BURNS BEACH BUSHLAND

Boundary Definition: protected area/bushland taken to cadastre boundary (Boundary proposed to be adjusted from that in draft *Perth's Bushplan.*)

SECTION 1: LOCATION INFORMATION

Bush Forever Site no. 322
Area (ha): bushland 407.9 (proposed boundary circumscribes 277.1ha bushland)
Map no. 26, 27
Map sheet series ref. no. 2034–IV SE
Other Names: South Mindarie (Semeniuk, V&C Research Group 1991a), Submission Areas 296 and 320
Local Authorities (Suburb): Shire of Wanneroo (Burns, Mindarie), City of Joondalup (Burns)
System 6 (1983): Part M2, part M6 area of bushland goes beyond System area boundaries, all bushland described

SECTION 2: REGIONAL INFORMATION

LANDFORMS AND SOILS
Spearwood Dunes
Sands derived from Tamala Limestone (Qts: S7)
Tamala Limestone (Qtl: LS1, LS3)
Quindalup Dunes (Holocene dunes)
Safety Bay Sands (Qhs: S1, S2, LS4)

VEGETATION AND FLORA
Vegetation Complexes
Spearwood Dunes
Cottesloe Complex — Central and South
Quindalup Dunes
Quindalup Complex

Floristic Community Types
Supergroup 4: Uplands centred on Spearwood and Quindalup Dunes
24 Northern Spearwood shrublands and woodlands
28 Spearwood *Banksia attenuata* or *B. attenuata* — *Eucalyptus* Woodlands
29a Coastal shrublands on shallow sands
29b *Acacia* shrublands on taller dunes
S11 Northern *Acacia rostellifera* — *Melaleuca systena* shrublands
S13 Northern *Olearia axillaris* — *Scaevola crassifolia* shrublands
S14 *Spinifex longifolius* grassland and low shrubland

WETLANDS
No wetlands mapped

THREATENED ECOLOGICAL COMMUNITIES
Not assessed, Not determined

SECTION 3: SPECIFIC SITE DETAIL

Landscape Features: dune landforms include parabolic dunes, sand blowout and cuspate foreland
Vegetation and Flora: limited survey (DEP 1999, DEP 2000, Griffin 1994 (MI 01–23), part Site — Griffin and Trudgen 1994, Keighery, GJ, 1991c, Kinhill Stearns 1983, LeProvost *et al.* 1984)
Structural Units: mapping (part Site — LeProvost *et al.* 1984)
Spearwood Dunes
Uplands — Sands derived from Tamala Limestone: *Banksia attenuata* and *B. menziesii* Low Woodland, occasional *Eucalyptus gomphocephala* trees
Uplands — Tamala Limestone: Closed to Open Heaths dominated by *Dryandra sessilis* var. *cygnorum*, *Calothamnus quadrifidus*, *Hakea trifurcata*, *Hibbertia hypericoides* and *Melaleuca huegelii*
Quindalup Dunes
Uplands — Older dunes and plains: Closed to Open Low Heaths of *Melaleuca systena*, *Acacia lasiocarpa*, *A. rostellifera*, *Scaevola nitens*, *Nemcia reticulata* and *Hibbertia racemosa* over Herblands dominated by *Lomandra maritima*; *Acacia rostellifera* Scrub; *Melaleuca cardiophylla* Low Forest to Closed Tall Scrub (southernmost area of this association)
Uplands — Younger dunes: Heaths dominated by *Olearia axillaris*, *Scaevola nitida* and *S. crassifolia*; low dunes with Heath dominated by *Scaevola crassifolia*, *Spyridium globulosum* and *Myoporum insulare*; deflated surface poorly vegetated with *Calocephalus brownii* and *Pelargonium capitatum*, the former giving way to *Acacia cyclops* as it ages
Uplands — Strand: *Spinifex longifolius* and *S. hirsutus* Grassland

Scattered Native Plants: not assessed
Vegetation Condition: >70% Excellent to Pristine, <30% Very Good to Good (Griffin and Trudgen 1994), with localised disturbance to north of Burns Beach
Total Flora: 168 native taxa, 24 weed taxa (Keighery, GJ, 1991c) (estimated <70% of the expected flora)
Significant Flora: *Conostylis pauciflora* subsp. *euryrhipis* (3), *Hibbertia spicata* subsp. *leptotheca* (3), *Stylidium maritimum* (3); *Sonchus megalocarpa* (most northern record, uncommon species); *Melaleuca cardiophylla, Allocasuarina lehmanniana, Acacia xanthina* (at southern limit in the PMR), *Lechenaultia linarioides*; *Conospermum triplinervium, Petrophile serruriae* subsp. nov. (GJK 11421), *Pimelea villifera* (only known population in PMR, Keighery, GJ, 1991c); typical of Tamala Limestone taxa (Keighery, GJ, 1991c) — *Grevillea preissii, Diplopeltis huegelii* subsp. *huegelii, Petrophile serruriae* subsp. nov. (GJK 11421), *Pimelea calcicola, Leptomeria empetriformis, Trymalium ledifolium* subsp. *ledifolium, Pimelea villifera, Jacksonia calcicola*
Fauna: limited survey for birds (54 species), native mammals (3 species), reptiles (23 species) and amphibians (1 species) (Kinhill Stearns 1983). Significant bird species: Scarlet Robin. Significant mammal species: Western Brush Wallaby and Honey Possum
Linkage: adjacent bushland to the south and east (Site 323, across road, then through Site 323 to Site 383); part of Greenways 1, 3, 4, 34 (Tingay, Alan & Associates 1998a); part of a regionally significant fragmented bushland/wetland linkage (Part A, Map 7)
Other Special Attributes
Meets all six specific coastal reserve criteria

(i) Quindalup Dune types: 'South Mindarie now represents the most well defined remaining cuspate foreland and its associated range of medium to small scale (Quindalup) dune landforms and vegetated habitats in this coastal sector (Whitfords to Lancelin)' (Semeniuk, V&C Research Group 1991a); 'small area of old low dunes perched on gently undulating Spearwood (Tamala) Limestone surface; moderate sized Q3 dunes ramped on coast side; small area of Q4 dunes forming steep sided closed vale; a number of small coastal blowouts with small Q4 dunes surrounding these; a major sandsheet with moderate to tall partially stabilised dune margins; bowl of sand sheet completely deflated near coast; foredune redeveloped in throat of sand sheet' and 'small area of old low dunes perched on gently undulating Spearwood (Tamala) Limestone surface with few small plains; large area of old, moderate sized dunes ramped on each other with small (if any) plains between; number of small coastal blowouts with small Q4 dunes surrounding; major sand sheet with partially stabilised dune margins; bowl of sand sheet completely deflated only near coast; foredune redeveloped in throat of sand sheet' (Griffin and Trudgen 1994)
(ii) Continuing natural processes: 338.5ha (260.8ha bushland) of Quindalup Dunes extending to 1.4kms inland (2.8kms inland in link to Site 323)
(iii) Shoreline: soft (sandy)
(iv) Linkage: contains Quindalup/Spearwood Dunes interface; part of semi-contiguous north–south vegetated coastal strip
(v) Vegetation: 'vegetation is variable and typifies the range of habitat types within a cusp (Semeniuk, V&C Research Group 1991a) and interfaces with Tamala Limestone surfaces and Spearwood Dunes
(vi) Habitats: variable;

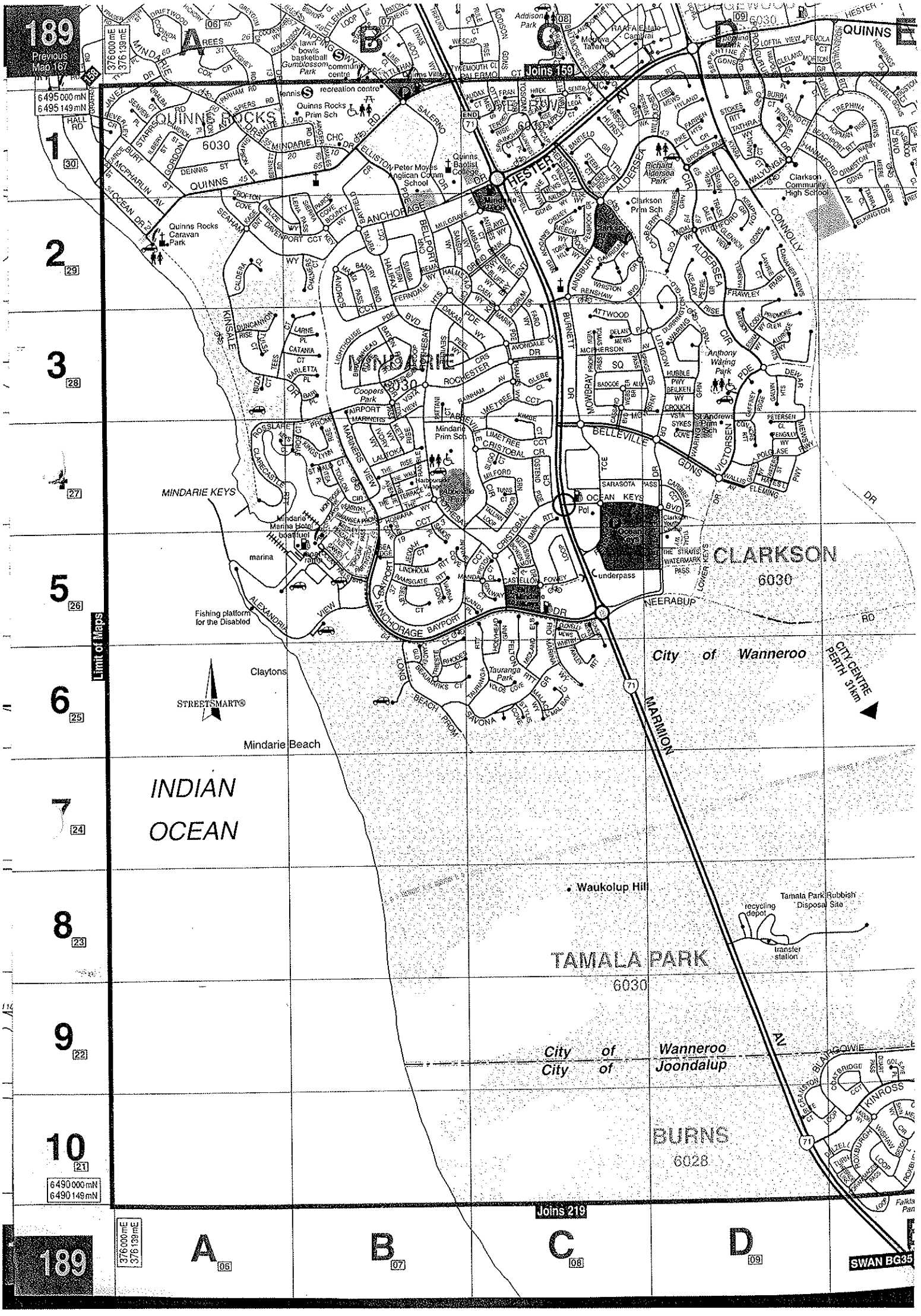
Includes core of areas recommended for conservation by Griffin and Trudgen (1994) and Semeniuk, V&C Research Group (1991a); Recommended for protection in study of City of Wanneroo bushland (Trudgen 1996)

SECTION 4: INTERNATIONAL AND NATIONAL SIGNIFICANCE

Not listed

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, Criteria not relevant to determination of regional significance, but which may be applied when evaluating areas having similar values
Recommendation: Part A: Site with Some Existing Protection; parts of this Site already reserved for Parks and Recreation in the MRS be made National Park, Conservation Park, Regional Park or Nature Reserve. Part B: Proposed Parks and Recreation Reservation. Part C: Urban Negotiated Planning Solution. Part D: Urban Negotiated Planning Solution (see Table 3, Volume 1).


189
Previous Map 167
376 000mE
376 139mE
6495 000mN
6495 149mN
6490 000mN
6490 149mN
QUINNS ROCKS
6030
MINDARIE
6030
CLARKSON
6030
TAMALA PARK
6030
BURNS
6028
INDIAN OCEAN
MINDARIE KEYS
Mindarie Beach
Limit of Maps
Joins 159
Joins 219
City of Wanneroo
City of Joondalup
CITY CENTRE PERTH 31KM
Waukolup Hill
Tamala Park Rubbish Disposal Site
recycling depot
transfer station
Quinns Rocks Caravan Park
Quinns Rocks Prim Sch
Peter Moyes Anglican Comm School
Quinns Baptist College
Clarkson Prim Sch
Clarkson Community High School
Mindarie Prim Sch
Anthony Waring Park
Richard Aldersea Park
Cooper Park
Tauranga Park
Mindarie Marina boat fuel
marina
Fishing platform for the Disabled
Claytons
STREETSMART®
underpass
Joins 159
Joins 219
SWAN BG35

Bush Forever Site 322: Burns Beach Bushland

Bush Forever Sites
Bush Forever, MRS Ammendments
Local Government Authority Boundaries
Floristic Survey Sites of the Southern Swan Coastal Plain
- GJKENV (Keighery 1996)
- GRIFFIN (Griffen 1994)
- SCP (Gibson et al 1994)
- SYS6ENV (DEP 1996 and Trudgen & Keighery 1995)
- SYS6ENV2 (DEP 1996 and Trudgen & Keighery 1995)

CALM Threatened Ecological Communities 2002
Roads - Perth Metropolitan
Swan Coastal Plain - Eastern Boundary

100 0 100 200 Meters

1:10000

N

GDA

Projection: GDA94
MGA Zone 50

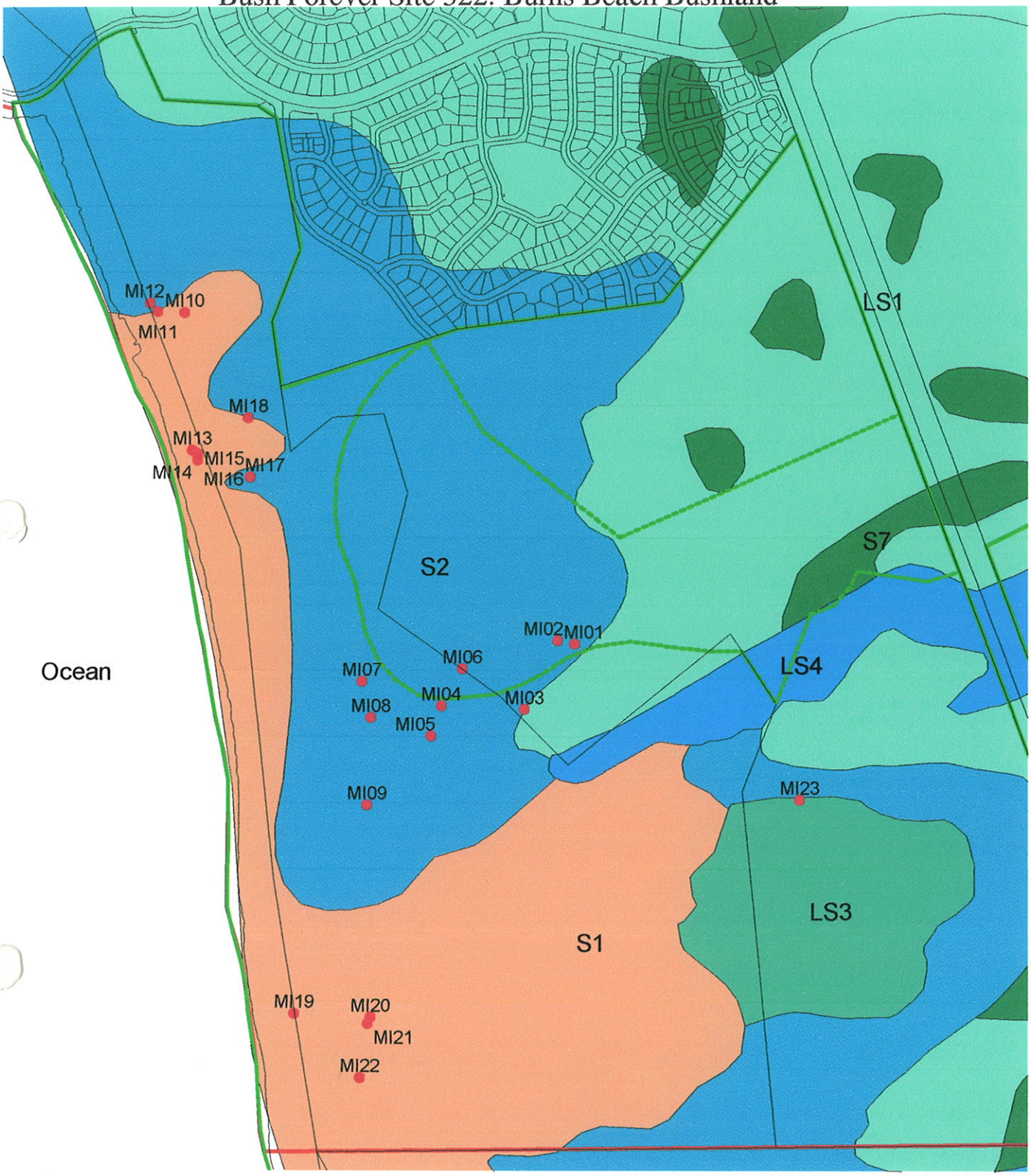
Department of Environment
Western Australia

This map has been produced using various data from other agencies. No responsibility is accepted for any error or omission.

Aerial Photography: Perth Metro Area - North West 2003

ENVIRONMENTAL GEOLOGY

Bush Forever Site 322: Burns Beach Bushland



Bush Forever Sites

Bush Forever, MRS Ammendments

Local Government Authority Boundaries

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CALM Threatened Ecological Communities 2002

Roads - Perth Metropolitan

Swan Coastal Plain - Eastern Boundary

100 0 100 200 Meters

1:10000

N

GDA

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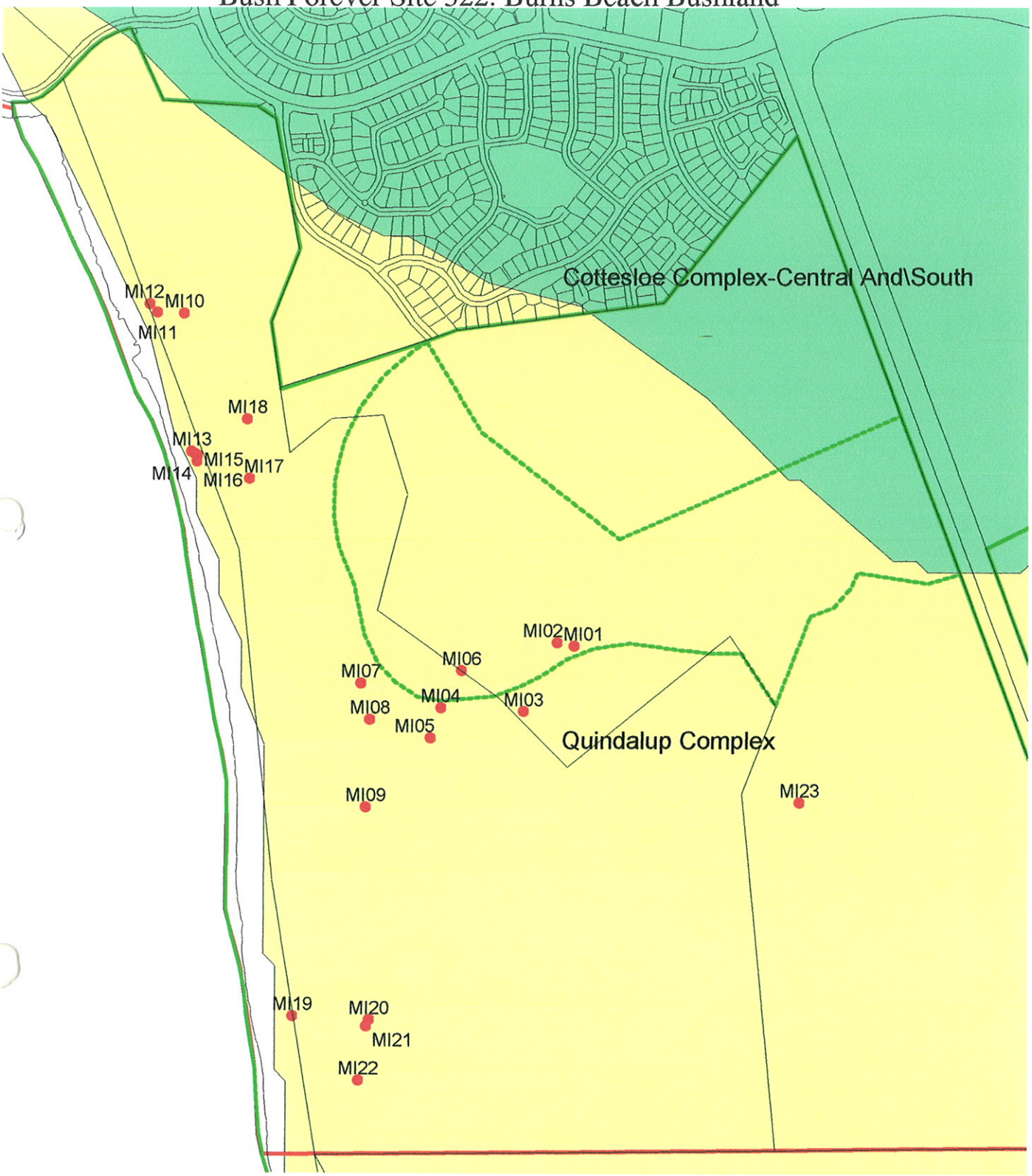
Aerial Photography: Perth Metro Area - North West 2003

VEGETATION COMPLEXES
Bush Forever Site 322: Burns Beach Bushland



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1:10000

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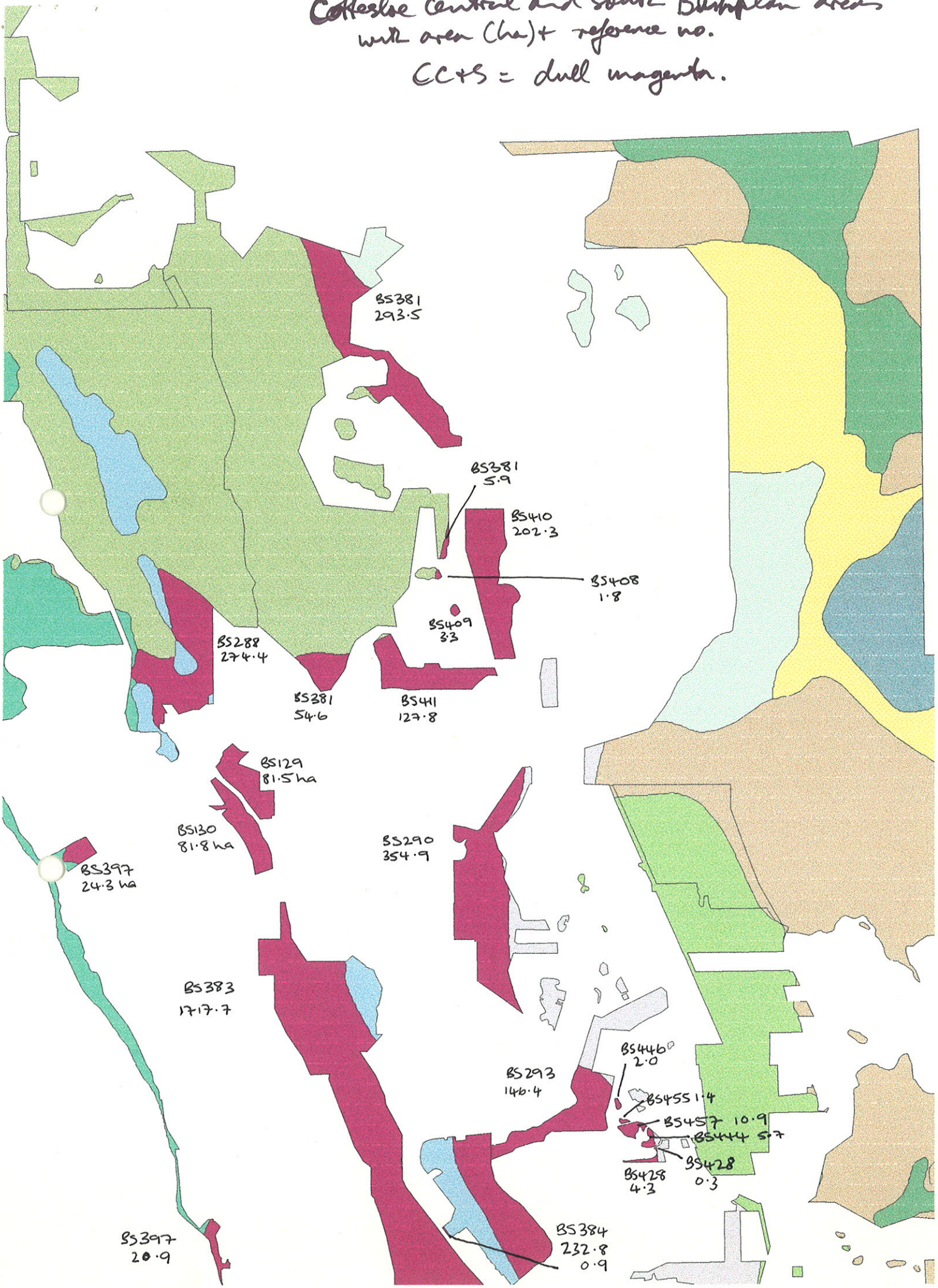
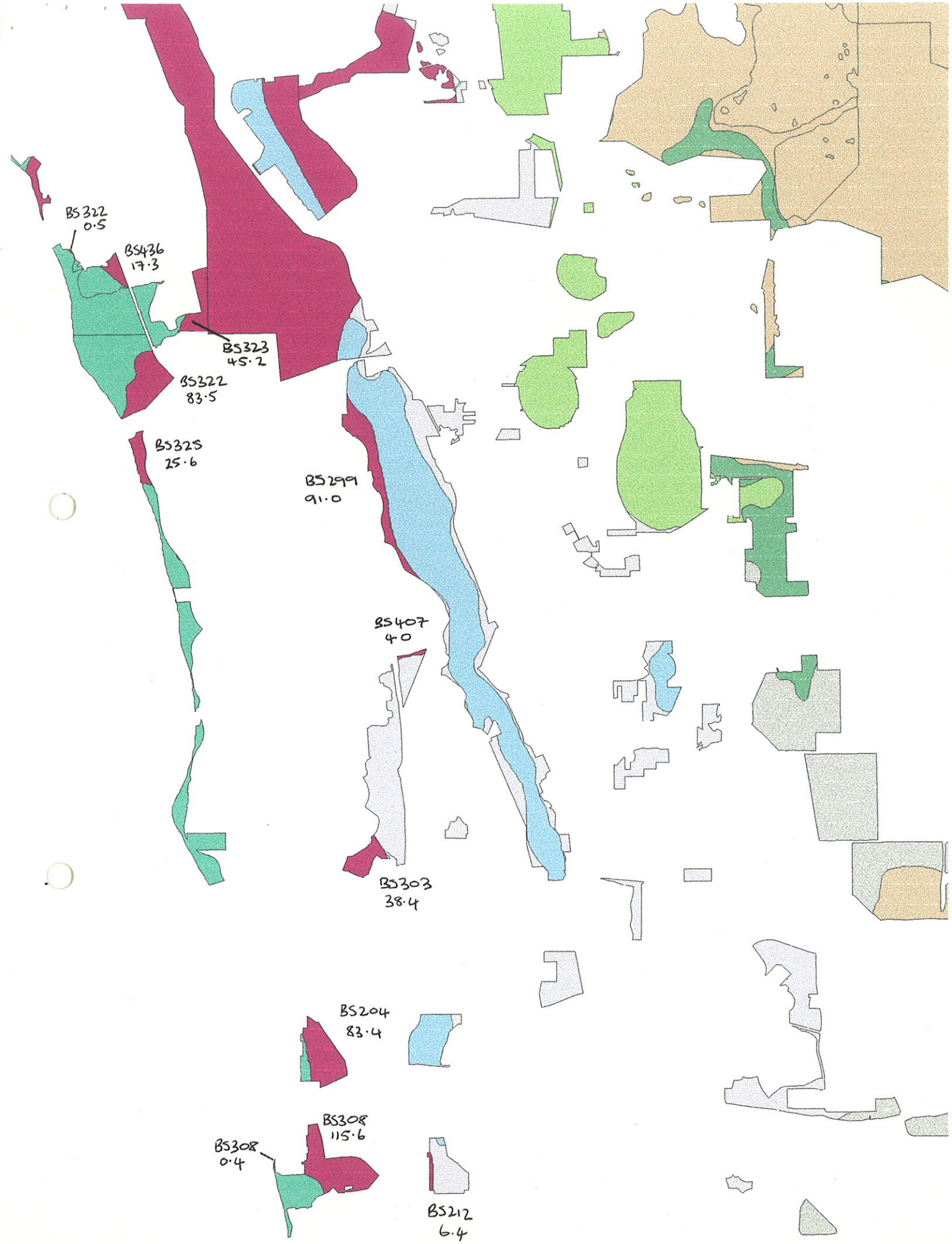
Aerial Photography: Perth Metro Area - North West 2003

Cotteslow Central and South Buckingham areas with area (ha) + reference no.

CC+S = dull magenta.

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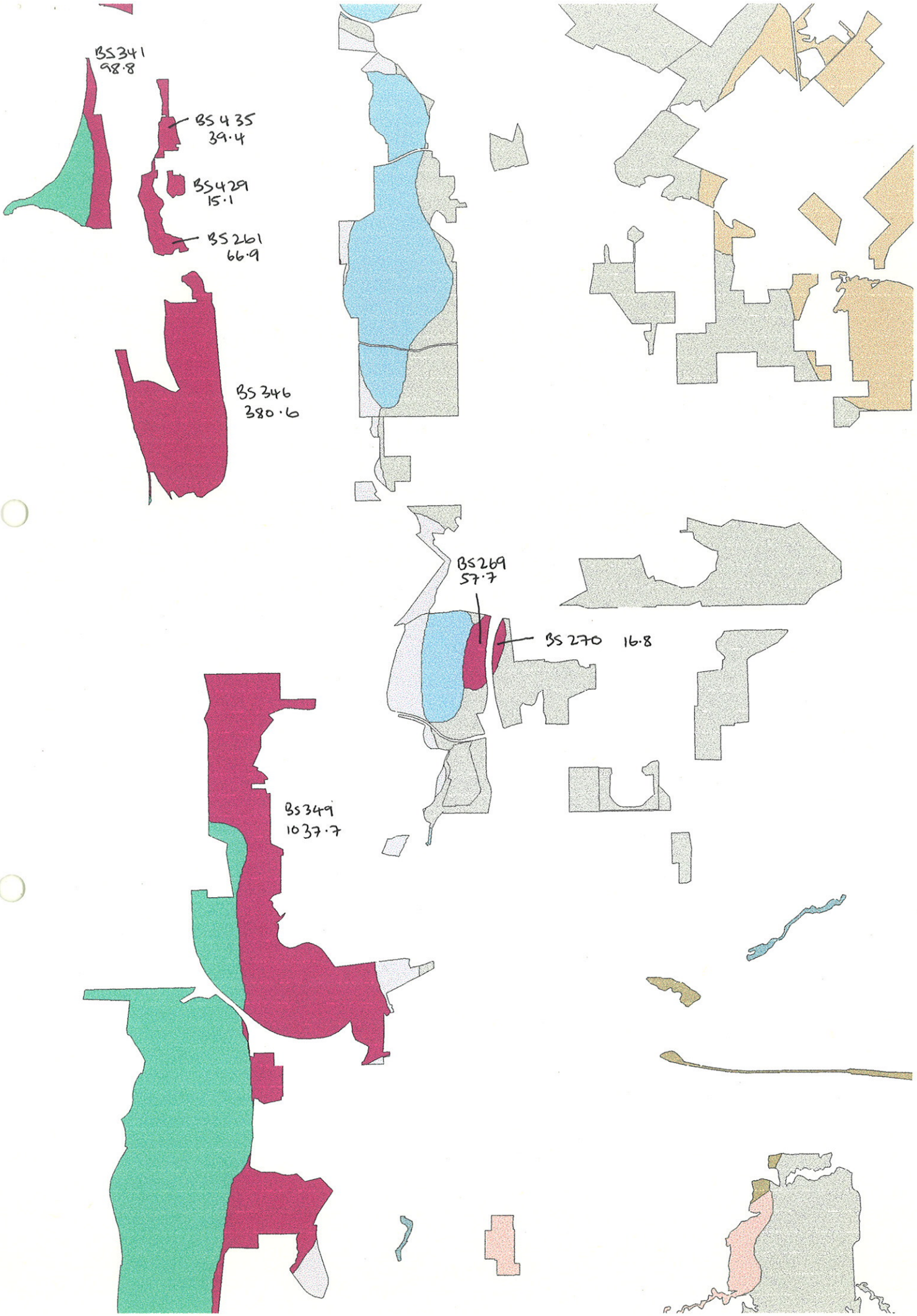
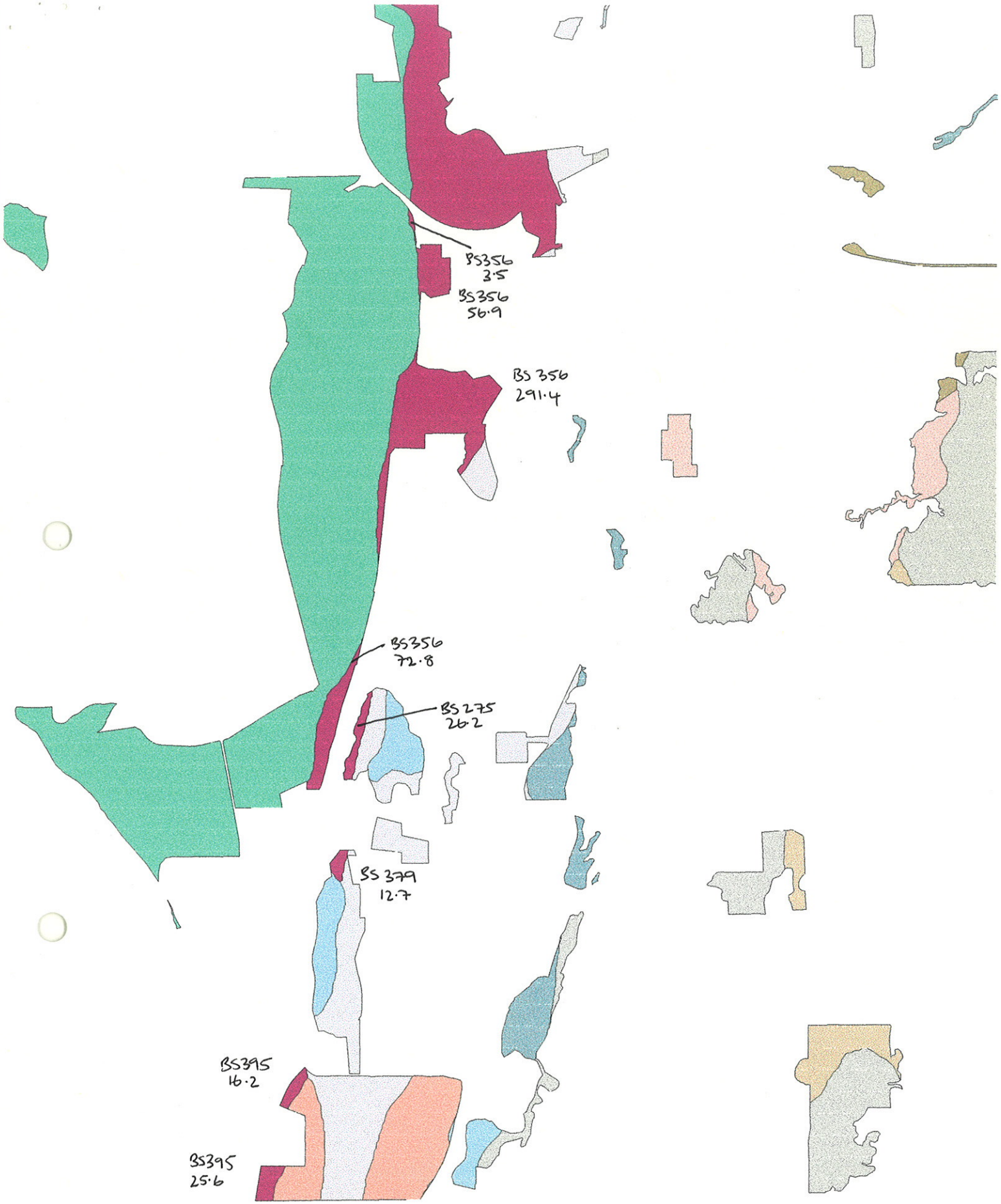
0·5
BS436
17·3
BS323
45·2
BS322
83·5
BS325
25·6
BS299
91·0
BS407
40
BS303
38·4
BS204
83·4
BS308
115·6
BS308
0·4
BS212
6·4


BS310
67·6
No Banksia
Woodland
BS312
408·7
BS315
86·0
BS315
13·2
BS403
0·1
BS403
2·4
BS334
2·4
BS334
0·01
0·01
BS334
24·0
BS335
12·1
BS331
0·1
BS59
BS247
86·7


BS341
98.8
BS435
39.4
BS429
15.1
BS261
66.9
BS346
380.6
BS269
57.7
BS270
16.8
BS349
1037.7


BS356
3·5
BS356
56·9
BS 356
291·4
BS356
72·8
BS 275
26·2
BS 379
12·7
BS395
16·2
BS395
25·6

Bush Forever Site 322: Burns Beach Bushland

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CALM Threatened Ecological Communities 2002
Roads - Perth Metropolitan
Swan Coastal Plain - Eastern Boundary

100 0 100 200 Meters

1:10000

N

GDA

Projection: GDA94
MGA Zone 50

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Aerial Photography: Perth Metro Area - North West 2003

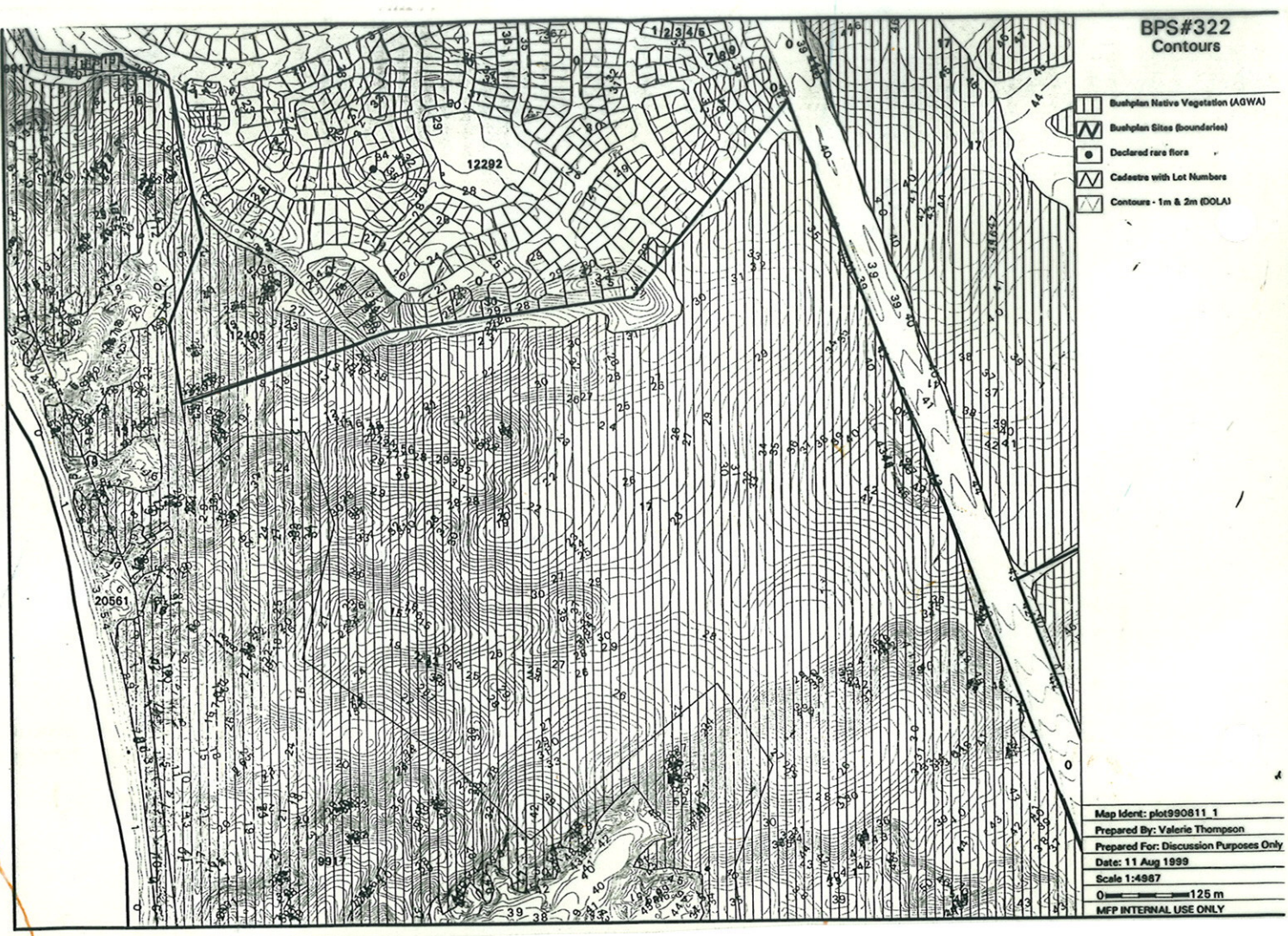
BPS#322
Contours

- Bushplan Native Vegetation (AGWA)
- Bushplan Sites (boundaries)
- Declared rare flora
- Cadastre with Lot Numbers
- Contours - 1m & 2m (DOLA)

9917
12292
12405
20561
17
0

Map Ident:	plot990811_1
Prepared By:	Valerie Thompson
Prepared For:	Discussion Purposes Only
Date:	11 Aug 1999
Scale	1:4987
0	125 m

MFP INTERNAL USE ONLY


BPS#322
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12292
12405
20561
9917
Map Ident: plot990811_1
Prepared By: Valerie Thompson
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Date: 11 Aug 1999
Scale 1:4987
0 125 m
MFP INTERNAL USE ONLY

MINDARIE KEYS

Figure 2: Map showing site and profile locations for geomorphology, soils and vegetation. The position of the number at each site indicates the exact location of the sampling site.

0 100 200 300 400 500 600 700 800 m

N

See Le Provost Semeniuk & Chalmer 1984

See Keighery 1991 & Semeniuk Res Group 1991

Griffin & Trudgen 1984

See Kinhill Skeet 1983

Lot 1

Woodlup Drive

SYSTEM 6 BUSHLAND SUBMISSION FORM
FOR CONSIDERATION IN THE UPDATE PROGRAMME

BURNS-MINDARIE DUNES

LOCATION, OWNERSHIP AND ZONING OF THE AREA

1. Location

a) Bordering Roads: Burns Beach Rd and Marmion Ave
b) Nearest Corner: as above
c) Lot Number: Lots 2 and 17
d) Suburb/Location: Burns Beach, Mindarie
e) Local Council: City of Wanneroo
f) Site Name: Burns-Mindarie Dunes
g) Approximate size of area (ha): estimated area size 250 ha
h) Location on map: please see attached copy of aerial photo
i) Map: Streetsmart Street Directory, 1996
j) Map no.: 14 and 18
k) Grid Ref.: Map 14: 6B (top left) to 6D (top right)
7B (bottom left) to 7C (bottom right)
Map 18: 1D (top left) to 1E (top right)
2D (bottom left) to 2E (bottom right)
l) Other information to find location: please see attached copy of aerial photo.
m) Aware of any development proposals that are likely to affect the area?
Yes, proposed urban development

2. Who owns the area? Cities of Wanneroo, Stirling and Perth and Burns Beach Property Trust.

3. If you own the land? not applicable

4. What is the area zoned? Rural, Parks and Recreation, Urban

PHYSICAL CHARACTERISTICS

5. Why do you consider this area important? This area that is recommended surrounds existing an area already recognised in System Six. We are concerned about the whole area between Burns Beach and Mindarie Keys, part is within

System 6 areas M2 and M6, the bushland outside of the System 6 area has conservation value and should be assessed as part of the Update.
The submitted area includes significant coastal vegetation and landforms. To enlargen the size of the existing System Six area will consolidate the existing System Six area and add important vegetation and landform representation to this. Habitat types in the submitted areas include *Dryandra sessilis* heathland in the northern part, stands of *Eucalyptus petrensis* and heathland on Quindalup dunes, the north eastern area includes *Dryandra sessilis* heathland, *Acacia rostellifera* shrubland and Banksia woodland. The southern area includes Banksia woodland, stands of *Eucalyptus decipiens* and *E. todtiana* and heathland on Quindalup dunes.

Protecting the whole area would allow protection of a large remnant of coastal bushland including landforms and vegetation associated with a cuspate foreland system with sand sheets and parabolic dunes, it would protect vegetation types of the Quindalup and western side of the Spearwood dune systems, a large area would enhance management and long-term ecological viability of the area. The conservation significance of the area or parts of it has been recognised by several studies (V & C Semeniuk Research Group, 1992; Griffin, 1993; Keighery, 1991).

6. What are the soil type/s and colours? White/Grey and Yellow sands of Quindalup and Cottesloe soil types.

7. Any special features such as unusual landforms/landscapes? Yes. Area includes a well defined cuspate foreland with range of dune landforms (V & C Semeniuk Research Group, 1992). It includes two large sand sheets or 'blow outs' and parabolic dunes. The Mindarie dune complex is characteristic of the Quindalup dune landforms of the Whitfords sector, but one of the few remaining intact examples of these geomorphic features (Semeniuk et al, 1989).

8. Is the area a wetland or does it include a wetland? No

9. What percentage of the wetland is open water in summer? not applicable

VEGETATION / FAUNA

10. What percentage of the area is indigenous vegetation? 100% with disturbances restricted to tracks and a small area which was grazed.

11. If the area includes regions of cleared native bushland please indicate reasons for the inclusion. not applicable

12. Has any previous flora or fauna work been done on the area? Yes. Flora of the cusp has been described by Keighery (1991) and was included in a regional survey of the Quindalup dunes by Griffin (1993). The area is also referred to by Semeniuk et al (1989) and V & C Semeniuk Research Group (1992). We understand a botanic survey and conservation assessment has been completed for the Burns Beach Property Trust. Also there was limited flora and fauna work done for the Mindarie Tip ERMP (Kinhill Stearns, 1983).

13. The condition of the native bushland? Excellent

14. Disturbances affecting the area?

d) Fire regime; southern part was burnt in March 1995
f) Weed invasion; some limited weed invasion
g) Animal impact; rabbit burrows have been seen in the area
m) Grazing; small area of Marmion Ave has been grazed.
n) Tracks; there are some tracks in area
o) Off-road vehicle use; yes mainly near beach.

15. Plant species of interest in the area? A large area of *Melaleuca cardiophylla* occurs here, the species is near its southern extent. The native thistle *Sonchus megalocarpa* has been recorded in large numbers on dune ridges, its occurrence here is a significant range extension. *Aloygne huegelii* var. *glabrata* is uncommon in the metropolitan region. Other significant flora has been noted by Keighery (1991).

16. Do you know of any animals that use the area? Several uncommon species of reptile and bird have been recorded in the area (see Kinhill Stearns, 1982, pp 72-3). The Western Brush Wallaby occurs here - this species is on the CALM Reserve List. White-tailed Black Cockatoos have been seen feeding here - this is

a specially protected species under Schedule 4 of the Wildlife Conservation Notice. The Honey Possum has also been reported here. We are also aware that Echidnas and Western Grey Kangaroos use the area.

17. Is the area used by any native animals of special interest? Other than what is listed above, it is difficult to know as only limited survey work has been done in area.

SURROUNDING AREA

18. Are there any bushland areas (including wetlands) near this area? Part of the adjacent area is covered by System Six and areas surrounding Mindarie Tip connects this area to Neerabup National Park. The adjacent System Six bushland is recommended for conservation.

19. Does the submitted area link other bushland areas? Yes, the submitted area is part of the link to Neerabup National Park from the coast. Further, it would enlarge an existing proposed conservation area.

Burns - Mindavie Dunes

This is a 1992 photo. Copy of 1995 photos are attached.

This includes part System Six area M2 and M6 as well as additional areas we are nominating.


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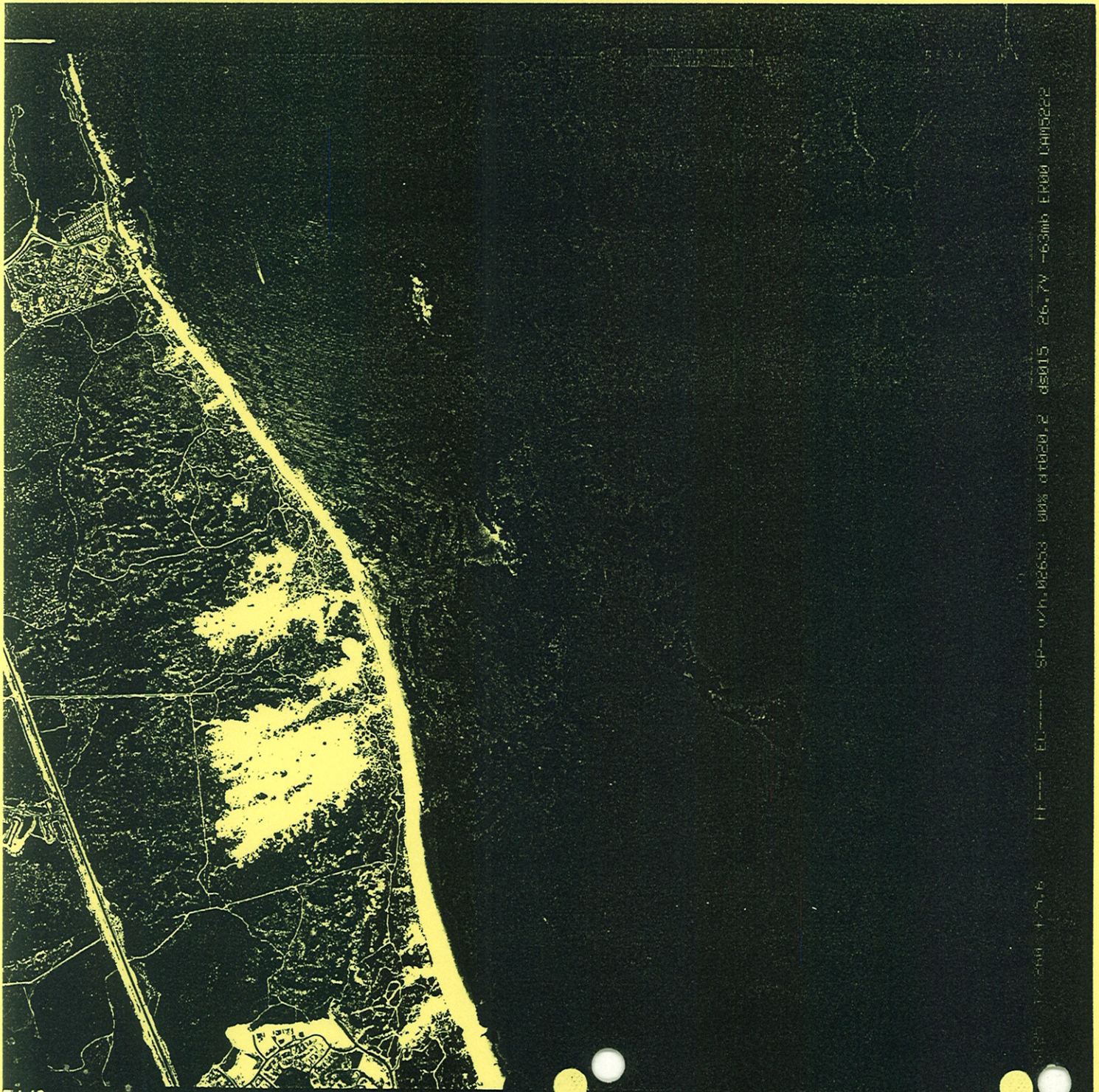

5140 WA3490 (C) METRO REGIONAL AREA
RUN 5N (5132-5157) 1:20000 06.01.95 940900
NL

Plotorsource	Na	Genus	Species	InfraspRank	InfraspName	Informal	ConsvCode
MI01		Acacia	rostellifera				
MI01		Acanthocarpus	preissii				
MI01	*	Anagallis	arvensis	var.	caerulea		
MI01	*	Boerhavia	coccinea				
MI01	*	Bromus	diandrus				
MI01		Calandrinia	corrigioloides				
MI01		Clematis	linearifolia				
MI01		Conostylis	pauciflora	subsp.	euryrhipis		P3
MI01	*	Crassula	glomerata				
MI01		Daucus	glochidiatus				
MI01		Desmocladus	fasciculatus				
MI01	*	Erodium	cicutarium				
MI01		Hardenbergia	comptoniana				
MI01	*	Heliophila	pusilla				
MI01		Lepidosperma	squamatum				
MI01		Leucopogon	parviflorus				
MI01		Lomandra	maritima				
MI01		Melaleuca	cardiophylla				
MI01		Melaleuca	systena				
MI01		Millotia	myosotidifolia				
MI01		Parietaria	debilis				
MI01		Phyllanthus	calycinus				
MI01		Poa	poiformis				
MI01		Spyridium	globulosum				
MI01		Thysanotus	patersonii				
MI01		Trachymene	pilosa				
MI01		Tricoryne	elatior				
MI01		Xanthorrhoea	preissii				

Plotorsource	Na	Genus	Species	InfraspRank	InfraspName	Informal	ConsvCode
MI02		Acacia	rostellifera				
MI02		Acanthocarpus	preissii				
MI02	*	Anagallis	arvensis	var.	caerulea		
MI02	*	Boerhavia	coccinea				
MI02	*	Bromus	diandrus				
MI02		Calothamnus	quadrifidus				
MI02	*	Cerastium	glomeratum				
MI02		Comesperma	integerrimum				
MI02		Conostylis	pauciflora	subsp.	euryrhipis		P3
MI02		Crassula	colorata	var.	colorata		
MI02	*	Crassula	glomerata				
MI02		Daucus	glochidiatus				
MI02	*	Desmazeria	rigida				
MI02		Desmocladus	fasciculatus				
MI02	*	Dischisma	arenarium				
MI02	*	Erodium	cicutarium				
MI02	*	Galium	murale				
MI02		Lomandra	maritima				
MI02		Melaleuca	systena				
MI02		Parietaria	debilis				
MI02	*	Pelargonium	capitatum				
MI02		Phyllanthus	calycinus				
MI02		Poa	poiformis				
MI02		Rhagodia	baccata	subsp.	baccata		
MI02	*	Silene	gallica	var.	gallica		
MI02	*	Sonchus	oleraceus				
MI02		Spyridium	globulosum				
MI02		Thysanotus	arenarius				
MI02		Trachymene	pilosa				
MI02	*	Vulpia	myuros				

Plotorsource	N	Genus	Species	InfraspRank	InfraspName	Informal	ConsvCode
MI03		Acanthocarpus	preissii				
MI03	*	Anagallis	arvensis	var.	caerulea		
MI03	*	Bromus	diandrus				
MI03		Clematis	linearifolia				
MI03		Daucus	glochidiatus				
MI03	*	Erodium	cicutarium				
MI03		Melaleuca	cardiophylla				
MI03	*	Orobanche	minor				
MI03		Parietaria	debilis				
MI03		Phyllanthus	calycinus				
MI03		Scaevola	nitida				
MI03		Thomasia	cognata				
MI03		Thysanotus	patersonii				
MI03		Trachymene	pilosa				

Plotorsource	N	Genus	Species	InfraspRank	InfraspName	Informal	ConsvCode
MI04		Acacia	lasiocarpa	var.	lasiocarpa		
MI04		Acacia	rostellifera				
MI04		Acanthocarpus	preissii				
MI04		Austrostipa	flavescens				
MI04		Carpobrotus	virescens				
MI04		Conostylis	pauciflora	subsp.	euryrhipis		P3
MI04		Desmocladus	fasciculatus				
MI04	*	Dischisma	arenarium				
MI04		Gompholobium	tomentosum				
MI04	*	Heliophila	pusilla				
MI04		Hemiandra	pungens				
MI04		Kennedia	prostrata				
MI04		Lepidosperma	squamatum				
MI04		Lomandra	maritima				
MI04		Melaleuca	systena				
MI04		Nemcia	reticulata				
MI04		Olearia	axillaris				
MI04		Ozothamnus	cordatus				
MI04	*	Pelargonium	capitatum				
MI04		Phyllanthus	calycinus				
MI04		Poa	poiformis				
MI04		Podotheca	angustifolia				
MI04		Santalum	acuminatum				
MI04		Scaevola	thesioides	subsp.	thesioides		
MI04		Spyridium	globulosum				
MI04		Thysanotus	arenarius				
MI04		Trachymene	pilosa				

Plotorsource	N	Genus	Species	InfraspRank	InfraspName	Informal	ConsvCode
MI05		Acacia	rostellifera				
MI05		Acanthocarpus	preissii				
MI05		Austrostipa	flavescens				
MI05		Comesperma	integerrimum				
MI05		Conostylis	pauciflora	subsp.	euryrhipis		P3
MI05	*	Crassula	glomerata				
MI05		Desmocladus	fasciculatus				
MI05	*	Dischisma	arenarium				
MI05		Gompholobium	tomentosum				
MI05		Hemiandra	pungens				
MI05		Kennedia	prostrata				
MI05		Lepidosperma	squamatum				
MI05		Leucopogon	parviflorus				
MI05		Lomandra	maritima				
MI05		Melaleuca	systena				
MI05		Olearia	axillaris				
MI05		Ozothamnus	cordatus				
MI05	*	Pelargonium	capitatum				
MI05		Phyllanthus	calycinus				
MI05		Spyridium	globulosum				
MI05		Thysanotus	arenarius				
MI05		Trachymene	pilosa				

Plotorsource	Na	Genus	Species	InfraspRank	InfraspName	Informal	ConsvCode
MI06		Acacia	rostellifera				
MI06		Acanthocarpus	preissii				
MI06	*	Anagallis	arvensis	var.	caerulea		
MI06		Austrodanthonia	caespitosa				
MI06		Austrostipa	flavescens				
MI06	*	Bromus	diandrus				
MI06		Calothamnus	quadrifidus				
MI06		Conostylis	pauciflora	subsp.	euryrhipis		P3
MI06		Crassula	colorata	var.	colorata		
MI06		Daucus	glochidiatus				
MI06	*	Desmazeria	rigida				
MI06		Desmocladus	fasciculatus				
MI06	*	Dischisma	arenarium				
MI06		Gompholobium	tomentosum				
MI06		Hardenbergia	comptoniana				
MI06	*	Heliophila	pusilla				
MI06		Leptorhynchos	scaber				
MI06		Lomandra	maritima				
MI06		Melaleuca	systena				
MI06		Olearia	axillaris				
MI06	*	Pelargonium	capitatum				
MI06		Phyllanthus	calycinus				
MI06		Poa	poiformis				
MI06		Podotheca	angustifolia				
MI06		Rhagodia	baccata	subsp.	baccata		
MI06		Spyridium	globulosum				
MI06		Thysanotus	arenarius				
MI06	*	Trachyandra	divaricata				
MI06		Trachymene	pilosa				
MI06		Tricoryne	elatior				
MI06		Wurmbea	monantha				

Plotorsource	Na	Genus	Species	InfraspRank	InfraspName	Informal	ConsvCode
MI07		Acacia	lasiocarpa	var.	lasiocarpa		
MI07		Acacia	rostellifera				
MI07		Acanthocarpus	preissii				
MI07	*	Anagallis	arvensis	var.	caerulea		
MI07		Austrodanthonia	caespitosa				
MI07		Austrostipa	flavescens				
MI07	*	Bromus	diandrus				
MI07		Conostylis	pauciflora	subsp.	euryrhipis		P3
MI07	*	Crassula	glomerata				
MI07	*	Desmazeria	rigida				
MI07		Desmocladus	fasciculatus				
MI07	*	Dischisma	arenarium				
MI07		Eremophila	glabra	subsp.	albicans		
MI07		Gompholobium	tomentosum				
MI07	*	Heliophila	pusilla				
MI07		Hemiandra	pungens				
MI07		Hibbertia	spicata	subsp.	leptotheca		P3
MI07		Isotoma	hypocrateriformis				
MI07		Lepidosperma	squamatum				
MI07		Leptorhynchos	scaber				
MI07		Lomandra	maritima				
MI07		Melaleuca	systena				
MI07		Olax	benthamiana				
MI07		Olearia	axillaris				
MI07		Opercularia	vaginata				
MI07		Ozothamnus	cordatus				
MI07		Pimelea	ferruginea				
MI07		Poa	poiformis				
MI07		Podotheca	angustifolia				
MI07		Rhagodia	baccata	subsp.	baccata		
MI07		Scaevola	thesioides	subsp.	thesioides		
MI07		Schoenus	trachycarpus				
MI07		Stylidium	junceum	subsp.	junceum		
MI07		Stylidium	maritimum				P3
MI07		Templetonia	retusa				
MI07		Thysanotus	arenarius				
MI07		Trachymene	pilosa				
MI07	*	Vulpia	myuros				

Plotorsource	Na	Genus	Species	InfraspRank	InfraspName	Informal	ConsvCode
MI08		Acacia	rostellifera				
MI08		Acanthocarpus	preissii				
MI08		Calandrinia	corrigioloides				
MI08		Clematis	linearifolia				
MI08		Daucus	glochidiatus				
MI08	*	Dischisma	arenarium				
MI08	*	Erodium	cicutarium				
MI08	*	Isolepis	marginata				
MI08		Lepidosperma	gladiatum				
MI08		Melaleuca	systena				
MI08		Parietaria	debilis				
MI08		Phyllanthus	calycinus				
MI08		Rhagodia	baccata	subsp.	baccata		
MI08		Scaevola	nitida				
MI08		Spyridium	globulosum				

Plotorsource	Na	Genus	Species	InfraspRank	InfraspName	Informal	ConsvCode
MI09		Acacia	lasiocarpa	var.	lasiocarpa		
MI09		Austrostipa	flavescens				
MI09	*	Bromus	diandrus				
MI09		Conostylis	pauciflora	subsp.	euryrhipis		P3
MI09	*	Crassula	glomerata				
MI09		Daucus	glochidiatus				
MI09	*	Desmazeria	rigida				
MI09		Desmocladus	fasciculatus				
MI09	*	Dischisma	arenarium				
MI09		Ficinia	nodosa				
MI09		Gompholobium	tomentosum				
MI09	*	Heliophila	pusilla				
MI09		Hemiandra	pungens				
MI09		Hibbertia	racemosa				
MI09	*	Isolepis	marginata				
MI09		Lepidosperma	gladiatum				
MI09		Lepidosperma	squamatum				
MI09		Leucopogon	parviflorus				
MI09		Lomandra	maritima				
MI09		Melaleuca	systena				
MI09		Nemcia	reticulata				
MI09		Olax	benthamiana				
MI09		Opercularia	vaginata				
MI09		Ozothamnus	cordatus				
MI09	*	Pelargonium	capitatum				
MI09		Poa	poiformis				
MI09		Santalum	acuminatum				
MI09		Scaevola	nitida				
MI09		Scaevola	thesioides	subsp.	thesioides		
MI09		Stylidium	junceum	subsp.	junceum		
MI09		Stylidium	maritimum				P3
MI09		Templetonia	retusa				

Plotorsource	N	Genus	Species	InfraspRank	InfraspName	Informal	ConsvCode
MI10	*	Bromus	diandrus				
MI10	*	Cakile	maritima				
MI10		Hardenbergia	comptoniana				
MI10		Lepidosperma	gladiatum				
MI10		Olearia	axillaris				
MI10	*	Pelargonium	capitatum				
MI10		Scaevola	crassifolia				
MI10		Spinifex	longifolius				
MI10	*	Tetragonia	decumbens				

Plotorsource	Na	Genus	Species	InfraspRank	InfraspName	Informal	ConsvCode
MI11		Acacia	rostellifera				
MI11		Acanthocarpus	preissii				
MI11	*	Bromus	diandrus				
MI11		Cassytha	racemosa				
MI11		Conostylis	pauciflora	subsp.	euryrhipis		P3
MI11	*	Crassula	glomerata				
MI11		Ficinia	nodosa				
MI11		Hardenbergia	comptoniana				
MI11	*	Isolepis	marginata				
MI11		Lepidosperma	gladiatum				
MI11		Olearia	axillaris				
MI11		Ozothamnus	cordatus				
MI11	*	Pelargonium	capitatum				
MI11		Scaevola	crassifolia				
MI11		Senecio	lautus	subsp.	dissectifolius		
MI11	*	Tetragonia	decumbens				
MI11	*	Trachyandra	divaricata				

Plotorsource	Na	Genus	Species	InfraspRank	InfraspName	Informal	ConsvCode
MI12		Acanthocarpus	preissii				
MI12	*	Bromus	diandrus				
MI12		Carpobrotus	virescens				
MI12		Cassytha	racemosa				
MI12		Conostylis	candicans	subsp.	calcicola		
MI12		Crassula	colorata	var.	colorata		
MI12	*	Crassula	glomerata				
MI12	*	Dischisma	arenarium				
MI12		Enchylaena	tomentosa	var.	tomentosa		
MI12		Ficinia	nodosa				
MI12		Hardenbergia	comptoniana				
MI12	*	Isolepis	marginata				
MI12		Lepidosperma	gladiatum				
MI12		Leucophyta	brownii				
MI12		Myoporum	insulare				
MI12		Olearia	axillaris				
MI12	*	Pelargonium	capitatum				
MI12		Rhagodia	baccata	subsp.	baccata		
MI12	*	Rostraria	cristata				
MI12		Scaevola	crassifolia				
MI12		Senecio	lautus	subsp.	dissectifolius		
MI12		Spinifex	longifolius				
MI12	*	Tetragonia	decumbens				
MI12	*	Trachyandra	divaricata				

Plotorsource	Na	Genus	Species	InfraspRank	InfraspName	Informal	ConsvCode
MI13		Actites	megalocarpus				
MI13	*	Cakile	maritima				
MI13		Carpobrotus	virescens				
MI13		Cassytha	racemosa				
MI13		Olearia	axillaris				
MI13		Spinifex	hirsutus				
MI13		Spinifex	longifolius				
MI13	*	Tetragonia	decumbens				
MI13	*	Trachyandra	divaricata				

Plotorsource	Na	Genus	Species	InfraspRank	InfraspName	Informal	ConsvCode
MI14		Actites	megalocarpus				
MI14	*	Cakile	maritima				
MI14		Ficinia	nodosa				
MI14		Leucophyta	brownii				
MI14	*	Pelargonium	capitatum				
MI14		Spinifex	hirsutus				
MI14		Spinifex	longifolius				
MI14	*	Tetragonia	decumbens				
MI14	*	Trachyandra	divaricata				

Plotorsource	Na	Genus	Species	InfraspRank	InfraspName	Informal	ConsvCode
MI15		Crassula	colorata	var.	colorata		
MI15	*	Crassula	glomerata				
MI15		Ficinia	nodosa				
MI15		Leucophyta	brownii				
MI15		Olearia	axillaris				
MI15	*	Parapholis	incurva				
MI15	*	Pelargonium	capitatum				
MI15		Senecio	lautus	subsp.	dissectifolius		
MI15		Spinifex	longifolius				
MI15	*	Trachyandra	divaricata				

Plotorsource	Na	Genus	Species	InfraspRank	InfraspName	Informal	ConsvCode
MI16	*	Crassula	glomerata				
MI16	*	Ehrharta	brevifolia	var.	cuspidata		
MI16		Ficinia	nodosa				
MI16		Leucophyta	brownii				
MI16		Olearia	axillaris				
MI16	*	Pelargonium	capitatum				
MI16		Scaevola	crassifolia				
MI16		Senecio	lautus	subsp.	dissectifolius		
MI16		Spinifex	longifolius				
MI16	*	Tetragonia	decumbens				
MI16	*	Trachyandra	divaricata				

Plotorsource	Na	Genus	Species	InfraspRank	InfraspName	Informal	ConsvCode
MI17		Acacia	rostellifera				
MI17		Acanthocarpus	preissii				
MI17		Cassytha	racemosa				
MI17		Conostylis	candicans	subsp.	calcicola		
MI17		Conostylis	pauciflora	subsp.	euryrhipis		P3
MI17		Crassula	colorata	var.	colorata		
MI17		Daucus	glochidiatus				
MI17	*	Dischisma	arenarium				
MI17	*	Ehrharta	brevifolia	var.	cuspidata		
MI17		Exocarpos	aphyllus				
MI17		Hardenbergia	comptoniana				
MI17		Hemiandra	pungens				
MI17		Myoporum	insulare				
MI17		Olearia	axillaris				
MI17		Ozothamnus	cordatus				
MI17	*	Pelargonium	capitatum				
MI17		Rhagodia	baccata	subsp.	baccata		
MI17	*	Tetragonia	decumbens				

Plotorsource	Na	Genus	Species	InfraspRank	InfraspName	Informal	ConsvCode
MI18		Acacia	lasiocarpa	var.	lasiocarpa		
MI18		Acacia	rostellifera				
MI18		Acanthocarpus	preissii				
MI18		Acrotriche	cordata				
MI18		Austrostipa	flavescens				
MI18	*	Boerhavia	coccinea				
MI18	*	Briza	maxima				
MI18	*	Bromus	diandrus				
MI18		Cassytha	racemosa				
MI18		Centrolepis	glabra				
MI18		Conostylis	pauciflora	subsp.	euryrhipis		P3
MI18	*	Crassula	glomerata				
MI18		Daucus	glochidiatus				
MI18	*	Dischisma	arenarium				
MI18		Hardenbergia	comptoniana				
MI18	*	Heliophila	pusilla				
MI18		Hibbertia	racemosa				
MI18		Leucopogon	parviflorus				
MI18		Lomandra	maritima				
MI18		Melaleuca	systena				
MI18		Microtis	media				
MI18		Nemcia	reticulata				
MI18		Olax	benthamiana				
MI18		Olearia	axillaris				
MI18		Ozothamnus	cordatus				
MI18	*	Pelargonium	capitatum				
MI18		Phyllanthus	calycinus				
MI18		Pimelea	ferruginea				
MI18		Poa	poiformis				
MI18		Scaevola	thesioides	subsp.	thesioides		
MI18		Spyridium	globulosum				
MI18	*	Vulpia	myuros				

Plotorsource	Na	Genus	Species	InfraspRank	InfraspName	Informal	ConsvCode
MI19		Cassytha	racemosa				
MI19		Lepidosperma	gladiatum				
MI19		Myoporum	insulare				
MI19		Olearia	axillaris				
MI19		Rhagodia	baccata	subsp.	baccata		
MI19		Scaevola	crassifolia				

Plotorsource	Na	Genus	Species	InfraspRank	InfraspName	Informal	ConsvCode
MI20		Crassula	colorata	var.	colorata		
MI20	*	Crassula	glomerata				
MI20	*	Dischisma	arenarium				
MI20		Ficinia	nodosa				
MI20		Lepidosperma	gladiatum				
MI20		Leucophyta	brownii				
MI20	*	Pelargonium	capitatum				
MI20		Senecio	lautus	subsp.	dissectifolius		
MI20	*	Vulpia	myuros				

Plotorsource	Na	Genus	Species	InfraspRank	InfraspName	Informal	ConsvCode
MI21		Austrodanthonia	caespitosa				
MI21		Austrostipa	flavescens				
MI21		Conostylis	candicans	subsp.	calcicola		
MI21		Crassula	colorata	var.	colorata		
MI21	*	Crassula	glomerata				
MI21		Ficinia	nodosa				
MI21	*	Heliophila	pusilla				
MI21		Hemiandra	pungens				
MI21		Leucophyta	brownii				
MI21	*	Pelargonium	capitatum				
MI21		Poa	poiformis				
MI21		Scaevola	crassifolia				
MI21		Senecio	lautus	subsp.	dissectifolius		
MI21		Spyridium	globulosum				
MI21	*	Vulpia	myuros				

Plotorsource	N	Genus	Species	InfraspRank	InfraspName	Informal	ConsvCode
MI22		Acacia	cyclops				
MI22		Acacia	rostellifera				
MI22	*	Bromus	diandrus				
MI22		Carpobrotus	virescens				
MI22		Cassytha	racemosa				
MI22		Conostylis	candicans	subsp.	calcicola		
MI22	*	Crassula	glomerata				
MI22	*	Dischisma	arenarium				
MI22		Exocarpos	aphyllus				
MI22		Ficinia	nodosa				
MI22	*	Heliophila	pusilla				
MI22	*	Isolepis	marginata				
MI22		Olearia	axillaris				
MI22	*	Pelargonium	capitatum				
MI22		Scaevola	crassifolia				
MI22		Spyridium	globulosum				
MI22	*	Vulpia	myuros				

Plotorsource	Na	Genus	Species	InfraspRank	InfraspName	Informal	ConsvCode
MI23		Acacia	rostellifera				
MI23		Acanthocarpus	preissii				
MI23	*	Anagallis	arvensis	var.	caerulea		
MI23		Austrostipa	flavescens				
MI23	*	Avena	barbata				
MI23	*	Boerhavia	coccinea				
MI23	*	Briza	maxima				
MI23	*	Briza	minor				
MI23	*	Bromus	diandrus				
MI23		Comesperma	integerrimum				
MI23		Conostylis	candicans	subsp.	calcicola		
MI23		Cryptandra	mutila				
MI23		Daucus	glochidiatus				
MI23	*	Desmazeria	rigida				
MI23		Desmocladus	fasciculatus				
MI23	*	Dischisma	arenarium				
MI23		Gompholobium	tomentosum				
MI23	*	Heliophila	pusilla				
MI23	*	Hypochaeris	glabra				
MI23	*	Isolepis	marginata				
MI23		Kennedia	prostrata				
MI23		Leptorhynchos	scaber				
MI23		Lomandra	maritima				
MI23		Melaleuca	systena				
MI23		Olearia	axillaris				
MI23		Opercularia	vaginata				
MI23	*	Pelargonium	capitatum				
MI23	*	Petrorhagia	dubia				
MI23		Phyllanthus	calycinus				
MI23	*	Romulea	rosea	var.	australis		
MI23	*	Taraxacum	officinale				
MI23	*	Trifolium	campestre	var.	campestre		
MI23	*	Vulpia	myuros				
MI23		Wurmbea	monantha				

Amg_e: 377,755.25 Amg-n: 6,491,412.94 Zone: 50
Study: QUI Site: MI03 Fe: F Ty: 2 Abt: 3
Date: 17.10.91 Observers: EA Griffin
Bare: 0 Litter: 99 Weeds: 1 Condition: E
Slope: 4 Aspect: 240 Wet: 1 Drainage: 1 Fire:M
Spec1: MYRMELCAR Spec2: STETHOCOG Spec3:
M2
Surface soil type: cal Colour: d g Texture: S
Sub-soil type: Colour: Texture:
Geol. rock type: lit Geo1: Geo2:
Landform: PL Topography: TLS Q: O
Location1: near coast
Location2: between Mindarie and Burns Beach
Reserve: 35890
Latitude: 314222S Longitude: 1154236E
Treesa: Tb: T1: T2: Malleet: Ms:
Shrubs: 1 Sa: Sb: Sc: 3 Sd:
Mat plants: Bunch grass: Herbs: 4 SedgesT: SedgesL:
S_gc: S_gp: D_gp: B_gc: B_gp: Q_gc: 51a4 Q_gp: 90
N_gp20: N_gp50: N_gp100: N_gp200: N_gp500:

Amg_e: 377,461.50 Amg-n: 6,490,749.66 Zone: 50
Study: QUI Site: MI22 Fe: F Ty: 2 Abt: 3
Date: 17.10.91 Observers: EA Griffin
Bare: 30 Litter: 50 Weeds: 0 Condition: G
Slope: 2 Aspect: 240 Wet: 1 Drainage: 1 Fire:M
Spec1: GERPELCAP Spec2: MIMACACYC Spec3: HAECONCANA
Surface soil type: cal Colour: p g Texture: S
Sub-soil type: Colour: Texture:
Geol. rock type: lih Geo1: Geo2:
Landform: PL Topography: BLS Q: V
M2
Location1: near coast
Location2: between Mindarie and Burns Beach
Reserve: 35890
Latitude: 314243S Longitude: 1154224E
Treesa: Tb: T1: T2: Malleet: Ms:
Shrubs: Sa: Sb: 3 Sc: Sd: 3
Mat plants: Bunch grass: Herbs: SedgesT: SedgesL:
S_gc: S_gp: D_gp: B_gc: B_gp: Q_gc: 10a Q_gp: 24
N_gp20: N_gp50: N_gp100: N_gp200: N_gp500:

Amg_e: 377,606.00 Amg-n: 6,491,419.53 Zone: 50
Study: QUI Site: MI04 Fe: F Ty: 2 Abt: 3
Date: 17.10.91 Observers: EA Griffin
Bare: 20 Litter: 5 Weeds: 3 Condition: E
Slope: 35 Aspect: 0 Wet: 1 Drainage: 1 Fire:M
Spec1: DASLOMMAR Spec2: GOOSCATHET Spec3: MYRMELACE
Surface soil type: cap Colour: p g Texture: S
Sub-soil type: Colour: Texture:
Geol. rock type: Geo1: Geo2:
Landform: DUS Topography: DSL Q: M
Location1: near coast
Location2: between Mindarie and Burns Beach
Reserve: 35890
Latitude: 314221S Longitude: 1154230E
Treesa: Tb: T1: T2: Malleet: Ms:
Shrubs: Sa: Sb: 3 Sc: 2 Sd:
Mat plants: Bunch grass: Herbs: 4 SedgesT: SedgesL: 2
S_gc: S_gp: D_gp: B_gc: B_gp: Q_gc: 42d2 Q_gp: 95
N_gp20: N_gp50: N_gp100: N_gp200: N_gp500:

Amg_e: 377,587.34 Amg-n: 6,491,365.72 Zone: 50
Study: QUI Site: MI05 Fe: F Ty: 2 Abt: 3
Date: 17.10.91 Observers: EA Griffin
Bare: 5 Litter: 20 Weeds: 1 Condition: G
Slope: 5 Aspect: 330 Wet: 1 Drainage: 1 Fire:M
Spec1: MIMACAROS Spec2: DASLOMMAR Spec3: MYRMELACE
Surface soil type: cal Colour: p g Texture: S
Sub-soil type: Colour: Texture:
Geol. rock type: Geo1: Geo2:
Landform: DUC Topography: DC Q: Y
Location1: near coast
Location2: between Mindarie and Burns Beach
Reserve: 35890
Latitude: 314223S Longitude: 1154229E
Treesa: Tb: T1: T2: Malleet: Ms:
Shrubs: Sa: Sb: 2 Sc: Sd: 2
Mat plants: Bunch grass: Herbs: SedgesT: SedgesL: 2
S_gc: S_gp: D_gp: B_gc: B_gp: Q_gc: 29e2 Q_gp: 95
N_gp20: N_gp50: N_gp100: N_gp200: N_gp500:

Amg_e: 377,643.56 Amg-n: 6,491,486.62 Zone: 50
Study: QUI Site: MI06 Fe: F Ty: 2 Abt: 3
Date: 17.10.91 Observers: EA Griffin
Bare: 8 Litter: 20 Weeds: 1 Condition: E
Slope: 4 Aspect: 0 Wet: 1 Drainage: 1 Fire:M
Spec1: DASLOMMAR Spec2: MYRMELACE Spec3: MIMACAROS
Surface soil type: cap Colour: g Texture: S
Sub-soil type: cap Colour: p g Texture: S
Geol. rock type: Geo1: Geo2:
Landform: DUC Topography: DC Q: M
Location1: near coast
Location2: between Mindarie and Burns Beach
Reserve: 35890
Latitude: 314219S Longitude: 1154232E
Treesa: Tb: T1: T2: Malleet: Ms:
Shrubs: Sa: Sb: 2 Sc: Sd: 2
Mat plants: Bunch grass: Herbs: 4 SedgesT: SedgesL: 2
S_gc: S_gp: D_gp: B_gc: B_gp: Q_gc: 43c2 Q_gp: 94
N_gp20: N_gp50: N_gp100: N_gp200: N_gp500:

Amg_e: 377,463.12 Amg-n: 6,491,463.31 Zone: 50
Study: QUI Site: MI07 Fe: F Ty: 2 Abt: 3
Date: 17.10.91 Observers: EA Griffin
Bare: 12 Litter: 5 Weeds: 3 Condition: E
Slope: 2 Aspect: 260 Wet: 1 Drainage: 1 Fire:M
Spec1: DASLOMMAR Spec2: MYRMELACE Spec3: MIMACAROS
Surface soil type: cap Colour: g Texture: S
Sub-soil type: cap Colour: p g Texture: S
Geol. rock type: Geo1: Geo2:
Landform: DUC Topography: DC Q: M
Location1: near coast
Location2: between Mindarie and Burns Beach
Reserve: 35890
Latitude: 314220S Longitude: 1154225E
Treesa: Tb: T1: T2: Malleet: Ms:
Shrubs: Sa: Sb: Sc: 3 Sd: 2
Mat plants: Bunch grass: Herbs: 4 SedgesT: SedgesL: 2
S_gc: S_gp: D_gp: B_gc: B_gp: Q_gc: 43c4 Q_gp: 95
N_gp20: N_gp50: N_gp100: N_gp200: N_gp500:

M2

Amg_e: 377,479.50 Amg-n: 6,491,398.66 Zone: 50
Study: QUI Site: MI08 Fe: F Ty: 2 Abt: 3
Date: 17.10.91 Observers: EA Griffin
Bare: 0 Litter: 50 Weeds: 0 Condition: E
Slope: 2 Aspect: 30 Wet: 1 Drainage: 1 Fire:M
Spec1: MIMACAROS Spec2: RANCLEMIC Spec3: GOOSCANIT
Surface soil type: cal Colour: g Texture: S
Sub-soil type: cap Colour: p g Texture: S
Geol. rock type: Geo1: Geo2:
Landform: DUT Topography: DT Q: M
Location1: near coast
Location2: between Mindarie and Burns Beach
Reserve: 35890
Latitude: 314222S Longitude: 1154225E
Treesa: Tb: T1: T2: Malleet: Ms:
Shrubs: 1 Sa: Sb: 3 Sc: Sd:
Mat plants: Bunch grass: Herbs: 3 SedgesT: 4 SedgesL:
S_gc: S_gp: D_gp: B_gc: B_gp: Q_gc: 29c Q_gp: 87
N_gp20: N_gp50: N_gp100: N_gp200: N_gp500:

M2

Amg_e: 377,472.53 Amg-n: 6,491,241.19 Zone: 50
Study: QUI Site: MI09 Fe: F Ty: 2 Abt: 3
Date: 17.10.91 Observers: EA Griffin
Bare: 10 Litter: 10 Weeds: 0 Condition: E
Slope: 50 Aspect: 150 Wet: 1 Drainage: 1 Fire:M
Spec1: PAPNEMRET Spec2: GOOSCANIT Spec3: MIMACALASL
Surface soil type: cal Colour: p g Texture: S
Sub-soil type: Colour: Texture:
Geol. rock type: Geo1: Geo2:
Landform: DUS Topography: DSW Q: Y
Location1: near coast
Location2: between Mindarie and Burns Beach
Reserve: 35890
Latitude: 314227S Longitude: 1154225E
Treesa: Tb: T1: T2: Malleet: Ms:
Shrubs: Sa: Sb: Sc: 3 Sd: 2
Mat plants: Bunch grass: Herbs: 4 SedgesT: SedgesL: 3
S_gc: S_gp: D_gp: B_gc: B_gp: Q_gc: 40c Q_gp: 95
N_gp20: N_gp50: N_gp100: N_gp200: N_gp500:

Amg_e: 377,143.19 Amg-n: 6,492,127.66 Zone: 50
Study: QUI Site: MI10 Fe: F Ty: 2 Abt: 3
Date: 17.10.91 Observers: EA Griffin
Bare: 15 Litter: 1 Weeds: 0 Condition: E
Slope: 35 Aspect: 40 Wet: 1 Drainage: 1 Fire:O
Spec1: AIZTETDEC Spec2: POASPILON Spec3: ASTOLEAXI
Surface soil type: cal Colour: p g Texture: S
Sub-soil type: Colour: Texture:
Geol. rock type: Geo1: Geo2:
Landform: DUS Topography: DSL Q: B
Location1: near coast
Location2: between Mindarie and Burns Beach
Reserve: 35890
Latitude: 314158S Longitude: 1154213E
Treesa: Tb: T1: T2: Malleet: Ms:
Shrubs: Sa: Sb: Sc: 4 Sd: 2
Mat plants: Bunch grass: Herbs: SedgesT: 3 SedgesL:
S_gc: S_gp: D_gp: B_gc: B_gp: Q_gc: 2a3 Q_gp: 19
N_gp20: N_gp50: N_gp100: N_gp200: N_gp500:

Amg_e: 377,095.03 Amg-n: 6,492,128.31 Zone: 50
Study: QUI Site: MI11 Fe: F Ty: 2 Abt: 3
Date: 17.10.91 Observers: EA Griffin
Bare: 15 Litter: 10 Weeds: 2 Condition: E
Slope: 25 Aspect: 90 Wet: 1 Drainage: 1 Fire:O
Spec1: GOOSCACRA Spec2: DASACAPRE Spec3: ASTOLEAXI
Surface soil type: cal Colour: p g Texture: S
Sub-soil type: Colour: Texture:
Geol. rock type: Geo1: Geo2:
Landform: DUS Topography: DSW Q: V
Location1: near coast
Location2: between Mindarie and Burns Beach
Reserve: 35890
Latitude: 314158S Longitude: 1154211E
Treesa: Tb: T1: T2: Malleet: Ms:
Shrubs: Sa: Sb: 4 Sc: 2 Sd:
Mat plants: Bunch grass: Herbs: SedgesT: 4 SedgesL: 4
S_gc: S_gp: D_gp: B_gc: B_gp: Q_gc: 23a2 Q_gp: 19
N_gp20: N_gp50: N_gp100: N_gp200: N_gp500:

Amg_e: 377,081.03 Amg-n: 6,492,143.88 Zone: 50
Study: QUI Site: MI12 Fe: F Ty: 2 Abt: 3
Date: 17.10.91 Observers: EA Griffin
Bare: 20 Litter: 10 Weeds: 10 Condition: E
Slope: 25 Aspect: 240 Wet: 1 Drainage: 1 Fire:O
Spec1: GOOSCACRA Spec2: ASTOLEAXI Spec3: GERPELCAP
Surface soil type: cal Colour: p g Texture: S
Sub-soil type: Colour: Texture:
Geol. rock type: Geo1: Geo2:
Landform: DFT Topography: DBS Q: Y
Location1: near coast
Location2: between Mindarie and Burns Beach
Reserve: 35890
Latitude: 314158S Longitude: 1154211E
Treesa: Tb: T1: T2: Malleet: Ms:
Shrubs: Sa: Sb: Sc: 4 Sd: 2
Mat plants: Bunch grass: Herbs: 2 SedgesT: SedgesL:
S_gc: S_gp: D_gp: B_gc: B_gp: Q_gc: 23a3 Q_gp: 19
N_gp20: N_gp50: N_gp100: N_gp200: N_gp500:

Amg_e: 377,157.59 Amg-n: 6,491,879.44 Zone: 50
Study: QUI Site: MI13 Fe: F Ty: 2 Abt: 3
Date: 17.10.91 Observers: EA Griffin
Bare: 30 Litter: 5 Weeds: 0 Condition: E
Slope: 3 Aspect: 250 Wet: 1 Drainage: 1 Fire:O
Spec1: POASPILON Spec2: AIZTETDEC Spec3: POASPIHIR
Surface soil type: cal Colour: p g Texture: S
Sub-soil type: Colour: Texture:
Geol. rock type: Geo1: Geo2:
Landform: DFI Topography: WB Q: Y
Location1: on coast
Location2: between Mindarie and Burns Beach
Reserve: 35890
Latitude: 314206S Longitude: 1154213E
Treesa: Tb: T1: T2: Malleet: Ms:
Shrubs: Sa: Sb: Sc: Sd: 3
Mat plants: Bunch grass: Herbs: SedgesT: 2 SedgesL:
S_gc: S_gp: D_gp: B_gc: B_gp: Q_gc: 1a Q_gp: 4
N_gp20: N_gp50: N_gp100: N_gp200: N_gp500:

Amg_e: 377,162.72 Amg-n: 6,491,875.28 Zone: 50
Study: QUI Site: MI14 Fe: F Ty: 2 Abt: 3
Date: 17.10.91 Observers: EA Griffin
Bare: 40 Litter: 0 Weeds: 0 Condition: G
Slope: 20 Aspect: 250 Wet: 1 Drainage: 1 Fire:O
Spec1: POASPILON Spec2: AIZTETDEC Spec3: POASPIHIR
Surface soil type: cal Colour: p g Texture: S
Sub-soil type: Colour: Texture:
Geol. rock type: Geo1: Geo2:
Landform: DFI Topography: WB Q: Y
Location1: on coast
Location2: between Mindarie and Burns Beach
Reserve: 35890
Latitude: 314206S Longitude: 1154214E
Treesa: Tb: T1: T2: Malleet: Ms:
Shrubs: Sa: Sb: Sc: Sd: 4
Mat plants: Bunch grass: Herbs: SedgesT: 2 SedgesL:
S_gc: S_gp: D_gp: B_gc: B_gp: Q_gc: 1a Q_gp: 4
N_gp20: N_gp50: N_gp100: N_gp200: N_gp500:

Amg_e: 377,168.59 Amg-n: 6,491,872.12 Zone: 50
Study: QUI Site: MI15 Fe: F Ty: 2 Abt: 3
Date: 17.10.91 Observers: EA Griffin
Bare: 80 Litter: 0 Weeds: 1 Condition: E
Slope: 2 Aspect: 0 Wet: 1 Drainage: 1 Fire:O
Spec1: ASTCALBRO Spec2: POASPILON Spec3:
Surface soil type: cal Colour: p g Texture: S
Sub-soil type: Colour: Texture:
Geol. rock type: Geo1: Geo2:
Landform: PL Topography: BS Q: B
Location1: on coast
Location2: between Mindarie and Burns Beach
Reserve: 35890
Latitude: 314207S Longitude: 1154214E
Treesa: Tb: T1: T2: Malleet: Ms:
Shrubs: Sa: Sb: Sc: Sd: 4
Mat plants: Bunch grass: Herbs: SedgesT: SedgesL: 4
S_gc: S_gp: D_gp: B_gc: B_gp: Q_gc: 19b1 Q_gp: 9
N_gp20: N_gp50: N_gp100: N_gp200: N_gp500:

Amg_e: 377,167.94 Amg-n: 6,491,860.91 Zone: 50
Study: QUI Site: MI16 Fe: F Ty: 2 Abt: 3
Date: 17.10.91 Observers: EA Griffin
Bare: 40 Litter: 10 Weeds: 99 Condition: F
Slope: 4 Aspect: 0 Wet: 1 Drainage: 1 Fire:M
Spec1: GERPELCAP Spec2: ASTOLEAXI Spec3: AIZTETDEC
Surface soil type: cal Colour: p g Texture: S
Sub-soil type: Colour: Texture:
Geol. rock type: Geo1: Geo2:
M2 Landform: DFR Topography: WF Q: Y
Location1: on coast
Location2: between Mindarie and Burns Beach
Reserve: 35890
Latitude: 314207S Longitude: 1154214E
Treesa: Tb: T1: T2: Malleet: Ms:
Shrubs: Sa: Sb: Sc: 4 Sd: 3
Mat plants: Bunch grass: Herbs: SedgesT: SedgesL:
S_gc: S_gp: D_gp: B_gc: B_gp: Q_gc: 10a Q_gp: 9
N_gp20: N_gp50: N_gp100: N_gp200: N_gp500:

Amg_e: 377,262.78 Amg-n: 6,491,830.81 Zone: 50
Study: QUI Site: MI17 Fe: F Ty: 2 Abt: 3
Date: 17.10.91 Observers: EA Griffin
Bare: 20 Litter: 30 Weeds: 0 Condition: E
Slope: 20 Aspect: 60 Wet: 1 Drainage: 1 Fire:O
Spec1: MYOMYOINS Spec2: ASTOLEAXI Spec3: CHERHABACB
Surface soil type: cal Colour: p g Texture: S
Sub-soil type: Colour: Texture:
Geol. rock type: Geo1: Geo2:
M2 Landform: DUS Topography: DSL Q: V
Location1: near coast
Location2: between Mindarie and Burns Beach
Reserve: 35890
Latitude: 314208S Longitude: 1154217E
Treesa: Tb: T1: T2: Malleet: Ms:
Shrubs: Sa: Sb: 3 Sc: 2 Sd:
Mat plants: Bunch grass: Herbs: 3 SedgesT: SedgesL: 3
S_gc: S_gp: D_gp: B_gc: B_gp: Q_gc: 22a1 Q_gp: 30
N_gp20: N_gp50: N_gp100: N_gp200: N_gp500:

Amg_e: 377,258.56 Amg-n: 6,491,937.47 Zone: 50
Study: QUI Site: MI18 Fe: F Ty: 2 Abt: 3
Date: 17.10.91 Observers: EA Griffin
Bare: 5 Litter: 10 Weeds: 0 Condition: E
Slope: 10 Aspect: 200 Wet: 1 Drainage: 1 Fire:M
Spec1: DASLOMMAR Spec2: EPAACRCOR Spec3: PAPNEMRET
Surface soil type: cal Colour: p g Texture: S
Sub-soil type: Colour: Texture:
Geol. rock type: Geo1: Geo2:
M2 Landform: DUS Topography: DSW Q: Y
Location1: near coast
Location2: between Mindarie and Burns Beach
Reserve: 35890
Latitude: 314204S Longitude: 1154217E
Treesa: Tb: T1: T2: Malleet: Ms:
Shrubs: Sa: Sb: Sc: Sd: 2
Mat plants: Bunch grass: Herbs: 4 SedgesT: SedgesL: 2
S_gc: S_gp: D_gp: B_gc: B_gp: Q_gc: 43j Q_gp: 95
N_gp20: N_gp50: N_gp100: N_gp200: N_gp500:

Amg_e: 377,343.72 Amg-n: 6,490,865.12 Zone: 50
Study: QUI Site: MI19 Fe: F Ty: 2 Abt: 3
Date: 17.10.91 Observers: EA Griffin
Bare: 0 Litter: 60 Weeds: 0 Condition: E
Slope: 5 Aspect: 0 Wet: 1 Drainage: 1 Fire:O
Spec1: GOOSCACRA Spec2: CYPLEPGLA Spec3: MYOMYOINS
Surface soil type: cal Colour: p g Texture: S
Sub-soil type: Colour: Texture:
Geol. rock type: Geo1: Geo2:
Landform: PL Topography: BS Q: V
Location1: near coast
Location2: between Mindarie and Burns Beach
Reserve: 35890
Latitude: 314239S Longitude: 1154220E
Treesa: Tb: T1: T2: Malleet: Ms:
Shrubs: Sa: Sb: Sc: 1 Sd:
Mat plants: Bunch grass: Herbs: SedgesT: 3 SedgesL:
S_gc: S_gp: D_gp: B_gc: B_gp: Q_gc: 23a2 Q_gp: 16
N_gp20: N_gp50: N_gp100: N_gp200: N_gp500:

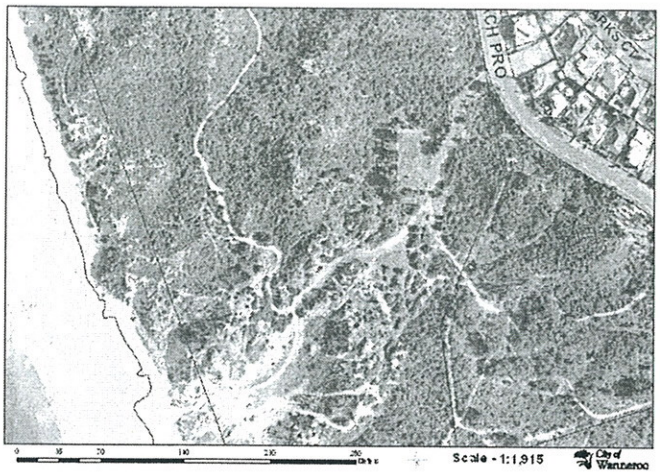
Amg_e: 377,480.25 Amg-n: 6,490,858.41 Zone: 50
Study: QUI Site: MI20 Fe: F Ty: 2 Abt: 3
Date: 17.10.91 Observers: EA Griffin
Bare: 60 Litter: 0 Weeds: 0 Condition: E
Slope: 3 Aspect: 0 Wet: 1 Drainage: 1 Fire:O
Spec1: ASTCALBRO Spec2: CYPISONOD Spec3: GERPELCAP
Surface soil type: cal Colour: p g Texture: S
Sub-soil type: Colour: Texture:
Geol. rock type: Geo1: Geo2:
Landform: PL Topography: THL Q: B
Location1: near coast
Location2: between Mindarie and Burns Beach
Reserve: 35890
Latitude: 314240S Longitude: 1154225E
Treesa: Tb: T1: T2: Malleet: Ms:
Shrubs: Sa: Sb: Sc: Sd: 3
Mat plants: Bunch grass: Herbs: SedgesT: SedgesL: 3
S_gc: S_gp: D_gp: B_gc: B_gp: Q_gc: 19b2 Q_gp: 9
N_gp20: N_gp50: N_gp100: N_gp200: N_gp500:

Amg_e: 377,474.66 Amg-n: 6,490,847.16 Zone: 50
Study: QUI Site: MI21 Fe: F Ty: 2 Abt: 3
Date: 17.10.91 Observers: EA Griffin
Bare: 50 Litter: 0 Weeds: 0 Condition: G
Slope: 4 Aspect: 250 Wet: 1 Drainage: 1 Fire:O
Spec1: CYPISONOD Spec2: GERPELCAP Spec3: ASTCALBRO
Surface soil type: cal Colour: p g Texture: S
Sub-soil type: Colour: Texture:
Geol. rock type: lit Geo1: Geo2:
Landform: PL Topography: TLH Q: B
Location1: near coast
Location2: between Mindarie and Burns Beach
Reserve: 35890
Latitude: 314240S Longitude: 1154225E
Treesa: Tb: T1: T2: Malleet: Ms:
Shrubs: Sa: Sb: Sc: Sd: 3
Mat plants: Bunch grass: Herbs: SedgesT: SedgesL: 3
S_gc: S_gp: D_gp: B_gc: B_gp: Q_gc: 10b Q_gp: 24
N_gp20: N_gp50: N_gp100: N_gp200: N_gp500:

City of Wanneroo

'HANDS ON FOR OUR COASTLINE'
MINDARIE FORESHORE RESTORATION PROJECT

The City of Wanneroo, in conjunction with Quinns Rocks Environmental Group, was successful in obtaining a $16,500 Coastwest grant for a coastal dune rehabilitation project off Long Beach Promenade, Mindarie.



Aerial photograph of Long Beach Coastwest Project Site, Mindarie

Why is the project necessary?

Mindarie Foreshore Reserve contains regionally significant natural vegetation and forms part of an important linkage with other natural areas. The foreshore reserve is part of Bush Forever Site 322 and is being managed by the City of Wanneroo as a high-priority conservation area.

Anti-social behaviour in the secluded swale of the foreshore reserve is a nuisance to nearby residents. Unauthorised camping and vehicle access is causing dune erosion. Heavy littering and deliberately lit fires are also affecting the condition of vegetation and aesthetics of the area.

Uncontrolled pedestrian access to the beach is denuding the dunes and encouraging weed invasion. The area lacks safe and direct pedestrian access to the beach.

Inappropriate landscaping is leading to the spread of non-indigenous woody species (including *Eucalyptus platypus* and *Melaleuca nesophylla*) through the coastal reserve.

What does the project involve?

The City of Wanneroo is working with Quinns Rocks Environmental Group, Mindarie Ratepayers and Residents Association and local schools to improve the environmental and social values of the foreshore reserve. The project is being implemented between January and August 2005 and involves the following:

- **Removing rubbish** to improve the aesthetics of the area;
- **Formalising access** by constructing limestone paths and fences to protect dune vegetation and provide safe pedestrian access to the beach;
- **Controlling weeds and removing other introduced species** using manual and chemical methods, to prevent further spread through the reserve;
- **Installing signage** to guide passive recreational use and raise awareness about the values of the reserve;
- **Stabilising coastal dunes** using the brush-layering technique and revegetation with local species to reduce erosion; and
- **Raising community awareness** about the values of the coastal reserve and the City's coastal management strategies, through newspaper articles, flyers and bushcare events.

This project is proudly supported by:

Coastwest

and Quinns Rocks Environmental Group (Inc.)

For more information please contact:

Parks Operations Officer (Conservation),
City of Wanneroo
Ph: 9405 5000

How can I get involved?

Contact Quinns Rocks Environmental Group to find out how you can help to improve your local area.

Volunteer your time at a community Coastcare event – meet new people, find some exercise, learn about the environment and have fun getting your hands dirty!

Upcoming Coastcare events:

Please wear sturdy shoes, long pants, hat and sunscreen.

Fungi Foray
Sunday 19 June 2005
10 am – 4 pm

Meet in car park at Mindarie Primary School on Rothesay Heights, Mindarie.

Registrations are essential: Call Roz Hart on 9334 0500

Dune Planting
Sunday 26 June 2005
9am – 12pm

Meet at entry to old Tuart Grove car park on Long Beach Promenade, Mindarie.

Please bring gardening gloves and tools. A free sausage sizzle will be provided.

beach

23 Dundebar Road, Wanneroo WA 6065 • Locked Bag 1, Wanneroo WA 6946
Telephone (08) 9405 5000 Facsimile (08) 9405 5499 Website www.wanneroo.wa.gov.au

Quinns Rocks Environmental Group

The Quinns Rocks Environmental Group is a group of local people seeking a greener future.
Formed in 1985, we have worked to raise awareness, take practical action and act on local environmental issues. Situated on Perth's urban fringe we face many environmental challenges.
We have:

- Campaigned to save bushland north of Burns Beach and protect Neerabup National Park.
- Commented on planning proposals and sought sustainable development.
- Held workshops and published a book on managing urban bushland.
- Prepared a guide to growing local indigenous plants for local residents, to conserve biodiversity and water.
- Held clean up and bush regeneration days, surveyed local flora and fauna and held bush and beach walks.

We focus on the area in and around Quinns from Burns Beach to Eglinton and we network with others including the Conservation Council and Urban Bushland Council.

Aims of the Group

- Raise public awareness about the values and threats to natural areas.
- Encourage active community involvement in the protection and management of natural areas.
- Support education and research in the field of conservation and environmental protection.
- Facilitate networking with all stakeholders to ensure effective communication on environmental issues.
- Lobby to secure significant areas of bushland in the region for conservation in new developments.
- Promote sustainable waste recycling.

As a local voluntary organisation Quinns Rocks Environmental Group Inc. relies on support from the community. With your support we can do more for a greener future.

I want to ❍ become a member
❍ renew my membership

Tick your choice
❍ Family $16.50 ❍ Adult $11.00
❍ Concession $5.50
❍ Donation $_____
GST included

I can volunteer to help.

I am interested in:
❍ practical projects like bush care
❍ working on local environmental issues
❍ others_____

❍ I would like to receive my newsletter by email

Name _____

Address _____

Phone _____

Email _____

Please send form and payment to:
Quinns Rocks Environmental Group Inc. PO BOX 27 QUINNS ROCKS WA 6030
ABN: 24 600 570 647

BECOME A MEMBER NOW

Up to 18 months membership for the price of 12
(when you join in Jan 05)

How you can help

- Become a member of the Group. With your support we can do more.
- Become the "eyes and ears" for your natural area. Anti social behaviour, vandalism and dumping of rubbish are unacceptable.
- Be vigilant. Report fire immediately. (dial 000)
- Your input into environmental issues is very important. Discuss your concerns with the group. We are here to help.

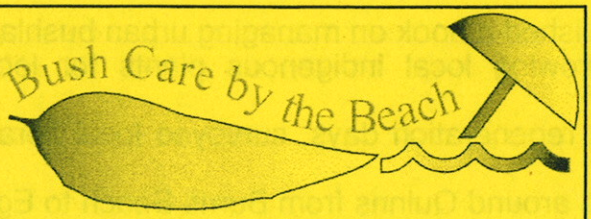
Quinns Rocks Environmental Group

WINNERS

City of Wanneroo Awards for Environmental Excellence 2004

"Community Achievement Award"

Quinns Rocks Environmental Group Regular Events



WHEN
2nd SUNDAY of EACH MONTH
8AM – 10AM
WHERE
Gumblossom Park
or
Quinns Beach
or
Long Beach Prominade

Stay on and enjoy morning tea as reward for your efforts.

GENERAL MEETINGS

WHEN
Bi-monthly on 3rd Wednesday of month
(Feb, April, June, Aug, Oct)
WHERE
Gumblossom Community Centre
Tapping Way, Quinns Rocks
TIME
7.30PM
Free
Join in the lively discussion about what is happening in the area and forthcoming events.
Supper provided.

For more information contact
Renata 9305 9382 or David 9305 9575

GROW LOCAL PLANTS



SAVE WATER, MONEY & BRING LIFE BACK TO YOUR GARDEN

A brochure produced to raise community awareness of local plant species and to promote their use in private gardens and public landscaping.

O Tick here for your free copy.

Join QREG now to go into the draw to WIN your own local plants starter kit.

Six local plant species all suitable for your coastal garden ready to plant with the first winter rains.

Winning entry drawn 1st April.

SITE	AMG_E	AMG_N	STU	FLORISTIC	FE	TY
MI01	377845.56	6491530.78	QUI	29b	F	2

ABT	OBSERVERS	DATE	BA	LI
3	EA Griffin	17/10/1991	5	60

WE	CO	SLO	ASP	W
0	E	10	130	1

DR	F	SPEC1	SPEC2	SPEC3	STY	SCL
1	M	MIMACAROS	DASLOMMAR	MYRMELACE	cal	g

STEX	SST	SSC	SSTE	GTY	GEO1	GEO2	LAN
S	cal	p g	S				DUT .

TOP	Q	LOCATION1	LOCATION2
DT	M	near coast	between Mindarie and Burns Beach

RESERVE	ZO	LATITUDE	LONGITUDE	TA	TB	TI
0	50	314218S	1154239E			

T2	MT	MS	S	SA	SB	SC	SD	MP	B	H	ST	SL	S_GC	S_GP
			2			2						2		

D_GP	B_GC	B_GP	Q_GC	Q_GP	N_GP20	N_GP50	N_GP100
			29e2	94			

N_GP200	N_GP500

SITE	AMG_E	AMG_N	STU	FLORISTIC	FE	TY
MI02	377815.12	6491537.19	QUI	29b	F	2

ABT	OBSERVERS	DATE	BA	LI
3	EA Griffin	17/10/1991	5	40

WE	CO	SLO	ASP	W
5	G	6	110	1

DR	F	SPEC1	SPEC2	SPEC3	STY	SCL
1	M	MYRMELACE	DASLOMMAR	MIMACAROS	cap	g

STEX	SST	SSC	SSTE	GTY	GEO1	GEO2	LAN
S	cap	p g	S				DUC

TOP	Q	LOCATION1	LOCATION2
DC	M	near coast	between Mindarie and Burns Beach

RESERVE	ZO	LATITUDE	LONGITUDE	TA	TB	TI
0	50	314218S	1154238E			

T2	MT	MS	S	SA	SB	SC	SD	MP	B	H	ST	SL	S_GC	S_GP
				3			2			3		2		

D_GP	B_GC	B_GP	Q_GC	Q_GP	N_GP20	N_GP50	N_GP100
			43c2	94			

N_GP200	N_GP500

SITE	AMG_E	AMG_N	STU	FLORISTIC	FE	TY
MI03	377755.25	6491412.94	QUI	29b*	F	2

ABT	OBSERVERS	DATE	BA	LI
3	EA Griffin	17/10/1991	0	99

WE	CO	SLO	ASP	W
1	E	4	240	1

DR	F	SPEC1	SPEC2	SPEC3	STY	SCL
1	M	MYRMELCAR	STETHOCOG		cal	d g

STEX	SST	SSC	SSTE	GTY	GEO1	GEO2	LAN
S				lit			PL

TOP	Q	LOCATION1	LOCATION2
TLS	O	near coast	between Mindarie and Burns Beach

RESERVE	ZO	LATITUDE	LONGITUDE	TA	TB	T1
35890	50	314222S	1154236E			

T2	MT	MS	S	SA	SB	SC	SD	MP	B	H	ST	SL	S_GC	S_GP
			1			3				4				

D_GP	B_GC	B_GP	Q_GC	Q_GP	N_GP20	N_GP50	N_GP100
			51a4	90			

N_GP200	N_GP500

SITE	AMG_E	AMG_N	STU	FLORISTIC	FE	TY
MI04	377606	6491419.53	QUI	s11	F	2

ABT	OBSERVERS	DATE	BA	LI
3	EA Griffin	17/10/1991	20	5

WE	CO	SLO	ASP	W
3	E	35	0	1

DR	F	SPEC1	SPEC2	SPEC3	STY	SCL
1	M	DASLOMMAR	GOOSCATHET	MYRMELACE	cap	p g

STEX	SST	SSC	SSTE	GTY	GEO1	GEO2	LAN
S							DUS

TOP	Q	LOCATION1	LOCATION2
DSL	M	near coast	between Mindarie and Burns Beach

RESERVE	ZO	LATITUDE	LONGITUDE	TA	TB	T1
35890	50	314221S	1154230E			

T2	MT	MS	S	SA	SB	SC	SD	MP	B	H	ST	SL	S_GC	S_GP
					3	2				4		2		

D_GP	B_GC	B_GP	Q_GC	Q_GP	N_GP20	N_GP50	N_GP100
			42d2	95			

N_GP200	N_GP500

SITE	AMG_E	AMG_N	STU	FLORISTIC	FE	TY
MI23	378250	6491250	QUI	24	F	2

ABT	OBSERVERS	DATE	BA	LI
3	EA Griffin	17/10/1991	5	20

WE	CO	SLO	ASP	W
99	G	3	0	1

DR	F	SPEC1	SPEC2	SPEC3	STY	SCL
1	M	DASLOMMAR	MYRMELACE	RESLOXASP	cal	g

STEX	SST	SSC	SSTE	GTY	GEO1	GEO2	LAN
S	cal	p g	S				DUC

TOP	Q	LOCATION1	LOCATION2
DC	O	near coast	between Mindarie and Burns Beach

RESERVE	ZO	LATITUDE	LONGITUDE	TA	TB	TI
35890	50	314227S	1154255E			

T2	MT	MS	S	SA	SB	SC	SD	MP	B	H	ST	SL	S_GC	S_GP
						4	2			2		2		

D_GP	B_GC	B_GP	Q_GC	Q_GP	N_GP20	N_GP50	N_GP100
			43c3	94			

N_GP200	N_GP500

SITE	AMG_E	AMG_N	STU	FLORISTIC	FE	TY
MIME-01	359500	6567300	SAN	23b*	F	1

ABT	OBSERVERS	DATE	BA	LI
3	BJ Keighery, ME Trudgen	09/07/1988	3	7

WE	CO	SLO	ASP	W
0	E	0	0	1

DR	F	SPEC1	SPEC2	SPEC3	STY	SCL
1	O	PROBANATT	RESALENIT	MYRMELSCA		p g

STEX	SST	SSC	SSTE	GTY	GEO1	GEO2	LAN
S		g	S				FL

TOP	Q	LOCATION1	LOCATION2

RESERVE	ZO	LATITUDE	LONGITUDE	TA	TB	TI
0	50	310110S	1153141E			

T2	MT	MS	S	SA	SB	SC	SD	MP	B	H	ST	SL	S_GC	S_GP
3						4	2			4			20	23

D_GP	B_GC	B_GP	Q_GC	Q_GP	N_GP20	N_GP50	N_GP100

N_GP200	N_GP500

SITE	AMG_E	AMG_N	STU	FLORISTIC	FE	TY
MI21	377474.66	6490847.16	QUI	29a	F	2

ABT	OBSERVERS	DATE	BA	LI
3	EA Griffin	17/10/1991	50	0

WE	CO	SLO	ASP	W
0	G	4	250	1

DR	F	SPEC1	SPEC2	SPEC3	STY	SCL
1	O	CYPISONOD	GERPELCAP	ASTCALBRO	cal	p g

STEX	SST	SSC	SSTE	GTY	GEO1	GEO2	LAN
S				lit			PL

TOP	Q	LOCATION1	LOCATION2
TLH	B	near coast	between Mindarie and Burns Beach

RESERVE	ZO	LATITUDE	LONGITUDE	TA	TB	T1
35890	50	314240S	1154225E			

T2	MT	MS	S	SA	SB	SC	SD	MP	B	H	ST	SL	S_GC	S_GP
							3					3		

D_GP	B_GC	B_GP	Q_GC	Q_GP	N_GP20	N_GP50	N_GP100
			10b	24			

N_GP200	N_GP500

SITE	AMG_E	AMG_N	STU	FLORISTIC	FE	TY
MI22	377461.5	6490749.66	QUI	s13	F	2

ABT	OBSERVERS	DATE	BA	LI
3	EA Griffin	17/10/1991	30	50

WE	CO	SLO	ASP	W
0	G	2	240	1

DR	F	SPEC1	SPEC2	SPEC3	STY	SCL
1	M	GERPELCAP	MIMACACYC	HAECONCANA	cal	p g

STEX	SST	SSC	SSTE	GTY	GEO1	GEO2	LAN
S				lih			PL

TOP	Q	LOCATION1	LOCATION2
BLS	V	near coast	between Mindarie and Burns Beach

RESERVE	ZO	LATITUDE	LONGITUDE	TA	TB	T1
35890	50	314243S	1154224E			

T2	MT	MS	S	SA	SB	SC	SD	MP	B	H	ST	SL	S_GC	S_GP
					3		3							

D_GP	B_GC	B_GP	Q_GC	Q_GP	N_GP20	N_GP50	N_GP100
			10a	24			

N_GP200	N_GP500

SMITH CORPORATION PTY. LTD.

ENVIRONMENTAL REVIEW AND MANAGEMENT PROGRAM FOR MINDARIE KEYS PROJECT

VOLUME II - TECHNICAL APPENDICES

March 1985

Scott & Furphy Engineers Pty. Ltd.
Consulting Engineers
Le Provost Semeniuk & Chalmer
Environmental Consultants

APPENDIX 5

TERRESTRIAL HABITATS, SOILS AND VEGETATION OF THE QUINNS ROCKS AREA

TECHNICAL APPENDIX 5

TERRESTRIAL HABITATS, SOILS AND VEGETATION OF THE QUINNS ROCK AREA

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15th November, 1984.

LSC Ref: J062

Report No. R071

TERRESTRIAL HABITATS, SOILS AND VEGETATION OF THE QUINNS ROCK AREA

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9 VEGETATION

Eleven vegetation units have been identified in the study area. Although there is an overlap in the floristics of most of the units, they may be separated on the basis of the relative abundance of species and the vegetation structure. For example, although Olearia axilaris occurs within all vegetation units, its structural significance ranges from being dominant in one assemblage to that of scattered individuals in another.

The greatest difference in floristics occurs in a gradient from seaward to landward. However, even vegetation units occurring at the gradient extremes have many species in common.

Aerial photographs show that much of the area is fire scarred but no attempt has been made to incorporate fire succession features into the mapping, but rather broad categories of assemblages, regardless of their status following fire regeneration, were identified.

The following sections provide a description of the assemblages in terms of vegetation structure, together with a listing of the major floristic components of the vegetation units. Geomorphic and soil units on which each assemblage occurs are also noted, and a summary of assemblage distribution relative to geomorphic and soil unit distribution is presented in Table 1. More detailed species lists for each of the assemblages are provided in Tables 2 and 3. A map of vegetation units is presented in Figure 8.

Olearia/Spinifex/Tetragonium Low Shrubland (Sites 11, 12)

This unit occurs on the cream, incipient quartz and skeletal soils of the seaward dune face and beach talus. The vegetation is a low shrubland to open heath (approx. 0.5m to 1m high) of Olearia axillaris and Pelargonium capitatum with Scaevola crassifolia, and Spyridium globulosum, a ground cover of Tetragonia decumbens,

Scirpus nodosus, Spinifex longifolius, S. hirsutus, Hardenbergia comptoniana and Carpobrotus, with other small grasses and herbs. Lepidospermum gladiatum may occur. Cakile maritima occurs at the foot of the beach talus.

Threlkeldia/Frankenia herbland

This vegetation unit occurs peripherally to the maritime limestone cliff, where the brown breccia soils either are very shallow, occurring as isolated pockets in karst features, or are absent. The vegetation consists of a herbland to open herbland of Threlkeldia diffusa and Frankenia paucifolia with Tetragonia and other scattered herbs.

Olearia/Melaleuca/Acacia/Santalum Open Heath (Sites 17,20,19,16,18)

This vegetation unit occurs on the grey soils of the steep, stabilised dune slopes. The unit consists of an open heath (to 1.5m high) of Olearia, Melaleuca spp, Acacia cochlearis, Santalum acuminatum and Spyridium globulosum, with patches of Melaleuca huegelii.

Melaleuca cardiofolia and Acacia cyanophylla occur as dense scrub within the assemblage. Anthobolus foveolatus may occur with this latter Acacia. A closed ground cover of Conostylis candicans, Phyllanthus calycinus, Leucopogon propinquis, Pelargonium capitatum, Acanthocarpus preissii, and small grasses and herbs occurs. Carpobrotus may occur and the weed Medicago is very common.

Eucalyptus gomphocephala/Lepidospermum Open Forest (Sites 21, 22)

This vegetation unit occurs on the depressions within the dune suite of geomorphic units. The understorey consists of scattered Spyridium globulosum shrubs, with Lepidospermum and a ground cover of

Medicago and introduced daisies, mixed herbs and grasses. Where the soil in the depression is too shallow (e.g. site 21 where soil depth to limestone is approximately 65cm) tuarts do not occur.

Olearia/Melaleuca Low Open Shrubland (Sites 5, 6, 14, 15)

This unit occurs on the shallow brown soils of the gently undulating limestone terrain adjacent to the dune suite. It consists of a low, open shrubland (to 1m high) of Olearia axillaris, Melaleuca heugelii. Scattered Petrophile serruiae and Grevillea thelmanniana, Spyridium globulosum, Melaleuca acerosa, with scattered Pelargonium, Templetonia retusa and Acacia cuneata occur. There is also a ground cover of Medicago, Conostylis, Phyllanthus and Acanthocarpus preissii, and weeds such as Geranium molle also occur.

Melaleuca/Thomasia/Grevillea Low Shrubland (Sites 2, 4, 8, 24)

This vegetation unit occurs on the shallow, dark brown quartz soils of the limestone hills, ridges, and saddles. It consists of a low, open shrubland of Melaleuca acerosa, Melaleuca sp. 1, Thomasia triphylla and Dryandra sessilis, Grevillea thelmanniana; Olearia, Acacia cuneata and Petrophile serruriae also occur. The ground cover layer is composed of Dryandra nivea, Phyllanthus calycinus, Medicago and mixed herbs and grasses. At site 24 in a situation which is relatively close to the sea and where a limestone ridge is in direct contact with the landward toe of the dune unit, species such as Templetonia retusa, Scaevola crassifolia and Acanthocarpus preissii occur as well as those species mentioned above.

Acacia/Melaleuca Closed Scrub (Sites 3, 9, 23)

This vegetation unit occurs as patches within the shallow, dark brown breccia soils of limestone hill units. A patch of Acacia rostellifera was also located in the dunes at site 15. The density of

the vegetation has developed a darker, leaf-litter covered soil sub-unit. Structurally the unit consists of a closed scrub (2m high) of Acacia rostellifera, Melaleuca cardiofolia and Acacia cyanophylla. Eucalyptus sp. and Anthobolus may also occur in this unit. Trymalium, Melaleuca heugelii, M. acerosa, Spyridium globulosum and Thomasia triphyllis may form a low, open shrubland understorey. The orchid Caladenia latifolia was found, but otherwise ground cover is generally not developed.

Acacia/Dryandra Tall Shrubland (Sites, 7, 1)

This vegetation unit occurs on the deeper brown and orange quartz sand soils of the discontinuous valley system within the limestone terrain. The vegetation consists of a tall shrubland (to 3m high) of Acacia cyanophylla and Acacia cyclops with an understorey of closed Dryandra sessilis heath (approx. 1m) with scattered to common Spyridium globulosum. A ground cover of Pelargonium capitatum and mixed herbs and grasses (many introduced) is present.

Sites 25 and 13, both located on the discontinuous valley unit, are presently vegetated by introduced weeds only. Apparently these local sites have been cleared and used as pasture, but would have originally supported this vegetation unit.

Dryandra/Melaleuca Closed Heath (Sites 10, 27)

This vegetation unit occurs on the brown and orange quartz sand soils of the gently sloping sand plains within the limestone suite of geomorphic units. The vegetation is a closed heath (approximately 1m high) of Dryandra sessilis with scattered Melaleuca huegelii, and M. cardiofolia (which is emergent above the general canopy). Beneath the Dryandra are M. acerosa, Petrophile serruriae, and Calothamnus quadrifidus, as well as Conostylis candicans, Hibbertia hypericoides, Trymalium and a scattering of small herbs and grasses.

Acacia cuneata Closed Heath (Site 10)

This unit occurs on the shallow brown soils of the limestone hills. Due to the high production of leaf litter, the soil is rich in organic material. The vegetation is a closed heath (approximately 1.5m high) of Acacia cuneata with scattered A. cyanophylla projecting through the canopy. There is very little understorey or ground cover. This unit is not obvious as an aerial photograph tone.

Banksia/Xanthorrea Low Open Woodland

A low open woodland (approximately 3m high) of Banksia attenuata has an understorey of Xanthorrea preissi, and a ground cover of Hibbertia hypericoides and small herbs and grasses. This is not a widespread unit within the study area.

10 RARE AND ENDANGERED SPECIES OF FLORA

Reference to the "Guide to the Gazetted Rare Flora of Western Australia" (Hopper, 1981) and Supplement 1 (Patrick & Hopper, 1982) indicates that no species of plant known to be rare or endangered has been previously found on the site or in the immediate locality. Vegetation studies carried out for this report have confirmed that the habitats present in the area (i.e. maritime-influenced, shallow limestone soils) do not coincide with the habitats of any rare species found in the region.

11 EXOTIC VEGETATION

The environment of the study area has been invaded by a host of foreign vegetation species. These occur in four main settings:

(i) A widespread distribution of herbivorous weeds in the "naturally" vegetated areas. In some locations weed species formed up to 50% of the composition of the vegetation. The weeds include the Blue Pimpernel, Anagallis foemina, Pig-face, Carpobrotus edulis, Geranium molle, the "wild geranium", Pelagonium capitatum, a variety of clovers and medics, and numerous grasses including wild oats, Avena fatua, hare's tail grass, Lagurus ovatus, and Blowfly grass, Briza maxima.

(ii) Local patches of pasture grasses and herbs which constitute ca 1% of the vegetation of the study area.

(iii) Local patches of cleared ground with planted exotics such as palms. These areas constitute less than 1% of the vegetation of the study area.

(iv) Introduced grasses colonising edges of tracks. Numerous pasture and other grasses including Avena, Lagurus, Briza and Bromus are commonly found in these areas, however the extent of this type of habitat comprises less than 1% of the vegetation of the study area.

In terms of species present, exotic weeds are most numerous in the first setting type although this varies depending on the assemblage present. Densely canopied native assemblages tend to exclude weeds and thus the Acacia closed scrub has no weed understorey, and the Dryandra closed heath has little or no weed intrusion. However, the open limestone hills and slopes, and much of the dune slopes, vegetated by low shrubs and herbs have the most abundant occurrence of exotic weeds. These habitats account for nearly 90% of the study area.

As a result, the vegetation of this study area cannot be considered to be regionally significant. In ecological terms the vegetation may be viewed as non pristine and degraded, although the area retains the high species diversity which is characteristic of the coastal limestone heath.

12 STATUS OF VEGETATION

The vegetation of the study area supports a variety of native plant species but it has been adversely affected by human use. It has been subject to large-scale and widespread invasion by exotic weeds, some areas have been cleared for pasture and there has been a recurring history of fire. Even the relatively natural assemblages have undergone modification as a result of widespread rough grazing.

The relatively few tracks in the area are mainly restricted to the very narrow shoreline strip. Thus the vast majority of the area is not heavily dissected by tracks.

Rare and endangered species of vegetation were not anticipated in this type of habitat/vegetation system and, as mentioned above, none were found.

TABLE 2

THE COMPOSITION OF THE ELEVEN ASSEMBLAGES DESCRIBED FROM THE QUINNS ROCK STUDY AREA

* Indicates introduced species

1. Olearia/Spinifex/Tetragonium Low Shrubland

SPECIES	DOMINANT TO COMMON WITHIN A STRUCTURAL COMPONENT	PRESENT WITHIN A STRUCTURAL COMPONENT
Asteraceae		
* Artotheca populifolia	.	+
Olearia axillaris	+	.
Senecio lautus	.	+
Aizoaceae		
* Carpobrotus edulis	.	+
Tetragonia decumbens	+	.
Brassicaceae		
Cakile maritima	.	+
Chenopodiaceae		
Atriplex isatidea	.	+
Rhagodia baccata	.	+
Rhagodia sp.	.	+
Cyperaceae		
Lepidospermum gladiatum	+	.
Scirpus nodosus	.	+
Euphorbiaceae		
Phyllanthus calycinus	.	+
Geraniaceae		
* Pelargonium capitatum	+	.
Goodeniaceae		
Scaevola crassifolia	+	.
Onagraceae		
* Oenthera drummondii	.	+

.....cont'd

TABLE 2 (continued)

1. Olearia/Spinifex/Tetragonium Low Shrubland (continued)

SPECIES	DOMINANT TO COMMON WITHIN A STRUCTURAL COMPONENT	PRESENT WITHIN A STRUCTURAL COMPONENT
Papilonaceae		
Hardenbergia comptoniana	.	+
Poaceae		
* Avena fatua	.	+
Spinifex hirsutus	+	.
S. longifolius	+	.
Liliaceae		
Acanthocarpus preisii	+	.
* Trachyandra divaricata	.	+
Myoporaceae		
Myoporum insulare	+	.
Rhamnaceae		
Spyridium globulosum	.	+
Santalaceae		
Santalum acuminatum	.	+

.....cont'd

TABLE 2 (continued)

2. Olearia/Melaleuca/Acacia/Santalum Open Heath

SPECIES	DOMINANT TO COMMON WITHIN A STRUCTURAL COMPONENT	PRESENT WITHIN A STRUCTURAL COMPONENT
Asteraceae		
Olearria axillaris	+	.
* Senecio elegans	.	+
Cyperaceae		
Lepidospermum gladiatum	+	.
Epacridaceae		
Leucopogon propinquus	.	+
Dilleniaceae		
Hibbertia racemosa	.	+
Euphorbiaceae		
Phyllanthus calycinus	.	+
Goodeniaceae		
Scaevola crassifolia	.	+
Geraniaceae		
* Geranium molle	+	.
* Pelargonium capitatum	+	.
Haemodoraceae		
Conostylis candicans	+	.
Liliaceae		
Acanthocarpus preissii	+	.
Mimosaeceae		
Acacia cochliaris	+	.
A. cyanophylla	.	+
A. pulchella	.	+
Myrtaceae		
Melaleuca acerosa	+	.
M. heugelii	.	+
M. cardiofolia	.	+

.....cont'd

TABLE 2 (continued)

2. Olearia/Melaleuca/Acacia/Santalum Open Heath (continued)

SPECIES	DOMINANT TO COMMON WITHIN A STRUCTURAL COMPONENT	PRESENT WITHIN A STRUCTURAL COMPONENT
Papilonaceae		
Hardenbergia comptoniana	.	+
* Medicago polymorpha	+	.
Poaceae		
* Avena fatua	+	.
Primulaceae		
* Anagallis sp.	+	.
Restionaceae		
Loxocarya sp.	.	+
Rhamnaceae		
Spyridium globulosum	+	.
Santalaceae		
Anthobolus sp.	.	+
Santalum acuminatum	.	+
Thymeliaceae		
Pimelia ferruginea	.	+

TABLE 2 (continued)

3. Olearia/Melaleuca Low Open Shrubland

SPECIES	DOMINANT TO COMMON WITHIN A STRUCTURAL COMPONENT	PRESENT WITHIN A STRUCTURAL COMPONENT
Aizoaceae		
* Carpobrotus edulis	.	+
Asteraceae		
Olearia axillaris	+	.
* Senecio elegans	.	+
Senecio lautus	.	+
Chenopodiaceae		
Rhagodia baccata	+	.
Cyperaceae		
Lepidospermum gladiatum	.	+
Dilleniaceae		
Hibbertia hypericoides	.	+
Epacridaceae		
Leucopogon propinquus	.	+
Euphorbiaceae		
Phyllanthus calycinus	.	+
Geraniaceae		
* Geranium molle	+	.
* Pelargonium capitatum	.	+
Goodeniaceae		
Scaevola crassifolia	.	+
Haemodoraceae		
Conostylis candicans	+	.
Liliaceae		
Acanthocarpus preissii	+	.
* Trachyandra divaricata	.	+

.....cont'd

TABLE 2 (continued)

3. Olearia/Melaleuca Low Open Shrubland (continued)

SPECIES	DOMINANT TO COMMON WITHIN A STRUCTURAL COMPONENT	PRESENT WITHIN A STRUCTURAL COMPONENT
Mimosaceae		
Acacia cuneata	.	+
Myoporaceae		
Eremophila glabra	.	+
Myoporum insulare	.	+
Myrtaceae		
Calothamus quadrifidus	.	+
Melaleuca acerosa	+	.
M. heugelii	.	+
Papilonaceae		
Gompholobium tomentosum	.	+
Hardenbergia comptoniana	.	+
Kennedia prostrata	.	+
* Medicago polymorpha	+	.
Templetonia retusa	.	+
Poaceae		
* Avena fatua	.	+
Proteaceae		
Dryandra nivea	.	+
Grevillea thelmaniana	.	+
Petrophile serruriae	.	+
Rhamnaceae		
Spyridium globulosum	+	.
Sterculiaceae		
Thomasia triphylla	.	+

.....cont'd

TABLE 2 (continued)

4. Eucalyptus gomphocephala/Lepidospermum Open Forest

SPECIES	DOMINANT TO COMMON WITHIN A STRUCTURAL COMPONENT	PRESENT WITHIN A STRUCTURAL COMPONENT
Cyperaceae		
Lepidospermum gladiatum	+	.
Myrtaceae		
Eucalyptus gomphocephala	+	.
Papilonaceae		
* Medicago polymorpha	+	.
Poaceae		
* Avena fatua	+	.
and mixed introduced species	+	.
Rhamnaceae		
Spyridium globulosum	+	.

.....cont'd

TABLE 2 (continued)

5. **Melaleuca/Thomasia/Grevillea Low Shrubland**

SPECIES	DOMINANT TO COMMON WITHIN A STRUCTURAL COMPONENT	PRESENT WITHIN A STRUCTURAL COMPONENT
Asteraceae		
Olearia axillaris	.	+
Helichrysum sp.	.	+
Epacridaceae		
Leucopogon propinquus	.	+
Euphorbiaceae		
Phyllanthus calycinus	.	+
Geraniaceae		
* Geranium molle	+	.
Goodeniaceae		
Scaevola crassifolia	+	.
Haemodoraceae		
Conostylis candicans	+	.
Liliacea		
Acanthocarpus preissii	.	+
Mimosaceae		
Acacia cuneata	+	.
A. rostellifera	.	+
Myoporaceae		
Eremophila glabra	.	+
Myrtaceae		
Calothamnus quadrifidus	.	+
Melaleuca acerosa	+	.
M. cardiophylla	.	+
M. heugelii	.	+

.....cont'd

TABLE 2 (continued)

5. **Melaleuca/Thomasia/Grevillea Low Shrubland** (continued)

SPECIES	DOMINANT TO COMMON WITHIN A STRUCTURAL COMPONENT	PRESENT WITHIN A STRUCTURAL COMPONENT
Papilonaceae		
Gompholobium tomentosum	.	+
Hardenbergia comptoniana	+	.
* Medicago polymorpha	+	.
Templetonia retusa	.	+
Poaceae		
* Briza maxima	.	+
Primulaceae		
* Anagallis sp.	+	.
Proteaceae		
Dryandra sessilis	+	.
D. nivea	+	.
Grevillea thelmaniana	+	.
Petrophile serruriae	.	+
Restionaceae		
Loxocarya sp.	+	.
Sterculiaceae		
Thomasia triphylla	+	.
Stylidiaceae		
Stylidium spp	.	+
Violaceae		
Hybanthus calycinus	.	+

....cont'd

TABLE 2 (continued)

6. Acacia/Melaleuca Closed Scrub

SPECIES	DOMINANT TO COMMON WITHIN A STRUCTURAL COMPONENT	PRESENT WITHIN A STRUCTURAL COMPONENT
Chenopodiaceae		
Rhagodia sp.	.	+
Euphorbiacea		
Phyllanthus calycinus	.	+
Haemodoraceae		
Conostylis candicans	.	+
Mimosaceae		
Acacia cyanophylla	+	.
A. rostellifera	+	.
Myrtaceae		
Calothamnus quadrifidus	.	+
Eucalyptus rudis	.	+
Melaleuca acerosa	.	+
M. cardiofolia	+	.
M. heugelii	+	.
Orchidaceae		
Caladenia latifolia	+	.
Rhamnaceae		
Spyridium globulosum	.	+
Santalaceae		
Anthobolus sp.	.	+

.....cont'd

TABLE 2 (continued)

7. Acacia/Dryandra Tall Shrubland

SPECIES	DOMINANT TO COMMON WITHIN A STRUCTURAL COMPONENT	PRESENT WITHIN A STRUCTURAL COMPONENT
Asteraceae		
* Senecio elegans	.	+
Chenopodiaceae		
Rhagodia sp.	.	+
Geraniaceae		
* Geranium molle	+	.
* Pelargonium capitatum	.	+
Mimosaceae		
Acacia cyanophylla	+	.
A. cyclops	.	+
Myrtaceae		
Calothamnus quadrifidus	.	+
Melaleuca acerosa	+	.
M. cardiofolia	.	+
M. heugelii	+	.
Papilonaceae		
* Medicago polymorpha	+	.
Poaceae		
* Avena fatua	+	.
Primulaceae		
* Anagallis sp.	+	.
Proteaceae		
Dryandra sessilis	+	.
Hakea glabella	.	+
Petrophile serruriae	.	+
Rhamnaceae		
Spyridium globulosum	.	+

.....cont'd

TABLE 2 (continued)

8. Dryandra/Melaleuca Closed Heath

SPECIES	DOMINANT TO COMMON WITHIN A STRUCTURAL COMPONENT	PRESENT WITHIN A STRUCTURAL COMPONENT
Dilleniaceae		
Hibbertia hypericoides	+	.
Haemodoraceae		
Conostylis candicans	+	.
Myrtaceae		
Melaleuca acerosa	+	–
M. cardiofolia	.	+
M. heugelii	.	+
Proteaceae		
Dryandra nivea	+	.
D. sessilis	+	.
Petrophile serruriae	+	.
Restionaceae		
Loxoncarya sp.	+	.

9. Acacia cuneata Closed Heath

SPECIES	DOMINANT TO COMMON WITHIN A STRUCTURAL COMPONENT	PRESENT WITHIN A STRUCTURAL COMPONENT
Mimosaceae		
Acacia cuneata	+	.
A. cyanophylla	.	+
Proteaceae		
Dryandra sessilis	.	+
Petrophile serruriae	.	+

.....cont'd

TABLE 2 (continued)

10. Banksia/Xanthorrea Low Open Woodland

SPECIES	DOMINANT TO COMMON WITHIN A STRUCTURAL COMPONENT	PRESENT WITHIN A STRUCTURAL COMPONENT
Dilleniaceae		
Hibbertia hypericoides	+	.
Haemodoraceae		
Conostylis candicans	.	+
Xanthorrea preissii	+	.
Proteaceae		
Banksia attenuata	+	.

11. Threlkeldia/Frankenia Herbland

SPECIES	DOMINANT TO COMMON WITHIN A STRUCTURAL COMPONENT	PRESENT WITHIN A STRUCTURAL COMPONENT
Chenopodiaceae		
Threlkeldia diffusa	+	.
Frankeniaceae		
Frankenia paucifolia	+	.
Myoporaceae		
Tetragonia decurrens	+	.

VEGETATION UNITS

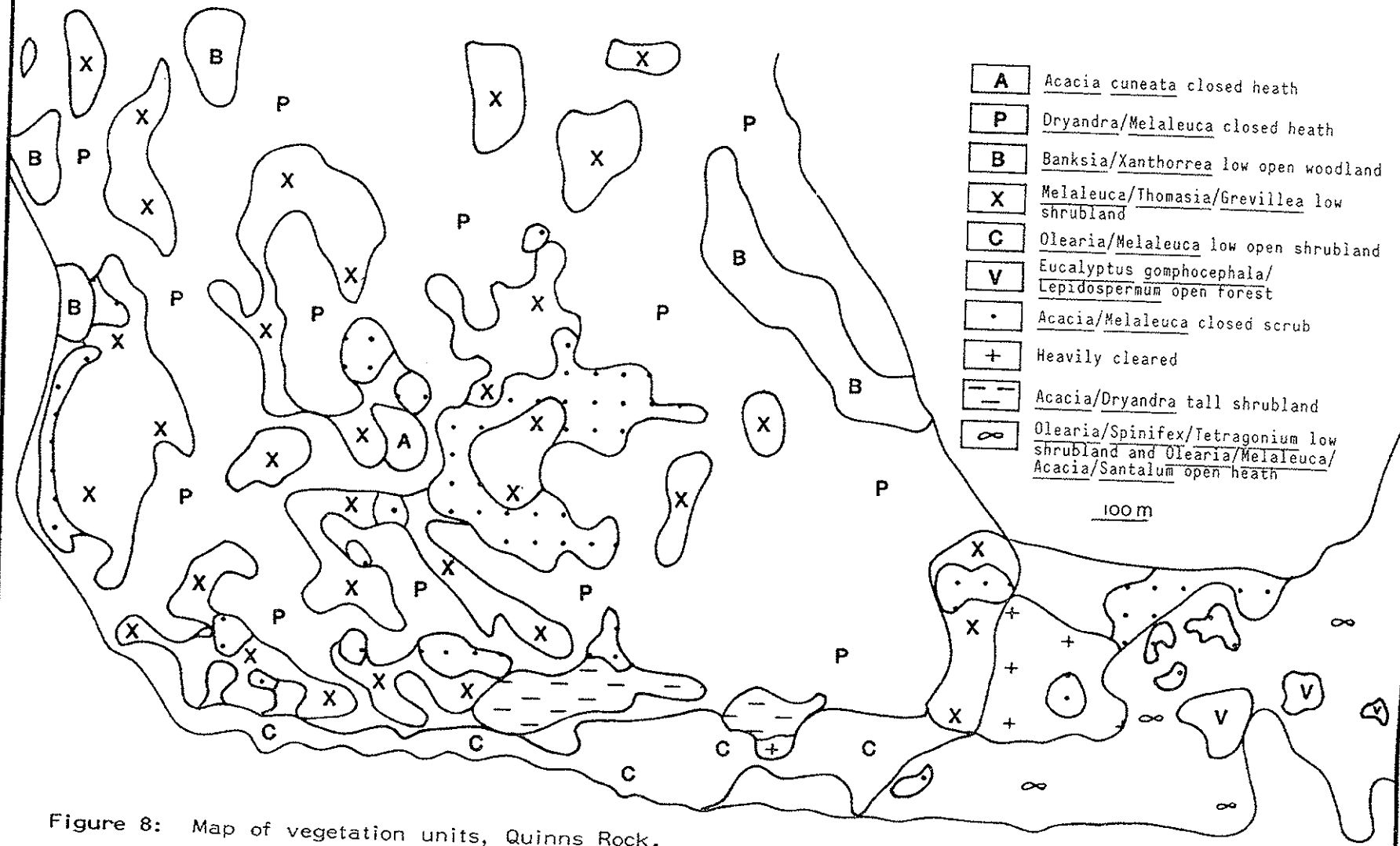

Figure 8: Map of vegetation units, Quinns Rock.

REMNANT VEGETATION

IN THE QUINNS ROCKS AREA:

DESCRIPTION OF VEGETATION AND FLORA

AND

ITS CONSERVATION SIGNIFICANCE

by

Nicky Robinson

cartography by Keith Breheny

report for Quinns Rocks Environmental Group Inc.
August 1997

ACKNOWLEDGEMENTS

My thanks to Keith for help in fieldwork, advice on mapping, compiling the photo mosaic, reviewing the manuscript, and uncompromising support.

Thanks to David Wake and Renata Zelina of QREG, for the opportunity to tackle this project and for their advice and comments on the manuscript, and to Renata for taking the time to look up species common names.

I am grateful for the assistance provided by: Paul Holmes at the City of Wanneroo, who gave me access to original maps from the report by Trudgen (1996); and to the database staff at the WA Herbarium, who gave me with access to the WACENSUS and WAHERB databases.

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1. SUMMAR

Remnant vegetation and flora of the Quinns Rocks area, bounded by Pipidinny Road, Burns Beach Road and Wanneroo Road, are described, major vegetation communities are mapped, and their conservation significance is assessed.

Aerial photography was used to identify major vegetation communities, and ground truthing together with information from previous studies in small sections of the study area, were synthesised to formulate vegetation descriptions and maps. Vegetation communities include two Strand communities, six Quindalup communities, six Spearwood communities, and one Herdsman community .

A total of 473 species representing 255 genera and 77 families of vascular plants are recorded. At least one species of Declared Rare Flora, five priority species, and 23 other significant taxa occur in the study. Introduced species total 89. The flora list was compiled from previous studies in most representative sections of the study area, but as these studies do not cover the entire study area, the list is likely to be incomplete.

Large areas of remnant vegetation exist in the study area, which are representative of communities within the Quindalup and Cottesloe – Central and South vegetation complexes of Heddle (1980). The remnants have high conservation value due to the high level of clearing of these vegetation complexes and their lack of reservation for conservation throughout their original range, particularly in the Perth Metropolitan Area. Remnants in the study area represent an opportunity to add substantial areas to the conservation estate that have the potential to maintain sustainable ecosystems. They are generally in good to very good condition and are relatively large with low border to area ratios. They also provide linkages to other conservation areas adjacent to the study area.

Much is still unknown about the Swan Coastal Plain vegetation and flora. Integration of conservation with planning for urban development in the area is vital in order to preserve the natural values of the area for future generations.

2. INTRODUCTION

2.1 Background

This report forms a part of the 'Quinns Rocks Remnant Vegetation Study' undertaken by the Quinns Rocks Environmental Group and funded through the National Landcare program's 'Save The Bush' community grants.

The aim of the overall study is to map and describe remnant vegetation in the Quinns Rocks area, and to document changes in vegetation cover that have occurred over time. The purpose is to identify issues, opportunities and strategies for its conservation.

This report documents the remnant vegetation. The major vegetation communities are mapped and described, the flora is listed and described, and an assessment is made of the conservation significance of the remnant vegetation.

The definition of 'remnant vegetation' can be equated to that of 'bushland' which is described by Keighery & Gray (1993, p.21) as "... land on which there is vegetation which is either a remainder of the natural vegetation of the land, or, if altered, is still representative of the structure and floristics of the natural vegetation."

Clearing for urban development is having a significant impact on the natural values of the area. It is hoped that this study will provide a better basis for sound land use planning, helping to integrate the conservation of biological diversity into planning and development of the area. It is also envisaged that the project will provide a useful case study for other community groups interested in protecting biological diversity.

2.2 The study area

The study area lies within the City of Wanneroo on the western margin of the Swan Coastal Plain, Western Australia. It encompasses over 5,000 hectares of land bounded by

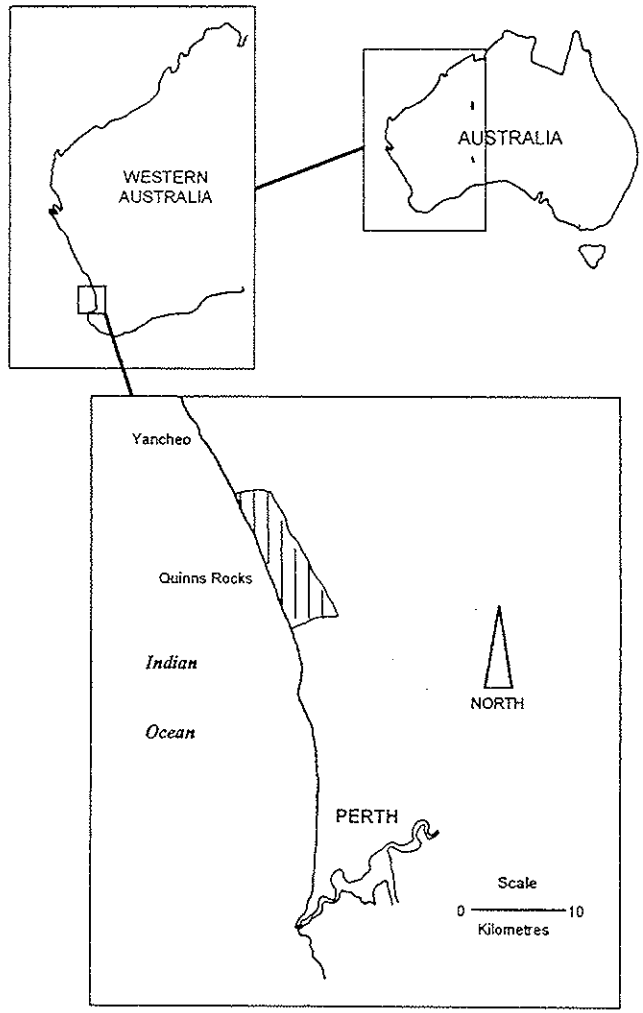

Figure 1. Location of study area: Quinns Rock area (Pipidinny to Burns Beach Road, west of Wanneroo Road)

the Indian Ocean in west, Wanneroo Road in the east, Pipidinny Road in the north and Burns Beach Road in the south (see Figure 1).

Substantial areas of the remaining bush are planned for urban development (Department of Planning and Urban Development, 1992). Areas reserved for parks and recreation include Neerabup National Park, which runs north-south, west of Wanneroo Road, and the coastal strip, from the beach to up to 1km inland. The other major land use is urban. There are also several small holdings under market gardening along the eastern edge of the study area.

Apart from land reserved for public use, the tenure of the remainder is freehold with most areas of remnant vegetation owned by private developers, Landcorp or Homeswest.

The study area includes parts of the System 6 areas M2, M3 and M6, recommended for reservation for conservation and public amenity (Environmental Protection Authority, 1983). Approximately half of M2 (the coastal strip from Two Rocks to Burns Beach) is within the study area. Beonaddy Swamp in the north-east corner of the study area forms part of M3 (Yanchep National Park). M6 (Neerabup National Park) and proposed additions, lie almost entirely within the study area.

The condition of remnant bushland varies from poor to very good, although much is in good to very good condition (see Appendix 1 for Condition Rating Scale). Condition depends largely on the level of disturbance. Disturbances include grazing, use of four-wheel drive and off-road vehicles, rubbish dumping, fire, feral animals (particularly rabbits), clearing for urban development, agriculture and road building. Surrounding land uses also influence condition.

3. PHYSICAL ENVIRONMENT

Vegetation communities present at any site are greatly influenced by a range and combination of characteristics of the physical environment.

3.1 Geology, Geomorphology, Soils and Topography

The dominant geological/geomorphological features of the study area are the Quindalup Dune (Holocene Safety Bay Sand) system of the western side which overlies the older Spearwood Dune (Pleistocene Tamala Limestone) system exposed on the eastern side. Both systems are derived from aeolian deposits (Churchward & McArthur, 1980).

The Quindalup system forms a discontinuous strip of beach ridges and parabolic dunes along the south-west coast of Western Australia. In the study area its width varies. It extends inland up to 3.8km at one point in the north, but for 1.5km south of Quinns Rocks and at Burns Beach it discontinues, and here the Tamala limestone is exposed at the coast (Churchward & McArthur, 1980).

The dunes of the Quindalup system can be classified according to age: Q1 dunes are the oldest and generally occur furthest inland, followed by Q2 and Q3 dunes, with the youngest Q4 dunes occurring along the immediate coastline. The soils of the Quindalup dunes comprise white calcareous sands, and each age is differentiated by steepness, relief, organic matter accumulation in the upper layer, cementation in the lower layers, and vegetation associations. The Q1 dunes are the least steep with the lowest relief, have the greatest accumulation of organic matter, and greatest cementation. There is little differentiation of the coastal heath vegetation associations between Q1, Q2 and Q3 dunes, but Q4 dune vegetation is distinct and typified by pioneer species able to tolerate the harsh conditions closest to the coast (McArthur & Bartle, 1980).

The more extensive Spearwood system is found generally to the east of the Quindalup system. It is characterised by grey-brown surface sand over yellow sand over Tamala

limestone. Sand depth varies, with a maximum of 2m, and the limestone is often exposed at the surface. Where this system extends to the coast, exposed limestone forms low cliffs (McArthur & Bartle, 1980). The deeper soils of the Spearwood system support *Eucalyptus* and *Banksia* open forests and woodlands, and the shallower soils support heath communities.

The system is sub-divided into Karrakatta and Cottesloe soils with the former having deep yellow sands, and the latter shallower sands with much exposed limestone (Churchward & McArthur, 1980). In the study area Cottesloe soils dominate, and only a small area in the south-east corner is covered by the Karrakatta soil.

Other important features of the study area are three small wetlands. Beonaddy Swamp in the north-eastern corner of the study area, and the un-named wetland in the south-eastern corner (an extension of the Lake Joondalup wetland chain, identified as "Joondalup, North" by Arnold, 1990), are part of the Herdsman unit which are described by Churchward & McArthur (1980) as "peaty swamps". Hill et al. (1996) describes them as "sumplands" (seasonally inundated basins). Beonaddy Swamp is 45% undisturbed or vegetated, and the Joondalup North wetland is 86% undisturbed or vegetated (Hill et al., 1996). Karli Spring is a small wetland in the Quindalup Dune system approximately 100m from the beach in the northern section of the study area.

Topographically the study area ranges in height from sea level at the beach, to 75m in the south-eastern corner. Typically, the parallel dunes rise steeply from the beach to 10 or 20m, with the parabolic dune crests reaching up to 50m. Beyond the dunes the landscape is gently undulating, rising gradually from 15 to 20 m in the central-west to 45 to 55m in the east (Department of Land Administration, 1987).

3.2 Climate

The study area has a Mediterranean climate with hot dry summers and reliable winter rainfall. Annual rainfall is approximately 625 – 750mm. Strong south-westerly winds in

summer have the potential to cause blowouts of sparsely vegetated dunes (Trudgen & Keighery, 1990).

4. LITERATURE REVIEW

Heddle et al. (1980) mapped vegetation complexes in relation to landforms, soils and climatic conditions. Each complex is described in terms of projected foliage cover and height of dominant life-forms and species, and understorey species composition. The main vegetation complexes represented in the study area are Quindalup and Cottesloe – Central and South. Karrakatta – Central and South and Herdsman complexes are represented to a minor extent.

The Quindalup system extends from Dongara in the north to Geographe Bay in the south (Semeniuk et al., 1989). The original extent of the Cottesloe – Central and South complex was a discontinuous strip from 13km north of Lake Pinjar (west of the study area) to Lake Preston (south of Mandurah) (Trudgen, 1996).

The Quindalup system is by no means uniform in terms of geomorphology and vegetation throughout its range. Semeniuk et al. (1989) recognised variation from north to south, and divided the system into 5 sectors based on distinct associations of geomorphic units and vegetation habitats (due to different sedimentological, geomorphic, climatic and other edaphic factors). The sector within which our study area lies is Whitfords to Lancelin.

Griffin (1993), in a floristic study of the Quindalup dunes between the Swan and Irwin Rivers, recognised floristic variation north-south attributable to variation in Pleistocene deposits and on this basis he divided the system into sectors. The sector, within which our study area lies, coincides with that of Semeniuk et al. (1989). Within sectors, vegetation composition also varied which he related primarily to variation in landforms with other factors being proximity to the coast, time since colonisation, geology and soils.
In a later study, Griffin & Trudgen (1994) divided this sector into sub-sectors based on this within sector variation. Our study area lies within two of these sub-sectors, Moore River to Quinns Rocks, and Quinns Rocks to Whitfords.

Trudgen (1996) assessed the conservation values of remnant vegetation in the context of Heddle's classification for the whole of the City of Wanneroo. The City has extensive and significant remnants which are important for conservation in a regional context. Recommendations were based on vegetation condition, the conservation status of complexes (including extent of clearing and adequacy of representation in reserves), and potential to connect remnants and existing conservation areas.

Recommendations were made to reserve much of the remnant vegetation in our study area as representative examples of vegetation complexes and transitions between complexes. Linkages between the coast, Neerabup National Park and Yanchep National Park were also recommended for reservation.

Gibson et al. (1994) took a different approach in studying the vegetation of the Swan Coastal Plain. Their concept of floristic community types was highly correlated to seasonal moisture regimes and geomorphology, but poorly correlated to Heddle's vegetation complexes. It is difficult to determine precisely which floristic community types occur in our study area because of differences in methodology between the Swan Coastal Plain study and this study. Their descriptions are based on very detailed and site specific data, whereas this study, which takes a broader, generalised approach in describing the vegetation communities.

Information on sites in the area could have been accessed and still could be - Trudgen 1996 does consider those in the City of Wanneroo

The sites are approximately as listed in next column

(Gibson et al sites are in
- Neerabup
- Yanchep
- Burns Beach (south)
- State Forest 65 E

Darling System 6 Sites
- Wilbinga/M1
- Cattin 1993 sites

While I would not suggest this be adopted at this late stage it would be useful to have the groups

The flora and vegetation of various sections of the study area have been mapped and/or described by several authors. Surveys by Keighery et al. (1996) and Mattiske (1990) covered Neerabup National Park and an adjacent Water Reserve in the eastern section. Other surveys were in the western section. Between Burns Beach and Mindarie surveys were conducted by Keighery (1991), Halpern Glick Maunsell (1995), and Kinhill Stearns (1983). Sections north of Quinns Rocks were surveyed by Robinson (1995), Trudgen & Keighery (1990), and LeProvost Environmental Consultants (1990). The coastal communities between Burns Beach and Jindalee were mapped by Hames Sharley Australia (1992). Flora of remnants in and near Quinns Rocks townsite have been surveyed by the Quinns Rocks Environmental Group (David Wake, QREG, pers. comm.)

Vegetation classifications used in these surveys differ in the level of detail of descriptions. They provide useful information on the flora and vegetation but are incomplete in their coverage of the study area.

5. MAPPING AND DESCRIPTION OF THE VEGETATION AND FLORA

5.1 Methods

5.1.1 Vegetation mapping and description

The vegetation maps were compiled from interpretation of aerial photography augmented with ground truthing and synthesis of information on vegetation maps from previous studies.

The aerial photographs used were 1 : 20,000 colour photographs taken for the Department of Land Administration on 6 January 1995 (WA3490 Metro Regional Area). A photo mosaic was compiled and the major vegetation communities were traced. Ground truthing was concentrated on easily accessible public land, and consequently assessment of the vegetation in large sections of the map relied on photo interpretation based on this ground truthing. The final maps produced here are reduced to approximately 1 : 22,500.

Some parts of the study area had been previously mapped by Halpern Glick Maunsell (1995); Hames Sharley Australia (1992); Keighery, Keighery and Gibson (1996); Kinhill Stearns (1983); LeProvost Environmental Consultants (1990); and Robinson (1995). These were used to aid photo interpretation.

The vegetation descriptions are based on observations made when ground truthing and synthesis of information from the above mentioned studies. The vegetation structural classification system used follows Keighery (1994) which was developed during floristic surveys on the Swan Coastal Plain (see Appendix 2).

5.1.2 Flora description

The flora list was compiled from previous flora surveys in various sections of the study area. These surveys were Keighery et al. (1996), Mattiske (1990), Keighery (1991), Robinson (1995), and Trudgen & Keighery (1990). No detailed surveys were found for the wetlands, but dominant species were given by Arnold (1990) for the two Herdsman complex wetlands.

5.2 Limitations of the study

5.2.1 Vegetation mapping and description

Due to limited resources and the large area covered by the project, some degree of generalisation is unavoidable in the vegetation maps and vegetation descriptions.

The scale of the maps (approximately 1 : 22,500) inevitably results in some loss of detail and precision in identifying communities. One consequence of scale limitations is that the narrow belt of coastal communities from the strand to the first stabilised dune, cannot be mapped, although the vegetation has been described in section 5.2. These communities are *Cakile maritima* Very Open Herbland, *Spinifex hirsutus/S. longifolius* Grassland, and *Scaevola crassifolia* Low Heath.

Small remnants (usually under 1 hectare) occur on some residential lots and public land, particularly in the Quinns Rocks townsite. These also were not mapped.

The use of aerial photography in composing a photo mosaic also results in some distortion. The vegetation maps should therefore be used with a degree of caution in this regard.

The aerial photographs were taken in 1995, two years before this study (in early 1997), and changes in land use and to remnant vegetation have since occurred. Some remnants

have been cleared for urban development and known changes have be corporated into the vegetation maps. Other changes may have occurred due to the natural dynamic processes in remnants, or due to disturbances such as fire and grazing. These may affect the structure, floristics and condition of remnants. The maps have incorporated these changes where known.

5.2.2 Flora description

Previous studies from which the flora list is derived, do not cover the entire study area and therefore the list is likely to be incomplete. In particular, species occurring in the Herdsman Complex are likely to be under-represented as no previous detailed studies were found for these wetlands.

6. VEGETATION DESCRIPTION

6.1 General description of the study area

The coastal foredunes are very steep along the much of the study area. Outcrops of limestone, forming low cliffs, also occur at a few locations along the coast.

Beyond the foredunes the Quindalup communities occur on dunes of various ages with the older Q1, Q2 and Q3 dunes landward of the youngest Q4 dunes. There are some large blowouts and several smaller ones close to the coast.

The mosaic of Spearwood communities generally occur east of the Quindalup communities. These comprise mainly of Cottesloe - Central and South Vegetation Complexes. There is also a small area of Karrakatta - Central and South Complex in the south-eastern corner of the study area (Trudgen, 1996).

Two small areas of the Herdsman Vegetation Complex occur in the north-eastern corner, and the south-eastern corner (Trudgen, 1996).

6.2 Detailed description

Most of the following vegetation communities are mapped on Figures 3, 4 and 5 (a legend for these maps is given in Figure 2). Those communities not mapped (due to limitations of scale) are notated in the text.

Areas on the maps marked urban (U), pasture (P) or cleared (C) are generally devoid of any native vegetation. (Some small patches occur in places but because of scale limitations, these could not be mapped.) Those marked as highly disturbed (S7) are all within the Spearwood system and generally have some remnant native overstorey species.

6.2.1 Strand vegetation communities

Cakile maritima Very Open Herbland (not mapped)

This narrow belt of strand vegetation occurs on low foredunes or beachridges seaward of the first stabilised (or partly stabilised) dune. *Spinifex* spp. are also be found here.

Spinifex hirsutus/S. longifolius Grassland (not mapped)

Occurs on the beach side of the first stabilised dune. The introduced *Ammophila arenaria* is also found on the dunes.

6.2.2 Quindalup vegetation communities

Blowouts (Q1)

There are two large blowouts south of Mindarie and several other smaller ones. They are very sparsely vegetated by *Spinifex* sp. or *Lepidosperma gladiatum* with *Scaevola crassifolia, Isolepis nodosa, Carpobrotus* sp. and the introduced *Trachyandra divaricata* on the blowout ridges. In places *Olearia axillaris* and *Spyridium globulosum* occur.

Scaevola crassifolia Low Heath (Q2) (not mapped)

This community is found on the white sand of the youngest dunes (the foredunes and primary dunes, classified as Q4 dunes by McArthur & Bartle (1980)), and merges with *Spinifex* sp. Grassland at the top of the first dune system.

Apart from *O. axillaris*, other common species are *Lepidosperma gladiatum, Isolepis nodosa, Acrotriche cordata, Hemiandra pungens, Rhagodia baccata, Conostylis candicans, Leucophyta brownii, Acanthocarpus preissii, Leucopogon parviflorus*, and the introduced species *Tetragonia decumbens, Pelargonium capitatum, Trachyandra divaricata* and *Lagarus ovatus*. Larger shrubs (but usually less than 1m) are scattered in the swales: these include *Olearia axillaris, Exocarpus sparteus, Acacia lasiocarpa, Acacia cyclops*, and *Spyridium globulosum*.

Olearia axillaris Open Heath (Q3)

Occurs on the white to grey, calcareous sand of the older, steep to undulating Q1, Q2 and Q3 dunes.

There are significant amounts of other shrubs, particularly *Spyridium globulosum* which dominates in some areas. Other common shrub species are *Acacia saligna, A. rostellifera, A. cochlearis, A. cyclops, Santalum acuminatum, Calothamnus quadrifidus*, and *Myoporum insulare*. Many of the larger shrubs, particularly *Acacia* spp. are found on the deeper soils of sheltered swales. The lower layer is often dominated by *Lomandra maritima*, with other common species *Rhagodia baccata, Melaleuca acerosa, Acanthocarpus preissii, Desmocladus flexuosus*, and many others. Single trees of *Eucalyptus gomphocephala* (tuart) are found occasionally in the swales with several trees forming a small woodland very rarely.

Density of the vegetation is highly variable with total cover varying from 50% in exposed sites on dune ridges, and up to 100% in the sheltered sites.

Melaleuca acerosa/Acacia lasiocarpa Closed Low Heath over *Lomandra maritima* Herbland (Q4)

Occurs on the white to grey, calcareous sand of the older, steep to undulating Q1, Q2 and Q3 dunes.

This community varies in the mix of dominants present. *L. maritima* and *M. acerosa* are single dominants in some areas such as north of Burns Beach and north of Quinns Rocks, while *M. acerosa* and *A. lasiocarpa* are co-dominants south of Pipidinny Road.

Other common species are *Acanthocarpus preissii, Rhagodia baccata, Phyllanthus calycinus, Conostylis candicans, Hemiandra pungens, Desmocladus flexuosus, Lepidosperma squamatum* and the introduced *Pelargonium capitatum*. *Acacia saligna* is

also common in small stands or single shrubs. *Eucalyptus gomphocep[illegible]* is found occasionally on the lower dune slopes and in the swales.

The density of the vegetation is variable, often covering only 50% of the ground. There is much evidence of fire immediately south of Mindarie Keys. Indicators of this include the burnt remains of many shrubs, the fairly common occurrence of *Anthoceris littorea* ('fireweeds'), and low *Acacia saligna* shrubs (less than 0.5m). A high level of weed invasion in some areas may also be indicative of frequent fires.

Acacia rostellifera Heath and Scrub (Q5)

Occurs commonly in the shelter and deeper soils between dune ridges.

The structure of this community varies from Closed Heath and Tall Scrub to Open Heath. Where it occurs as Closed Heath and Tall Scrub there is little understorey in the dense thickets. Some stands show evidence of fire with the dead stems protruding above the shrubs that have apparently resprouted from suckers. It is expected that Low Heath would mature into Heath in the absence of fire.

Closed Sedgeland (Q6)

This community refers to Karli Spring, a small wetland behind the parallel dunes between Quinns Rocks and Pipidinny Road. The dominant species is *Lepidosperma gladiatum* (David Wake, QREG, pers. comm.). No other studies were found for the spring.

6.2.3 Spearwood vegetation communities

Banksia attenuata B. menziesii Low Woodland (S1)

Occurs in flat to undulating areas on grey over yellow sand.

B. attenuata is the dominant species with *B. menziesii* less common. *Nuytsia floribunda*, *Eucalyptus gomphocephala*, *E. todtiana* and *Allocasuarina fraseriana* are also found occasionally. The taller understorey dominants are *Xanthorrhoea preissii* and *Macrozamia riedlei*. The lower layer is very variable in species present, and in density of

cover. In some locations the layer is very dense, and in others, bare ground is dotted with rabbit burrows.

Eucalyptus marginata Open Forest and Woodland over *Banksia attenuata* Low Woodland (S2)

Occurs generally east of the Connolly Drive alignment on grey over yellow sand.

The presence and density of *E. marginata* and *B. attenuata* varies in this community. Other important overstorey species include *Corymbia calophylla* (previously *E. calophylla*), *E. todtiana* and *B. menziesii*. On higher ground, particularly along the western side of the Wanneroo Road alignment, *E. marginata/C. calophylla* Open Forest merges into *E. gomphocephala* Woodland.

Common species in the *Banksia* layer include *Allocasuarina fraseriana* and *B. grandis*, and *B. ilicifolia* and *B. littoralis* occur occasionally. The next layer is dominated by *Xanthorrhoea preissii* and *Macrozamia riedlei*. Common understorey species are *Hibbertia hypericoides*, *Petrophile* sp., *Hakea* spp., and *Mesomelaena stygia*.

Eucalyptus gomphocephala Woodland (S3)

Occurs on grey over yellow sand over limestone, usually on rises where the sand is shallow.

Between the Tamala Park Landfill Site and the Connolly Drive alignment, in the south of the study area, this community has an understorey of *Banksia attenuata*, *Xanthorrhoea preissii* and introduced grasses. This area has obviously been subject to grazing.

In the eastern portion of the study area *E. gomphocephala* Woodland is associated with *Dryandra sessilis* Heath on the higher ground, and merges with *E. marginata Corymbia calophylla* Forest/Woodland down the slopes. It is generally in much better condition although there are some degraded areas outside the boundary of Neerabup National Park, which have few native understorey species.

Limestone Heath (S4)

Occurs on limestone ridges on shallow grey over yellow sand, commonly with exposed rock.

This vegetation community is very variable. The most common dominant species is *Dryandra sessilis* which often occurs in dense monotypic stands, but other commonly occurring co-dominant species are *Xanthorrhoea preissii, Melaleuca huegelii, Acacia truncata* and *M. cardiophylla*. The latter two species also form dense stands with little or no *D. sessilis* present.

Known locations of substantial areas of *Melaleuca cardiophylla* Heath are: adjacent to the large blowout north of Burns Beach; in the large remnant near Mindarie Keys; and close to the coast approximately 1.5km north of Quinns Rocks.

In the eastern section of the study area, *D. sessilis* Heath is found in association with *Eucalyptus gomphocephala* which forms a woodland around the perimeter, and sometimes trees are scattered through the heath.

Other common species of this community are *Acacia saligna, A. pulchella, Calothamnus quadrifidus, Hakea trifurcata, H. prostrata, Hibbertia hypericoides* and *M. acerosa*.

A. pulchella occurs where *D. sessilis* is less than 1m. These areas have obviously been subject to a fairly recent fire. The structural classification of this association varies according to the time since the last fire. In some areas *D. sessilis* is less than 0.5m (Low Heath), and in others it is over 2m (Closed Tall Scrub). The latter is presumably the climax community. Height may also be determined by degree of exposure to winds from the ocean.

Xanthorrhoea preissii Shrubland (S5)

Occurs in the central eastern section of the study area on grey over yellow sand.

Common understorey shrubs include *Hibbertia hypericoides*. Keighery et al. (1996) recorded *Hakea trifurcata, Calothamnus quadrifidus, Melaleuca acerosa, Dryandra sessilis, Conostylis aculeata, Mesomelaena pseudostygia* and *Desmocladus flexuosus* for this vegetation association.

Eucalyptus foecunda-E. petrensis Closed Mallee (S6)

The only known area of this community large enough to be mapped occurs west of Marmion Avenue in the southern section of the study area. It is associated with a Limestone Heath community. There are other areas of this community, but due to the limitations of this study, their locations could not be confirmed.

Highly Disturbed Areas (S7)

These areas generally occur in the central section of the study area. They have been subject to grazing to the extent that the understorey consists almost entirely of introduced grasses, with very few or no native species. The trees and shrubs of the overstorey occur as either isolated or scattered individuals, or small to large stands. Species include *Eucalyptus marginata, E. todtiana, E. gomphocephala, Corymbia calophylla, Banksia* spp. and *Xanthorrhoea preissii*.

6.2.4 Herdsman vegetation communities

Melaleuca rhaphiophylla Low Open to Closed Forest (H1)

This is the dominant fringing community of Beonaddy Swamp in the north-east, and the Joondalup North wetland in the south-east. Other important species at both wetlands are *Eucalyptus rudis* with *Typha* sp. occurring in dense stands in disturbed areas. Some *Melaleuca lateritia* occurs at the Joondalup North wetland, and *M. preissiana*, a species

uncharacteristic of the Spearwood system, occurs to the south of the we...id (Arnold, 1990).

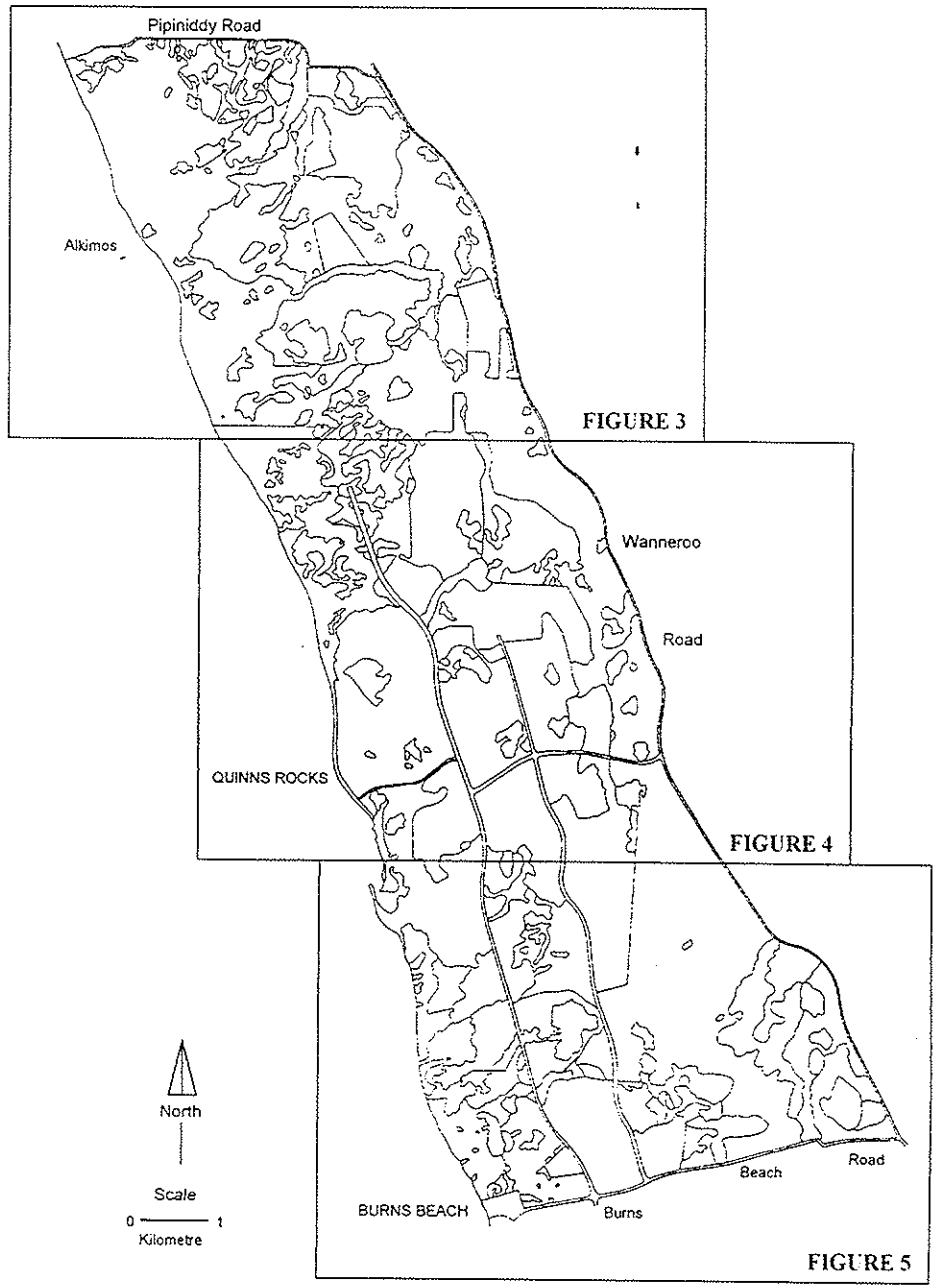

Figure 2. Legend showing layout of vegetation map coverage

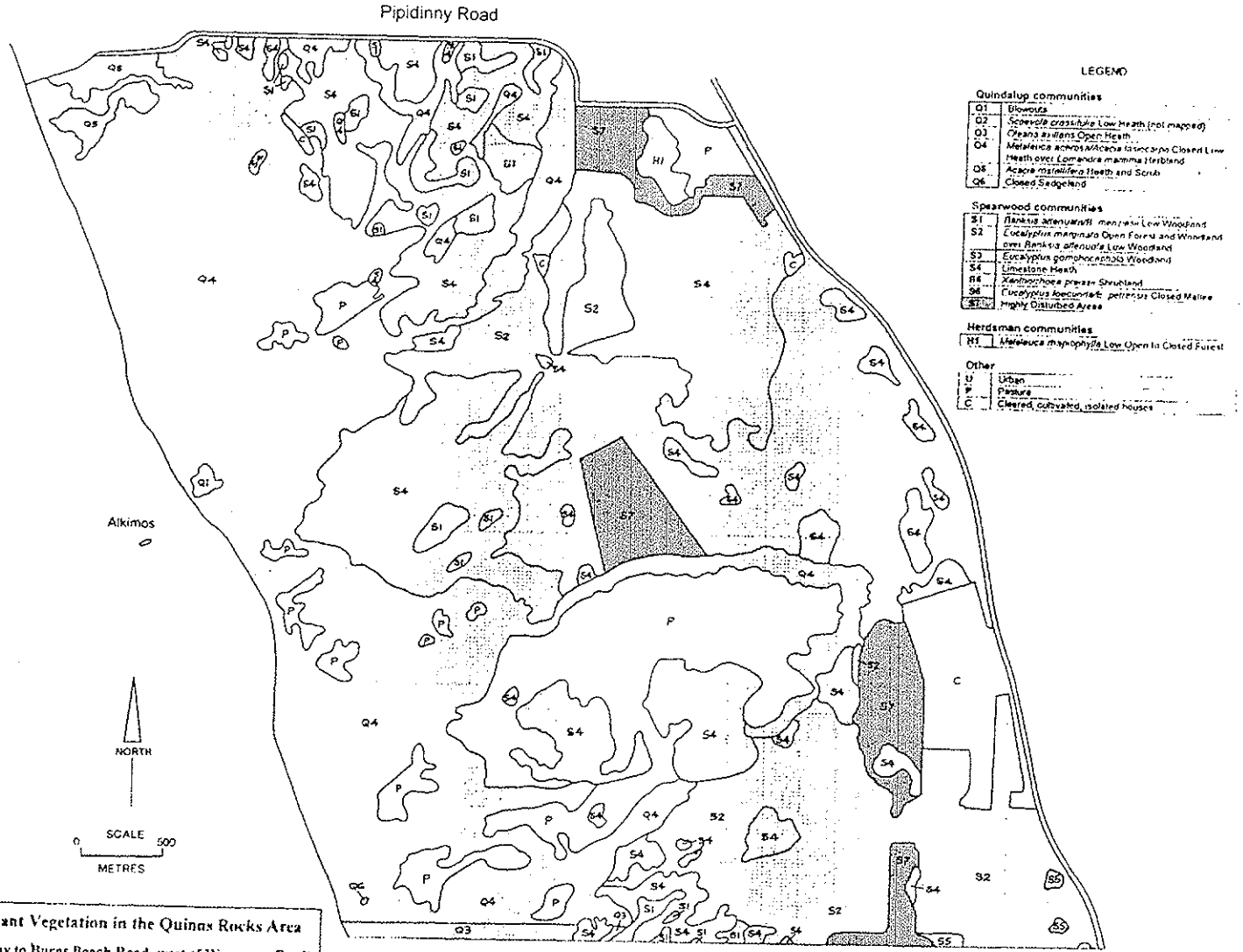

Figure 3. Remnant Vegetation in the Quinns Rocks Area
(Pipidinny to Burns Beach Road, west of Wanneroo Road)
- Northern Section

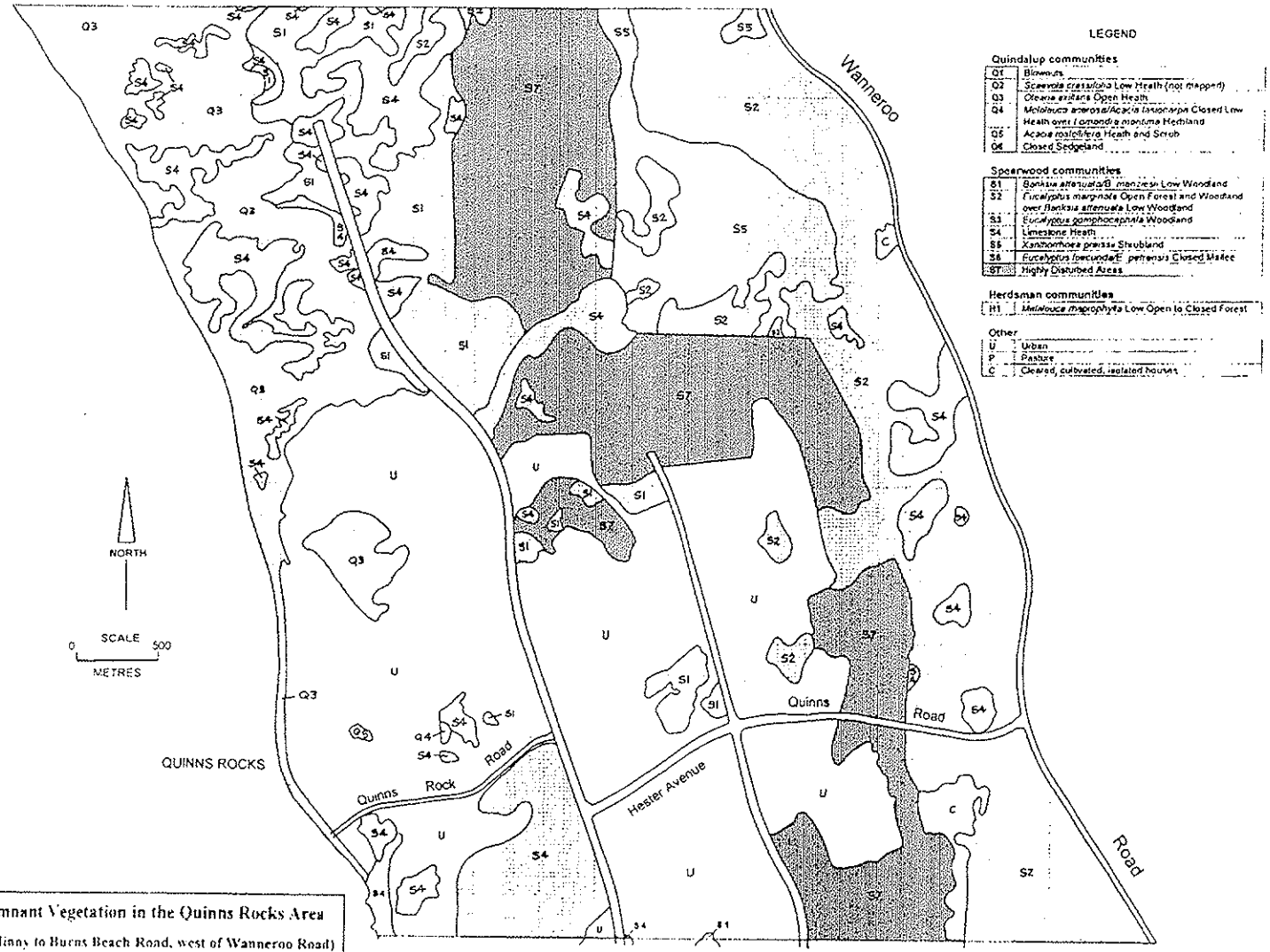

Figure 4. Remnant Vegetation in the Quinns Rocks Area
(Pipidinny to Burns Beach Road, west of Wanneroo Road)
- Central Section

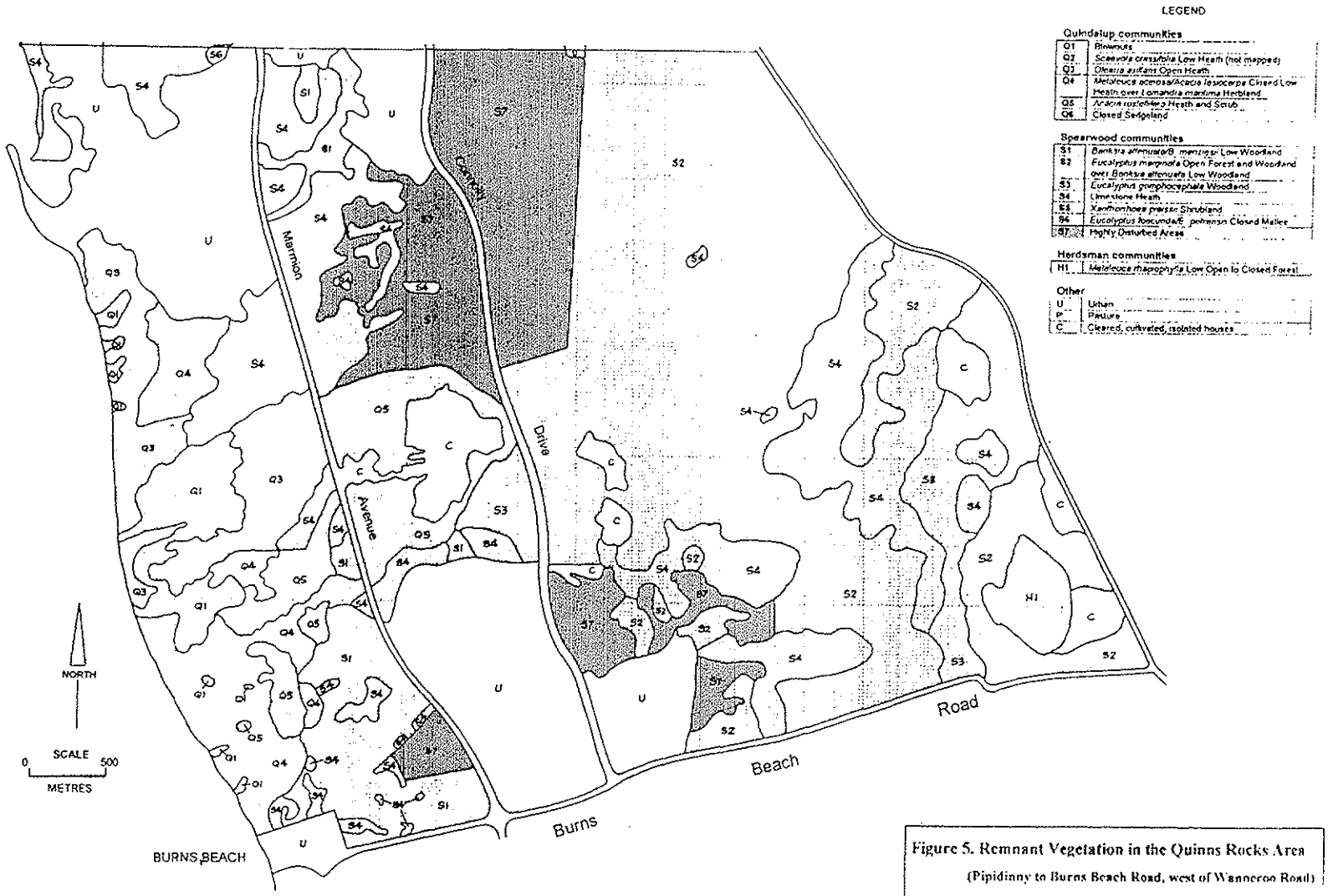

Figure 5. Remnant Vegetation in the Quinns Rocks Area
(Pipidinny to Burns Beach Road, west of Wanneroo Road)
- Southern Section

7. FLORA DESCRIPTION

7.1 General description

A total of 473 species representing 255 genera and 77 families of vascular plants were recorded. Introduced (weed) species total 89. A flora list is given in Appendix 3.

The most species rich families are Proteaceae (29 natives), Myrtaceae (27 natives), Asteraceae (27 native and 12 weed species), Cyperaceae (25 natives), Orchidaceae (25 natives), Papilionaceae (23 natives, 12 weeds), Epacridaceae (16 natives), and Poaceae (15 natives, 22 weeds).

Families with the most weed species are Poaceae (22 species), Asteraceae (12), and Papilionaceae (12).

7.2 Significant Taxa

7.2.1 Declared Rare and Priority Taxa

At least one species of Declared Rare Flora (DRF) and five priority (poorly known) species listed by Atkins (1996), occur in the study area. DRF have special protection under the *Wildlife Conservation Act 1950* and cannot be harvested, injured in any way, or destroyed without written permission from the Minister for CALM. Priority (P) species are taxa that are poorly known and require further survey to determine their conservation status, or are rare but not threatened and require monitoring.

Eucalyptus argutifolia (Myrtaceae) - DRF
Small stands of this rare mallee species occur at the southern end of its range in the study area. It extends north only as far as Seabird (Keighery, 1992).

Lepidium pseudohyssopifolium (Brassicaceae) - P1
This herb occurs on limestone surfaces and has only been found in Western Australia on the Nullabor and the Swan Coastal Plain (Keighery et al., 1996).

Hibbertia spicata subsp. *leptotheca* (Dilleniaceae) - P3
This is endemic to Tamala Limestone ridges between Yalgorup and Wedge Island (Keighery et al., 1996).

Conostylis pauciflora subsp. *euryhipis* (Haemodoraceae) - P3
This is found only on the Quindalup dunes between the northern part of the study area and Cervantes (Trudgen & Keighery, 1990).

Jacksonia sericea (Papilionaceae) - P3
This species is at the northern end of its range in the study area, in Neerabup National Park (Keighery et al., 1996).

Stylidium maritima ms (Stylidiaceae) - P3
Although locally common, there of few populations of this species and much of its habitat has been cleared or degraded (Keighery et al., 1996).

7.2.2 Other significant taxa

Other significant taxa include species that: are at the end of their range or close to it in the study area; occur as disjunct populations in the study area; are poorly known or uncommon species but not listed by CALM as rare; are undescribed; or are endemic to the Swan Coastal Plain.

Laxmannia sessiliflora subsp. *australis* (Anthericaceae)
This is a widespread species but the southern end of its range on the Swan Coastal Plain is in the north of the study area (Trudgen & Keighery, 1990).

Leptorhynchos scabrus (Asteraceae)
This is locally common on the Quindalup Q2 and Q3 dunes in the north of the study area, and although it is widespread it is poorly collected and may be uncommon (Trudgen & Keighery, 1990).

Sonchus megalocarpa (Asteraceae)
The northern most population of this species is on blowout ridges in the south of the study area. It is the only known mainland population north of Bunbury. It also occurs on Garden Island (Keighery, 1991).

Allocasuarina lehmanniana (Casuarinaceae)
This once common Quindalup dune species is not well known in reserves (Keighery, 1991).

Cyatochaeta avenacea (Cyperaceae) – unlikely need to be listed
This sedge occurs along the coast to Fitzgerald River National Park but the northern end of its range is close to the study area (Gibson et al., 1994).

Schoenus latitans (Cyperaceae)
A sedge at the southern end of its range close to the study area (Gibson et al., 1994).
limestone endemic

Astroloma microcalyx (Epacridaceae)
This is a limestone endemic species only occurring on the Swan Coastal Plain (Keighery et al., 1996).

Lechenaultia linarioides (Goodenaceae)
This shrub extends to Dirk Hartog Island and inland to Mingenew but the southern end of its range is near Perth (Marchant et al., 1987).

Gyrostemon ramulosus (Gyrostemonaceae)

This small tree is widespread in drier parts of Australia but it is uncommon in the Metropolitan Region and Perth is the southern end of its range on the Swan Coastal Plain (Powell, 1990).

Conostylis teretifolia subsp. *planescens* (Haemodoraceae)

This uncommon *Banksia* Woodland species is at the southern end of its range in the study area (Trudgen & Keighery, 1990).

Hemiandra pungens (Lamiaceae)

A dune form of this widespread species found in the study area, only occurs from Wanneroo to Seabird (Keighery et al., 1996).

Baeckea robusta (Myrtaceae)

The southern end of this species' range is close to the study area (Gibson et al., 1994).

Leptospermum spinescens (Myrtaceae)

This shrub is at the southern end of its coastal range at Perth. Outside the Perth Region its leaves are often shorter and broader (Marchant et al., 1987).

Melaleuca cardiophylla (Myrtaceae)

Low dense shrublands of this species are not well conserved on the Swan Coastal Plain (Keighery, 1992), and the southern end of its range is at Bold Park (Gibson et al., 1994).

Jacksonia stricta (Papilionaceae)

This near coastal shrub it at the southern end of its range in or close to the study area. It extends north to Eneabba (Marchant et al., 1987).

Nemcia retica (Papilionaceae)

The coastal form of this species extends from the study area (Burns Beach) to Northampton and is not known in any conservation reserves south of Nambung (Gibson et al., 1994).

Billardiera variifolia (Pittosporaceae)

This twining shrub occurs only occasionally on the Swan Coastal Plain and the northern end of its range is close to the study area (Marchant et al., 1987).

Persoonia comata (Proteaceae)

This is at the southern end of its range in the north of the study area (Trudgen & Keighery, 1990).

Petrophile aff. *brevifolia* (Proteaceae)

This undescribed species occurs only on the Swan Coastal Plain (Trudgen & Keighery, 1990).

Petrophile aff. *serruriae* (Proteaceae)

An undescribed species of the Swan Coastal Plain between Perth and Geraldton (Trudgen & Keighery, 1990).

Veronica aff. *calycina* (Scrophulariaceae)

This Quindalup dune species is known only from Alkimos and Yalgorup. Its favoured habitat type has mostly been degraded by grazing or cleared, and consequently it is uncommon and may be rare. It is probably *V. stolonifera* described from Fremantle (Gibson et al., 1994).

Stylidium aff. *repens* (Stylidiaceae)

The southern most locality of this undescribed species occurs near the coast in the north of the study area (Trudgen & Keighery, 1990).

Pimelea rosea (Thymelaeaceae)

This shrub occurs near the coast (Marchant et al., 1987), and is at the northern end of its range close to the study area at Lake Pinjar (Gibson et al., 1994).

8. CONSERVATION SIGNIFICANCE

8.1 The values of remnant vegetation

The values attached to remnant vegetation, or bushland, are many.

The conservation value of bushland lies in the need to conserve representative samples of all species and communities both common and rare, and to preserve natural processes that maintain the biosphere in which we live. Such processes are outline in the State Planning Strategy Discussion Paper on Environmental Issues (in Keighery & Gray, 1993). These include maintaining water cycles, regulating climate, protecting soil, nutrient cycling, regulating insect populations, providing renewable resources, protecting species and genetic diversity, and providing habitat for pollinators of agricultural crops.

All bushland has an intrinsic value. Whether species are common or rare, they are part of the unique and diverse flora of Western Australia which is part of our heritage. The aesthetic values of bushland provide us with a source of artistic inspiration and a sense of place and of well-being. Bushland also provides places for active and passive recreation.

Bushland is an educational resource enabling students to observe and understand how organisms function and how natural processes work and contribute to our own survival. There is still many aspects of our natural environment to be studied and documented. Remnant bushland provides an opportunity to increase our scientific knowledge at all levels of study and gain a greater understanding of how to manage our natural resources for the benefit of present and future generations.

The economic value of bushland includes its' potential to attract tourists who come to see Western Australia's famous wildflowers. Other economic benefits are protection from land and water supply degradation associated with clearing native vegetation, and as a potential genetic resource for agricultural crops, the cut flower and nursery industries, or chemical compounds with medicinal or other industrial uses.

By conserving remnant bush, we are not only preserving biodiversity and natural processes (which also implies conserving fauna and their habitats, and geomorphological features and processes), but by default are also preserving all other values. Assessment of conservation value or significance will therefore will focus on the biological values of the vegetation.

8.2 Criteria for assessing conservation value

Criteria adopted here for assessing conservation value are similar to those used by other authors, such as Trudgen (1996). They are as follows:

1. The value of vegetation in a regional context.

This refers to where the remnant occurs in the overall distribution of the vegetation type, how it varies throughout its range and how well this variation is represented in reserves.

2. The potential for maintaining sustainable ecosystems.

This refers to the conditions required to allow ecosystem processes to continue functioning in the long-term in order to retain the integrity of the remnant. Factors to be considered include the size and shape of reserves, external influences, connectivity, duplication of reserves, and the condition of the vegetation.

3. The significance of flora present.

This refers to the diversity of flora, and the presence of Declared Rare Flora (DRF), Priority species (poorly known and geographically restricted taxa), species at their range ends, and isolated populations of species.

8.3 Assessment of conservation value

The map of remnant vegetation in the study area (Figure 6) shows relatively large areas on both the Quindalup and Spearwood systems remaining.

8.3.1 Value of vegetation in a regional context

8.3.1.1 Extent, variation and reservation of the Quindalup system

The Quindalup system extends from Dongara to Geographe Bay. Semeniuk et al. (1989), Griffin (1993), and Griffin & Trudgen (1994) discuss the reservation status of the Quindalup system and draw the same conclusion: that the variation within the system is inadequately represented in reserves between Lancelin and Whitfords. The narrow coastal reserves of the sector in the Perth Metropolitan Area, only preserves the seaward parts of the system.

Given that very little of the Quindalup system is reserved in this sector, and that the entire width of the system is still largely intact in the study area, the remnant vegetation has a very significant conservation value.

Karli Spring is currently under review by CALM as a possible "Critically Endangered Ecological Community" (Val English, CALM, pers. comm.).

8.3.1.2 Extent, variation and reservation of the Spearwood system

The variation found within the Quindalup system is also likely to occur in the Spearwood system (Trudgen, 1996). The diverse flora of this system was once extensive and escaped clearing because the poor sandy soils were little use for agriculture. However as urbanisation expands plant communities, such as *Banksia* Woodlands, are fast disappearing (Keighery & Gray, 1993).

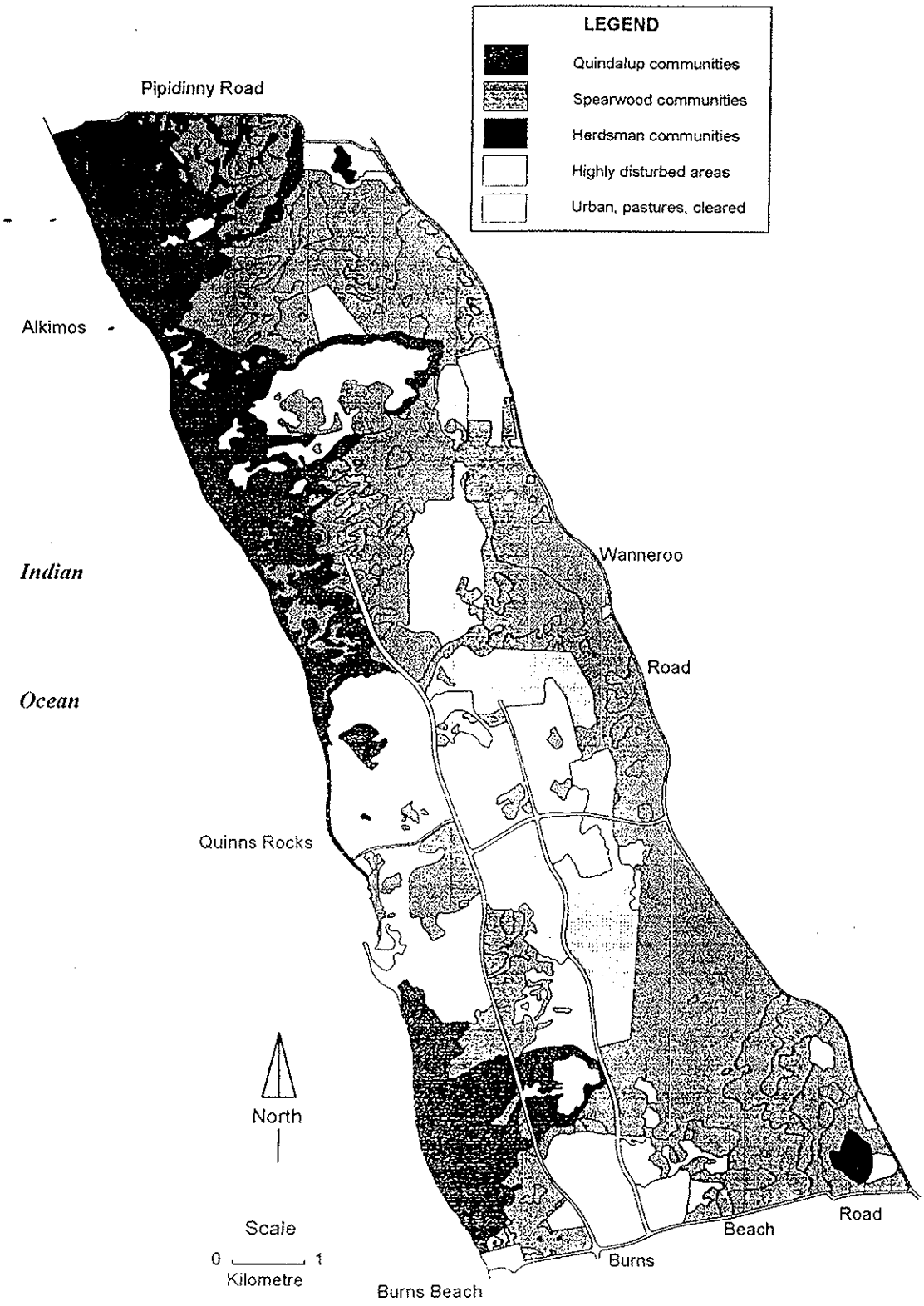

Figure 6. Remnant vegetation in the Quinns Rocks Area (Pipidinny to Burns Beach Road, west of Wanneroo Road)

With only 20-30% of the original area of Cottesloe – Central and South remaining (the largest portion being north of the Swan River), and only 8% represented in reserves (Trudgen, 1996), the section found in the study area has a very significant conservation value.

This view is supported by Keighery et al. (1996, p.81) in a study of the floristics of Neerabup National Park. They conclude that the Park is a "... very significant regional conservation area" due in part to its "... relatively large areas of the regional floristic community types typical of the Spearwood Dunes."

8.3.1.3 Extent and reservation of the Herdsman unit

Trudgen (1996) estimates that only 20-30% of this unit is extant in the Perth Metropolitan Area, and of the original distribution only 5-10% is represented in reserves. Both wetlands in the study area therefore have significant conservation value because of the high level of clearing of this unit despite being in only poor to good condition. The Joondalup North wetland in the south-east has particularly significant value because it occurs in a transition zone between Cottesloe – Central and South and Karrakatta – Central and South vegetation complexes. It is subject to the Environmental Protection (Swan Coastal Plain Lakes) Policy (Hill et al., 1996).

8.3.1.4 Vegetation transitions and combination of vegetation complexes

The ecotones or transition areas between the Quindalup and Spearwood communities are also important for conservation, and in the study area they are well represented. Ecotones are often areas of greater diversity than within discrete communities. At the boundary, suites of species from each habitat may be found together with those that utilise both habitats, and those that thrive under conditions provided by the boundary (Smith, 1990).

Trudgen (1996) states that these transitions have significant conservation value, and the combined area increases the total value. Conserving interfaces also conserves the sequence of these systems (Griffin & Trudgen, 1994).

8.3.2 Potential for maintaining sustainable ecosystems

In assessing conservation value of an area, the potential for maintaining viable and sustainable ecosystems is an important factor. A review of the principles of reserve design for preserving long-term conservation values is useful in this assessment.

In an ideal situation reserves should be as large as possible with a minimum border length (Lunney & Recher, 1986). If reserves are compact in shape then the border/area ratio, and consequently external influences, are minimised. External influences include different physical conditions at the edge, such as levels of solar radiation, wind, water and nutrients, all of which can have a profound effect on the biota (Saunders et al., 1991). Other impacts on reserves with large borders, or on small reserves, particularly in urban areas, are vulnerability to weed infestation, frequent fires, invasion by feral animals, and increased accessibility and disturbance by human activity (Lunney & Recher, 1986). These factors lead to a cycle of disturbance, which in turn leads to degradation of the natural values of the reserve.

Other design principles include providing connections or corridors of natural habitat between reserves to facilitate the movement of flora propagules and fauna. The capacity for movement aids in preservation of species and genetic diversity. If connection is not possible, movement is more likely between closely clustered reserves than between those that are isolated by large tracts of land devoid of native vegetation (Lunney & Recher, 1986).

Reserves should also be duplicated so that outbreaks of disease or natural catastrophes in one reserve do not lead to extinction of species which are dependent on specific habitats (Lunney & Recher, 1986).

The condition of reserves is also important. If they are in good condition initially they are more likely to retain integrity in the long-term.

While it is unlikely that an ideal situation will ever exist (particularly in areas close to urban centres which historically have been subject to some form of disturbance, such as is the case in the study area), these principles are still useful in assessing conservation value and in reserve design.

Substantial areas of remnant vegetation with minimum border length/area ratios, and which are in very good condition (according to Trudgen, 1996), exist in the study area. The largest area is in the northern section, north of Quinns Rocks (see Figure 6). Although there are sections of highly disturbed, pasture, and cleared land, the remnant vegetation is interconnected in this area. It also links to Neerabup National Park in the south and east of the study area.

Other substantial, well-shaped areas in very good condition (Trudgen, 1996) are the Quindalup and Spearwood communities west of Marmion Avenue in the southern section, and the southern part of Neerabup National Park and proposed additions (see Figures 5 and 6). These two areas are linked by the land surrounding the Tamala Park landfill site which is in poor to good condition (Trudgen, 1996), and which was recommended for reservation in the System 6 report (EPA, 1983). The value of this connection is reduced to some degree by Marmion Avenue and Connolly Drive (two fairly major roads which dissect it north-south).

The smaller remnants in the central, urban areas of Quinns Rocks, Mindarie and Merriwa are in good to very good condition (Trudgen, 1996). The clustered nature of these remnants and their close proximity to larger remnants helps facilitate some exchange of biota, which consequently helps protect their long-term viability.

The Herdsman unit wetlands and Karli Spring are also relatively small but they adjoin larger remnants, and the former act as links to remnants outside the study area.

The highly disturbed sections of the study area are concentrated along the western boundary of Neerabup National Park. These areas can have a negative impact on adjoining bush by providing a source of weeds. However the scattered native trees and shrubs, while they cannot be described as remnant vegetation, still have some value as a part of the natural landscape (Keighery & Gray, 1993) and can provide important habitats. Tuart (*Eucalyptus gomphocephala*), the largest tree of the coastal plain, is particularly important as "one of the most biologically valuable trees of Perth" (Powell, 1990). Hollows are used by nesting birds and other fauna, virtually every part of the tree is utilised by insects which are also a food source for larger fauna, the bark shelters lizards, and large fungi growing on the trunk are in turn inhabited by thousands of insects.

The study area is also linked to adjoining bushland. In the north it is linked or closely connected, to bushland at Eglinton and to Yanchep National Park. In the east it has some linkage to a north-south chain of wetlands and remnant bushland east of Wanneroo Road. In the south-east Neerabup National Park and surrounding bushland (proposed for addition to the Park), is connected to Yellagonga Regional Park by the Joondalup North wetland. In the south-west bushland forms a continuum with that at Iluka and with the coastal reserve. These linkages, despite some dissection by roads of various widths, may well contribute to the long-term preservation of conservation values of the study area and it's surrounding bushland and wetlands.

This assessment has not considered proposed land uses. Development is planned for much of the study area, including large parts of what is remnant vegetation (DPUD, 1992). The conservation values described here would be affected by such development and should be considered in land use planning for the area.

8.3.3 Significance of flora

No definitive assessment can be made of flora diversity in the study area due to the limitations of this study in compiling the flora list. However some general comments can

be made based on previous studies. Trudgen (1996, p.46) described the flora of the City of Wanneroo as "diverse". Keighery et al. (1996, p.81) recognised that the Spearwood dunes have a "diverse flora". Griffin (1993) found species richness in the Quindalup dunes relatively low but this was in comparison to the particularly rich kwongan flora.

The presence of one species of Declared Rare Flora, six Priority species, and at least twenty-three other significant taxa, attests to the area's conservation significance. It is not only these taxa that add to the conservation significance of the area, but also locally common species that do not occur, or are not common elsewhere. Trudgen & Keighery (1990) give the examples of *Lomandra maritima* and *Pimelea ferruginea* which only occur on the Quindalup dunes: if communities found on this inadequately reserved complex are not protected, common species such as these may also become rare.

Gibson et al. can be used to consider species richness & diversity associated with part of floristic province?

9. DISCUSSION AND CONCLUSION

The study area has large remnants of native vegetation on the Quindalup and Spearwood systems, and many of these are in good to very good condition. The vegetation communities and flora found in the study area are inadequately represented in reserves, as outlined in the previous section. An opportunity exists here to preserve conservation values in the long-term by the addition of significant areas to the conservation estate.

The area has high conservation value, and this view is supported by other authors:

- "the Alkimos area and adjoining uncleared areas have considerable conservation value for flora, vegetation and geomorphological types" (Trudgen & Keighery, 1990, p.45);
- The area between Burns Beach and Mindarie has "... a mixture of very important and important areas for conservation of vegetation with lesser, but still significant value for flora" (Griffin & Trudgen, 1994, p.1-2);
- "Neerabup National Park is a very significant regional conservation area ..." (Keighery et al., 1996, p.81);
- The entire area has "significant", "high" or "very high" conservation value (Trudgen, 1996).

Many remnants in the study area clearly fulfills the Western Australian Government's Urban Bushland Strategy definition of regionally significant bushland (see Appendix 4), and others have high local significance.

The presence of many poorly known species highlights the fact that, despite the study area being readily accessible in terms of distance from our main urban centre, there is still much we don't know about its flora. Gibson et al. (1994, p.1) found "... significant gaps in our knowledge of the distribution of flora and floristic communities ..." of the Swan Coastal Plain. With the gradual encroachment of urban development in the study area, "Availability of such knowledge is vital if conservation of our unique flora and plant

communities is to be integrated with urban and industrial growth" (Gibson et al., 1994, p.1). Scarce complex plant communities cannot be restored once land is cleared for development – they are gone forever (Keighery & Gray, 1993).

Fragmentation of bushland into small reserves does not ensure long-term preservation of conservation values. A comparative study between a section of the coastal reserve in the study area surrounded by large tracts of relatively undisturbed bushland, and a section of coastal reserve surrounded by long established urban development at City Beach, showed dramatic differences. The undisturbed reserve had a statistically significant higher diversity and significantly lower weed cover that the urban reserve (Robinson, 1995).

Only by conserving large areas of remnant vegetation can we hope to gain a better knowledge of our vegetation and flora, and preserve them for future generations.

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APPENDIX 1 - VEGETATION CONDITION SCALE

The scale follows that of the Ministry for Planning's Perth Environment Project, as used by Trudgen (1996).

Description	Very Poor	Poor	Good	Very Good
High level disturbance	> 50%	25-50%	< 25%	0
Low level disturbance	> 75%	50-75%	25-50%	< 25%
Species recruitment	absent	local	general	general
Population structure	senescent	senescent	good	good
Vertical strata	> 75% lost	25-75% lost	< 25% lost	intact
Community diversity	> 75% lost	25-75% lost	< 25% lost	intact

APPENDIX 2 - VEGETATION STRUCTURAL CLASSIFICATION

The vegetation structural classification system in the table below follows Keighery (1994).

	Canopy Cover (percentage)			
Life form /Height class	100 - 70	70 - 30	30 - 10	10 - 2
Trees over 30m	Tall Closed Forest	Tall Open Forest	Tall Woodland	Tall Open Woodland
Trees 10-30m	Closed Forest	Open Forest	Woodland	Open Woodland
Trees under 10m	Low Closed Forest	Low Open Forest	Low Woodland	Low Open Woodland
Tree Mallee	Closed Tree Mallee	Tree Mallee	Open Tree Mallee	Very Open Tree Mallee
Shrub Mallee	Closed Shrub Mallee	Shrub Mallee	Open Shrub Mallee	Very Open Shrub Mallee
Shrubs over 2m	Closed Tall Scrub	Tall Open Scrub	Tall Shrubland	Tall Open Shrubland
Shrubs 1-2m	Closed Heath	Open Heath	Shrubland	Open Shrubland
Shrubs under 1m	Closed Low Heath	Open Low Heath	Low Shrubland	Low Open Shrubland
Grasses	Closed Grassland	Grassland	Open Grassland	Very Open Grassland
Herbs	Closed Herbland	Herbland	Open Herbland	Very Open Herbland
Sedges	Closed Sedgeland	Sedgeland	Open Sedgeland	Very Open Sedgeland

APPENDIX 3 - FLORA LIST

The following list is compiled from previous flora surveys in various parts of the study area. These surveys are Keighery (1991) and species recorded are denoted by 'K', Trudgen & Keighery (1990) denoted by 'TK', Robinson (1995) denoted by 'R', Mattiske (1990) denoted by 'M', Keighery, Keighery & Gibson (1996) denoted by 'KG', and Arnold (1990) denoted by 'A'.

'K', 'TK' and 'R' are surveys from the western section of the study area, while 'M', 'KG' and 'A' are from the eastern section.

Common names are taken from Powel & Emberson (199), Marchant et al. (1987), Bennett (1988), and Rippey & Rowland (1995).

FAMILY/Taxon	Common Name	K	TK	R	M	KG	A
AIZOACEAE							
* Carpobrotus edulis	Pigface; Hottentot Fig	+	+	+	+	+	
Carpobrotus virescens	Native Pigface	+	+	+			
Carpobrotus modestus						+	
* Tetragonia decumbens		+	+	+			
AMARANTHACEAE							
Ptilotus drumondii	Narrow Leaf Mulla Mulla					+	
Ptilotus manglesii	Pom-Poms	+			+	+	
Ptilotus polystachyus	Prince Of Wales Feathers	+	+			+	
Ptilotus stirlingii	Stirling's Mulla Mulla		+			+	
ANTHERICACEAE							
Caesia micrantha	Pale Grass Lily	+				+	
Chamaescilla corymbosa	Blue Squill					+	
Corynotheca micrantha	Sand Lily	+	+			+	
Dichopogon capillipes		+			+	+	
Laxmannia sessiliflora ssp. australis	Nodding Lily		+				
Sowerbaea laxiflora	Purple Tassels		+		+	+	
Thysanotus arenarius		+	+			+	
Thysanotus manglesianus	Fringed Lily					+	

FAMILY/Taxon	Common Name	K	TK	R	M	KG	A
Thysanotus multiflorus	Many-Flowered Fringe Lily					+	
Thysanotus patersonii	Twining Fringe Lily	+	+	+	+	+	
Thysanotus sparteus						+	
Thysanotus triandrus			+				
Tricoryne elatior	Yellow Autumn Lily	+	+	+		+	
APIACEAE							
Daucus glochidiatus	Native Carrot	+	+	+		+	
Eryngium pinnatifidum	Blue Devils				+	+	
Homalosciadum homalocarpum			+			+	
Hydrocotyle blepharocarpa						+	
Hydrocotyle callicarpa	Small Pennywort					+	
Hydrocotyle diantha				+		+	
Hydrocotyle hispidula						+	
Trachymene coerulea	Blue Lace Flower	+				+	
Trachymene pilosa	Small Lace Flower	+	+	+	+	+	
Xanthosia huegelii		+	+			+	
ASPARAGACEAE							
* Myrsiphyllum asparagoides						+	
ASPHODELACEAE							
* Asphodelus fistulosus	Wild Onion; Onion Weed			+			
* Trachyandra divaricata		+	+	+			
ASTERACEAE							
Actites megalocarpa		+					
* Arctotheca calendula	Capeweed			+	+	+	
* Arctotheca populifolia	Dune Arctotheca; Dune Cabbage	+					
Asteridea pulverulenta	Common Bristle Daisy					+	
Brachyscome iberidifolia	Swan River Daisy				+	+	
* Carduus pycnocephalus						+	
* Centaurea melitensis	Maltese Cockspur					+	

FAMILY/Taxon	Common Name	K	TK	R	M	KG	A
* Cirsium vulgare						+	
* Conyza albida	Tall Fleabane	+				+	
Euchiton sphaericus			+			+	
* Hedypnois rhagadioloides	Cretan Weed					+	
Hyalosperma cotula					+	+	
* Hypochaeris glabra	Flat Weed	+	+	+	+	+	
Lagenifera huegelii	Coarse Lagenifera	+	+			+	
Lagenifera sp. Should not be listed, unless for area					+		
Leptorhyncuos scabrus			+				
Leucophyta brownii				+			
Millotia myosotidifolia					+	+	
Millotia tenuifolia	Soft Millotia	+	+				
Olearia axillaris	Coast Daisy Bush	+	+	+	+	+	
Olearia rudis	Azure Daisy Bush	+	+			+	
Ozothamnus cordatus	Tangle Daisy	+	+	+	+	+	
Podolepis canescens	Bright Podolepis		+				
Podolepis gracilis	Slender Podolepis	+	+		+	+	
Podolepis lessonii					+		
Podotheca angustifolia	Sticky Longheads	+	+			+	
Podotheca chrysantha	Yellow Podotheca					+	
Podotheca gnaphalioides	Golden Long Heads		+				
Pterochaeta paniculata						+	
Quinetia urvillei		+	+			+	
Rhodanthe citrina						+	
Senecia lautus	Coastal Groundsel	+	+	+		+	
Siloxerus humifusus	Siloxerus	+	+			+	
* Sonchus asper				+	+	+	
Sonchus hydrophilus	Native Sowthistle					+	
* Sonchus oleraceus	Common Sowthistle			+		+	

FAMILY/Taxon	Common Name	K	TK	R	M	KG	A
* Urospermum picroides	False Hawkbit					+	
* Ursinia anthemoides	Ursinia	+	+		+	+	
Waitzia suaveolens	Fragrant Waitzia	+	+		+	+	
BRASSICACEAE							
* Brassica barrelieri subsp. oxyrrhina	Smooth-Stem Turnip			+			
* Brassica tournefortii	Mediterranean Turnip					+	
* Cakile maritima	Sea Rocket	+	+	+			
* Heliophila pusilla		+	+	+		+	
Lepidium pseudohyssopifolium						+	
Lepidium rotundum	Veined Peppercress					+	
* Raphanus raphanistrum	Wild Radish					+	
Stenopetalum gracile						+	
CAMPANULACEAE							
* Wahlenbergia capensis	Cape Bluebell		+			+	
Wahlenbergia preissii						+	
CARYOPHYLLACEAE							
* Cerastium glomeratum	Mouse Ear Chickweed	+		+		+	
* Minuartia mediterranea						+	
* Petrorhagia velutina	Velvet Pink		+			+	
* Petrorhagia sp.					+		
* Sagina apetala	Annual Pearlwort					+	
* Silene gallica	French Catchfly	+		+		+	
CASUARINACEAE							
Allocasuarina fraseriana	Common Sheok	+	+		+	+	
Allocasuarina humilis	Dwarf Sheok	+	+		+	+	
Allocasuarina lehmanniana	Dune Sheok	+	+				
Casuarina obesa	Salt Sheok		+				
CENTROLEPIDACEAE							
Centrolepis aristata	Pointed Centrolepis			+		+	

FAMILY/Taxon	Common Name	K	TK	R	M	KG	A
Centrolepis drummondiana		+				+	
CHENOPODIACEAE							
Atriplex cinerea	Grey Saltbush	+					
Halosarcia indica ssp. bidens				+			
Rhagodia baccata	Berry Saltbush	+	+	+	+	+	
Salsola kali	Prickly Saltbush	+					
Threlkeldia diffusa	Wallaby Saltbush	+	+	+			
COLCHICACEAE							
Burchardia congesta		+	+		+	+	
Wurmbea monantha						+	
CONVOLVULACEAE							
Dichondra repens	Kidney Weed					+	
CRASSULACEAE							
Crassula colorata	Dense Stonecrop	+	+	+		+	
Crassula exserta		+	+				
* Crassula glomerata		+	+	+			
Crassula pedicellosa						+	
CUSCUTACEAE							
* Cuscuta epithymum	Lesser Dodder					+	
CYPERACEAE							
Carex preissii		+				+	
Cyatochaeta avenacea Not likely, showed he checked prob. misid.					+		
Isolepis cernua	Nodding Club-Rush		+			+	
Isolepis cyperoides						+	
Isolepis marginata	Coarse Club-Rush			+		+	
Isolepis nodosa	Knotted Club-Rush	+	+	+	+	+	
Lepidosperma costale			+				
Lepidosperma gladiatum	Sword Sedge	+	+	+			
Lepidosperma leptostachyum						+	

FAMILY/Taxon	Common Name	K	TK	R	M	KG	A
Lepidosperma longditudinale	Pithy Sword-Sedge	+					
Lepidosperma scabrum			+				
Lepidosperma squamatum		+	+	+	+	+	
Lepidosperma tenue					+		
Lepidosperma 'coastal terete' (BJK & NG 231)						+	
Mesomelaena pseudostygia					+	+	
Mesomelaena stygia	Telegraph Sedge	+	+				
Schoenus brevisetis						+	
Schoenus clandestinus		+	+			+	
Schoenus curvifolius		+	+			+	
Schoenus discifer						+	
Schoenus grandiflorus	Large Flowered Bog-Rush	+	+			+	
Schoenus lanatus	Woolly Bog-Rush					+	
Schoenus latitans					+		
Schoenus subbarbatus	Bearded Bog-Rush		+				
Tetraria octandra					+	+	
DASYPOGONACEAE							
Acanthocarpus preissii	Prickle Lily	+	+	+	+	+	
Calectasia cyanea	Blue Tinsel Lily					+	
Dasypogon bromeliifolius	Pinapple Bush					+	
Lomandra caespitosa	Tufted Mat-Rush	+	+			+	
Lomandra hermaphrodita					+	+	
Lomandra maritima	Coast Mat-Rush	+	+	+		+	
Lomandra preissii		+				+	
Lomandra sericea	Silky Mat-Rush					+	
Lomandra sonderi					+		
Lomandra suavocolens		+	+			+	
DILLENIACEAE							
Hibbertia aurea						+	

FAMILY/Taxon	Common Name	K	TK	R	M	KG	A
Hibbertia hypericoides	Common Buttercups	+	+		+	+	
Hibbertia racemosa	Stalked Guinea-Flower	+	+	+	+	+	
Hibbertia spicata ssp. leptotheca		+	+			+	
Hibbertia subvaginata						+	
DROSERACEAE							
Drosera erythrorhiza	Red-Ink Sundew				+	+	
Drosera glandulifera	Pimpernel Sundew					+	
Drosera macrantha	Bridal Rainbow					+	
Drosera menziesii subsp. penicillaris	Pink Rainbow					+	
Drosera pallida	Pale Sundew		+			+	
Drosera stolonifera	Leafy Sundew					+	
Drosera sp. (climbing)					+		
EPACRIDACEAE							
Acrotriche cordata	Coast Ground-Berry	+	+	+			
Andersonia lehmanniana						+	
Astroloma ciliatum	Moss-Leaved Cranberry					+	
Astroloma microcalyx	Native Cranberry					+	
Astroloma pallidum	Kick Cranberry	+	+		+	+	
Conostephium pendulum	Pearl-Flower	+	+		+	+	
Conostephium preissii		+					
Leucopogon australis	Spiked Beard-Heath					+	
Leucopogon insularis			+				
Leucopogon aff. nutans (GJK 11159)	Nodding Beard-Heath					+	
Leucopogon parviflorus		+	+	+	+	+	
Leucopogon polymorphus			+			+	
Leucopogon aff. polymorphus			+				
Leucopogon propinquus		+	+	+	+	+	
Leucopogon sprengeloides		+				+	
Lysinema ciliatum	Curry Flower					+	

FAMILY/Taxon	Common Name	K	TK	R	M	KG	A
EUPHORBIACEAE							
Adriana quadripartita	Bitter Bush	+	+				
* Euphorbia peplus	Pretty Spurge					+	
* Euphorbia terracina	Geraldton Carnation Weed; False Caper	+				+	
Phyllanthus calycinus	Phyllanthus; False Boronia	+	+	+	+	+	
Poranthera microphylla	Small Microphylla					+	
Ricinocarpus glaucus	Wedding Bush		+			+	
FUMARIACEAE							
* Fumaria capreolata	Whiteflower Fumitory					+	
FRANKENIACEAE							
Frankenia pauciflora	Seaheath			+			
GENTIANACEAE							
* Centaurium erythraea	Common Centaury		+			+	
GERANIACEAE							
* Erodium cicutarium	Common Crowfoot; Common Storksbill			+		+	
* Geranium molle	Dove's Foot Cranesbill				+	+	
Geranium retrorsum				+		+	
Geranium solanderi	Native Geranium		+				
Pelargonium australe						+	
* Pelargonium capitatum	Rose Pelargonium	+	+	+	+	+	
Pelargonium littorale			+			+	
GOODENIACEAE							
Lechenaultia linarioides	Fountain Leschenaultia	+	+	+	+	+	
Scaevola canescens	Grey Flower		+			+	
Scaevola crassifolia	Thick-Leaved Fanflower	+	+	+			
Scaevola nitida	Shining Fanflower		+				
Scaevola paludosa			+				
Scaevola repens var. repens						+	
Scaevola thesioides	Rats' Tails		+			+	

FAMILY/Taxon	Common Name	K	TK	R	M	KG	A
Verreauxia reinwardtii			+				
GYROSTEMONACEAE							
Gyrostemon ramulosus	Corkybark					+	
Tersonia cyathifolia	Button Runner	+				+	
HAEMODORACEAE							
Anigozanthos humilis	Cats Paw		+		+	+	
Anigozanthos manglesii	Kangaroo Paw		+			+	
Conostylis aculeata	Spring Cottonheads	+	+	+	+	+	
Conostylis aculeata x candicans						+	
Conostylis candicans	Grey Cottonheads	+	+	+	+	+	
Conostylis pauciflora ssp. euryhipis	Dawesville Cottonheads		+				
Conostylis setigera	Bristly Cottonheads					+	
Conostylis stylidioides		+					
Conostylis teretifolia subsp. planescens			+				
Haemodorum laxum			+			+	
Haemodorum paniculatum	Mardja	+	+		+	+	
Haemodorum spicatum	Mardja	+	+			+	
Phlebocarya ciliata						+	
HALORAGACEAE							
Glischrocaryon aureum	Common Popflower					+	
IRIDACEAE							
* Gladiolus caryophyllaceus	Wild Gladiolus		+		+	+	
* Homeria flaccida	One Leaf Cape Tulip	+			+	+	
Orthrosanthos laxus	Morning Iris		+			+	
Patersonia occidentalis	Purple Flag				+	+	
* Romulea rosea	Guildford Grass	+	+	+		+	
* Sparaxis bulbifera	Harlequin Flower					+	
JUNCACEAE							
Luzula meridionalis	Field Woodrush	+					

FAMILY/Taxon	Common Name	K	TK	R	M	KG	A
JUNCAGINACEAE							
Triglochin calcitrapum	Spurred Arrowgrass					+	
Triglochin centrocarpum	Dwarf Arrowgrass					+	
Triglochin trichophorum						+	
LAMIACEAE							
Hemiandra pungens	Snake Bush	+	+	+		+	
LAURACEAE							
Cassytha flava	Dodder-Laurel	+	+	+		+	
Cassytha glabella	Tangled Dodder-Laurel	+				+	
Cassytha racemosa	Dodder-Laurel	+	+			+	
LOBELIACEAE							
Isotoma hypocrateriformis	Woodbridge Poison		+			+	
Lobelia gibbosa	Tall Lobelia					+	
Lobelia tenuior	Slender Lobelia		+			+	
LOGANIACEAE							
Logania vaginalis		+				+	
LORANTHACEAE							
Amyema miquelii	Stalked Mistletoe; Broad-Leaved Mistletoe					+	
Nuytsia floribunda	Christmas Tree		+			+	
MALVACEAE							
Alyogyne huegelii	Lilac Hybiscus	+				+	
MIMOSACEAE							
Acacia cochlearis	Rigid Wattle	+	+	+	+	+	
Acacia cyclops	Red-Eyed Wattle	+	+	+		+	
Acacia huegelii		+	+			+	
Acacia lasiocarpa	Dune Moses	+	+	+		+	
Acacia pulchella	Prickly Moses	+	+		+	+	
Acacia rostellifera	Summer-Scented Wattle	+	+	+	+	+	
Acacia rostellifera x saligna			+				

FAMILY/Taxon	Common Name	K	TK	R	M	KG	A
Acacia saligna	Coojong; Golden-Wreath Wattle	+	+	+	+	+	
Acacia truncata		+	+	+		+	
Acacia willdenowiana	Grass Wattle					+	
MYOPORACEAE							
Eremophila glabra	Tarbush	+		+		+	
Myoporum insulare	Boobialla	+	+	+			
MYRTACEAE							
Baeckea robusta						+	
Calothamnus quadrifidus	One-Sided Bottlebrush	+	+		+	+	
Calothamnus sanguineus	Pindak; Silky-Leaved Blood-Flower				+	+	
Calytrix angulata	Yellow Starflower		+				
Calytrix flavescens	Summer Starflower					+	
Corymbia calophylla					+	+	
Eremaea asterocarpa subsp. asterocarpa	Star-Fruited Eremaea					+	
Eremaea pauciflora	Orange-Flowered Eremaea		+			+	
Eucalyptus argutifolia	Yanchep Mallee	+					
Eucalyptus decipiens	Limestone Marlock		+			+	
Eucalyptus foecunda	Fremantle Mallee	+				+	
Eucalyptus gomphocephala	Tuart	+	+		+	+	
Eucalyptus marginata	Jarrah		+		+	+	
Eucalyptus petrensis	Rock Mallee	+					
Eucalyptus rudis	Flooded Gum						+
Eucalyptus todtiana	Pricklybark		+			+	
Hypocalymma robustum	Pink Myrtle	+			+	+	
Leptospermum spinescens		+	+			+	
Melaleuca acerosa	Coast Honey-Myrtle	+	+	+	+	+	
Melaleuca cardiophylla	Tangling Honey-Myrtle	+	+	+			
Melaleuca huegelii	Chenille Honey-Myrtle	+	+	+	+	+	
Melaleuca lateritia							+

FAMILY/Taxon	Common Name	K	TK	R	M	KG	A
Melaleuca preissiana							+
Melaleuca rhaphiophylla	Freshwater Paperbark						+
Melaleuca trichophylla			+				
Scholtzia involucrata	Spiked Scholtzia					+	
Scholtzia laxiflora		+					
OLACACEAE							
Olax benthamiana	Olax	+		+		+	
ORCHIDACEAE							
Caladenia arenicola	Carousel Spider Orchid					+	
Caladenia flava	Cowslip Orchid			+		+	
Caladenia georgei	Tuart Spider Orchid					+	
Caladenia latifolia	Pink Fairy Orchid	+		+		+	
Caladenia longicauda subsp. calcigena ms	White Spider Orchid					+	
Caladenia reptans	Little Pink Fairy Orchid					+	
Cyanicula gemmata	Blue China Orchid					+	
Cyrtostylis reniformis ms						+	
Diuris corymbosa	Common Donkey Orchid					+	
Elythranthera brunonis	Purple Enamel Orchid					+	
Eriochilus dilatatus	White Bunny Orchid					+	
Leporella fimbriata	Hare Orchid					+	
Leptoceras menziesii	Rabbit Orchid					+	
Microtis media	Common Mignonette Orchid		+	+			
Prasophyllum fimbria	Fringed Leek Orchid					+	
Prasophyllum parvifolium	Autumn Leek Orchid					+	
Pterostylis aspera	Brown-Veined Shell Orchid					+	
Pterostylis brevisepala						+	
Pterostylis pyramidalis	Tall Snail Orchid					+	
Pterostylis recurva	Jug Orchid					+	
Pterostylis sanguinea	Dark Banded Greenhood					+	

FAMILY/Taxon	Common Name	K	TK	R	M	KG	A
Pterostylis vittata	Banded Greenhood				+	+	
Pyrorchis nigricans	Red Beaks	+				+	
Thelymitra campanulata	Shirt Orchid					+	
Thelymitra sp.					+		
OROBANCHACEAE							
* Orobanche minor	Lesser Broomrape	+		+	+	+	
OXALIDACEAE							
Oxalis perennans						+	
* Oxalis pes-caprae	Soursos					+	
PAPILIONACEAE							
Bossiaea eriocarpa	Common Brown Pea	+	+		+	+	
Daviesia decurrens	Winged Bitter-Pea	+			+	+	
Daviesia divaricata	Marno	+				+	
Daviesia nudiflora		+			+	+	
Daviesia triflora		+			+	+	
Gompholobium aristatum	Yellow Pea	+				+	
Gompholobium knightianum						+	
Gompholobium marginatum						+	
Gompholobium tomentosum	Hairy Yellow Pea		+	+	+	+	
Hardenbergia comptoniana	Hardenbergia; Native Wisteria	+	+	+	+	+	
Hovea pungens	Devil's Pins					+	
Hovea trisperma	Common Hovea	+	+		+	+	
Isotropis cuneifolia	Granny's Bonned; Common Lamb-Poison	+	+			+	
Jacksonia furcellata			+			+	
Jacksonia sericea	Waldjumi	+			+	+	
Jacksonia sternbergiana			+		+	+	
Jacksonia stricta			+	+		+	
Kennedia prostrata	Running Postman	+	+	+	+	+	
* Lupinus cosentinii	Sandplain Lupin			+		+	

FAMILY/Taxon	Common Name	K	TK	R	M	KG	A
* Lupinus sp.					+		
* Medicago polymorpha	Burr Medic		+				
* Medicago sp.					+		
* Melilotis indica	King Island Melitot; Hexham Scent		+				
Mirbelia trichcalyx						+	
Nemcia capitata	Bacon-And-Eggs				+	+	
Nemcia reticulata		+	+	+		+	
* Ornithopus compressus	Yellow Serradella					+	
Sphaerolobium medium						+	
Templetonia retusa	Cockie's Tongue	+	+	+		+	
* Trifolium arvense	Hare's Foot Clover					+	
* Trifolium campestre	Hop Clover		+			+	
* Trifolium cernuum	Drooping Flower Clover					+	
* Trifolium glomeratum	Cluster Clover					+	
* Trifolium scabrum	Rough Clover					+	
* Vicia sativa	Common Vetch					+	
PHORMIACEAE							
Dianella revoluta	Flax Lily	+	+	+	+	+	
PHYTOLACCACEAE							
* Phytolacca octandra	Pink Ink Plant; Inkweed					+	
PITTOSPORACEAE							
Billardiera variifolia			-	-		+	
PLANTAGINACEAE							
Plantago exilis						+	
POACEAE							
* Agropyron racemosum		+	+				
* Aira caryophyllea	Silvery Hairgrass	+				+	
* Aira cupaniana			+				
* Ammophila arenaria	Marram Grass		+				

FAMILY/Taxon	Common Name	K	TK	R	M	KG	A
Amphipogon turbinatus		+	+		+	+	
* Avena barbata	Bearded Oat; One-Sided Oat	+				+	
* Avena fatua	Wild Oats		+				
* Briza maxima	Blowfly Grass	+	+		+	+	
* Briza minor	Shivery Grass		+		+	+	
* Bromus diandrus	Great Brome	+	+	+	+	+	
* Bromus madritensis	Madrid Brome	+			+		
* Bromus rubens					+		
* Cynodon dactylon	Couch					+	
Danthonia acerosa			+				
Danthonia caespitosa	Common Wallaby-Grass	+	+		+		
Danthonia occidentalis			+			+	
* Desmazeria rigida			+			+	
Dichelachne crinata	Plumegrass				+	+	
* Ehrharta calycina	Perennial Veldtgrass		+		+	+	
* Ehrharta longiflora		+	+	+		+	
* Holcus setiger					+	+	
* Lagarus ovatus	Hare's Tail Grass	+		+		+	
* Lolium perenne	Perennial Ryegrass			+			
* Lolium rigidum	Annual Ryegrass	+				+	
Microlaena stipoides	Weeping Grass					+	
Neurachne alopecuroidea	Foxtail Mulga-Grass	+				+	
* Pentaschistis airoides						+	
Poa drummondiana	Shaking Grass	+	+	+		+	
Poa porphyroclados		+	+	+		+	
Spinifex hirsutus	Satin-Leaved Spinifex	+	+				
Spinifex longifolius	Long-Leaved Spinifex	+	+	+			
Sporobolus virginicus	Salt Couch	+		+			
Stipa compressa		+	+	+		+	

FAMILY/Taxon	Common Name	K	TK	R	M	KG	A
Stipa elegantissima	Feather Grass					+	
Stipa flavescens	Tall Speargrass	+	+			+	
* Vulpia bromoides	Squirrel Tail Fescue					+	
* Vulpia myuros	Rat's Tail Fescue				+	+	
POLYGALACEAE							
Comesperma calymega	Blue-Spike Milkwort	+	+			+	
Comesperma confertum						+	
Comesperma integerrimum		+	+				
Comesperma volubile			+				
POLYGONACEAE							
Muehlenbeckia adpressa						+	
PORTULACCACEAE							
Calandrinia brevipedata	Short-Stalked Purslane					+	
Calandrinia corrigioloides	Strap Purslane	+				+	
Calandrinia liniflora	Parakeelya		+	+		+	
PRIMULACEAE							
* Anagallis arvensis	Pimpernel	+	+	+		+	
PROTEACEAE							
Adenanthos cygorum	Woolly Bush					+	
Banksia attenuata	Candle Banksia	+	+		+	+	
Banksia grandis	Bull Banksia		+		+	+	
Banksia ilicifolia	Holly-Leaf Banksia	+					
Banksia littoralis	Swamp Banksia						+
Banksia menziesii	Firewood Banksia	+	+		+	+	
Banksia prionotes	Saw-Tooth Banksia	+					
Conospermum triplinervum	Tree Smokebush	+	+			+	
Dryandra lindleyana		+	+	+	+	+	
Dryandra sessilis	Parrotbush	+	+	+	+	+	
Grevillea crithmifolia		+				+	

FAMILY/Taxon	Common Name	K	TK	R	M	KG	A
Grevillea preissii	Spider-Net Grevillea	+	+	+		+	
Grevillea vestita			+		+	+	
Hakea candolleana						+	
Hakea costata	Ribbed Hakea		+			+	
Hakea lissocarpha	Honey Bush	+	+	+	+	+	
Hakea prostrata	Harsh Hakea		+		+	+	
Hakea ruscifolia	Candle Hakea		+			+	
Hakea trifurcata	Two-Leaf Hakea	+	+		+	+	
Persoonia comata			+			+	
Persoonia saccata	Thread-Leaf Snottygobble				+	+	
Petrophile brevifolia		+	+		+	+	
Petrophile aff. brevifolia			+				
Petrophile linearis	Pixie Mops	+	+		+	+	
Petrophile macrostachya		+	+		+	+	
Petrophile serruriae		+	+		+	+	
Petrophile aff. serruiae			+				
Stirlingia latifolia	Blueboy	+	+		+	+	
Synaphea spinulosa						+	
RANUNCULACEAE							
Clematis linearifolia	Old Man's Beard; Small Leaved Clematis	+	+	+		+	
Ranunculus colonorum	Buttercup				+		
Ranunculus pumilio	Small-Flowered Buttercup					+	
RESTIONACEAE							
Alexgeorgia nitens		+	+			+	
Desmocladus flexuosus		+	+	+	+	+	
Hypolaena exsulca			+			+	
Loxocarya cinerea						+	
Loxocarya fasicularis		+		+			
Lyginia barbata		+	+		+	+	

FAMILY/Taxon	Common Name	K	TK	R	M	KG	A
RHAMNACEAE							
Cryptandra glabriflora						+	
Cryptandra mutila						+	
Cryptandra pungens			+			+	
Spyridium globulosum	Basket Bush	+	+	+		+	
Stenanthemum tridentatum		+	+			+	
Trymalium ledifolium		+	+	+		+	
Trymalium floribundum					+		
ROSACEAE							
* Acaena ?echinata	Sheep's Burr				+		
RUBIACEAE							
* Galium murale						+	
Opercularia vaginata	Dog Weed	+	+	+	+	+	
RUTACEAE							
Eriostemon spicatus	Pepper-And-Salt	+				+	
SANTALACEAE							
Exocarpus sparteus	Broom Ballart	+	+	+		+	
Leptomeria empetriformis		+				+	
Leptomeria priessiana				+		+	
Leptomeria spinosa	Spiny Currant Bush					+	
Santalum acuminatum	Quandong	+		+		+	
SAPINDACEAE							
Diplopeltis huegelii		+		+		+	
Dodonaea aptera			+			+	
SCROPHULARIACEAE							
* Bartsia trixago						+	
* Dischisma arenarium			+	+		+	
* Verbascum virgatum						+	
Veronica aff. calycina	Cup Speedwell		+				

FAMILY/Taxon	Common Name	K	TK	R	M	KG	A
SOLANACEAE							
Anthocercis littorea	Yellow Tailflower	+	+			+	
Anthocercis ilicifolia	Yellow Tailflower					+	
* Solanum nigrum	Black Berry Nightshade	+	+		+	+	
* Solanum linnaeanum		+	+			+	
STACKHOUSIACEAE							
Stackhousia monogyna			+			+	
Tripterococcus brunonis	Winged Stackhousia					+	
STERCULIACEAE							
Thomasia cognata		+	+			+	
Thomasia triphylla			+	+		+	
STYLIDIACEAE							
Levenhookia pusilla	Midget Stylewort					+	
Levenhookia stipitata	Common Stylewort		+			+	
Stylidium brunonianum	Pink Fountain Triggerplant		+		+	+	
Stylidium calcaratum	Book Triggerplant		+		+	+	
Stylidium diuroides	Donkey Triggerplant					+	
Stylidium junceum	Reed Triggerplant	+	+		+	+	
Stylidium maritima ms			+			+	
Stylidium macrocarpum	Flagon Triggerplant					+	
Stylidium piliferum	Common Butterfly Triggerplant		+			+	
Stylidium repens	Matted Triggerplant					+	
Stylidium aff. repens			+				
Stylidium schoenoides	Cow-Kicks				+	+	
THYMELAEACEAE							
Pimelea argentea		+			+	+	
Pimelea calcicola		+	+			+	
Pimelea ferruginea	Coast Banjine		+	+			
Pimelea rosea	Rose Banjine					+	

FAMILY/Taxon	Common Name	K	TK	R	M	KG	A
TYPHACEAE							
* Typha sp.							+
URTICACEAE							
Parietaria debilis	Native Pellitory		+	+		+	
VIOLACEAE							
Hybanthus calycinus	Native Violet		+	+	+	+	
XANTHORRHOEACEAE							
Xanthorrhoea preissii	Blackboy; Grasstree; Balga	+	+		+	+	
ZAMIACEAE							
Macrozamia riedlei	Zamia		+		+	+	

APPENDIX 4

DEFINITIONS OF REGIONALLY AND LOCALLY SIGNIFICANT

These definitions are from the Urban Bushland Strategy (Government of Western Australia, 1995.

REGIONALLY SIGNIFICANT	LOCALLY SIGNIFICANT
* Example of a regional vegetation type which is threatened or poorly reserved or a site with special value for flora or fauna conservation.	One of the better examples of a local vegetation type.
* Having considerable biodiversity or supports a population of Declared Rare Flora, priority listed flora, or threatened fauna.	Having biodiversity value but unlikely to include Declared Rare Flora. May include geographically significant species at the limit of their range.
* Vegetation in good condition or better. Threatened vegetation types may be regionally significant even if in poor condition.	Vegetation may be in poor condition but if poor, capable of regeneration.
* Usually greater than 20 hectares but may be smaller in the case of threatened or poorly reserved vegetation types, or areas with special significance for other purposes.	Ideally greater than 4 hectares but smaller areas may be of significance depending on how much remains in the locality.
Suitable for passive recreation by people from both within and beyond the locality.	Suitable for passive recreation by the local community.
Region wide use or potential for scientific or educational study.	Use or potential for use by local schools.
Having cultural heritage values of a regional or greater significance.	Having local heritage value.
Regular shape is desirable unless the area functions as a significant corridor linking other remnants.	Shape not critical but remnant should be capable of ongoing management.

* Essential criteria for bushland to be regarded as regionally significant.

FLORA AND VEGETATION OF THE MINDARIE CUSP AREA

G.J. KEIGHERY
WILDLIFE RESEARCH CENTRE
CALM

VEGETATION

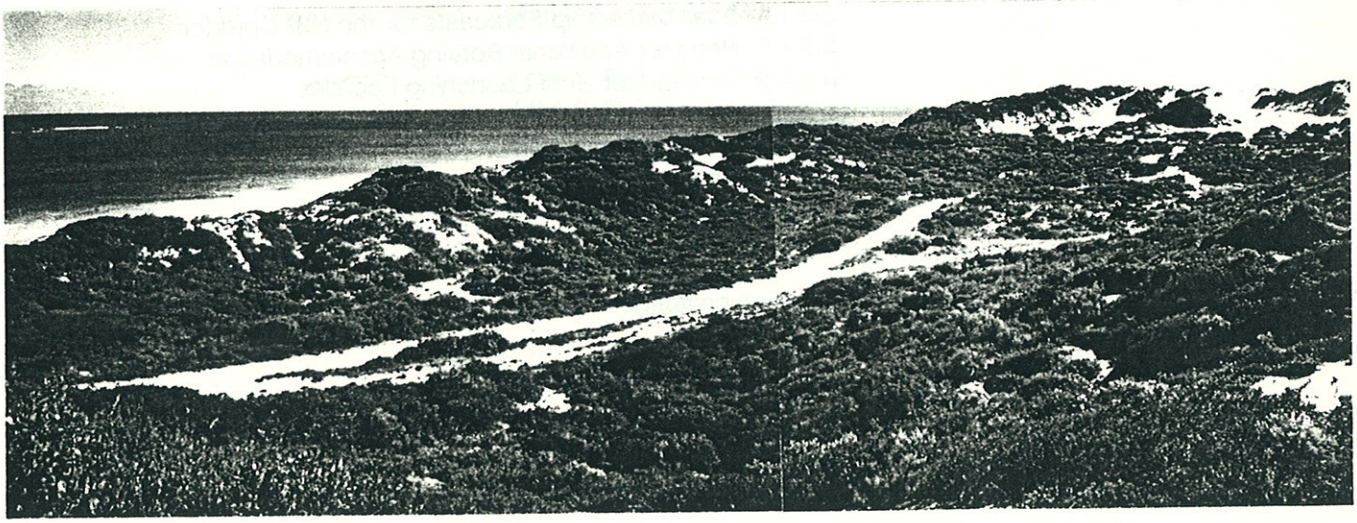
The vegetation of the area, despite peripheral disturbance and numerous 4WD tracks, is in excellent condition, intact in structure with few weeds present.

From the coast inland, the vegetation consists of a narrow belt of strand vegetation backed by tall dunes. The beach has a *Cakile maritima* herbfield, immediately backed by a *Spinifex hirsutus/S. longifolius* hummock grassland, which rapidly merges into a *Scaevola/Myoporum* heath on the relatively unstable foredunes.

The large "blow-outs" present are sparsely vegetated (or not at all) usually on ridge tops with a mixture of rhizomatous species such as *Lepidosperma gladiatum/Spinifex hirsutus* and *S. longifolius*.

The flats and ridges around the blow-outs are covered with a low open heath dominated by *Olearia axillaris*, generally with a significant proportion of sedges in the lower layer (especially *Lomandra maritima*).

LOT 2
BURNS BEACH
Coastal Land Use Study



CITY OF PERTH

CITY OF STIRLING

SHIRE OF WANNEROO

PROPOSED REFUSE DISPOSAL FACILITY AT MINDARIE

ENVIRONMENTAL REVIEW AND MANAGEMENT PROGRAMME

Prepared by:

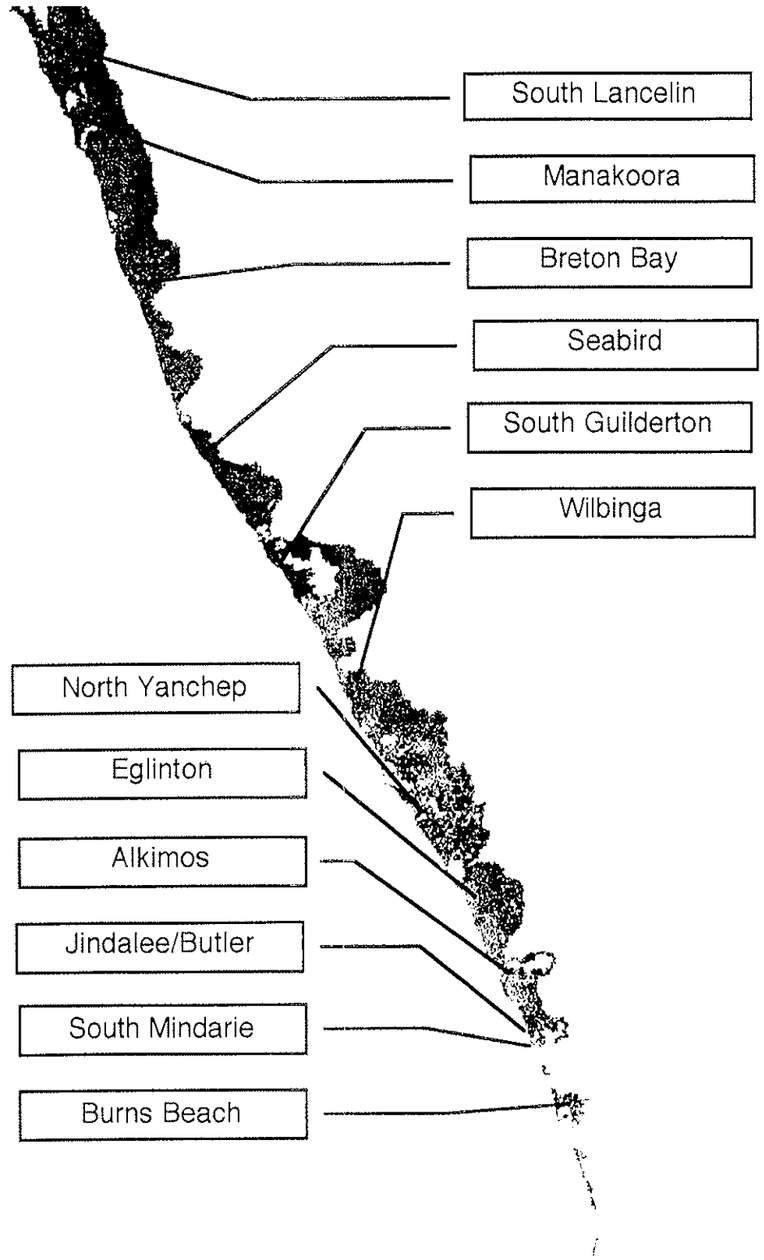
Kinhill Stearns
47 Burswood Road
Victoria Park, WA 6100

December 1983
Ref.1-2

Halpern
Glick
Maunsell

Burns Beach Property Trust

Distribution of Quindalup Dune Vegetation and Coastal Landforms in the Whitfords to Lancelin Subsector



Response to Department of Environmental Protection Request

Halpern
Glick
Maunsell

Public Environmental Review for:

Proposed Residential Development of the Western Cell, Lot 2 Burns Beach

Burns Beach Property Trust

October 1995

Proposed Residential Development of the Western Cell, Lot 2, Burns Beach

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7.0 Biological Conservation Value

The study area was recently subject to an intense fire, which affected ove 90% of the Western Cell, destroying most of the native vegetation. This v also have had severe effects on the resident fauna, with considerable loc deaths and migration from the area.

The vegetation of the study area will undergo a natural regeneration proc but only over an extended period. It will be beyond the timeframe of this before any significant level of diversity and condition is re-attained. Faun communities will recover at a slower rate as suitable habitat becomes re-established. The current assessment of the biological conservation value the study area has been based on the existing knowledge of the communities present prior to the fire, on the basis that these communities (or others similar in species composition) would ultimately be restored if the regeneration and succession process was left to run its course.

7.1 Fauna

7.1.1 Fauna Communities

A search was conducted of the Western Australian Museum (WAM) database of vertebrate records for species records from the Western Cell area. The initial search found no records from the study area and was expanded to cover a surrounding area of 2 km in an effort to pick up species records representative of those present in local communities. This expanded search still yielded no species records.

The fauna of the study area has not to date been assessed by a formal field survey. Given the effects of the recent fire, the results of any fauna survey work conducted as part of the PER process would not have been representative of the normal full species complement for the Cell. Nonetheless, it is possible to predict on the basis of known patterns of species distribution, habitat utilisation and data from other nearby surveys in similar habitats, the likely fauna assemblage occurring in the Cell.

The fauna community likely to occur in the area would be typical of the coastal heath habitat that dominates the vegetation. Reptile species such as the bobtail *Tiliqua rugosa* and kings skink *Egernia kingii*, several species of the sand dwelling skink genera *Ctentotus* and *Lerista*, and other coastally distributed species would be likely to occur. Bird communities would likely be diverse, with the area supporting a range of heathland species. Mammal communities are likely to be less species rich with introduced species such as mice and rabbits outnumbering natives. Larger native species such as the Western Grey Kangaroo *Macropus fuliginosus* are likely to be moderately abundant. Feral predators such as cats and foxes would certainly be present, largely accounting for the poor representation of native small mammal species.

Kinhill Stearns (1989) conducted a fauna survey in Lot 17 immediately adjoining the study area to the north, and Ninox (1990) conducted a similar survey further north in the ecologically similar Eglinton area. Both fauna surveys recorded species assemblages similar to those expected for the Western Cell. Neither survey recorded any Schedule One fauna, or other species of particular note.

7.1.2 Rare and Endangered Fauna

There are no records of any of the species that appear on CALM's Schedule fauna listing of rare and endangered species from the Western Cell area. It is possible that this is due to the lack of fauna survey for the area, and, based on known distributions and habitat requirements, the following rare species might occur in the study area:

Falco peregrinus **Peregrine Falcon**

The Peregrine Falcon is widespread across all of Australia, but only occurs at very low densities and with a patchy distribution. It is know to favour coastal woodlands amongst other habitats (Schodde and Tidemann, 1990) and may be a transitory visitor to the study area. *F. peregrinus* is a Schedule Two species, indicating that while it is considered to require special protection, it is not regarded as being in danger of extinction.

Morelia spilota imbricata **Carpet Python**

This Schedule Two subspecies occurs across much of the south-west, but has been given its protected status due to the fact that it is not common anywhere in its range. The species has not been recorded in the vicinity of the Western Cell, and is not considered likely to be present there.

If any more sedentary rare species were resident in the area, it is likely they were present in low abundance, and whether such small populations could have survived the recent fire is questionable.

Detailed survey work in the adjoining Lot also recorded no Schedule One fauna, or any other fauna species of particular significance (Kinhill Stearns, 1990). On this basis, it is considered unlikely that any Schedule One Rare and Endangered fauna species occur in the study area.

7.2 Flora and Vegetation

7.2.1 Flora

The flora and vegetation types represented in the study area have been well documented by a number of detailed botanical surveys (V and C Semeniuk Research Group, 1989; Halpern Glick Maunsell, 1991; Kheighery, 1991; Trudgen, 1991; Kheighery and Kheighery, 1991; Griffin and Trudgen, 1994), incorporating field survey work, vegetation mapping and aerial photography. Detailed flora survey work has also been carried out at the nearby Alkimos area (Trudgen and Kheighery, 1990) and Lot 17 Tamala Park (Kinhill Stearns, 1983).

In general terms the flora of the study area appears to be fairly typical of the north-west corridor coastal belt. The area lies within the Darling Botanical district, in the Drummond botanical subdistrict (Beard, 1990), and its flora is regarded as having a high degree of similarity to that of the nearby Alkimos area (Trudgen, 1991), where field survey work detected 224 plant species, 36 of which were introduced (Trudgen and Kheighery, 1990). The best represented monocotyledon families were the Cyperaceae, Poaceae, Haemodoraceae, and Anthericaceae. Dicotyledon species belonged largely to the Proteaceae, Asteraceae, Myrtaceae, Papilionaceae and the Epacridaceae (Trudgen and Kheighery, 1990). This assemblage of plant species is as expected for the area and substrate types (Marchant *et al.*, 1987), and similar

A

Report on the

Flora and Vegetation

of an area at Burns Beach

and the Conservation Issues affecting it

Prepared for Halpern Glick Maunsell

by

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December 1990

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References

1.0 INTRODUCTION

This report has been prepared to describe the existing flora and vegetation of the study area at Burns Beach, it's conservation value and conservation issues affecting the area.

1.0 INTRODUCTION

This report has been prepared to describe the existing flora and vegetation of the study area at Burns Beach, it's conservation value and conservation issues affecting the area.

1.1 Location

The study area is a roughly square area on the coast at Burns Beach some 30 km north of Perth. It lies on the coast opposite Neerabup National Park.

1.2 Climate

The Burns Beach area is only 37 km from Fremantle and 30 from Perth and the climate is essentially similar to these locations, particularly Fremantle. That is a Mediteranean climate with a hot dry summer and reliable winter rainfall. However, there is a significant drop in rainfall along the coast north of Fremantle and Perth, which lie between the 30 and 35 inch isohyets on the rainfall map and Burns Beach would recieve a few inches less rainfall per annum (Comm. Bureau Met. 1962). Another feature of the climate of the area is the strong south-westerly sea breezes that blow on many days in summer. These not only make the summer more pleasant but, are important for their ability to cause blowouts of the dunes if the vegetation cover is disturbed.

1.3 Geology

The study area lies on the Swan Coastal Plain and contains two major geological types. These are the Quindalup Dunes (= Safety Bay Sand) and the Spearwood dunes (= Tamala limestone). The former can be divided into dunes of various ages, often with different topography and the latter into areas with "limestone" at or very close to the surface and areas with deeper sand.

The Quindalup dunes, which abut the coastline in the study area, are composed largely of calcareous sand formed from the remains of calcareous algae, foraminifers and molluscs with some rounded quartz material (Lowry 1974). They have been subdivided into four ages with the oldest referred to as Q1 dunes and the youngest (which are still forming in places) as Q4 dunes, the intermediate age dunes are

referred to Q3 and Q2 depending on their age (McArthur and Bartle 1980a, 1980b). The Quindalup Dunes form a narrow to moderately broad but discontinous strip from the Bunbury area to north of Lancelin however, some of the breaks in this strip are quite large. Also the development along the strip is not uniform, with some areas having only more recent dunes others having older dunes next to the beach and no younger dunes and others having partial or well developed sequences. The Q1 and Q2 dunes tend to be well developed parabolic dunes, the Q3 dunes to be rather irregular (possibly being in places remobilised Q2 dunes with some additional sand material) while the Q4 dunes tend to be a narrow strip of one or two dunes parallel to the coast but also include areas of recent (but small compared to the Q1 and Q2 dunes) parabolic dunes and stabilisedblowouts.

Predating the Quindalup dunes are the Spearwood dunes, the other geologic component of the study area. These have been subjected to prolonged weathering, resulting in a profile with siliceous sand at the surface underlain by a cap rock consisting of kankar (sandy accretionary limestone formed in the soil)and indurated and recrystalised eolianite. The cap rock is 1 to 3 m thick and grades down into softer, bedded eolianite. In many areas the siliceous sand has been removed by erosion, resulting in a variety of ecological situations from exposed cap rock to shallow sand over cap rock to deep sand with the latterusually on the east of the exposed cap rock (Lowry 1974). While in situ change within the Spearwood dunes has resulted in the development of a hard cap rock, similar processes have only resulted in weak lithificationof some of the older Quindalup dunes (Lowry 1974). (Note: In the rest of this report the cap rock of the Spearwood dunes isreferred to as limestone.)

The Quindalup dunes have transgressed over the earlier Spearwood dunes so that generally the surface expression of these is on the inland side of the Quindalup dunes, but they are also often exposed in swales within the older Quindalup dunes (particularly areas of cap rock but also areas of sand). In some places the border between the two ages of sand isfairlystraight,in others itisquite irregular.

Development of geological types in the study area

The south-eastern section of the study area has a large area of the sand surface type of the Spearwood dunes with smaller areas of the limestone caprock surface exposed on high points. The Spearwood sand surface type almost reaches the coast in the south-west corner of the study area but is separated from it by a thin strip of Q2 and Q4 age Quindalup dunes. The width of the Quindalup dunes system increase rapidly north from the south-west corner of the study area and this dune system extends right across the study are in the northern part where there is a well formed Q1 (oldest) Quindalup dune that reaches to the easten boundary. However, within the swale formed inside this dune there are some areas of the limestone caprock surface of the underlying Spearwood dunes system exposed. All the ages (Q1, Q2, Q3, Q4) of the Quindalup dunes are representedas well as a swale type (Qp).

1.4 Condition of the vegetation

From the aerial photographs the condition of the vegetation appears to be quite good. However, there are some blowouts especially in the younger age dunes of the Quindalup dune system. There also appears to have been some reduction in cover from repeated burning. Further detail on the condition of hte vegetaiton would require a fieldvisit.

2.0 METHODS AND LIMITATIONS

This report is a desk study largely based on experience in similar areas (Alkimos and Ningana) nearby and examination of soils maps and aerial photographs. It is intended for preliminary environmental assessment rather than for detailed final environmental assessment.

2.1 Limitations of the flora information

As the area was not visited it is presumed that the flora is similar to that found in similar vegetation near to the study area. However, the presence or absence of flora species could only be determined by actual survey.

2.2 Limitations of the vegetation information

It is presumed, and this seems very likely from the aerial photographs, that the vegetation is similar to that found on the same soil types a short distance north of the study area. However, there may be some differences that could only be determined by fieldstudy.

3.0 FLORA

In a nearby area (Alkimos) with the same range of vegetation types but larger in area, one native non-flowering plant (Macrozamia reidlei, the Zamia Palm) and 223 flowering plants were recorded (Trudgen and Keighery 1990). Thirty six of the flowering plant species were introduced species.

Of the 187 native species recorded at Alkimos 49 were monocotyledons from twelve different plant families and 138 were dicotyledons from thirty-nine families. The families of monocotyledons with the most species were Cyperaceae (11 species), Poaceae (10), Haemodoraceae (9) and Anthericaceae (7). The most abundant families of dicotyledons were Proteaceae (19), Asteraceae (15), Myrtaceae (12), Papilionaceae (12), Mimosaceae (9) and Epacridaceae (8).

3.2 Biogeographical relationships of the flora

The family makeup of the native flora at Burns Beach would be very similar to that at Alkimos, where it is relatively typical of the flora of the south-west of Western Australia and is comparable with that of two previous studies (Trudgen 1984, 1988) of coastal and near coastal areas on the Swan Coastal Plain. In all three surveys the Poaceae and Asteraceae are somewhat higher in numbers than would be expected when compared with the flora of the south west as a whole. This is probably because of the sandy soils of the area, particularly the presence of calcareous sands as well as siliceous sands. The absence or poor representation on the list for Alkimos of several families (Orchidaceae, Droseraceae and Juncaginaceae) which were better represented in the previous studies and whose species are mostly geophytes or annuals is almost certainly a result of the timing of the survey. Consequently it is likely these families would also be better represented at Burns Beach.

There is a gradual change in the flora along the coast that correlates with the gradual change in climate, particularly the decrease in rainfall. The degree of change is quite significant at the species level with relatively little change at the family level.

3.3 Introduced flora

Poaceae, Asteraceae and Papilionaceae would be the families with the most exotic

species present in the study area, some members of these families would be very common. Other families represented would include Caryophyllaceae, Brassicaceae and Gentianaceae. Species present would include *Briza maxima ,*Briza minor , *Petrorhagia velutina ,*Crassula glomerata ,*Dischisma arenarium ,*Romulea rosea , *Hypochaeris glabra, *Ursinia anthemoides ,*Avena fatua, *Erharta calycina, *E. longiflora ,*Carpobrotus edulis .

3.4 Species of particular interest

No gazetted rare species were recorded for the Alkimos area and it is not likely that such species would be at Burns Beach. However, this could only be definitely determined by field searches. Several other species of interest were recorded at Alkimos and at least some of thse are likely to be at Burns Beach, these are:

Laxmania sessiliflora ssp. australis (Anthericaceae)

At its most southern locality on the coastal plain at Alkimos (Keighery, G. pers. com.).

Conostylis pauciflora ssp. euryhipis (Haemodoraceae)

A locally common but restricted taxon confined to the consolidated dunes within 10 Km of the coast between Cervantes and Yanchep (Hopper 1987). Appears to be restricted to the Quindalup dunes.

Conostylis teretifolia ssp. planescens (Haemodoraceae)

An uncommon taxon found in isolated localities between Gingin, Yanchep and Wanneroo (Hopper, 1987) in Banksia woodland.

Petrophile affinity brevifolia (Proteaceae)

The material referred to this taxon appears to be an undescribed ("new") species that occurs on the coastal plain from the Murchison River to Ongerup (Marchant et al).

Petrophile affinity serruriae (Proteaceae)

Probably a separate species allied to Petrophile serruriae

Veronica affinity calycina (Scrophulariaceae)

This taxon is related to V. calycina but is more robust and less densely pubescent.

Persoonia comata (Proteaceae)

This species grows on sand in heath and woodlands from Yanchep to Enneabba and is at the southern end of its known range at Alkimos.

Stylidium affinity repens (Stylidiaceae)

This taxon is another undescribed species that had not previously been recorded south of the Moore River (A Burbidge pers com). It is closely related to Stylidium repens .

Stylidium sp. ("maritima ") (Stylidiaceae)

This species is related to Stylidium affine but occurs in near coastal locations on calcareous soils and limestone on the coastal plain from Yanchep to Breton Bay. Populations are not common and much of its habitat has been cleared or degraded and it should be considered uncommon.

Leptorhynchos scabrus (Asteraceae)

This is a poorly collected species both in the Perth Region (where it has been recorded from Mandurah) and elsewhere although, it is fairly widespread extending from Jurien Bay to Bremer Bay. Found on Q2, and Q3 dunes.

4.0 VEGETATION

The vegetation of the Burns Beach area is varied, reflecting the substantial variation in soil, topography and distance from the sea that occurs there. It is very strongly controlled by the substrate (soil) that it occurs on and is described below in 'complexes' consisting of several vegetation types that occur on a particular geomorphological type. The information provided is from a study at Alkimos a short distance to the north of the Burns Beach area where similar soils units have similar vegetation however, there may be some differences at Burns Beach that could only be determined by field study.

The geomorphic types present in the study area are the strand, Q4, Q3, Q2 and Q1 age dunes of the Quindalup dune system and associated swales mapped as Qp by McArthur and Bartle (1980a) and the limestone and sand surface types of the Spearwood dune system.

Vegetation of the strand

The strand (or area of the beach above the tidal zone) has only simple vegetation of colonizing species, where the beach is narrow this is often pushed up onto the base of the first stabilised dune. Where it is well developed the vegetation can include a foredune (beach ridge) that is reasonably well stabilised, with denser cover of Spinifex species. On stable or prograding beaches these can become completely stabilised over a period of time. In exceptional case such as at port Kennedy (south of Rockingham) series of such dunes can be developed, one behind the other.

ShSl Spinifex hirsutus, Spinifex longifolius Open hummock grassland.

This unit is part of a complex of variation containing the two Spinifex units that occurs on sandy beaches along much of the coast of South-western Western Australia.

Sh Spinifex hirsutus Hummock grassland.

The Spinifex hirsutus (20-40 cm, 40%) is much denser in this unit than in the preceding one and there are also more associated species.

Vegetation of the Q4 age Quindalup dunes

The dunes treated under this category have Scaevola crassifolia as a major component of their vegetation and have soil that is distinctly a very pale grey rather than cream coloured, Acacia truncata and Myoporum insulare are prominent in their vegetation. They probably belong to the older group of Q4 dunes (see Trudgen 1988) but may be transitional to Q3.

ScAt Scaevola crassifolia, Acacia truncata Low open heath

In this unit the Scaevola crassifolia (30-60 cm, 20-25%) is slightly more abundant than the Acacia truncata (20-40 cm, 10-15%). Other shrub species present would include Myoporum insulare, Spyridium globulosum, Olearia axillaris, Rhagodia baccata and Acanthocarpus preissii.

MiSg Myporum insulare, Spyridium globulosum shrubland

This unit grades into the preceding one, but while both have Scaevola crassifoliaas the most abundant species, in this unit there are taller shrubs of Myporum insulare (0.3-1.2(2)m, 5-10(15)%) and Spyridium globulosum (0.4-1.4(2)m, 5%) forming an upper shrub layer.

Vegetation of the Q3, Q2 and Q1 age Quindalup dunes

The vegetation on these dunes is often misinterpreted as being highly disturbed because of its low stature and the grassy look given to it by the liliaceous herb Lomandra maritima.

ArMa Acacia rostellifera, Melaleuca acerosa Low Open Heath.

This unit (which is very variable) is common on the slopes of Q2 dunes. Under and between the shrubs of Acacia rostellifera (30-50 cm, 15-30%) and Melaleuca acerosa (25-40 cm, 35-40%) there is a herb/sedge layer of the liliaceous herb Lomandra maritima.

Ma Melaleuca acerosa low shrubland to shrubland.

The Melaleuca is the most abundant shrub species in this unit and at the site recorded was the only one, except for scattered Acacia saligna and Rhagodia baccata.

This unit covers large sections of this dune type and has a lot of variants (which would be treated as separate vegetation types in a more detailed study) including stands with Pimelea ferruginea, Trymalium albicans, Acacia lasiocarpa or Leucopogon parviflorus dominant or co-dominant, very dense large patches of Acacia rostellifera, patches of Spyridium globulosum and on crests Gompholobium tomentosum. Other species that occur in this unit are, Hibbertia racemosa, Oxylobium reticulatum, and Kennedia prostrata.

Eg Eucalyptus gomphocephala (Tuart) open woodland

There are occassional open stands of Tuart on the Q2 dunes.

Vegetation of the Spearwood dunes system, limestone areas

The area of vegetation (mainly heaths) on areas with limestone at or very near the surface in the study area has been repeatedly burnt (some of it fairly recently). This has resulted in the vegetation on it being mostly pre-climax in structure and may have (due to the repeated burning) resulted in changes in the balance of the species present.

The vegetation of these limestone areas is a mosaic with the changes in the vegetation reflecting small changes in the soil. Dryandra sessilis dominates much of the area with Melaleuca huegelii where the limestone outcrops strongly. Large areas are also dominated by Acacia pulchella, with smaller areas dominated by Xanthorrhoea preissii, Calothamnus quadrifidus or Melaleuca cardiophylla. Along the ecotone where the limestone (spearwood sand systems abuts the Quindalup (Q1/Q2 dunes) system there is probably a belt of Xanthorrhoea preissii shrubland, especially where the ecotone is in a swale.

Ds Dryandra sessilis open heath

The Dryandra sessilis is usually clearly dominant but, there would have a significant admixture of Xanthorrhoea preissii (1.5-3 m, 10-15%) and an occassional Acacia saligna (2.6m) in the upper shrub layer. The lower shrub layer is usually also quite

dense with the most abundant species being Hibbertia hypericoides .

Mc Melaleuca cardiophylla closed heath.

Lower shrubs present would be Rhagodia baccata, Dodonaea aptera, Leucopogon parviflorus, Melaleuca acerosa, Melaleuca huegelii and Grevillea thelemanniana.

MhDs Melaleuca huegelii, Dryandra sessilisopen heath to heath

The siterecorded in this unit at Alkimos had been recently burnt and the Melaleuca huegelii (50 cm, 20-25%) had not recovered itspre-fire height and cover (> 1 m, > 35%). The Dryandra sessilis(30 cm, patchy 10-20%) also had obviously not regained its full height or cover. Other shrub species present were Gompholobium tomentosum , Hibbertia spicata, Melaleuca acerosa , Grevillea thelemanniana , Dryandra nivea , Leucopogon propoinqus and Scaevola thesoides .

Xp Xanthorrhoea preissii shrubland

The Xanthorrhoea preissii (1-2.4 m, 20-25%) was the only tall shrub in this unit. However, the lower shrub layer was moderately dense with species including Jacksonia stricta, Hakea lissocarpha , Melaleuca acerosa , Gompholobium tomentosa and Hibbertia hypericoides

Vegetation of the sand surface areas of the Spearwood dunes system

The areas of the Spearwood dune system that have a deep sand cover in the study area have a range of woodland and forest vegetation developed on them. The dominant species are usually Banksia attenuata and Banksia menziesii but in places Allocasuarina fraseriana or Eucalyptus gomphocephala (Tuart) are dominant. Other tree species present are Banksia grandis , Nuytsia floribunda (West Australian Christmas tree), Eucalyptus decipiens , Eucalyptus marginata (Jarrah) and Eucalyptus todtiana (Pricklybark). There is considerable variation in the understorey as well as in the overstorey.

BaAfJs Banksia attenuata , Allocasuarina fraseriana low open forest over Jacksonia sternbergiana high shrubland

This unit is part of the considerable variation in the Banksia spp. Allocasuarina

fraseriana woodlands to forests that occur on the Spearwood sands in the study area. The Banksia attenuata was fairlylow but moderately dense and was more abundant than the Allocasuarina fraseriana. There were also small amounts of Banksia menziesii ,Banksia grandis and Nuytsia floribunda in the tree layer.

EtBaBm Eucalyptus todtiana ,Banksia attenuata ,B. menziesii low open woodland
This variant of the Banksia woodlands has a significant amount of Eucalyptus todtiana (Pricklybark) with the Banksia attenuata , Banksia menziesii and small amount of Banksia grandis .The tallershrub layer was quite open, with Calothamus quadrifidus ,Allocasuarina humilus and others.

AfBEt Allocasuarina fraseriana, Banksia spp., Eucalyptus todtiana Low Open Forest to Open Forest.
This unit has a mixed tree layer with Allocasuarina fraseriana the most abundent tree species although Banksia attenuata ismore abundant in some places. The other tree species are Banksia menziesii , Banksia grandis , Eucalyptus todtiana and occassional Nuytsia floribunda. The only tallshrubs were Jacksonia sternbergiana (2-4m) which was very patchy in itscover and Xanthorrhoea preissii.

5.0 CONSERVATION VALUE OF THE BURNS BEACH AREA

5.1 Introduction

The Burns Beach area undoubtedly has conservation value for flora and vegetation types. The extent of this value is a function of many variables that need to be taken into account when assessing the conservation value of an area for flora and vegetation. These variables are discussed below and then applied to the Burns Beach area in sections 5.2 and 5.3.

1) the vegetation types and species of flora found there, obviously an area has conservation value for those species or vegetation types that are found within it.

2) how extensive the vegetation type is or how large the population sizes of a species of flora are (both in the area and elsewhere), vegetation types which exist nowhere else or rare flora will be considered to have higher conservation value than vegetation that is extensive or species that are very common over large areas. However it should be noted that this is a human value system that is being applied and that even populations of very common species or stands of common vegetation types still have intrinsic value.

3) their distribution, different vegetation types and individual flora species occur in different ways, for example as single blocks, as part of a recurring pattern or related to a specialised ecological situation such as the strand or wetlands.

4) where in the distribution of the vegetation type or the species the stand or population occurs. It is generally considered important to conserve a vegetation type or species over its range so that a representative sample of the variation is conserved and consequently stands or populations at the ends of the range of a vegetation type or flora species are considered to have higher conservation value.

5) how previous development has effected the extent of a vegetation type or population sizes of flora species have been reduced by clearing and other development.

6) how well reserved the vegetation types or flora species are in secure

conservation reserves. While the conservation value of a particular stand or population is from one point of view an intrinsic value, the percieved need to conserve a particular stand or population (i.e.part of the common useage of the term "conservation value") will vary depending on how well represented the vegetation type or species is in secure conservation reserves.

The factors listed above relate to the value of an area for the conservation of vegetation types or flora species for their continued existence rather than for use by man. An area of land can also have value through the conservation of the vegetation and flora on it from an anthropocentric point of view. For example areas of land with native vegetation in an urban setting offer opportunities for education, enjoyment (bushwalking, observing native flora) and research that would not be possible on areas at a long distance from centres of population because of the distances involved in travel. Kings Park is an excellent example of such a reserve where there is widespread community acceptance that such values exceed the value of the land for development. Another anthropocentric viewpoint is an economic one where conservation value can be understood to exist because of a potential to find value in the flora of an area for economic purposes such as a source of wildflower species for cultivation for export, or as a source of drugs or alternative crops. Such value is extremely difficult to quantify because it is extremely difficult to forsee the circumstances that will apply in the future to make a particular plant valuable.

Although this section is largely concerned with the conservation value for the protection of flora and vegetation brief comment will be made on the conservation value of the study area from other points of view (see subsections 5.4 & 5.5).

5.2 Conservation value for flora

The Burns Beach area has particular value for the conservation of the populations of those species likely to be found on it that although not gazetted as rare flora are either not common or not widespread. These are Conostylis pauciflora subspecies euryhipis, Stylidium sp. ("maritima"), Leptorhynchos scabrus, Veronica affinity calycina and Conostylis teretifolia ssp. planescens (see section 3.2 for more details on

individual species). It also has significant value for the conservation of species that are at or near the end of their range in the study area these are Stylidium affinity repens, Veronica affinity calycina and Laxmannia sessiliflora subspecies australis.

It also has value for the conservation of the species that do not fall into any of the above categories. Although on an individual basis the value for these species may be smaller than that for the less common species or those at the ends of their range it can still individually be significant and is collectively probably as significant, or more so, than the total value for the special case species (if common species are not adequately protected they will also become rare). For example the study area has significant value for the conservation of species such as Lomandra maritima and Pimelea ferruginea which are almost entirely restricted to the Quindalup dune system which is not adequately reserved in the metropolitan region (see section 5.3 and section 6).

5.3 Conservation value for vegetation

The Alkimos area does not have any vegetation types that are restricted to it however, it contains vegetation types that are restricted to coastal and near coastal areas. These are the vegetation types of the Quindalup dune system and the near coastal variants of the vegetation of the Spearwood dune system. These vegetation types are not adequately reserved.

5.3.1 Conservation value for vegetation of the Quindalup dunes

The vegetation of the Quindalup dune system is moderately well conserved at the extremes of its distribution in Yalgorup National Park (south of Mandurah) and in Nambung National Park and the adjoining Wanagaran Nature Reserve (both north of Lancelin). However it is not conserved in the middle of its distribution. As a consequence the Burns Beach area (as well as the nearby Alkimos and Ningana areas and adjoining uncleared areas, especially to the north) have very significant conservation value for the vegetation of the Quindalup dunes. The degree of this significance is increased by the following points:

1. There are changes in the vegetation of the Quindalup dunes from north to

south caused by the gradient of climatic change from north to south over the distribution of the dune systems.

2. Due to the discontinuous distribution of the dunes and disturbance by urban development and agriculture there is no significant opportunity to reserve this vegetation complex between the Burns Beach general area and Mandurah.

3. The Quindalup dune system is not represented in Neerabup National Park and there are only a few hectares of the system in Yanchep National Park.

5.3.2 Conservation value for vegetation of the Spearwood dune system

The Spearwood dune system has a similar pattern of distribution to that of the Quindalup dune system, except that it is more continuous and broader. It is generally not well represented in conservation reserves with moderate representation in Yalgorup National Park (south of Mandurah) and areas in Nambung National Park and the adjoining Wanagaran Nature Reserve (both north of Lancelin). However, unlike the Quindalup dune system, the Spearwood dune system has significant representation in conservation reserves in the metropolitan area (in Neerabup and Yanchep National Parks and some other smaller conservation reserves). Notwithstanding this latter point, the areas of the Spearwood dunes in the Burns Beach general area (and the adjoining uncleared areas) have significant conservation value. The degree of this significance is increased by the following points:

1. There are changes in the vegetation on this dune system (both the sand and limestone surface types) from north to south and from east to west (Trudgen, 1988, 1987) and the areas of the system in the Burns Beach area represent the westernmost portion of the system, which is poorly represented in the metropolitan reserves.

2. Even though this system is better represented in reserves in the metropolitan area than the Quindalup system, it is still not well represented

and there are very few oppportunities to redress this. (This is also the case to the south of Perth where most of the system has been cleared or very badly degraded.)

3. The vegetation of the Spearwood dunes is more diverse than that of the Quindalup dunes and this means that to adequately conserve this variation larger areas are required.

5.4 Conservation value for protection of landforms

The Burns Beach area (and adjoining areas) also has value for the conservation of landforms. It includes a relatively undisturbed beach, several ages of Quindalup dunes and areas of the limestone and sand surfaces (including several of the units of McArthur and Bartle 1980) of the Spearwood dune system in a relatively small area. In a similar fashion to the vegetation and flora of the Quindalup dunes these features are in conservation reserves towards the limits of their distribution but are not adequately reserved in the centre of their range.

6.0 REGIONAL CONSERVATION ISSUES AFFECTING THE CONSERVATION VALUE OF THE BURNS BEACH AREA

The regional conservation issues affecting the Burns Beach area are:

1) the very extensive clearing of the native vegetation of the Swan Coastal Plain on which the Alkimos area occurs.

Beard and Sprenger (1984) gives figures for alienation (which they equate with clearing, although there are remnants in private ownership) of the Plain as 78% overall, with south of Perth virtually 100%. This means that many species of plants found on the Plain have had their populations and ranges decimated and many vegetation types have been lost or reduced to fragentary remains, particularly south of Perth. It also means that the areas of vegetation remaining have greatly increased significance for conservation because of the reduced opportunities for conservation. It should be noted that Beard and Sprenger's figures are now six years old and that some of the data (particularly aerial photography) they were based on could be older than that.

2) the low reservation in the metropolitan area of areas of native vegetation.

Significant areas have been recommended for reservation as reserves and regional parks in the areas surrounding Perth through the "System Six" process (EPA 1983). However, many of these have not been implemented, including a significant number of proposed reserves that have unfortunately been cleared. The result is that there are relatively few secure conservation areas within the urbanised zone. Alkimos is currently at the fringe of the urbanised zone and is likely to be within it within the reasonably near future. It does have the advantage of being close to both Neerabup and Yanchep National Parks but, as noted above, has complimentary conservation values.

3) the desirability of improving the boundary to area ratio of Neerabup National Park.

Neerabup National Park has an attenuated shape that is undesirable because it potentially reduces the effectiveness of the reserve for the protection of the

vegetation types and flora species found in it, complicating and making management more exspensive. Consequently it is desirable to improve the boundary to area ratio of the park by making additions to it.

7.0 INTEGRATING MAINTENANCE OF CONSERVATION VALUE WITH DEVELOPMENT

There are practical limits to the successful integration of development and conservation as development brings with itnot only the removal of the vegetation of the areas actually developed but, also disturbance to adjoining areas (both during and after the actual development) this includes:

- physical disturbance by vehicles, including earthworking vehicles as well as cars and trucks

- the introduction of weeds, resulting in displacement of native species and changes to vegetation structure (and often increased flamability).

- changes to fire regimes (usually in Western Australia this means increased frequency of fire to protect valuable property such as buildings but arson can also be a problem) which results in changes to species composition and in time degradation of the vegetation

- changes to other environmental parameters caused by activities associated with the development can also affect the vegetation and flora. For example: increases in nutrient levels through the use of fertilisers in areas with very nutrient deficient soils such as the Quindalup dune system could result in significant changes in species composition and could very significantly increase the degree of weed invasion; drawdown of water tables can lead to the death of some species, as can increases in water tables caused by clearing of vegetation.

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