in the kangaroo population is undesirable, in our judgement, for two reasons. The native vegetation will become overgrazed and the economic viability of cattle grazing the buffer zone will be reduced. The cattle grazing provides fire control and its economic viability is probably important in maintaining the integrity of the Park's buffer zone. CSIRO is currently investigating the benign control of kangaroos. Should this technique prove effective in the field, it would be ideal for controlling population numbers in the Park.

At this stage we cannot make any firm recommendation on a policy for kangaroo management. The information obtained from the monitoring, together with a decision on the number of cattle required for economic viability, will allow a decision to be made on whether to cull the kangaroo population or not.

In the south-west of the state, the Black-gloved Wallaby has been shown to have decreased in numbers by a factor of ten in the last ten years (CALM News Dec. 1990, p2). It is considered important that the population in Whiteman Park be conserved. It is

recommended that a special management plan be drawn up for that area of the Park where the wallabies are found. The Wallabies need areas of thick, tall scrub for shelter that can only develop after many years following fire. Preferably, fire should be avoided, but if it is deemed necessary in the overall management of the Park, it should be infrequent (once every 20 years). Burning should be in patches of 50-100 hectares. The wallabies have a very high fidelity to their home ranges which are probably 50 hectares or less in area and include areas of dense as well as more open vegetation. It is also recommended that the population numbers be monitored annually by Park staff as was done in this study. Since very little is known about the ecology of this wallaby, it is recommended that the Park provide the funding for a postgraduate student to study the ecology of the species in areas similar to that of the Park. Such a study would aim to establish the sizes of home ranges of individual wallabies so that a sound basis for patch burning can be obtained. Foxes need to be controlled because they are a predator of juvenile wallabies. One fox was seen in Hidden Valley where the wallabies live and one fox can have a devastating effect on a small population of small marsupials (K. Johnson pers. comm.). It is recommended that a baiting program to control foxes be initiated under the guidance of the Agriculture Protection Board.

5 TERRESTRIAL VERTEBRATES

5.1 METHODS

The terrestrial vertebrates were sampled using pitfall traps; 20 litre white plastic pails, 400mm deep and 280mm in diameter with a seven metre by 240mm high drift fence of aluminium flyscreen. At each sampling site, six pitfall traps were established on a 3x2 grid with 25m between each pit. Three sites were selected in each of the six vegetation associations present in the part of the Conservation Area burnt in the spring of 1985 (see Mattiske 1989 and Appendix A for descriptions of the vegetation). To obtain some data on the possible different effects of Spring and Autumn fires, three pitfall grids were established in vegetation type J and one in vegetation type I in the area burnt in the Autumn of 1986. The location of all grids is shown on Figure 5.1.

The pits were opened for four successive days beginning on 14 March, 29 March, 8 April, 22 October, 21 November and 11 December, giving a total of 3024 pit-trap days. Only two grids were used in vegetation types JK and K1 during the three autumn sampling periods. The traps were visited each morning and all vertebrates were identified, sexed, measured (weight, total length, length of snout to vent, length of tibia; in the case of the Honey-Possum *Tarsipes rostratus* the length of the head and the width of the scrotum were also measured; the House Mouse *Mus musculus* was only sexed and weighed) and, where appropriate, marked (toe clips) and then released.

5.2 RESULTS

During the 12 days of trapping in autumn, 540 individuals of 25 species (2 mammals, 17 reptiles and 6 amphibians) were captured; with the same trapping effort in spring but with two additional grids, 392 individuals of 27 species (2 mammals, 22 reptiles and 3 amphibians) were captured. There were marked differences between the seasons in the

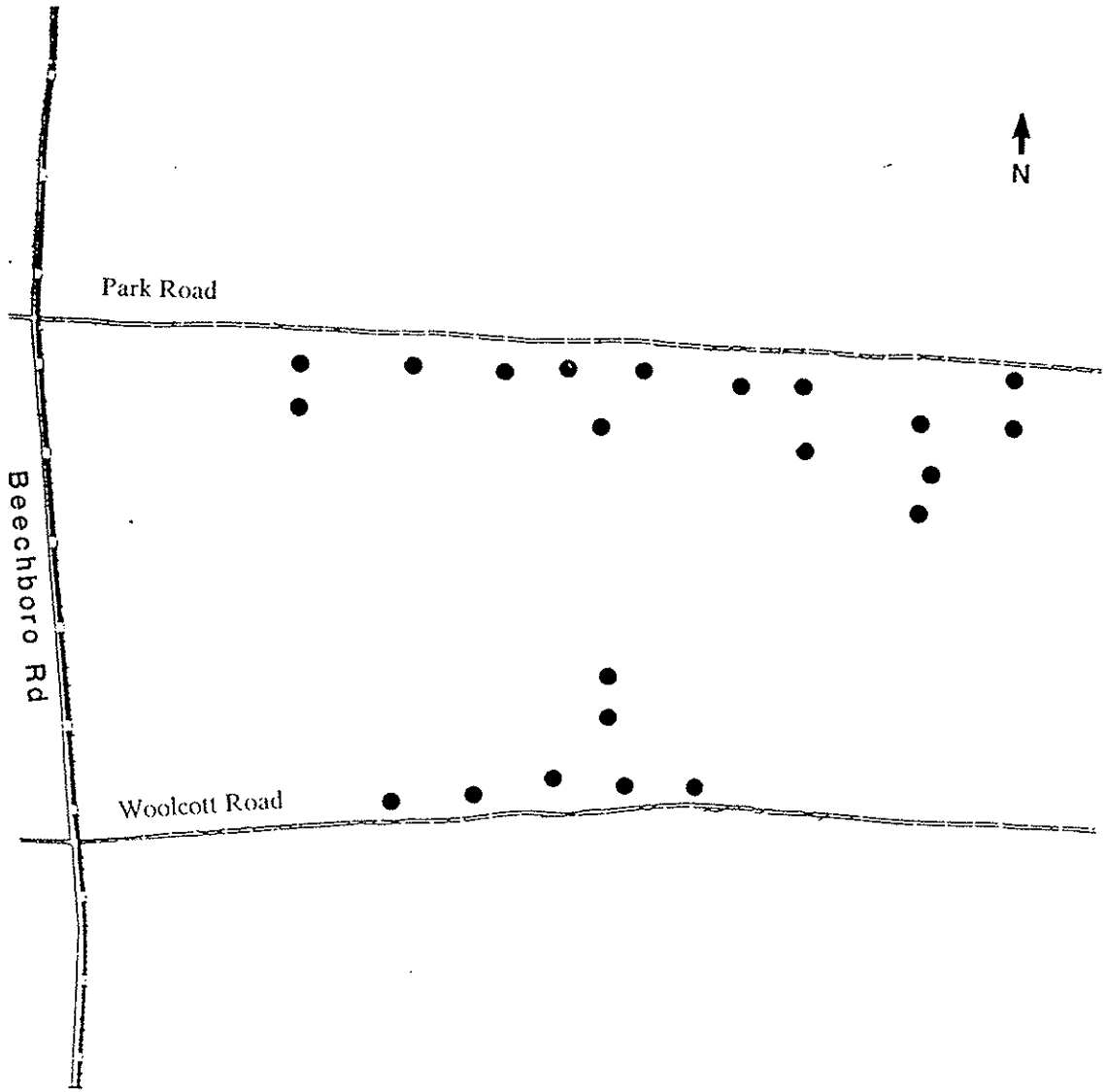


Figure 5.1 Locations of terrestrial vertebrate sampling sites within the Conservation Area.

numbers of the major taxa captured; amphibian captures were high (N=299) in the autumn because of a heavy rainfall episode during one sampling period (8 April) which caused a large increase in the number of foraging frogs, especially the Moaning Frog *Heleioporus eyrei* and the Turtle Frog *Myobatrachus gouldii*. In spring captures were low (N=37). Reptile captures increased from 182 in autumn to 317 in spring. The Honey-Possum was more frequently caught in the spring, 11/17; whereas the House mouse was less frequently caught (19/72).

The capture data for both seasons were combined and are given for each species, for each vegetation type in Table 5.1. Within the Conservation Area, one amphibian, the Moaning Frog *Heleioporus eyreii* was abundant (N=236), two, the Banjo Frog *Limnodynastes dorsalis* (N=55) and the Turtle Frog *Myobatrachus gouldii* (N=42), were common and the remaining three species were caught only once. *Tympanocryptis adelaidensis* (N=78), *Ctenotus lesueurii* (N=76) and *Lerista elegans* (N=75) were the most abundant reptiles; another seven species which were caught more than 10 times may be considered common to uncommon, while the 12 species that were caught less than ten times may be considered scarce, although, for some species such as *Phyllodactylus marmoratus*, low capture rates merely reflected the inefficiency of pitfall traps in capturing some species. Other species such as the Bobtail *Tiliqua rugosa*, which were caught only three times in vegetation types J and JK, were observed in all vegetation types but in low densities.

The number of species caught in the various vegetation types ranged from 22 in type I to 16 in type JK which also had the lowest abundance of animals (N=86); animals were most abundant in type J (N=216) and type I (N=183). Analysis of the relationship between vegetation type and vertebrate species composition revealed that there were no significant differences in the suite of species found in the various vegetation types. Most of the abundant species (N=15) were found in all vegetation types, although there were individual species variations in abundance in the different vegetation types (Table 5.2) which were related to the species microhabitat requirements; e.g. *T. adelaidensis* was most abundant in vegetation types G, H and K1 because these had larger areas of open ground. The Honey-Possum was the only species that showed a definite habitat preference, it was

Table 5.1 The numbers of each species caught in the six vegetation types (see Mattiske 1989 and Appendix A for description of vegetation). Data from sites in areas burnt in Spring 1985 and Autumn 1986 combined.

Species	G	H	I	J	JK	K1	Total
MAMMALS							
Tarsipes rostratus	6	1	4	0	0	6	17
Mus musculus	7	4	18	23	8	12	72
REPTILES							
Phyllodactylus marmoratus	0	0	0	1	0	1	2
Diplodactylus alboguttatus	6	3	2	1	0	1	11
Aprasia repens	1	2	3	4	5	6	21
Lialis burtonis	1	0	1	1	0	0	3
Pletholax gracilis	0	2	1	0	4	1	8
Pogona minor	7	5	3	11	3	4	33
Tympanocryptis adelaidensis	16	20	7	9	3	23	78
Cryptoblepharus plagiocephalus	11	3	13	6	4	3	40
Ctenotus fallens	0	0	1	2	3	2	8
Ctenotus gemmula	0	0	1	3	0	0	4
Ctenotus impar	3	3	3	1	1	4	15
Ctenotus lesueurii	18	11	12	15	13	7	76
Egernia napoleonsis	0	0	0	0	0	1	1
Lerista elegans	14	6	15	21	12	7	75
Menetia greyii	5	8	10	29	2	5	59
Morethia lineoocellata	0	3	2	0	1	0	6
Morethia obscura	2	7	10	22	6	9	56
Tiliqua rugosa	0	0	0	1	2	0	3
Ramphotyphlops australis	1	0	1	1	0	0	3
Pseudonaja affinis	0	0	0	0	0	1	1
Vermicella calonotos	0	1	2	0	0	0	3
Vermicella fasciolata	1	0	0	0	0	0	1
FROGS							
Crinia georgiana	0	0	0	0	0	1	1
Heleioporus eyrei	47	33	58	29	10	59	236
Limnodynastes dorsalis	7	5	7	15	8	13	55
Myobatrachus gouldii	9	3	9	20	0	1	42
Pseudophryne guentheri	0	0	0	1	0	0	1
Ranidella insignifera	0	0	1	0	0	0	1
Number of individuals	162	120	183	216	86	164	932
Number of species	18	18	22	21	16	21	29

Table 5.2 List of terrestrial vertebrates whose distribution and habitat requirements suggest that they may occur at Whiteman Park (Source: Anon 1978), together with those species found by the 1970 Western Australian Museum survey (Jackson *et al.* 1975) and this study.

Species	Museum	This study
MAMMALS		
Tachyglossidae		
Tachyglossus aculeatus Short-beaked Echidna		x
Peramelidea		
Isoodon obesulus Southern Brown Bandicoot	x	x
Phalangeridea		
Trichosurus vulpecula Common Brushtail Possum		
Burramyidae		
Cercartetus concinnus Western Pygmy-Possum		
Tarsipedidae		
Tarsipes rostratus Honey-Possum		x
Macropodidae		
Macropus fuliginosus Western Grey Kangaroo	x	x
Macropus irma Black-gloved Wallaby	x	x
Muridae		
Hydromys chrysogaster Water-rat		
Pseudomys albocinereus Ash-grey Mouse	x	
Rattus fuscipes Bush Rat		
Rattus rattus Black Rat	x	
Mus musculus House Mouse	x	x
Leporidae		
Oryctolagus cuniculus Rabbit	x	x
Canidae		
Vulpes vulpes Fox	x	x
REPTILES		
Chelidae		
Chelodina oblongata Oblong Turtle	x	x
Gekkonidae		
Diplodactylus spinigerus		
Diplodactylus alboguttatus		x
Phyllodactylus marmoratus Marbled Gecko	x	x
Pygopodidae		
Aprasia repens	x	x
Delma fraseri		
Lialis burtonis	x	x
Pletholax gracilis		x
Pygopus lepidopodus		x
Agamidae		
Pogona minor	x	x
Tympanocryptis adelaidensis	x	x

Table 5.2 cont.

Species	Museum	This study
REPTILES cont.		
Varanidae		
Varanus gouldii Bungarra	x	
Varanus rosenbergi	x	x
Scincidae		
Cryptoblepharus plagiocephalus	x	x
Ctenotus fallens	x	x
Ctenotus gemmula	x	x
Ctenotus impar	x	x
Ctenotus lesueurii	x	x
Egernia napoleonsis	x	x
Hemiergris peronii		
Leiolopisma trilineatum	x	
Lerista elegans		x
Lerista lineopunctulata		
Lerista praepedita		
Menetia greyii	x	x
Morethia lineoocellata	x	x
Morethia obscura	x	x
Tiliqua occipitalis	x	x
Tiliqua rugosa Bobtail	x	x
Typhlopidae		
Ramphotyphlops australis	x	x
Elapidae		
Notechis coronatus Crowned Snake		
Notechis curtus Bardick		
Notechis scutatus Tiger Snake	x	
Pseudonaja affinis Dugite	x	x
Rhinoplocephalus gouldii Gould's Snake	x	
Vermicella bertholdi Jan's Banded Snake		
Vermicella bimaculata Black-naped Snake		
Vermicella calonotos Black-striped Snake		x
Vermicella fasciolata Narrow-banded Snake		x
Vermicella semifasciata Southern Shovel-nosed Snake		
AMPHIBIANS		
Leptodactylidae		
Crinia georgiana		x
Heleioporus eyrei Moaning Frog	x	x
Limnodynastes dorsalis Banjo Frog	x	x
Myobatrachus gouldii Turtle Frog	x	x
Neobatrachus pelobatoides Humming Frog		
Pseudophryne guentheri	x	x
Ranidella insignifera	x	x
Hylidae		
Litoria adelaidensis Slender Tree Frog	x	
Litoria moorei Bull Frog	x	

not found in J or JK which reflects the lack of flowering shrubs in these vegetation types. The Turtle Frog and *Diplodactylus alboguttatus* also were not recorded in vegetation type JK.

The lack of a significant relationship between vertebrate species composition and vegetation type is due in part to the small scale mosaic of vegetation types which allows animals to move between areas of preferred habitat, to the similarity of the basic habitat variables in most of the vegetation types and to the use of different vegetation types for different activities. An example of the latter factor is given by *Tympanocryptis adelaidensis* which was most frequently caught in vegetation type K1. Most were juveniles and it is possible that these areas were preferred breeding areas for the species.

5.3 DISCUSSION

The trapping results and observations showed that there was a minimum of 40 species (8 mammals, 26 reptiles and 6 amphibians) in the Conservation Area (Table 5.2). Together with those recorded from the Western Australian Museum survey, a total of 48 species (10 mammals, 30 reptiles and 8 amphibians) of terrestrial vertebrates have now been recorded in Whiteman Park. Table 5.2 lists those species whose distribution and habitat requirements suggest that they may occur in Whiteman Park. The fourteen species expected but not recorded in the Park are generally rare to uncommon and it will require further sampling to determine if they are present in the Park. In other studies using the same techniques, new species were still being recorded after 7000 pit-trap nights (Smith unpublished data) i.e. over twice the number of pit-trap nights used in the present study. To obtain a full inventory of the fauna in the Park it is recommended that further sampling be undertaken, especially in areas with permanent wetlands. Species such as the Western Pygmy-Possum *Cercatetus concinnus* and the Common Brush-tailed Possum *Trichosurus vulpecula* may no longer occur because of logging and fire, while the Bush Rat *Rattus fuscipes* and the Water-rat *Hydromys chrysogaster* may no longer occur because of the substantial changes that have taken place in the permanent wetlands. Despite these omissions, Whiteman Park represents an important link in the series of conservation areas

on the northern Swan Coastal Plain; its importance will increase in the future as the Perth metropolitan area continues to expand.

Comparison of the results of this study with those of the Museum Survey showed that nine new species were recorded (Echidna, Honey-Possum, *Diplodactylus alboguttatus*, *Pletholax gracilis*, *Pygopus lepidopus*, *Lerista elegans*, Black-striped Snake and Narrow-banded Snake). The Echidna record was based on observations of its distinctive digging holes (G. W. Arnold pers. comm.). Further observations will be needed to confirm this record. The other additional species are a reflection of the trapping effort rather than any increase in the the number of species in the Park. Eight species recorded by the Museum were not found in this study; five species (Slender Tree Frog, Bull Frog, *Leiolopisma trilineatum*, Tiger Snake and Black Rat) were found in areas of permanent wetland associated with Mussel Pool that were not sampled during this study. The absence of the two frogs from the ephemeral wetlands sampled in this study may be a direct result of the lowered watertable. Two species, the Bungarra and Gould's Snake, are in low densities and their infequency is probably a reflection of the sampling effort rather than a loss of species. The failure to capture the Ash-grey Mouse probably is due to it's ability to escape from pit-traps. The difference between the techniques used in this study and in the Museum Survey make it difficult to comment on whether or not there have been changes in the abundances of any species. However, it appears unlikely that there have been any changes in abundance, with the possible exception of the two frogs mentioned above. This situation may not last, given the changes in the vegetation caused by Dieback Disease and/or the fall in the watertable. It is recommended that further monitoring be undertaken to determine if the fauna is being adversely affected by changes in the vegetation.

Only two species are of special conservation interest. The Southern Brown Bandicoot or Quenda is listed in Schedule 1 (likely to become extinct or is rare) by the Western Australian Department of Conservation and Land Management (CALM). Only two sightings of this species were made during the survey, and given its status, further studies should be made to determine the size and status of its population and habitat requirements within the Park. It should be noted that observations of this species in both surveys were in ephemeral swamps, which are probably the most vulnerable areas with

regard to the adverse effect of groundwater removal on the vegetation. The other species is the Honey-Possum. Although this species is relatively common in undisturbed areas of Kwongan, on the coastal plain north of Perth, it is sparsely distributed and the Western Australian Museum survey in this region in 1977 recorded the species at only two localities. The report further suggested that fires may have been the cause of the decline and that a fire frequency of not less than six years is essential for their survival. The seventeen specimens found in this study were in all vegetation types except J and JK, that is those ones with adequate flowering shrubs and trees (*Banksia* spp.). The results of this survey suggest that the population is small but widely distributed and it would be worthwhile to carry out further studies to determine the population size, distribution and habitat preference. In addition, the well documented fire history of the area provides an excellent opportunity to study the effect of different fire frequencies on the species. This would make an excellent short-term (one to two years) post graduate study. The population may be one of the few now surviving in the near metropolitan area.

The terrestrial fauna now present make Whiteman Park an important conservation area, which will become increasingly important as the boundaries of urban development expand. For the fauna to survive as a representative community, the Park needs to be soundly managed. Currently there are three threats facing the biota of the Park.

Fire can be both beneficial and destructive and as noted above, a fire frequency of less than six years may result in the loss of the Honey-Possum. This conclusion is tentatively supported by the present study. The areas where the Honey-Possums have been recorded were burnt in July 1980 and again in the Spring of 1985. The effect of fire on the other species is unknown, however, fire frequencies of not less than 10 - 15 years would seem to be a reasonable initial management objective. Clearly, further research is required to determine the effect of fire frequency on the fauna. An important aspect of this research should be detailed habitat studies in relation to the fire history; these studies could then be used to obtain a better understanding of the optimal fire frequencies required and in particular the consequences of management and/or wildfires at sub-optimal frequencies, should other priorities dictate such an option.

The second problem is the physiological stress on plant species reported by Mattiske

(1989). The loss of a large number of dead and dying eucalypts and banksias may, in the long term, be detrimental to many vertebrates now present, especially those favouring the wetland areas such as some of the Amphibians, or species such as the Honey-Possum which is dependent on Banksias and other flowering shrubs. Also, some of these wetland areas may provide important breeding sites for some species. The increasing dryness may reduce their suitability, resulting in a decline in reproductive output. A detailed analysis of the habitat requirements of the terrestrial vertebrates will be needed before more precise comments can be made.

The third potential threat is Dieback Disease *Phytophthora cinnamomi* which is widely distributed in the Banksia woodlands on the coastal plain. Further, it has been recorded in the Gnangara pine plantation to the north of the Park. Clearly steps should be taken to determine if this disease is already present in the park and if it is, to minimise its spread. If *Phytophthora cinnamomi* is absent, strict hygiene measures should be implemented to reduce the chance of it becoming established.

6 BIRDS

6.1 METHODS

6.1.1 Selection of sites.

(i) *Park Road Census*. The vegetation map (Mattiske 1989) was gridded at 100 m intervals and 87 bird census points were selected, mostly 200 m apart (Figure 6.1). These sites were located within three blocks of different fire histories and their distribution covered all of Mattiske's vegetation classes in this area. In order to make the most economical use of the time available, sites were selected mostly on north/south transects, commencing from Park Road. All sites were censused six times - twice in Autumn 1990, once in Winter 1990, twice in Spring 1990 and once in Summer 1991.

(ii) *Westrek Census*. In addition to the Park Road Census, 19 sites along the Westrek track (Figure 6.1), south of Woolcott Road, were censused once per month for 14 months.

6.1.2 Demarcation of sites

The centre point of each Park Road site was located in the field by measurement with a 100 m tape from reference pegs along the southern side of Park Road (compass bearing for north = 4°, south = 184°) and each was marked with a steel peg.

6.1.3 Census techniques

The aims of the census were to obtain a full list of species for the Conservation Area and to provide some information on the distribution within the area of as many species as possible. Simple techniques were chosen so that they could be used for future monitoring without the need for extensive training of observers. A combination of three techniques was employed :-

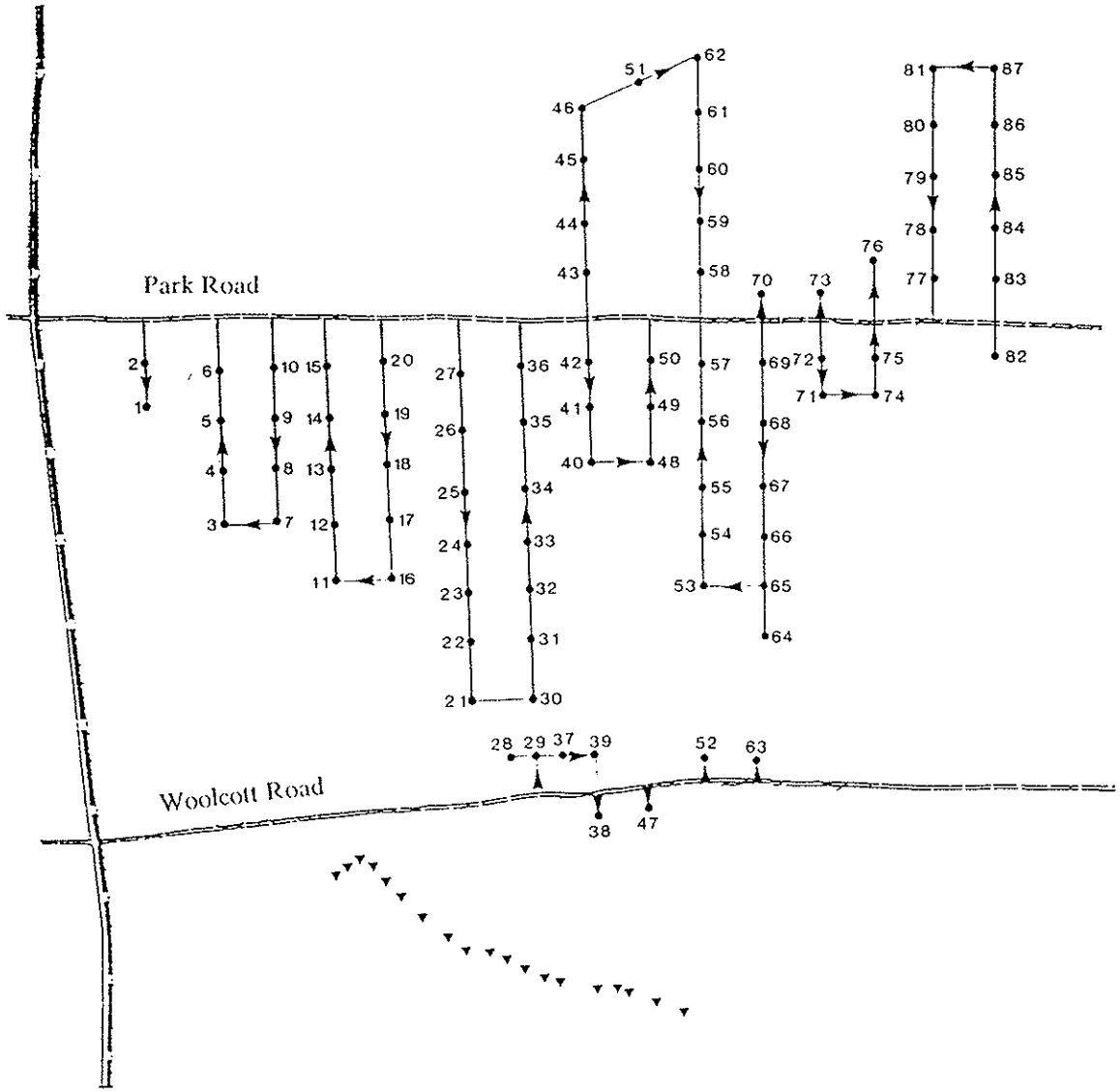


Figure 6.1 Locations of 87 Bird Census sites (●) within the Park Road Area and 19 sites on the Westrek Trail (▼).

(i) *Fixed Circle Counts*. At each site, all birds seen within 25 m of the centre point were identified and counted during a three minute interval. Birds flying through or over the site were excluded unless they were obviously foraging. Birds which were seen on the site as the observer approached and which moved off the site before the count commenced, were included. Where doubt existed as to whether a bird was within the prescribed radius of the count, the distance was checked (by pacing) at the end of the count period.

(ii) *Point Counts*. All species which were seen or heard during the 3 minute period were recorded, regardless of their distance from the centre point. Each species was recorded only once per site.

(iii) *Transect Counts*. As the observer walked the 200 m between points, all species seen within 50 m (estimated by eye) were recorded.

6.1.4 Census design

(a) *Coverage*. The area covered by the Park Road Census encompassed approximately 50% of the Conservation Area and the proportions of each vegetation type sampled (see Mattiske 1989 and Appendix A for description of vegetation types) was in accordance with that of the area as a whole (Table 6.1).

Table 6.1 Percentages of each vegetation type (see Mattiske 1989 and Appendix A for descriptions) in the Conservation Area compared with those within 100m of the Bird Census Sites.

	Area (ha)	% vegetation type G	H	I	J	JK	K1
Conservation Area	650	17	7	23	25	18	10
Area within 100m of Census Sites	297	15	9	20	24	19	13

(b) *Detection Distance*. It is possible to categorize each species according to the maximum distance at which its call normally can be detected. Using the data of Brooker and Braithwaite (1985) and the observer's personal experience, those species with a detection distance of not greater than 100 m (Detectability Class 1 species) were determined (see Table 6.2).

6.1.5 Application of Census Techniques.

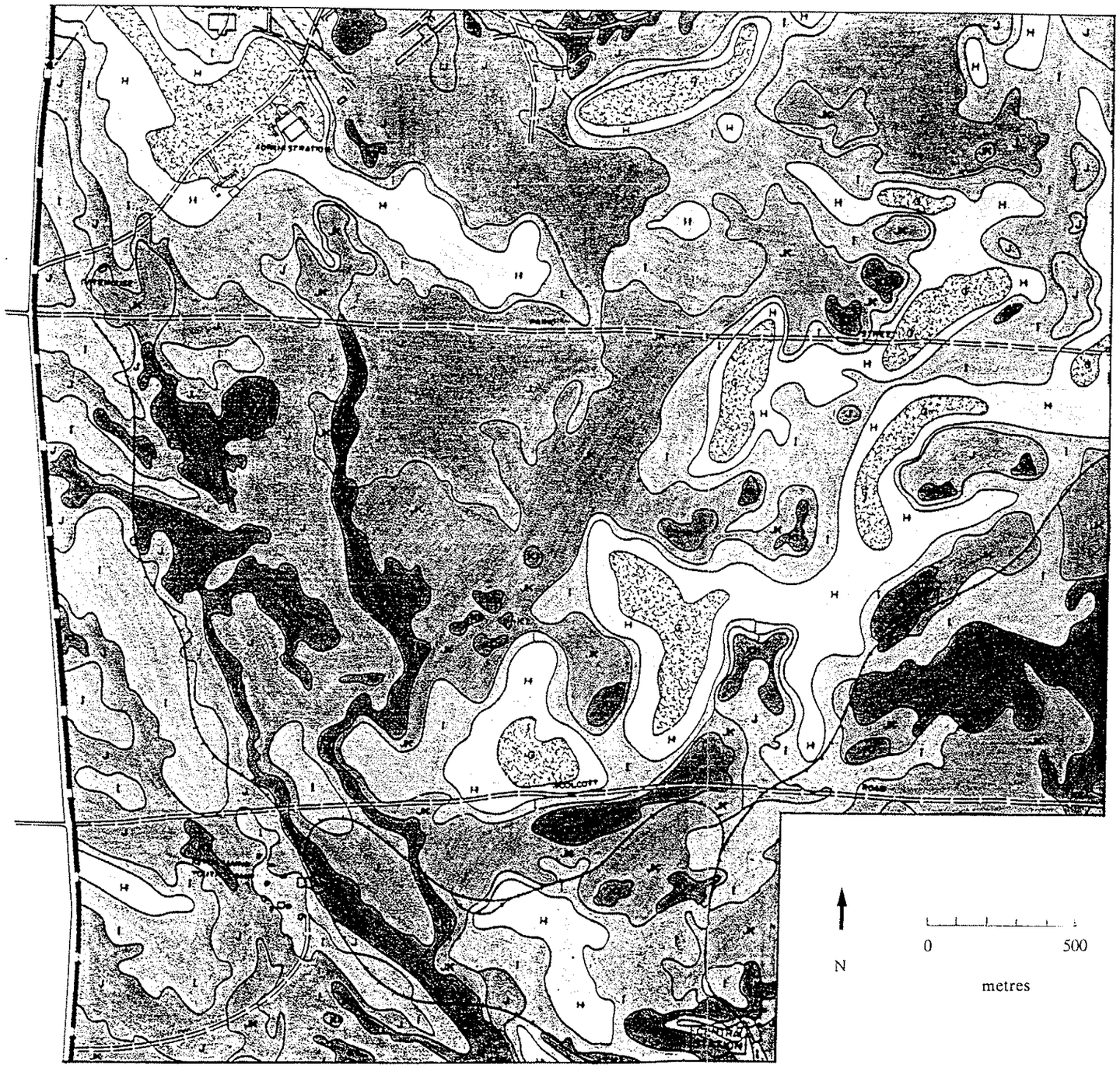
The Fixed Circle Counts and Transect Counts can be undertaken by any observer capable of identifying all species by sight. It is possible to check the identity of an individual bird at the conclusion of the census period without adversely affecting the results. In other words, these methods were chosen so that the observer would not need to be an expert ornithologist. In order to accurately perform the Point Counts, however, a knowledge of the calls of all species is required. An observer would therefore require more training to perform Point Counts than is needed for Fixed Circle Counts or Transect Counts.

6.2 ABUNDANCE

A total of 95 species of birds were recorded on Whiteman Park during the survey (see Figure 6.2 for map of Conservation Area and Table 6.2 for list of species, order and nomenclature follows Blakers *et al.* 1984). Only eight species previously seen, were not observed during the survey and except for Emu, Whistling Kite and Rufous Songlark, all of these were waterbirds (see also Section 6.5.2). Twenty-two species were added to the previous Whiteman Park Bird List (Section 6.5.1) and a further 19 land birds may be present as residents or occasional visitors (Section 6.5.4).

At least 27 species of waterbirds were recorded in wetlands (Section 6.6) during 1990 and a further five (Great Cormorant, Great Egret, Australasian Bittern, Black-tailed Native-hen and Purple Swamphen) were recorded by Jackson *et al.* (1975). It is likely that more species will be added with time. Two of the waterbirds, Pacific Black Duck and Maned Duck, were also seen in the Conservation Area during the nesting season.

Sixty-six landbirds were found in the Conservation Area (included in Table 6.2, together with their breeding and migratory status). It is expected that most species classed as resident or migrant will breed on the Conservation Area in some or all years. The number of breeding landbirds at Whiteman Park (55-60) compares favourably with that found in Gooseberry Hill heathland, where around 50 species breed (M.B. pers. obs.). During a three year study of the flora and fauna in Banksia Woodland near Gin Gin, Bamford (1986) recorded 67 species. These included six species which one might expect to find at Whiteman Park but which were not recorded during the present survey; *viz.* Emu, Stubble Quail, Purple-crowned Lorikeet, White-backed Swallow, Restless Flycatcher and Mistletoebird and two irregular visitors, Little Button-quail and Regent Parrot .



G Low woodland of *Banksia attenuata*, *B. menziesii* and *Eucalyptus todtiana*

H Low woodland to low open forest of *Banksia attenuata*, *B. menziessii* and *B. ilicifolia*

I Open woodland of *Eucalyptus marginata*, *E. calophylla* and *Banksia ilicifolia*

J Open woodland of *Eucalyptus calophylla*

JK Elements of both J and K1 vegetation types

K1 Ranging from low open forest of *Melaleuca preissiana* and *Banksia littoralis* to closed heath of Myrtaceae species.

Figure 6.2 Whiteman Park vegetation types (from Mattiske 1989)

Table 6.2 Birds observed on Whiteman Park, January 1990 - January 1991.

A Recorded in Conservation Area
B Migratory Status (Landbirds). R = Resident; (R)= Present throughout year, some resident, some nomadic; M= Regular Migrant; (M)= Migrant or Nomad; V= Irregular Visitor; SU= Unknown
C Breeding Status. B = Breeds at Whiteman Park; (B) = Probably breeds; N = Does not breed here; SU = Unknown
D * = Detectability Class 1 (see Section 6.1.4)

Species		A	B	C	D
Hoary-headed Grebe	*Poliocephalus poliocephalus*				
Australasian Grebe	*Tachybaptus novaehollandiae*				
Australian Pelican	*Pelecanus conspicillatus*				
Little Pied Cormorant	*Phalacrocorax melanoleucos*				
Pacific Heron	*Ardea pacifica*				
White-faced Heron	*Ardea novaehollandiae*				
Glossy Ibis	*Plegadis falcinellus*				
Sacred Ibis	*Threskiornis aethiopica*				
Straw-necked Ibis	*Threskiornis spinicollis*				
Yellow-billed Spoonbill	*Platalea flavipes*				
Black Swan	*Cygnus atratus*				
Australian Shelduck	*Tadorna tadornoides*				
Pacific Black Duck	*Anas superciliosa*	+			
Grey Teal	*Anas gibberifrons*				
Australasian Shoveler	*Anas rhynchotis*				
Hardhead	*Aythya australis*				
Maned Duck	*Chenonetta jubata*	+			
Black-shouldered Kite	*Elanus notatus*		V	SU	
Brown Goshawk	*Accipiter fasciatus*	+	(R)	(B)	
Collared Sparrowhawk	*Accipiter cirrhocephalus*		(R)	(B)	
Wedge-tailed Eagle	*Aquila audax*		V	SU	
Little Eagle	*Hieraaetus morphnoides*	+	(R)	(B)	
Peregrine Falcon	*Falco peregrinus*		V	SU	
Australian Hobby	*Falco longipennis*		V	SU	
Brown Falcon	*Falco berigora*	+	(R)	(B)	
Australian Kestrel	*Falco cenchroides*	+	R	B	
Painted Button-quail	*Turnix varia*	+	R	B	
Eurasian Coot	*Fulica atra*				

Table 6.2 cont.

Species		A	B	C	D
Masked Lapwing	*Vanellus miles*				
Banded Lapwing	*Vanellus tricolor*	+	(R)	(B)	
Black-fronted Plover	*Charadrius melanops*				
Black-winged Stilt	*Himantopus himantopus*				
Laughing Turtle-Dove	*Streptopelia senegalensis*	+	R	(B)	
Common Bronzewing	*Phaps chalcoptera*	+	R	(B)	
Crested Pigeon	*Ocyphaps lophotes*	+	R	(B)	
White-tailed Black-Cockatoo	*Calyptorhynchus baudinii*	+	V	N	
Galah	*Cacatua roseicapilla*	+	(R)	B	
Red-capped Parrot	*Purpureicephalus spurius*	+	(R)	B	
Western Rosella	*Platycercus icterotis*		V	N	
Port Lincoln Ringneck	*Barnardius zonarius*	+	(R)	B	
Elegant Parrot	*Neophema elegans*	+	(R)	B	
Pallid Cuckoo	*Cuculus pallidus*	+	M	(B)	
Fan-tailed Cuckoo	*Cuculus pyrrhophanus*	+	M	(B)	
Horsfield's Bronze-Cuckoo	*Chrysococcyx basalis*	+	M	B	
Shining Bronze-Cuckoo	*Chrysococcyx lucidus*	+	M	B	
Southern Boobook	*Ninox novaeseelandiae*	+	SU	(B)	
Tawny Frogmouth	*Podargus strigoides*	+	(R)	(B)	
Fork-tailed Swift	*Apus pacificus*	+	V	N	
Laughing Kookaburra	*Dacelo novaeguineae*	+	R	(B)	
Sacred Kingfisher	*Halcyon sancta*	+	M	B	
Rainbow Bee-eater	*Merops ornatus*	+	M	B	
Welcome Swallow	*Hirundo neoxena*	+	(R)	(B)	
Tree Martin	*Cecropis nigricans*	+	(R)	(B)	
Richard's Pipit	*Anthus novaeseelandiae*	+	(R)	(B)	*
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	+	(R)	(B)	
White-winged Triller	*Lalage sueurii*	+	M	(B)	
Scarlet Robin	*Petroica multicolor*	+	R	B	*
Red-capped Robin	*Petroica goodenovii*	+	(R)	B	*
Hooded Robin	*Melanodryas cucullata*	+	R	B	*
Golden Whistler	*Pachycephala pectoralis*	+	V	N	*
Rufous Whistler	*Pachycephala rufiventris*	+	R	B	*
Grey Shrike-thrush	*Colluricincla harmonica*	+	R	B	
Crested Bellbird	*Oreoica gutteralis*	+	SU	SU	

Table 6.2 cont.

Species		A	B	C	D
Grey Fantail	*Rhipidura fuliginosa*	+	(M)	B	*
Willie Wagtail	*Rhipidura leucophrys*	+	R	B	
Splendid Fairy-Wren	*Malurus splendens*	+	R	B	*
White-winged Fairy-Wren	*Malurus leucopterus*	+	R	(B)	*
Weebill	*Smicromis brevirostris*		SU	SU	
Western Gerygone	*Gerygone fusca*	+	(M)	B	*
Inland Thornbill	*Acanthiza apicalis*	+	R	(B)	*
Western Thornbill	*Acanthiza inornata*	+	R	B	*
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*	+	R	B	*
Varied Sittella	*Daphoenositta chrysoptera*	+	R	(B)	*
Red Wattlebird	*Anthochaera carunculata*	+	(R)	(B)	
Little Wattlebird	*Anthochaera chrysoptera*	+	(R)	B	
Yellow-throated Miner	*Manorina flavigula*	+	R	(B)	
Singing Honeyeater	*Lichenostomus virescens*	+	R	(B)	
Brown-headed Honeyeater	*Melithreptus brevirostris*		SU	SU	
Brown Honeyeater	*Lichmera indistincta*	+	(R)	(B)	
New Holland Honeyeater	*Phylidonyris novaehollandiae*	+	(R)	B	
White-cheeked Honeyeater	*Phylidonyris nigra*	+	(R)	B	
Tawny-crowned Honeyeater	*Phylidonyris melanops*	+	(M)	SU	
Western Spinebill	*Acanthorhynchus superciliosus*	+	(R)	B	
White-fronted Chat	*Ephthianura albifrons*	+	V	SU	*
Spotted Pardalote	*Pardalotus punctatus*	+	V	N	
Striated Pardalote	*Pardalotus striatus*	+	(M)	(B)	
Silvereye	*Zosterops lateralis*	+	(R)	(B)	*
Red-eared Firetail	*Emblema oculata*	+	SU	SU	*
Australian Magpie-lark	*Grallina cyanoleuca*	+	R	(B)	
Masked Woodswallow	*Artamus personatus*	+	V	N	
Black-faced Woodswallow	*Artamus cinereus*	+	(R)	B	
Dusky Woodswallow	*Artamus cyanopterus*	+	(R)	(B)	
Grey Butcherbird	*Cracticus torquatus*	+	R	(B)	
Australian Magpie	*Gymnorhina tibicen*	+	R	(B)	
Australian Raven	*Corvus coronoides*	+	R	B	

The data set for the Whiteman Park Survey comprises over 5000 records, summarised in Appendices B, C and D for the Park Road Census and Appendix E for the Westrek Census. These counts provide indices of abundance and seasonal distributions and will constitute the basis for any future monitoring program. Point Count data for some selected species is also shown in Figure 6.3.

The Point Counts recorded 62 (94%) of the 66 species of landbirds present on the Conservation Area. The mean number of species per site over the six censuses was 21.6 ± 3.7, ranging from 12 (Site 15) to 31 (Site 78). Eighty-nine percent of the species were seen on the Transect Counts and 61% on the Fixed Circle Counts.

It is apparent from an examination of the abundance estimates that among the most common species at Whiteman Park are Brown Honeyeaters, Port Lincoln Ringnecks, Rufous Whistlers and Western Spinebills. Honeyeaters dominate the avifauna numerically in most seasons, a result expected from other studies in Banksia Woodland near Perth (e.g. Tullis *et al.* 1982, Newland and Wooller 1985, Ramsey 1989). Probably of more interest, however, are the less common, more specialised species such as Inland Thornbills, Red-capped, Scarlet and Hooded Robins and Splendid and White-winged Fairy-Wrens, to which the maintenance of specific vegetation types may be important for their continued presence within the Park. For this reason the analyses are confined to the examination of habitat preferences within the Park Community.

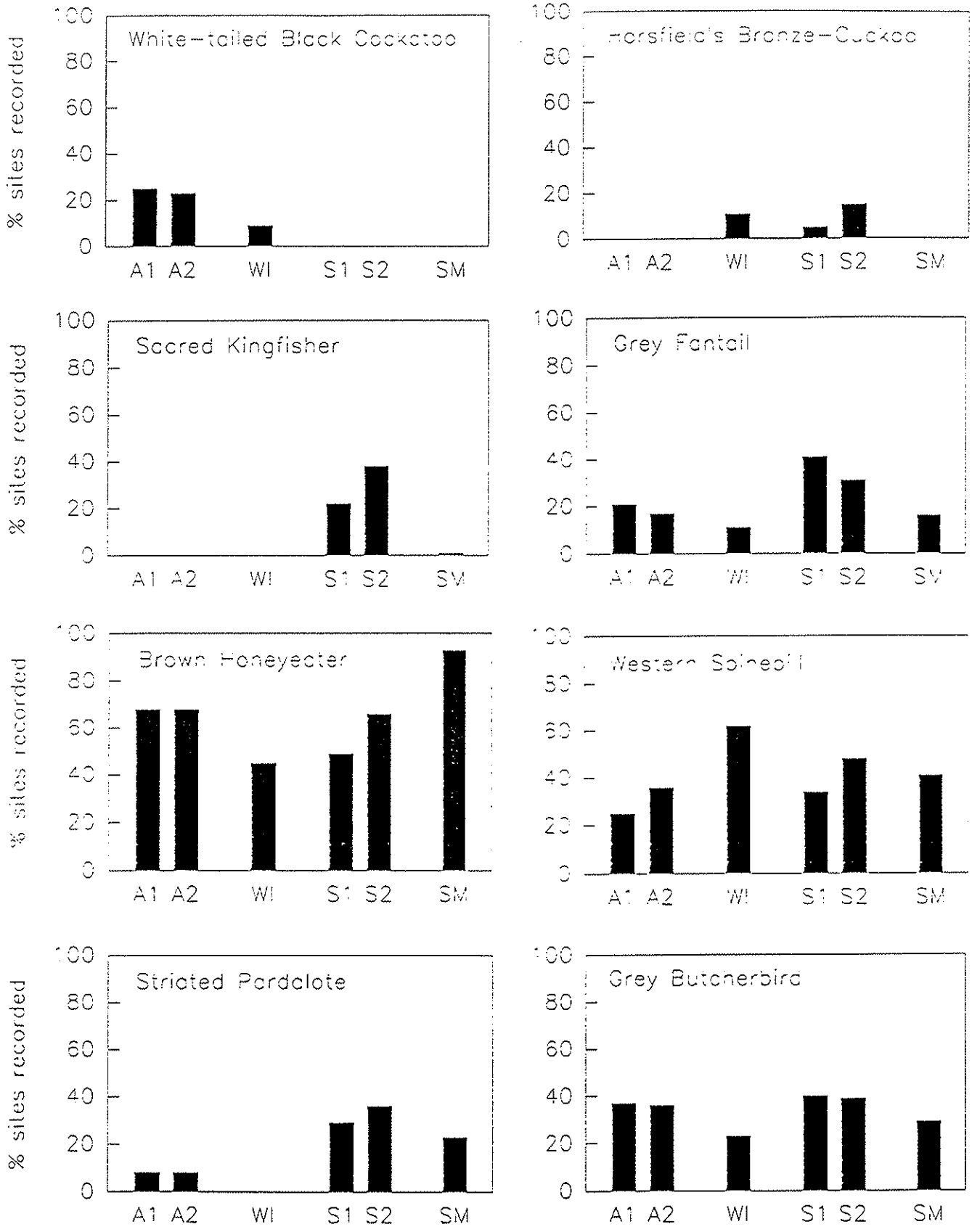


Figure 6.3 Point Count data for some selected species. Percentage of Park Road Sites on which the species was recorded (A1,2 = Autumn 1, 2; WI = winter; S1,2 = Spring 1, 2; SM = summer).

6.3 DISTRIBUTION

The total number of species recorded on each of the 160 Transect Count sites over the entire survey are plotted in Figure 6.4 (and overlay) for all species and Figure 6.5 (and overlay) for honeyeater species. The distribution of sightings of some of the less common species is shown in Figure 6.6 (and overlay). (The overlay figures are located inside the back cover of the report and are designed to be used in conjunction with Figure 6.2)

In order to identify the habitat preferences of the different bird communities within the Conservation Area, the site data (transformed into presence/absence data for the six Park Road Censuses pooled) were classified using the computer package PATN (Belbin 1987) using the Bray & Curtis measure of association. The classification grouped the sites with respect to the bird communities occurring on them. In the second stage of the analysis, the probability of each bird community occurring within the Park Road Census Area was estimated with logistic regression models using the computer package GLIM (Baker and Nelder 1978). The models used as predictor variables, the percentage cover of Mattiske's vegetation types, the time since the vegetation was last burnt, and the distance of the site from the nearest bore. The models were developed using a forward stepwise fitting procedure, at each step adding to the model the variable with the greatest significant change in deviance. The classification and modelling was performed twice, once for the Transect Count data and once for the Detectability Class 1 species (see Section 6.1.4 (b) for explanation and Table 6.2 for list of species) for the Point Count data.

6.3.1 Transect classification

The Transect Count classification (Table 6.3) provides a description of three obviously distinct bird communities: Community A is characterized by the presence of Yellow-throated Miners and the absence of almost all other species. Only 17 species are present in the community and the mean species richness of the sites is 3.06; Community B is typified by the presence of Grey Fantails, Splendid Fairy-Wrens, Port Lincoln Ringnecks, Western Thornbills and Yellow-rumped Thornbills.

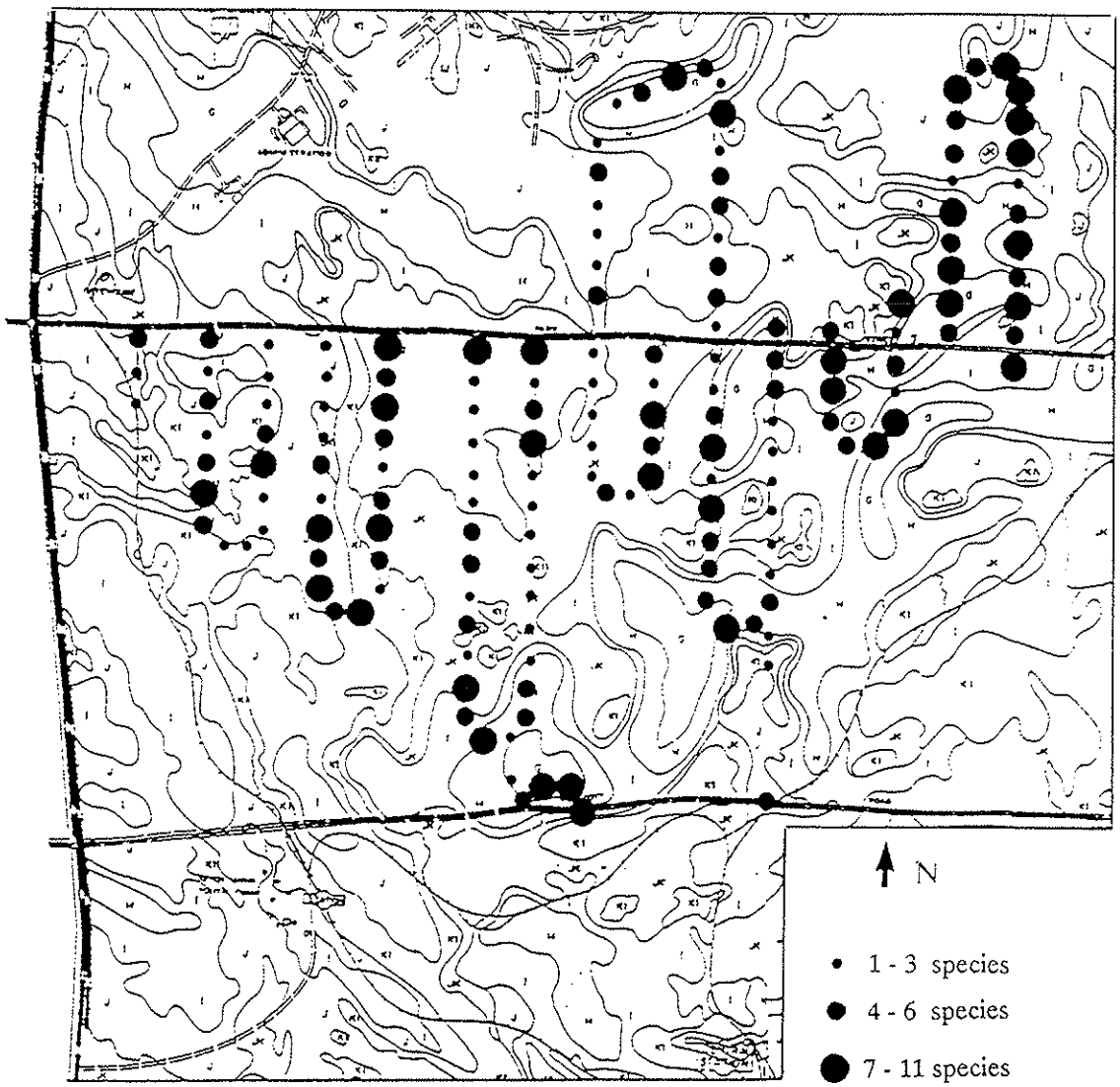


Figure 6.4 Total number of species at each site from Transect Count data.

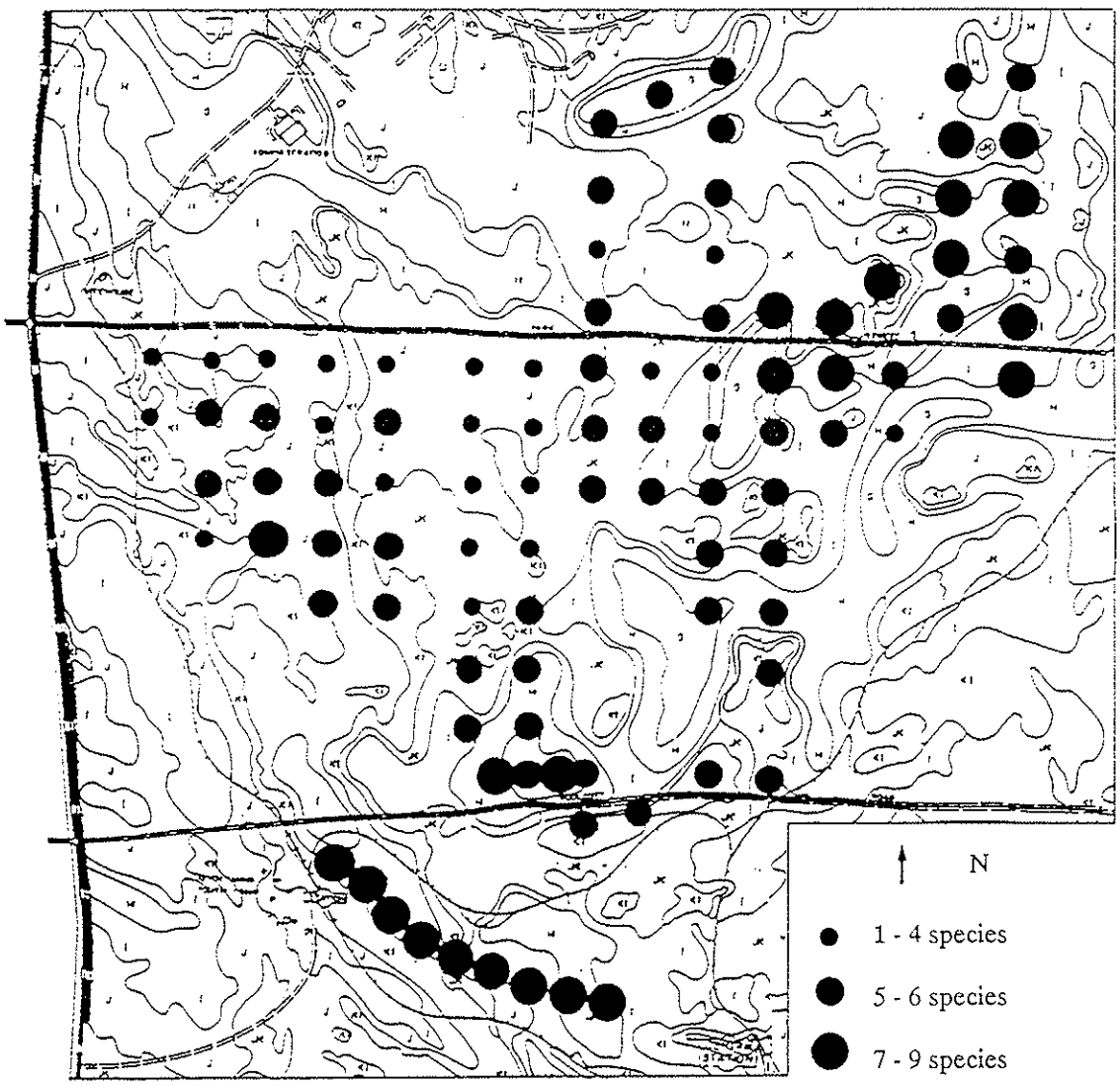


Figure 6.5 Total number of honeyeater species at each site from Point Count data.

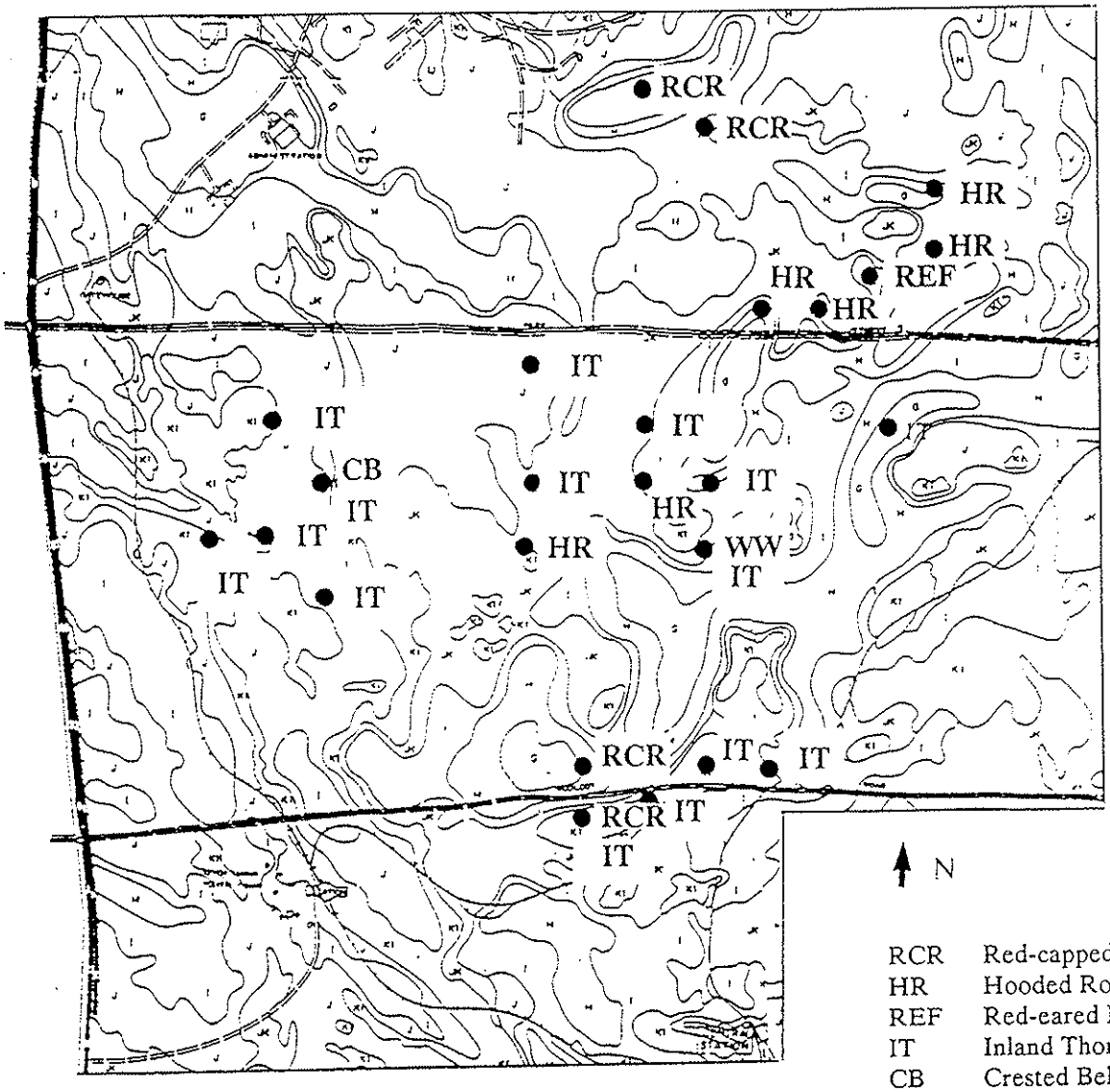
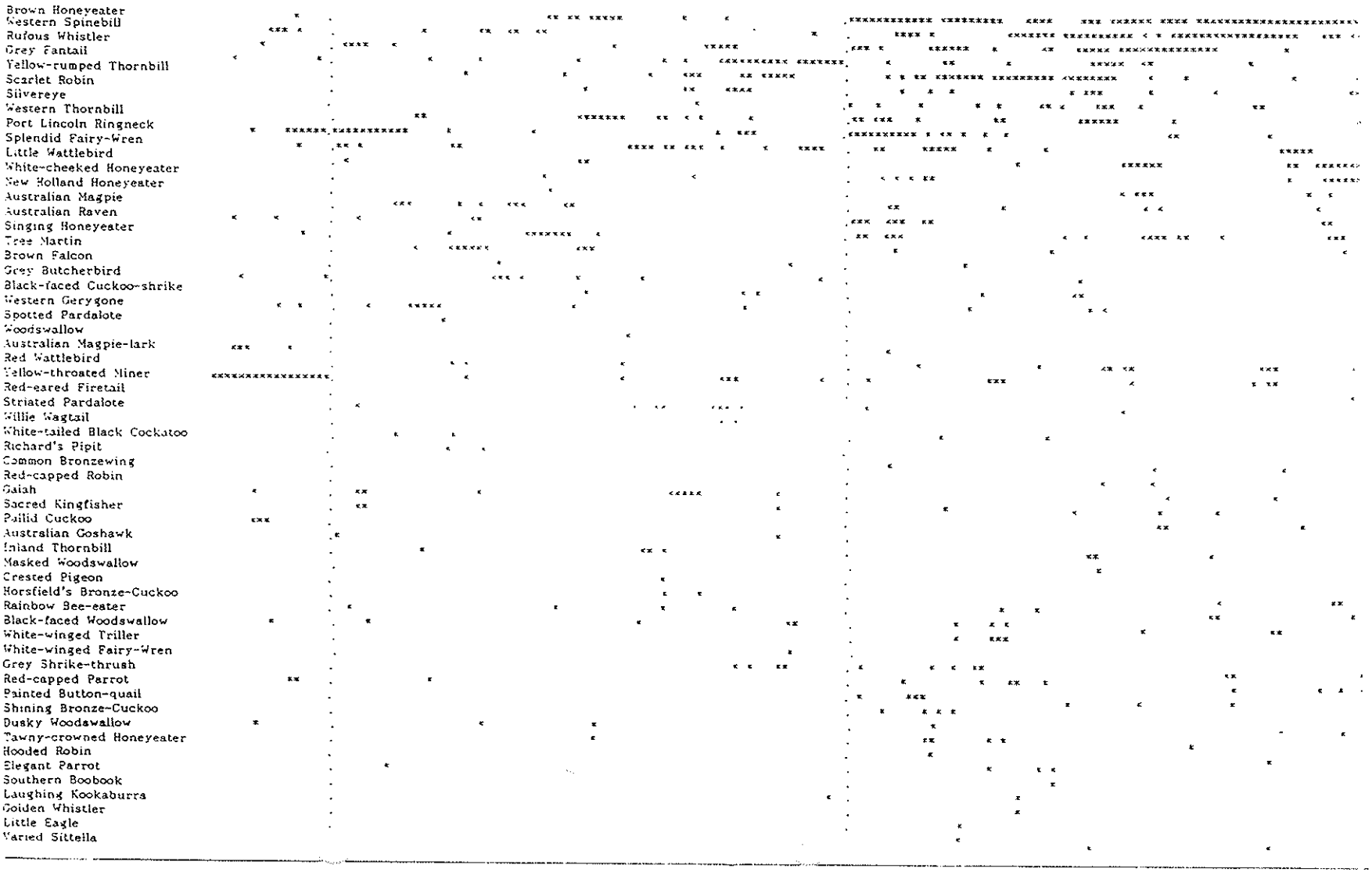


Figure 6.6 Distribution of sightings of some uncommon species of birds.

Table 6.3 Two-way table of species x sites arranged according to Bird Community Groups using presence/absence data from Transect Counts.

Bird Community	A	B	C
Model Parameters		Firc+J+JK+K1	G+H+I
Total number of sites	17	72	71



Forty-three species are present in the community and the mean species richness of the sites is 3.43; Community C is the most species rich of the three groups (mean species richness of sites 6.25), containing 51 species. The community is typified by the presence of Brown Honeyeaters, Western Spinebills, Rufous Whistlers and Yellow-rumped Thornbills.

We were unable to formulate a satisfactory model for predicting the occurrence of the Miner Community (A) using the variables available. Factors not examined here, such as the relative density and structure of the vegetation on the different sites or the differing behaviours of avian species (see Section 6.5.3 Yellow-throated Miner) may be influencing this species association. The patchy distribution of the Yellow-throated Miner is plotted in

Table 6.4 Logistic regression models of the relationship between environmental variables (percentage vegetation cover and years since fire) and Bird Communities B and C.

Model	Deviance	d.f.	Change in deviance	Change in d.f	Significance
Bird Community B					
Mean	220.2	159			
Years since fire	208.9	158	11.3	1	***
Vegetation J	197.2	157	11.6	1	***
Vegetation JK	188.8	156	8.4	1	**
Vegetation K1	183.0	155	5.8	1	*
Bird Community C					
Mean	219.8	159			
Vegetation G	201.1	158	18.6	1	***
Vegetation I	187.7	157	13.4	1	***
Vegetation H	182.4	156	5.3	1	*

* = $P < .05$; ** = $P < .01$; *** = $P < .001$

Figure 6.7 (and overlay). The model for Bird Community B (Table 6.4) predicts that it will occur in those parts of the Park Road Census Area which have been burnt least recently and in vegetation types J, JK and K. In general terms, the model predicts that a less rich but substantial avian community of the more common species will be found in vegetation types of the moister areas not recently burnt.

The model for species rich Bird Community C (Table 6.4) predicts that it will be found in G, I, and H vegetation types within the Park Road Census Area. The predicted distribution of Community C is shown in Figure 6.8 and represents the "best" bird habitat in the Census Area.

6.3.2 Interval classification

The Point Count classification is based on a much smaller suite of species (n = 16), being only those birds whose call is normally detectible at 100m or less. In effect these comprise most of the small insectivorous passerines. The classification (Table 6.5) again resulted in three identifiable avian communities: Community D is characterized by the presence of Silvereyes and Western Thornbills and by the absence of Inland Thornbills and Grey Fantails. Twelve species are present in the community and the mean species richness of the sites is 3.94: Community E is the most species rich of the three communities, comprising 15 species (mean species richness of sites 5.79) and is the only one to contain Inland Thornbills. Community F is the most depauperate of the three, containing only 5 species. The mean species richness of the sites is 3.93.

Satisfactory regression models were obtained for all three Point Count communities. The model for Bird Community D (Table 6.6) predicts that it will occur in the more recently burnt parts of the Park Road Census Area and in vegetation types G and I. It is significant that this community is characterized by the absence of Inland Thornbills and provides confirmatory evidence that the species is fire-sensitive (Brooker and Rowley, 1991) (see also Section 6.5.3 Inland Thornbill).

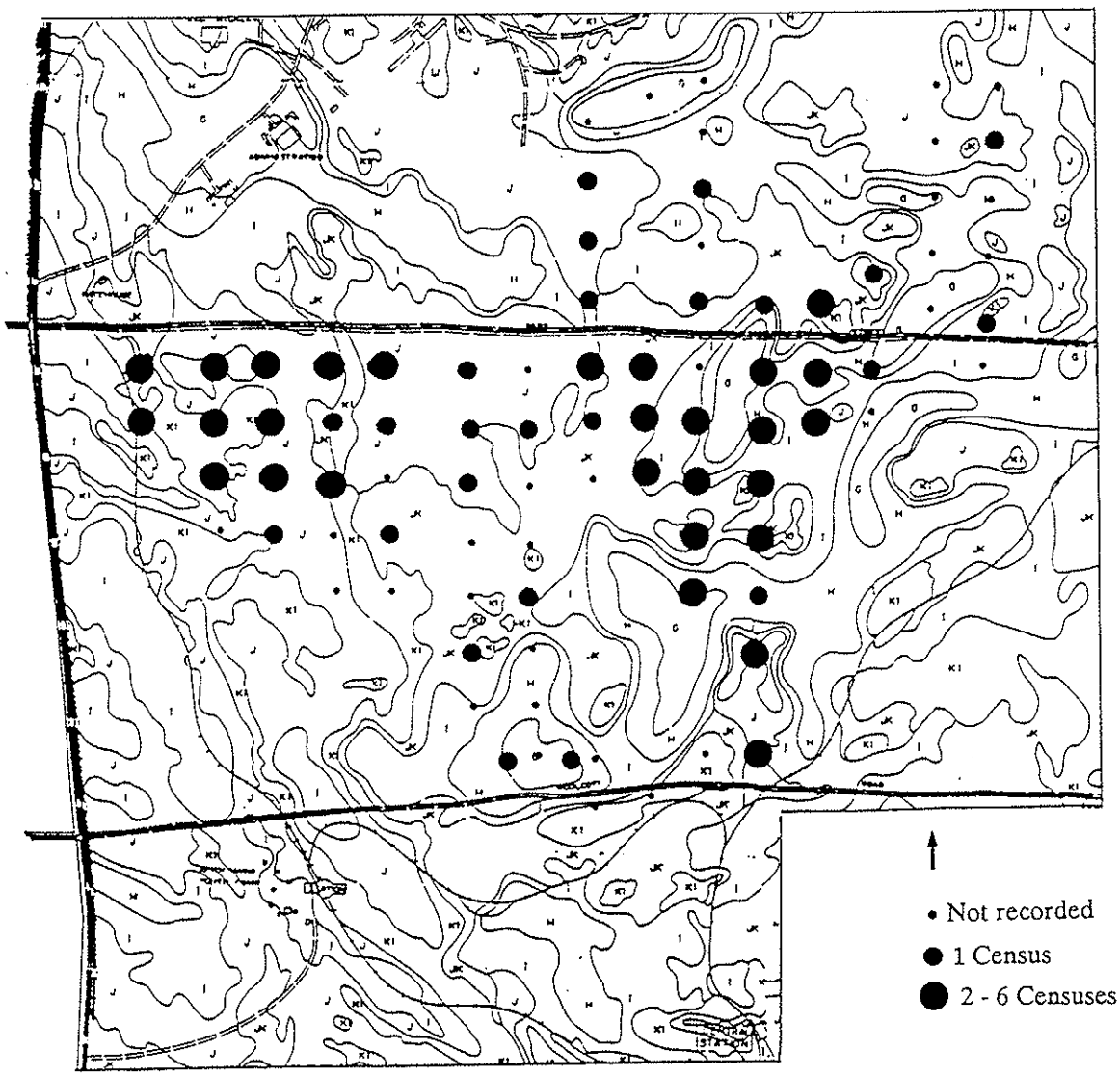


Figure 6.7 The number of Point Counts on which Yellow-throated Miners were recorded at each site.

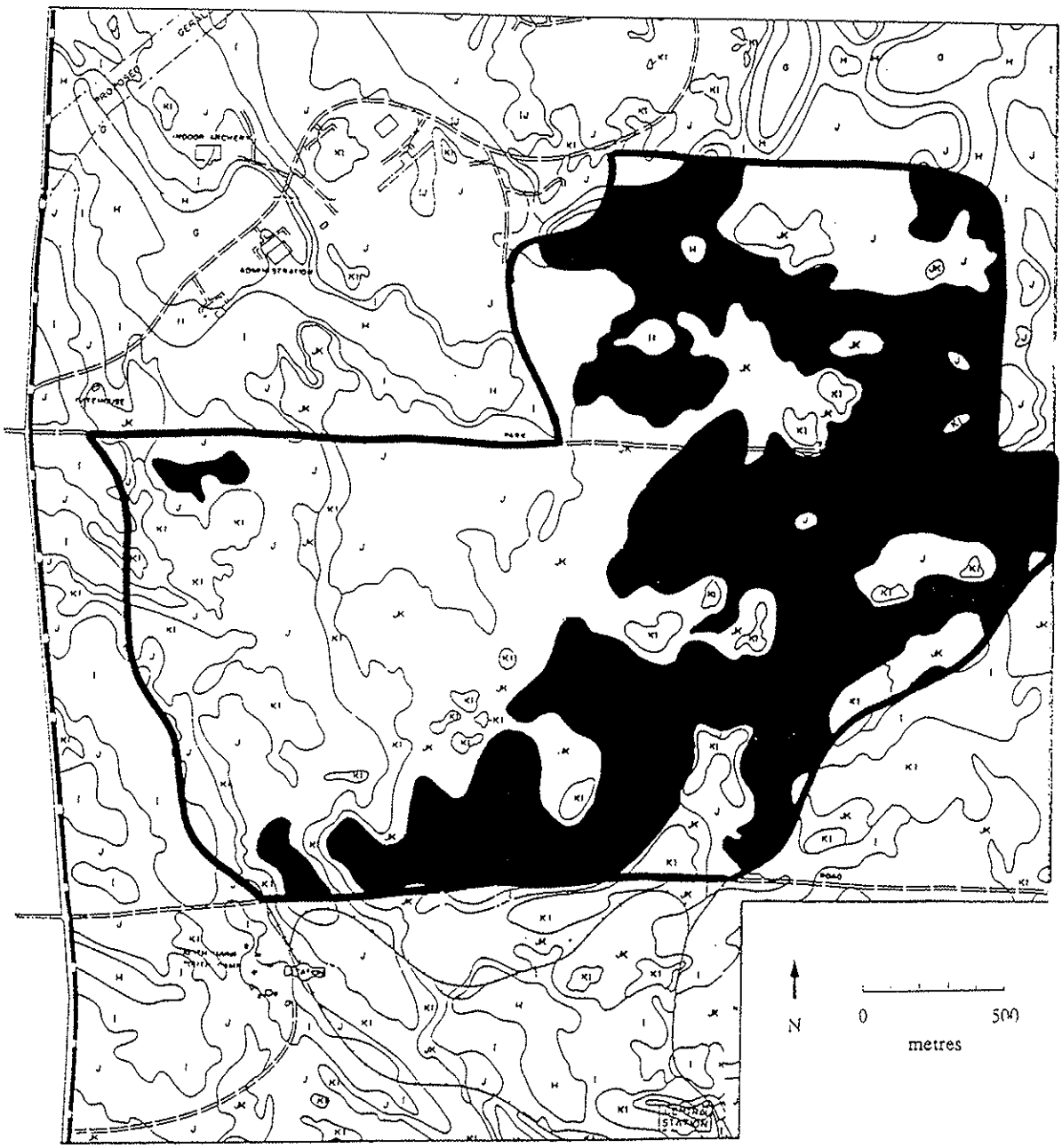


Figure 6.8 Predicted distribution within the Park Road Census Area of species-rich Bird Community C from a statistical model of the Transect Count data.

Table 6.5 Two-way table of species x sites arranged according to Bird Community Groups using Point Count data

Bird Community	D	E	F
Model parameters	Fire+G+I	Fire+Bore+K1	J
Number of sites	34	39	14
Inland Thornbill		** ** **** * * **	
White-winged Wren		*	
Red-capped Robin	*	* *	
Hooded Robin	* * **	* *	
Varied Sittella	* * *	* ******	
Golden Whistler		*	
Richard's Pipit	* *		
White-fronted Chat		*	
Grey Fantail	* ** **	********** ********** *	**********
Rufous Whistler	********** **********	********** **********	**********
Western Gerygone	**** *****	**** ******* ******** ** ******	**** ********
Splendid Fairy-Wren	* *********	********** ***** *	
Scarlet Robin	* ** * *** ******	********* *** ******	****
Yellow-rumped Thornbill	***** ********** *	****** ********** ** **	**********
Silvereye	********* ******** **** *	* ** ********	
Western Thornbill	****** *** * **	********* * ***	*

The model for species rich Bird Community E (Table 6.6) predicts that it will occur in areas less recently burnt and at sites furthest from bores. The model provides some evidence that changes to the water-table from the introduction of bores may affect the local occurrence of avian species and secondly that unburnt areas may be most suitable for maintaining a species rich community.

Table 6.6 Logistic regression models of the relationship between environmental variables (percentage vegetation cover, time since fire and distance from nearest bore) and Bird Communities D and E and F.

Model	Deviance	d.f.	Change in deviance	Change in d.f.	Significance
Bird Community D					
Mean	116.4	86			
Years since fire	104.4	85	12.0	1	***
Vegetation G	93.7	84	10.8	1	**
Vegetation I	88.3	83	5.4	1	*
Bird Community E					
Mean	119.7	86			
Years since fire	105.9	85	13.8	1	***
Distance from bore	100.4	84	5.5	1	*
Vegetation K1	91.4	83	9.0	1	**
Bird Community F					
Mean	76.7	86			
Vegetation J	63.4	85	13.4	1	***

* $P < .05$; ** $P < .01$; *** $P < .001$

The model for Bird Community F (Table 6.6) predicts that it will occur in areas of vegetation type J. This suggests that the parts of the Park Road Census Area least attractive to the broad spectrum of small passerines are the open Marri woodlands.

While the models give a general indication of the environmental variables which may influence the distribution of birds within the Park, further stratified sampling of the whole Conservation Area would be necessary to verify these predictions.

6.4 WESTREK CENSUS

The Westrek Trail was censused monthly for 14 months at 19 sites using the Fixed Circle Count and Point Count techniques (Appendix E). All counts commenced half an hour after sunrise. Transect Counts were not employed as the sites were less than 200m apart. Most of the species present in the Conservation Area were seen also on the Westrek Trail. These monthly censuses showed seasonal variations, particularly for migrants, in much greater detail than did the six Park Road Censuses. At Westrek, Yellow-throated Miners and some of the rarer species such as Hooded and Red-capped Robins were not seen and woodswallows infrequently so. However, other species, especially New Holland Honeyeaters were more abundant on Westrek than the Park Road Census (compare Appendices D and E). There are a number of possible explanations for these differences which are not explored here.

6.5 NOTABLE SPECIES.

This section deals with bushland bird species which are of special interest with regard to Whiteman Park. General biological information for other species is available from publications (e.g. Storr and Johnstone 1988) and from the standard ornithological literature and is therefore not repeated here.

6.5.1 "New" Species

The following species were not recorded by the brief Museum Survey (Jackson *et al.* 1975).

Black-shouldered Kite *Elanus notatus*. Seen in cleared country in May; probably an autumn-winter visitor.

Collared Sparrowhawk *Accipiter cirrhocephalus*. A scarce and easily overlooked species which is probably a resident. Records in January, March, April and October near the stream on the Westrek Trail.

Little Eagle *Hieraaetus morphnoides*. A scarce resident and/or autumn-winter visitor.

Peregrine Falcon *Falco peregrinus*. Single birds were seen at Mussel Pool in October 1990 and January 1991 and a pair was seen on the Park Road Census Area in November 1990 (G. Smith pers. comm.). An uncommon visitor, especially to wetlands, according to Storr and Johnstone (1988).

Australian Hobby *Falco longipennis*. There was one record for 1990 at Westrek in April. The species is a visitor to the coastal plain, mostly in February - July.

Banded Lapwing *Vanellus tricolor* were recorded on the Conservation Area in July but were probably more common in other areas of the Park in its preferred habitat of short-

grass flats.

Galah *Cacatua roseicapilla*. Not uncommon on Whiteman Park. It was not seen during the Museum Survey in 1975 but its range has increased; e.g. it had become established at Gin Gin by 1955, Bullsbrook by 1960, Swan View by 1965 (Storr and Johnstone 1988).

Western Rosella *Platycercus icterotis*. Two were observed by Graham Arnold in bushland during March. Considered to be rare or uncommon but, like the Galah, may be expanding their range.

Fan-tailed Cuckoo *Cuculus pyrrhophanus* were present from May to September. Its major host here, in the absence of White-browed Scrubwrens, is the Inland Thornbill (Brooker and Brooker 1989).

Fork-tailed Swift *Apus pacificus*. A flock of 25 was seen on 30 March 1990. March is the month when swifts are most commonly recorded in the Perth region.

Red-capped Robin *Petroica goodenovii* breed in the Conservation Area and may well be resident, utilizing both woodland and cleared habitats.

Hooded Robin *Melanodryas cucullata*. A scarce breeding resident on Whiteman Park. Previous records for the northern outskirts of Perth have all been north of Mullaloo (Storr and Johnstone 1988).

Golden Whistler *Pachycephala pectoralis* was recorded only in July. The species is probably a scarce winter visitor to the Park.

Crested Bellbird *Oreoica gutturalis*. A single bird was seen in November 1990 in the centre of the Conservation Area and calls were heard from the same area in January 1991. The absence of this conspicuous bird from previous censuses suggests that it had recently moved into the area which is on the southern edge of its present range (Storr and

Johnstone 1988). These two records are of interest because they show, not only that Bellbirds still occur in the area, but also that corridors for re-colonization still exist to the north of the Park.

Only one family of **White-winged Fairy-wren** *Malurus leucopterus* was seen during the survey, but it is likely that others are present in patches of the closed heath form of K1 vegetation. Storr and Johnstone (1988) give a record for Mussel Pool. Although these wrens are common in adjacent coastal habitats, they may be vulnerable to fire (see Brooker *et al.* 1979).

Weebill *Smicromis brevirostris*. Recorded during Kangaroo Counts on the southern edge of the Park in April. It normally occurs in the Tuart *Eucalyptus gomphocephala* Belt to the west of the Park and the Wandoo *E. wandoo* Belt to the east (Storr and Johnstone 1988).

Brown-headed Honeyeater *Melithreptus brevirostris* were recorded in January 1990 on the Westrek Trail. They are rare visitors to the Swan Coastal Plain according to Storr and Johnstone (1988) although they were seen frequently over a three year period in Banksia Woodland near Gin Gin (Bamford 1986).

White-cheeked Honeyeater *Phylidonyris nigra*. A frequently recorded species in bushland on all surveys with nesting records in March.

Tawny-crowned Honeyeater *Phylidonyris melanops*. This species appeared to be more abundant in summer than other seasons and is probably nomadic in this area.

Spotted Pardalote *Pardalotus punctatus*. Present in permanent swamp areas in April and woodland in May and July; an autumn-winter visitor to the area.

Red-eared Firetail *Emblema oculata.* We had one summer record for this species which is near the northern edge of its range at Whiteman Park. Since Firetails are not easily detectible, it is possible that they are irregular visitors to waterside habitats in the Park, as

not easily detected unless calling. They are in general scarce on the Coastal Plain (Storr and Johnstone 1988), so the Park may be an important refuge for them.

Elegant Parrot *Neophema elegans* was recorded on all censuses and on most of the Westrek counts and are known to nest within the Park. Unless 1990 was an exceptional year, Elegant Parrots appear to be more than "uncommon visitors" (Storr and Johnstone 1988) and the Park may be an important refuge for them on the Coastal Plain.

Inland Thornbill *Acanthiza apicalis* were found in the area between Park Road and Woolcott Road but were not seen in the north-eastern section of the Conservation Area. This could have been due to the effect of fire (see Section 6.3.2) as the north-eastern area was the most recently burnt (November 1987) and Inland Thornbills are fire-sensitive (Brooker and Rowley 1991).

Yellow-throated Miner *Manorina flavigula* have a patchy distribution within the area censused (Figure 6.7 and overlay) and their presence characterizes one of the groups defined in the PATN analysis. The presence of this species in areas where other birds are less common could be due to a tendency toward interspecific aggression, as has been reported in other members of this genus (e.g. Dow 1977, Poiani *et al.* 1990).

Miners and eight other species of honeyeaters form a numerous and conspicuous segment of the Park's avifauna. Except for Tawny-crowned and Brown-headed Honeyeaters (see Section 6.5.1), this group of species was recorded throughout the year and it is likely that at least some individuals are sedentary. The suite of trees and shrubs within the Park can be expected to provide some flowering plants in all months of the year (Table 6.7).

they are to the Gooseberry Hill area (M. Brooker per. obs.).

Masked Woodswallow *Artamus personatus*. There was an influx of this nomadic species in Spring 1990 and it was recorded also in November. Masked Woodswallows are very infrequent visitors to the coastal plain; other records were in 1890, 1948, 1972, 1980, and 1981 (Storr and Johnstone 1988).

6.5.2 Landbirds previously recorded, not seen 1990.

Emu *Dromaius novaehollandiae* was recorded at Mussel Pool in 1975. It is still seen occasionally near the Park (H. Gratz Jnr. pers. comm.) although there have been no sightings in the Conservation Area.

Whistling Kite *Haliastur sphenurus* is not as common on the Coastal Plain as it once was but probably still visits the swamps and lakes in the Park. Jackson *et al.* (1975) reported three sightings in 1975.

Rufous Songlark *Cinclorhamphus mathewsi* were recorded as common in some cleared paddocks in the southern and eastern sections of the Park by Jackson *et al.* (1975), but are scarce spring-summer visitors to this area according to Storr and Johnstone (1988).

6.4.3 Other species of special interest.

Wedge-tailed Eagle *Aquila audax* appear to be only occasional visitors to the Park. Although the abundance of prey items, such as rabbits, macropods and reptiles (Brooker and Ridpath 1980) seems adequate and suitable nest sites are available, the area of the Park itself may be too small to support a resident breeding pair.

Painted Button-quail *Turnix varia* appear to be fairly numerous given that the species is

Table 6.7 Flowering periods of some common species of trees and shrubs. Data from Marchant et al. (1987) (+ = main flowering period; o = some flowers, irregular)

Species	MONTH											
	D	J	F	M	A	M	J	J	A	S	O	N
TREES												
Banksia attenuata	+	+	+							+	+	+
B. grandis	+									+	+	+
B. ilicifolia	+	+	o	o	o	o	o	o	o	o	o	+
B. littoralis				+	+	+	+	+				
B. menziesii			+	+	+	+	+	+	+			
Eucalyptus calophylla		+	+	+	+	+						
E. marginata	o	o	o							o	o	o
E. rudis					+	+	+	+	+	+	+	+
E. todtiana		o	+	o								
Melaleuca preissiana	+	+										+
M. rhaphiophylla	+	+								+	+	+
Nuytsia floribunda	+	+									+	+
SHRUBS												
Adenanthos cygnorum	+	+	o	o	o	o	o	o	o	+	+	+
Calothamnus lateralis									+	+	+	+
Calytrix flavescens	+	+										+
C. fraseri	+	+	+	+	o	o	o	o	o	o	o	o
Conostephium pendulum							+	+	+	+		
Hypocalymma angustifolium								+	+	+	+	
Jacksonia densiflora	+	+									+	+
J. furcellata	+	+	+	+					+	+	+	+
J. sternbergiana	o	o	o	o	o	o	o	o	o	o	o	o
Petrophile linearis										+	+	+
Regelia ciliata	+	+	o	o	o	o	o	o	o	o	o	+
Verticordia nitens	+	+										+

6.5.4 Landbirds expected but not recorded during the survey.

Square-tailed Kite *Lophoictinia isura* should be expected as a summer visitor, especially over heath.

Marsh Harrier *Circus aeruginosus*. Likely to be a visitor to the swamps and other wetlands on Whiteman Park.

Stubble Quail *Coturnix novaezealandiae* are likely to be visitors (November - April) to the cleared and swamp margin areas of the Park.

Feral Pigeon *Columba livia* may be expected in the Park as suburbia increases on the perimeter.

Spotted Turtle-Dove *Streptopelia chinensis* probably occurs in the settled areas of the Park.

Purple-crowned Lorikeet *Glossopsitta porphyrocephala*. This nomad is likely to make irregular visits to the Park in some years to feed on flowering Eucalypts.

Of nocturnal birds, Southern Boobook and Tawny Frogmouth were recorded during diurnal observations. Other species such as **Barn Owl** *Tyto alba*, **Masked Owl** *Tyto novaehollandiae* and **Australian Owlet-nightjar** *Aegotheles cristatus* probably occur in the Park and **Barking Owl** *Ninox connivens* and **Spotted Nightjar** *Caprimulgus guttatus* are possibilities.

White-backed Swallow *Cheramoeca leucosternum* can be expected as an occasional visitor to the Park although it prefers more coastal habitats. Its range has expanded on the Coastal Plain.

Fairy Martin *Cecropis ariel* may be a rare irregular visitor. It nested at Bullsbrook and

Middle Swan in 1964 (Storr and Johnstone 1988)

Clamorous Reed-warbler *Acrocephalus stentoreus* and **Little Grassbird** *Megalurus gramineus* are species which occur in permanent swamp and stream habitats, neither of which were searched extensively during this survey.

Restless Flycatcher *Myiagra inquieta* was once widespread on the Coastal Plain. It could occur in streamlines on Whiteman Park.

White-browed Scrubwren *Sericornis frontalis*. Whilst this species in not usually found in Banksia Woodlands, it was surprising that there are no records from the *Melaleuca* thickets such as those along the Westrek Trail. Scrubwrens are not favoured by repeated burning of their habitat (Brooker & Rowley 1991).

White-naped Honeyeater *Melithreptus lunatus* is another species which has declined on the Coastal Plain although it probably still visits this area irregularly. It was recorded at Bold Park by How and Dell (1990).

Mistletoebird *Dicaeum hirundinaceum* was recorded at Gin Gin (Bamford 1986) and is a scarce to moderately common nomad on parts of the Coastal Plain (Storr and Johnstone 1988). Its main food source, mistletoe berries, appear to be very scarce in the Park - only two mistletoes were noted during the survey (Westrek) and none was recorded by Mattiske (1989).

6.6 WETLAND SPECIES

The winter of 1990 was relatively dry and none of the "winter-wet" habitats (K1) on the Conservation Area were inundated. However, some opportunistic observations were made of wetlands located outside the Conservation Area, notably Mussel Pool and Horse Swamp. At Mussel Pool only small numbers of a few species were seen (Table 6.8).

Horse Swamp was monitored during the 1990 wet season and a full count was made on 14 November 1990 (Table 6.9). Hoary-headed Grebe, not seen in the November count, were present on 22 September 1990 and an Australian Pelican was reported there by Alan Brien.

Whilst permanent wetlands such as Mussel Pool are useful as summer refugia, others such as Horse Swamp provide large areas of shallow water and mud flats which are equally important habitats for waterbirds. The annual dry/wet cycle in these swamps enhances the production of detritus and detritivorous invertebrates and this provides the food resources necessary for successful breeding by some waterbirds (Crome 1986).

Table 6.8 Waterbirds on Mussel Pool during early morning counts.

Species	13.4.90	26.7.90	14.11.90	14.12.90	13.1.91
Australasian Grebe	1	1		1	
Pacific Black Duck	24	14	2	3	9
Grey Teal		8	1		
Maned Duck		2	1	5	4

Table 6.9 Waterbirds seen on Horse Swamp, 14 November 1990.

Species	Count
Australasian Grebe	7
Little Pied Cormorant	1
Pacific Heron	2
White-faced Heron	6
Glossy Ibis	1
Sacred Ibis	3
Straw-necked Ibis	12
Yellow-billed Spoonbill	2
Black Swan	4
Australian Shelduck	20
Pacific Black Duck	15
Grey Teal	200
Australasian Shoveler	1
Hardhead	5
Eurasian Coot	1
Black-winged Stilt	10

6.7 MANAGEMENT AND LANDUSE OPTIONS

A total of 66 landbirds were found in the Conservation Area, most of which are likely to breed there. At least 10 other species may occur there or are likely to visit the Park irregularly. This means that the majority of species expected on the Northern Coastal Plain, including several whose numbers have declined since European settlement, are still present within the Park.

Nature reserves such as the Conservation Area should be as large as possible and there should be many of them (Soule and Simberloff 1986). As there can be no guarantee that such areas will be replicated on the Northern Coastal Plain, it is vital that the size and condition of the Conservation Area be maintained.

Given this broad aim, a number of management and landuse options should be considered:

6.7.1 Fire

There are usually two objectives of fire management in urban regions. The first is to reduce the risk of bushfire damage to life and property both within and adjacent to the area in question. The second is to protect and conserve the natural features of the area. Bearing in mind both these often incompatible objectives, we discuss three fire management options with respect to the avifauna.

(a) *A No-Fire Policy*

There appears to be no evidence that a prescribed burning regime is required to maintain populations of avian species in habitats such as those found on Whiteman Park. In his detailed study of the effect of fire on the flora and fauna in Banksia Woodland near Gin Gin, Bamford (1986) observed 48 species in areas that had not been burnt for more than 20 years. Hooded Robin was the only notable species which he found more frequently on areas burnt less than six years previously. Woinarski (1990) found that birds which feed or nest in the shrub understorey occur in greater densities in long-unburnt areas.

A No-Fire Policy runs the risk of the whole Conservation Area being burnt in a single wildfire started, perhaps, during extreme weather conditions. Most resident species will survive such an event (Rowley and Brooker 1987) but not all will remain in a completely burnt environment (Brooker and Rowley 1991) and the long-term survival of species such as the Splendid Fairy-Wren may be endangered (Rowley *et al.* in press). A major fire could lead to local extinctions if the Park cannot be re-colonized from adjoining areas of similar vegetation. Re-colonization will be more difficult as the Park becomes increasingly isolated.

(b) *Prescribed burning of the Conservation Area in late Summer/Autumn.*

While fire is beneficial for some species (Bamford 1986, Brooker and Rowley 1991), a short-rotation burning regime will reduce the density and productivity of Splendid Fairy-Wrens (Rowley and Brooker 1987) and probably also other understorey species. For small understorey passerines, the time interval between burns should be as long as possible (at least 10 years). The risk to adjacent facilities could be decreased by fuel-reduction techniques such as cattle grazing and burning-off the land between the facilities and the Conservation Area, to enhance the effectiveness of the existing firebreaks.

(c) Patch-burning in Spring/early Summer.

The effect of patch-burning on the avifauna is not well known. It could disrupt the breeding activities of those species which nest in the understorey, but its main effect is likely to be differential burning of the vegetation. At Whiteman Park, the most likely areas to be burnt by patch-fires are vegetation types G, H and I which grow on the drier upland soils, and these are ones supporting the richest avifauna.

6.7.2 Bird-watching

If public bird-watching were to be permitted within the Conservation Area some disturbance would be unavoidable and its consequences unpredictible. Other more accessible and already-disturbed areas such as the Westrek Trail and the southern wetlands would be almost as good from the bird-watching point of view and more convenient and enjoyable to the casual bird-watcher as ticks are less prevalent there than in areas "off the beaten track".

To set-up the Westrek area for birding the following could be considered:

(a) Establish both long and short walk routes. The present Westrek Trail is suitable for the former, a loop north from the Trail to an existing road, the latter.

(b) Erect a number of weather-proof, vandal-proof information bays at strategic locations on the walks, to illustrate and describe the vegetation and birds.

(c) Erect numbered poles as already provided on the Westrek Trail and provide a list of birds previously seen at each point, together with instructions for registering "new finds" at the Park Office. This challenges the bird-watcher to find additional species.

(d) The Australian Bird Banding Scheme is considering the establishment of fixed-site, fixed-effort banding sites in Australia along the lines of similar schemes overseas. The location of a site within the Park (but not necessarily on one of the walk trails) could be another focus for birding in the Park as well as collecting useful information on the avifauna.

(e) As an adjunct to the above suggestion, but more commercially oriented, prepare a booklet or book on the landbirds of Whiteman Park suitable for sale. This could be designed so as to be educationally and ecologically orientated rather than trying to compete with the already available field guides. The text and illustrations should cover such aspects as breeding, movements, behaviour, foraging techniques, food and conservation - topics not usually dealt with in non-specialist publications.

6.7.3 Changes in the water-table due to pumping.

It is possible that landbirds may be sensitive to a lowering of the water-table (see Table 6.6) but this is difficult to measure from bird observations. More sessile organisms such as plants, small reptiles and some invertebrates may be more suitable for such a study.

Small changes in water-table levels can have significant effects on wetland environments (Water Authority 1987). None of the "winter-wet" swamps in the Conservation Area held water during 1990 but the lower than average winter rainfall could also have contributed to this. Anecdotal information suggests that these swamps almost always filled during winter in the past but there are no published data on their use or otherwise by waterbirds.

No firm recommendations for the management of the Whiteman Park wetlands are given in this report as our observations in this habitat were brief. However, we make three suggestions, application of which could prove beneficial. These are mainly related to Horse Swamp (Figure 6.9) and are made on the assumption that grazing by cattle will continue.

1. Construct fencing around a small area in the centre of Horse Swamp (A in Figure 6.9) to exclude cattle. Grazing could continue outside the exclusion area so as to reduce the risk of fire which would be damaging to the wetland vegetation (Mattiske 1989). The vegetation in the exclusion area should provide an enhanced habitat for nesting waterbirds and would give some indication of the effects, if any, of grazing.

2. Construct fencing around a second area of Horse Swamp (B in Figure 6.9). Area B appears to have been less affected by clearing, it retains denser vegetation on its edges but was not extensively flooded in 1990. The central area possibly could be deepened and the excavated soil formed into islands. As with Area A, this should provide a suitable breeding and feeding area for waterbirds. If successful, further improvements could be made, such as the erection of hides and walkways for public viewing of the wetlands and their birds.

3. Arum Lily *Zantedeschia aethiopica* has invaded some of the wetlands on the southern section of Whiteman Park. Its impact has not been assessed but it has proved to be a major problem on Garden Island, Western Australia. It may be prudent, therefore, to eliminate it.

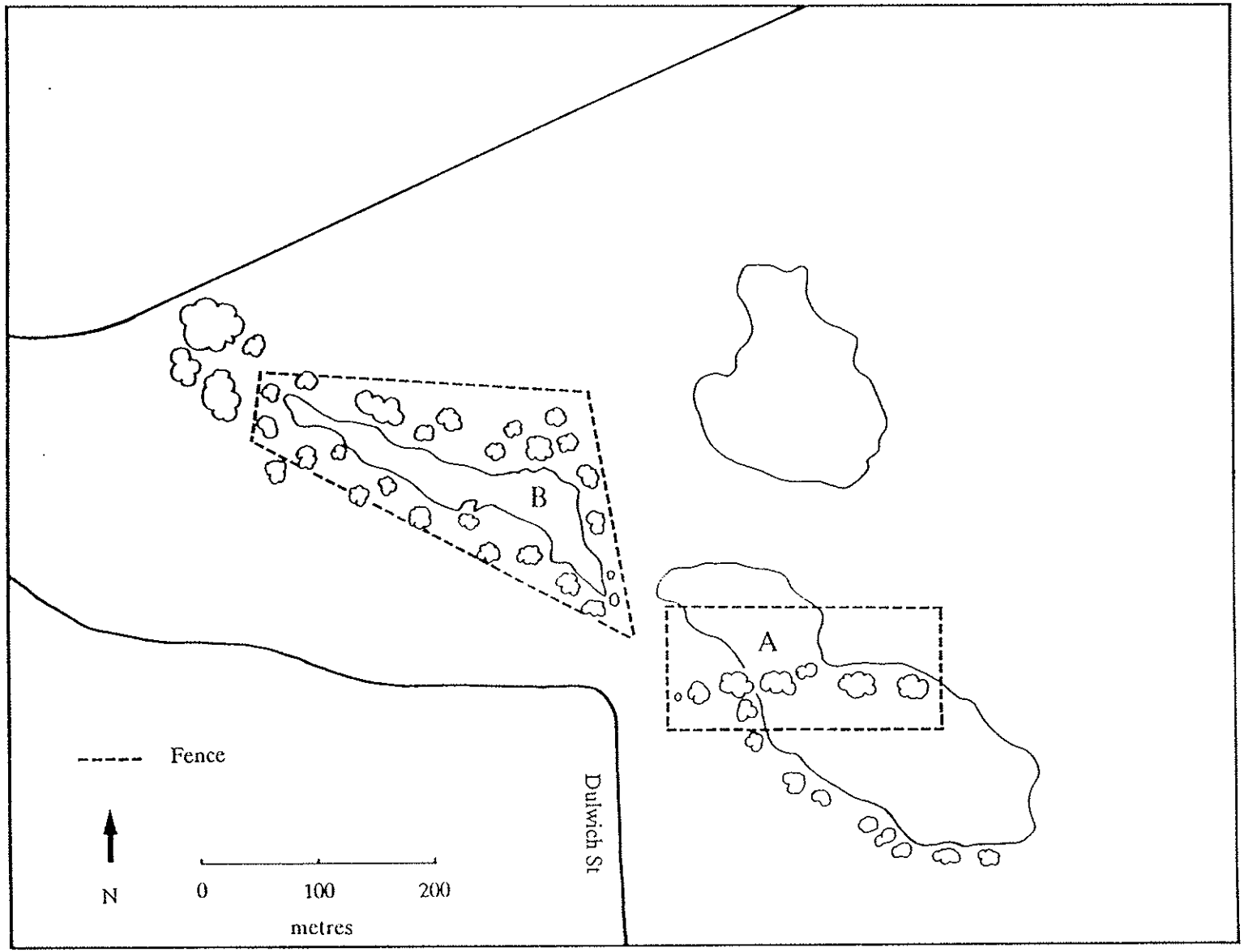


Figure 6.9 Horse Swamp showing suggested exclusion areas.

6.8 FURTHER STUDIES AND MONITORING PROGRAM

The use of the Conservation Area as a general research site is not recommended. However a regular monitoring program is recommended using the study sites (Figure 6.1) or a sub-set of them. No detailed procedure is given here as input from managers and decision-makers will be required to ensure that such a program is useful and cost-effective. Further studies should be aimed at supplementing the present data set to provide a solid basis for monitoring. These could include the following:-

(a) A more detailed survey of the floristics, structure and condition of the vegetation at the study sites.

This would allow for a more discriminating analysis of bird / habitat relationships and the effects on the bird species of changes to the vegetation due to altering of the watertable or to changing fire regimes. The vegetation types as mapped by Mattiske (1989) are excellent. However some species, such as *Adenanthos cygnorum, Allocasuarina fraseriana* and *Nuytsia floribunda*, which could be important determinants of the distribution and abundance of birds, need to be mapped with respect to our study sites, as does the present extent of tree dieback.

(b) *Repeat a full bird census in at least two seasons.*

This would produce refined density estimates for resident species, give an indication of year to year variation and enhance the value of the data base for monitoring purposes.

(c) *Census the nocturnal species.*

Only two of a possible seven nocturnal species were detected from the diurnal censuses.

(d) *Census the waterbirds and their breeding on Horse Swamp, Mussel Pool and other selected Wetlands*

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9 APPENDICES

Appendix A. Description of Whiteman Park vegetation types (after Mattiske 1989).

G: Low woodland of *Banksia attenuata - Banksia menziesii - Eucalyptus todtiana* on dry pale grey sands on slopes and dune crests. This type occurred on the series of upper dune slopes which were scattered through Whiteman Park. Indicator species included - *Beaufortia elegans, Conostephium minus, Hibbertia helianthemoides, Leucopogon conostephioides, Scholtzia involucrata, Oxylobium capitatum, Melaleuca scabra, Eremaea pauciflora, Jacksonia densiflora, Astroloma xerophyllum, Boronia purdieana* and the tree species - *Banksia attenuata*, *Banksia menziesii* and *Eucalyptus todtiana*.

H: Low woodland to low open forest of *Banksia attentuata - Banksia menziesii - Banksia ilicifolia* on deep pale grey sands, dry at surface and moist at depth on dune slopes. This type occurred on the dune slopes on the series of higher dunes scattered through Whiteman Park. Indicator species included - *Leucopogon conostephioides, Scholtzia involucrata, Xanthorrhoea preissii, Dasypogon bromeliifolius* and the tree species - *Banksia attenuata, Banksia menziesii* and *Banksia ilicifolia*.

I: Open woodland of *Eucalyptus marginata - Eucalyptus calophylla - Banksia ilicifolia* and occasionally *Banksia grandis* on moist sandy soils with dark grey humisoid surface on lower slopes. This type occurred on the drier less undulating areas and dune slopes. Indicator species included - *Xanthorrhoea preissii*, *Dasypogon bromeliifolius*, *Melaleuca seriata*, *Adenanthos obovatus* and the tree species - *Banksia attenuata, Banksia menziesii* and *Banksia ilicifolia*.

J: Open woodland of *Eucalyptus calophylla* on moister dark grey humusoid soils on flatter lower areas; with local additional species reflecting moister (*Melaleuca preissiana*) or sandier (*Banksia ilicifolia* and *Banksia menziesii*) soils. This type occurred on the extensive flatter areas, which at times have been infrequently subjected to seasonal inundation. Indicator species included - *Xanthorrhoea preissii, Hypocalymma angustifolium, Pultenaea reticulata, Adenanthos obovatus* and the tree species - *Eucalyptus calophylla*.

K1: Ranging from low open forest of *Melaleuca preissiana - Banksia littoralis* (very occasional *Eucalyptus rudis* on old flow-lines), to closed heath of Myrtaceae species on seasonally water saturated sands and peats of swamp areas. This type occurred primarily on the seasonally wet depressions and swamps scattered through Whiteman Park. Indicator species included - *Pericalymma ellipticum, Astartea fascicularis, Calothamnus lateralis, Regelia ciliata, Typha orientalis, Verticordia* spp., *Melaleuca* spp., *Schoenus rodwayanus, Leptocarpus scariosus* and the tree species - *Melaleuca preissiana*, *Banksia littoralis* and the occasional *Eucalyptus rudis*.

K2: Low open forest to open forest of *Eucalyptus rudis - Melaleuca rhaphiophylla* on sands and organic silty clays along water-courses or seasonally flooded areas. This type was confined largely to the clayey soils associated with the Bennett Brook and its main tributaries. Indicator species included - *Juncus pallidus, Agonis linearifolia, Lepidosperma tetraquetrum* and the tree species - *Eucalyptus rudis* and *Melaleuca rhaphiophylla.*

JK: Areas of vegetation types J and K1 which either were cleared or contained a series of very small wetlands.

Appendix B. Point Count data. Percentage of Park Road Sites on which birds were recorded.

	Autumn1 1990	Autumn2 1990	Winter 1990	Spring1 1990	Spring2 1990	Summer 1991
Pacific Black Duck			1			
Maned Duck			1			
Brown Goshawk				3		
Little Eagle	1		2	3	8	2
Brown Falcon	2	5		1	3	2
Australian Kestrel			1	1		2
Unidentified raptor						1
Painted Button-quail						1
Banded Lapwing			1			
Laughing Turtle-Dove				2	3	
Common Bronzewing				1	2	
White-tailed Black-Cockatoo	25	23	9			
Galah	5	2	16	22	21	6
Red-capped Parrot	5	2	6	22	14	10
Port Lincoln Ringneck	51	32	53	71	66	39
Elegant Parrot	7	1	5	6	10	2
Pallid Cuckoo			82	9		
Fan-tailed Cuckoo			9			
Horsfield's Bronze-Cuckoo			11	5	15	
Shining Bronze-Cuckoo				15	10	1
Tawny Frogmouth		1				
Laughing Kookaburra	1	2	3	2	9	7
Sacred Kingfisher				22	38	1
Rainbow Bee-eater				7	16	24
Welcome Swallow		1			1	
Tree Martin	13	14	6	14	14	11
Richard's Pipit			1			1
Black-faced Cuckoo-shrike	6	5	8	13	13	16
White-winged Triller				1	1	1
Scarlet Robin	7	7	5	9	15	8
Red-capped Robin				1	3	
Hooded Robin	3			3	1	
Golden Whistler			1			
Rufous Whistler	22	22	25	74	78	34
Grey Shrike-thrush	7	8	13	17	28	5
Crested Bellbird						1

Appendix B cont.

	Autumn1 1990	Autumn2 1990	Winter 1990	Spring1 1990	Spring2 1990	Summer 1991
Grey Fantail	21	17	11	41	31	16
Willie Wagtail		1		1	1	7
Splendid Fairy-Wren	8	8	11	32	29	14
White-winged Fairy-Wren					1	1
Western Gerygone	9	8	2	26	30	10
Inland Thornbill		3	5	2	5	5
Western Thornbill	2	3	8	8	8	8
Yellow-rumped Thornbill	11	7	18	21	26	16
Varied Sittella	2	1	1	1	2	3
Red Wattlebird	30	30	21	6	5	45
Little Wattlebird	30	43	22	17	15	34
Yellow-throated Miner	21	25	22	25	18	30
Singing Honeyeater	16	31	34	33	41	37
Brown Honeyeater	68	68	45	49	66	93
New Holland Honeyeater	5	3	15		2	1
White-cheeked Honeyeater	11	8	16	11	7	6
Tawny-crowned Honeyeater		1				8
Western Spinebill	25	36	62	34	48	41
White-fronted Chat						1
Spotted Pardalote			2			
Striated Pardalote	8	8		29	36	23
Silvereye	6	5	1	5	3	25
Australian Magpie-lark	17	10	11	13	6	3
Masked Woodswallow				1	1	
Black-faced Woodswallow	2	1	1	2	1	3
Dusky Woodswallow	2		1	2	1	3
Unidentified woodswallow			1	1	1	
Grey Butcherbird	37	36	23	40	39	29
Australian Magpie	24	31	43	37	51	30
Australian Raven	36	49	59	60	45	39

Appendix C Transect Count data. Percentage of Transects on which birds were recorded.

	Autumn1 1990	Autumn2 1990	Winter 1990	Spring1 1990	Spring2 1990	Summer 1991
Brown Goshawk				1		
Little Eagle					1	
Brown Falcon	1				1	
Painted Button-quail	1			1	1	1
Common Bronzewing				1	1	1
Crested Pigeon					1	
White-tailed Black-Cockatoo	1	1				
Galah	2	1	1	3	2	1
Red-capped Parrot	1	2	1	1		3
Port Lincoln Ringneck	4	5	1	9	12	3
Elegant Parrot		1		1	1	1
Pallid Cuckoo			4			
Horsfield's Bronze-Cuckoo			1	1	1	1
Shining Bronze-Cuckoo	1			1	1	
Southern Boobook				1		
Laughing Kookaburra	1					1
Sacred Kingfisher				2	3	
Rainbow Bee-eater				1	1	5
Welcome Swallow						
Tree Martin	1	1	1	1	3	2
Richard's Pipit			1			
Black-faced Cuckoo-shrike	1			2		1
White-winged Triller					1	2
Scarlet Robin	2	1	3	2	3	3
Red-capped Robin			1		1	
Hooded Robin		1				1
Golden Whistler			1			
Rufous Whister	4	1	4	12	8	4
Grey Shrike-thrush	1		2	3	2	1
Crested Bellbird						
Grey Fantail	4	4	3	8	6	5
Willie Wagtail			1	1		1
Splendid Fairy-Wren	1	3	3	8	10	6
White-winged Fairy-Wren						1
Western Gerygone		1	1	4	3	1
Inland Thornbill	1	1	1	1	1	1
Western Thornbill	3	1	3	4	3	6
Yellow-rumped Thornbill	3	2	6	6	8	7

Appendix C cont.

	Autumn1 1990	Autumn2 1990	Winter 1990	Spring1 1990	Spring2 1990	Summer 1991
Varied Sittella	1		1		1	
Red Wattlebird	4					6
Little Wattlebird	3	4	2	2		4
Yellow-throated Miner	7	5	4	5	5	5
Singing Honeyeater	2	2	4	3	3	6
Brown Honeyeater	12	9	3	13	18	37
New Holland Honeyeater		1	3			
White-cheeked Honeyeater	3	4	1	2	1	3
Tawny-crowned Honeyeater						4
Western Spinebill	6	4	15	8	8	9
Spotted Pardalote			1			
Striated Pardalote	1	1		1	3	2
Silvereye	3				1	7
Red-eared Firetail						1
Australian Magpie-lark	1	1		1	1	
Masked Woodswallow				1		
Black-faced Woodswallow	1	1	1	1	2	2
Dusky Woodswallow	1			1		1
Woodswallow			1			
Grey Butcherbird	1	1		3	2	
Australian Magpie	1	1	3	3	2	3
Australian Raven	3	2	2	2	3	1

Appendix D Fixed Circle Count data. Total numbers of birds seen (per 10 ha). Area censused 17.1 ha.

	Autumn1 1990	Autumn2 1990	Winter 1990	Spring1 1990	Spring2 1990	Summer 1991
Australian Kestrel						1
Painted Button-quail						1
Red-capped Parrot		1			1	2
Port Lincoln Ringneck	4		2	2		3
Elegant Parrot	1					
Shining Bronze-Cuckoo				1	1	
Tawny Frogmouth		1				
Sacred Kingfisher				1	1	
Rainbow Bee-eater						2
Tree Martin						1
White-winged Triller						1
Black-faced Cuckoo-shrike	1					
Scarlet Robin		1	1	2		1
Red-capped Robin				1		
Hooded Robin	1			1	1	
Rufous Whistler	1			2	1	1
Grey Shrike-thrush				1		
Grey Fantail	5	1	2	2	1	3
Yellow-throated Miner	4	1	3	1	1	1
Singing Honeyeater		1	1	2		1
Willie Wagtail						1
Splendid Fairy-Wren	1	1	2	2	5	4
White-winged Fairy-Wren					1	
Western Gerygone	1	1	1	1	1	
Inland Thornbill		2	1		1	1
Western Thornbill	1	2	1	4	1	1
Yellow-rumped Thornbill	3		4	5	1	1
Varied Sittella	1				1	
Red Wattlebird	1	1				5
Little Wattlebird			1	1	1	2
Brown Honeyeater	11	7	1	5	8	19
New Holland Honeyeater	2		2			
White-cheeked Honeyeater	4	2	2	1		
Tawny-crowned Honeyeater						1
Western Spinebill	2	4	5	2	5	4
Striated Pardalote			1	1	1	1
Silvereye	1					1
Black-faced Woodswallow	2			1		
Grey Butcherbird	1			1	1	1
Australian Magpie			1			1

Appendix E Westrek Census. Total numbers of birds seen (per 10 ha) during 19 Fixed Circle Counts on the Westrek Trail, January 1990-February 1991 (+ = present but not on count). Area censused 3.7 ha.

	J	F	M	A	M	J	J	A	S	O	N	D	J	F
Pacific Black Duck								+						
Maned Duck						+		+	+					
Collared Sparrowhawk	3			+						+				
Little Eagle	+													
Australian Hobby				+										
Brown Falcon	+													
Laughing Turtle-Dove		3	+						+	+		+		+
Common Bronzewing								+						
Crested Pigeon		+												
White-tailed Black-Cockatoo							+							
Galah		+	+					+	+		+	+		
Red-capped Parrot		+	3	+	+	8	+	5	+	+	+	3	+	+
Port Lincoln Ringneck	+	+	11	+	5	3	+	5	+	3	+	3	3	+
Elegant Parrot	+	+	+	5	+		+	+	+	+	+		+	+
Pallid Cuckoo						+	+	+	+	+		+		
Fan-tailed Cuckoo					+	+	+	+	+					
Horsfield's Bronze-Cuckoo					+	+	+		+	+	+			
Shining Bronze-Cuckoo		3						3	3	+	+	+		
Laughing Kookaburra		+			+	+		+	+	+	+	+	+	
Sacred Kingfisher									+	+	+	+		
Rainbow Bee-eater	+	+								+	+	+		
Welcome Swallow			+											
Tree Martin	+	+	+	+		+	+	+	+	+	+		+	+
Black-faced Cuckoo-shrike	+				+	+			+	+	+	+		+
Scarlet Robin	+	+	+	+	+		+	+	3	3	+	3	3	+
Rufous Whistler	3	5	3	+	3	+	3	3	+	8	3	3	5	+
Grey Shrike-thrush	+	+	+	3	+	3	+	3	+	+	+	+	+	
Grey Fantail	11	5	8	3	8	+	11	8	11	5	11	11	3	

Appendix E cont.

	J	F	M	A	M	J	J	A	S	O	N	D	J	F
Willie Wagtail				+					+	+				
Splendid Fairy-Wren	11	5	5	19	+	+	+	3	3	8	11	19	3	+
Western Gerygone		+	+		+	+		+	+	5	+	8	+	3
Inland Thornbill				3	+		+	+	3	+				3
Western Thornbill		8	5	5	3		+	11		8	5	+	+	
Yellow-rumped Thornbill	+	3	+	+		5	+	5	+	3	3	+	+	
Varied Sittella			+			+			+					
Red Wattlebird	+	+	+	+	+	3	+	+		+	+	+	+	+
Little Wattlebird	8	+	3	21	8	5	13	+	+	+	+	16	3	11
Singing Honeyeater		+	+	+	+	+	+	3	+	+	+	+	+	+
Brown-headed Honeyeater	+													
Brown Honeyeater	59	76	35	21	32	13		3	+	3	21	35	27	56
New Holland Honeyeater	11	27	35	27	32	13	32	29	13	5	3	19	11	35
White-cheeked Honeyeater	5	+											+	11
Tawny-crowned Honeyeater	+		3											5
Western Spinebill	3	5	13	5	3	+	5	13	8	5	3	5	5	5
Spotted Pardalote					3	3	+	+						
Striated Pardalote	3	3	5	3					3	+	3	+	+	
Silvereye		+	5	+	3	+	8	+	+	11	11	5	8	3
Australian Magpie-lark			+	+	+	+	+	+	+	+		+	+	+
Black-faced Woodswallow										+			+	
Australian Magpie	+	3	+	+	+	+	+	+	+	+	+	+	+	+
Australian Raven	+	+	+	+	3	+	+	3	+	3	+	+	+	+

ECOLOGICAL STUDIES - WHITEMAN PARK

Prepared By: E.M. Mattiske & Associates

Prepared For: State Planning Commission

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BS 304
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Whiteman Park - Fire History 1978-83.

Whiteman Park - Fire History 1984-88.

1. SUMMARY

A range of plant ecological studies were undertaken by E.M. Mattiske & Associates for the State Planning Commission at Whiteman Park.

A total of 55 families and 260 species (including 46 introduced species) were recorded in Whiteman Park. This total is estimated to be approximately 75% of the flora. The latter largely relates to the timing of the survey in the autumn months. The contribution of the introduced flora to the plant cover is particularly high in the semi-disturbed areas in Whiteman Park. Several pose particular management problems. The latter are discussed in more detail in the following text.

The dominant native families include Cyperaceae, Proteaceae, Papilionaceae, Myrtaceae and Epacridaceae. The wetlands are dominated by the species of the Myrtaceae family, namely - species of *Melaleuca*, *Regelia*, *Pericalymma*, *Verticordia* and *Agonis*.

A total of 6 main site-vegetation types were defined and mapped for Whiteman Park. The site-vegetation types form a continuum from the dry pale grey sands on the dune crests to the seasonally water saturated sands and peats occurring on the permanent swamps in the Park. The vegetation map provides an assessment of the boundaries between types. The limitations of the map relate to the very nature of the continuum (with individual species overlapping several types) and the sampling regime (restricted to 16 transects which were located north-south and approximately 300 metres apart).

A range of summaries were also prepared for Whiteman Park. These included maps of species richness (total number of species), total number of introduced species, physiological stress, total number of fires (1978-1988) and fire history maps (1978-1983 and 1984 - 1988). Additional assessments were made on clearing activities, grazing effects, drought, logging and dieback (*Phytophthora cinnamomi*). The data supplied should assist in determining management options for the Whiteman Park area.

2. INTRODUCTION

Whiteman Park is located on the northern edges of the rapidly expanding metropolitan area of Perth on the northern Swan Coastal Plain. The area of study is approximately 2730 hectares in area. The Park is bounded by Gnangara Road in the north, Marshall Road and Harrow Street in the south, Beechboro Road to the west and the future location of Lord Street to the east.

Whiteman Park offers a range of attractive features. Foremost amongst these are the natural resources of relatively undisturbed native vegetation and areas of semi-disturbed open woodlands.

The growth rate of Perth, particularly in the northern suburbs will place increasing pressures on the Park's resources. As such, it has the potential to match Kings Park in day usage.

Previous detailed studies of Whiteman Park have been carried out by Jackson et al. (1975) and Maunsell & Partners Pty. Ltd. (1978). In view of recent developments in the area, E.M. Mattiske & Associates were commissioned to review the flora and vegetation of Whiteman Park as a basis for future planning options. The scope of the study was restricted to the native flora, vegetation and factors which interact with the plant species and communities.

2.1 Climate

Whiteman Park has a Mediterranean climate with a defined seasonal pattern of wet-mild winters and dry-hot summers (Gentilli, 1947, 1951, 1972; Commonwealth Bureau of Meteorology, 1966, 1969). The winter rain accounts for the majority of the annual rainfall (79% falls in the months May to September). The rainfall data for Perth is summarized in Appendix A. The latter results in marked seasonal trends in the local wetlands, with seasonal dry peaks in April and seasonal wetter peaks in September.

Rainfall data for Perth is summarized in Appendix A. Since the mid 1970's there has been an extended period of below average annual rainfall years, Appendix A.

The temperature varies form a mean monthly maximum in February of 29.7 ^{o}C to a mean monthly minimum in July of 8.8^{o}. Highest maximum daily temperatures reach 44.6^{o}C, while the lowest minimum daily of -2.2^{o}C has been recorded. These extremes in temperatures pose particular management problems. Foremost amongst these is the extreme fire hazard conditions created on

very hot summer days, with the strong prevailing winds (generally from the east or east north-east in the mornings or west or south-west in the afternoons).

The evaporation averages 1600mm per annum, which is nearly double the mean annual rainfall.

2.2 Landform and Soils

The Swan Coastal Plain consists of a series of geomorphic entities parallel to the coastline. The northern part of the Plain is formed of either fluviatile or aeolian depositional material. The Swan Coastal Plain consists of the Pinjarra Plain and three dune systems of different ages whose soils are at different stages of leaching and soil formation.

The Whiteman Park area occurs on the border of the Bassendean dune system and the Guildford formation (Bettenay et al., 1960; Churchward and McArthur, 1980). The area is dominated by the leached grey sands of the Bassendean dune system, with the transition to clayey soils of the Guildford formation in the south-east corner of the Park.

The area is subdivided by a series of sand dunes which tend to run from the south-west to north-east. These dunes provide views to the Darling Scarp and the City of Perth.

The southern and western parts of the Park are dissected by Bennett Brook and its tributaries.

In addition the dunes of the Bassendean system are interspersed with a series of wetlands. There is some local variation in the soil types within these wetlands, ranging from peat seasonal swamps to organic silty clays near the tributaries of Bennett Brook.

2.3 Flora and Vegetation

The regional vegetation has been documented and mapped by Seddon (1972), Beard (1979), Heddle (1979) and Heddle et al. (1980). In addition, Havel (1968) carried out a range of ecological studies on the Spearwood and Bassendean dune systems (north of Gnangara Road). These latter studies integrated the site conditions (e.g. soils - degree of leaching and local moisture conditions) and the range of species which reflected specific site conditions (indicator species).

The flora and vegetation of the Whiteman Park has been documented previously by Jackson et al. (1975) and summarized by Maunsell and Partners Pty Ltd. (1978). Jackson et al. (1975) concentrated on the plant formation level and recognized some 152 species in Whiteman Park.

In the review of vegetation in this current study it was decided to adopt the site-vegetation type system of Havel (1968) and integrate it with the study by Jackson et al. (1975) and the field studies undertaken in the earlier part of 1989.

2.4 Hydrology

Whiteman Park occurs on the shallow unconfined aquifer called the Gnangara Mound. The underground waters stored in the Gnangara Mound rise to the surface over quite large areas in the latter part of the winter months. The water table reaches a peak in September to October each year. The significance of these surface and shallow waters to the native vegetation have been studied on the Gnangara Mound since 1966 by Havel (1968), Heddle (1980) and E.M. Mattiske & Associates (1981, 1982, 1985 and 1988).

The findings by Heddle and E.M. Mattiske & Associates have indicated that the native vegetation has shifted to the xeric end of the continuum in response to the series of below average rainfall years in the 1970's. Since the mid 1970's the effects of pumping for Perth's water supply have placed increasing pressures on many wetlands and plant communities on the lower slopes of the dune systems on the northern Swan Coastal Plain (Water Authority of Western Australia ,1986).

The Water Authority of Western Australia, which is the State Authority responsible for supplying water to Perth, has installed a series of pumping bores (as part of the Mirrabooka Groundwater Scheme) through the Whiteman Park area. The possible impact of these bores on the native plant communities was reviewed in this

study through an assessment of the physiological stress present in the vegetation. The appraisal mechanism has been applied in other survey areas both on the Swan Coastal Plain and in the Darling Ranges.

2.5 Other Parameters

During the botanical studies additional recordings were made on factors which have influenced the distribution, condition and current status of the native vegetation. These factors included:

- Fire History (based on information supplied by the State Planning Commission).
- Grazing (native and introduced, data based on observations).
- Water Stress (based on physiological stress which does not appear to be related to disease).
- Plant disease areas (based on observations, although no testing was carried out prior to the release of this report).
- Location of the main tracks, roads, fire-breaks and cleared areas in relation to the native plant communities (based on field observations. maps supplied and aerial photographs).
- Past clearing activities (mining, grazing, agricultural and development of recreational uses in the Park area).

3. OBJECTIVES

The objectives of the ecological studies were to:

- Prepare an inventory of the species present in the Whiteman Park area.
- Prepare a vegetation map of the Whiteman Park area.
- Review the condition of the native vegetation in the Whiteman Park area as a basis for future planning options.
- Prepare appropriate summaries to assess the levels of disturbance.
- Update the fire history for the Whiteman Park area (using data supplied by the State Planning Commission).

4. METHODS

An initial reconnaissance of Whiteman Park was undertaken to determine the most appropriate sampling regime. Field studies were carried out in early to mid 1989. The main sampling was based on transects spaced approximately 300 metres apart. A total of 540 recording sites were sampled (see attached Map showing location of the recording sites). In addition opportunistic collecting was carried out for plant species not recorded during the survey.

4.1 Flora

All specimens were dried, identified and checked with specimens at the Western Australian State Herbarium. The common species (e.g. *Banksia attenuata*, *Eucalyptus calophylla*) were not collected. Identifications for the common species were based on the experience of the botanists.

4.2 Vegetation

The vegetation was recorded on the 540 sites along the 16 transects running north - south through the Park. All data recorded has been coded for future reference. Selected data was also presented on a grid system (see enclosed Appendices B, C, D and E). The grid was used to provide a means of summarizing data for presentation (ranking results for the recording sites within a 400 metre x 400 m grid were averaged).

During the survey work additional notes were made on obvious changes in vegetation and site conditions. Data collected at each site included:

Tree Species
(based on an abundance scale as defined by Havel, 1975).

The rating of each tree species was recorded for an area of 20 metres radius from the recording site, according to the following scale:

0 Absent,
1 One or two trees,
2 Three to five trees,
3 More than 5 trees, but containing less than one third of the total stand,
4 Between one third and one half of the total tree stand, and
5 More than one half of the total tree stand.

In areas where the tree cover had been markedly affected by clearing and agricultural activities the radius was increased to allow coverage of the tree species for community definition.

The tree species recorded in the survey area are summarized in Table 1.

Table 1: List of Tree Species recorded in Whiteman Park.

Scientific Name	Common Name
Allocasuarina fraseriana	Sheoak
Banksia attenuata	
Banksia grandis	Bull Banksia
Banksia ilicifolia	
Banksia littoralis	Swamp Banksia
Banksia menziesii	Firewood Banksia
Eucalyptus calophylla	Marri
Eucalyptus marginata	Jarrah
Eucalyptus rudis	Flooded Gum
Eucalyptus todtiana	Coastal Blackbutt
Melaleuca preissiana	Moonah or Paperbark
Melaleuca rhaphiophylla	Swamp Paperbark
Nuytsia floribunda	Christmas Tree
* Pinus pinaster	Pinaster Pine

(* - Denotes introduced species)

Understorey Species
(based on an abundance scale as defined by Havel, 1975).

The rating of each tree species was recorded for an area of 5 metres radius from the recording site, according to the following scale:

0 Absent,
1 Only occasional plant around recording site,
2 Present,but not generally around site,
3 Generally around site, but not common,
4 Common, but not dominant around site, and
5 Dominant around site.

In areas where the understorey cover had been markedly affected by clearing and agricultural activities the radius was increased to allow coverage of the species for community definition.

The understorey species are summarized by family in Appendix B.

4.3 Other Parameters

The following data was recorded for each recording site to assist in the interpretation of species distribution data and the delineation of boundaries on the vegetation map.

Position in the Landscape

The landscape was subdivided into the following categories: Dune Crest, Upper Slope, Mid Slope, Lower Slope, Gully, Swamp, Creek and Water-course.

Land Use

The current land use was classified into the following categories: Paddocks, Cleared Areas, Uncleared Areas, Semi-cleared Areas, Grazed Areas and Tracks.

Community Condition

The plant community at each recording site was assessed for fire damage, drought damage, dieback (*Phytophthora cinnamomi*), grazing, disturbance from clearing (irrespective of type - tracks, paddocks) and past logging impact.

Physiological stress in any plant community can be caused by a variety of factors (Old et al., 1980). The obvious factors operating in the plant communities on the Swan Coastal Plain appear to relate primarily to water stress (drought or pumping effects), insect infestations and the fungal disease caused by *Phytophthora cinnamomi*.

In areas where physiological stress was evident, each tree species at each recording site was recorded according to the following scale:

0 No evidence of stress in plants,
1 Odd plant showing signs of stress, none dead,
2 One or two stressed plants, usually under severe stress and near death (but not dead),
3 Scattered stressed and dead plants around plot,
4 Susceptible plants dying or dead, and
5 "Graveyard" death, most trees dead or removed.

Observations were also made on understorey species reflecting stress.

4.4 Vegetation Map

The vegetation map was prepared from an interpretation of the reconnaissance, survey data and the aerial photographic mosaic of Whiteman Park, as follows:

- the distribution of indicator species (Havel, 1968),
- the distribution of non-indicator species, particularly those which illustrated a regularity in their occurrence, and
- the structural differences in the plant communities in the survey area.

All boundaries were checked with aerial photograph mosaic.

5. RESULTS

5.1 Flora

A total of 55 families, 158 genera and 260 species (including 46 introduced species) were recorded in Whiteman Park, Appendix B. This total is estimated to be approximately 75% of the flora. The latter largely relates to the timing of the survey in the autumn months. If additional studies were carried out in the spring months the total of species would be higher.

The dominant native families include Cyperaceae, Proteaceae, Papilionaceae, Myrtaceae and Epacridaceae. The wetlands are dominated by the species of the Myrtaceae family, namely - species of *Melaleuca*, *Regelia*, *Pericalymma*, *Verticordia* and *Agonis*.

The dominant introduced families include Poaceae, Iridaceae, Papilionaceae and Asteraceae, see asterisks in Appendix B. The contribution of the introduced flora to the plant cover is particularly high in the semi-disturbed and disturbed areas of Whiteman Park.

5.2 Species Richness of the Flora

The species richness results, for all plant species and all introduced species, at each recording site are summarized on the enclosed Maps and in Appendix C.

The findings for all species and all native species reflect the relatively undisturbed areas in Whiteman Park. The number of species at several sites exceeded 40 species for a 5 metre radius

area. This factor should assist in determining boundaries for the delineation of conservation areas within Whiteman Park. The species richness obviously varies with the site-vegetation type or plant community at a particular point, so the results should be averaged to accommodate the lower numbers of native species in wetland areas (where a few species usually dominant and form a dense plant cover). The results in Appendix C should assist in this aspect (where results were averaged for a grid area of 400 metres x 400 metres). In addition in selecting conservation priorities the representation of poorly conserved or restricted species and communities within the Park and region should also be addressed.

5.3 Tree Species

The results for the tree species are summarized on the grid system in Appendix D. The exception is the results for the introduced *Pinus pinaster* which is predominantly restricted to the disturbed areas on the northern part of the Park.

Results reflect the earlier groupings of trees by Havel (1968), namely:

(a) Species tolerant of excessive wetness:
Melaleuca preissiana, *Eucalyptus rudis* and *Banksia littoralis*, see Appendices D5, D9 and D11.

Havel did not include *Melaleuca rhaphiophylla* in this group as the study did not cover the water-courses similar to Bennett Brook.

Melaleuca rhaphiophylla and *Eucalyptus rudis* were restricted largely to the southern end of the Park, see Appendices D9 and D12. In contrast *Melaleuca preissiana* and *Banksia littoralis* were scattered through the Park on the series of seasonal wetlands.

(b) Species of optimum moist sites, intolerant of extremes in moisture conditions:
Eucalyptus marginata, *Eucalyptus calophylla*, *Banksia ilicifolia* and less frequently *Banksia grandis*, see Appendices D3, D4, D7 and D8.

These species were scattered through the Park on the lower lying moist soils. The lower frequency of *Banksia grandis* relates to the distribution pattern of this species in the south-west of Western Australia. On the northern Swan

Coastal Plain this species is reaching its northern extension.

(c) Species with wide tolerance, but with maximum development on dry sites:
Banksia attenuata and *Banksia menziesii*, see Appendices D2 and D6.

These species are scattered throughout the Park, although they avoid the wetter areas, particularly in the south and south-west of the Park.

(d) Species without clear cut site preference:
Eucalyptus todtiana and *Nuytsia floribunda*, see Appendices D10 and D13.

Havel did not include *Allocasuarina fraseriana* in this group. All three species are relatively without a site preference, although they all avoid the wet and clayey soils, see Appendices D1, D10 and D13.

5.4 Native Species

The results for the selected understorey species are summarized on the grid system in Appendix E. The selection of these species, from the total of 260, was based on their dominance or their significance in reflecting specific site conditions. The data base for all species is available for later reference.

Results reflect the earlier groupings of shrubs by Havel (1968), with some additions:

(a) Species tolerant of excessive wetness:
Agonis linearifolia (see Appendix E4), *Astartea fascicularis* (see Appendix E7), *Calothamnus lateralis* (see Appendix E9), *Euchilopsis linearis* (see Appendix E16), *Hakea varia* (see Appendix E18), *Hypocalymma angustifolium* (see Appendix E20), *Juncus pallidus* (see Appendix E25) and *Pericalymma ellipticum* (see Appendix E32).

(b) Species of optimum moist sites, intolerant of extremes in moisture conditions:
Adenanthos obovatus (see Appendix E3), *Dasypogon bromeliifolius* (see Appendix E14), *Melaleuca seriata* (see Appendix E30), *Phlebocarya ciliata* (see Appendix E34) and *Xanthorrhoea preissii* (see Appendix E39).

(c) Species with wide tolerance, but with maximum development on dry sites:
Jacksonia floribunda (see Appendix E22) and *Melaleuca scabra* (see Appendix E29).

(d) Species without clear cut site preference:
Calytrix flavescens (see Appendix E11) and *Conostephium pendulum* (see Appendix E13).

The results for other specific species are referred to in the following sections on introduced species and the definition of the site-vegetation types.

5.5 Introduced Species

The results illustrated the higher number of introduced species on the disturbed outer sections of Whiteman Park. These results would be even higher if plant cover results had been collected or if the total rankings for introduced species had been plotted, as many of the introduced species dominate the disturbed areas.

The results for selected introduced species are provided in Appendix E (see species with asterisks). Several of the introduced species pose potential management problems, namely:

Ehrharta calycina and *Ehrharta longiflora*:
Potential aggressive weed in native areas on sand dune systems on the Swan Coastal Plain, also increases fuel loads for wildfires. Fusilade may control this weed, however the options of restricting its spread through reducing tracks, disturbed areas and the reduction of intense fires should be addressed by management.

Zantedeschia aethiopica:
Potential aggressive weed in low lying wetlands and water-courses. This species competes strongly with native sedges. Control measures should include grubbing and removal.

Gladiolus caryophyllaceus:
Potential to spread aggressively into relatively undisturbed native vegetation. Control measures should include pulling and removing plant material (including corms).

Typha orientalis:
Potential to invade seasonal wetlands, currently restricted to a swamp in the south-western corner of the Park and on the northern fringes of the Park, Appendix C.

5.6 Vegetation

Following the initial appraisal of the distribution of all species (including those not covered in this report summary) it was decided to map the vegetation using the site-vegetation types as defined by Havel in 1968 for the northern Swan Coastal Plain. The extension of these types to cover the fringing woodlands of Flooded Gum (*Eucalyptus rudis*) and Swamp Paperbark (*Melaleuca rhaphiophylla*) was made at the time of this mapping exercise. A total of 6 site-vegetation types were defined and mapped for Whiteman Park; with several areas being grouped (see attached Vegetation Map - types IJ and JK). The IJ areas were generally cleared, while the JK areas were either cleared or contained a series of very small wetlands which were too small to map separately at the mapping scale.

The site-vegetation types form a continuum from the dry pale grey sands on the dune crests to the seasonally water saturated sands and peats occurring on the permanent swamps in the Park. The vegetation map provides an assessment of the boundaries between types. The limitations of the map relate to the very nature of the continuum (with individual species overlapping several types) and the sampling regime (restricted to 16 transects which were located north-south and approximately 300 metres apart).

Site-vegetation types, G to K were based on Havel, 1968.

G: Low woodland of *Banksia attenuata - Banksia menziesii - Eucalyptus todtiana* on dry pale grey sands on slopes and dune crests. This type occurred on the series of upper dune slopes which were scattered through Whiteman Park.

Indicator species included - *Beaufortia elegans, Conostephium minus, Hibbertia helianthemoides, Leucopogon conostephioides, Scholtzia involucrata, Oxylobium capitatum, Melaleuca scabra, Eremaea pauciflora, Jacksonia densiflora, Astroloma xerophyllum, Boronia purdieana* and the tree species - *Banksia attenuata, Banksia menziesii* and *Eucalyptus todtiana.*

H: Low woodland to low open forest of *Banksia attenuata - Banksia menziesii - Banksia ilicifolia* on deep pale grey sands, dry at surface and moist at depth on dune slopes. This type occurred on the dune slopes on the series of higher dunes scattered through Whiteman Park.

Indicator species included - *Leucopogon conostephioides, Scholtzia involucrata, Xanthorrhoea preissii, Dasypogon bromeliifolius* and the tree species - *Banksia attenuata, Banksia menziesii* and *Banksia ilicifolia.*

I: Open woodland of *Eucalyptus marginata - Eucalyptus calophylla - Banksia ilicifolia* and occasionally *Banksia grandis* on moist sandy soils with dark grey humusoid surface on lower slopes.This type occurred on the drier less undulating areas and dune slopes.

Indicator species included - *Xanthorrhoea preissii and Dasypogon bromeliifolius, Melaleuca seriata, Adenanthos obovatus* and the tree species - *Banksia attenuata, Banksia menziesii* and *Banksia ilicifolia.*

J: Open woodland of *Eucalyptus calophylla* on moister dark grey humusoid soils on flatter lower areas; with local additional species reflecting moister (*Melaleuca preissiana*) or sandier (*Banksia ilicifolia* and *Banksia menziesii*) soils. This type occurred on the extensive flatter areas, which at times have been infrequently subjected to seasonal inundation.

Indicator species included - *Xanthorrhoea preissii, Hypocalymma angustifolium, Pultenaea reticulata, Adenanthos obovatus* and the tree species - *Eucalyptus calophylla.*

K1: Ranging from low open forest of *Melaleuca preissiana - Banksia littoralis* (very occasional *Eucalyptus rudis* on old flow-lines), to closed heath of Myrtaceae species on seasonally water saturated sands and peats of swamp areas. This type occurred primarily on the seasonally wet depressions and swamps scattered through Whiteman Park.

Indicator species included - *Pericalymma ellipticum, Astartea fascicularis, Calothamnus lateralis, Regelia ciliata, Typha orientalis, Verticordia* spp.,*Melaleuca* spp. *Schoenus rodwayanus, Leptocarpus scariosus* and the tree species - *Melaleuca preissiana, Banksia littoralis* and the occasional *Eucalyptus rudis.*

K2: Low open forest to open forest of *Eucalyptus rudis - Melaleuca rhaphiophylla* on sands and organic silty clays along water-courses or seasonally flooded areas. This type was confined largely to the clayey soils associated with the Bennett Brook and its main tributaries.

Indicator species included - *Juncus pallidus*, *Agonis linearifolia*, *Lepidosperma tetraquetrum* and the tree species - *Eucalyptus rudis* and *Melaleuca rhaphiophylla*.

In reviewing the vegetation of the Park, a series of summaries were extracted from the data collected (see the following sections).

5.7 Physiological Stress

The level of physiological stress was recorded at each site in the survey area at Whiteman Park. The results presented on the attached map illustrate the total stress at each site, based on the scale developed, for example:

At one particular site the following species are ranked as follows:

Banksia attenuata - 3
Banksia menziesii - 2
Banksia ilicifolia - 4

The total physiological rating for that site would be 9. Obviously the higher the number, the greater the stress in the plant community. The emphasis was on tree species as they tend to reflect physiological stress more rapidly than the understorey species, see earlier studies by Heddle (1980).

It is well recognized that physiological stress or dieback can be caused by a variety of factors (Old et al., 1980). The results from this study reflect a distinct pattern of higher stress levels on the lower lying slopes on the central western part of Whiteman Park (between Park Street and Woolcott Road) and on the eastern section of the Park (both north and south of Woolcott Road). Both these areas are dominated by types I, J and K1. On the basis of the studies by Heddle (1980) and E.M. Mattiske & Associates (1981, 1982, 1985 and 1988) the cause of this stress could be related to recent pumping activities within Whiteman Park. Nevertheless the susceptibility of species in site-vegetation types I and J to the fungal disease (*Phytophthora cinnamomi*) must also be recognized as a possibility.

On the basis of the field interpretations at the respective recording sites it was estimated that 104 recording sites (19.25%) were reflecting water stress (either from the recent below average annual rainfall years or the pumping of the shallow unconfined aquifer) and 133 recording sites (24.63%) were reflecting possible

signs of disease. Obviously the signs are similar for both causes, with dying back of upper branches. Consequently these interpretations may be altered as more information is extracted and sampling is carried out to test causes.

No verification of the causes of physiological stress was undertaken at the time of the survey, however it is recommended that testing for the fungal disease is carried out in conjunction with officers from the Department of Conservation and Land Management at the earliest opportunity. The location of sampling sites should be based on the stress map provided. In the longer-term a series of transects should be located in several of these pockets to investigate the relationships and changes occurring in the native vegetation. The latter should assist in reviewing management options for the future.

5.8 Other Parameters

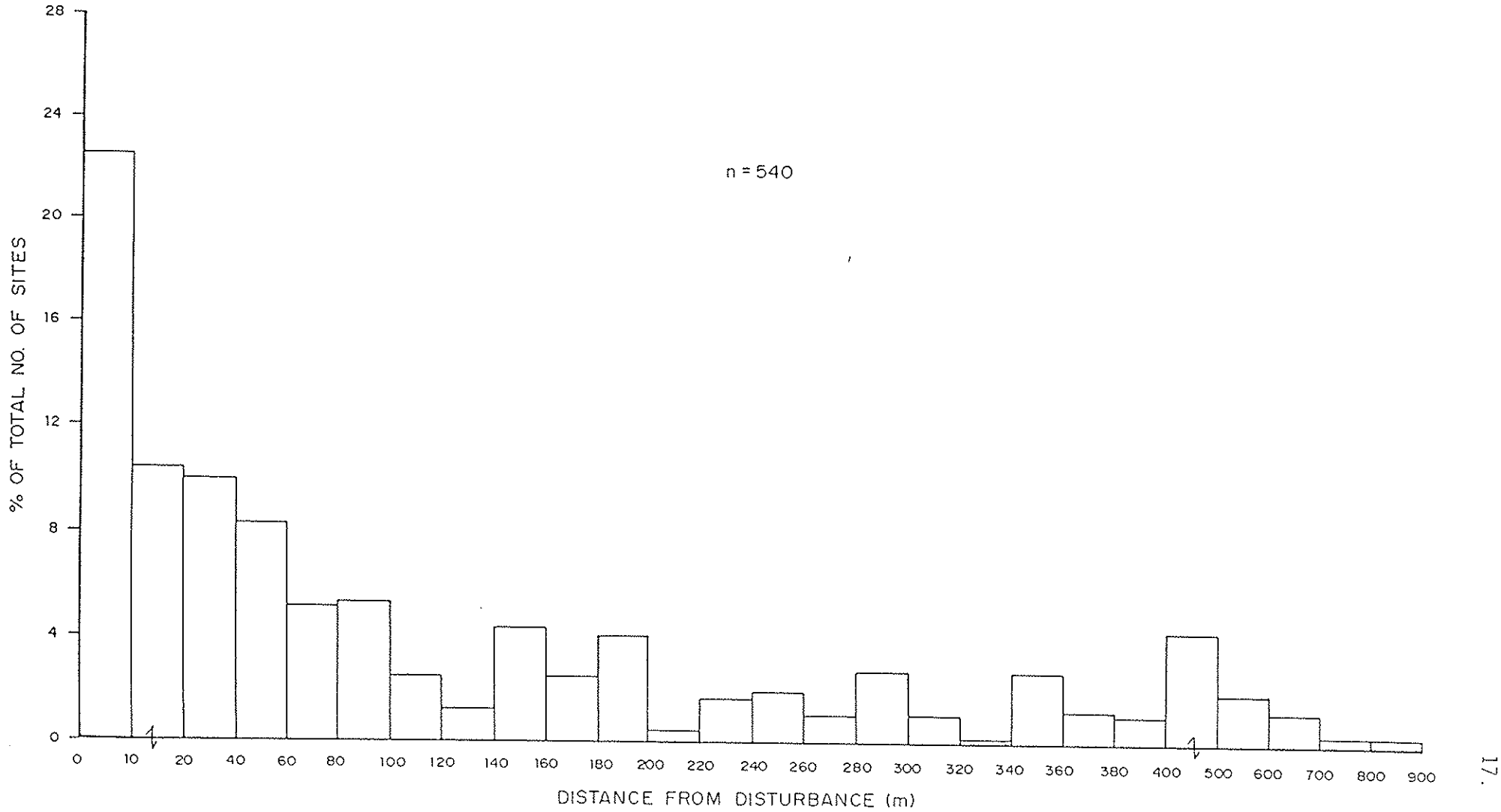
A significant section of Whiteman Park has been cleared for agricultural activities. These activities have included logging, mining, grazing and the development of recreational and parking facilities.

To review the effects of clearing (irrespective of the type - e.g. paddocks, tracks, fire-breaks, car parks) the distance of each recording site to a cleared area or disturbance area was summarized, see Figure 1.

The results indicate that a significant number of sites were relatively close to a cleared or disturbed area (43% of sites were less than 40 metres from a disturbed site). Although the recording sites were not regularly spaced, these results give an indication of the aerial extent of clearing and disturbance. In contrast 14.8% of sites were located 300 metres or more from a disturbed area and 22.6% of sites were located 200 metres or more from a disturbed area. The latter indicates that significant areas have the possibility of maintaining significant areas in relatively undisturbed condition.

Logging activities were recorded on 19.6% of the sites. The majority of the logging has been carried out on species of *Banksia* and *Eucalyptus*. This activity should be restricted to areas where falling timber may occur (e.g. near access routes - tracks, cycle paths and roads). Any logging of healthy trees should be discouraged.

Figure 1: Comparison of Position of Recording Sites with Distance from Disturbance.



Grazing pressure from horses and cows was reflected in ring-barking of tree species at 12 sites (2%) in the cleared areas. In addition some of the persistent native species in the cleared and semi-cleared areas had been heavily grazed, e.g. *Xanthorrhoea preissii* and *Dasypogon bromeliifolius*.

5.9 Fire History

The fire history maps illustrate a regular burning regime for large sections of Whiteman Park, see attached maps on Fire History (1978-83, 1984-88 and the Total Number of Fires). A review of the options for future burning policies should include the following:

- The integrity of the native vegetation (conservation of native plants and communities should be a priority).
- The location of the native plant communities (e.g. protect some areas of each type for flora and fauna conservation).
- The choices of utilizing already disturbed areas, thereby minimizing the need for new clearings and fire-breaks.
- The need to protect the recreational facilities and the people using these facilities.
- The occurrence of introduced species which are favoured by frequent burning.

The effects of severe fires in Whiteman Park, particularly in the wetland areas, was evident through the loss of bark and vigour on some of the tree species.

6. DISCUSSION

A range of ecological studies were undertaken in Whiteman Park. The integrity of the native communities in the less disturbed areas was relatively high, with only small infestations of weeds in the less disturbed areas. Therefore it is recommended that:

Recommendation 1:

The less disturbed areas should be maintained for nature conservation (areas with higher numbers of native plant species and communities).

In these areas recreational use should only be passive, although access could be assisted through surfaced walk-ways and cycle-paths. In any expansion of access routes the significance of

weeds along disturbed tracks and the potential spread of the

dieback disease (*Phytophthora cinnamomi*) should be addressed in the planning stage. Therefore it is recommended that:

Recommendation 2:

The problems of weeds and dieback disease should be addressed at the planning stage.

The aspects of landscape and visual impacts of tracks and other Park users should also be addressed at the planning stage. The vistas which are possible from some of the high points in the Park should not be imposed on by formal tracks. In several areas of the Park it was possible to gain an appreciation of distance and remoteness. Therefore it is recommended that:

Recommendation 3:

The landscape and visual aspects of any developments in the Park should be addressed at the planning stage.

The need to educate the public on the native species and communities is critical. Therefore it is recommended that:

Recommendation 4:

Education programmes should be developed on the native flora and fauna in Whiteman Park.

The long term options for management of semi-cleared and cleared areas should be addressed. Several alternatives could include planting local native species in the disturbed areas around potential recreational areas. The latter could be used for educational and conservation purposes, as well as improving the landscape of local degraded areas. The options of grazing some areas which are already disturbed should be addressed. It is therefore recommended that:

Recommendation 5:

Detailed reviews are undertaken in consultation with a range of groups (e.g. biologists and landscape architects) to assess the management options for the disturbed areas of the Park. At all times the values of the Park for conservation and passive recreation should be considered.

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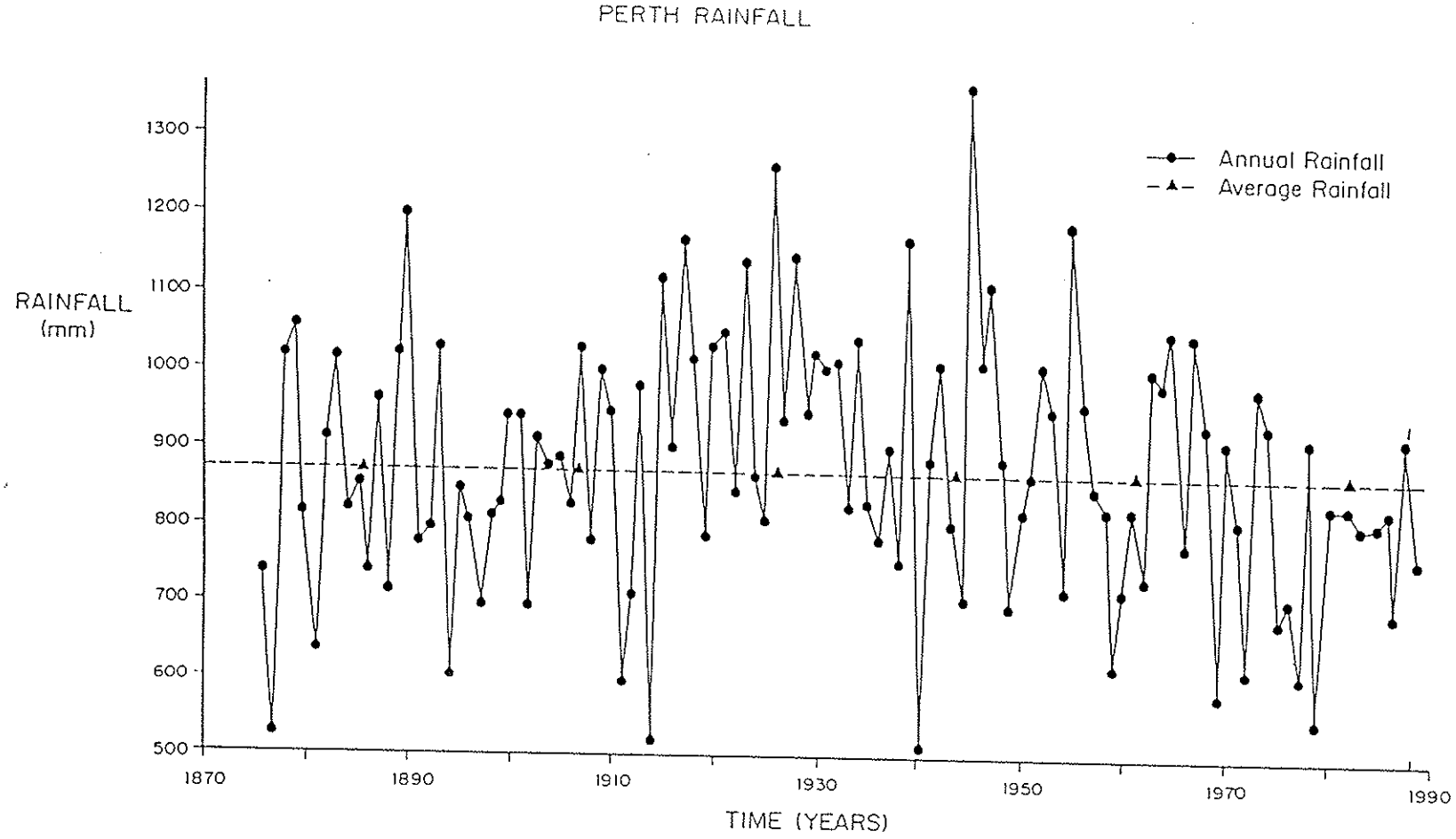

APPENDIX A

RAINFALL DATA – PERTH

APPENDIX C: SUMMARY OF RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

SPECIES RICHNESS - TOTAL NUMBER OF SPECIES

NORTH

Site Numbers

1	2	3	4	5	6	7	8	9	10	
11	12	11	11	13	15	13	16	17	-	
16	21	17	28	15	24	28	24	19	8	
29	31	16	29	21	28	19	22	14	7	
29	22	13	30	26	30	22	26	16	6	
32	30	30	28	18	27	28	27	16	8	
27	23	23	32	21	23	38	29	32	16	
18	24	15	32	29	25	30	26	21	12	
16	19	27	40	31	22	23	10	9	12	
25	29	22	30	29	12	16	13	9	15	
18	16	19	20	20	21	18	15	12	23	
19	15	15	12	24	15	17	13	17	16	13
25	15	16	22	21	22	16	13	12	15	17
18	17	23	14	17	19	16	9	13	8	19
22	13	16	13	28	17	14	13	14	6	-
9	5	10	4	7	8					
7	7	6	6	6	5					
7	8	7	6	14	8					

APPENDIX C: SUMMARY OF RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

TOTAL NUMBER OF NATIVE SPECIES

NORTH

Site Numbers

1	2	3	4	5	6	7	8	9	10	
7	6	6	7	8	9	8	14	16	-	
12	18	12	28	14	21	24	22	17	3	
26	26	12	25	19	26	19	20	12	3	
24	16	8	25	25	29	20	25	15	3	
25	23	27	24	15	25	25	25	14	3	
24	19	21	28	19	22	35	27	28	9	
16	21	14	27	26	22	27	25	17	7	
13	18	23	35	29	22	17	7	3	7	
21	24	20	28	27	10	13	9	5	10	
13	13	18	19	19	18	15	9	8	19	
13	12	13	11	23	12	14	8	13	11	8
18	12	14	18	18	20	12	10	9	8	8
12	14	19	12	15	16	14	3	5	3	9
14	8	12	10	23	15	8	7	10	2	-
3	1	4	1	2	3					
2	1	3	3	2	1					
2	4	3	2	6	3					

APPENDIX C: SUMMARY OF RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

TOTAL NUMBER OF INTRODUCED SPECIES

NORTH

Site Numbers										
1	2	3	4	5	6	7	8	9	10	
4	6	5	4	5	6	5	2	1	-	
4	3	5	0	1	3	4	2	2	5	
3	5	4	3	2	2	0	2	2	4	
5	6	5	5	1	1	2	1	1	3	
7	6	3	4	3	2	3	2	2	5	
3	4	2	4	2	1	3	2	4	7	
2	3	1	5	3	3	3	1	4	5	
3	1	4	5	2	0	2	3	6	5	
4	5	2	2	2	2	3	4	4	5	
5	3	1	1	1	3	3	6	4	4	
6	3	2	1	1	3	3	5	4	5	8
7	3	2	4	3	2	4	3	3	7	9
6	3	4	2	2	3	2	6	8	5	10
8	5	4	3	5	2	6	6	4	4	-
6	4	6	3	5	5					
5	6	3	3	4	4					
5	4	4	4	8	5					

APPENDIX D: SUMMARY OF TREE SPECIES RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

Allocasuarina fraseriana NORTH

Site Numbers

1	2	3	4	5	6	7	8	9	10	
0	0	1	0	0	0	0	0	0	0	
0	1	1	0	1	1	1	0	0	1	
0	1	1	1	1	1	1	0	1	0	
0	1	0	0	1	1	1	1	1	0	
1	1	1	1	0	1	1	1	1	0	
0	0	1	0	0	2	1	0	1	1	
1	1	0	1	1	1	1	1	0	0	
1	1	2	1	1	1	1	0	0	1	
2	1	1	1	0	0	2	1	0	1	
0	0	1	1	2	1	1	1	2	4	
0	0	1	0	2	1	2	1	2	1	0
0	1	0	0	1	0	1	1	1	0	0
1	0	0	1	1	1	1	0	0	0	1
0	1	0	0	1	4	0	2	0	0	0
0	0	0	0	0	0					
0	0	0	0	0	0					
0	0	0	2	0	0					

APPENDIX D: SUMMARY OF TREE SPECIES RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

Banksia attenuata

NORTH

Site Numbers										
1	2	3	4	5	6	7	8	9	10	
0	0	0	0	0	0	0	5	4	0	
1	0	1	4	1	2	2	3	5	0	
4	4	1	2	1	2	2	0	2	0	
2	1	0	2	3	3	1	5	3	0	
2	1	1	0	1	2	2	2	3	0	
2	1	4	2	0	2	4	4	4	1	
1	2	1	1	3	2	3	2	2	0	
1	1	2	2	3	2	2	0	0	1	
3	3	2	4	3	0	2	1	0	1	
0	1	0	1	1	1	2	2	0	2	
1	0	0	0	1	1	2	0	1	1	0
0	0	0	0	2	4	1	1	0	0	0
0	0	0	0	1	3	1	0	0	0	0
0	0	0	1	0	4	0	1	1	0	0
0	0	0	0	0	0					
0	0	0	0	0	0					
0	0	0	0	0	1					

APPENDIX D: SUMMARY OF TREE SPECIES RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

Banksia grandis NORTH

Site Numbers

1	2	3	4	5	6	7	8	9	10	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	1	0	0	
1	0	0	0	0	0	0	0	0	0	
0	1	1	1	0	0	0	0	1	0	
0	1	0	1	0	0	0	0	0	0	
0	0	0	1	0	0	0	0	0	0	
0	0	0	1	0	0	1	0	0	0	
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	1	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0					
0	0	0	0	0	0					
0	0	0	0	0	0					

APPENDIX D: SUMMARY OF TREE SPECIES RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

Banksia ilicifolia NORTH

Site Numbers

1	2	3	4	5	6	7	8	9	10	
0	0	0	0	0	0	0	3	1	0	
0	1	0	1	0	1	1	1	1	0	
1	1	0	0	0	1	1	1	0	0	
1	1	0	1	2	1	0	2	1	0	
1	0	1	1	1	1	1	2	1	1	
1	1	2	2	0	1	1	2	2	1	
0	1	2	2	1	0	1	0	1	0	
1	1	1	2	1	0	1	0	0	1	
2	1	1	1	1	0	1	1	0	1	
1	0	0	1	1	1	1	0	1	0	
0	0	0	0	1	1	1	0	1	2	0
0	0	0	0	0	1	0	1	1	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	3	1	1	2	0	0
0	0	0	0	0	0					
0	0	0	0	0	0					
0	0	0	0	0	0					

APPENDIX D: SUMMARY OF TREE SPECIES RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

Banksia littoralis

NORTH

Site Numbers

1	2	3	4	5	6	7	8	9	10	
0	0	0	0	0	0	0	0	0	0	
1	0	0	0	0	0	0	0	0	0	
0	0	1	0	0	0	0	0	0	0	
0	0	1	0	0	0	0	0	0	0	
0	0	1	0	1	0	0	1	0	0	
1	1	2	0	0	0	0	0	0	0	
1	1	3	1	0	0	0	2	0	0	
0	1	1	0	0	1	1	1	0	0	
0	0	0	0	1	0	0	0	0	1	
0	1	1	1	0	0	0	0	0	0	
0	0	0	1	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	1	0	0	0	0	3
0	0	0	0	0	0	0	0	1	0	0
0	0	0	0	0	0					
0	0	0	0	0	0					
0	0	0	0	0	1					

APPENDIX D: SUMMARY OF TREE SPECIES RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

Banksia menziesii

NORTH

Site Numbers

1	2	3	4	5	6	7	8	9	10	
0	0	0	0	0	0	0	2	3	0	
1	1	1	3	1	1	2	1	2	0	
3	3	1	1	1	1	1	1	1	0	
2	1	0	2	1	2	0	2	3	0	
1	1	0	0	1	1	1	2	1	1	
2	1	3	2	1	1	3	4	3	1	
1	2	0	1	2	2	2	2	1	0	
1	1	3	2	2	1	1	0	0	1	
3	2	2	4	2	0	1	1	0	1	
0	1	1	2	1	2	1	1	2	2	
0	0	0	1	2	0	1	1	1	2	0
1	0	0	1	2	4	1	1	1	0	0
0	0	0	0	1	3	1	0	0	0	0
0	0	1	0	0	4	0	2	1	0	0
0	0	0	0	0	0					
0	0	0	1	0	0					
0	0	0	1	0	2					

APPENDIX D: SUMMARY OF TREE SPECIES RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

Eucalyptus calophylla

NORTH

Site Numbers

1	2	3	4	5	6	7	8	9	10	
3	4	2	3	3	2	0	0	0	0	
3	4	3	2	2	0	1	0	0	1	
1	2	2	1	1	0	0	1	1	2	
1	1	0	1	1	0	0	0	0	2	
2	2	1	1	1	0	0	0	1	2	
3	1	2	3	1	0	1	1	1	1	
3	3	1	5	2	0	1	1	2	1	
1	2	2	2	1	1	1	1	3	3	
2	1	1	1	0	0	2	5	3	2	
2	1	1	0	1	2	3	4	2	2	
3	1	0	1	1	1	2	3	2	3	5
1	1	1	0	1	0	2	1	4	1	0
1	1	0	1	1	0	2	0	2	0	4
1	1	0	0	0	0	1	0	1	1	0
0	0	1	0	0	0					
1	0	1	0	1	0					
0	0	1	0	2	0					

APPENDIX D: SUMMARY OF TREE SPECIES RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

Eucalyptus marginata

NORTH

Site Numbers										
1	2	3	4	5	6	7	8	9	10	
2	1	1	1	0	0	0	0	0	0	
2	2	1	0	1	0	0	0	0	1	
1	1	1	1	1	1	1	0	1	1	
1	1	1	0	1	0	1	0	1	1	
1	1	1	2	1	0	0	1	0	0	
1	1	2	4	1	0	0	0	1	1	
0	1	1	2	1	0	1	0	1	0	
1	1	2	1	1	1	1	0	0	0	
1	0	0	1	0	1	1	1	1	1	
1	1	1	0	1	1	1	1	1	3	
1	0	1	1	1	1	1	0	2	1	0
1	0	1	0	0	2	1	0	1	0	0
0	1	1	0	1	1	1	0	0	0	0
0	1	0	1	1	0	1	3	1	0	-
0	0	0	0	0	0					
0	0	0	2	0	0					
0	0	0	0	0	1					

APPENDIX D: SUMMARY OF TREE SPECIES RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

Eucalyptus rudis

NORTH

Site Numbers

1	2	3	4	5	6	7	8	9	10	
0	0	0	0	0	0	0	0	0	-	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
1	0	0	0	0	0	0	0	0	0	
0	1	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	1	0	0	0	0	
1	0	0	0	0	0	0	1	0	0	0
0	0	0	0	0	0	1	0	1	5	2
0	0	0	0	1	1	2	3	1	2	0
0	0	0	0	0	0	1	0	0	1	-
0	0	0	0	0	0					
0	0	1	0	0	1					
0	0	0	0	0	0					

APPENDIX D: SUMMARY OF TREE SPECIES RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

Eucalyptus todtiana

NORTH

Site Numbers

1	2	3	4	5	6	7	8	9	10	
0	0	0	0	1	1	0	2	1	-	
0	0	0	0	0	1	1	1	1	0	
1	0	0	0	1	1	1	2	0	0	
1	1	1	0	0	1	1	1	1	0	
0	0	1	1	1	0	1	0	1	1	
0	1	0	0	0	0	1	1	1	1	
0	0	0	0	1	1	1	1	0	0	
0	0	0	0	1	0	1	0	0	1	
0	1	1	1	1	0	0	1	1	0	
1	0	0	1	1	0	1	1	1	0	
0	0	0	0	1	0	1	1	0	0	0
1	1	1	1	1	2	0	0	0	0	0
2	1	1	1	0	1	0	0	0	0	2
3	1	0	0	1	1	1	0	1	0	0
0	0	0	0	0	0					
0	0	0	1	0	0					
0	0	0	0	0	0					

APPENDIX D: SUMMARY OF TREE SPECIES RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

Melaleuca preissiana NORTH

Site Numbers

1	2	3	4	5	6	7	8	9	10	
0	0	0	0	1	1	1	0	0	0	
1	1	2	0	2	1	0	0	0	1	
0	0	1	1	1	1	1	1	0	1	
0	1	1	0	1	0	0	0	0	0	
1	1	1	1	1	0	1	0	1	0	
1	3	0	1	3	1	0	1	0	2	
3	1	4	1	1	0	2	3	3	4	
1	2	1	2	1	1	1	4	3	2	
0	0	0	0	1	2	2	1	6	2	
1	1	2	0	1	3	1	3	4	0	
0	1	1	2	1	1	3	3	3	2	1
0	1	2	1	0	0	2	1	3	4	4
1	1	0	1	1	0	1	0	2	2	3
0	1	0	1	0	0	2	0	1	0	0
1	0	2	0	2	1					
1	0	1	0	0	0					
0	0	1	0	1	0					

APPENDIX D: SUMMARY OF TREE SPECIES RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

Melaleuca rhaphiophylla

NORTH

Site Numbers

1	2	3	4	5	6	7	8	9	10	
0	0	0	0	0	6	0	0	0	-	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	1	0	0	0	0	0	0	0	0	
0	0	1	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	1	2	2	3
0	1	0	1	1	2	2	3	1	3	0
0	1	2	0	0	0	1	2	0	3	-
1	0	0	0	0	1					
0	0	2	0	1	0					
0	0	0	0	0	0					

APPENDIX D: SUMMARY OF TREE SPECIES RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

Nuytsia floribunda

NORTH

Site Numbers

1	2	3	4	5	6	7	8	9	10	
1	1	2	1	2	2	1	1	1	0	
1	2	1	1	2	1	1	0	2	0	
2	1	1	1	0	1	1	1	0	0	
1	1	1	0	1	1	1	1	0	0	
1	1	1	1	1	0	0	1	1	1	
1	1	1	2	2	0	1	2	0	1	
1	0	1	2	1	1	1	1	0	1	
1	1	1	1	1	1	1	1	0	0	
1	1	1	0	1	0	1	3	1	1	
1	1	0	1	1	1	3	1	1	1	
2	1	1	0	1	1	1	1	1	2	1
1	1	1	2	0	1	1	0	0	1	0
1	1	2	1	0	0	0	0	0	0	1
1	0	0	1	1	0	1	0	0	0	0
1	0	0	0	0	0					
0	0	0	0	0	0					
0	0	0	0	0	0					

APPENDIX E: SUMMARY OF SELECTED UNDERSTOREY SPECIES RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

Acacia pulchella

NORTH

Site Numbers

1	2	3	4	5	6	7	8	9	10	
0	0	0	0	0	1	0	0	1	0	
0	0	0	0	1	0	1	0	0	0	
0	1	0	1	0	0	1	0	0	0	
1	0	1	0	1	1	1	1	0	0	
0	1	1	0	1	1	1	0	1	0	
1	0	0	0	0	0	2	2	1	1	
0	1	0	0	0	1	1	1	0	0	
0	1	0	1	1	1	1	1	0	0	
0	1	1	1	0	0	1	0	0	0	
1	0	0	1	0	1	0	0	0	0	
0	0	1	1	0	1	1	0	0	0	0
2	1	1	1	1	0	0	0	1	0	0
2	1	1	1	1	0	2	0	0	0	0
1	0	1	0	0	0	1	0	0	0	0
0	0	0	0	0						
0	0	0	0	0						
0	0	0	0	0						

APPENDIX E: SUMMARY OF SELECTED UNDERSTOREY SPECIES RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

Adenanthos cygnorum

NORTH

Site Numbers										
1	2	3	4	5	6	7	8	9	10	
0	0	0	0	0	0	1	2	0	0	
0	0	0	3	1	3	0	3	0	0	
3	0	0	1	1	1	0	1	0	0	
2	0	0	0	1	1	1	0	1	0	
1	0	1	0	0	0	1	1	1	0	
1	0	0	0	0	1	1	1	1	0	
0	0	0	0	0	1	1	1	0	0	
1	1	0	1	1	0	1	0	0	0	
1	1	1	1	1	0	0	0	0	0	
0	1	1	1	0	0	0	0	0	3	
0	1	1	0	1	0	0	0	1	0	0
3	1	1	1	1	0	0	0	0	0	0
0	1	1	1	1	0	0	0	0	0	0
0	0	2	1	3	0	0	0	0	0	0
0	0	0	0	0	0					
0	0	0	0	0	0					
0	0	0	0	0	0					

APPENDIX E: SUMMARY OF SELECTED UNDERSTOREY SPECIES RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

Adenanthos obovatus

NORTH

Site Numbers										
1	2	3	4	5	6	7	8	9	10	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	1	1	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	1	0	0	0	
0	0	0	0	0	0	0	2	2	0	
0	0	0	0	0	0	1	2	2	0	
0	0	0	0	0	1	1	0	0	0	
0	0	0	0	0	0	0	0	0	1	
0	0	0	1	0	0	0	0	0	0	
0	0	0	0	0	0	1	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	1	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0					
0	0	0	0	0	0					
0	0	0	0	0	0					

APPENDIX E: SUMMARY OF SELECTED UNDERSTOREY SPECIES RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

Agonis linearifolia

NORTH

Site Numbers

1	2	3	4	5	6	7	8	9	10	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	1	
0	0	0	0	0	0	0	0	2	1	
0	1	0	0	0	0	0	0	0	0	
0	0	0	0	1	0	0	0	0	0	
0	1	1	0	0	0	0	0	0	0	
0	0	0	2	1	1	0	0	1	0	0
0	1	0	0	0	0	0	1	1	0	0
0	1	0	1	1	1	1	0	0	0	0
0	0	1	0	0	0	0	0	0	0	0
0	0	0	0	0	0					
0	0	0	0	0	0					
2	0	0	0	0	0					

APPENDIX E: SUMMARY OF SELECTED UNDERSTOREY SPECIES RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

* Aira caryophyllea

NORTH

Site Numbers

1	2	3	4	5	6	7	8	9	10	
4	5	2	4	5	5	5	5	0	0	
3	3	5	0	1	2	3	3	3	4	
2	2	4	2	1	1	1	2	4	4	
2	4	5	0	1	1	2	3	2	4	
3	4	2	5	2	1	2	3	2	5	
2	2	3	5	3	0	1	1	4	5	
1	1	1	5	2	2	1	3	4	3	
1	1	2	5	1	1	1	3	0	5	
2	1	1	1	1	4	3	5	3	4	
4	3	2	0	1	5	4	5	3	4	
5	3	2	0	1	4	4	5	4	2	4
4	3	3	3	2	1	3	3	3	2	0
2	2	5	1	1	0	1	0	3	0	4
4	4	3	3	5	2	1	4	3	2	0
0	0	0	0	0	1					
0	2	0	0	0	0					
0	0	0	0	0	0					

APPENDIX E: SUMMARY OF SELECTED UNDERSTOREY SPECIES RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

* Arctotheca calendula

NORTH

Site Numbers

1	2	3	4	5	6	7	8	9	10	
0	0	3	0	2	1	0	0	0	0	
0	0	1	0	0	0	0	0	0	3	
0	0	2	0	0	0	0	0	2	2	
0	1	1	0	0	0	0	0	0	2	
0	0	0	0	1	0	0	0	1	1	
0	0	0	0	0	0	0	0	0	2	
0	0	0	0	0	0	0	0	0	1	
1	0	0	0	0	0	0	0	0	1	
0	0	0	0	0	0	0	1	1	1	
0	0	0	0	0	0	0	1	1	0	
0	0	1	0	0	1	0	1	1	0	0
0	0	1	1	0	0	0	1	0	0	0
0	1	0	0	0	0	0	0	2	0	0
1	1	0	0	0	0	1	0	1	2	0
3	0	3	3	5	3					
2	1	0	2	1	4					
0	0	0	5	0	5					

APPENDIX E: SUMMARY OF SELECTED UNDERSTOREY SPECIES RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

Astartea fascicularis

NORTH

Site Numbers

1	2	3	4	5	6	7	8	9	10	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	1	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	1	
1	1	2	0	0	0	1	1	2	2	
1	1	0	0	1	1	0	1	0	0	
0	0	0	0	0	0	1	0	0	1	
0	1	1	0	0	0	0	0	0	0	
0	0	1	1	1	1	0	1	1	2	0
0	0	1	1	0	0	1	1	1	1	1
2	1	0	2	2	0	2	0	1	0	0
0	0	1	0	0	0	0	0	0	0	0
0	0	0	0	0	0					
0	0	0	0	0	0					
1	0	0	0	0	0					

APPENDIX E: SUMMARY OF SELECTED UNDERSTOREY SPECIES RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

* Briza maxima

NORTH

Site Numbers

1	2	3	4	5	6	7	8	9	10	
0	0	0	0	0	1	1	0	0	0	
0	0	1	0	1	1	1	2	0	0	
0	1	0	0	1	1	0	0	0	0	
1	1	0	0	0	1	0	0	0	0	
2	2	0	0	1	1	1	0	1	0	
1	1	0	1	0	0	1	0	1	1	
1	0	0	2	0	1	1	0	1	0	
1	1	0	2	0	0	1	1	0	0	
0	1	0	0	0	0	1	0	0	1	
0	1	0	1	1	0	1	0	1	3	
0	1	0	0	1	1	2	2	1	2	0
1	1	0	1	1	2	1	1	1	0	1
1	1	0	1	1	2	2	0	1	0	0
0	0	0	0	1	4	1	0	1	0	0
0	0	0	0	0	0					
0	0	0	0	0	0					
0	0	0	0	0	0					

APPENDIX E: SUMMARY OF SELECTED UNDERSTOREY SPECIES RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

Calothamnus lateralis

NORTH

Site Numbers

1	2	3	4	5	6	7	8	9	10
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	1	0	0	0
1	1	1	0	0	1	0	0	0	0
0	0	0	0	0	1	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	1	0	0	0	1	0	0	0	0
0	0	0	1	0	0	0	0	0	0	0
0	1	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0

APPENDIX E: SUMMARY OF SELECTED UNDERSTOREY SPECIES RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

Calytrix angulata

NORTH

Site Numbers

1	2	3	4	5	6	7	8	9	10	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	2	0	0	0	0	0	0	0	0	
1	1	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	1	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	1	1	0	0	0	0	0	0	
0	0	0	0	1	0	0	0	0	1	
0	0	0	0	0	0	0	0	1	0	
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	1	0	0	1	0	0	0
0	0	0	0	0	1	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0					
0	0	0	0	0	0					
0	0	0	0	0	0					

APPENDIX E: SUMMARY OF SELECTED UNDERSTOREY SPECIES RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

Calytrix flavescens NORTH

Site Numbers

1	2	3	4	5	6	7	8	9	10	
0	0	0	0	0	1	0	1	4	0	
0	0	0	4	1	2	1	3	0	0	
3	1	0	0	1	2	1	2	2	0	
1	1	0	0	1	2	2	1	3	0	
1	1	1	1	1	2	1	1	2	0	
1	0	2	2	0	2	4	2	1	1	
0	1	0	0	2	2	2	2	1	0	
1	0	0	1	2	1	2	0	0	0	
0	1	1	1	2	0	0	0	0	0	
0	1	0	1	1	1	1	0	0	3	
0	0	0	0	1	0	0	0	0	0	0
0	1	0	1	1	1	0	0	0	0	0
1	1	1	1	1	1	0	0	0	0	0
0	0	0	0	1	0	0	0	0	0	0
0	0	0	0	0	0					
0	0	0	0	0	0					
0	0	0	0	0	0					

APPENDIX E: SUMMARY OF SELECTED UNDERSTOREY SPECIES RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

Calytrix fraseri

NORTH

Site Numbers

1	2	3	4	5	6	7	8	9	10	
0	0	0	0	0	0	0	0	0	0	
0	1	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	1	1	0	0	0	0	
1	0	0	2	1	1	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
1	1	0	1	1	0	1	0	0	0	
0	1	0	0	0	0	1	0	0	0	
0	0	1	1	1	1	1	0	0	0	
0	0	0	1	0	1	0	0	0	0	0
0	0	1	0	0	0	0	0	0	0	0
0	1	0	0	0	0	1	0	0	0	0
0	0	1	0	0	0	0	0	0	0	0
0	0	0	0	0	0					
0	0	0	0	0	0					
0	0	0	0	0	0					

APPENDIX E: SUMMARY OF SELECTED UNDERSTOREY SPECIES RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

Conostephium pendulum NORTH

Site Numbers

1	2	3	4	5	6	7	8	9	10	
0	0	0	0	1	1	0	4	2	0	
0	0	1	3	1	1	2	1	0	0	
0	2	1	1	0	1	1	1	1	0	
1	1	0	2	1	2	2	3	2	0	
1	1	1	0	0	1	1	1	1	0	
1	0	1	2	0	1	3	1	1	0	
0	2	0	2	1	1	1	2	1	0	
1	1	1	3	2	2	1	0	0	0	
1	1	1	2	2	0	0	0	0	0	
1	0	1	1	1	0	1	0	0	0	
0	1	0	1	1	1	1	0	1	0	0
1	1	1	1	2	3	0	1	0	0	0
1	1	0	1	1	1	0	0	0	0	0
0	1	0	0	1	0	0	0	0	0	0
0	0	0	0	0	0					
0	0	0	0	0	0					
0	0	0	0	0	0					

APPENDIX E: SUMMARY OF SELECTED UNDERSTOREY SPECIES RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

Dasypogon bromeliifolius NORTH

Site Numbers										
1	2	3	4	5	6	7	8	9	10	
1	0	1	1	1	1	0	0	0	0	
2	1	1	2	2	1	2	0	0	0	
3	1	1	2	1	1	1	3	0	1	
3	1	1	2	1	1	1	2	2	0	
2	2	2	2	1	1	1	1	2	0	
2	3	3	3	2	1	0	2	2	0	
2	2	2	4	2	0	1	3	2	0	
1	2	3	3	1	2	1	1	0	2	
3	2	0	3	0	1	1	2	0	1	
2	1	1	1	1	1	2	2	1	2	
3	1	1	1	1	1	2	1	2	4	0
1	1	1	1	2	0	2	1	1	0	0
0	1	1	1	0	0	1	0	0	0	2
1	1	0	1	1	4	0	1	1	0	0
0	0	0	0	0	0					
0	0	0	0	0	0					
0	0	0	0	0	0					

APPENDIX E: SUMMARY OF SELECTED UNDERSTOREY SPECIES RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

* Ehrharta calycina

NORTH

Site Numbers										
1	2	3	4	5	6	7	8	9	10	
3	3	3	4	3	2	3	0	0	0	
3	0	3	0	1	1	1	2	0	0	
2	1	3	0	1	1	0	0	0	0	
2	1	2	1	0	0	0	0	0	0	
2	1	1	1	1	1	1	0	0	2	
0	0	0	0	0	0	0	0	0	1	
0	0	0	0	0	0	0	0	0	1	
1	0	0	0	0	0	0	0	0	2	
0	2	0	0	0	0	1	1	1	2	
4	1	1	0	1	1	0	1	2	4	
4	1	1	0	1	1	1	0	1	3	5
3	1	0	0	1	0	2	1	0	1	2
2	1	2	0	1	1	1	0	2	1	2
3	1	1	0	2	3	1	5	3	0	0
0	1	0	0	0	0					
0	0	0	0	0	0					
4	0	0	3	0	3					

APPENDIX E: SUMMARY OF SELECTED UNDERSTOREY SPECIES RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

Euchilopsis linearis NORTH

Site Numbers

1	2	3	4	5	6	7	8	9	10	
0	0	0	0	0	0	0	0	0	0	
2	1	1	0	0	0	0	0	0	0	
0	0	0	1	0	1	0	0	0	0	
0	0	0	0	0	0	1	0	0	0	
0	1	0	0	1	0	0	1	0	0	
0	0	0	0	0	0	0	1	0	0	
0	0	0	0	0	0	1	0	1	0	
1	0	0	0	1	0	0	1	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	1	1	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	1	0	0	0
0	0	0	0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0					
0	0	0	0	0	0					
0	0	0	0	0	0					

APPENDIX E: SUMMARY OF SELECTED UNDERSTOREY SPECIES RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

Gompholobium tomentosum NORTH

Site Numbers

1	2	3	4	5	6	7	8	9	10	
0	0	0	0	1	1	0	0	0	0	
1	1	1	0	1	1	1	1	0	0	
2	2	0	0	1	1	0	0	0	0	
1	1	1	2	1	1	0	1	0	0	
1	1	2	0	1	1	1	2	1	0	
1	0	1	2	1	1	1	1	3	0	
1	1	0	2	1	1	1	1	1	0	
1	1	1	3	2	2	2	0	0	0	
1	1	1	3	1	0	0	0	0	0	
0	1	0	1	1	0	0	0	0	0	
0	0	0	0	1	1	1	0	1	0	0
0	0	1	1	1	0	1	1	0	0	0
0	1	0	0	1	0	0	0	0	0	0
0	1	1	0	0	0	0	0	0	0	0
0	0	0	0	0	0					
0	0	0	0	0	0					
0	0	0	0	0	0					

APPENDIX E: SUMMARY OF SELECTED UNDERSTOREY SPECIES RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

Hakea varia

NORTH

Site Numbers

1	2	3	4	5	6	7	8	9	10	
0	0	0	0	0	0	0	0	0	0	
1	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	1	0	0	0	0	0	0	0	
1	1	0	0	0	0	0	0	0	0	
1	0	2	0	0	0	0	1	0	0	
1	1	1	0	0	0	0	0	0	0	
0	0	0	0	0	1	0	0	0	0	
0	0	0	0	1	0	0	0	0	0	
0	0	1	1	0	0	1	0	0	0	0
0	0	0	1	0	0	1	1	0	0	0
0	0	0	0	1	0	0	0	0	0	0
0	0	0	0	0	0	0	0	1	0	0
1	0	0	0	0	0					
0	0	0	0	0	0					
0	0	0	0	0	0					

APPENDIX E: SUMMARY OF SELECTED UNDERSTOREY SPECIES RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

Hibbertia hypericoides

NORTH

Site Numbers

1	2	3	4	5	6	7	8	9	10	
0	0	0	0	0	1	0	3	4	0	
0	0	0	2	0	2	0	3	2	0	
0	1	0	0	1	1	1	1	1	0	
1	1	1	1	1	1	1	1	1	0	
1	1	1	1	0	1	1	0	1	0	
1	0	1	0	0	2	1	2	1	1	
1	2	0	0	1	2	1	2	0	0	
1	1	2	1	1	1	1	0	0	0	
1	2	2	2	1	0	2	1	0	1	
0	1	0	1	1	2	2	0	1	4	
0	1	1	0	1	1	1	1	1	1	0
3	1	0	1	1	2	1	1	0	0	0
2	1	0	1	1	3	1	0	0	0	0
1	1	1	1	1	2	0	1	0	0	0
0	0	0	0	0	0					
0	0	0	0	0	0					
0	0	0	0	0	0					

APPENDIX E: SUMMARY OF SELECTED UNDERSTOREY SPECIES RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

Hypocalymma angustifolium NORTH

Site Numbers										
1	2	3	4	5	6	7	8	9	10	
0	0	0	1	0	0	3	0	0	0	
1	1	0	0	1	0	0	0	0	0	
0	0	1	1	0	1	1	1	0	0	
0	0	0	0	1	0	0	0	0	0	
2	1	0	0	1	0	0	1	0	0	
1	3	3	0	1	0	0	2	0	0	
0	1	3	0	1	0	2	2	2	0	
1	1	0	1	1	1	1	1	0	0	
0	0	0	0	1	0	1	0	0	1	
0	0	0	1	0	1	0	0	0	0	
0	1	1	2	1	0	1	0	1	0	1
0	1	1	1	0	0	1	0	1	0	0
0	1	0	1	1	0	1	0	0	0	0
0	0	0	0	1	0	1	0	0	0	0
0	0	0	0	0	0					
0	0	0	0	0	0					
0	0	0	0	0	0					

APPENDIX E: SUMMARY OF SELECTED UNDERSTOREY SPECIES RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

* Hypochaeris glabra

NORTH

Site Numbers

1	2	3	4	5	6	7	8	9	10	
0	1	3	4	3	1	0	0	0	0	
0	0	2	0	1	0	0	0	0	3	
0	1	1	0	0	0	0	0	2	3	
0	1	2	3	0	0	0	0	1	2	
3	2	0	1	1	0	0	0	1	2	
1	1	0	0	0	0	0	0	0	2	
1	0	0	0	0	0	1	0	3	2	
0	0	0	0	0	0	1	1	4	3	
1	1	0	0	0	0	0	1	1	1	
0	1	0	1	0	0	3	2	0	0	
0	1	2	0	0	0	1	1	0	1	4
0	1	2	1	0	0	1	1	1	2	1
2	1	0	1	1	1	0	2	1	0	1
0	1	1	3	0	0	3	1	0	2	0
3	3	3	1	0	1					
4	3	5	0	3	3					
4	3	3	0	2	0					

APPENDIX E: SUMMARY OF SELECTED UNDERSTOREY SPECIES RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

Jacksonia densiflora NORTH

Site Numbers

1	2	3	4	5	6	7	8	9	10	
0	1	1	1	0	1	0	1	0	0	
0	1	1	2	1	1	1	1	0	0	
2	2	1	1	1	1	1	2	0	0	
2	1	1	2	2	1	1	3	0	0	
1	1	1	2	1	1	1	1	1	0	
1	0	2	3	0	2	2	1	3	1	
1	1	0	3	1	2	1	1	1	0	
1	0	1	3	2	0	1	0	0	0	
1	1	1	1	2	0	1	0	0	1	
1	1	0	0	0	0	0	0	0	1	
2	1	0	0	0	0	0	0	0	0	0
3	1	0	1	0	3	0	0	0	0	0
2	1	0	1	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0					
0	0	0	0	0	0					
0	0	0	0	0	0					

APPENDIX E: SUMMARY OF SELECTED UNDERSTOREY SPECIES RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

Jacksonia furcellata

NORTH

Site Numbers

1	2	3	4	5	6	7	8	9	10	
1	0	0	3	0	1	0	0	0	0	
1	1	1	1	1	0	0	0	0	0	
0	0	1	0	0	0	0	1	0	0	
1	1	0	1	0	0	0	0	0	0	
1	1	0	0	1	1	0	0	0	0	
1	1	0	0	1	0	0	0	0	0	
2	1	0	0	1	0	0	0	0	0	
1	1	0	0	0	0	1	0	0	1	
0	1	0	1	0	1	0	0	0	0	
0	1	1	0	1	0	0	0	0	0	
0	1	0	0	0	0	0	1	1	0	0
0	0	0	0	1	0	1	0	0	0	0
0	0	0	0	1	1	1	0	0	0	1
0	1	0	1	0	0	1	1	3	0	0
0	0	0	0	0	0					
0	0	0	0	0	0					
0	0	0	0	0	0					

APPENDIX E: SUMMARY OF SELECTED UNDERSTOREY SPECIES RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

Jacksonia sternbergiana

NORTH

Site Numbers

1	2	3	4	5	6	7	8	9	10	
1	2	0	1	0	0	0	0	4	0	
1	1	0	0	1	0	0	0	0	0	
0	1	2	1	0	0	1	0	0	0	
0	1	1	1	0	0	0	0	0	0	
0	1	0	0	0	0	1	0	0	0	
1	0	0	0	1	0	0	0	0	0	
0	1	0	0	1	0	0	0	0	0	
0	0	0	1	0	0	0	0	0	2	
0	0	0	0	0	0	0	1	0	0	
0	1	1	0	0	2	0	1	0	0	
0	0	0	1	0	0	1	1	1	1	0
1	0	0	0	0	0	1	0	0	0	0
1	1	0	0	1	0	0	0	0	0	0
0	0	0	1	0	1	0	0	0	0	0
0	0	0	0	0	0					
0	0	0	0	0	0					
0	0	0	0	0	0					

APPENDIX E: SUMMARY OF SELECTED UNDERSTOREY SPECIES RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

Juncus pallidus NORTH

Site Numbers

1	2	3	4	5	6	7	8	9	10	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	2	
0	0	0	0	0	0	0	0	0	1	
0	0	0	0	0	0	0	0	0	2	
0	0	0	0	0	0	0	0	0	1	
0	0	0	0	0	0	0	0	0	2	
0	0	0	0	0	0	0	0	0	1	
0	0	0	0	0	0	0	1	0	1	
0	0	0	0	0	0	0	0	1	1	
0	0	0	0	0	1	0	0	0	0	
0	1	1	0	0	0	1	1	0	1	0
0	0	0	0	0	0	1	0	2	3	3
0	1	0	0	0	1	1	2	2	1	2
0	1	0	2	0	0	1	0	0	2	0
3	3	1	0	1	0					
1	1	1	0	1	0					
2	1	1	0	1	0					

APPENDIX E: SUMMARY OF SELECTED UNDERSTOREY SPECIES RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

Kunzea ericifolia

NORTH

Site Numbers

1	2	3	4	5	6	7	8	9	10	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
1	0	0	0	0	0	0	0	0	0	
0	0	1	1	0	0	0	0	0	0	
0	0	0	1	1	0	0	0	0	0	0
0	0	0	0	0	0	1	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	1					
0	0	0	0	0	0					
0	0	0	0	0	0					

APPENDIX E: SUMMARY OF SELECTED UNDERSTOREY SPECIES RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

Macrozamia riedlei

NORTH

Site Numbers

1	2	3	4	5	6	7	8	9	10	
0	0	0	0	0	1	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	1	0	0	0	0	0	
0	1	1	0	1	0	0	0	0	0	
0	1	0	0	0	0	0	0	0	0	
1	0	0	0	0	0	1	0	0	0	
0	0	0	0	1	1	0	1	0	0	
1	0	1	0	1	1	0	0	0	0	
1	1	0	0	0	0	0	0	0	0	
0	0	1	1	0	0	0	0	0	2	
0	0	0	0	1	0	0	0	0	0	0
0	0	0	0	1	0	0	0	0	0	0
0	0	0	0	1	0	0	0	0	0	0
0	1	0	1	0	1	0	0	0	0	0
0	0	0	0	0	0					
0	0	0	0	0	0					
0	0	0	0	0	0					

APPENDIX E: SUMMARY OF SELECTED UNDERSTOREY SPECIES RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

Melaleuca laterita NORTH

Site Numbers

1	2	3	4	5	6	7	8	9	10	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	1	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0					
0	0	0	0	0	0					
0	0	0	0	0	0					

APPENDIX E: SUMMARY OF SELECTED UNDERSTOREY SPECIES RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

Melaleuca scabra

NORTH

Site Numbers										
1	2	3	4	5	6	7	8	9	10	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	1	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	1	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	1	0	0	
0	0	0	0	0	0	0	1	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	1	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0					
0	0	0	0	0	0					
0	0	0	0	0	0					

APPENDIX E: SUMMARY OF SELECTED UNDERSTOREY SPECIES RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

Melaleuca seriata

NORTH

Site Numbers										
1	2	3	4	5	6	7	8	9	10	
0	0	0	0	0	1	1	0	0	0	
0	0	0	0	2	1	1	0	0	0	
0	0	0	1	0	0	1	0	0	0	
0	0	1	0	0	0	0	0	1	0	
1	1	1	2	1	0	1	1	0	0	
0	2	0	1	2	0	0	2	1	0	
0	0	0	0	1	2	0	0	0	0	
1	1	0	0	1	0	0	0	0	0	
1	0	0	0	0	0	1	0	0	1	
0	0	0	0	1	0	1	0	0	0	
0	0	0	0	0	0	1	0	0	0	0
0	1	0	1	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	2
0	0	0	0	0	2	0	0	0	0	0
0	0	0	0	0	0					
0	0	0	0	0	0					
0	0	0	0	0	0					

APPENDIX E: SUMMARY OF SELECTED UNDERSTOREY SPECIES RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

Patersonia occidentalis

NORTH

Site Numbers

1	2	3	4	5	6	7	8	9	10	
1	1	1	2	2	2	1	2	2	0	
2	2	3	4	3	1	3	4	2	0	
3	2	1	1	1	1	1	4	2	1	
3	2	1	2	1	2	1	4	2	0	
2	2	1	1	1	1	2	1	2	0	
3	2	3	3	2	1	2	2	3	1	
2	2	0	4	2	1	2	2	2	1	
1	1	3	3	2	1	1	0	0	1	
3	1	1	2	2	1	2	2	1	2	
2	1	0	1	2	2	2	2	0	4	
2	1	0	0	2	1	1	1	1	2	1
2	1	1	2	1	2	1	1	0	1	1
1	1	2	1	1	2	1	0	1	0	0
0	1	0	1	1	4	1	1	2	0	0
0	0	0	0	0	1					
0	0	0	0	1	0					
0	0	0	0	0	0					

APPENDIX E: SUMMARY OF SELECTED UNDERSTOREY SPECIES RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

Pericalymma ellipticum

NORTH

Site Numbers

1	2	3	4	5	6	7	8	9	10	
0	0	0	0	0	0	0	0	0	0	
2	1	0	3	0	0	0	0	0	0	
0	0	0	1	0	1	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
1	1	1	0	0	0	0	1	0	0	
1	4	2	0	0	0	0	2	0	0	
1	1	3	1	1	0	1	3	1	0	
1	1	1	1	1	1	1	1	0	0	
0	0	0	0	1	2	0	0	0	0	
0	0	0	1	1	0	0	0	0	4	
0	0	1	0	2	0	2	0	0	2	1
0	1	0	1	0	0	1	0	0	0	0
0	1	0	0	1	0	0	0	0	0	0
0	0	1	0	0	0	0	0	0	0	0
0	0	0	0	0	0					
0	0	0	0	0	0					
0	0	0	0	0	0					

APPENDIX E: SUMMARY OF SELECTED UNDERSTOREY SPECIES RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

Petrophile linearis NORTH

Site Numbers

1	2	3	4	5	6	7	8	9	10	
0	0	1	0	0	1	0	1	3	0	
0	1	1	4	1	1	1	1	3	0	
2	1	0	2	1	1	1	1	2	0	
1	1	0	2	2	1	1	3	2	0	
1	1	1	1	1	1	1	1	2	0	
1	0	2	0	1	2	3	2	2	0	
0	1	0	0	2	1	1	1	1	0	
1	1	1	0	2	1	1	0	0	0	
1	1	1	1	2	1	1	0	0	1	
1	1	0	1	1	1	1	0	1	0	
1	1	1	0	1	1	1	0	0	0	0
2	1	1	1	1	1	0	1	0	0	0
1	0	1	1	1	1	0	0	0	0	0
0	1	1	1	2	1	0	0	0	0	0
0	0	0	0	0	0					
0	0	0	0	0	0					
0	0	0	0	0	0					

APPENDIX E: SUMMARY OF SELECTED UNDERSTOREY SPECIES RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

Phlebocarya ciliata

NORTH

Site Numbers										
1	2	3	4	5	6	7	8	9	10	
0	0	0	0	0	0	1	0	0	0	
0	2	0	0	1	1	2	0	0	0	
3	3	0	4	2	1	2	0	0	0	
2	2	0	3	2	1	1	0	0	0	
2	2	1	3	1	1	2	2	1	0	
3	3	0	3	5	3	0	1	4	0	
3	2	0	3	2	3	1	0	2	0	
1	1	2	4	1	1	1	0	0	0	
2	2	0	2	1	0	0	0	0	0	
1	1	1	1	2	0	0	0	0	2	
2	1	1	1	1	0	0	0	0	0	0
1	1	1	0	1	0	0	1	0	0	0
2	1	0	0	0	0	0	0	0	0	0
0	1	0	0	1	0	0	0	0	0	0
0	0	0	0	0	0					
0	0	0	0	0	0					
0	0	0	0	0	0					

APPENDIX E: SUMMARY OF SELECTED UNDERSTOREY SPECIES RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

Pteridium esculentum

NORTH

Site Numbers

1	2	3	4	5	6	7	8	9	10	
0	0	0	0	0	0	0	0	0	0	
0	0	0	1	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	1	0	0	0	0	0	0	0	0	
0	1	3	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	1	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0					
0	0	0	0	0	0					
0	0	0	0	0	0					

APPENDIX E: SUMMARY OF SELECTED UNDERSTOREY SPECIES RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

Stirlingia latifolia

NORTH

Site Numbers

1	2	3	4	5	6	7	8	9	10	
1	0	1	0	0	1	0	0	4	0	
0	1	0	0	0	3	1	4	0	0	
0	1	1	0	1	1	0	1	2	0	
2	1	1	0	0	1	2	3	3	0	
1	1	2	1	1	1	2	1	3	0	
1	1	1	0	1	2	4	2	1	0	
1	1	0	0	1	2	1	3	0	0	
1	1	2	1	1	1	1	0	0	0	
1	1	3	2	3	0	1	0	0	1	
1	1	1	1	1	2	1	0	4	0	
0	1	1	0	1	1	1	0	1	0	0
2	1	1	1	1	3	1	1	0	0	0
2	0	0	1	1	3	0	0	0	0	0
0	1	1	0	2	3	0	1	0	0	0
0	0	0	0	0	0					
0	0	0	0	0	0					
0	0	0	0	0	0					

APPENDIX E: SUMMARY OF SELECTED UNDERSTOREY SPECIES RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

* Typha orientalis

NORTH

Site Numbers										
1	2	3	4	5	6	7	8	9	10	
0	0	0	1	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	1	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0					
0	0	0	0	0	0					
0	0	0	0	0	0					

APPENDIX E: SUMMARY OF SELECTED UNDERSTOREY SPECIES RESULTS ON THE GRID SYSTEM IN WHITEMAN PARK

* Ursinia anthemoides

NORTH

Site Numbers										
1	2	3	4	5	6	7	8	9	10	
1	3	3	0	3	2	1	2	0	0	
1	2	3	2	1	1	2	0	0	0	
2	2	1	2	1	1	0	0	0	0	
1	1	0	0	0	1	1	0	0	0	
2	2	1	2	1	1	1	1	1	0	
2	1	2	3	1	2	1	2	3	0	
1	2	1	3	2	1	1	0	3	0	
1	1	2	3	1	0	1	2	2	1	
2	2	2	2	1	2	2	1	1	1	
2	1	0	1	1	3	1	2	0	0	
2	1	0	0	1	1	1	2	1	1	0
2	1	1	1	1	0	2	0	1	0	0
1	1	2	1	1	0	1	0	1	0	0
0	0	1	0	2	0	1	1	2	0	0
0	0	0	0	0	0					
0	0	0	0	0	0					
0	0	0	0	0	0					

Department for **Planning and Infrastructure**
Government of **Western Australia**

Environmental Planning
Bush Forever

Memorandum

TO:	Gary Whisson – Department of Environmental Protection	DATE:	September 18, 2002
FROM:	Patrick Hollingworth - Environmental Planner Bush Forever	FILE NO:	
SUBJECT:	**Proposed Water Feature in Whiteman Park**		

Hi Gary,

Enclosed is a copy of a plan for the Proposed Water Feature, Whiteman Park Village, Whiteman Park. The Bush Forever Office is concerned with two issues relating to this proposal:

1. The justification provided for the removal of 7 ha of regionally significant bushland is not sufficient.
2. Insufficient information on the potential impacts upon vegetation within Whiteman Park from water stress associated with a decline in groundwater levels has been provided.

Could you please provide comments on the proposal to the Bush Forever Office by Friday 28th September 2002. If you have any queries relating to this matter please contact me on 9264 7773.

Kind regards

Patrick Hollingworth

Patrick Hollingworth

Department for Planning and Infrastructure
Government of Western Australia

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Memo

Comment B. Boyle 14/11/02

TO: Glenn Ahola

FROM: Kate Williams
Bush Forever Project Officer

SUBJECT: Proposed Water Feature - Whiteman Park

DATE: 14 November 2002 FILE: 21-50065-2
805-2-1-40P

MESSAGE:

Glenn

Thank you for referring the above development application to the Bush Forever Office for comment. I understand the proposed development includes the construction of a water feature for 'passive' recreational amenity close to the Tourist Village within Whiteman Park. As you are aware, the proposed development proposes to clear 7 hectares of vegetation within Bush Forever Site 304 (Whiteman Park, Whiteman/West Swan). Whiteman Park has been included in Bush Forever in recognition of the regionally significant vegetation and its high conservation values.

→ This is NOT identified or discussed in proposal

The Bush Forever Office does not support the proposal in its current form. Please note the following information in support of our objections.

Background

Comment: There is only 2001 in what I have and this does NOT specifically address the differences between

I understand both the Strategic Plan for Whiteman Park (1998) and the Whiteman Park Master Plan (2000) outlines possible future development within the Park while seeking to protect the conservation values of the Park. I further understand the flora and fauna of the Park have been assessed and documented relatively recently (1998) by Mattiske. This report identifies categories of importance in terms of conservation values and include conservation; rehabilitation; conservation buffer and recreational. The proposed water feature is located in an area designated in this report as 'recreational'. It should be noted that these categories of importance in terms of conservation values have yet to be endorsed by the Bush Forever Office.

With regards to implementing Bush Forever within Whiteman Park, Practice Note 14: Existing Parks and Recreation Reserves (Appendix 3 Site Implementation Guidelines Practice Notes) applies to lands currently reserved in the MRS for Parks and Recreation. This Practice Note seeks to secure wider conservation outcomes and planning objectives for areas already reserved for Parks and Recreation, although it is clearly stated that future recreation, servicing or community objectives may be appropriate in cleared or degraded portions of Parks and Recreation reservations within Bush Forever Sites.

Bush Forever Considerations

Although the majority of the regionally significant bushland within the area proposed for the water feature has been degraded due to cattle grazing, the Bush Forever Office is concerned with the removal of such a large parcel of remnant bushland (7 hectares). In particular, a number of remnant stands of *Melaleuca* sp. in good condition would be cleared. Furthermore,

the vegetation within this area is mapped as being typical of the Southern River vegetation complex. Only 10% of the original extent of this complex on the Swan Coastal Plain portion of the Perth Metropolitan Region is proposed for protection through Bush Forever due to extensive clearing in the past. Bush Forever recognises that there will be a general presumption against clearing bushland in instances where vegetation complexes less than 10% remain.

Bush Forever aims to protect existing regionally significant bushland. The improvement of regionally significant bushland through endorsed revegetation or rehabilitation plans is encouraged in Bush Forever Sites, however the development proposed is not considered to meet, or be consistent with Bush Forever objectives. The development proposed is of a *constructed* water feature that is significantly modified from a natural state and seeks to provide 'passive' recreation rather than increasing the conservation value of the area (that, for example, a rehabilitation or revegetation plan would aim to achieve).

Furthermore, the proposal states 'the primary impact of the lake on the vegetation of the site is through the physical removal of trees...the removal of 7 ha of low density modified vegetation is not considered a significant impact given the site will be re-instated as a wetland environment with a much greater species diversity in the long term.' (p13) With the current information provided, the Bush Forever Office does not support this statement. The typical plant species as part of the Landscaping that were provided as examples of Western Australian natives (p10) include plant species native to the eastern States and species that are not endemic to the area. Some of the species are considered to be invasive weed species for the existing bushland.

Further Information Required

This should include a detailed description of the existing vegetation (vegetation map, veg condition map and species list)

Further information is required to be provided by the proponent before the Bush Forever Office can fully assess the impacts of such a development within this Bush Forever Site. Issues to be addressed include:

- Detailed justification for the removal of 7 hectares of regionally significant bushland that is considered typical of the Southern River complex of which only 10% is proposed for protection on the Swan Coastal Plain portion of the Perth Metropolitan Region; — see (2)
- Are any mitigation measures proposed to offset the loss of bushland such as revegetation or rehabilitation programs in nearby areas;
- Providing further information regarding the impact of such a development on the surrounding vegetation and how these impacts will be managed if necessary;
- Detailed list of plant species proposed for the landscaping plan and; and
- How weed management is to be addressed.

If you have any further queries regarding this advice, please do not hesitate to contact me on extension 7804.

Regards

General Comments

Kate Williams

(i) Was comments particularly the example quoting such a wet year at time when restrictions apply AND vegetation in Whiteman Park is being affected by the drought.

(ii) The vegetation may not meet the definition of bushland, this needs to be addressed as part of the detailed justification

(iii) what are the mosaic wetlands, why not look other there?

General Comments:

- Removal of Bush Forever areas without detailed justification is NOT acceptable.

- 'Water feature' is NOT a WETLAND

- Overall changes to Bush Forever or possible changes from Moffiske and Bamford (2001) need to be addressed <u>before</u> any change in Bush Forever boundaries. Moffiske and Bamford (2001) as viewed does not adequately address Bush Forever issues.

KEIGHERY Bronwen

From: Bamforth, Emma [Emma.Bamforth@planning.wa.gov.au]
Sent: Monday, 16 September 2002 17:08
To: KEIGHERY Bronwen
Subject: Whiteman Park

Importance: High

Hi Bronwen,
Sorry to hassle you again, but I was wandering whether you have had a chance to look through the survey reports for Whiteman Park that I provided to you a short while ago. They have just sent through another development application (for a constructed wetland) that we will copy and send to your section for comment (your evaluations department may have already received a copy but I'd like to send one to you directly just in case....) but we need to sort out a protocol with Whiteman Park (ie an MOU) for their future development and management of the site, so if you have any comments regarding the Mattiskee reports they would be greatly appreciated asap.

If you'd like to discuss the proposed development application for Whiteman Park when you receive it, please call me.
Cheers
Emma

Emma Bamforth
Senior Environmental Planner
Bush Forever
Department for Planning and Infrastructure
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Proposed Water Feature
Whiteman Park Village
Whiteman Park

Prepared On Behalf Of The Whiteman Park Board Of Management

WHITEMAN PARK

APP
Argenta

Wood & Grieve
ENGINEERS

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1 INTRODUCTION

Whiteman Park is located in the fast growing north-eastern corridor of metropolitan Perth. Significant urban development has grown around Whiteman Park since it started life as a public amenity and facility in the mid 1970's.

The Park's early history was centered around Mussel Pool - a privately owned picnic ground built in the 1960's by the late Lew Whiteman. The State Government acquired this land and a further 4,200 hectares in the surrounding localities, now known as Whiteman and Cullacarbardee, through the bringing down of Improvement Plan No.8 in 1977.

Whiteman Park is now the largest single recreation park of its kind in the metropolitan area, being nearly 9 times larger than Kings Park. The City of Swan (who managed the Park in the early years) and the Planning Commission have enjoyed a long association in the strategic development of the Park.

Whiteman Park has long been identified as a regionally important area for active and passive recreation and the development of infrastructure and facilities have been integral to meeting these growing community and visitor needs.

2 STRATEGIC PLANNING PERSPECTIVE

An Improvement Plan for Whiteman Park was announced in 1975 for the purposes of future educational, health, institutional and recreational purposes as well as the protection of the underground water aquifer known as the Gnangara Water Mound. Uses specifically identified in this Plan included recreation activities, Government requirements (special purposes and institutional uses) and conservation areas.

The first step in the development of the Park was commissioning a strategic document to steer the Park's future. This was completed in 1978 and became known as the Maunsell Report.

This report identified the Parks' potential as the most significant recreation area in northern metropolitan Perth with its' ability to support important regional recreation facilities tied to strong environmental protection for the Gnangara Water Mound. Facilities identified included picnic areas, bike and walk trails, sporting facilities, museum and heritage opportunities and provision for specialist sporting and recreational needs. This report also identified that "Perth residents are attracted to picnic spots associated with water" and proposed a network of lakes covering 2.5ha.

In the early 1980's considerable investment was made in Whiteman Park through a series of programs of capital development including State Planning Commission funding, volunteer input and labour programs. Significant projects at this time included the International Shooting complex on Beechboro road, the creation of the Whiteman Tourist Village with an Administration Centre and Café, extended picnic grounds, craft shops and workshops, together with the construction of tram lines for Perth Electric Tramways and narrow gauge train lines for the Bennett Brook railways. A workshop area where volunteer groups could restore and store heritage equipment was built.

Subsequent improvements have included a new entry road and front gate area, road connections between Mussel Pool and the newly created Tourist Village, car parks and toilets.

Developments through the late 1980's and early 1990's were limited although new volunteer groups relocated activities to the park including the Tractor Museum of WA and the Bus Preservation Society. Premises were found for the Model Aircraft Association and the Off Road Model Buggy Club near the Keith Maine Youth Camp on Beechboro Road.

The most significant development of the 1990's was the construction of a building to house the Motor Museum of WA in the Tourist Village in 1995. Over 2000 m^2 of display space was created to showcase public and private collections of the motor vehicles important to Western Australia's' development today and in the past.

Following the 1978 Maunsell Report, a Strategic Plan for Whiteman Park was completed in 1998 by Synectics, followed by the Whiteman Master Plan 2000, prepared by Consultants headed by EPCAD.

The Strategic Plan confirms findings of earlier reports and plans that a future role of the Park is to develop and adopt a significant recreation and conservation strategy. It identifies the development of a new water amenity as a priority. The Whiteman Master Plan (2000) is consistent with the goals of the Synectics Strategic Plan and builds on the concept of incorporating a lake into the heart of the village for its' recreation value and aesthetic appeal.

The goal of future development is to improve the amenity, attractiveness and viability of Whiteman Park by providing a long term stable base for the commercial/tourism operations based within the Park and to protect the conservation values across the whole of the Park, including P1 and non P1 areas. This proactive development approach will see the establishment of a revitalized Park in the next five years with new attractions and amenities.

Projects commissioned for development in 2001/02 include

- A new access road from Beechboro Road linking directly to the major highway networks of Tonkin and Reid Highways and a direct link to the planned extension of Hepburn Avenue from the Coast.
- Relocation of a local wildlife park into Whiteman, with associated infrastructure and visitor facilities.
- Refurbishment of the existing village
- Improvements to the State Transport Heritage Centre

2.1 PURPOSE OF WATER FEATURE

The immediate benefit of the proposed water body will be to provide a significant 'passive' recreational amenity close to the Tourist Village, promoting all year visitations to an attractive and viable area. Anticipated activities include water recreation, picnicking, family groups, walking, bird watching and similar "environment enjoyment" style activities. Further benefits will include reintroduction of lost wetlands, with associated water quality management and habitat creation opportunities.

The Strategic Plan also identified the opportunity to develop interpretation and educational facilities and the Park has been actively researching integration of a water education resource centre.

The Strategic Plan identified several positive and complementary outcomes from the creation of the water body including:

- Enhancement of the amenity of the Park
- Water Management technologies (aquifer and artificial wetlands management and urban water management systems)
- Education (ecology, industry image and promotion, interactive multi-media exhibits to promote a global audience to Perth's' water management.)

3 REGIONAL PLANNING CONTEXT

3.1 REGIONAL RECREATION DEMAND

A substantial water body that allowed public access would not just be a welcome hot weather activity option, it would ATTRACT visitors to the Park.

Mussel Pool was a popular picnic spot in the early days because of the water. The water was (and remains) an attraction in it's own right with dinghies being available for hire in previous years. A good example of a well used artificial inland water body is Lake Leschenaultia (This was originally excavated to provide gravel ballast for the Great Eastern Railway construction and when it filled with water, they used it to supply their steam locos with water!) It is heavily used in summer and is considered by visitors to be safe (no stingers, sharks, waves or syringes!) It is not just visited by "locals" either. It has an artificial white sand beach, a jetty and a bushland setting. There is grass to sit on, barbecues to cook on, and trees to provide shade - all of which are not readily available at most Perth beaches.

Another example of a well utilised waterbody is Loch McNess at Yancep National Park, which provides similar facilities. Both water bodies encourage and provide an opportunity for an all day outing.

Whiteman Park has annual visitation of around 200,000, with high repeat visitation from within a 20 km radius (20 min travelling time), mostly from the area in arc from Hammersley through Wanneroo across to Bindoon, the hills suburbs, Midland region and down to Perth. There are few places in the Swan Valley/Midland region offering water recreation in a natural setting. The importance of this from a regional perspective is increasing with the river becoming less user friendly, particularly during the summer period.

3.2 ENVIRONMENTAL MANAGEMENT

Whiteman Park is listed as Bush Forever Site No. 304 due to its ecological attributes and conservation value. The Park is representative of the Bassendean Central and South vegetation complexes. The Park is part of the Mirrabooka Underground Water Pollution Control Area classified for Priority 1 source protection. The Water Corporation intends to shift the P1 boundary into the northern part of the Park which excludes both the Park Village and proposed lake location.

Whitman Park contains a range of vegetation ranging from high conservation bushland to simple pasture. The flora and fauna of the Park have been subject to numerous surveys and a recent assessment (Mattiske, 1998) where the land was separated into various categories of importance in terms of conservation value. These categories are conservation, rehabilitation, conservation buffer and recreational. The proposed lake is located in an area designated as suitable for recreation as the land is mostly cleared with a high level of disturbance which is reflected in the low species richness and high levels of weed invasion.

Implementation Guideline 12 of Bush Forever notes that future planned recreational development should avoid regionally significant bushland within Parks and Recreation reserves. The proposed lake is within a degraded part of the Park adjacent to the Village.

The geology of the site is generally topsoil overlying Bassendean Sand. Beneath the sand is the presence of coffee rock, at what was likely to be the peak ground water level, generally in September/October. Groundwater was found between 2.8m and 4.0m below the existing ground level.

The sand was typical quartz/silica with minor impurities such as iron oxides, organics and dark minerals. It was considered to be suitable for general fill only, and had no higher commercial value.

Groundwater levels at Whiteman Park have declined as a result of a drier climate over the last couple of decades in conjunction with the installation of the borefield some 25 years ago, and the presence of the Gnangara pine plantation upgradient of the Park. This has resulted in a noticeable reduction in the extent of wetlands within the Park. Wetland conservation is a primary objective of Bush Forever. The reintroduction of wetlands into the Park is a key objective of this.

4 THE PROPOSED WATER FEATURE

4.1 GENERAL DISCRIPTION OF PROPOSAL

As part of the ongoing development of Whiteman Park, it is proposed to construct and maintain a fully functioning wet land eco-system.

This will involve the clearing of land currently used for mainly cattle grazing, excavation to below groundwater of the water body area, and creating a mix of open water and shallow seasonal wetlands.

The water body will then be extensively landscaped to recreate a native natural eco-system. A small part of the adjoining area will be developed into picnic areas under strict environmental management.

The Purpose of the water body is to supply the following:

- An educational wetland habitat with nature walks
- To establish a Groundwater Interpretative Centre for public education
- Recreational activities such as canoeing and rowing boats (not swimming)

4.2 CONSTRAINTS

The site of the water body is bounded by the Whiteman Park Village immediately to the South. It is considered important to locate the open water part of the water body within the "vista" from the main Village centre, to offer views across the water body.

To the East of the water body, a proposed Wildlife Park would form the eastern boundary of the area under consideration. Constraints to the West include the future access road and to the North, the Mirrabooka Borefield.

The results of the groundwater investigation showed the existing groundwater graded down in the general direction from Northwest to Southeast. Over the area of investigation, the level of the groundwater ranged from RI 25.5m in the Northwest to 23.5m (AHD) in the Southeast. The establishment of a waterbody into the groundwater will act as a "short circuit", with the upgradient water levels dropping and the downgradient water levels rising. To minimise the impact on this gradient, the water body should be placed on an East – West axis.

4.3 INTER-RELATIONSHIP WITH THE MASTERPLAN

The Whiteman Masterplan included the introduction of a large water body in order to extend the recreation and amenity value of the area, providing waterside picnic sites, water based activities, habitat creation and a cool retreat in hot summer temperatures.

The Masterplan determined the village as the "hub" of the site and the location of the water body is considered critical in establishing a close relationship with the village, both physically and visually. For this reason, the water body is close to the northern end of the village, exploiting long vistas and views from the village. It is in close proximity to car parking (both existing and proposed) and within easy walking distance of the village. The water body also forms an important part of a larger circuit of core facilities, linking with the Transport Heritage Centre, Wildlife Park, village and bushland activities.

It should be noted that the original planning of the water body was on a North/South axis in order to provide the vistas mentioned above. Whilst the axis is now generally East/West, the open water section of the body has retained the vistas desired.

4.4 RELATIONSHIP TO WHITEMAN PARK

Construction of the lake will introduce a water feature back into the Park and increase the available number of habitats for what is currently a highly modified environment. The permanent water feature will introduce a greater variety of species into the Park, thus increasing its ecological value and attractiveness to visitors. The Interpretation Centre and hides will allow visitors to gain an appreciation and awareness of environmental values in a setting that also facilitates recreational pursuits.

Currently the only permanent water feature at the Park is at Mussel Pool, which is servicing an ever-growing local population. As visitor numbers increase, pressure is being placed on this part of the Park, especially over the warmer summer period. A second feature to compliment Mussel Pool, which is within easy access of the Park Village, would allow the Park to grow without compromising existing attributes.

Apart from providing an environmental focal point for the Village, the lake would also provide a cooling influence due to the late arrival of the sea breeze.

4.5 WATER BODY OPTIONS

The location, design concept and shape of the water body is strongly related to the physical aspects of the site, particularly existing ground water levels, low lying contours, existing vegetation and transpiration. It also has considered the fundamental social and aesthetic relationship with the village - the water body vistas, recreational, educational and amenity value.

A series of concept sketches (Figures 1 to 6) have been produced and assessed based upon these criteria, and a final shape determined (Figure 6), which best satisfies the physical and aesthetic considerations as above. These include:

- Vistas from the village centre
- Open water
- Wetland habitat
- East-West orientation
- Picnic and Wildlife areas down gradient (groundwater)
- Masterplan integration

4.6 ENGINEERING DETAIL

The wetland/lake is sited to align in the East – West direction to follow the direction of the ground water contours. This limits any the localised disturbance to the ground water flow via short-circuiting, to a minimum.

The lake construction will incorporate the following activities:

- Clearing of surface vegetation where required
- Mulching of all cleared material for later use
- Stripping of topsoil to a stock pile
- Excavation of the bulk soil (includes some de-watering)
- Stockpiling and later removal of the excess sand
- Fine shaping of the water body
- Replacement of topsoil
- Hand-over for Landscaping

Battering around the wet land will be kept to a general minimum of 1 in 6, however some areas may be steeper in order to make it as "natural" as possible.

Stormwater drainage from surrounding impervious pavements (primarily car parking) will not be discharged directly into the wetland. It is proposed that all carparking be used for water harvesting into swale drains for soakage.

4.7 LANDSCAPING

Wherever possible the water body design will retain and incorporate significant existing tree groups and reflect the existing contours, to give a sense of maturity and continuity.

The northern side and wetland areas of the water body will be subject to conservation management and rehabilitation. Plant species shall emulate the existing flora as much as possible and the creation of a wetland habitat will help to enrich the bushland diversity.

Planting to the southern side will still be native to Western Australia, but grass areas will be introduced with groups of shade trees for family based recreation purposes.

Typical species would be as follows:

- Agonis flexuosa
- Banksia grandis
- Callistemon "Kings Park Special"
- Casuarina equisetifolia
- Eucalyptus calophylla
- Eucalyptus citriodora
- Eucalyptus ficifolia
- Eucalyptus leucoxylon
- Melaleuca lanceolata
- Melaleuca quiquinervia

- Melaleuca rhaphiophylla
- Nuytsia floribunda
- Xanthorrhoea preissii

4.8 HABITAT DEVELOPMENT

The water body will be developed as a fringing wetland with an extensive area of open water to provide visual amenity for recreational users and to help maintain acceptable water quality. The open water will serve to aid in the mixing of the water body and prevent stagnation. The water body will be constructed and developed with an emphasis towards creating a viable wetland environment rich in biodiversity.

The water body will be constructed by excavating into the water table. This will result in a grade from the natural surface down to the water level. The base of the water body will be mostly flat once the desired depth is reached. Due to the normal seasonal groundwater fluctuation of some 1.5m, there will be a shoreline (up to 15m) between winter and summer water levels, the shoreline will be graded to a slope of between 1 in 5 and 1 in 10. The grade will be steeper in the western part in order to provide a greater retention of open water during the summer months. This part of the water body will provide a vista from the Village. The grade will be gentler in the eastern part, which is to be developed more as a wetland than a water feature.

The shoreline will be planted/seeded with the appropriate vegetation for the degree of submersion, as the water body level will rise and fall in the order of 1.5m. Flood tolerant species such as the endemic Melaleuca sp will be used on the upper shoreline with emergence in the ephemeral zone and reed beds in permanent water. The final selection of species will be both indigenous to the local area and suitable for the habitat.

The shape of the water body will be irregular to provide interest and to maximise the length and variety of edge habitat. This will create a number of connected smaller open water bodies. Small isolated shallow ponds will be avoided to prevent breeding habitats for mosquitoes. Hides will be installed in the eastern part to promote bird watching.

An island will be left in the middle of the water body to serve as both a feature and as refuge for breeding birds. The extensive areas of shallow open water in summer will provide a feeding habitat for wading birds.

4.9 INTERPRETIVE CENTRE

An integral part of the wetland and water body experience at Whiteman Park will be an Interpretative Centre. This will provide an interactive learning place for the public to become informed on all groundwater issues and how groundwater relates to the environment. The dynamics and construction of the lake will be clearly explained including how it interrelates with the groundwater. How groundwater in Perth is managed will also be demonstrated in the form of displays and models. The Centre will also focus on the dependency relationship between the environment and groundwater. The ecology of the lake will be outlined in detail.

The lake will be used to show how groundwater can be managed as a resource in which all can benefit without resulting in environmental harm. The Centre will provide an important educational tool on managing a resource critical to the enjoyment of the Perth lifestyle.

The Centre will be located outside on the fringe of the lake close to the Village infrastructure and parking. The building will be constructed in a manner and form that blends with the local environment.

5 ENVIRONMENTAL IMPACT

5.1 IMPACT ON FLORA AND FAUNA

In response to falling groundwater levels, vegetation communities in parts of the Park are slowly changing. Additionally, extensive grazing in the southern part of the Park have modified much of the existing vegetation. Vegetation at the site of the lake consists of an understorey of pasture and grasses with remnant stands of Paperbarks (*Melaleuca sp*). Species diversity is low.

Native fauna species at the lake site is dominated by the presence of Kangaroos (*Macropus sp*).

The primary impact of the lake on the flora and fauna of the site is through the physical removal of trees. Given that *Melaleuca sp* are widely represented in the Park, the removal of 7 ha of low density modified vegetation is not considered a significant impact given the site will be reinstated as a wetland environment with a much greater species diversity in the long term.

Groundwater depth currently at the site is in the order of 3 m to 5 m dependent upon time of year and topography. Groundwater levels are expected to alter following construction of the lake. The lake will average out groundwater levels compared to the current gradient, levels are expected to decline at the up gradient end and increase at the down gradient end.

Potential impacts on vegetation could occur due to water stress associated with a significant decline in groundwater levels upgradient of the lake. The report from JDA (appendix 2), however, shows little impact on the ground water levels. Groundwater tends to be slightly deeper in this area. Given the depth to groundwater and that existing vegetation is not dependent upon seasonal inundation or a shallow water table, any further gradual decline in groundwater levels is not expected to significantly effect existing vegetation.

5.2 RELATIONSHIP TO BUSH FOREVER SITES.

5.2.1 Whiteman Park Conservation and Recreation Precinct study

In preparation for implementation of the development of stage 1 (including the water body), Whiteman Park commissioned Mattiske Consultants Pty Ltd to undertake a detailed vegetation survey and develop a conservation and recreation precinct classification for the Park. This study was undertaken in two parts. The first being the area bounded by Gnangara Road, Lord Street, Marshall Road and Beechboro Road and was completed in 1998. The second part included the areas of Cullacarbardee and Bennett Brook Reserve. These two studies were combined, encompassing the whole of Whiteman Park, producing the final report of September

2001. ("Concept Plan for Conservation and Recreation Precincts" Mattiske Consultants Pty Ltd, 2001)

This study allocated conservation precincts according to the conservation needs and characteristics of flora, vegetation and vertebrate fauna. The principles used for conservation precincts were area, shape, degree of clearing, vegetation condition, degree of disturbance, diversity of communities, fauna habitats and species, linkages with other natural habitats, fauna utilisation of different areas of the Park and the edge effects from adjacent land uses. The requirement to balance people and conservation was also taken into consideration.

The report identifies 4 levels of precincts for Whiteman Park and has been adopted by the Whiteman Park Board of Management as a working tool to assist in the preparation of strategic opportunities and land management operations. Mattiske were also commissioned by Whiteman Park management to carry out a one-year study to search for rare flora. Five Priority three species were identified, all of which had been recorded in previous studies. No rare or endangered plants were found.

5.2.2 Whiteman Park Conservation and Recreation Precincts

C 1	Conservation Precinct	Protecting where ever feasible those areas of bushland which were least disturbed by previous grazing and recreational pressures in the Park.
C 2	Rehabilitation Precinct	Protecting those areas of bushland which were only partly disturbed, and which, with management, could be rehabilitated to increase the biological values on the areas through increased native species numbers and cover, and increased variety of fauna habitats.
C 3	Conservation Buffer Precinct	Delineating a series of conservation buffer precincts to protect the adjacent values of drainage lines or provide fauna linkages to adjacent areas of native vegetation.
C 4	Recreation Usage Precinct	Delineating particular parts of the Park which were mostly cleared or modified bush land areas for recreational activities.

5.2.3 Bush Forever Site 304

Whiteman Park is listed as **Bush Forever Site Nos. 198, 304 and 305** and is representative of the Bassendean Central and South vegetation complexes.

The proposed Water Body is located entirely within a C4 precinct identified as being suitable for recreation purposes being 'mostly cleared or modified bushland'. Draft protocols for the assessment of developments within Whiteman Park have been submitted to Bush Forever, based on the Whiteman Park Conservation and Recreation Zoning Plan. Under these draft protocols, developments within a C4 Recreational Usage precinct do not require additional assessment.

The location of the proposed Water Body is limited to an area which has been cleared and grazed over the last 40 years. This high level of disturbance is reflected in the low species richness and high levels of weed invasion.

Implementation Guideline 12 of Bush Forever notes that future planned recreational development should avoid regionally significant bushland within Parks and Recreation reserves. The proposed Water Body is within a degraded part of Whiteman Park and its' location, adjacent to the Village and in a C4 recreation precinct, avoids areas of more significant bushland as identified in the C2 (rehabilitation) and C1(conservation) areas represented elsewhere within the Park

5.3 IMPACT ON GROUNDWATER USE

Water & Rivers Commission (WRC) has advised Whiteman Park of its concern over any land use change which may result in greater loss of water from the Gnangara Mound aquifer, either by greater evaporation from a wetland, or greater abstraction for irrigation of additional areas within the Park.

The context for the review of water management within Whiteman Park follows a sequence of recent dry rainfall years and the operation of the Water Corporation Public Water Supply Borefield, referred to as the Mirrabooka Groundwater Scheme. This Scheme includes a number of production bores within Whiteman Park, which the Water Corporation has been unable to abstract groundwater from over the last few years due to the likelihood of Environmental Water Provisions (EWP's) being breached.

Although the Water Corporation hold licenses within an overall quota for groundwater abstraction in the Mirrabooka Groundwater Area, negotiation occurs annually between Water Corporation and WRC as to which bores should be pumped, at what rate, and other bore conditions so that EWP's are not breached. The most recent report on groundwater abstraction from the Gnangara Mound (WRC, 2001) highlights the complex issues surrounding the Water Corporation's license from Office of Water Regulation (OWR) which includes the requirement to actively encourage further reduction in public water demand through its Water Conservation Strategy. The Department of Environmental Protection (DEP) has interpreted this requirement to extend to encouraging a reduction in private abstraction also.

WRC has not, to date, restricted licensed private groundwater abstraction within Whiteman Park, in the same way as it has restricted public abstraction.

It is within this context that WRC has provided advice to Whiteman Park Board on its concerns with respect to the proposed water feature.

The Board considers that development of a wetland in Whiteman Park would enhance the ecological and habitat aspects of the park.

Analysis of groundwater abstraction for public and private use within Whiteman Park shows that actual abstraction by Whiteman Park (261.5 ML/yr) is far less than the quantity of licenses which have been issued to the Park by WRC (374 ML/yr). This 112.5 ML/yr difference is already twice the estimated 60 ML/yr evaporation loss from the proposed wetland.

Whiteman Park has already initiated water use efficiency measures to reduce groundwater abstraction for irrigation. As well as continued improvement to water use efficiency measures within the irrigation system.

The Board will continue to seek water use efficiency measures within the Park. These measures incorporated with the 112.5 ML/yr. difference in licensing allocation and actual abstraction, more than offset the estimated water loss of approximately 60 ML/yr due to evaporation from the proposed wetland.

5.4 GROUNDWATER LICENCE ALLOCATIONS

Whiteman Park is located within the IP8 and Whiteman Park Groundwater Sub Areas of the Mirrabooka Groundwater Area (Figure 8). Within the Whiteman Park Sub Area, Whiteman Park, a few private users and the Water Corporation abstract groundwater from the superficial aquifer.

Current licensed private allocation from the superficial aquifer within these Groundwater Sub Areas according to WRC (2001) is 374 ML/yr compared to the public allocation of 14,000 ML/yr. This private allocation only equates to 2.7% of the total licensed allocation from the superficial aquifer within the Whiteman Park and IP8 Groundwater Sub Areas.

However, due to the risk of EWP's being breached Water Corporation has not been able to abstract any groundwater for public supply from Whiteman Park in recent years, whereas private abstraction has not been similarly restricted (WRC, 2001). The Water Corporation is under some obligation as a condition of its license from the Office of Water Regulation (OWR) to encourage water conservation both in the public and private sectors.

Within Whiteman Park there is evidence that the Water Corporation has taken major steps to reduce abstraction, but that private abstraction has not been similarly controlled.

The drawdown associated with present private abstraction is estimated to be 0.1 m, on the basis that all private abstraction up to the quota is estimated to result in drawdown of 0.25 m (WRC, 1997a, p.62).

Total private groundwater abstraction is estimated to be only 261.5 ML/yr, rather than the licensed total of 374 ML/yr (WRC, 2001). This represents abstraction 30% or 112.5 ML/yr less than licensed.

5.5 GROUNDWATER IMPACTS

Whiteman Park is within the Whiteman Park Groundwater Sub Area for which a private groundwater allocation was allowed for during environmental impact assessment of the Lexia Groundwater Scheme (WRC, 1997a).

Present abstraction by Whiteman Park is well within the quota and the proposed wetland does not formally represent a water use that requires a license from WRC.

Whiteman Park has implemented irrigation water use efficiency measures and will continue to do so which will more than offset the proposed wetland evaporation loss. Rationalisation of licenses and metering of bores would assist in quantification of the abstracted water.

The proposed wetland evaporation loss of approximately 60 ML/yr is considered negligible in context to abstraction licenses held by both the Water Corporation. The 112.5 ML/yr difference between the licensed private allocation of 374 ML/yr and actual private abstraction of 261.5 ML/yr is already twice the volume estimated as evaporation loss from the proposed wetland.

Appendix 2 contains a report by JDA Consultant Hydrologists detailing groundwater issues.

6 ENVIRONMENTAL MANAGEMENT

6.1 WATER QUALITY MANAGEMENT

The water body will provide a variety of wetland habitats, which will enhance the ecological attractiveness, and value of Whiteman Park to the general public. Whiteman Lake will be designed and managed to maximise its environmental attributes and aesthetic appeal.

As the water level drops during summer months, there is a concern that it may increase in water temperature and potentially stagnate. To prevent unacceptable water quality, open water will be maintained in summer, the base of the water body will be a minimum 1m to 2 m depth at the end of summer and no more than 4m in winter to prevent possible stratification of the water column. Maintaining an open water body in summer when the water levels are low will help mix and aerate the water so reducing the potential for algal blooms.

The lake quality will be a function of groundwater quality which has been observed to be generally good with low salinity, slightly acidic and elevated iron levels. Such groundwater quality is typical for Bassendean Sand aquifers. Nutrients in the groundwater are generally at low concentrations, however grazing activities including fertiliser application have impacted upon the quality.

The primary threat to the water body will be through nutrient enrichment or eutrophication of the water body. Excessive nutrients, principally phosphorous, can lead to toxic blue-green algal blooms, which can pollute the water body. Total phosphorous levels in the groundwater are at concentrations which could sustain a potential algal bloom given the right conditions, however acidic groundwater in conjunction with high expected levels of gilvin (breakdown of eucalyptus and melaleucas leaves resulting in coloured water) will help prevent this.

In order to maintain acceptable lake water quality and prevent toxic algal blooms, activities on and surrounding the lake will need to be effectively managed. Given that the lake will be under the control of one entity, this will allow for much more effective administration and management of activities and land uses.

The lake may become stagnant and too warm over the summer months as water levels drop. To prevent unacceptable water quality, open water will be maintained in summer, the base of the lake will be a minimum 1 m to 2 m depth at the end of summer and no more than 4 m in winter to prevent possible stratification of the water column. Maintaining an open water body in summer when lake levels are low will help mix and aerate the water so reducing the potential for algal blooms.

Contamination other than nutrients will be managed by ensuring stormwater does not discharge into the water body. Pathogens are likely due to animal contact with the water. As the primary purpose of the water body is ecology and aesthetic values, direct human contact with the water in the water body will be restricted. The possible use of the water body for small boats (row boats) may be considered contingent upon acceptable water quality for secondary human contact and there being no disruption to wildlife and/or vegetation.

The long-term management of nutrient input into the water body can be achieved by:

- Restricting lawn areas to the down gradient side of the water body and not within 50 metres of the water body boundary;
- Using low phosphorous fertilisers on all lawn areas adjacent to the water body;
- Stormwater from the Village and roads will not to be disposed directly into the water body;
- The northern shore of the water body will contain the greatest proportion of ephemeral vegetation to act as a nutrient stripping barrier for up gradient groundwater moving into the water body;
- Possible use of a fountain or aeration units to maintain dissolved oxygen levels; and
- The proposed Wildlife Park is to be located down gradient (groundwater gradient) of the water body, with no animal access to the water.

Water birds ? ?

6.2 WATER BODY SURROUNDS

The primary risks (as determined by ENV Australia, environmental scientists) to the water body surrounds are from an uncontrolled fire and excessive visitor numbers (compaction of tracks and littering of pathways).

Tracks can be upgraded to accommodate the number of visitors and facilities provided for the disposal of wastes. An uncontrolled fire could damage the entire terrestrial ecosystem. To manage the risk of fire damage, the water body will be designed with adequate firebreaks for rapid access. The design of the water body surrounds will be such as to ensure there are no large tracts of inaccessible vegetation. These controls may already be incorporated into the existing WP fire management procedures.

6.3 WATER FEATURE RISK MANAGEMENT

The lake will be a focal point of attraction for park visitors. Contamination of the water body itself is unlikely as there will be no motor boats or direct water contact. Degradation of water quality could arise from the poor management of land use described earlier. The primary risks to lake surrounds are from an uncontrolled fire and excessive visitor numbers (compaction of tracks and littering of pathways).

Tracks can be upgraded to accommodate the number of visitors and facilities provided for the disposal of rubbish. An uncontrolled fire could damage the entire terrestrial ecosystem. To manage the risk of fire damage, the lake will be designed with adequate firebreaks for rapid access. The design of the lake surrounds will be such as to ensure there are no large tracts of inaccessible vegetation.

Animals contained in the Wildlife Park will be isolated from the lake and fringing vegetation with appropriate fencing. Large animals have the potential to compact ground and erode banks. Any effluent from the Wildlife Park would need to be disposed at least 100 m down gradient of the lake edge.

7 CONCLUSION

The construction of a water body is an important element of the development of Whiteman Park for the following reasons;

- Establishes a further recreational and marketing opportunity for Whiteman Park
- Establishes an important inland water based regional recreation facility in the northern corridors
- Re establishes an emphasis on wetlands and water which has in the past been a strong component of Whiteman Parks physical character and attraction.
- Provides an opportunity to expand the interpretation elements of Whiteman Park to appropriately include wetlands and groundwater, both significant features of Whiteman Parks character and function.

The water body has been located with due regard to, the relationship to the Whiteman Park Village, the impact on Groundwater regimes, loss of remnant vegetation and relationship to future development projects within the Park.

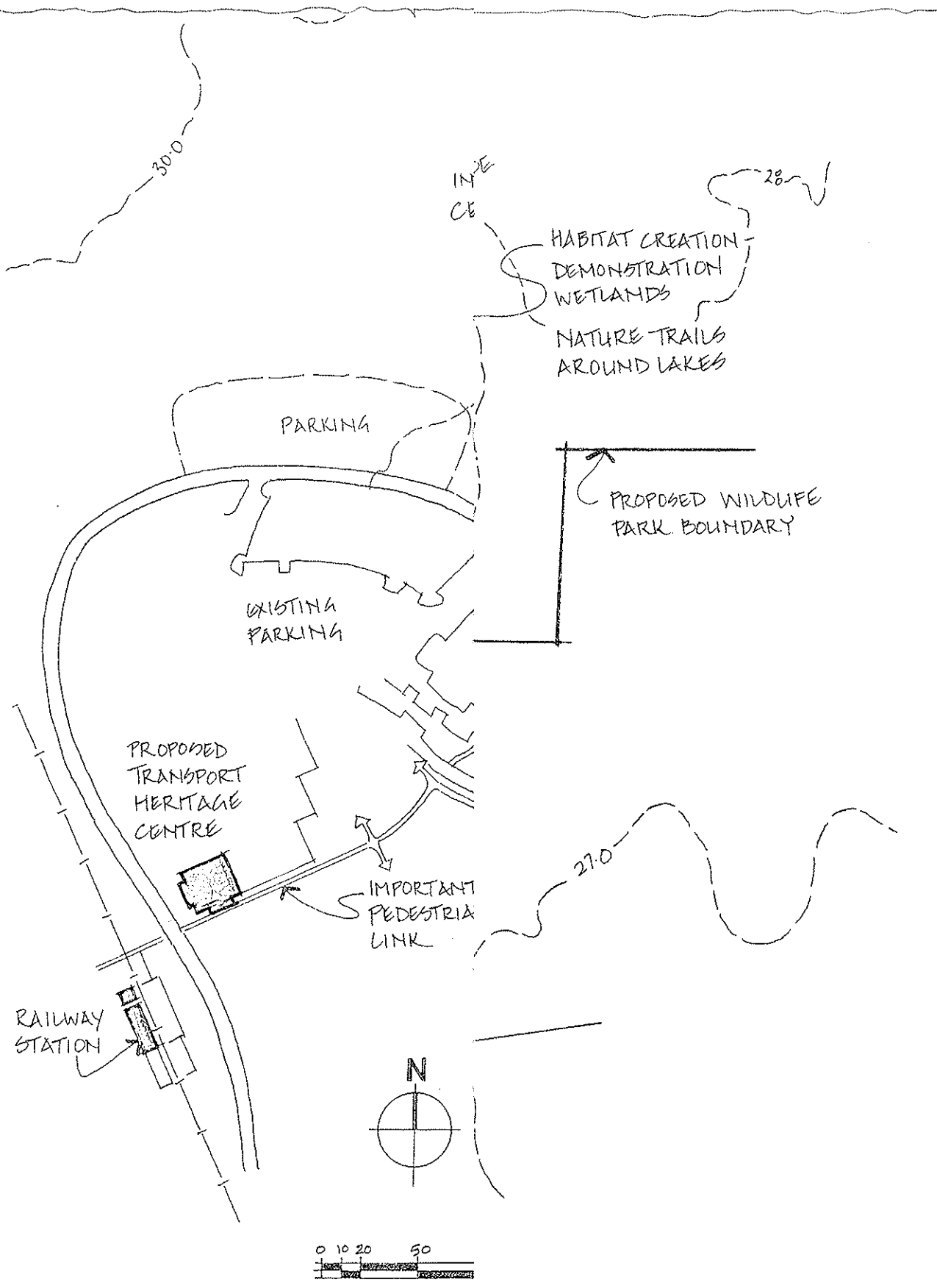
The water body is consistent with the strategic objects of Whiteman Park and its management plan as well as with other Regional Planning policy objectives such as Bushplan. Bushplan seeks to encourage the promotion and retention of significant remnant vegetation areas. The proposed water body has been design to encourage the reintroduction of wetlands and will be landscaped accordingly. The landscape program is proposed to reintroduce species diversity and indigenous vegetation types.

The water body is cognisant of and designed to make provision for the minimisation of water loss to evaporation and has regard to the risks associated with the development of an expression of the groundwater table.

The establishment of the water body is critical to the progressive development of Whiteman Park.

Appendix One

Water Regulations



PROPOSED WATER FEATI

DRWG N° B0351/SK02 REI

EPCAD

INTERPRETATION CENTRE

PICNIC PARKLANDS

PARKING

PARKING

EXISTING PARKING

PARKING

PICNIC

POSSIBLE LEASE LOT

VILLAGE VISTA

LIMITED TRAILS TO MAIN 'RESERVE' AREAS

HIDE

HABITAT CREATION - DEMONSTRATION WETLANDS

NATURE TRAILS AROUND LAKES

SUMMER WL 23.7
WINTER WL 25.3

PROPOSED WILDLIFE PARK BOUNDARY

PROPOSED WILDLIFE PARK BOUNDARY

PROPOSED TRANSPORT HERITAGE CENTRE

IMPORTANT PEDESTRIAN LINK

RAILWAY STATION

VILLAGE TOWN HALL

PROPOSED VILLAGE EXTENSION

30.0 29.0 28.0 27.0 26.0 25.5

N

0 10 20 50 100

PROPOSED WATER FEATURE : WHITEMAN PARK

DRWG Nº B0351/SK02 REV A AUGUST 2002

EPCAD

Appendix Two

Environmental Noise Assessment

Wood & Grieve Consulting Engineers

Whiteman Park Proposed Wetland Water Balance Issues

February 2002

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1. WRC Correspondence Regarding Proposed Wetland Feature

EXECUTIVE SUMMARY

Whiteman Park is located in the fastest growing north eastern corridor of metropolitan Perth. A Strategic Development Plan was completed in 1998 followed by a Master Plan for Whiteman Park (2000) which have been endorsed by WAPC through the Whiteman Park Board of Management (Board). The proposed recreation and infrastructure developments, which include the re-creation of a wetland waterbody, are centered in the area near to the Village.

The proposed wetland site is strategically located in the south eastern area of Whiteman Park, being on the south side of the Gnangara Mound, where it is outside of the public abstraction P1 area and away from the production bores to the north and west where the water resources have been almost fully exploited. Water & Rivers Commission (WRC) has advised the Board of its concern over any land use change which may result in greater loss of water from the Gnangara Mound aquifer, either by greater evaporation from a wetland, or greater abstraction for additional irrigated areas within the Park.

The context for the review of water management within Whiteman Park follows a sequence of recent dry rainfall years and the operation of the Water Corporation Public Water Supply Borefield, referred to as the Mirrabooka Groundwater Scheme. This Scheme includes a number of production bores within the north sector of Whiteman Park, from which the Water Corporation has been unable to abstract groundwater over the last few years due to the likelihood of Environmental Water Provisions (EWP's) being breached.

Although the Water Corporation holds licenses within an overall quota for groundwater abstraction in the Mirrabooka Groundwater Area, negotiation occurs annually between Water Corporation and WRC as to which bores should be pumped, at what rate, and other bore conditions so that EWP's are not breached. The most recent report on groundwater abstraction from the Gnangara Mound (WRC, 2001) highlights the complex issues surrounding the Water Corporation's licence from Office of Water Regulation (OWR) which includes the requirement to actively encourage further reduction in public water demand through its Water Conservation Strategy. The Department of Environmental Protection (DEP) has interpreted this requirement to extend to encouraging a reduction in private abstraction also.

WRC has not, to date, restricted licensed private groundwater abstraction within Whiteman Park, in the same way as it has restricted public abstraction.

It is within this context that WRC has provided advice to Whiteman Park Board on its concerns with respect to the proposed wetland.

The Board considers that development of a wetland in Whiteman Park would enhance the ecological and habitat aspects of the Park as well as reinstate and increase the regional significance of the recreational and interpretive values of Whiteman Park.

The following data and points of significance support the view that the evaporation loss from the proposed wetland is not material in the context of overall water use and balance for Whiteman Park.

1. Analysis of groundwater abstraction for public and private use within Whiteman Park shows that actual abstraction by Whiteman Park of 261.5 ML/yr is far less than the quantity of licences issued to the Park by WRC of 374 ML/yr, a difference of 112.5 ML/yr or 30%.

2. This difference is approximately twice the estimated 60 ML/yr evaporation loss from the proposed wetland.

3. The proposed wetland evaporation loss of approximately 60 ML/yr is considered negligible in context to abstraction licences held by both the Water Corporation (14,000 ML/yr) and Whiteman Park (374 ML/yr).

4. The proposed wetland does not formally represent a water use that requires a licence from WRC.

5. Current licensed private allocation from the superficial aquifer within these Groundwater Sub Areas according to WRC (2001) is 374 ML/yr compared to the public allocation of 14,000 ML/yr. This private allocation only equates to 2.7% of the total licensed allocation from the superficial aquifer within the Whiteman Park Groundwater Sub Areas.

6. The drawdown associated with present private abstraction is estimated to be 0.1 m, on the basis that all private abstraction up to the quota is estimated to result in drawdown of 0.25 m (WRC, 1997a, p.62).

Whiteman Park has implemented irrigation water use efficiency measures and will continue to seek efficiency measures which will more than offset the proposed wetland evaporation loss. Rationalisation of licences and metering of bores would also assist in quantification of the abstracted water.

1. INTRODUCTION

1.1 Background

Whiteman Park is located in the fastest growing north eastern corridor of metropolitan Perth.

Whiteman Park is a freehold property owned by the Western Australian Planning Commission (WAPC) and managed by the Department of Planning and Infrastructure (previously Ministry for Planning) for education and recreation purposes and as a conservation reserve. In addition, small parcels of land within the Park perimeter boundary are also leased to other organisations.

Whiteman Park lies on the southern boundary of the Gnangara Mound, an important unconfined aquifer exploited for both public water supply and private purposes.

To service the activities of the Park, a number of irrigation bores abstract water from this aquifer.

A Strategic Development Plan was completed in 1998 followed by a Master Plan for Whiteman Park (2000) which have been endorsed by WAPC through the Whiteman Park Board of Management (Board). The Master Plan was developed in consultation with government agencies. No formal approval process was completed.

To commence implementation of the Master Plan, a team of consultants led by Wood & Grieve Consulting Engineers and Coffey Geosciences was appointed in mid 2001.

Whiteman Park Board is committed to any land use change being consistent with a rational water resources management framework. As evidence of this commitment, Whiteman Park Board has for many years managed land use within the Park consistent with guidelines of Water & Rivers Commission (WRC) for water source protection.

Within the Master Plan concept, a key aspect is to construct an artificial wetland feature, located immediately north of the main village. The Park administration has received advice from Water & Rivers Commission (WRC) in two letters, included in Appendix 1, that the wetland has not been formally approved by WRC. The letters do not support the proposed wetland on the basis of concern over evaporative water loss, and state that any application for a groundwater licence to service irrigation of additional land within the Park would require justification.

JDA was appointed by Wood & Grieve in October 2001, on behalf of WAPC, to advise on the water balance issues relating to the proposed wetland.

This report presents the findings of the study, and describes the proposed wetland within a water resources management framework for Whiteman Park as a whole.

1.2 Proposed Wetland

Whiteman Park is proposing to construct a 7 hectare wetland feature immediately north of the existing main village (Figure 1). This feature is proposed to contain a permanent open water body, with suitable fringing vegetation to form a constructed wetland.

The creation of a wetland in the Park would provide opportunities for nature walks, recreation facilities, and the construction of educational interpretation points to provide the community with education on groundwater issues and management.

The proposed layout of the wetland is shown in Figure 10. The preliminary design concept of the wetland (EPCAD, 2000) indicates that it will be excavated into the superficial aquifer. The permanent water body will contain approximately 2m depth of water with open space areas above the water having side slopes of 1 in 8 to 1 in 15.

A preliminary water balance for the lake estimated an approximate evaporation loss of 60 ML/yr.

The proposed wetland will be located immediately north of the main village, and is also located south of, and external to the UWPCA and the Priority Source Protection Area boundaries. Thus the creation of the proposed constructed wetland could be seen as an enhancement to the existing surrounding conservation areas.

The proposed wetland and its associated uses should not significantly increase nutrient concentrations in groundwater. The wetland will contain strategically planted macrophytes to reduce contamination in groundwater, particularly nutrient reduction through adherence to biofilm on the macrophytes.

2. WHITEMAN PARK DESCRIPTION

2.1 Background

Whiteman Park is located approximately 17 kilometres north of the Perth central business district and is situated in the City of Swan. Whiteman Park is bounded generally by Gnangara Road to the north, Lord Street to the east, Marshall Road to the South, and Alexander Drive/Telstra Communications site/suburb of Ballajura to the west. Until recently, the Park covered an area of 2600ha and was known as the eastern parcel of the Western Australian Planning Commission (WAPC) area designated as Improvement Plan No.8 (IP8). The western parcel, known as IP8 land, covered a total area of approximately 1000ha.

The Park has now expanded and covers the total original IP8 area of approximately 3600ha (Figure 1).

The Park is a freehold property owned by the WAPC and managed by the Ministry for Planning for education and recreation purposes and as a conservation reserve.

2.2 Land Use

The following is a list of present land uses in the Park (Figure 1):

- Conservation Reserve
- Cattle Grazing
- Main Village and Picnic Areas
- Mussel Pool and Wetland Areas
- Roads, tracks, car parks, railway and tramway
- Equestrian Centre
- Western Australian International Shooting Complex
- Keith Maine Youth Camp
- State Model Aircraft Centre
- Cyrenian House
- Cullacabardee Village

2.3 Shallow Groundwater

The Gnangara Mound is a major underground drinking water source in the superficial aquifer that supplies the Perth Metropolitan Area.

The superficial aquifer extends under the Park from the natural surface to –10m AHD, representing a thickness varying from 40m to 30m depending on topography. The Park contains 19 bores in the superficial aquifer for drinking water and irrigation abstraction.

WRC has 5 monitoring bores located in the superficial aquifer within the Park for monitoring purposes (see Section 6).

2.4 Surface Water

The Park contains the upper reaches of Bennett Brook, a tributary of the Swan River.

Within the Park, Bennett Brook comprises surface expressions of groundwater, mainly comprised of swamps in low-lying areas that flow into Mussel Pool, at the lower, southeastern corner of the Park. Outflow from Mussel Pool generally occurs each winter. Horse Swamp is located in the south east of the Park and also flows into Bennett Brook during rainfall events.

Simon Mead (Whiteman Park) has performed monitoring of outflow from Mussel Pool approximately weekly since August 2001. Over this monitoring period of 90 days, calculated outflow from Mussel Pool was 552 ML. Over this period rainfall was approximately 255 mm. Over the Mussel Pool catchment of approximately 1000 ha the winter outflow equates to approximately 20% of rainfall.

Although 2001 has been a very dry year, average rainfall in Perth during the 90 day monitoring period was 270mm, and actual measured rainfall was comparable at 255 mm. Thus the outflow measured in Mussel Pool from 9 August 2001 to 6 November 2001 is considered to be representative of an average rainfall year.

2.5 Rainfall

Changes in groundwater levels are strongly influenced by rainfall, as it is the major component of groundwater recharge on the Gnangara Mound. The rate and volume of recharge varies considerably depending on factors such as rainfall duration and intensity, land use and vegetation.

Figure 2 shows the annual rainfall totals for Perth Regional Rainfall Station (Bureau of Meteorology Stations 9034 & 9225) since 1880 to 2000. It also shows the 10-year moving average and the long-term average annual rainfall of 864mm.

Since 1975 the 10-year moving average of rainfall indicates rainfall has been below the long-term annual average. Rainfall recorded between September 2000 to April 2001 was the lowest ever recorded for 124 years. From 1 January to 31 October 2001, rainfall totalled 658mm compared to the long-term average of 834mm. This represents a shortfall of 176mm or 21% less rainfall than average.

This prolonged period of less than long-term average rainfall since the mid 1970's has resulted in a general decline in groundwater levels, as described in section 3.

3. ECOLOGICAL WATER REQUIREMENTS (EWR'S) AND ENVIRONMENTAL WATER PROVISIONS (EWP'S)

Ecological water requirements (EWR's) are minimum groundwater levels designed to protect the terrestrial vegetation in the Park from the impacts of groundwater drawdown from the Lexia and Mirrabooka Groundwater Abstraction Schemes, and private abstraction.

In 1997 WRC produced a Public Environmental Review titled "East Gnanagara Environmental Water Provisions Plan" which extended over Whiteman Park and recommended EWR's for groundwater monitor bores within the Park (WRC, 1997a).

EWR's for monitor bores MM18, MM49B, MM53, MM55B and MM59B, locations shown in Figure 3, are presented in Table 1 below.

Based on the EWR, an allocation of water is made available to the environment. This allocation is known as the Environmental Water Provision (EWP). A minimum groundwater level represents the EWP and should it be breached, contingency measures are invoked, which may include switching off nearby production bores. Table 1 shows that the EWP's have been set equal to the EWR's for the 5 WRC monitoring bores.

TABLE 1: WHITEMAN PARK EWR'S AND EWP'S

Monitoring Bore	EWR[1] (m AHD)	EWP[2] (m AHD)
MM18	38.6	38.6
MM49B	24.7	24.7
MM53	33.3	33.3
MM55B	29.5	29.5
MM59B	36.3	36.3

Source: East Gnangara Environmental Water Provisions Plan (WRC, 1997a).
1. EWR = Ecological Water Requirement
2. EWP = Environmental Water Provision

Groundwater levels measured in these monitoring bores are provided in Figures 4, 5 and 6. It can be seen that groundwater levels have been steadily declining since the mid 1970's and many of the minimum water levels recorded recently have either been below, or are close to, their absolute minimum.

4. GNANGARA LAND USE AND WATER MANAGEMENT STRATEGY

Public water supplies have been obtained from bores within the Park since the 1970's. The Mirrabooka Groundwater Scheme established in 1970 was the first of its kind in the metropolitan area.

The Gnangara Land Use and Water Management Strategy (GLUWMS) was developed to protect the Gnangara Mound from contamination (WAPC, 1999). This report prescribes boundaries for Underground Water Pollution Control Areas and Priority Source Protection Areas, and examines existing land uses and the impacts on water quality and potential risks of contamination.

Approximately 2800 ha of the Park is located within the Priority 1 Source Area of the Mirrabooka UWPCA (Figures 1 & 7). The Priority 1 Source Protection Area is defined to ensure that there is no degradation of the water source. It is declared over land where the provision of the highest quality public drinking water is the prime beneficial land use (WAPC, 1999).

Figure 7 shows that the remainder of Whiteman Park is outside the revised UWPCA boundary – and as such is beyond the Priority 1, 2 & 3 Source Protection Areas.

The bold line on Figure 7 also shows the revised underground Water Pollution Control Area (UWPCA) of the Gnangara Mound. This line is effectively the limit of capture zones of existing and proposed bores on the mound.

The revised (recommended) boundary in the vicinity of Whiteman Park, on the southern extremity of the mound, is seen to have shrunk compared with the previous boundary. This was achieved through groundwater modelling and the revised boundary is referred to as scientific boundary on this basis.

The effect is that the southern part of Whiteman Park including the Main Village and Mussel Pool area (Figures 1 & 7) are no longer within the UWPCA area.

5. GROUNDWATER MANAGEMENT IN WHITEMAN PARK

5.1 Introduction

This chapter describes the management of groundwater within the context of WRC allocation and licensing policies, for both public and private purposes within Whiteman Park.

In this Chapter the term "quota" refers to the annual volume of water for which WRC will issue groundwater abstraction licences, within a groundwater sub-area.

"Allocation" refers to that part of the quota for which licences have been issued at any time.

Public and private groundwater abstraction from within and adjacent to Whiteman Park has occurred for several decades. In 1997 WRC prepared a Public Environmental Review of the East Gnangara Environmental Water Provisions Plan.

For licensing purposes, the Gnangara Mound is divided into Groundwater Areas and Sub Areas. The Park is located in the Whiteman Park and Improvement Plan 8 Groundwater Sub Areas of the Mirrabooka Ground Area (Figure 8) (WRC, 1997a). Within this Groundwater Area, the Water Corporation and Whiteman Park operate several production bores for Mirrabooka Groundwater Abstraction Scheme and irrigation, respectively.

5.2 Public Purposes

5.2.1 Public Groundwater Quota

The layout of the Mirrabooka Groundwater Abstraction Scheme is shown in Figure 9. This scheme is licensed by WRC for abstraction of approximately 14,000 ML/yr of groundwater for public water supply. There is no specific quota for the Water Corporation bores within Whiteman Park as part of the total from the Mirrabooka Groundwater Area. Within Whiteman Park Water Corporation operates 22 production bores (20 in the unconfined aquifer and 2 in the confined aquifer).

A borefield abstraction strategy is developed on an ongoing basis between Water Corporation and Water & Rivers Commission in response to water levels in monitoring bores and wetlands.

Over the last few years the Water Corporation has not been allowed to operate any of the abstraction bores within Whiteman Park, as a result of low water levels in WRC monitoring bores. Water Corporation abstraction from the Mirrabooka Borefield in total has been approximately 10 to 11,000 ML/yr. That is, approximately 3,000 to 4,000 ML/yr below the quota. This shortfall is directly due to closure of the production bores located within Whiteman Park. That is, the Water Corporation has been allowed to abstract from other bores within the Mirrabooka Borefield, but not from those located within Whiteman Park.

5.2.2 Public Groundwater Allocation

Total bore allocation (licences) within Whiteman Park total approximately 3,300 ML/yr as described above.

5.2.3 Public Groundwater Abstraction

As described above actual abstraction from the Mirrabooka Borefield within Whiteman Park has been zero or negligible over the last few years, due to a combination of factors including low rainfall, the effects of private abstraction, and breaches of EWP's.

5.3 Private Purposes

5.3.1 Private Groundwater Quota

Private superficial groundwater allocation quota in Whiteman Park and IP8 Groundwater Sub Areas are presented in Table 2 below. Whiteman Park quota is 1,300 ML/yr. IP8 quota was 3,000 ML/yr (WRC, 1997a) and reduced to 2,500 ML/yr (WRC, 2001).

Total quota for both sub-areas was therefore 4,300 ML reducing to 3,800 ML in the latest report.

TABLE 2: PRIVATE GROUNDWATER ALLOCATION BY GROUNDWATER SUB AREA

Sub Area	WRC (1997a)			WRC (2001)		
	Superficial Allocation Quota (ML)	Allocation at November 1996 (ML)	Unallocated Availability (at Nov 1996) (ML)	Superficial Allocation Quota (ML)	Allocation as at 1999/00 (ML)	Unallocated Availability (1999/00) (ML)
Whiteman Park	1,300	281	1,019	1,300	297	1,003
IP8	3,000	76	2,924	2,500	77	2,423
TOTAL	4,300	357	3,943	3,800	374	3,426

Source: East Gnangara Environmental Water Provisions Plan (Table E) (WRC, 1997a).
Environmental Management of Groundwater Abstraction on the Gnangara Mound (Table 3) (WRC, 2001).

Correspondence from Natasha Hyde (WRC) dated 29 March 2001 (Appendix 1) indicates that WRC are unlikely to allocate all of the unallocated volume in these Groundwater Sub Areas due to environmental constraints. WRC may therefore reduce the quota for individual groundwater sub areas.

Whiteman Park Sub Area allocation increased from 281 to 297 ML/yr between two reports (WRC, 1997a & 2001). The unallocated volume reduced correspondingly from 1,019 to 1,003 ML/yr.

In IP8 the sub-area allocation is 76 ML/yr, with the unallocated volume reducing from 2,924 to 2,423 ML/yr between WRC (1997a & 2001).

Total allocation has therefore increased from 357 to 374 ML/yr with a corresponding decrease in total unallocated volume of 3,943 to 3,426 ML/yr (Table 2).

JDA has not been able to determine the reasons for the changes to the allocations stated WRC 1997a (2001).

5.3.2 Private Groundwater Allocation

Whiteman Park has 9 production bores within Whiteman Park sub area and IP8 sub area for irrigation, drinking and stock purposes. As the Park does not hold the licence papers, license records were obtained previously from WRC records by Whiteman Park staff. Copies of the records were not taken.

Table 3 below provides a summary of the licences. It has been suggested the WRC licensing records could be outdated, as several bores were previously used for cattle but have since been decommissioned (Simon Mead *pers. comm.*, Whiteman Park).

Total licensed allocation from the superficial aquifer for Whiteman Park east of Beechboro Rd is 144 ML/yr. In the IP8 land to the west of Beechboro Rd, WRC (2001) state 77 ML/yr is licensed for private use. Total licensed abstraction by Whiteman Park is therefore 221 ML/yr (Table 3).

Licensed groundwater allocation in Whiteman Park by other private users is estimated to be 119 ML/yr (Table 4).

Total private groundwater licenses (Whiteman Park and other users) is therefore 340 ML/yr (see Tables 3 & 4).

In contrast, WRC (2001) shows total private allocation of 374 ML/yr. Reasons for this difference are unknown.

5.3.3 Private Groundwater Abstraction

This section describes actual abstraction of groundwater within Whiteman Park with reference to specific bores.

Whiteman Park production bores east of Beechboro Road are not metered and water use is estimated to be 174.1 ML/yr (Table 3) based on multiplying irrigated areas with WRC standard irrigation rates for various land uses (Simon Mead, pers. comm.).

On IP8 land (west of Beechboro Road) the only bores currently known are Cyrenian House and the Cullacabardee Village, however it is considered that these bores abstract negligible volume compared with the licensed volume of 77 ML/yr.

Other groundwater users located within the Park include the Equestrian Centre, Western Australian International Shooting Complex, Keith Maine Youth Camp and the State Model Aircraft Centre. A total of 6 bores are used for irrigation, drinking and stock purposes. These bores are not metered and estimated water use is 87.4 ML/yr (Table 4).

Total private groundwater abstraction (Whiteman Park and other users) is therefore 261.5 ML/yr (see Tables 3 & 4).

TABLE 3: PRODUCTION BORE SUMMARY – WHITEMAN PARK BOARD

Groundwater Sub Area	Bore No.	Location	Licence No.	Licensed (ML/yr)	Estimated Use (ML/yr)
WP	Bore 7	Village	49755	7.5	30
WP	Bore 8	Village	34211	30	33.3
WP	Bore 9	Village	34212	1.5	0
WP	Bore 10	Village	100569	5	5
WP	Bore 11	Entrance	26726	1.5	0.5
WP	Bore 12	Mussel Pool	220	20	2
			41144	1.5	0
WP	Bore 13	Bennett Brook	41142	30	45
WP	Bore 14	Mussel Pool	240	20	58.3
WP	Bore 15	Mussel Pool	230	20	0
WP	Mussel Pool Soak	Mussel Pool	M2520	7	0
Sub Total				**144**	**174.1**
IP8	?	IP8 Land	?	77	0
Sub Total				**77**	**0**
WP + IP8	**TOTAL**			**221**	**174.1**

Notes:

1. WP = Whiteman Park
2. IP8 = Improvement Plan 8
3. 1 ML = 1000 kL

TABLE 4: PRODUCTION BORE SUMMARY - OTHER PRIVATE USERS

Groundwater Sub Area	Bore No.	Area	Licence No.	Licensed (ML/yr)	Estimated Use (ML/yr)
WP	Bore 1	Equestrian	45028	1.5	1.5
WP	Bore 2	Shooting Complex	26476	36.0	58.1
				36.0	
WP	Bore 3	Shooting Complex	65525	8	
WP	Bore 4	House	00461	10.2	1
				1.5	
WP	Bore 5	Keith Maine Centre	?	14	15
WP	Bore 6	Model Centre	105530	11.8	11.8
Sub Total				**119**	**87.4**
	IP8			0	0
Sub Total				**0**	**0**
TOTAL				**119**	**87.4**

Notes:

4. WP = Whiteman Park
5. IP8 = Improvement Plan 8
6. 1 ML = 1000 kL

5.3.4 Impact of Private Abstraction on Groundwater Levels

WRC (1997a) p. 52 states that the groundwater model was run to assess the impact of private users taking the full quota. Water levels were estimated to fall by approximately 0.25 m under this scenario. At present with the actual private abstraction water table levels are estimated by JDA to perhaps only be 0.1 m depressed. This is small compared with the typical seasonal variation of approximately 1.0 m.

5.4 Water Use Efficiency in Whiteman Park

The majority of groundwater abstracted within the Park is used for irrigation. The Irrigation Programme adopted by the Park includes water use efficiency measures as described below:

- Overnight watering to minimise water loss through evaporation
- Watering times adjusted to suit prevailing weather conditions (visual inspection by horticulturist)
- Irrigation sprinklers adjusted to avoid watering bitumen areas.

Although the exact efficiency of these measures has not been calculated, the Park recognises that there may still be opportunities to implement further water use efficiency measures into the Irrigation Programme.

5.5 Summary

Whiteman Park is located within the IP8 and Whiteman Park Groundwater Sub Areas of the Mirrabooka Groundwater Area (Figure 8). Within the Whiteman Park Sub Area, Whiteman Park, a few private users and the Water Corporation abstract groundwater from the superficial aquifer.

Current licensed private allocation from the superficial aquifer within these Groundwater Sub Areas according to WRC (2001) is 374 ML/yr compared to the public allocation of 14,000 ML/yr. This private allocation only equates to 2.7% of the total licensed allocation from the superficial aquifer within the Whiteman Park and IP8 Groundwater Sub Areas.

However, due to the risk of EWP's being breached Water Corporation has not been able to abstract any groundwater for public supply from Whiteman Park in recent years, whereas private abstraction has not been similarly restricted (WRC, 2001). The Water Corporation is under some obligation as a condition of its licence from the Office of Water Regulation (OWR) to encourage water conservation both in the public and private sectors.

Within Whiteman Park there is evidence that the Water Corporation has taken major steps to reduce abstraction, but that private abstraction has not been similarly controlled.

The drawdown associated with present private abstraction is estimated to be 0.1 m, on the basis that all private abstraction up to the quota is estimated to result in drawdown of 0.25 m (WRC, 1997a, p.62).

Total private groundwater abstraction is estimated to be only 261.5 ML/yr, rather than the licensed total of 374 ML/yr (WRC, 2001). This represents abstraction 30% or 112.5 ML/yr less than licensed.

6. PRESENT LANDUSE IMPACT

Land use within the Park is strictly determined by WRC land use compatibility for Priority 1 Source Protection Areas. The Priority 1 Source Protection Area is created to ensure that there is minimal risk of groundwater contamination. Only land uses deemed compatible (ie. low groundwater contamination risk) or incompatible land uses that are specially managed are accepted. The northern section of the Park is located within the Priority 1 Source Protection Area.

Alan Tingay and Associates (1999) conducted a study to develop a process and methodology for assessing proposals for development and recreational activities within the Priority 1 Source Protection Area. The study showed that the current total nutrient loading from land uses within the Park in the Priority 1 Source Protection Area, are within the WRC criteria of an allowable 1% increase from the National Health and Medical Research Council (NHMRC) limit above the natural concentration for nitrogen in groundwater.

Many of the land uses within this priority area have occurred for many years and are mainly comprised of non-conforming land uses, that is, land uses deemed incompatible with Priority 1 Source Protection Areas (ATA, 1999).

Given that the current incompatible land uses in the Priority 1 Source Protection Areas do not pose a risk of contamination of groundwater (ie. nutrient loadings within 1% of NHMRC health guidelines), this indicates that Whiteman Park is managing these land uses extremely carefully.

7. CONCLUSIONS

Whiteman Park is within the Whiteman Park Groundwater Sub Area for which a private groundwater allocation was allowed for during environmental impact assessment of the Lexia Groundwater Scheme (WRC, 1997a).

Present abstraction by Whiteman Park is well within the quota and the proposed wetland does not formally represent a water use that requires a licence from WRC.

Whiteman Park has implemented irrigation water use efficiency measures and will continue to do so which will more than offset the proposed wetland evaporation loss. Rationalisation of licences and metering of bores would assist in quantification of the abstracted water.

The proposed wetland evaporation loss of approximately 60 ML/yr is considered negligible in context to abstraction licences held by both the Water Corporation (14,000 ML/yr) and Whiteman Park (374 ML/yr).

The 112.5 ML/yr difference between the licensed private allocation of 374 ML/yr and actual private abstraction of 261.5 ML/yr is already twice the volume estimated as evaporation loss from the proposed wetland.

8. REFERENCES

Alan Tingay & Associates (1999) *Water Resource Protection Assessment Guidelines for Whiteman Park,* report for Whiteman Park and the Water and Rivers Commission.

Davidson WA (1995) *Hydrogeology and Groundwater Resources of the Perth Region Western Australia,* GSWA, Bulletin 142.

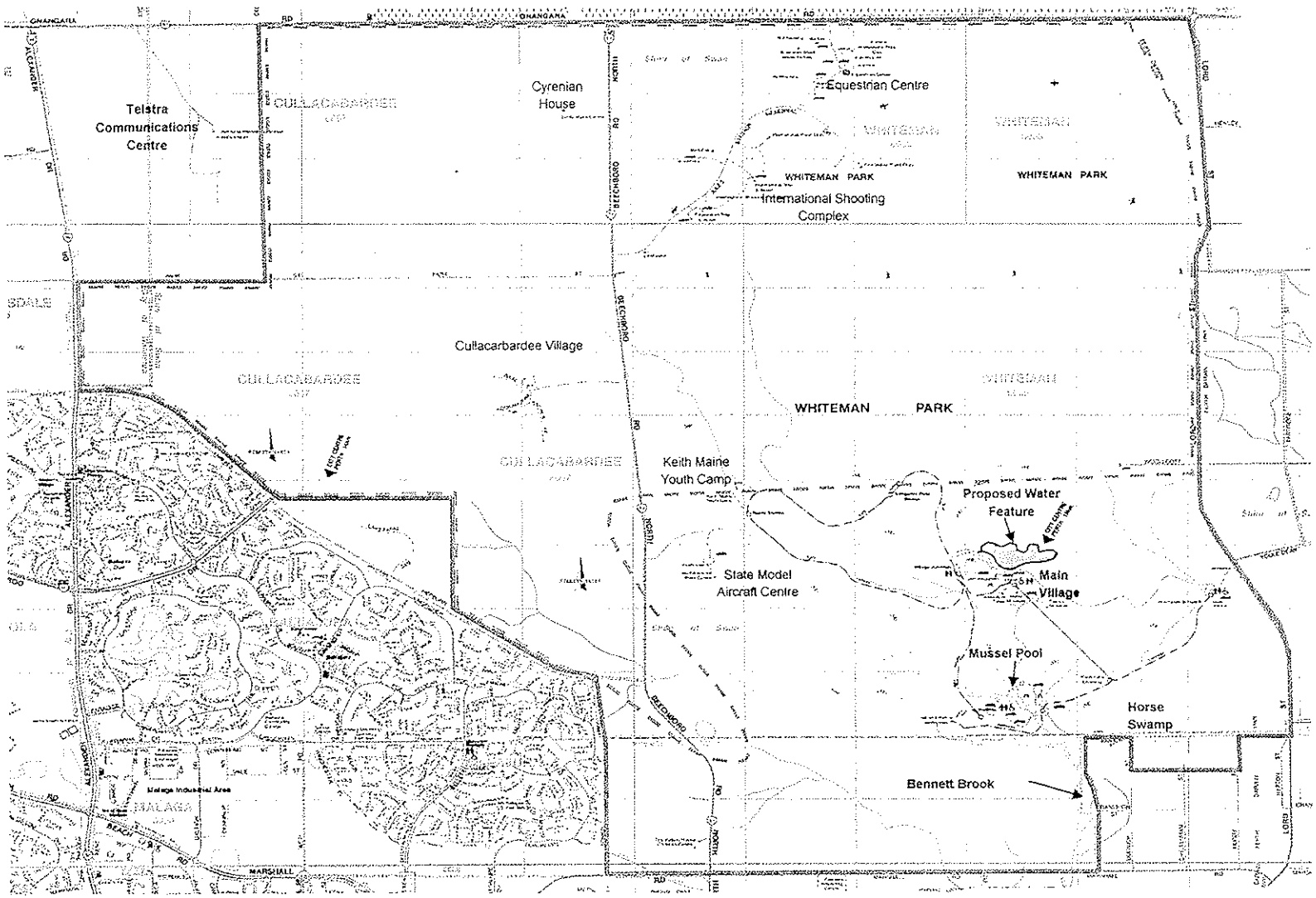
Western Australian Planning Commission (1999) *Gnangara Land Use and Water Management Strategy (Parts 1 and 2).*

Water and Rivers Commission (1997a) *East Gnangara Environmental Water Provisions Plan – Public Environmental Review.*

Water and Rivers Commission (1997b) *Perth Groundwater Atlas.*

Water and Rivers Commission (2001) *Environmental Management of Groundwater Abstraction on the Gnangara Mound - Triennial Report to the Environmental Protection Authority July 1997 to June 2000.*

FIGURES



Base Map reproduced from StreetSmart Digital Street Directory 2000.

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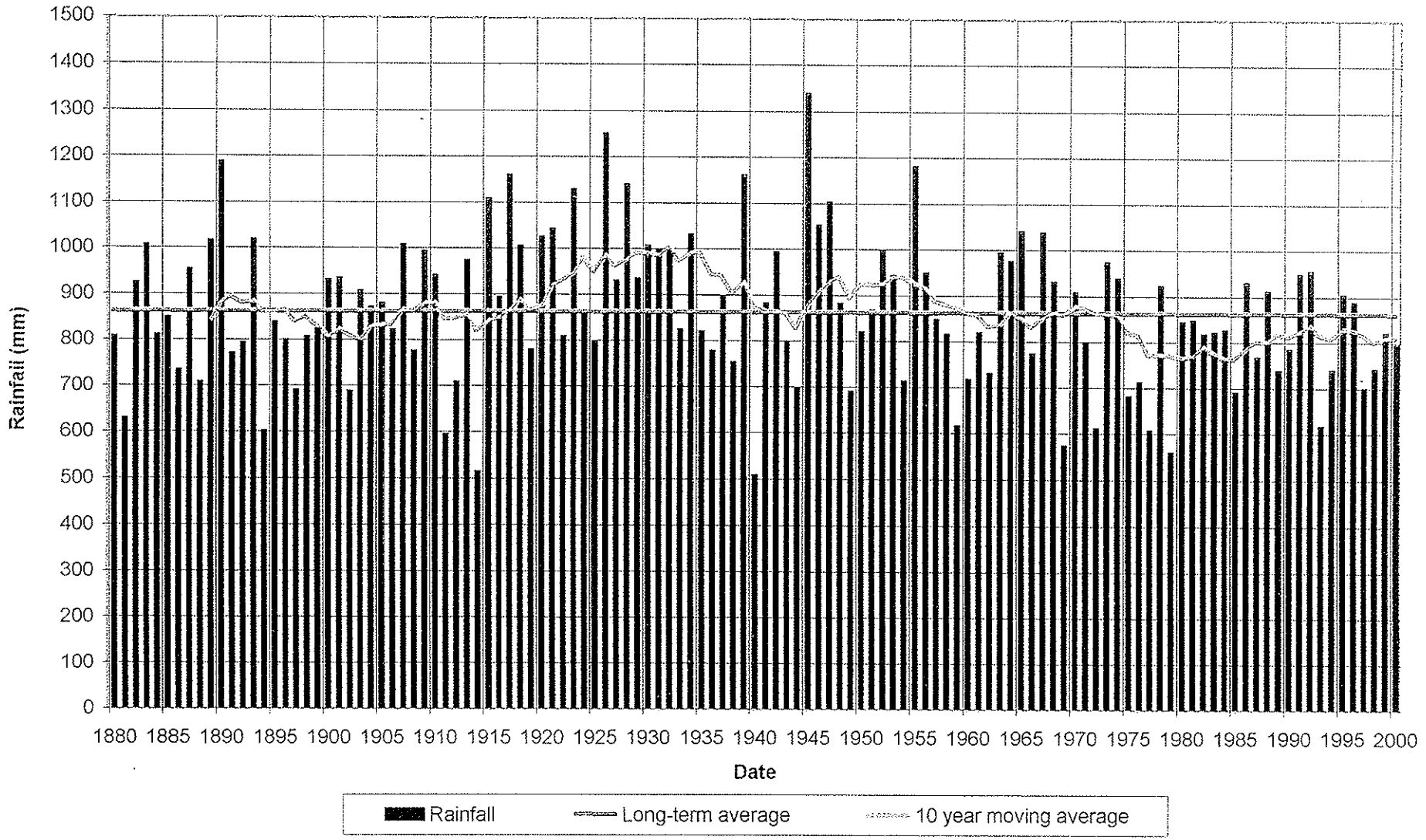
Job No.: J2935	**Wood & Grieve Consulting Engineers**
Scale: 1 : 45 000	**Proposed Wetland Water Balance Issues**
	Figure 1: Whiteman Park Location Map

Rainfall at Perth Regional Station



Source: Bureau of Meteorology, (Rainfall Station 9034 prior to 1993 & Rainfall Station 9225 after 1993).

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	Figure 2: Perth Annual Rainfall

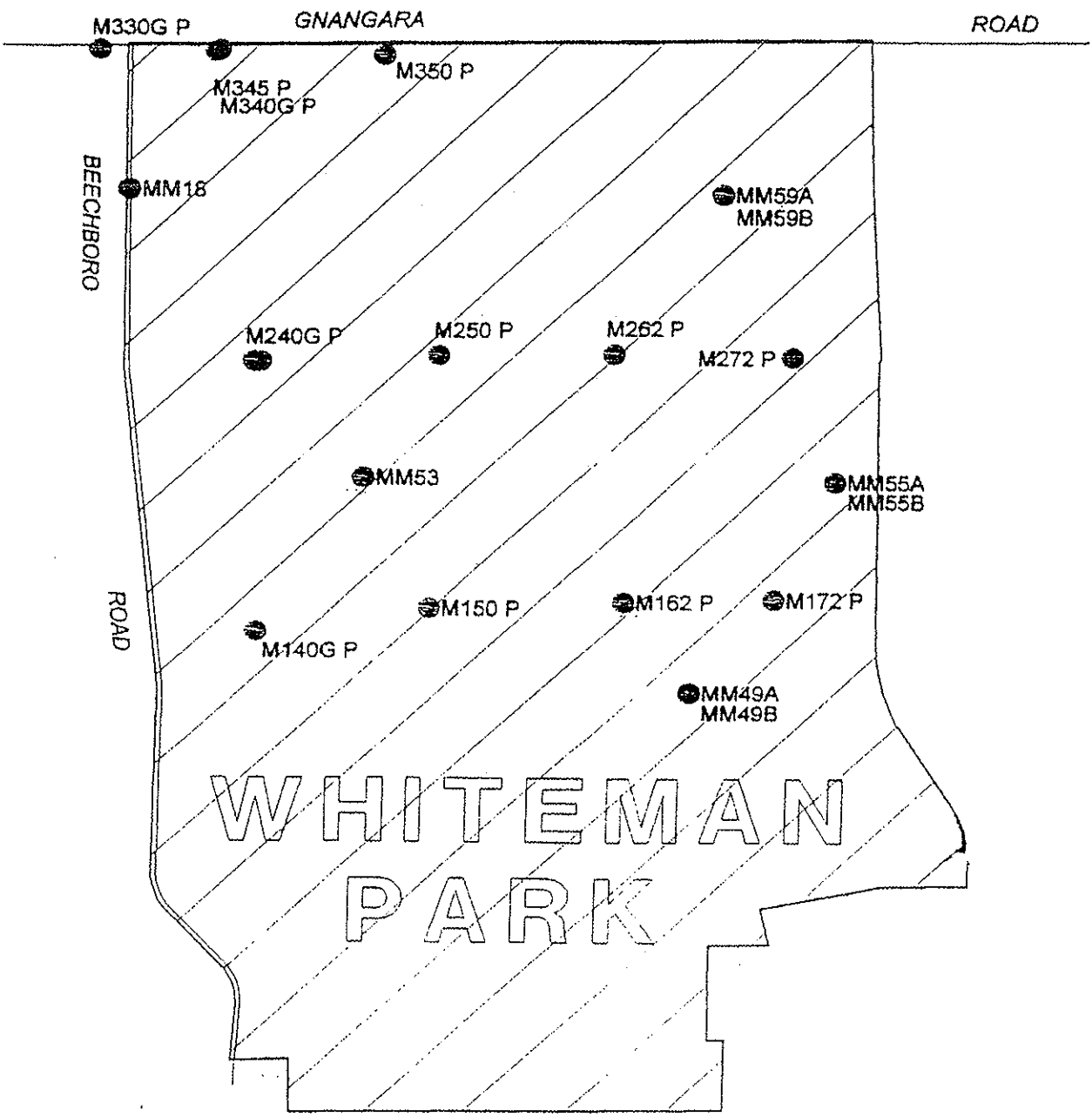

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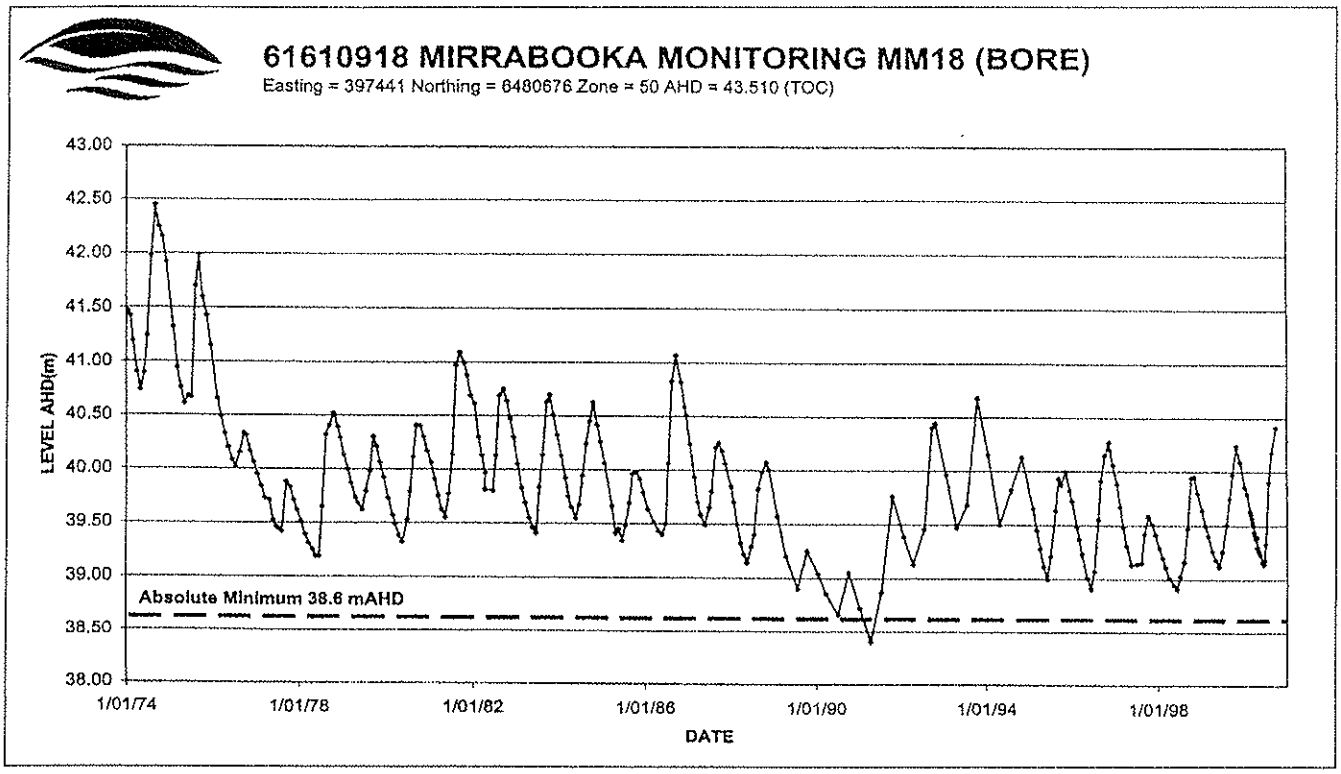
Figure 3: WRC Monitoring Bore Locations



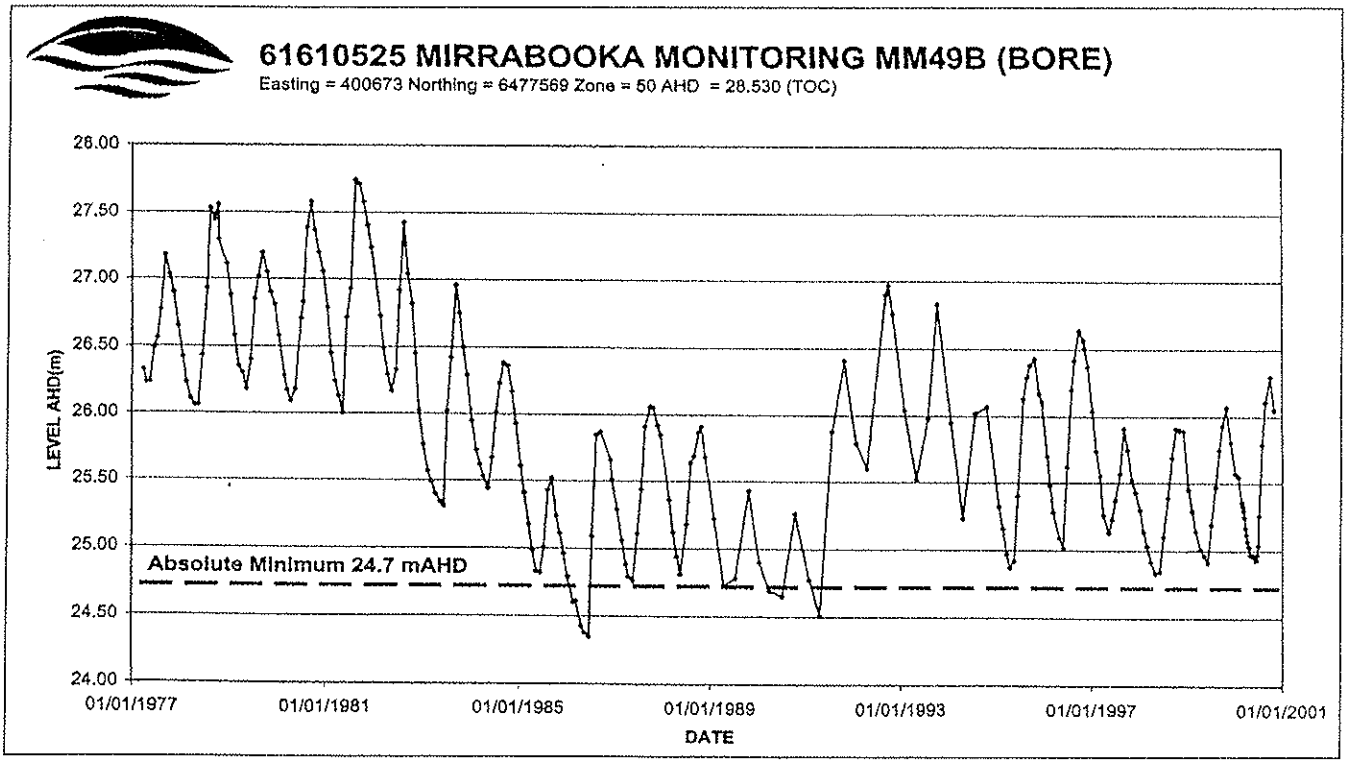


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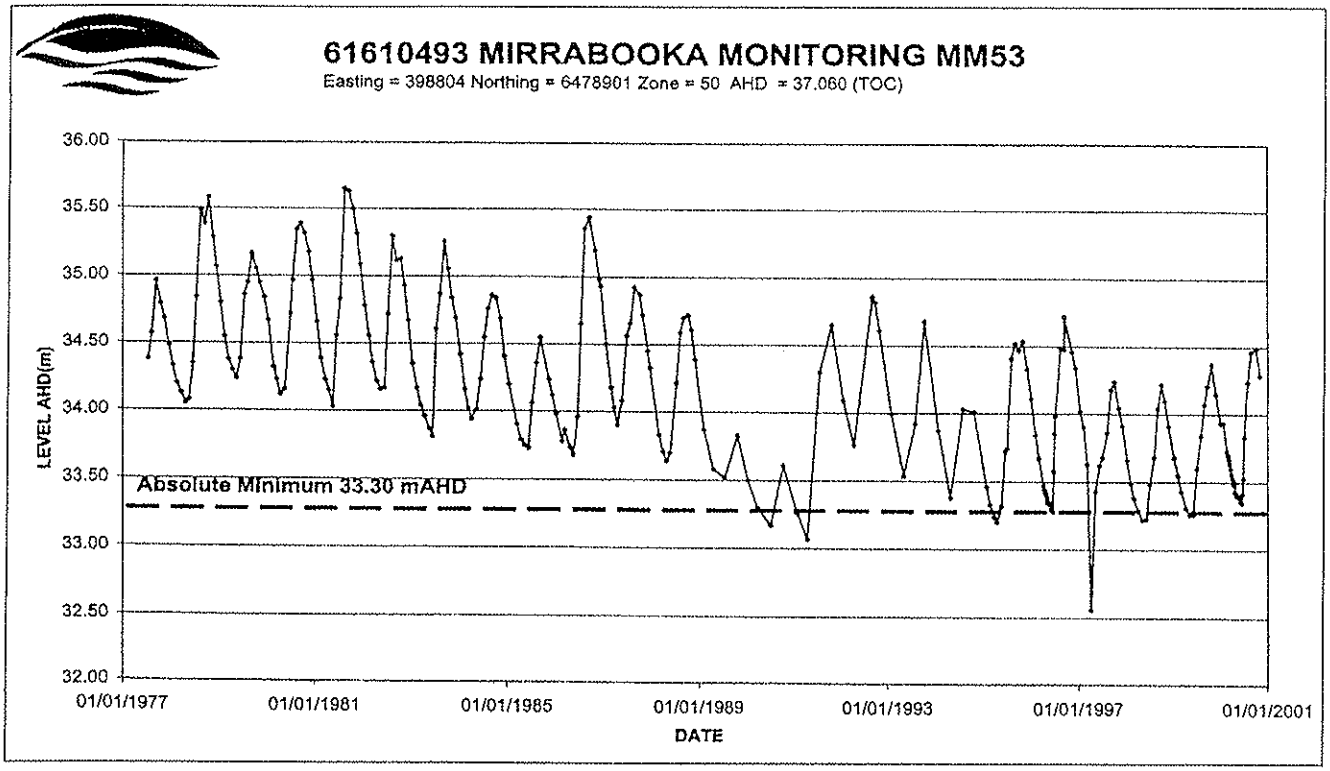
	Figure 4: WRC Monitoring Bores MM18 and MM49B Hydrographs



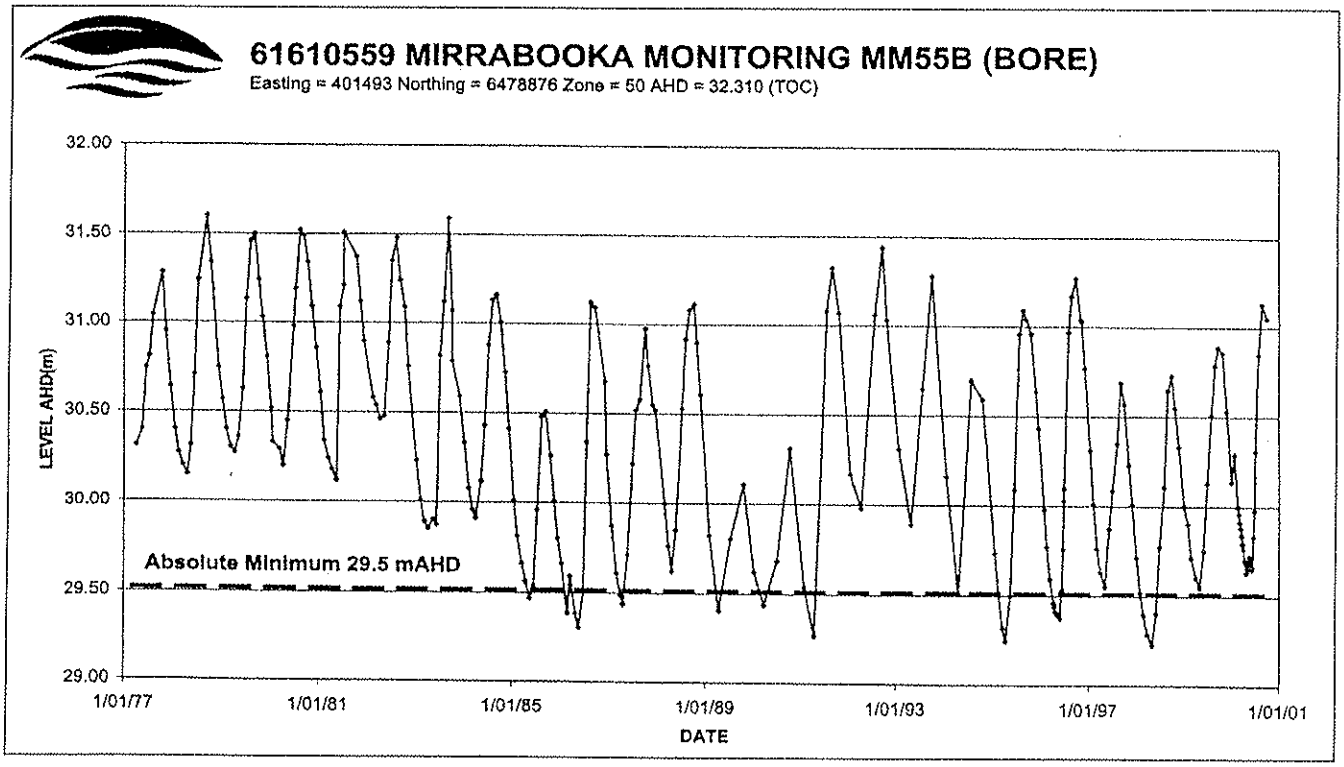


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Figure 5: WRC Monitoring Bores MM53 and MM55B Hydrographs

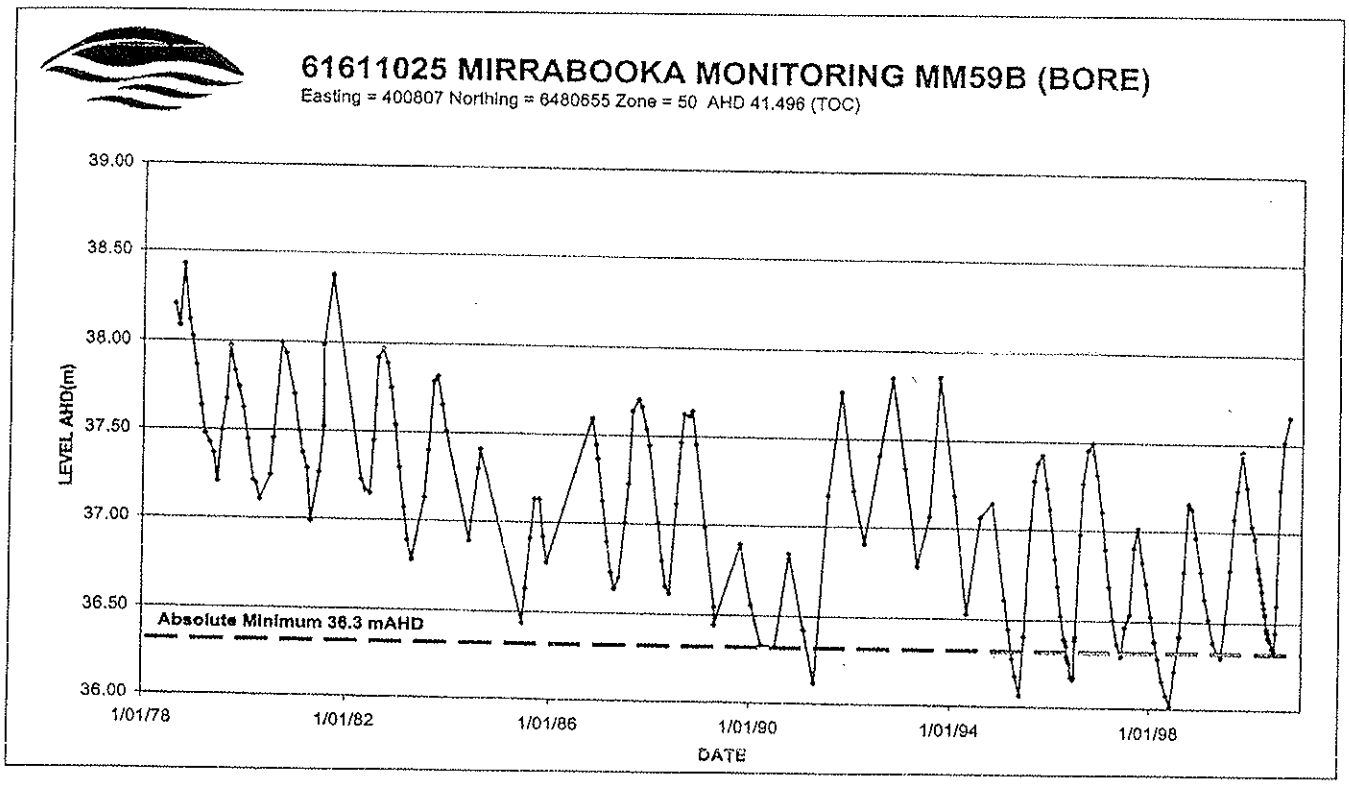

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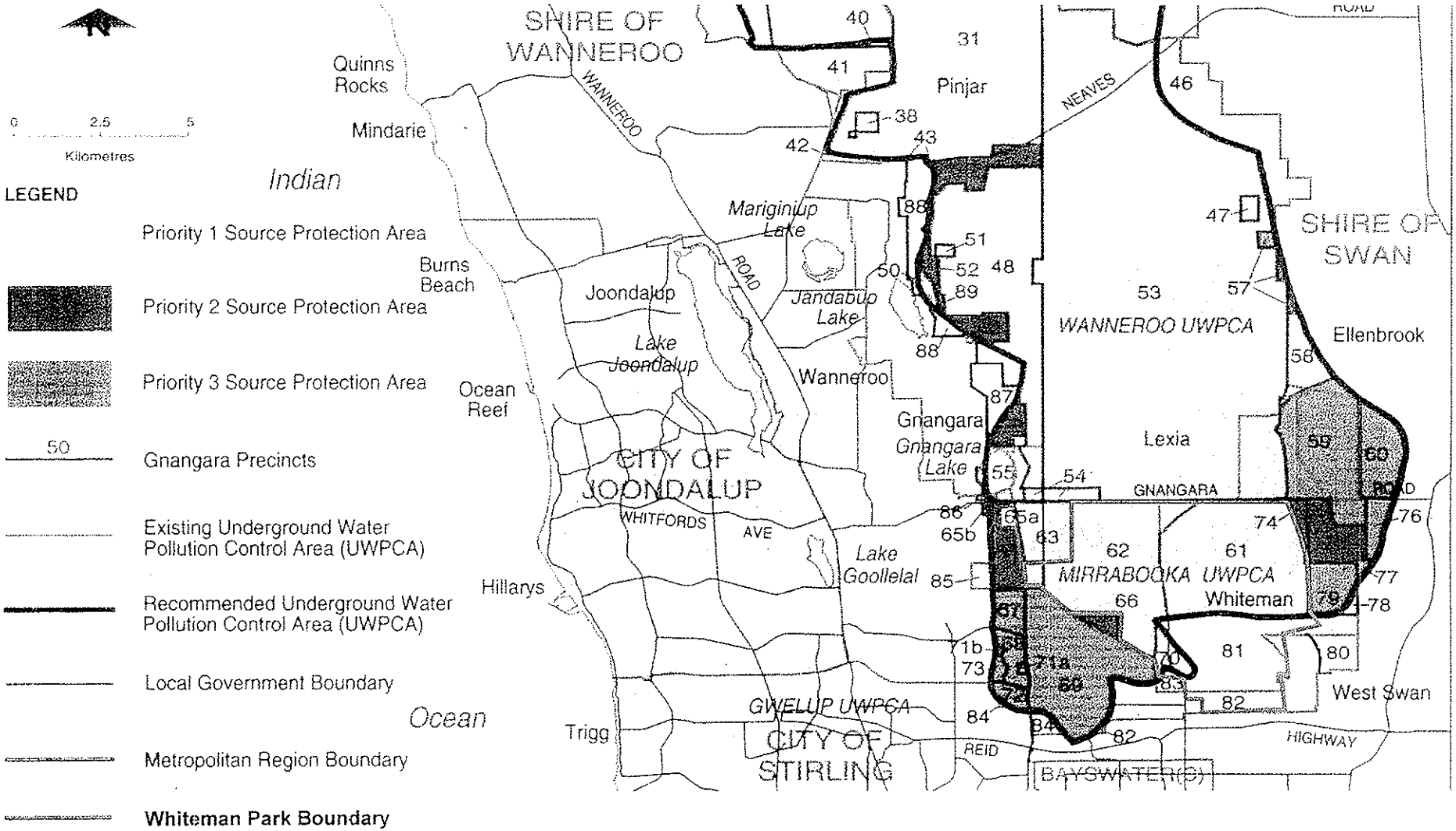
	Figure 6: WRC Monitoring Bore MM59B Hydrograph



Map Source: Western Australian Planning Commission (1999) Gnangara Land Use and Water Strategy

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Proposed Wetland Water Balance Issues

Figure 7: UWPCA and Priority Source Protection Areas

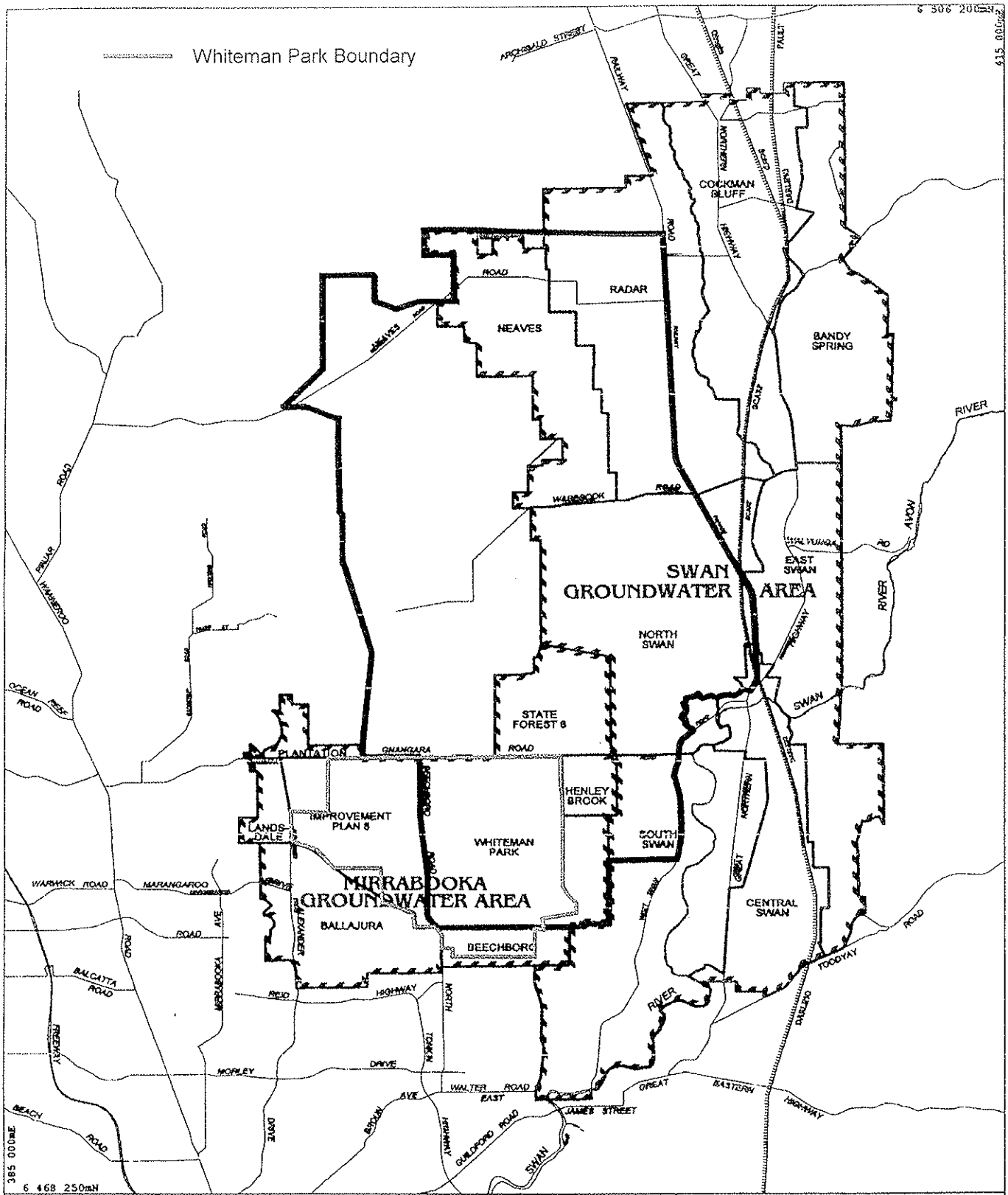

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Figure 8: Mirrabooka Groundwater Area and Sub Areas

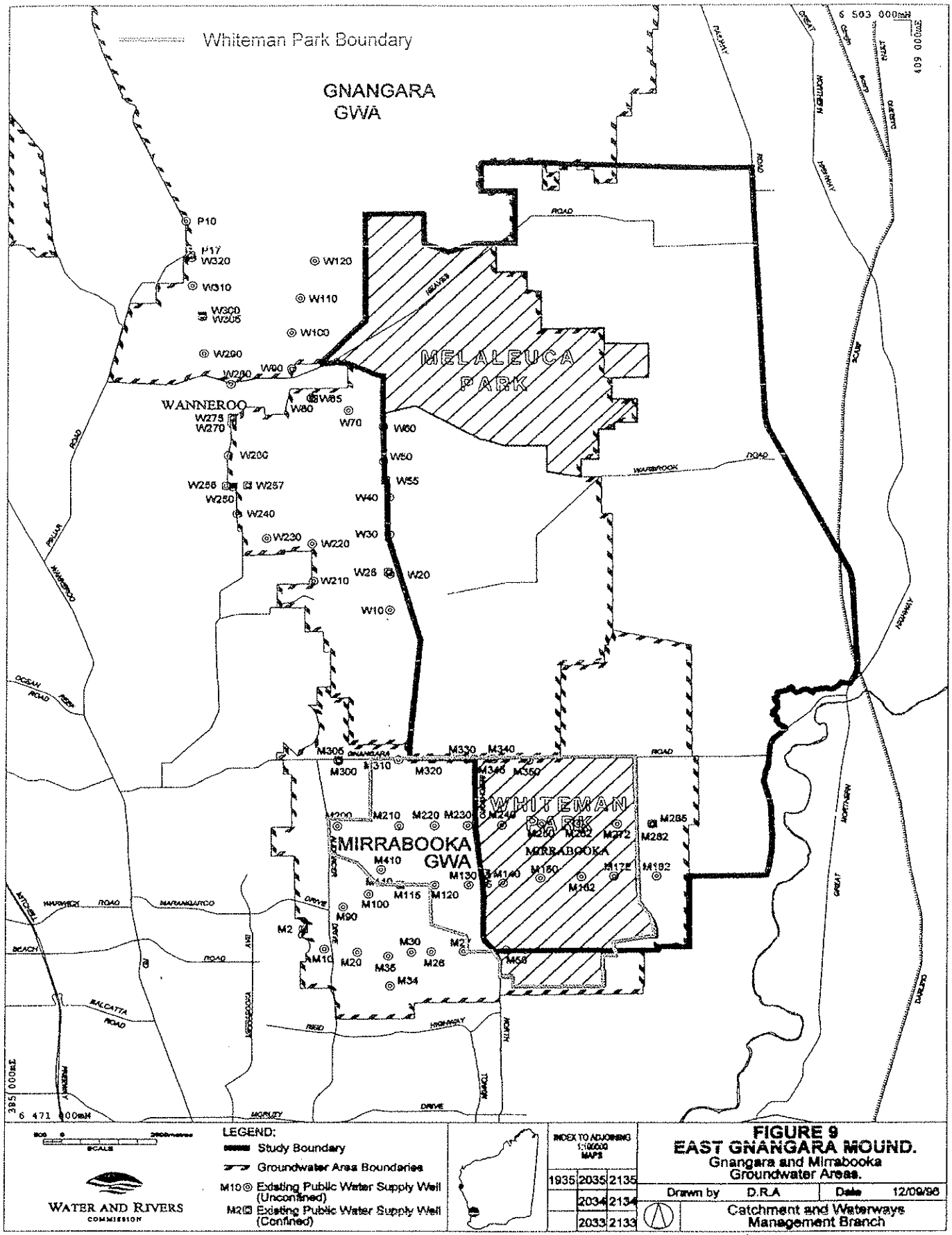

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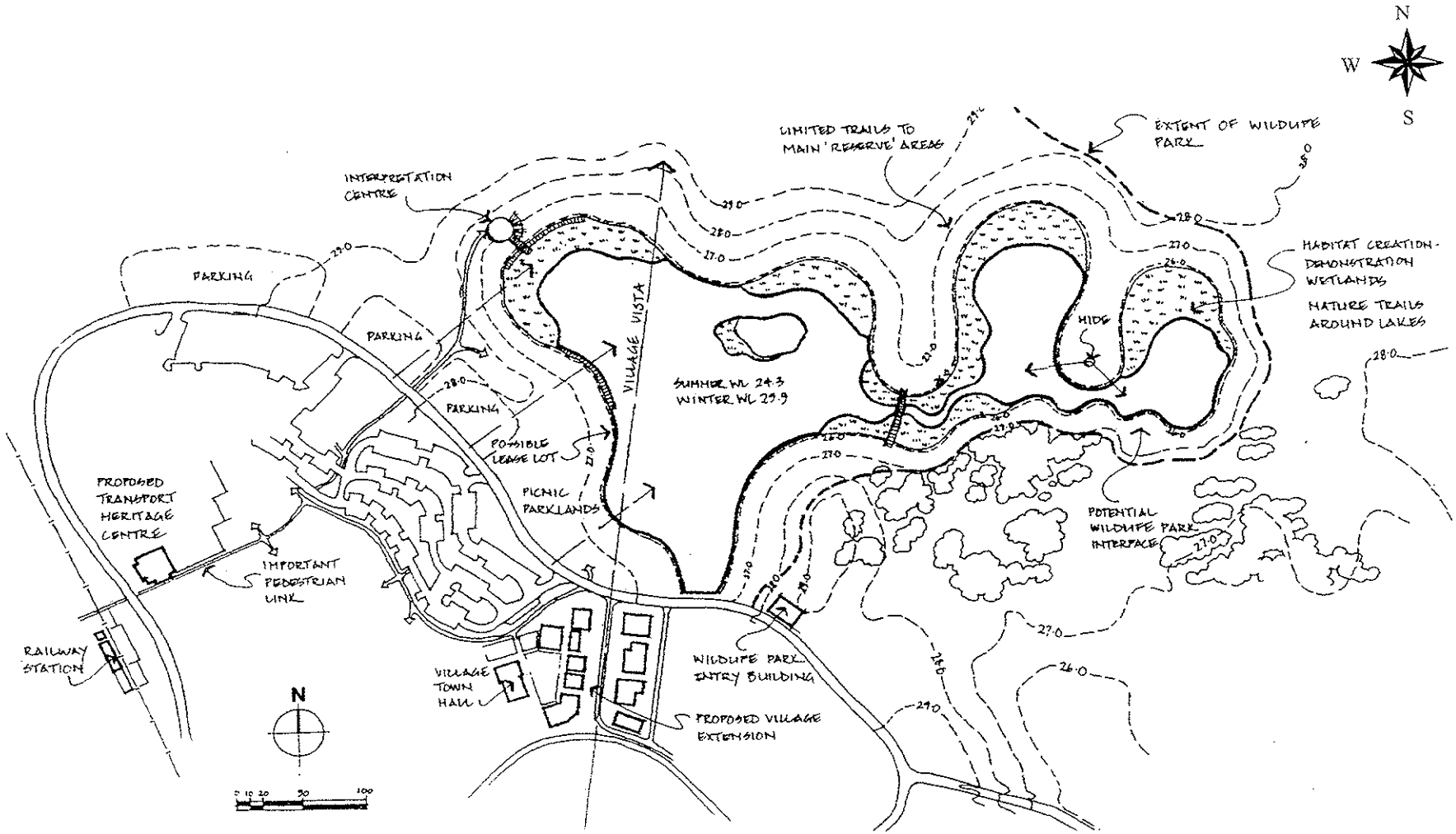
Figure 9: Water Corporation Production Bore Layout



Map reproduced from EPCAD "Whiteman Park - Preliminary Sketch Concept Plan" (Drawing No. B0351/SK01 Rev B)

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	Figure 10: Proposed Wetland Layout

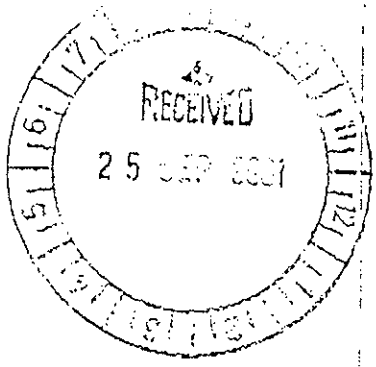
APPENDIX 1

WRC Correspondence Regarding Proposed Lake Feature

WATER AND RIVERS
COMMISSION

YOUR REF
OUR REF 15186
ENQUIRIES Bill Till
DIRECT TEL. 9278 0561

Mr Nigel McCombe
Manager
Whiteman Park
Lord Street
WHITEMAN WA 6068



Dear Nigel

WHITEMAN PARK MASTER PLANNING PROPOSALS AND RELATED WATER USE

I am writing in response to your letter dated 25 July 2001 addressed to Linda Moore.

Your letter refers to the Whiteman Park Master Plan (2000) as being "approved" and seeks the Water and Rivers Commission's assistance in its implementation. Extensive enquires have been made within the Commission and although a number of officers have been consulted by both you and your consultants in the preparation of this plan, the Commission has not been requested to, nor provided any, endorsement for this Plan.

The proposal to construct a large artificial lake/wetland is of concern. Creation and maintenance of the water feature, as outlined in your letter, would place further stress on an already stressed system. Given the current drought conditions and long term decline in aquifer levels on the Gnangara Mound such a high water consumptive development by Government is likely to be heavily criticised by the community.

With regard to the groundwater allocation, the Commission has no record of an agreement to allocate a total of 1,300,000 kL/year to Whiteman Park. Groundwater resources within the Whiteman Park Subarea are typically allocated on the 'first in first served' principle, with applicants being required to demonstrate that they have an immediate need for the water and that the intended use is not going to have an unacceptable impact on other groundwater users, including the environment, and that they will use the water efficiently. Any licence application received will be considered in accordance with groundwater availability and policy at that time it is received.

In summary, the Commission does not support the construction of a large water body as currently proposed in the Master Plan. Should further clarification of the issues raised above be required please contact Dr Marnie Leybourne, Manager Catchment Management on 9278 0706.

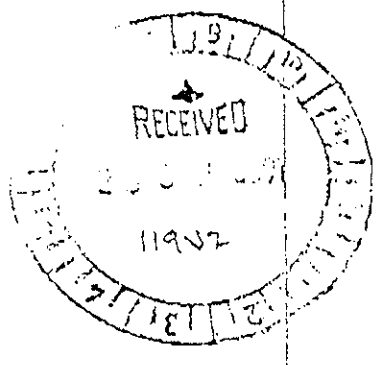
Yours sincerely

Dr Don McKenzie
DIRECTOR RESOURCE MANAGEMENT

[illegible] September 2001

WATER AND RIVERS
COMMISSION

YOUR REF
OUR REF SN6061-2
ENQUIRIES M Viskovich
DIRECT TEL 6250-8004



Whiteman Park
Lord Street
WHITEMAN WA 6068
ATTENTION: Nigel McCombe

Dear Mr McCombe,

RE: WATER ALLOCATION – WHITEMAN PARK

The Water and Rivers Commission acknowledges receipt of your letter dated September 7, 2001 concerning reserved water allocation for Whiteman Park.

As advised in previous correspondence, the Commission has not agreed to reserve 1.3 million kilolitres of groundwater for future development of Whiteman Park.

It should be noted that the Commission does not generally put water aside, the exception being for public water supply reserves. To do this would be inappropriate as recreational uses is only one of the many market demands on groundwater. The Commission's method for water allocation is on a first in first served approach, this is where water is allocated in chronological order of receipt of application. This method is used extensively throughout Australia and has been the approach used in Western Australia for many years.

As managers of the States water resources, the Commission can not allocate groundwater beyond a sustainable level. To do so would not only be irresponsible, but would jeopardise the long term security of other groundwater users in the area and associated impacts on the environment.

Whiteman Park is located within the Whiteman sub-area of the Mirrabooka Groundwater Area. Presently, the superficial aquifer within this sub-area is the only source of groundwater available for allocation. The Commission has calculated the sustainable allocation limit for this sub area which is set at 3,370,000 kilolitres (kL), of this 2,379,111 kL has been allocated to both private and public water supply purposes. Therefore, at the time of this correspondence, there remains 990,889 kL available for allocation.

Accordingly, should Whiteman Park submit an application to increase their current water requirements, the Commission could not complete it's assessment until the following supporting information had been provided:

- A water audit for Whiteman Park which demonstrates existing water use and where water efficiencies have and can be adopted.
- A detailed development time table for all future groundwater requirements.

SWAN GOLDFIELDS AGRICULTURAL REGION
7 Ellam Street Victoria Park WA 6100 Tel: (08) 6250 8000 Fax (08) 6250 8050
E-mail Address correspondence@wrc.wa.gov.au
NATIONAL RELAY SERVICE (AUSTRALIAN COMMUNICATION EXCHANGE) 13 36 44
MANAGING AND PROTECTING WESTERN AUSTRALIA'S WATER RESOURCES
ABN 60 061 306 330

- A report by a groundwater professional,who has undertaken modelling to simulate the impact on other groundwater users , including the environment, should the Commission give approval for additional groundwater to be abstracted within the Park.

Please note there is no guarantee following receipt and assessment of the above, that additional water will be allocated to Whiteman Park.

Should you have any further enquires or require further clarification please contact Matt Viskovich on 6250-8004.

Yours sincerely

R.D HAMMOND
REGIONAL MANAGER
SWAN GOLDFIELDS AGRICULTURAL REGION.
21 September 2001

WATER AND RIVERS
COMMISSION

FACSIMILE TRANSMISSION

To:		Date:	29 March, 2001
Attention:		Fax No:	
From:	Natasha Hyde	Phone No:	9278 0389
Total pages:		Direct Fax No:	9278 0585
Subject:	Whiteman Park artificial lake		

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Message:

Sorry for the delay in replying. In response to your phone call last week, I will try to give a summary of WRC issues in relation to Whiteman Park's proposal for a 4 to 10 hectare lake/water body to be located near their proposed new village centre. Please be aware that this is not an extensive list and until WRC receives a proposal in writing from Whiteman Park, I cannot provide specific guidelines on what the Commission will or will not approve.

Past meetings

I have been involved in two meetings at which the lake proposal was discussed. The first was held at least twelve months ago at WRC offices and was attended by Howard Mitchell, a consultant employed by Whiteman Park. Mr Mitchell produced a large, colour concept plan of the Park, on which a large, blue blob marked the site of the proposed lake. Mr Mitchell stated that the size of the blob was not an indication of the size of the proposed lake, however, Whiteman Park wished to discuss the practicalities of creating a sizeable artificial lake somewhere near the village centre. A Groundwater Discovery Centre was suggested as an appropriate facility to build beside it. At this point, WRC indicated that due to environmental concerns caused by low water levels in the vicinity and the history of tree deaths and breaches of environmental water level criteria within the Park, WRC could not support any proposal for such a large water body. However, a small constructed wetland may be feasible, depending on its size and the proposed water usage. Mr Mitchell indicated that he would forward WRC a copy of the latest plan, so that WRC could provide general comments on the proposal, including the artificial lake. WRC never received a copy of the plan and so no written comments were provided to Mr Mitchell.

On October 27 last year, Nicholas Dufty and Nigel McCombe met with Linda Moore, Melanie Strawbridge and I at WRC offices to specifically discuss the artificial wetland proposal. Nigel and Nicholas stated that they were looking at creating a six to ten hectare wetland, which they'd originally planned as being a recreational water body, but were now focusing on a constructed wetland or lake concept. They had imagined that parts of it would be down to the water table and

would retain water all year round. They were looking at the source of water for the wetland as being the water table, possibly existing drainage and Albion townsite drainage. They indicated that they would be discussing this possibility with Albion shortly after our meeting.

Our comments at that meeting were consistent with those of the previous meeting. We indicated that WRC would consider a large, open permanent water body as a wasteful use of water and therefore would not approve a groundwater licence for such a purpose, particularly as we have instructed Water Corporation to switch off ten of their bores in the Whiteman Park vicinity so that we do not continue to fail environmental water level conditions in monitoring bores. This equates to over 2 Gigalitres in lost production for the Water Corporation. These bores are concentrated in the central and northern parts of the park, close to the area planned for the artificial wetland. Therefore, despite there being approximately one Gigalitre of water 'available' for private use in the Whiteman Park Sub-Area, due to environmental constraints, the Commission is unlikely to allocate all of this water, and particularly not for purposes such as an ornamental lake, where the water will simply evaporate away. It would be difficult to justify allocating a large amount of water to an artificial lake when the Water Corporation has been forced to switch off public water supply bores for several summers.

Water set aside for the Park

I understand that Whiteman Park currently has a licence for approximately 300,000 kl/year and that there was an agreement in the 1970s that water would be set aside for the Park. However, the Park has never used or been licensed for that amount of water, and as we have been in a drought situation for the last 25 years or more, circumstances have changed, water levels have declined and continue to decline and the Commission must now be very careful when allocating water. There is no binding condition to say that the Commission must allocate more water to Whiteman Park.

How much water is available?

It is impossible to say how much water is available for use in an artificial wetland in Whiteman Park without first seeing a concept plan of the proposal. Firstly, the Park must prove that the evaporative losses will not cause any breaches in any of the Commissions criteria monitoring bores located nearby. The lake should not be a permanent water body. Though the Whiteman Park Authority have commented that by creating this lake they will be returning the Park to something more like its natural state, there would never have been permanent water bodies in the Park in the past. Putting a Groundwater Discovery/Interpretive Centre near an artificial permanent water body would be giving visitors a false impression of what Gnangara Mound wetlands are actually like. It may be possible for the wetland to have some areas of permanent water, perhaps if some sections of the water body were lined, or maintained by drainage water. However, most of the wetland would have to dry out in summer. It is likely that the Commission would support the concept of a constructed wetland to treat drainage water, generated either from the Park or from Albion town site. I know that the Commission's Melanie Strawbridge was approached by Whiteman Park, as Melanie's group has been looking at developing a constructed wetland in a suitable area as a case study. I am sure she would be happy to help again in this area.

I am sorry that I cannot give you more definitive advice, however, I must stress that something is needed in writing so that we have a specific plan to assess and all the relevant groups within the Commission can provide input.

Kind regards,

Natasha Hyde

Appendix Three

Consultant's Report

WHITEMAN PARK WATER FEATURE

Contacts schedule

Organisation	Name	Issues	Response
DPI	David Nunn	Land Clearing Act requirements	Act doesn't apply to C4 land (No action required)
DPI – Bush Forever	Emma Bamsorth	Impacts on other non C4 areas	No impact, down gradient (section 5)
DPI	Glenn Ahola	Summary of contacts	Undertaken
Water & Rivers Commission	Bill Till	Ground Water losses due to evaporation	Losses shown to be negligible. See JDA report – (Appendix two)

WHITEMAN PARK

CONCEPT PLAN FOR

CONSERVATION AND RECREATION PRECINCTS

Prepared for:
Ministry for Planning

Prepared by:
Mattiske Consulting Pty Ltd
& M.J. & A.R. Bamford

September 2001

MATTISKE CONSULTING PTY LTD

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1. OVERVIEW

This report by Mattiske Consulting Pty Ltd and M.J. & A.R. Bamford, is an expansion of the 1998 Concept Plan for Conservation and Recreational Precincts within Whiteman Park by the same authors. The present study re-assesses the Whiteman Park precinct boundaries and allocates precincts to the additional Whiteman Park areas using guidelines of the 1998 study (Mattiske Consulting Pty Ltd and M.J. and A.R. Bamford, 1998).

The significant expansion of Whiteman Park and development of surrounding public lands since 1998, has necessitated the revision of precinct boundaries in the Park (see Map 1). Whiteman Park's total area has been augmented to include Bennett Brook and Grogan Swamp and the adjacent IP8 area located west of Beechboro Road and Whiteman Park (see Map 1). Additionally, further land developments, such as roads and urban spread, have changed the characteristics and therefore precinct boundaries within the Park.

Map 1 delineates the following precincts within Whiteman Park. Conservation and recreational precincts place emphasis on the following characteristics for the definition of respective areas.

C1	**Conservation Precinct**	Protecting wherever feasible those areas of bushland which were least disturbed by previous grazing and recreational pressures in the Park.
C2	**Rehabilitation Precinct**	Protecting those areas of bushland which were only partly disturbed and which, with management, could be rehabilitated to increase the biological values on the areas through increased native species numbers and cover, and increased variety of fauna habitats.
C3	**Conservation Buffer Precinct**	Delineating a series of conservation buffer precincts to protect the adjacent values of drainage lines or provide fauna linkages to adjacent areas of native vegetation.
C4	**Recreational Usage Precinct**	Delineating particular parts of the Park which were mostly cleared or modified bushland areas for recreational activities.

2. BACKGROUND

A Concept Plan for Conservation and Recreational Zones within Whiteman Park was prepared by Mattiske Consulting Pty Ltd and M.J & A.R. Bamford (1998) by the review of recent biological studies and discussions with the Whiteman Park management team. The study allocated conservation precincts according to the conservation needs and characteristics of flora, vegetation and vertebrate fauna.

Precincts were defined by:

- previous botanical and zoological field investigations by the authors (E.M. Mattiske and Associates, 1989, Mattiske Consulting Pty Ltd 1995 a and b, 1996, Bamford, 1997);
- 1997 Whiteman Park Concept Plan report by the Western Australian Planning Commission defining the conservational values of the Park;

- 1998 Mattiske Consulting Pty Ltd and M.J. and A.R. Bamford Concept Plan for the Conservation and Recreation Zones of Whiteman Park. The report outlines a plan for management practices within the different precincts recognising that flora and fauna species utilise and occupy different environments. Additionally, native bushland areas should be maintained as an integral part of the Park to provide the opportunity for people to experience nature first-hand.

As a result of this review and discussions with the park management team, a four level precincts was proposed for Whiteman Park.

C1: Conservation Precinct
C2: Rehabilitation Precinct
C3: Conservation Buffer Precinct
C4: Recreational Usage Precinct

Since Mattiske Consulting Pty Ltd & M.J and A.R. Bamford's 1998 report, the expansion of Whiteman Park and development of adjoining public lands has necessitated the revision of precinct boundaries in the Park (see Map 1).

The purpose of the present study is to reassess Whiteman Park precinct boundaries proposed in the 1998 Concept Plan and to allocate precincts to the additional Whiteman Park areas using the same guidelines of the 1998 study (Mattiske Consulting Pty Ltd and M.J. and A.R.Bamford, 1998).

2.1 Flora and Vegetation

The amalgamated Whiteman Park area occurs on the Drummond Botanical Subdistrict within the Southwest Province as defined by Beard (1990). Beard (1990) further describes the vegetation of the Bassendean area near Whiteman Park as mainly "*Banksia* low woodland on leached sands with *Melaleuca* swamps where ill-drained".

As described by Churchward and McArthur (1980):
"The Bassendean Dunes are represented by three landform-soil units which differ mainly in the nature of associated swamps. The Bassendean unit with peaty podzols in the swamps is separated from the Southern River unit, which occurs where sand appears to have been blown over the alluvial soils and so the swamps often have a clay base. The Caladenia unit has a pattern of low dunes and intervening discrete rounded permanent lakes. ..."

Whiteman Park occurs almost entirely along the interface of the Bassendean and Southern River soil units. Bennett Brook and Grogan Swamp comprise the most southerly section of the park that is located on the interface between the Bassendean Dunes and the Guildford unit of the Pinjarra Plain (Gozzard 1986). As a result of these differences in underlying soils, the vegetation differs on the three areas.

Heddle *et al.* (1980) produced a vegetation map at 1:250 000 scale, which defined vegetation complexes in relation to the landform-soil units determined by Churchward and McArthur (1980). The majority of Whiteman Park occurs on the Bassendean Dunes (Central and South) and Southern River Complex, with only Grogan Swamp encompassing the Guildford unit component of the Pinjarra Plain (Heddle *et al.* 1980).

The vegetation on the northern and north western parts of Whiteman Park is more typical of the communities on the Bassendean dune system with deeper sands supporting largely low woodlands of *Banksia* species, with open woodlands of Eucalypt species including *Corymbia calophylla, Eucalyptus todtiana* and *Eucalyptus marginata* on the lower lying shallower sands and with low open woodlands of *Melaleuca preissiana* and *Banksia littoralis* in lower lying seasonally moist swamps. The southern section of Whiteman Park, excluding Grogan Swamp, is more typical of the vegetation on the Southern River soil unit with woodlands of *Eucalyptus rudis* (flooded gum) – *Melaleuca rhaphiophylla* on the drainage lines that dissect the flatter unit. On the low-lying sand dunes that overly the alluvial soils, the vegetation is similar to the northern end of the Park with a low open woodland of *Banksia* species. The Grogan Swamp vegetation is largely characteristic of the Guildford vegetation unit. The banks and wet flats of the Swamp have a high clay content due to flows and deposition from Bennett Brook and comprise woodlands of *Casuarina obesa, Melaleuca rhaphiophylla* and *Eucalypus rudis* over sedges. The south eastern portion of the swamp supports a halophytic complex, while the elevated area west of the swamp supports *Banksia* species and *Corymbia calophylla* communities, which are more characteristic of the Bassendean dune system.

The majority of the northern section of the Park has been modified by grazing so that in parts the swamp vegetation is dominated by sedgelands and remnant trees of *Melaleuca* species on the wetland and dampland fringes.

The former IP8 area has been subject to past disturbance, largely in terms of weed invasion, particularly in the north and south. A considerable proportion of the Grogan Swamp and Bennett Brook area is weed infested, largely due to edge effects.

The flora and vegetation values of Whiteman Park have been studied previously by E.M. Mattiske and Associates (1989) and Mattiske Consulting Pty Ltd (1995, 1996, 2000, 2001). These studies have highlighted species richness values, the occurrence of introduced species and the occurrence of Priority species in the drainage lines. All these factors were used in delineating the conservation precincts in Whiteman Park.

2.2 Vertebrate Fauna

The fauna of Whiteman Park is representative of that which once occurred right across the Swan Coastal Plain north of Perth (Jackson *et al.* undated) and the great value of Whiteman Park is that it retains most of this fauna, whereas much of the general region has been developed and some or most of the fauna lost (Western Australian Planning Commission 1997). This fauna is part of Perth's heritage; conservation of this fauna is therefore akin to the role Whiteman Park plays in the protection of other heritage values, such as old cars and steam trains.

Fauna conservation within Whiteman Park has been achieved to the present time through a policy of minimal disturbance to the main areas of native vegetation, a conservative fire regime and the control of Foxes. In the long term, however, fauna conservation needs to recognise that Whiteman Park is gradually becoming surrounded by urban development. It is therefore a large fragment of more or less natural habitats much like King's Park and Bold Park elsewhere in Perth.

Guidelines for fauna conservation in Whiteman Park, including the recognition of precincts for fauna conservation, can therefore be determined on the basis of experience gained in other bushland fragments within the urban area and on general fauna conservation principles within multiple-use landscapes. These guidelines can be used to determine the most appropriate boundary for the conservation precinct in Whiteman Park.

The fauna of bushland remnants within Perth has been studied quite extensively (eg. How and Dell 1989, 1990 and unpub., Turpin 1990, Wykes 1991 and Recher and Serventy 1991). These studies have focussed on terrestrial vertebrate fauna, but at least one current study (at Edith Cowan University) is being carried out into the persistence of terrestrial insects in urban bushland. Hay *et al.* (Undated) review the butterflies of the Perth area while Davis and Christidis (1997) provide a guide to the wetland invertebrates of the SouthWest. These provide some comments of relevance to the designation of boundaries for conservation precincts. There is also an extensive literature on the general principle of fauna conservation in fragmented landscapes (e.g. Harris and Scheck 1991, Margules *et al.* 1982 and Noss and Harris 1986).

Wetland Environments

Aquatic invertebrates are sensitive to changes in nutrient availability, turbidity, available light, seasonal fluctuations in water level, presence of introduced species (fish and some aquatic plants), salinity, water movement and structural complexity in their environment. Native fish and larval frogs (tadpoles) are also affected by these factors. Of native fish found in the Perth area, the Swan River Goby *Pseudogobius olorum* seems to be the most tolerant of alterations to its environment, while a number of the frog species (*Crinia* spp., *Litoria moorei)* are also tolerant. Some other frog species, such as *Heleioporus eyrei*, are sensitive to changes in the seasonal fluctuation of water levels.

Many of these environmental factors can be controlled only through broad management practices rather than by the designation of a boundary and are therefore beyond the scope of the present study.

Dryland or Upland Environments

A number of species of frogs in the Perth area are largely terrestrial, requiring wetlands only for breeding, and one species, the Turtle Frog *Myobatrachus gouldii*, also breeds terrestrially (Roberts 1981). They have been found to persist in disturbed upland environments as long as nearby wetlands are mostly undisturbed, but are adversely affected by barriers to movement, such as solid fencing. Cleared land is not a barrier to the movement of frogs (Bamford 1997).

Perth supports a very diverse reptile fauna and many species have been found to persist in small, degraded fragments of native vegetation. Species that tend not to persist are large carnivores that occur at a low density, such as the Carpet Python *Morelia spilota imbricata* and the goannas *Varanus gouldii* and *Varanus rosenbergi*. A number of species will survive in fallow farmland but reptiles generally show poor dispersal through unfavourable habitat (Bamford 1997).

The persistence of birds in remnants of native vegetation within the urban landscape is complicated. Resident, insectivorous species tend to disappear even from large remnants such as King's Park due to factors such as: increased fire frequency, altered habitat due to weed invasion (Recher and Serventy 1991) and possibly due to increased mortality (Domestic Cats) combined with a small, isolated population (Paton 1991). Fairy-wrens, scrub-wrens, robins, whistlers and thornbills are included in this group, although species vary in their sensitivity. They persist in large reserves that are linked to other areas, the linkage presumably allowing for the movement of birds through the area. There are reports of some of these resident birds "island hopping" from one remnant to the next (J. Dell, pers. comm.).

Nomadic and migratory species of birds utilise bushland remnants. These species include most of the honeyeaters, the Silvereye and the Striated Pardalote. These birds will use degraded vegetation as they are often exploiting a simple resource such as nectar-bearing flowers. They will also visit non-native plants and vegetation along road reserves. These birds may not access Bushland remnants that are completely surrounded by unfavourable environments, but the presence of nearby favourable habitat can result in these sorts of birds being widespread.

Of all vertebrate fauna, mammals are the least able to persist in bushland remnants. Small, native mammals (such as the Noodji or Ashy-grey Mouse *Pseudomys albocinereus,* and dunnarts *Sminthopsis* spp.) disappear even from fringing woodland outside the urban area, possibly due to altered fire regimes and cats. The Honey Possum *Tarsipes rostratus,* which is much more mobile and has a more flexible reproductive system than the previous species, seems able to persist on the fringe but has not been recorded recently even in large fragments such as King's Park and Bold Park.

Small, insectivorous bats appear to be slightly better at surviving in urban areas than small, terrestrial mammals, but appear to be confined to the outer suburbs (Wykes 1991).

Of the larger mammals, the only species to persist within bushland remnants are the Rakali or Water-rat *Hydromys chrysogaster,* The Quenda or Southern Brown Bandicoot *Isoodon obesulus* and the Brush-tailed Possum *Trichosurus vulpecula.* The Western Grey Kangaroo *Macropus fuliginosus* survives in managed populations such as on some golf courses, but it and the Black-gloved Wallaby *Macropus irma* do not generally survive in isolated remnants. They do occur, however, where remnants are linked to large areas of native vegetation outside the urban area. For example, kangaroos still graze around Lake Goollelal in Kingsley, which is linked by the bushland fringe of Lake Joondalup to Neerabup National Park 10 km to the north.

The Brush-tailed Possum is unusual in that, like a few species of native birds, it can survive in true urban landscape without bushland remnants, although it tends to be common only in suburbs where such remnants do occur nearby. The Rakali requires more or less natural wetlands with natural fringing vegetation and corridors of habitat to enable animals to access suitable areas. It will, however, cross urban areas for at least distances of several hundred metres (M. Bamford pers. obs.). The Quenda requires dense, native vegetation, especially associated with sumplands and damplands, but will live in badly degraded vegetation and can disperse along road verges with some vegetation cover. Both the Quenda and the possum are preyed upon by Foxes.

2.3 Principles for Conservation Precincts

On the basis of extensive field observations of Whiteman Park's flora and fauna, and experience in other bush remnants, a number of principles for conservation precincts were developed and applied at Whiteman Park. These principles include:

Areas of Proposed Precincts - the conservation precincts should be compact and as large as possible. Therefore, the boundaries of the conservation precinct should encompass as great an area of suitable habitat as possible, subject to other land uses and restraints.

Shape of Proposed Precincts - the conservation precincts should account for the variety within the landscape, drainage, edge effects and boundary/area ratios to maximise the potential to maintain the values within the precincts in the longer term. The conservation precinct should be a compact shape to minimise the relationship between edge length and area. This reduces areas of potential weed invasion and makes management, such as fencing, easier to carry out. Note, however, that guidelines such as the need for linkage and the need to conserve a variety of habitats may require shapes that are more difficult to manage. Within the Park, existing areas of less disturbed bushland with higher conservation values should be contained within the conservation precinct with the most economic shape possible.

Degree of Clearing - areas that are relatively uncleared were given a higher priority for retention within the proposed Conservation Precinct in the Park.

Degree of Disturbance - areas of native vegetation that are relatively undisturbed were given a high priority for retention within the proposed Conservation Precinct in the Park.

Vegetation Condition - vegetation that is healthy and with minimal weed invasion is preferable to degraded vegetation within the conservation precinct. Including degraded vegetation within the conservation precinct can present problems for management as this could lead to increased weed invasion of native vegetation. Degraded vegetation may require a considerable management commitment, so it needs to be important from a fauna conservation perspective to be included.

Diversity of Plant Communities, Fauna Habitats and Species - the conservation precinct should contain as much of the diversity of habitats contained within Whiteman Park as possible. In this case, it may be necessary to include some degraded habitats within the conservation precinct. For example, Horse Swamp and parts of Bennett Brook are badly degraded due to weed invasion, but even in that condition they make a valuable contribution

to the biodiversity and linkage of the conservation precinct.

The Wetlands of the Swan Coastal Plain (DEP) - 50 and 200 metre precincts were considered in determining these linkage corridors not only for the protection of the flora and fauna values, but also the water resources.

Linkage with other natural areas - the conservation precinct should extend to the boundaries of the park wherever suitable vegetation exists and especially where native vegetation that is likely to be retained is present in adjacent areas. As noted above, areas within the park that are of conservation value should be linked. The areas of wetlands and drainage lines irrespective of the degree of disturbance were given a high priority for retention within the proposed Conservation Precinct in the Park. This in part conflicts with considerations on shape and area. The linkages are particularly important for a lot of fauna, as population isolation is a problem particularly for some birds and mammals.

Bushland Forever Sites – these areas were considered significant due to the presence of regionally significant vegetation values documented in Bushland Forever (2000).

Fauna Utilisation of the different areas within the Park - the ability of some fauna species to utilize different disturbed and undisturbed communities and habitats was taken into consideration.

Edge Effects from adjacent Land Uses - the ability to protect and conserve the values in the respective precincts was taken into consideration. Adjacent land uses such as farming and the operation of steam engines have implications for the conservation precinct. In places where conflict might occur, a buffer precinct managed differently from the conservation precinct may be necessary.

Where livestock are present, it is probably most appropriate for the conservation precinct boundary to be fenced so as to allow stock to graze close to the native vegetation without damaging it, with a firebreak on the conservation precinct side of the fence Including a buffer of farmland within the conservation precinct in such situations would probably just encourage weed invasion in the conservation precinct. Close to wetlands, however, livestock should be excluded from the water's edge even if this means enclosing weeds within the conservation precinct.

Potential impacts of trampling and nutrient enrichment in pasture upon adjacent conservation areas need to be considered, however. If nutrient enrichment of Bennett Brook is a problem, then a buffer planted with vegetation that will capture some of these nutrients before they reach the water course may help. Where trains run close to the conservation precinct, a 50 m wide buffer for fuel reduction burns should be considered to reduce the potential of sparks causing fires in the conservation precinct.

The nature of adjacent land uses will also determine the sort of fencing required for the boundary. In many ways, no fence is preferable as it allows fauna to move unimpeded through the area. Where livestock are present, appropriate fencing for the type of stock will be required. Where people need to be regulated, a post and rail fence would be in harmony with the character of the park but might be prohibitively expensive for all but short sections.

It may become necessary to fence main roads to guide wildlife toward underpasses, such as has been carried out by Main Roads WA near Mt Barker and along sections of the Kwinana Freeway and Highway. MRWA has fence designs suitable for this purpose.

Balancing People and Conservation - this led to the rationalisation of the boundaries so that the impact of the people and recreational needs on conservation values in the central area and the southern drainage and wetland areas were minimised. Further the need to allow some recreational uses in the triangular area northwest of the Shooting Gallery was considered, however the biological values of the latter area were also stressed to the management team. The minimisation of impacts or any further clearing on the latter area should be considered through lease arrangements.

There is clearly some conflict between these guidelines, such as the need for the conservation precinct to have a compact shape, but also to link areas of conservation value. The actual application of these guidelines and the sorts of compromises that could be reached are discussed in the following selection.

3. DEFINITION AND DELINEATION OF PRECINCT CATEGORIES

3.1 General Application of Principles

The above observations on the persistence of flora, native vegetation and fauna in bushland remnants around Perth are generally consistent with observations made on the survival of flora, native vegetation and fauna in fragmented and multiple-use landscapes (e.g. Department of Conservation and Environment 1983, Noss and Harris 1986, Keighery and Trudgen 1992, Scheltema and Harris 1995, Mattiske Consulting Pty Ltd 1997, 2000, 2001).

In applying the principles defined in Section 2.3 it has been possible to conserve the maximum diversity of flora, native vegetation and fauna at Whiteman Park.

In addition some principles are management-oriented and therefore fire management, vehicle access, dieback disease hygiene measures and predator control have additional influences on the biological values in the Park.

Further, conservation doesn't have to stop at the boundaries of the conservation precinct has profound implications for the management of the rest of the Park.

A number of the guidelines have direct implications for the boundary of the conservation precinct. It is also worth noting that the principles do not apply to all of the species all of the time and that plant communities and therefore fauna habitats can be modified with changes in climatic conditions and seasonal conditions. When the aim is to conserve maximum biodiversity, then some species will make greater "demands" upon a site and principles should be applied for these species. Less demanding species should then be covered. In Whiteman Park, the most demanding of the species that are still present (or are believed to be present) are:

- most of the vascular plant species which may be influenced by aggressive weed invasions (e.g. Veldt Grass),
- the vascular plant species that may be influenced by changes in local hydrological conditions (drought or ground water extraction for other uses),
- the vascular plant species that may be influenced by the fungal species of *Phytophthora*,
- the vascular plant species that do not regenerate readily and that may be dependent on infrequent germination and establishment events,
- the native mammals (particularly the Noodji or Ashy-grey Mouse, the Black-gloved Wallaby and the Honey Possum),
- the resident, insectivorous birds, and
- some frog species dependent upon seasonal wetlands for the completion of their life-cycle, particularly the Moaning Frog - *Heleioporus eyrei*.

3.2 Specific Application of Principles to Whiteman Park

The proposed boundary for the conservation precinct is indicated on the accompanying map. Parts of the boundary follow those which already exist and much of the area enclosed is the already recognised conservation precinct which is a large area of good quality native vegetation. The boundary recognises conservation priority areas (minimal development and disturbance) and management areas which have conservation values that need to be protected, but where activities are already taking place (existing leases) or where some new activities wouldn't compromise the conservation values. The following sections provide an explanation on how decisions were made for the proposed boundaries.

Conservation Precinct between Park and Woolcott Streets

This area provides the maximum coverage of flora, vegetation and fauna on the Bassendean dune systems within the Park. This area includes a large range of vascular plant species and a variety of plant communities and therefore fauna habitats. The area is relatively difficult to access, except by foot along some old north-south tracks that dissect the block. It should be noted that some sections of this area are infected with the dieback disease caused by *Phytophthora cinnamomi,* particularly around swamps and damplands.

Conservation Precinct between Gnangara Road and Hepburn Avenue

In combination with the previous conservation precinct, this area further enhances the high range of flora, vegetation and fauna habitat on the Bassendean Dunes. The area is encompassed in the Bushland Forever Site 198. The southern section is healthy with high plant diversity. The southern border adjoins private residences and will require fencing to minimise edge effects.

The thin northern strip is part of an important fauna corridor, despite being fairly degraded. The entire western border is adjacent to extensive bushland owned by the Perth International Communication Centre, which links with Gnangara Lake bushland to the north. To the east of Gnangara bushland lies pine plantations managed by the Water and Rivers Commission, which may be rehabilitated back to bushland and tied in with the area to the proposed Gnangara Park. Planting and seeding programs will be required along the western edge to improve the conservation value of the area. If protected from grazing, the degraded understorey of the adjoining C2 precinct to the north east should readily regenerate.

Linkages to Gnangara Road and Hepburn Avenue Conservation Precinct

The degraded C3 precinct to the east of the above conservation precinct represents seasonal wetlands and Bassendean Dune vegetation within Bushland Forever Site 304. This area also acts as a buffer between the degraded parkland and the conservation precinct. By limiting public access via fencing, wetlands could be much improved. The C3 buffer and Bushland Forever Site 198 encompass the Cullacabardee Aboriginal Village. The bushland is in good to moderate condition and has experienced some clearing and modification around the village. To improve vegetation condition, the private property should be fenced, access limited to one track, and environmental management programs carried out by the Park management team in conjunction with the Village.

Northern Potential Corridors across Gnangara Road

Linkage towards Gnangara Road and the proposed Gnangara Park. This area requires rehabilitation but already supports a range of native species and, if protected from grazing, could regenerate readily with only minor effort as some overstorey and dominant species persist in the area. This area also readily supports a wide range of fauna species. High ground in this area will make it possible to create an under pass for fauna such as Quendas when Gnangara Road is upgraded. The Perth-Darwin Highway will form the eastern edge of both Whiteman Park and the Gnangara Park at this point. Within the former IP8 area, the degraded C2 precinct (encompassing private land) adjoining Gnangara Road has been proposed as an additional Bushland Forever Site. A comprehensive rehabilitation effort could protect the bushland's integrity from private usage and enable it to act as a wildlife corridor across Gnangara Road. Just to the south lies another C2 precinct supporting vegetation in good condition but surrounded by cleared lands. This vegetation should be maintained via periodic rehabilitation as it acts as a fauna linkage with the northern C2 precinct.

Eastern Linkages towards vegetation East of Proposed Perth-Darwin Highway

Linkage towards native vegetation east of the Proposed Perth-Darwin Highway will be limited due to the large size of the proposed development. Along the south eastern corner of Whiteman Park a wildlife underpass will be required under the proposed Darwin to Perth Highway This is primarily a corridor linkage for native fauna as the majority of the native vegetation on the eastern fringes of the Park have been modified by grazing and clearing.

If grazing was ceased in this corridor many of the native species could be returned rapidly by seeding and planting. The latter work could be undertaken with local schools and friends groups under supervision.

Rationalisation of Eastern Fenceline within the Park
Rationalisation of fence-line at eastern end of Park Street to make an even edge. The boundary could either exclude a small area of native vegetation from the conservation precinct, or it could included this area and some adjacent pasture. This may depend upon the potential for weed invasion into the conservation precinct from this area of pasture. Active weed control and seeding with local native species will be required on this interface area.

Between Archery Field and Beechboro Road
The native vegetation between the Archery Field and Beechboro Road is in very good condition, supports a particularly high density of Black-gloved Wallabies and is in a position where it could act to link the conservation precinct to parts of the proposed Gnangara Park.

Although leased as part of the Archery Park, the significance of this area should be recognised in some way. For example, future developments should minimise any further disturbance of the native vegetation within the lease and no further clearing of native vegetation should be undertaken in this area.

West of Beechboro Road and North of Marshall Road
The native vegetation in this pocket is in good condition and supports a variety of site vegetation types including wetland communities. It is surrounded by cleared lands that are particularly weedy, and consequently active rehabilitation of this bushland will be required to remove weeds, improve the structure and function and protect the integrity of this area.

Linkage South of Woolcott Street to Bennett Brook
It is important that this linkage not be constricted or broken by the two development nodes of the Village and the Youth Camp. This area provides a range of wetlands and corridors for fauna movement. The linkage of the Bennett Brook Conservation Area to the Swan River is separated by a piece of private land. Conservation efforts by private owners, in conjunction with Park staff, would minimise down stream weed invasion and bushland fragmentation.

Bennett Brook Extension of the Conservation Precinct
Bennett Brook extension of the conservation precinct encompasses the main block of riparian vegetation associated with Bennett Brook south of Woolcott Street. It includes narrow arms of native vegetation which encompass wetlands as these habitat types are poorly represented elsewhere in Whiteman Park.

Wetlands in these areas are probably the main breeding sites for many species of frogs for which adjacent paddocks would not be a barrier for movement. Some of the seasonal wetlands may also be potential release sites for the priority Black-striped Jollytail or Minnow *Galaxiella nigrostriata*. An isolated population of this species is known from a single wetland to the north of Whiteman Park. Fencing of these areas should incorporate the remnant native vegetation areas, the seasonal wetlands and any proposed rehabilitation areas. Such a buffer could also be valuable for nutrient stripping. Livestock should be excluded from the brook even where the vegetation is currently degraded; rehabilitation of such degraded sections should take place.

These riparian areas also have conservation values for the vascular plant species through the presence of a Priority species – *Cyathochaeta teretifolia* (Mattiske Consulting Pty Ltd 1996).

Conservation Precinct - Grogan Swamp and Bennett Brook south to the Swan River
This area forms part of the Bushland Forever Site 305 and is part of contiguous and fragmented bushland/wetland linkages. Plant communities surrounding Grogan Swamp are largely in good condition, particularly in seasonally or permanently inundated areas due to lower potential for weed invasion. The adjoining Bennett Brook is badly degraded but still displays important conservation values. For example, existing flooded weeds provide shelter for native fish. Bennett Brook's poor condition is due to the adjacent pastureland, close proximity of public recreation areas and domestic gardens, and vehicle tracks that have caused physical disturbance and spread of weeds. A large portion of this area will require remedial management to restore the structure and function of degraded areas, and to protect the good condition of existing remnant areas. If grazing was ceased and vehicle access restricted in Bennett Brook and associated wetlands, many of the native species could be returned rapidly by seeding and planting. The latter work could be undertaken under supervision with local schools and friends groups. Weeding could be carried out by Park staff and volunteers. To the west and east of Grogan Swamp, buffer precincts to industrial and private aim to minimise physical disturbance and weed infestations within this conservation area.

Management Conservation Precinct alongside Bennett Brook
This management conservation precinct alongside Bennett Brook would permit low impact developments and could be a focus for rehabilitation. It is an area of upland habitats that visitors could access easily.

Conservation Precinct around Mussel Pool
The area around Mussel Pool is significant as one of the two substantial areas of permanent water in the park; it is part of the link from native vegetation in the north of the park to the narrow corridor that extends along Bennett Brook to the south. The development of recreation facilities around Mussel pool should consider its value for conservation.

Development and Recreational Precincts
Native vegetation within the development region of the park has value for some tree species and selected persistent plants and fauna that utilise these modified habitats. Therefore, there should be a general policy of retaining and rehabilitating such vegetation where possible.

4. CONCLUSIONS

As a result of this review and discussions with the park management team, a four level precincts was proposed for Whiteman Park (see map attached):

C1: Conservation Precinct

These areas included:

- the main relatively undisturbed areas,
- the areas with high species richness,
- the areas with lower levels of disturbance in the understorey and overstorey,
- the areas with lower levels of weed invasion,
- the areas with intact fauna habitats and

- the areas with high plant community diversity.

C2: Rehabilitation Precinct

These areas included:

- some disturbance, although the degree of disturbance is still moderate and the integrity of the communities remains relatively high,
- the areas with moderate species richness,
- the areas with moderate levels of disturbance in the understorey and overstorey,
- the areas with low weed invasion, and
- the areas that with management could be rehabilitated to increase the biological values on the areas, through increased native species numbers and cover, increased variety of fauna habitats

C3: Conservation Buffer Precinct

These areas include:

- substantial disturbance either through regular burning and or grazing,
- the degree of disturbance is relatively high, however there is generally an overstorey present and with active rehabilitation may be returned potentially to a C2 category,
- the drainage lines with associated vegetation,
- the areas with low to moderate species richness,
- the areas with moderate to high levels of disturbance in the understorey and overstorey, and
- the areas with higher level of weed invasion.

C4: Recreational Usage Precinct

These areas include:

- substantial disturbance either through regular burning and or grazing,
- the degree of disturbance is high to very high,
- the areas with low species richness,
- the areas with high levels of disturbance in the understorey and overstorey,
- the areas which were mostly cleared or modified bushland areas for recreational activities, and
- the areas with higher level of weed invasion.

The exceptions to the latter included the partly disturbed areas of bushland north-west of the shooting gallery facilities and south of the main settlement. Any modifications to these two areas should consider the inherent values of the native vegetation cover in these respective areas.

5. LIST OF PARTICIPANTS

Dr Libby Mattiske – Manager and Principal Plant Ecologist - Mattiske Consulting Pty Ltd

Dr Mike Bamford – Principal Zoologist – MJ and AR Bamford – Consulting Ecologists

Ms Alice O'Connor - Environmental Scientist - Frost O'Connor & Associates

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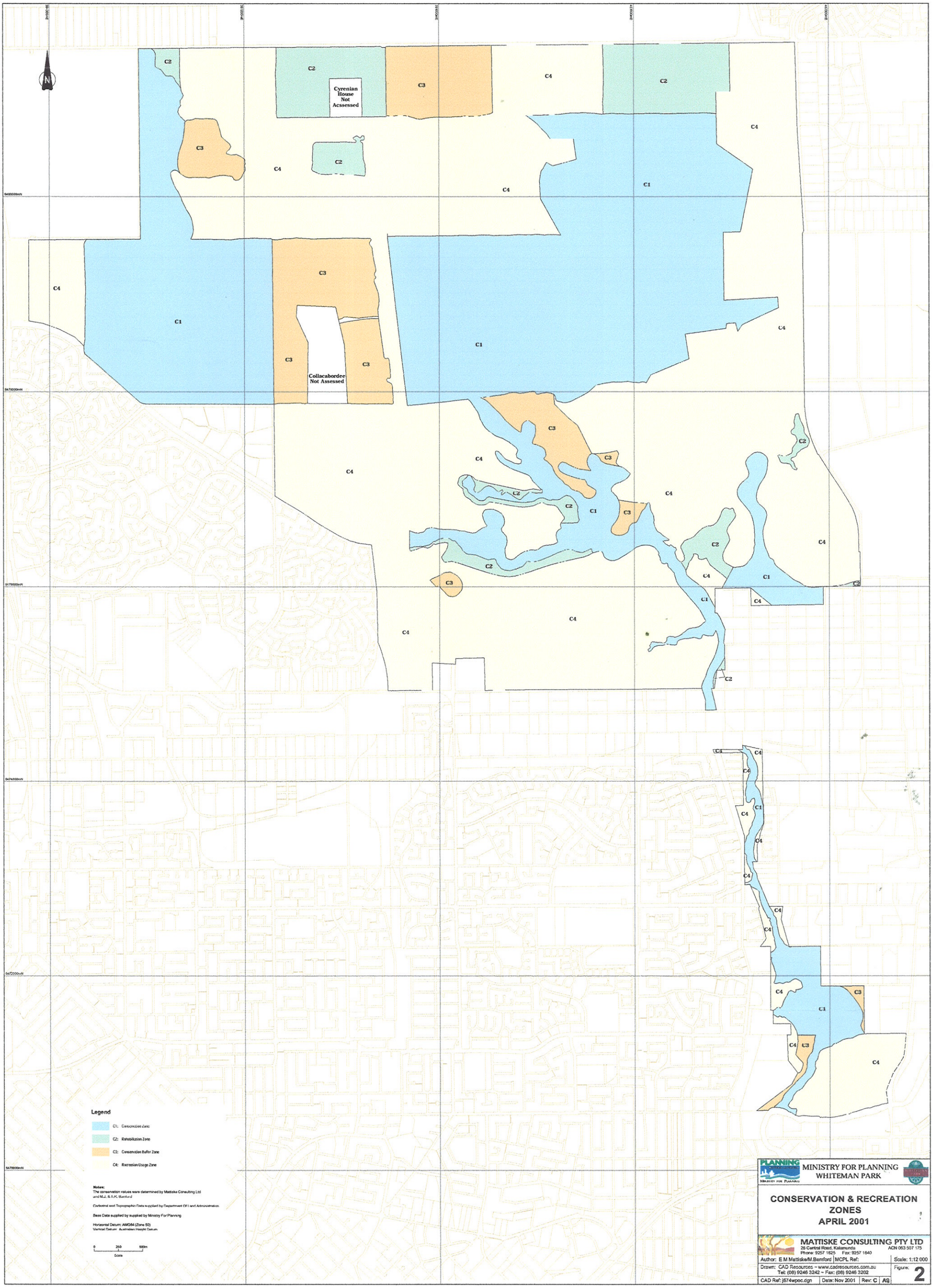
Cyrenian House Not Acssessed
Collacabordee Not Assessed
C1
C2
C3
C4
6480000mN
6478000mN
6476000mN
6474000mN
6472000mN
6470000mN
Legend
C1: Conservation Zone
C2: Rehabilitation Zone
C3: Conservation Buffer Zone
C4: Recreation Usage Zone
Notes:
The conservation values were determined by Mattiske Consulting Ltd and M.J. & A.K. Bamford
Cadastral and Topographic Data supplied by Department Of Land Administration
Base Data supplied by supplied by Ministry For Planning
Horizontal Datum: AMG84 (Zone 50)
Vertical Datum: Australian Height Datum
0 250 500m
Scale
MINISTRY FOR PLANNING
WHITEMAN PARK
CONSERVATION & RECREATION ZONES
APRIL 2001
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CAD Ref: j674wpoc.dgn
Date: Nov 2001
Rev: C
A0

Cyrenian House Not Acssessed

Collacabordee Not Assessed

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Legend

In sections of the survey area the vegetation was largely degraded or modified and in some cases the understorey species had largely been replaced by introduced species.

- **G:** Low Woodland of Banksia attenuata, Banksia menziesii and Eucalyptus todtiana on dry pale grey sands on slopes and dune crests.
- **Gd:** Degraded G community, largely as a result of past grazing activities.
- **H:** Low Woodland to Low Open Forest of Banksia attenuata, Banksia menziesii and Banksia illicifolia on deeper pale grey sands, dry at surface and moist at depth on dune slopes.
- **Hd:** Degraded H community, largely as a result of past grazing activities.
- **I:** Open Woodland of Eucalyptus marginata, Corymbia calophylla, Banksia illicifolia and occasionally Banksia grandis on moist sandy soils with dark grey humusoid surface on lower surfaces.
- **Id:** Degraded I community, largely as a result of past grazing activities.
- **IJ:** Combination of I and K communities
- **IJd:** Degraded IJ community, largely as a result of past grazing activities.
- **J:** Open Woodland of Corymbia calophylla on moister dark grey humusoid soils on flatter lower areas, with local additional species reflecting moister soils (Melaleuca preissiana) or sandier soils (Banksia illicifolia and Banksia menziesii).
- **Jd:** Degraded J community, largely as a result of past grazing activities.
- **JK:** Combination of J and K communities.
- **JKd:** Degraded J and K communities, largely as a result of past grazing activities.
- **K1:** Ranging from Low Open Forest of Melaleuca preissiana, Banksia littoralis (very occasional Eucalyptus rudis on old flow lines) to Closed Heath of Myrtaceae species on seasonally water saturated sands and peats of swamp area.
- **K1d:** Degraded K1 community, largely as a result of past grazing activities.
- **K2:** Low Open Forest to Open Forest of Eucalyptus rudis and Melaleuca rhaphiophylla on sands and organic silty clays along watercourses or seasonally flooded areas.
- **K3:** Open Forest of Eucalyptus rudis and Melaleuca rhaphiophylla with scattered Casuarina obesa over Juncus kraussii subsp. australiensis and Juncus subsecundus.
- **K4:** Woodland of Casuarina obesa, Melaleuca rhaphiophylla and Eucalyptus rudis over Melaleuca viminea on the edges of the cleared pastureland.
- **K5:** Low Open Woodland of Melaleuca rhaphiophylla in waterlogged areas with Cassytha racemosa forma racemosa and Juncus subsecundus.
- **K6:** Low Open Woodland of Melaleuca rhaphiophylla and Eucalyptus rudis over Melaleuca viminea, Frankenia pauciflora and Halosarcia ?lepidosperma.
- **K7:** Halophytic Complex of Halosarcia halocnemoides subsp. halocnemoides, Halosarcia pergranulata, Halosarcia ?lepidosperma and Sarcocornia quinqueflora subsp. quinqueflora with scattered Casuarina obesa. Typha orientalis occurred on the edges of the open water with Cyperus eragrostis.
- **K8:** Low Woodland of Casuarina obesa over Juncus kraussii subsp. australiensis.
- **K8d:** Sedgeland of Juncus pallidus with an abundance of introduced species.
- **K9:** Low Open Woodland of Melaleuca rhaphiophylla over Juncus subsecundus, Cyperus eragrostis and Centella asiatica.
- **K10:** Low Open Woodland of Melaleuca rhaphiophylla - Casuarina obesa over Halosarcia spp.
- **K11:** Woodland of Eucalyptus rudis, Melaleuca rhaphiophylla and Casuarina obesa over dense Cyperus eragrostis with patches of Juncus spp. and Halosarcia pergranulata. The introduced species Typha orientalis occurred on the edges of the open water.
- **OW:** Open Water
- **CL:** Cleared

Notes:
Cadastral and Topographic Data supplied by Department Of Land Administration.

Base Data supplied by Ministry For Planning

Horizontal Datum: AMG84 (Zone 50)
Vertical Datum: Australian Height Datum

0 250 500m
Scale

MINISTRY FOR PLANNING
WHITEMAN PARK

VEGETATION MAPPING
APRIL 2001

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Author: E M Mattiske	MCPL Ref: MFP002	Scale: 1:12 000
Drawn: CAD Resources – www.cadresources.com.au Tel: (08) 9246 3242 – Fax: (08) 9246 3202		Figure: 1
CAD Ref: j674wpov.dgn	Date: Jun 2001	Rev: A A0

Keighery Bronwen

From: Honour, Juliet [Juliet.Honour@planning.wa.gov.au]
Sent: Monday, 8 July 2002 12:53
To: Keighery Bronwen
Cc: Bamforth, Emma; Ahola, Glenn
Subject: Whiteman Park

Waterbody DA application June ...

Bronwen,
I attach a draft paper I have prepared which seeks to determine the application of MRS amendment 1009/33A on future developments at Whiteman Park as a basis for our meeting on Wednesday 10 July at 11am at DPI. I have put a full copy in the mail which includes the various attachments referenced in the paper.
I will look forward to meeting you on Wednesday.
With regards, Juliet.

<<Waterbody DA application June 02.doc>>

Juliet Honour
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Whiteman Park
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APPLICATION OF MRS AMENDMENT NO 1009/33A on FUTURE DEVELOPMENTS AT WHITEMAN PARK
Development Application process and approval

July 2002

1. Background and purpose

Whiteman Park is in the process of implementing major recreation and tourism based projects as identified in the Whiteman Park Masterplan 2000[i] (Appendix 7).
These projects include

- A new entry road from Beechboro Road to the village and associated landscape and entry statements
- Relocating Caversham Wildlife Park into Whiteman Park
- Creation of a new water body and wetland area
- Development of a Transport Heritage precinct area
- Establishment of a tourist demonstration farm
- Upgrade of the village environment, infrastructure and associated features

Planning Bulletin No 53[ii] (Appendix 1), dated May 2002 outlines the recent changes to the process to be followed by Public Authorities in carrying out development on land reserved under the MRS following the amendment no 1009/33A (gazetted on 12 April 2002)

Whiteman Park seeks to clarify the application of this amendment to the proposed developments within the Park, and in particular the proposed water body and wetland area. The concept design for this project is complete and designs for other projects are well advanced. Determination of the process of development approval is therefore critical to the progress and implementation of these works.

In addition to development projects undertaken by the Park, there are also several lease sites within Whiteman Park. The application of the MRS amendment also needs to be determined in relation to approval of developments by groups on lease and licence areas.

Two Park development projects have been submitted recently for Development Approval, namely

1. A new access road from Beechboro Road to Whiteman Park village (21-50068-1) Approval received dated 13 March 2002, and
2. The relocation of Caversham Wildlife Park into Whiteman Park (21-50082-1) Approval received dated 18 June 2002.

2. Discussion

Planning Bulletin no 53 states that

> "The effect of amendment no 1009/33A is that development on land reserved for Parks and Recreation, where the works are in accordance with a management plan endorsed by the Commission, on land that is owned by or vested in the public authority, is 'permitted

development' under clause 16 of the MRS and therefore exempt from the need to obtain development approval."

It goes on to state

"The exemptions do not apply to the clearing of regionally significant vegetation on a Bush Forever site identified in the Bush Forever final report of December 2000. Further, the exemption in respect to parks and recreation reserves now only applies to development consistent with a management plan endorsed by the Commission."

In consideration of the application of the amendment and the requirement for development approval for future projects at Whiteman Park, the following issues must be determined.

1. Does Whiteman Park meet the stated ownership and zoning criteria ?
2. Does the Whiteman Masterplan 2000 and supporting studies constitute a "Management Plan endorsed by the Commission" ?
3. Do the proposed projects constitute "permitted development" under clause 16 of the MRS ?
4. Is Whiteman Park exempt from the need to obtain development approval being identified as a Bush Forever site ?

2.1 Ownership and Land zoning

Whiteman Park is owned by The Planning Commission, as recorded on the Certificate of Title 99/P22611. State Government acquired the land through the bringing down of Improvement Plan no 8 in 1977, for the purposes of future educational, health, institutional and recreational needs as well as the protection of the Gnangara water mound.

Whiteman Park covers an area of 4,200ha of which 2,600 is reserved P&R under the MRS. The remaining areas are subject to rezoning under the proposed MRS amendment no 1072/33 which was initiated by the PRPC to rationalise the boundary of Whiteman Park and make adjustments to the adjoining regional road network. The proposed amendment is illustrated on the attached plans, (appendix 2).

2.2 Management plan

A series of studies have been undertaken to identify the strategic development of Whiteman Park. The Maunsell Report[iii] was completed in 1978 and identified the Parks potential to support important regional recreation facilities tied to strong environmental protection for the water mound.

A 30 year strategic plan for Whiteman Park ("Whiteman Park and Contiguous WAPC Landholdings Strategic Opportunities and Financial Feasibility Study", SOAFF[iv], Appendix 6) was completed in 1998. This confirmed that the role of the Park is to adopt a significant recreation and conservation strategy, with the goal of improving the long term amenity, attractiveness and viability of Whiteman Park by providing a range of commercial / tourism and community based recreation operations within the Park. This study also identified to need to protect the conservation values across the whole Park, including P1 and non P1 areas.

The strategic plan for Whiteman Park was approved by the WAPC in February 1999 and endorsed by State Cabinet in August 1999.

A master plan for Whiteman was developed by EPCAD Consultants in 2000. This is consistent with the strategic direction identified for the Park in the two previous studies and will guide the development of the Park over the next 10 to 12 years. The Master Plan identifies improvements to existing infrastructure and a series of new recreation and tourist developments in the areas

surrounding the village. It identifies lease areas and their strategic integration with the Park. There is also a strong emphasis on Park wide environmental conservation and education opportunities.

The master plan was endorsed by the Whiteman Park Board of Management in December 2000.

Planning Bulletin no 53 states that

> "there is no statutory planning process in the legislation setting out the procedure for the preparation of Management plans."

It goes on to state

> "such plans are however, prepared following extensive public consultation and employ a methodology that typically involves, among other things, analysis of regional and local context; resources and values (eg flora, fauna, landform, hydrology; cultural heritage) regional and local recreation needs; and development opportunities and constraints."

This is consistent with the methodology supporting both the SOAFF strategic plan and the Whiteman master plan 2000 and is evidenced in the executive summaries attached (appendices 6 and 7).

Whiteman Park also commissioned Mattiske Consultants Pty Ltd to undertake a detailed vegetation survey and develop a conservation and recreation precinct classification study for the Park. The final report was completed in September 2001. (Concept plan for Conservation and recreation Precincts, Mattiske Consultants Pty Ltd, 2001[v], Appendix 5) The Whiteman Park Board of Management endorsed this plan as a planning tool for the Park in February 2002. This plan enables future land use planning to be carried out in a manner that supports and is consistent with the strategic and master plan.

The Whiteman Park Board of Management does not see these as static documents. Review and supporting studies are regularly commissioned and incorporated into the strategic and master planning for the Park. The Whiteman Park Board of Management endorses all adopted studies. The Park has recently appointed ERM Environmental Consultants to prepare a Land and Environment Management Plan. The purpose of this plan is to ensure that sustainable conservation, landscape, heritage and recreation values within the Park are maintained and enhanced. This will be completed over the next 18 months and will incorporate a systems analysis of previous work into one benchmarked plan (Appendix 8).

We consider that the following core Whiteman Park planning documents are consistent with the requirement for a Management Plan endorsed by the Commission through the Whiteman Park Board of Management, under the MRS amendment 1009/33A.

- Whiteman Park and Contiguous WAPC Landholdings Strategic Opportunities and Financial Feasibility Study, 1998 (SOAFF strategic plan)
- Whiteman master plan, EPCAD, 2000 (master plan)
- Whiteman Park Concept Plan for Conservation and Recreation Precincts, Mattiske, 2001 (conservation precinct plan)

2.3 Permitted development

> Amended Clause 16 of the MRS identifies "permitted development" as "works on land reserved for Parks and Recreation where the works are in accordance with a management plan endorsed by the Commission"

The proposed development projects are identified in the Whiteman master plan 2000 and are consistent with the strategic direction for the Park as identified in the core planning documents for Whiteman Park as stated above.

2.4 Identified Bush Forever site

Whiteman Park is included in Bush Forever sites 198, 304 and 305, as identified in the Bush Forever Final Report December 2000 (Appendix 3).

In September 2001, a development application was submitted on behalf of Whiteman Park for construction of a new access road from Beechboro Road to Whiteman Village. The proposed road passes through areas of high conservation value and Bush Forever requested evaluation of the impact on the vegetation of these works. Development approval for this road was received in March 2002, following completion of an impact study by Environmental Consultants.

As a result of this study, Whiteman Park developed a draft protocol with Bush Forever to determine the level of assessment for proposed developments at Whiteman Park, when development approval is required. These protocols are based on the conservation and recreation precinct classification study for the Park and set out appropriate levels of assessment for developments in each type of precinct. (Bush Forever Assessment of an Environmental Statement as part of a development application for developments at Whiteman Park. Bush Forever / Whiteman park Protocol Guidelines (Draft), February 2002. Appendix 4)

Four precincts have been identified within Whiteman Park.
(source Concept Plan for Conservation and Recreation Precincts)

Whiteman Park Conservation and Recreation Precincts		
C1	Conservation Precinct	Protecting where ever feasible those areas of bushland which were least disturbed by previous grazing and recreational pressures in the Park.
C2	Rehabilitation Precinct	Protecting those areas of bushland which were only partly disturbed, and which, with management, could be rehabilitated to increase the biological values on the areas through increased native species numbers and cover, and increased variety of fauna habitats.
C3	Conservation Buffer Precinct	Delineating a series of conservation buffer precincts to protect the adjacent values of drainage lines or provide fauna linkages to adjacent areas of native vegetation.
C4	Recreation Usage Precinct	Delineating particular parts of the Park which were mostly cleared or modified bush land areas for recreational activities.

The following levels of assessment are proposed for each of the precincts.
(source Bush Forever / Whiteman Park draft protocol guidelines for assessment)

Proposed level of assessment required for each conservation or recreation precinct at Whiteman Park		
C1	Conservation precinct	Whiteman Park internal evaluation of impact and mitigation, supported by existing documentation, including flora assessment by botanical consultant.
C2	Rehabilitation precinct	Whiteman Park internal evaluation of impact and mitigation, supported by existing documentation. Botanical consultant review of findings and comment.
C3	Conservation Buffer precinct	Whiteman Park internal evaluation of impact and mitigation, supported by existing documentation.
C4	Recreation Usage precinct	No statement required.

The C4 (recreation precinct) is consistent with the areas selected for infrastructure and major recreation based developments identified in the master plan 2000.

In April 2002, a development application for the relocation of Caversham Wildlife Park into Whiteman Park was submitted. The proposed works are contained within the identified C4 recreation precinct for the Park. Following endorsement through SPC, approval has been received and development conditions agreed. Bush Forever required no additional assessment of the proposal, which is consistent with the proposed level of assessment required for projects within a C4 precinct, as identified in the Bush Forever / Whiteman Park draft Protocol Guidelines.

3. Conclusion

In order to clarify the application of the amended MRS to proposed developments within Whiteman Park and to agree a process to identify the criteria under which development approval is required, we request determination that:

1. Development in Whiteman Park is exempt from the Development Approval requirements of the MRS, under amendment no 1009/33A, where

1.1 Developments proposed for Whiteman Park are in accordance with the following documents
- Whiteman Park and Contiguous WAPC Landholdings Strategic Opportunities and Financial Feasibility Study, 1998 (SOAFF Strategic Plan)
- Whiteman master plan, EPCAD, 2000 (Master plan 2000)
- Whiteman Park Concept Plan for Conservation and Recreation Precincts, Mattiske, 2001 (Conservation Precinct Plan)

which together form the Management Plan endorsed by the Commission, through the Whiteman Park Board of Management, and therefore constitute "permitted developments" *and*

1.2 The proposed development is contained entirely within a C4 recreation precinct as identified in the Concept Plan for Conservation and Recreation Precincts *or*

1.3 The proposed development is outside a C4 recreation precinct as identified in the Concept Plan for Conservation and Recreation Precincts and does not involve the clearing of any significant bushland or vegetation.

2. This exemption *does not apply* where the proposed development would involve the clearing of regionally significant bushland on an area of Whiteman Park classified as a C1 (Conservation), C2 (Rehabilitation) or C3 (Conservation Buffer) precinct, as identified in the Concept Plan for Conservation and Recreation Precincts.

3. Where a development project falls outside of a C4 (recreation precinct) area, the project details will be submitted to DPI for determination whether development approval is required in relation to Bush Forever requirements and the draft protocols for assessment.

4. This protocol agreement would apply to developments by the Park as well as developments by groups on lease or licence areas.

List of Attachments

Appendix 1 Planning Bulletin no 53, Development by Public Authorities on land reserved under the Metropolitan Scheme.

Appendix 2 Whiteman Park and Environs, MRS amendment 1072/33 proposed land re-zoning.

Appendix 3 Bush Forever plan of sites 198,304 and 305.

Appendix 4 Draft Bush Forever / Whiteman Park Protocol Guidelines, February 2002.

Appendix 5 Whiteman Park Concept Plan for Conservation and Recreation Precincts, including Conservation and recreation areas map and vegetation map.

Appendix 6 SOAFF Strategic Plan Executive Summary and Plan.

Appendix 7 EPCAD Whiteman Master Plan Executive Summary and Plans.

Appendix 8 Land and Environment Management Plan, scope of works, April 2002.

References

[i] EPCAD Consultants (August 2000)
Whiteman. Report and drawings prepared for the Ministry for Planning, Western Australia

[ii] Planning Bulletin no 53, May 2002, Department for Planning and Infrastructure
Developments by Public Authorities on Land Reserved under the Metropolitan Region Scheme.

[iii] Maunsell & Partners Pty Ltd, Perth (1978)
Whiteman Park. Prepared for the Metropolitan Region Planning Authority Perth, Western Australia.

[iv] Synetics Creative Collaboration, Canberra: James Coulter Young Pty Ltd, Perth; Tract (WA) Pty Ltd, Perth; Creating Communities, Perth (December 1998)
Whiteman Park and Contiguous WAPC Landholdings Strategic Opportunities and Financial Feasibility Study. Report prepared for the Ministry for Planning, Western Australia

[v] Mattiske Consulting Pty Ltd and M.J & A.R. Bamford (September 2001)

Whiteman Park Concept Plan for Conservation and Recreation Precincts. Report prepared for the Ministry of Planning

Incorporates the earlier study

Mattiske Consulting Pty ltd and M.J & A.R. Bamford (June 1998)

Whiteman Park Concept Plan for Conservation and Recreation Zoning. Report prepared for the Ministry of Planning

Publications

Planning Bulletin No. 53 May 2002

Development by Public Authorities on Land Reserved under the Metropolitan Region Scheme

1. Purpose

This Planning Bulletin outlines recent changes to the procedures to be followed by public authorities in carrying out development on land reserved under the Metropolitan Region Scheme (MRS) following the gazettal, on Friday 12 April 2002, of MRS Amendment No. 1009/33A.

This Planning Bulletin supersedes Planning Bulletin No. 42 which was issued in September 2000.

2. Background

The Bayswater Case

Section 32 of the *Town Planning and Development Act 1928* (TPDA) relieves public authorities and local governments, when undertaking, constructing or providing any public work, from the specific requirements for approval under a local government town planning scheme. Instead, public authorities are required to consult the local government prior to such development taking place.

It was understood that a similar exemption applied to zoned land under the MRS. It was also assumed that clause 16 of the MRS exempted development by a public authority on land reserved under the MRS which is owned by or vested in a public authority from the requirements under clause 13 of the MRS to obtain approval to commence or carry out development.

Those interpretations changed following the handing down of a decision by the Full Court of

the Supreme Court of Western Australia in *City of Bayswater v Minister for Family and Children Services and Others* [2000] WASCA 151 (the Bayswater Case).

In the Bayswater Case, the City of Bayswater requested the Department of Family and Children's Services (DFCS), through the Department of Contract and Management Services (CAMS), to submit an application for development approval under the MRS for certain demolitions, extensions and refurbishments to the Bedford Hostel to provide accommodation for youth under its care. The land was zoned under the MRS and DFCS/CAMS refused the request arguing that s.32 of the TPDA relieved them from any obligation to obtain development approval. The City of Bayswater commenced an action in the Supreme Court. The argument by DFCS/CAMS was successful in the first instance before Murray J, who held that s.32 of the TPDA provided an exemption to the general approval requirements and this extended to land both zoned and reserved under the MRS.

The City of Bayswater appealed against the decision of Murray J to the Full Court. By a majority of two to one the Full Court reversed that decision and held that the MRS provisions applied so as to require an application for approval to commence development in respect of the works concerned.

The effect of the decision of the Full Court was that approval to commence development for public works by public authorities was required in respect of land both zoned and reserved under the MRS.

MRS Amendment 1009/33A

MRS Amendment No. 1009/33A was initiated to address the anomaly highlighted by the decision in the Bayswater Case in so far as reserved land under the MRS is concerned.

The amendment, in its draft form, proposed to exempt development by a public authority from the need to obtain development approval under the MRS where the subject land is owned by or vested in the public authority and the land is reserved under the MRS for that particular purpose. The amendment was predicated on the fact that the planning implications arising from most public works - such as roads, railways and other infrastructure - are assessed at the time

the land is initially reserved under the MRS.

The draft amendment was advertised from February to April 1999 during which time a total of 30 submissions were received. Of those 30 submissions:

- 28 objected to the amendment.
- One supported the amendment.
- One was a request for further information as to the operation of clause 16 of the MRS.

The main objections to the draft amendment were as follows:

- It would permit significant and potentially controversial development to occur on land owned by a public authority without any planning oversight by the Commission or local government.[1]
- It would allow public authorities (including local governments) to commence or carry out development on reserved land owned by or vested in the public authority without the need to consider and accommodate environmental and conservation issues arising in relation to such development.
- It would allow the Commission to approve development on a regional reserve owned by or used by a public authority for a purpose other than that for which the land is reserved, without the need for a scheme amendment.

Following consideration of the submissions, the amendment has been modified as follows:

- The scope of exemption from development approval has been limited to development associated with roads, port facilities, railways, water, electricity, gas, high schools, regional parks and State Forests within their respective reserves. This is generally in accordance with the range of reservations set out in clause 12(2) of the MRS.
- The exemptions do not apply to the clearing of regionally significant vegetation on a *Bush Forever* site identified in the *Bush Forever Final Report* published by the Commission in December 2000. Further, the exemption in respect to Parks and Recreation reserves now only applies to development

consistent with a management plan endorsed by the Commission. This will prevent the development of playing fields, sports fields, car parks and other facilities, and associated clearing of vegetation, where the development is not provided for in a management plan endorsed by the Commission, without the approval of the Commission.

The concerns about the Commission's ability to approve development on a regional reserve for a purpose other than that for which the land is reserved without the need for a scheme amendment were noted. The Commission's ability in this regard, however, has always been available under clause 30 of the MRS.

3. Development by public authorities that is now exempt from the development approval requirements of the MRS

The effect of Amendment No. 1009/33A, following its gazettal on Friday 12 April 2002, is that development for the following purposes, on land that is owned by or vested in a public authority, is "permitted development" under clause 16 of the MRS and therefore exempt from the need to obtain development approval:

- Works on land reserved for Primary Regional Roads or Other Regional Roads for the purpose of or in connection with a road within the meaning of the Main Roads Acts 1930.
- Works on land reserved for Port Installations for the purpose of or in connection with a port.
- Works for the purpose of or in connection with the supply of water, electricity or gas, or the drainage or treatment of waste, water or sewerage.
- Works on land reserved for Railways for the purpose of or in connection with a railway, but this does not include the construction or alteration of a railway station or any related car parks, public transport interchange facilities, or associated means of pedestrian or vehicular access.
- Works on land reserved for Parks and Recreation where the works are in accordance with a management plan endorsed by the Commission.
- Works on land reserved for Public Purposes - High School for the purpose of or incidental to a high school.

- Operational works on land reserved for State Forests for the purpose of or incidental to a State Forest.

These exemptions do not apply where the development would involve the clearing of regionally significant vegetation on a site specified as a *Bush Forever* site in the *Bush Forever Final Report* published by the Commission in December 2000.
A copy of the gazetted amendment is attached as Schedule 1 of this Planning Bulletin.
In so far as the exemptions for works on Parks and Recreation reserves and Public Purpose – High School reserves are concerned, the following points should be noted:

- There is no statutory planning process in the legislation setting out the procedure for the preparation of management plans. Such plans are, however, prepared following extensive public consultation and employ a methodology that typically involves, among other things, analysis of regional and local context; resources and values (e.g. flora, fauna, landform, hydrology; cultural heritage); regional and local recreation needs; and development opportunities and constraints.
- The Minister for Education has agreed to establish consultation and arbitration procedures with the Western Australian Local Government Association to deal with high school proposals on land reserved Public Purposes – High School that may potentially give rise to amenity and other community concerns.

4. Development by public authorities that still requires development approval under the MRS

Development by public authorities that still requires development approval under the MRS includes:

- Development on reserved land owned by or vested in a public authority, where the development does not fall within the meaning of "permitted development" under clause 16 of the MRS.
- Development on reserved land owned by or vested in a public authority, where the development falls within the meaning of

"permitted development" under clause 16 of the MRS, but involves the clearing of regionally significant vegetation on a site specified as a *Bush Forever* site in the *Bush Forever Final Report* published by the Commission in December 2000.

- Development by public authorities on zoned land (this requirement is currently being reviewed).

5. Application requirements under the MRS

Applications by public authorities for approval to commence development under the MRS should be made on Form 1 of the MRS and should be submitted in duplicate, in the first instance, to the relevant local government.

The local government is required to forward a copy of the application to the Commission within seven (7) days of receipt and may, within forty-two (42) days of receipt (or such further period as the Commission may allow) forward recommendations to the Commission for consideration in respect of the application.

The Commission is (in respect of public works by public authorities) the responsible authority for determining the application. The Commission may consult with any authority it thinks appropriate and must have regard to the purpose for which the land is zoned or reserved under the MRS, the orderly and proper planning of the locality, and the preservation of the amenities of the locality when making its determination. The Commission may refuse its approval or grant approval subject to such conditions as it may deem fit.

The Commission has sixty (60) days to make a decision (or such further time as may be agreed in writing) after which an application is deemed refused.

An exception to the above procedures applies in respect of roadworks on land reserved for regional roads under the MRS. Under the terms of the Notice of Delegation published in the *Government Gazette* on 28 September 2001, applications for development on regional road reservations are determined by the local government following consultation with the Department for Planning and Infrastructure or Main Roads WA, depending on the category of road. Where a recommendation of the Department for Planning and Infrastructure and Main Roads WA is not acceptable to the local government, the application is forwarded to the Commission for determination.

There is a right of appeal where an application

has been refused by the Commission or approved subject to unacceptable conditions. There is also a right of appeal in respect of a deemed refusal.

The MRS Form 1 does not specify in detail the information to be submitted with applications. For guidance, applications should ordinarily be accompanied by:

(a) A plan or plans to a scale of not less than 1:500 showing:

(i) the location of the site including street names, lot numbers, north point and the dimensions of the site;

(ii) the existing and proposed ground levels over the whole of the land that is the subject of the application, and the location, height and type of all existing structures, and structures and vegetation proposed to be removed;

(iii) the existing and proposed use of the site, including proposed hours of operation, and buildings and structures to be erected on the site;

(iv) the existing and proposed means of access for pedestrians and vehicles to and from the site;

(v) the location, number, dimensions and layout of all car parking spaces intended to be provided;

(vi) the location and dimensions of any area proposed to be provided for the loading and unloading of vehicles carrying goods or commodities to and from the site and the means of access to and from those areas;

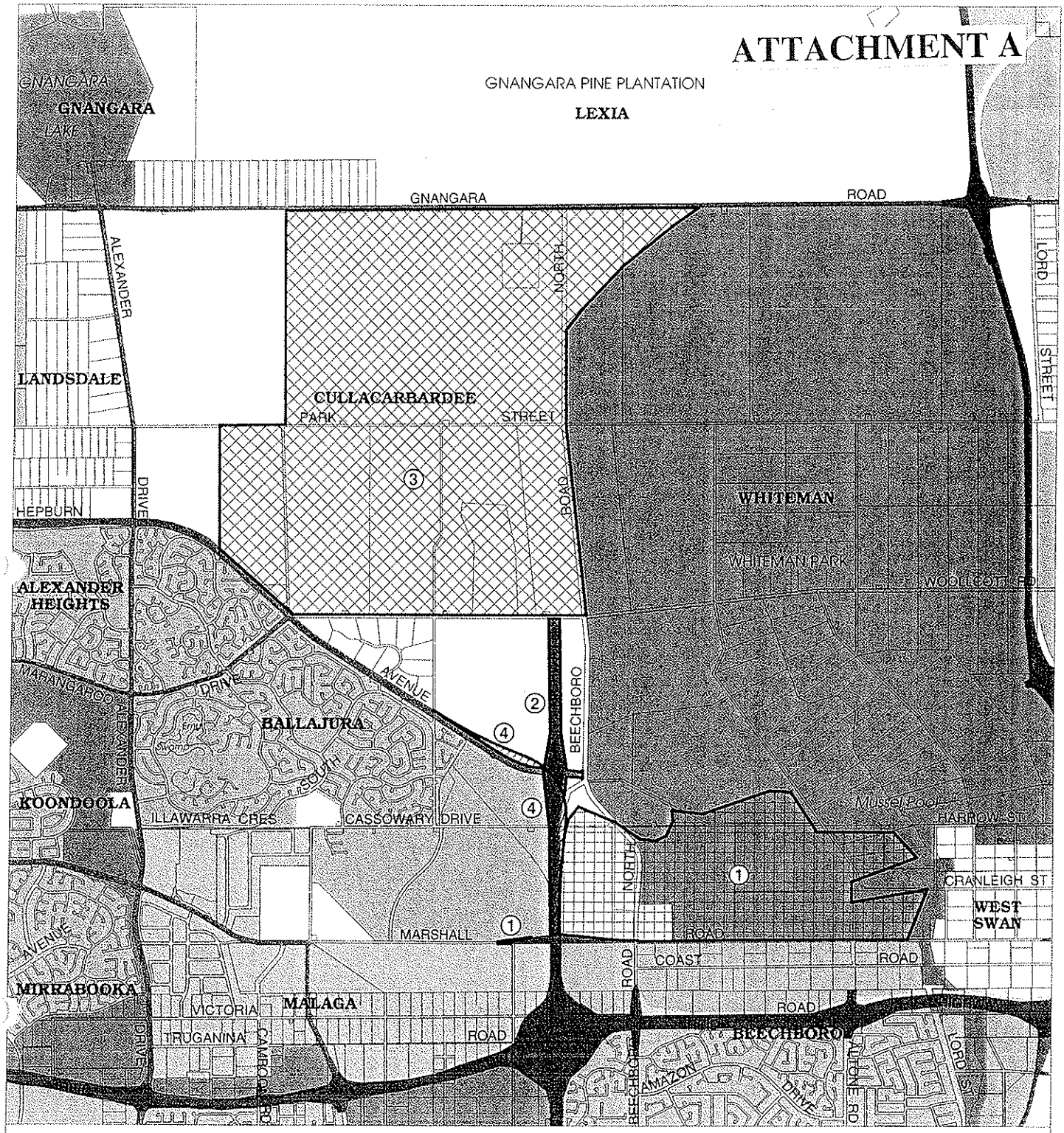
(vii) the location, dimensions and design of any open storage and particulars of the manner in which it is proposed to develop same; and

(viii) the nature and extent of any open space and landscaping proposed for the site.

(b) Plans, elevations and sections of any building proposed to be erected or altered and of any building it is intended to retain.

The need for development approval increases the administrative workload and can create the potential for delays to public works. Delays can

ATTACHMENT A



WHITEMAN PARK & ENVIRONS

AS ADVERTISED

11th FEBRUARY 2000

FIGURE 1

WESTERN AUSTRALIAN PLANNING COMMISSION

CUSTOMER FOCUS

N

SCALE 1:50000

0 1000 metres

FILENAME: bw1.fig

LEGEND

PROPOSED:

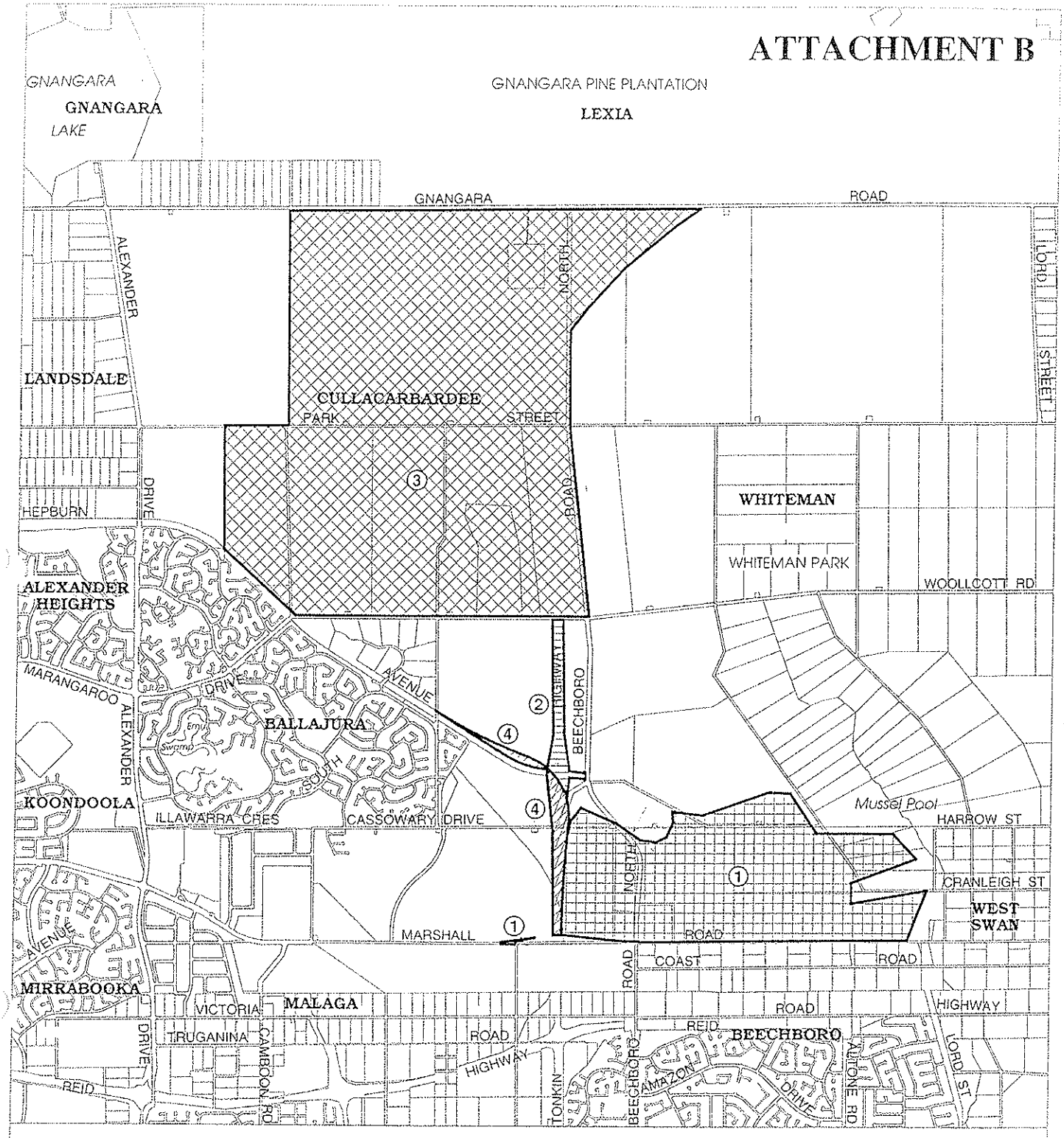
- ① URBAN ZONE
- ② RURAL ZONE
- ③ PARKS AND RECREATION RESERVATION
- ④ OTHER REGIONAL ROADS RESERVATION

EXISTING:

- URBAN ZONE
- RAILWAYS RESERVATION
- INDUSTRIAL ZONE
- URBAN DEFERRED ZONE
- PARKS AND RECREATION RESERVATION
- STATE FORESTS RESERVATION
- PUBLIC PURPOSES (HS, SEC, SU & WSD) RESERVATION
- PRIMARY REGIONAL ROADS RESERVATION
- OTHER REGIONAL ROADS RESERVATION

Produced by Statutory Mapping Section, Geographic and Planning Information Branch, Ministry for Planning

ATTACHMENT B



WHITEMAN PARK & ENVIRONS

AS ADVERTISED

11th FEBRUARY 2000

FIGURE 1

WESTERN AUSTRALIAN PLANNING COMMISSION

CUSTOMER FOCUS

N

SCALE 1:50000

0 1000 metres

FILENAME bw1.fig

LEGEND

PROPOSED:

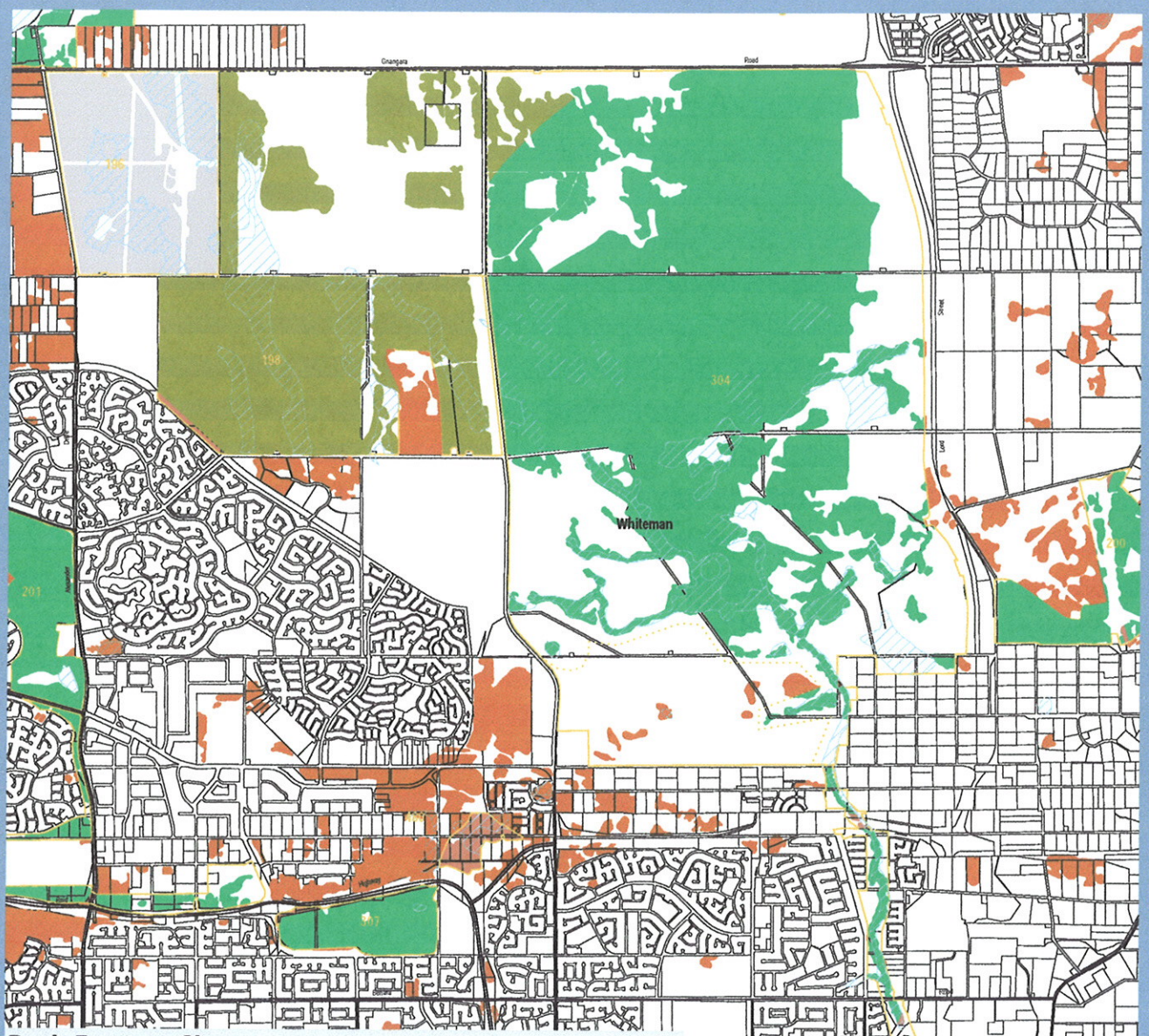
① URBAN ZONE

② RURAL ZONE

③ PARKS AND RECREATION RESERVATION

④ OTHER REGIONAL ROADS RESERVATION

Produced by Statutory Mapping Section, Geographic and Planning Information Branch, Ministry for Planning



Bush Forever Sites - Whiteman Park

Department for Planning and Infrastructure

GDA

N

SCALE 1:40000

0 200 400 600 800 1000

Metres

Bushforever.dgn
12 Feb 2002
PRODUCED BY STATUTORY MAPPING SECTION
GEOGRAPHIC AND PLANNING INFORMATION BRANCH

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

Produced by Project Mapping Section, Geographic & Planning Information Branch, from information supplied by Environmental Planning Branch, Ministry for Planning, Perth, W.A. Dec. 2000

mie-map17\environt\bushplan\bpfinal_v1_A0.dgn

Cadastral and Road Centreline Data supplied by Department of Land Administration, WA

Native Vegetation Extent for Study Area supplied by Agriculture, W.A.

Wetland Data supplied by Water and Rivers Commission, W.A.

Garden Island Vegetation Data supplied by McArthur, WM 1998

Photographs supplied by Bronwen and Gregory Keighery

Boundary Interpretations :

Agreed

Area to be Protected for Conservation

Agreement Proposed

Proposed Bush Forever Boundary

Areas Proposed to be Protected for Conservation

LEGEND

275 Bush Forever Sites (or parts thereof) ★

Regionally Significant Bushland

- Some Existing Protection
- Proposed Parks and Recreation
- Rural Complementary
- Urban, Urban Deferred, Industrial Negotiated Planning Solutions (Agreed)
- Urban, Urban Deferred, Industrial Negotiated Planning Solutions (Agreement Proposed and To Be Determined)
- Strategic - Negotiated Planning Solutions
- Basic Raw Materials/Titanium Minerals Negotiated Planning Solutions *
- Cemeteries
- Other Government Lands (including existing and proposed public utilities)
- Local Town Planning Scheme Reserves (including existing and proposed public utilities)
- Major Road/Railway Reserves
- Regional Creeklines (with Mapped Vegetation)
- Conservation Category Wetlands (both within and outside Bush Forever Sites)
- Other Native Vegetation
- Swan Coastal Plain Boundary
- Eastern Side of the Plain Boundary
- Dandaragan Plateau Boundary
- Perth Metropolitan Region Boundary
- Bush Forever Study Area Boundary

★ Where there is more than one implementation recommendation for a Bush Forever Site, each part has been assigned a letter (A, B, C etc)

* Basic Raw Materials/Titanium Minerals Negotiated Planning Solutions may also apply to regionally significant bushland with some existing protection and/or existing mining approvals/SPP No.10 policy areas

Bush Forever Assessment of an Environmental Statement

as part of a Development Application for Developments at Whiteman Park

BUSH FOREVER / WHITEMAN PARK PROTOCOL GUIDELINES

February 2002

Background to Whiteman Park

Whiteman Park is located in the fastest growing north-eastern corridor of metropolitan Perth. Significant urban development has grown around Whiteman since it started its life as a public amenity in the mid 1970's. The Park's early history centred around Mussel Pool – a privately owned picnic ground built around a constructed lake in the 1960's by the late Lew Whiteman. The State Government acquired this land and subsequently other surrounding lands, through bringing down of Improvement Plan no 8 in 1977, for the purposes of future educational, health, institutional and recreational needs as well as the protection of the Gnangara Water Mound. Whiteman Park includes the localities of Whiteman, Cullacarbardee and Bennett Brook Reserve covering an area of 4,200 ha. from Gnangara Road in the north to the Swan River in the south.

draft

Whiteman Park has long been identified as a regionally important area for active and passive recreation and the development of infrastructure and facilities is integral to meeting these growing community and visitor needs.

The Maunsell Report[i] was completed in 1978 and was the first step in the strategic development of the Park. The report identified the Parks potential to support important regional recreation facilities tied to strong environmental protection for the water mound.

During the early 1980's considerable investment was made in Whiteman Park through a series of capital development programs including State Planning Commission funding, together with volunteer input. Projects at this time included the shooting complex on Beechboro Road, the construction of Whiteman Village, extended picnic grounds, installation of tram-lines for the Perth Electric Tramways and narrow gauge train lines for the Bennett Brook Railways.

Subsequent improvements included an entry road from Lord Street to the Village, road connections between the Village and Mussel Pool, car parks and toilets. The most significant development of the 1990's was the construction of a large building to house the Motor Museum of WA, located in the Village.

A strategic plan for Whiteman Park ("Whiteman Park and Contiguous WAPC Landholdings Strategic Opportunities and Financial Feasibility Study", SOAFF[ii]) was completed in 1998. This confirmed that the role of the Park is to adopt a significant recreation and conservation strategy, with the goal of improving the long term amenity, attractiveness and viability of Whiteman Park by providing a range of commercial / tourism and community based recreation operations the Park. This study also identified to need to protect the conservation values across the whole Park, including P1 and non P1 areas.

A Master Plan for Whiteman[iii] was developed by EPCAD Consultants in 2000. This is consistent with the strategic direction identified for the Park and will guide the development of the Park over the next 10 years. The Master Plan focuses on recreation and tourist developments in the areas surrounding the village. There is also a strong emphasis on Park wide environmental conservation and education opportunities.

Whiteman Park Conservation and Recreation Precinct study

In preparation for implementation of these developments, Whiteman Park commissioned Mattiske Consultants Pty Ltd to undertake a detailed vegetation survey and develop a conservation and recreation precinct classification for the Park. This study was undertaken in two parts. The first being the area bounded by Gnangara Road, Lord Street, Marshall Road and Beechboro Road and was completed in 1998. The second part included the areas of Cullacarbardee and Bennett Brook Reserve. These two studies were combined, encompassing the whole of Whiteman Park, producing the final report of September 2001. ("Concept Plan for Conservation and Recreation Precincts" Mattiske Consultants Pty Ltd, 2001[iv])[1]

This study allocated conservation precincts according to the conservation needs and characteristics of flora, vegetation and vertebrate fauna. The principles used for conservation precincts were area, shape, degree of clearing, vegetation condition, degree of disturbance, diversity of communities, fauna habitats and species, linkages with other natural habitats, fauna utilisation of different areas of the Park and the edge effects from adjacent land uses. The requirement to balance people and conservation was also taken into consideration.

The report identifies 4 levels of precincts for Whiteman Park and has been adopted by the Whiteman Park Board of Management as a working tool to assist in the preparation of strategic opportunities and land management operations. Mattiske were also commissioned by Whiteman Park management to carry out a one year study to search for rare flora[v]. Five Priority three species were identified, all of which had been recorded in previous studies. No rare or endangered plants were found.

Whiteman Park Conservation and Recreation Precincts

C1	Conservation Precinct	Protecting where ever feasible those areas of bushland which were least disturbed by previous grazing and recreational pressures in the Park.
C2	Rehabilitation Precinct	Protecting those areas of bushland which were only partly disturbed, and which, with management, could be rehabilitated to increase the biological values on the areas through increased native species numbers and cover, and increased variety of fauna habitats.
C3	Conservation Buffer Precinct	Delineating a series of conservation buffer precincts to protect the adjacent values of drainage lines or provide fauna linkages to adjacent areas of native vegetation.
C4	Recreation Usage Precinct	Delineating particular parts of the Park which were mostly cleared or modified bush land areas for recreational activities.

Bush Forever

Whiteman Park is included in Bush Forever sites 198, 304 and 305. Perth's Bush Plan (now Bush Forever) was open for comment in 1999. A submission was made by Whiteman Park management in April 1999, and identified that many areas within the Park have been cleared and grazed since 1940 resulting in a loss of understorey and subsequently, where grazing has ceased, large areas of regrowth consisting of only a few dominant species. The Mattiske report and Conservation and Recreation Precinct Plan were also submitted in support of the response by Whiteman Park. Although not incorporated into the final Bush Forever Plan, the report and identification of precincts were noted as a relevant local planning tool.

[1] Whiteman Park Board of Management resolved at its meeting in February 2002 to amend the title of this document from "Concept Plan for Conservation and Recreation Zoning" to "Concept Plan for Conservation and Recreation Precincts" and all words within the report from "Zone" to "Precinct".

Protocol agreement for Development Application assessment

Infrastructure and recreation based developments are now being planned for Whiteman Park as implementation of the Master Plan proceeds. In order to streamline the assessment of Development Applications for these projects, Whiteman Park seeks to agree the following protocols with Bush Forever to provide a higher degree of certainty for the content of the landscape and environmental statements that are required as a component of the Development Application submissions.

1. Bush Forever acknowledge the strategic planning (SOAFF study 1998) and master plan (EPCAD 2000) and the proposed recreation and infrastructure developments for Whiteman Park, as endorsed by WAPC through the Whiteman Park Board of Management.

2. Bush Forever endorse the documented "Whiteman Park Concept Plan for Conservation and Recreation Precincts" (Mattiske Consulting Pty Ltd & M.J. & A.R. Bamford, June 1998 and September 2001) which constitutes the environmental management statement for Whiteman Park.

3. Bush Forever endorse the 4 levels of conservation and recreation precincts identified in the "Whiteman Park Concept Plan for Conservation and Recreation Precincts" (Mattiske Consulting Pty Ltd & M.J. & A.R. Bamford, June 1998 and September 2001) which will provide the background and form the supporting basis of any environmental statement required as part of a Development Application for assessment by Bush Forever.

4. The conservation and recreation precincts category (as identified by Mattiske Consultants Pty Ltd) applied to the existing area of the proposed development will determine the level of impact study required for each Development Application submission.

5. The evaluation criteria required to assess the proposed developments in each of the conservation and recreation precincts will be agreed between Bush Forever and Whiteman Park.

6. Acknowledgement of Whiteman Park's commitment to conservation and endorsement of Whiteman Parks draft land management strategy as meeting Bush Forever assessment criteria for environmental mitigation applications.

OBSOLETE

Process

1. Agreement of the protocol items outlined above, through submission of the following documents, for evaluation, verification and endorsement by Bush Forever.

Reports

Mattiske Consulting Pty Ltd and M.J. & A.R. Bamford,."Whiteman (September 2001)
Whiteman Park Concept Plan for Conservation and Recreation Precincts"

Mattiske Consulting Pty Ltd and M.J. & A.R. Bamford, (June 1998)
"Whiteman Park Concept Plan for Conservation and recreation Precincts"

Mattiske Consulting Pty Ltd (April 2000)
"Flora and Vegetation Assessment of IP8 Area Beechboro Road"

Mattiske Consulting Pty Ltd, (March 2001)
"Flora and Vegetation – Bennett Brook and Grogan Swamp"

Plans

Mattiske Consulting Pty Ltd, (April 2001)
Conservation and Recreation Precincts.

Mattiske Consulting Pty Ltd, (April 2001)
Vegetation Mapping.

draft

2. Bush Forever and Whiteman Park to agree the evaluation criteria required to assess the proposed developments in each of the conservation and recreation precincts.

Proposed level of assessment required for each conservation or recreation precinct at Whiteman Park	
C1 Conservation precinct	Whiteman Park internal evaluation of impact and mitigation, supported by existing documentation, including flora assessment by botanical consultant.
C2 Rehabilitation precinct	Whiteman Park internal evaluation of impact and mitigation, supported by existing documentation. Botanical consultant review of findings and comment.
C3 Conservation Buffer precinct	Whiteman Park Internal evaluation of impact and mitigation, supported by existing documentation.
C4 Recreation precinct	No statement required.

References

[i] Maunsell & Partners Pty Ltd, Perth (1978)
Whiteman Park. Prepared for the Metropolitan Region Planning Authority Perth, Western Australia.

[ii] Synetics Creative Collaboration, Canberra: James Coulter Young Pty Ltd, Perth; Tract (WA) Pty Ltd, Perth; Creating Communities, Perth (December 1998)
Whiteman Park and Contiguous WAPC Landholdings Strategic Opportunities and Financial Feasibility Study. Report prepared for the Ministry for Planning, Western Australia

[iii] EPCAD Consultants (August 2000)
Whiteman. Report and drawings prepared for the Ministry for Planning, Western Australia

[iv] Mattiske Consulting Pty Ltd and M.J & A.R. Bamford (September 2001)
Whiteman Park Concept Plan for Conservation and Recreation Precincts. Report prepared for the Ministry for Planning
Incorporates the earlier study
Mattiske Consulting Pty Ltd and M.J & A.R. Bamford (June 1998)
Whiteman Park Concept Plan for Conservation and Recreation Zoning. Report prepared for the Ministry for Planning

[v] Mattiske Consulting Pty Ltd (2000 to 2001)
No report submitted as no new findings.

draft

WHITEMAN PARK

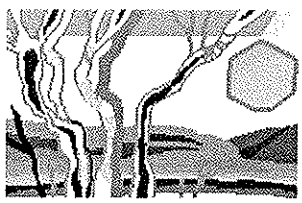
CONCEPT PLAN FOR

CONSERVATION AND RECREATION PRECINCTS

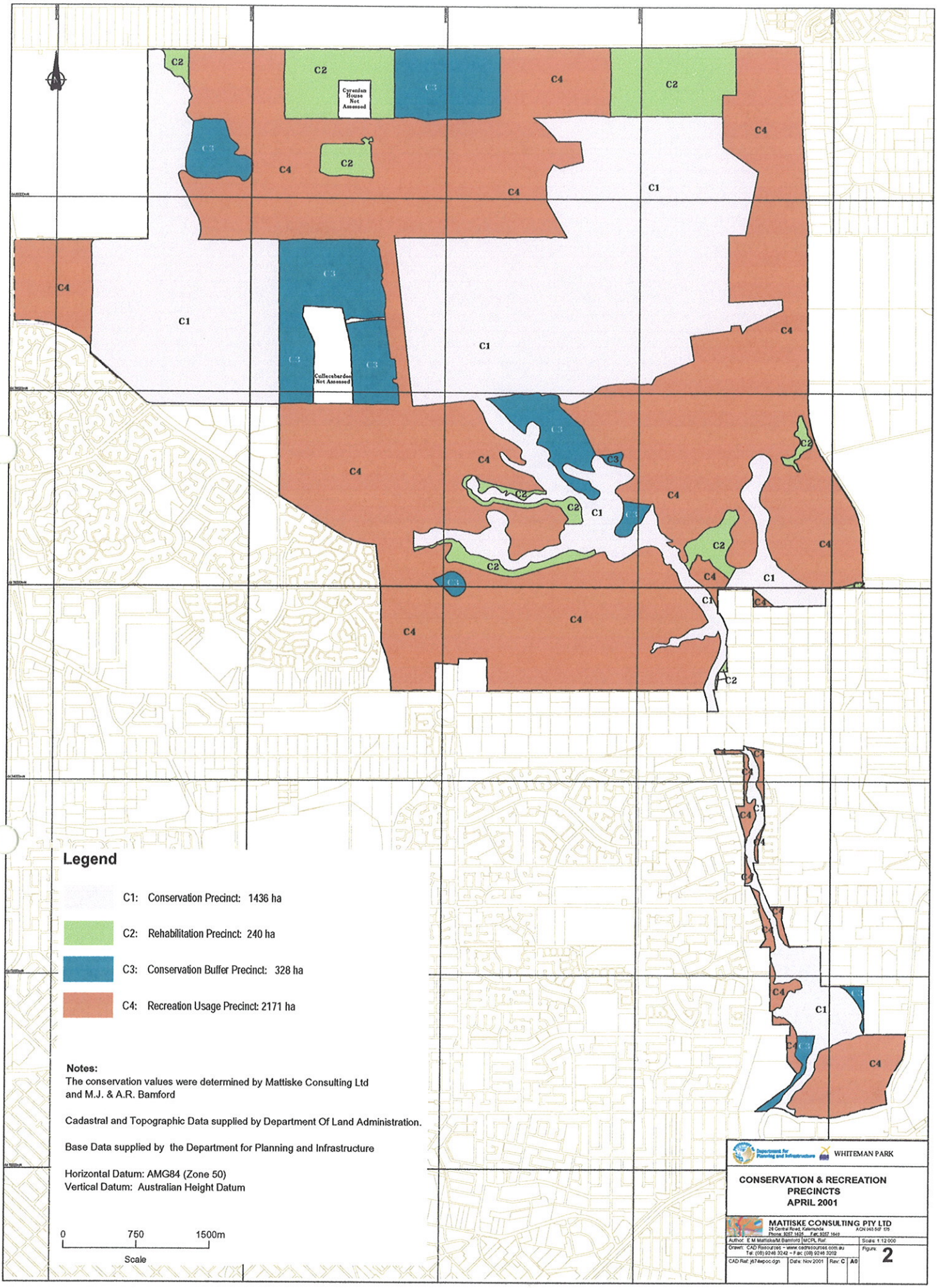
Prepared for:
Ministry for Planning

Prepared by:
Mattiske Consulting Pty Ltd
& M.J. & A.R. Bamford

September 2001



MATTISKE CONSULTING PTY LTD



Legend

- C1: Conservation Precinct: 1436 ha
- C2: Rehabilitation Precinct: 240 ha
- C3: Conservation Buffer Precinct: 328 ha
- C4: Recreation Usage Precinct: 2171 ha

Notes:
The conservation values were determined by Mattiske Consulting Ltd and M.J. & A.R. Bamford

Cadastral and Topographic Data supplied by Department Of Land Administration.

Base Data supplied by the Department for Planning and Infrastructure

Horizontal Datum: AMG84 (Zone 50)
Vertical Datum: Australian Height Datum

0 750 1500m
Scale

Department for Planning and Infrastructure

WHITEMAN PARK

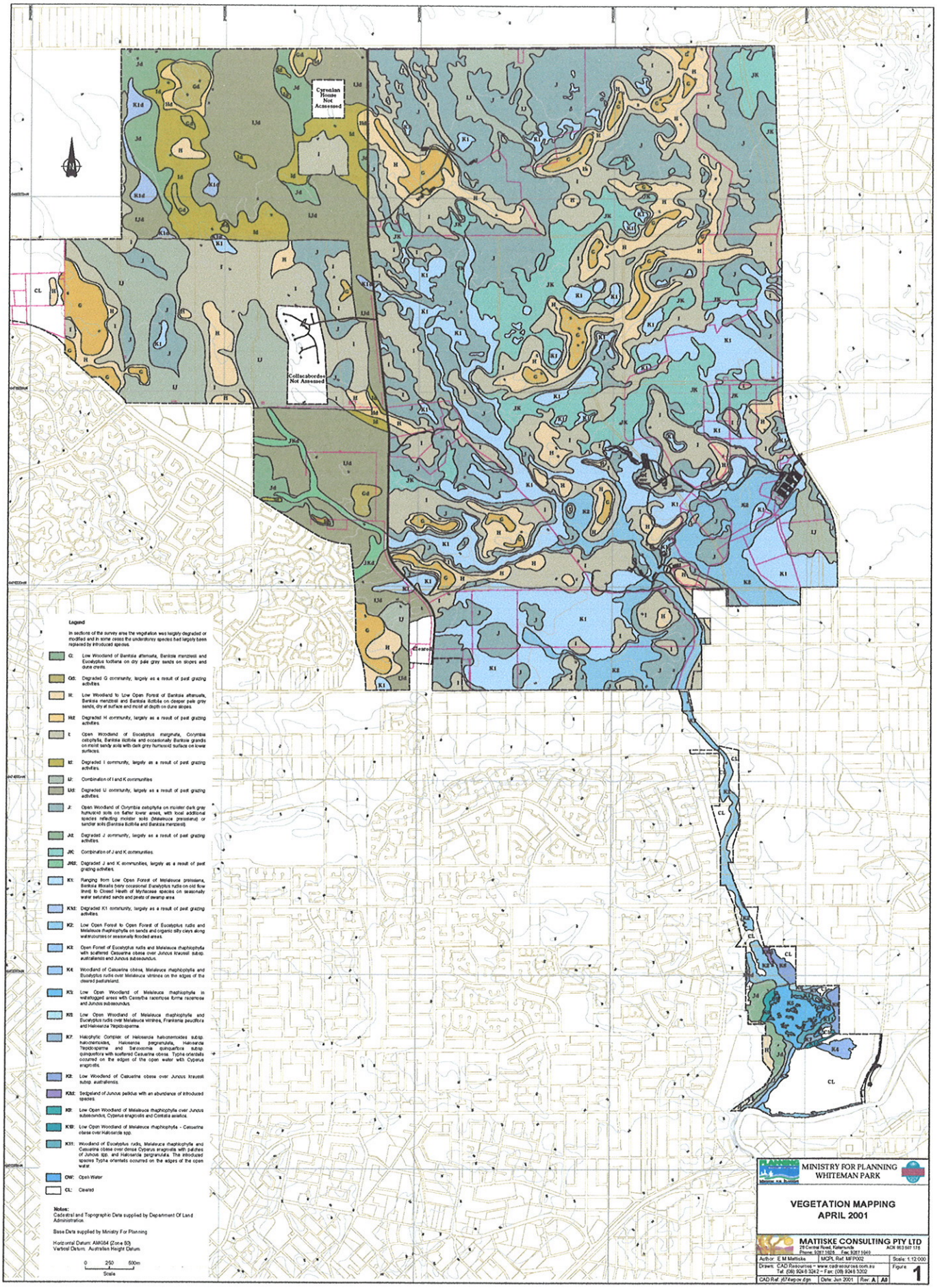
CONSERVATION & RECREATION PRECINCTS APRIL 2001

MATTISKE CONSULTING PTY LTD
28 Central Road, Kalamunda ACN 065 597 575
Phone: 9257 1420 Fax: 9257 1649

Author: E.M.Mattiske/M.Bamford | MCPL Ref: | Scale: 1:12 000

Drawn: CAD Resources - www.cadresources.com.au
Tel: (08) 9246 3242 - Fax: (08) 9246 3202 | Figure: 2

CAD Ref: j67wpoc.dgn | Date: Nov 2001 | Rev: C | A0



Legend

In sections of the survey area the vegetation was largely degraded or modified and in some cases the understorey species had largely been replaced by introduced species.

- G: Low Woodland of Banksia attenuata, Banksia menziesii and Eucalyptus todtiana on dry pale grey sands on slopes and dune crests.
- Gd: Degraded G community, largely as a result of past grazing activities.
- H: Low Woodland to Low Open Forest of Banksia attenuata, Banksia menziesii and Banksia ilicifolia on deeper pale grey sands, dry at surface and moist at depth on dune slopes.
- Hd: Degraded H community, largely as a result of past grazing activities.
- I: Open Woodland of Eucalyptus marginata, Corymbia calophylla, Banksia ilicifolia and occasionally Banksia grandis on moist sandy soils with dark grey humicoid surface on lower surfaces.
- Id: Degraded I community, largely as a result of past grazing activities.
- IJ: Combination of I and K communities
- IJd: Degraded IJ community, largely as a result of past grazing activities.
- J: Open Woodland of Corymbia calophylla on moister dark grey humicoid soils on flatter lower areas, with local additional species reflecting moister soils (Melaleuca preissiana) or sandier soils (Banksia ilicifolia and Banksia menziesii).
- Jd: Degraded J community, largely as a result of past grazing activities.
- JK: Combination of J and K communities.
- JKd: Degraded J and K communities, largely as a result of past grazing activities.
- K1: Ranging from Low Open Forest of Melaleuca preissiana, Banksia littoralis (very occasional Eucalyptus rudis on old flow lines) to Closed Heath of Myrtaceae species on seasonally water saturated sands and peats of swamp area.
- K1d: Degraded K1 community, largely as a result of past grazing activities.
- K2: Low Open Forest to Open Forest of Eucalyptus rudis and Melaleuca rhaphiophylla on sands and organic silty clays along watercourses or seasonally flooded areas.
- K3: Open Forest of Eucalyptus rudis and Melaleuca rhaphiophylla with scattered Casuarina obesa over Juncus krausii subsp. australiensis and Juncus subsecundus.
- K4: Woodland of Casuarina obesa, Melaleuca rhaphiophylla and Eucalyptus rudis over Melaleuca viminea on the edges of the mixed pastureland.
- K5: Low Open Woodland of Melaleuca rhaphiophylla in waterlogged areas with Casuarina racemosa forma racemosa and Juncus subsecundus.
- K6: Low Open Woodland of Melaleuca rhaphiophylla and Eucalyptus rudis over Melaleuca viminea, Frankenia pauciflora and Halosarcia halpidosperma.
- K7: Halophytic Complex of Halosarcia halocnemoides subsp. halocnemoides, Halosarcia pergranulata, Halosarcia halpidosperma and Sarcocornia quinqueflora subsp. quinqueflora with scattered Casuarina obesa. Typha orientalis occurred on the edges of the open water with Cyperus eragrostis.
- K8: Low Woodland of Casuarina obesa over Juncus krausii subsp. australiensis.
- K8d: Sedgeland of Juncus pallidus with an abundance of introduced species.
- K9: Low Open Woodland of Melaleuca rhaphiophylla over Juncus subsecundus, Cyperus eragrostis and Centella asiatica.
- K10: Low Open Woodland of Melaleuca rhaphiophylla - Casuarina obesa over Halosarcia spp.
- K11: Woodland of Eucalyptus rudis, Melaleuca rhaphiophylla and Casuarina obesa over dense Cyperus eragrostis with patches of Juncus spp. and Halosarcia pergranulata. The introduced species Typha orientalis occurred on the edges of the open water.
- OW: Open Water
- CL: Cleared

Notes:
Cadastral and Topographic Data supplied by Department Of Land Administration.

Base Data supplied by Ministry For Planning

Horizontal Datum: AMG84 (Zone 50)
Vertical Datum: Australian Height Datum

0 250 500m
Scale

MINISTRY FOR PLANNING
WHITEMAN PARK

VEGETATION MAPPING
APRIL 2001

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1. OVERVIEW

This report by Mattiske Consulting Pty Ltd and M.J. & A.R. Bamford, is an expansion of the 1998 Concept Plan for Conservation and Recreational Precincts within Whiteman Park by the same authors. The present study re-assesses the Whiteman Park precinct boundaries and allocates precincts to the additional Whiteman Park areas using guidelines of the 1998 study (Mattiske Consulting Pty Ltd and M.J. and A.R. Bamford, 1998).

The significant expansion of Whiteman Park and development of surrounding public lands since 1998, has necessitated the revision of precinct boundaries in the Park (see Map 1). Whiteman Park's total area has been augmented to include Bennett Brook and Grogan Swamp and the adjacent IP8 area located west of Beechboro Road and Whiteman Park (see Map 1). Additionally, further land developments, such as roads and urban spread, have changed the characteristics and therefore precinct boundaries within the Park.

Map 1 delineates the following precincts within Whiteman Park. Conservation and recreational precincts place emphasis on the following characteristics for the definition of respective areas.

C1	**Conservation Precinct**	Protecting wherever feasible those areas of bushland which were least disturbed by previous grazing and recreational pressures in the Park.
C2	**Rehabilitation Precinct**	Protecting those areas of bushland which were only partly disturbed and which, with management, could be rehabilitated to increase the biological values on the areas through increased native species numbers and cover, and increased variety of fauna habitats.
C3	**Conservation Buffer Precinct**	Delineating a series of conservation buffer precincts to protect the adjacent values of drainage lines or provide fauna linkages to adjacent areas of native vegetation.
C4	**Recreational Usage Precinct**	Delineating particular parts of the Park which were mostly cleared or modified bushland areas for recreational activities.

2. BACKGROUND

A Concept Plan for Conservation and Recreational Zones within Whiteman Park was prepared by Mattiske Consulting Pty Ltd and M.J & A.R. Bamford (1998) by the review of recent biological studies and discussions with the Whiteman Park management team. The study allocated conservation precincts according to the conservation needs and characteristics of flora, vegetation and vertebrate fauna.

Precincts were defined by:

- previous botanical and zoological field investigations by the authors (E.M. Mattiske and Associates, 1989, Mattiske Consulting Pty Ltd 1995 a and b, 1996, Bamford, 1997);
- 1997 Whiteman Park Concept Plan report by the Western Australian Planning Commission defining the conservational values of the Park;

- 1998 Mattiske Consulting Pty Ltd and M.J. and A.R. Bamford Concept Plan for the

Conservation and Recreation Zones of Whiteman Park. The report outlines a plan for management practices within the different precincts recognising that flora and fauna species utilise and occupy different environments. Additionally, native bushland areas should be maintained as an integral part of the Park to provide the opportunity for people to experience nature first-hand.

As a result of this review and discussions with the park management team, a four level precincts was proposed for Whiteman Park.

C1: Conservation Precinct
C2: Rehabilitation Precinct
C3: Conservation Buffer Precinct
C4: Recreational Usage Precinct

Since Mattiske Consulting Pty Ltd & M.J and A.R. Bamford's 1998 report, the expansion of Whiteman Park and development of adjoining public lands has necessitated the revision of precinct boundaries in the Park (see Map 1).

The purpose of the present study is to reassess Whiteman Park precinct boundaries proposed in the 1998 Concept Plan and to allocate precincts to the additional Whiteman Park areas using the same guidelines of the 1998 study (Mattiske Consulting Pty Ltd and M.J. and A.R.Bamford, 1998).

2.1 Flora and Vegetation

The amalgamated Whiteman Park area occurs on the Drummond Botanical Subdistrict within the Southwest Province as defined by Beard (1990). Beard (1990) further describes the vegetation of the Bassendean area near Whiteman Park as mainly "*Banksia* low woodland on leached sands with *Melaleuca* swamps where ill-drained".

As described by Churchward and McArthur (1980):
"The Bassendean Dunes are represented by three landform-soil units which differ mainly in the nature of associated swamps. The Bassendean unit with peaty podzols in the swamps is separated from the Southern River unit, which occurs where sand appears to have been blown over the alluvial soils and so the swamps often have a clay base. The Caladenia unit has a pattern of low dunes and intervening discrete rounded permanent lakes. ..."

Whiteman Park occurs almost entirely along the interface of the Bassendean and Southern River soil units. Bennett Brook and Grogan Swamp comprise the most southerly section of the park that is located on the interface between the Bassendean Dunes and the Guildford unit of the Pinjarra Plain (Gozzard 1986). As a result of these differences in underlying soils, the vegetation differs on the three areas.

Heddle *et al.* (1980) produced a vegetation map at 1:250 000 scale, which defined vegetation complexes in relation to the landform-soil units determined by Churchward and McArthur (1980). The majority of Whiteman Park occurs on the Bassendean Dunes (Central and South) and Southern River Complex, with only Grogan Swamp encompassing the Guildford unit component of the Pinjarra Plain (Heddle *et al.* 1980).

The vegetation on the northern and north western parts of Whiteman Park is more typical of the communities on the Bassendean dune system with deeper sands supporting largely low woodlands of *Banksia* species, with open woodlands of Eucalypt species including *Corymbia calophylla, Eucalyptus todtiana* and *Eucalyptus marginata* on the lower lying shallower sands and with low open woodlands of *Melaleuca preissiana* and *Banksia littoralis* in lower lying seasonally moist swamps. The southern section of Whiteman Park, excluding Grogan Swamp, is more typical of the vegetation on the Southern River soil unit with woodlands of *Eucalyptus rudis* (flooded gum) – *Melaleuca rhaphiophylla* on the drainage lines that dissect the flatter unit. On the low-lying sand dunes that overly the alluvial soils, the vegetation is similar to the northern end of the Park with a low open woodland of *Banksia* species. The Grogan Swamp vegetation is largely characteristic of the Guildford vegetation unit. The banks and wet flats of the Swamp have a high clay content due to flows and deposition from Bennett Brook and comprise woodlands of *Casuarina obesa, Melaleuca rhaphiophylla* and *Eucalypus rudis* over sedges. The south eastern portion of the swamp supports a halophytic complex, while the elevated area west of the swamp supports *Banksia* species and *Corymbia calophylla* communities, which are more characteristic of the Bassendean dune system.

The majority of the northern section of the Park has been modified by grazing so that in parts the swamp vegetation is dominated by sedgelands and remnant trees of *Melaleuca* species on the wetland and dampland fringes.

The former IP8 area has been subject to past disturbance, largely in terms of weed invasion, particularly in the north and south. A considerable proportion of the Grogan Swamp and Bennett Brook area is weed infested, largely due to edge effects.

The flora and vegetation values of Whiteman Park have been studied previously by E.M. Mattiske and Associates (1989) and Mattiske Consulting Pty Ltd (1995, 1996, 2000, 2001). These studies have highlighted species richness values, the occurrence of introduced species and the occurrence of Priority species in the drainage lines. All these factors were used in delineating the conservation precincts in Whiteman Park.

2.2 Vertebrate Fauna

The fauna of Whiteman Park is representative of that which once occurred right across the Swan Coastal Plain north of Perth (Jackson *et al.* undated) and the great value of Whiteman Park is that it retains most of this fauna, whereas much of the general region has been developed and some or most of the fauna lost (Western Australian Planning Commission 1997). This fauna is part of Perth's heritage; conservation of this fauna is therefore akin to the role Whiteman Park plays in the protection of other heritage values, such as old cars and steam trains.

Fauna conservation within Whiteman Park has been achieved to the present time through a

policy of minimal disturbance to the main areas of native vegetation, a conservative fire regime and the control of Foxes. In the long term, however, fauna conservation needs to recognise that Whiteman Park is gradually becoming surrounded by urban development. It is therefore a large fragment of more or less natural habitats much like King's Park and Bold Park elsewhere in Perth.

Guidelines for fauna conservation in Whiteman Park, including the recognition of precincts for fauna conservation, can therefore be determined on the basis of experience gained in other bushland fragments within the urban area and on general fauna conservation principles within multiple-use landscapes. These guidelines can be used to determine the most appropriate boundary for the conservation precinct in Whiteman Park.

The fauna of bushland remnants within Perth has been studied quite extensively (eg. How and Dell 1989, 1990 and unpub., Turpin 1990, Wykes 1991 and Recher and Serventy 1991). These studies have focussed on terrestrial vertebrate fauna, but at least one current study (at Edith Cowan University) is being carried out into the persistence of terrestrial insects in urban bushland. Hay *et al.* (Undated) review the butterflies of the Perth area while Davis and Christidis (1997) provide a guide to the wetland invertebrates of the SouthWest. These provide some comments of relevance to the designation of boundaries for conservation precincts. There is also an extensive literature on the general principle of fauna conservation in fragmented landscapes (e.g. Harris and Scheck 1991, Margules *et al.* 1982 and Noss and Harris 1986).

Wetland Environments

Aquatic invertebrates are sensitive to changes in nutrient availability, turbidity, available light, seasonal fluctuations in water level, presence of introduced species (fish and some aquatic plants), salinity, water movement and structural complexity in their environment. Native fish and larval frogs (tadpoles) are also affected by these factors. Of native fish found in the Perth area, the Swan River Goby *Pseudogobius olorum* seems to be the most tolerant of alterations to its environment, while a number of the frog species (*Crinia* spp., *Litoria moorei)* are also tolerant. Some other frog species, such as *Heleioporus eyrei*, are sensitive to changes in the seasonal fluctuation of water levels.

Many of these environmental factors can be controlled only through broad management practices rather than by the designation of a boundary and are therefore beyond the scope of the present study.

Dryland or Upland Environments

A number of species of frogs in the Perth area are largely terrestrial, requiring wetlands only for breeding, and one species, the Turtle Frog *Myobatrachus gouldii*, also breeds terrestrially (Roberts 1981). They have been found to persist in disturbed upland environments as long as nearby wetlands are mostly undisturbed, but are adversely affected by barriers to movement, such as solid fencing. Cleared land is not a barrier to the movement of frogs (Bamford 1997).

Perth supports a very diverse reptile fauna and many species have been found to persist in small, degraded fragments of native vegetation. Species that tend not to persist are large carnivores that occur at a low density, such as the Carpet Python *Morelia spilota imbricata* and the goannas *Varanus gouldii* and *Varanus rosenbergi*. A number of species will survive

in fallow farmland but reptiles generally show poor dispersal through unfavourable habitat (Bamford 1997).

The persistence of birds in remnants of native vegetation within the urban landscape is complicated. Resident, insectivorous species tend to disappear even from large remnants such as King's Park due to factors such as: increased fire frequency, altered habitat due to weed invasion (Recher and Serventy 1991) and possibly due to increased mortality (Domestic Cats) combined with a small, isolated population (Paton 1991). Fairy-wrens, scrub-wrens, robins, whistlers and thornbills are included in this group, although species vary in their sensitivity. They persist in large reserves that are linked to other areas, the linkage presumably allowing for the movement of birds through the area. There are reports of some of these resident birds "island hopping" from one remnant to the next (J. Dell, pers. comm.).

Nomadic and migratory species of birds utilise bushland remnants. These species include most of the honeyeaters, the Silvereye and the Striated Pardalote. These birds will use degraded vegetation as they are often exploiting a simple resource such as nectar-bearing flowers. They will also visit non-native plants and vegetation along road reserves. These birds may not access Bushland remnants that are completely surrounded by unfavourable environments, but the presence of nearby favourable habitat can result in these sorts of birds being widespread.

Of all vertebrate fauna, mammals are the least able to persist in bushland remnants. Small, native mammals (such as the Noodji or Ashy-grey Mouse *Pseudomys albocinereus,* and dunnarts *Sminthopsis* spp.) disappear even from fringing woodland outside the urban area, possibly due to altered fire regimes and cats. The Honey Possum *Tarsipes rostratus,* which is much more mobile and has a more flexible reproductive system than the previous species, seems able to persist on the fringe but has not been recorded recently even in large fragments such as King's Park and Bold Park.

Small, insectivorous bats appear to be slightly better at surviving in urban areas than small, terrestrial mammals, but appear to be confined to the outer suburbs (Wykes 1991).

Of the larger mammals, the only species to persist within bushland remnants are the Rakali or Water-rat *Hydromys chrysogaster,* The Quenda or Southern Brown Bandicoot *Isoodon obesulus* and the Brush-tailed Possum *Trichosurus vulpecula.* The Western Grey Kangaroo *Macropus fuliginosus* survives in managed populations such as on some golf courses, but it and the Black-gloved Wallaby *Macropus irma* do not generally survive in isolated remnants. They do occur, however, where remnants are linked to large areas of native vegetation outside the urban area. For example, kangaroos still graze around Lake Goollelal in Kingsley, which is linked by the bushland fringe of Lake Joondalup to Neerabup National Park 10 km to the north.

The Brush-tailed Possum is unusual in that, like a few species of native birds, it can survive in true urban landscape without bushland remnants, although it tends to be common only in suburbs where such remnants do occur nearby. The Rakali requires more or less natural wetlands with natural fringing vegetation and corridors of habitat to enable animals to access suitable areas. It will, however, cross urban areas for at least distances of several hundred metres (M. Bamford pers. obs.). The Quenda requires dense, native vegetation, especially associated with sumplands and damplands, but will live in badly degraded vegetation and can

disperse along road verges with some vegetation cover. Both the Quenda and the possum are preyed upon by Foxes.

2.3 Principles for Conservation Precincts

On the basis of extensive field observations of Whiteman Park's flora and fauna, and experience in other bush remnants, a number of principles for conservation precincts were developed and applied at Whiteman Park. These principles include:

Areas of Proposed Precincts - the conservation precincts should be compact and as large as possible. Therefore, the boundaries of the conservation precinct should encompass as great an area of suitable habitat as possible, subject to other land uses and restraints.

Shape of Proposed Precincts - the conservation precincts should account for the variety within the landscape, drainage, edge effects and boundary/area ratios to maximise the potential to maintain the values within the precincts in the longer term. The conservation precinct should be a compact shape to minimise the relationship between edge length and area. This reduces areas of potential weed invasion and makes management, such as fencing, easier to carry out. Note, however, that guidelines such as the need for linkage and the need to conserve a variety of habitats may require shapes that are more difficult to manage. Within the Park, existing areas of less disturbed bushland with higher conservation values should be contained within the conservation precinct with the most economic shape possible.

Degree of Clearing - areas that are relatively uncleared were given a higher priority for retention within the proposed Conservation Precinct in the Park.

Degree of Disturbance - areas of native vegetation that are relatively undisturbed were given a high priority for retention within the proposed Conservation Precinct in the Park.

Vegetation Condition - vegetation that is healthy and with minimal weed invasion is preferable to degraded vegetation within the conservation precinct. Including degraded vegetation within the conservation precinct can present problems for management as this could lead to increased weed invasion of native vegetation. Degraded vegetation may require a considerable management commitment, so it needs to be important from a fauna conservation perspective to be included.

Diversity of Plant Communities, Fauna Habitats and Species - the conservation precinct should contain as much of the diversity of habitats contained within Whiteman Park as possible. In this case, it may be necessary to include some degraded habitats within the conservation precinct. For example, Horse Swamp and parts of Bennett Brook are badly degraded due to weed invasion, but even in that condition they make a valuable contribution to the biodiversity and linkage of the conservation precinct.

The Wetlands of the Swan Coastal Plain (DEP) - 50 and 200 metre precincts were considered in determining these linkage corridors not only for the protection of the flora and fauna values, but also the water resources.

Linkage with other natural areas - the conservation precinct should extend to the boundaries of the park wherever suitable vegetation exists and especially where native vegetation that is likely to be retained is present in adjacent areas. As noted above, areas within the park that are of conservation value should be linked. The areas of wetlands and drainage lines irrespective of the degree of disturbance were given a high priority for retention within the proposed

Conservation Precinct in the Park. This in part conflicts with considerations on shape and area. The linkages are particularly important for a lot of fauna, as population isolation is a problem particularly for some birds and mammals.

Bushland Forever Sites – these areas were considered significant due to the presence of regionally significant vegetation values documented in Bushland Forever (2000).

Fauna Utilisation of the different areas within the Park - the ability of some fauna species to utilize different disturbed and undisturbed communities and habitats was taken into consideration.

Edge Effects from adjacent Land Uses - the ability to protect and conserve the values in the respective precincts was taken into consideration. Adjacent land uses such as farming and the operation of steam engines have implications for the conservation precinct. In places where conflict might occur, a buffer precinct managed differently from the conservation precinct may be necessary.

Where livestock are present, it is probably most appropriate for the conservation precinct boundary to be fenced so as to allow stock to graze close to the native vegetation without damaging it, with a firebreak on the conservation precinct side of the fence Including a buffer of farmland within the conservation precinct in such situations would probably just encourage weed invasion in the conservation precinct. Close to wetlands, however, livestock should be excluded from the water's edge even if this means enclosing weeds within the conservation precinct.

Potential impacts of trampling and nutrient enrichment in pasture upon adjacent conservation areas need to be considered, however. If nutrient enrichment of Bennett Brook is a problem, then a buffer planted with vegetation that will capture some of these nutrients before they reach the water course may help. Where trains run close to the conservation precinct, a 50 m wide buffer for fuel reduction burns should be considered to reduce the potential of sparks causing fires in the conservation precinct.

The nature of adjacent land uses will also determine the sort of fencing required for the boundary. In many ways, no fence is preferable as it allows fauna to move unimpeded through the area. Where livestock are present, appropriate fencing for the type of stock will be required. Where people need to be regulated, a post and rail fence would be in harmony with the character of the park but might be prohibitively expensive for all but short sections.

It may become necessary to fence main roads to guide wildlife toward underpasses, such as has been carried out by Main Roads WA near Mt Barker and along sections of the Kwinana Freeway and Highway. MRWA has fence designs suitable for this purpose.

Balancing People and Conservation - this led to the rationalisation of the boundaries so that the impact of the people and recreational needs on conservation values in the central area and the southern drainage and wetland areas were minimised. Further the need to allow some recreational uses in the triangular area northwest of the Shooting Gallery was considered, however the biological values of the latter area were also stressed to the management team. The minimisation of impacts or any further clearing on the latter area should be considered through lease arrangements.

There is clearly some conflict between these guidelines, such as the need for the conservation precinct to have a compact shape, but also to link areas of conservation value. The actual application of these guidelines and the sorts of compromises that could be reached are discussed in the following selection.

3. DEFINITION AND DELINEATION OF PRECINCT CATEGORIES

3.1 General Application of Principles

The above observations on the persistence of flora, native vegetation and fauna in bushland remnants around Perth are generally consistent with observations made on the survival of flora, native vegetation and fauna in fragmented and multiple-use landscapes (e.g. Department of Conservation and Environment 1983, Noss and Harris 1986, Keighery and Trudgen 1992, Scheltema and Harris 1995, Mattiske Consulting Pty Ltd 1997, 2000, 2001).

In applying the principles defined in Section 2.3 it has been possible to conserve the maximum diversity of flora, native vegetation and fauna at Whiteman Park.

In addition some principles are management-oriented and therefore fire management, vehicle access, dieback disease hygiene measures and predator control have additional influences on the biological values in the Park.

Further, conservation doesn't have to stop at the boundaries of the conservation precinct has profound implications for the management of the rest of the Park.

A number of the guidelines have direct implications for the boundary of the conservation precinct. It is also worth noting that the principles do not apply to all of the species all of the time and that plant communities and therefore fauna habitats can be modified with changes in climatic conditions and seasonal conditions. When the aim is to conserve maximum biodiversity, then some species will make greater "demands" upon a site and principles should be applied for these species. Less demanding species should then be covered. In Whiteman Park, the most demanding of the species that are still present (or are believed to be present) are:

- most of the vascular plant species which may be influenced by aggressive weed invasions (e.g. Veldt Grass),
- the vascular plant species that may be influenced by changes in local hydrological conditions (drought or ground water extraction for other uses),
- the vascular plant species that may be influenced by the fungal species of *Phytophthora*,
- the vascular plant species that do not regenerate readily and that may be dependent on infrequent germination and establishment events,
- the native mammals (particularly the Noodji or Ashy-grey Mouse, the Black-gloved Wallaby and the Honey Possum),
- the resident, insectivorous birds, and
- some frog species dependent upon seasonal wetlands for the completion of their life-cycle, particularly the Moaning Frog – *Heleioporus eyrei*.

3.2 Specific Application of Principles to Whiteman Park

The proposed boundary for the conservation precinct is indicated on the accompanying map. Parts of the boundary follow those which already exist and much of the area enclosed is the already recognised conservation precinct which is a large area of good quality native vegetation. The boundary recognises conservation priority areas (minimal development and disturbance) and management areas which have conservation values that need to be protected, but where activities are already taking place (existing leases) or where some new activities wouldn't compromise the conservation values. The following sections provide an explanation on how decisions were made for the proposed boundaries.

Conservation Precinct between Park and Woolcott Streets

This area provides the maximum coverage of flora, vegetation and fauna on the Bassendean dune systems within the Park. This area includes a large range of vascular plant species and a variety of plant communities and therefore fauna habitats. The area is relatively difficult to access, except by foot along some old north-south tracks that dissect the block. It should be noted that some sections of this area are infected with the dieback disease caused by *Phytophthora cinnamomi,* particularly around swamps and damplands.

Conservation Precinct between Gnangara Road and Hepburn Avenue

In combination with the previous conservation precinct, this area further enhances the high range of flora, vegetation and fauna habitat on the Bassendean Dunes. The area is encompassed in the Bushland Forever Site 198. The southern section is healthy with high plant diversity. The southern border adjoins private residences and will require fencing to minimise edge effects.

The thin northern strip is part of an important fauna corridor, despite being fairly degraded. The entire western border is adjacent to extensive bushland owned by the Perth International Communication Centre, which links with Gnangara Lake bushland to the north. To the east of Gnangara bushland lies pine plantations managed by the Water and Rivers Commission, which may be rehabilitated back to bushland and tied in with the area to the proposed Gnangara Park. Planting and seeding programs will be required along the western edge to improve the conservation value of the area. If protected from grazing, the degraded understorey of the adjoining C2 precinct to the north east should readily regenerate.

Linkages to Gnangara Road and Hepburn Avenue Conservation Precinct
The degraded C3 precinct to the east of the above conservation precinct represents seasonal wetlands and Bassendean Dune vegetation within Bushland Forever Site 304. This area also acts as a buffer between the degraded parkland and the conservation precinct. By limiting public access via fencing, wetlands could be much improved. The C3 buffer and Bushland Forever Site 198 encompass the Cullacabardee Aboriginal Village. The bushland is in good to moderate condition and has experienced some clearing and modification around the village. To improve vegetation condition, the private property should be fenced, access limited to one track, and environmental management programs carried out by the Park management team in conjunction with the Village.

Northern Potential Corridors across Gnangara Road
Linkage towards Gnangara Road and the proposed Gnangara Park. This area requires rehabilitation but already supports a range of native species and, if protected from grazing, could regenerate readily with only minor effort as some overstorey and dominant species persist in the area. This area also readily supports a wide range of fauna species. High ground in this area will make it possible to create an under pass for fauna such as Quendas when Gnangara Road is upgraded. The Perth-Darwin Highway will form the eastern edge of both Whiteman Park and the Gnangara Park at this point. Within the former IP8 area, the degraded C2 precinct (encompassing private land) adjoining Gnangara Road has been proposed as an additional Bushland Forever Site. A comprehensive rehabilitation effort could protect the bushland's integrity from private usage and enable it to act as a wildlife corridor across Gnangara Road. Just to the south lies another C2 precinct supporting vegetation in good condition but surrounded by cleared lands. This vegetation should be maintained via periodic rehabilitation as it acts as a fauna linkage with the northern C2 precinct.

Eastern Linkages towards vegetation East of Proposed Perth-Darwin Highway
Linkage towards native vegetation east of the Proposed Perth-Darwin Highway will be limited due to the large size of the proposed development. Along the south eastern corner of Whiteman Park a wildlife underpass will be required under the proposed Darwin to Perth Highway This is primarily a corridor linkage for native fauna as the majority of the native vegetation on the eastern fringes of the Park have been modified by grazing and clearing.

If grazing was ceased in this corridor many of the native species could be returned rapidly by seeding and planting. The latter work could be undertaken with local schools and friends groups under supervision.

Rationalisation of Eastern Fenceline within the Park

Rationalisation of fence-line at eastern end of Park Street to make an even edge. The boundary could either exclude a small area of native vegetation from the conservation precinct, or it could included this area and some adjacent pasture. This may depend upon the potential for weed invasion into the conservation precinct from this area of pasture. Active weed control and seeding with local native species will be required on this interface area.

Between Archery Field and Beechboro Road
The native vegetation between the Archery Field and Beechboro Road is in very good condition, supports a particularly high density of Black-gloved Wallabies and is in a position where it could act to link the conservation precinct to parts of the proposed Gnangara Park.

Although leased as part of the Archery Park, the significance of this area should be recognised in some way. For example, future developments should minimise any further disturbance of the native vegetation within the lease and no further clearing of native vegetation should be undertaken in this area.

West of Beechboro Road and North of Marshall Road
The native vegetation in this pocket is in good condition and supports a variety of site vegetation types including wetland communities. It is surrounded by cleared lands that are particularly weedy, and consequently active rehabilitation of this bushland will be required to remove weeds, improve the structure and function and protect the integrity of this area.

Linkage South of Woolcott Street to Bennett Brook
It is important that this linkage not be constricted or broken by the two development nodes of the Village and the Youth Camp. This area provides a range of wetlands and corridors for fauna movement. The linkage of the Bennett Brook Conservation Area to the Swan River is separated by a piece of private land. Conservation efforts by private owners, in conjunction with Park staff, would minimise down stream weed invasion and bushland fragmentation.

Bennett Brook Extension of the Conservation Precinct
Bennett Brook extension of the conservation precinct encompasses the main block of riparian vegetation associated with Bennett Brook south of Woolcott Street. It includes narrow arms of native vegetation which encompass wetlands as these habitat types are poorly represented elsewhere in Whiteman Park.

Wetlands in these areas are probably the main breeding sites for many species of frogs for which adjacent paddocks would not be a barrier for movement. Some of the seasonal wetlands may also be potential release sites for the priority Black-striped Jollytail or Minnow *Galaxiella nigrostriata.* An isolated population of this species is known from a single wetland to the north of Whiteman Park. Fencing of these areas should incorporate the remnant native vegetation areas, the seasonal wetlands and any proposed rehabilitation areas. Such a buffer could also be valuable for nutrient stripping. Livestock should be excluded from the brook even where the vegetation is currently degraded; rehabilitation of such degraded sections should take place.

These riparian areas also have conservation values for the vascular plant species through the presence of a Priority species – *Cyathochaeta teretifolia* (Mattiske Consulting Pty Ltd 1996).

Conservation Precinct - Grogan Swamp and Bennett Brook south to the Swan River
This area forms part of the Bushland Forever Site 305 and is part of contiguous and fragmented bushland/wetland linkages. Plant communities surrounding Grogan Swamp are largely in good condition, particularly in seasonally or permanently inundated areas due to

lower potential for weed invasion. The adjoining Bennett Brook is badly degraded but still displays important conservation values. For example, existing flooded weeds provide shelter for native fish. Bennett Brook's poor condition is due to the adjacent pastureland, close proximity of public recreation areas and domestic gardens, and vehicle tracks that have caused physical disturbance and spread of weeds. A large portion of this area will require remedial management to restore the structure and function of degraded areas, and to protect the good condition of existing remnant areas. If grazing was ceased and vehicle access restricted in Bennett Brook and associated wetlands, many of the native species could be returned rapidly by seeding and planting. The latter work could be undertaken under supervision with local schools and friends groups. Weeding could be carried out by Park staff and volunteers. To the west and east of Grogan Swamp, buffer precincts to industrial and private aim to minimise physical disturbance and weed infestations within this conservation area.

Management Conservation Precinct alongside Bennett Brook
This management conservation precinct alongside Bennett Brook would permit low impact developments and could be a focus for rehabilitation. It is an area of upland habitats that visitors could access easily.

Conservation Precinct around Mussel Pool
The area around Mussel Pool is significant as one of the two substantial areas of permanent water in the park; it is part of the link from native vegetation in the north of the park to the narrow corridor that extends along Bennett Brook to the south. The development of recreation facilities around Mussel pool should consider its value for conservation.

Development and Recreational Precincts
Native vegetation within the development region of the park has value for some tree species and selected persistent plants and fauna that utilise these modified habitats. Therefore, there should be a general policy of retaining and rehabilitating such vegetation where possible.

4. CONCLUSIONS

As a result of this review and discussions with the park management team, a four level precincts was proposed for Whiteman Park (see map attached):

C1: Conservation Precinct

These areas included:

- the main relatively undisturbed areas,
- the areas with high species richness,
- the areas with lower levels of disturbance in the understorey and overstorey,
- the areas with lower levels of weed invasion,
- the areas with intact fauna habitats and
- the areas with high plant community diversity.

C2: Rehabilitation Precinct

These areas included:

- some disturbance, although the degree of disturbance is still moderate and the integrity of the communities remains relatively high,
- the areas with moderate species richness,
- the areas with moderate levels of disturbance in the understorey and overstorey,

- the areas with low weed invasion, and
- the areas that with management could be rehabilitated to increase the biological values on the areas, through increased native species numbers and cover, increased variety of fauna habitats

C3: Conservation Buffer Precinct

These areas include:

- substantial disturbance either through regular burning and or grazing,
- the degree of disturbance is relatively high, however there is generally an overstorey present and with active rehabilitation may be returned potentially to a C2 category,
- the drainage lines with associated vegetation,
- the areas with low to moderate species richness,
- the areas with moderate to high levels of disturbance in the understorey and overstorey, and
- the areas with higher level of weed invasion.

C4: Recreational Usage Precinct

These areas include:

- substantial disturbance either through regular burning and or grazing,
- the degree of disturbance is high to very high,
- the areas with low species richness,
- the areas with high levels of disturbance in the understorey and overstorey,
- the areas which were mostly cleared or modified bushland areas for recreational activities, and
- the areas with higher level of weed invasion.

The exceptions to the latter included the partly disturbed areas of bushland north-west of the shooting gallery facilities and south of the main settlement. Any modifications to these two areas should consider the inherent values of the native vegetation cover in these respective areas.

5. LIST OF PARTICIPANTS

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Whiteman Park and Contiguous WAPC Landholdings

Strategic Opportunities Analysis

and

Financial Feasibility Study

Executive Summary

by

Synectics Creative Collaboration, Canberra
Jones Coulter Young Pty Ltd, Perth
Tract (WA) Pty Ltd, Perth
Creating Communities, Perth

December 1998

BROOK

CYRENIAN HOUSE REHABILITATION CENTRE

TELSTRA OVERSEAS COMMUNICATIONS

POSSIBLE FUTURE TELSTRA BUFFER ZONE

POSSIBLE FUTURE WATER SENSITIVE DEVELOPMENT/USE

WHITEMAN PARK CONSERVATION ZONE (PREVIOUSLY I.P.8 WEST)

LAKE FARM SPECIAL RURAL (EXISTING)

CULLACABARDEE ABORIGINAL HOUSING ESTATE

POSSIBLE FUTURE WATER SENSITIVE DEVELOPMENT/USE

POSSIBLE FUTURE WATER SENSITIVE DEVELOPMENT/USE

(SUBJECT TO OUTCOME OF JOINT WRC & MPP GROUNDWATER STUDY)

SOUTHERN DEGRADED FARMING LAND SUITABLE FOR REZONING & DISPOSAL

(NOTE: PROCEEDS FROM DISPOSAL OF THIS LAND SUPPORT FUTURE CONSERVATION & DEVELOP OF THE PARK)

WESTERN AUSTRALIAN SHOOTING ASSOCIATION

ALIENATED LAND - SUITABLE FOR DISPOSAL

EXISTING GRAZING LAND - SUITABLE FOR WATER SENSITIVE USE

WHITEMAN PARK CONSERVATION ZONE

BIG TOWN

INDOOR/OUTDOOR EVENTS COMPLEX

INDIGENOUS CULTURAL/ EDUCATION CENTRE

EXPANDED WHITEMAN PARK TOURIST VILLAGE

EDU-POLIS (GROUP OF TERTIARY EDUCATION CAMPUS AND SUPPORTING SERVICES)

RETREATS/SHORT STAY ACCOMMODATION

FUTURE PERTH/DARWIN HIGHWAY.

FUTURE N/E CORRIDOR RAIL LINK

BENNETT BROOK RESERVE

RIVER

WESTERN AUSTRALIAN PLANNING COMMISSION

WHITEMA

Strategic

December 1998

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Whiteman Park: No longer one of Perth's best kept secrets

1.0 Executive Summary

Strategic Issues

The *Strategic Opportunities Analysis and Financial Feasibility Study for Whiteman Park and the contiguous WAPC Landholdings* examined three (3) strategic issues in relation to Whiteman Park and the adjacent land owned by the WAPC, being:

- What is the highest and best future use for Whiteman Park and the 1,570 hectares of land owned by the WAPC adjacent to the Park?
- Can Whiteman Park develop the potential to operate on a financially self-sufficient basis, given a set of reasonable options for future development? and
- The future management structure and legislative requirements for Whiteman Park.

Through consultation and assessment this Study identified a package of Development Options for implementation at Whiteman Park that would, in conjunction with the existing infrastructure, give the Park the potential to operate on a financially self-sufficient basis.

Priority Development Options

The nine (9) Priority Development Options established during the stakeholder consultation process are:

1. *Marshall Road Precinct:* Urban Development Potential - Rezoning and Disposal
2. *Education:* a Cluster of Educational Campuses and Supporting Communities and a Horticultural/Agricultural Education Centre - Midland TAFE and Lockridge Agricultural High School
3. *International Indigenous Education and Cultural Centre:* International Indigenous Hub / Corroboree-Community for Indigenous Cultures
4. *Events Infrastructure:* Improved 'Events' Infrastructure, including a Convention Park, Professional Sports Facilities and Export Gaming, Showgrounds and Gloucester Park Relocation, Major Events and a Sound Stage
5. *Rebadging:* Gnangara Park and the Coastal Walking Trail with a New Commercial Front Door to Whiteman Park and Gnangara Park and Regional Linking
6. *Retreats:* Community Recreation, Tourism and Natural Systems
7. *Water Features:* Water Aquifer Attraction with Water Management - Albion Town
8. *Management Systems:* Whiteman Park and other IP8 Land Management Systems
9. *Funding and Financing:* Funding the Future - Process Options

In addition to these Priority Development Options the WAPC and the Ministry for Planning had earlier identified a number of additional priority development options for further consideration including the *Heritage Transport Centre* and *Wildlife Park*. Recommendations are made as the timing and scale of development of these two initiatives.

Impacts of Priority Development Options

The Priority Development Options contain a package of initiatives that fall into three (3) groups of impacts;

1. Options which have significant potential to raise funds for re-investment in Whiteman Park such as the rezoning and disposal of the *Marshall Road Precinct,* the development of a family accommodation enterprise within the *Retreats* option for sale as a going concern, the sale of fill to Albion Town in the *Water Features* option and the leasing of land to Telstra in the *Funding and Financing* option.
2. Options which have potential to provided a small cashflow from lease and/or licence revenues, however they provide substantial social, community and environmental benefits as well as wider economic benefits such as the *Education Cluster* option, *the International Indigenous Education and Cultural Centre* option, the Aquifer Water Attraction in the *Water Features* option, and the *Heritage Transport Centre* and the *Wildlife Park.* These activities would all attract additional visitors to Whiteman Park and substantially increase the economic sustainability of the existing enterprises and activities in the Park.
3. Options which have a significant cost to Whiteman Park, such as the *Events* option for the provision of support infrastructure, however, this seed funding pales into insignificance compared to the private sector funding it can attract and the impact this would have on visitor numbers to Whiteman Park and its overall revenues.

A New and Expanded Whiteman Park

The Study concluded that Whiteman Park should expand and redefine its boundaries by incorporating Bennett Brook to its confluence with the Swan River. The Park should also expand over the balance of the IP8 Lands (except for the urban development south of Hepburn Avenue and the Lakefarm Special Rural area) to facilitate the implementation of the Priority Development Options and to enable more effective and efficient land management practices over this strategically important landholding.

Strategic Plan

The Study developed a *Strategic Plan for Whiteman Park* to help guide the implementation and on-going operation of the Preferred Development Options. It will also provide a framework for the operations of the existing enterprises and activities in the Park and the other future activities and options that have and will continue to emerge for assessment by Whiteman Park management. Whiteman Park's Mission Statement is:

> *To create a world-class Metropolitan Park through innovative and economically-sustainable:*
>
> - *expansions and enhancements of the natural, cultural and heritage resource base of Whiteman Park; and*
> - *integration of Whiteman Park with its regional setting and its local, national and global markets.*

The Strategic Plan sets out six (6) goals for the development of Whiteman Park:

Goal 1: Deliver World-Class Metropolitan Park Status

To create a world-class, economically-sustainable Metropolitan Park that integrates social, cultural, heritage, recreational, educational, built and natural environments.

Goal 2: Enrich Bush Experiences

To enhance the understanding of residents and visitors to Perth of the 'bush experiences' of regional, rural and remote Western Australia, past, present and future.

Goal 3: Create a Place for All Seasons

To create natural environments providing welcoming retreats from summer heat and an overall sense and spirit of place delivering a diversity of experiences that compels the residents of Perth and its surrounds to visit often throughout the year.

Goal 4: Increase Metropolitan Self-Containment

To contribute significantly to increasing the efficiency and productivity of metropolitan Perth by providing a major and rapidly growing source of employment for neighbouring towns and suburbs.

Goal 5: Link to Global and Regional Markets

To link Whiteman Park with increasing effect to global markets, the urban Park system of the northern metropolitan region, and the realisation of aspirations of the businesses and residents of neighbouring towns and suburbs.

Goal 6: Deliver Innovative Funding and Financing

To identify, specify and deliver the range of innovative funding and financing packages to implement "core-business" Development Options to a scale that will stimulate, and as required induce, the private sector to invest in implementing the projected Development Options as a whole.

Implementation Plan and Financial Feasibility Memorandum

The Study produced an Implementation Plan including schedules and sketches and maps for the staged introduction of the Portfolio of Priority Development Options and enabling physical infrastructure for a ten-year period. The Implementation Plan also contained an assessment of the Financial Feasibility of delivering the Implementation Plan.

Each Development Option was considered with respect to the actions required to implement it, the responsible stakeholders, the timing for these actions, the potential source of funding, and an estimate of the initial development costs and the operating costs. The cashflows to Whiteman Park were also estimated for each Development Option. A conclusion for each Development Option provided a succinct expression for the way forward.

The Financial Feasibility assessment drew the individual Development Options together to consider the financial feasibility of delivering the Implementation Plan as a package of Development Options.

Cross Subsidisation

The Financial Feasibility assessment indicated that the package of Priority Development Options have a positive Net Present Value overall and in each year except Year 1. On this basis the surplus funds can be diverted to the existing Park enterprises and activities and towards the costs of Park operations.

Individually, a number of the Development Options are very viable while others are marginal or may be provided for their non-financial benefits to the Park and the community. However, as a package, the more viable ones provide the necessary cross subsidisation to develop the optimum mix of activities and infrastructure for an expanded and 'new' Whiteman Park.

This cross subsidisation between Development Options will enable activities that would, individually, be un-viable and unsustainable, to be provided within the Park for the benefit of the Western Australian community.

The activity generated by the Development Options when established will have benefits for the existing enterprises and activities in the Park as they will be more viable as a result of increased visitor numbers to the Park.

Institutional Arrangements

Fundamental to the delivery of the Implementation Plan are the Institutional Arrangements for Whiteman Park. As the new and enlarged Whiteman Park prepares itself to plan and implement the various Development Options it must operate within a 'best practice' management framework.

Creation of an independent entity or authority with powers to operate at a profit, and retain any profit for re-investment in the Park, would mean that Whiteman Park is operated in the same manner as most other major public venues in Australia.

The Implementation Plan contains a series of recommendations for consideration by the Whiteman Park Board of Management, the Ministry for Planning and the WAPC regarding changed Institutional Arrangements for Whiteman Park.

These recommendations are based on the Study Team's assessment of park management systems around the world but shaped to reflect the needs and potential of an expanded Whiteman Park.

Whiteman Park Development and Management Master Plan

The melding of the Development Options into the Park in a seamless manner requires the establishment of planning and landscape goals that are consistent with and complement the goals established in the Strategic Plan.

Consequently, there is a need to develop a Master Plan for Whiteman Park. It should incorporate the findings of previous studies and take account of the impacts of current projects and proposals.

To this end the Study Team prepared a *Consultant's Brief* to prepare the *Whiteman Park Development and Management Master Plan.* This Master Plan will provide a practical and workable framework for the future development and management of the package of Development Options at Whiteman Park in conjunction with the existing Park infrastructure and activities.

Conclusion

Whiteman Park and the contiguous WAPC landholdings are important regional recreational and conservation resources for metropolitan Perth. These landholdings, located between the North West and North East urban corridors, will provide an increasing contribution to the needs of the growing urban population, over time.

This Study identified and analysed strategic opportunities for the landholdings taking account of existing and future recreational and other requirements of the community. The Study Outputs included realistic recommendations regarding the future management and use of Whiteman Park and the contiguous WAPC landholdings including the expansion of Whiteman Park to take in all the IP 8 Lands, other than the Lakefarm Special Rural area and the urban development south of Hepburn Avenue. It also recommended including Bennett Brook to its confluence with the Swan River.

Overall, the recommendations made are flexible and have the capacity to respond to current and future economic, social and environmental development opportunities for the landholding. The strategies and policies put forward are forward looking, and take into account the likely economic climate and regional perspective over the Study's thirty (30) year planning horizon, and with the Implementation Plan and proposed Whiteman Park Development and Management Master Plan set within a ten (10) year development framework.

Whiteman Park: No longer one of Perth's best kept secrets

WHITEMAN
EXECUTIVE SUMMARY
DOCUMENT 1

Document 1
EXECUTIVE SUMMARY
(This document)

■

VOLUME ONE

Document 2
Master Plan Report

Document 3
Corporate Plan

■

VOLUME TWO
WORKING PAPERS

Document 4
Action Plans

Document 5
Development Plan
10 year outlook

Document 6
Whiteman Development Trust

Document 7
Public and Media Statements

Document 8
Design Guidelines

Document 9
Traffic Study

Document 10
Consultation Report

■

EPCAD CONSULTANTS
AUGUST 2000

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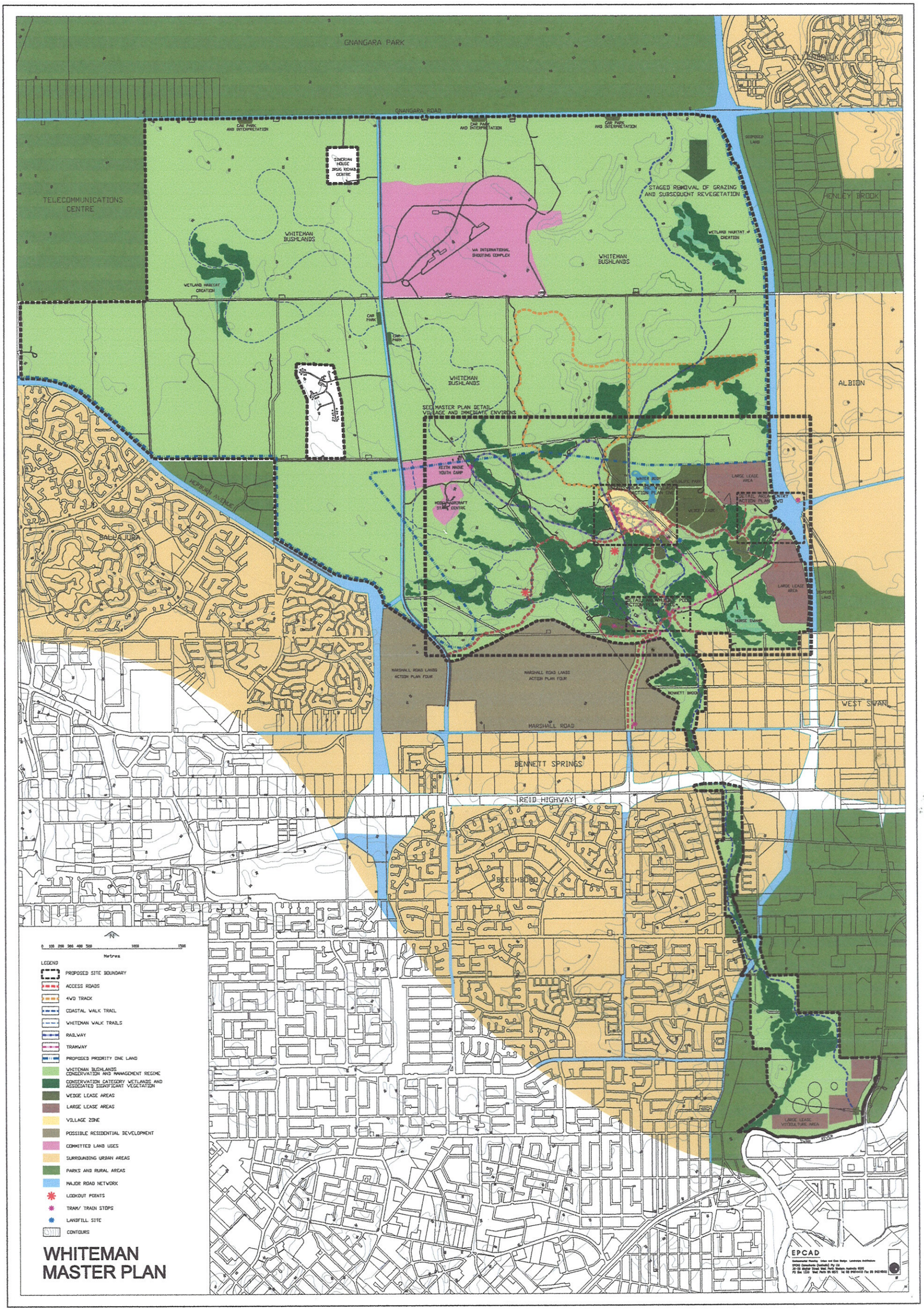
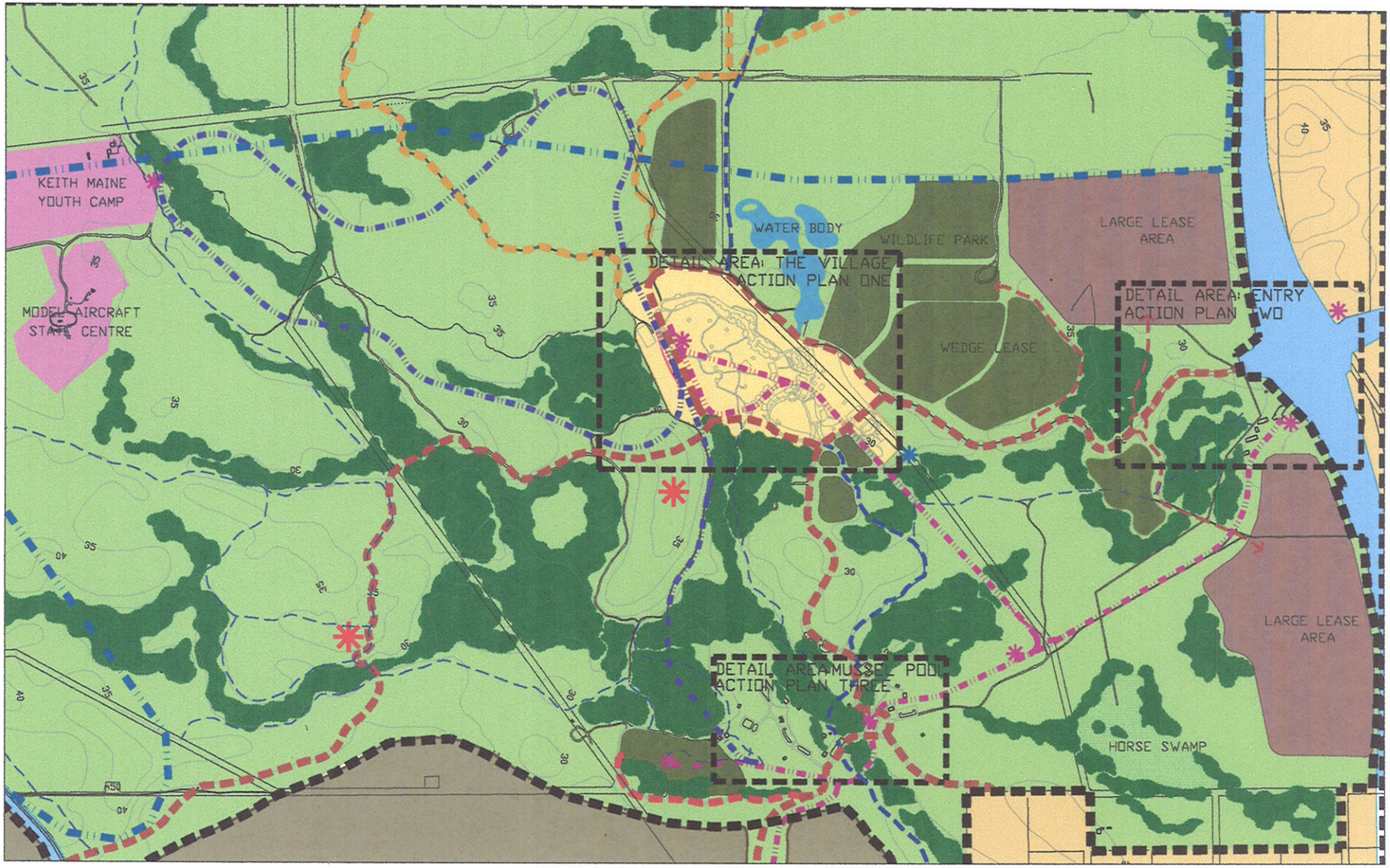

GNANGARA PARK
GNANGARA ROAD
ELLENBROOK
TELECOMMUNICATIONS CENTRE
CAR PARK AND INTERPRETATION
GINGIRAN HOUSE DRUG REHAB CENTRE
WHITEMAN BUSHLANDS
WETLAND HABITAT CREATION
WA INTERNATIONAL SHOOTING COMPLEX
STAGED REMOVAL OF GRAZING AND SUBSEQUENT REVEGETATION
HENLEY BROOK
DISPOSED LAND
CAR PARK
SEE MASTER PLAN DETAIL VILLAGE AND IMMEDIATE ENVIRONS
ALBION
KEITH MAINE YOUTH CAMP
HOVERCRAFT STATE CENTRE
HEPBURN AVENUE
BALLAJURA
WATER BODY
PUBLIC PARK
WEDGE LEASE
LARGE LEASE AREA
DETAIL AREA STRUCTURE PLAN
MARSHALL ROAD LANDS ACTION PLAN FOUR
BENNETT BROOK
MARSHALL ROAD
WEST SWAN
BENNETT SPRINGS
REID HIGHWAY
BEECHBORO
HORSE SWAMP
LARGE LEASE VITICULTURE AREA
SWAN RIVER
N
0 100 200 300 400 500 1000 1500
Metres
LEGEND
PROPOSED SITE BOUNDARY
ACCESS ROADS
4WD TRACK
COASTAL WALK TRAIL
WHITEMAN WALK TRAILS
RAILWAY
TRAMWAY
PROPOSED PRIORITY ONE LAND
WHITEMAN BUSHLANDS CONSERVATION AND MANAGEMENT REGIME
CONSERVATION CATEGORY WETLANDS AND ASSOCIATED SIGNIFICANT VEGETATION
WEDGE LEASE AREAS
LARGE LEASE AREAS
VILLAGE ZONE
POSSIBLE RESIDENTIAL DEVELOPMENT
COMMITTED LAND USES
SURROUNDING URBAN AREAS
PARKS AND RURAL AREAS
MAJOR ROAD NETWORK
LOOKOUT POINTS
TRAM/ TRAIN STOPS
LANDFILL SITE
CONTOURS
WHITEMAN MASTER PLAN
EPCAD



WHITEMAN: MASTER PLAN DETAIL

VILLAGE AND IMMEDIATE ENVIRONS

LEGEND
EXISTING BUILT FORM
INDICATIVE LAYOUT OF BUILT FORM
KEY ELEVATIONS TO ADDRESS PUBLIC SPACE
POTENTIAL BUILDING ENVELOPE
PROPOSED CAVERSHAM WILDLIFE PARK
WHITEMAN VILLAGE
ACTION PLAN ONE
GHANDARA MOUND INTERPRETATION CENTRE
WATER BODY
WAREHOUSE/ STORAGE AREA
EXHIBIT AND WORKSHOP AREA
COVERED PLAZA TO CAR PARKING
APRON AREA
EXHIBIT AREA
EXISTING NATIVE VEGETATION
EXHIBIT AND WORKSHOP AREA
OUTDOOR POOL AND BEACHES
LOCAL PARKING FACILITIES
EQUESTRIAN CENTRE
PHASE 2
PHASE 1
ADVENTURE PLAYGROUND
HILLTOP LOOKOUT
POTENTIAL MANAGEMENT COMPOUND
TO LORD STREET
CONTROLLED CROSSING
EXISTING WETLAND AREAS
EXISTING WETLAND AREAS
TO MUSSEL POOL
TO MUSSEL POOL AND ALTONE ROAD
TO BEECHBORO ROAD
N
EPCAD

GLOSSARY OF TERMS

Boulevard	The proposed, direct link between the existing town square and the village railway station.
Tourist Precinct	The area identified, surrounding the village nucleus, which comprises tourist attractions and activities within the Whiteman bushlands, for both active and passive recreation. This includes the wedge leases, Mussel Pool, picnic sites and sports facilities. The extent of the precinct is shown in the Master Plan Report. (Document 2; Volume Two)
Town Square	Area in front of the existing Town Hall
Village Square	Proposed area in front of the existing westernmost street building
Vernacular	Style or materials indigenous to the local area.
Whiteman	The overall area (previously referred to as Whiteman Park) contained within the extended site boundary. See the structure figure in Section 3.0 of the Master Plan Report (Document 2; Volume Two)
Whiteman Bushlands	Comprises mainly the native bushland area, but also includes the Bennett Brook Reserve Linear Park and Large Lease Areas. Marshall Road lands are excluded. See the structure figure in Section 3.0 of the Master Plan Report (Document 2; Volume Two)
Whiteman Village	Area identified as the commercial nucleus within the Whiteman Bushlands and as shown in Figure 1 of the Design Guidelines (Document 8; Volume Two) and detailed in Action Plan 1 (Document 4; Volume Two)

1. INTRODUCTION

The Whiteman Master Plan has been prepared to guide the development of the extended Whiteman over the medium to long term (up to 10-12 years). The Master Plan Report is structured into two volumes. Volume One contains an overview of the plan, its key elements and describes how it relates to the SOAFF study Priority Development Options. Volume Two, Working papers, include Action Plans, the Development Plan, Whiteman Development Trust structure, recommendations for Public and Media statements, Design Guidelines and Traffic Study.

The vision for Whiteman to be achieved by the Master Plan is;
the development of a metropolitan park, providing attractions and facilities of the highest standards for the Perth population and tourists.
This is consistent with the principles formulated and adopted in the earlier SOAFF study.

2. OBJECTIVES AND TERMS OF REFERENCE

The development of the Master Plan has been guided by objectives and desired outcomes that have been established and refined through the course of its development. These objectives should be made explicit and formally adopted by the Board as a point of reference to guide detailed planning and implementation. The overall aims of the implementation of the Master Plan have been accepted as:

- To develop Whiteman as a high quality and accessible resource;
- To maintain and enhance conservation values of the Whiteman area;
- To develop commercial activity within Whiteman Village to enable it to be financially self-sufficient in the long term;
- To enable disposal of land surplus to Whiteman requirements to create a capital fund.

The Master Plan defines five key land use areas:

- WHITEMAN BUSHLANDS
  Activities and Characteristics
  Diverse habitat management.
  Long term revegetation, habitat creation & environmental enhancement.
  Fire management.
  Controlled enhanced access.
  Restricted committed lease areas.
  Short stay accommodation.

- WHITEMAN VILLAGE AND TOURIST PRECINCT
  Activities and Characteristics
  A viable village with a mix of retail, commercial, attractions, recreation and accommodation.
  Contains consolidated Transport Heritage Centre.
  Significant upgrade of services infrastructure.
  Creation of an adjacent major water body and wetlands

- BENNETT BROOK RESERVE LINEAR PARK
  Conservation corridor.
  Community involvement.

- MARSHALL ROAD LANDS
  Simultaneously a buffer and an integration with suburban development to the south.

Encourage complementary and linked activities to the Tourist Precinct.
Provides capital base for long term financial self sufficiency of Whiteman.

- LARGE LEASE AREAS
  Avenue for future institutional uses.

3. MASTER PLAN IMPLEMENTATION – KEY RECOMMENDATIONS

A number of strategies are to be utilised to realise the development objectives, these form key recommendations;

- Increase access routes, in particular from the south-west and drop entry fee;
- Significantly upgrade the function of the village so that it becomes a commercially viable, desirable destination with a 24 hour-a-day site presence, a choice of activities and attractions, retail opportunities and accommodation as a centre for experiencing the wider locality;
- Accept that the majority of Whiteman land is retained as a conservation area and subject to long term enhancement measures;
- Create a special Tourist Precinct in the southern part of the site, incorporating the village, lake, Wildlife Park, Mussel Pool area and adjacent tourist orientated development;
- Upgrade services provision to enable development;
- Rezone and dispose of Marshall Road Lands;
- Create a water attraction adjacent to the village;
- Restructure management to focus on the separate activities of the Whiteman bushlands and the village;
- Establish and initiate transition strategy to achieve change;
- Establish a new identity for Whiteman as two distinct elements, Whiteman Bushlands and Whiteman Village; and
- Create a Transport Heritage Centre, consolidating disparate existing workshops and collections.

To follow through the key recommendations, several major initiatives are required:

3.1 Management Structure

- Move to transfer ownership of the land to a Trust directed by a small and specifically skilled Board of Trustees;
- Separate Whiteman and Village management: Whiteman Bushlands Management would be responsible for the overall operations of Whiteman land, focussing on conservation measures, interpretation and enhancement of the natural assets and provision and management of access. Whiteman Village Management would be responsible for the commercial operations of the Whiteman Village and Tourist Precinct operations. This latter function may be considered appropriate for "contracting out" dependant on further advice being obtained on the disposal of land in the Village area.
- Review staffing levels and the level of contracted-out services to ensure they are appropriate for the modified requirements; and
- Initiate appropriate transition strategy, attending to infrastructure initiatives, appropriate zoning, marketing initiatives, leasing arrangements, relationship with volunteer groups, access management, carparking management, location of major events and fire management.

3.2 Management Tools

To enable a coordinated approach to development and presentation of Whiteman, three main tools need to be used;

- Design Guidelines (refer to Document 8; Volume Two);
- Style Manual (collection of standard detailing and materials);

- Action Plans (detailed plans for identified projects and areas, refer to Document 4, Volume Two)

It is important that all changes within Whiteman are managed professionally to ensure the creation and reinforcement of a Whiteman identity.

3.3 Infrastructure

Upgrading and changing road and service infrastructure is an essential step. Key infrastructure projects and their timing are summarised below. This timing is dependent upon availability of funds for its construction. In summary, the major stages in Whiteman development are:

- Improve village access by the construction of new access roads. This is the most significant initiating step. Upon completion of at least one new access road, gate charges can be dropped. This will be the appropriate time for the major public launching of the Whiteman's new direction with sufficient funds that could be scheduled for mid 2001;
- Undertake village enhancement projects;
- Commence Whiteman bushland upgrade and re-vegetation projects; and
- Upgrade village services. This is a pre-requisite for the development of new lease areas and the provision of overnight accommodation on the village. Until that time, only development of some of the 'wedge' leases and limited expansion of village operations is possible.

3.4 Appropriate Zoning

MARSHALL ROAD LANDS

The Marshall Road lands have been previously identified as not essential to the operations and integrity of Whiteman and suitable for disposal for development. Development on the land will require changes to the MRS and to the City of Swan Town Planning Scheme.

Any development on the Marshall Road lands must complement and support the Whiteman proposals. The opportunity exists for the Marshall Road lands to incorporate development that is unique to this location and is an integrator and a buffer between Whiteman and the suburban development to the south

Appropriate zoning changes have to be obtained for development on the land and the planning and environmental review process does not confer any level of certainty. Any sale to the private sector before these changes are in place, will take account of this uncertainty and substantially discount the land value. Therefore, to optimise sale value, MRS and City TPS changes should first be obtained.

WHITEMAN VILLAGE

Whiteman is currently reserved "Parks and Recreation" under the Metropolitan Region Scheme. The Master Plan indicates a range of uses that may be outside of the allowable uses under that zoning, but within the needs of a vibrant tourist and recreation precinct that serves both the local community and the broader market.

There may prove to be some reluctance to fully develop the village as defined in the Master Plan and incorporate some of the uses required to

realise the development strategy under this zoning lest it sets a precedent for other P & R areas. There is precedent for individual projects (for example, a restaurant or craft centre) within the current zoning. However, any institutional or educational uses would probably require the introduction of a special purposes zone. Although precedents exist (example Hillarys Boat Harbour), the scale of the proposed development and the anticipated combination of uses may be considered to push it beyond the limits of the Parks and Recreation zoning. This would be an unnecessary barrier for the development of Whiteman Village to its full potential.

It is therefore recommended that either, explicit confirmation of the scale and nature of uses allowed in a Parks and Recreation reserve is obtained or a Tourist Precinct be negotiated for the area. Such a zone would have a defined range of allowable uses, giving certainty and flexibility.

3.5 Marketing and Public Relations

A new public face for Whiteman is required. Existing market research indicates high awareness of Whiteman Park, but low recognition of it as an attractive and interesting place for repeat visits.

It is imperative that public awareness of Whiteman's restructuring and development is carefully managed. It is recommended that a specific individual or organisation is appointed to provide a strategy and manage the release of information, press releases, stakeholder briefings etc. Without a focused strategy, it is likely that media and specific interest groups will interpret the development of Whiteman as a loss of public assets. This appointment is required immediately.

3.6 Lease Arrangements

It is intended to enable private sector development of buildings within the village and in major tourist facilities. For this to be viable, developers will need:

- Sufficient longevity of tenure to enable a return on funds invested; and
- A form of tenure which enables funds to be borrowed against the project.

These are maximised with freehold tenure. However, this option may not be available. It is most likely to be easier to achieve other changes if land was retained in public ownership. Therefore, allowing private land use via a long lease is considered an acceptable alternative. The disadvantage of this option is that the lease return is likely to be less than for a freehold sale. The advantage of this option is that Whiteman remains in public ownership.

It is possible that the entire Tourist Precinct and Village could be leased as a package to a single operator, subject to further study of the viability of this option.

The main tasks are:

- Establish tenure for short term to long term (25 year to 99 year) leasehold; and
- Initiate contract arrangements with volunteer groups. The new direction requires a level of committed service to the Whiteman users and visitors by tram, rail and bus operators. This will necessitate a change in the relationship between the volunteer groups and Whiteman management. The current agreement allowing volunteer groups to operate in Whiteman should become a contract of service requiring a level of service delivery. This may result in a contribution to operating funds to these groups by Whiteman.

- The Master Plan envisages the following leased areas;

Village Lease Area	30,000sqm	3.00 hectares
Wedge Lease Areas	406,500sqm	40.65 hectares
Large Lease Areas	565,250sqm	56.52 hectares
Total Potential Leasing	1,001,750sqm	100.17 hectares

4. OVERALL DEVELOPMENT RATIONALE

Whiteman, at this stage has three broad development alternatives:

- Continue the status quo;
- Immediate implementation of the Master Plan;
- Staged implementation of the Master Plan.

4.1 The Status Quo:

The operations cash flow for Whiteman for 1999/2000 is shown in the table below.

WHITEMAN CASH FLOW	Current Operations *1999 / 2000* ($'000)
EXPENDITURE	
• Whiteman Management / Conservation	525
• Village Operation	986
• Whiteman Collection	137
• Development Projects	343
TOTAL EXPENDITURE	1,991
REVENUE	
Whiteman Management / Conservation	
• Leases & Licences	58
• Commercial (grazing)	68
Village Operation	
• Entry Fees	165
• Facility Fees & other revenue	39
• Leases & Licences	64
• Events & Programs	147
Whiteman Collection	0
Development Projects	0
TOTAL REVENUE	541
NET OPERATIONS	(1,450)

Current annual operating expenditure for Whiteman is in the order of $2.0 million. This is offset by revenue of $0.54 million. Of this 30% is made up of entry fees (primarily gate charges). These account for 8% of overall expenditure. The remainder is made up by Government support, most notably from the MRIF.

The result of a continuation of the status quo is likely to be:

- Continuation of annual Government support of approximately $1.3 – 1.5 million.
- Limited capital expenditure and no or limited implementation of the Master Plan.
- Probable stagnation of Whiteman visitation numbers. This is particularly the case if entry fees are maintained. The local recreational value of Whiteman is likely to become less of a scarce resource, as high quality areas of public open space are built by the private sector in adjacent new developments, such as Ellenbrook and Albion Town, and as Swan Valley and Hills tourist facilities upgrade over time.

- Difficulty in meeting the objective of moving Whiteman towards a stage of financial self-sufficiency.

On the assumption of a continuing base level of activity, that is, including current operations but with no allowance for capital expenditure except for the costs of gaining a rezoning of Marshall Road lands, the 10-year cost of Whiteman under this scenario is $13.5 m. After allowing for inflation of 3% p.a., the projected annual operating deficit in 2009/2010 is $1.45 m. Receipts from the sale of Marshall Road Lands are not allowed for.

4.2 Master Plan Implementation – Timing options

A summary of the overall costs of implementing the Master Plan is shown in the table below.(note: expenditure estimates include fees and contingency)

WHITEMAN MASTERPLAN: EXPENDITURE	1999/2000 actual ($'000)	Projected ($'000)	Frequency
Whiteman Conservation / Management			
1 Current Program	525	525	annual
2 Conservation / Management Projects			
• Mussel Pool projects		110	item
• Screen planting - initial		55	annual (expand after villag works completion
• Rehabilitate wetlands, bush		55	annual (expand after villag works completion
• New footpaths / cycleways		89	item
3 Bennett Brook Entry - site preparation		69	Item
Whiteman Village			
1 Current Operations	986	986	annual
2 Development Projects			
• Initial Works		83	Item
• Stage 1: access roads and initial village works		2,086	Item
• Stage 2: services upgrade		2,104	Item
• Stage 3: Village expansion		179	Item
• Stage 4: Village enhancement projects		1,815	item
Heritage Projects			
1 Whiteman Collection	137	137	annual
2 Transport Heritage Projects		69	annual (after village work completion)
Development Projects			
1 Current projects	343	0	
• Wildlife Park infrastructure		688	item
• Lease relocations – equestrian		275	item
• Signage		69	item
• Entry Works		550	item
• Marshall Road Lands Approvals		150	annual: Until completion (est. 5 years)

Two scenarios have been investigated in the implementation of the Master Plan, styled as Capital Unrestricted, with works undertaken on an earliest reasonable date basis, and Capital Restricted, with works staged to limit the call on additional capital funds in any one year.

4.2.1 Capital Unrestricted: Immediate Implementation of the Master Plan

Under this scenario works are undertaken on an earliest reasonable date basis, with no restrictions on availability of capital. Most development works would be complete by 2004/2005

The objective of the immediate implementation of the Master Plan is to move Whiteman as quickly as possible from a reliance on Government support, supplemented by entry fees, to a reliance on land lease and licence income. The expansion of operations within Whiteman is limited by services, particularly water service, power and sewerage. Upgrading these services will cost approximately $2.1 million, including fees and contingency. This investment will enable significant expansion in the number of people that can be accommodated on site. The creation of a 24-hour village is only really possible with these services in place. It is possible that with this investment, lease and licence revenue can be more than that projected in other sections of this report. In any event, the full implementation of the Master Plan should reduce the reliance on Government support to around $ 0.7 million per annum by 2009 / 2010, before allowing for a sinking fund that could be created sale of the Marshall Road lands.

The result of immediate implementation of the Master Plan is:

- Restructuring of Whiteman operations to allow reliance on land lease and licence income;
- Substantial reduction in the requirement for Government support;
- The creation of options to increase private sector development in aspects of Whiteman operations and capital works.

The 10-year cost of Whiteman under this scenario is $19.3 m. After allowing for inflation of 3% p.a., the projected annual operating deficit in 2009/2010 is $0.7 m. Receipts from the sale of Marshall Road Lands are not allowed for.

Refer to Appendix 1 – Capital Expenditure and Cash Flows, of the Corporate Plan (Document 3; Volume One) for further details.

4.2.2 Capital Restricted: Staged Implementation of the Master Plan

With this scenario, works are staged to limit the call on additional capital funds in any one year, with major items of capital expenditure, notably the upgrading of Village services, delayed until the sale of the Marshall Road lands. Note that the substantial expansion of village operations, particularly the provision of overnight accommodation, is dependant on this services upgrade and the projected revenue from expanded operations and from land leases is consequently delayed. Under this scenario, most development work would be completed by 2007 / 2008.

The result of a staged implementation of the Master plan would be to

- Limit the call on Government for development funds;
- Make the full implementation of the Master Plan dependant on the sale of Marshall Road lands;
- Delay the implementation of key development stages and of private sector investment in Whiteman.

The 10-year cost of Whiteman under this scenario is $20.8 m. After allowing for inflation of 3% p.a., the projected annual operating deficit in 2009 / 2010 is $0.8 m. Receipts from the sale of Marshall Road Lands are not allowed for.

Refer to Appendix 1 – Capital Expenditure and Cash Flows, of the Corporate Plan (Document 3; Volume One) for further details.

4.3 Funding and Timing

For Whiteman to become financially self-sustaining, it must change its revenue base from a reliance on Government contributions, supplemented by gate charges and licences and concessions. The Master Plan proposes a substantial increase in revenue from land leases and operating licence fees over time, supplemented by a sinking fund based on the revenue from the sale of the Marshall Road lands. Given the long lead time for disposal of Marshall Road lands, funding must be secured from other sources for the short and medium term development program.

Within the cost structures, a desk study has been undertaken to appraise the financial implications of lake construction and arising sand sale. At this time it appears that at best lake construction costs would be balanced by the sale of arising materials.

Timing of removal of gate charges will coincide with completion of access roads. In general, the gate charge revenue will be replaced by increased lease and licence revenue. The timing of development is solely governed by the availability of funds.

4.4 Revenues

The development of the village is expected to substantially increase revenues from existing licences and leases and to increase new revenue opportunities. New opportunities may be in the form of land leases in the new village lot areas and 'Wedge' lease areas (which may include a turnover component), and new operating concessions in the expanded village.

Two revenue scenarios to 2009/2010 have been prepared to match the capital expenditure scenarios. The general assumption is that revenues will grow more strongly with earlier and more definite commitments to expenditure.

4.5 Financial Risk

The full benefits of the implementation of the Master Plan will not be fully realised except in the very long term. The Master Plan implementation creates a variety of opportunities in many areas of Whiteman, particularly in the Whiteman Village and Tourist Precinct, for substantially increased activity and revenue generation.

The financial risks therefore are contingent on the rate and timing of the take-up of opportunities by the private sector, rather than whether they will be taken up at all. The longer the build-out time and the rate of take–up, the longer the period until financial self-sufficiency.

4.5.1 Revenue Risk

Projected overall revenue growth is composed of a number of elements;

- Increases in return from an expansion of existing activities, namely facility fees, leases, licences, events and programs. These are projected to grow

at a rate of 5-10% p.a., following the construction of access roads and the dropping of the gate charge. Visitation to Whiteman is likely to increase substantially at this time. As a proportion of total revenue, these items will drop from 57% (currently) to approximately 40% in 2009/2010, as other revenue items become relatively more important. Failure to achieve the projected growth rates in any one of the activity categories will leave only a small effect on the overall revenue outcome.

- New land leases in the village.
  These are projected to commence relatively late in the development time frame, and by 2009/2010 still constitute only 9% of overall revenue.

  The Plan allows for the delivery of up to a maximum of 30,000 m2 lettable land inclusive of existing facilities. This allocation is proposed in the context of dramatically increased accessibility, long term lease arrangements and the increased population in the immediate local area. Continuing enhanced demand for tourism facilities in the Swan Valley area and further growth in the future, it is reasonable to expect that the proposed leasing opportunities will be taken up with diverse uses. The precise mix of these is uncertain, but given the existing diverse range of accommodation, attractions, retail and craft operations within the area, it is expected that lessees will be similar in land take. It is expected therefore, that out of the 30,000 m2 total allocation within the village, up to 15,000 m2 of this would be of built form.

  The expansion of uses beyond the current narrow range is only possible after the upgrading of services. The mix will be market driven. Based upon discussions with interested parties, assessment of competing operations, consultation with bodies such as the WA Tourism Commission and local Chamber of Commerce, an example of a mix may be;

5,000 sqm	Food and festival retail – includes craft / produce
6,000 sqm	Various classes of accommodation
2,000 sqm	Reception area
2,000 sqm	Community / recreation facilities

  Over the time frame of 10-15 years, this is considered to be modest in scale and take up and should be achievable through effective marketing and management

  Initial consolidation of the existing retail outlets in the village in to one managed area (the existing administration block) releases considerable infrastructure to new uses, without a substantial outlay. This new core of retail provides the impetus for future marketing and growth.

- Wildlife Park and Other Wedge Leases
  These form a substantial component of projected revenue and are the item of greatest variability. By 2009/2010, they are projected to constitute approximately 40% of total revenue. Delays in attracting lessees for the wedge leases will substantially affect the overall revenue. These leases are likely to have a turnover component, therefore the choice of lessee and the management of the relationship between the lessee and the Whiteman Management will be important.

4.5.2 Construction Risk

Construction projects are likely to use standard techniques and approaches. Provided good project management procedures are followed, construction costs risks are likely to be low.

4.6 Summary

In summary, the financial comparison after 10 years with each alternative (not accounting for the revenue from the sale of Marshall Road lands) is shown below:

	Completion of most development work	10-year cost	Operating Deficit, 2009 / 2010
Continue Status Quo	Never	$ 13.5 m.	$ 1.5 m.
Capital Unrestricted	2004 / 2005	$ 19.3 m.	$ 0.7 m.
Capital Restricted	2007 / 2008	$ 20.8 m.	$ 0.8 m.

Implementation of the Master Plan will best meet the objective to move the operations of Whiteman towards financial self-sufficiency. The Status Quo option has a lower 10-year cost than the Master Plan implementation options. However, it provides no prospect of moving the operations of Whiteman towards financial self-sufficiency. If funds from the sale of Marshall Road lands were to be applied to operations, they would be quickly eaten up by the on-going operations deficit.

On the other hand, investment in Master Plan implementation will substantially reduce the operational deficit within a ten-year time frame. Projected revenue growth resulting from the investment means that this deficit will decrease in subsequent years and move towards the achievement of financial self-sufficiency some time in the subsequent decade.

Funds from the sale of Marshall Road lands will make a substantial contribution towards this investment in upgraded activity and will help to realise the full potential of Whiteman, providing a valuable, useful recreational and conservation resource for the community.

The reports and supporting working documents are structured as follows:

Document 1
EXECUTIVE SUMMARY

■

VOLUME ONE

Document 2
Master Plan Report

Document 3
Corporate Plan

■

VOLUME TWO
WORKING PAPERS

Document 4
Action Plans

Document 5
Development Plan
10 year outlook

Document 6
Whiteman Development Trust

Document 7
Public and Media Statements

Document 8
Design Guidelines

Document 9
Traffic Study

Document 10
Consultation Report

■

1 INFORMATION FOR THE TENDERER

1.1 Introduction and Background

The Department for Planning and Infrastructure was formed in July 2001 by an amalgamation of divisions from the Department of Transport and the Ministry for Planning. The Department also provides services and support to the Western Australian Planning Commission (WAPC).

Whiteman Park is managed on behalf of the WAPC by the Whiteman Park Board of Management ("The Board"), which is supported in the operation of the Park by the Department for Planning and Infrastructure.

1.1.1 Objective

Whiteman Park requires a land and environmental management plan (the Management Plan) that covers both the land areas of conservation value and other land areas. The Management Plan will be complementary to the Operational Plan prepared by staff annually on the basis of the overall Management Plan.

The written Management Plan is needed to assist The Board in directing park operations and making the most of limited resources. It will communicate ideas so that The Board can progress in a purposeful and coordinated way towards a set of sustainable systems within the Park. The Management Plan will need to be developed with significant community input.

Changes over time in social values, environment and available resources will present challenges however, the Management Plan shall be effective for many years with the operational plan showing changes annually to compensate.

1.1.2 Overview of Whiteman Park

Whiteman Park occupies an area of 4,200 hectares mostly within the locality of Whiteman, Cullacabardee, and the Bennett Brook reserve to the Swan River, Western Australia. These three distinct areas can be used as major sub areas or management zones. It is located 18 kilometres north east of the Perth Central Business District and is generally bounded by Gnangara Road to the north, Lord Street to the east, Marshall Road and the Swan River to the south and Alexander Drive to the west.

Whiteman Park was established by the then Metropolitan Planning Authority (now know as the Western Australian Planning Commission or "WAPC") in 1975 and originally occupied around 1,400 hectares. The Park was officially opened in 1986. This has expanded to around 4,200 hectares with final acquisitions and disposals of small areas yet to be finalised.

Whiteman Park is an important regional recreational and conservation resource for metropolitan Perth. It protects 2,800 hectares of Priority One groundwater from which is extracted around 10 million cubic metres of water by the Water Corporation annually. Public visitation is around 250,000 per year and is expected to double over the next five years as new projects are established. The Park is located between the North West and North East urban corridors and will provide an increasing contribution to the recreational needs of the growing population over time. The Park has significant natural heritage and collections of cultural heritage, the latter particularly in transport, mining, forestry and farming activities related to the development of Western Australia.

2 SCOPE OF WORK / STATEMENT OF REQUIREMENTS

The Consultant shall develop a land and environmental management plan and provide the consultancy services outlined in this document for the area of Whiteman Park.

The Consultant is not however, required to prepare a plan for the public areas of Mussel Pool and the Village, or areas held by lease holders (licence areas will be included in the plan). Effects of activities within these areas on the surrounding area of the Park are however to be considered.

A map of Whiteman Park is attached.

The scope of the project and the general services required are listed below followed by text describing the scope of services applicable.

2.1 Consultant's Responsibilities

The Consultant is responsible for the full delivery of the project including reporting, budget control, liaison with the Principal's representatives, community groups and individuals, end users and relevant Authorities.

The Consultant shall provide all the necessary skills required to deliver the outcomes critical to this contract which may include (but is not necessarily limited to):

- Full planning and research skills
- Environmental
- Ethnographic
- Historian
- Estimator/cost planner (for budget estimates)

The Consultant will be required to manage the whole process including the input of sub-contractors and special advisers on both the Consultant's team and the Principal's team.

2.1.1 Project Management

A Project Control Group (PCG) has been established for this project comprising:

- Nigel McCombe, Manager Whiteman Park
- Harry Gratte, Assistant Manager, Whiteman Park
- Dr Stephen Davies, Board member
- Such other representative as may be required

The Project Control Group will be responsible for decision making however, the Project Control Group may delegate areas of the plan to individual members. Site-specific issues will be raised with the Consultant as may be required. It is required that the Consultant attend most Project Control Group Meetings.

The Consultant shall work with the Project Control Group to deliver the requirements of the contract.

2.2 Overall Scope

Scope of coverage list for the Management Plan:

2.2.1 Land Use Management

- Level and type of public use.
- Access and use by utilities (Telstra, Water Corp, Water and Rivers, Western Power etc).
- Park boundary management
  - Joint boundaries, fences, access etc.
  - Joint initiatives with neighbours.
  - Road reserve shoulder management.
  - Neighbour impacts.
- Management of the areas grazed by cattle.

2.2.2 Management for Conservation

- Physical resource management - climate, geology, geomorphology, soils, hydrology, visual landscape values etc.
- Biological resource management - Vegetation and native flora, fauna including fish, biodiversity, fire management, disease and pests, feral and domestic animals, re-introduction of native fauna, protection of native fauna habitat, barriers to wildlife movement, environmental weeds, restoration of disturbed areas, and impacts of adjacent urban areas and development sites within the Park.
- Pollution management.
- Waste management.
- Cultural resource management - Aboriginal Heritage and post settlement history.
- Management zones with all areas prioritised.
- Groundwater levels management for vegetation or wetlands.
- Wildfire management, minimisation and prevention.

2.2.3 Management for Recreation

- Recreational activities.
- Access including disabled.
- Public safety and risk management.
- User facilities eg water, toilets.
- Management zones with all areas prioritised.

2.2.4 Administration, Interpretation and Education

- Information and interpretative facilities eg signage, walk trails.
- Administration and workshop location and facilities.
- Education values, programs and facilities.
- Public consultation (ongoing).

2.2.5 Research and Monitoring

- Research programs
- Monitoring programs

2.3 Specific Service Requirements

2.3.1 Consultation and Liaison

The Consultant shall regularly liase with the PCG. The Consultant will be required to prepare the minutes of the regular PCG meetings and distribute these to all participants. The PCG is an informed client and intends to provide technical assistance and advice to assess, validate and support the Consultant's outputs from the study.

The PCG will make available all available maps, reports and other information they have at their disposal. Much of this information is also available in digital form. Other information will need to be separately accessed by the Consultant.

Involvement of the public is a key component of the preparation of the Management Plan. A significant community consultation program will need to be implemented to:

- Inform the community and involve them in the development of the management plan.
- Educate the community in the issues involved.
- Access information on the study area available in the community.
- Identify the values placed on the study area by members of the community.
- Involve the community in decision-making processes.

The Consultant in conjunction with Principal's representatives will determine exact methods. Methods may include workshops; open days, leaflets and surveys. The park has around 30 resident lease groups some of which hold licence area which are subject to this plan. The Bennett Brook Catchment Group and City of Swan are expected to be heavily involved.

The Consultant is expected to represent the PCG at all times during the process, including preparation for and participation in presentations to the public, Government departments and agencies, councils etc.

2.4 Outputs

The preparation and implementation of management plans for the study area is vital to ensure that sustainable conservation, landscape, heritage and recreation values are maintained and enhanced.

Outputs from the study to develop management plans shall include but are not necessarily limited to the following:

2.4.1 Management Objectives

The Board's policy and or commitments eg:

- P1 water area requirements and agreed policy.
- Attainable management objectives, based on relevant issues.
- A summary of relevant environmental issues, which result in the need for the Management Plan.

Objectives will need to be determined by the Consultant and the PCG.

2.4.2 Resource Information

- A resource inventory for the three sub areas as a basis for management strategies.
- Existing conflicts and stresses, and projected demands. The resource information should cover the environmental characteristics outlined in the scope.

2.4.3 Management Strategies or Actions

- Strategies describing the intent and management approach to be used in the achievement of objectives.
- A priority listing of specific tasks to be undertaken to implement the plan.

Management strategies and actions should address all issues outlined in the scope.

2.4.4 Concept Plans.

Plans exist for firebreaks, fire rotation, permitted activity by fire danger rating, conservation priority zones and recreation zones. This Management Plan must review the plans and include the reviewed plans in the Management Plan. Additional concept plans in other areas will need to be produced.

2.4.5 Summary and Recommendations.

Provide an overview of the Management Plan, its objectives, management strategies and community involvement.

Provide recommendations to consolidate the intent of the Management Plan and provide a focus for the implementation phase of the plan.

2.4.6 Implementation Program.

Outline and chart the various stages for implementing the Management Plan, including priorities and frequencies. Community involvement in the implementation phase shall also occur in determining the success of the plan. On completion, the draft Management Plan shall be advertised and made available for public comment for a period of two months. Comments received will be considered by the Consultant and the PCG and incorporated into the plan by the Consultant where appropriate. The final plan will be considered by the Whiteman Park Board of Management and made available to the public.

2.4.7 Resource Implications.

Human resource implementations including responsible personnel. Budgetary implementations of the plan over a five year period are required.

2.4.8 Performance Indicators.

A checklist to measure performance is required. A procedure to monitor and evaluate outputs against objectives and strategies of the plan will form part of this evaluation.

2.4.9 Documents, Reports and Other Deliverables

The reporting requirement is for a draft and later a final plan.

Thirty copies of the draft plan are needed however, the final plan will only require 10 copies initially as publication will be done by Whiteman Park.

The preparation of leaflets and draft summary for public comment will be as needed. The Consultant is to produce all copies required.

All documents, reports, maps and work prepared by the Consultant is to be made available to the Principal in digital and hard copy form. The digital copy must be compatible with Whiteman Park and Department of Planning and Infrastructure systems currently in use (Windows / Word 2000).

2.4.10 Legislation.

A list is required of relevant Commonwealth and State Government legislation that may need to be considered in implementing the Management Plan.

2.4.11 References.

A list is required of references that may provide guidance for personnel responsible for implementing the Management Plan.

2.5 Project Timeline and Milestones.

The Consultant is to outline its proposed methodology, milestones and deliverable phases and provide a time plan indicating the staged progression towards the completion of this contract in accordance with the following major milestones are:

- June 2002 appointment of consultants
- 30 July 2002 review of maps, reports and other information completed.
- 30 June 2003 draft report completed and submitted.
- November 2003 final report submitted.

The Consultant is to prepare a detailed program for this project which must be agreed by the PCG prior to work starting and payment of any fees.

2.6 Term Of Management Plans

The term of application of the Management Plan is a minimum of 10 years from the date of endorsement. The Consultant shall outline and chart the process of review of the Management Plan to be implemented in the final year of the plans.

2.7 Special Requirement for the Plan

The Botanic Gardens and Parks Authority will assume management of Whiteman Park within the life of the Management Plan. The Management Plan must be compatible with any requirements of the Botanic Gardens and Parks Authority Act (King's Park).

2.8 Budget Estimate

The budget for this project is:	2001/02 year	$12,500
	2002/03 year	$37,500
	2003/04 year	to be advised.

These figures are the maximum that the Consultant can invoice in the appropriate financial year.

2.9 On-site Office Availability

An office is available for use on-site at Whiteman Park. The office is equipped with a computer facility linked to the DPI system, air-conditioning, filing cabinet, phone, desk and chairs. If the Consultant wishes to use this facility and work on-site then this must be declared within the tender response.

2.10 Attachments

Attached is a library list of reports relevant to Whiteman Park.

Attached is a selection of maps available digitally.

Not attached is other information that may be available eg: out of date fire plan, fire history maps, fencing maps grazing area map etc

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DEPARTMENT OF PLANNING AND URBAN DEVELOPMENT
LIBRARY
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ACCESSION NO 10378 VOLUME NO
COPY NO

BOTANICAL STUDIES - WHITEMAN PARK

Full document available on request

Prepared for: Water Authority of Western Australia
& Department of Planning and Urban Development

Prepared by: E.M. Mattiske & Associates

February 1992

MB

BS 304

BASS. N.

WHITEMAN

WESTERN AUSTRALIA UR147 PERTH

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A SPRING, 1975, BIOLOGICAL SURVEY OF THE PROPOSED MUSSEL POOL COMPLEX AND RECOMMENDATIONS FOR ITS FUTURE DEVELOPMENT

Compiled by:

M. Jackson, K. Morris, G. Harold and D. Kitchener

With contributions from:

K. Morris and B. Muir (Vegetation)
M. Jackson and K. Morris (Mammals)
G. Harold and J. Dell (Birds, reptiles and frogs)
J. Scott* (Fish)
H. Merrifield, M. Sinclair and C. Bryce (Molluscs)
S. Postmus (Insects)

Western Australian Museum
*University of Western Australia

Full document available on request

FOR PUBLIC COMMENT
MARCH 1997

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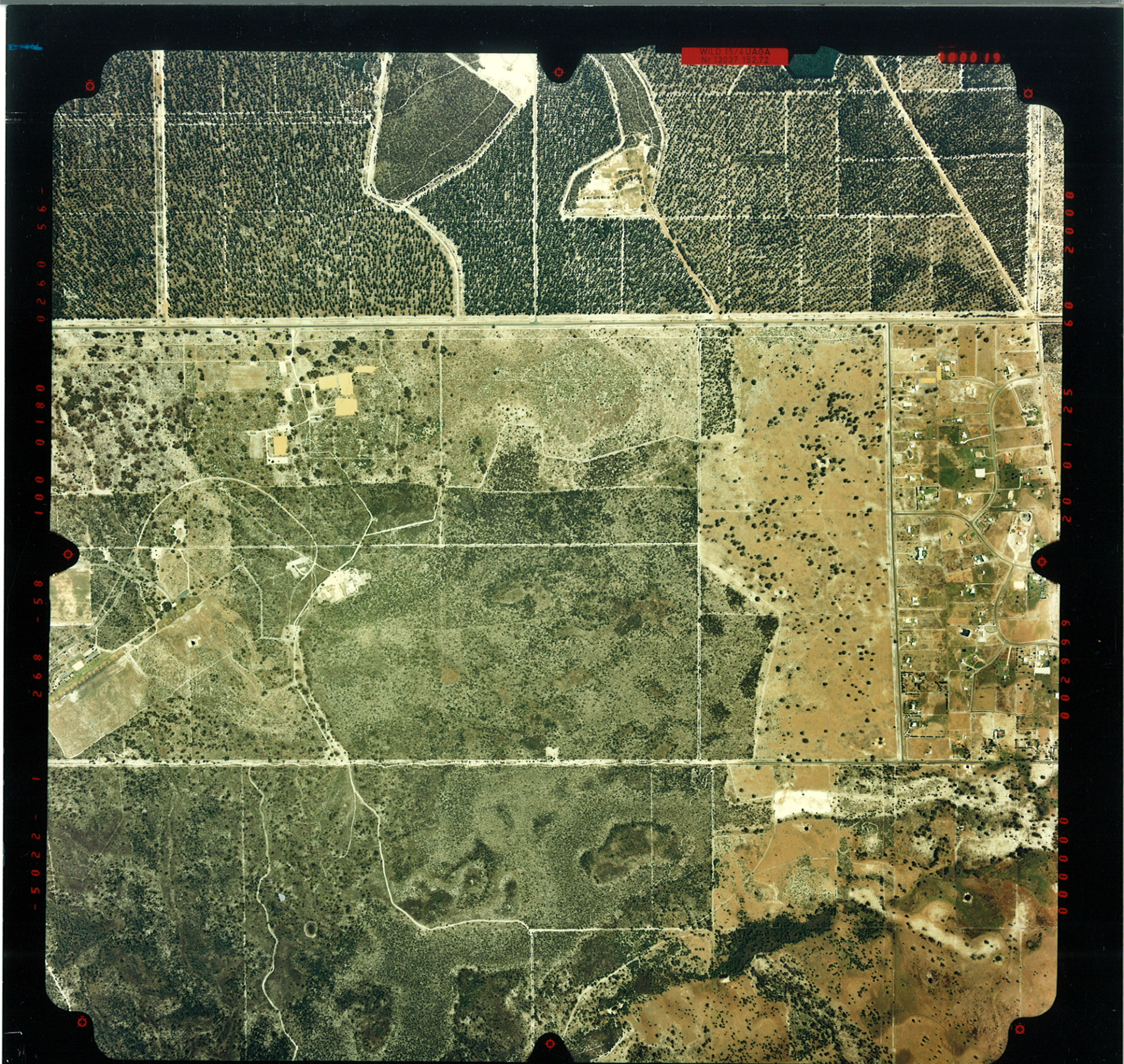

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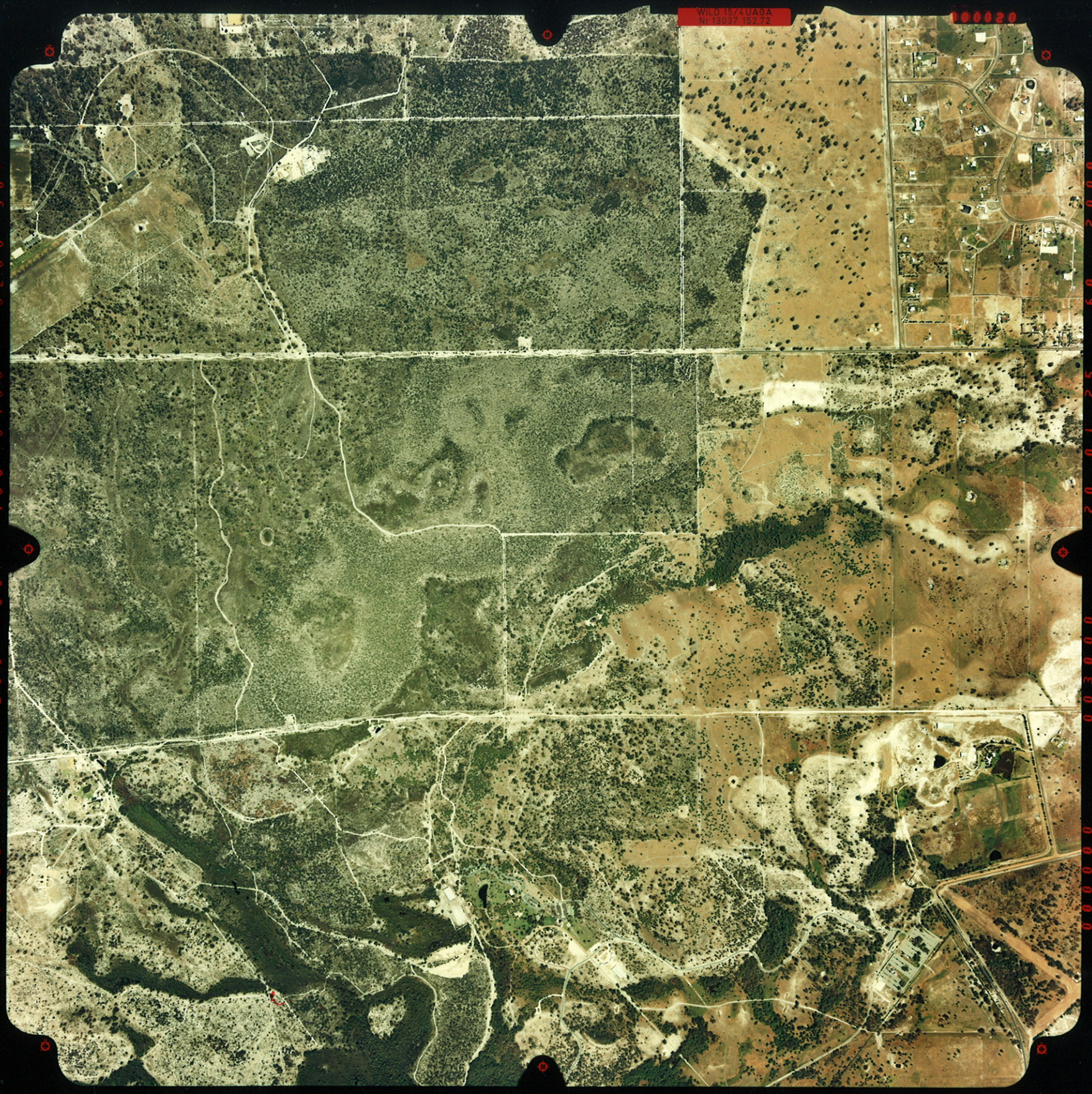

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5097 WA 3169(C) METRO REGIONAL AREA & EXT. RUN 13 (5082-5157) 1:20000 15-DEC-92 920676

5098 WA 3169(C) METRO REGIONAL AREA & EXT. RUN 13 (5082-5157) 1:20000 15-DEC-92 920676

5170 WA 2942(C) METRO STREET DIRECTORY & EXT. RUN 12 (5100-5183) 1:20000 5.1.91 910400