MARALLA ROAD BUSHLAND, ELLENBROOK/UPPER SWAN

Boundary Definition: protected area/ bushland taken to cadastre/bushland group/conservation wetland boundary

SECTION 1: LOCATION INFORMATION

Bush Forever Site no. 300 **Area (ha):** bushland 641.5 (Site also includes open water.)
Map no. 30, 31, 32, 37
Map sheet series ref. no. 2034–I SE, 2034–II NE, 2134–III NW, 2134–IV SW
Other Names: Ellenbrook Bushland Conservation Area, part Submission Areas 116 and 117
Local Authorities (Suburb): Shire of Swan (Ellenbrook, The Vines, Upper Swan)

SECTION 2: REGIONAL INFORMATION

LANDFORMS AND SOILS
Pinjarra Plain
Guildford Formation (Qpa: Mgsi, S11)
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
Pinjarra Plain
Guildford Complex (none in Site)
Swan Complex
Yanga Complex
Bassendean Dunes
Bassendean Complex — North (most southern occurrence)
Bassendean Complex — North Transition (restricted complex)

Floristic Community Types: * not sampled, type inferred
Supergroup 2: Seasonal Wetlands
4 *Melaleuca preissiana* damplands
*5 Mixed shrub damplands
18 Shrublands on calcareous silts
S2 Northern *Pericalymma ellipticum* dense low shrublands
S3 Wet sedgelands on sandy clays
S5 *Acacia saligna* wetlands (restricted type, known from two localities, this is the only area in the PMR)
S6 Northern dense low shrublands (most southern occurrence)
S17 *Eucalyptus rudis/Agonis linearifolia* wetlands in Bassendean Dunes
Supergroup 3: Uplands centred on Bassendean Dunes and Dandaragan Plateau
21a Central *Banksia attenuata — Eucalyptus marginata* woodlands
21c Low-lying *Banksia attenuata* woodlands or shrublands
22 *Banksia ilicifolia* woodlands
23b Northern *Banksia attenuata — B. menziesii* woodlands (most southern occurrence)
S9 *Banksia attenuata* woodlands over dense low shrublands (most southern and only occurrence)

REGIONAL WETLANDS
Wetland Types: sumpland, dampland, palusplain, floodplain, creek, river
Natural Wetland Groups
Bassendean—Pinjarra transition OR Bassendean with fluvial features
Muchea (B/P.3)
Bassendean Dunes
Jandakot (B.3)
Swan Coastal Plain Rivers
Ellen Brook (R.3)
Wetland Management Objectives: Conservation (221.6ha, 3235.3m), Resource Enhancement, Multiple Use
Swan Coastal Plain Lakes EPP: 2.2ha + 0.6ha + 63.5ha + 7.2ha + 33.9ha + 0.8ha = 108ha (total)

THREATENED ECOLOGICAL COMMUNITIES
Not assessed, Not determined, Vulnerable (floristic community type 18)

SECTION 3: SPECIFIC SITE DETAIL

Landscape Features: tall dune, open water, vegetated wetland, creek, vegetated uplands

Vegetation and Flora: limited survey (part Site — Dames and Moore 1990 and 1992, DEP 1999); detailed survey (part Site — Weston *et al.* 1993)

Structural Units: mapping (part Site — Weston *et al.* 1993)

Uplands (mainly Bassendean Sands): Low Closed Woodlands to Low Open Woodlands of *Banksia attenuata*, *B. menziesii* or *B. ilicifolia* and combinations of these, sometimes with *Eucalyptus todtiana*, *E. calophylla* or *E. marginata*; *E. calophylla* Woodland

Wetlands: Low Closed Forests and Closed Forests to Woodlands of *Eucalyptus rudis*, *Melaleuca preissiana*, *M. rhaphiophylla*, *Banksia littoralis* or *Acacia saligna* and combinations; Closed Tall Scrub to Low Shrubland of *Agonis linearifolia*, *Astartea* aff. *fascicularis*, *Pericalymma ellipticum*, *Acacia saligna*, *Melaleuca viminea*, *Kunzea recurva*, *Regelia ciliata* or others and in combination; Mixed Herblands of species of *Utricularia*, *Stylidium*, *Drosera* and other small plants; Herblands dominated by *Phlebocarya ciliata* and other herbs such as *Patersonia occidentalis* often in combination with a variety of sedges; Sedgelands of *Baumea articulata, Baumea* species, *Lepidosperma longitudinale*, *Carex appressa* and *Harperia lateriflora*

Vegetation Condition: >90% Excellent to Very Good, <10% Good to Degraded, with areas of severe localised disturbance

Total Flora: 427 native taxa, 50 weed taxa (Weston *et al.* 1993) (area greater than that of the Site, estimated <10% not in Site, estimated >85% expected flora)

Significant Flora: *Caladenia huegelii* (R); *Grevillea curviloba* subsp. *curviloba* (R); *Haloragis tenuifolia* (1), *Eryngium subdecumbens* ms (1), *Eryngium pinnatifidum* subsp. *palustre* ms (2), *Aotus cordifolia* (3), *Anthotium junciforme* (4), *Conostephium minus* (4), *Stachystemon axillaris* (4); *Astroloma macrocalyx*, *Burchardia bairdii*, *Blancoa canescens*, *Boronia purdieana*, *Conospermum triplinervium*, *Kunzea* aff. *recurva* (GJK 12828), *Darwinia* sp. Muchea (BJK 2006), *Eremaea purpurea*, *Hibbertia perfoliata*, *Leucopogon kingianus*, *Levenhookia preissii*, *Macarthuria apetala*, *Dielsia stenostachya*, *Verticordia nitens*; significant groups of species: 4 species of *Mesomelaena* recorded in Site; >30 species characteristic of heavy soils on the eastern side of the coastal plain

Fauna: limited survey for birds (57 species), native mammals (3 species), reptiles (31 species) and amphibians (9 species) (Watkins, Bamford and Bamford 1993). Significant bird species: category 3 (13) and category 4 (10). Significant populations of Scarlet Robin, Hooded Robin, Golden Whistler, Splendid Fairy-wren, Western, Yellow-rumped and Broad-tailed Thornbills, and Australian Sittella. Significant mammal species: Quenda and Western Brush Wallaby. Significant reptile species: Spiny-tailed Gecko (*Diplodactylus spinigerus*), dragon (*Tympanocryptis adelaidensis*), skink lizards (*Ctenotus gemmula* and *Lerista christinae*), Black-striped Snake (*Simoselaps calonotus*), legless lizard (*Pletholax gracilis*) and Black-Headed Snake (*Parasuta gouldii*)

Linkage: adjacent native vegetation to the north and south outside of the Site, east (Site 301) and west (Site 399); adjacent bushland north available; part of Greenways 36, 40, 59 (Tingay, Alan & Associates 1998a) part of a regionally significant contiguous bushland/wetland linkage (Part A, Map 7)

Other Special Attributes: contains diversity of floristic community types (13) and mapped vegetation types (19) (Weston *et al.* 1993); contains plant communities representative of the eastern side of the Swan Coastal Plain; contains outstanding flora diversity (>380 native species recorded for Site), (i) an exceptionally large number of significant flora and (ii) high conservation value for vegetation (Weston *et al.* 1993, p. 74) including: (a) a variety of wetlands in near-pristine condition (b) many other vegetation types in excellent or better condition and (c) a number of vegetation types on a range of landform/soil complexes that are in conjunction (a conjunction which does not exist elsewhere in the PMR except possibly in Locations 1500 and 2766, north of Muchea); contains a relatively rich fauna compared to bushland remnants closer to Perth (Bowman Bishaw Gorham 1993); National Trust of Australia (WA) Classification; contains part of the channels (Saw Pit Gully and Ellen Brook) recommended for conservation by Semeniuk, V&C Research Group (1992); contains part of the area recommended for conservation by Semeniuk, V&C Research Group (1992); contains 4010m of regionally significant river and 728m of regionally significant creek (WRC 1996a GIS)

SECTION 4: INTERNATIONAL AND NATIONAL SIGNIFICANCE

Entered in the Register of the National Estate; 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, Maintaining ecological processes or natural systems, Scientific or evolutionary importance, General criteria for the protection of wetland, streamline and estuarine fringing vegetation and coastal vegetation

Recommendation: Part A: Site with Some Existing Protection; the Site is already reserved for Parks and Recreation in the Metropolitan Region Scheme and should be purchased for National Park, Conservation Park, Nature Reserve or Regional Park. Part B: Regional Creekline Mechanism (with mapped vegetation). Part C: Proposed Parks and

Recreation Reservation (see Table 3, Volume 1).

MARALLA ROAD BUSHLAND, ELLENBROOK/UPPER SWAN

Boundary Definition: protected area/ bushland taken to cadastre/bushland group/conservation wetland boundary

SECTION 1: CADASTRAL INFORMATION

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

Bushplan Site no. 300 **Map no.** 35, 36, 41, 42 **Map sheet series ref. no.** 2034–I SE, 2034–II NE, 2134–III NW, 2134–IV SW

Other Names
Ellenbrook Bushland Conservation Area, part Submission Areas 116 and 117

Local Authorities (Suburb)
Shire of Swan (Ellenbrook, The Vines, Upper Swan)

Ownership Categories
State Government, Private (including commercial organisation), Local Government, Not identified

Area (ha): total 648.1 (includes open water); bushland 641.5

Zoning
MRS: Parks and Recreation, Rural, Urban, Controlled Access Highways, Public Purposes-Special Uses, Railways, State Forests
TPS: Landscape, Special Rural, General Rural, Special Purpose, No Zone

Lot/Location/Reserve numbers (Purpose), Street name
(Creekline lots not identified)
1, 46, 47, 75, 76, 80, 81, 82, 83, 84, 85 Maralla Rd; 1, 5 Lexia Ave
Crown Reserve

SECTION 2: REGIONAL INFORMATION

LANDFORMS AND SOILS

Pinjarra Plain
Guildford Formation (Qpa: Mgs1, S11)

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

Pinjarra Plain
Guildford Complex (none in Site)
Swan Complex
Yanga Complex

Bassendean Dunes
Bassendean Complex — North (most southern occurrence)
Bassendean Complex — North Transition (restricted complex)

Floristic Community Types: * not sampled, types inferred

Supergroup 2: Seasonal Wetlands
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*5 Mixed shrub damplands
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S6 Northern dense low shrublands (most southerly occurrence)
S17 *Eucalyptus rudis/Agonis linearifolia* wetlands in Bassendean Dunes

Supergroup 3: Uplands centred on Bassendean Dunes and Dandaragan Plateau
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Bassendean—Pinjarra transition OR Bassendean with fluvial features
Muchea (B/P.3)

Bassendean Dunes
Jandakot (B.3)
Swan Coastal Plain Rivers
Ellen Brook (R.3)

Wetland Management Objectives: Conservation (221.6ha, 3235.3m), Resource Enhancement, Multiple Use
Swan Coastal Plain Lakes EPP: 2.2ha + 0.6ha + 63.5ha + 7.2ha + 33.9ha + 0.8ha = 108ha (total)
THREATENED ECOLOGICAL COMMUNITIES
Not assessed, Not determined, Vulnerable (floristic community type 18)

SECTION 3: SPECIFIC SITE DETAIL

Landscape Features: tall dune, open water, vegetated wetland, creek, vegetated uplands
Vegetation and Flora: detailed survey (part Bushplan Site — Weston *et al.* 1993); limited survey (part Bushplan Site — Dames and Moore 1990 and 1992c)

Structural Units: mapping (part Bushplan Site — Weston *et al.* 1993)
Uplands (mainly Bassendean Sands): Low Closed Woodlands to Low Open Woodlands of *Banksia attenuata, B. menziesii* or *B. ilicifolia* and combinations of them, sometimes with *Eucalyptus todtiana, E. calophylla* or *E. marginata*; *E. calophylla* Woodland
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Linkage: adjacent native vegetation to the north and south outside of the Bushplan Site, east (BS301) and west (BS399); adjacent bushland north available; part of proposed Greenways 37, 41, 68, 50 (Tingay, Alan & Associates 1997a), part of a regionally significant contiguous bushland/wetland linkage (Volume 2A, Map 8)
Other Special Attributes: contains diversity of floristic community types (13) and mapped vegetation types (19) (Weston *et al.* 1993); contains plant communities representative of the eastern side of the Swan Coastal Plain; outstanding flora diversity (>380 native species recorded for Bushplan Site), (i) an exceptionally large number of significant flora, (ii) high conservation value for vegetation (Weston *et al.* 1993, p. 74) including: (a) a variety of wetlands in near-pristine condition (b) many other vegetation types in excellent or better condition and (c) a series of vegetation types on a range of landform/soil complexes that are in conjunction (a conjunction which does not exist elsewhere in the PMR except possibly in Locations 1500 and 2766, north of Muchea); a relatively rich fauna compared to bushland remnants closer to Perth (Bowman Bishaw Gorham 1993, p.32); National Trust of Australia (WA) Classification; contains part of the channels (Saw Pit Gully and Ellen Brook) recommended for conservation by Semeniuk, V&C Research Group (1992); contains part of the area recommended for conservation by Semeniuk, V&C Research Group (1992); contains 4010m of regionally significant river and 728m of regionally significant creek (WRC 1996a GIS)

SECTION 4: INTERNATIONAL AND NATIONAL SIGNIFICANCE

Listed on the Register of the National Estate

SECTION 5: SELECTION CRITERIA AND RECOMMENDATIONS

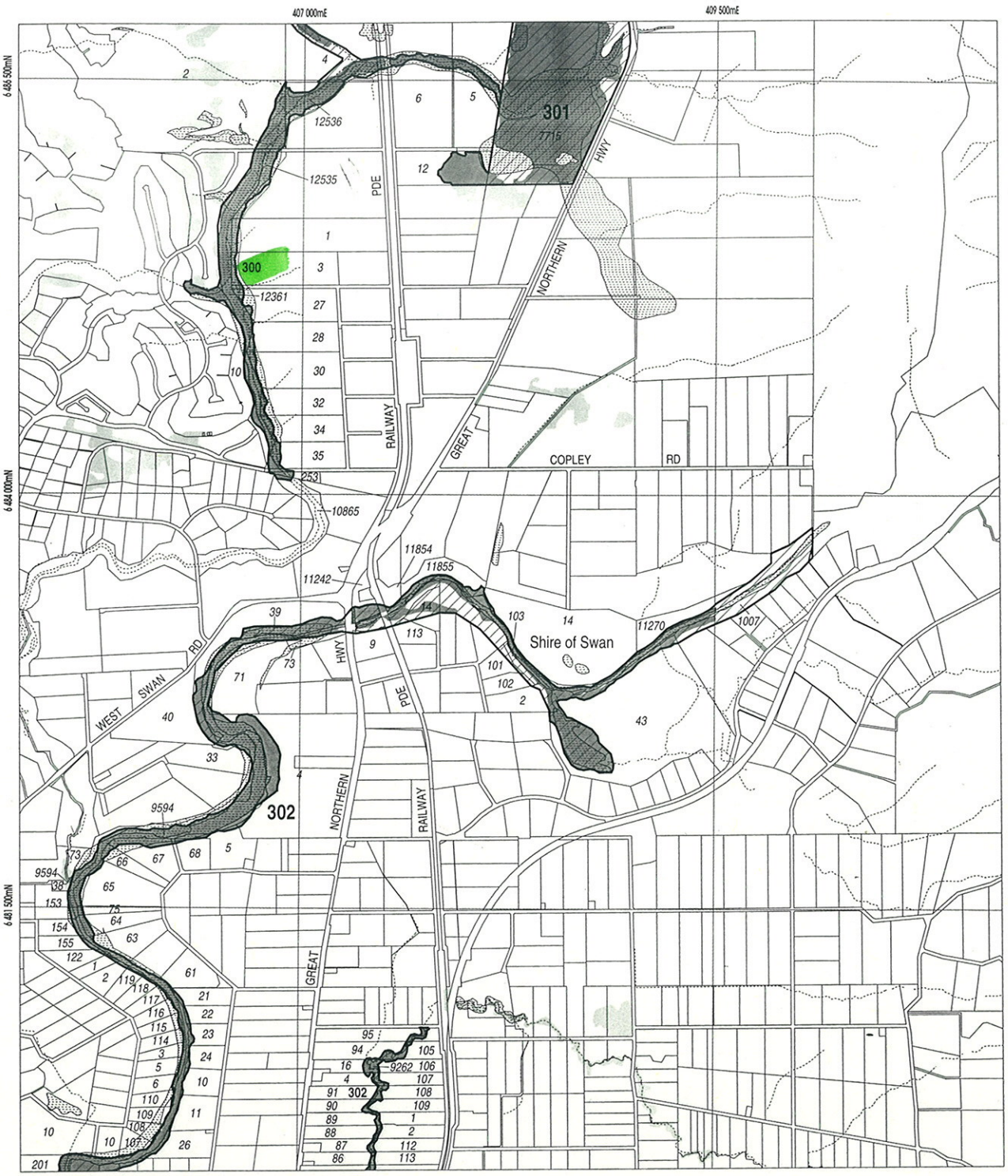
Criteria: Representation of ecological communities, Diversity, Rarity, Maintaining ecological processes or natural systems, Scientific or evolutionary importance, General criteria for the protection of wetland, streamline and estuarine fringing and coastal vegetation

Opportunities and/or Constraints

Opportunities: Bushplan Site/part Bushplan Site subject to Swan Coastal Plain Lakes EPP, Swan and Canning Rivers EPP, Western Swamp Tortoise Draft EPP; location of Declared Rare Flora, conservation category wetlands; under MRS Parks and Recreation Reservation and TPS Landscape Zoning, Crown Reserve

Constraints: private land; under MRS Urban Zoning, MRD regional road requirements, General Mineral Resource Area (clay, sand)

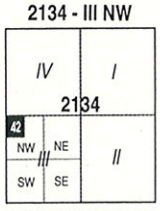
Recommendation: The Bushplan Site is already reserved for Parks and Recreation in the Metropolitan Region Scheme and should be purchased for National Park, Conservation Park, Nature Reserve or Regional Park.



LEGEND

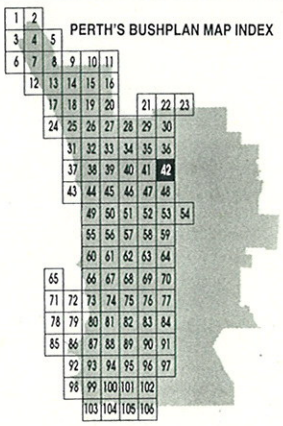
- 472 — Bushplan Sites With Regionally Significant Bushland
- Other Native Vegetation
- Conservation Category Wetlands
- Bushplan Sites With Some Existing Protection
- 696 — Lot Number, Location Number
- Channel Wetlands
- Local Government Boundary

2134 - III NW



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_42.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

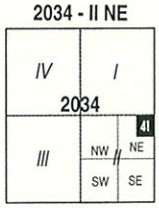
Bushplan Site Map

Map 42

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



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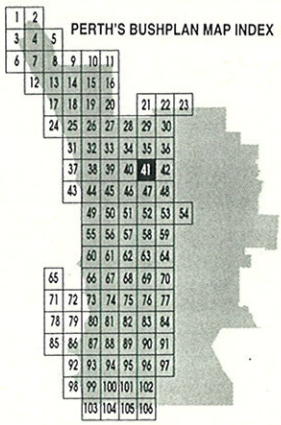
PERTH'S BUSHPLAN MAP INDEX



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

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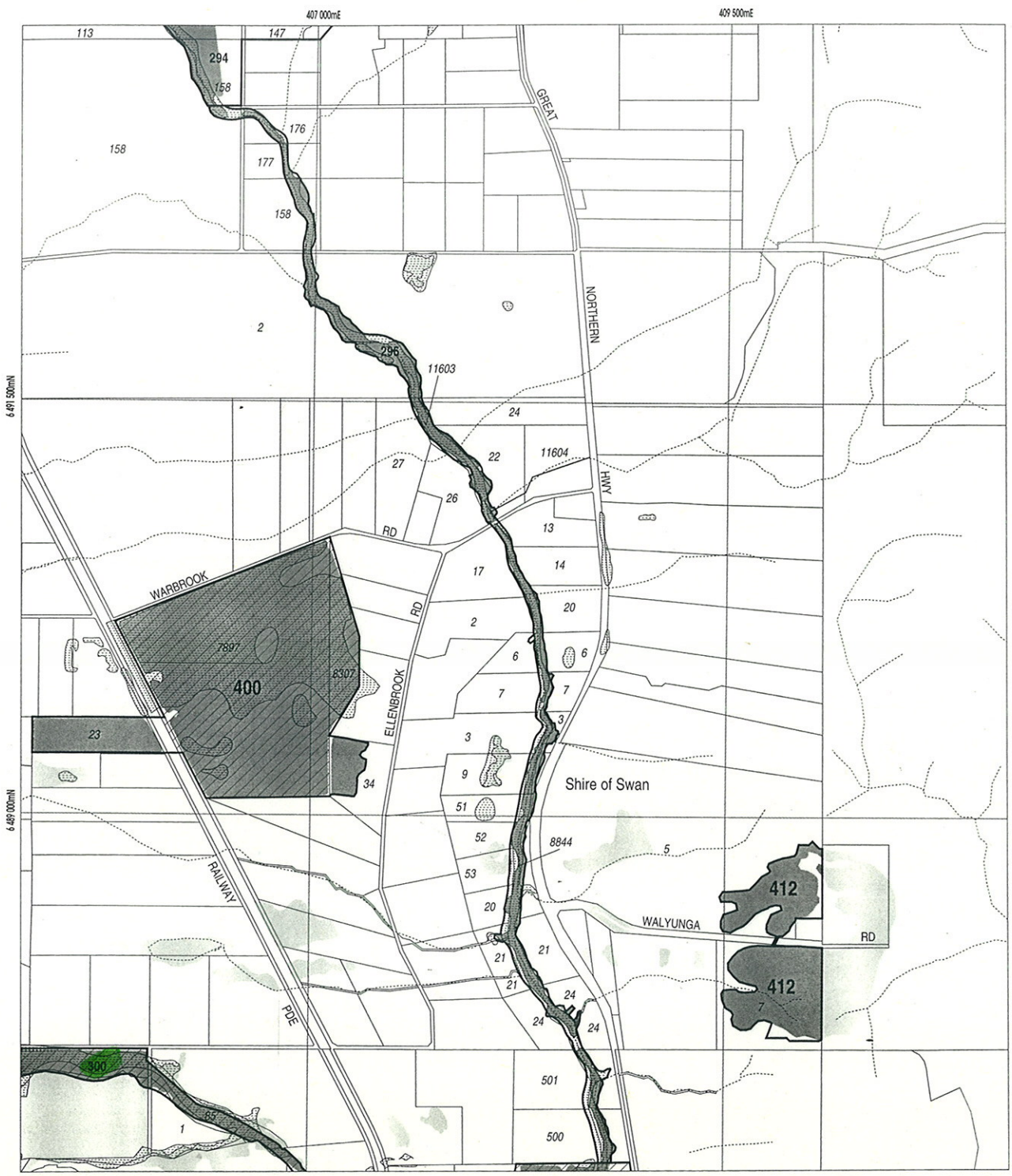
Cadastral Data supplied by Department of Land Administration, W.A.

Wetlands Data supplied by Water and Rivers Commission

Native Vegetation Extent for Study Area supplied by Agriculture Western Australia

Bushplan Site Map

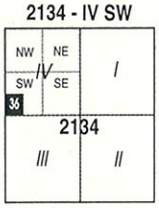
Map 41



LEGEND

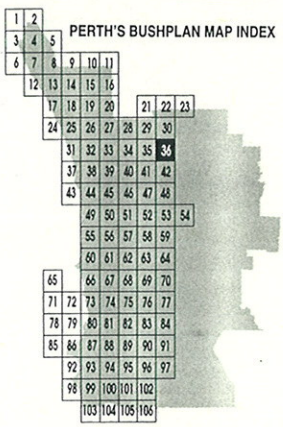
- 472 — Bushplan Sites With Regionally Significant Bushland
- Other Native Vegetation
- Conservation Category Wetlands
- Bushplan Sites With Some Existing Protection
- 696 — Lot Number, Location Number
- Channel Wetlands
- Local Government Boundary

2134 - IV SW



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

PERTH'S BUSHPLAN MAP INDEX



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Metres

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

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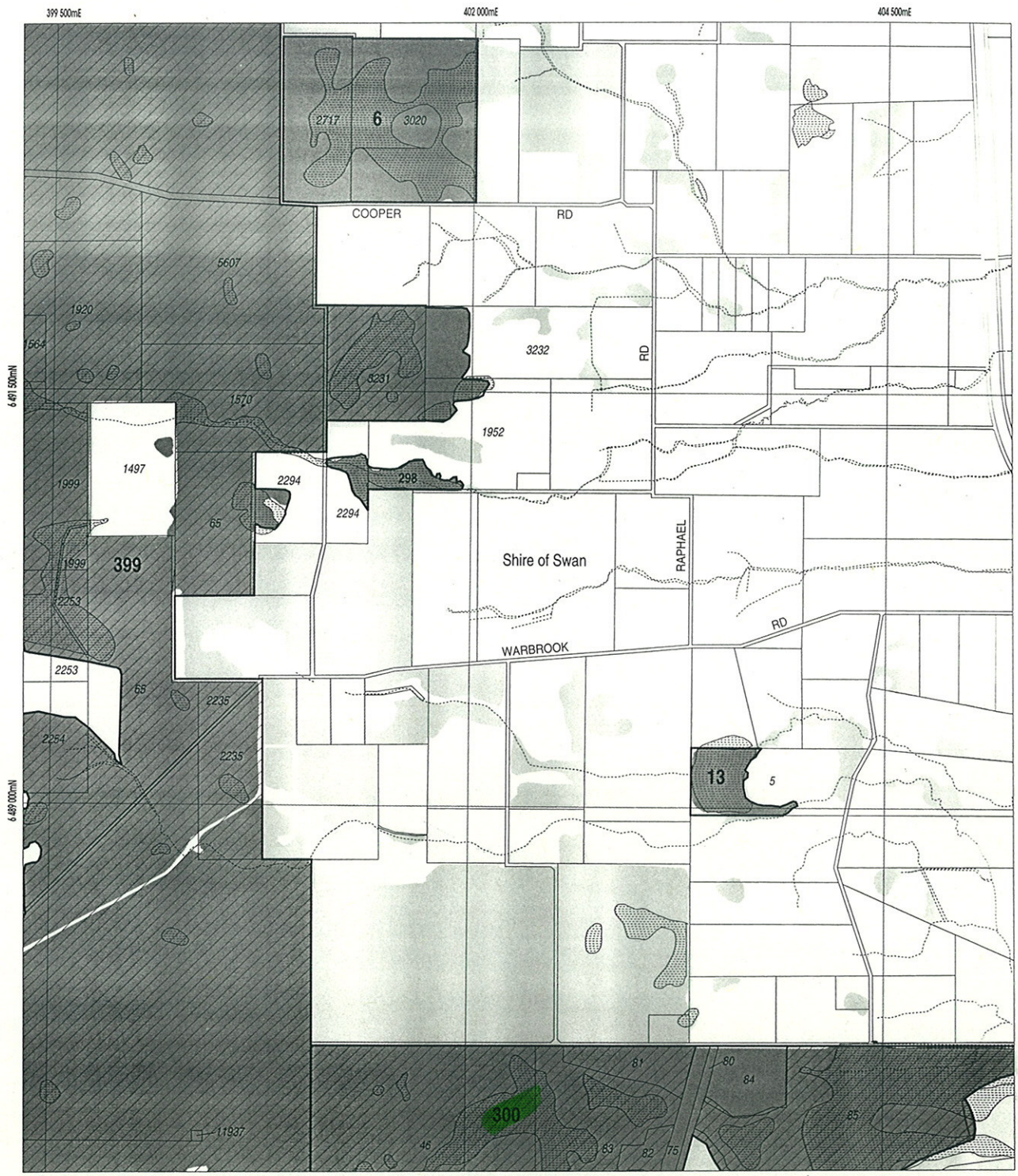
Cadastral Data supplied by Department of Land Administration, W.A.

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 - I SE

IV	NW	NE
	SW	SE 35
2034		
III		II

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		
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		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		
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		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

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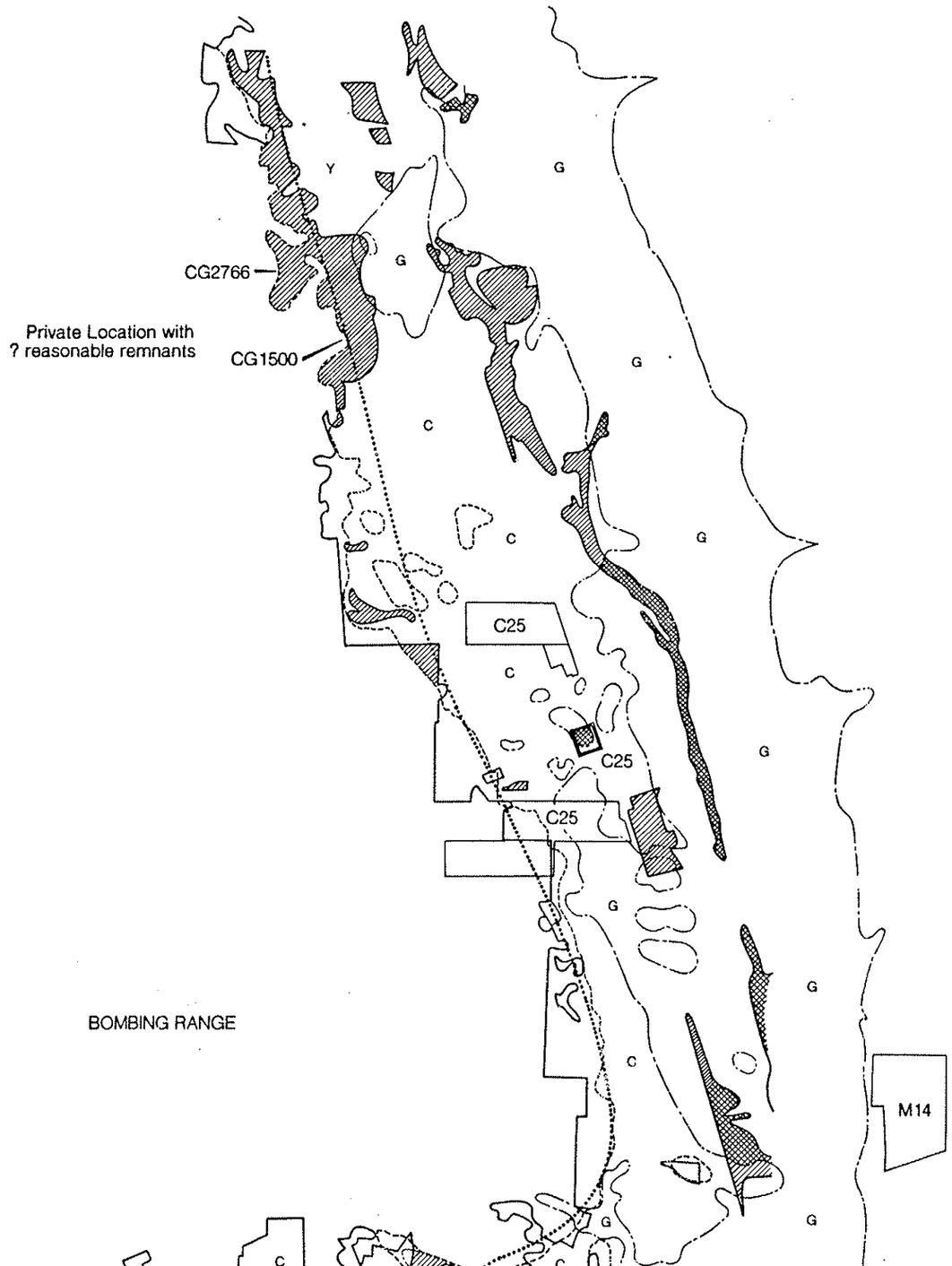
Cadastral Data supplied by Department of Land Administration, W.A.

Wetlands Data supplied by Water and Rivers Commission

Native Vegetation Extent for Study Area supplied by Agriculture Western Australia

Bushplan Site Map

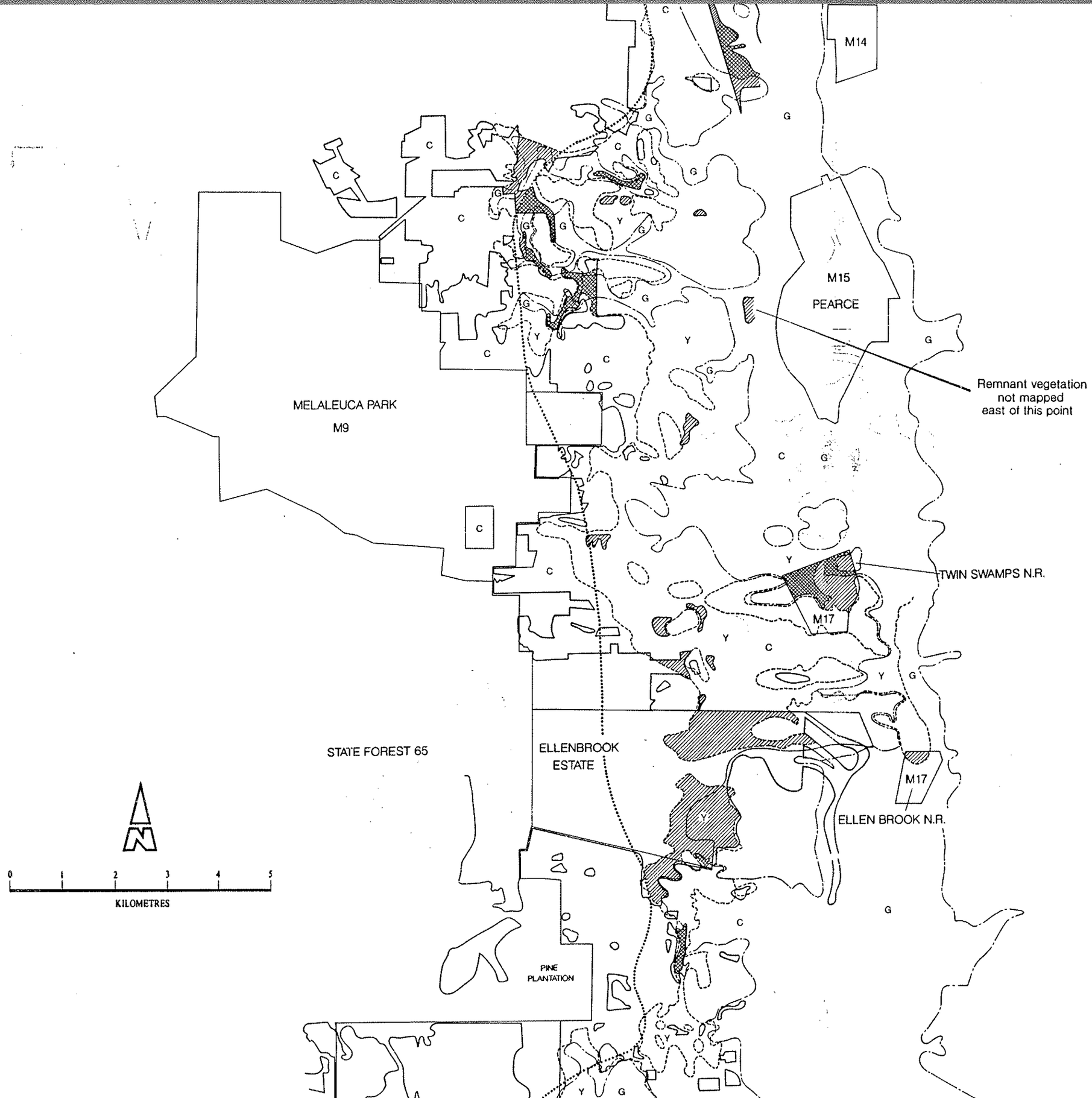


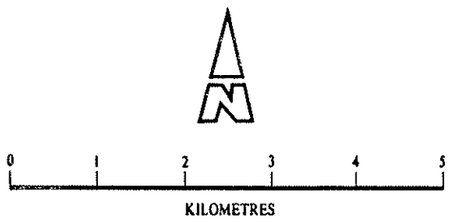
LEGEND

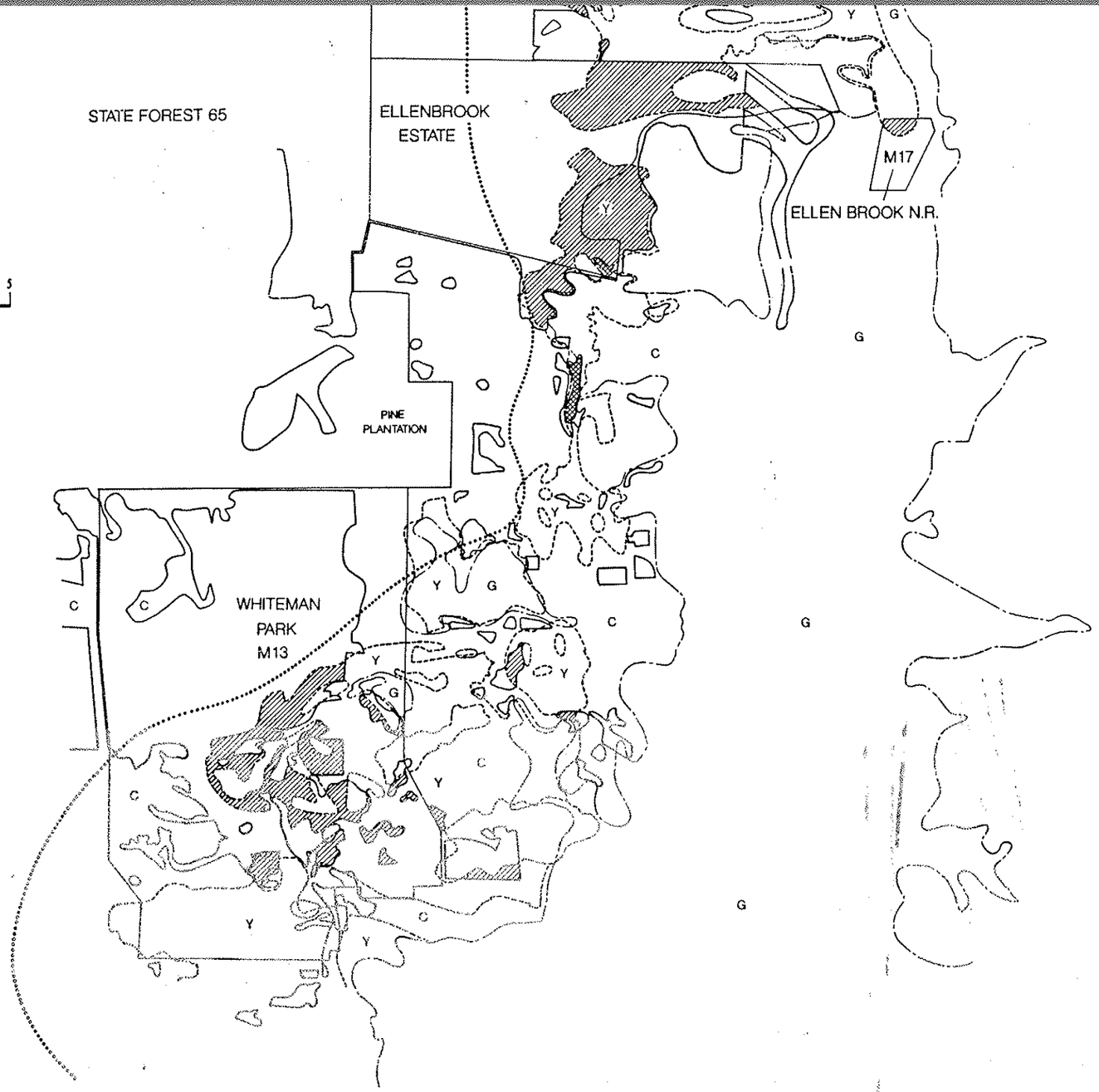
G	Guildford Formation (Gozzard 1982, 1986)
.....	Western limit of clay facies at Guildford Formation (Gozzard 1982, 1986)
Y	Yanga Formation (From McArthur in Dames & Moore 1986, & McArthur 1985)
C	Cleared areas (From maps made available by Department of Agriculture GIS unit)
	Remnant vegetation on "sandy" Yanga (Remnants on Yanga / shallow Bassendean Sand)
	Remnant vegetation on "clayey" Yanga (Remnants on Yanga / Guildford Formation

System 6 Areas:

C25	Country
M14	Metropolitan


M14
M15
PEARCE
MELALEUCA PARK
M9
STATE FOREST 65
ELLENBROOK
ESTATE
PINE
PLANTATION
M17
TWIN SWAMPS N.R.
M17
ELLEN BROOK N.R.
Remnant vegetation
not mapped
east of this point
N
0 1 2 3 4 5
KILOMETRES





Map 3

MAP OF REMNANT VEGETATION ON YANGA FORMATION (PRELIMINARY)

Interpretation and Mapping conducted by
B.A.Orr Griffin GRIFFIN & ASSOCIATES

Gc (4)

Cp

Cp

Cp

Cp

0 20

METRES

METRES

LEGEND

Aj	*Anthotium junciforme*
Ac	*Aotus ovatifolia*
Cm	*Conostephium minus*
Cp	*Carpoxema phillydroides*
Dp	*Daviesia physodes*
Ep	*Eryngium pinnatifida* ssp. *paulustre* ms
Es	*Eryngium subdecumbens* ms
Gc	*Grevillea curviloba*
Gp	*Gonocarpus pithyoides*
Mn	*Macarthuria apetala*
Pl	*Pericalymma floridum*
Rs	*Restio stenostachyus*
Sa	*Stachystemon axillaris*
Sl	*Stylidium longitubum*
Su	*Stylidium uniceloriodes*

Compiled by: Arthur Weston

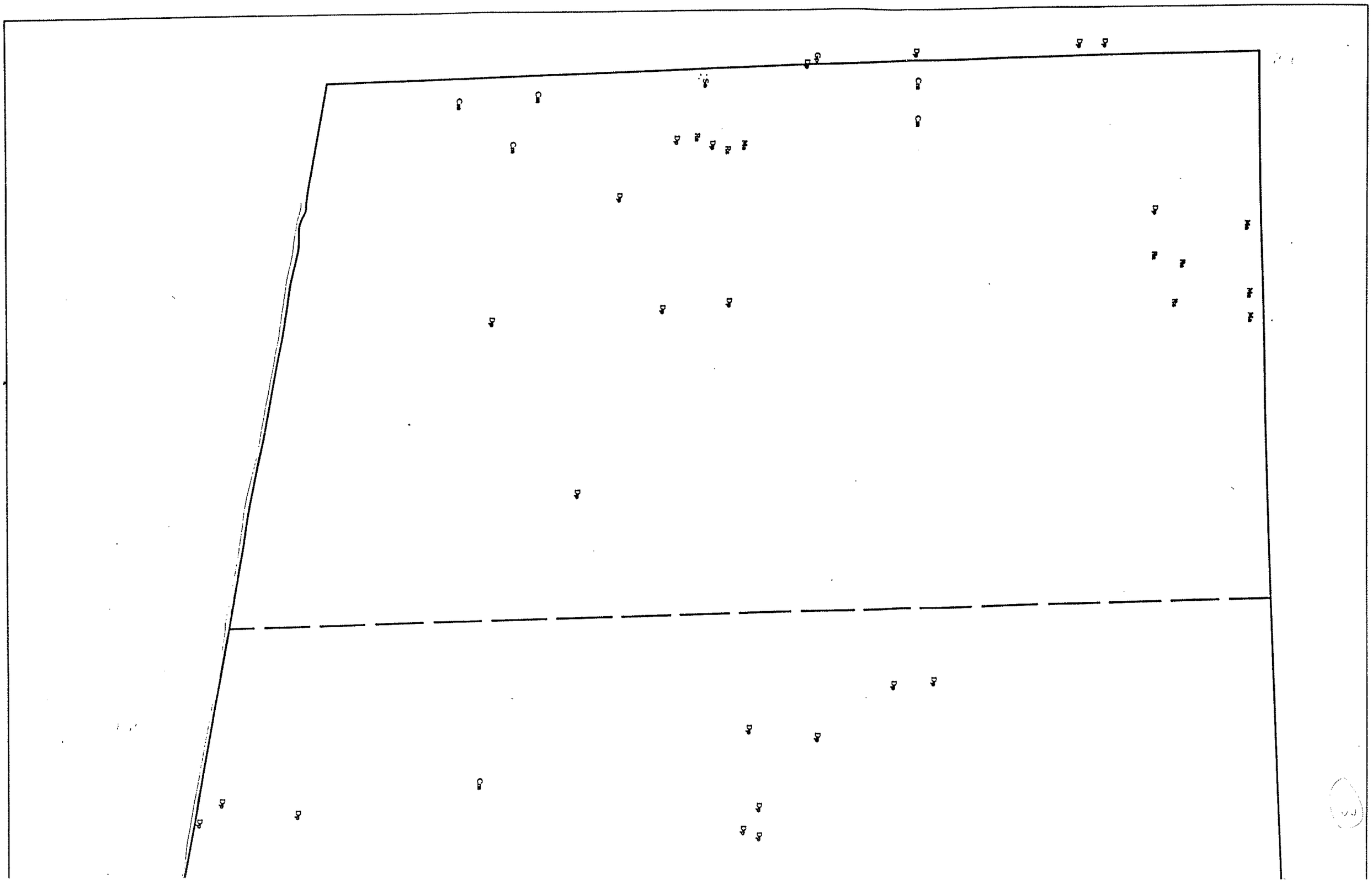
Compiled by:

MAP OF DISTRIBUTION OF PRIORITY SPECIES IN THE ELLENBROOK ESTATE

Map 1

Map 1

BOWMAN BISHAW GORHAM



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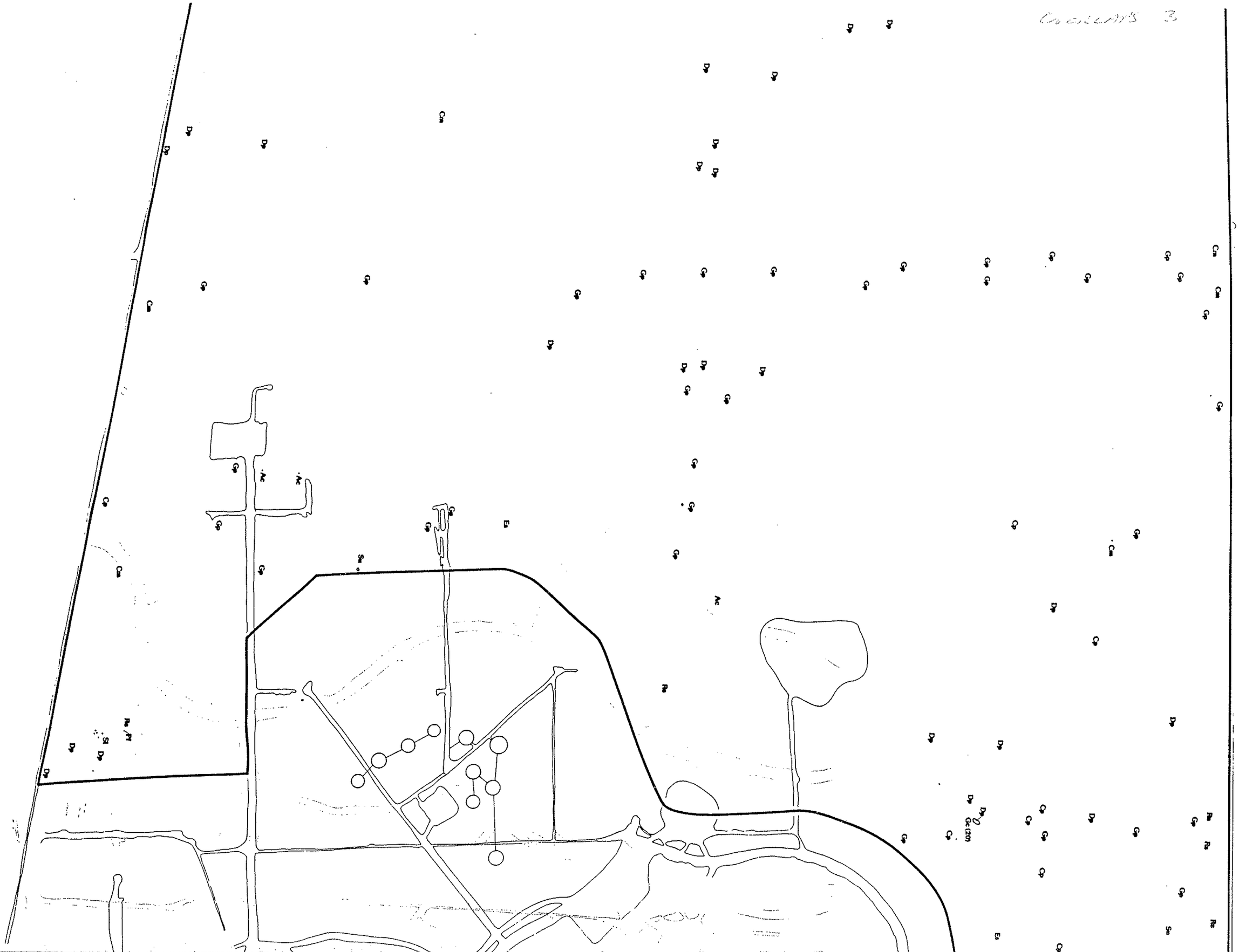
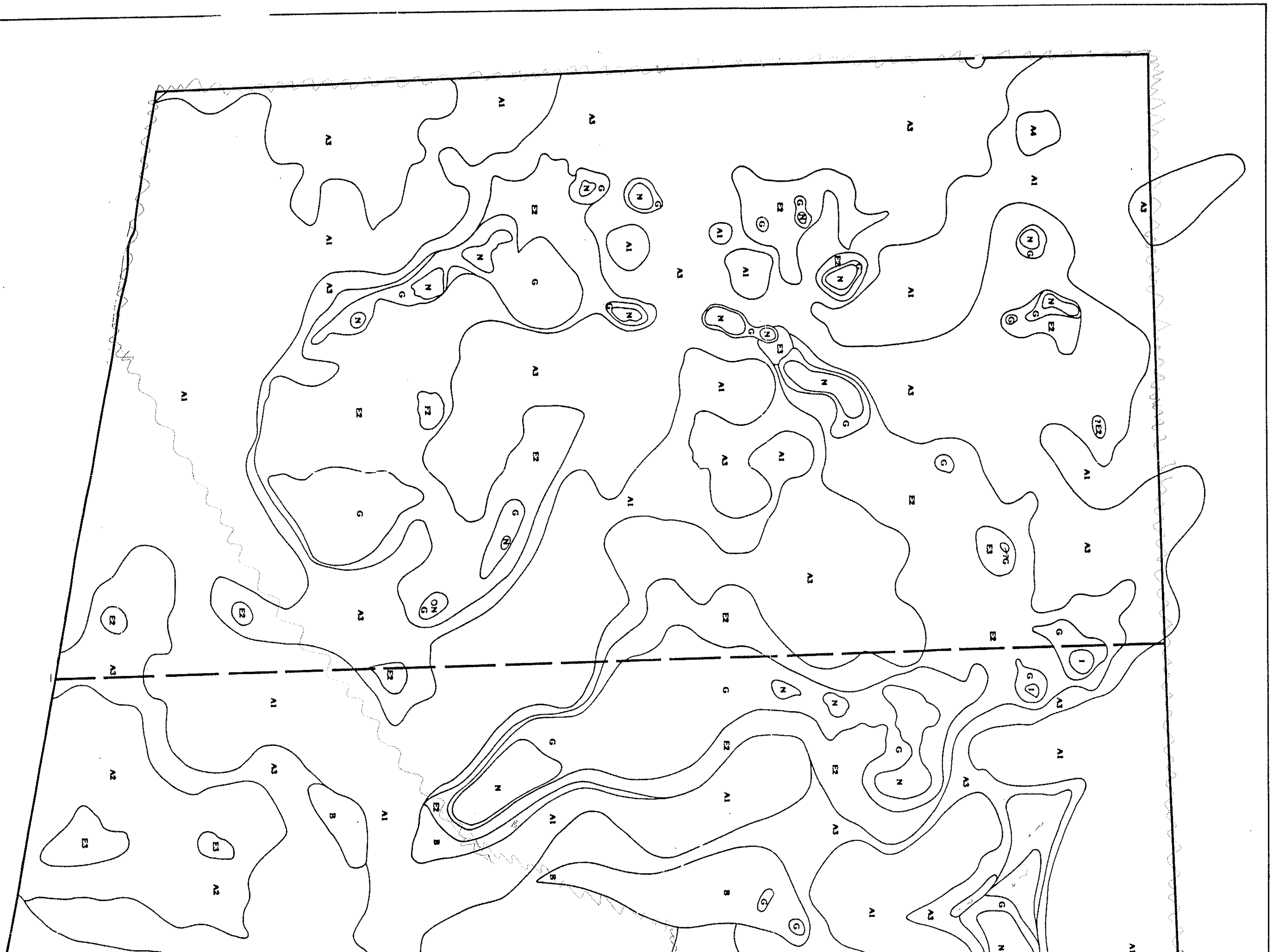
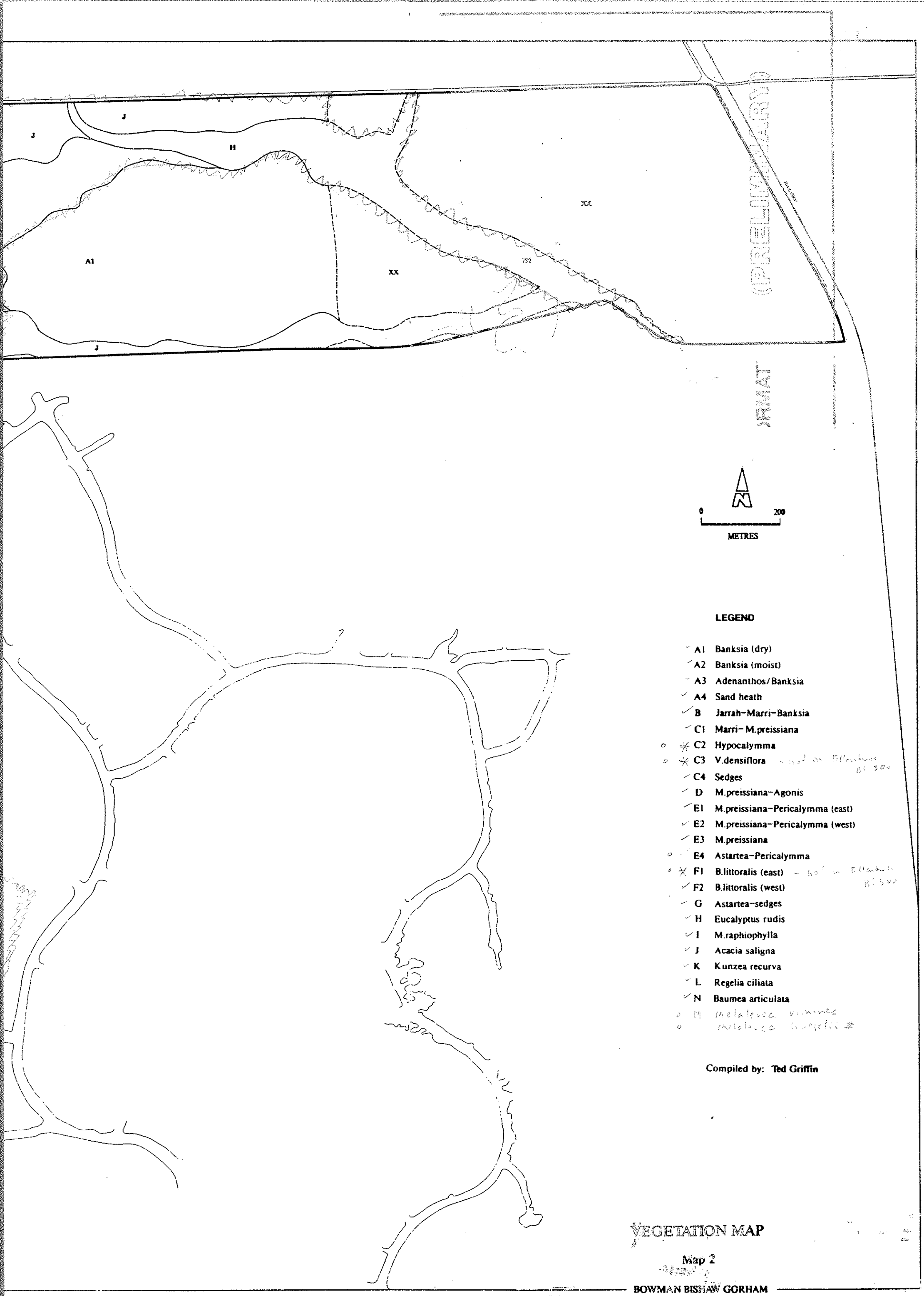





Main Ada Road
A1
A2
A3
B
C1
C2
C3
C4
D
E1
E2
E3
F1
F2
G
H
J
K
L
N
? A2
? A3
? B
? C4
? L
? E3



LEGEND

- A1 Banksia (dry)
- A2 Banksia (moist)
- A3 Adenanthos/Banksia
- A4 Sand heath
- B Jarrah–Marri–Banksia
- C1 Marri– M.preissiana
- C2 Hypocalymma
- C3 V.densiflora
- C4 Sedges
- D M.preissiana–Agonis
- E1 M.preissiana–Pericalymma (east)
- E2 M.preissiana–Pericalymma (west)
- E3 M.preissiana
- E4 Astartea–Pericalymma
- F1 B.littoralis (east)
- F2 B.littoralis (west)
- G Astartea–sedges
- H Eucalyptus rudis
- I M.raphiophylla
- J Acacia saligna
- K Kunzea recurva
- L Regelia ciliata
- N Baumea articulata

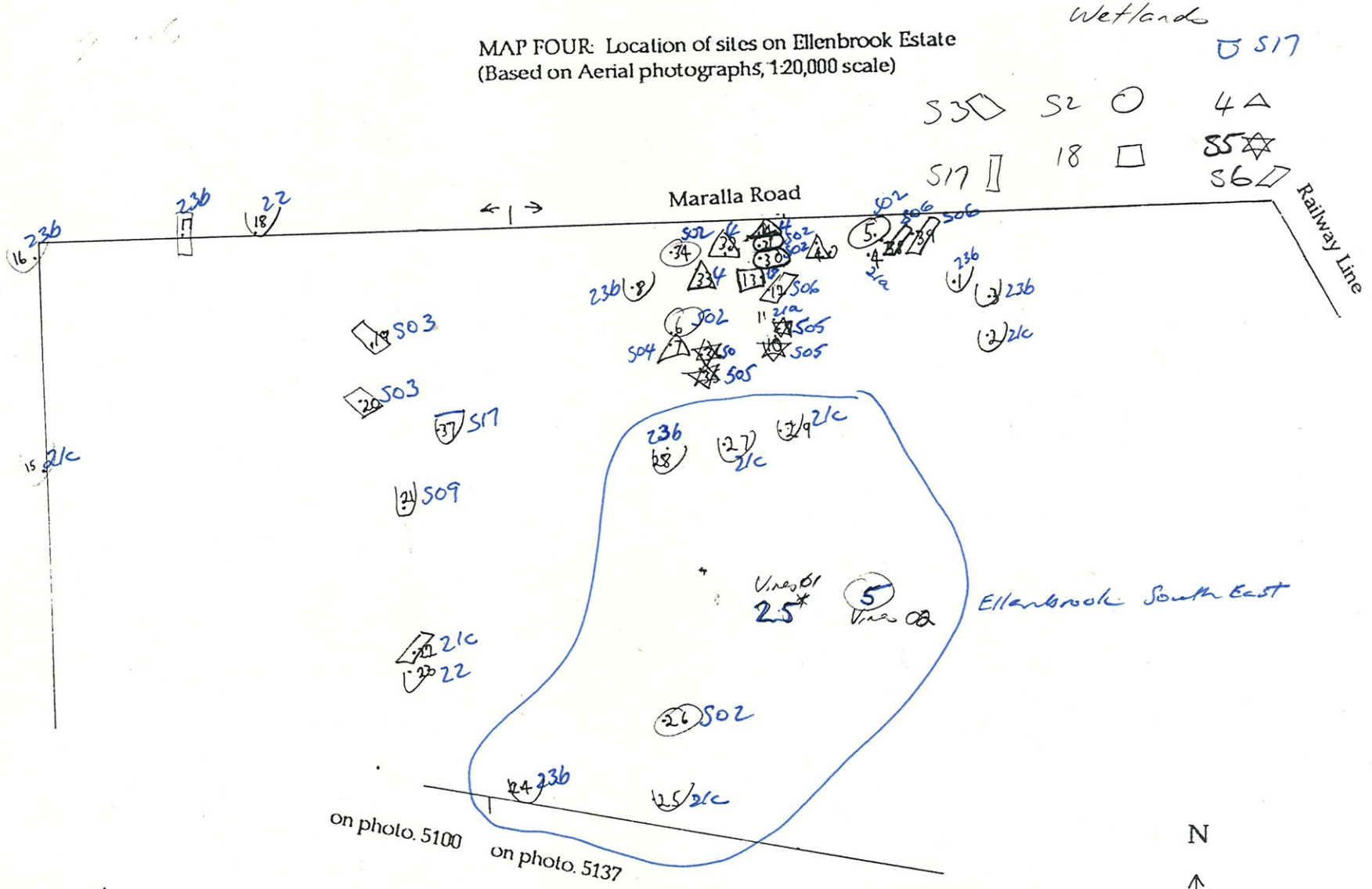
Compiled by: **Ted Griffin**

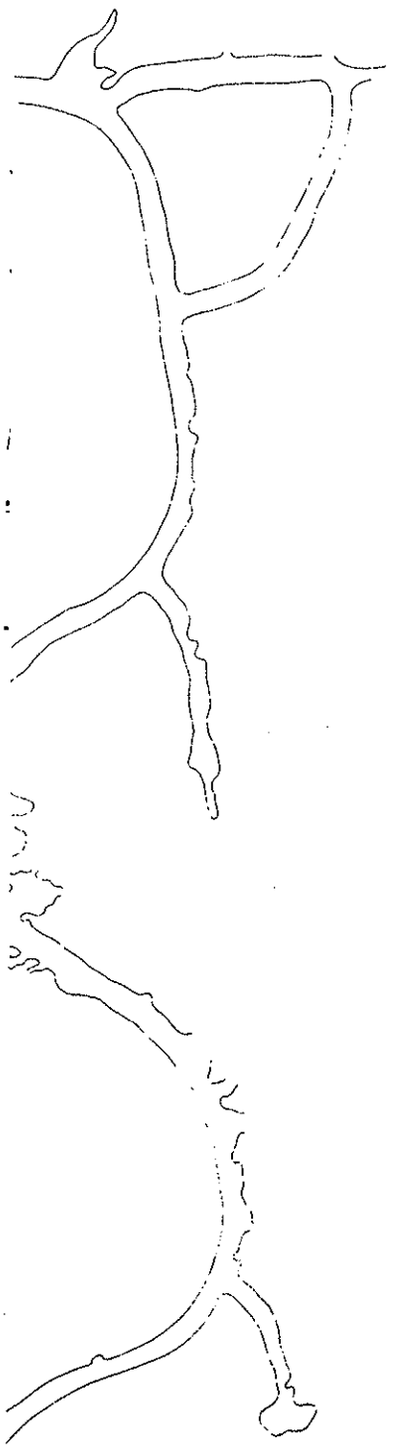
VEGETATION MAP

Map 2

BOWMAN BISHAW GORHAM

MAP FOUR: Location of sites on Ellenbrook Estate
(Based on Aerial photographs, 1:20,000 scale)





0 200
METRES

LEGEND

A1 Banksia (dry) 236(1, 3, 8, 28, 46) 7, 24)
A2 Banksia (moist) 21C(2, 11, 15, 25, 27, 29, 22) 59(21)
A3 Adenanthos/Banksia
A4 Sand heath
B Jarrah-Marri-Banksia 22/22C(TWIN)
C1 Marri- M.preissiana 44/52(26)
C2 Hypocalymma
C3 V.densiflora
C4 Sedges (20, 19) (34)
D M.preissiana-Agonis 53/52
E1 M.preissiana-Pericalymma (east) 52/4(32, 33, 40)
E2 M.preissiana-Pericalymma (west) 52(30)
E3 M.preissiana
E4 Astartea-Pericalymma
F1 B.littoralis (east)
F2 B.littoralis (west)
G Astartea-sedges 517(37)
H Eucalyptus rudis
I M.raphiophylla
J Acacia saligna 55(19, 9, 35, 3C)
K Kunzea recurva 8(1, 3, 2, 5)
L Regelia ciliata 11/6 (NOT CE)
N Baumea articulata

Compiled by: Ted Griffin

VEGETATION MAP

Map 2

BOWMAN BISHAW GORHAM

0 200

METRES

Ellenbrook South east (Vines)

Ellenbrook North East/west

LEGEND

- A1 Banksia (dry)
- A2 Banksia (moist)
- A3 Adenanthos/Banksia
- A4 Sand heath
- B Jarrah–Marri–Banksia
- C1 Marri– M.preissiana
- C2 Hypocalymma
- C3 V.densiflora – not in Ellenbrook BF 300
- C4 Sedges
- D M.preissiana–Agonis
- E1 M.preissiana–Pericalymma (east)
- E2 M.preissiana–Pericalymma (west)
- E3 M.preissiana
- E4 Astartea–Pericalymma
- F1 B.littoralis (east) – not in Ellenbrook BF 300
- F2 B.littoralis (west)
- G Astartea–sedges
- H Eucalyptus rudis
- I M.raphiophylla
- J Acacia saligna
- K Kunzea recurva
- L Regelia ciliata
- N Baumea articulata
- M melaleuca viminea
- melaleuca huegelii #

Compiled by: Ted Griffin

VEGETATION MAP

Map 2

BOWMAN BISHAW GORHAM

0 200

METRES

Ellenbrook North East/west

Ellenbrook South east

LEGEND

- A1 Banksia (dry)
- A2 Banksia (moist)
- A3 Adenanthos/Banksia
- A4 Sand heath
- B Jarrah–Marri–Banksia
- C1 Marri– M.preissiana
- C2 Hypocalymma
- C3 V.densiflora – not in Ellenbrook BC 300
- C4 Sedges
- D M.preissiana–Agonis
- E1 M.preissiana–Pericalymma (east)
- E2 M.preissiana–Pericalymma (west)
- E3 M.preissiana
- E4 Astartea–Pericalymma
- F1 B.littoralis (east) – not in Ellenbrook BC 300
- F2 B.littoralis (west)
- G Astartea–sedges
- H Eucalyptus rudis
- I M.raphiophylla
- J Acacia saligna
- K Kunzea recurva
- L Regelia ciliata
- N Baumea articulata
- M melaleuca viminea
- melaleuca huegelii #

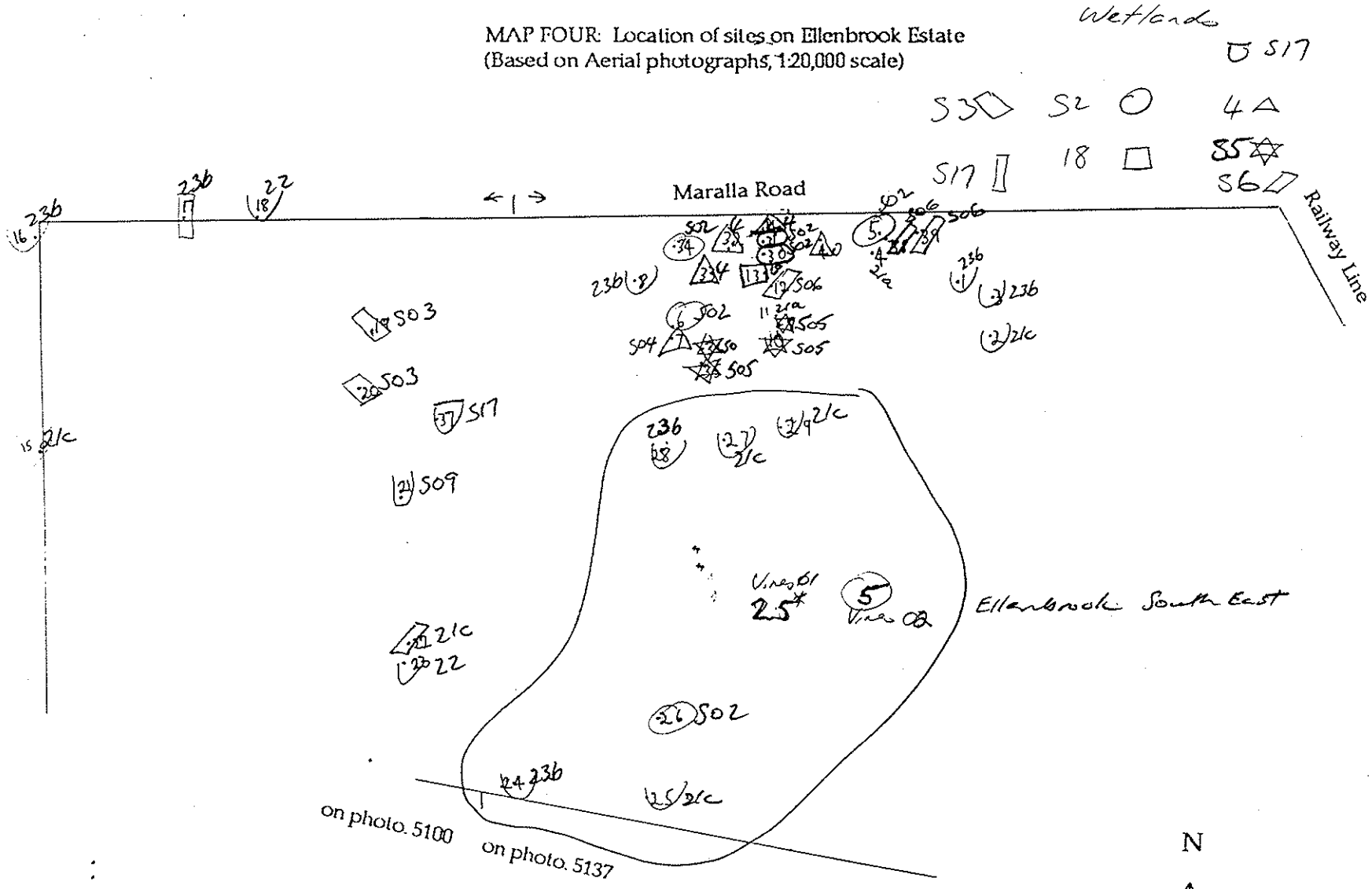
Compiled by: Ted Griffin

VEGETATION MAP

Map 2

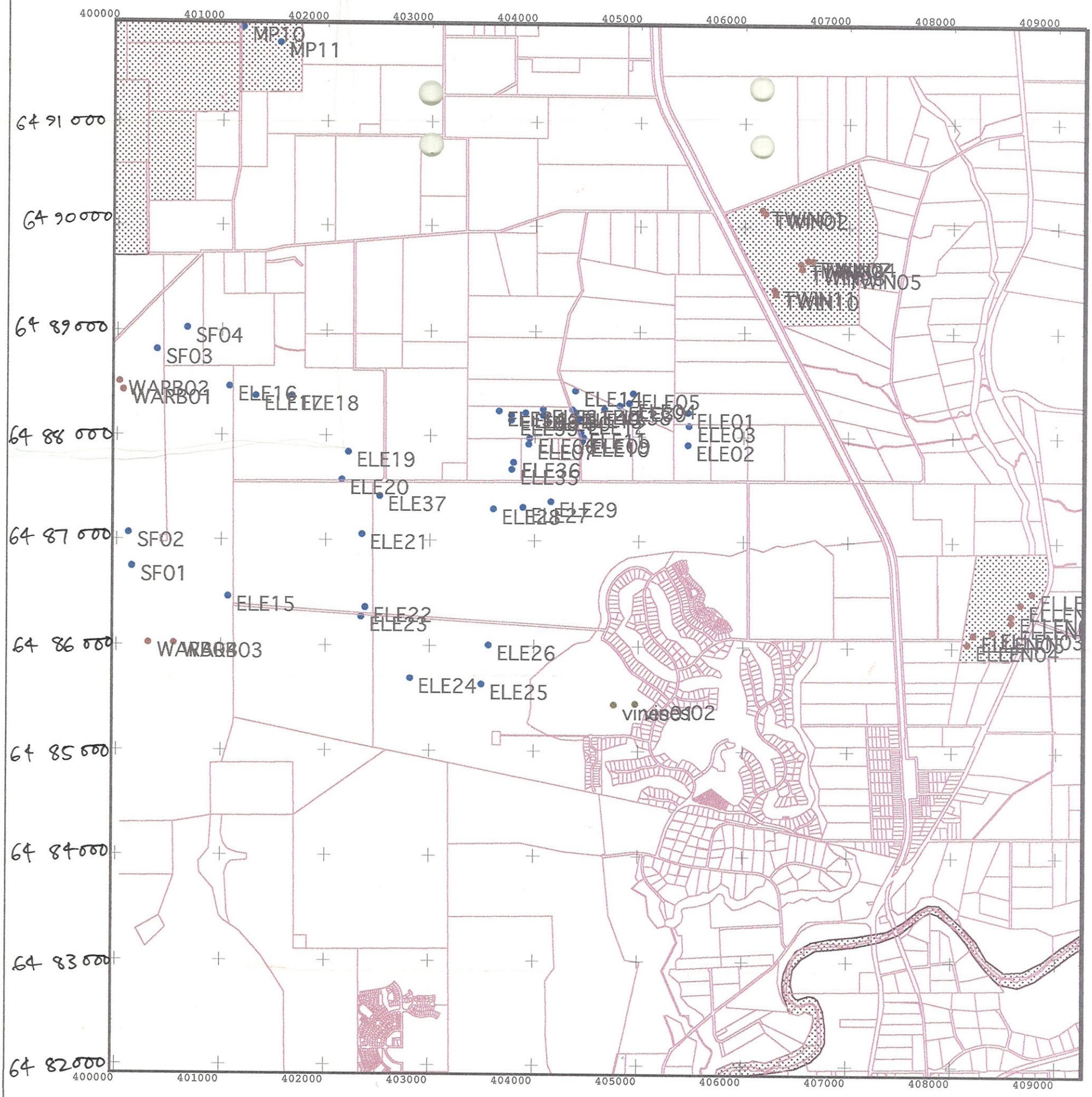
BOWMAN BISHAW GORHAM

MAP FOUR: Location of sites on Ellenbrook Estate
(Based on Aerial photographs, 1:20,000 scale)



Ellenbrook Bushland EA Griffin Floristic Sites ELE01-40

Department of Environmental Protection Western Australia



ELE 19 402189/6488853 ELE 02

ELE

1:40000

Cadastral Boundaries

FLORISTIC SITES

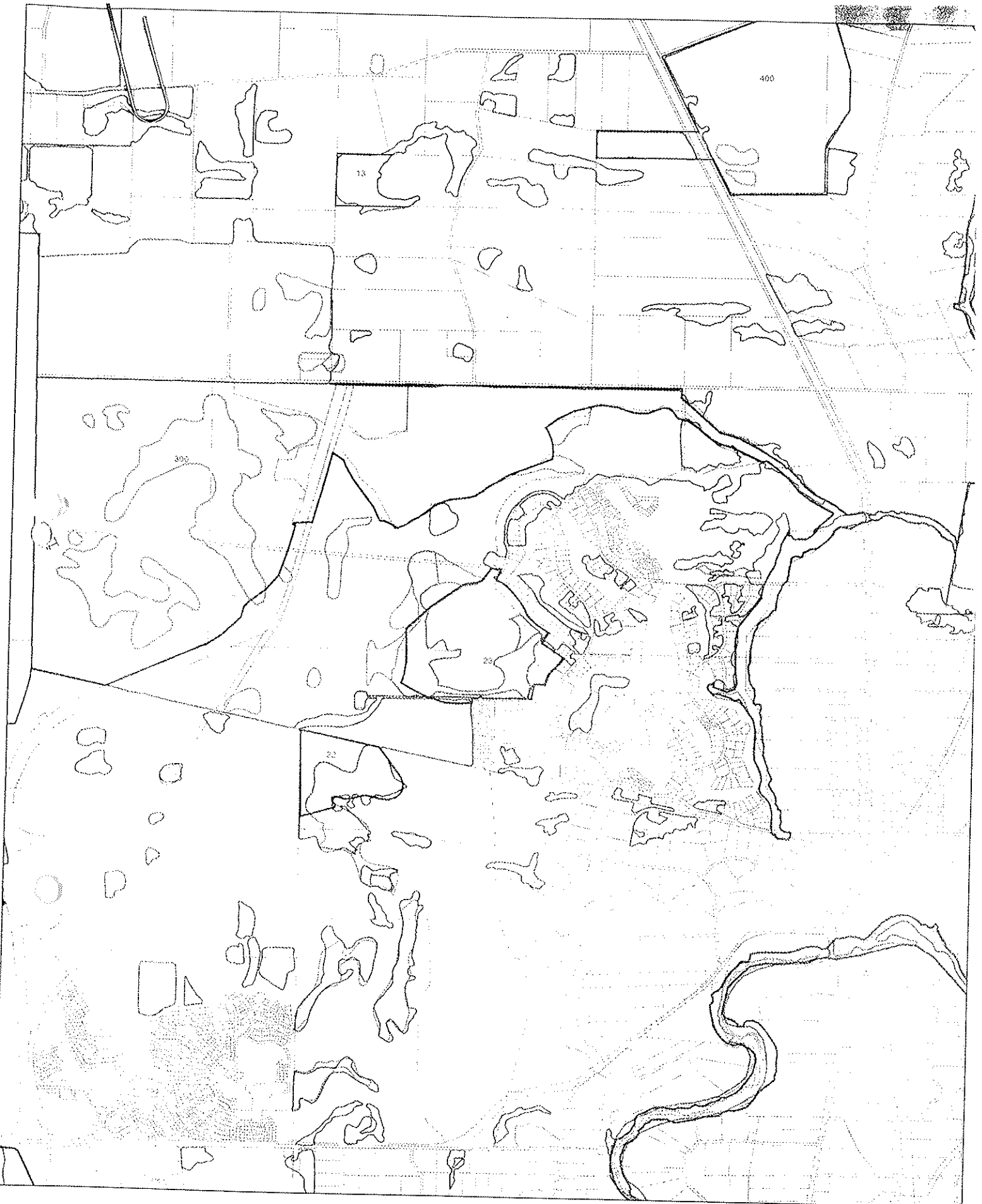
- GJ KEIGHERY
- EA GRIFFIN
- GIBSON ET AL
- SYSTEM 6 YR1
- SYSTEM 6 YR2

System 6

405 474
648 7934

≈ 700m N

N



BUSHPLAN SITES CORRECTED

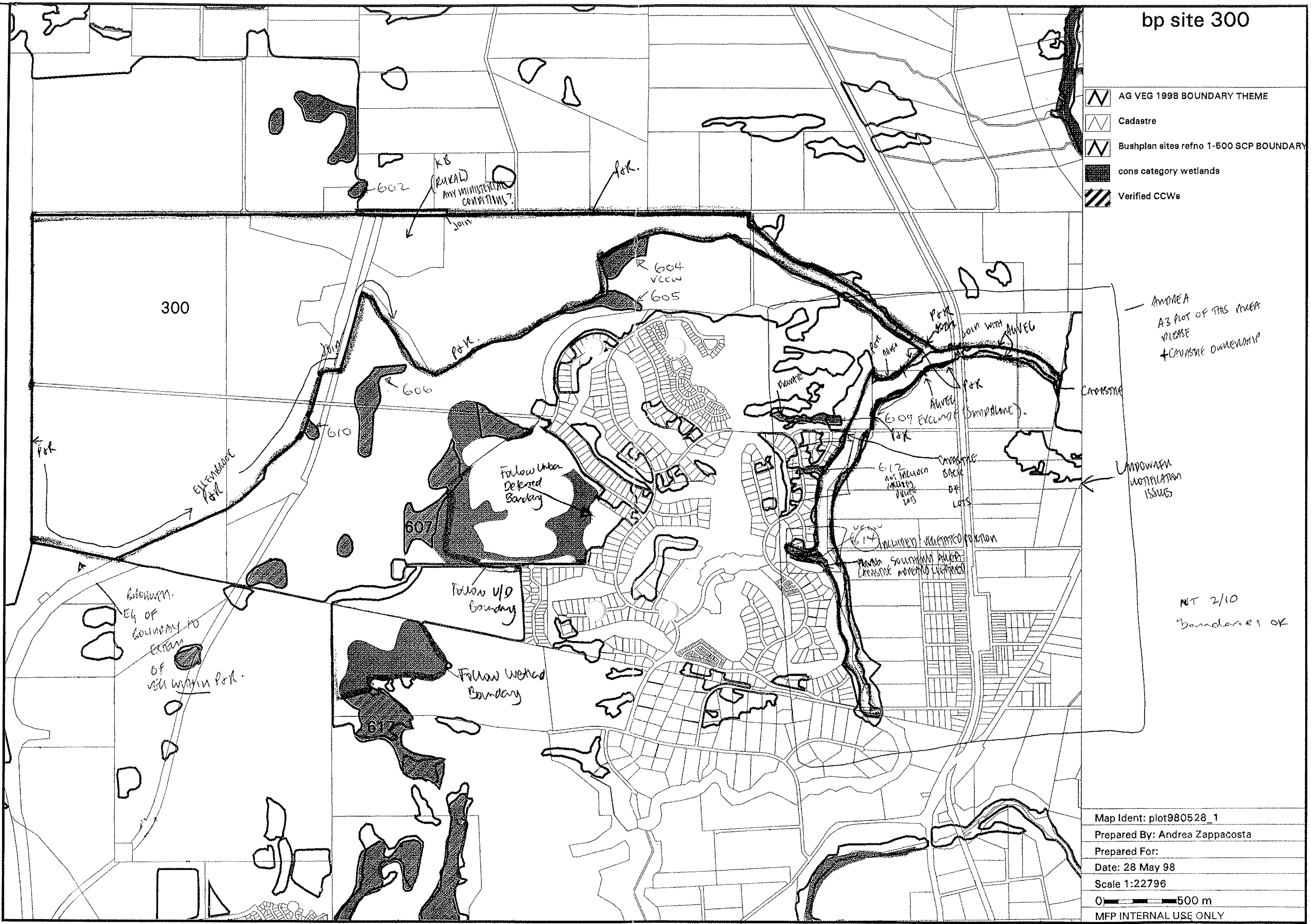
THE GOVERNMENT OF WESTERN AUSTRALIA

WESTERN AUSTRALIAN PLANNING COMMISSION

CUSTOMER FOCUS WESTERN AUSTRALIA

D BK/TG 22/10/98

N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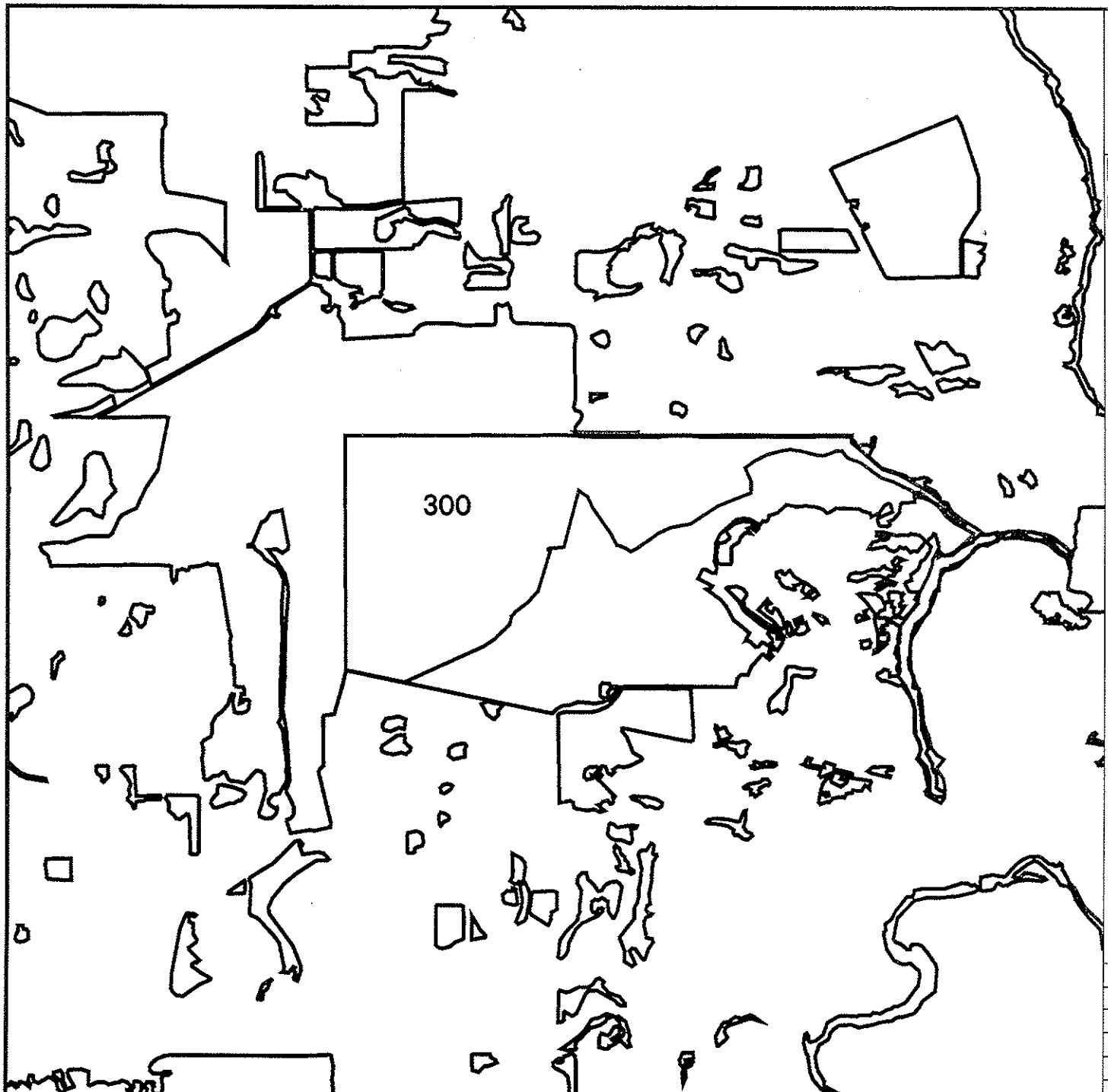
AG VEG 1998 BOUNDARY THEME
Cadastre
Bushplan sites refno 1-500 SCP BOUNDARY
cons category wetlands
Verified CCWs
300
607
617
Map Ident: plot980528_1
Prepared By: Andrea Zappacosta
Prepared For:
Date: 28 May 98
Scale 1:22796
0 500 m
MFP INTERNAL USE ONLY



bp site 300

Bushplan sites refno 1-500 SCP BOUNDARY

AG VEG 1998 BOUNDARY THEME

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Prepared For:
Map Ident: plot980708_1
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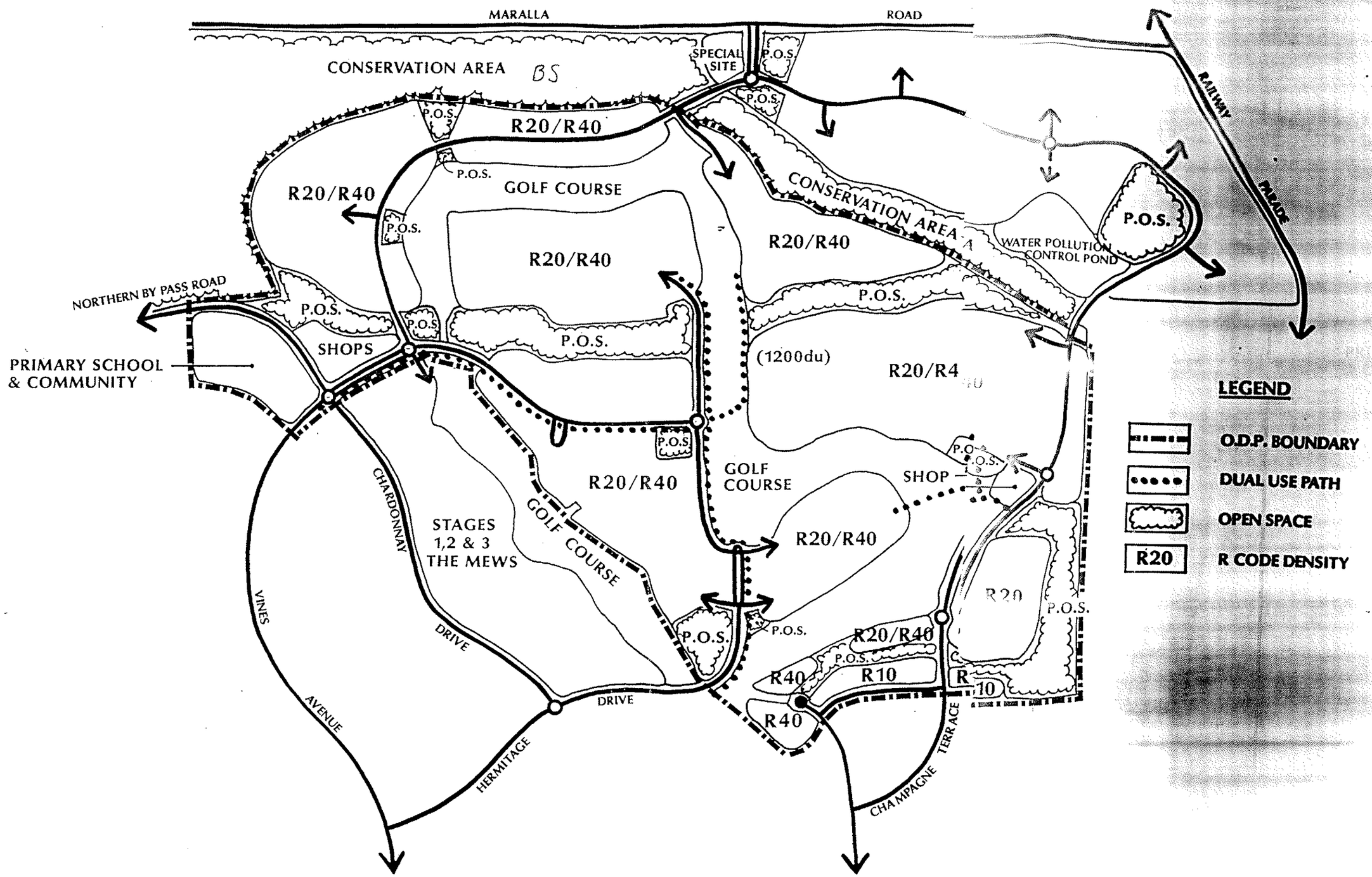

OUTLINE DEVELOPMENT PLAN

CHAPPELL & LAMBERT PLANNING & DESIGN CONSULTANTS

PLAN N°: 5

Conservation and Development
Opportunities at Ellenbrook

(Responses to Conditional
Environmental Approval)

March 1993

ELLENBROOK FAUNA

1. Report on Fauna Conservation Values of the Northern Section of the Ellenbrook Project Area (Watkins D.G. & Bamford M.J. & A.R)

2. Survey for Western Swamp Tortoises (Burbridge A.A. & Fuller P.J)

CONTENTS

TABLE 1. Amphibian and reptile species recorded on the coastal plain between the Swan and Moore Rivers, indicating those species known (+) or expected (?) at Ellenbrook and species recorded at Whiteman and Melaleuca Parks.

Species	Ellenbrook	Whiteman Park	Melaleuca Park
Leptodactylidae (ground frogs)			
Crinia georgiana	+	+	+
Crinia glauertii	+		+
Crinia insignifera	+	+	+
Heleioporus albopunctatus	?		
Heleioporus barycragus	?		
Heleioporus eyrei	+	+	+
Heleioporus psammophilus	?		
Limnodynastes dorsalis	+	+	+
Myobatrachus gouldii	+	+	
Neobatrachus pelobatoides	?		
Pseudophryne guentheri	+	+	+
Hylidae (tree frogs)			
Litoria adelaidensis	+		+
Litoria moorei	+		
Chelidae (side-neck tortoises)			
Chelodina oblonga	+	+	+
Pseudemydura umbrina			
Gekkonidae (geckoes)			
Crenadactylus ocellatus			
Diplodactylus alboguttatus	?	+	
Diplodactylus polyopthalmus			
Diplodactylus spinigerus	+		+
Phyllodactylus marmoratus	?	+	
Underwoodisaurus milii			
Pygopodidae (legless lizards)			
Aclys concinna			
Aprasia pulchella			
Aprasia repens	+	+	
Delma fraseri	+		+
Delma grayii	?		
Lialis burtonis	+	+	+
Pletholax gracilis	+	+	
Pygopus lepidopodus	?	+	+
Agamidae (dragon lizards)			
Pogona minor	+	+	+
Tympanocryptis adelaidensis	+	+	+
Varanidae (monitors or goannas)			
Varanus gouldii	+	+	
Varanus rosenbergi	?	+	
Varanus tristes	?		
Scincidae (skink lizards)			

Bassiana trilineata	+	+	+
Cryptoblepharus plagiocephalus	+	+	+
Ctenotus fallens	+	+	+
Ctenotus gemmula	+	+	+
Ctenotus impar	?	+	
Ctenotus lesueurii	+	+	+
Egernia napoleonis	+	+	+
Egernia luctuosa			
Egernia kingii			
Hemiergis peronii	+		
Lerista christinae	+		
Lerista elegans	+	+	+
Lerista lineopunctulata	?		
Lerista praepedita	+		+
Menetia greyii	+	+	+
Morethia lineoocellata	+	+	+
Morethia obscura	+	+	+
Omelepida branchialis			
Tiliqua occipitalis	+	+	
Tiliqua rugosa	+	+	+
Typhlopidae (blind snakes)			
Ramphotyphlops australis	+	+	
Ramphotyphlops bituberculata	?		
Boidae (pythons)			
Morelia spilotes	?		
Morelia stimsoni	?		
Elapidae (front-fanged snakes)			
Demansia reticulata	?		
Notechis curtus	?		
Notechis scutatus	+	+	
Notechis coronata	?		
Pseudechis australis	?		
Pseudonaja affinis	+	+	+
Pseudonaja nuchalis	?		
Rhinoplocephalus gouldii	+	+	+
Vermicella bertholdi	+		+
Vermicella bimaculata	?		+
Vermicella calonotus	+	+	+
Vermicella semifasciata	+		
Vermicella fasciolata	?	+	

Totals	coastal plain	known	possible		
frogs	13	9	4	6	7
tortoises	2	1		1	1
geckoes	6	1	2	2	1
pygopodids	8	4	2	4	3
dragons	2	2		2	2
goannas	3	1	2	2	
skinks	20	15	2	13	12
snakes	15	7	10	6	5
all	69	40	22	36	31

TABLE 2. Species of birds known (+) or expected (?) at Ellenbrook. Known species are based on RAOU surveys and personal records, expected species on records from Whiteman Park, January 1990 to January 1991 (Arnold *et al.* 1991). Introduced species are indicated (I).

Species	Status at Ellenbrook
Emu *Dromaius novaehollandiae*	+
Pacific Heron *Ardea pacifica*	+
Black-shouldered Kite *Elanus notatus*	+
Brown Goshawk *Accipiter fasciatus*	+
Collared Sparrowhawk *Accipiter cirrhocephalus*	+
Wedge-tailed Eagle *Aquila audax*	+
Little Eagle *Hieraaetus morphnoides*	?
Peregrine Falcon *Falco peregrinus*	?
Australian Hobby *Falco longipennis*	+
Brown Falcon *Falco berigora*	+
Australian Kestrel *Falco cenchroides*	+
Unidentifed Quail *Coturnix* sp.	+
Painted Button-quail *Turnix varia*	?
Spotless Crake *Porzana tabuensis*	?
Laughing Turtle-Dove *Streptopelia senegalensis* (I)	?
Common Bronzewing *Phaps chalcoptera*	+
Baudin's Black-Cockatoo *Calyptorhynchus latirostris*	?
Carnaby's Black-Cockatoo *Calyptorhynchus carnabyi*	?
Galah *Cacatua roseicapilla*	?
Red-capped Parrot *Purpureicephalus spurius*	+
Western Rosella *Platycercus icterotis*	?
Port Lincoln Ringneck *Barnardius zonarius*	+
Elegant Parrot *Neophema elegans*	+
Pallid Cuckoo *Cuculus pallidus*	?
Fan-tailed Cuckoo *Cuculus pyrrhophanus*	+
Horsfield's Bronze-Cuckoo *Chrysococcyx basalis*	?
Shining Bronze-Cuckoo *Chrysococcyx lucidus*	?
Southern Boobook Owl *Ninox novaeseelandiae*	+
Barn Owl *Tyto alba*	+
Tawny Frogmouth *Podargus strigoides*	+
Australian Owlet-nightjar *Aegotheles cristatus*	+
Fork-tailed Swift *Apus pacificus*	?
Laughing Kookaburra *Dacelo novaeguineae* (I)	+
Sacred Kingfisher *Halcyon sancta*	?
Rainbow Bee-eater *Merops ornatus*	+
Welcome Swallow *Hirundo neoxena*	+
Tree Martin *Cecropis nigricans*	+
Richard's Pipit *Anthus novaeseelandiae*	?
Black-faced Cuckoo-shrike *Coracina novaehollandiae*	+
White-winged Triller *Lalage sueurii*	?
Scarlet Robin *Petroica multicolor*	+
Red-capped Robin *Petroica goodenovii*	?
Hooded Robin *Melanodryas cucullata*	+

Rufous Whistler *Pachycephala rufiventris*	+
Golden Whistler *Pachycephala pectoralis*	+
Grey Shrike-thrush *Colluricincla harmonica*	+
Crested Bellbird *Oreoica gutturalis*	?
Grey Fantail *Rhipidura fuliginosa*	+
Willie Wagtail *Rhipidura leucophrys*	+
Splendid Fairy-wren *Malurus splendens*	+
White-winged Fairy-wren *Malurus leucopterus*	?
unidentified, chestnut-winged fairy-wren *Malurus* sp.	+
Weebill *Smicrornis brevirostris*	+
Western Gerygone *Gerygone fusca*	+
Inland Thornbill *Acanthiza apicalis*	+
Western Thornbill *Acanthiza inornata*	+
Yellow-rumped Thornbill *Acanthiza chrysorrhoa*	+
Varied Sittella *Daphoenositta chrysoptera*	+
Red Wattlebird *Anthochaera carunculata*	+
Little Wattlebird *Anthochaera chrysoptera*	+
Yellow-throated Miner *Manorina flavigula*	+
Singing Honeyeater *Lichenostomus virescens*	+
Brown-headed Honeyeater *Melithreptus brevirostris*	?
Brown Honeyeater *Lichmera indistincta*	+
New Holland Honeyeater *Phylidonyris novaehollandiae*	+
White-cheeked Honeyeater *Phylidonyris nigra*	+
Tawny-crowned Honeyeater *Phylidonyris melanops*	+
Western Spinebill *Acanthorhynchus superciliosus*	+
Mistletoebird *Dicaeum hirundinaceum*	+
Spotted Pardalote *Pardalotus punctatus*	+
Striated Pardalote *Pardalotus striatus*	+
Silvereye *Zosterops lateralis*	+
Red-eared Firetail *Stagonopleura oculata*	?
Australian Magpie-lark *Grallina cyanoleuca*	+
Black-faced Woodswallow *Artamus cinereus*	+
Dusky Woodswallow *Artamus cyanopterus*	?
Masked Woodswallow *Artamus personatus*	?
Grey Butcherbird *Cracticus torquatus*	+
Australian Magpie *Gymnorhina tibicen*	+
Australian Raven *Corvus coronoides*	+

known species	57
expected species	80

TABLE 3. Species of mammals known (+) or expected (?) at Ellenbrook, on the basis of records at Whiteman Park (Arnold *et al.* 1991) and personal records for the general region.

Species	Ellenbrook	Whiteman Park
Tachyglossidae (echidnas)		
Tachyglossus aculeatus Echidna	?	+
Dasyuridae		
Sminthopsis griseoventer dunnart	?	
Dasyurus geoffroii Chuditch	?	
Peramelidae (bandicoots)		
Isoodon obesulus Quenda or Southern Brown Bandicoot	+	+
Phalangeridae (possums)		
Trichosurus vulpecula Brush-tailed Possum	?	
Burramyidae (pygmy possums)		
Cercartetus concinnus Western Pygmy Possum	?	
Tarsipedidae (honey possum)		
Tarsipes rostratus Honey Possum	?	+
Macropodidae (kangaroos and wallabies)		
Macropus fuliginosus Western Grey Kangaroo	+	+
Macropus irma Brush Wallaby	+	+
Mollosidae (mastiff bats)		
Tadarida australis White-striped Bat	?	
Mormopterus planiceps	?	
Vespertilionidae (vesper bats)		
Chalinolobus gouldii Gould's Wattled Bat	?	
Chalinolobus morio Chocolate Wattled Bat	?	
Eptesicus regulus	?	
Nyctophilus geoffroyi Lesser Long-eared Bat	?	
Nyctophilus major Greater Long-eared Bat	?	
Muridae (rats and mice)		
Hydromys chrysogaster Water-rat	?	+
Mus musculus House Mouse (I)	?	+
Pseudomys albocinereus Ashy-grey Mouse	?	+
Rattus fuscipes Southern Bush-Rat	?	
Rattus rattus Black Rat (I)	?	+
Leporidae (rabbits and hares)		
Oryctolagus cuniculus Rabbit (I)	+	+

TABLE 3 (cont.).

Species	Ellenbrook	Whiteman Park
Canidae (foxes and dogs)		
Vulpes vulpes European Red Fox (I)	+	+
Felidae (cats)		
Felis catus Feral Cat (I)	?	
Number of species known	5	11
Number of species known and possible	24	

Conservation and Development
Opportunities at Ellenbrook

(Responses to Conditional
Environmental Approval)

March 1993

FLORA AND VEGETATION

Objection Assessment

of the

Ellenbrook National Estate area

flora and vegetation values

Prepared for the

Australian Heritage Commission

by

Malcolm Trudgen
Consultant Botanist

January 1998

TABLES

1.0 INTRODUCTION

1.1 Purpose of this assessment

The purpose of this assessment is to assist and advise the Australian Heritage Commission (AHC) in the assessment of the national estate significance of the bushland areas of the interim listed area at Ellenbrook (see definition in the paragraph below) and to advise the Commission of the national estate significance of bushland areas within the interim listed area at Ellenbrook and on adjoining areas (after AHC 1997, Schedule 1 paragraph A).

In this report the area called the interim listed area at Ellenbrook is the area shown on Map One, suggested additions to the interim listed area are also shown on Map One. This map is from AHC 1997 and shows the area which has been placed on the Interim List of the National Estate by the AHC and which is the subject of this report. The name interim listed area at Ellenbrook is used for this area in this report except when quoting or paraphrasing sources who have used other names for the area. It should be noted here that the interim listed area at Ellenbrook lies partly in the localities of Ellenbrook, The Vines and Bullsbrook. The Egerton property is in the locality of Ellenbrook. The name Ellenbrook Estate has been used by some authors, for example Weston, Griffin and Trudgen (1992), for an area that is part of the interim listed area at Ellenbrook.

1.2 Objection assessment process

The points the assessor has been asked to address in this report are:

(i) is the database information produced by the Commission accurate and comprehensive;

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(iii) are the boundaries of the proposed area appropriate, given the significance of the place? What adjustments to the boundary, if any, are needed to define the significant area accurately and closely? (NB. The answer to this question may involve deletion or addition of areas; however, substantial proposed additions will be dealt with separately by the Commission and must not be dealt with in the assessment report. Any such proposed additions must be the subject of a separate report);

(iv) Given the definition of the "National Estate" contained in the *Australian Heritage Commission Act* and the criteria illuminating that definition, does the place, in your opinion, warrant entry in the Register?;

(v) do you have any comments on the integrity of the place, or other views of a technical nature, which may assist the Commission in deciding whether the place should be entered in the Register of the National Estate."

These points are all from the document AHC 1997, attachment 1, paragraph 2. (In relation to section (ii), it should be noted that there is no section entitled 'Terms of Reference' in the contract for this assessment).

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Not all the criteria (AHC 1997, attachment 2) for listing on the Register of the National Estate are potentially relevant to the bushland of the interim listed area at Ellenbrook in relation to the flora found in and making up that bushland.

The criteria that seem potentially relevant to the flora of the interim listed area at Ellenbrook are:

Criterion A: ITS IMPORTANCE IN THE COURSE, OR PATTERN, OF AUSTRALIA'S NATURAL OR CULTURAL HISTORY

A.1: Importance in the evolution of Australian flora, fauna landscapes or climate;

A.2.: Importance in maintaining existing processes or natural systems at the regional or national scale;

A.3. Importance in exhibition unusual richness or diversity of flora, fauna, landscapes or cultural features.

Criterion B: ITS POSSESSION OF UNCOMMON, RARE OR ENDANGERED ASPECTS OF AUSTRALIA'S NATURAL OR CULTURAL HISTORY.

B.1 Importance for rare, endangered or uncommon flora, fauna, communities, ecosystems, natural landscapes or phenomena, or as a wilderness.

Criterion D: ITS IMPORTANCE IN DEMONSTRATING THE PRINCIPAL CHARACTERISTICS OF :

(I) A CLASS OF AUSTRALIA'S NATURAL OR CULTURAL PLACES; OR

(II) A CLASS OF AUSTRALIA'S NATURAL OR CULTURAL ENVIRONMENTS.

D.1 Importance in demonstrating the principal characteristics of the range of landscapes, environments or ecosystems, the attributes of which identify them as characteristic of their class.

It needs to be noted that AHC 1997 uses the term flora in a very broad sense, to include both individual species and the vegetation they form. The meaning used in this report is clarified where this has seemed necessary.

1.5 Main objections raised by the landowners of the interim listed area at Ellenbrook and the Western Australian Government

1.5.1 Objections of the Western Australian Government

The Hon. Richard Lewis, Western Australia's (then) Minister for Planning and Heritage, in objecting on behalf of the State Government to the inclusion of the interim listed area at Ellenbrook in the Register of the National Estate, argues that the State Government has already taken steps to set aside 600 ha within the nominated area, that the Australian Heritage Commission has failed to demonstrate its claim for land outside this already reserved area, that the data used in the nomination based on the presence of priority taxa is out of date and misleading, that over twelve of the taxa in the nomination are of uncertain taxonomic status, only priority 1 and 2 species are under threat, and only four species fall into this category, not the 15 quoted. Mr Lewis also opposes the nomination on the basis that many of the species mentioned are wetland plants and are conserved in the Lexia wetlands area; that one species, *Grevillea curviloba* is a common garden plant, although it is uncommon in the wild, and that the only rare plant cited in the nomination, *Caladenia huegelii*, has sporadic distribution from Perth to Busselton, has been found in the Sawpit Gully area which has been recognised and reserved, and in any case was acknowledged to have been a misidentification when originally reported for the area. Mr Lewis' objections also include the argument that the nomination's statements about the conservation status of the vegetation complexes is misleading because over 3800 hectares of *Banksia* woodland and associated vegetation or wetland and

associated vegetation have recently been reserved by the State Government. Furthermore, he says:

> *State Government agencies have almost completed the first definitive inventory of remnant vegetation of the Perth Metropolitan Region and can now confidently state that the Southern River vegetation complex has approximately 18% remaining and the Yanga vegetation complex has approximately 16% remaining, not "less than 10%" as quoted.*

Mr Lewis also criticises the lack of mention in the nomination of 3500 ha (11.2%) of the Southern River vegetation complex having been set aside in State planning schemes. He also states that the planning scheme has recognised the Bassendean Vegetation Complex (-North, sic) and 438 ha have now been reserved through the planning scheme in the Lexia wetlands. Equally, Mr Lewis maintains that the scarcity of the Yanga Vegetation Complex is also already recognised in the reservation of the Sawpit Gully area, and that about half of the Twin Swamps Nature Reserve and a small portion of the Ellenbrook Nature Reserve contain Yanga vegetation complex. Mr Lewis challenges the nomination further:

> *the Ellenbrook area is on the southeast periphery of the a larger chain of remnant vegetation; vegetation corridors are with the rest of that chain, not with Twin Swamps and Ellen Brook Nature Reserve [as claimed in the nomination]. The area has no connection whatsoever to Walyunga National Park and has peripheral connections to Whiteman Park*

Other major criticisms by Mr Lewis include criticisms of the AHC for failing "to consult adequately with all affected landowners", as well as for including an area in the Register which is earmarked for development.

The State Governments objections to the nomination are discussed in Section Seven. However, one point will be made here in relation to the objection's figures for the conservation status of the Yanga and Southern River vegetation complexes. It is claimed in the State Governments objections that these vegetation complexes have 18% and approximately 16% remaining respectively. The source for these figures has not been provided in the objection. However, it is likely that the figures were obtained from the data base compiled by the Western Australian Ministry for Planning for the Perth Metropolitan Region. This particular data base has an artificial boundary based on the Perth

Metropolitan Region. This fact inevitably leads to an overestimate of the total remaining percentage of those vegetation complexes which have a higher proportion of their boundaries in the Perth Metropolitan Region when figures from the Ministry for Planning database are used in the context of how much remains of a vegetation complex over its original extent (except of course for vegetation complexes confined to the Perth Metropolitan Region).

1.5.2 Main Objections of Multiplex Constructions Pty Ltd.

The main objections raised by Multiplex Construction to the proposed listing of a part of the Egerton property on the Register of the National Estate include:

An objection that there is no locality known officially as either Ellenbrook National Estate or Maralla Area, the names used in the documentation forwarded by the AHC;

An objection that the majority of the Egerton property, including the nominated area, is zoned Urban in the Metropolitan Region Scheme as are areas to the north and west of Egerton. Consequently, it is stated, any land which is retained in its natural condition in Egerton will not be linked by other land in natural condition to the major reserves in the Ellenbrook National Estate Area;

An objection that the Egerton property has not been accessed to examine its natural attributes in respect of preparing a nomination for listing by the AHC. None of the bibliography used to support the nomination is directly related to Egerton. Consequently, the objector says the nomination is unjustified;

An objection that all references in the nomination to 427 plants and 25 vegetation types are to the Ellenbrook Estate site (Weston et al. 1992) and not to the Egerton property. This point concludes: "Therefore the Egerton section of the nomination is not significant in this criterion";

An objection that the list of 15 CALM priority species refers only to species identified at Ellenbrook and that the list itself is out of date: six of the species have been deleted from the then most recent priority list (14 September 1994). Again the objection states that as this criterion only refers to the Ellenbrook area, the Egerton portion of the nomination is not significant. The objection further notes that "*Lycopodium serpentinum*, which occurs in the Egerton seepage area", is mentioned in the nomination as "being found nowhere else on the Swan

Coastal Plain. The objector claims that this is erroneous, "as it is not listed as a Declared Rare Flora, nor is it on the CALM Priority list".

An objection relating to a mound spring: mentioned in the nomination as an unusual structure in the south of the area which supports a number of uncommon species, but which the objector states is not a true mound spring. but a type of groundwater discharge common in the Swan Valley in areas of low elevation;

An objection in relation to rare or restricted species in Ellenbrook Estate, specifically that as no reference in the nomination is to Egerton, the Egerton property "can not be considered important in this criterion"[Criterion B1];.

That the distribution of *Lycopodium serpentinum* is erroneous: while the nomination says that *Lycopodiumn serpentinum* occurs in 'mound spring-like structure and nowhere else on the Swan Coastal Plain', Weston et al. - lists *L. serpentinum* as occurring in the Ellenbrook Estate area adjacent to Egerton;

That the nomination refers to a "mound spring", an "unusual structure in the south of the area which supports a number of uncommon species". The objector states that the seepage area, which has been shown not to be a mound spring, will be retained and protected within the Wetland Open Space in the future development.

An objection that it is unclear whether the nominated part of the Egerton property is included because of the regional significance of the vegetation. The objector's position is that the regional significance of the Egerton vegetation is low due to the large area (approximately 600 ha) of Banksia Woodland and wetland vegetation to be retained in the Ellenbrook Estate development "and the similarity and lesser value of the Egerton communities, compound to this future reserve area"(sic).

1.5.3 Main objections of Messrs Anthony Kourtesis, Jack Kourtesis and Luke Stambelos

The objectors maintain that their land, which is included in the nomination, bears little in terms of distinctive flora and fauna, has no particular aesthetic importance, is close to a major development, would not be accessible to tourists, is unremarkable for its natural attributes, that flora identified by the nomination

The objectors also claim the AHC nomination contains inaccurate data evaluation and omissions:

Contrary to the claims of the nomination, it is the Yanga Complex which is the significant complex within the site;

Contrary to statements in the nomination, available data does not indicate that the Lexia wetlands are 'unusually diverse". (The objectors maintain that most of the floristic diversity occurs within the winter damp heathland in the eastern sector of the site, which "is comparable or less diverse than other colluvial or alluvial landforms");

The term 'mound springs' used in the nomination should not be confused with a true mound spring, "*the known mound spring is located on the adjacent Egerton Property and has been more accurately described as "a break in grade" spring, as it occurs at the interface of the Bassendean Sand Dune landform and the Guildford Formation(Pinjarra Plain) landform*";

The Department of Conservation and Land Management's List of Priority flora does not cite *Cassytha micrantha* and *Lycopodium serpentinum* as Priority Species;

No declared rare flora has been found on the site. Of the 15 priority species found in the area, eight species are restricted in distribution whilst seven species are of low priority, found in other locations and are not considered to be under immediate threat. Almost all of the priority species are represented in the Eastern Sawpit area of the site; (the objectors suggest that the high number of priority species in this one location indicates that the eastern area is of regional significance for threatened or restricted plants);

The high species diversity in Ellenbrook is partly due to the higher sampling intensity. The high species diversity in the eastern sector of Ellenbrook is more typical of other sites which occur on colluvial or alluvial soils (e.g. Brixton Street, Yule Reserve, Ellenbrook - Eastern damplands only). The relatively small area of eastern dampland with clayey subsoils at Ellenbrook has the highest concentration of species (64% of the flora) and is considered to have regionally significant conservation values);

Objection Assessment

of the

Ellenbrook National Estate area

flora and vegetation values

Prepared for the

Australian Heritage Commission

by

Malcolm Trudgen
Consultant Botanist

January 1998

CONTENTS

TABLES

1.0 INTRODUCTION

1.1 Purpose of this assessment

The purpose of this assessment is to assist and advise the Australian Heritage Commission (AHC) in the assessment of the national estate significance of the bushland areas of the interim listed area at Ellenbrook (see definition in the paragraph below) and to advise the Commission of the national estate significance of bushland areas within the interim listed area at Ellenbrook and on adjoining areas (after AHC 1997, Schedule 1 paragraph A).

In this report the area called the interim listed area at Ellenbrook is the area shown on Map One, suggested additions to the interim listed area are also shown on Map One. This map is from AHC 1997 and shows the area which has been placed on the Interim List of the National Estate by the AHC and which is the subject of this report. The name interim listed area at Ellenbrook is used for this area in this report except when quoting or paraphrasing sources who have used other names for the area. It should be noted here that the interim listed area at Ellenbrook lies partly in the localities of Ellenbrook, The Vines and Bullsbrook. The Egerton property is in the locality of Ellenbrook. The name Ellenbrook Estate has been used by some authors, for example Weston, Griffin and Trudgen (1992), for an area that is part of the interim listed area at Ellenbrook.

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The points the assessor has been asked to address in this report are:

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(ii) what are the grounds for objection which relate to the national estate significance of the place. (These grounds are identified in the 'Terms of Reference' for the contract or the assessment);

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The objectors maintain that their land, which is included in the nomination, bears little in terms of distinctive flora and fauna, has no particular aesthetic importance, is close to a major development, would not be accessible to tourists, is unremarkable for its natural attributes, that flora identified by the nomination

is commonly found throughout the State of Western Australia, that the objectors' land does not contain any woodland or wetlands which warrant special protection and given all that, that the land ought to be set aside for development.

1.5.4. Main objections by Mount Lawley Pty Ltd

The objector makes a number of points relating to lack of commitment by the State Government to properly preserve the land which has been reserved for Parks and Recreation and refers to new threats to it, for example the proposed Perth to Darwin National Highway. He argues that there will be negative impacts on the preservation of this land, that the reserved land will be degraded, thereby defeating the purpose of its reservation. The objector does not raise points specific to flora.

1.5.5. Main objections by Ellenbrook Joint Venture (representing Sanwa Vines Pty Ltd and the State Housing Commission (Homeswest)

The objectors state that the current listing does not have regard to all of the available information describing the conservation values of the site, that the listing does not meet the intended functions of the Register in providing an objective resource inventory as required by the Act, and that much of the land will be developed for affordable housing, and therefore cannot be available or protected in its current state for future generations. The objectors argue that listing such land under these circumstances is inconsistent with the objectives of the Act.

The objectors claim the AHC nomination is inaccurate and that it contains misinterpretations, for example:

Caladenia huegelii is absent from the site;

The 'statement of significance' does not recognise the variability of conservation values over the nominated area and does not refer to the presence of nearby secure conservation reserves which include representative areas of flora, vegetation and habitats also found at Ellenbrook;

Water level impacts in the Lexia wetlands, caused by the existence of very expansive areas of pine plantation in the adjacent State Forest no. 65, are not recognised.

The objectors also claim the AHC nomination contains inaccurate data evaluation and omissions:

Contrary to the claims of the nomination, it is the Yanga Complex which is the significant complex within the site;

Contrary to statements in the nomination, available data does not indicate that the Lexia wetlands are 'unusually diverse". (The objectors maintain that most of the floristic diversity occurs within the winter damp heathland in the eastern sector of the site, which "is comparable or less diverse than other colluvial or alluvial landforms");

The term 'mound springs' used in the nomination should not be confused with a true mound spring, "*the known mound spring is located on the adjacent Egerton Property and has been more accurately described as "a break in grade" spring, as it occurs at the interface of the Bassendean Sand Dune landform and the Guildford Formation(Pinjarra Plain) landform*";

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The high species diversity in Ellenbrook is partly due to the higher sampling intensity. The high species diversity in the eastern sector of Ellenbrook is more typical of other sites which occur on colluvial or alluvial soils (e.g. Brixton Street, Yule Reserve, Ellenbrook - Eastern damplands only). The relatively small area of eastern dampland with clayey subsoils at Ellenbrook has the highest concentration of species (64% of the flora) and is considered to have regionally significant conservation values);

The mosaic of *Banksia* woodlands of the Bassendean Complex (Jandakot and Gavin landform units) are not significant associations, but are common and well represented on the Swan Coastal Plain. The Yanga and Southern River Complexes (11 vegetation units) are significant due to their lack of representation on the Swan Coastal Plain. The objectors recognise the wetlands as having intrinsic value, but not the associations of the seasonal swamps (particularly to the west);

The previous record for the rare orchid *Caladenia huegelii* was most likely a misidentification;

Historic groundwater data indicates that the Lexia wetlands to the west of the site may have been impacted by a reduction in groundwater level due to adjacent pine plantations and have contracted significantly over the past 50 years.

This submission also argues that 70 per cent of the total flora on the site is represented in nearby conservation reserves and managed areas, and additional representation of species are likely to occur in other, more distant conservation reserves.

1.5.6 Major objections by Stefanelli Nominees Pty Ltd and Brajkovich Holdings Pty Ltd

The landowners contend that the property is degraded by grazing as it was an operational cattle farm and grazing extended into the areas currently identified within the boundaries of the heritage listing.

The land was acquired for its high grade silica sand resource. They state that the land is identified as a Priority Resource Area in the context of the State Government's Basic Raw Materials Policy, a policy intended to provide a planning framework for identifying and protecting valuable resources within the Metropolitan Region. The land is also subject to a current mining lease over the major portion of the property. While the mining lease is granted to the landowners, Amatek have entered into an agreement with the landowners to mine sand from the property.

Amatek are presently in the process of designing and constructing road access to the site to commence extraction. The status of the land as a priority area for resource extraction has been reinforced in the North East Corridor Structure Plan

(DPUD 1994). In view of these facts and the fact that the owners originally acquired the land for its resource value, the objectors request that the land not be included in the heritage listing for the Ellenbrook area.

1.5.7 Objections by Rocla Quarry Products

In a verbal objection, Rocla Quarry Products argued that the nomination to the Register of the National Estate of the Ellenbrook Area was inadequate because more information was now available. Rocla also objected that some of the information in the AHC listing was inaccurate, that in any case the purpose of the listing could no longer be met because planning approvals were given two years ago. Rocla emphasised that they were working closely with the Department of Conservation and Land Management to whom they submit an annual report on vegetation clearing. Rocla has also engaged an Honours student to study rehabilitation of cleared areas. The student is supervised by Kingsley Dixon of Kings Park Board and the data are now available.

1.6 Definitions of rare and unusual flora, of rare flora communities (vegetation) and of rare ecosystems

Some of the criteria by which national estate value is to be judged (particularly Criterion B1) involve the presence of "rare, endangered or unusual flora, fauna, communities, natural landscapes or phenomena" (AHC, 1997). This immediately raises the question of the definition of rarity.

In Western Australia, there is an accepted definition of rare flora under the Wildlife Act. A defacto definition of uncommon species can be inferred for those that are on the Department of Conservation and Land Management (CALM) *Declared Rare and Priority Flora List* (Atkins 1997) but are not declared rare (although some of these are considered rare by CALM, but for various reasons are not gazetted). Some of the difficulties of working with definitions of rare, uncommon or restricted flora in Western Australia are set out in Appendix 2 of Weston, Griffin and Trudgen (1992). Notwithstanding these difficulties, the Department of Conservation and Land Management's *Declared Rare and Priority Flora List* (Atkins 1997) provides useful information on the status of rare and uncommon species in Western Australia.

In contrast to rare flora species, there are no generally accepted definitions of rare flora communities (vegetation) and ecosystems and no simple definition is practical in all regards. For the purposes of this report, the following definition is advanced: an ecosystem or vegetation type (whether plant community, association, vegetation complex or floristic community type) should be considered rare when

- its original extent was less than 2,000 hectares, irrespective of what proportion of its original extent survives; or

- its original extent was 2,000 to 20,000 hectares and less than 2,000 hectares or less than 30% of its original extent survives; or

- its original extent was 20,000 to 100,000 hectares or more, and the portion of the original extent remaining is less than 30% for an original extent of 20,000 ha, declining to less than 20% for an original extent of 50,000 ha and declining again to less than 10% for an original extent of 100,000 ha or more.

The thrust of this definition is to define vegetation as rare when its original extent was very small (2,000 ha or less) and as having become rare compared to an original extent, when the original distribution has been reduced by clearing or other activities below the areas suggested above. The end of this sliding scale has been taken as ten percent for areas of 100,000 hectares or more, as ten percent is the minimum area recommended for protection of an ecosystem by the International Union for the Conservation of Nature (IUCN). However, this percentage would obviously not be appropriate for vegetation types (or ecosystems) with very small original areas. Therefore, a sliding scale was chosen to link small areas through intermediate sized areas to the general standard. Obviously, this is somewhat arbitrary, but a vegetation type with an original extent of only 2,000 hectares is rare or at least unusual on a state or national scale and a vegetation type that originally had an extent of more than 100,000 hectares and has been reduced to 10,000 hectares or less is certainly uncommon (or rare) compared to its original extent. The scale attempts to provide a resolution of a problem that is partly absolute (for small original extents) and partly relative (for large original extents) and should be taken as a guide only.

The definition of 'rare' flora and vegetation is also addressed in the Federal *Endangered Species Protection Act 1992*, which came into effect on 30 April 1993. The following definitions apply to listings under the Act: a species is 'endangered' if:

- it is likely to become extinct unless the circumstances and factors threatening its abundance, survival or evolutionary development cease to operate; or

- its numbers have been reduced to such a critical level, or its habitats have been so drastically reduced, that it is in immediate danger of extinction; or

- it might already be extinct, but it is not Presumed Extinct.

The Federal *Endangered Species Protection Act of 1992* also addresses the concept of 'endangered community'. For the purpose of the Act an endangered community is "an ecological community which is likely to become extinct in nature unless the circumstances and factors threatening its extent, survival or evolutionary development cease to operate; or it might already be extinct". For the purpose of the Act an "ecological community" is "an assemblage of native

species that inhabits a particular area in nature". Criteria for an endangered ecological community include:

- the community may already be extinct.

- the community is subject to current and continuing threats likely to lead to extinction as demonstrated by one or more of:

(a) marked decrease in geographic distribution
(b) marked alteration of community structure
(c) loss or decline of native species that are believed to play a major role in the community
(d) restricted geographic distribution such that the community could be lost rapidly by the action of a threatening process
(e) community processes being altered to the extent that a marked alteration of community structure will occur.

The definition advanced in this report for assessing the rarity of ecosystems or vegetation types (whether plant community, plant association, vegetation complex or floristic community type) is broadly in agreement with the area criteria of both the IUCN and Australian Federal legislation when defining the need for conservation (IUCN) or conservation status (the Federal Act). However, the definition advanced considers rarity rather than conservation status categories such as "endangered" (although, one implies the other to a substantial degree). The definition for rarity advanced in this report suggests that the definitions of conservation status categories used by Gibson et al. (1994) are out of step with contemporary scientific thinking and Federal legislation and fail to adequately recognise the degree to which vegetation on the Swan Coastal Plain is threatened. English and Blyth (1997) have also considered the issue of vegetation conservation categories in relation to the South West Botanical Province. Their categories "are based on the most recent World Conservation Union (IUCN) categories for threatened species or communities" (English and Blyth, 1997, page 3). An example of this to be found in the their definition of 'Critically Endangered':

"An ecological community will be listed as Critically Endangered when it is facing extremely high risk of total destruction in the immediate future. This will

be determined on the basis of the best available information, by it meeting any one or more of the following criteria (A,B or C);

> A) The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% and ..."

Their definition then goes on to take account of processes of decline affecting the ecological community involved. Their definition of 'Endangered' includes a criterion of reduction by at least 70%.

2.0 GEOMORPHOLOGY AND SOILS

The interim listed area at Ellenbrook lies on the Swan Coastal Plain, the plain between the Darling Scarp and the coastline. The Swan Coastal Plain is a fairly narrow but quite long plain that has been developed by the deposition of material washed down from the plateau above the scarp and in more recent times from material that has blown in from the coastline. On the eastern side of the Swan Coastal Plain the soils are predominantly alluvial deposits washed down from the plateau and are mostly clayey although there are areas of sands. On the western side of the plain the soils are mostly sands blown in from the coast. These two major types meet in the Southern River Soil unit, which has areas with low sand dunes, or low sand drifts where they are too small (say about 1 to 3 metres thick) to justify being called dunes, and between these there are flat areas with sandy clay or clayey sand soils. The dunes and sand drifts of the Southern River Soil unit are the eastern most extension of the Bassendean Sands. To the west of the Southern River Soil unit, these sands form larger dunes without clayey soils between them. This soil/geomorphological unit is the Bassendean Dunes (Churchward et al. 1980).

The particular mode of occurrence of these major soil/geomorphic units in the interim listed area at Ellenbrook is of particular interest for this report because of the generation of a range of plant habitats including several that are quite unusual. The mode of occurrence is also of interest in its own right. The Bassendean sands form a large dunefield that has been blown in from the west. There is considerable variation in the height and shape of the dunes developed in this dunefield but most of the part in the interim listed area at Ellenbrook is between 50 and 85 metres above sea level. Running roughly north-south through the eastern part of the interim listed area at Ellenbrook (on a line that includes the part of the Egerton property that is in the interim listed area) there is a group of crests that reach up to 65 metres above sea level. To the east of these crests, the dune field slopes quickly down to the clayey alluvial plain at the base of the Darling Scarp, with contours of 30 metres present about 1.5 kilometres from the group of dune crests mentioned above. This is a substantial drop in height for this distance on the Swan Coastal Plain. Perched on the dunefield just to the west of the group of crests are the group of wetlands referred to as the Lexia wetlands. Not surprisingly, in winter water seeps through the dunes and emerges on the slope that drops off to the alluvial plain. This seepage is responsible for the development of unusual vegetation types on slopes that are dominated by species such as *Pericalymma ellipticum* that are usually associated

with wetlands or damplands that occur in swales rather than on slopes. The water can also travel through the dunes until it reaches the underlying clay and then comes to the surface where the sand layer over the clays is thin (near the base of the slope) as springs. Jasinska and Knott (1994) studied remnant Ellenbrook mounds springs, emphasising the fact that they are different structures from their namesakes in the Great Artesian Basin and proposing the term *tumulus* springs for them (after 'tumulus' - 'little mound' in Latin). Of the tumulus springs Jasinska and Knott studied, the Egerton property mound springs were the only springs retaining their original native flora. Jasinska and Knott concluded that the fauna and physicochemistry of wetlands and springs of the Ellenbrook catchment differ considerably from those elsewhere on the Swan Coastal Plain. They identified three of the mound springs as having high conservation value: a site off Gnangara Road (their site 1s/1L), Egerton mound springs and pools and dams at Bevan Peters property at Muchea. They recommended that these springs be protected and studied further.
Although groundwater discharge points at the boundary between the Bassendean sands and the Guildford formation are not uncommon, permanent springs issuing from raised areas of boggy peat such as that on the Egerton Property are very unusual.

Weston, Griffin and Trudgen (1993), examining vegetation/landforms/soil/-geological complexes for the Ellenbrook Estate area, identified the three major units as being present in their study area. These are the Yanga, Bassendean and Southern Rivers units. Within the Bassenndean sands they noted the presence of the Joel, Gavin and Jandakot subunits. They noted that the areas of Yanga in the Ellenbrook Estate differed significantly from the descriptions provided in either McArthur in Dames and Moore (1986) or Heddle et al. (1980), and concluded that the Yanga unit is clearly heterogeneous.

3.0 FLORA OF THE REGION INCLUDING THE INTERIM LISTED AREA AT ELLENBROOK

The flora of the region including the interim listed area at Ellenbrook is now moderately well known. The *Flora of the Perth Region* (Marchant et al. 1987) covers the region, including part of the adjacent Darling Plateau, and records 1510 native plant species (flowering plants, ferns, fern allies and gymnosperms). This is a reasonably diverse flora for the size of the area covered (10,500 square kilometres) but is not particularly diverse when compared to other parts of the South West Botanical Province. A later study by Gibson et al. (1994) of the southern Swan Coastal Plain, which is mostly in the area covered by Marchant et al., recorded 1313 taxa (species, subspecies, varieties) of native flowering plants, but was almost entirely limited to public land.

Gibson et al. (1994) also provide information on undescribed species, which made up 8.7% of their records, indicating there is still a significant deficit in our knowledge. They also report a figure of 61 species recorded as being endemic to their study area, with a significant proportion of these (28 species) restricted to the eastern side of the Swan Coastal Plain. The interim listed area at Ellenbrook straddles the boundary of this part of the plain and the higher dune areas (Bassendean Dunes) to the west. Gibson et al. consider that a further 13 taxa not encountered by them are also endemic to the southern Swan Coastal Plain.

3.1 The flora of the interim listed area at Ellenbrook

Of the various studies that address the flora of parts of the interim listed area at Ellenbrook (Dames & Moore (1990), Dames and Moore (1992), Environmental Protection Authority (1992), Feilman Planning Consultants (1992), Weston, Griffin and Trudgen (1992), Tingay and Associates (1994), the most detailed is Weston, Griffin and Trudgen (1992). Weston, Griffin and Trudgen collated previous records of flora species and surveyed part of the interim listed area at Ellenbrook to give an overall flora list for an area that covers much of the interim listed area at Ellenbrook. Their flora list of 427 native taxa and 50 weeds was estimated by them to represent approximately 85% of the flora that occurs in their study area. The study area of Weston, Griffin and Trudgen did not include the part of the interim listed area at Ellenbrook that is owned by Multiplex (part of the Egerton property). However, the Egerton property has been surveyed by Tingay and Associates (Tingay and Associates 1994) who list 159 native flora taxa for the area.

The study of Gibson et al. and work by the Department of Environmental Protection (DEP, 1997) together with the latest Department of Conservation and Land Management *Declared Rare and Priority Flora List* (Atkins 1997) have resulted in some changes to the status of the priority flora species and other significant flora species listed in Weston, Griffin and Trudgen (1992) for their study area and thus for the species known for the interim listed area at Ellenbrook.

Table 1: Declared Rare and Priority Flora Species and other species of interest in the interim listed area at Ellenbrook

Taxon and Conservation Code in Atkins (1997) for species listed in Atkins (1997)	
Caladenia huegelii	R
Grevillea curviloba ssp. *curviloba*	P1*
Eryngium subdecumbens (ms)	P1
Haloragis tenuifolia	P1
Eryngium pinnatifidum ssp. *palustre* (ms)	P2
Aotus cordifolia	P3
Cyathochaeta teretifolia	P3
Stylidium longitubum	P3
Anthotium junciforme	P4
Conostephium minus	P4
Stachystemon axillaris	P4
Other species of interest (i.e. not in Atkins 1997) and their status	
Darwinia sp. "Muchea" very uncommon, probably deserves "R" (Declared Rare)	

Notes to Table 1: This table is based on Weston, Griffin and Trudgen (1992) and DEP (1997). The priority ranking for the individual species have been checked against the latest Department of CALM *Declared Rare and Priority Flora List* (Atkins 1997).

Code: R - Extant Declared Rare Flora Species (or other taxon); Priority One (P1) - are taxa which are known from one or a few (generally <5) populations, which are under threat; Priority Two (P2) - are taxa which are known from one or a few (generally < 5) populations, at least some of which are not believed to be under

immediate threat; Priority Three (P3) - are taxa which are known from several populations, at least some of which are not believed to be under immediate threat; Priority Four (P4) - are taxa considered to have been adequately surveyed and, at least in Australia, to be rare but not currently threatened by any identifiable factors.

A comparison of the latest Department of Conservation and Land *Management Declared Rare and Priority Flora List* (Atkins 1997) with the rare and priority flora list in Weston, Griffin and Trudgen (1992) shows one taxon, *Caladenia huegelii*, under the conservation Code R (Extant Declared Rare Flora Species) for the area. Weston, Griffin and Trudgen (1992) concluded that the report prior to their survey of this orchid species in the Sawpit Gully area was probably a misidentification of the similar but more common *Caladenia paludosa*. They also stated that *Caladenia huegelii* is a species that does not flower every year and that 1992 [the survey year] was not a good year for this species. However, as there is apparently suitable habitat for this rare orchid in the interim listed area at Ellenbrook and because there is a confirmed record of the species nearby (north of Maralla Road) in a more typical habitat for the species (*Banksia* woodland), they concluded that it is possible that it also occurs in the Ellenbrook Estate. The species list in Tingay and Associates (1994) lists a *Caladenia* aff. *huegelii* from the Egerton property. The combination of the record at Egerton of *Caladenia* aff. *huegelii* and the record from north of Maralla Road suggests that there is a strong possibility that *Caladenia huegellii* is in the interim listed area at Ellenbrook.

Weston, Griffin and Trudgen (1992) recommended that the *Darwinia* sp. (sometimes referred to as *Darwinia* sp. Muchea) recorded in their survey area be given a conservation code of R (Rare). The continued absence of this species from the CALM *Declared Rare and Priority Flora List* is apparently an oversight as this *Darwinia* species continues to be considered rare by botanists. This oversight is of some significance in the consideration of the heritage status of the interim listed area at Ellenbrook as the population there is of significant conservation value.

Grevillea curviloba ssp. *curviloba* is currently a Priority 1 species (see note to table 1). According to DEP (1997), *Grevillea curviloba* is known in the wild from two populations, of which the largest population is estimated to be less than 200 plants (paradoxically, it is fairly commonly cultivated) *Grevillea curviloba* ssp.

curviloba and *Grevillea curviloba* ssp. *incurva* may be entirely or almost entirely restricted to the Muchea Limestones (Keighery, 1996), a critically threatened ecological community (see below, section five). Keighery (1996) considers that these two subspecies of *Grevillea* species, both endemic to the Swan Coastal Plain, require urgent survey to determine if they should be declared rare.

Eryngium subdecumbens (ms) has remained a Priority 1 species on the latest *Declared Rare and Priority Flora List* (Atkins 1997). *Haloragis tenuifolia* has been added as a Priority 1 species and *Cyathochaeta teretifolia* as a Priority 3 species. *Aotus cordifolia* has been retained as a Priority 3 species and *Stachystemon axillaris* and *Anthotium junciforme* as Priority 4 species. *Conostephium minus* has been upgraded from P4 to P3 and *Stylidium longitubum* is now P3 instead of P1, while *Eryngium pinnatifidum* subsp. *palustre* (ms) is currently listed as a Priority 2 species, not Priority 1. Thus there are one declared Rare Flora species and eleven Priority Flora species currently known for the interim listed area at Ellenbrook. In addition one declared rare flora species (*Caladenia huegelii*) is likely to be in the interim listed area at Ellenbrook and another species that occurs in the area (*Darwinia* sp. Muchea) is either very uncommon or rare.

Daviesia physodes, Gonocarpus pithyoides and *Cartonema philydroides* which were on the 1992 *CALM Declared Rare and Priority Flora List* as Priority 3 species have been dropped from the list as Weston, Griffin and Trudgen (1992) recommended. Similarly, the Priority 3 species *Restio stenostachyus* no longer appears on the*Declared Rare and Priority Flora List* as it has been found to be more common than previously thought.

3.2 Other significant species in the interim listed area at Ellenbrook

A number of other species (than Declared Rare Flora or Priority Flora Species, or species of similar conservation status) that occur in the interim listed area at Ellenbrook are of interest from the point of view of their contribution to heritage values. Some of these species (from DEP 1997) are listed in table two. This list is not exhaustive as the data for an exhaustive list is not readily available. Other categories of species that could be added to this list would include species that are at the end of their range in the interim listed area at Ellenbrook or have particularly large populations there.

Table 2: Other species present in the interim listed area at Ellenbrook considered by the Department of Environmental Protection (DEP 1997) to be of significance. Some data from Gibson et al. (1994) have been added.

Taxon	
Astroloma microcalyx (formerly considered endemic to coastal limestone)	
Astroloma xerophyllum	
Blancoa canescens	(extends south to the Serpentine River)
Boronia purdieana	
Burchardia bairdiae	(extends south to Forrestdale Lake)
Conospermum triplinervium	
Darwinia sp. Muchea	
Eremaea purpurea	(southern limit in Whiteman Park)
Hensmania turbinata	
Hibbertia perfoliata	
Kunzea littoricola	(endemic to the Pinjarra Plain)
Leucopogon kingianus	(on the Muchea Limestone site)
Levenhookia preissii	
Macarthuria apetala	(extends south to Jandakot)
Restio stenostachyus	(extends south to Lowlands)
Stylidium crossocephalum	(extends south to Wanneroo)
Stylidium utricularioides	
Verticordia nitens	

4.0 VEGETATION OF THE SWAN COASTAL PLAIN INCLUDING THE INTERIM LISTED AREA AT ELLENBROOK

4.1 Introduction

There are many levels and ways in which vegetation can be described and analysed. Consequently, there are several broadscale treatments of the vegetation of the Swan Coastal Plain, on which the interim listed area at Ellenbrook lies, that have different approaches to the study of vegetation. Among the available broadscale vegetation treatments, two are the most useful in a discussion of the national estate value of the vegetation of the interim listed area at Ellenbrook. These are the "vegetation complexes" of Heddle et al. (1980) and the "floristic community types" of Gibson et al. (1994). These treatments differ significantly in their approaches to the study of vegetation. They will be discussed below and used in subsequent sections to define the national estate value for flora, in the broad sense of vegetation, of the interim listed area at Ellenbrook. In addition, a summary of the more detailed vegetation descriptions from Weston, Griffin and Trudgen (1992) for the Ellenbrook Estate, part of the interim listed area at Ellenbrook, will be included below to indicate the range of vegetation types that are present in that part of the interim listed area.

4.2 Vegetation complexes

4.2.1 Concept of vegetation complexes

Each of the major geomorphological units on the Swan Coastal Plain has a particular range of vegetation types, developed in response to the particular soil and geomorphic characteristics of the unit. The name given to the range of vegetation types on each of these major units is "vegetation complex" (Heddle et al. 1980), to reflect the fact that they contain a variety of vegetation types. Vegetation complexes are generally named after the geomorphological units on which they occur. However, more than one vegetation complex may be identified on one geomorphological unit. For example, on the Swan Coastal Plain the vegetation varies markedly from south to north along the Plain and as a result more than one vegetation complex may be defined on a geomorphological unit. An instance of this is that the vegetation of the Bassendean Dunes has been divided into the Bassendean Vegetation Complex - Central and South (extending south from the vicinity of the interim listed area at Ellenbrook almost to Busselton) and the Bassendean Vegetation Complex - North which extends northwards from near the interim listed area at Ellenbrook. Alternatively, another vegetation complex may be described when the underlying geomorphological unit contains significant variation. For example,

the Bassendean vegetation Complex - North-Transition was described because the vegetation on very high Bassendean Dunes differs from that elsewhere on the Bassendean sands.

A vegetation complex is a grouping of vegetation types. However, it is not a hierarchical grouping; that is, the different vegetation types (plant communities or plant associations) found in a vegetation complex are grouped according to where they occur rather than by having some characteristic, such as the same dominant species, in common. An extension of this is that a plant community (the lower level of vegetation classification) may occur in more than one vegetation complex but the overall grouping of plant communities and the relative amounts of different plant communities in a vegetation complex will be different. For example, a close comparison of the vegetation of the Southern River Vegetation Complex and of the Bassendean Vegetation Complex - Central and South (the latter lying to the west of the former on the Swan Coastal Plain) would show that while both have a plant community with *Banksia* woodland over *Stirlingia latifolia, Allocasuarina humilis* shrubland, there is much more of this community in the latter vegetation complex. The reason is that the community occurs on dune crests in these complexes and the Southern River soil unit has much lower dunes than the Bassendean unit and so has fewer and smaller crests. To look at the other side of this example, the Southern River Vegetation Complex has more extensive areas of lower slope vegetation types due to having low, gently sloping dunes, that often are not thick enough to have vegetation types characteristic of crests. The differences go beyond this, however, as in the Southern River unit, the dunes are separated by clayey flats or sandy-clayey flats and these can have quite different vegetation to that found in the Bassendean Vegetation Complex - Central and South. Also, where the sand is very thin, vegetation types not found in the Bassendean Vegetation Complex - Central and South can occur. Vegetation complexes can be viewed as broad ecosystems or sub-systems, that contain a range of habitats for both flora and fauna species, each particular vegetation complex being unique in the mix and relative abundance of the plant communities found in it. This means that vegetation complexes can be a useful guide to the assessment of conservation value or national estate value.

4.2.2 Distribution of the vegetation complexes on the Swan Coastal Plain

The development of the geomorphology/soil units on the Swan Coastal Plain has tended to be parallel to the coast (although those associated with rivers cut

across this). Therefore it is not surprising that the predominant distribution pattern of the vegetation complexes is also north-south. However, vegetation complexes generally occur in discrete blocks rather than as continuous strips, as there are breaks in the development of the underlying geomorphology (many of these breaks are related to the rivers).

4.2.3 Vegetation complexes present in the interim listed area at Ellenbrook

There are four vegetation complexes present in the interim listed area at Ellenbrook. They are:

- the Southern River Vegetation Complex (on aeolian and alluvial deposits)

- the Yanga Vegetation Complex (on alluvial deposits)

- the Basssendean Vegetation Complex - North (on aeolian deposits)

- the Basssendean Vegetation Complex - North Transition (on aeolian deposits).

4.3 Floristic Community Types

4.3.1 Concept of Floristic Community Types

Gibson et al. (1994) approached the study of vegetation on the Swan Coastal Plain with the concept that flora species occur in groups as a response to environmental factors and that defining such groups of species over the Swan Coastal Plain would enable sites from individual stands of vegetation to be assigned to a group of sites with similar flora composition. These groups of sites with similar flora composition are referred to as "floristic community types"; in other words, they have groups of species that consistently occur together. Such groups are not absolutely consistent, since some species have environmental tolerances that are broader than the groups and others will occur too infrequently to be useful in the analysis

The methodology used by Gibson et al. (1994) was to sample a large number of plots (five hundred and nine, each ten by ten metre squares) on publicly owned land in different vegetation types, to determine which species were present and then to compare the species present using computer programs. More than thirteen hundred species were recorded in the plots and used in the analysis.

4.3.2 Results of floristic community type approach

Gibson et al. (1994) looked at two levels of analysis: a four group level (supergroups) and a thirty group level. At the four group level the groups reflected "major geomorphological elements" and seasonal wetlands, the last occurring "across all geomorphological groups". The thirty group level "best reflected the scale of pattern seen in the field.".

The four supergroups are (quotes are from Gibson et al. 1994):

1. Sites which are "almost entirely restricted to the Pinjarra Plain and the Ridge Hill Shelf" (i.e. the eastern part of the Swan Coastal Plain);

2. Sites which are "the almost entirely seasonal wetlands group", the largest and most diverse group occurring across all geomorphic units. That is, within the major geomorphological groups, the seasonal wetland habitat occurs in appropriate places and the water relations, rather than the geomorphology, determine the flora and vegetation;

3. Sites which are "centred on, but not exclusive to the Bassendean Dunes.

There are also significant occurrences on the Pinjarra Plain and Spearwood Dune Systems" (and also some on the Whicher Scarp);

4. Group 4 is "almost exclusively a Spearwood and Quindalup Dunes group."

Within the four supergroups, thirty floristic community types were recognised (the thirty group level referred to above), some with distinct subunits, giving a total of forty-three floristic community types and subtypes. These were grouped under the four group (supergroup) headings in the following way:

- Floristic community types of heavy soils: types 1a, 1b, 2, 3a, 3b, 3c;

- Floristic community types of the seasonal wetlands: types 4 to 19;

- Floristic community types centred on the Bassendean System: types 20 to 23;

- Floristic community types centred on the Spearwood and Quindalup Systems: types 24 to 30c.

The individual floristic community types are discussed in Gibson et al. (1994) pp. 29-46, who also provide maps of the distribution of sites recorded in each floristic community type. The delineation of the floristic community types provides a regional framework for the assessment of floristic variation on the Swan Coastal Plain and thus can enable assessment of the value for flora, at a broad level, of a specific area. However, for some of the floristic community types with more restricted distribution, a more specific assessment of value for flora can be made if the floristic community type is known. It should also be appreciated, that the "floristic community type" approach to studying vegetation is a very different approach to describing plant communities and that these two categories are not equivalent. While they are not equivalent, floristic community types as used by Gibson et al. are more akin to plant associations or formations than plant communities, i.e., they are mostly quite broad units.

As part of the System 6 update, the Western Australian Department of Environmental Protection has continued the Gibson et al. study and identified additional floristic communities, located further occurrences of some community types, extended the range of some types, located vegetated areas of Muchea Limestones and described the floristic community types associated with these limestones (DEP 1997). The DEP has also reassessed significant species of the region, including those occurring in the Ellenbrook National Estate Area (DEP 1997). The new floristic community types relevant to the Ellenbrook area are discussed in the next section.

The 43 floristic community types and subtypes on the Swan Coastal Plain which Gibson et al. identified, together with the 15 supplementary groups identified subsequently, mean that a total of 66 floristic community types are currently recognised for the Swan Coastal Plain and some adjoining areas (see Section 5.3 for a more detailed discussion).

4.4 Comparison of vegetation complexes and floristic community types

Floristic community types can be thought of as equivalent to somewhere between the more traditional vegetation association and vegetation formation. They are mostly quite broad units and are fairly variable in the diversity found in them. Unlike vegetation complexes, the individual plant communities found in floristic communities are fairly closely related in terms of species composition, although structure can still vary considerably. As a result, their distribution is

somewhat different to that of the vegetation complexes. For example, wetland floristic community types tend to occur across several vegetation complexes. In some cases, there is good correspondence between floristic community type and vegetation complex. In others, such as the Southern River Vegetation Complex, the complex is made up of a mosaic of different floristic community types.

4.5 Floristic community types in the interim listed area at Ellenbrook

As noted above, the 43 floristic community types recognised by Gibson et al. (1994) for the southern Swan Coastal Plain have been extended in work carried out by the Department of Environmental Protection (DEP 1997). As a result of this substantial work, a total of fifteen floristic community types, falling into three Supergroups, are now recognised as occurring in the interim listed area at Ellenbrook. These are (reproduced from DEP 1997):

FLORISTIC COMMUNITY TYPES OF SUPERGROUP 2 - SEASONAL WETLANDS

4 *Melaleuca preissiana* damplands
5 Mixed shrub damplands
18 Shrublands on calcareous silts
S2 Northern *Perycalymma ellipticum* dense low shrublands
S3 Wet sedgelands on sandy clays
S5 *Acacia saligna* wetlands (restricted type, sampled at two localities; this is the only area in the Perth Metropolitan Area; the other is on calcareous silts in Bunbury)
S6 Northern dense low shrublands
S17 *Eucalyptus rudis/Agonis linearifolia* wetlands in Bassendean Dunes

SUPERGROUP 3 - UPLANDS, CENTRED ON BASSENDEAN DUNES AND THE DANDARAGAN PLATEAU

21a Central *Banksia attenuata -Eucalyptus marginata* woodlands
21c Low lying *Banksia attenuata* woodlands or shrublands
22 *Banksia illicifolia* woodlands
23a Central *Banksia attenuata - B. menzieesii* woodlands
23b Northern *Banksia attenuata - B. menziesii* woodlands
S9 *Banksia attenuata* woodlands over dense low shrublands

SUPERGROUP 4 - UPLANDS CENTRED ON SPEARWOOD AND QUINDALUP DUNES

25 Southern *Eucalyptus gomphocephala - Agonis flexuosa* woodlands (atypical member to this floristic community type associated with Muchea limestone)

Gibson et al. (1994) also addressed the reservation and conservation status of the floristic community types they identified, work which has been continued by English and Blyth (1997). Gibson et al. (1994) use their own definitions for reservation status such as 'well reserved', 'poorly reserved', etc. Their terms are relative, referring to the situation on the southern Swan Coastal Plain (where there are few substantial reserves), rather than being generally accepted definitions (see also section 1). Their usage is as follows: a community is considered well reserved if it occurs in two widely separated National Parks and/or Nature Reserves. If a community is known from only one National Park or Nature Reserve, it is considered poorly reserved, since it is susceptible to catastrophe. If a community is not known from any National Park and Nature Reserve, it is considered unreserved. Gibson et al. recognise the limitations of their definitions of reservation status categories, which include that no estimate of the actual area of the floristic community types in National Parks or Nature Reserve has been made. They stress that some communities that they classified as "well reserved", may in fact only be represented by two small remnants, because "many of the Nature Reserves on the eastern side of the plain are small remnants". The problems of the definitions of reservation status categories used by Gibson et al. are illustrated in table 3. This table contrasts the reservation status and conservation status categories of some floristic community types that occur in the interim listed area at Ellenbrook. Two of the floristic community types in the table which Gibson et al. assign to the reservation status "well reserved", are also given the conservation status "susceptible".

Table 3: Comparison of the reservation and conservation status of some floristic community types occurring in the interim listed area at Ellenbrook as given by Gibson et al. (1994).

Floristic Community type no.	Description	Reservation status	Conservation status
18	Shrublands on calcareous silts	Poorly reserved	Vulnerable
22	*Banksia illicifolia* woodlands	Poorly reserved	Susceptible
23b	Northern *Banksia attenuata* - *B. menziesii* woodlands	Unreserved	Susceptible
25	Southern *Eucalyptus gomphocephala* - *Agonis flexuosa* woodlands	Poorly reserved	Susceptible
21a	Central *Banksia attenuata* - *Eucalyptus marginata* woodlands	Well reserved	Susceptible
21c	Low lying *Banksia attenuata* woodlands or shrublands	Well reserved	Susceptible

According to the Department of Environmental Protection (DEP 1997), there are three ecological communities (a term which includes the total flora and fauna of a biological type) in the interim listed area at Ellenbrook which have vegetation of very high concern for its conservation. These are:

The vegetation of the Muchea limestone (critically endangered)
Communities of Tumulus Springs (critically endangered)
Floristic community type 18 - Shrubland on calcareous silts (vulnerable).

However, not all the additional research on community types supplementary to the Gibson et al. (1994) study have been assessed (DEP 1997).

4.6 Two detailed studies of the vegetation of parts of the interim listed area at Ellenbrook

A flora and vegetation survey of the Ellenbrook Estate by Weston, Griffin and Trudgen (1992) is still the most detailed study available that covers a substantial part of the interim listed area at Ellenbrook. The vegetation section of Tingay and Associates (1994) describes the vegetation of the Egerton property, including the small part of that property which is within the interim listed area at Ellenbrook.

4.6.1 Some aspects of the vegetation of the Ellenbrook Estate

Weston, Griffin and Trudgen (1992) made a number of observations about the vegetation in their study area (the Ellenbrook Estate) which will help in an understanding of the national estate value of the vegetation of the interim listed area at Ellenbrook. These observations are:

- the 25 vegetation types mapped and described in their study area by Weston, Griffin and Trudgen are more than in the nearby Whiteman Park. They considered that the reason for the richness in vegetation types in their study area compared to Whiteman Park was partly due to "the absence from Whiteman Park of a wide range of vegetation types typical of the Yanga formation" (i.e. of the Yanga Vegetation Complex).

- *Banksia* woodlands on dry sites were the most common vegetation type in the Ellenbrook Estate and ranged from the Lexia Wetland area to Saw Pit Gully. However, the composition of understorey species varied considerably and in a manner that at that time was not explained in the literature.

- Other woodlands associated with small patches of Lexia wetlands or damp areas in the east of the site varied considerably, apparently depending on the moisture status of the soil and the proximity to the surface of impeding layers, mainly clays, but also a small patch of bog iron-ore.

- There existed on the site quite variable seepage areas with trees of *Melaleuca preissiana* and/or marri and several shrub species - *Agonis linearifolia* and *Aotus cordifolia* as well as bracken (*Pteridium esculentum*) and often dense sedges. The reason for the variability apparently related to the thickness of sand cover.

- The Lexia Wetlands had a consistent sequence of vegetation types. However, the relative importance of the components of the vegetation type in any particular wetland depended on the morphology of the landscape.

- The shrub communities in the eastern part of the site are generally quite different from those of the Lexia wetlands. There is a broad area of *Pericalymma ellipticum* on the northern side of the eastern section, on the gentle sandy slopes below the seepages in this area. Sub-surface clay layers are responsible for the seepages and the flowing water in winter. In the eastern part of the site, a different suite of associated species accompanies the *Pericalymma*.

- Drier sites were commonly dominated by *Acacia saligna*. *Acacia saligna* also dominated narrow sandy drainage lines, with little besides sedges as understorey.

4.6.2 Vegetation types described by Weston, Griffin and Trudgen for the Ellenbrook Estate

Weston, Griffin and Trudgen mapped and described twenty-five vegetation units in their survey of the Ellenbrook Estate. These are reproduced below in an abbreviated form. For the complete descriptions refer to Weston, Griffin and Trudgen (1992), Section 4.4. The interim listed area at Ellenbrook is a significantly larger area than the area surveyed by Weston, Griffin and Trudgen and has a significantly greater range of plant habitats. It is obvious from this that if the whole interim listed area at Ellenbrook were surveyed in similar detail to the Ellenbrook Estate, the range of vegetation types described at this level for the interim listed area at Ellenbrook would be increased substantially. This assertion is supported by the fact that twenty-four vegetation units have been mapped by Tingay and Associates (1994) for the Egerton Property. The vegetation units mapped and described by Weston, Griffin and Trudgen for the Ellenbrook Estate are:

A1 *Banksia* woodlands (dry)

Principally low woodland (open to closed) dominated by *Banksia attenuata* with *B. menziesii* and occasionally *Eucalyptus todtiana* and *Banksia ilicifolia*.

A2 *Adenanthos cygnorum* in *Banksia* woodland

This vegetation type appeared to have a relatively dense cover of low trees, mainly *Banksia attenuata* and *B. menziesii* with some *B. ilicifolia*.

A3 *Banksia* woodlands (moist)
Mostly these woodlands were more open with *Banksia ilicifolia* commonly the most important tree species.

A4 sand heath
There were a couple of areas on the aerial photographs which were not easily assigned to one of the other vegetation types. As the name implies there were few trees.

B Jarrah, Marri, *Banksia* open forest
This appears to be a further progression from dry to damp types. The Marri and perhaps the Jarrah appear to be responding to the presence of clayey layers. *Banksia ilicifolia, B. attenuata, Melaleuca preissiana* and *Nuytsia floribunda* are also present as a low tree stratum.

C1 Marri, *Melaleuca preissiana* open forest
Downslope of one of the seepages in the east of the Estate was a stand of forest dominated by (at times, large old) trees of Marri and *Melaleuca preissiana.*

C2 *Hypocalymma , Melaleuca preissiana* heath or woodland
Between the *Banksia* woodlands and the various heath communities of the winter wet areas, there was usually a band of this type, but at times it was very narrow. It appeared to be more typical of the Lexia wetlands.

C3 *Verticordia densiflora* heath
Verticordia densiflora is often present on the sandy margin of clayey drainage flats. One small stand on the Estate had a heath dominated by this species.

C4 Sedgeland
An area in a similar position in the landscape to vegetation type C3 above was dominated by sedge-like species. In particular *Phlebocarya ciliata, Dasypogon bromeliifolius* and *Patersonia occidentalis* were very common.

D *Melaleuca preissiana , Agonis linearifolia* woodland
This vegetation type, and in particular *Agonis linearifolia,* was typical of the several soaks and springs on the western margin of the Yanga formation. There were a few trees of marri and *Banksia littoralis* in some areas.

E1 *Melaleuca preissiana, Pericalymma* (eastern variant)
A dense heath dominated by *Pericalymma ellipticum* was an important vegetation type of the winter wet areas. *Melaleuca preissiana* was an important species in this type, either as an occasional tree or small groves. *Banksia littoralis* was also conspicuous in most stands.

E2 *Melaleuca preissiana ,Pericalymma elliptica* (western variant)
As in vegetation type E1, *Pericalymma ellipticum* dominates unit E2, which has occasional emergent trees of *Melaleuca preissiana* and *Banksia littoralis*. The stands of this unit are often very narrow and are not distinguishable as separate bands around some of the Lexia Wetlands.

E3 *Melaleuca preissiana*
In a couple of stands *Melaleuca preissiana* formed closed low forests. These were in areas not normally as wet as E1 or E2.

E4 *Astartea, Pericalymma*
Around some of the Lexia wetlands there were stands which were a dense heath of *Astartea fasciculata* and *Pericalymma ellipticum*. No tree species were noted. This may be an ecotone between vegetation types E2 and G.

F1 *Banksia littoralis* closed forest (eastern variant)
Along a poorly defined drainage line on the Yanga formation is an area of closed low forest of *Banksia littoralis*. Like the closed low forest of *Melaleuca preissiana* (vegetation type E3) there were very few shrubs beneath the *Banksia*.

F2 *Banksia littoralis* forest (western variant)
A small stand of closed low forest of *Banksia littoralis* occurs in the Lexia wetlands. This was not visited, it apparently has an understorey of *Baumea articulata*.

G *Astartea facicularis* heath/sedges
These dense heath areas in the Lexia wetlands (and in other wetlands in Melaleuca Park) grew in sandy soils, often with a peaty layer but always very wet if not under water for much of the winter.

H *Eucalyptus rudis* forest

Eucalyptus rudis formed a narrow band of forest in some of the better developed drainage lines. Depending on the situation, there was an occasional *Melaleuca preissiana* or *Banksia littoralis* forming a low tree stratum.

I *Melaleuca raphiophylla* closed forest

Closed low forest of *Melaleuca rhaphiophylla* in the Lexia wetlands. This species typically grows with well sorted sand in areas with permanent fresh water available at least beneath the surface.

J *Acacia saligna* scrub to low closed forest

Acacia saligna dominated parts of the Yanga formation. However, stands of this vegetation type varied in structure and composition. This vegetation type can be subdivided into at least two distinct sub-types on the associated species present.

K *Kunzea recurva* heath

In several areas where clay was very close to the soil surface there were stands of *Kunzea recurva*. These formed closed heaths, generally in the centre of small shallow drainage flats. These were waterlogged most of the winter.

L *Regelia ciliata* heath

Dense patches of heath along the side of Maralla Road were dominated by *Regelia ciliata*. with Marri and Nuytsia occasionally present as emergents. These stands were on well sorted sandy soils, occasionally waterlogged in winter.

M *Melaleuca viminea* heath

A small patch of heath dominated by *Melaleuca viminea* was noted north of the sewerage treatment area. No descriptions were made of this.

N *Baumea articulata* sedgeland

The centre of the wettest parts of the Lexia wetlands were dominated by *Baumea articulata*. This species is normally associated with permanent shallow fresh water lakes.

The distribution of these units within the Ellenbrook Estate and their relationship to the underlying soils and geomorphology is shown in table 4.

Table 4: Distribution of the vegetation mapping units of Weston, Griffin and Trudgen (1992) in the Lexia Wetlands, the Central *Banksia* woodlands and the eastern wetlands on the relevant vegetation/landform units. The vegetation types are ordered to emphasise their fidelity for the three major parts of the Ellenbrook Estate (the Lexia wetlands, the Central Banksia area and the eastern wetlands). Vegetation/landform units: Ja = Jandakot, G = Gavin, J = Joel, W = Wetlands, Y = Yanga (Reproduced from Weston, Griffin and Trudgen 1992).

	Lexia Wetlands				**Central Banksia Woodlands**			**Eastern Wetlands**		
	Soil/geomorphological units									
Vegetation mapping unit	**Ja**	**G**	**J**	**W**	**Ja**	**J**	**G**	**J**	**Y**
A4 sand heath	.	1	.	.	.	.	.	.	.
E4 Astartea - Pericalymma	.	.	1	.	.	.	.	.	.
F2 B. littoralis (west)	.	.	1	.	.	.	.	.	.
G Astartea - sedges	.	.	1	.	.	.	.	.	.
I M. raphiophylla	.	.	1	.	.	.	.	.	.
N Baumea articulata	.	.	.	1	.	.	.	.	.
E2 M. preissiana									
- Pericalymma (west)	.	.	1	.	.	1	.	.	.
A3 Adenanthos/Banksia	.	1	.	.	.	1	.	.	.
A1 Banksia (dry)	1	.	.	.	1	.	1	.	.
A2 Banksia (moist)	.	1	.	.	.	1	1	.	.
B Jarrah - Marri - Banksia	.	1	.	.	.	1	.	.	1
C2 Hypocalymma	.	1	.	.	.	1	.	.	1
E3 M. preissiana	.	.	1	.	.	1	.	.	1
C4 Sedges	.	.	.	.	.	.	1	.	.
C1 Marri - M. preissiana	.	.	.	.	.	.	.	1	1
C3 V. densiflora	.	.	.	.	.	.	.	.	1
D M. preissiana - Agonis	.	.	.	.	.	.	.	.	1
E1 M. preissiana									
- Pericalymma (east)	.	.	.	.	.	.	.	.	1
F1 B. littoralis (east)	.	.	.	.	.	.	.	.	1
H Eucalyptus rudis	.	.	.	.	.	.	.	.	1
J Acacia saligna	.	.	.	.	.	.	.	.	1
K Kunzea recurva	.	.	.	.	.	.	.	.	1
L Regelia ciliata	.	.	.	.	.	.	.	.	1
M Melaleuca viminea	.	.	.	.	.	.	.	.	1
Melaleuca huegelii									

While Table 4 demonstrates the localisation of vegetation types within the Ellenbrook Estate and therefore to a major degree within the interim listed area at Ellenbrook, Weston, Griffin and Trudgen (1992) qualified these results by stating that the vegetation types are not necessarily homogeneous across their range (i.e. significant variation beyond that described exists in the Ellenbrook Estate), a fact also emphasised in others of their observations and conclusions.

5.0 AMOUNT REMAINING AND IMPLICATIONS FOR NATIONAL ESTATE STATUS, OF THE NATIVE VEGETATION TYPES FOUND IN THE INTERIM LISTED AREA AT ELLENBROOK

5.1 Introduction

The amount remaining of the different native vegetation types found in the interim listed area at Ellenbrook as a proportion of their total original (i.e. prior to European settlement) area has obvious implications for the assessment of the national estate value of the different native vegetation types found there.

The national estate value of the vegetation types found in the interim listed area at Ellenbrook can be assessed at various levels, for example, as a proportion of the original cover of the Swan Coastal Plain, or parts of it such as the eastern part, or the part north of the Swan River. While these broad levels are useful in a regional context, a more detailed assessment can be made based on the proportion remaining of the total original area of each of the four vegetation complexes represented in the interim listed area at Ellenbrook.

An equally useful assessment would be based on the proportion that remains of each of the floristic community types represented in the interim listed area at Ellenbrook. Unfortunately, this assessment cannot be undertaken since the floristic community types have not been mapped, except as point occurrences. However, very useful information on the conservation status of the floristic community types is available from the reservation and conservation status information provided by Gibson et al. (1994), notwithstanding the criticism of the limitations of their categories made in section 4.5. Further information on the conservation status of the floristic community types found on the Swan Coastal Plain is provided by English and Blyth (1997), based on their work compiling the "Threatened Ecological Community Database".

It is currently very difficult to obtain accurate figures on the area still existing of the vegetation complexes that occur on the Swan Coastal Plain, except for the proportion within the Metropolitan Region. The problems with the latter figures have already been discussed in section 1.5.1: considering the area remaining of the vegetation complexes only within part of their range skews the figures.

5.2 Amount remaining of the original vegetation of the Swan Coastal Plain

The amount of native vegetation remaining on the Swan Coastal Plain is reviewed because this is the regional geomorphological unit on which the interim listed area at Ellenbrook occurs.

The total area of the Swan Coastal Plain is 780 000 ha (Bowman Bishaw Gorham, 1993). The area south of the Swan River is very highly cleared with more than 97% of the original vegetation removed (Trudgen 1995 section 5.2, Gibson et al. 1994, Keighery 1996). The part of the Swan Coastal Plain north of the Swan River (where the interim listed area at Ellenbrook is located) has retained a higher proportion of its original vegetation cover than the area south of the Swan River. However, it has still lost much of the original native vegetation cover.

For the eastern part of the Swan Coastal Plain, using the boundaries of the Reagan and Coonambidgee units set by Churchward and McArthur (1980) and those set for the Reagan unit by King and Wells (1990), it has been estimated that 97% of the original vegetation has been cleared and that only very small scattered amounts remain of the vegetation complexes of this part of the Swan Coastal Plain (Keighery and Trudgen 1992, Keighery and Keighery 1992, Gibson et al. 1994).

The extent of clearing on the Swan Coastal Plain and particularly of the eastern side of the Plain means that the national estate values of the vegetation in the interim listed area at Ellenbrook are almost inevitably high or very high. However, the condition of the surviving vegetation, the conservation status of the vegetation complexes and floristic community types present, the diversity of vegetation complexes or floristic community types present, the diversity of lower levels of vegetation types (e.g. the units of Weston, Griffin and Trudgen), the diversity of flora and the presence of rare, priority or uncommon species discovered in an area would influence a final determination of national estate value.

5.3 Amount remaining of the original area of those vegetation complexes present in the interim listed area at Ellenbrook

The amount of each of the vegetation complexes remaining in the interim listed area at Ellenbrook will be discussed separately, together with other factors relating to their occurrence in the interim listed area.

The figures for the amount remaining of the four vegetation complexes discussed below are taken from figures that are now more than ten years old (CALM 1986, quoted in Bowman, Bishaw Gorham 1993). These figures are conceded to be outdated and too optimistic, as more areas have been cleared since 1986. For example, mapping by Weston, Griffin and Trudgen, along with examination of existing maps (Weston, Griffin and Trudgen, 1992, Section 7) showed that "the Yanga vegetation/land- form complex is very largely cleared and inadequately conserved, with most areas in reserves being small". Similarly, Bowman Bishaw and Gorham agree that the Yanga vegetation is "predominantly cleared and is poorly represented in conservation reserves". The Department of Conservation and Land Management in 1992 indicated that "less than 1% of the Yanga is contained in conservation reserves" (Bowman Bishaw and Gorham, 1993),

5.3.1 Amount remaining of the Southern River Vegetation Complex

There is apparently 8.6% (5017 ha) remaining of the original area of the Southern River Vegetation Complex (CALM 1986, quoted in Bowman, Bishaw Gorham 1993). Over 90% of the original extent of the Southern River Vegetation Complex has been cleared and with probably at most five to seven percent of its total original area remaining, it should be considered to be a rare and endangered vegetation type or ecosystem. If it is desirable to reserve in secure conservation reserves at least ten percent of an ecosystem, it is obvious that any significantly sized remnant of the Southern River Vegetation Complex in good or better condition has very significant national estate and conservation value. It also means that any area of the Southern River Complex that is a part of a significant sized remnant, even if it is not a large part of it, can contribute significantly to the national estate value of that remnant. The interim listed area at Ellenbrook area contains at least 63 ha of the Southern River Vegetation Complex in the Ellenbrook Estate section and a small amount more in the Egerton property.

While the area of the Southern River Vegetation Complex in the interim listed area at Ellenbrook is not very large, it has particular importance, as it is at the far northern end of the distribution of the vegetation complex. In addition, the interim listed area contains areas of the boundary or transitions between the Southern River Vegetation Complex and the Bassendean North Vegetation Complex. This boundary is rare as there was only ever a very small area of it (there may also exist in the interim listed area a transition from the Southern

River Vegetation Complex to the Yanga Complex; if the latter transition is present, it would be unique).

5.3.2 Amount remaining of the Bassendean North Vegetation Complex

A 1986 estimate put the total remaining area of the Bassendean North Vegetation Complex at 49,930 ha or 63.8% (CALM 1986, quoted in Bowman Bishaw Gorham 1993). Table 4 in Bowman Bishaw and Gorham (1993) assesses the area of the Bassendean North Complex in Ellenbrook Estate at 320 ha. The interim listed area extends well to the east and north of the Ellenbrook Estate and contains a much larger area of this vegetation complex. There is also a small area of this complex in the Egerton property.

A relatively large proportion (compared to many other vegetation complexes) of the Bassendean North Vegetation Complex is extant. The area of it in the interim listed area at Ellenbrook has particular value because it has a large area which is near the southern end of the distribution of the complex and has a transect from the eastern side of the vegetation complex well in to the centre of the complex.

Another issue arises with regard to the national estate value of those complexes that have relatively large proportions of their original extent remaining. This is that because a significant number of the vegetation complexes on the Swan Coastal Plain have so little of their original area remaining, the heritage value of those that have a larger proportion of their original extent remaining is higher than it would have been because of their (now) greater contribution to regional vegetation cover.

5.3.3 Amount remaining of the Bassendean - North Transition Vegetation Complex

The area of this complex that is in the interim listed area at Ellenbrook is an odd shaped small to moderate sized outlier. Other small outliers originally existed near Lake Gnangara but have had significant parts of their areas cleared. The main areas of the complex are located near Muchea and further to the north. According to CALM (1986, quoted in Bowman, Bishaw Gorham 1993), 24,950 hectares or 86.5 % remain of the Bassendean North - Transition Vegetation Complex.

The outlier in the interim listed area at Ellenbrook has significant national estate value because of its location at the south-eastern extent of the complex. Because of this, the vegetation will probably differ from other parts of the complex further to the north and the west because of the influence of different climatic conditions at the different locations. The national estate value of the area of the complex in the interim listed area at Ellenbrook is reduced somewhat by the fact that there has been some disturbance of the vegetation.

5.3.4. Amount remaining of the Yanga Vegetation Complex

There are apparently 2,427 ha of Yanga Vegetation Complex (9.2%) remaining (CALM 1986, quoted in Bowman Bishaw Gorham 1993). However, due to the age of the figure, it may be optimistic with regard to the amount that actually remains.

Mapping by Weston, Griffin and Trudgen as well as examination by them of existing maps showed that the Yanga Vegetation Complex is very largely cleared and inadequately conserved, with most areas in reserves being small (Weston, Griffin and Trudgen, 1992, section 7). The Yanga vegetation is "predominantly cleared and is poorly represented in conservation reserves" according to Bowman Bishaw and Gorham (1993). Quoting the Department of Conservation and Land Management, they state that "less than 1% of the Yanga is contained in conservation reserves". However, table 5 of the Bowman Bishaw and Gorham document also cites 1986 figures by CALM, according to which 90.8 per cent of the original 26,389 ha of the Yanga vegetation complex has been cleared. This figure suggests that a total of 2427 ha of the complex has survived, of which 225 ha are in the interim listed area at Ellenbrook. According to Table 5 of Bowman Bishaw Gorham (1993) there are, however, 306 ha of the Yanga Vegetation Complex in conservation reserves in the vicinity of Ellenbrook. The figures quoted for the extant Yanga vegetation are a little difficult to reconcile and suggest that there is a need for caution in accepting precise figures about remnants of vegetation complexes in the absence of a careful survey of what remains.

Given the above discussion of the Yanga Vegetation Complex, it is obvious that this vegetation complex is rare and threatened.

5.4 Status of the floristic community types present in the interim listed area at Ellenbrook

In this section, the status of each of the floristic community types in the interim listed area at Ellenbrook are discussed separately. Other pertinent factors relating to their occurrence there are also discussed when available. One point that needs to be made here is that there is a significant diversity of floristic community types in the interim listed area at Ellenbrook. This is presumably due the range of geomorphological and soil situations present in the interim listed area at Ellenbrook. The floristic community types are discussed under the "supergroup" to which they belong (see section three).

SUPERGROUP 2 - SEASONAL WETLANDS

The seasonal wetlands of Supergroup 2 are more or less uniformly spread across the Swan Coastal Plain, except in its north west, with its lower rainfall and the steeper landforms of the Spearwood Dunes. Unlike the other three super groups, this group does not exhibit a correlation with major geomorphological elements of the Swan Coastal Plain, rather occurring across all of them. The seasonal wetlands group of floristic community types has the lowest species richness of the 43 groups established by Gibson et al. and exhibits a high level of heterogeneity. It is the most variable group and has by far the largest number of floristic community types, many of which are represented by only a few quadrats with restricted distribution (Gibson et al. p. 37).

Floristic community type 4: *Melaleuca preissiana* damplands

This community is distributed over the length of the coastal plain and is generally found on the Bassendean or Southern River units. A shrub rich community, it has *Melaleuca preissiana* as an overstorey; where tree species are absent, it forms heaths or scrubs. It shares a number of species with upland Bassendean communities.

Reservation status: Well reserved
Conservation status: Low risk

The interim listed area appears to be in the northern part of the distribution of this floristic community type.

Floristic community type 5: Mixed shrub damplands

This floristic community type has no consistent dominant overstorey, dominants being either *Banksia ilicifolia, Melaleuca preissiana, Actinostrobus pyramidalis* or *Kunzea ericifolia*. It generally has more open ground, a less dense shrub layer than community type 4 and a higher frequency of wet *Banksia* woodlands species and of annual species.

Reservation status:	Well reserved
Conservation status:	Low risk

The interim listed area appears to be in the centre of the range of this floristic community type.

Floristic community type 18: Shrublands on calcareous silts
This floristic community type is a very species rich formerly though to be restricted to a calcareous silt flat in Yalgorup National Park. The two sites located were open low scrubs with rich annual flora. Common taxa were *Acacia saligna, Leptomeria lehmannii* (a taxon apparently restricted to this community type) *Xanthorrea preissii, Gahnia trifida* and *Melaleuca teretifolia.*

Reservation status: Poorly reserved
Conservation status; Vulnerable

The interim listed area appears to be northern limit of the range of this community type.

Floristic community type S2: Northern *Perycalymma ellipticum* dense low shrublands
There is not yet a published description of this floristic community type as it was not sampled by Gibson et al. (1994). This indicates that it is uncommon (see also Weston, Griffin and Trudgen 1992 for a description of the *Pericalymma* unit on slopes that equates to this floristic community type in their vegetation classification of the Ellenbrook Estate).

Floristic community type S3: Wet sedgelands on sandy clays
There is not yet a published description of this floristic community type as it was not sampled by Gibson et al. (1994). This indicates that it is uncommon.

Floristic community type S5: *Acacia saligna* wetlands
Restricted type, sampled at two localities; this is the only locality for this floristic community type in the Perth Metropolitan Area; the other is on calcareous silts in Bunbury. This floristic community type is a candidate for critically endangered status (DEP 1997) on the Threatened Ecological Communities Database.

Floristic community type S6: Northern dense low shrublands
There is not yet a published description of this floristic community type as it was not sampled by Gibson et al. (1994). This indicates that it is uncommon.

Floristic community type S17: *Eucalyptus rudis/ Agonis linearifolia* wetlands in Bassendean Dunes

There is not yet a published description of this floristic community type as it was not sampled by Gibson et al. (1994). This indicates that it is uncommon.

SUPERGROUP 3 - UPLANDS, CENTRED ON THE BASSENDEAN DUNES AND THE DANDARAGAN PLATEAU

Centred on but not exclusive to Bassendean Dunes, with significant occurrences also on Pinjarra Plain and Spearwood Dunes system. Has the highest species diversity of the supergroups.

Floristic community type 21a: Central *Banksia attenuata - Eucalyptus marginata* woodlands

Primarily *Eucalyptus marginata-Banksia attenuata* woodlands, *Eucalyptus marginata-Eucalyptus calophylla - Banksia attenuata* woodlands or *Banksia attenuata* woodlands.

Average species richness in this floristic community type is 54.6 species per plot. Two outlying occurrences of this floristic community type have been recorded north of Perth, where these *Eucalyptus calophylla -Banksia attenuata* woodlands surround small lakes in the Bassendean Dunes east of State Forest 65. In the Gibson et al. study about half the sites of this group occur on Bassendean Dunes, a third on Spearwood Dunes, and the rest on alluvial soils.

Reservation status: Well reserved
Conservation status: Low risk

The interim listed area is in the northern part of the range of this community type.

Floristic community type 21c: Low lying *Banksia attenuata* woodlands or shrublands

This community type occurs sporadically between GinGin and Bunbury. It is significantly less species rich than 21a and 21b, is largely restricted to the Bassendean systems. Floristic community type 21c tends to occupy the more low lying wetter sites, is variously dominated by *Melaleuca preissiana, Banksia attenuata , Banksia menziesii, Regelia ciliata, Eucalyptus marginata* or *Eucalyptus calophylla*, either singly or in combination. Structurally Floristic community type 21c is either a woodland or occasionally shrubland.

Reservation status: Well reserved
Conservation status: Low risk

The interim listed area is in the northern part of the range of this community type.

Floristic community type 22: *Banksia illicifolia* woodlands
On low lying sites and significantly lower slopes than all other floristic community types in super group 3, except for floristic community type 21c. Generally the sites in this group were *Banksia ilicifolia - Banksia attenuata* woodlands, occasionally *Melaleuca preissiana* woodlands and scrubs. Species richness is low. Recorded on the Bassendean and Spearwood dune systems, typically had open understorey and is likely to be seasonally waterlogged. Found in the central coastal plain north of Rockingham.

Reservation status: Poorly reserved
Conservation status: Low risk

The interim listed area appears to be in the centre of the range of this community type.

Floristic community type 23a: Central *Banksia attenuata - Banksia menzieesii* woodlands
Generally restricted to the Bassendean Dune system. Type 23a stretches from Bullsbrook south to the Woodman Point area; species richness is very high with an average of 62.8 species/plot recorded.

Reservation status: Well reserved
Conservation status: Low risk

The interim listed area appears to be in the centre to northern part of the range of this community type.

Floristic community type 23b: Northern *Banksia attenuata - B. menziesii* woodlands
Generally restricted to the Bassendean system, but has a more northern distribution (from Melaleuca Park to GinGin) than type 23a. It has a lower species richness (53.8) than floristic community type 23a (62.8) and a significantly lower

weed frequency, reflecting the more extensive and intact *Banksia* woodlands which still occur north of Perth

Reservation status: Well reserved
Conservation status: Low risk

The interim listed area appears to be in the centre of the range of this Community type.

Floristic community type S9: *Banksia attenuata* woodlands over dense low shrublands
There is not yet a published description of this floristic community type as it was not sampled by Gibson et al. (1994). This indicates that it is uncommon.

SUPERGROUP 4 - UPLANDS CENTRED ON SPEARWOOD AND QUINDALUP DUNES
Almost exclusively a Spearwood and Quindalup Dunes group.

Floristic community type 25: Southern *Eucalyptus gomphocephala - Agonis flexuosa* woodlands
The site in the interim listed area at Ellenbrook referred to this floristic community type is atypical and is associated with the Muchea limestone, which has several species otherwise found on the coastal areas of the Swan Coastal Plain (B.J. Keighery pers comm.)

6.0 NATIONAL ESTATE VALUES OF THE FLORA AND VEGETATION AT THE ELLENBROOK INTERIM LISTED AREA

6.1 Introduction

It would be extremely repetitive to discuss the national estate values for flora and vegetation of each part of the interim listed area at Ellenbrook individually. The approach taken here is to discuss these values for the interim listed area at Ellenbrook as a whole, and then to refer to the values present in each part of the interim listed area at Ellenbrook as necessary when that individual part is discussed. It should be noted that, although the criteria include aspects other than flora (including vegetation as a broad sense of flora), this report centres on flora values. The fact that other values are not discussed does not mean they are not present (rather they are the subject of separate reports by other authors).

6.2 Flora and vegetation national estate values present in the interim listed area at Ellenbrook

6.2.1 Criterion A: Its importance in the course, or pattern, of Australia's natural or cultural history.

Criterion A.1: Importance in the evolution of Australian flora, fauna, landscapes or climate.

The physical environment of the Swan Coastal Plain on which the interim listed area at Ellenbrook is situated is relatively young compared to that on the adjoining plateau and is quite different in its soils and landforms. This different physical environment has allowed the development of vegetation assemblages (vegetation complexes) which are unique to the Swan Coastal Plain (Heddle et al. 1980) and floristic community types which are either unique to the Swan Coastal Plain, or are found only on it and adjacent areas, with most of their occurrence on the Swan Coastal Plain (Gibson et al. 1994). Thus in the broader sense of the term "flora", i.e. that of including the development of flora as vegetation, the remnant of vegetation in the interim listed area at Ellenbrook is an important example that demonstrates the evolution of Australian flora in response to a relatively new environment. Thus, the National Estate value of the flora (in the sense of vegetation) remnant in the interim listed area at Ellenbrook for Criterion A.1 is very high because:

(i) Of the four vegetation complexes that are represented there and which are examples of the response to the environment, the Yanga and Southern River Vegetation Complexes have been reduced to less than ten percent of their

original extent and thus can reasonably be described as rare vegetation. The areas of these vegetation complexes in the interim listed area thus have high national estate value as examples of the course or pattern of Australia's natural history.

(ii) Although a much higher proportion of the original area of the Bassendean North Vegetation Complex is extant, the area of this vegetation complex in the interim listed area at Ellenbrook has significant national estate value under Criterion A1 for the following reasons: a) the area of this vegetation complex in the interim listed area at Ellenbrook is at the southern end of its distribution and therefore has particular value as there is a change from south to north on the Swan Coastal Plain in the species composition of the vegetation in response to changing environmental factors (particularly rainfall); b) the interim listed area contains a cross section from the eastern side to the centre of the complex, this cross section is largely cleared elsewhere and demonstrates changes in response to the environment. c) the high level of clearing on the Swan Coastal Plain means that in order to meet internationally recognised minimum levels of conservation on the Plain and so protect adequate representation of the values under criterion A1, it is necessary to protect more than 10% of those vegetation complexes that have more than 10% of their original area extant;

(iii) The example of the Bassendean North - Transition Vegetation Complex that is found in the interim listed area at Ellenbrook is a disjunct occurrence that lies well south of the main occurrences of this vegetation complex. This occurrence of the Bassendean North - Transition Vegetation Complex has particular value both because it is a small outlier further south than the main occurrences and because other small outliers of the complex (near Lake Gnangara) south of the main occurrences have had a significant proportion of their area cleared. While the main occurrences of this vegetation complex have fairly high proportions remaining and are well reserved, there are likely to be significant differences between the vegetation and flora of these occurrences and the outlier in the interim listed area at Ellenbrook. This is due to the distance separating them and the fact that the outlier in the interim listed area occurs on a narrow, irregular dune (i.e has a somewhat different geomorphology) while the main occurrences are more regular areas.

(iv) The area of the interim listed area at Ellenbrook is relatively large compared to many other remnants of native vegetation remaining on the Swan Coastal Plain and is one of the largest in the Metropolitan region. The large size implies

the possibility of maintaining the national estate values present under criterion A1 in the long term with less intensive management than would be necessary for smaller areas.

(v) There are transitions present between the various vegetation complexes in the interim listed area at Ellenbrook and these transitions have value as environments that have different environmental conditions and that show how the flora has adapted differently (in the sense of developing different vegetation) on different soil types with otherwise identical environmental factors.

(vi) A number of floristic community types have been recorded from the interim listed area at Ellenbrook that are almost entirely restricted to the Yanga formation and have become rare because almost all of the Yanga has been cleared. This overlaps with the interpretation of the Yanga Vegetation Complex as an example of the development (evolution) of the flora in response to the environment of a particular part of the Swan Coastal Plain and as a rare vegetation unit. However, it supports that interpretation and shows that within the Yanga Vegetation Complex there is more than one definable floristic unit, i.e. more than one evolutionary response by the flora to the Yanga environment. It is significant that a large study (Gibson et al. and DEP 1997) independent of the vegetation complex approach to vegetation description has shown a similar result for the rarity of the remaining vegetation on the Yanga formation.

(vii) Most of the interim listed area at Ellenbrook is in good, very good or excellent condition, with other parts maintaining significant national estate value despite some level of disturbance, and by providing buffers to weed invasion and other disturbance, maintaining national estate values in adjoining areas at a higher level. That is, the values identifiable under section A1 have been maintained in the interim listed area and can be maintained there, so the importance of the interim listed area at Ellenbrook for Criterion A1 can be maintained.

(viii) There are a number of species present in the interim listed area at Ellenbrook that are endemic to the seasonally inundated heavy soils of the eastern side of the Swan Coastal Plain (see section four). The presence of these species in the interim listed area at Ellenbrook is important under criterion A1 as they demonstrate an aspect of the evolution of the Australian flora in response to the environment found on the eastern side of the Swan Coastal Plain.

(ix) As an example of the landscapes developed on the Swan Coastal Plain, that is the landforms (geomorphological components) with their extant original natural vegetation the bushland in the interim listed area at Ellenbrook also has high national estate value under Criterion A.1 for landscape. In the course of Australia's natural history, these landscapes have only developed on the Swan Coastal Plain and the examples in the interim listed area at Ellenbrook include rare remnants of these landscapes, which have both the geomorphological component and the biological component relatively intact. This value is obviously higher for the landform/vegetation complexes that have suffered higher degrees of clearing than for the others.

Criterion A.2: Importance in maintaining existing processes or natural systems at the regional or national scale.

The bushland in the interim listed area at Ellenbrook maintains a variety of ecological processes or natural systems, including those found in wetlands and damplands of several types and on sand dunes of varying shape and height. While from one (very wide) point of view these processes may be found in all such environments, the particular natural systems developed in the bushland in the interim listed area at Ellenbrook occur in vegetation either restricted to the Swan Coastal Plain or are found there and in other parts of the South West Botanical Province adjacent to the Swan Coastal Plain. Therefore the range of processes occurring in the interim listed area at Ellenbrook are modifications of very general ones that are specific to the different vegetation assemblages found on the Swan Coastal Plain and adjacent areas.

The maintenance of these processes in the interim listed area at Ellenbrook has moderately high to very high national estate significance because the extent of clearing on the Swan Coastal Plain is so high that loss of these processes in the interim listed area at Ellenbrook would have a major impact on the extent of the continued existence of these processes at the regional scale. This is particularly so for the areas of the vegetation complexes that are restricted to the eastern side of the Swan Coastal Plain that are found in the interim listed area at Ellenbrook but the value in the other parts of the interim listed area is also moderately high to high .

The value of the interim listed area at Ellenbrook for these processes is increased by the fact that the interim listed area at Ellenbrook is contiguous with other

areas of native vegetation in State Forest (to the west). That is, rather than being an isolated remnant, the interim listed area at Ellenbrook is part of a larger area of bushland and those processes that involve the larger area can still continue. An example of such a process would be the migration of plant reproductive material into the interim listed area at Ellenbrook from the adjoining area of State Forest, or vice versa.

Criterion A3: Importance in exhibiting unusual richness or diversity of flora, fauna, landscapes or cultural features.
The interim listed area at Ellenbrook straddles the border between the eastern side of the Swan Coastal Plain, which has mostly clayey soils or thin sand over clay and the area to the west of this that has higher dunes. There are very few areas where there are remnants of native vegetation that include this boundary and significant sized areas of the vegetation of both sides of it. Therefore, the interim listed area at Ellenbrook has moderate to high national estate value under criterion A3 because the particular diversity of flora (in the broad sense of vegetation) that is found there is unusual.

The interim listed area at Ellenbrook contains an area of the Southern River Complex, which is a diverse mosaic of the vegetation of damplands typical of the eastern side of the Swan Coastal Plain and of dunes with *Banksia* woodland more typical of the centre of the Swan Coastal Plain and also contains areas of two other vegetation complexes. It therefore also has a higher richness of vegetation types than would be expected from a similar sized area that was not located on the border between the eastern part of the Swan Coastal Plain and the dunes to the west of the eastern part of the Swan Coastal Plain. As areas where the border between the eastern part of the Swan Coastal Plain and the dunes to the west of the eastern part of the Swan Coastal Plain have become rare or unusual because of the extent of clearing and such areas have a high richness of vegetation types, then the interim listed area at Ellenbrook has moderate to high national estate value due to its importance for richness of flora (in the broad sense of vegetation) under criterion A3 and this is supported by the fact that the particular diversity (see previous paragraph) is also unusual.

The interim listed area at Ellenbrook also has a diverse flora in the narrow sense of the meaning, i.e. in the number of species recorded there, and therefore also has moderate to high national estate value under criterion A3 for the richness and diversity of the flora species found in it. Weston, Griffin and Trudgen (1992)

recorded 427 species for the Ellenbrook Estate portion of the interim listed area after a fairly low intensity of survey. It is likely that survey of the additional areas in the interim listed area at Ellenbrook would add significantly to the flora recorded, in fact Tingay and Associates (1994) have recorded additional species on the Egerton property. It is also likely that if the intensity of survey were increased, the total flora recorded would increase substantially again, as has happened at other survey areas on the Swan Coastal Plain such as Brixton Street, where a quite small area has a high number of species recorded, partly due to the intensity of the surveys of the area and partly due to the particular habitats present. The diversity of flora species in the interim listed area at Ellenbrook is directly related to its diversity of habitats and the fact that the interim listed area includes areas of the heavy soils of the eastern side of the Swan Coastal Plain and the sandy soils of the Bassendean dunes and the transitions between them. The unusual nature of the diversity of the flora recorded for the particular assortment of habitats in the interim listed area at Ellenbrook is due to the fact that the extensive clearing of the Swan Coastal Plain has made such areas very uncommon.

6.2.2 Criterion B: Its possession of uncommon, rare or endangered aspects of Australia's natural or cultural history in the course, or pattern, of Australia's natural or cultural history.

Criterion B.1: Importance for rare, endangered or uncommon flora, fauna, communities, ecosystems, natural landscapes or phenomena, or as a wilderness. The interim listed area at Ellenbrook has high national estate value under criterion B1 due to the presence of areas of the Yanga and Southern River Vegetation Complexes, both of which have become rare compared to their original extent due to the degree of clearing for agriculture and urban development on the Swan Coastal Plain. Each of these vegetation complexes is discussed in more detail in section five (see above).

The interim listed area also has high national estate value under criterion B1 for rare, endangered and uncommon floristic community types, which have been equated with "threatened ecological communities" for conservation purposes by Blyth and English (1997). The status of the individual floristic community types present in the interim listed area at Ellenbrook is discussed in section five (see above).

The interim listed area at Ellenbrook also has moderate value under criterion B1 for individual flora species that are rare, endangered or uncommon. The particular flora species that are of importance under criterion B1 are discussed in section three of this report (see above). It needs to be noted here that the full extent of this aspect of the national estate significance of the interim listed area at Ellenbrook is probably not fully known due to the relatively low intensity of collecting of flora in the area. Not only is the intensity of flora searches low in the parts surveyed, but in addition large parts of the interim listed area have not yet been surveyed for flora species, although their values at the vegetation complex level is well known.

6.2.3 Criterion D: Its importance in demonstrating the principal characteristics of: (II) a class of Australia's natural or cultural environments

Criterion D.1: Importance in demonstrating the principal characteristics of the range of landscapes, environments or ecosystems, the attributes of which identify them as characteristic of their class.

The western part of the interim listed area at Ellenbrook is a large area of an aeolian sandfield (the Bassendean Dunes) on which is developed a range of landscapes and ecosystems which are characteristic of the class of landscape and ecosystems developed on aeolian dunefields in Australia and especially in the South-west of Western Australia. The interim listed area has moderate to high national estate value for demonstrating the characteristics of this class of natural environment.

The eastern part of the interim listed area at Ellenbrook is an area of a seasonally inundated alluvial plain with clayey soils or thin sands over clays where the aeolian and alluvial natural environments intergrade. This area has a range of landscapes and ecosystems which are characteristic of seasonally inundated alluvial plains, modified in places by a thin layer of sand from the adjoining aeolian environment. The interim listed area at Ellenbrook has moderate to high value for demonstrating the characteristics of this class of natural environment.

The interim listed area at Ellenbrook has very high value for demonstrating the characteristics of the class of natural environment that is developed on the interzone between the aeolian dunefield environment and the alluvial plain environment. This is a very uncommon class of environment that by its nature

is restricted to narrow strips. Some of the particular developments (landscapes, ecosystems) within this class of natural environment in the interim listed area at Ellenbrook that have particularly high national estate value are:

- the "mound" or "tumulus" spring on the Egerton property

- the steep slope to the east of the Lexia wetlands that has areas of *Melaleuca rhaphiophylla* woodlands in an atypical environment for this species and which has areas of *Lycopodium serpentinum* in the understorey due to the seepage from the dunefield in winter.

- the more gentle slopes that have *Pericalymma ellipticum* shrublands in an atypical environment due to the extensive seepage of water from the dunefield in winter.

It should be noted that the national estate values present include a combination of flora and geomorphological values.

7.0 DETAILED OBJECTION ASSESSMENT FOR FLORA VALUES OF THE INTERIM LISTED AREA AT ELLENBROOK

7.1 Introduction

This section comments on the grounds for objection which relate to the national estate significance of the interim listed area at Ellenbrook and the adequacy of the database information produced by the AHC. Different objectors' grounds for objection have been grouped where they were identical or similar.

7.2 Adequacy of the Commission database

The Commission database in relation to the flora and vegetation of the interim listed area at Ellenbrook is adequate for the purposes of the nomination process but contains some, mostly small, errors and does not access all the information currently available for elucidating the national estate value of the interim listed area.

Research and surveys carried out since the interim listing database was compiled have increased the knowledge of the interim listed area at Ellenbrook and the Swan Coastal Plain on which it lies, enabling the importance of the interim listed area in a regional context to be better understood. The extensive study by Gibson et al. (1994) of floristic community types on the Swan Coastal Plain and the continuation of this study by the Western Australian Department of Environmental Protection (DEP 1997) has made available a powerful computer based analysis tool for assessing the conservation value of stands of vegetation on the coastal plain, which supplements the descriptive work previously available. This work and work by Blyth and English (1997) who assessed the conservation status of the floristic community types on the Swan Coastal Plain for the Threatened Ecological Communities database have contributed significantly to an understanding of the area, its regional context and its national estate significance. Additional information specific to the interim listed area such as data on the floristic community types present and the investigation of the "tumulus" or small mound spring on the Egerton property have added to the definition of the values of the interim listed area.

The additional information now available, while showing the need for updating the AHC's database, also strengthens the case for listing the interim listed area at Ellenbrook on the Register of the National Estate.

7.3 Objection assessment

7.3.1 Objections to National Estate value under Criterion A1

Several objectors challenged the inclusion of the interim listed area at Ellenbrook in the Register of the National Estate on the basis that Criterion A1 (Importance in the evolution of Australia's flora, fauna, landscapes or climate) is inappropriate, or erroneous on the basis advanced by the AHC. The grounds advanced for the inappropriateness of listing the area were either that the values were not there, or that they were already adequately protected in other areas.

While the flora values identified by the AHC under Criterion A1 have relied heavily on the presence of particular species of flora, the discussion in earlier sections of this report shows that the values for flora can be substantiated on both vegetation (flora in the broad sense) and flora grounds. While some values identified by the AHC on the grounds of particular species may no longer be appropriate, others have held up well, such as the emphasis on the importance of *Lycopodium serpentinum*. Further data, such as that in table 2 in Section 3 of this assessment report details the plants, other than declared rare or priority species, currently considered significant for the interim listed area at Ellenbrook (DEP 1997). Although some species have been deleted, the number of species on the list has increased since the AHC made its value statement under Criteria A1. The interest in the evolutionary role of some species has also grown in the interim. For example, *Grevillea curviloba* var. *curviloba* and *Darwinia* sp. A (Muchea) are now of additional interest as they occur in the until recently presumed extinct Muchea Limestones floristic community types (Keighery and Keighery, 1996). A number of species present in the interim listed area at Ellenbrook are now known to be endemic to the seasonally inundated heavy soils of the eastern side of the Swan Coastal Plain (see section four). These species in the interim listed area at Ellenbrook demonstrate an aspect of the evolution of the Australian flora in response to the environment found on the eastern side of the Swan Coastal Plain.

Objectors sought to correct a statement in the value statement under Criterion A1 attributed to N. Marchant relating to *Lycopodium serpentinum*. They suggested that the nomination is in error when stating that *Lycopodium serpentinum* only occurs in "the mound spring-like structure and nowhere else on the Swan Coastal Plain", since it is listed by Weston et al. as occurring in the Ellenbrook Estate area adjacent to Egerton. A careful reading of the value statement suggests, however, that the objectors have misinterpreted the statement and that the

nomination does not claim *Lycopodium serpentinum* occurs only on the mound. Instead, the nomination refers to disjunct populations of *Lycopodium serpentinum* (statement of significance), and to the whole of Ellenbrook as supporting a number of uncommon plant species, including *Lycopodium serpentinum* (Criterion B1 of Value statement). *Lycopodium serpentinum* is not a priority species, nor is it stated to be so in the nomination. However, the plant is of interest because the population at Ellenbrook is disjunct from other populations in the south-west of Western Australia and is the most northerly on the Swan Coastal Plain

Lycopodium serpentinum is absent from the species list produced as part of the Egerton Structure Plan Consultative Environmental Review (Tingay and Associates, 1994), but occurs on the "tumulus spring" on the Egerton property. Another species recorded from the tumulus spring (Jasinska and Knott 1994) which is absent from the species list for the Egerton property is *Baumea riparia*. Both species are of interest under Criterion 1A as they are part of the critically endangered Tumulus springs community type.

The AHC value statement under A1 could also make reference to a number of other values of the interim listed area at Ellenbrook. These values are set out in Section 6 in detail.

7.3.2 Objections to National Estate value under Criterion A3

Criterion A3 relates to the importance of a place in exhibiting unusual richness or diversity of flora, fauna, landscapes or cultural features. Several of the objectors argued that the diversity of the flora of the interim listed area at Ellenbrook is restricted to particular parts of the interim listed area (the clayey eastern part) and that the biodiversity of the area is adequately represented in existing reserves.

The part of the statement of value by the AHC for criterion A3 relating to flora mentions several points, including the total flora species number, the diversity of vegetation types and the diversity of the wetland vegetation.

The 427 native species recorded for a portion of the Interim listed area at Ellenbrook by Weston, Griffin and Trudgen (1992) represents a significantly diverse flora, which equals more than a fifth of the flora recorded by Marchant (1987) for the entire Perth Region. It is highly likely that the flora of the interim listed area at Ellenbrook is considerably greater than recorded by Weston, Griffin

and Trudgen (1992). Their survey was moderately detailed for the vegetation but based on relatively low survey intensity for the flora. As the interim listed area includes many habitats not sampled by them, the flora list would increase significantly if further work were carried out. This is substantiated by the species recorded by Tingay and Associates (1994) for the Egerton property, but not recorded by Weston, Griffin and Trudgen (1992). Given the large number of species and the scarcity of areas where there is the same combination of habitats, it does in fact seem reasonable to state that the interim listed area has an "unusual richness or diversity of flora" in the sense of individual species of flora. Undoubtedly, as pointed out in some of the objections, a significant part of this diversity is in the eastern section of the interim listed area and relates to the flora species found in the Yanga and Southern River Vegetation Complexes in that section of the interim listed area. However, there is no requirement in criterion A3 for the diversity or richness in the flora to be evenly spread and it is an error of fact for objectors to say that the values in the eastern part of the interim listed area are adequately reserved elsewhere. It is a fact that the extent of clearing of the Yanga Vegetation Complex is such that it can never be adequately reserved if the criterion to judge this is internationally accepted criteria such as that of the IUCN minimum of ten percent of the original extent. This issue is addressed in some detail in earlier sections of this report. Although more of the Southern River Vegetation Complex remains than of the Yanga, it also has less remaining than would be needed for it to be adequately reserved.

One objector (The Hon. Richard Lewis, representing the Western Australian Government) claimed that the Southern River Vegetation Complex has approximately 18 % remaining and the Yanga vegetation has approximately 16% remaining. As noted in section one of this report, it is likely that these figures relate to the part of the original range that occurs in the Perth Metropolitan Region rather than to the total original distribution. Therefore the figures put forward by Lewis are not a proper basis for discussing the values of the interim listed area for the purposes of National Estate Listing.

The conservation status of the Yanga complex is precarious; the Department of CALM stated in 1992 that only 1% of the Yanga was in reserves (EPA 1992, also Bowman Bishaw Gorham 1993, Weston, Griffin and Trudgen 1992). A number of floristic community types have been recorded from the interim listed area at Ellenbrook that are almost entirely restricted to the Yanga formation and have become rare because almost all of the Yanga has been cleared. Two such

ommunities are listed as critically endangered in the Threatened Ecological Communities data base, with several more being considered.

The twenty-five vegetation units described and mapped by Weston, Griffin and Trudgen for the Ellenbrook Estate were acknowledged by them to not deal with all the diversity of the Estate. Given that the interim listed area at Ellenbrook includes habitat diversity not sampled by Weston, Griffin and Trudgen, it undoubtedly contains vegetation units not in the Ellenbrook Estate. Given the number of units already identified for the area, the likelihood that it includes substantially more, and the scarcity of areas containing the same grouping of geomorphological types as the interim listed area at Ellenbrook, it is quite reasonable for the AHC to identify the interim listed area as having unusual richness of flora in the sense of having an array of vegetation types. Section three and four of this report provide details of the diversity of habitats and floristic community types in the Interim listed area at Ellenbrook. Weston, Griffin and Trudgen also found that the vegetation of the Ellenbrook Estate was different in floristic composition from apparently comparable vegetation types in nearby areas. While they noted that the differences were most pronounced for dampland communities, especially those dominated by *Melaleuca preissiana, Pericalymma ellipticum* and *Regelia ciliata*, they also observed distinctions in the composition of the *Banksia* woodlands on dry sites. In fact, the authors concluded that the floristic composition of many of the vegetation types in their survey area were distinct from structurally similar vegetation types in existing conservation reserves.

7.3.3. Objections to National Estate value under Criterion B1

Criterion B1 relates to the "Importance for rare, endangered or uncommon flora, fauna, communities, ecosystem, natural landscapes or phenomena such as wilderness".

Some objectors challenged the importance of particular species, lists of species and habitats, or statements relating to distribution and rarity of plants. Some objectors argued that the area does not support uncommon species and that there are not 15 Priority species in the area. Several objectors claimed that *Caladenia huegelii* is should not be on the list of Declared Rare Flora for the interim listed area at Ellenbrook, because it is absent from the area, or because Weston, Griffin and Trudgen had not found it within the Estate and had discovered that a previous report of a sighting was a misidentification. One objector (Multiplex)

claimed that their land is excluded from the AHC statements of significance and value for the Interim listed area. Multiplex also stated that the nomination refers to a "mound spring" as an "unusual structure in the south of the area which supports a number of uncommon species" and claimed that tests showed seepage originates from relatively young shallow groundwater within the Bassendean aquifer to the west known as the Gnangara Groundwater Mound and that this type of seepage is common in the Swan Valley in areas of low elevation".

The objections to the presence of some species in the AHC statement of value for the interim listed area at Ellenbrook partly relates to changes in the state of knowledge of such species since the statement was written. The current CALM *Declared Rare and Priority Flora List* (Atkins 1997) has 12 species on it which occur in the interim listed area at Ellenbrook. Of these twelve species, one is declared rare flora, three are Priority 1, one is Priority 2, three are Priority 3 and three are Priority 4 (see also Table 1 in this report). However, Atkins (1997) omits the very rare *Darwinia* sp. A (Muchea) which is known to occur in the interim listed area at Ellenbrook. Government botanists also consider that *Grevillea curviloba* subspecies *curviloba* (currently a Priority 1 taxon and recorded for the interim listed area) may be rare, being known from two populations including the largest known population in a bushland area, estimated to be less than 200 plants in the wild (DEP 1997). The presence or absence of *Caladenia huegelii* for the interim listed area is still not resolved. While Weston, Griffin and Trudgen (1992) did conclude that the specimen that the record was based on had been mis-identified, they also concluded that the species could still be present in the Ellenbrook Estate as there is apparently suitable habitat for it there and there is a confirmed record of the species nearby. The species continues to be included in the Department of Environment listing of DRF/Priority flora for the interim listed area (DEP 1997). In addition, a *Caladenia* aff. *huegelii* is included on the species list for the Egerton property (Tingay and Associates 1994). Botanists use the designation 'aff' (short for affinis) to indicate similarities between a plant not fully identified and a known species and this record may be of *Caladenia huegelii*.

While the list of uncommon and rare species recorded for the interim listed area at Ellenbrook has changed somewhat since the AHC statement of values for the area was prepared, the available evidence indicates that the interim listed area at Ellenbrook does have National Estate values for rare and uncommon flora species for a similar number of species to that identified by the AHC and therefore does have National Estate value in this regard.

The objections to the presence in the statement of significance or value of rare or uncommon vegetation or habitat are also wrong in fact. Earlier sections of this report detail the existence in the interim listed area of areas of the Yanga and Southern River vegetation complexes and explain why they should be considered rare or at least uncommon. The presence in the interim listed area of floristic community types that are endangered due to the fact that they are rare or uncommon is also noted in earlier sections. The available evidence strongly confirms that the interim listed area at Ellenbrook has substantial value for vegetation types (either as vegetation complexes or as floristic community types) that are uncommon or rare. In fact it would seem that rather than overstating these values, the AHC has understated them and there is little doubt that the interim listed area at Ellenbrook has substantial national estate value under criterion B1.

Specific objections were made as to the importance of the "tumulus" spring on the Egerton property. This feature has now been included on the Department of Conservation and Land Management database of threatened ecological communities. From all reports, including that of Jasinka (1994) this is a rare and wonderful natural feature the presence of which in the interim listed area adds significantly to the national estate values found there. Part of the value of the "tumulus" spring relates to the presence of *Lycopodium serpentinum* on it but the majority of the value relates to the development of the vegetation type and habitat that the springs represent.

The nomination refers to the mound as "the mound spring like structure" (Discussion in Value statement of Criterion A1) and as " an unusual structure, similar to a mound spring" (Discussion in Value statement of Criterion B1). Jasinska and Knott (1994) in describing the remnant Ellenbrook mound springs, emphasise the fact that they are different structures from the Great Artesian Basin springs which were given the same name. They propose the term *tumulus* springs (from Latin *tumulus* small mound). It is important to note that Jasinska and Knott found that the Egerton mound springs were the only mound springs in the area which still supported the original native flora. They found other areas of mound springs; however, these were degraded. (Jasinska and Knott 1994). The authors state specifically in relation to the Egerton mound that

> *there were no weeds present and that among plants identified were Lycopodium serpentinum (bog clubmoss), Drosera pulchella, Baumea*

riparia, Lepidosperma (2spp), Aotus cordifolia, Agonis linearifolia and four liver-worts Riccardia aequicellularis, Jungermannia inundata, Goebelobryum unguiculatum and Hyalolepidozia longiscypha. Some of this flora is common in the southwest of WA but has been recorded only from mound springs so far north, the previous northern limit of their distribution being the mound springs at Muchea.

The owners of the Egerton property objected to parts of their property being included in the interim listed area on the grounds that the "Regional significance of the Egerton vegetation is low due to the large area (approximately 600 ha) of *Banksia* Woodland and wetland vegetation to be retained in the Ellenbrook Estate development and the similarity and lesser value of the Egerton communities, compound (sic) to this future reserve area".

The objection is not supported by the facts. The property contains examples of both Yanga and Southern River vegetation complexes which are considered in this report to be rare vegetation. The property includes the "tumulus" spring (see above) which has high national estate value. In addition, the 24 vegetation associations recorded for the property (Tingay and Associates 1994) indicate a very diverse vegetation (some of this may be out of the interim listed area) and priority species have been recorded for the property. The property also has some of the other species of interest recorded for the interim listed area at Ellenbrook (DEP 1997), specifically *Astroloma xerophyllum, Hibbertia perfoliata and Verticordia nitens.*

7.3.4 Objections to National Estate value under Criterion D1

Criterion D1 relates to the "Importance in demonstrating the principal characteristics of the range of landscapes, environments or ecosystems, the attributes of which identify them as characteristic of their class".

The objections to listing under this criterion are vague. Multiplex Constructions objected on the grounds that some specific aspects of the interim listed area at Ellenbrook mentioned in the statement of value made by the AHC under Criterion D1 relate to other parts of the interim listed area and not to the Egerton property.

The statement of value made by the AHC under Criterion D1 is not very thorough and alludes to some parts of the value of the interim listed area under

Criterion D1 rather than being a succinct statement of the overall value under Criterion D1. In section six of this report the values under Criterion D1 have been identified as being representation of three "classes" of ecosystems or environments or landscapes. These are the dunefields of the Bassendean Sands, the seasonally inundated alluvial plain and the contact zone or interface between them. This obviously implies that there would be a range of specific values such as those identified by the AHC in the statement of the value under Criterion D1. As pointed out in section six, the interim listed area at Ellenbrook has very high national estate value for the three classes of ecosystem identified as being present (using ecosystem in a wide sense). The Egerton property has particular value for the interface "class", through the presence of the "tumulus" springs with its very high value as the last example of this threatened ecological community that has not suffered significant degradation. The number of plant associations described by Tingay and Associates (1994) for the Egerton property suggests that this property would also have other specific values under Criterion D1.

8.0 APPROPRIATENESS OF THE BOUNDARIES OF THE INTERIM LISTED AREA AT ELLENBROOK

For the most part the boundaries of the interim listed area at Ellenbrook are appropriate. However, some small additions are proposed and there is a need for further investigation of areas to the north-west of the interim listed area.

8.1 Recommended additions to the interim listed area at Ellenbrook

The small additions to the interim listed area at Ellenbrook are:

1) an addition to the western part of the north side of the interim listed area. This addition is recommended to include an area of dampland vegetation within the Bassendean North Vegetation Complex along the south side of the drain near the north-west corner of the interim listed area. This would increase the representation of this vegetation type, which appears to be different to that in the Lexia wetlands.

2) an addition along the west side of the interim listed area, extending down to the south-west corner. It is recommended that this area be added in order to: a) include additional areas of the Bassendean North Vegetation Complex, including some that are in very good to excellent condition; b) include additional areas of the outlier of the Bassendean Complex - North - Transition that is partly within the interim listed area; c) rationalise the boundaries so that they correspond better to land use boundaries by moving closer to the pine plantations rather than leaving a strip of land between the pines and the proposed national estate area.

8.2 Comment on Kourtesis block

The Kourtesis block that has been included in the interim listed area is a mosaic of low dunes and seasonal wetlands. The dunes appear to be degraded, while the seasonal wetlands appear to be in good or better condition (from aerial photography). These wetlands have a clay base and therefore represent small inclusions of the Yanga Complex within the area of Bassendean Sand. As such they are significant in representing the intergradation between the Yanga and Bassendean - North vegetation complexes. Thus although the drylands are degraded this block should remain in the interim listed area.

8.3 Need for further investigation of areas at the north-west corner of the interim listed area

Adjacent to the north-west corner of the interim listed area there is an area of the Bassendean North Vegetation Complex that has a mosaic of low dunes and broad open damplands. This area is quite dissimilar in the dampland habitats present (and thus vegetation and to a lesser degree flora) to the other areas of the Bassendean North Vegetation Complex in the interim listed area.

It may be desirable to add this area to the interim listed area so that the range of habitat is increased. However, it would be inappropriate to recommend this at the present time, as insufficient data about the values of the area is available to allow recommendation of a boundary.

8.4 Limitations to the detail of the boundary specifications

The boundary recommendations made in this report (both for the acceptance of part of the boundary as shown in AHC 1997 and the proposal of additional areas) have been made on the basis of January 1997 aerial photography. It is possible, if not likely, that there have been some changes in land use since these photographs were taken, particularly in the extent of the Ellenbrook development, the extent of the Rocla sand pit and the development of the Amatrek sand pit. This may necessitate minor changes to the boundaries recommended and it is suggested that the Australian Heritage Commission should access more up to date aerial photography before finalising the boundaries for the interim listed area at Ellenbrook.

It should also be noted that no boundary was placed around the Rocla sand pit to exclude it from the interim listed area. It was felt that it was more appropriate for the AHC to deal with the issue of activities within the interim listed area at Ellenbrook that conflict with maintenance of heritage values.

9.0 ACKNOWLDGEMENTS

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