UNDERWOOD AVENUE BUSHLAND, SHENTON PARK

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

SECTION 1: LOCATION INFORMATION

Bush Forever Site no. 119
Area (ha): bushland 31.5 (Proposed boundary circumscribes 8.2ha bushland.)
Map no. 46 **Map sheet series ref. no.** 2034–II SW
Other Names: not known
Local Authorities (Suburb): City of Nedlands (Shenton Park)

SECTION 2: REGIONAL INFORMATION

LANDFORMS AND SOILS
Spearwood Dunes
Sands derived from Tamala Limestone (Qts: S7)
VEGETATION AND FLORA
Vegetation Complexes
Spearwood Dunes
Karrakatta Complex — Central and South
Floristic Community Types: *not sampled, type inferred
Supergroup 4: Uplands centred on Spearwood and Quindalup Dunes
*28 Spearwood *Banksia attenuata* or *B. attenuata — Eucalyptus* woodlands
WETLANDS
No wetlands mapped
THREATENED ECOLOGICAL COMMUNITIES
Not assessed

SECTION 3: SPECIFIC SITE DETAIL

Landscape Features: tall dune, vegetated uplands
Vegetation and Flora: limited survey (DEP 1999, Tingay, Alan & Associates 1999)
Structural Units
Uplands: Woodland dominated by *Eucalyptus marginata* or *E. gomphocephala* over *Banksia attenuata, B. menziesii* and *Allocasuarina fraseriana* Low Woodland; Woodland dominated by *Eucalyptus marginata* or *E. calophylla* over *Banksia prionotes* Low Woodland; *Banksia attenuata, B. menziesii* and *Allocasuarina fraseriana* Low Woodland generally with scattered emergent *Eucalyptus marginata* or *E. gomphocephala* or, rarely, *Eucalyptus calophylla*
Vegetation Condition: >50% Very Good, <50% Good to Degraded, with areas of severe localised disturbance
Significant Flora: *Jacksonia sericea* (3) (Tingay, Alan & Associates 1999)
Fauna: structured survey for birds (37 species), reptiles (16 species) and amphibians (3 species) (P. Berry pers. comm.). Significant bird species: category 1 (1), category 3 (3) and category 4 (3)
Linkage: adjacent bushland/canopy to the south; part of Greenway 19 (Tingay, Alan & Associates 1998a); part of a regionally significant potential bushland/wetland linkage (Part A, Map 7)

SECTION 4: INTERNATIONAL AND NATIONAL SIGNIFICANCE

Not listed

SECTION 5: SELECTION CRITERIA AND RECOMMENDATIONS

Criteria: Representation of ecological communities
Recommendation: Urban Negotiated Planning Solution (see Table 3, Volume 1).

UNDERWOOD AVENUE BUSHLAND, SHENTON PARK

Boundary Definition: bushland (part taken to cadastre) boundary

SECTION 1: CADASTRAL INFORMATION

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

Bushplan Site no. 119 **Map no.** 55 **Map sheet series ref. no.** 2034–II SW

Other Names: not known

Local Authorities (Suburb)
City of Nedlands (Shenton Park)

Ownership Categories
State Government

Area (ha): total: 32.1; bushland 31.5

Zoning
MRS: Urban, Important Regional Roads
TPS: Development

Lot/Location/Reserve numbers (Purpose), Street name
0, 4 Underwood Ave
Crown Reserve

SECTION 2: REGIONAL INFORMATION

LANDFORMS AND SOILS

Spearwood Dunes
Sands derived from Tamala Limestone (Qts: S7)

VEGETATION AND FLORA

Vegetation Complexes

Spearwood Dunes
Karrakatta Complex — Central and South

Floristic Community Types: *not sampled, types inferred

Supergroup 4: Uplands centred on Spearwood and Quindalup Dunes
*28 Spearwood *Banksia attenuata* or *B. attenuata — Eucalyptus* woodlands

WETLANDS
No wetlands mapped

THREATENED ECOLOGICAL COMMUNITIES
Not assessed

SECTION 3: SPECIFIC SITE DETAIL

Landscape Features: tall dune, vegetated uplands

Vegetation and Flora: limited survey (DEP 1996, surveyed from roadside)

Structural Units
Uplands: Woodland dominated by *Eucalyptus marginata* or *E. gomphocephala* over *Banksia attenuata, B. menziesii* and *Allocasuarina fraseriana* Low Woodland; *Banksia attenuata, B. menziesii* and *Allocasuarina fraseriana* Low Woodland generally with scattered emergent *Eucalyptus marginata* or *E. gomphocephala* and sometimes with scattered emergent *Eucalyptus calophylla*

Vegetation Condition: >50% Very Good, <50% Good to Degraded, with areas of severe localised disturbance

Significant Flora: not surveyed

Fauna: limited survey by J. Dell (pers. comm.) for birds (12) and reptiles (3)

Linkage: adjacent bushland/canopy to the south; part of proposed Greenway 20 (Tingay, Alan & Associates 1997a); part of a regionally significant potential bushland/wetland linkage (Volume 2A, Map 8)

SECTION 4: INTERNATIONAL AND NATIONAL SIGNIFICANCE

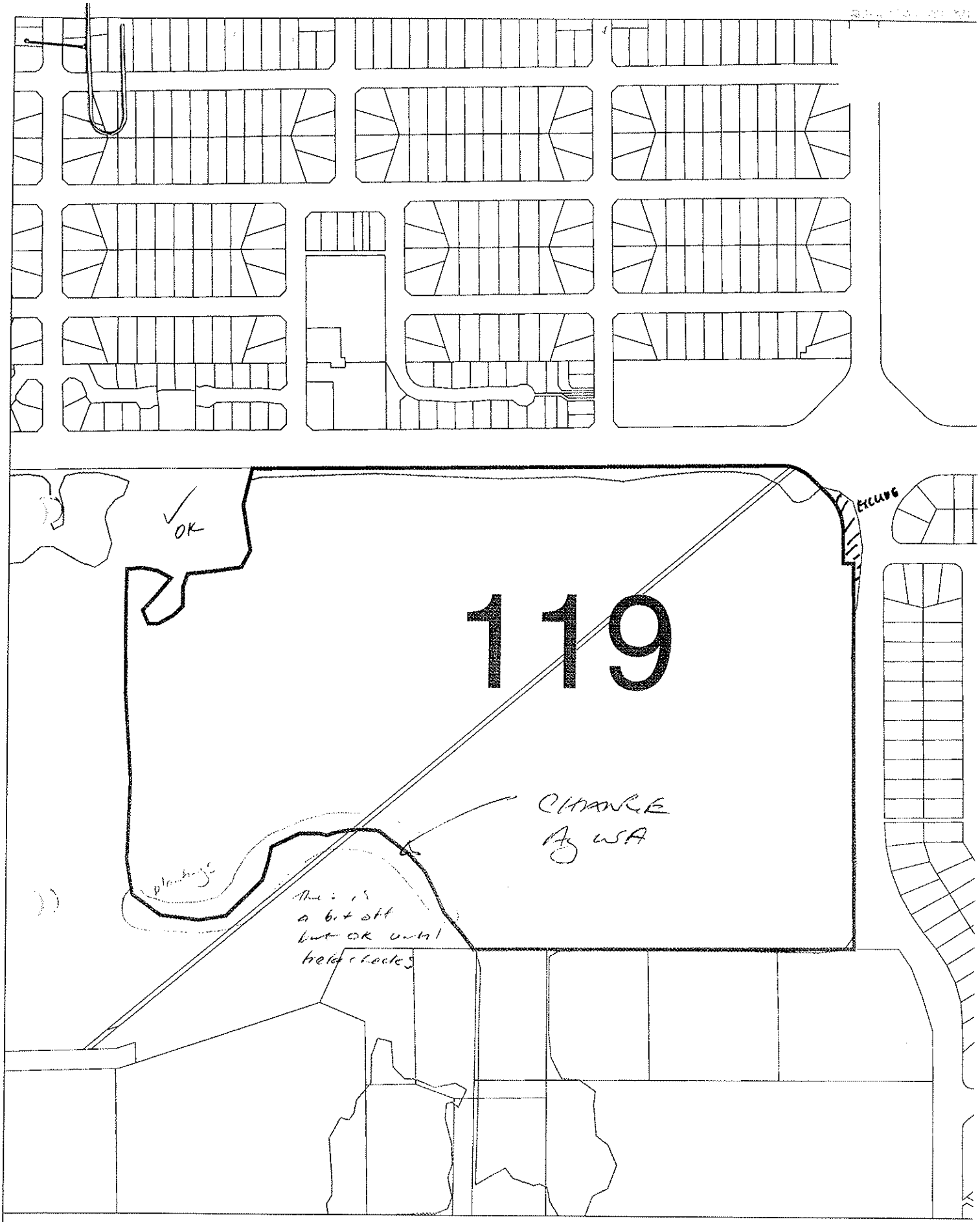
Not listed

SECTION 5: SELECTION CRITERIA AND RECOMMENDATIONS

Criteria: Representation of ecological communities

Opportunities and/or Constraints
Opportunities: Bushplan Site/part Bushplan subject to Swan and Canning Rivers EPP; under Crown Reserve
Constraints: under MRS Urban Zoning, MRD regional road requirements

Recommendation: The most appropriate mechanism for the protection of this Bushplan Site be considered through the public comment period in consultation with the land owner(s).



BUSHPLAN SITES CORRECTED

WESTERN AUSTRALIAN PLANNING COMMISSION

CUSTOMER FOCUS

AGWA CHANGES.

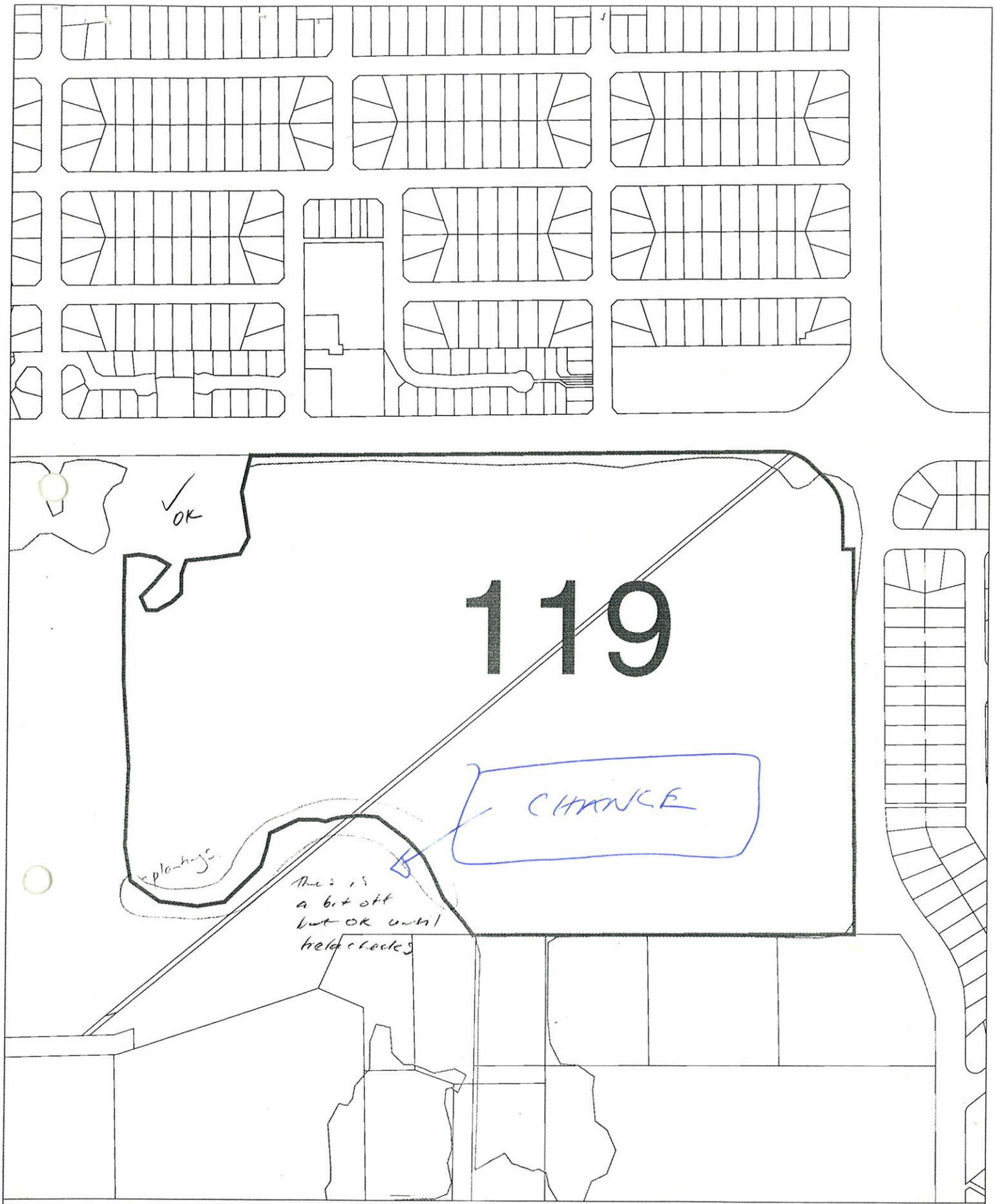
B TC/BK 21/10/98

N

SCALE 1:2500

0 50m

Metres



BUSHPLAN SITES CORRECTED

THE GOVERNMENT OF WESTERN AUSTRALIA

WESTERN AUSTRALIAN PLANNING COMMISSION

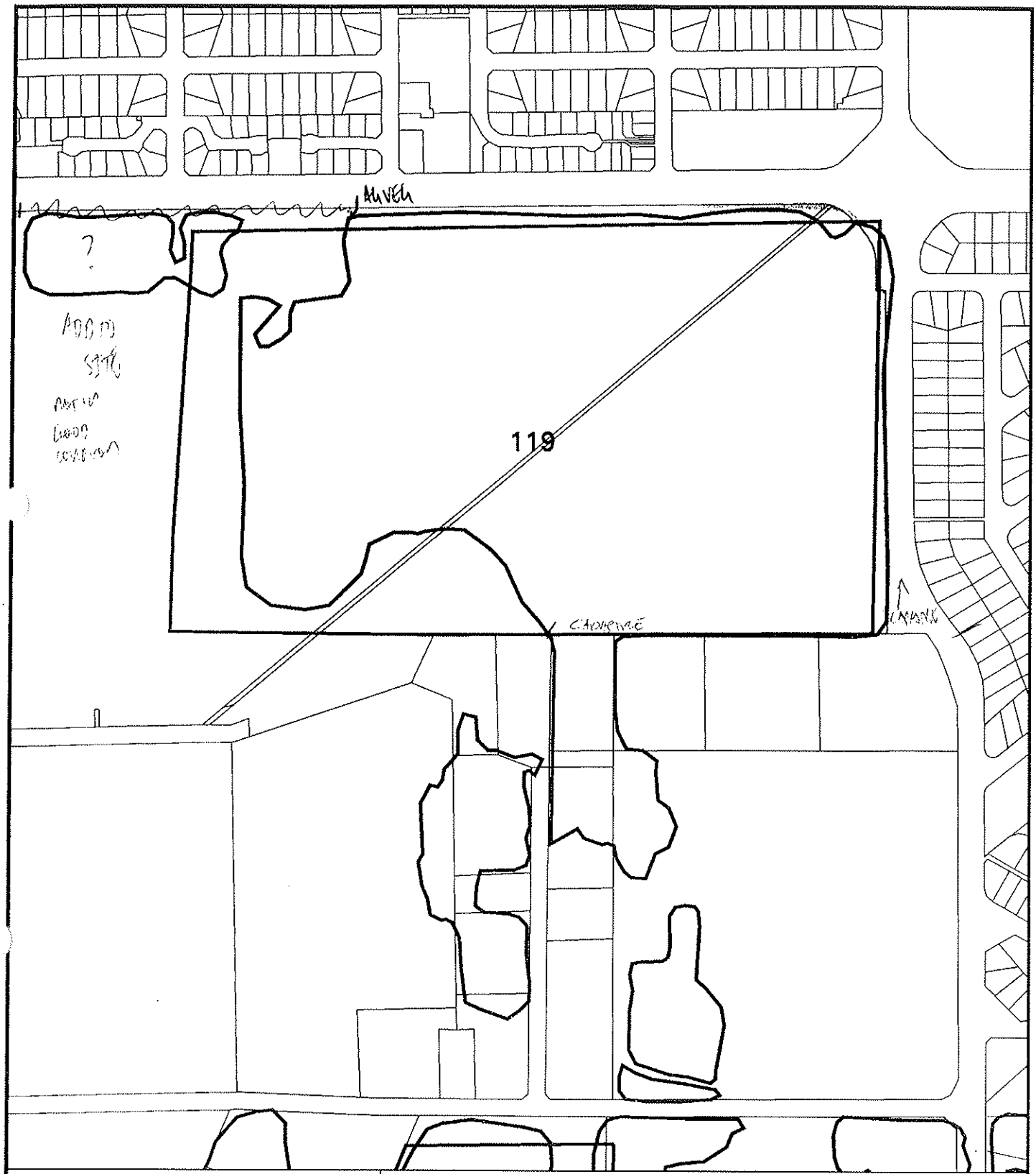
CUSTOMER FOCUS WESTERN AUSTRALIA

N

SCALE 1:2500

0 50m

Metres



bp site 119

AG VEG 1998 BOUNDARY THEME

Cadastre

Bushplan sites refno 1-500 SCP BOUNDARY THEME

MFP INTERNAL USE ONLY
Prepared By: Andrea Zappacosta
Prepared For:
Map Ident: plot980525_4
Date: 25 May 98
Scale 1:6245

BUSHLAND PLANT SURVEY RECORDING SHEET 1- use pencil only

BUSHLAND AREA UNDERWOOD AVE SITE NUMBER UND01

DATE TRIP 14/8/03 RECORDERS BKEIGHERY — Bec RYAN

DATE TRIP _____ RECORDERS _____

DATE TRIP _____ RECORDERS _____

BOTANIST _____

1. LOCATION of the QUADRAT

From 'Bushland Plant Survey' written B. Keighery (1994) and published by Wildflower Society of WA (Inc.), PO Box 64 Nedlands WA 6008.

Mud Map Draw a sketch of the location of the site below.

N

See diagram.

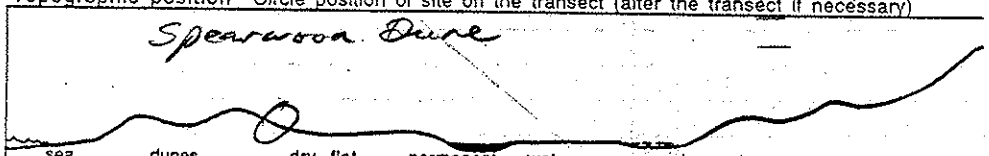
Road Location

Geographic Location Latitude S Longitude E Altitude

Reference Map

Photograph Photographer's Name Photo No

Topographic position Circle position of site on the transect (alter the transect if necessary)



2. SITE DATA Circle the correct response.

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

Surface Soil Sand Colour grey

Exposed rock type % surface

Sub-surface Soil Sand Colour Cream

Rock type depth to rock

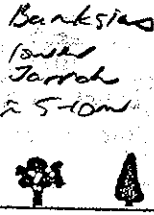
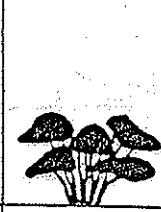
Drainage (well) mod poor depth water cm Wet all year winter/spring

Litter 70 % cover

1 leaf Depth cm

Bare Ground <10 %cover

TREES

	over 30m	30 - 30m (10-15m)	under 10m	MALLEES over 8m	MALLEES under 8m
LIFE FORM					
COVER CLASS (%)		30-70			
DOMINANT SPECIES		Euc. marg Bank. men			

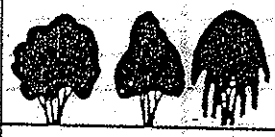
Plot Base ba denser patches

Banksias (some Jarrah ~ 5-10m)

30m

10m

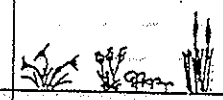
SHRUBS

	over 2m	2m - 1m	under 1m
LIFE FORM			
COVER CLASS (%)		2-10	10-30
DOMINANT SPECIES		Xanth	Hibb hyp

Xanth to 2m but also no trunks in place

2m

1m

	GRASSES	HERBS	SEDGES	OTHER
LIFE FORM				1m
COVER CLASS (%)	30-70	2-10	10-30	
DOMINANT SPECIES	Aostro. comp	* Stad Ceng Burd. cong	Tet. oct Desmo. Flax Meso. pseudo	

4. VEGETATION CONDITION (show range + indicate predominant class)

1 'PRISTINE'	
2 EXCELLENT	
3 VERY GOOD	XX
4 GOOD	
5 DEGRADED	
6 Completely Degraded	

Scale from Keighery (1994)

COMMENTS Low Veldt Grass Cover <2%, Small diameter trunks? past logging, Post fire summer 2001/02

Specific aspects of disturbance

partial clearing

weeds (list): See listing

selective removal of species: (timber cutting) mowing fire grazing dieback %area

fire frequency:

'enrichment plantings' (list)

animal impact: horse foxes rabbits cats dogs goats pigs overgrazing by native mammals

soil movement: mining dumping rubbish dumping roadworks

changes in water regimes: flooding drainage watering nutrient influx

Tracks: fire breaks walk trails off road vehicle use animal tracks

Service corridors: SEC Main Roads Water Authority. Telecom

Other

UNDERWOOD Ø1

Adjacent (within 'new area'

Mauroziamia reidl. (occ)

* Freesia sp.

Daviesia divaricata.

Synaphea spinulosa

Dianella revoluta

Stylidium brunonianum.

Orthrosanthus laxus.

Acacia cyclops.

Conostylis setigera

Dasytis occidentalis Petrophile macrostachya Calodemia sp	Acacia huegelii	Adjacent but outside 'new area'

occ Patches with 7 Valdt Cross

cover.

BUSHLAND PLANT SURVEY RECORDING SHEET 3 - use pencil only

5. SPECIES PRESCENCE

SITE No UND 01

Date 14/07/03

Label each plant with plants number, site code, date and plant's name or working name if required

Record on Sheet

- Column 1 plant name
- Column 2 plant number
- Column 3 flowering time- TICK if species flowering
- Column 4 identification check

TREES	No	Fl	ID
Euc. marg.	1		
Bank. menz.	2		
(Seedling Bank. ?menz)	3		
(Bank. aff scaffend but less common in this unit)			
MALLEES			
SHRUBS			
Xanth. preissii	3		
Hibb. hyp	4		
Rchrop. Rhear	5		
Acacia stenoptera	6		
Hard. Comp.	7		
Scaevola repens	8		
Hypo. robustum.	9		
Stirling. latifolia.	10		
Astrol. pallidum	11		
Jack. hurall (suckers)	12		
# Nemcia capitata	13		
Conostep pendulum	14		
Comp. tomentos.	15		
Leuco ?propinqus	16		
Daviesia nudiflora	17		
Daviesia triflora	18		
Phlothecia spicata	19		
# ? Hovea trisp. (seedlings)	20		

SHRUBS (cont.)	No	Fl	ID
GRASSES			
Austrostipa compressa	1		
* Briza maxima	2		
* Avra caryi	3		
* Ehrharta calycina	4		
* Briza minor			
HERBS			
* Gladiolus caryophyllaceus	5		
Burchardia congesta	6		
Haemadorum spicatum	7		
Lomandra hermaphrodita	8		
Homalosorus pycnocarpos	9		
* Romulea rosea	10		
Lomandra caespitosa	11		
Trachymene pilosa	12		
Pyrorchis nigricans	13		
* Dichopogon strictus ?	14		
Kennedia prostrata	15		
Thysanotus patersonii	16		

HERBS (cont.)	No	Fl	ID
Conostylis aculeata	7		
Lomandra nigricans	8		
Lomandra preissii	9		
Thysanotus ?speciosus	10		
Eryng. pinnat. subsimat	11		
Drosera erythro.			
(7)*			
SEDGES			
Desmocladus ? flexuosa	2		
Meeso. pseudoschoenus	3		
Alex. nitens	4		
Tetraria octandra	5		
Lepidosperma tenue ?	16		
Isolepis marg.	17		
ADD			
Haem. laxum			
Lyginia barbata			
Stirlb. huegelii			
Monotaxis grandiflora			
Hovea trisp.			
Scaevola cuneiformis			
Schoenus clandest.			
Hak. prostrata			
Schoenus caespiticius			
Stylid. piliferum			

Nemcia and Hovea seedlings are diffi

PTO

(47)

BUSHLAND PLANT SURVEY RECORDING SHEET 3 - use pencil only

5. SPECIES PRESCENCE

SITE No UND 02

Date 14/01/03

Label each plant with plants number, site code, date and plant's name or working name if required

Record on Sheet

- Column 1 plant name-
- Column 2 plant number
- Column 3 flowering time- TICK if species flowering
- Column 4 identification check

From '*Bushland Plant Survey*' written by B. Keighery (1994) and published by the Wildflower Society of WA (Inc.), PO Box 64 Nedlands WA 6008.

TREES	No	Fl	ID
Bank. ait.	1		
Bank. menz	2		
Euc. marg.	3		
Acacia saligna (seedlings)	4		
Allocas hus (sprouts)	5		
MALLEES			
Xanth. preissii	6		
Petroph. macrostachy	7		
Mbb hyp.	8		
Conostylis micrantha	9		
Gdmph. tomentosum	10		
Jacksonia sericea (seedlings possibly J. sternbergiana)			
Isotropis cuneifolia	2		
Hakea prostrata	3		

SHRUBS (cont.)	No	Fl	ID
GRASSES			
* Ehrharta calycina	4		
* Briza minor	5		
* Avra caryophyllea	6		
Microstylis compressa	7		
* Briza maxima	8		
HERBS			
Cono. occulata	9		
Konnedya prostrata	10		
* Gladiolus caryophyllaceus	1		
Burchardia congesta	2		
Orthrosanthos laxus	3		
* Romulea rosea	4		
Hemiandra glabra	5		
Haem. spicatum	6		
Haem. laxum	7		
* Dichisma arenarium	8		
* Conyza sp.	9		

HERBS (cont.)	No	Fl	ID
* Ursinia anthemoides	30		
Crassula colorata	1		
* Lactuca saligna	2		
* Petrorhagia velutina	3		
* Trifolium	4		
Dianella revoluta	5		
Trachy. pilosa	6		
Lom. preissii	7		
Poranth. microphylla	8		
Thy. patens/many	9		
Hyp. glabra	40		
* Cerastium glomer.	1		
SEDGES Schoenus clandestinus			
Alex nitens	3		
Desmocladus flexuosus	4		
Meso. pseudostygia	5		
Tetra. octandra	6		
Isolepis marginata	7		
ADJ			
Euc. gomph.			
Bank. / prionotes			
Cono. sessilis			

BUSHLAND PLANT SURVEY RECORDING SHEET 3 - use pencil only

5. SPECIES PRESCENCE

SITE No UND 02
Date 14/01/03

Label each plant with plants number, site code, date and plant's name or working name if required

Record on Sheet
- Column 1 plant name-
- Column 2 plant number
- Column 3 flowering time- TICK if species flowering
- Column 4 identification check

From 'Bushland Plant Survey' written by B. Keighery (1994) and published by the Wildflower Society of WA (Inc.), PO Box 64 Nedlands WA 6008.

TREES	No	Fl	ID
Bank aff.			
Bank menz			
Euc. marg.			
Acacia saligna (seedling)			
Allocas bas (sprouts)			
MALLEES			
SHRUBS			
Xanth. preissii			
Petroph. macrostachy			
Hibb hyp			
Conostylis micrantha			
Gdnyph. tomentosum			
Jacksonia "Senicea" (sucker, possibly J. sternbergiana)			
Isotropis cuneifolia			
Hakea prostrata			

SHRUBS (cont.)	No	Fl	ID
GRASSES			
* Ehrharta calyc			
* Briza minor			
* Avena barb			
Austrostip. compressa			
* Briza maxima			
HERBS			
Cono. aculeata			
Kennedia prostrata			
* Stady / Carex			
Burchardia congesta			
Orthrosanthus laxus			
* Romulea rosea			
Honalo scadiosum homal.			
Haem. spicatum			
Haem. laxum			
* Dichisma arenarium			
* Conyza sp.			

HERBS (cont.)	No	Fl	ID
* Ursinia anthemoides			
Crassula colorata			
* Lactuca saligna			
* Petrorhagia velutina			
* Trifolium			
Dianella revoluta			
Trachy. pilosa			
Lom. preissii			
Poranth. microphylla			
Thy. patersonii			
Hyp. glabra			
* Cerastium glomer.			
SEDGES Schoenus clandest			
Alex nitens			
Desmocladus flex			
Meso. pseudostygia			
Tetra. octandra			
Isolepis marg.			
ADJ			
Euc. gomph.			
Bank prionotes			
Cono. sessilis			

DEP Natural Values Lot Survey 1999 - Version 3 March 1999

BUSHPLAN SITE LOT SURVEY SHEET 1: BOUNDARY /VEGETATION UNIT VERIFICATION

*Use a **Survey Sheet 1** for each Lot inspected.*

BUSHPLAN SITE 119

LOT INSPECTED 2103 Underwood Ave

DATE TRIP 11/5/99 RECORDERS BJK.

VEGETATION UNITS *(Compare units observed with Bushplan Site description units. **Circle/complete** appropriate response)*

MATCHES DESCRIBED UNITS THAT IS:

As amended after Tingay 1999 with slight enlargement of Euc. decipiens area

_____ ADDITIONAL VEGETATION UNITS DESCRIBED (***SEE RECORDING SHEET 2***)

BOUNDARY *(Compare boundary observed with mapped boundary. **Circle/complete** appropriate response)*

MATCHES CURRENT BOUNDARY

_____ CHANGES RECOMMENDED (***OUTLINE EACH CHANGE BELOW AND NUMBER AND DRAW EACH CHANGE ON THE MAP***)

General Changes	Lots	Photo No
Rationale for change		

Change 1	Photo No
Rationale for change	

Subm 1968

BS119

Attachment N:
1 of 2

185

PB042

PERTH'S BUSHPLAN

Submission from the City of Nedlands

Bold Park **Bushplan Site [redacted]2**

The City of Nedlands has a small portion in the south eastern corner of Bold Park. This land is currently reserved for Parks and Recreation within the Metropolitan Region Scheme. The area has regional significance as a flora and fauna reserve. The City of Nedlands supports the inclusion of this area as a Bushplan site, and endorses the recommendations in Volume 2 Part B page 294 of Perth's Bushplan.

Shenton Bushland **Bushplan Site [redacted]8**

This area is currently zoned for light industrial use, however there is a proposal to amend the zoning to Parks and Recreational use. The City of Nedlands has actively encouraged a support group "The Friends of Shenton Bushland" in their efforts to ensure the conservation of this area. The City supports the inclusion of this area as a Bushplan site, and endorses the recommendations in Volume 2 Part B page 296 of Perth's Bushplan.

The City also supports the inclusion of bushland remnants adjoining the proposed Bushplan site. These comprise a strip of bushland down the eastern side of Shenton Bushland, part of the Lemnos hospital and Stubbs Terrace hospital grounds, and remnant bushland on the southern side, part of Irwin Barracks. Inclusion of these areas should be with the co-operation of the landowners.

Underwood Avenue Bushland **Bushplan Site [redacted]19**

This area is owned by UWA and is currently used for agricultural research. There are some pockets of localised severe degradation within this site, however the area has high conservation value due to the proximity of Shenton Bushland Site 218, and its potential as part of Greenway 20 a green corridor linking Bold Park, Lake Claremont and Allen Park bushland. The City is aware that the UWA have plans to develop this site, and endorses the recommendations on Volume 2 Part B page 294 of Perth's Bushplan that "the most appropriate mechanism for this Bushplan Site be considered through the public comment period in consultation with the land owner(s)".

Swanbourne Bushland **Bushplan Site [redacted]15**

This area within the City of Nedlands comes mainly within the jurisdiction of the Commonwealth Government and the Water Corporation, but also includes the majority of a small triangle of land (area 1, Map 55), owned in fee simple by the City and currently a Local Scheme Reserve. This is an important coastal section of Quindalup Dune and its conservation should be a high priority. In principle the City of Nedlands supports the inclusion of this area as a Bushplan site and endorses the recommendations in Volume 2 Part B page 346, although with some reservations (refer to general comments section below).

The City also supports the inclusion of bushland contained in Allen Park an area adjacent to this Bushland site. Its inclusion is warranted on the grounds that it is currently listed by the National Trust of Australia, contains a high level of bio-diversity and its potential as part of Greenway 20 linkage to the Lake Claremont wetland area.

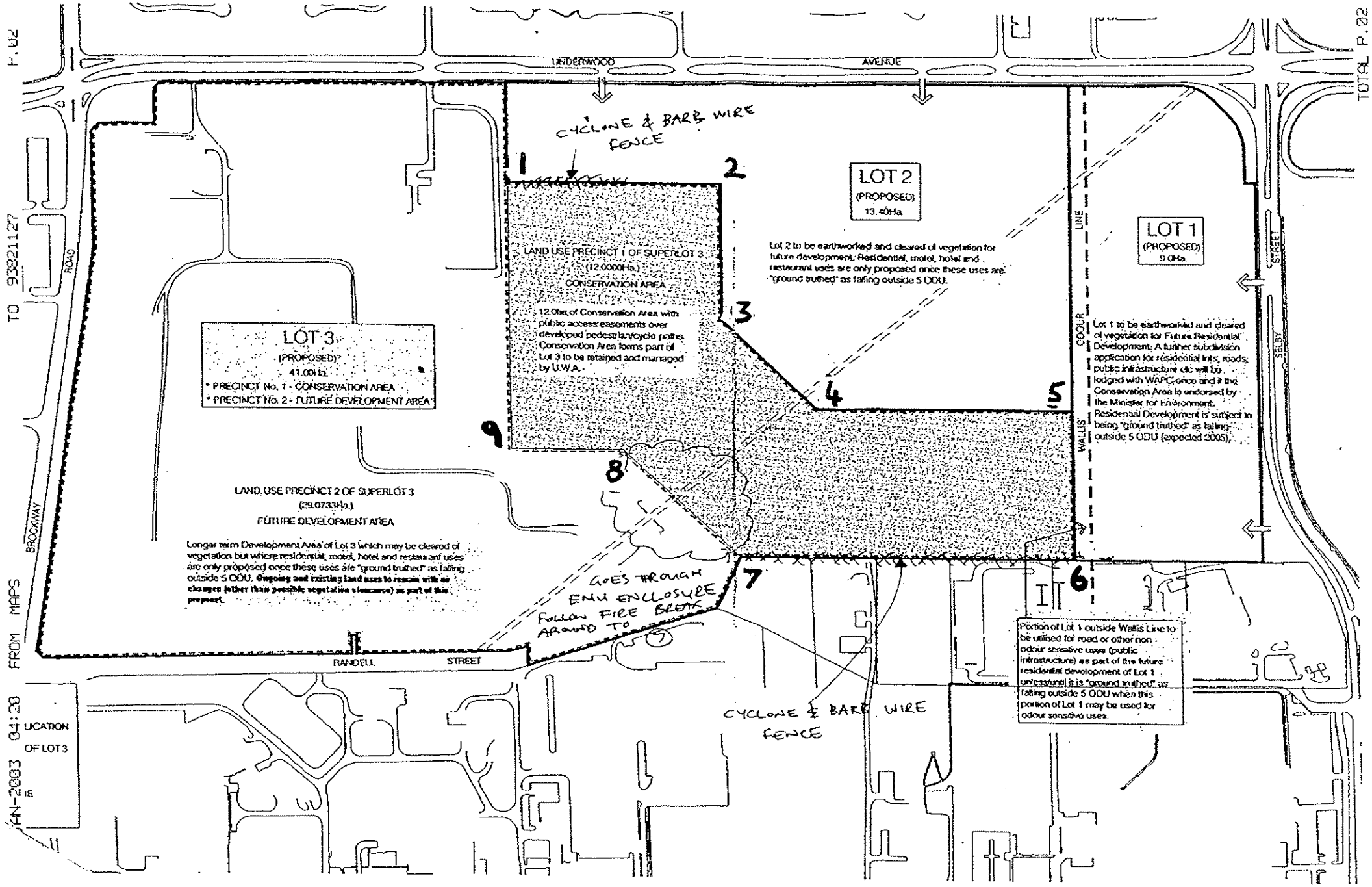


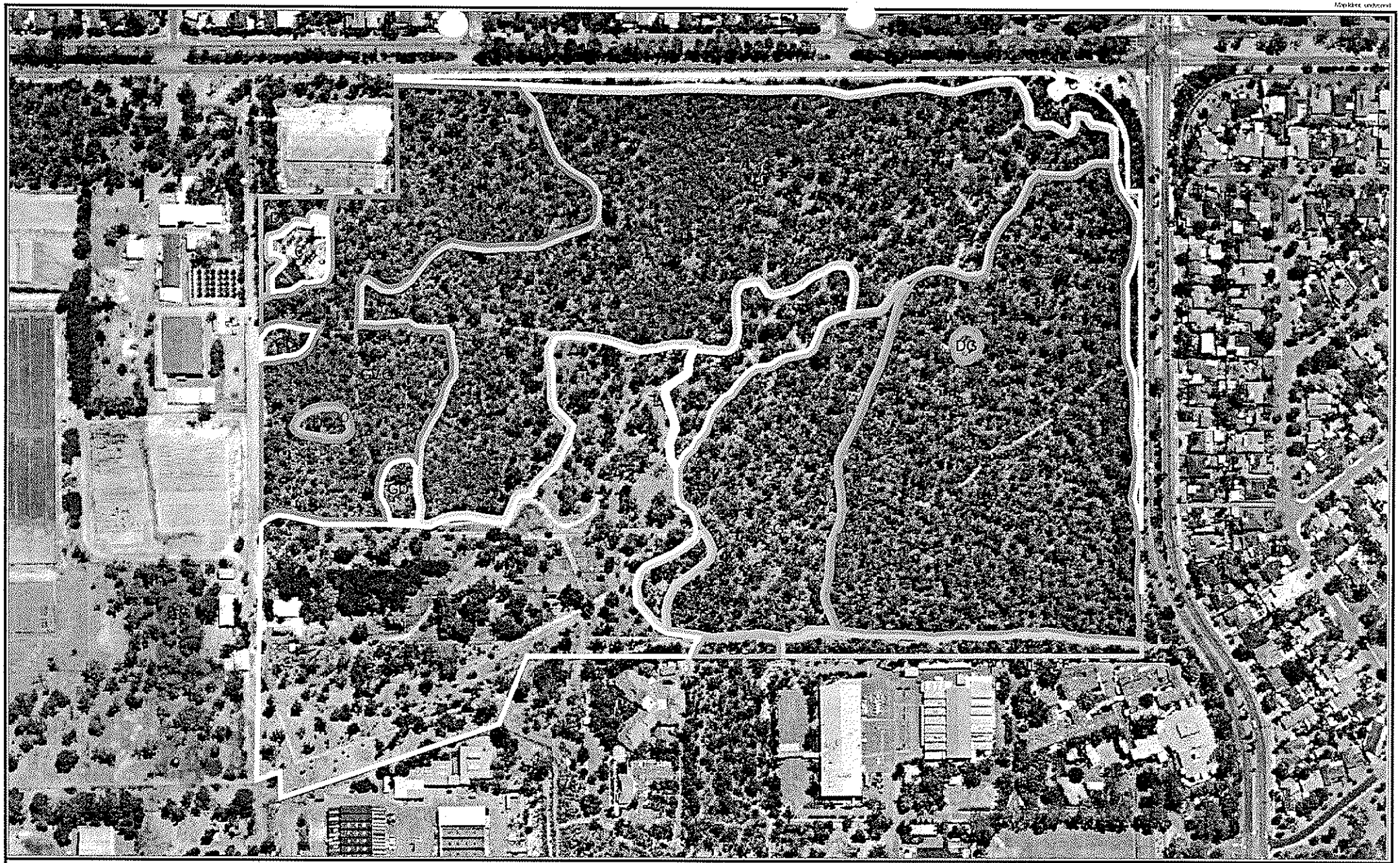
PRINTED: Mon 20 Jan
CHECKED BY: SM 20-1-03
DRAWN BY: GLM/TE 20-1-03
DATUM: AMG
98101/20_133F4.dgn

ATA Environmental
environmental scientists

LOT 2103 UNDERWOOD AVENUE
SHENTON PARK
VEGETATION CONDITION
FIGURE 4

* STAKES WITH PINK FLAG NG AND NUMBERS.
- PINK FLAGGING ALONG LINES.





Department for Planning and Infrastructure

GDA

Produced by the Geographic and Planning Information Branch, Department for Planning and Infrastructure, Perth, Western Australia.
Date: 24 Jan 2003

LEGEND

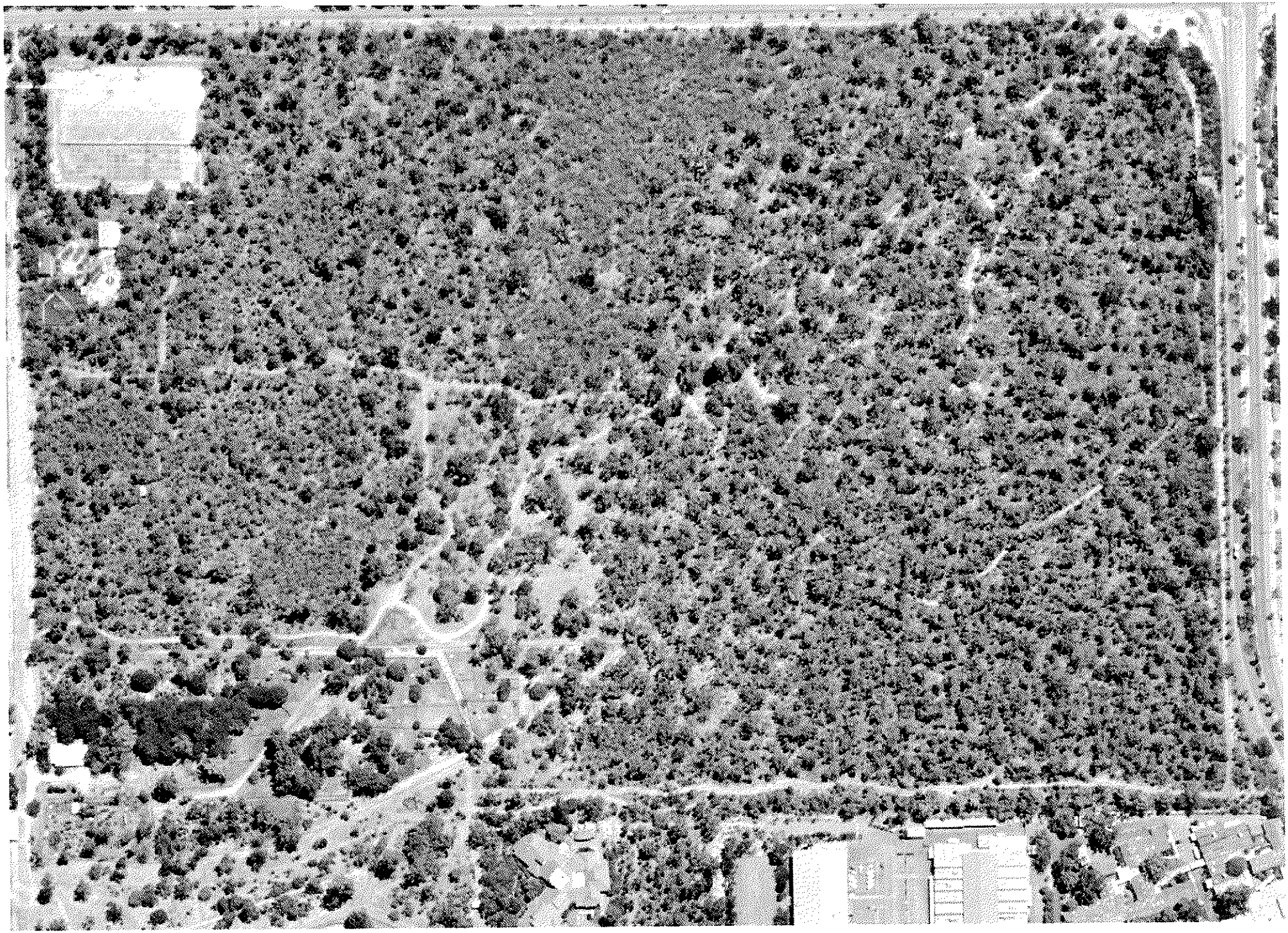
- Cleared
- Degraded To Good
- Good
- Good To Degraded
- Good To Very Good
- Very Good
- Very Good To Good
- Underwood Ave - Quadrats

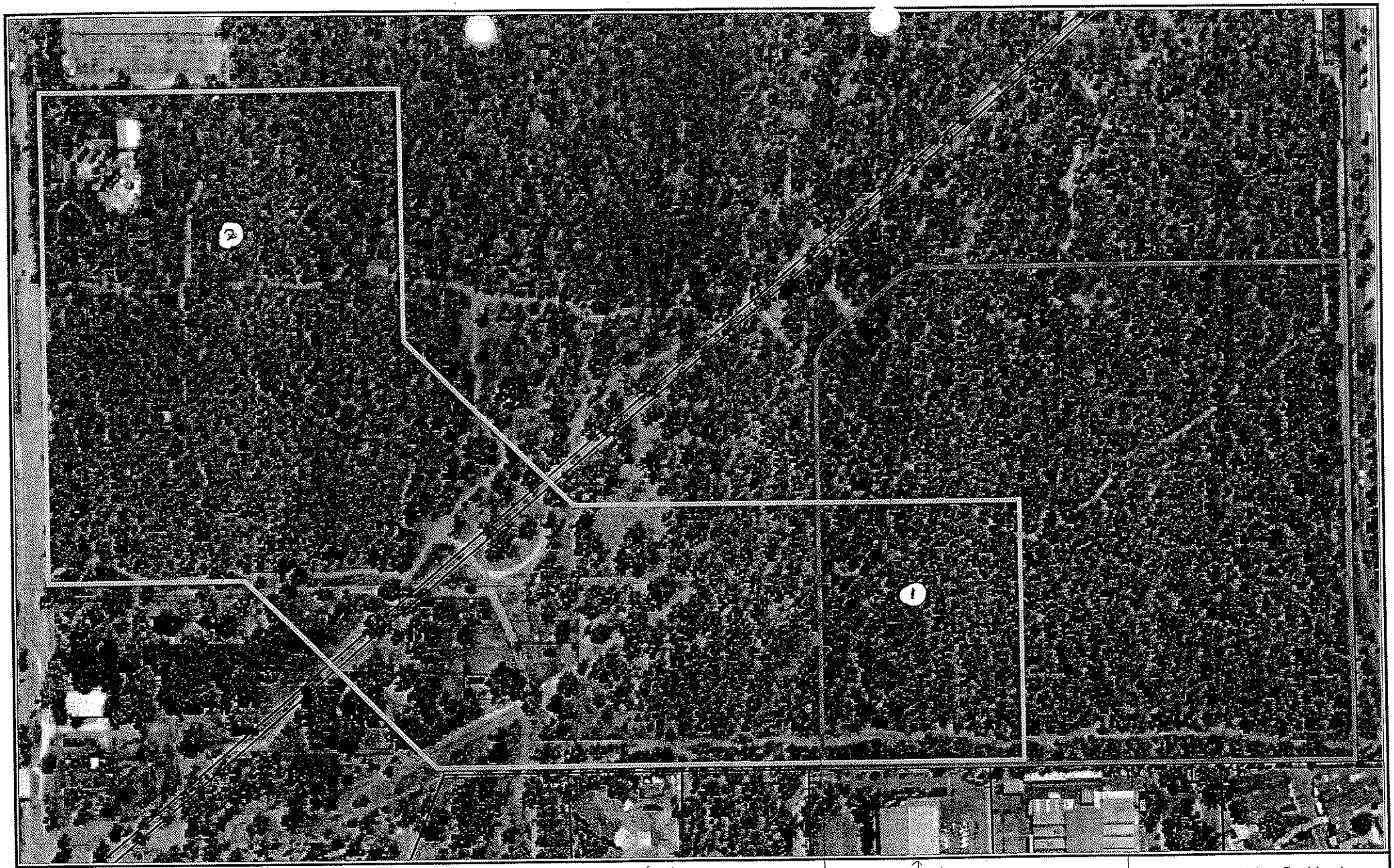
Underwood Avenue Vegetation Condition And Quadrats

N

Scale 1:3000

0 50 m


0
60
120 Meters
1:3000



Department for Planning and Infrastructure

GDA

Produced by the Geographic and Planning Information Branch, Department for Planning and Infrastructure, Perth, Western Australia.
Date: 13 Jan 2003

LEGEND PLOT LOCATIONS 14/01/03.

Cadastre

Underwood Ave - June 2001 Subdivision Plan

Underwood Ave - Nov 2002 Subdivision Plan

3 - 2nd plot

N Fence/firebreak veg understorey mostly removed

Underwood Ave Bushland
Proposed Subdivisions

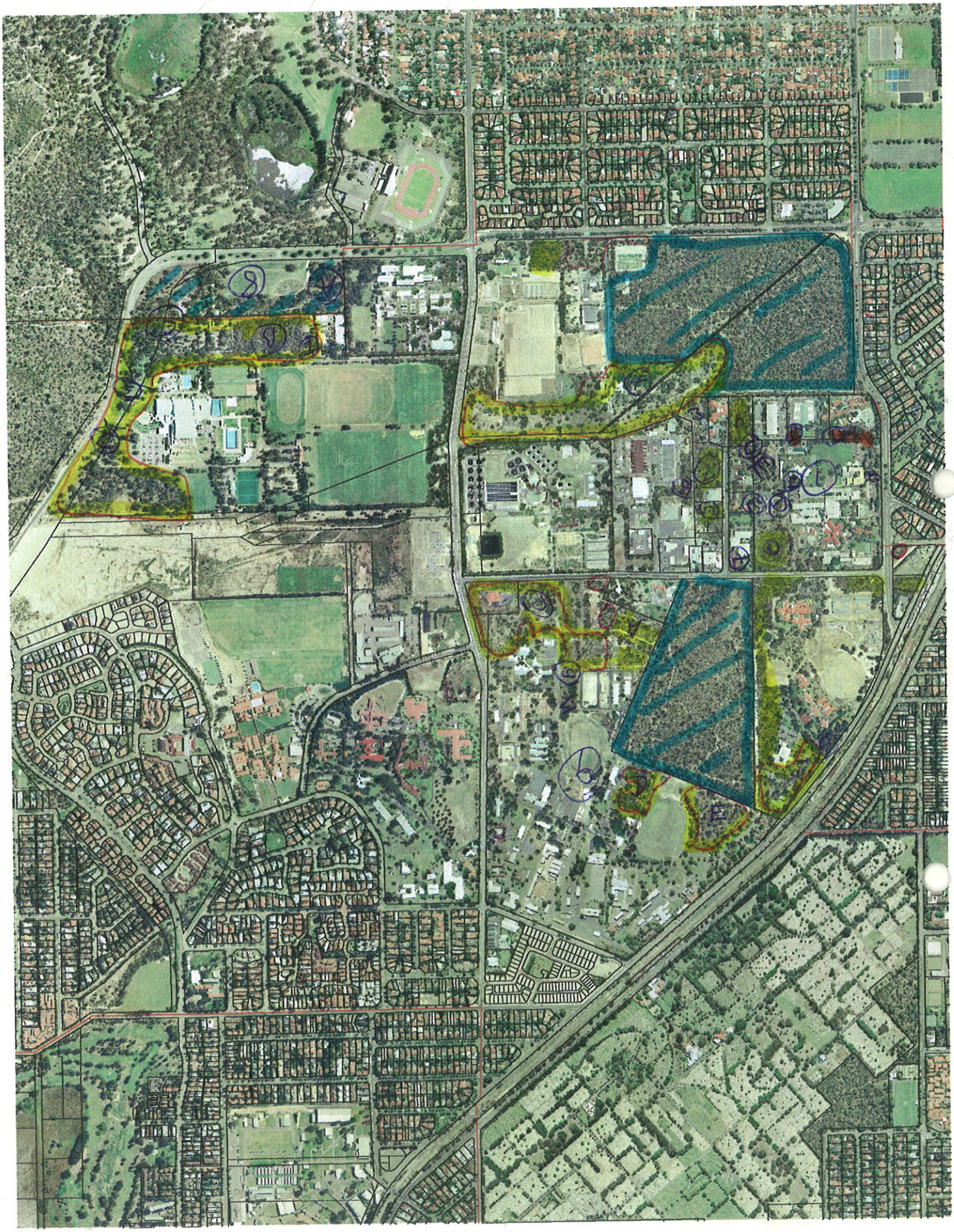
N

Scale 1:2000

0 50 m


Underwood Ave
Good to Degraded
Cleared
V.G
Good to Very Good
Good
Very Good
Cleared
Good
Good to Degraded
Very Good
Very Good to Good
Good
Degraded
Selby Street
Go
Mulch
Fire lane
Take to dump
6
5
3
Very Good
Good
Degraded
Good
Very Good
Good to Degraded
Cleared
Good
Very Good
Very Good to Good
Good
Degraded
Go
Selby Street
metres
PHOTO & CAD SOURCE: Ontario_s Land Inf. 2022
ATA Environmental
LOT 2103 UNDERWOOD AVENUE
SHENTON PARK
VEGETATION CONDITION
FIGURE

Field plots


Bushland
Key Sig (bush
? Native Veg



Underwood Ave
Subdivision Option C2
Vegetation Condition (Revised)

- Underwood Ave - Vegetation Condition (Revised)
- Conservation Area - Option C2
- Public Open Space - Option C2
- Cadastre

Map Ident: plot030129_3
Prepared By: Andrea Zappacosta
Prepared For: K. BEARDMORE
Date: 30 Jan 2003
Scale 1:3000
0 50 m
DPI INTERNAL USE ONLY



Underwood Ave
Subdivision Option A, B, C1
Vegetation Condition (Revised)

- Underwood Ave - Vegetation Condition (Revised)
- Underwood Ave - Option A - June 2001 Subdivision
- Underwood Ave - Option B - Nov. 2002 Subdivision
- Conservation Area - Option C1
- Public Open Space - Option C1
- Cadastre

Map Ident: plot030129_4
Prepared By: Andrea Zappacosta
Prepared For: K.BEARDMORE
Date: 30 Jan 2003
Scale 1:3000
0 50 m
DPI INTERNAL USE ONLY

UNDERWOOD AVENUE

SELBY STREET

TURF FARM

UIWA ZOOLOGY RESEARCH

metres

0 50 100

SCALE 1: 3,000

LEGEND

- Boundary of subject land
- 30 Topographic contours (m AHD)
- 23.8 Spot height (m AHD)
- Track/firebreak

VEGETATION CONDITION

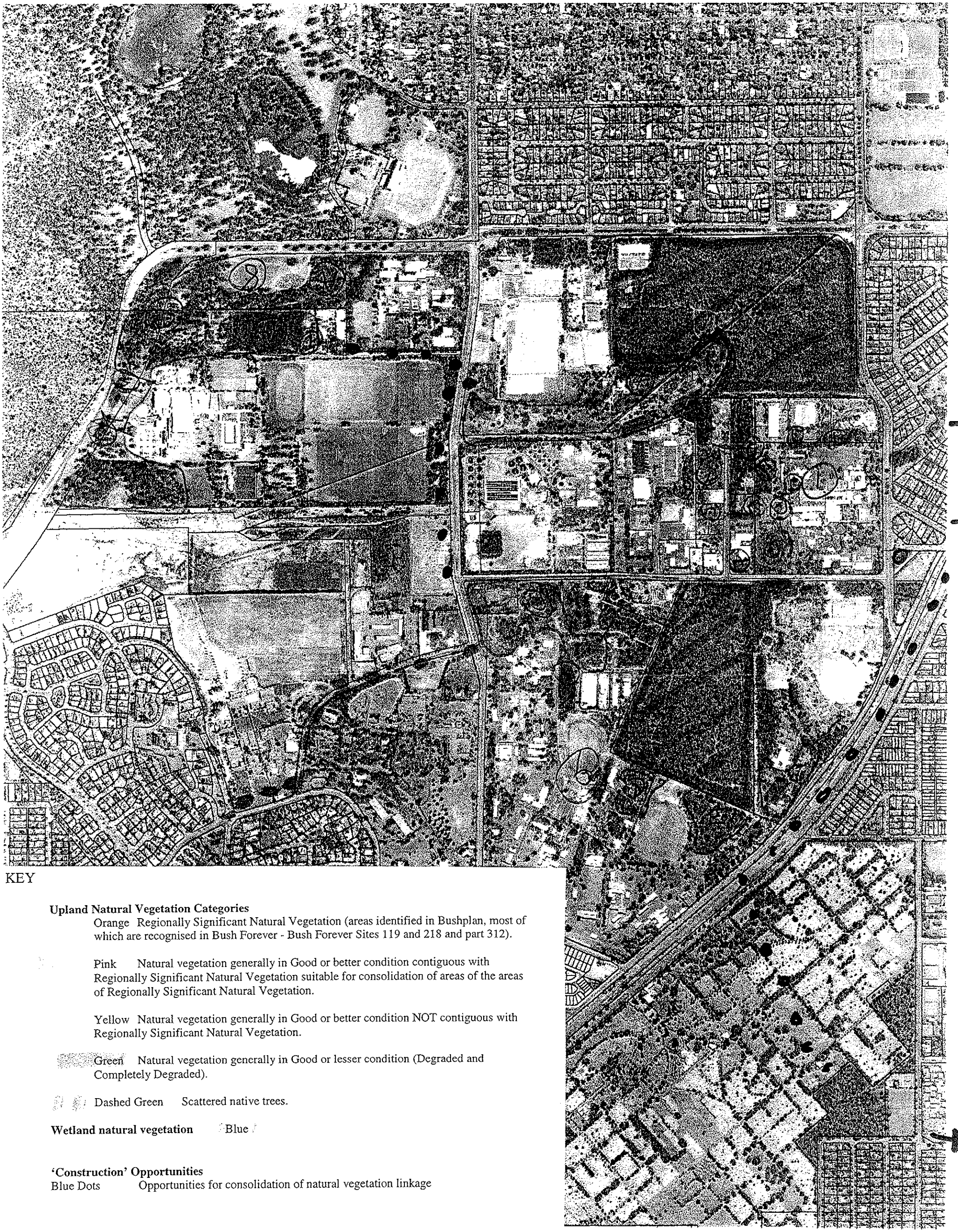
- Disturbed — Very Good
- Obvious Disturbance — Good
- Severely Disturbed — Degraded
- Degraded

LOT 2103
UNDERWOOD AVE SHENTON PARK
VEGETATION CONDITION
FIGURE 4

DRAWN BY: TE 11.8.98 CHECKED BY: SM. 19-8-98

98101

ALAN TINGAY & ASSOCIATES



KEY

Upland Natural Vegetation Categories

Orange Regionally Significant Natural Vegetation (areas identified in Bushplan, most of which are recognised in Bush Forever - Bush Forever Sites 119 and 218 and part 312).

Pink Natural vegetation generally in Good or better condition contiguous with Regionally Significant Natural Vegetation suitable for consolidation of areas of the areas of Regionally Significant Natural Vegetation.

Yellow Natural vegetation generally in Good or better condition NOT contiguous with Regionally Significant Natural Vegetation.

Green Natural vegetation generally in Good or lesser condition (Degraded and Completely Degraded).

Dashed Green Scattered native trees.

Wetland natural vegetation Blue

'Construction' Opportunities

Blue Dots Opportunities for consolidation of natural vegetation linkage

Underwood Avenue
Subdivision Options A,B
Vegetation Conditions
(Revised)

- Degraded to Good
- Good
- Good to Degraded
- Very Good
- Very Good to Good
- CLEARED
- DEGRADED TO GOOD
- GOOD
- GOOD TO DEGRADED
- GOOD TO VERY GOOD
- VERY GOOD
- VERY GOOD TO GOOD
- Underwood Ave - Option A - June 2001 Subdivi
- Underwood Ave - Option B - Nov. 2002 Subdivi

DG
C
GD
GVG
DG
G
GD
VGG
VG
GD
VGG
G
C
VGG
VG
DG
DG
G
G

Map Ident:	plot030128_2
Prepared By:	Andrea Zappacosta
Prepared For:	K. BEARDMORE
Date:	29 Jan 2003
Scale	1:3000
0	50 m

DPI INTERNAL USE ONLY

Underwood Ave
Subdivision Option A,B,C1
Vegetation Condition
(Revised)

- Underwood Ave - Vegetation Condition (Revise
- Underwood Ave - Option A - June 2001 Subdiv
- Underwood Ave - Option B - Nov. 2002 Subdiv
- Conservation Area - Option C1
- Public Open Space - Option C1
- Cadastre
- Area of interest for additional 1ha of Bushland

CLEARED
GOOD TO DEGRADED
DEGRADED TO GOOD
CLEARED
GOOD
GOOD TO DEGRADED
DEGRADED TO GOOD
GOOD TO DEGRADED
GOOD TO VERY GOOD
DEGRADED TO GOOD
POS
GOOD TO DEGRADED
VERY GOOD
VERY GOOD TO GOOD
CA
GOOD
COMPLETELY DEGRADED
DEGRADED TO GOOD
GOOD

Map Ident: plot030129_4
Prepared By: Andrea Zappacosta
Prepared For: K.BEARDMORE
Date: 29 Jan 2003
Scale 1:3000
0 50 m
DPI INTERNAL USE ONLY

Underwood Ave
Subdivision Option C2
Vegetation Condition
(Revised)

- Underwood Ave - Vegetation Condition (Revised)
- Conservation Area - Option C2
- Public Open Space - Option C2
- Cadastre

CLEARED
GOOD TO DEGRADED
DEGRADED TO GOOD
GOOD
CLEARED
GOOD TO DEGRADED
GOOD TO DEGRADED
DEGRADED TO GOOD
GOOD TO VERY GOOD
POS
DEGRADED TO GOOD
GOOD TO DEGRADED
VERY GOOD
VERY GOOD TO GOOD
CA
GOOD
COMPLETELY DEGRADED
DEGRADED TO GOOD
GOOD

Map Ident:	plot030129_3
Prepared By:	Andrea Zappacosta
Prepared For:	K. BEARDMORE
Date:	29 Jan 2003
Scale	1:3000
	0 50 m

DPI INTERNAL USE ONLY

EPA - 10.1 ha needed to be restricted
five acres hectares - not working

	Species	ATA	und01	und02	und03	und04	und05	und06
	Acacia cyclops	1	1					
	Acacia huegelii	1	1					
	Acacia lasiocarpa	1						
	Acacia pulchella	1						
	Acacia rostellifera	1						
	Acacia saligna	1		1	1	1		
	Acacia stenoptera	1	1					
	Acacia willdenowiana	1			1			
	Agonis flexuosus							+
*	Aira caryophyllea		1	1				
	Alexgeorgea nitens	1	1	1	1		1	
	Allocasuarina fraseriana	1		1	1	1	1	1
	Anigozanthos humilis	1						
	Anigozanthos manglesii	1						
*	Arctotheca calendula	1						
	Astroloma pallidum	1	1					
	Austrodanthonia occidentalis		1					
	Austrostipa compressa		1	1				1
*	Avena barbata					1		
*	Avena fatua	1						
	Banksia attenuata	1	1	1	1	1		1
	Banksia grandis	1						
	Banksia menziesii	1	1	1	1	1	1	1
	Banksia prionotes	1		1				1
*	Briza maxima	1	1	1	1	1	1	1
*	Briza minor	1	1	1			1	
*	Bromus diandrus					1		
	Burchardia congesta	1	1	1	1		1	
	Caesia micrantha				1			
	Caesia parviflora	1						
	Caladenia arenicola	1						
	Caladenia flava	1						
	Caladenia latifolia	1						
	Calectasia narragara	1						
*	Callitris preissii	1						
	Calytrix fraseri	1						
*	Carpobrotus edulis	1						
	Cerastium glomeratum			1				
*	Chamaecytisus palmensis							+
*	Chamelaucium uncinatum	1						
	Clematis microphylla	1						
	Comesperma calymega	1						
	Conostephium pendulum	1	1					
	Conostylis aculeata	1	1	1	1	1	1	1
	Conostylis aurea	1						
	Conostylis setigera	1	1	1	1			
	Conyza sp.			1				
	Corymbia calophylla	1						
	Corynotheca micrantha	1		1				
*	Crassula colorata	1		1				
*	Cynodon dactylon	1						
*	Cytissus proliferus	1						
	Daviesia decurrens	1						
	Daviesia divaricata	1	1					
	Daviesia nudiflora	1	1					
	Daviesia triflora	1	1					

	Species	ATA	und01	und02	und03	und04	und05	und06
	Desmocladus flexuosus	1	1	1	1			
	Dianella revoluta var. divaricata	1	1	1	1	1		1
	Dischisma arenarium		1	1				
	Diuris corymbosa	1						
	Drosera erythrorhiza	1	1					
	Drosera macrantha	1						
	Drosera stolonifera	1						
	Dryandra lindleyana	1						
	Dryandra sessilis	1						
*	Ehrharta calycina	1	1	1	1	1	1	1
*	Ehrharta longiflora	1						
*	Eragrostis curvula	1						
	Eremaea beaufortioides	1						
	Eriostemon spicatus	1						
	Eryngium pinnatifidum subsp. pinnatifidum ms	1	1					
	Eucalyptus decipiens	1				1		
	Eucalyptus gomphocephala	1		1				
	Eucalyptus macrocarpa							+
	Eucalyptus marginata	1	1	1	1			
*	Euphorbia peplus	1				1		
*	Euphorbia terracina	1				1		
*	Freesia alba x leichtlinii		1					
*	Freesia leichtlinii	1						
*	Fumaria capreolata	1						
*	Gladiolus caryophyllaceus	1	1	1	1	1	1	1
	Gompholobium marginatum							1
	Gompholobium tomentosum	1	1	1	1		1	
	Haemodorum laxum	1	1	1	1		1	1
	Haemodorum spicatum	1	1	1				1
	Hakea prostrata	1	1	1		1	1	1
	Hardenbergia comptoniana	1	1					
*	Heliophila pusilla	1						
*	Helipterum roseum	1						
	Hibbertia huegelii	1	1					
	Hibbertia hypericoides	1	1	1	1	1	1	
	Hibbertia racemosa	1						
	Homalosciadium homalocarpum		1	1				
	Hovea trisperma	1	1					
	Hybanthus calycinus	1						
	Hypocalymma robustum	1	1					
*	Hypochaeris glabra	1		1				
	Isolepis cernua	1						
*	Isolepis marginata		1	1				
	Isotropis cuneifolia	1		1				
	Jacksonia furcellata	1	1				1	1
	Jacksonia sericea (P3)	1		1			1	
	Jacksonia sternbergiana	1						
	Kennedia prostrata	1	1	1				1
*	Labichea lanceolata subsp. lanceolata	1						
	Lactuca saligna			1		1		
	Lagenifera huegelii	1						
*	Lagurus ovatus	1						
	Laxmannia squarrosa	1						
	Lepidosperma leptostachyum	1						
	Lepidosperma scabrum	1						
	Lepidosperma tenue		1		1		1	

	Species	ATA	und01	und02	und03	und04	und05	und06
*	Leptospermum laevigatum	1						
	Leucopogon parviflorus	1			1			
	Leucopogon propinquus	1	1					
	Lomandra caespitosa	1	1					
	Lomandra hermaphrodita		1				1	
	Lomandra micrantha						1	
	Lomandra nigricans	1	1					
	Lomandra preissii	1	1	1				
*	Lupinus consentinii	1						
*	Lupinus mutabilis	1						
	Lyginia barbata	1	1					
	Macarthuria australis	1						
	Macrozamia fraseri	1	1					
	Mesomelaena pseudostygia	1	1	1	1	1	1	
*	Disa bracteata				1			
	Microtis media				1			
	Monotaxis grandiflora		1					
	Nemcia capitata	1	1		1			
	Olearia axillaris	1				1		
*	Ornithopis sativus	1						
	Orthrosanthus laxus	1	1	1				
*	Osteospermum clandestinum	1						
*	Oxalis pes-caprae	1						
	Ozothamnus cordatus	1						
*	Pelargonium capitatum	1				1		
*	Pennisetum setaceum	1						
	Petrophile linearis	1	1		1			
	Petrophile macrostachya	1	1	1	1		1	1
	Petrophile media	1						
	Petrorhagia dubia			1			1	
	Philotheca spicata		1					
	Phyllanthus calycinus	1						
	Pimelea sulphurea	1						
*	Poa annua	1						
	Podolepis gracilis	1						
	Poranthera microphylla	1		1				
	Pterostylis vittata	1						
	Ptilotus drummondii	1			1			
	Ptilotus polystachyus	1						
	Pyrorchis nigricans	1	1					
	Quinetia urvillei	1						
*	Romulea rosea	1	1	1	1	1	1	1
	Scaevola canescens	1	1				1	
	Scaevola repens var. repens	1	1					
	Schoenus clandestinus		1	1	1		1	
	Schoenus curvifolius		1					
	Schoenus grandiflorus					1		
*	Sonchus oleraceus	1						
	Sowerbaea laxiflora	1						
*	Stenotaphrum secundatum	1						
	Stirlingia latifolia	1	1					
	Stylidium brunonianum	1	1					
	Stylidium calcaratum	1						
	Stylidium piliferum		1					
	Stylidium repens	1						
	Synaphea spinulosa	1	1		1			1

	Species	ATA	und01	und02	und03	und04	und05	und06
	Tetraria octandra	1	1	1				
	Thysanotus patersonii	1	1	1				
	Thysanotus sparteus	1	1		1	1	1	
	Thysanotus triandrus			1				
	Trachymene pilosa	1	1	1				
	Trichoryne elatior				1		1	
*	Trifolium campestre	1		1		1		
*	Ursinia anthemoides	1		1	1		1	1
*	Vicia sp.					1		
	Xanthorrhoea preissii	1	1	1	1	1	1	1
	Grand Total	146	71	51	35	26	28	21

77 in New Option (und02, 03, 04, 05 and 06 combined)
71 in Old Option (und01)
106 in und plots

Compare und01 to rest of plots

		Species	und01	und02	und03	und04	und05	und06
		Alexgeorgea nitens	1	1	1		1	
		Banksia attenuata	1	1	1	1		1
		Banksia menziesii	1	1	1	1	1	1
1	*	Briza maxima	1	1	1	1	1	1
		Burchardia congesta	1	1	1		1	
		Conostylis aculeata	1	1	1	1	1	1
		Conostylis setigera	1	1	1			
		Desmocladus flexuosus	1	1	1			
		Dianella revoluta var. divaricata	1	1	1	1		1
2	*	Ehrharta calycina	1	1	1	1	1	1
		Eucalyptus marginata	1	1	1			
3	*	Gladiolus caryophyllaceus	1	1	1	1	1	1
		Gompholobium tomentosum	1	1	1		1	
		Haemodorum laxum	1	1	1		1	1
		Hibbertia hypericoides	1	1	1	1	1	
		Mesomelaena pseudostygia	1	1	1	1	1	
		Petrophile macrostachya	1	1	1		1	1
4	*	Romulea rosea	1	1	1	1	1	1
		Schoenus clandestinus	1	1	1		1	
		Xanthorrhoea preissii	1	1	1	1	1	1
5	*	Aira caryophyllea	1	1				
		Austrostipa compressa	1	1				1
6	*	Briza minor	1	1			1	
		Dischisma arenarium	1	1				
		Haemodorum spicatum	1	1				1
		Hakea prostrata	1	1		1	1	1
		Homalosciadium homalocarpum	1	1				
7	*	Isolepis marginata	1	1				
		Kennedia prostrata	1	1				1
		Lomandra preissii	1	1				
		Orthrosanthus laxus	1	1				
		Tetraria octandra	1	1				
		Thysanotus patersonii	1	1				
		Trachymene pilosa	1	1				
		Lepidosperma tenue	1		1		1	
		Nemcia capitata	1		1			
		Petrophile linearis	1		1			
		Synaphea spinulosa	1		1			1
		Thysanotus sparteus	1		1	1	1	
		Jacksonia furcellata	1				1	1
		Lomandra hermaphrodita	1				1	
		Scaevola canescens	1				1	
		Acacia cyclops	1					
		Acacia huegelii	1					
		Acacia stenoptera	1					
		Astroloma pallidum	1					
		Austrodanthonia occidentalis	1					
		Conostephium pendulum	1					
		Daviesia divaricata	1					
		Daviesia nudiflora	1					
		Daviesia triflora	1					
		Drosera erythrorhiza	1					
8		Eryngium pinnatifidum subsp. pinnatifidum ms	1					
	*	Freesia alba x leichtlinii	1					
		Hardenbergia comptoniana	1					
		Hibbertia huegelii	1					

		Species	und01	und02	und03	und04	und05	und06	
		Hovea trisperma	1						
		Hypocalymma robustum	1						
		Leucopogon propinquus	1						
		Lomandra caespitosa	1						
		Lomandra nigricans	1						
		Lyginia barbata	1						
		Macrozamia fraseri	1						
		Monotaxis grandiflora	1						
		Philotheca spicata	1						
		Pyrorchis nigricans	1						
		Scaevola repens var. repens	1						
		Schoenus curvifolius	1						
		Stirlingia latifolia	1						
		Stylidium brunonianum	1						
		Stylidium piliferum	1						
		Acacia saligna		1	1	1			
		Allocasuarina fraseriana		1	1	1	1	1	
9	*	Ursinia anthemoides		1	1		1	1	
		Banksia prionotes		1				1	
		Cerastium glomeratum		1					
		Conyza sp.		1					
		Corymbotheca micrantha		1					
10	*	Crassula colorata		1					
		Eucalyptus gomphocephala		1					
11	*	Hypochaeris glabra		1					
		Isotropis cuneifolia		1					
		Jacksonia sericea (P3)		1			1		
		Lactuca saligna		1		1			
		Petrorhagia dubia		1			1		
		Poranthera microphylla		1					
		Thysanotus triandrus		1					
12	*	Trifolium campestre		1		1			
		Acacia willdenowiana			1				
		Caesia micrantha			1				
		Leucopogon parviflorus			1				
13	*	Disa bracteata			1				
		Microtis media			1				
		Ptilotus drummondii			1				
		Trichoryne elatior			1		1		
14	*	Avena barbata				1			
15	*	Bromus diandrus				1			
		Eucalyptus decipiens				1			
16	*	Euphorbia peplus				1			+
17	*	Euphorbia terracina				1			
		Olearia axillaris				1			
18	*	Pelargonium capitatum				1			
		Schoenus grandiflorus				1			
19	*	Vicia sp.				1			
		Lomandra micrantha					1		
		Gompholobium marginatum						1	
				77 in New Option (und02, 03, 04, 05 and 06 cor					
				71 in Old Option (und01)					

TABLE 1
UNDERWOOD AVENUE BUSHLAND
PROPOSED SUBDIVISIONS
AREA CALCULATIONS (IN HECTARES) OF VEGETATION CONDITIONS (REVISED)

		Jun-01	Nov-02	
OPTIONS	Bushplan 98	A	B	C
VEGETATION CONDITION				
VERY GOOD	7.93	6.3	0.9563	1.35
VERY GOOD TO GOOD	3.07	1.37	1.63	1.79
GOOD TO VERY GOOD	4.43		3.07	3.09
GOOD	10.58	0.5993	2.44	3.17
TOTAL GOOD OR BETTER	**26.01**	**8.2693**	**8.0963**	**9.4**
GOOD TO DEGRADED	2.48	0.1872	0.2725	0.2641
DEGRADED TO GOOD	0.42	0.0442	0.4038	0.237
CLEARED	0.19		2.99	
COMPLETELY DEGRADED **	3			2.1
TOTAL ALL CONDITIONS	**32.1**	**8.5**	**11.7**	**12.00**

UNDERWOOD AVENUE BUSHLAND
PROPOSED SUBDIVISIONS
AREA CALCULATIONS (HECTARES) OF VEGETATION CONDITIONS (REVISED)

	Jun-01	Nov-02	Jan-03			
OPTIONS	A	B	C1 *	D	E	C2 *
VEGETATION CONDITION						
VERY GOOD	6.3	0.9563	1.41	1.9	3.37	1.54
VERY GOOD TO GOOD	1.37	1.63	2.63	2.14	1.63	2.96
GOOD TO VERY GOOD		3.07	3.01	3.01	3.01	3.17
GOOD	0.5993	2.44	2.08	2.15	2.39	2.71
TOTAL GOOD OR BETTER	**8.2693**	**8.0963**	**9.13**	**9.2**	**10.4**	**10.38**
GOOD TO DEGRADED	0.1872	0.2725	0.4314	0.3261	0.3324	0.4081
DEGRADED TO GOOD	0.0442	0.4038	0.2204	0.2204	0.2204	0.2204
~~CLEARED~~		2.99	2.22	2.22	2.2	
COMPLETELY DEGRADED **						2.41
TOTAL ALL CONDITIONS	**8.5**	**11.7**	**12**	**12**	**13.1**	**13.4**

* excludes areas in POS

** Some areas of Cleared was changed to Completely Degraded

ATA Environmental
environmental scientists

ENVIRONMENTAL BENEFITS OF THE 12 HECTARE CONSERVATION AREA PRESENTED TO THE BUSH FOREVER TECHNICAL ADVISORY GROUP

18 DECEMBER 2002

The 12.0ha Conservation Area:

1. Provides a greater area for conservation (12.0ha) compared to the 8.23ha Bush Forever outcome, the 8.5ha EPA assessed area and the 9.7ha likely EPA revised assessment outcome.

   The 12ha consists of 9ha Good to Very Good (5ha Very Good, 4ha Good) condition vegetation and 3ha Degraded. The 9ha Good to Very Good is slightly more than the Good to Very Good vegetation in the 8.5ha assessed area and 0.7ha less than the likely EPA revised area which consisted of 3.3ha Good and 6.4ha Very Good vegetation.

   BUT 2 parcels

   UWA is committed to rehabilitating the 3ha degraded area back to a Very Good condition. ? timing KP being approached to do the work.

2. Provides a greater diversity of vegetation type representative of the Karrakatta Central and South Complex.

Vegetation Type	12ha Version	8.5ha Version	9.7ha Version
Jarrah/Banksia/Sheoak Low Woodland	4.0	8.5	10.0
Jarrah/Tuart Open Woodland	1.5	0	0
Banksia attenuata/B. menziesii Woodland	5.4	0	0
Banksia prionotes Closed Scrub	0.1	0	0
Eucalyptus decipiens Low Woodland	0.1	0	0
Jarrah over *Banksia menziesii* Low Woodland	0.6	0	0
Cleared	0.3	0	0

3. As a result of 2 above, the area also provides a greater diversity of flora and possibly fauna. Key

4. Provides immediate protection for all populations of *Jacksonia sericea* (Priority 3) rather than a commitment to protect some populations in POS in the future development of that area.

5. Provides immediate protection for the stand of *Eucalyptus decipiens* rather than a commitment to protect the area in future POS.

6. Provides additional linkage to the south to the Lemnos Street Bushland.

7. Provides a more aesthetic passive recreational area situated across the hill with 360 views.

8. Better satisfies the wishes of the Aboriginal Elders who prefer the top of the hill to be retained as bush and the area recognised for its Aboriginal heritage.

9. UWA is committed to managing the Conservation Area by means of an agreed Environmental Management Plan.

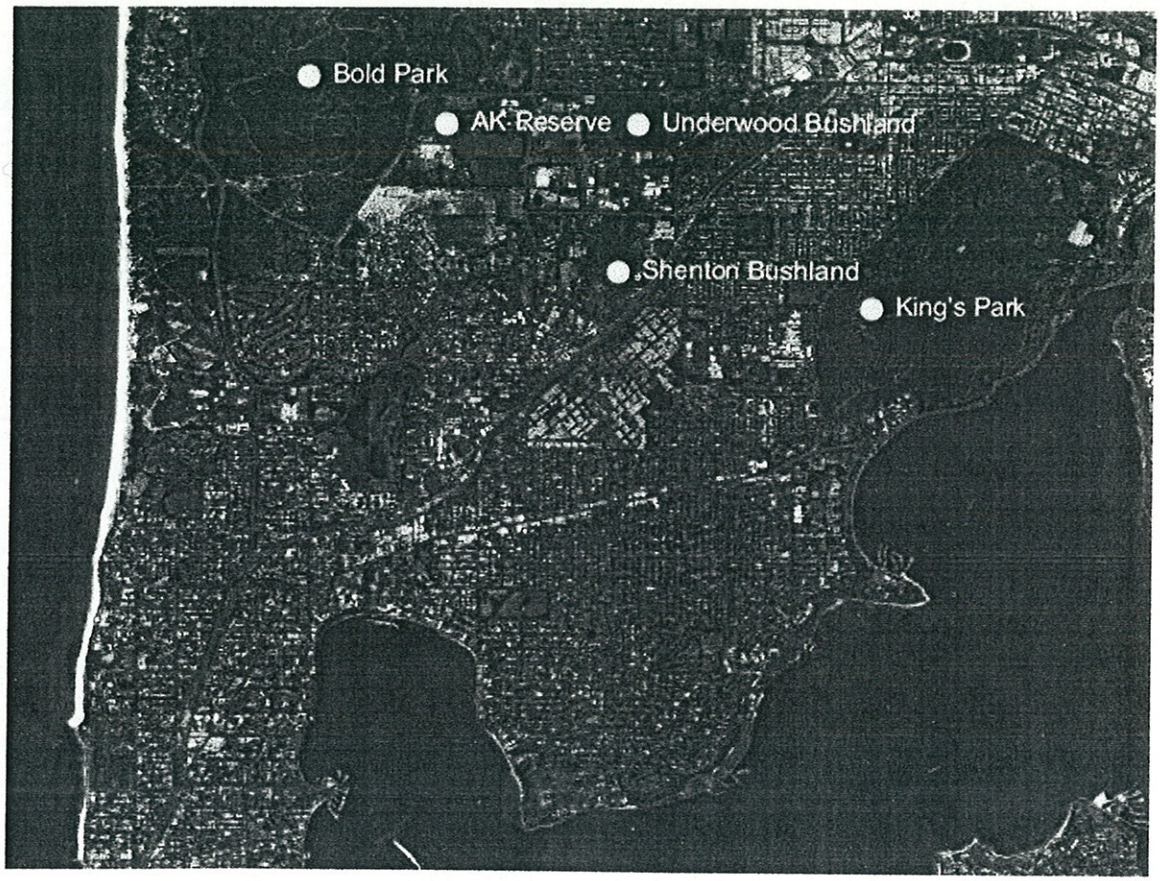
Djandoo Bush Link

This visionary proposal would link Kings Park to Bold Park and on to the coast, through a green bush corridor.

Kings Park is too small by itself to maintain its biodiversity in the long term and its survival depends on linkages to surrounding areas. The corridor to Bold Park is the only remaining corridor. Key sections of the corridor may be lost forever if not protected now.

MAIN ELEMENTS OF THE DJANDOO BUSH LINK

- Kings Park (404 hectares and Bush Forever site 317) Managed by BPGA
- Shenton Bushland (24.5ha and Bush Forever site 218) Vested in the City of Nedlands and managed in collaboration with the Friends of Shenton Bushland, with input from the City of Nedlands.
- Underwood Avenue Bushland (38ha and Bush Forever site 119) Vested to the University of WA in 1904.
- Bold Park (437ha and Bush Forever site 312) Managed by BPGA



For Origin
See Shenton Park Bushland File
BS Ref 218
PB069

Underwood Avenue - Alternative conservation proposal

This alternative conservation outcome is based on improving the size and characteristics of the previous proposal that was accepted by UWA, but rejected by the Minister as not environmentally acceptable on biodiversity and conservation outcomes. It is consistent with EPA (Guidance Statement 10) expectations of Bush Forever negotiated outcomes that the core and most significant areas of Bush Forever Sites would be retained.

Conservation priorities

1. **Retain large consolidated area of bushland in the best condition.**

- Optimal representation of the most intact area of flora and vegetation within boundaries that minimise the boundary to area ratio.
- Additional area included an unmapped population of *Banksia prionotes*.
- Conservation of best available habitat (dense relatively diverse canopy and intact understorey) for birds species that are declining on the Swan Coastal Plain because of habitat fragmentation and loss of condition.

2. **Representation of range of habitats present at Underwood Avenue**

- Representation of west-facing slope with Banksia dominated woodland vegetation (*Banksia menziesii, B. attenuate* and *B. prionotes*) and Jarrah-Allocasuarina Woodland. (The small population of *E. decipiens* and *Jacksonia sericea* (P3) was not considered a priority over the representation of best habitat and linkage)
- Retention of multiple Banksia species is significant as feeding habitat for a variety of nectar feeders, insectivores and seed eating species (Carnaby's Cockatoo)

2. **Retention of Tuart Trees and bushland on/along the high point of the ridge**

- Important role as line-of-sight habitat to maintain bird movement between the Bold Park and Kings Park via Underwood Avenue and Shenton Park

3. **Maintenance of semi-contiguous canopy linkage with Bold Park**

- Retention of bushland linking to edge of Underwood Avenue where the best option exists for maintenance and potential future enhancement of tree canopy and large shrub vegetation to facilitate movement particularly for small bushland bird species. Expected to be important in maintaining viable populations in the smaller bushland area at Underwood Avenue of several poorly dispersing bird species that are declining on the Swan Coastal Plain.

Other Issues

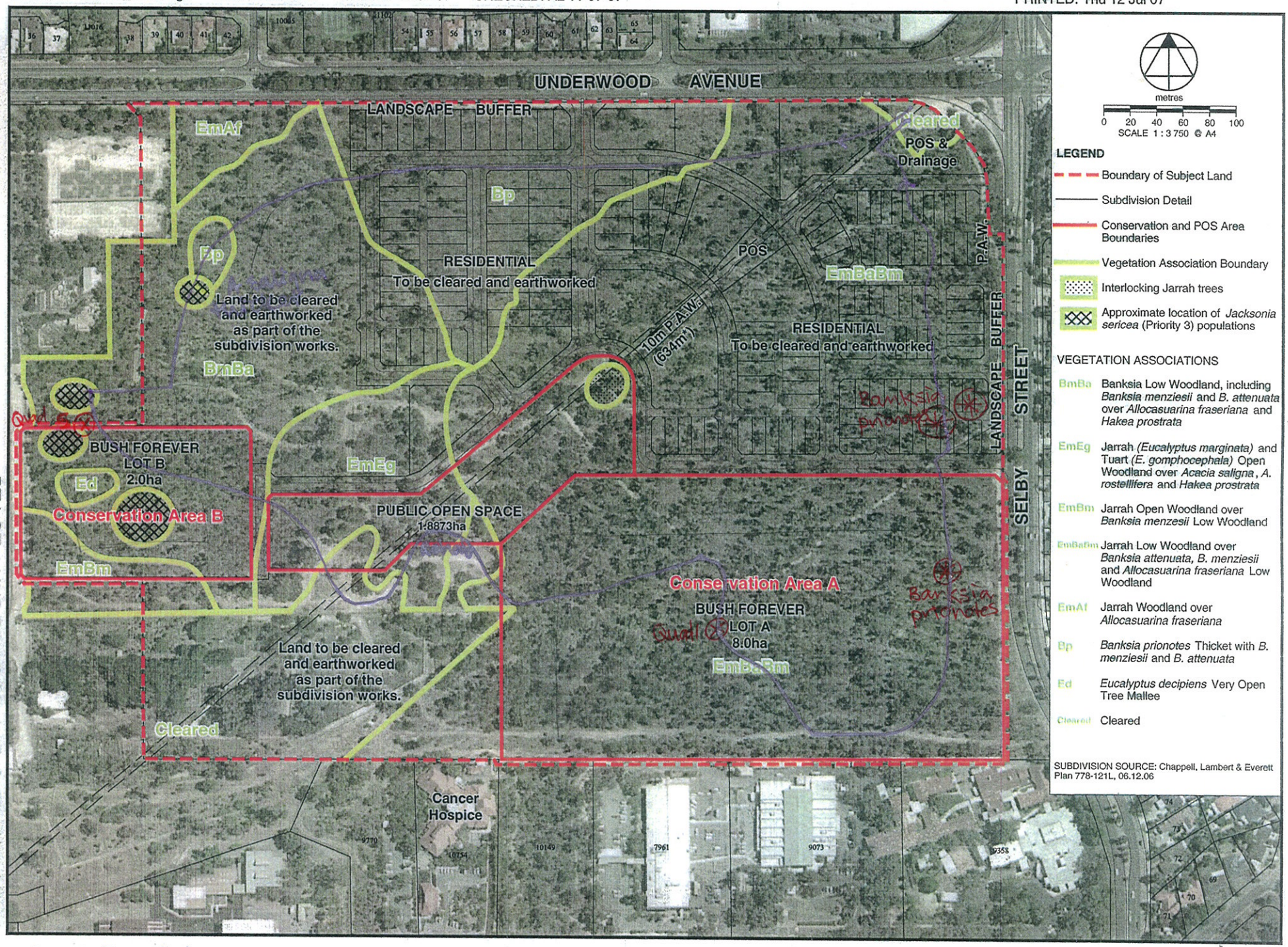
Significant feeding habitat for Carnaby's Cockatoo – Underwood is in close proximity to a major seasonal roosting site for Carnaby's (Hollywood Hospital). The existence of several bushland reserves in close proximity is considered to be important to minimising foraging distance and optimising energy budget of the Cockatoos.

Potential habitat for Graceful Sun Moth (Schedule 1 - Rare likely to become extinct) The Graceful Sun Moth has been recorded in similar habitat at nearby Shenton Park Bushland. The sedge *Lomandra hermaphrodita* a recognised food plant for the larval stage of the moth is widespread through Underwood Avenue and represents suitable habitat.

UWA-2003-001/26_263f3.dgn DATUM: MGA50 DRAWN: 11-07-07 CHECKED: AL 11-07-07 PRINTED: Thu 12 Jul 07

ATA Environmental
environmental scientists

PT LOT 4 UNDERWOOD AVE, SHENTON PARK
2007 DEVELOPMENT & CONSERVATION PROPOSAL:
ENVIRONMENTAL REVIEW REPORT
VEGETATION ASSOCIATIONS



Site visit 21/9/07 - Paul VDMoezel, Gary Whissan, John Dell, Bec Ryan

* B. prion small patch
X 1, 5 – Quadrats 14/1+20/1/03 = confirmed Lomandra hermaph
foot traverse 3hrs

Swan EIA 68 1999 6/2

DRAFT PRELIMINARY COMMENT ON BUSHPLAN SITE 119 IN RELATION TO ENVIRONMENTAL ASSESSMENT (ATA ENVIRONMENTAL NOVEMBER 2000 REPORT NO 2000/133)

Synopsis

The Environmental Assessment adequately documents the flora and vegetation of Bush Forever Site 119. In the 38ha Site the report describes

- a rich flora of 112 native taxa including one Priority taxon (*Jacksonia sericea*),
- a variety of communities, seven plant communities being mapped and
- the vegetation as being in Very Good to Good condition.

Previous to this report (together with its draft in 1999) little information was available on the flora and vegetation of the Bush Forever Site the bushland area being included in Perth's Bushplan (and Bush Forever) on the basis of aerial photography interpretation, broad vegetation mapping and the vegetation complex it represents. The report clearly acknowledges the regional value of the bushland, section 5 concluding that Lot 4 "…contains regionally significant urban bushland…".

However no serious attempt is made to describe these values in terms of the criteria used to identify regionally significant bushland in Perth's Bushplan and identify areas for inclusion in Perth's Bushplan/Bush Forever. It would be expected that such a report would describe the values of the Site's bushland, in particular its regional significance and compare the area with other regionally significant bushland identified on the same landform/vegetation unit (Spearwood Dunes/Karrakata Central and South Vegetation Complex). The report only goes as far as listing some comparable areas and listing the criteria for the identification of regionally significant and locally significant bushland in the Urban Bushland Strategy and avoids any serious discussion of the bushland's values in a regional context. The report's conclusion that

"While several species and vegetation types occurring at the study area are of interest within the local area none of them are unique to the study site". ~~is likely to be correct but~~ is not substantiated in the report. ~~This does not address its significance as~~

The report is characterised by a series of unsubstantiated or poorly constructed discussion of the conservation attributes of the bushland that effectively undervalue the ~~value~~ significance of the bushland in Lot 4 recognised in the Site. Some examples of this approach are

- The Karrakatata Central and South Vegetation Complex is not well reserved in Bushplan (less than 10% recognised).
- Significant features of the vegetation
- The signifcance of the various units of vegetation. The presence of *Banksia prionotes* in the Site is significant and there is no other known area of similar vegetation in the PMR (Site 303 – Pinaroo area has *Banksia prionotes* but at a different position in the landscape). This vegetation does not occur in Bushplan Site 218. Shenton Bushland.
- The failure to compare vegetation condition in regionally significant bushland areas in the Karrakatata Central and South Vegetation Complex. Most regionally significant bushland in the Karrakatata Central and South Vegetation Complex have been significantly disturbed.
- DEP has not agreed to this NPS as indicated on page 1 of the Executive Summary. DEP has contributed to discussions on the selection, design and management of an

area that could be identified in a NPS. The document fails to address many of the issues raised in respect to identifying this area. Some of the unresolved issues are:

- DEP considers that the best consolidation would be a rectangle, not an L shaped area. The discussion on page 13 is misleading in its reference to perimeter only.
- The conservation area should be protected through a covenant and provision made for its management for conservation in any approved subdivision plan.
- An area of 8.3ha is not suitable for research activities.
- DEP has queried the size any area less than 20ha would need active management especially as the best area of bushland will no longer be buffered by areas that have a greater level of disturbance. The presence of the easement and its management was seen as of significant concern as it had already removed bushland in the north east corner (revegetation of the area was totally inappropriate).

Comment

We only have subdivision plan (no text) so I do not know how these issues have been addressed.

- There is 2ha of connected POS identified in which it is indicated that 'trees' will be present, these may well be mature Jarrah and Tuart. Retention of the large trees and younger offspring and of bushland on the verges should be possible. These would need to be protected by covenants. Their contribution to bushland protection is questionable but they may well provided some habitat for ~~animal~~s fauna (see comment below).
- The rationale of delineating the western edge of the Site for University purposes with no reference to bushland protection has been questioned by DEP. There is no response to this issue and the area has been reduced by nearly 1.5h from original plan. The only area of *Eucalyptus decipiens* occurs here.

Other Issues

- There is substantial local support for protection of the entire Site. This group includes members from the University of WA (Zoology professor). Core members of this group were involved with recognition of BS 214. ~~This group will be aware that they are able to refer the proposed development to the EPA.~~
- The Museum has done fauna survey at the Site (submission to Bushplan, Paddy Berry has done the work with his son with permission from UWA), they found it was very like BS 214 but supported larger numbers of individuals of many species. Also they feel it could be the a breeding site for 3 bird species. The local action group is focussing on one of these species, the Little Eagle, in their campaign.

carried out

DRAFT SUMMARY OF FAUNA VALUES OF UNDERWOOD AVENUE BUSHLAND, SHENTON PARK

AND COMMENT ON:

THE UNIVERSITY OF WESTERN AUSTRALIA LOT 4, LOC 2103 UNDERWOOD AVE SHENTON PARK ENVIRONMENTAL ASSESSMENT (UPDATED) By ATA ENVIRONMENTAL NOVEMBER 2000

By JOHN DELL 13 FEBRUARY 2001

FAUNA VALUES OF UNDERWOOD AVENUE BUSHLAND, SHENTON PARK

When draft *Perth's Bushplan* was published in 1998 there was limited information available on the faunal values of Underwood Avenue Bushland, Shenton Park (Bushplan Site 119). Available information was limited to:

"limited survey by J. Dell (pers. comm..) for birds (12) and reptiles (3)"

At the time of the final *Bush Forever* report in December 2000 considerably more fauna data had been acquired by P. F. Berry and this information was summarised in *Bush Forever* as:

"structured survey for birds (37 species), reptiles (16 species) and amphibians (3 species) (P. Berry pers. comm.). Significant bird species: category 1 (1), category 3 (3) and category 4 (3)"

The significant bird species in category 1 was Carnaby's Cockatoo which is listed in Schedule 1 of the Wildlife Conservation Act as "threatened". The three category 3 species were species which were included in *Bush Forever* as "habitat specialists with a reduced distribution on the Swan Coastal Plain". The three category 4 species were species which were included in *Bush Forever* as "wide-ranging species with reduced populations on the Swan Coastal Plain".

Both draft *Perth's Bushplan* and the final *Bush Forever* also recognized the role of Underwood Avenue Bushland, Shenton Park (Bush Forever Site 119) as "part of a regionally significant potential bushland/wetland linkage".

Bush Forever (Vol. 2 p. 345-346) summarised the considerable conservation value and significance for vertebrate fauna of Underwood Avenue Bushland, Shenton Park. In particular it presenteds data on values related to

- the number of species contained within the bushland
- the presence of at least six conservation significant bird species that were recognized in Bush Forever as "habitat specialists with a reduced distribution on the Swan Coastal Plain" or "wide-ranging species with reduced populations on the Swan Coastal Plain".

- the role of the bushland in enhancing the conservation values of other reserves in the region because it was "part of a regionally significant potential bushland/wetland linkage".

The fauna values as summarised in *Bush Forever* Vol. 2 p. 345-346 indicated that Underwood Avenue Bushland maintains at least 37 bird species, 16 reptile species, and 3 amphibian species.

- Of particular note is the presence of the threatened Carnaby's Cockatoo and at least six conservation significant bird species that were listed in *Bush Forever* as having special conservation significance on the Swan Coastal Plain as they are either "habitat specialists with a reduced distribution on the Swan Coastal Plain" or they are "wide-ranging species with reduced populations on the Swan Coastal Plain".

  It is known (Dell, J., How, R.A. & Burbidge, A.H. Vertebrate Fauna of Tuart Woodlands. *In:* Proceedings of a Workshop on Tuart Woodlands. CALM and Wildflower Society of Western Australia. (in press)) that specialist woodland insectivorous bird species have declined in both Tuart as well as other woodlands on the Coastal Plain and some species, including those referred to above as of conservation significance, are now infrequently recorded in other vegetation associations on the Coastal Plain.

Tuart and other trees in Underwood Avenue Bushland also provide essential hollows for obligate tree hollow breeders as well as tall trees for other species such as diurnal birds of prey.

- The Underwood Avenue Bushland is also part of a significant potential bushland/wetland linkage (*Bush Forever* vol 1 Map 6). This is likely to facilitate movement of birds between other conservation reserves including Kings Park, Shenton Park Bushland and Bold Park.

Fire in urban bushlands is inimical to the survival of many species of vertebrate fauna. This has been documented in Dell J. & How, R. 1995. Faunal Responses to Fire in Urban Bushland. pp 35-41. *In: Burning our Bushland.* Proceedings of a Conference about Fire and Urban Bushland. Urban Bushland Council (W.A.).. Replication of conservation reserves will increase the likelihood that species will survive regionally if severe disturbances such as wildfires eliminate species temporarily on one area.. If reserves are linked by corridors then species that are eliminated by fire on one site can re-colonise burnt sites thus increasing their regional survival.

With reptiles there is a strong relationship between the number of different species occurring on bushland remnants and the size of the remnant. Smaller remnants have fewer species surviving long-term. This has been demonstrated recently in:

HOW, R.A. and DELL, J. 2000. Ground Vertebrate Fauna of Perth's Vegetation Remnants: Impact of 170 Years of Urbanization. *Pacific Conservation Biology*, Vol. **6**: 198-217.

COMMENT ON SECTION 2.5 VERTEBRATE FAUNA, AND SECTION 3.3 THE SIGNIFICANCE FOR VERTEBRATE FAUNA IN:

THE UNIVERSITY OF WESTERN AUSTRALIA
LOT 4, LOC 2103 UNDERWOOD AVE SHENTON PARK
ENVIRONMENTAL ASSESSMENT (UPDATED) By ATA ENVIRONMENTAL NOVEMBER 2000

SECTION 1.1 BACKGROUND AND SCOPE OF ASSESSMENT

Note: Comments on this report are made in the context of the contract brief which was "a desktop review of the vertebrate fauna likely to occur in the area and an assessment of the local and regional conservation significance of the site, in accordance with recognized government policy"

SECTION 2.5 VERTEBRATE FAUNA

The assessment of the vertebrate fauna likely to occur on the study site is very limited and only refers to two references (How and Dell 1990 and Berry and Berry 1998) and does not include a number of significant recent references that would have contributed to a better understanding of the vertebrate fauna likely to occur. Relevant references that could have been included are:

HOW, R.A. & DELL, 1993. J. Vertebrate Fauna of the Perth Metropolitan Region: Consequences of a Modified Environment. pp 28-47. *In:* M.Hipkins. (Ed.) *Urban Bush Management.* Aust. Inst. of Urban Studies, Western Australia.

HOW, R.A. & DELL 1994. J. The Zoogeographic Significance of Urban Bushland Remnants to Reptiles in the Perth Region, Western Australia. *Pacific Conservation Biology* Vol.**1**: 132 - 140.

DELL J. & HOW, R. 1995 Faunal Responses to Fire in Urban Bushland. pp 35-41. *In: Burning our Bushland.* Proceedings of a Conference about Fire and Urban Bushland. Urban Bushland Council (W.A.).

DELL, J. & HOW, R.A. 1996. Painted Button-quail on the Swan Coastal Plain. *West. Aust. Nat.* **21**: 87-88.

HOW, R.A., HARVEY, M.S., DELL, J. & WALDOCK, J.M. 1996. *Ground Fauna of Urban Bushland Remnants in Perth.* Report to the Australian Heritage Commission. NEP Grant N93/04.

HARVEY, M.S., WALDOCK, J.M., HOW, R.A., DELL, J. & KOSTAS, A. 1997. Biodiversity and Biogeographic Relationships of Selected Invertebrates from Urban Bushland Remnants, Perth, Western Australia. Proceedings of Invertebrate Biodiversity and Conservation Symposium. *Memoirs of Museum of Victoria.* **56**: 275-280.

DELL, J., HOW, R.A. & BURBIDGE, A.H. 1998. Vertebrate Fauna of Tuart Woodlands. *In*: Proceedings of a Workshop on Tuart Woodlands. CALM and Wildflower Society of Western Australia. (in press).

As a result of limited reference use the assessment of the vertebrate fauna likely to be present on the site is not comprehensive and the significance of the site to vertebrate fauna is not adequately recognized. This is apparent from the limited list of species (especially birds) in Appendix 2 in the report.

It is not true that "no native mammals are likely to inhabit the ... site". The statement that the Common Brushtail Possum is unlikely to occur in the Underwood Avenue Bushland is based on an inadequate literature search on its known habitats in the region. It is likely to utilize much of the Underwood Avenue Bushland as key elements of the habitat there are similar to other locations where it is known to occur.

The statements about bats are intriguing. Firstly it is stated that "no native mammals are likely to inhabit the ... site" and then it is stated that at least one bat species may occur at Bold Park but is not confirmed. No attempt was made to consult either recent or historic records to elucidate which bat species are likely to inhabit the area. Reference to :

HOW, R.A. & DELL, 1993. J. Vertebrate Fauna of the Perth Metropolitan Region: Consequences of a Modified Environment. pp 28-47. *In:* M.Hipkins. (Ed.) *Urban Bush Management.* Aust. Inst. of Urban Studies, Western Australia.

would have revealed that several species are known from the Spearwood Landform Unit and could occur in the Underwood Avenue Bushland.

SECTION 3.3 SIGNIFICANCE FOR VERTEBRATE FAUNA

This section provides some general discussion of the role of remnants in preserving sub-populations, when severe disturbances such as fire exterminate populations in other areas as well as the role of corridors in facilitating movement. However it does not make the distinction between those species that require the area to move through as compared to those which do not, e.g. "habitat provided at the site, therefore, is not a crucial

component for the movemenrt of all fauna species throughout the region".

Other information within this section especially the data on the Little Eagle is generally correct. However the point should have been made that the area has considerable conservation value which is recognized in *Bush Forever* (Vol. 2 p. 345-346) which summarised the considerable conservation value and significance for vertebrate fauna of Underwood Avenue Bushland, Shenton Park.

CONSERVATION BRANCH DOCUMENT TRACKING SHEET

DOCUMENT TYPE	EIA referral		
OFFICER	BKEIGHRY		
DATE SENT	12/1/01	**DATE DUE**	29/1/01
SUBJECT	Underwood Av		

ENTER DATE	**CHECK LIST**
12/1/01	1. Entered by Craig, template draft enclosed
	2. Competed by officer
	3. Signed off by Gary
	4. Distributed by Craig
	5. Final outcome/advice filed

Guidelines for Ministerials, Briefing Notes & PQs:

- ☐ Electronic copy - Leanne Kolin
- ☐ Correct Salutations
- ☐ Date on cover note
- ☐ Text body justified
- ☐ B/Notes 1 page preferred
- ☐ Insert reference No's

Guidelines for development applications/NPS:

- ☐ Check Bushplan/CTRC, Admin & Biological
- ☐ Check Eval. Prev. ass'd
- ☐ B/ground - Gary & Bronwen
- ☐ Records EPACIS search
- ☐ Check outcome against EPA guidance statement

Guidelines for EIA advice:

- ☐ Site characteristics, values, information, limitations
- ☐ Local & Regional contact
- ☐ Direct/Indirect impacts & alternative options
- ☐ Recommendations

Guidelines for 'Other':

- ☐ GIS (System 6 & Bushplan)
- ☐ Rare flora/fauna & communities

INTRA-DEPARTMENTAL REFERRAL

EVALUATION DIVISION, ENVIRONMENTAL PLANNING BRANCH

TO:	Bronwen Keighery C/o Rob Sippe Anthony Stuart C/o Paul Vogel
SUBJECT:	Proposed residential subdivision – Underwood Avenue/Selby Street, Shenton Park
FROM:	Natalie Thorning
DATE REFERRED:	12 January 2001

The Proposal

Proposed residential subdivision – Underwood Avenue/Selby Street, Shenton Park

Stage in the process

The proposal has been referred to the EPA/DEP by the Ministry for Planning and the Friends of Underwood Avenue, however, decision on level of assessment has been deferred until the EPA have information on the odour impacts of the Subiaco Waste Water Treatment Plant and the negotiation of the Bush Forever Site.

Minter Ellison are representing the landowner, University of Western Australia, and have advertised the enclosed documents for public submissions closing 2 February 2001.

All submissions will be forwarded to the EPA to be considered in determining level of assessment.

Information/advice requested

Please provide comment on the enclosed report/s in reference to the proposed residential subdivision of UWA's land.

This is and will continue to be a contentious proposal, so a detailed assessment and response would be appreciated.

The original documents are in a lever arch file on my desk, please contact me with any queries.

Bronwen - I assume the information and advice sought relates to level of assessment decision. My view is that there are wider factors than Bush Forever involved (eg. waste water treatment plant) and that formal assessment may prove to be the best way forward for govt. decision-making. 12/1/01

Thanks, Natalie (x7079)

PLEASE CAN YOU FORWARD YOUR REPLY TO BARBARA JONES BY: **29 January 2001**

IF YOU HAVE NO COMMENTS OR IF YOU CANNOT MEET THIS DATE PLEASE ADVISE ME ASAP - THANK YOU.

EXECUTIVE SUMMARY

This is an introduction to a suite of documents assembled by The University of Western Australia ('University') to assist the public in making submissions on a proposal to subdivide Lot 4 Underwood Avenue, Shenton Park for residential and bushland conservation purposes.

The University became the owner of Lot 4 Underwood Avenue, Shenton Park in 1904. Development of the land for residential housing was proposed as least as early as the 1920s but it was not until 1997 that the University considered that it was time to subdivide and thereby realise the asset. This proposal is in accordance with the current City of Nedlands Town Planning Scheme and the Metropolitan Region Scheme.

The proposed development area, encompassing approximately 38ha, comprises remnant bushland in varying condition, which is currently partially used by the University as a research park for botanical, zoological and agricultural studies. The site is surrounded by residential, business and public purpose developments.

A study team of planning, environmental, landscape and engineering consultants was engaged by the University to investigate the site's opportunities and constraints in relation to the development of the site for residential housing.

An Environmental Assessment Report was prepared for the site during 1997 and 1998 and later updated in light of subsequent detailed flora surveys and fauna habitat assessments. This culminated in a final report being prepared in November 2000. The assessment identified that the retention of approximately 25% of the vegetation in a research park would ensure the environmental values of the site would be maintained in the long-term. This assumption is based on the following findings:

- The 8.5ha bushland parcel to be retained is representative of the local bushland (ie Bold Park and Kings Park) and is in very good to good condition;
- Several species and vegetation types occurring at the study area are of interest within a local area however, none of them are unique to the study site;
- Mature Tuart and Jarrah trees will be retained in public open space and in the subdivision design; and
- Underwood Avenue bushland would largely only be of corridor value to bird species, as the surrounding area is fully developed. The retention of bushland and mature trees on the site will retain this corridor function.

The development concept plan for the site was referred to the Bushplan Interagency Coordinating Group in 1998. The Group identified its support for the proposed retention of 8.5ha of bushland along Selby Street to be managed by UWA as "Conservation Open Space" with residential development supported on the balance.

The Water Corporation has objected to the residential development of the site because of a perceived conflict between that use and its use of an adjacent site for the Subiaco

The report concludes that it is possible to retain the current values of the site and meet Bushplan objectives by protecting representative bushland areas within a residential development. Significantly, the development of the site would see the retention of (8.5 hectares of 38.6 hectares) of the bushland to be managed for conservation purposes and public open space.

Subiaco Wastewater Treatment Plant – Review of Odour Impact Assessment and Response, Alan Tingay & Associates (November 1999)

On the basis of the documents obtained from the Water Corporation under the Freedom of Information Act, and other public documents, ATA Environmental reviewed:

(a) a number of qualitative and quantitative assessments of odour impacts on the area surrounding the SWWTP; and

(b) the odour problems associated with the SWWTP in light of its historical operation; and

(c) the possible future impacts of odour emitted from the SWWTP.

On the basis of their review ATA Environmental concluded that:

(a) the SWWTP represented dated technology and which, notwithstanding successive modifications, struggled to meet the requirements of the Department of Environmental Protection; and

(b) the SWWTP did not achieve best practice in terms of design or operation.

Odour Impact Assessment Subiaco Wastewater Treatment Facility, CH2M Hill, March 1997

CH2M Hill is a consultancy firm recognised as being highly competent in odour modelling. CH2M Hill was retained by the Water Corporation to:

(a) undertake an odour audit of the SWWTP;

(b) review the results of previous odour audits undertaken in 1992, 1993 and 1996; and

(c) undertake odour dispersion modelling, using the 1996 audit results, to predict the dispersion of odours from the existing plant and predict improvements in community odour impact arising from odour control measures planned by the Water Corporation.

As a result of its investigations, CH2M Hill concluded that:

(d) the majority of community complaints regarding odour arose when the ambient odour concentration exceeded 5 odour units per cubic metre ($5OU/m^3$).



THE UNIVERSITY OF WESTERN AUSTRALIA

LOT 4, LOC 2103 UNDERWOOD AVE SHENTON PARK

ENVIRONMENTAL ASSESSMENT (UPDATED)

ATA ENVIRONMENTAL

NOVEMBER 2000

REPORT NO: 2000/133

ATA Environmental

THE UNIVERSITY OF WESTERN AUSTRALIA

LOT 4, LOC 2103 UNDERWOOD AVE SHENTON PARK

ENVIRONMENTAL ASSESSMENT (UPDATED)

ATA ENVIRONMENTAL

NOVEMBER 2000

REPORT NO: 2000/133

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QUALITY ASSURANCE

ATA Environmental has implemented a comprehensive range of quality control measures on all aspects of the company's operation and has Quality Assurance certification to ISO 9001.

An internal quality review process has been applied to each project task undertaken by us. Each document is carefully reviewed by core members of the consultancy team and signed off at Director level prior to issue to the client. Draft documents are submitted to the client for comment and acceptance prior to final production.

Document No:	98101_023_pvdm		
Report No:	2000.133		
Report Status:	Final		
Checked by:	Sarah Maxwell	Date:	17 November 2000
Approved by:	Paul van der Moezel	Date:	17 November 2000

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2. Potential Vertebrate Fauna List for Lot 4, Loc 2103, Shenton Park

1. INTRODUCTION

1.1 Background and Scope of Assessment

ATA Environmental (previously Alan Tingay & Associates) has been engaged by The University of Western Australia (UWA) to conduct an environmental assessment of Location 2103 Underwood Avenue, Shenton Park.

The following report documents the findings of flora surveys and a vegetation assessment of the site, a desktop review of the vertebrate fauna likely to occur in the area and an assessment of the local and regional conservation significance of the site, in accordance with recognised government policy.

The identification of a significant portion of the study area in the draft Perth's Bushplan (Government of Western Australia, 1998) has necessitated close consultation with the relevant government agencies, including the Department of Environmental Protection and the Ministry for Planning to achieve an environmentally responsible negotiated planning solution, as recommended by Bushplan.

1.2 Location and Land Use

The study area comprises a 38.57ha portion of Lot 4 of Swan Loc 2103 Underwood Avenue, Shenton Park (refer Location Plan). The land is presently held in Fee Simple by UWA. Lot 4 comprises a total area of 62.9142ha and is bounded by Brockway Road, Underwood Avenue and Selby Street in the City of Nedlands.

The study area is currently used by UWA as a research park for botanical, zoological and agricultural studies. The public currently has no access to the site. The site is adjacent to the UWA agricultural field station and wildlife research centre. The study area lies adjacent to residential and business developments on the northern boundary and is located less than 1km from Lemnos Street Bushland and is within a 5 kilometre radius of Bold Park and Kings Park.

The site is zoned Urban under the Metropolitan Region Scheme and is a Development Zone under the City of Nedland's Town Planning Scheme No.2. The site was originally intended for a future campus and/or technology park.

2. EXISTING ENVIRONMENT

2.1 Climate

The study area is characterised by a mild Mediterranean type climate with hot dry summers and mild wet winters. The climate shows marked seasonality, with rainfall, temperature and winds following a well defined annual cycle. Rainfall is concentrated in the winter months with 90% of all rain falling between April and October.

Temperatures are lowest in July and August with an average daily minimum and maximum temperature of approximately 8.5°C and 18°C, respectively. The highest temperatures have been recorded in January with an average daily maximum of 29.5°C.

A typical summer wind pattern exists, with strong easterly winds in the morning swinging to strong southwesterly winds in the afternoon. The winds are strongest during the summer months with 50% of the winds in December exceeding 20 kilometres per hour compared to only 20% in May and 25% in June, July and August (Bureau of Meteorology, 2000).

2.2 Soils and Topography

The study area is comprised primarily of deep calcareous sand of aeolian origin. The soils of the study area are part of the Spearwood Dune System and consist of shallow to deep yellow, medium to fine grained quartz and Pleistocene aeolianite limestone (Semeniuk and Glassford, 1989).

The Spearwood Association can be further divided into the Cottesloe and Karrakatta soil types. Within the study area, the yellow sands of the Karrakatta type soil predominates and at the central ridge the underlying Tamala limestone is partially exposed.

The area rises gently from 15m AHD at the eastern boundary up to 44m AHD at the central ridge and falls gradually to 25m at the western boundary. The outcropping of Tamala limestone at the central ridge provides a vantage point to other prominent regional landmarks including Kings Park, the city and Bold Park. The topography of the study area is shown in Figure 2.

2.3 Hydrology

There are no natural drainage channels or expressions of the groundwater within the study area.

Depth to groundwater varies from 38m at the central ridge, 17m at the western boundary and a low of 8m depth at the north-east corner of the site (WRC, 1997). There is a regional groundwater flow of between 50 and 100m per year in the study area in a southwesterly direction (WAWA, 1986).

A groundwater extraction bore is located adjacent to the study area on the agricultural field station. This bore is used to extract groundwater for local irrigation purposes and is unlikely to have a significant draw-down effect on the regional groundwater table.

2.4 Flora and Vegetation

2.4.1 Methodology

An initial interpretation of the vegetation of the study site was conducted using colour aerial photograph (1:1000) to determine patterns in the vegetation.

Preliminary field surveys were undertaken in January and July 1998 to record flora, determine the distribution of vegetation units and identify the location of any significant flora populations present at the site. Field reconnaissance and a number of 10x10m quadrats defined the floristic composition, vegetation condition and weed invasion of each unit.

A further flora survey was undertaken in September 2000 to record ephemeral species such as orchids, annual grasses and herbs.

The description of the vegetation was based on a system devised by Specht and modified by Aplin (1979) which classifies vegetation on the basis of height and cover of the tallest stratum (eg. Low Woodland). Individual plant associations were named according to the dominant species eg. *Banksia attenuata* Low Woodland.

A map of the vegetation associations in the study area was prepared from the aerial photograph taken in January 1997 together with field data and verification.

The condition of the vegetation was assessed and mapped using the following categories as defined in Bushplan:

Pristine	Pristine or nearly so, no obvious signs of disturbance.
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non aggressive species.
Very Good	Vegetation structure altered, obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbance. Retains basic vegetation structure or ability to regenerate. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.

Completely Degraded The structure of the vegetation is no longer intact and the areas is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora composing weed or crop species with isolated native trees or shrubs.

2.4.2 Flora

A total of 149 species of vascular plants has been recorded at the site (Appendix 1). Of these, 112 are native to the site and 37 are introduced species not native to the area (includes native Australian species which are garden escapes). Approximately two thirds of the species are Dicotyledons. Within the Dicotyledonae the families well represented at the site include the Papilionaceae (Pea family, 17 species including 4 introduced), Proteaceae (*Banksia* family, 12 species), and Asteraceae (Daisy family, 12 species including 7 introduced). The dominant Monocotyledonae family is the Poaceae (Grasses, 11 species all of which are introduced).

2.4.3 Declared Rare and Priority Flora

A search was carried out of the CALM Threatened Flora database, the Priority Species List and the WA Herbarium specimen database for significant species known from the general vicinity of the study area (CALM, 1999). Table 1 shows the conservation status of significant taxa known to occur within a 5km radius of the study area.

TABLE 1
CONSERVATION STATUS OF SIGNIFICANT TAXA IN THE VICINITY OF THE STUDY AREA

SPECIES	CONSERVATION STATUS	LOCALITY
Acacia benthamii	2	Kings Park
Beyeria cygnorum	2	Bold Park
Hibbertia spicata ssp. leptotheca	3	Bold Park
Fabronia hampeana	2	Bold Park
Jacksonia sericea	3	Kings Park, Bold Park, Shenton Park
Lepidium pseudohyssopifolium	1	Herdsman Lake
Picris compacta	1	Kings Park

1-3 Priority Species which are poorly known

No Declared Rare Flora were recorded during the botanical survey of the study area. Four populations of the Priority 3 species, *Jacksonia sericea*, were located in the western part of the site.

Priority 3 species are defined by CALM (1999) as:

> *Taxa which are known from several populations, at least some of which are not believed to be under immediate threat (ie not currently endangered). Such taxa are under consideration for declaration as 'rare flora' but are in need of further survey.*

2.4.4 Vegetation Associations

The vegetation units of the study area are shown in Figure 3.

The vegetation is dominated by a *Eucalyptus Banksia/Allocasuarina* Low Woodland to Open Woodland with species variations in upper and lower stories. The variation in species composition reflects the depth of soil, proximity of limestone to the surface and past fire regimes.

The principal vegetation unit has been divided into three vegetation associations consisting of a *Banksia* Low Woodland, a *Banksia prionotes* Closed Scrub and a Jarrah (*Eucalyptus marginata*) Woodland with significant variation in structure and composition.

Banksia Low Woodland

The *Banksia* Low Woodland is structurally dominated by *B. menziesii* and *B. attenuata* and, less consistently, by *Allocasuarina fraseriana*. In places, there are stunted Jarrah and emergent Tuart (*E. gomphocephala*). Species which are common in the understorey of the Woodland include *Hakea prostrata* up to 2m and low shrubs including *Mesomelaena pseudostygia*, *Xanthorrhoea preissii*, *Petrophile linearis* and *P. macrostachya*. *Alexgeorgea nitens*, *Desmocladus flexuosus*, *Dryandra lindleyana* and several weed species dominate the ground cover.

This association occurs over much of the western region of the study area and contains four populations of the Priority 3 species, *Jacksonia sericea*. In addition, a small population of the mallee *Eucalyptus decipiens* was found on the lower slopes of the site. *Eucalyptus decipiens* is not a Priority or DRF species but is uncommon in the Perth Metropolitan Region.

Banksia prionotes Closed Scrub

The *Banksia prionotes* Closed Scrub dominates the northern part of the central ridge at the site along Underwood Avenue. This association has been adversely affected by fire as evidenced by the extent of weed invasion, particularly Veldt Grass, and the apparent young age of the Banksias. Throughout the Closed Scrub are scattered young *Banksia menziesii* and *B. attenuata* and mature or dead Tuart trees. The native species diversity in the Closed Scrub is very low as the understorey layer is dominated by weeds. Other species such as *Acacia saligna* and *Pelargonium capitatum* which are often associated with disturbed areas are present at the periphery of the Closed Scrub.

Jarrah Low Woodland to Open Woodland

The Jarrah Woodlands at the site vary significantly in species composition and density. The eastern area comprises a Jarrah Woodland with scattered Tuarts and Marri trees over a lower tree canopy of *Banksia attenuata*, *B. menziesii* and *Allocasuarina fraseriana*. An isolated stand of *Banksia grandis* was found in a relatively open and degraded area of the eastern Jarrah Woodland.

Typical taller shrub species include *Jacksonia furcellata*, *Hakea prostrata*, *Xanthorrhoea preissii* and *Macrozamia fraseri*. Common smaller shrubs include *Gompholobium*

tomentosum, *Hibbertia hypericoides*, *Acacia pulchella*, *Calytrix fraseri*, *Mesomelaena pseudostygia*, *Desmocladus flexuosus* and *Petrophile linearis*. Parrot Bush (*Dryandra sessilis*) occurs in one small stand near the eastern boundary, possibly indicating the presence of limestone at shallow depths below the sand.

2.4.5 Vegetation Condition

The vegetation condition of the study area ranges from very good to degraded (Figure 4). All of the vegetation associations recorded at the site show some signs of disturbance including the presence of non-aggressive and aggressive weeds, partial clearing, frequent fires, and informal tracks.

The vegetation towards the western and eastern boundaries of the site is in very good condition and are the least disturbed regions of the site. While the vegetation structure in these areas has been affected by clearing or selective logging in the past, the native understorey layer is intact with minimal signs of disturbance.

Several mature Tuart and Jarrah trees occur on the central ridge of the study area and along the Water Corporation easement in the eastern region of the site (Figure 3).

Areas of high disturbance are found at the higher elevations and at the ridge where informal tracks and weeds are numerous as a result of clearing and fires. The installation of Water Corporation infrastructure in the existing easement resulted in some clearing of vegetation in this area.

The abundance of *Banksia prionotes* in the northern ridge area along Underwood Avenue is possibly due to an increase in the frequency of fires in this area. Anecdotal evidence suggests that *B. prionotes* was not as abundant on this site in the past.

French Serradella (*Ornithopis sativus*) is very common in disturbed areas on the ridgetop. Serradella was part of the UWA Agriculture Department's research trials on the adjacent land in past years.

The UWA Zoology Research centre located in the south-west of the site is extensively cleared with only a few remnant Eucalypt and *Acacia* species remaining. The area has been planted with exotics, in particular Flame Trees (*Erythrina indica*).

The Eucalypt and *Banksia* species of the study area are in very good condition and do not appear to have been affected by Jarrah dieback (*Phytophthora cinnamomi*) or other pathogenic diseases. Some plants of *Acacia saligna* and *A. rostellifera* have been affected by the borer weevil.

2.5 Vertebrate Fauna

An assessment of the vertebrate fauna likely to occur on the study site is based on studies conducted at nearby Bold Park (How and Dell, 1990) and a study undertaken in the Shenton Park Bushland in 1997 and 1998 (Berry and Berry, 1998).

The vegetation assessment identified one principal habitat in the study area consisting of *Eucalyptus Banksia* woodlands although there is local variation in composition and

structure due to disturbance factors and minor changes in soil. Fauna likely to be present on the site will be typical of mixed *Banksia* Woodlands within the Perth Metropolitan Area although some species may no longer be represented due to development of surrounding areas and fragmentation of habitat.

A total of 77 species of vertebrate fauna are considered possible inhabitants of the site. This is based on the size and range of habitat available, surveys of similar habitats in Lemnos Street bushland and Bold Park and the known distribution and habitat of species. This list consists of 3 amphibians, 28 reptiles and 46 birds. These species are listed in Appendix 2.

Of the three frogs listed only the Turtle Frog (*Myobatrachus gouldii*) is likely to inhabit the site throughout its life-cycle as it does not require surface water to breed. The Moaning Frog (*Heleioporus eyrei*) and Pobblebonk or Banjo Frog (*Limnodynastes dorsalis*) may also occur at the site provided suitable breeding sites are available in the surrounding area.

Surveys at Bold Park indicate a greater diversity of reptile was recorded in the Banksia woodland habitats. Therefore the study area is also expected to support a diverse array of reptiles. A total of 28 reptiles are listed as possible for the site. A burrow has been recorded in the eastern region of the site and is thought to belong to a Gould's Monitor (*Varanus gouldii*). The occurrence of this species has been confirmed at nearby bushland areas such as Bold Park and ~~Lemnos Street bushland~~. Remnant bushland

The avifauna considered likely to inhabit the woodlands at the site consists of 46 species, 42 of which were recorded during surveys of Bold Park between 1986-89 (How and Dell, 1990). Site investigations have revealed that a nest occupied by a pair of Little Eagles (*Heiraaetus morphnoides*) occurs on the site in a Eucalypt tree in the central upland region.

No native mammals are considered likely to inhabit the Shenton Park site. Only the Common Brushtail Possum was recorded in Bold Park during surveys between 1986 to 1989 (How and Dell, 1990). This species is unlikely to occur within the study area due to differing habitats. The possum species was detected in *Eucalyptus rudis* and *E. gomphocephala* woodlands at Bold Park, a habitat which does not occur within the study area. The presence of the White-striped Mastiff-bat (*Tadarida australis*) was suspected at Bold Park during the same surveys but was not confirmed. No additional bat species were detected at Perry Lakes and Bold Park during netting and call monitoring with ultra-sonic detectors in 1990-91 (Wykes pers. comm.).

One of the species listed as likely to occur at the site is declared "in need of special protection" and listed on Schedule 1 of the Wildlife Conservation Act, 1950. The Short-billed Black-Cockatoo (*Calyptorhynchus latirostris*) may utilise the Jarrah and Banksia woodlands of the site for feeding but is not known to breed in the area. The Short-billed Black Cockatoo occurs within Bold Park and is known to regularly occur within the Metropolitan area on a seasonal basis, utilising native bushland and suitable vegetation along roads and within backyards.

3. CONSERVATION VALUE

This section of the report discusses the attributes of the study area in the context of current Government Policy on bushland within the Perth Metropolitan Region.

3.1 Government Initiatives

A portion of Lot 4, Loc 2103 Underwood Avenue (32.1ha) has been nominated as regionally significant bushland in the draft Perth's Bushplan released in November 1998 (Site 119).

Perth's Bushplan is a 'whole of Government' report that builds on the System 6 Update and the findings of the Perth Environment Project. Prepared jointly by the Ministry for Planning (MFP), Department of Environmental Protection (DEP), Department of Conservation and Land Management (CALM) and the Water & Rivers Commission, it identifies areas of regional significance worthy of protection to conserve the biodiversity of the Swan Coastal Plain portion of the Perth Metropolitan Region.

The approach to determining the regional significance of an area of bushland under Bushplan is based on compliance with at least one of the following criteria, as defined in the Urban Bushland Strategy (Government of Western Australia, 1995) and shown in Table 2.

TABLE 2
CRITERIA FOR LOCALLY AND REGIONALLY SIGNIFICANT BUSHLAND
(Urban Bushland Strategy, 1995)

Criteria for Regional Significance	
Vegetation Type	Example of a regional vegetation type which is threatened or poorly reserved or a site with special value for flora or fauna conservation.
Significant Flora	Having considerable biodiversity or supports a population of Declared Rare Flora, priority listed flora, or threatened fauna.
Vegetation Condition	Vegetation is in good condition or better. Threatened vegetation types may be regionally significant even if in poor condition.
Remnant Size	Usually greater than 20 hectares but may be smaller in the case of threatened or poorly reserved vegetation types, or in areas with special significance for other purposes.
Recreational Attributes	Suitable for passive recreation by people from both within and beyond the locality.
Educational Value	Region wide use or potential for scientific or educational study.
Cultural Significance	Having cultural heritage values of a regional or greater significance.
Shape and Linkage Function	Regular shape is desirable unless the area functions as a significant corridor linking other remnants

3.2 Significance of Flora and Vegetation

3.2.1 Flora

The study area is predominantly a mixed *Banksia/Eucalyptus* Woodland composed of young and mature *Banksia* and Eucalypt species which show some signs of disturbance. The flora surveys identified a total of 149 species of flora in the bushland. Of these, 112 are native and 37 are introduced to the area.

The composition of the vegetation associations represents a typical Spearwood soil system, and is found in other local bushland areas of similar soils such as Bold Park and Kings Park.

Botanical studies have been conducted at a number of reserves and open spaces of varying proximity to the Shenton Park site, including Kings Park and Bold Park, Shenton Bushland, Trigg Reserve, Star Swamp, Hepburn Heights and Woodvale Nature Reserve. The flora and vegetation at each of these areas enables the flora and vegetation at the study site to be placed within a local (<5km radius) and regional (>5km radius) context.

Table 3 summarises the total number of indigenous species and floristic community types present at each site.

TABLE 3
BUSHLAND AREAS AND NUMBER OF INDIGENOUS SPECIES

BUSHLAND AREA	REFERENCE	SIZE (ha)	NO. OF COMMUNITY TYPES	NO. OF NATIVE SPECIES
Kings Park	Bennett, 1988; Beard, 1997	400	1	290
Bold Park	Keighery et al. 1990	221	4	221
Trigg Reserve	City of Stirling, 1991	120	4	117
Star Swamp	Bell et al, 1984	100	3	191
Hepburn Heights	Alan Tingay & Assoc, 1991	55	2	200
Woodvale Nature Reserve	Keighery and Langley, 1994	44	1	170
Loc 2103 Shenton Park	Present study	33	1	113
Shenton Bushland	Ecoscape 1994	20	1	100

None of the species is a Declared Rare Flora species nor on the Commonwealth threatened flora list.

Populations of the Priority 3 species, *Jacksonia sericea* were found in the study area. *Jacksonia sericea* has been recorded in other nearby bushland areas, including Shenton Bushland to the south, Kings Park and in the *Banksia* Woodlands and Limestone Heath at Bold Park.

3.2.2 Vegetation

The criteria for including the native vegetation in the study area as regionally significant vegetation in the draft Perth's Bushplan is that the area contains a "representation of

ecological communities". This is presumably related to the Karrakatta-Central and South Vegetation Complex on the site.

The State Government's objective is to protect at least 10% of the original extent of each vegetation complex in the Perth Metropolitan Area and in at least five geographically distinct areas if possible. The Karrakatta Complex-Central and South has approximately 5.6% of its original extent included within existing reserves. Conservation initiatives proposed under Bushplan will increase this figure by approximately 2.4% to bring the total to 8% of the original extent currently reserved or proposed for reservation. This is below the Government's objective of 10% protection of this vegetation complex.

In considering the regional significance of the vegetation it is useful to compare the vegetation of the site to nearby reserves. The Jarrah/*Banksia* Woodland vegetation associations at the study site are generally well represented at other local reserves and open spaces. Bold Park is composed of up to 70% (approximately 145ha) *Banksia* Low Woodland and Kings Park is composed predominantly of a mixed *Eucalyptus/Allocasuarina/Banksia* Open Woodland. Jarrah Woodlands are not as well represented locally, comprising only 2% (10ha) of the vegetation in Bold Park. Surveys conducted at the nearby Shenton Bushland area (Alan Tingay and Associates, 1993) revealed a similar species composition associated with a Jarrah/*Banksia* Woodland, however of poorer quality than at Lot 4, Loc 2103, Underwood Avenue. Kings Park and Shenton Bushland both consist solely of Karrakatta Complex-Central and South.

The vegetation on the site can also be categorised according to floristic community types (Gibson *et al.*, 1994). Floristic community types group vegetation with similar species composition rather than based on geomorphology and climate as is the case with the Heddle *et al.* vegetation complexes. The Jarrah and *Banksia* vegetation on the site belongs to Floristic Community Type 28 - Spearwood *Banksia attenuata* or *B. attenuata* - *Eucalyptus* species woodlands. Within the local area Community Type 28 is abundant at Kings Park and at Shenton Bushland and is common in other metropolitan reserves with Spearwood soil types.

Floristic Community Type 28 is not considered a threatened ecological community at the state level (English & Blyth, 1997) nor at the Commonwealth level.

The condition of the vegetation in the study area is variable and is similar to vegetation associations found at Bold Park and Kings Park. Fire and lack of weed control and management at the site has led to significant weed invasion on similar scales as at Bold Park and Kings Park.

3.3 Significance for Vertebrate Fauna

A desktop assessment was conducted to identify potential vertebrate fauna occurring at the site. The principal habitat of the study area, mixed *Eucalyptus/Banksia* woodland, is not unique or unusual on the Swan Coastal Plain. In addition, the relatively small size of the bushland area, past landuses and occurrence of fire reflects the high degree of habitat alteration it has experienced.

The site is located between Kings Park and Bold Park and is also close to the Shenton Bushland at Lemnos Street. The significance of the site as part of a wildlife corridor or as a refuge in this part of the Metropolitan Area has not been established.

The role of remnant native vegetation in an urbanised area can be likened to the role of remnant patches of vegetation in the wheatbelt. There, patches of geographically isolated vegetation may be important in preserving sub-populations where factors such as fire might cause local extinctions in other patches (Lambeck and Saunders, 1993). This would be similar to a major fire in either Kings Park or Bold Park causing local extinction of a particular bird species with replenishment in time from individuals protected in the Underwood Avenue or Shenton Bushland.

The role of corridors in maintaining viable populations of some bird species in an environment of small fragmented parcels of remnant vegetation has also been demonstrated in the wheatbelt of Western Australia. There, it has been demonstrated that roadside corridors of only 4m allow some species of bird to move along them (Saunders and de Rebiera, 1991). The wider the corridor the more species that move along it.

Underwood Avenue bushland would largely only be of corridor value to bird species, as the surrounding area is fully developed. However, the residential suburbs around the site are old, established suburbs with a high proportion of trees, both native and exotic that provide linkage between bushland patches and facilitate movement of some fauna species. It is expected that many species move throughout the area without requiring the use of vegetation and habitat at the Underwood Avenue site. Habitat provided at the site, therefore, is not a crucial component for the movement of all fauna species throughout the region.

The Schedule 1 Short-billed Black Cockatoo has been recorded at Bold Park and Shenton Bushland. It is highly probable that this species will also frequent the site opportunistically on a seasonal basis. No other species of significant fauna are expected to inhabit the site.

Two other species known or suspected to occur at the site are possibly significant within the Perth area. These are Gould's Monitor and the Little Eagle.

Habitat for populations of Gould's Monitor within the site is limited due to the size of the area. While Gould's Monitor may occur at the site it is likely that this is limited to a few individuals occurring within the site and adjoining areas. Potential frequent fires, foxes, and roads within the area are expected to presently be significantly affecting the survival of this species within the site. Fencing of the site in 1995 may have also restricted movement for this species to and from other bushland areas. The site is likely to be too small to support a sustainable population by itself. Gould's Monitor continue to occur within the Perth area at sites with more extensive bushland such as Bold Park.

The site is reported to support a breeding pair of Little Eagles. The Little Eagle is a raptor which inhabits lightly to moderately densely wooded areas largely throughout mainland Australia. It preys on mammals, birds and reptiles and less frequently feeds on carrion. Young rabbits represent a large proportion of their diet, particularly in the southern areas of the state.

The species is not globally or nationally threatened and is considered common and widespread in Australia and scarce to moderately common in WA. The Little Eagle is thought to have benefited by European colonisation through tree thinning and the introduction of the rabbit, and to have increased in distribution and abundance. Prior to arrival of the European rabbit in WA early this century, this species was supposedly rare or absent in the southern portion of the state.

The first record in the Perth area is reportedly 1929, after the arrival of the rabbit (How & Dell, 1992). It is now known to occur over the coastal plain and the Darling Range and has been recorded recently at the following locations:

- Walyunga National Park (Van Delft, 1997)
- Bold Park (How & Dell, 1990)
- Perth Airport (How & Dell, 1992; Alan Tingay & Associates, 1994)
- Victoria Park (How & Dell, 1992)
- Whiteman Park (CSIRO, 1991; How & Dell, 1992)
- Burns (Alan Tingay & Associates, 1999)
- Jindalee (ATA Environmental, 2000a & b)
- Kenwick (Keighery, 1995)
- Alkimos-Eglinton (Alan Tingay & Associates, 1997b)
- Guilderton (Alan Tingay & Associates, 1997c)
- Yanchep–Two Rocks (Alan Tingay & Associates, 1991)
- Melville (City of Melville, undated)
- Lake Clifton (Alan Tingay & Associates, 1998)
- Shenton Park (J.Dell, pers.comm., 2000)
- Wanneroo (How & Dell, 1992)
- Jandakot Airport (J.Dell, pers.comm., 2000)

These sightings represent breeding pairs as well as non-breeding birds that have entered the area looking for prey or are young birds dispersing from the nest. About 6 to 10 breeding pairs are known in the Swan Coastal Plain in the Metropolitan Region (John Dell, pers. comm., September 2000). These are known to occur at Perth Airport, Shenton Park, Neerabup National Park and Jandakot Airport, and probably at Whiteman Park.

The feeding range of breeding animals is expected to be at least about 3km radius from the nesting site. No breeding pairs occur in Kings Park and Bold Park possibly because the territory of the Shenton Park pair excludes breeding at these locations (John Dell, pers. comm., September 2000).

While the birds are not easily disturbed at the nest (Debus, 1998) they would normally select nesting locations distant from housing and disturbance factors. The presence of birds at sites in the Perth Metropolitan Area such as Shenton Park and Perth Airport indicate that they will nest in trees within developed areas.

Removal of trees within the Shenton Park site may affect the breeding potential at the site through increased human disturbance of the area. However, large areas of suitable habitat are retained within the nearby Bold Park and Kings Park that could provide suitable breeding trees. The breeding pair at Shenton Park may relocate to Bold or Kings Park if the breeding site is disturbed as this area is likely to be within the pair's current territory.

An important aspect affecting the continual presence of the Little Eagle is the abundance of a nearby food supply such as young rabbits. If development at the site threatens the current availability of food then the species may move away from the area and select alternative breeding areas. Given the likely feeding area and the diet of the birds, however, development at Shenton Park itself would probably not affect food resources sufficiently to stop breeding in the area.

3.4 Bushplan Process

As a result of UWA's intention to subdivide the land for residential purposes in accordance the land's zoning of 'Urban' under the MRS and 'Development Zone' in the City of Nedlands Town Planning Scheme, the University entered into a negotiated planning solution with the Bushplan Interagency Co-ordinating Group to define an appropriate Bushplan area for the study site.

The negotiation process involved a submission by UWA on Bushplan in which a suggested compromise outcome was proposed based on detailed environmental assessment of the site by ATA Environmental. The submission triggered a series of meetings and a site inspection with the Ministry for Planning and Department of Environmental Protection (DEP) Bushplan officers. Following these and subsequent meetings in which several iterations of the subdivision design were reviewed, an agreed outcome for Bushplan was obtained from the Bushplan Interagency Co-ordinating Group. The Co-ordinating Group identified its support for a compromise design whereby 8.5ha along Selby Street would be managed by UWA as "Conservation Open Space" with residential development supported on the balance. A copy of the agreed design is included as Figure 5 and discussed in the following section.

Further discussions have taken place with officers of the DEP regarding the optimal shape of the Conservation Area. Optimal reserve management is usually achieved by minimising the perimeter to area ratio of a reserve. In the case of the UWA site this could be improved by designing the conservation area as a rectangle of 8.5ha rather than as an "L" shape. This would result in a reduction in the perimeter length from around 1500m for the current "L" shape to around 1400m for a rectangular shape. The "L" shaped design of the conservation area has been based on planning and traffic requirements as well as environmental characteristics. The marginal reduction in perimeter to area ratio that would be achieved with a rectangular reserve is not considered significant enough to change the Concept Plan at this stage.

4. OUTLINE DEVELOPMENT PLAN

The present environmental assessment has determined that it is possible to retain current values of the site and meet Bushplan objectives by protecting representative bushland areas within a residential development. Surveys of the site identified bushland worthy of protection particularly in the eastern part as well as mature trees on the central ridge area and service easement.

The Concept Plan for Lot 4, Loc 2103 Underwood Avenue, Shenton Park produced by Chappell & Lambert, as shown in Figure 5, represents an integration of environmental, planning, landscape and engineering objectives. The Concept Plan has achieved a balance between the different sets of objectives, however the retention of bushland in an urban setting has been a primary objective.

Overall, the plan provides for the protection of more than 22% (8.5ha of 38.6ha) of the bushland at the site to be managed by The University of Western Australia for conservation purposes. In addition, a further 2ha is set aside for the provision of Public Open Space.

Importantly, local open space which would normally be required as a condition of subdivision approval, is identified in addition to the proposed bushland conservation area. This is considered very reasonable as:

i) The land is zoned both "Urban" in the Metropolitan Region Scheme and "Development" zone is the City of Nedlands Town Planning Scheme. On this basis, the landowner has always had an expectation of ultimate full development on the site. The offer to set aside 27% as non-urban land is, under these circumstances, a substantial compromise.

ii) Land which would constitute subdivisional open space has been located to protect substantial trees on the site in a parkland setting. Parkland clearing which will result in the retention of the trees will therefore meet both conservation and recreation objectives.

iii) The site, when developed will be in close proximity to major local recreational open space and sporting facilities including Pat Goodridge Park, Matthews Netball Centre, McGillivray Sportsground and Challenge Stadium. Large grassed park areas are, therefore not required within the subdivisional area.

The main environmental features of the plan are:

- Retention by The University of Western Australia of approximately 8.5 hectares of good quality Jarrah Woodland along Selby Street for conservation purposes.

- Retention of a number of large mature Jarrah and Tuart trees within well located open space and or special treatments within the development area.

The University of Western Australia will prepare and implement a conservation plan for the 8.5ha Bushplan area. The plan will address the following issues:

- Fencing to deter uncontrolled access and possibly vermin control:

- The requirement for and nature of access paths boardwalks through the area:
- Management of weeds:
- Rehabilitation of degraded areas:
- Management of drainage in the subdivision to avoid impacts on the area:
- Requirement for signage
- Possible reintroduction of native fauna
- Potential research opportunities
- Implementation and costing of the conservation plan

The conservation plan would be prepared in consultation with UWA departments, DEP, CALM, the City of Nedlands and the local community.

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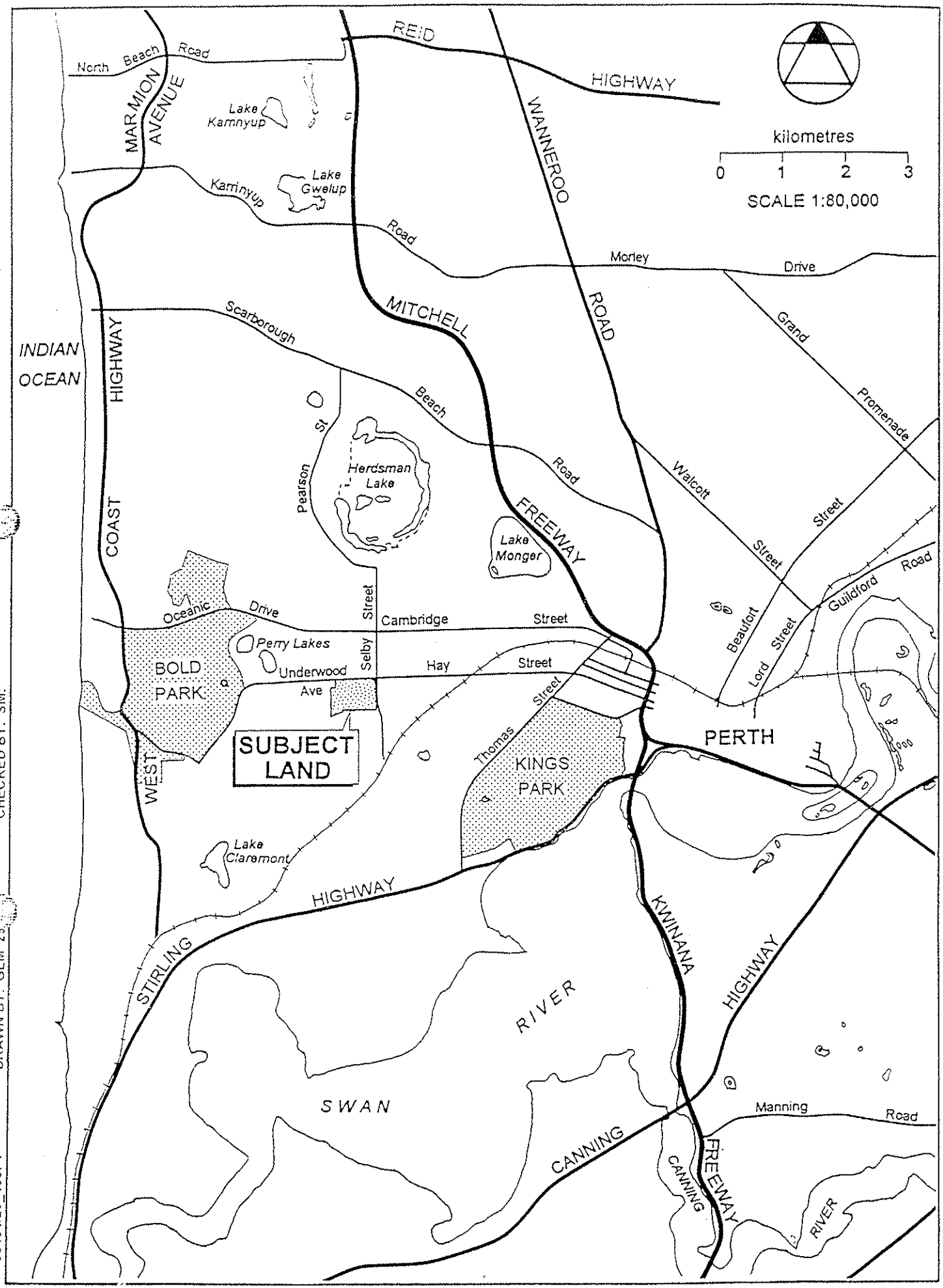
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FIGURES



CHECKED BY: SM:

DRAWN BY: GLM 29

98101/20_133F1

ATA Environmental
environmental scientists

LOT 2103 UNDERWOOD AVE SHENTON PARK
REGIONAL LOCATION
FIGURE 1

GOVERNMENT OF WESTERN AUSTRALIA

MINISTER FOR THE ENVIRONMENT; SCIENCE

ENVIRONMENTAL
PROTECTION AUTHORITY
DATE RECEIVED 10-8-05
EPA FILE NO 428-66
CORRESPONDENCE
REF NO EPIN721

CHAIRMAN
ENVIRONMENTAL PROTECTION AUTHORITY

SUPERLOT SUBDIVISION LOT 4 & LOT 105 UNDERWOOD AVENUE, SHENTON PARK (Assessment No. 1476)

As you are aware, I previously determined appeals relating to the Environmental Protection Authority's report on the above proposal and decided that the proposal should not proceed and shall not be implemented.

In line with my decision on appeals and following consultation with the Western Australian Planning Commission as a decision making authority for the proposal, I am hereby notifying you pursuant to section 45(8) of the *Environmental Protection Act 1986*, that the proposal may not be implemented.

Judy Edwards

Dr Judy Edwards MLA
MINISTER FOR THE ENVIRONMENT; SCIENCE

08 AUG 2005

OFFICE OF THE APPEALS CONVENOR

Environmental Protection Act (1986)
Waterways Conservation Act (1976)
Rights in Water and Irrigation Act (1914)
Swan River Trust Act (1988)

ENVIRONMENTAL PROTECTION AUTHORITY
DATE RECEIVED 19-7-4
EPA FILE NO 428-03
CORRESPONDENCE REF NO EPIN 193

CHAIRMAN
ENVIRONMENTAL PROTECTION AUTHORITY

Pursuant to Regulation 9 of the Environmental Protection Regulations, enclosed is a copy of the summary papers for appeal numbers 096/03 – 117/03.

Margaret Johnston
APPEALS REGISTRAR

July 14, 2004

enc.

13th Floor Allendale Square, 77 St George's Terrace, Perth 6000
Telephone: (08) 9221 8711 Facsimile: (08) 9221 8244
Internet Address: http://www.wa.gov.au/appeals

LEADR ACCREDITED MEDIATOR

APPEAL DECISION SUMMARY

Appeal Number 096 of 2003

The appeal is lodged in objection to the Report and Recommendations of the Environmental Protection Authority (EPA) in Bulletin 1099

Appellant:	Birds Australia
Proponent:	The University of Western Australia & Water Corporation
Proposal:	Superlot subdivision, Lot 4 & Lot 105 Underwood Avenue, Shenton Park
Minister's Decision:	Allowed to the extent that appeals contend that the proposal is environmentally unacceptable and should not proceed
Date of Decision:	14 June 2004

Grounds of Appeal and Reasons for Decision:

Appeal Grounds relate to:

1. *Loss of habitat, flora and fauna*
2. *Ecological linkages and impacts on other bushland areas*
3. *Shape of area proposed for conservation*
4. *Size of area proposed for conservation*
5. *Vegetation condition*

Consideration

The proposal currently the subject of appeals relates to the creation of three superlots on an overall site of 64.3 hectares. Of these 3 lots one lot – proposed Lot 1 would be subdivided and developed for residential purposes, whilst the remainder of the proposal area, excluding a 12 hectare area proposed for conservation, would be developed at a later date, depending on the outcomes of odour reduction works associated with the Subiaco Wastewater Treatment Plant, and further planning for the site.

The EPA reported on the proposal in May 2003, recommending that the proposal proceed subject to a range of conditions.

An Appeals Committee was appointed to consider and report to the Minister for the Environment on appeals.

A portion of the overall proposal area contains regionally significant vegetation which was recognised through its inclusion in *Bush Forever* site 119, and prior to that, in the draft *Perth's Bushplan*. The site contains approximately 31.5 hectares of vegetation comprising the Karrakatta central and south complex, a complex which is proposed to have less than 10% protection within the Perth metropolitan area under *Bush Forever*. The vegetation on the site has been previously identified by the EPA as being of a condition which is, in many cases, better than other regionally significant areas on the Spearwood dunes, and that a significant portion of the bushland on the site is in good condition.

The site has been identified as a valuable ecological linkage and stepping stone for fauna between bushland areas in the vicinity, including Bold Park and Kings Park, and there is significant community opposition to the proposal based on biodiversity issues.

All of these factors mean that any proposal which impacts on the regionally significant bushland on the site needs to provide an adequate biodiversity outcome.

A range of issues were raised in appeals. Several appeals related to the level and method of assessment by the EPA and argued for the proposal to be subject to fuller and more public assessment. Many of appeals contended that the EPA's Report and Recommendations did not provide for a suitable biodiversity outcome in terms of conservation of the regionally significant vegetation on the site and argued for the full retention of the regionally significant vegetation on the site.

The Appeals Committee's report on appeals addressed the issues raised in appeals in detail.

In terms of the key issues raised in appeals, the Appeals Committee concluded while there remained community concerns with respect to the level and method of assessment by the EPA, that the process had provided sufficient information with respect to community views on the proposal to enable an informed decision on the proposal to be made.

With respect to biodiversity issues, the Appeals Committee's report identified that the proposed area for conservation represented the minimum desirable conservation outcome. The Appeals Committee also identified that the shape of the proposed conservation area was less than ideal, that it did not contain all of the vegetation in the best condition of the site, and that there is uncertainty in terms of the likely success of the proposed bushland restoration approach. It concluded that the overall environmental outcome would be improved by a larger percentage of the *Bush Forever* site being retained, particularly the areas of the site containing vegetation in very good condition, or of the proposed site generally, being retained for conservation purposes.

Taking into account:

- The identification of vegetation on the site as being of regional significance;
- That the vegetation on the site represents a good example of the Karrakatta central and south complex, which is a complex that will not reach the 10% conservation target under *Bush Forever*;
- The condition of the vegetation, particularly the areas of very good condition vegetation on the site;
- The role of the bushland on the site as an ecological linkage and stepping stone between bushland areas in the vicinity, including Kings Park and Bold Park, and as an important fauna habitat area;
- The need to ensure that there is a long term sustainable conservation outcome in terms of vegetation to be retained on the site; and,
- The level of community concern with respect to the biodiversity outcomes for this proposal;

The Minister for the Environment formed the view that the proposal is not environmentally acceptable in terms of biodiversity and conservation outcomes as the area proposed for conservation is inadequate for the following reasons:

- It fails to provide for an adequate portion of the vegetation in the best condition of the site being protected – only 17%, or 1.35 hectares of the 8 hectares of vegetation rated in "very good" condition is proposed to be retained;
- The condition of the vegetation to be retained in the conservation area is generally at the lower end of vegetation condition for the site;
- The uncertainties associated with the ability to restore the vegetation condition of the area proposed to be conserved;
- The suboptimal shape of the area proposed for conservation in terms of edge to area ratio and manageability;
- The overall size of the area proposed to be retained – it is questionable as to whether it is large enough to remain sustainable and maintain biodiversity values over the long term; and,
- The reliance on rehabilitation and restoration, along with a significant management effort in maintaining the biodiversity values of the site is uncertain and not preferable when compared to in situ conservation of bushland.

On this basis appeals are allowed to the extent that they contend that the proposal is environmentally unacceptable and should not proceed.

APPEAL DECISION SUMMARY

Appeal Number 097 of 2003

The appeal is lodged in objection to the Report and Recommendations of the Environmental Protection Authority (EPA) in Bulletin 1099

Appellant:	Brian Perriam
Proponent:	The University of Western Australia & Water Corporation
Proposal:	Superlot subdivision, Lot 4 & Lot 105 Underwood Avenue, Shenton Park
Minister's Decision:	Allowed to the extent that appeals contend that the proposal is environmentally unacceptable and should not proceed
Date of Decision:	14 June 2004

Grounds of Appeal and Reasons for Decision:

Appeal Grounds relate to:

1. *Vegetation condition*
2. Financial need for development
3. *Odour reduction*

Consideration

The proposal currently the subject of appeals relates to the creation of three superlots on an overall site of 64.3 hectares. Of these 3 lots one lot – proposed Lot 1 would be subdivided and developed for residential purposes, whilst the remainder of the proposal area, excluding a 12 hectare area proposed for conservation, would be developed at a later date, depending on the outcomes of odour reduction works associated with the Subiaco Wastewater Treatment Plant, and further planning for the site.

The EPA reported on the proposal in May 2003, recommending that the proposal proceed subject to a range of conditions.

An Appeals Committee was appointed to consider and report to the Minister for the Environment on appeals.

A portion of the overall proposal area contains regionally significant vegetation which was recognised through its inclusion in *Bush Forever* site 119, and prior to that, in the draft *Perth's Bushplan*. The site contains approximately 31.5 hectares of vegetation comprising the Karrakatta central and south complex, a complex which is proposed to have less than 10% protection within the Perth metropolitan area under *Bush Forever*. The vegetation on the site has been previously identified by the EPA as being of a condition which is, in many cases, better than other regionally significant areas on the Spearwood dunes, and that a significant portion of the bushland on the site is in good condition.

The site has been identified as a valuable ecological linkage and stepping stone for fauna between bushland areas in the vicinity, including Bold Park and Kings Park, and there is significant community opposition to the proposal based on biodiversity issues.

All of these factors mean that any proposal which impacts on the regionally significant bushland on the site needs to provide an adequate biodiversity outcome.

A range of issues were raised in appeals. Several appeals related to the level and method of assessment by the EPA and argued for the proposal to be subject to fuller and more public assessment. Many of appeals contended that the EPA's Report and Recommendations did not provide for a suitable biodiversity outcome in terms of conservation of the regionally significant vegetation on the site and argued for the full retention of the regionally significant vegetation on the site.

The Appeals Committee's report on appeals addressed the issues raised in appeals in detail.

In terms of the key issues raised in appeals, the Appeals Committee concluded while there remained community concerns with respect to the level and method of assessment by the EPA, that the process had provided sufficient information with respect to community views on the proposal to enable an informed decision on the proposal to be made.

With respect to biodiversity issues, the Appeals Committee's report identified that the proposed area for conservation represented the minimum desirable conservation outcome. The Appeals Committee also identified that the shape of the proposed conservation area was less than ideal, that it did not contain all of the vegetation in the best condition of the site, and that there is uncertainty in terms of the likely success of the proposed bushland restoration approach. It concluded that the overall environmental outcome would be improved by a larger percentage of the *Bush Forever* site being retained, particularly the areas of the site containing vegetation in very good condition, or of the proposed site generally, being retained for conservation purposes.

Taking into account:

- The identification of vegetation on the site as being of regional significance;
- That the vegetation on the site represents a good example of the Karrakatta central and south complex, which is a complex that will not reach the 10% conservation target under *Bush Forever*;
- The condition of the vegetation, particularly the areas of very good condition vegetation on the site;
- The role of the bushland on the site as an ecological linkage and stepping stone between bushland areas in the vicinity, including Kings Park and Bold Park, and as an important fauna habitat area;
- The need to ensure that there is a long term sustainable conservation outcome in terms of vegetation to be retained on the site; and,
- The level of community concern with respect to the biodiversity outcomes for this proposal;

The Minister for the Environment formed the view that the proposal is not environmentally acceptable in terms of biodiversity and conservation outcomes as the area proposed for conservation is inadequate for the following reasons:

- It fails to provide for an adequate portion of the vegetation in the best condition of the site being protected – only 17%, or 1.35 hectares of the 8 hectares of vegetation rated in "very good" condition is proposed to be retained;
- The condition of the vegetation to be retained in the conservation area is generally at the lower end of vegetation condition for the site;
- The uncertainties associated with the ability to restore the vegetation condition of the area proposed to be conserved;
- The suboptimal shape of the area proposed for conservation in terms of edge to area ratio and manageability;
- The overall size of the area proposed to be retained – it is questionable as to whether it is large enough to remain sustainable and maintain biodiversity values over the long term; and,
- The reliance on rehabilitation and restoration, along with a significant management effort in maintaining the biodiversity values of the site is uncertain and not preferable when compared to in situ conservation of bushland.

On this basis appeals are allowed to the extent that they contend that the proposal is environmentally unacceptable and should not proceed.

APPEAL DECISION SUMMARY

Appeal Number 098 of 2003

The appeal is lodged in objection to the Report and Recommendations of the Environmental Protection Authority (EPA) in Bulletin 1099

Appellant: Patricia Weaver

Proponent: The University of Western Australia & Water Corporation

Proposal: Superlot subdivision, Lot 4 & Lot 105 Underwood Avenue, Shenton Park

Minister's Decision: Allowed to the extent that appeals contend that the proposal is environmentally unacceptable and should not proceed

Date of Decision: 14 June 2004

Grounds of Appeal and Reasons for Decision:

Appeal Grounds relate to:

1. *Size of proposed conservation area*
2. *Shape of proposed conservation area*
3. *Vegetation condition*
4. *Financial need for development*
5. *Value beyond residential development*

Consideration

The proposal currently the subject of appeals relates to the creation of three superlots on an overall site of 64.3 hectares. Of these 3 lots one lot – proposed Lot 1 would be subdivided and developed for residential purposes, whilst the remainder of the proposal area, excluding a 12 hectare area proposed for conservation, would be developed at a later date, depending on the outcomes of odour reduction works associated with the Subiaco Wastewater Treatment Plant, and further planning for the site.

The EPA reported on the proposal in May 2003, recommending that the proposal proceed subject to a range of conditions.

An Appeals Committee was appointed to consider and report to the Minister for the Environment on appeals.

A portion of the overall proposal area contains regionally significant vegetation which was recognised through its inclusion in *Bush Forever* site 119, and prior to that, in the draft *Perth's Bushplan*. The site contains approximately 31.5 hectares of vegetation comprising the Karrakatta central and south complex, a complex which is proposed to have less than 10% protection within the Perth metropolitan area under *Bush Forever*. The vegetation on the site has been previously identified by the EPA as being of a condition which is, in many cases, better than other regionally significant areas on the Spearwood dunes, and that a significant portion of the bushland on the site is in good condition.

The site has been identified as a valuable ecological linkage and stepping stone for fauna between bushland areas in the vicinity, including Bold Park and Kings Park, and there is significant community opposition to the proposal based on biodiversity issues.

All of these factors mean that any proposal which impacts on the regionally significant bushland on the site needs to provide an adequate biodiversity outcome.

A range of issues were raised in appeals. Several appeals related to the level and method of assessment by the EPA and argued for the proposal to be subject to fuller and more public assessment. Many of appeals contended that the EPA's Report and Recommendations did not provide for a suitable biodiversity outcome in terms of conservation of the regionally significant vegetation on the site and argued for the full retention of the regionally significant vegetation on the site.

The Appeals Committee's report on appeals addressed the issues raised in appeals in detail.

In terms of the key issues raised in appeals, the Appeals Committee concluded while there remained community concerns with respect to the level and method of assessment by the EPA, that the process had provided sufficient information with respect to community views on the proposal to enable an informed decision on the proposal to be made.

With respect to biodiversity issues, the Appeals Committee's report identified that the proposed area for conservation represented the minimum desirable conservation outcome. The Appeals Committee also identified that the shape of the proposed conservation area was less than ideal, that it did not contain all of the vegetation in the best condition of the site, and that there is uncertainty in terms of the likely success of the proposed bushland restoration approach. It concluded that the overall environmental outcome would be improved by a larger percentage of the *Bush Forever* site being retained, particularly the areas of the site containing vegetation in very good condition, or of the proposed site generally, being retained for conservation purposes.

Taking into account:

- The identification of vegetation on the site as being of regional significance;
- That the vegetation on the site represents a good example of the Karrakatta central and south complex, which is a complex that will not reach the 10% conservation target under *Bush Forever*;
- The condition of the vegetation, particularly the areas of very good condition vegetation on the site;
- The role of the bushland on the site as an ecological linkage and stepping stone between bushland areas in the vicinity, including Kings Park and Bold Park, and as an important fauna habitat area;
- The need to ensure that there is a long term sustainable conservation outcome in terms of vegetation to be retained on the site; and,
- The level of community concern with respect to the biodiversity outcomes for this proposal;

The Minister for the Environment formed the view that the proposal is not environmentally acceptable in terms of biodiversity and conservation outcomes as the area proposed for conservation is inadequate for the following reasons:

- It fails to provide for an adequate portion of the vegetation in the best condition of the site being protected – only 17%, or 1.35 hectares of the 8 hectares of vegetation rated in "very good" condition is proposed to be retained;
- The condition of the vegetation to be retained in the conservation area is generally at the lower end of vegetation condition for the site;
- The uncertainties associated with the ability to restore the vegetation condition of the area proposed to be conserved;
- The suboptimal shape of the area proposed for conservation in terms of edge to area ratio and manageability;
- The overall size of the area proposed to be retained – it is questionable as to whether it is large enough to remain sustainable and maintain biodiversity values over the long term; and,
- The reliance on rehabilitation and restoration, along with a significant management effort in maintaining the biodiversity values of the site is uncertain and not preferable when compared to in situ conservation of bushland.

On this basis appeals are allowed to the extent that they contend that the proposal is environmentally unacceptable and should not proceed.

APPEAL DECISION SUMMARY

Appeal Number 099 of 2003

The appeal is lodged in objection to the Report and Recommendations of the Environmental Protection Authority (EPA) in Bulletin 1099

Appellant:	Minter Ellison
Proponent:	The University of Western Australia & Water Corporation
Proposal:	Superlot subdivision, Lot 4 & Lot 105 Underwood Avenue, Shenton Park
Minister's Decision:	Dismissed
Date of Decision:	14 June 2004

Grounds of Appeal and Reasons for Decision:

Appeal Grounds relate to:

1. *Reference to odour buffer*

Consideration

The proposal currently the subject of appeals relates to the creation of three superlots on an overall site of 64.3 hectares. Of these 3 lots one lot – proposed Lot 1 would be subdivided and developed for residential purposes, whilst the remainder of the proposal area, excluding a 12 hectare area proposed for conservation, would be developed at a later date, depending on the outcomes of odour reduction works associated with the Subiaco Wastewater Treatment Plant, and further planning for the site.

The EPA reported on the proposal in May 2003, recommending that the proposal proceed subject to a range of conditions.

An Appeals Committee was appointed to consider and report to the Minister for the Environment on appeals.

A portion of the overall proposal area contains regionally significant vegetation which was recognised through its inclusion in *Bush Forever* site 119, and prior to that, in the draft *Perth's Bushplan*. The site contains approximately 31.5 hectares of vegetation comprising the Karrakatta central and south complex, a complex which is proposed to have less than 10% protection within the Perth metropolitan area under *Bush Forever*. The vegetation on the site has been previously identified by the EPA as being of a condition which is, in many cases, better than other regionally significant areas on the Spearwood dunes, and that a significant portion of the bushland on the site is in good condition.

The site has been identified as a valuable ecological linkage and stepping stone for fauna between bushland areas in the vicinity, including Bold Park and Kings Park, and there is significant community opposition to the proposal based on biodiversity issues.

All of these factors mean that any proposal which impacts on the regionally significant bushland on the site needs to provide an adequate biodiversity outcome.

A range of issues were raised in appeals. Several appeals related to the level and method of assessment by the EPA and argued for the proposal to be subject to fuller and more public assessment. Many of appeals contended that the EPA's Report and Recommendations did not provide for a suitable biodiversity outcome in terms of conservation of the regionally significant vegetation on the site and argued for the full retention of the regionally significant vegetation on the site.

The Appeals Committee's report on appeals addressed the issues raised in appeals in detail.

In terms of the key issues raised in appeals, the Appeals Committee concluded while there remained community concerns with respect to the level and method of assessment by the EPA, that the process had provided sufficient information with respect to community views on the proposal to enable an informed decision on the proposal to be made.

With respect to biodiversity issues, the Appeals Committee's report identified that the proposed area for conservation represented the minimum desirable conservation outcome. The Appeals Committee also identified that the shape of the proposed conservation area was less than ideal, that it did not contain all of the vegetation in the best condition of the site, and that there is uncertainty in terms of the likely success of the proposed bushland restoration approach. It concluded that the overall environmental outcome would be improved by a larger percentage of the *Bush Forever* site being retained, particularly the areas of the site containing vegetation in very good condition, or of the proposed site generally, being retained for conservation purposes.

Taking into account:

- The identification of vegetation on the site as being of regional significance;
- That the vegetation on the site represents a good example of the Karrakatta central and south complex, which is a complex that will not reach the 10% conservation target under *Bush Forever*;
- The condition of the vegetation, particularly the areas of very good condition vegetation on the site;
- The role of the bushland on the site as an ecological linkage and stepping stone between bushland areas in the vicinity, including Kings Park and Bold Park, and as an important fauna habitat area;
- The need to ensure that there is a long term sustainable conservation outcome in terms of vegetation to be retained on the site; and,
- The level of community concern with respect to the biodiversity outcomes for this proposal;

The Minister for the Environment formed the view that the proposal is not environmentally acceptable in terms of biodiversity and conservation outcomes as the area proposed for conservation is inadequate for the following reasons:

- It fails to provide for an adequate portion of the vegetation in the best condition of the site being protected – only 17%, or 1.35 hectares of the 8 hectares of vegetation rated in "very good" condition is proposed to be retained;
- The condition of the vegetation to be retained in the conservation area is generally at the lower end of vegetation condition for the site;
- The uncertainties associated with the ability to restore the vegetation condition of the area proposed to be conserved;
- The suboptimal shape of the area proposed for conservation in terms of edge to area ratio and manageability;
- The overall size of the area proposed to be retained – it is questionable as to whether it is large enough to remain sustainable and maintain biodiversity values over the long term; and,
- The reliance on rehabilitation and restoration, along with a significant management effort in maintaining the biodiversity values of the site is uncertain and not preferable when compared to in situ conservation of bushland.

On this basis appeals are allowed to the extent that they contend that the proposal is environmentally unacceptable and should not proceed.

APPEAL DECISION SUMMARY

Appeal Number 100 of 2003

The appeal is lodged in objection to the Report and Recommendations of the Environmental Protection Authority (EPA) in Bulletin 1099

Appellant:	Jim Crandell
Proponent:	The University of Western Australia & Water Corporation
Proposal:	Superlot subdivision, Lot 4 & Lot 105 Underwood Avenue, Shenton Park
Minister's Decision:	Allowed to the extent that appeals contend that the proposal is environmentally unacceptable and should not proceed
Date of Decision:	14 June 2004

Grounds of Appeal and Reasons for Decision:

Appeal Grounds relate to:

1. *Loss of habitat, flora and fauna*
2. *Financial need for development*
3. *Value beyond residential development*

Consideration

The proposal currently the subject of appeals relates to the creation of three superlots on an overall site of 64.3 hectares. Of these 3 lots one lot – proposed Lot 1 would be subdivided and developed for residential purposes, whilst the remainder of the proposal area, excluding a 12 hectare area proposed for conservation, would be developed at a later date, depending on the outcomes of odour reduction works associated with the Subiaco Wastewater Treatment Plant, and further planning for the site.

The EPA reported on the proposal in May 2003, recommending that the proposal proceed subject to a range of conditions.

An Appeals Committee was appointed to consider and report to the Minister for the Environment on appeals.

A portion of the overall proposal area contains regionally significant vegetation which was recognised through its inclusion in *Bush Forever* site 119, and prior to that, in the draft *Perth's Bushplan*. The site contains approximately 31.5 hectares of vegetation comprising the Karrakatta central and south complex, a complex which is proposed to have less than 10% protection within the Perth metropolitan area under *Bush Forever*. The vegetation on the site has been previously identified by the EPA as being of a condition which is, in many cases, better than other regionally significant areas on the Spearwood dunes, and that a significant portion of the bushland on the site is in good condition.

The site has been identified as a valuable ecological linkage and stepping stone for fauna between bushland areas in the vicinity, including Bold Park and Kings Park, and there is significant community opposition to the proposal based on biodiversity issues.

All of these factors mean that any proposal which impacts on the regionally significant bushland on the site needs to provide an adequate biodiversity outcome.

A range of issues were raised in appeals. Several appeals related to the level and method of assessment by the EPA and argued for the proposal to be subject to fuller and more public assessment. Many of appeals contended that the EPA's Report and Recommendations did not provide for a suitable biodiversity outcome in terms of conservation of the regionally significant vegetation on the site and argued for the full retention of the regionally significant vegetation on the site.

The Appeals Committee's report on appeals addressed the issues raised in appeals in detail.

In terms of the key issues raised in appeals, the Appeals Committee concluded while there remained community concerns with respect to the level and method of assessment by the EPA, that the process had provided sufficient information with respect to community views on the proposal to enable an informed decision on the proposal to be made.

With respect to biodiversity issues, the Appeals Committee's report identified that the proposed area for conservation represented the minimum desirable conservation outcome. The Appeals Committee also identified that the shape of the proposed conservation area was less than ideal, that it did not contain all of the vegetation in the best condition of the site, and that there is uncertainty in terms of the likely success of the proposed bushland restoration approach. It concluded that the overall environmental outcome would be improved by a larger percentage of the *Bush Forever* site being retained, particularly the areas of the site containing vegetation in very good condition, or of the proposed site generally, being retained for conservation purposes.

Taking into account:

- The identification of vegetation on the site as being of regional significance;
- That the vegetation on the site represents a good example of the Karrakatta central and south complex, which is a complex that will not reach the 10% conservation target under *Bush Forever*;
- The condition of the vegetation, particularly the areas of very good condition vegetation on the site;
- The role of the bushland on the site as an ecological linkage and stepping stone between bushland areas in the vicinity, including Kings Park and Bold Park, and as an important fauna habitat area;
- The need to ensure that there is a long term sustainable conservation outcome in terms of vegetation to be retained on the site; and,
- The level of community concern with respect to the biodiversity outcomes for this proposal;

The Minister for the Environment formed the view that the proposal is not environmentally acceptable in terms of biodiversity and conservation outcomes as the area proposed for conservation is inadequate for the following reasons:

- It fails to provide for an adequate portion of the vegetation in the best condition of the site being protected – only 17%, or 1.35 hectares of the 8 hectares of vegetation rated in "very good" condition is proposed to be retained;
- The condition of the vegetation to be retained in the conservation area is generally at the lower end of vegetation condition for the site;
- The uncertainties associated with the ability to restore the vegetation condition of the area proposed to be conserved;
- The suboptimal shape of the area proposed for conservation in terms of edge to area ratio and manageability;
- The overall size of the area proposed to be retained – it is questionable as to whether it is large enough to remain sustainable and maintain biodiversity values over the long term; and,
- The reliance on rehabilitation and restoration, along with a significant management effort in maintaining the biodiversity values of the site is uncertain and not preferable when compared to in situ conservation of bushland.

On this basis appeals are allowed to the extent that they contend that the proposal is environmentally unacceptable and should not proceed.

APPEAL DECISION SUMMARY

Appeal Number 101 of 2003

The appeal is lodged in objection to the Report and Recommendations of the Environmental Protection Authority (EPA) in Bulletin 1099

Appellant:	Wildflower Society of WA
Proponent:	The University of Western Australia & Water Corporation
Proposal:	Superlot subdivision, Lot 4 & Lot 105 Underwood Avenue, Shenton Park
Minister's Decision:	Allowed to the extent that appeals contend that the proposal is environmentally unacceptable and should not proceed
Date of Decision:	14 June 2004

Grounds of Appeal and Reasons for Decision:

Appeal Grounds relate to:

1. *Bush Forever and National targets for vegetation conservation*

Consideration

The proposal currently the subject of appeals relates to the creation of three superlots on an overall site of 64.3 hectares. Of these 3 lots one lot – proposed Lot 1 would be subdivided and developed for residential purposes, whilst the remainder of the proposal area, excluding a 12 hectare area proposed for conservation, would be developed at a later date, depending on the outcomes of odour reduction works associated with the Subiaco Wastewater Treatment Plant, and further planning for the site.

The EPA reported on the proposal in May 2003, recommending that the proposal proceed subject to a range of conditions.

An Appeals Committee was appointed to consider and report to the Minister for the Environment on appeals.

A portion of the overall proposal area contains regionally significant vegetation which was recognised through its inclusion in *Bush Forever* site 119, and prior to that, in the draft *Perth's Bushplan*. The site contains approximately 31.5 hectares of vegetation comprising the Karrakatta central and south complex, a complex which is proposed to have less than 10% protection within the Perth metropolitan area under *Bush Forever*. The vegetation on the site has been previously identified by the EPA as being of a condition which is, in many cases, better than other regionally significant areas on the Spearwood dunes, and that a significant portion of the bushland on the site is in good condition.

The site has been identified as a valuable ecological linkage and stepping stone for fauna between bushland areas in the vicinity, including Bold Park and Kings Park, and there is significant community opposition to the proposal based on biodiversity issues.

All of these factors mean that any proposal which impacts on the regionally significant bushland on the site needs to provide an adequate biodiversity outcome.

A range of issues were raised in appeals. Several appeals related to the level and method of assessment by the EPA and argued for the proposal to be subject to fuller and more public assessment. Many of appeals contended that the EPA's Report and Recommendations did not provide for a suitable biodiversity outcome in terms of conservation of the regionally significant vegetation on the site and argued for the full retention of the regionally significant vegetation on the site.

The Appeals Committee's report on appeals addressed the issues raised in appeals in detail.

In terms of the key issues raised in appeals, the Appeals Committee concluded while there remained community concerns with respect to the level and method of assessment by the EPA, that the process had provided sufficient information with respect to community views on the proposal to enable an informed decision on the proposal to be made.

With respect to biodiversity issues, the Appeals Committee's report identified that the proposed area for conservation represented the minimum desirable conservation outcome. The Appeals Committee also identified that the shape of the proposed conservation area was less than ideal, that it did not contain all of the vegetation in the best condition of the site, and that there is uncertainty in terms of the likely success of the proposed bushland restoration approach. It concluded that the overall environmental outcome would be improved by a larger percentage of the *Bush Forever* site being retained, particularly the areas of the site containing vegetation in very good condition, or of the proposed site generally, being retained for conservation purposes.

Taking into account:

- The identification of vegetation on the site as being of regional significance;
- That the vegetation on the site represents a good example of the Karrakatta central and south complex, which is a complex that will not reach the 10% conservation target under *Bush Forever*;
- The condition of the vegetation, particularly the areas of very good condition vegetation on the site;
- The role of the bushland on the site as an ecological linkage and stepping stone between bushland areas in the vicinity, including Kings Park and Bold Park, and as an important fauna habitat area;
- The need to ensure that there is a long term sustainable conservation outcome in terms of vegetation to be retained on the site; and,
- The level of community concern with respect to the biodiversity outcomes for this proposal;

The Minister for the Environment formed the view that the proposal is not environmentally acceptable in terms of biodiversity and conservation outcomes as the area proposed for conservation is inadequate for the following reasons:

- It fails to provide for an adequate portion of the vegetation in the best condition of the site being protected – only 17%, or 1.35 hectares of the 8 hectares of vegetation rated in "very good" condition is proposed to be retained;
- The condition of the vegetation to be retained in the conservation area is generally at the lower end of vegetation condition for the site;
- The uncertainties associated with the ability to restore the vegetation condition of the area proposed to be conserved;
- The suboptimal shape of the area proposed for conservation in terms of edge to area ratio and manageability;
- The overall size of the area proposed to be retained – it is questionable as to whether it is large enough to remain sustainable and maintain biodiversity values over the long term; and,
- The reliance on rehabilitation and restoration, along with a significant management effort in maintaining the biodiversity values of the site is uncertain and not preferable when compared to in situ conservation of bushland.

On this basis appeals are allowed to the extent that they contend that the proposal is environmentally unacceptable and should not proceed.

APPEAL DECISION SUMMARY

Appeal Number 102 of 2003

The appeal is lodged in objection to the Report and Recommendations of the Environmental Protection Authority (EPA) in Bulletin 1099

Appellant:	Roz Hart
Proponent:	The University of Western Australia & Water Corporation
Proposal:	Superlot subdivision, Lot 4 & Lot 105 Underwood Avenue, Shenton Park
Minister's Decision:	Allowed to the extent that appeals contend that the proposal is environmentally unacceptable and should not proceed
Date of Decision:	14 June 2004

Grounds of Appeal and Reasons for Decision:

Appeal Grounds relate to:

1. *Loss of habitat, flora and fauna*
2. *Ecological linkages and impacts on other bushland areas*
3. *Vegetation condition*
4. *Value beyond residential development*
5. *Financial need for development*

Consideration

The proposal currently the subject of appeals relates to the creation of three superlots on an overall site of 64.3 hectares. Of these 3 lots one lot – proposed Lot 1 would be subdivided and developed for residential purposes, whilst the remainder of the proposal area, excluding a 12 hectare area proposed for conservation, would be developed at a later date, depending on the outcomes of odour reduction works associated with the Subiaco Wastewater Treatment Plant, and further planning for the site.

The EPA reported on the proposal in May 2003, recommending that the proposal proceed subject to a range of conditions.

An Appeals Committee was appointed to consider and report to the Minister for the Environment on appeals.

A portion of the overall proposal area contains regionally significant vegetation which was recognised through its inclusion in *Bush Forever* site 119, and prior to that, in the draft *Perth's Bushplan*. The site contains approximately 31.5 hectares of vegetation comprising the Karrakatta central and south complex, a complex which is proposed to have less than 10% protection within the Perth metropolitan area under *Bush Forever*. The vegetation on the site has been previously identified by the EPA as being of a condition which is, in many cases, better than other regionally significant areas on the Spearwood dunes, and that a significant portion of the bushland on the site is in good condition.

The site has been identified as a valuable ecological linkage and stepping stone for fauna between bushland areas in the vicinity, including Bold Park and Kings Park, and there is significant community opposition to the proposal based on biodiversity issues.

All of these factors mean that any proposal which impacts on the regionally significant bushland on the site needs to provide an adequate biodiversity outcome.

A range of issues were raised in appeals. Several appeals related to the level and method of assessment by the EPA and argued for the proposal to be subject to fuller and more public assessment. Many of appeals contended that the EPA's Report and Recommendations did not provide for a suitable biodiversity outcome in terms of conservation of the regionally significant vegetation on the site and argued for the full retention of the regionally significant vegetation on the site.

The Appeals Committee's report on appeals addressed the issues raised in appeals in detail.

In terms of the key issues raised in appeals, the Appeals Committee concluded while there remained community concerns with respect to the level and method of assessment by the EPA, that the process had provided sufficient information with respect to community views on the proposal to enable an informed decision on the proposal to be made.

With respect to biodiversity issues, the Appeals Committee's report identified that the proposed area for conservation represented the minimum desirable conservation outcome. The Appeals Committee also identified that the shape of the proposed conservation area was less than ideal, that it did not contain all of the vegetation in the best condition of the site, and that there is uncertainty in terms of the likely success of the proposed bushland restoration approach. It concluded that the overall environmental outcome would be improved by a larger percentage of the *Bush Forever* site being retained, particularly the areas of the site containing vegetation in very good condition, or of the proposed site generally, being retained for conservation purposes.

Taking into account:

- The identification of vegetation on the site as being of regional significance;
- That the vegetation on the site represents a good example of the Karrakatta central and south complex, which is a complex that will not reach the 10% conservation target under *Bush Forever*;
- The condition of the vegetation, particularly the areas of very good condition vegetation on the site;
- The role of the bushland on the site as an ecological linkage and stepping stone between bushland areas in the vicinity, including Kings Park and Bold Park, and as an important fauna habitat area;
- The need to ensure that there is a long term sustainable conservation outcome in terms of vegetation to be retained on the site; and,
- The level of community concern with respect to the biodiversity outcomes for this proposal;

The Minister for the Environment formed the view that the proposal is not environmentally acceptable in terms of biodiversity and conservation outcomes as the area proposed for conservation is inadequate for the following reasons:

- It fails to provide for an adequate portion of the vegetation in the best condition of the site being protected – only 17%, or 1.35 hectares of the 8 hectares of vegetation rated in "very good" condition is proposed to be retained;
- The condition of the vegetation to be retained in the conservation area is generally at the lower end of vegetation condition for the site;
- The uncertainties associated with the ability to restore the vegetation condition of the area proposed to be conserved;
- The suboptimal shape of the area proposed for conservation in terms of edge to area ratio and manageability;
- The overall size of the area proposed to be retained – it is questionable as to whether it is large enough to remain sustainable and maintain biodiversity values over the long term; and,
- The reliance on rehabilitation and restoration, along with a significant management effort in maintaining the biodiversity values of the site is uncertain and not preferable when compared to in situ conservation of bushland.

On this basis appeals are allowed to the extent that they contend that the proposal is environmentally unacceptable and should not proceed.

APPEAL DECISION SUMMARY

Appeal Number 103 of 2003

The appeal is lodged in objection to the Report and Recommendations of the Environmental Protection Authority (EPA) in Bulletin 1099

Appellant:	Urban Bushland Council
Proponent:	The University of Western Australia & Water Corporation
Proposal:	Superlot subdivision, Lot 4 & Lot 105 Underwood Avenue, Shenton Park
Minister's Decision:	Allowed to the extent that appeals contend that the proposal is environmentally unacceptable and should not proceed
Date of Decision:	14 June 2004

Grounds of Appeal and Reasons for Decision:

Appeal Grounds relate to:

1. *Loss of habitat, flora and fauna*
2. *Ecological linkages and impacts on other bushland areas*
3. *Bush Forever and National targets*
4. *Negotiated planning solution*
5. *Abrogation of responsibility*
6. *Odour reduction*
7. *Not a full environmental assessment*
8. *Deferring of decisions through conditions*

Consideration

The proposal currently the subject of appeals relates to the creation of three superlots on an overall site of 64.3 hectares. Of these 3 lots one lot – proposed Lot 1 would be subdivided and developed for residential purposes, whilst the remainder of the proposal area, excluding a 12 hectare area proposed for conservation, would be developed at a later date, depending on the outcomes of odour reduction works associated with the Subiaco Wastewater Treatment Plant, and further planning for the site.

The EPA reported on the proposal in May 2003, recommending that the proposal proceed subject to a range of conditions.

An Appeals Committee was appointed to consider and report to the Minister for the Environment on appeals.

A portion of the overall proposal area contains regionally significant vegetation which was recognised through its inclusion in *Bush Forever* site 119, and prior to that, in the draft *Perth's Bushplan*. The site contains approximately 31.5 hectares of vegetation comprising the Karrakatta central and south complex, a complex which is proposed to have less than 10% protection within the Perth metropolitan area under *Bush Forever*. The vegetation on the site has been previously identified by the EPA as being of a condition which is, in many cases, better than other regionally significant areas on the Spearwood dunes, and that a significant portion of the bushland on the site is in good condition.

The site has been identified as a valuable ecological linkage and stepping stone for fauna between bushland areas in the vicinity, including Bold Park and Kings Park, and there is significant community opposition to the proposal based on biodiversity issues.

All of these factors mean that any proposal which impacts on the regionally significant bushland on the site needs to provide an adequate biodiversity outcome.

A range of issues were raised in appeals. Several appeals related to the level and method of assessment by the EPA and argued for the proposal to be subject to fuller and more public assessment. Many of appeals contended that the EPA's Report and Recommendations did not provide for a suitable biodiversity outcome in terms of conservation of the regionally significant vegetation on the site and argued for the full retention of the regionally significant vegetation on the site.

The Appeals Committee's report on appeals addressed the issues raised in appeals in detail.

In terms of the key issues raised in appeals, the Appeals Committee concluded while there remained community concerns with respect to the level and method of assessment by the EPA, that the process had provided sufficient information with respect to community views on the proposal to enable an informed decision on the proposal to be made.

With respect to biodiversity issues, the Appeals Committee's report identified that the proposed area for conservation represented the minimum desirable conservation outcome. The Appeals Committee also identified that the shape of the proposed conservation area was less than ideal, that it did not contain all of the vegetation in the best condition of the site, and that there is uncertainty in terms of the likely success of the proposed bushland restoration approach. It concluded that the overall environmental outcome would be improved by a larger percentage of the *Bush Forever* site being retained, particularly the areas

of the site containing vegetation in very good condition, or of the proposed site generally, being retained for conservation purposes.

Taking into account:

- The identification of vegetation on the site as being of regional significance;
- That the vegetation on the site represents a good example of the Karrakatta central and south complex, which is a complex that will not reach the 10% conservation target under *Bush Forever*;
- The condition of the vegetation, particularly the areas of very good condition vegetation on the site;
- The role of the bushland on the site as an ecological linkage and stepping stone between bushland areas in the vicinity, including Kings Park and Bold Park, and as an important fauna habitat area;
- The need to ensure that there is a long term sustainable conservation outcome in terms of vegetation to be retained on the site; and,
- The level of community concern with respect to the biodiversity outcomes for this proposal;

The Minister for the Environment formed the view that the proposal is not environmentally acceptable in terms of biodiversity and conservation outcomes as the area proposed for conservation is inadequate for the following reasons:

- It fails to provide for an adequate portion of the vegetation in the best condition of the site being protected – only 17%, or 1.35 hectares of the 8 hectares of vegetation rated in "very good" condition is proposed to be retained;
- The condition of the vegetation to be retained in the conservation area is generally at the lower end of vegetation condition for the site;
- The uncertainties associated with the ability to restore the vegetation condition of the area proposed to be conserved;
- The suboptimal shape of the area proposed for conservation in terms of edge to area ratio and manageability;
- The overall size of the area proposed to be retained – it is questionable as to whether it is large enough to remain sustainable and maintain biodiversity values over the long term; and,
- The reliance on rehabilitation and restoration, along with a significant management effort in maintaining the biodiversity values of the site is uncertain and not preferable when compared to in situ conservation of bushland.

On this basis appeals are allowed to the extent that they contend that the proposal is environmentally unacceptable and should not proceed.

APPEAL DECISION SUMMARY

Appeal Number 104 of 2003

The appeal is lodged in objection to the Report and Recommendations of the Environmental Protection Authority (EPA) in Bulletin 1099

Appellant:	Max Hipkins
Proponent:	The University of Western Australia & Water Corporation
Proposal:	Superlot subdivision, Lot 4 & Lot 105 Underwood Avenue, Shenton Park
Minister's Decision:	Allowed to the extent that appeals contend that the proposal is environmentally unacceptable and should not proceed
Date of Decision:	14 June 2004

Grounds of Appeal and Reasons for Decision:

Appeal Grounds relate to:

1. *Size of area proposed for conservation*
2. *Financial need for development*
3. *Value beyond residential development*
4. *Odour*

Consideration

The proposal currently the subject of appeals relates to the creation of three superlots on an overall site of 64.3 hectares. Of these 3 lots one lot – proposed Lot 1 would be subdivided and developed for residential purposes, whilst the remainder of the proposal area, excluding a 12 hectare area proposed for conservation, would be developed at a later date, depending on the outcomes of odour reduction works associated with the Subiaco Wastewater Treatment Plant, and further planning for the site.

The EPA reported on the proposal in May 2003, recommending that the proposal proceed subject to a range of conditions.

An Appeals Committee was appointed to consider and report to the Minister for the Environment on appeals.

A portion of the overall proposal area contains regionally significant vegetation which was recognised through its inclusion in *Bush Forever* site 119, and prior to that, in the draft *Perth's Bushplan*. The site contains approximately 31.5 hectares of vegetation comprising the Karrakatta central and south complex, a complex which is proposed to have less than 10% protection within the Perth metropolitan area under *Bush Forever*. The vegetation on the site has been previously identified by the EPA as being of a condition which is, in many cases, better than other regionally significant areas on the Spearwood dunes, and that a significant portion of the bushland on the site is in good condition.

The site has been identified as a valuable ecological linkage and stepping stone for fauna between bushland areas in the vicinity, including Bold Park and Kings Park, and there is significant community opposition to the proposal based on biodiversity issues.

All of these factors mean that any proposal which impacts on the regionally significant bushland on the site needs to provide an adequate biodiversity outcome.

A range of issues were raised in appeals. Several appeals related to the level and method of assessment by the EPA and argued for the proposal to be subject to fuller and more public assessment. Many of appeals contended that the EPA's Report and Recommendations did not provide for a suitable biodiversity outcome in terms of conservation of the regionally significant vegetation on the site and argued for the full retention of the regionally significant vegetation on the site.

The Appeals Committee's report on appeals addressed the issues raised in appeals in detail.

In terms of the key issues raised in appeals, the Appeals Committee concluded while there remained community concerns with respect to the level and method of assessment by the EPA, that the process had provided sufficient information with respect to community views on the proposal to enable an informed decision on the proposal to be made.

With respect to biodiversity issues, the Appeals Committee's report identified that the proposed area for conservation represented the minimum desirable conservation outcome. The Appeals Committee also identified that the shape of the proposed conservation area was less than ideal, that it did not contain all of the vegetation in the best condition of the site, and that there is uncertainty in terms of the likely success of the proposed bushland restoration approach. It concluded that the overall environmental outcome would be improved by a larger percentage of the *Bush Forever* site being retained, particularly the areas of the site containing vegetation in very good condition, or of the proposed site generally, being retained for conservation purposes.

Taking into account:

- The identification of vegetation on the site as being of regional significance;
- That the vegetation on the site represents a good example of the Karrakatta central and south complex, which is a complex that will not reach the 10% conservation target under *Bush Forever*;
- The condition of the vegetation, particularly the areas of very good condition vegetation on the site;
- The role of the bushland on the site as an ecological linkage and stepping stone between bushland areas in the vicinity, including Kings Park and Bold Park, and as an important fauna habitat area;
- The need to ensure that there is a long term sustainable conservation outcome in terms of vegetation to be retained on the site; and,
- The level of community concern with respect to the biodiversity outcomes for this proposal;

The Minister for the Environment formed the view that the proposal is not environmentally acceptable in terms of biodiversity and conservation outcomes as the area proposed for conservation is inadequate for the following reasons:

- It fails to provide for an adequate portion of the vegetation in the best condition of the site being protected – only 17%, or 1.35 hectares of the 8 hectares of vegetation rated in "very good" condition is proposed to be retained;
- The condition of the vegetation to be retained in the conservation area is generally at the lower end of vegetation condition for the site;
- The uncertainties associated with the ability to restore the vegetation condition of the area proposed to be conserved;
- The suboptimal shape of the area proposed for conservation in terms of edge to area ratio and manageability;
- The overall size of the area proposed to be retained – it is questionable as to whether it is large enough to remain sustainable and maintain biodiversity values over the long term; and,
- The reliance on rehabilitation and restoration, along with a significant management effort in maintaining the biodiversity values of the site is uncertain and not preferable when compared to in situ conservation of bushland.

On this basis appeals are allowed to the extent that they contend that the proposal is environmentally unacceptable and should not proceed.

APPEAL DECISION SUMMARY

Appeal Number 105 of 2003

The appeal is lodged in objection to the Report and Recommendations of the Environmental Protection Authority (EPA) in Bulletin 1099

Appellant:	Kim Gates
Proponent:	The University of Western Australia & Water Corporation
Proposal:	Superlot subdivision, Lot 4 & Lot 105 Underwood Avenue, Shenton Park
Minister's Decision:	Allowed to the extent that appeals contend that the proposal is environmentally unacceptable and should not proceed
Date of Decision:	14 June 2004

Grounds of Appeal and Reasons for Decision:

Appeal Grounds relate to:

1. *Worse environmental outcome than the UWA proposal rejected in EPA Bulletin 1034 and subsequent clarification to the Minister*
2. *Abrogation of responsibility of the EPA to the Department of Planning and Infrastructure*
3. *Inadequate environmental and odour impact assessment*
4. *Negotiated outcome far short of metropolitan average*
5. *Not taking into account the public interest*
6. *Errors of fact by UWA*

Consideration

The proposal currently the subject of appeals relates to the creation of three superlots on an overall site of 64.3 hectares. Of these 3 lots one lot – proposed Lot 1 would be subdivided and developed for residential purposes, whilst the remainder of the proposal area, excluding a 12 hectare area proposed for conservation, would be developed at a later date, depending on the outcomes of odour reduction works associated with the Subiaco Wastewater Treatment Plant, and further planning for the site.

The EPA reported on the proposal in May 2003, recommending that the proposal proceed subject to a range of conditions.

An Appeals Committee was appointed to consider and report to the Minister for the Environment on appeals.

A portion of the overall proposal area contains regionally significant vegetation which was recognised through its inclusion in *Bush Forever* site 119, and prior to that, in the draft *Perth's Bushplan*. The site contains approximately 31.5 hectares of vegetation comprising the Karrakatta central and south complex, a complex which is proposed to have less than 10% protection within the Perth metropolitan area under *Bush Forever*. The vegetation on the site has been previously identified by the EPA as being of a condition which is, in many cases, better than other regionally significant areas on the Spearwood dunes, and that a significant portion of the bushland on the site is in good condition.

The site has been identified as a valuable ecological linkage and stepping stone for fauna between bushland areas in the vicinity, including Bold Park and Kings Park, and there is significant community opposition to the proposal based on biodiversity issues.

All of these factors mean that any proposal which impacts on the regionally significant bushland on the site needs to provide an adequate biodiversity outcome.

A range of issues were raised in appeals. Several appeals related to the level and method of assessment by the EPA and argued for the proposal to be subject to fuller and more public assessment. Many of appeals contended that the EPA's Report and Recommendations did not provide for a suitable biodiversity outcome in terms of conservation of the regionally significant vegetation on the site and argued for the full retention of the regionally significant vegetation on the site.

The Appeals Committee's report on appeals addressed the issues raised in appeals in detail.

In terms of the key issues raised in appeals, the Appeals Committee concluded while there remained community concerns with respect to the level and method of assessment by the EPA, that the process had provided sufficient information with respect to community views on the proposal to enable an informed decision on the proposal to be made.

With respect to biodiversity issues, the Appeals Committee's report identified that the proposed area for conservation represented the minimum desirable conservation outcome. The Appeals Committee also identified that the shape of the proposed conservation area was less than ideal, that it did not contain all of the vegetation in the best condition of the site, and that there is uncertainty in terms of the likely success of the proposed bushland restoration approach. It concluded that the overall environmental outcome would be improved by a larger percentage of the *Bush Forever* site being retained, particularly the areas

of the site containing vegetation in very good condition, or of the proposed site generally, being retained for conservation purposes.

Taking into account:

- The identification of vegetation on the site as being of regional significance;
- That the vegetation on the site represents a good example of the Karrakatta central and south complex, which is a complex that will not reach the 10% conservation target under *Bush Forever*;
- The condition of the vegetation, particularly the areas of very good condition vegetation on the site;
- The role of the bushland on the site as an ecological linkage and stepping stone between bushland areas in the vicinity, including Kings Park and Bold Park, and as an important fauna habitat area;
- The need to ensure that there is a long term sustainable conservation outcome in terms of vegetation to be retained on the site; and,
- The level of community concern with respect to the biodiversity outcomes for this proposal;

The Minister for the Environment formed the view that the proposal is not environmentally acceptable in terms of biodiversity and conservation outcomes as the area proposed for conservation is inadequate for the following reasons:

- It fails to provide for an adequate portion of the vegetation in the best condition of the site being protected – only 17%, or 1.35 hectares of the 8 hectares of vegetation rated in "very good" condition is proposed to be retained;
- The condition of the vegetation to be retained in the conservation area is generally at the lower end of vegetation condition for the site;
- The uncertainties associated with the ability to restore the vegetation condition of the area proposed to be conserved;
- The suboptimal shape of the area proposed for conservation in terms of edge to area ratio and manageability;
- The overall size of the area proposed to be retained – it is questionable as to whether it is large enough to remain sustainable and maintain biodiversity values over the long term; and,
- The reliance on rehabilitation and restoration, along with a significant management effort in maintaining the biodiversity values of the site is uncertain and not preferable when compared to in situ conservation of bushland.

On this basis appeals are allowed to the extent that they contend that the proposal is environmentally unacceptable and should not proceed.

APPEAL DECISION SUMMARY

Appeal Number 106 of 2003

The appeal is lodged in objection to the Report and Recommendations of the Environmental Protection Authority (EPA) in Bulletin 1099

Appellant: Regina Drummond

Proponent: The University of Western Australia & Water Corporation

Proposal: Superlot subdivision, Lot 4 & Lot 105 Underwood Avenue, Shenton Park

Minister's Decision: Allowed to the extent that appeals contend that the proposal is environmentally unacceptable and should not proceed

Date of Decision: 14 June 2004

Grounds of Appeal and Reasons for Decision:

Appeal Grounds relate to:

1. *Loss of habitat, flora and fauna*
2. *Ecological linkages and impacts on other bushland areas*
3. *Vegetation condition*
4. *Negotiated planning solution*
5. *Ignored officers advice*
6. *Designed to satisfy odour constraint*
7. *Not a full environmental assessment*

Consideration

The proposal currently the subject of appeals relates to the creation of three superlots on an overall site of 64.3 hectares. Of these 3 lots one lot – proposed Lot 1 would be subdivided and developed for residential purposes, whilst the remainder of the proposal area, excluding a 12 hectare area proposed for conservation, would be developed at a later date, depending on the outcomes of odour reduction works associated with the Subiaco Wastewater Treatment Plant, and further planning for the site.

The EPA reported on the proposal in May 2003, recommending that the proposal proceed subject to a range of conditions.

An Appeals Committee was appointed to consider and report to the Minister for the Environment on appeals.

A portion of the overall proposal area contains regionally significant vegetation which was recognised through its inclusion in *Bush Forever* site 119, and prior to that, in the draft *Perth's Bushplan*. The site contains approximately 31.5 hectares of vegetation comprising the Karrakatta central and south complex, a complex which is proposed to have less than 10% protection within the Perth metropolitan area under *Bush Forever*. The vegetation on the site has been previously identified by the EPA as being of a condition which is, in many cases, better than other regionally significant areas on the Spearwood dunes, and that a significant portion of the bushland on the site is in good condition.

The site has been identified as a valuable ecological linkage and stepping stone for fauna between bushland areas in the vicinity, including Bold Park and Kings Park, and there is significant community opposition to the proposal based on biodiversity issues.

All of these factors mean that any proposal which impacts on the regionally significant bushland on the site needs to provide an adequate biodiversity outcome.

A range of issues were raised in appeals. Several appeals related to the level and method of assessment by the EPA and argued for the proposal to be subject to fuller and more public assessment. Many of appeals contended that the EPA's Report and Recommendations did not provide for a suitable biodiversity outcome in terms of conservation of the regionally significant vegetation on the site and argued for the full retention of the regionally significant vegetation on the site.

The Appeals Committee's report on appeals addressed the issues raised in appeals in detail.

In terms of the key issues raised in appeals, the Appeals Committee concluded while there remained community concerns with respect to the level and method of assessment by the EPA, that the process had provided sufficient information with respect to community views on the proposal to enable an informed decision on the proposal to be made.

With respect to biodiversity issues, the Appeals Committee's report identified that the proposed area for conservation represented the minimum desirable conservation outcome. The Appeals Committee also identified that the shape of the proposed conservation area was less than ideal, that it did not contain all of the vegetation in the best condition of the site, and that there is uncertainty in terms of the likely success of the proposed bushland restoration approach. It concluded that the overall environmental outcome would be improved by a larger percentage of the *Bush Forever* site being retained, particularly the areas of the site containing vegetation in very good condition, or of the proposed site generally, being retained for conservation purposes.

Taking into account:

- The identification of vegetation on the site as being of regional significance;
- That the vegetation on the site represents a good example of the Karrakatta central and south complex, which is a complex that will not reach the 10% conservation target under *Bush Forever*;
- The condition of the vegetation, particularly the areas of very good condition vegetation on the site;
- The role of the bushland on the site as an ecological linkage and stepping stone between bushland areas in the vicinity, including Kings Park and Bold Park, and as an important fauna habitat area;
- The need to ensure that there is a long term sustainable conservation outcome in terms of vegetation to be retained on the site; and,
- The level of community concern with respect to the biodiversity outcomes for this proposal;

The Minister for the Environment formed the view that the proposal is not environmentally acceptable in terms of biodiversity and conservation outcomes as the area proposed for conservation is inadequate for the following reasons:

- It fails to provide for an adequate portion of the vegetation in the best condition of the site being protected – only 17%, or 1.35 hectares of the 8 hectares of vegetation rated in "very good" condition is proposed to be retained;
- The condition of the vegetation to be retained in the conservation area is generally at the lower end of vegetation condition for the site;
- The uncertainties associated with the ability to restore the vegetation condition of the area proposed to be conserved;
- The suboptimal shape of the area proposed for conservation in terms of edge to area ratio and manageability;
- The overall size of the area proposed to be retained – it is questionable as to whether it is large enough to remain sustainable and maintain biodiversity values over the long term; and,
- The reliance on rehabilitation and restoration, along with a significant management effort in maintaining the biodiversity values of the site is uncertain and not preferable when compared to in situ conservation of bushland.

On this basis appeals are allowed to the extent that they contend that the proposal is environmentally unacceptable and should not proceed.

APPEAL DECISION SUMMARY

Appeal Number 107 of 2003
The appeal is lodged in objection to the Report and Recommendations of the Environmental Protection Authority (EPA) in Bulletin 1099

Appellant: Jennifer Carson

Proponent: The University of Western Australia & Water Corporation

Proposal: Superlot subdivision, Lot 4 & Lot 105 Underwood Avenue, Shenton Park

Minister's Decision: Allowed to the extent that appeals contend that the proposal is environmentally unacceptable and should not proceed

Date of Decision: 14 June 2004

Grounds of Appeal and Reasons for Decision:

Appeal Grounds relate to:

1. *Loss of habitat, flora and fauna*
2. *Ecological linkages and impacts on other bushland areas*
3. *Size and shape of area proposed for conservation*
4. *Vegetation condition*
5. *Value beyond residential development*
6. *Negotiated planning solution*
7. *Ignored officers advice*
8. *Designed to satisfy odour constraint*
9. *Odour reduction*
10. *Public consultation*
11. *Not a full environmental assessment*

Consideration

The proposal currently the subject of appeals relates to the creation of three superlots on an overall site of 64.3 hectares. Of these 3 lots one lot – proposed Lot 1 would be subdivided and developed for residential purposes, whilst the remainder of the proposal area, excluding a 12 hectare area proposed for conservation, would be developed at a later date, depending on the outcomes of odour reduction works associated with the Subiaco Wastewater Treatment Plant, and further planning for the site.

The EPA reported on the proposal in May 2003, recommending that the proposal proceed subject to a range of conditions.

An Appeals Committee was appointed to consider and report to the Minister for the Environment on appeals.

A portion of the overall proposal area contains regionally significant vegetation which was recognised through its inclusion in *Bush Forever* site 119, and prior to that, in the draft *Perth's Bushplan*. The site contains approximately 31.5 hectares of vegetation comprising the Karrakatta central and south complex, a complex which is proposed to have less than 10% protection within the Perth metropolitan area under *Bush Forever*. The vegetation on the site has been previously identified by the EPA as being of a condition which is, in many cases, better than other regionally significant areas on the Spearwood dunes, and that a significant portion of the bushland on the site is in good condition.

The site has been identified as a valuable ecological linkage and stepping stone for fauna between bushland areas in the vicinity, including Bold Park and Kings Park, and there is significant community opposition to the proposal based on biodiversity issues.

All of these factors mean that any proposal which impacts on the regionally significant bushland on the site needs to provide an adequate biodiversity outcome.

A range of issues were raised in appeals. Several appeals related to the level and method of assessment by the EPA and argued for the proposal to be subject to fuller and more public assessment. Many of appeals contended that the EPA's Report and Recommendations did not provide for a suitable biodiversity outcome in terms of conservation of the regionally significant vegetation on the site and argued for the full retention of the regionally significant vegetation on the site.

The Appeals Committee's report on appeals addressed the issues raised in appeals in detail.

In terms of the key issues raised in appeals, the Appeals Committee concluded while there remained community concerns with respect to the level and method of assessment by the EPA, that the process had provided sufficient information with respect to community views on the proposal to enable an informed decision on the proposal to be made.

With respect to biodiversity issues, the Appeals Committee's report identified that the proposed area for conservation represented the minimum desirable conservation outcome. The Appeals Committee also identified that the shape of the proposed conservation area was less than ideal, that it did not contain all of the vegetation in the best condition of the site, and that there is uncertainty in terms of the likely success of the proposed bushland restoration approach. It concluded that the overall environmental outcome would be improved by a larger percentage of the *Bush Forever* site being retained, particularly the areas

of the site containing vegetation in very good condition, or of the proposed site generally, being retained for conservation purposes.

Taking into account:

- The identification of vegetation on the site as being of regional significance;
- That the vegetation on the site represents a good example of the Karrakatta central and south complex, which is a complex that will not reach the 10% conservation target under *Bush Forever*;
- The condition of the vegetation, particularly the areas of very good condition vegetation on the site;
- The role of the bushland on the site as an ecological linkage and stepping stone between bushland areas in the vicinity, including Kings Park and Bold Park, and as an important fauna habitat area;
- The need to ensure that there is a long term sustainable conservation outcome in terms of vegetation to be retained on the site; and,
- The level of community concern with respect to the biodiversity outcomes for this proposal;

The Minister for the Environment formed the view that the proposal is not environmentally acceptable in terms of biodiversity and conservation outcomes as the area proposed for conservation is inadequate for the following reasons:

- It fails to provide for an adequate portion of the vegetation in the best condition of the site being protected – only 17%, or 1.35 hectares of the 8 hectares of vegetation rated in "very good" condition is proposed to be retained;
- The condition of the vegetation to be retained in the conservation area is generally at the lower end of vegetation condition for the site;
- The uncertainties associated with the ability to restore the vegetation condition of the area proposed to be conserved;
- The suboptimal shape of the area proposed for conservation in terms of edge to area ratio and manageability;
- The overall size of the area proposed to be retained – it is questionable as to whether it is large enough to remain sustainable and maintain biodiversity values over the long term; and,
- The reliance on rehabilitation and restoration, along with a significant management effort in maintaining the biodiversity values of the site is uncertain and not preferable when compared to in situ conservation of bushland.

On this basis appeals are allowed to the extent that they contend that the proposal is environmentally unacceptable and should not proceed.

APPEAL DECISION SUMMARY

Appeal Number 108 of 2003

The appeal is lodged in objection to the Report and Recommendations of the Environmental Protection Authority (EPA) in Bulletin 1099

Appellant:	Bronwen Tyson
Proponent:	The University of Western Australia & Water Corporation
Proposal:	Superlot subdivision, Lot 4 & Lot 105 Underwood Avenue, Shenton Park
Minister's Decision:	Allowed to the extent that appeals contend that the proposal is environmentally unacceptable and should not proceed
Date of Decision:	14 June 2004

Grounds of Appeal and Reasons for Decision:

Appeal Grounds relate to:

1. *Loss of habitat, flora and fauna*
2. *Financial need for development*
3. *Negotiated planning solution*
4. *Ignored officers advice*
5. *Odour*

Consideration

The proposal currently the subject of appeals relates to the creation of three superlots on an overall site of 64.3 hectares. Of these 3 lots one lot – proposed Lot 1 would be subdivided and developed for residential purposes, whilst the remainder of the proposal area, excluding a 12 hectare area proposed for conservation, would be developed at a later date, depending on the outcomes of odour reduction works associated with the Subiaco Wastewater Treatment Plant, and further planning for the site.

The EPA reported on the proposal in May 2003, recommending that the proposal proceed subject to a range of conditions.

An Appeals Committee was appointed to consider and report to the Minister for the Environment on appeals.

A portion of the overall proposal area contains regionally significant vegetation which was recognised through its inclusion in *Bush Forever* site 119, and prior to that, in the draft *Perth's Bushplan*. The site contains approximately 31.5 hectares of vegetation comprising the Karrakatta central and south complex, a complex which is proposed to have less than 10% protection within the Perth metropolitan area under *Bush Forever*. The vegetation on the site has been previously identified by the EPA as being of a condition which is, in many cases, better than other regionally significant areas on the Spearwood dunes, and that a significant portion of the bushland on the site is in good condition.

The site has been identified as a valuable ecological linkage and stepping stone for fauna between bushland areas in the vicinity, including Bold Park and Kings Park, and there is significant community opposition to the proposal based on biodiversity issues.

All of these factors mean that any proposal which impacts on the regionally significant bushland on the site needs to provide an adequate biodiversity outcome.

A range of issues were raised in appeals. Several appeals related to the level and method of assessment by the EPA and argued for the proposal to be subject to fuller and more public assessment. Many of appeals contended that the EPA's Report and Recommendations did not provide for a suitable biodiversity outcome in terms of conservation of the regionally significant vegetation on the site and argued for the full retention of the regionally significant vegetation on the site.

The Appeals Committee's report on appeals addressed the issues raised in appeals in detail.

In terms of the key issues raised in appeals, the Appeals Committee concluded while there remained community concerns with respect to the level and method of assessment by the EPA, that the process had provided sufficient information with respect to community views on the proposal to enable an informed decision on the proposal to be made.

With respect to biodiversity issues, the Appeals Committee's report identified that the proposed area for conservation represented the minimum desirable conservation outcome. The Appeals Committee also identified that the shape of the proposed conservation area was less than ideal, that it did not contain all of the vegetation in the best condition of the site, and that there is uncertainty in terms of the likely success of the proposed bushland restoration approach. It concluded that the overall environmental outcome would be improved by a larger percentage of the *Bush Forever* site being retained, particularly the areas of the site containing vegetation in very good condition, or of the proposed site generally, being retained for conservation purposes.

Taking into account:

- The identification of vegetation on the site as being of regional significance;
- That the vegetation on the site represents a good example of the Karrakatta central and south complex, which is a complex that will not reach the 10% conservation target under *Bush Forever*;
- The condition of the vegetation, particularly the areas of very good condition vegetation on the site;
- The role of the bushland on the site as an ecological linkage and stepping stone between bushland areas in the vicinity, including Kings Park and Bold Park, and as an important fauna habitat area;
- The need to ensure that there is a long term sustainable conservation outcome in terms of vegetation to be retained on the site; and,
- The level of community concern with respect to the biodiversity outcomes for this proposal;

The Minister for the Environment formed the view that the proposal is not environmentally acceptable in terms of biodiversity and conservation outcomes as the area proposed for conservation is inadequate for the following reasons:

- It fails to provide for an adequate portion of the vegetation in the best condition of the site being protected – only 17%, or 1.35 hectares of the 8 hectares of vegetation rated in "very good" condition is proposed to be retained;
- The condition of the vegetation to be retained in the conservation area is generally at the lower end of vegetation condition for the site;
- The uncertainties associated with the ability to restore the vegetation condition of the area proposed to be conserved;
- The suboptimal shape of the area proposed for conservation in terms of edge to area ratio and manageability;
- The overall size of the area proposed to be retained – it is questionable as to whether it is large enough to remain sustainable and maintain biodiversity values over the long term; and,
- The reliance on rehabilitation and restoration, along with a significant management effort in maintaining the biodiversity values of the site is uncertain and not preferable when compared to in situ conservation of bushland.

On this basis appeals are allowed to the extent that they contend that the proposal is environmentally unacceptable and should not proceed.

APPEAL DECISION SUMMARY

Appeal Number 109 of 2003

The appeal is lodged in objection to the Report and Recommendations of the Environmental Protection Authority (EPA) in Bulletin 1099

Appellant:	Margaret Owen
Proponent:	The University of Western Australia & Water Corporation
Proposal:	Superlot subdivision, Lot 4 & Lot 105 Underwood Avenue, Shenton Park
Minister's Decision:	Allowed to the extent that appeals contend that the proposal is environmentally unacceptable and should not proceed
Date of Decision:	14 June 2004

Grounds of Appeal and Reasons for Decision:

Appeal Grounds relate to:

1. *Loss of habitat, flora and fauna*
2. *Ecological linkages and impacts on other bushland areas*
3. *Adequacy of area proposed for conservation*
4. *Value beyond residential development*
5. *Public consultation*

Consideration

The proposal currently the subject of appeals relates to the creation of three superlots on an overall site of 64.3 hectares. Of these 3 lots one lot – proposed Lot 1 would be subdivided and developed for residential purposes, whilst the remainder of the proposal area, excluding a 12 hectare area proposed for conservation, would be developed at a later date, depending on the outcomes of odour reduction works associated with the Subiaco Wastewater Treatment Plant, and further planning for the site.

The EPA reported on the proposal in May 2003, recommending that the proposal proceed subject to a range of conditions.

An Appeals Committee was appointed to consider and report to the Minister for the Environment on appeals.

A portion of the overall proposal area contains regionally significant vegetation which was recognised through its inclusion in *Bush Forever* site 119, and prior to that, in the draft *Perth's Bushplan*. The site contains approximately 31.5 hectares of vegetation comprising the Karrakatta central and south complex, a complex which is proposed to have less than 10% protection within the Perth metropolitan area under *Bush Forever*. The vegetation on the site has been previously identified by the EPA as being of a condition which is, in many cases, better than other regionally significant areas on the Spearwood dunes, and that a significant portion of the bushland on the site is in good condition.

The site has been identified as a valuable ecological linkage and stepping stone for fauna between bushland areas in the vicinity, including Bold Park and Kings Park, and there is significant community opposition to the proposal based on biodiversity issues.

All of these factors mean that any proposal which impacts on the regionally significant bushland on the site needs to provide an adequate biodiversity outcome.

A range of issues were raised in appeals. Several appeals related to the level and method of assessment by the EPA and argued for the proposal to be subject to fuller and more public assessment. Many of appeals contended that the EPA's Report and Recommendations did not provide for a suitable biodiversity outcome in terms of conservation of the regionally significant vegetation on the site and argued for the full retention of the regionally significant vegetation on the site.

The Appeals Committee's report on appeals addressed the issues raised in appeals in detail.

In terms of the key issues raised in appeals, the Appeals Committee concluded while there remained community concerns with respect to the level and method of assessment by the EPA, that the process had provided sufficient information with respect to community views on the proposal to enable an informed decision on the proposal to be made.

With respect to biodiversity issues, the Appeals Committee's report identified that the proposed area for conservation represented the minimum desirable conservation outcome. The Appeals Committee also identified that the shape of the proposed conservation area was less than ideal, that it did not contain all of the vegetation in the best condition of the site, and that there is uncertainty in terms of the likely success of the proposed bushland restoration approach. It concluded that the overall environmental outcome would be improved by a larger percentage of the *Bush Forever* site being retained, particularly the areas of the site containing vegetation in very good condition, or of the proposed site generally, being retained for conservation purposes.

Taking into account:

- The identification of vegetation on the site as being of regional significance;
- That the vegetation on the site represents a good example of the Karrakatta central and south complex, which is a complex that will not reach the 10% conservation target under *Bush Forever*;
- The condition of the vegetation, particularly the areas of very good condition vegetation on the site;
- The role of the bushland on the site as an ecological linkage and stepping stone between bushland areas in the vicinity, including Kings Park and Bold Park, and as an important fauna habitat area;
- The need to ensure that there is a long term sustainable conservation outcome in terms of vegetation to be retained on the site; and,
- The level of community concern with respect to the biodiversity outcomes for this proposal;

The Minister for the Environment formed the view that the proposal is not environmentally acceptable in terms of biodiversity and conservation outcomes as the area proposed for conservation is inadequate for the following reasons:

- It fails to provide for an adequate portion of the vegetation in the best condition of the site being protected – only 17%, or 1.35 hectares of the 8 hectares of vegetation rated in "very good" condition is proposed to be retained;
- The condition of the vegetation to be retained in the conservation area is generally at the lower end of vegetation condition for the site;
- The uncertainties associated with the ability to restore the vegetation condition of the area proposed to be conserved;
- The suboptimal shape of the area proposed for conservation in terms of edge to area ratio and manageability;
- The overall size of the area proposed to be retained – it is questionable as to whether it is large enough to remain sustainable and maintain biodiversity values over the long term; and,
- The reliance on rehabilitation and restoration, along with a significant management effort in maintaining the biodiversity values of the site is uncertain and not preferable when compared to in situ conservation of bushland.

On this basis appeals are allowed to the extent that they contend that the proposal is environmentally unacceptable and should not proceed.

APPEAL DECISION SUMMARY

Appeal Numbers 110 and 117 of 2003

The appeals were lodged in objection to the level of assessment and Report and Recommendations of the Environmental Protection Authority (EPA) in Bulletin 1099

Appellant:	Zoe Jones
Proponent:	The University of Western Australia & Water Corporation
Proposal:	Superlot subdivision, Lot 4 & Lot 105 Underwood Avenue, Shenton Park
Minister's Decision:	Allowed to the extent that appeals contend that the proposal is environmentally unacceptable and should not proceed
Date of Decision:	14 June 2004

Grounds of Appeal and Reasons for Decision:

Appeal Grounds relate to:

1. *Negotiated planning solution*
2. *Public consultation*
3. *Level of assessment*
4. *Adequacy of area proposed for conservation*

Consideration

The proposal currently the subject of appeals relates to the creation of three superlots on an overall site of 64.3 hectares. Of these 3 lots one lot – proposed Lot 1 would be subdivided and developed for residential purposes, whilst the remainder of the proposal area, excluding a 12 hectare area proposed for conservation, would be developed at a later date, depending on the outcomes of odour reduction works associated with the Subiaco Wastewater Treatment Plant, and further planning for the site.

The EPA reported on the proposal in May 2003, recommending that the proposal proceed subject to a range of conditions.

An Appeals Committee was appointed to consider and report to the Minister for the Environment on appeals.

A portion of the overall proposal area contains regionally significant vegetation which was recognised through its inclusion in *Bush Forever* site 119, and prior to that, in the draft *Perth's Bushplan*. The site contains approximately 31.5 hectares of vegetation comprising the Karrakatta central and south complex, a complex which is proposed to have less than 10% protection within the Perth metropolitan area under *Bush Forever*. The vegetation on the site has been previously identified by the EPA as being of a condition which is, in many cases, better than other regionally significant areas on the Spearwood dunes, and that a significant portion of the bushland on the site is in good condition.

The site has been identified as a valuable ecological linkage and stepping stone for fauna between bushland areas in the vicinity, including Bold Park and Kings Park, and there is significant community opposition to the proposal based on biodiversity issues.

All of these factors mean that any proposal which impacts on the regionally significant bushland on the site needs to provide an adequate biodiversity outcome.

A range of issues were raised in appeals. Several appeals related to the level and method of assessment by the EPA and argued for the proposal to be subject to fuller and more public assessment. Many of appeals contended that the EPA's Report and Recommendations did not provide for a suitable biodiversity outcome in terms of conservation of the regionally significant vegetation on the site and argued for the full retention of the regionally significant vegetation on the site.

The Appeals Committee's report on appeals addressed the issues raised in appeals in detail.

In terms of the key issues raised in appeals, the Appeals Committee concluded while there remained community concerns with respect to the level and method of assessment by the EPA, that the process had provided sufficient information with respect to community views on the proposal to enable an informed decision on the proposal to be made.

With respect to biodiversity issues, the Appeals Committee's report identified that the proposed area for conservation represented the minimum desirable conservation outcome. The Appeals Committee also identified that the shape of the proposed conservation area was less than ideal, that it did not contain all of the vegetation in the best condition of the site, and that there is uncertainty in terms of the likely success of the proposed bushland restoration approach. It concluded that the overall environmental outcome would be improved by a larger percentage of the *Bush Forever* site being retained, particularly the areas of the site containing vegetation in very good condition, or of the proposed site generally, being retained for conservation purposes.

Taking into account:

- The identification of vegetation on the site as being of regional significance;
- That the vegetation on the site represents a good example of the Karrakatta central and south complex, which is a complex that will not reach the 10% conservation target under *Bush Forever*;
- The condition of the vegetation, particularly the areas of very good condition vegetation on the site;
- The role of the bushland on the site as an ecological linkage and stepping stone between bushland areas in the vicinity, including Kings Park and Bold Park, and as an important fauna habitat area;
- The need to ensure that there is a long term sustainable conservation outcome in terms of vegetation to be retained on the site; and,
- The level of community concern with respect to the biodiversity outcomes for this proposal;

The Minister for the Environment formed the view that the proposal is not environmentally acceptable in terms of biodiversity and conservation outcomes as the area proposed for conservation is inadequate for the following reasons:

- It fails to provide for an adequate portion of the vegetation in the best condition of the site being protected – only 17%, or 1.35 hectares of the 8 hectares of vegetation rated in "very good" condition is proposed to be retained;
- The condition of the vegetation to be retained in the conservation area is generally at the lower end of vegetation condition for the site;
- The uncertainties associated with the ability to restore the vegetation condition of the area proposed to be conserved;
- The suboptimal shape of the area proposed for conservation in terms of edge to area ratio and manageability;
- The overall size of the area proposed to be retained – it is questionable as to whether it is large enough to remain sustainable and maintain biodiversity values over the long term; and,
- The reliance on rehabilitation and restoration, along with a significant management effort in maintaining the biodiversity values of the site is uncertain and not preferable when compared to in situ conservation of bushland.

On this basis appeals are allowed to the extent that they contend that the proposal is environmentally unacceptable and should not proceed.

APPEAL DECISION SUMMARY

Appeal Numbers 111 and 116 of 2003

The appeals were lodged in objection to the level of assessment and Report and Recommendations of the Environmental Protection Authority (EPA) in Bulletin 1099

Appellant:	Alex Jones
Proponent:	The University of Western Australia & Water Corporation
Proposal:	Superlot subdivision, Lot 4 & Lot 105 Underwood Avenue, Shenton Park
Minister's Decision:	Allowed to the extent that appeals contend that the proposal is environmentally unacceptable and should not proceed
Date of Decision:	14 June 2004

Grounds of Appeal and Reasons for Decision:

Appeal Grounds relate to:

1. *Value beyond residential development*
2. *Salinity*
3. *Conservation covenant*
4. *Public consultation*
5. *Conflicts of interest*
6. *process for environmental assessment*
7. *adequacy of area proposed for conservation*
8. *level of assessment*

Consideration

The proposal currently the subject of appeals relates to the creation of three superlots on an overall site of 64.3 hectares. Of these 3 lots one lot – proposed Lot 1 would be subdivided and developed for residential purposes, whilst the remainder of the proposal area, excluding a 12 hectare area proposed for conservation, would be developed at a later date, depending on the outcomes of odour reduction works associated with the Subiaco Wastewater Treatment Plant, and further planning for the site.

The EPA reported on the proposal in May 2003, recommending that the proposal proceed subject to a range of conditions.

An Appeals Committee was appointed to consider and report to the Minister for the Environment on appeals.

A portion of the overall proposal area contains regionally significant vegetation which was recognised through its inclusion in *Bush Forever* site 119, and prior to that, in the draft *Perth's Bushplan*. The site contains approximately 31.5 hectares of vegetation comprising the Karrakatta central and south complex, a complex which is proposed to have less than 10% protection within the Perth metropolitan area under *Bush Forever*. The vegetation on the site has been previously identified by the EPA as being of a condition which is, in many cases, better than other regionally significant areas on the Spearwood dunes, and that a significant portion of the bushland on the site is in good condition.

The site has been identified as a valuable ecological linkage and stepping stone for fauna between bushland areas in the vicinity, including Bold Park and Kings Park, and there is significant community opposition to the proposal based on biodiversity issues.

All of these factors mean that any proposal which impacts on the regionally significant bushland on the site needs to provide an adequate biodiversity outcome.

A range of issues were raised in appeals. Several appeals related to the level and method of assessment by the EPA and argued for the proposal to be subject to fuller and more public assessment. Many of appeals contended that the EPA's Report and Recommendations did not provide for a suitable biodiversity outcome in terms of conservation of the regionally significant vegetation on the site and argued for the full retention of the regionally significant vegetation on the site.

The Appeals Committee's report on appeals addressed the issues raised in appeals in detail.

In terms of the key issues raised in appeals, the Appeals Committee concluded while there remained community concerns with respect to the level and method of assessment by the EPA, that the process had provided sufficient information with respect to community views on the proposal to enable an informed decision on the proposal to be made.

With respect to biodiversity issues, the Appeals Committee's report identified that the proposed area for conservation represented the minimum desirable conservation outcome. The Appeals Committee also identified that the shape of the proposed conservation area was less than ideal, that it did not contain all of the vegetation in the best condition of the site, and that there is uncertainty in terms of the likely success of the proposed bushland restoration approach. It concluded that the overall environmental outcome would be improved by a larger percentage of the *Bush Forever* site being retained, particularly the areas

of the site containing vegetation in very good condition, or of the proposed site generally, being retained for conservation purposes.

Taking into account:

- The identification of vegetation on the site as being of regional significance;
- That the vegetation on the site represents a good example of the Karrakatta central and south complex, which is a complex that will not reach the 10% conservation target under *Bush Forever*;
- The condition of the vegetation, particularly the areas of very good condition vegetation on the site;
- The role of the bushland on the site as an ecological linkage and stepping stone between bushland areas in the vicinity, including Kings Park and Bold Park, and as an important fauna habitat area;
- The need to ensure that there is a long term sustainable conservation outcome in terms of vegetation to be retained on the site; and,
- The level of community concern with respect to the biodiversity outcomes for this proposal;

The Minister for the Environment formed the view that the proposal is not environmentally acceptable in terms of biodiversity and conservation outcomes as the area proposed for conservation is inadequate for the following reasons:

- It fails to provide for an adequate portion of the vegetation in the best condition of the site being protected – only 17%, or 1.35 hectares of the 8 hectares of vegetation rated in "very good" condition is proposed to be retained;
- The condition of the vegetation to be retained in the conservation area is generally at the lower end of vegetation condition for the site;
- The uncertainties associated with the ability to restore the vegetation condition of the area proposed to be conserved;
- The suboptimal shape of the area proposed for conservation in terms of edge to area ratio and manageability;
- The overall size of the area proposed to be retained – it is questionable as to whether it is large enough to remain sustainable and maintain biodiversity values over the long term; and,
- The reliance on rehabilitation and restoration, along with a significant management effort in maintaining the biodiversity values of the site is uncertain and not preferable when compared to in situ conservation of bushland.

On this basis appeals are allowed to the extent that they contend that the proposal is environmentally unacceptable and should not proceed.

APPEAL DECISION SUMMARY

Appeal Number 112 of 2003

The appeal is lodged in objection to the Report and Recommendations of the Environmental Protection Authority (EPA) in Bulletin 1099

Appellant:	Friends of Shenton Bushland
Proponent:	The University of Western Australia & Water Corporation
Proposal:	Superlot subdivision, Lot 4 & Lot 105 Underwood Avenue, Shenton Park
Minister's Decision:	Allowed to the extent that appeals contend that the proposal is environmentally unacceptable and should not proceed
Date of Decision:	14 June 2004

Grounds of Appeal and Reasons for Decision:

Appeal Grounds relate to:

1. *Ecological linkages and impacts on other bushland areas*
2. *Inadequate environmental assessment*

Consideration

The proposal currently the subject of appeals relates to the creation of three superlots on an overall site of 64.3 hectares. Of these 3 lots one lot – proposed Lot 1 would be subdivided and developed for residential purposes, whilst the remainder of the proposal area, excluding a 12 hectare area proposed for conservation, would be developed at a later date, depending on the outcomes of odour reduction works associated with the Subiaco Wastewater Treatment Plant, and further planning for the site.

The EPA reported on the proposal in May 2003, recommending that the proposal proceed subject to a range of conditions.

An Appeals Committee was appointed to consider and report to the Minister for the Environment on appeals.

A portion of the overall proposal area contains regionally significant vegetation which was recognised through its inclusion in *Bush Forever* site 119, and prior to that, in the draft *Perth's Bushplan*. The site contains approximately 31.5 hectares of vegetation comprising the Karrakatta central and south complex, a complex which is proposed to have less than 10% protection within the Perth metropolitan area under *Bush Forever*. The vegetation on the site has been previously identified by the EPA as being of a condition which is, in many cases, better than other regionally significant areas on the Spearwood dunes, and that a significant portion of the bushland on the site is in good condition.

The site has been identified as a valuable ecological linkage and stepping stone for fauna between bushland areas in the vicinity, including Bold Park and Kings Park, and there is significant community opposition to the proposal based on biodiversity issues.

All of these factors mean that any proposal which impacts on the regionally significant bushland on the site needs to provide an adequate biodiversity outcome.

A range of issues were raised in appeals. Several appeals related to the level and method of assessment by the EPA and argued for the proposal to be subject to fuller and more public assessment. Many of appeals contended that the EPA's Report and Recommendations did not provide for a suitable biodiversity outcome in terms of conservation of the regionally significant vegetation on the site and argued for the full retention of the regionally significant vegetation on the site.

The Appeals Committee's report on appeals addressed the issues raised in appeals in detail.

In terms of the key issues raised in appeals, the Appeals Committee concluded while there remained community concerns with respect to the level and method of assessment by the EPA, that the process had provided sufficient information with respect to community views on the proposal to enable an informed decision on the proposal to be made.

With respect to biodiversity issues, the Appeals Committee's report identified that the proposed area for conservation represented the minimum desirable conservation outcome. The Appeals Committee also identified that the shape of the proposed conservation area was less than ideal, that it did not contain all of the vegetation in the best condition of the site, and that there is uncertainty in terms of the likely success of the proposed bushland restoration approach. It concluded that the overall environmental outcome would be improved by a larger percentage of the *Bush Forever* site being retained, particularly the areas of the site containing vegetation in very good condition, or of the proposed site generally, being retained for conservation purposes.

Taking into account:

- The identification of vegetation on the site as being of regional significance;
- That the vegetation on the site represents a good example of the Karrakatta central and south complex, which is a complex that will not reach the 10% conservation target under *Bush Forever*;
- The condition of the vegetation, particularly the areas of very good condition vegetation on the site;
- The role of the bushland on the site as an ecological linkage and stepping stone between bushland areas in the vicinity, including Kings Park and Bold Park, and as an important fauna habitat area;
- The need to ensure that there is a long term sustainable conservation outcome in terms of vegetation to be retained on the site; and,
- The level of community concern with respect to the biodiversity outcomes for this proposal;

The Minister for the Environment formed the view that the proposal is not environmentally acceptable in terms of biodiversity and conservation outcomes as the area proposed for conservation is inadequate for the following reasons:

- It fails to provide for an adequate portion of the vegetation in the best condition of the site being protected – only 17%, or 1.35 hectares of the 8 hectares of vegetation rated in "very good" condition is proposed to be retained;
- The condition of the vegetation to be retained in the conservation area is generally at the lower end of vegetation condition for the site;
- The uncertainties associated with the ability to restore the vegetation condition of the area proposed to be conserved;
- The suboptimal shape of the area proposed for conservation in terms of edge to area ratio and manageability;
- The overall size of the area proposed to be retained – it is questionable as to whether it is large enough to remain sustainable and maintain biodiversity values over the long term; and,
- The reliance on rehabilitation and restoration, along with a significant management effort in maintaining the biodiversity values of the site is uncertain and not preferable when compared to in situ conservation of bushland.

On this basis appeals are allowed to the extent that they contend that the proposal is environmentally unacceptable and should not proceed.

APPEAL DECISION SUMMARY

Appeal Number 113 of 2003

The appeal is lodged in objection to the Report and Recommendations of the Environmental Protection Authority (EPA) in Bulletin 1099

Appellant:	Friends of Underwood Avenue Bushland
Proponent:	The University of Western Australia & Water Corporation
Proposal:	Superlot subdivision, Lot 4 & Lot 105 Underwood Avenue, Shenton Park
Minister's Decision:	Allowed to the extent that appeals contend that the proposal is environmentally unacceptable and should not proceed
Date of Decision:	14 June 2004

Grounds of Appeal and Reasons for Decision:

Appeal Grounds relate to:

1. *Loss of habitat, flora and fauna*
2. *Ecological linkages and impacts on other bushland areas*
3. *Negotiated planning solution*
4. *Abrogation of responsibility*
5. *Public consultation*
6. *Not a full environmental assessment*
7. *Deferring of decisions through conditions*
8. *Violation by the EPA of its legal obligations*

Consideration

The proposal currently the subject of appeals relates to the creation of three superlots on an overall site of 64.3 hectares. Of these 3 lots one lot – proposed Lot 1 would be subdivided and developed for residential purposes, whilst the remainder of the proposal area, excluding a 12 hectare area proposed for conservation, would be developed at a later date, depending on the outcomes of odour reduction works associated with the Subiaco Wastewater Treatment Plant, and further planning for the site.

The EPA reported on the proposal in May 2003, recommending that the proposal proceed subject to a range of conditions.

An Appeals Committee was appointed to consider and report to the Minister for the Environment on appeals.

A portion of the overall proposal area contains regionally significant vegetation which was recognised through its inclusion in *Bush Forever* site 119, and prior to that, in the draft *Perth's Bushplan*. The site contains approximately 31.5 hectares of vegetation comprising the Karrakatta central and south complex, a complex which is proposed to have less than 10% protection within the Perth metropolitan area under *Bush Forever*. The vegetation on the site has been previously identified by the EPA as being of a condition which is, in many cases, better than other regionally significant areas on the Spearwood dunes, and that a significant portion of the bushland on the site is in good condition.

The site has been identified as a valuable ecological linkage and stepping stone for fauna between bushland areas in the vicinity, including Bold Park and Kings Park, and there is significant community opposition to the proposal based on biodiversity issues.

All of these factors mean that any proposal which impacts on the regionally significant bushland on the site needs to provide an adequate biodiversity outcome.

A range of issues were raised in appeals. Several appeals related to the level and method of assessment by the EPA and argued for the proposal to be subject to fuller and more public assessment. Many of appeals contended that the EPA's Report and Recommendations did not provide for a suitable biodiversity outcome in terms of conservation of the regionally significant vegetation on the site and argued for the full retention of the regionally significant vegetation on the site.

The Appeals Committee's report on appeals addressed the issues raised in appeals in detail.

In terms of the key issues raised in appeals, the Appeals Committee concluded while there remained community concerns with respect to the level and method of assessment by the EPA, that the process had provided sufficient information with respect to community views on the proposal to enable an informed decision on the proposal to be made.

With respect to biodiversity issues, the Appeals Committee's report identified that the proposed area for conservation represented the minimum desirable conservation outcome. The Appeals Committee also identified that the shape of the proposed conservation area was less than ideal, that it did not contain all of the vegetation in the best condition of the site, and that there is uncertainty in terms of the likely success of the proposed bushland restoration approach. It concluded that the overall environmental outcome would be improved by a larger percentage of the *Bush Forever* site being retained, particularly the areas

of the site containing vegetation in very good condition, or of the proposed site generally, being retained for conservation purposes.

Taking into account:

- The identification of vegetation on the site as being of regional significance;
- That the vegetation on the site represents a good example of the Karrakatta central and south complex, which is a complex that will not reach the 10% conservation target under *Bush Forever*;
- The condition of the vegetation, particularly the areas of very good condition vegetation on the site;
- The role of the bushland on the site as an ecological linkage and stepping stone between bushland areas in the vicinity, including Kings Park and Bold Park, and as an important fauna habitat area;
- The need to ensure that there is a long term sustainable conservation outcome in terms of vegetation to be retained on the site; and,
- The level of community concern with respect to the biodiversity outcomes for this proposal;

The Minister for the Environment formed the view that the proposal is not environmentally acceptable in terms of biodiversity and conservation outcomes as the area proposed for conservation is inadequate for the following reasons:

- It fails to provide for an adequate portion of the vegetation in the best condition of the site being protected – only 17%, or 1.35 hectares of the 8 hectares of vegetation rated in "very good" condition is proposed to be retained;
- The condition of the vegetation to be retained in the conservation area is generally at the lower end of vegetation condition for the site;
- The uncertainties associated with the ability to restore the vegetation condition of the area proposed to be conserved;
- The suboptimal shape of the area proposed for conservation in terms of edge to area ratio and manageability;
- The overall size of the area proposed to be retained – it is questionable as to whether it is large enough to remain sustainable and maintain biodiversity values over the long term; and,
- The reliance on rehabilitation and restoration, along with a significant management effort in maintaining the biodiversity values of the site is uncertain and not preferable when compared to in situ conservation of bushland.

On this basis appeals are allowed to the extent that they contend that the proposal is environmentally unacceptable and should not proceed.

APPEAL DECISION SUMMARY

Appeal Numbers 114 and 115 of 2003

The appeals were lodged in objection to the level of assessment and Report and Recommendations of the Environmental Protection Authority (EPA) in Bulletin 1099

Appellant:	Conservation Council of Western Australia
Proponent:	The University of Western Australia & Water Corporation
Proposal:	Superlot subdivision, Lot 4 & Lot 105 Underwood Avenue, Shenton Park
Minister's Decision:	Allowed to the extent that appeals contend that the proposal is environmentally unacceptable and should not proceed
Date of Decision:	14 June 2004

Grounds of Appeal and Reasons for Decision:

Appeal Grounds relate to:

1. *Value beyond residential development*
2. *Negotiated planning solution*
3. *Abrogation of responsibility*
4. *Odour reduction*
5. *Public consultation*
6. *Deferring of decisions through conditions*
7. *Loss of habitat, flora and fauna*
8. *Ecological linkages and impacts on other bushland areas*
9. *Level of assessment*

Consideration

The proposal currently the subject of appeals relates to the creation of three superlots on an overall site of 64.3 hectares. Of these 3 lots one lot – proposed Lot 1 would be subdivided and developed for residential purposes, whilst the remainder of the proposal area, excluding a 12 hectare area proposed for conservation, would be developed at a later date, depending on the outcomes of odour reduction works associated with the Subiaco Wastewater Treatment Plant, and further planning for the site.

The EPA reported on the proposal in May 2003, recommending that the proposal proceed subject to a range of conditions.

An Appeals Committee was appointed to consider and report to the Minister for the Environment on appeals.

A portion of the overall proposal area contains regionally significant vegetation which was recognised through its inclusion in *Bush Forever* site 119, and prior to that, in the draft *Perth's Bushplan*. The site contains approximately 31.5 hectares of vegetation comprising the Karrakatta central and south complex, a complex which is proposed to have less than 10% protection within the Perth metropolitan area under *Bush Forever*. The vegetation on the site has been previously identified by the EPA as being of a condition which is, in many cases, better than other regionally significant areas on the Spearwood dunes, and that a significant portion of the bushland on the site is in good condition.

The site has been identified as a valuable ecological linkage and stepping stone for fauna between bushland areas in the vicinity, including Bold Park and Kings Park, and there is significant community opposition to the proposal based on biodiversity issues.

All of these factors mean that any proposal which impacts on the regionally significant bushland on the site needs to provide an adequate biodiversity outcome.

A range of issues were raised in appeals. Several appeals related to the level and method of assessment by the EPA and argued for the proposal to be subject to fuller and more public assessment. Many of appeals contended that the EPA's Report and Recommendations did not provide for a suitable biodiversity outcome in terms of conservation of the regionally significant vegetation on the site and argued for the full retention of the regionally significant vegetation on the site.

The Appeals Committee's report on appeals addressed the issues raised in appeals in detail.

In terms of the key issues raised in appeals, the Appeals Committee concluded while there remained community concerns with respect to the level and method of assessment by the EPA, that the process had provided sufficient information with respect to community views on the proposal to enable an informed decision on the proposal to be made.

With respect to biodiversity issues, the Appeals Committee's report identified that the proposed area for conservation represented the minimum desirable conservation outcome. The Appeals Committee also identified that the shape of the proposed conservation area was less than ideal, that it did not contain all of the vegetation in the best condition of the site, and that there is uncertainty in terms of the likely success of the proposed bushland restoration approach. It concluded that the overall environmental outcome would be improved by a

larger percentage of the *Bush Forever* site being retained, particularly the areas of the site containing vegetation in very good condition, or of the proposed site generally, being retained for conservation purposes.

Taking into account:

- The identification of vegetation on the site as being of regional significance;
- That the vegetation on the site represents a good example of the Karrakatta central and south complex, which is a complex that will not reach the 10% conservation target under *Bush Forever*;
- The condition of the vegetation, particularly the areas of very good condition vegetation on the site;
- The role of the bushland on the site as an ecological linkage and stepping stone between bushland areas in the vicinity, including Kings Park and Bold Park, and as an important fauna habitat area;
- The need to ensure that there is a long term sustainable conservation outcome in terms of vegetation to be retained on the site; and,
- The level of community concern with respect to the biodiversity outcomes for this proposal;

The Minister for the Environment formed the view that the proposal is not environmentally acceptable in terms of biodiversity and conservation outcomes as the area proposed for conservation is inadequate for the following reasons:

- It fails to provide for an adequate portion of the vegetation in the best condition of the site being protected – only 17%, or 1.35 hectares of the 8 hectares of vegetation rated in "very good" condition is proposed to be retained;
- The condition of the vegetation to be retained in the conservation area is generally at the lower end of vegetation condition for the site;
- The uncertainties associated with the ability to restore the vegetation condition of the area proposed to be conserved;
- The suboptimal shape of the area proposed for conservation in terms of edge to area ratio and manageability;
- The overall size of the area proposed to be retained – it is questionable as to whether it is large enough to remain sustainable and maintain biodiversity values over the long term; and,
- The reliance on rehabilitation and restoration, along with a significant management effort in maintaining the biodiversity values of the site is uncertain and not preferable when compared to in situ conservation of bushland.

On this basis appeals are allowed to the extent that they contend that the proposal is environmentally unacceptable and should not proceed.

UNDERWOOD AVENUE BUSHLAND - SUMMARY OF CONSERVATION VALUES AND OUTCOMES

Vegetation and Flora Values

The Underwood Avenue Bushland is regionally significant as a representative example of the ecological communities present on the Spearwood Dunes in the Karrakatta Complex — Central and South (Heddle *et al* 1980).

This Vegetation Complex is not considered to be adequately conserved according to Bush Forever targets as less than 10% of this complex is proposed to be protected in *Bush Forever* (Government of WA 2000a).

On a regional floristic grouping scale the vegetation is considered to represent floristic community type 28, Spearwood *Banksia attenuata* or *B. attenuata — Eucalyptus* woodlands which is centred on sands in upland sites on Spearwood Dunes (Gibson *et al* 1994, Government of WA 2000b). Hence, the area is typical and representative of the vegetation complex mapped.

At the local vegetation scale the Bushland contains a diversity of upland woodland units. These woodlands contain a diversity of diversity of flora which is typical and representative of the Spearwood Dune System. 80 native (and 16 weed) species have been recorded in the bushland (ATA 2000). Significant occurrences of *Jacksonia sericea*, a priority 3 species which is endemic to the Spearwood Dune System in the Perth Metropolitan Region (PMR), are found in the Bushland (ATA 2000, Government of WA 2000b).

The majority of the Bushland is in Very Good to Good condition with areas in Good and Degraded condition (Government of WA 2000b, ATA 2000). The area of Jarrah/Tuart Open Woodland ranges from Good to Completely Degraded but there is a mixed age stand of Tuart in the area indicating that this species is still able to regenerate well. The condition of the Bushland is comparable, and in many cases better, than other regionally significant areas on the Spearwood Dunes.

Significant features of this vegetation are:

- A comparatively large and diverse area of Spearwood Dune woodlands in Very Good to Good condition.
- Areas of *Banksia prionotes* Low Woodland - While *Banksia prionotes* is typically found on the Spearwood Dune vegetation in the Perth Metropolitan Region there are only two other areas in which this species is known to have a comparable abundance.
- The prominent north-south ridge crest dominated by Tuart.

Fauna Values

The relatively large size of the Bushland and the vegetation present provides significant habitat for diverse vertebrate fauna. At least 37 bird species, 16 reptile species, and 3 amphibian species have been recorded in the bushland (P. Berry pers. comm.). The Common Brushtail Possum is also likely to occur in the Underwood Avenue Bushland as key elements of the habitat there are similar to other locations where it is known to occur.

Of particular significance in the Bushland are the following.

- The *Banksia* Woodland with three species of *Banksia* which flower at different seasons are important for nectar feeding honeyeaters that utilise different nectar sources at different seasons.
- The presence of Carnaby's Cockatoo, which is listed in Schedule 1 of the Wildlife Conservation Act as "threatened".
- Included in the 37 bird species are at least six bird species with special conservation significance on the Swan Coastal Plain. Three of these species are "habitat specialists with a reduced distribution on the Swan Coastal Plain" and the other three are "wide-ranging species with reduced populations on the Swan Coastal Plain".
- Tuart and other trees in Underwood Avenue Bushland also provide hollows for obligate tree hollow breeders as well as tall trees for other species such as diurnal birds of prey eg Little Eagle. The tall Tuart trees provide nesting sites for those bird species that nest in tall trees such as birds of prey as well as those that require hollows for nesting.
- The prominent location and high visibility of the Tuart trees on the crest of the ridge is also likely to be a significant factor in maintaining the ecological linkage functions of the Underwood Avenue Bushland for the movement of birds through surrounding suburbs and bushland areas.
- The relatively large size of the area. With reptiles there is a strong relationship between the number of different species occurring on bushland remnants and the size of the remnant. Smaller remnants have fewer species surviving long-term.

The Underwood Avenue Bushland is also part of a significant potential bushland/wetland linkage that is likely to facilitate movement of birds between other conservation reserves including Kings Park, Shenton Bushland and Bold Park. The possible linkage with Shenton Bushland is particularly significant as species are able to move in response to fire or if they are eliminated by fire on one area they can re-colonise burnt sites thus increasing their regional survival.

Implications of the proposed development on the conservation values of the Underwood Avenue Bushland

The Bush Forever Site and current subdivision, is designed (within the constraints of the area that the proponents were prepared to retain), to:

- protect a representation of the bushland that is in the best (Very Good) condition, in a single consolidated area to maximise its viability :
- retain a connection with the current, but unprotected, bushland linkage between Underwood Avenue Bushland and Shenton Bushland;
- retain and maintain connection to Tuart stands on the crest of the ridge in POS; and
- maintain some limited canopy linkage through to the narrow strip of vegetation to be retained along Underwood Avenue.

The current proposal does not protect:

- the populations of the Priority 3 flora species *Jacksonia sericea*;
- a small area mapped as *Eucalyptus decipens* Very Open Tree Mallee (ATA 2000). *E. decipens* vegetation associations are restricted to areas with limestone in the soil profile and are considered to be poorly protected. (Both

these occurrences are close to the western boundary of the property in an area that does not offer an opportunity to protect a consolidated area of bushland in Very Good condition);

- the main populations of *Banksia prionotes*. The large stands of *Banksia prionotes* in Underwood Avenue are largely confined to areas of lesser (Good) condition, with considerably less species diversity. (Note: *B. prionotes* is a fire succession species, so populations may be transient or managed over time). The loss of the main population of *B. prionotes* will reduce the seasonal feeding opportunities for honeyeaters provided by the presence of three *Banksia* species in Underwood Avenue;

- The reduced area of bushland and more attenuated linkage to Bold Park will have some impact over time on the ability of the remaining bushland to retain some of the fauna species, particularly reptile and perhaps frog species, currently recorded from this area and to reduce the potential for recolonisation from Bold Park in the event that the whole of the remaining area is burnt.

- The smaller area will require more intensive management to maintain its conservation values over time.

Summary of Conservation Outcome

The area proposed to be protected, at 8.5 ha bushland (26.5%), plus 2.01 ha Tuart stand in POS, is arguably somewhat below the area that could reasonably be expected to be retained as bushland through an Urban Negotiated Planning Solution (NPS) outcome of the Development Application for the 32.05 ha site that was considered through Bush Forever at the time, given no other constraints on the site. The normal 'target' for an Urban NPS outcome is at least 30% of the area, though this will vary depending on the conservation values and other environmental and planning constraints on the site.

In the context of an 8.5 ha limit, the consolidated shape proposed in the revised plan is considered to be the best conservation option. Given some potential to expand the protected area, the first priority would be to extend the current protected area to the north to include additional bushland in Very Good condition within a consolidated boundary. A second priority may be to improve linkage to and along Underwood Avenue to improve both the connection to Bold Park and increase representation of the *Banksia prionotes* thicket in the protected area.

However, if conservation options were to be considered in terms of a NPS of the Outline Development Plan now being proposed for the future development of the entire 62.9 ha University of WA land holdings in Shenton Park (Nedlands City Council Minutes 10/7/01) as arguably it should be, then the area currently proposed for conservation should be expanded accordingly (30% of 62.9 ha is 18 .9 ha).

Gary Whisson
Manager Conservation Branch
(from information provided by Bronwen Keighery and John Dell)

29 August 2001

Comparative Consideration Against Criteria using Bush Plan (BP) boundaries

The Site as delineated in Perth's Bushplan contains regionally significant vegetation of the Karrakatta Central and South vegetation complex (Heddle *et al.* 1980). The Bushplan Site was identified for a negotiated planning solution. The table below compares two negotiated planning solutions (see Map1).

Note: Non BP area is equivalent to the non-bushland area in the SW corner of lot.

Criteria	Option A	Option B
1. Representation of Ecological Communities		
Vegetation Complex	**BP Area** Karrakatta Complex Central and South [A].	**BP Area** Karrakatta Complex Central and South [A]. **Non BP Area** Not representative of a vegetation complex.
	[A] While approximately 18% of Karrakatta – Central and South vegetation complex remains in the Perth Metropolitan Region of the Swan Coastal Plain, less than 10% of this complex is proposed for protection in designated conservation areas in *Bush Forever*, and is therefore not considered to be adequately conserved in the Perth Metropolitan Region of the Swan Coastal Plain at this stage. Compared with most other remnants of this vegetation complex, the Underwood Avenue Bushland is comparatively large and diverse.	
Floristic Community Type	**BP Area** Floristic community type 28, Spearwood *Banksia attenuata* or *B. attenuata* — *Eucalyptus* woodlands from Supergroup 4: Uplands centred on Spearwood and Quindalup Dunes. This is typical and representative of the vegetation complex mapped.	**BP Area** Floristic community type 28, Spearwood *Banksia attenuata* or *B. attenuata* — *Eucalyptus* woodlands from Supergroup 4: Uplands centred on Spearwood and Quindalup Dunes. This is typical and representative of the vegetation complex mapped. **Non BP Area** Not representative of a floristic community type.
Vegetation Unit	**BP Area** Three units: 1. *Eucalyptus marginata* Low Woodland over a *Banksia attenuata, B. menziesii* and *Allocasuarina fraseriana* Low Woodland (ATA 2000). Approx. equivalent to *Eucalyptus marginata* and *Banksia menziesii* Open Forest (und01). 2. *Eucalyptus marginata* Open Woodland over *Banksia menziesii* Low Woodland (ATA 2000, not mapped).	**BP Area** Seven units: 1. *Banksia menziesii* and *B. attenuata* Low Woodland over *Allocasuarina fraseriana* and *Hakea prostrata* (ATA 2000). Approx. equivalent to *Banksia attenuata, B. menziesii* and *Eucalyptus marginata* Low Woodland (und02) 2. *Eucalyptus marginata* and *E. gomphocephala* Open

	3. *Banksia prionotes* Closed Scrub with *B. menziesii* and *B. attenuata* (ATA 2000, not mapped) While there is generally an overstorey of *Eucalyptus marginata* there are patches of *B. menziesii* and *B. attenuata,* and *B. prionotes* Low Woodland in the area. These are generally to small to map at the scale in ATA (2000). The 2002 summer fire has killed most tree *Banksia prionotes.* Areas of vegetation with an overstorey of *Eucalyptus marginata* are uncommon in the Spearwood Dunes.	Woodland over *Acacia saligna, A. rostellifera* and *Hakea prostrata* (ATA 2000). 3. *Eucalyptus marginata* Open Woodland over *Banksia menziesii* Low Woodland (ATA 2000). *Eucalyptus marginata, Banksia attenuata* and *B. menziesii* Low Open Forest (und03). 4. *Eucalyptus marginata* Low Woodland over a *Banksia attenuata, B. menziesii* and *Allocasuarina fraseriana* Low Woodland (ATA 2000). Approx. equivalent to *Eucalyptus marginata* and *Banksia menziesii* Open Forest (und01). 5. *Banksia prionotes* Closed Scrub with *B. menziesii* and *B. attenuata* (ATA 2000). Approx. equivalent to *Banksia prionotes* Low Closed Forest (und06). 6. Scattered *Eucalyptus decipiens* trees. Approx. equivalent to *Eucalyptus decipiens* Tree Mallee (und04). 7. *Jacksonia furcellata* and *Hakea prostrata* Tall Open Scrub (und05). Not defined in ATA 2000. At the local vegetation scale the bushland contains a diversity of upland woodland units typical and representative of the Spearwood Dune System. **Non BP Area** Completely degraded parkland.
Vegetation Condition	**BP Area** The majority of the bushland is in very good condition with patches in good and very good to excellent condition. The condition of the bushland is comparable to, and in many cases better than, other regionally significant areas on the Spearwood Dunes.	**BP Area** The majority of the bushland is in good condition with areas in very good, degraded and some severe localised disturbance. It appears there has been an historically higher level of disturbance in the western bushland than in the south eastern bushland. The presence of a series of non-indigenous woody species, soil disturbance (mounding and trenching) and patches with reduced species diversity and increased weed cover were indications of this. In addition the effect of any disturbance may be greater in this area as it is exposed to

		westerly winds. Spot deaths of *Banksia* trees in the unburnt section of the western area could be related to this and/or shallower soils on the ridge. **Non BP Area** Completely degraded.
Habitat	**BP Area** Consolidated *Eucalyptus marginata* overstorey with dense cover of understorey. Direct linkage to adjacent bushland south to Shenton Bushland and southeast along Selby Street road reserve.	**BP Area** Unconsolidated and canopy sparse, likely to be greater threat from predation. Does contain a variety of structural units, including mallees, trees and *Banksias*. Direct linkage to adjacent bushland south to Shenton Bushland, south west along Lemnos Street and northwest along Underwood Ave to Bold Park. **Non BP Area** Reduced canopy cover, but does contain some significant habitat trees.
Comment	**BP Area** Meets BP Representative criteria as representative of the Karrakatta – Central and South vegetation complex on the Spearwood Dunes[A] and Representative of floristic community type 28. This option in better condition overall than Option B.	**BP Area** Meets BP Representative criteria as representative of the Karrakatta – Central and South vegetation complex on the Spearwood Dunes[A] and Representative of floristic community type 28. Considerable management effort required to restore entire area to equivalent condition as Option A. **Non BP Area** Not representative of a vegetation complex or floristic community type. Completely degraded and would require maximum restoration effort.
2. Diversity		
Landform	**BP Area** Eastern facing gentle slope and flat.	**BP Area** Eastern facing gentle and steep slope, western facing gentle and steep slope and NS ridge. **Non BP Area** Eastern facing steep slope and NS ridge.
Vegetation Complex	**BP Area** One vegetation complex	**BP Area** One vegetation complex

		Non BP Area Not representative of a vegetation complex.
Floristic Community Type	**BP Area** One floristic community type	**BP Area** One floristic community type **Non BP Area** Not representative of a floristic community type
Vegetation Structural Unit (see Criteria 1)	**BP Area** Three structural units. At the local vegetation scale the bushland contains a moderate diversity of upland woodland units typical and representative of the Spearwood Dune System.	**BP Area** Seven structural units. At the local vegetation scale the bushland contains a higher diversity of upland woodland units compared to Option A. However it should be noted that elements of this diversity may be related to the disturbance history. **Non BP Area** Completely degraded parkland.
Flora	**BP Area** 64 native and 7 weed species und01 and adjacent (90% native). • 40 native and 7 weed species recorded in und01	**BP Area** 83 native and 18 weed species recorded in und01, 02, 03, 04, 05 and 06 combined quadrats and adjacent (78% native): • 40 native and 7 weed species recorded in und01 • 34 native and 13 weed species recorded in und02 • 24 native and 5 weed species recorded in und03 • 11 native and 11 weed species recorded in und04 • 21 native and 6 weed species recorded in und05 • 16 native and 5 weed species recorded in und06 2 obvious taxa observed in this option that were not observed in Option A (*Eucalyptus decipiens* and *Olearia axillaris*) **Non BP Area** Species poor.
Fauna	No comparison possible	No comparison possible
Habitat	**BP Area** One principal habitat in the study area consisting of *Eucalyptus/Banksia* woodlands although there is local variation in composition and structure (ATA 2000).	**BP Area** One principal habitat in the study area consisting of *Eucalyptus/Banksia* woodlands although there is local variation in composition and structure (ATA 2000). **Non BP Area**

		Reduced canopy cover, but does contain some significant habitat trees.
Comment	Does not meet BP Diversity criteria as such diversity is typical of this complex.	Does not meet BP Diversity criteria as such diversity is typical of this complex. This option demonstrates more structural diversity than Option A (note comment under condition).
3. Rarity		
Vegetation Complex	**BP Area** Karrakatta Complex Central and South [A]	**BP Area** Karrakatta Complex Central and South [A] **Non BP Area** Not representative of a vegetation complex.
Threatened Ecological Communities	**BP Area** No threatened ecological communities located.	**BP Area** No threatened ecological communities located. **Non BP Area** No threatened ecological communities located.
Flora	**BP Area** • *Jacksonia sericea* (P3) is endemic to the PMR of the SCP, small populations. ~~-~~*Banksia prionotes* of some significance scattered across area, pattern of distribution possibly related to disturbance. At least one small area of *Banksia prionotes* Low Woodland/Closed Scrub.	**BP Area** • *Jacksonia sericea* (P3) is endemic to the PMR of the SCP, larger population conserved in Option B. • *Banksia prionotes* of some significance scattered across area, pattern of distribution possibly related to disturbance noted under condition, but may be a natural feature. There was a small area of *B. prionotes* Low Closed Forest in this option before the fire in 2002. • *Eucalyptus decipiens* of some local significance as uncommon within site, but is not regionally significant because although patchy is widespread on the Swan Coastal Plain (thus not listed in BF as a significant species). **Non BP Area** No flora of significance
Fauna	No comparison possible.	No comparison possible
Comments	Does not meet BP Rarity criteria as no TEC, DRF, Scheduled fauna or considerable assemblage of significant	Does not meet BP Rarity criteria as no TEC, DRF, Scheduled fauna or considerable assemblage of significant

	flora/fauna located.	flora/fauna located. This option has a larger population of significant flora than the Option A.
4. Maintaining Ecological Processes and Natural Systems		
Regionally significant link	Potential linkage between Kings Park, Shenton Bushland and Bold Park but no assurance that adjacent vegetation that forms linkage will be maintained.	Potential linkage between Kings Park, Shenton Bushland and Bold Park but no assurance that adjacent vegetation that forms linkage will be maintained.
Size/Shape/Consolidation	Area of compact shape and very good condition - the largest consolidated area in best condition.	**BP Area** Two separated smaller areas, one of compact shape in very good to good condition, the other of good to very good condition with severe localised disturbance. **Non BP Area** Completely degraded condition.
Ecological restoration	Minimal restoration effort required.	**BP Area** Moderate restoration effort required. **Non BP Area** Large restoration effort required.
Comments	Does not meet BP criteria.	Does not meet BP criteria.
5. Scientific or Evolutionary Importance		
	NA	NA
6. General Criteria for the protection of Wetland, Streamline and Estuarine fringing vegetation and Coastal vegetation		
	NA	NA
7. Social or Planning Criteria		
	NA	NA

Summary

Option A	Option B
Criteria • Meets BP Representative criteria as representative of the Karrakatta – Central and South vegetation complex on the Spearwood Dunes[A] and Representative of floristic community type 28. • Does not meet BP Diversity criteria, as such diversity is typical of this complex. • Does not meet BP Rarity criteria.	**Criteria** • Meets BP Representative criteria as representative of the Karrakatta – Central and South vegetation complex on the Spearwood Dunes[A] and Representative of floristic community type 28. • Does not meet BP Diversity criteria, as such diversity is typical of this complex. • Does not meet BP Rarity criteria.

Comparison – This option:
• is the largest consolidated area in best condition;
• in better condition overall than Option B being mostly very good;
• contains the largest area of the vegetation unit with a highest diversity of species and life forms in the best condition;
• is less structurally diverse than Option B; ~~and~~
• contains a smaller population of *Jacksonia sericea* (significant flora) than Option B; and~~.~~
• has some potential for direct linkage to adjacent bushland south to Shenton Bushland and southeast along Selby Street road reserve.
	Comparison – This option:
	• is unconsolidated, the bushland being divided into two blocks, west and south east with a non – Bushplan area between;
	• is generally in a more degraded condition than Option A
	  • west block: variable, good to very good, good, degraded
	  • south east block: half very good, half good to very good
	(As a consequence this option will require a considerable management effort to restore to equivalent condition as Option A and then maintain it in this condition);
	• contains an area not representative of a vegetation complex or floristic community type that is completely degraded and would require maximum restoration effort (non – Bushplan area).
	• demonstrates more structural diversity than Option A by including units ~~dominated by *E. decipiens* or *B. prionotes*~~not found within Option A; ~~and~~
	• has a larger population of *Jacksonia sericea* (significant flora) than Option A; and~~.~~
	• has more potential for direct linkage to adjacent bushland south to Shenton Bushland, south west along Lemnos Street and northwest along Underwood Ave to Bold Park; greater opportunity for protection of linkages than Option A.

Significance for flora and vegetation of Lot 4 Underwood Avenue, Shenton Park

Prepared for

The Friends of Underwood Avenue Bushland,

Shenton Park, Inc.

by

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Consultant Botanist

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February, 2001

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Summary

The Underwood Avenue Bushland (the bushland on Location 2103 Underwood Avenue), Shenton Park has been included in Perth's Bushplan (now re-named Bush Forever) as an area recommended for protection on the criterion of "Representation of ecological communities". Inclusion of the Underwood Avenue Bushland in Perth's Bushplan means that the authors of the document, who are presenting the results of an exhaustive review process of the variation in the remnant bushland of the Perth Metropolitan Region and the distribution of vegetation and flora conservation values in the area, have assessed the bushland as having regional significance.

The status of the Underwood Avenue Bushland as regionally significant is accepted by the environment consultants appointed by the University of Western Australia who say "Lot 4, Location 2103 Underwood Avenue, Shenton Park is an area which contains regionally significant urban bushland as well as completely degraded areas" (ATA 2000, p16, para 1).

I agree with the assessment of the Underwood Avenue Bushland as being of regional significance, but would add that neither Perth's Bushplan nor ATA (2000) adequately conveys the importance of this area for the conservation of native flora species and native vegetation, or the loss of value that would occur if it was cleared.

The Underwood Avenue Bushland is located on a part of the Swan Coastal Plain that has largely been cleared, the extent of this clearing being such that the variation of the original vegetation and flora would not be adequately represented in conservation reserves even if all remaining bushland on that plain south from about Woodvale was protected. To put it bluntly, the native vegetation and native flora populations of this region have already been decimated and the on going pressures on remnant vegetation will undoubtedly cause further loss of populations that are too small to be viable without intensive management. That is, the overall context within which decisions on the fate of vegetation remnants such as the Underwood Avenue Bushland should be made is one of a tragedy of a loss of values which can never be replaced and for which this and earlier generations are responsible through a lack of proper care in planning and environmental assessment processes.

What has been lost, and what is at stake in protecting what remains, needs to be clearly understood. What has been lost is most of a diverse, large ecosystem and its constituent flora, fauna and vegetation that once covered the entire Swan Coastal Plain and which consisted of a large number of sub systems of great variety. All of these sub systems and most of the biota within them were naturally restricted to the south-west of Western Australia. To not conceive the destruction of this ecosystem as a loss, is itself a tragedy of a lack of understanding and knowledge.

To try to clarify the values of the Underwood Avenue Bushland it is useful to understand it as part of the *Banksia* vegetation of the Drummond Subdistrict/Swan IBRA region to which most of it belongs. This vegetation should be considered a unit at a biome level, that is a broad unit with particular values, many restricted to it. This gives us a key to properly considering the conservation value of this vegetation and from there the values of the Underwood Avenue Bushland. On an international, national and state scale, this *Banksia* vegetation is a vegetation unit that ranks in importance with other, better known, woodlands and forests. For example, this is a vegetation that is of similar level of distinction, and conservation and scientific importance, to the Jarrah forests and Karri forests of the south-west of Western Australia, the rainforests of Queensland or the Californian Redwoods. *Banksia* woodlands may not have the physical stature of some of these forests, but that is not relevant to their conservation or scientific importance, although it largely explains their lack of recognition by the public as a vegetation of considerable conservation and scientific importance.

Another important part of assessing the value of the Underwood Avenue Bushland is understanding its rarity and its conservation status. The Underwood Avenue Bushland can be considered part of one broad unit (in one classification system), the Karrakatta Central and South Vegetation Complex. This complex has about 18% of its original cover in the Perth Metropolitan Region remaining uncleared, a figure that includes areas in good condition, areas in poor condition and larger and smaller areas. It is a figure that is steadily decreasing. In the face of this loss and continuing loss, only 5.6% is in secure reserves and the Perth's Bushplan (Bush Forever) process will add only 2.4% to total 8%). So, in the absence of increased protection, the long term future for this vegetation complex is one of greater loss than decimation - in the modern use of the term of reduced to one tenth. "This is below the Government's objective of 10% protection of this vegetation complex." (ATA 2000, p.10). It is also below minimum

recommended levels of protection advocated by the IUCN (International Union for the Protection of Nature) and is an extremely poor result for a society which considers itself to be advanced. Let me expand on this, if the long term (say fifty years) result for the Karrakatta Central and South Vegetation Complex is that only 8% is protected, and this is largely what remains (given current pressures), then this vegetation complex will under our steward ship have become (at least relatively) rare and threatened. Not only that, because of the inevitable loss of values from small remnants (ie decline in species numbers, decline in condition) what will be left will suffer further loss. We cannot entirely stop these processes, but we can do as much as is possible to limit the destruction of the bushland by them. In the face of such a situation, reducing the Underwood Avenue Bushland to 25% of its current size would be doing significantly less than is possible to maintain the conservation values of the area.

Another important consideration to take into account when assessing the conservation value of the Underwood Avenue Bushland is how well the variation in the bushland types there is represented in secure reserves. From the discussion above it would seem unlikely that it is well represented. However, the issue does bear further exploration. A second type of classification of the Underwood Avenue Bushland puts the vegetation there into a unit called Floristic Community Type 28. This unit is quite widespread, however, critical examination of detailed site data from a number of sites recorded in this unit shows that it has very significant variation within it. This is confirmed by examination of the vegetation map of the area provided by ATA (2000) combined with inspection of the area, which shows a layer of variation within that mapped. This variation includes some that is poorly reserved in the Perth Metropolitan Region for example, *Banksia prionotes* woodland and lower dune slopes with good Jarrah stands. There is insufficient data available to determine whether or not some of the other vegetation present is also poorly reserved.

Turning from the vegetation to the flora, some 15% of the flora species present in the Underwood Avenue Bushland are considered to be less than well reserved on the southern Swan Coastal Plain. This is a particularly significant statistic. When properly interpreted in the context of ongoing loss of native vegetation in this region, it means that the native flora of which we are custodians has a far poorer level of protection than is necessary to provide a responsible level of representation in conservation reserves. This suggests that in the longer term

many native species formerly common in the IBRA Swan Region/ Drummond Botanical District will become rare or even extinct there.

Another important consideration in assessing the conservation value for vegetation and flora of the Underwood Avenue Bushland is the linkage of the area to other areas and the potential for rehabilitating other linkages. The following two quotes sum up the situation in regard to this issue.

"Another factor that can affect the assessment of the value of an area is how it relates to other areas, and particularly whether or not it has effective links to other areas. In a fragmented system, there is great value for flora and fauna populations in having effective linkages between areas through them being joined by corridors of bushland or regenerated vegetation. The existence of such linkages allows seeds to be transported by fauna, or pollen to be carried by fauna, to re-establish flora populations where a population of a species has been lost or to maintain genetic diversity through cross pollination." (Trudgen and Keighery 1995).

"A very important corollary of the value of linkages is that a linked group of remnants can thus have a greater value than the simple sum of their area. This is because together they can better cope with the pressures that would otherwise reduce their diversity, limiting the loss of diversity to some degree." (Trudgen and Keighery 1995).

In summary, in my view there is a very substantial case, based on either the flora or vegetation of the Underwood Avenue Bushland for retention of all the bushland on Lot 4. The combination of the values for flora and vegetation provides a compelling case.

1.0 INTRODUCTION

1.1 Subjects of this report

The subjects of this report are:

- analysis of the conservation value for flora of Lot 4 Underwood Avenue, Shenton Park;

- analysis of the conservation value for vegetation of Lot 4 Underwood Avenue, Shenton Park;

- discussion of the problems (including different approaches) relating to the description of vegetation and assessment of conservation value for vegetation and flora on the Swan Coastal Plain.

Lot 4 Underwood Avenue, Shenton Park is owned by the University of Western Australia.

This report was commissioned by "The Friends of Underwood Avenue Bushland, Shenton Park, Inc.".

1.2 Reliance on description of the vegetation and flora by ATA

This report does not present a vegetaton and flora survey. For description of the vegetation and listing of the flora of Lot 4 Underwood Avenue, Shenton Park, it draws on the report (ATA 2000) prepared for the University of Western Australia by ATA Environmental, while recognising the limits of that study.

1.3 Development from earlier reports

This report has been developed from earlier reports (Trudgen 1999, 2001). Changes have had to be made to reflect the different circumstances (location, geomorphology, vegetation types etc.) of the different land areas involved.

2.0 DEFINITION AND DISCUSSION OF SOME TERMS AND CONCEPTS USED

This section will give definitions of a number of terms used in this report and where appropriate some discussion of them. It should be noted that what is being done here is to present working, practical definitions. It should be understood that it is difficult to present definitions of some concepts, such as species, plant community and conservation value, that are unequivocal or for which exceptions cannot be found. However, as noted below, while the definition of species is notoriously difficult, this does not stop biologists and others from using the concept in a practical way. Thus the approach taken here is to try to impart the general use (or best use) of terms such as species, plant community and conservation value, rather than to present legalistic definitions.

Flora

The term flora has different meanings in different contexts. A flora species is a member of the plant kingdom, which includes the flowering plants, pines, cycads, ferns, mosses, liverworts, algae, lichens and some other groups. Flora in this sense is generally taken to include the fungi which used to be included in the plant kingdom, but are now considered a separate group. The flora of an area or region is all the plant species of that area or region. An example of the latter use is: an area may be said to have a diverse flora or a poor flora, depending on the number of species of flora present, its area, habitat diversity etc.

Species

The *Oxford Dictionary of Plant Sciences* (Allaby 1998, p. 420) entry for species reads "Literally, a group of organisms that resemble one another closely: the term derives from the Latin *speculare*, to look. In taxonomy, it is applied to one or more groups (populations) of individuals that can interbreed within the group but cannot exchange genes with other groups (populations), or, in other words an interbreeding group of biological organisms that is isolated reproductively from all other organisms..."

Thus the generally (but not universally) accepted definition of species by biologists is that a species consists of a population of individuals that can interbreed. Wilson (1993, p. 36) states it thus "I will try to cut to the heart of the matter with the 'biological species concept': *a species is a population whose members are able to interbreed freely under natural conditions*."

Declared rare flora

Declared rare flora are species that are protected by the State through the Wildlife Conservation Act. Without the consent of the Minister, it is illegal to "take"

declared rare flora. The Department of Conservation and Land Management (CALM) administers the Wildlife Conservation Act and makes recommendations on what species should be gazetted.

Priority flora

Priority flora are species that the Department of Conservation and Land Management (CALM) considers are rare, although not declared as such, or which are considered potentially under threat. There are four priority ratings (Atkins 1995, 1998), the definitions of which are reproduced in Appendix 1. A list of priority flora is maintained by CALM with the declared rare flora list and updated once or twice a year (Atkins 1999 is the latest version at the time of writing this report). At least some of the species on the priority flora list are under consideration for gazettal as declared rare flora.

Priority species are not protected directly by legislation. However, it is usual for them to be considered during assessment of the potential environmental impact of a proposal by the Environmental Protection Authority (EPA).

Species of conservation significance

Declared rare and priority species are species of conservation significance. However, while declared rare flora are legally protected and priority flora have a level of de facto protection there are other categories of flora or specific populations of flora that botanists consider have special conservation value and would recommend they should be given some level of protection. These include:

- previously unknown taxa (species or subspecies). The fact that a species or subspecies has not been previously found very often indicates that it is not common and may be rare. This is especially the case in the botanically better known parts of the State, such as the Swan Coastal Plain;

- disjunct populations. These are populations that are separated from the main area of distribution of the species they belong to by a significant distance. They are of conservation significance because they are likely to be genetically different from the main population, having the potential to evolve into a separate species over time because of this difference and the disjunction. They may also indicate the ability of the species to inhabit a different habitat;

- populations at the ends of the range of a species. The populations at the ends of the range of a species may have genetic differences that enable the species to inhabit areas that are environmentally different from the main part of the distribution and also demonstrate the ability of the species to inhabit areas less favourable to it than the main part of the range;

- uncommon or rare species that have not been gazetted as rare or recognised as requiring priority species status. Due to the size of the flora of Western Australia and the small number of botanists working on this flora, it is not uncommon for species to have not been recognised as requiring protection as declared rare flora or as priority species when one of these categories would be appropriate. This is less of a problem in the botanically well known parts of the State than the less well known areas.

The discussion of species of conservation significance above relates to the general treatment of species in environmental assessments and surveys, that is it focuses on species and populations that are considered of particular importance. However, an equally, or arguably more, valid proposition is that all flora populations have conservation significance, but that to simplify the issue for practical considerations we talk of flora of conservation significance when we mean flora (species and populations) of special conservation significance. That is flora species or populations that natural or human processes have made of more restricted occurrence or placed under threat.

The degree to which a narrow focus such as declared rare and priority flora as practiced in Western Australia ignores the reality of loss of conservation value for species is shown by Keighery (1999) which reviews the flora of the southern Swan Coastal Plain. This publication shows that many species which are neither declared rare nor priority flora are in fact poorly conserved over this part of their original range.

Flowering plants (Angiosperms)

Flowering plants are those that reproduce by the production of a seed that develops from an ovule that is enclosed in an ovary. They are the dominant group of land plants in terms of the number of species currently extant. Most tree and shrub species are flowering plants, a relatively small number are gymnosperms (pines and cycads). The grasses and sedges are also flowering plants as are most herbaceous plants. One species relevant to the current report that is not a flowering plant is *Macrozamia fraseri* (the Zamia Palm, a cycad).

Fungi

The fungi are a group of organisms that reproduce by spores or simple division, some members are unicellular while others consist of filamentous strands called hyphae which grow through the soil, plant litter and dead and living wood. The fruiting (spore bearing) bodies of the latter types of fungi are the structures referred to as mushrooms and toadstools. Fungi are important in the working of ecosystems as they play an essential part in the recycling of nutrients by breaking down dead plant material. They also play an important role through the symbiotic relationships they have with many plant species.

Vegetation

Vegetation is the communities that flora species, including flowering plants, ferns, mosses, fungi etc., form. A range of terms exists to describe various levels of different classifications of vegetation. The definitions of terms such as *plant community* and *vegetation association* are inherently difficult due to the range and types of variation that vegetation exhibits.

Plant community

The best use of the term plant community is as a fairly narrow unit of vegetation that consists of one type. That is, it is best regarded as a basic unit that has a low level of synthesis and is not readily dividable into more than one distinct type, although it will have a range of variation. I

Vegetation association

There are different approaches to the definition of vegetation association. Most commonly, it is conceived of as a group of plant communities with similar structure and dominance (this is the approach taken in this report). For example, forests dominated by Jarrah might form one or more associations depending on how the concept is interpreted, how large an area is under consideration and how much variation there is in the understorey.

Vegetation Formation

A vegetation formation is a very broad unit of vegetation description that is defined by structure only, that is the particular species making up the vegetation are not taken into account, only its physiognomy. Examples of vegetation formations are tall forest, open forest, low woodland, heath and grassland.

Vegetation Complex

A vegetation complex as used by Heddle *et al* (1980), the meaning relevant to this report, is the range of different vegetation types found on a broad

geomorphological/soil unit or a major part of such a unit that has been subdivided on the basis of variation in the vegetation. Different vegetation complexes may have part of their variation in common. See section 6.2. for further discussion of this concept.

Floristic Community Type

A floristic community type is a group of flora recording quadrats (or releves, depending on the study) that represent a range of vegetation separated from other such groups of quadrats on the presence or absence of flora species, so that quadrats with similar assemblages of flora species are grouped together.

The grouping of quadrats into floristic community types is carried out using appropriate computer programs. Floristic community types can be defined at a wide range of levels depending on the purpose of the study and the size of the data set. There is no standardised terminology to rank floristic community types in a similar hierarchy to plant community, vegetation association etc.

The floristic community types referred to in this report will be those defined by Gibson *et al* (1994) and the extension of that study published in Perth's Bushplan (Government of Western Australia 1998). The floristic community types of Gibson *et al* (1994) are the result of a regional study and were deliberately selected to represent broad regional groups, they are discussed in more detail in section 6.0.

Habitat

For the purposes of this report the term habitat is used to refer to a physical position in the landscape when used to describe the place of occurrence of a vegetation type. For example, dune slope, dune crest, or a swale between dunes.

While the various positions in the landscape provide habitats (in conjunction with other variables such as water tables) for vegetation types, the vegetation and landscape provide habitat for individual flora and fauna species.

Conservation value

Conservation value is the value of an aspect or part of nature such as a flora or animal species, a type of vegetation, the geomorphology of an area or the geology of a particular outcrop that relates to, or is brought about by, its development or evolution, often over very long periods of time, as a part of natural systems.

3.0 TOPOGRAPHY, LANDFORM, SOILS, GEOLOGY

3.1 Topography

Lot 4 Underwood Avenue has a significant range of topography, including part of a quite high ridgeline and slopes down from it. There is significant variation in the slopes, with steeper and gentler slopes. The latter having different vegetation, apparently reflecting deeper siols.

3.2 Broad geomorphological and geological setting of the Lot 4 Underwood Ave

Lot 4 Underwood Avenue lies on a large area of the Spearwood Dune System that extends northwards from the Swan River, this dune system being part of the Swan Coastal Plain, a geomorphological province which is part of the surface of the onshore part of the Perth Basin.

The Swan Coastal Plain has been built up by the deposition of sediments washed down from the adjoining Darling Plateau and sand (siliceous and calcareous) blown inland from the coast. The surface deposits of the western parts of the plain are largely composed of aeolian deposits, with some small areas of marine deposits (Biggs and Wilde 1980 & Churchward and McArthur 1980). These different types of deposits and their various subdivisions (including those that have resulted from processes altering them after deposition) form major subdivisions of the surface geology, geomorphology, soils and plant habitats of the plain.

The aeolian deposits of the central and western parts of the Swan Coastal Plain consist of three large dune systems. From west to east these are the Quindalup Dunes, the Spearwood Dunes and the Bassendean Dunes. These dune systems are not continuous along the coastal plain, rather each occurs as a number of areas separated by areas of other units (Churchward and McArthur 1980 and accompanying maps). The geological (name) equivalent of the Spearwood Dune System is (roughly) the Tamala Limestone, although this is not generally used to include the loose sand covering associated with the limestone (Gozzard 1982, 1986 - see map keys).

3.3 Regional scale landform/soil units of the region including Lot 4 Underwood Ave

Churchward and McArthur (1980) mapped the landforms and soils of a large area of the Swan Coastal Plain and some adjoining areas (the area within the System Six boundary, see DCE 1980). This mapping described twenty-two units for the Swan Coastal Plain. Lot 4 Underwood Avenue Shento Park is in an area mapped as one of these units, the Karrakatta unit, one of two defined by Churchward and

McArthur for the Spearwood Dunes. This unit generally has deeper sand, but often has some limestone at high points.

The division of the Spearwood Dune System by Churchward and McArthur (1980) into two regional scale units (the Cottesloe unit and the Karrakatta unit) gives an indication of the variation in this dune system. This is a significant dune system on a global scale and has a wide range of landscape, varying in shape, aspect, height, steepness and depth to water table. That is, the Spearwood Dune System provides a significant range of plant habitats.

3.4 Relationship of landform/soils units of Churchward and McArthur to the vegetation complexes of Heddle *et al*

The mapping of the vegetation complexes described by Heddle *et al* (1980) largely uses the same map outlines as the landform and soils mapping of Churchward and McArthur (1980). The significant difference is that the vegetation complex mapping defines more than one vegetation complex for some of the landform/soils units, mostly to reflect changes in the vegetation from south to north caused by a decrease in rainfall along the Swan Coastal Plain.

For example, the Karrakattta Central and South and Karrakatta - North vegetation complexes of Heddle *et al* (1980) combined have the same outline as the Karrakatta soil/landform unit of Churchward and McArthur (1980). The vegetation complexes of Heddle *et al* (1980) for an area icluding Lot 52 are shownon Map 2.

4.0 DISCUSSION OF DIFFERENT METHODOLOGIES THAT HAVE BEEN USED FOR STUDYING, DESCRIBING AND MAPPING VEGETATION RELEVANT TO DESCRIPTION AND ASSESSMENT OF THE CONSERVATION VALUE OF THE VEGETATION OF LOT 4 UNDERWOOD AVENUE

4.1 Scope of the section

This section discusses some of the different methodologies used for studying, describing and mapping vegetation that have been used for the region in which Lot 4 Underwood Avenue lies. An understanding of how these approaches treat vegetation is essential to properly use them for assessing conservation value.

It also needs to be recognised that regional vegetation studies often cannot adequately answer questions about the details of the vegetation of a particular place that require a more detailed knowledge of the vegetation of an area.

The approaches discussed (see section 7.2 below) are the:

- more traditional structure and dominant species approach using the classification of Specht as modified by Aplin (1979) as an example;

- use of the boundaries of major geological or geomorphological units as boundaries for vegetation units, eg. the mapping of vegetation complexes for the Darling System by Heddle *et al* 1980;

- the floristic method, for example the definition of floristic community types by Gibson *et al* (1994) for the southern Swan Coastal Plain;

Before discussing them, it is worthwhile considering why there are a number of different methods and why there is not a simple, agreed resolution of the classification of the vegetation of the Swan Coastal Plain.

The essence of the problem is that vegetation is very diverse as a result of:

- the number of species available within a region to form a stand;

- the number of species that may be in a stand (ie. few to many);

- the contribution to biomass that the available species can make in different stands (one, a few or more species may be dominant or co-dominant in a stand and their relative abundance may change between stands);

- the number of different habitats that vegetation occurs in, even in one region and the significant number of factors involved in defining habitat beyond the concept of physical place (ie., habitat as used for vegetation may be considered as a place such as dune crest, dune slope, swale and then the description modified by factors such as soil type, water availability and aspect - all of which can affect the type of vegetation developed);

- the fact that habitats are often not discrete, that is change from one habitat to another may be gradual in one instance or abrupt in another;

- the range of structural types that vegetation can take, for example from herblands with one low stratum of herbs to forests or woodlands with two tree layers, three shrub layers and herb or sedge layers;

- the range of climate that vegetation occurs in even within a region such as the Swan Coastal Plain, this factor interacting with others.

Thus, the study of vegetation is a particular case of the general problem faced by biologists that nature (in the limited sense of living things and aggregates of them) is incredibly diverse. For non-specialists, the problem is complicated by the fact that unless you can recognise a reasonable number of plant species, which takes a significant amount of experience, you have great difficulty entering the issue in the first place. This is a significant point, as it raises the question of how non-specialists can value vegetation if they cannot adequately appreciate the diversity of it.

4.2 Discussion of different approaches to studying vegetation used in the region surrounding Lot 4 Underwood Avenue

4.2.1 Structure and dominant species approach

This type of approach places emphasis on the species within the vegetation being described that are abundant or relatively abundant and often on the tallest stratum of the vegetation. Thus this type of approach generally emphasises the species that are more important in forming the structure of the vegetation and/or which are often visually important from a human perspective.

An examples of this approach, is the modification by Aplin (1979) of Specht's classification. This uses only the upper stratum in describing or classifying the vegetation at higher classification levels but at lower levels uses the understorey species also. This approach is often used without taking the latter point into

account. At higher levels under this system, stands that have similar upper strata but dissimilar lower strata are grouped together. Aplin's version of Specht's classification is used in this report to describe all the strata present in the vegetation being studied. Muir (1977) has published a somewhat more detailed classification table, designed for use in the Western Australian wheatbelt.

Using the simplest format of the structure and dominant species approach (ie. only describing the tallest stratum) can be unsatisfactory for ecological studies or for conservation assessment below a very broad level because it can lump together otherwise dissimilar vegetation, and because the upper stratum may not be a good indicator of the value of the vegetation as habitat for other species of flora (or fauna).

This type of approach defines basic units or plant communities that are then grouped into vegetation associations and then into vegetation formations (intermediate groupings are also sometimes used, such as sub-formation and society), the left hand column of Table 3 shows the hierarchy. At the upper level of this approach, the vegetation formation, only the structure is used. In understanding this hierarchy, it should be noted that the break between plant community and association is one of level of grouping both taking into account structure and dominant species, while the break between association and formation is conceptually larger as the formation level only involves structure, with the identity of the species making up the vegetation ignored.

Under this approach, stands of vegetation observed in the field should be able to be referred to a plant community which should consist of a series of similar stands. Similar stands in this context should include similarity in structure, dominant species and species composition. Note, that what is specified is similar, not identical, as the latter would not be appropriate for the type of biological system being considered.

4.2.2 Use of the boundaries of major geological, geomorphological or soil units as boundaries for vegetation units, eg. the mapping of vegetation complexes for the Darling System by Heddle *et al* (1980)

This approach uses the boundaries of major geological, geomorphological or soil map units as a surrogate for vegetation mapping boundaries, working from the generally observed fact that such boundaries often coincide because of the influence of geology, geomorphology and soils on flora distribution and vegetation development.

Heddle *et al* (1980) published a map of most of the Swan Coastal Plain and some adjoining areas with descriptions of the vegetation of their units (which they call vegetation complexes). An example of a vegetation complex is the *Karrakatta Central and South Vegetation Complex* of Heddle *et al* (1980) within which the vegetation of Lot 4 Underwood Avenue Shenton Park falls.

The strength of this method is that it can provide maps fairly readily that give a broad idea of what vegetation is present within each unit if geological, geomorphological or soil maps already exist. It has the disadvantage, that what is mapped in each discrete area of the maps produced is not one vegetation type but a group of vegetation types (plant communities and vegetation associations) that occur together as parts of one or more catenary sequences. The vegetation types found within a vegetation complex may be either quite similar on structural or floristic criteria, or very dissimilar, but they will generally occur in some repeating pattern or group of patterns within the vegetation complex.

This weakness of the maps produced using this methodology can be seen as a lack of precision as to what is at any particular point within a map unit boundary. In the case of units such as the Karrakatta Central and South Vegetation Complex, this imprecision can be quite high.

4.2.3 The floristic approach, for example the definition of floristic community types for the Swan Coastal Plain by Gibson *et al* (1994)

The floristic (overall species makeup) approach is based on defining units in the vegetation of an area on the basis of the flora species present in it, ignoring the structure of the vegetation or the contribution (cover or biomass) of each species.

Generally, computer programs such as the CSIRO "PATN" package (Belbin 1987) are used to sort sites for which detailed floristic lists have been collected into clusters or groups of sites which have more similar flora lists to each other than to other sites. The resultant groups of sites are used to define (or actually define) a unit which is often referred to as a "floristic community type". Most commonly, the analysis is done taking into account only the presence or absence of species. However, where the site data has information on the cover of the species present some programs can take this into account also, the approach then tends back towards the structure/dominance approach but with a heavy accent on floristics.

The study of Gibson *et al* (1994) is of particular interest in the context of floristic studies on the Swan Coastal Plain, as it is the only such study of the vegetation of the Swan Coastal Plain based on a large number of apparently rigorously recorded

quadrats. As such, it is a world class study in terms of the data set. The processing of the data also appears to have been carried out well, although there are some problems with using the results because of the particular software package used. However, I would be critical of aspects of the writing up of the study, including the terms used to describe conservation status, which were poorly chosen and open to misuse (and have been!). The lack of adequate discussion of the appropriate use of the units defined was also a serious omission.

The strength of the floristic community types defined by Gibson *et al* (1994) is that if the floristic community type of a stand of vegetation is known then this can give valuable information on the stand's conservation value through knowledge of the conservation and reservation status of the floristic community type to which it can be referred. The weakness of the study from the point of view of conservation assessment of vegetation is that the units defined are of a broad level. This means that the level of question that they can answer is a similarly broad level.

5.0 APPROPRIATE USE OF THE UNITS DEFINED BY DIFFERENT STUDIES OF VEGETATION ON THE SWAN COASTAL PLAIN IN THE ASSESSMENT OF CONSERVATION VALUE FOR VEGETATION

5.1 General comment on the use of regional units

The use of regional units such as the vegetation complexes of Heddle *et al* (1980) and the floristic community types of Gibson *et al* (1994) in the assessment of conservation value for vegetation should take into account the variation within them. This variation can be regional or subregional variation in the flora composition, structure or dominance of stands caused by changes in climate or other factors such as soil over distance, or it can be variation related to the fact that broad units contain a range of sub-units at a local or subregional level that are related to local or subregional changes in environmental factors such as slope, aspect, depth to water table and soil type. The overall point here is that broad regional vegetation units should not be perceived of as uniform entities when they mostly are in fact quite variable in ways that respond to both regional and subregional variation in the different variables that affect the development of the vegetation.

Thus, regional units should be used to identify the need for conservation, or assess values at a regional level, understanding that for localised issues (such as comparing the values of two nearby areas) studies that look at the vegetation at a more detailed level would need to be used.

Where the relative value of two areas of the same regional unit is being considered, then:

- if they are distant, then it is likely that they will have significant differences in those characteristics that vary on a regional scale, the amount of difference depending on the distance of separation, the change in factors such as climatic variables between the two locations, the type of unit under consideration and the degree of variability of that unit;

- if they are located near each other then they are likely to be fairly similar in those characteristics that vary on the regional scale, but may differ in characteristics that vary on a local scale or subregional scale. For example, the range of vegetation and its associated flora on two nearby areas of the Cottesloe Central and South Vegetation Complex is likely to be similar but there may be significant differences. For example, two such areas may differ in the amount of limestone outcropping, the steepness of the dunes and the presence or absence of dampland areas. Such differences would indicate the

possibility of significantly different vegetation and flora conservation values.

5.2 Use of the vegetation complexes of Heddle *et al*(1980) in the assessment of the conservation value of vegetation

The vegetation complexes of Heddle *et al* (1980) are regional scale mapping units that divide the landscape on a broad rather than a fine scale. Therefore, it is generally appropriate to use them for assessing the value of areas at this scale. For example, if areas belong to two different vegetation complexes, then they will have different values at a very significant level.

Where the same geomorphological unit is divided into more than one vegetation complex, as is the case with the Spearwood Dunes, there will generally be a lesser difference than between two vegetation complexes that occur on different geomorphological units. However, it should be borne in mind that by defining different vegetation complexes for one underlying geomorphological unit, Heddle *et al* (1980) have implied that they have identified differences in the vegetation on that geomorphological unit, caused either by climate or by variation in the soils or landform of the geomorphological unit. However, in some cases, including the Spearwood Dunes, the underlying geomorphological/ soil unit has very significant variation in soil and this can be greater than between the soils under some pairs of vegetation complexes. In the case of the Spearwood Dunes, the soil includes areas of siliceous sand and areas with much limestone at the surface. To cope with this, Churchward and McArthur divided the Spearwood Dunes into two landform/soils units (the Cottesloe and Karrakatta landform/soils units).

When assessing the value of different areas within a vegetation complex (or group of related ones) that occur on a relatively uniform substrate over large distances that have a gradient of climate, the scientific value of sampling (ie., protecting representative areas of) the system at different points should be recognised. This type of situation presents an opportunity for studying the response of different species to climatic variables and for studying the response of the development of vegetation to those variables and is an illustration of the scientific value aspect of conservation value.

As a result of the fact that the vegetation complex mapping of Heddle *et al* (1980) breaks the vegetation of the Swan Coastal Plain up into that found on major geomorphic components and then for some of these further breaks it up based on the affects of climate and medium scale geomorphic variation it can be used to

identify - at a broad level - the value for conservation of vegetation and flora of areas based on principles such as:

- where in the original extent of a complex an area lies (an indicator of what values from within the range of values in a complex might be present);

- how many complexes are represented in the area (a crude measure of the diversity of vegetation and flora present);

- what transitions between complexes are present (of importance as an indicator of the possible presence of unusual habitat for flora and vegetation and of importance as areas where the responses of species to changes in the environment can be studied); and

- how typical the area being assessed is for the complex(es) which it falls within.

5.3 Use of the floristic community types of Gibson *et at* (1994) in the assessment of the conservation value of vegetation

The floristic community types of Gibson *et al* (1994) and the extension of this work published in Perth's Bushplan (Government of Western Australia 1998) are broad scale units that divide the landscape at a medium scale. This needs some clarification. They are broad scale units because of the relatively limited number of them in relation to the large diversity of vegetation types (based on structure and dominant species) in the region they are defined for, which results in the degree of variation in vegetation structural types of stands referred to many of them (see section 13 below and Table 3 above and also the descriptions of individual floristic community types in Gibson *et al* (1994)).

These units divide the landscape at a medium level because they divide it to a significant degree across and within the boundaries of the major landform/soil units of Churchward and McArthur (1980), in a way that reflects the effect of other environmental variables (such as water relations and soils) on plant distribution.

Thus the floristic community types of Gibson *et al* (1994) and the extension of them published in Perth's Bushplan (Government of Western Australia 1998) give an understanding for the Swan Coastal Plain of:

- the floristic composition of the vegetation of different parts of the Plain and how this differs from the floristic composition of the vegetation of other parts of the Plain;

- how the flora is distributed in the landscape at a medium scale within a particular area. For example, how swamps would differ from lower dune slopes and crests;

- how the floristic composition of the vegetation of one area differs from another, if the floristic community types of both are known;

- what diversity of broad scale units of the vegetation based on their floristic composition at a regional scale exist in an area. That is, how the floristic diversity of the vegetation of an area relates to the vegetation of the Plain as a whole, or to another area;

Thus the floristic community types of Gibson *et al* (1994) can be used as a broad measure of the conservation value of medium scale parts of the vegetation. For some of the rarer floristic community types of Gibson *et al*, such as their southern ironstone floristic community type, the approach has demonstrated the presence of extremely rare vegetation at a broad level of definition. However, these units do not give information on the rarity of vegetation below their level of definition. For example, some floristic community types have significant variation in the structural types that are developed in the vegetation referred to them. Some of these may be quite rare in their own right, but this information is not available from the definition of the floristic type of a stand.

5.4 Use of the plant community concept in the assessment of the conservation value of vegetation

Plant communities (as used in this report) are units of vegetation that fairly closely reflect how vegetation occurs in the field. They are thus low level units that describe the vegetation at a fairly fine level compared to units such as Heddle *et als* (1980) vegetation complexes or Gibson *et als* (1994) floristic community types. The appropriate use of plant communities in the assessment of the conservation value of areas of vegetation is thus to allow:

- a measure of the real variation and diversity of the vegetation of an area taking into account the structure of the vegetation, the dominance of individual species and (ideally) the overall floristic make-up of stands;

- comparison of areas of vegetation at a comparatively fine level to assess their relative values for vegetation at this level.

Thus two areas could be mapped as entirely the same vegetation complex, or assigned completely to the same floristic community type, but have quite different vegetation when described at the plant community level. As an example, an area of the Karrakatta Central and South Vegetation Complex could have all sandy soil and no limestone outcropping, while another area of the same complex could be like Lot 4 and have some areas of limestone near the surface as well as areas with deep sandy soil.

6.0 REGIONAL BOTANICAL PERSPECTIVE

6.1 Botanical province and district mapping of Beard

Beard (1980) has defined detailed boundaries for botanical provinces, districts and subdistricts for Western Australia on the basis of his vegetation mapping of the State. In this framework, Lot 4 Underwood Avenue Shento Park lies in the Drummond Botanical Subdistrict (more or less equivalent to the Swan Coastal Plain and part of the Dandaragan Plateau.) of the Darling Botanical District of the South western Botanical Province of Western Australia.

The South western Botanical Province covers the area of the State south-west of a line from the southern part of Shark Bay to Israelite Bay east of Esperance (Beard 1980, p. 53 and Figure 7 on p. 45). The Darling Botanical District covers the areas that were originally mainly Jarrah Forest, Karri Forest and *Banksia* woodland, the latter often with an open overstorey of Jarrah (*Eucalyptus marginata*) or Tuart (*Eucalyptus gomphocephala*). These forests and woodlands originally amounted to about a quarter of the South western Botanical Province. Nearer the coast it also includes areas of heath and shrubland on limestone and calcareous sands.

6.2 Biogeographic regions of Thackway and Cresswell

Thackway and Cresswell (1995) have devised a system of biogeographic regions for Australia (they are referred to as IBRA or "Interim Biogeographic Regionalisation For Australia" regions, as the study has produced an iterative series of versions for discussion). In this system, Lot 4 Underwood Avenue lies in the Swan Coastal Plain IBRA region, which includes the Swan Coastal Plain and part of the Dandaragan Plateau, that is, there is close agreement between the IBRA Swan Coastal Plain biogeographic region of Thackway and Cresswell (1995) and the Drummond Botanical Subdistrict of Beard (1980).

The purpose of the development of the IBRA bioregions was to "provide a broad framework for identifying deficiencies in the existing system of protected areas, and for setting priorities for action in establishing the national reserves system in Australia" (Thackway and Cresswell 1995, piii). That is, the IBRA bioregions system was devised to enable conservation values to be identified and is therefore suitable, at a very broad level, for identifying factors that should be taken into account when assessing the conservation value of Lot 4 Underwood Avenue.

Table 14 of Thackway and Cresswell (1995, p. 43-45) summarises the "Reservation of each IBRA region and the relative bias sampling the major environmental heterogeneity within each region". The entry for the Swan Coastal Plain IBRA region for Reservation status is "1-5%"; the entry for Averaged Reservation codes

is "3"; the entry for Index of bias is "H"; and the entry for Averaged bias codes is "4".

This means that at the time of publication of Thackway and Cresswell, that 1-5% of the Swan Coastal Plain IBRA region was in secure reserves and that the reserves did not evenly represent the variation that occurs within the native vegetation of the region. This is a poor state of affairs, because it means that the biota (including vegetation, flora and fauna) of the region is inadequately reserved overall and that some parts of the variation in the region are likely to be unprotected.

6.3 Vegetation complex mapping of Heddle *et al*

For the Swan Coastal Plain, Heddle *et al* (1980) distinguished twenty-nine vegetation complexes.

Of significant interest for the assessment of the conservation value of Lot 4 Underwood Avenue is that Heddle *et al* (1980) divided the Spearwood Dune System into four vegetation complexes. The first division was based on changes in the vegetation found on this dune system from east to west related to the west part (Cottesloe landform/soil unit) of the system frequently having much limestone exposed at the surface whereas the east part (Karrakatta landform/soil unit) generally has deep siliceous sand at the surface. The second division divides each of the eastern and western parts into southern and northern sections, reflecting changes in the vegetation caused by the gradient in climate (particularly a drop in rainfall) along the Swan Coastal Plain from south to north. Full recognition of these changes would require a much more complex representation of the biota than broadscale maps at the level of vegetation complex.

6.4 The floristic community types of Gibson *et al*

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

The 43 floristic community types and subtypes (at the 30 group level) on the Swan Coastal Plain which Gibson *et al* (1994) identified, together with the 15 supplementary groups identified subsequently, mean that a total of 66 floristic community types are currently recognised for the Swan Coastal Plain and adjoining areas, including the Dandaragan Plateau. That is, for the Drummond

Botanical Subdistrict/IBRA Swan Coastal Plain Biogeographic Region area we have 66 broad floristic groupings of a similar level to a vegetation formation or sub formation (or which possibly range from alliance to formation level).

6.5 The *Banksia* vegetation and the vegetation of the limestone and lime (calcareous) sands of the Swan IBRA Region

6.5.1 Issues relating to the *Banksia* vegetation and the vegetation of the limestone and calcareous sands of the Swan IBRA Region/ Drummond Botanical Subdistrict of importance for conservation assessment

The *Banksia* vegetation and the vegetation of the limestone and calcareous sands of the Swan IBRA region cover a large part of the Swan IBRA region/ Drummond Botanical Subdistrict and are major divisions of the vegetation of that area. As a result of this, proper understanding of what these two groups of vegetation are, in terms of their diversity of vegetation and flora and their appropriate rank in classifications of vegetation, is critically important for understanding the botanical context of Lot 4 Underwood Avenue, and for assessing its conservation value for vegetation and flora.

These issues can be identified more fully as:

- the variability of this vegetation;
- how this variation occurs and what causes it;
- the appropriate "rank" of this vegetation;
- the implication of the "rank" of this vegetation for conservation assessment;
- the conservation status of this vegetation, overall and for different parts of it's variation; and
- the reservation status of this vegetation, overall and for different parts of it's variation.

6.5.2 The *Banksia* vegetation of the Swan IBRA Region/ Drummond Botanical Subdistrict

The *Banksia* vegetation of the Swan IBRA region/Drummond Botanical subdistrict consists of:

- the *Banksia* woodland vegetation of the Bassendean Dune System, including large parts of the four vegetation complexes (Bassendean - North vegetation complex etc. on the Bassendean landform/soil unit) of Heddle (1980) and parts of some of the adjoining complexes where they have drifts or low dunes of the Bassendean Sand over the underlying soil;

- the *Banksia* woodland vegetation of the Spearwood Dune System, including parts of the four vegetation complexes (Cottesloe Central and South, Karrakatta Central and South vegetation complexes etc.) of Heddle (1980) on the Cottesloe (where this has deeper sands at the surface) and Karrakatta landform/soil units;

- the *Banksia* woodland vegetation of the Dandaragan Plateau;

- smaller areas of *Banksia* woodland vegetation on the Whicher Scarp.

It is this vegetation that was been used by Beard (1980) as the major vegetation type to characterise the Drummond Botanical Subdistrict. The latter boundary having subsequently been accepted by Thackway and Cresswell (1995), as the boundary for their Swan IBRA region (see above).

6.5.3 Variation in the *Banksia* vegetation of the Swan IBRA region/Drummond Botanical Subdistrict

The variation in the *Banksia* vegetation of the Swan IBRA region/Drummond Botanical Subdistrict can be described in different ways, or at different levels.

Gibson *et al* (1994) allocated the *Banksia* woodlands of the Swan IBRA region/Drummond Botanical Subdistrict to ten of their florisitic community types/subtypes. These are florisitic community types 20a, 20b, 20c, 21a, 21b, 21c, 22, 23a, 23b and 28. Of these, three occur on the Spearwood Dune System (Gibson *et al* 1994, Table 14, p 46), florisitic community types 20a (also on the Pinjarra Plain), 21b (also on the Bassendean Dunes) and 28 (mostly on the Spearwood Dunes).

The floristic analysis of Gibson *et al* (1994) thus indicates that from a floristic point of view the *Banksia* woodlands of the Swan IBRA region/Drummond Botanical Subdistrict are quite diverse, making up ten of the 43 floristic community types and subtypes defined at the thirty group level by these authors. However, this level of analysis is at a broad level, conceptually equivalent (but of a different nature) to the formation level in the structure/species dominance approach.

There is no full documentation of the structural variation of the *Banksia* vegetation of the Swan IBRA region/Drummond Botanical Subdistrict at the plant community level. However, some indication of the likely diversity at this level is given by Trudgen (1993) who describes about twenty *Banksia* plant communities from the western part of the Bassendean landform/soil unit in a study of an area in the City of Wanneroo. This would suggest that significantly more than one hundred plant communities dominated by *Banksia* species would be likely to occur in the Swan IBRA Region/Drummond Botanical Subdistrict.

The reasons for the significant variation in the *Banksia* vegetation of the Swan IBRA region/Drummond Botanical Subdistrict at different levels or types of analysis such as the floristic community types of Gibson *et al* (1994) and the plant community level can be readily found in the geographic extent of this vegetation, the range of geomorphology (with variations in soil and water availability) that it occurs on, the range of climate that it extends through and the diversity of flora species that occur on it. The interaction of these factors producing the diversity of vegetation.

6.5.4 The rank of the *Banksia* vegetation of the Swan IBRA region/Drummond Botanical Subdistrict

This vegetation has variation that probably includes more than one hundred plant communities with a range of structure that places them in several different vegetation formations and ten of the floristic community types of Gibson *et al* (1994), that are of similar conceptual "width" to vegetation formations. Therefore the *Banksia* vegetation of the Bassendean Sand must be described as a unit above the vegetation formation level. The appropriate level would seem to be to consider this vegetation to be an example of a Mediterranean woodland/forest biome dominated by *Banksia* species.

The implication of the status of the *Banksia* vegetation of the Drummond Subdistrict/Swan IBRA region being appropriately considered a unit at a biome level is significant. This gives us a key to properly considering the conservation value of this vegetation. On an international, national and state scale, this is a vegetation unit that ranks in importance with other better known woodlands and forests. For example, this is a vegetation that is of similar level of distinction, and conservation and scientific importance, to the Jarrah forests and Karri forests of the south-west of Western Australia, the rainforests of Queensland or the Californian Redwoods. They may not have the physical stature of some of these forests, but that is not relevant to their conservation or scientific importance,

although it largely explains their lack of recognition by the public as a vegetation of considerable conservation and scientific importance.

Having defined the "rank" or appropriate status of the *Banksia* vegetation of the Drummond Subdistrict/Swan IBRA region and thereby confirmed the conservation and scientific importance of this vegetation demonstrated by its variation at lower levels, it is possible to discuss the conservation and reservation status of this vegetation in a meaningful way.

6.5.5 The limestone/calcareous sand vegetation of the Swan IBRA region/ Drummond Botanical Subdistrict

The vegetation of the limestone and calcareous sands of the Swan IBRA region is largely found on the parts of the Spearwood Dune System with limestone at the surface (mostly in the Cottesloe landform/soil unit), or close to it (with a thin covering of siliceous sand) and on the Quindalup Dune System, which generally abuts the western side of the Spearwood Dunes.

The vegetation of limestone and calcareous sands of the Swan IBRA region mostly consists of shrub lands, heaths, and scrub dominated by a range of species. Where there is a tree layer, Tuart (*Eucalyptus gomphocephala*) is the species most often present.

6.5.6 Variation in the limestone/calcareous sand vegetation of the Swan IBRA region/Drummond Botanical Subdistrict

The vegetation of the limestone/calcareous sand vegetation of the Swan IBRA region/Drummond Botanical Subdistrict is very variable in structure and dominance. For example, Trudgen (1991) for a survey area covering about forty-five kilometres of the coastline of the Shire of Mandurah described one hundred and thirty-eight vegetation units. This suggests that over its range, the limestone/calcareous sand vegetation of the Swan IBRA region/Drummond Botanical Subdistrict would have a large number of plant communities, certainly over two hundred. That is, it is very varied.

6.5.7 The rank of the limestone/calcareous sand vegetation of the Swan IBRA region/Drummond Botanical Subdistrict

In a similar way to the *Banksia* vegetation (see above), the question of the appropriate rank of the vegetation of the limestone/calcareous sand vegetation of the Swan IBRA region/Drummond Botanical Subdistrict can be answered by considerationof the range of vegetation within it. This vegetation has variation that probably includes more than two hundred plant communities with a range of

structure that places them in several different vegetation formations and eleven of the floristic community types of Gibson *et al* (1994), that are of similar conceptual "width" to vegetation formations. Therefore the limestone/ calcareous sand vegetation of the Bassendean Sand must be described as a unit above the vegetation formation level. The appropriate level would seem to be to consider this vegetation to be an example of a Mediterranean climate mainly shrubland, heath, scrub biome with some areas of woodland and forest, many of which occur in transitional situations. That is, the shrubland, heaths and scrub vegetation typify the biome, with the woodland and forest vegetation tending to occur where the environment is at the edges of the environmental range of the biome (particularly where soils are older, or more complex).

As for the *Banksia* vegetation, the implication of the status of the limestone/ calcareous sand vegetation of the Drummond Subdistrict/Swan IBRA region being appropriately considered a unit at a biome level is significant. Again, this gives us a key to properly considering the conservation value of this vegetation. On an international, national and state scale, this is a vegetation unit that ranks in importance with other better known vegetation.

6.5.8 High diversity of species in the Swan IBRA region/Drummond Botanical Subdistrict

There is no published figure of the number of (vascular) flora species known for the Swan IBRA region/Drummond Botanical Subdistrict, however Gibson *et al* (1994) recorded more than thirteen hundred flora species in the plots they recorded on the southern part of the Swan Coastal Plain and Keighery (1999) has reviewed the flora of the same area, recording 1,749 native flora taxa (species, subspecies).

When compared to the latest figure (Paczkowska and Chapman 2000, page 6, Table 3) of native flora species known for the whole of Western Australia of 8,588 species (an underestimate as only published species are included) it can be seen that the Swan IBRA region/Drummond Botanical Subdistrict has a quite diverse flora for its size with probably between 15 and 20% of the flora of the State.

As many of the soils of the Swan IBRA region/Drummond Botanical Subdistrict are highly leached, quite poor soils and the climate of the region includes long, hot, dry summers this diversity is quite remarkable. The reasons for this diversity are not fully understood, but it is a significant aspect of the botanical background to making an analysis of the conservation value of Lot 4 Underwood Avenue.

7.0 A DISCUSSION OF RARITY IN RELATION TO VEGETATION

The validity of any assessment of the rarity of an area of vegetation is related to the level of description of the vegetation used, the boundary the assessment is related to, to a decision as to what size area constitutes rarity and to what constitutes rarity in the sense of whether or not it is an absolute (ie. size of area only) or relative measure (ie., relates to some other attribute of the type under consideration, such as original extent or pattern of distribution) or both at different times.

The same area of vegetation may be thought to be common if considered at the level of very broad units or less common if less broad units are used for the assessment. That is, when broad units are used to assess rarity of vegetation then what is assessed is the rarity of that unit, not the rarity of some component of the variation within the broad unit.

Thus, if broad (or poorly defined) units are used to assess rarity then the real rarity of an area of vegetation may not actually be assessed. Broad units often include unusual areas that have been included in them on maps to minimise the number of units described, or because their separation was not relevant to the aim of the mapping at the time it was carried out. The critical point here is that the real rarity of vegetation is a function of what actually occurs in the field (stands) rather than the rarity of abstract units defined at broad levels and it is important that units that reflect this real variation as closely as possible (plant communities) are used, or that the limitations of using broader units are well understood and taken into account. It also means that assessments based on different levels of information (or different types) when combined can give the best overall understanding of the importance of the vegetation of an area in the absence of critical mapping of regions at a level that identifies rarity in a meaningful way. For example, using the detailed mapping of a small area to interpret the value of an area of a broad unit can give critical insight into how the values of the broad unit vary.

Turning to the boundary an assessment is made within, an area of vegetation may appear to be common if a small surrounding area is considered, but rare when a wider region is considered. Such a situation is described as locally common but regionally rare, with the latter more accurately reflecting the real status of the vegetation. An extreme example of how the selection of boundaries effects the conception of the rarity of a vegetation type, is that from a whole world viewpoint, *Banksia attenuata, Banksia menziesii* woodlands/low forests are rare, being restricted to a small corner of Western Australia, while from a different

viewpoint, say only considering an area around Gingin, they appear to be very common. The point here is that in the assessment of rarity of vegetation, that a boundary has to be selected that has some meaning in relation to the distribution of the vegetation type being considered. To achieve a full understanding of the significance of an area of vegetation, it may be necessary to look at more than one boundary to reflect the relationship of different contexts to different levels of assessment. If the area being considered is not homogenous, then it may be necessary to consider the rarity of different parts of it in relation to different boundaries, or concepts. For example, the development of wetland vegetation is related to water availability as much as to soil. So it may be valid to assess rarity of the drier parts of an area in relation to a geomorphological unit and the wetter parts across such units if they are of a type that occurs across such boundaries. To fully assess the rarity of an area of vegetation it makes sense to use boundaries that are relevant to the vegetation rather than arbitrary ones. For example, the types of boundaries that are most useful are botanical district or subdistrict boundaries and geomorphological boundaries.

The question of how much area of vegetation qualifies as rare, either in an absolute sense or a relative sense, is a matter of opinion, as there is no way of devising a standard from any basic principles. Trudgen (1995) considered the question of the definition of rarity in relation to vegetation for the purpose of an assessment for the Australian Heritage Commission and made the following observation and suggestions (in the Western Australian context):

"there are no accepted definitions of rare flora communities (vegetation) and ecosystems and no simple definition is practical. For the purposes of this analysis, the following definition is advanced: an ecosystems or vegetation type (whether plant community, association, vegetation complex or floristic community type) should be considered rare when:

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

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

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

The thrust of this definition is to define vegetation as rare when its original extent was very small (2,000 ha or less) and as having become rare compared to an original extent when the original distribution has been reduced by clearing or other activities below the areas suggested above. The end of this sliding scale has been taken as ten percent for areas of 100,000 hectares or more, as ten percent is the minimum area recommended for protection of an ecosystem by the International Union for the Conservation of Nature (IUCN). However, this would obviously not be appropriate for vegetation types (or ecosystems) with very small original extents. Therefore, a sliding scale was chosen to link small areas through intermediate sized areas to the general standard. Obviously, this is somewhat arbitrary, but a vegetation type with an original extent of only 2,000 hectares is rare or at least unusual on a national scale and a vegetation type that originally had an extent of more than 100,000 hectares and has been reduced to 10,000 hectares or less is certainly uncommon (or rare) compared to its original extent. The scale attempts to provide a resolution of a problem that is partly absolute (for small original extents) and partly relative (for large original extents) and should be taken as a guide." (Trudgen 1995, pp. 7-9)

While this approach does not solve the problem (as it is one opinion), it at least makes the issues clearer when considering the effect of the absolute and relative aspects of rarity of vegetation on the conservation value of the vegetation of an area of land.

Although there is no generally agreed approach to the assessment of rarity of vegetation in Western Australia, English and Blyth (1997) have developed "categories for assigning conservation status to ecological communities". The categories they selected "are based on the most recent World Conservation Union (IUCN) categories for threatened species or communities". Their categories are:

"a) presumably totally destroyed (PD)
b) critically endangered (CR)
c) endangered (EN)
d) vulnerable (VU)
e) data deficient (DD)
f) lower risk (LR)
g) not evaluated" (English and Blyth 1997, p. 3 and Attachment 1)

The definition advanced by English and Blyth (1997, Attachment 1, p. 3) for their *critically endangered* category is "an ecological community which has been adequately surveyed and found to have been subject to a major contraction in area

and/or which was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated."

Later in their report (English and Blyth 1997, Attachment 6, p. 4), they give criteria for listing of critically endangered ecological communities:

"An ecological community will be listed as **Critically Endangered** when it is facing an extremely high risk of total destruction in the immediate future. This will be determined on the basis of the best available information, by it meeting **any one or more of** the following criteria (A, B or C);

A) The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% **and either or both** of the following apply (i or ii);

i) geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately 5 years)

ii) modification throughout its range is continuing such that in the immediate future (within approximately 5 years) the community is unlikely to be capable of being substantially rehabilitated

B) Current distribution is limited, and **one or more of** the following apply (i, ii or iii);

i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately 5 years)

ii) there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes

iii) there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes

C) The ecological community exists only as highly modified occurrences which may be capable of being rehabilitated if such work begins in the immediate future (within approximately 5 years)."

While these criteria recognise the absolute and relative aspects of rarity and in fact recognise the same level (10% remaining) as an indication of a critical reduction in original area that indicates relative rarity, they are aimed at identifying entities that are under immediate threat. While this is a reasonable reaction to what is arguably a crisis of loss of vegetation, it is aimed at determining those ecological communities that are in need of urgent management or protection due to threatening factors, rather than simply to identify rarity.

As a result of their work, English and Blyth (1997) have identified sixteen critically endangered, seven endangered, ten vulnerable and five data deficient "ecological communities", which they list in their Table 1 (English and Blyth 1997, p. 4). Examination of this list shows that what is being dealt with by English and Blyth is the rarest of the rare and to a very significant degree that part of that category that is under threat of loss in the near future. That is, while their work is extremely valuable and will result in the protection of areas of conservation and scientific value that otherwise might be lost, it does not deal with the more general question of what constitutes rarity for the question of assessment of conservation value, although it does identify extremely rare biotas that deserve protection through the environmental impact assessment system. Another feature of many of the communities listed by English and Blyth (1997) is that they tend to be ones that are readily distinguishable from other communities.

One notable feature of the list in Table 1 of English and Blyth (1997, p. 4) that is relevant to assessment of the conservation value of Lot 4 Underwood Avenue (or parts of it), is that the vegetation types that are listed on it for the Swan Coastal Plain are all based on floristic community types of Gibson *et al* (1994). These particular units from Gibson *et al* (1994) are undoubtedly rare, however, this is a very broad level of definition of vegetation types to base rarity on and excludes vegetation types that fit the definition of "ecological community" given by English and Blyth (1997, Attachment 1, p.1) as "A naturally occurring biological assemblage that occurs in a particular type of habitat", but are not floristic groupings of the level of the Gibson *et al* floristic community types.

To be blunt, English and Blyth (1997) appear to have only applied their definition of "ecological community" to one broad level of vegetation description on the Swan Coastal Plain (see Table 3 of this report). Consequently, they have failed to

advance a workable methodology for identifying vegetation that fits their definition of "ecological community" and potentially their definitions of critically endangered etc., the description of which takes into account structure and dominance rather than just floristic composition. As a consequence of this, the assessment of the conservation value of vegetation on the Swan Coastal Plain has been skewed towards seeing only the rare floristic community types of Gibson *et al* as rare. This is a serious flaw, as it results in a situation where vegetation of significant conservation and scientific value could be lost due to a lack of a fundamental appreciation of the level and type of classification of vegetation being used.

An example of this is that wetlands and damplands on the Swan Coastal Plain are generally acknowledged to have been reduced to about 10% of their original extent. These include a wide range of structural/dominance types, as well as the floristic types of Gibson *et al* (1994). It seems very likely that the approach taken by English and Blyth, that is, reliance on Gibson *et al* (1994) for definition of ecological community on the Swan Coastal Plain, will allow significant variation to be lost.

8.0 DEFINITION OF CONSERVATION VALUE, AIMS FOR CONSERVATION OF VEGETATION AND FLORA, LEVELS OF SIGNIFICANCE OF CONSERVATION VALUE, PRINCIPLES FOR ASSESSMENT OF CONSERVATION VALUE FOR VEGETATION AND FLORA, IMPORTANCE OF LINKAGES AND THE CONTROVERSIAL NATURE OF CONSERVATION ASSESSMENTS

8.1 Definition of conservation value

A definition of conservation value was given above, as: conservation value is the value of an aspect or part of nature such as a flora or animal species, a type of vegetation, the geomorphology of an area or the geology of a particular outcrop that relates to, or is brought about by, its development or evolution, often over very long periods of time, as a part of natural systems.

For vegetation the accrual or building up of conservation value relates to the development of a vegetation type or types from the available species, as they continue to evolve in response to each other, to the arrival of other species of flora, fauna and fungi and to the changing physical parameters of the environment over long periods of time.

Therefore, conservation value for vegetation is a value that can be imitated in part by man but not replicated or replaced as all the factors that lead to the development of a particular stand of vegetation are not understood and/or cannot be reproduced. For vegetation, conservation value relates to the development of a vegetation type or types from the available species, as they continue to evolve in response to the changing environment and changing biota,

8.2 Overall aims for conservation of vegetation and flora

The generally accepted overall aim for the conservation of vegetation (including its role as a habitat for flora and fauna) is to produce a reserve system that is:

- *comprehensive*, or protects all types;

- *adequate*, or protects sufficient area of each type to enable them to continue existing and functioning as biological systems; and

- *representative;* or protects examples of each type through its range that properly represent its variation.

To be valid, an assessment of the conservation value of an area should take into account this aim. It should be noted that the scientific aim of a comprehensive, adequate and representative (CAR) reserve system is not based on rarity.

However, it takes rarity into account through inclusion in a broader context. That is, the focus of conservation in a scientific framework is broader than just on protecting rare areas although the value of these is acknowledged. To put it another way, it is hoped that implementation of a comprehensive, adequate and representative reserve system will prevent many more types of vegetation from becoming rare. Also, if reservation is representative, then rare vegetation will be protected as well as more common vegetation.

It is also hoped that the development of a comprehensive, adequate and representative reserve system for vegetation will lead to the protection of flora species through protecting their habitat and thus partly meet an aim of protecting all species of flora by preventing many more species from becoming rare. However, it is obvious from the number of species that are either declared rare or priority species in Western Australia (Atkins 1995, 1998) that the reserve system is unlikely to ever meet the aim of adequately protecting all flora species in this State. In a similar way, it is not possible for the reserve system to adequately protect vegetation in the south-west of Western Australia because too much has already been lost.

The equivalent aim for flora species to protecting vegetation through a comprehensive, adequate and representative reserve system is to protect representative populations of species over their original range so that the genetic diversity they have is protected and so that they may continue to evolve.

8.3 Derivative values of conservation value for vegetation

If conservation value for vegetation is accepted as an inherent value, that is one that a stand has because of its history, then other values related to this or dependent on it can be considered derivative values.

These include:

- *scientific value*, the value that a stand may have for science as a physical entity that can be studied, or the summation of different aspects of it that can be studied in isolation or as part of regional variation;

- *educational value*, the value that a stand may have as a resource to demonstrate the working of nature in fields such as ecology;

- *aesthetic value*, the value that a stand of vegetation may have for intrinsic appeal as a place of natural beauty;

- *wilderness value*, the value of a stand to be a place that is isolated from modern society and enables retreat from modern society;

- *habitat value*, the value of a stand as habitat for a particular species of flora or fauna.

8.4 Levels of conservation value for vegetation: towards a scale of values

The assessment of the level of the conservation value of an area is a critical part of environmental assessment and one which is critical to the assessment of the vegetation of Lot 4 Underwood Avenue. This is an area of assessment that is to some degree a matter of personal opinion. Hopefully however, the table presented here (see Table 4 below) can to some degree indicate that if the range of possible conservation values (extremely high to extremely low) is divided into a simplification of the range of possible richness of flora species and plant communities in an area ranging down from an exceptionally diverse biome (the Amazon Basin Rainforests) to a small remnant, then it will be possible to see that the issue of personal opinion is not as significant as it is sometimes purported to be. The table needs to be used with caution however, as it is coarse in the number of divisions compared to the real diversity of natural systems. That is, the table is a guide - personal opinion or informed judgement will alter the appropriate assessment of a particular area depending on factors such as the type of system being considered, the degree of reservation for a region and the typicality of the area being considered for the broader unit it is a part of.

An example of vegetation that may be very significant internationally but which Table 4 would not deal with well would be an example of a desert biome with poor species diversity. That is, the table deals better with "average", rather than atypical, vegetation.

Table 1. The range of possible values, extremely high to extremely low, for ranking the conservation value in a hierarchy of scales from local value to global value of an area defined in terms of a simplification of the range of possible richness of flora species and plant communities of an area.

Richness of flora and vegetation of the area being considered	**Value on Global scale**	**Value on National scale**	**Value on State scale**	**Value on Regional scale**	**Value on Local scale**	**Examples**
Thousands of flora species. Several hundred or more plant communities	Extremely high					Amazon rainforests
About 1000- 2,000+ flora species. A few hundred plant communities.	Very high	Extremely high				*Banksia* Mediterranean woodlands of the Swan Coastal Plain IBRA region. The Jarrah forests of south-western Western Australia. Fitzgerald River National Park and Biosphere Reserve
About 1,000 flora species. 100-200 plant communities	High	Very High	Extremely high			Lane Poole Nature Reserve in the Northern Jarrah forest.
Less than 1,000 flora species (± 700-900?) Less than 100 plant communities	Medium	High	Very High	Extremely high		Yalgorup National Park (largest national park on the Swan Coastal Plain south of Perth).
Less than 500 flora species ± 50 plant communities	Low	Medium	High	Very high	Extremely high	Yanchep National Park. Neerabup National Park.
Less than 300 flora species ± 25 plant communities	Very low	Low	Medium	High	Very high	Bold Park (221 species, ?plant communities)
Less than 150 flora species Less than 10 plant communities	Extremely low	Very low	Low	Medium	High	Lot 4 Underwood Avenue (at the upper end of this category, or the lower end of the one above Signal Hill Remnant (Belmont)
Less than 100 flora species Less than 5 plant communities			Very low	Low	Medium	

8.5 Assessment of conservation value for vegetation

The level of the conservation value of an area for vegetation is assessed on a number of parameters. These are:

- the conservation and reservation status of the vegetation in the area. For the Swan Coastal Plain this can be based on the vegetation complexes of Heddle *et al* (1980), the floristic community types of Gibson *et al* (1994), or the mapping of Beard (1979), taking into account the plant communities present on the land being assessed and how they indicate the vegetation of the land being assessed relates to the variation of the broad scale units available;

- the diversity of vegetation types on the area. On the Swan Coastal Plain this can be assessed at different levels. These are the vegetation complexes of Heddle *et al* (1980), the floristic community types of Gibson *et al* (1994), the mapping of Beard (1979), the vegetation association level and the plant community level;

- whether or not the particular assemblage of vegetation present is common or uncommon. That is, is the particular mix of vegetation present unusual, for example (on the Swan Coastal Plain), an unusual combination of the floristic community types of Gibson *et al* (1994), or does it included transitions between different vegetation complexes of Heddle *et al* (1980) - which can be unusual in that some transitions are intrinsically rare and others have become so;

- where the area being assessed falls in the geographic range of the type or types of vegetation present on it. Again, this can be assessed at the different levels of vegetation description available. Outlying areas, or areas at the ends of the range of a vegetation type will generally be considered of higher value than areas near the centre, particularly if the latter are well reserved.

- the condition of the vegetation on the area. The better the condition of the vegetation of an area, the higher its conservation value will be rated. However, vegetation of a type that has become scarce will still be of high value if it has been degraded as long as there is potential to protect significant parts of its original vegetation structure and flora.

"Thus, vegetation that is rare will be considered to have more value than vegetation that is common, an area with a diverse range of vegetation types or floristic community types will be considered to be of more value that one that has few types, an area of vegetation that represents that type in a region where it is less common than in other areas will be considered to have more value than a similar stand in an area that has several such stands." (Trudgen and Keighery 1995).

The shape of an area can also affect perception of conservation value for vegetation. However, this is not a straightforward issue, as noted by Trudgen and Keighery (1995, section 1.6.1): "While it is not a basic determinant of conservation value, the shape of an area has an impact on the practicalities of managing an area to maintain its conservation value. Areas with long boundaries being considered more difficult to manage than areas with short boundaries, because there are more places where pressures are present that can reduce conservation value if "the boundary to area ratio" is high". So two areas may have the same vegetation values on them, but if one has a better boundary to area ratio (say, it is square and the other a narrow strip) then it will be able to be managed to protect the values on it more effectively. It follows from this, that if the boundary to area ratio of an area is increased by clearing part of it then protection of its vegetation conservation values will become more difficult.

8.6 Assessment of conservation value for flora

The level of the conservation value of an area for flora is assessed on a number of parameters. These are:

- the diversity of the flora present. That is, how many species are present;

- whether or not any rare species (particularly Declared Rare Flora or priority taxa), poorly known species, poorly protected species, or geographically restricted species are present;

- whether or not there are species present that are at the ends of their known ranges;

- whether or not the flora present includes populations of species that are poorly represented in conservation reserves;

- how well the species present in an area are protected through their range and where in their range the populations of the area lie.

An area with a diverse flora will generally be considered to have more value for flora than an area with few species, and an area with rare species or species at the ends of their range will be considered to be more valuable than areas without such species, all other things being equal. Also, areas that have many species that while not rare or threatened are not well reserved will be considered to have more value than areas with a similar number of species, but without significant numbers of ones that are not well reserved.

8.7 Value of linkages for maintaining conservation value

"Another factor that can affect the assessment of the value of an area is how it relates to other areas, and particularly whether or not it has effective links to other areas. In a fragmented system, there is great value for flora and fauna populations in having effective linkages between areas through them being joined by corridors of bushland or regenerated vegetation. The existence of such linkages allows seeds to be transported by fauna, or pollen to be carried by fauna, to re-establish flora populations where a population of a species has been lost or to maintain genetic diversity through cross pollination." (Trudgen and Keighery 1995).

"A very important corollary of the value of linkages is that a linked group of remnants can thus have a greater value than the simple sum of their area. This is because together they can better cope with the pressures that would otherwise reduce their diversity, limiting the loss of diversity to some degree." (Trudgen and Keighery 1995).

".... studies of the diversity of island ecosystems (relating the diversity found on islands to possible long term outcomes for maintenance of diversity in conservation reserves, treating the latter as essentially islands of vegetation in a cleared "sea" of agricultural/urban land) suggest that if 10% of the original extent of an ecosystem is retained, then this will in the long term only protect about 50% of the species found in the ecosystem. This is because over a period of time populations of some species die out because of the changed conditions under a situation where their population is changed from part of a large population in a large area of habitat to a small population in a small or relatively small area of habitat. The process starts quickly, with large mammals being the first to go then other species of animals or plants depending on their individual requirements for habitat area or their susceptibility to perturbations. For example, a species may happily exist in a remnant seemingly with no problems maintaining a fairly stable population until a severe fire occurs or until there are a series of very dry years and then its population crashes or starts to decline. Or, a species is susceptible to genetic problems associated with inbreeding and the population is too small to

prevent these so it suffers a loss of vigour and then dies out." (Trudgen and Keighery 1995).

"In a landscape where a large area of native vegetation has been reduced to remnants by clearing for rural or urban development, it is believed that if these remnants are linked by corridors of vegetation then these will to some degree reduce the impact of clearing on the remnants by in effect making each a part of a larger area. This is likely to work best for animals as they are more mobile. However, animals are a major vector for the transport of the seeds of plants and so plants should be assisted as well. Also, insects, some birds and some mammals are important vectors for the movement of pollen and linking areas will thus help to provide sources (and transport mechanisms) of pollen for outbreeding. While some animals and insects will cross cleared areas this is not the case for many of them, and the more highly developed areas are, the less likely such crossings become. Thus, it seems likely that linking remnants will ameliorate but not overcome the impact of reducing large areas of vegetation to a series of "island like" remnants." (Trudgen and Keighery 1995).

8.8 Controversial nature of assessment of conservation value

"The assessment of conservation value is at times very controversial. Usually this is not related to the assessment using criteria such as those outlined above (or similar ones for other values such as fauna conservation, landscape conservation) rather, it is to do with the competing philosophies or aims of the individuals/groups concerned (and a consequent refusal of one side to accept the existence of values) or a lack of awareness of what the real values are and why it is important to protect them. It can also be a result of issues of conservation value being raised when decisions (eg. planning decisions) have been made and the consequent creation of a situation where recognition of conservation values would create a cost problem or other problem for one side.

Lack of awareness is a major problem in gaining acceptance for the validity of conservation assessments. One aspect of this is a view that is fairly widely held that conservation value exists in a few special places. This is not the case; conservation value for flora, vegetation and fauna exists wherever there are species of animals and plants growing in their original distribution (some would say even outside it). A second aspect of this lack of awareness is the fact that people often have trouble accepting that vegetation that they are familiar with, and see often, is valuable from a conservation perspective. This is certainly the case for the *Banksia* woodlands on the Swan Coastal Plain, which are underrated greatly by the local people who have most exposure to them. A third aspect is that

people cannot value what they do not know. If you ask people if they would save a patch of scrub or use it for development many or possibly most will say no to saving it. If you ask if they would save an area of a unique to Western Australian ecosystem that has many unique to Western Australian species in it, that has high diversity of flora species, rare jewel beetles, native geckos, Western Australia Christmas trees with wonderful bright flowers etc, many will say it would be crass to damage it." (Trudgen and Keighery 1995).

9.0 REGIONAL VEGETATION AND FLORA CONSERVATION PERSPECTIVE

9.1 Conservation status and reservation status of the vegetation of the Swan IBRA region/Drummond Botanical Subdistrict

Thackway and Cresswell (1995, their Appendix 4, p. 84) indicate that the reservation status of the Drummond Subdistrict/Swan IBRA region is that 4% of its area is in conservation reserves with a high bias caused by the outwash plains not being represented. The outwash plains referred to are the geomorphological units to the east of the Bassendean Sand, so this would suggest that the other units are better represented than 4% in the conservation estate, but that they occur in a biogeographic region with an overall poor reservation status. This provides the regional reservation context for assessment of the conservation value of Lot 4 Underwood Avenue, which needs to be considered in the context of more detailed information about the reservation status of the vegetation on the land.

Table 15 of Thackway and Cresswell (1995, p. 54, 55) gives the "dominant condition" of the Drummond Subdistrict/Swan IBRA region as "Modified ecosystems dominant ie. very little indigenous ecosystems remain". This provides the regional context for the conservation assessment of the vegetation of Lot 4 Underwood Avenue. That is, the biogeographical region that the land lies in has a high degree of clearing of the natural vegetation. However, it should be noted that the southern part of the Swan Coastal Plain is more highly cleared than the northern part and that the eastern side of the Swan Coastal Plain is generally considered to have only about 2 to 3% of its original vegetation remaining (Keighery and Trudgen 1992) (referred to in Government of Western Australia, 1998 Part B, p19).

The high degree of clearing of the southern part and the eastern side of the Swan Coastal Plain means that to meet any regional objectives for retention of native vegetation, that more of those types (and parts of the region) that have a larger part of their original extent remaining would need to be protected than if all types (or parts of the region) had a similar proportion remaining.

Thackway and Cresswell (1995) give the "Dominant limiting factors and constraint codes" for the Swan Coastal Plain IBRA region as "URB, FER, WEED, CLE, AG", that is, the "Limiting Factors and Constraints to Conservation Planning and Management" in their view are: clearing for urbanisation, the effects of feral animals, invasion of the vegetation by weeds with consequent displacement of native species and clearing for agriculture. This range of impacts on the vegetation has significant implications for the assessment of conservation value of an area such as the Lot 4 Underwood Avenue because of the fact that they

impact the vegetation of different areas of land differently and can interact. For example, developing part of an area for urbanisation, or even an adjoining area, can make it more susceptible to weed invasion by introducing new vectors to distribute seeds, making new pathways for weeds to move along and by making the vegetation more susceptible to weed invasion by more frequent burning (either due to arson, or through pressure for fuel reduction fires to protect buildings).

9.2 Conservation and reservation status of the floristic community type of Gibson *et al* found on Lot 4 Underwood Avenue

Gibson *et al* (1994) have commented on the reservation status of their floristic community types. However, the definitions they used for their categories were poorly conceived. They are relative, relating to the state of reservation of vegetation on the Swan Coastal Plain at the time of their study, rather than to any agreed standard of reservation and do not deal with the actual area reserved. Gibson *et al* (1994, p 59) recognised the deficiencies of their approach, noting that a consideration of actual areas reserved was beyond the scope of their study. They also note that many of the reserves on the eastern side of the Swan Coastal Plain are small, as are others not on the east side of the plain. This means that a floristic community type may be present in two such reserves and be "well reserved" as the term is used by Gibson *et al*, but very poorly reserved in terms of the actual area protected. Even the "poorly reserved" category of Gibson *et al* (1994, p 59) is poorly conceived, as a floristic community type could have a large area in a national park and actually be better protected and less subject to catastrophe than if it had much smaller areas in two parks. At least the "unreserved" category is unambiguous. Given the poor definitions of "well reserved" and "poorly reserved" they used and that they could not give areas, Gibson *et al* would have been less subject to misrepresentation of this part of their study if they had used a simple statement such as, known from one, two, etc reserves, as this would have been accurate as far as it went, while the terms they have used are misleading when the definitions used are not clearly understood.

Gibson *et al* (1994, Table 23 p. 62) have tabulated the reservation and conservation status for each of their floristic community types, one of which (floristic community types 28 is considered to occur on the Lot 4 Underwood Avenue.

Gibson *et al* (1994, page 62, table 23) classify floristic community type 28 as "Well reserved" and "Low risk".

The type of definitions used in Gibson *et al* (1994) are problematical, because they do not have a component that refers to the actual area remaining of the unit under consideration, or to its original extent. They are to a significant degree forecasts of likely outcomes, rather than statements of the amount of a unit remaining at a particular time. While such forecasts are very useful, they would be more useful if combined with an estimate of the amount of the unit remaining and the area of its original extent when applied to a particular case. As there is no mapping of the floristic community types of Gibson *et al* (1994), this is not currently possible for their units.

9.3 Conservation and reservation status of the vegetation complexe of Heddle *et al* found on Lot 4 Underwood Avenue

There is data available for the amount remaining uncleared for the vegetation complexes of Heddle *et al* (1980). The data used here is from Perth's Bushplan (Government of Western Australia 1998), but was sourced for that document from the Agriculture W.A. geographic information system. It should also be noted that the boundary used is the Perth Metropolitan Area. That is, the percentages given are estimates of the amount remaining of that which occurred in the Perth Metropolitan Area rather than over the entire original extent. Using this basis of calculation causes bias in the figures for complexes where the percentage remaining in the Perth Metropolitan Area is significantly different to that remaining over the entire original extent.

The amounts remaining of the Karrakatta Central and South Vegetation Complex is 18% (Government of Western Australia 1998, Volume 2 Part B, p. 239,), note that this figure is now a few years old and the amount remaining is likley to have declined due to clearing, especially for housing.

Unfortunately, figures for the amount of the various vegetation complexes securely reserved are not readily available, but the outcome predicted from the Perth's Bushplan/Bush Forever process is for some 8% of the Karrakatta Central and South Vegetation Complex to be protected.

9.4 Reservation of flora species on the southern Swan Coastal Plain

There is no data readily available for the reservation and conservation status of the flora of the IBRA Swan Region/Drummond Botanical District. However, Keighery (1999) has tabulated flora reservation data for species on the southern Swan Coastal Plain (the same survey area as Gibson *et al* 1994). He points out (Keighery 1999, summary, paragraph 3) that for the Southern Swan Coastal Plain "Fifteen percent of taxa (261) in the study area were not recorded from any

conservation reserve. Nearly twenty percent (350) were only recorded from one conservation reserve. Twelve percent (211 taxa) were recorded from 2 reserves. Hence 47% of the flora is considered unreserved or very poorly reserved being known from 2 or fewer reserves.".

When combined with the fact that only some 4% of the IBRA Swan Region/ Drummond Botanical District is in conservation reserves (Thackway and Cresswell 1995, also see section 11.1 above) the data from Kieghery (1999) shows that the flora of the IBRA Swan Region/ Drummond Botanical District is very poorly represented in conservation reserves and that the conservation status and reservation status of many species is very poor or extremely poor for this region.

This suggests that in the longer term many native species formerly common in the IBRA Swan Region/ Drummond Botanical District will become rare or even extinct there.

10.0 HETEROGENEITY OF FLORISTIC COMMUNITY TYPE 28

The vegetation of Lot 4 Underwood Avenue Shenton Park is considered to be referrable to Floristic Community Type 28 of Gisbon *et al* (1994). A review of the sites allocated to Floristic Community Type 28 by Griffin (2001) "shows that most of the sites grouped together in this Floristic Community Type are not actually very similar to each other with an average similarity of 0.62." [The co-efficient is a dis-similarity co-efficient, with 1 = totally dis-similar.] "That some sites are fairly similar (about 0.3 to 0.55) suggests that a number of distinct units within Floristic Community Type 28 could be identified...." (All quotes from Griffin 2001).

The review also indicates that there are four subgroups in Floristic Community Type 28 which "tend to be geographically related". "From experience, such geographic grouping tends to suggest that there is a 'real' basis to the subgroups." ".....there is a suite of taxa common to most sites in the group (Floristic Community Type 28), eg. *Banksia attenuata*. However, these taxa are a small portion of the total taxa in this data set." (All quotes from Griffin 2001)

"All this points to a conclusion that there are a number of distinct vegetation units within Floristic Community Type 28. While no specific meaning is assigned to the groupings (in Table 3) it is an indication of the subgroups that might be identified. The nature of these can only be defined with more data than is presently available, however, experience with this kind of data suggests that these would be of the plant association and plant community ranks." (Griffin, Appendix 4, section 4.3)

Given the range of topography, and the range of vegetation dominance/structural types present on Lot 4 Underwood Avenue it would be very likely that significant variation in the floristics of the vegetation would also be found, representing examples of the type of variation described above for Floristic Community Type 28. This would suggest a need to protect the range of structural variaiton found on the Lot and the range of habitats (lower slopes, mid-slopes, uppper slopes) found on the Lot.

11.0 CONSERVATION VALUE FOR FLORA OF LOT 4 UNDERWOOD AVENUE

11.1 Context for assessing the conservation value for flora of Lot 4 Underwood Avenue

The appropriate context for assessing the conservation value of the Lot 4 Underwood Avenue for flora is that it lies on the Swan Coastal Plain part of the Drummond Botanical District/Swan Coastal Plain IBRA bioregion and within this region on the Karrakatta landform/soil unit of Churchward and McArthur (1980), one of two divisions of the Spearwood Dune System.

Within this context it would be appropriate to consider the various aspects of the flora of the Lot 4 Underwood Avenue, such as the overall population of plant species, the presence of rare or uncommon species, and the presence of species the populations of which on the land are of biogeographical interest. Some of this data is available, but some is not (such as whether or not some species are at or near the ends of their range).

The report by ATA Environmental (ATA 2000, p. 4 and Appendix 1) records "A total of 149 species of vascular plants..... Of these, 112 are native to the site..." One of the species recorded is *Jacksonia sericea*, a Priority 3 species on the CALM Priority and Declared Rare Flora list.

11.2 The conservation value of the overall flora population of Lot 4 Underwood Avenue

The overall flora conservation value of Lot 4 Underwood Avenue is that this area of native vegetation has (on current knowledge) populations of one hundred and twelve (112) native species of vascular plants (2 gymnosperms and one hundred and ten angiosperms) that have a total population (very approximately) of 1,000,000 individuals. There would also be populations of fungi and lichens and smaller populations of mosses and liverworts. The conservation value of these populations is that the flora of the Lot 4 Underwood Avenue persists in a context where the original extent of native plant populations has been greatly reduced by clearing of native vegetation for various purposes (agriculture, urbanisation etc.), and the proportion of the original vegetation of the region in secure conservation reserves is very low.

The implication of the extent of clearing of the Drummond Botanical District/Swan Coastal Plain IBRA region is that the original (pre-Europaen settlement) populations of the native species still found on Lot 4 Underwood Avenue have been greatly reduced in this region. In this context, the flora populations on the land have significant value, and are important for

maintaining populations of native species in the central part of the Perth Metropolitan Region, in the Metropolitan region as a whole and in the Drummond Botanical District/Swan Coastal Plain IBRA region as a whole.

Additionally, while the species list for the land is not very large it samples a range of habitat and soil type from near the top of a large dune to lower slopes.

It is arguable that the values for native flora species described above are in themselves sufficient reason for protecting all of the populations of the native flora on Lot 4 Underwood Avenue, as failing to protect the populations of native flora species on the land would lead to further reduction of their overall populations in the Drummond Botanical District/Swan Coastal Plain IBRA region. To summarise the situation, the Swan Coastal Plain south from about the Wanneroo area is a disaster area from the point of view of the conservation of native flora species and any area of vegetation in this area that could be manged to maintain flora populations (ie. of sufficient size) has very significant value in this context.

Only protecting a small part of the vegetation on Lot 4 Underwood Avenue would greatly reduce the contribution of the vegetation on the Lot to maintaining populations of species. Specifically, protecting some eight (8) hectares of the thirty-two (32) hectares of regionally significant bushland would lead initially to approximately a 75% loss of conservation value for flora populations. However, the smaller size of the proposed remainder would mean that further loss of species would occur that would compound this loss.

11.3 Conservation value of the Lot 4 Underwood Avenue for priority flora species

One Priority Flora Species, *Jacksonia sericea*, has been recorded from Lot 4 Underwood Avenue Shenton Park. The land has high value for this species, and it is noted that the populations recorded (ATA 2000) are not in the 8 hectares proposed for retention. Note that this species (see next section) is only "moderately [well] reserved" in the terminology of Kieghery (1999).

11.4 Conservation value of Lot 4 Underwood Avenue for flora species not considered to be well reserved

Keighery (1999, p 6 section 4.1.5) considers taxa (species, subspecies) known from 15 (fifteen) or more reserves to be well reserved. Comparison of the flora list for Lot 4 Underwood Avenue Shenton Park with data from Kieghery (1999) indicates that:

- one (1) native species recorded from Lot 4 Underwood Avenue Shenton Park is "very poorly" reserved on the Southern Swan Coastal Plain; and

- two (2) native species recorded from Lot 4 Underwood Avenue Shenton Park are "poorly reserved" on the Southern Swan Coastal Plain; and

- fourteen (14) native species recorded from Lot 4 Underwood Avenue Shenton Park are only "moderately reserved" on the Southern Swan Coastal Plain.

These species, with the number of reserves they have been recorded for on the Southern Swan Coastal Plain by Keighery (1999) in brackets are:

Petrophile media (2)
Caladenia arenicola (3)
Eryngium rostratum (3)
Lepidosperma scabrum (10)
Mesomelaena pseudostygia (14)
Consotylis aurea (7)
Xanthorrhoea brunonis (9) (Record based on ATA 2000, but probably a mis-identification)
Hibbertia huegelii (14)
Scaevola repens var. repens (10)
Macarthuria australis (12)
Calytrix fraseri (11)
Eucalyptus decipiens (6)
Daviesia decurrens (12)
Daviesia nudiflora (14)
Jacksonia sericea (12)
Banksia prionotes (6)
Pimelea sulphurea (10)

Data such as this illustrates how inadequate the protection of many flora species is on the southern Swan Coastal Plain (south of Gingin). The above list shows that just over 15% of the native vascular flora of Lot 4 Underwood Avenue Shenton Park is considered to be poorly reserved over a large part (ca. 50%) of the Drummond Botanical District/Swan Coastal Plain IBRA region. <u>This is sufficient reason by itself</u> for protecting all the native flora of Lot 4 Underwood Avenue.

The position of Lot 4 underwood Avenue in the Perth Metropolitan Region increases this value, as it lies near the centre of the Region, where - except in its immediate vicinity - reservation of native vegetationis very low.

12.0 CONSERVATION VALUE FOR VEGETATION OF LOT 4 UNDERWOOD AVENUE

12.1 Context for assessing the conservation value for vegetation of Lot 4

The appropriate context for assessing the conservation value of Lot 4 Underwood Avenue Shenton Park for vegetation is that the land lies on the Swan Coastal Plain part of the Drummond Botanical District/Swan Coastal Plain IBRA region and within this region on the Karrakatta landform/soil unit (Churchward and McArthur 1980), one of two division of the Spearwood Dune System. Within the Karrakatta landform/soil unit Lot 4 lies in the part mapped by Heddle *et al* (1980) as the Karrakatta Central and South Vegetation Complex.

12.2 Conservation value of the vegetation of Lot 4 Underwood Avenue in isolation from the nearby native vegetation

Considered in isolation of the interactions its values for vegetation have with the vegetation of nearby areas, the vegetation of Lot 4 Underwood Avenue has the following attributes:

- its location in the northern part of the Karrakatta Central and South Vegetation Complex, which if *Perth's Bushplan* (now *BushForever*) were fully implemented for this complex would have only 8% of that part of its original extent in the Perth Metropolitan region protected;

- its location in an area of the Swan Coastal Plain which is largely cleared of native vegetation, although at a local level there is a moderate level of reservation;

- a large stand of vegetation dominated by Banksia prionotes, such vegetation being very uncommon in the Perth Metropolitan Region. Note that this stand is not included in the eight hectares proposed to be protected.

- significant variation from within Floristic Community Type 28, including some (lower slopes with very good condition stands dominated by Jarrah) that is poorly reserved;

- some of its plant communities dominated by *Eucalyptus gomphocephala* (Tuart), a species endemic to the the vegetation of the limestone and calcareous sands of the western part of the Swan IBRA Region/ Drummond Botanical Subdistrict. Vegetation dominated by

this species "is not well represented in conservation reserves" (Trudgen 1991).

- a moderate diversity of different vegetation at the level of the plant community/vegetation association, that is, of types with different structure, dominance and species composition, for the size of the land (although not an unusual diversity for the landform/soil unit). Six vegetation units are mapped (ATA 2000, fig. 3) at this level, with inspection of the area suggesting at least some of these units could be subdivided.

The first, second or third of these attributes should individually be enough to ensure protection of the native vegetation on Lot 4 Underwood Avenue. Combined, they are a powerful argument for protecting this vegetation.

The fourth and fifth of these attributes would also each justify the protection of the vegetation of Lot 4 Underwood Avenue. because of the poor level of conservation of Tuart as a species and as the dominant in vegetation and the poor reservation of good quality stands of Jarrah vegetation on lower slopes in the Karrakatta Central and South Vegetation Complex.

The combination of the attributes the vegetation of Lot 4 Underwood Avenue has in isolation from nearby vegetation is a good case for the protection of this area of vegetation, which deserves protection and management to maintain its conservation value for vegetation.

12.3 Conservation value of the vegetation of Lot 4 in context as part of a group of areas that are linked or could be linked

Considered in the context of the larger remnant it is a part of (the land itself, Shenton Park Bushland, Kings Park and Bold Park) the vegetation of the land:

- makes a significant contribution to the presence of vegetated areas in the surrounding region. The land lies in a locality where the degree of clearing is quite high;

- makes a contribution to the diversity of plant communities in the overall remnant and/or (presumably) to the replication of stands of others, and to the diversity of floristic variation in the vegetation of the overall remnant (see section 14.4 above, especially 14.4.3).

- makes an important contribution to linkage between Shenton Park Bushland and Bold Park

On the attributes outlined above, the contribution of the vegetationon Lot 4 Underwood Avenue to the conservation value of the group of remnants and to the maintenance of this value is moderate to high. Thus the land has significant conservation value as part of the group of remnant which is higher than its value in isolation (that is, the value in isolation in conjunction with the value as a part of the remnant is higher than the value in isolation).

As a result of the attributes of the vegetation of Lot 4 Underwood Avenue listed in this section that contribute to the overall conservation value of the group of remnants it is part of, Lot 4 Underwood Avenue has sufficient conservation value to warrant its protection. When attributes of the vegetation of the land listed in this section are combined with the values it's vegetation has in isolation, the value is easily sufficient to warrant the protection of the vegetation of the subject land.

13.0 RANKING THE CONSERVATION VALUE FOR FLORA AND VEGETATION OF LOT 4 UNDERWOOD AVENUE

13.1 Purpose of this section

The purpose of this section is to try to approach the definition of the conservation value of the vegetation and flora of the Underwood Avenue Bushland in a different way to that carried out above to see if this can confirm the land has significant conservation value. This will be done by using Table three and the values of the land that would modify where in the table the remnant would be placed.

13.2 Appropriate rank of the conservation value for vegetation and flora of the Underwood Avenue Bushland

The vegetation of the Underwood Avenue Bushland is obviously much small than Yanchep National Park, but although it is not a large area it has vegetation that is moderately structurally diverse, and has a known flora of 112 native species. With these attributes, the land has fits near the top of the second from bottom row of Table four in numbers of flora species and on the boundary between this row and the next in terms of plant communities.

Therefore, the land should be viewed as having medium value at a regional level, or possibly medium-high value at a regional level of assessment of conservation value for flora and vegetation

The particular attributes of the vegetation, such as the presence of the stand of Banksia prionotes, or the good Jarrah stands would then suggest that the value is higher than the simple numbers of vegetation types or the known number of species would indicate.

13.4 Appropriate rank of derivative values of the conservation value of the Lot 4 Underwood Avenue for vegetation

The medium value level for conservation of flora and vegetation of the subject land implies a medium value for values that depend on these values. These include value for fauna, research and passive recreation, but are not limited to these.

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Residential Subdivision – Pt Lot 4 Underwood Avenue/Selby Street, Shenton Park

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University of Western Australia

Report and recommendations of the Environmental Protection Authority

Full document available on request

Environmental Protection Authority
Perth, Western Australia
Bulletin 1034
November 2001



THE UNIVERSITY OF WESTERN AUSTRALIA

LOT 4 UNDERWOOD AVENUE SHENTON PARK 2007 DEVELOPMENT AND CONSERVATION PROPOSAL

ENVIRONMENTAL REVIEW REPORT

EPA ASSESSMENT NO. 1403

VERSION 4

JULY 2007

REPORT NO: 2006/263

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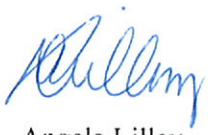
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INVITATION

The Environmental Protection Authority (EPA) invites people to make a submission on this proposal.

The University of Western Australia proposes to develop the north eastern portion of Lot 4 Underwood Avenue, Shenton Park for residential purposes. The total development area of Lot 4 is 33.4 hectares (ha), of which approximately 11.9ha of bushland will be retained for conservation and passive recreation, 13ha will be cleared for a residential subdivision and a further 8.5ha will continue to be used for University purposes but is set aside for future development and will be cleared and earth-worked as part of the residential subdivision. In accordance with the *Environmental Protection Act 1986*, this Environmental Review Report (ERR) has been prepared which describes this proposal and its likely effects on the environment. The ERR is available for a public review period of 4 weeks from Monday 16 July 2007, closing on Monday 13 August 2007.

Comments from government agencies and from the public will assist the EPA to prepare an assessment report in which it will make recommendations to government. If you are able to, the EPA would welcome electronic submissions in particular, emailed to the project assessment officer or via the EPA's website (see address below).

Where to get copies of this document

Printed copies of this document may be purchased for $10.00 (including postage) or a CD-rom version may be provided free of charge from:

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Why write a submission?

A submission is a way to provide information, express your opinion and put forward your suggested course of action – including any alternative approach. It is useful if you indicate any suggestions you have to improve the proposal.

All submissions received by the EPA will be acknowledged. Electronic submissions will be acknowledged electronically. The proponent will be required to provide adequate responses to points raised in submissions. In preparing its assessment report for the Minister for the Environment, the EPA will consider the information in submissions, the proponent's responses and other relevant information. Submissions will be treated as public documents unless provided and received in confidence subject to the requirements of the *Freedom of Information Act 1992*, and may be quoted in full or in part in each report.

Why join a group?

If you prefer not to write your own comments, it may be worthwhile joining a group or other groups interested in making a submission on similar issues. Joint submissions may help to reduce the workload for an individual or group, as well as increase the pool of ideas and information. If you form a small group (up to 10 people) please indicate all the names of the participants. If your group is larger, please indicate how many people your submission represents.

Developing a submission

You may agree or disagree with, or comment on, the general issues discussed in the ERR or the specific proposals. It helps if you give a reason for your conclusions, supported by relevant data. You may make an important contribution by suggesting ways to make the proposal environmentally more acceptable.

When making comments on specific proposals in the ERR:

- Clearly state your point of view;
- Indicate the source of your information or argument if this is applicable;
- Suggest recommendations, safeguards or alternatives.

Points to keep in mind

By keeping the following points in mind, you will make it easier for your submission to be analysed:

- Attempt to list points so that issues raised are clear. A summary of your submission is helpful;
- Refer each point to the appropriate section, chapter or recommendation in the ERR;
- If you discuss different sections of the ERR, keep them distinct and separate, so there is no confusion as to which section you are considering;
- Attach any factual information you may wish to provide and give details of the source. Make sure your information is accurate.

Remember to include:

- Your name
- Address;
- Date; and
- Whether you want your submission to be confidential.

The closing date for submissions is 13 August 2007.

The EPA prefers submissions to be sent electronically. You can either email the submission to the following address: submissions.eia@dec.wa.gov.au

Or use the submission form on the EPA's website: www.epa.wa.gov.au/submissions.asp and click on the EIA Assessment Submission option.

Alternatively, you can post your submission to:

The Chairman
Environmental Protection Authority
PO Box K822
PERTH WA 6842
Attention: Kirsty Quinlan

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2. CURRENT PROPOSAL

The current proposal by the University is to develop the north eastern portion of Lot 4 Underwood Avenue, Shenton Park for residential purposes. The total development area of Lot 4 is 33.38 hectares (ha), of which approximately 11.88ha of bushland will be retained for conservation and passive recreation, 13ha will be cleared for a residential subdivision and a further 8.5ha will continue to be used for University purposes but is set aside for future development and will be cleared and earth-worked as part of the residential subdivision. The retention of approximately 11.88ha for conservation and passive recreational purposes represents more than 35% of the total developable area of 33.38ha, which includes the area shown as future development in Figure 2.

This proposal represents an improvement of the original proposal assessed in Bulletin 1034. The current proposal incorporates the recommendations of the EPA in Bulletin 1034, embraces the underlying principles identified during the Shenton Park/Mt Claremont Structure Plan Charrette process initiated in 2001. Table 1 outlines the key characteristics of the development proposal.

TABLE 1
KEY CHARACTERISTICS OF THE DEVELOPMENT PRPPOSAL

Element	Description
Proposal	• 13ha residential subdivision creating 163 single residential lots, in addition to 8 grouped housing sites that will yield approximately 105 dwelling units • 10ha for conservation • 1.88ha for Public Open Space • 8.5ha set aside for future development
Area (including Public Open Space and reserves)	Pt Lot 4 Underwood Avenue, Shenton Park comprises a total area of 33.38ha.
Area of Disturbance	The plan is to clear, subdivide and develop 13ha of the north east portion of the subject land. A further 8.5ha will be cleared and earth-worked as part of the subdivision, and is set aside for 'future development'.
Infrastructure	Roads within the subdivision. 1.5m wide footpath on at least one side of all internal roads, plus all cottage lots will have a 1.5m footpath adjoining them. Installation of sewerage connections, soak wells and swales.
Setbacks	5m wide landscape buffer on Underwood Avenue
Rehabilitation	Rehabilitation of 1.46ha of the proposed conservation area which is currently in a Degraded condition.

2.1 Conservation and Public Open Space Areas

It is proposed to retain two conservation areas (8ha and 2ha for a total of 10ha) joined by a vegetated Public Open Space (POS) area. The 10ha of bushland set aside for conservation is 1.5ha more than the original Bulletin 1034 proposal and represents an approximate 22% increase on the agreed 8.23ha Negotiated Planning Solution as depicted in Bush Forever (Government of Western Australia, 2000).

The 1.88ha of POS is strategically located between Conservation Areas A and B. This in effect represents an addition to the conservation areas by virtue of the fact that this open space is predominantly vegetated with native species and will be managed in a way that recognises and enhances the adjacent conservation values while maximizing compatible passive recreational opportunities. It constitutes part of the future subdivisional open space requirement of the residential subdivision. It will perform both conservation and passive recreational functions with rehabilitation of degraded areas using locally native species and restoration of understorey species together with walk trails, tables and seating in a natural bushland setting. The POS is a critical element in the overall linkage objective as defined within the Shenton Park/Mt Claremont Structure Plan Charrette process initiated in 2001 and is an important recreational asset for those residents that will ultimately live within this residential estate. Included in the POS are the two important Jarrah trees (known as the interlocking Jarrahs).

The current proposal will result in 40% more bushland (including the POS area) being retained than the original Bulletin 1034 proposal, which retained 8.5ha of bushland.

2.1.1 Conservation Area A

Conservation Area A (refer to Figure 2) occupies a total area of 8ha and is located in the southeast corner of Lot 4 adjacent to Selby Street.

The vegetation of Conservation Area A (Figure 3) consists entirely of a Jarrah dominated Woodland with scattered Tuart and Marri trees over a lower tree canopy of *Banksia attenuata, B. menziesii* and *Allocasuarina fraseriana.* Typical taller shrub species include *Jacksonia furcellata, Hakea prostrata, Xanthorrhoea preissii* and *Macrozamia fraseri.* Common understorey species include *Gompholobium tomentosum, Hibbertia hypericoides, Acacia pulchella, Calytrix fraseri, Mesomelaena pseudostygia, Desmocladus flexuosus* and *Petrophile linearis.*

The bushland in Conservation Area A is mainly in Very Good to Good condition or better (Figure 4).

2.1.2 Conservation Area B

Conservation Area B (refer to Figure 2) occupies 2ha and is located in the western portion of the proposed developable area. Conservation Area B contains a greater variety of vegetation associations than Conservation Area A (Figure 3). It mostly comprises *Banksia menziesii – B. attenuata* woodland over *Allocasuarina fraseriana* and *Hakea prostrata.* In places, there is stunted Jarrah or emergent Tuart. Species common in the understorey of the *Banksia* Low Woodland include *Hakea prostrata* up to 2m and low shrubs of *Mesomelaena pseudostygia, Xanthorrhoea preissii, Petrophile linearis* and *P. macrostachya. Alexgeorgea nitens, Desmocladus flexuosus, Dryandra lindleyana* and several weed species dominate the ground cover. However, also protected in this area is Jarrah Open Woodland over *Banksia menziesii* Low Woodland and a *Eucalyptus decipiens* stand. Conservation Area B also protects a stand of *Eucalyptus decipiens,* which is not a Priority or Declared Rare Flora (DRF) species but is uncommon in the Perth Metropolitan Region, usually occurring in very small stands on shallow sand over limestone. Also protected in this conservation area are two populations of the Priority 3 species *Jacksonia sericea* that were not protected in the Bulletin 1034 proposal. As illustrated in Figure 3, these populations are located in the north west and centre of Conservation Area B.

The bushland in Conservation Area B is mapped mainly as Good to Very Good condition (Figure 4). The balance of Conservation Area B is mapped as Good.

2.1.3 Public Open Space

The central POS spine that links Conservation Areas A and B comprises of two vegetation associations, the Jarrah dominated Woodland with scattered Tuart and Marri trees over a lower tree canopy of *Banksia attenuata, B. menziesii* and *Allocasuarina fraseriana* and the Jarrah and Tuart Open Woodland over *Acacia saligna*, *A. rostellifera* and *Hakea prostrata* (Figure 3).

The vegetation condition in the POS area is variable and ranges from Good through to Degraded (Figure 4).

The central region of the POS area includes the highest point of the site at 44mAHD. This high point has been modified by partial clearing in the past and the installation of tracks and firebreaks.

The University is committed to rehabilitating the POS area and other weedy sections back to a Good to Very Good condition (Refer to Section 5.2). The University has demonstrated its ability to rehabilitate the site through its rehabilitation of two degraded sites on Lot 4 in 2004 and 2005. The results achieved to date at these two sites are provided in Appendix 1.

3. BULLETIN 1034 PROPOSAL

3.1 Background

The University has considered a number of options for the delineation of a conservation area at the Shenton Park landholding. The Bush Plan/Bush Forever process and community guided the preparation of the various proposals initially and with agency consultation resulted in a proposed 8.23ha Negotiated Planning Solution.

The proposal assessed by the EPA (Bulletin 1034) was formulated following a protracted planning and negotiation process as outlined below.

The University commissioned a preliminary environmental assessment of Lot 4 to determine if the environmental values of the site could be protected while meeting the objectives of Bush Forever (formerly Bush Plan) by retaining a representative portion of the bushland as part of a Structure Plan. The environmental assessment guided the preparation of an Outline Development Plan (ODP) that contained an 'L-shaped' area of bushland mapped as Very Good condition along Selby Street and Underwood Avenue. The University lodged a submission to the Ministry for Planning (now Department for Planning and Infrastructure) in 1999 delineating an area of bushland of high conservation value to be retained as Conservation Open Space in any future development on Lot 4. The Ministry for Planning agreed with the proposal and subsequently, in 2000 the Minister for Planning endorsed the agreed negotiated outcome. This proposal is shown in Bush Forever (Government of Western Australia, 2000) as the 8.23ha Negotiated Planning Solution for Lot 4.

Further discussions with the former Department of Environmental Protection (DEP) regarding the optimal shape of the conservation area identified that a reduced perimeter to area ratio would be preferred. This resulted in the formulation of a rectangular-shaped conservation area.

Further refinement of the conservation area was requested by the DEP following extensive consultation and site inspections with officers and the project team. During a site inspection, and subsequent meeting in May 2001 the DEP and EPA confirmed preference for a 'square' shaped conservation area. Correspondence was received from the EPA Chairman on 20 June 2001 indicating provisional support for the square reservation.

Consequently, a revised subdivision application was lodged in June 2001 followed by an ODP in September 2001 delineating the square conservation area encompassing 8.5ha in the south-eastern region of the site (Figure 1). The EPA assessed this application and Bulletin 1034 was released in November 2001.

3.2 Conservation Area

The proposed conservation area in the original proposal occupied a total area of 8.5ha and is located in the southeast corner of Lot 4 adjacent to Selby Street.

The vegetation of the conservation area consisted entirely of a Jarrah dominated Woodland with scattered Tuart and Marri trees over a lower tree canopy of *Banksia attenuata, B. menziesii* and *Allocasuarina fraseriana*. Typical taller shrub species include *Jacksonia furcellata, Hakea prostrata, Xanthorrhoea preissii* and *Macrozamia fraseri*. Common understorey species include *Gompholobium tomentosum, Hibbertia hypericoides, Acacia pulchella, Calytrix fraseri, Mesomelaena pseudostygia, Desmocladus flexuosus* and *Petrophile linearis*.

The bushland in the conservation area is mainly in Very Good to Good condition or better.

3.3 EPA Assessment of Bulletin 1034 Proposal

In relation to the conservation area, the EPA provided the following recommendation to the Minister for the Environment in Bulletin 1034:

'That the Minister notes that the EPA has concluded that in its current form the proposed 8.5ha identified for bushland conservation is considered inadequate to protect the core (highest conservation value) area/s of the Bush Plan Site. The EPA is of the view that a larger area of the Bush Plan Site, but not substantially so, should be set aside for conservation.'

The particular issues that were raised by the EPA in its report and recommendations are summarised as follows:

- Impact on populations of *Jacksonia sericea*
- Impact on a population of *Eucalyptus decipiens*
- Ecological Linkage
- Tuart trees
- Size of the bushland conservation area

The Minister for the Environment received a number of appeals on the content of the EPA's report and recommendations. In determining the appeals, the Minister forwarded the proposal back to the EPA to more fully consider the area of native vegetation that should be conserved on site.

4. ENVIRONMENTAL EVALUATION OF THE CONSERVATION AND PUBLIC OPEN SPACE AREAS

The following sections provide an environmental evaluation of the current proposal and compare this proposal with the original Bulletin 1034 proposal according to recognised criteria (i.e. Bush Forever[1]).

An area of regionally significant bushland (Site 119) was identified on the site under the heading of a 'Negotiated Planning Solution' in Bush Forever mapping (Government of Western Australia, 2000). The selection criteria used to identify the regionally significant parcel at the site was that of '*representation of ecological communities*'. According to Bush Forever, other criteria used to determine the selection of regionally significant bushland areas, including diversity, rarity, maintaining ecological processes, scientific or evolutionary importance are not considered relevant to this area of bushland.

The evaluation of the conservation area in the following sections, however, does not exclude the other criteria listed under Bush Forever.

4.1 Representation of Ecological Communities

Missing: the bushland at this site...

According to Bush Forever, the State Government's objective is to protect at least 10% of the original extent of each vegetation complex in the Perth Metropolitan Area and in at least five geographically distinct areas if possible. The Karrakatta Complex-Central and South has approximately 5.6% of its original extent with some level of existing protection (e.g. included within existing reserves). Implementation of Bush Forever initiatives will increase this figure by approximately 2.4% to bring the total to 8% of the original extent currently retained or proposed for retention. Outside the Perth Metropolitan Region, the amount of Karrakatta Central and South Vegetation Complex remaining is well over the 30% target set by the Government in non-urban areas.

• no ref
• incorrect
29.5%
in G10

In comparison with the original Bulletin 1034 proposal, the current proposal has a minor positive impact on the conservation status of the Karrakatta Central and South vegetation complex (Table 2).

TABLE 2
AREAS OF VEGETATION RETAINED IN PREVIOUS AND CURRENT PROPOSALS

Proposal	Area
Original Bulletin 1034 proposal	8.50ha
Current Proposal (excluding POS)	10.00ha
Current Proposal (including POS)	11.88ha

[1] Government of WA (2000) Bush Forever. Volume 1 – Policies, Principles and Processes.
Government of WA (2000) Bush Forever. Volume 1 – Policies, Principles and Processes – Appendix 3: Site Implementation Guidelines – Practice Notes.
Government of WA (2000) Bush Forever. Volume 2 – Directory of Bush Forever Sites.

4.2 Diversity

The current proposal contains a greater representation of vegetation associations of the Karrakatta Central and South Complex than the Bulletin 1034 proposal (five compared with one), as shown in Table 3. Consequently, it would be expected that the current proposal would also provide a greater diversity of flora and fauna.

but no data to support this assumption

TABLE 3
AREA OF VEGETATION ASSOCIATIONS RESERVED IN PREVIOUS AND CURRENT PROPOSALS

Vegetation Type	Original Bulletin 1034 Proposal	Current Proposal	
		Conservation Areas A and B	POS
Jarrah/Banksia/Sheoak Low Woodland	8.50ha	7.98ha	1.03ha
Jarrah/Tuart Open Woodland	-	-	0.72ha
Banksia attenuata/B. menziesii Woodland	-	1.57ha	-
Banksia prionotes Closed Scrub	-	-	-
Eucalyptus decipiens Low Woodland	-	0.1ha	-
Jarrah over *Banksia menziesii* Low Woodland	-	0.33ha	-
Cleared	-	0.005ha	0.14ha

In considering the regional significance of the vegetation, it is useful to compare the vegetation of the site to nearby reserves. The Jarrah/*Banksia* Woodland vegetation type of the conservation and POS areas (and balance of the subject land) are well represented at other local reserves and open spaces. Bold Park is composed of up to 70% (approximately 145ha) *Banksia* Low Woodland and Kings Park is composed predominantly of a mixed *Eucalyptus/Allocasuarina/Banksia* Open Woodland. Jarrah Woodlands are not as well represented locally, comprising only 2% (10ha) of the vegetation in Bold Park. Bush Forever (Government of Western Australia, 2000) identified that the vegetation associations present at the nearby Shenton Bushland (Bush Forever Site 218) are similar to those present on Lot 4 Underwood Avenue. Kings Park and Shenton Bushland both consist solely of Karrakatta Complex-Central and South.

The vegetation in the conservation and POS areas can also be categorised according to floristic community types (Gibson *et al.*, 1994). Floristic community types group vegetation with similar species composition rather than based on geomorphology and climate, as is the case with the Heddle *et al.* vegetation complexes. All vegetation types in the conservation and POS areas belong to Floristic Community Type 28 - Spearwood *Banksia attenuata* or *B. attenuata* - *Eucalyptus* species woodlands. Within the local area, Floristic Community Type 28 is abundant at Kings Park and at Shenton Bushland and is common in other metropolitan reserves with Spearwood soil types.

Floristic Community Type 28 is not a Threatened Ecological Community at the state level (English and Blyth, 1997) or at the Commonwealth level.

The current proposal has a minor positive impact on the conservation status of floristic community types compared to the Bulletin 1034 proposal.

The current proposal retains representative examples of five of the six vegetation associations at the site and based on the general high quality of the bushland it can be expected that a significant proportion of the species recorded at the site occur in the conservation and POS areas.

In terms of fauna values, the principal habitat of the proposed Conservation Areas A and B (mixed *Eucalyptus/ Banksia* woodland) is consistent with the vegetation of the original Bulletin 1034 proposal. A key advantage of the current proposal over the original Bulletin 1034 proposal is that the current proposal incorporates a representative sample of most vegetation associations occurring over the balance of the site. However, it is anticipated that modifying the conservation areas from 8.5ha to 11.88ha would make little difference to the species of vertebrate fauna protected on the site, as species recorded previously are generally not habitat specific.

which? lack of references. No actual comparison of faunal values between proposals.

4.3 Rarity

In total, 149 species of vascular plants were recorded from the six principal vegetation associations identified at the site. Of the total species recorded, 112 are native to the site and 37 are introduced species not native to the area (includes native Australian species which are garden escapes). One species recorded at the site is listed as a Priority 3 species *Jacksonia sericea.* Although *Jacksonia sericea* is a Priority species it is not a species of high importance and has not been declared as rare. It is not uncommon in this locality and is present in significant numbers in nearby Bold Park, Kings Park and Shenton Bushland. The original Bulletin 1034 proposal did not include the main populations of this species on the site but committed to protecting some of the populations in open space within future developments. The current proposal retains the two largest populations of the Priority 3 species, representing protection of approximately 50% of the population present on Lot 4 rather than a commitment to protect some populations in POS in the future development of that area.

rare fauna not mentioned.

Eucalyptus decipiens is not a Declared Rare or Priority species and communities in which it is dominant are not Threatened Ecological Communities. However, stands of *Eucalyptus decipiens* are uncommon in the Perth Metropolitan Region. The original Bulletin 1034 proposal did not include the stand of this species but committed to protecting it in open space within future developments. The current proposal retains this small stand of *Eucalyptus decipiens* rather than a commitment to protect the area in future POS.

4.4 Maintaining Ecological Processes or Natural Systems

ATA Environmental has previously identified that the existing bushland at Underwood Avenue primarily provides (to an extent) ecological linkage with other nearby bushland areas, catering mainly for birds. The extent of surrounding development, particularly the existing road network, would prevent the movement of reptiles and amphibians.

lack of detailed discussion

The original Bulletin 1034 proposal only provides a link in part to Shenton Bushland located south of Lot 4. There is no westerly connection. The current proposal provides linkage functions to both the west and south.

lack of detail

4.5 Scientific or Evolutionary Importance

The original Bulletin 1034 proposal and the current proposal do not meet the criteria for identification as a site of scientific or evolutionary importance. However, current scientific research would be able to be maintained, as The University would retain ownership and management of the bushland.

4.6 General Criteria for the Protection of Wetland, Streamline and Estuarine Fringing Vegetation and Coastal Vegetation

This criterion is not relevant, because the subject land does not contain any of these features.

4.7 Other Criteria

Other criteria that are important or can add to the value of the bushland and enhance its contribution to Bush Forever not specifically addressed in the above criteria are addressed in the following sections.

4.7.1 Vegetation Condition

Vegetation condition was assessed using the condition rating scale of Keighery published in Bush Forever (Government of Western Australia, 2000). Keighery's condition rating scale ranges from Pristine (where the vegetation exhibits no visible signs of disturbance) to Completely Degraded (where the vegetation structure is no longer intact and without native plant species). A description of the vegetation condition ratings is presented in Table 4.

Vegetation condition as mapped by ATA Environmental is shown in Figure 4.

TABLE 4
VEGETATION CONDITION RATING SCALE

Code	Description
P	Pristine. Pristine or nearly so, no obvious signs of disturbance.
Ex	Excellent. Vegetation structure intact, disturbance affecting individual species and weeds are non aggressive species.
VG	Very Good. Vegetation structure altered, obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
G	Good. Vegetation structure significantly altered by very obvious signs of multiple disturbance. Retains basic vegetation structure or ability to regenerate. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.
Deg	Degraded. Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
CD	Completely Degraded. The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora composing weed or crop species with isolated native trees or shrubs.
C	Cleared. The area is totally devoid of native vegetation.

(Government of Western Australia, 2000)

The current proposal (including the POS area) protects the largest area of vegetation with a condition rating of Good or better (10.42ha) when compared with the original Bulletin 1034 proposal (8.32ha) (refer to Table 5). Excluding the POS area, the current proposal protects 9.7ha of vegetation classed as Good or better, which exceeds the entire area of vegetation proposed to be retained in the original Bulletin 1034 proposal.

TABLE 5
VEGETATION CONDITION OF RETAINED BUSHLAND IN BULLETIN 1034 PROPOSAL AND CURRENT PROPOSAL

Vegetation Condition	Original Bulletin 1034 Proposal	Current Proposal	
		Conservation Areas A and B	POS Area
Very Good	6.35ha	4.87ha	-
Very Good to Good	1.37ha	2.19ha	0.33ha
Good to Very Good	-	1.48ha	-
Good	0.6ha	1.16ha	0.39ha
Good to Degraded	0.18ha	-	0.63ha
Degraded to Good	-	0.12ha	-
Degraded	-	0.05ha	0.53ha

4.7.2 Aboriginal Significance

Previous consultation with indigenous people by The University has identified a preference for the retention of the elevated portion of the landscape with recognition for its indigenous heritage values. The current proposal retains this part of the landscape in the POS area whereas the original Bulletin 1034 proposal did not retain this landscape feature. The mature interlocking Jarrah trees will also be retained in the POS area.

There is an opportunity to acknowledge indigenous heritage through interpretive signage and other means.

4.7.3 Landscape Features

The POS area is a more aesthetic passive recreational area than previous reservations as it is located across the upland ridge with panoramic views including the City and to Bold Park.

4.7.4 Shape of Conservation Areas

The original Bulletin 1034 proposal is the most regular shape, which is generally more optimal in minimising degrading edge effects, compared to narrow, elongated shaped areas of bushland. The current proposal includes conservation areas that are divided into two regular shaped rectangular areas, one of 8ha (Conservation Area A) and the other of 2ha (Conservation Area B) with an inter-connecting POS area in between. If considered as two parcels, then each parcel is regular and meets desirable reserve shape criteria. However, if considered one 10ha parcel separated by POS then the shape is not as regular as the original proposal.

Size in relation to fauna requirements

To retain an east-west linkage, the current proposal has connected the 2 regular-shaped Conservation Areas with an irregular-shaped area of POS. This has compromised the overall shape of the conservation and POS areas, making it less regular than the conservation area outlined in the Bulletin 1034 proposal. The EPA noted *"the prominent location and high visibility of the Tuart trees on the crest of the ridge is also likely to be a significant factor in maintaining the ecological linkage functions of the Underwood Avenue Bushland for the movement of birds through surrounding suburbs and bushland areas"*. The current proposal maintains an east-west linkage as well as retaining the Tuart trees on the crest of the ridge in the proposed POS area.

The University proposes that management of the POS area be for conservation and passive recreation activities that are consistent with the conservation intent. The POS will be rehabilitated to improve its vegetation condition in accordance with the preliminary management measures outlined in section 5.

The perimeter to area ratio for the original Bulletin 1034 proposal was 135m/ha (the smaller the number the better from a reserve design viewpoint). The perimeter to area ratio for the two separate parcels of bushland in the current proposal are 144m/ha for Conservation Area A and 286m/ha for Conservation Area B. Direct comparison of perimeter to area ratios for different sized areas of bushland is strictly not statistically valid, hence the relatively large number for Conservation Area B. Furthermore, in terms of reserve size, all configurations on the subject land are relatively small, and regardless of shape would require intensive management to maintain biodiversity values.

No - indicative of small size!

5. PROPOSED MANAGEMENT OF BUSHLAND AND PUBLIC OPEN SPACE AREAS

5.1 General

The University commits to preparing a management plan for the conservation and POS areas. The University will retain ownership and manage the conservation areas in conjunction with an appropriate body. The University proposes that the POS area is vested with the local authority, however discussions on this matter are yet to take place. The University is willing to enter into a Memorandum of Understanding with the local authority to assist in the on-going management of the POS area.

The retention of bushland in an urban setting will provide an important function of improving the community's appreciation and understanding of the local bushland flora, vegetation and associated fauna. In this way, while conservation of the flora and fauna values of the bushland will be the management priority, the bushland will also function as an educational resource for the local and broader community.

On this basis, the objectives of the conservation areas will be to:

- Ensure the native flora, vegetation and fauna values are maintained and protected through appropriate management of the site;
- Improve community awareness and appreciation by utilising the conservation area for educational purposes consistent with maintaining the conservation value of the bushland; and
- Maintain linkages with other nearby bushland areas.

The POS area will provide the local community with opportunities for passive recreation in a manner that will not further degrade existing conservation values. This area is currently degraded in part and establishment of the POS will involve retention of any native trees and understorey species, where appropriate, and establishment of grass and installation of seating and tables. The balance of the POS area will be rehabilitated and managed for conservation purposes.

• not consistent w 2.1.3 nor with 5.2

The following sections provide an overview of the key environmental strategies that will be addressed in a Management Plan for bushland and POS areas. The primary aim of the Management Plan will be to maintain the conservation value of the bushland following development of the adjacent land for residential purposes.

5.2 Rehabilitation

The upland region of the POS area has been somewhat degraded through past land use activities that have resulted in the loss of native vegetation and allowed subsequent weed invasion. This area will require rehabilitation to restore and maintain a bushland ecosystem to ultimately promote natural regeneration by reducing or eliminating disturbance factors such as weed invasion, fire, pests, and disease.

While it is anticipated that the bushland may change over time because of subtle changes in climatic conditions and natural events such as fire, it is anticipated that the natural plant community will regenerate naturally and will be resilient if managed properly.

The rehabilitation and restoration of degraded areas within the conservation area will involve two main processes:

1. Removal and prevention of the disturbances that lead to the deterioration of the bushland such as weed control, control of access, fires; and

   (ie not grass!)

2. Implementation of revegetation techniques such as brush/mulch application, direct seeding and tube or seedling planting.

The implementation of revegetation works may not be required in areas which regenerate well naturally, however, parts of the POS area are currently degraded and will therefore require assistance to restore the natural bushland.

A management plan for the conservation and POS areas will be prepared and will describe in detail the guidelines for the implementation of restoration measures, including species selection, planting densities, protection measures, and timing of works.

5.2.1 Weed Control

The introduction and spread of weeds in bushland areas presents a major threat to biodiversity including the loss of native floristic diversity, vegetation structure and native fauna habitat. In addition, the prevalence of weeds in bushland areas increases the threat of fire. The control of weeds in the conservation and POS areas will form an important component of the rehabilitation strategy and will be the focus of primary works in the area.

A number of weeds are present in the conservation area including invasive grasses (Perennial Veldt Grass, Buffalo Grass and Couch Grass), tuberous/cormous species (Freesia, Gladiolus), herbs (Pigface, Geranium and Lupin) and woody plants (Geraldton Wax).

Many of these species were introduced to the bushland as garden escapes or from the dumping of garden rubbish in the surrounding area prior to the installation of the boundary fence. Some weeds such as Ursinia and Gladiolus have been introduced by wind-borne seed and have become established in already degraded areas of the bushland such as along tracks and firebreaks.

The most effective method of keeping weeds out of the conservation area will be to control and prevent the source of invasion. For example, prevent dumping of garden refuse, keep irrigated lawns away from the bushland and minimise disturbance by installing fewer tracks and firebreaks.

In most instances, it is not possible, nor desirable, to remove all weeds initially as the factors contributing to weed invasion will be continually operating. Therefore, for a successful weed control program it will be important to re-weed the site on a regular basis. The program should focus on implementing the following principles:

- Work from areas in good condition towards weed infested areas;
- Ensure minimal disturbance to soil and vegetation;
- Let the rate of regeneration of native plants determine the rate of weed removal (as appropriate); and
- Implement a long-term maintenance program to monitor weed control methods and native flora regeneration.

The following management recommendations are proposed for bushland areas:

- The control of invasive weeds should be a major priority in the management of the conservation area.
- Investigate the feasibility and implications of extending the native understorey layer to the road kerbing so that the road acts as a firebreak.
- Grassed areas adjacent to the conservation area should be reticulated in such a manner that water does not impinge on the bushland area.
- Weed control programs should not be undertaken in isolation but as a component of a vegetation rehabilitation program.

5.3 Fire Management

The protection of life, property and environmental and community values in the bushland will be the important components of fire management within the proposed development area.

The incidence and impact of potential unplanned fires in the conservation area will be reduced by maintaining a strategic fire access system and implementing measures to control weeds which contribute to a high fuel load (such as Grass species – Veldt Grass). Fire control measures within the conservation area and surrounding development will comply with WAPC and FESA guidelines in "Planning for Bush Fire Protection" (WAPC and FESA, 2001).

In addition, early detection of fires and rapid attack will play an important role in fire control in the conservation area. Importantly, no burning for fuel reduction purposes will be undertaken in the bushland area.

5.4 Access

Access within bushland areas will be managed with designated paths designed to protect conservation values. The installation of paths in bushland areas requires careful consideration as too many paths can cause problems such as fragmentation of bushland and increase the boundary to area ratio. Consequently, heavily disturbed edges are open to weed invasion and may result in the loss of sensitive native species found within the bushland.

Following the fencing of the site in 1995, the establishment of informal paths and tracks in the bushland has been significantly reduced. However, a number of tracks have been cleared in and around the bushland to allow vehicle access for fire and maintenance purposes.

The maintenance of conservation values will require that some of the more appropriately aligned tracks are formalised for pedestrian access and those that are surplus to these requirements be rehabilitated.

All paths which are to be maintained and upgraded in the conservation area will be sealed with crushed limestone to a width of 2m and enclosed with pine bollards to prevent further establishment of informal tracks.

5.4.1 Fencing

To ensure that the environmental values of the conservation areas are maintained in the long-term, a 1.5m high pine post and ring-lock fence and 2.0m high cyclone fence will be installed at the periphery of the bushland areas. The 1.5m high fence will be along the boundaries between the bushland areas and future residential areas.

The construction materials will be selected to ensure that the fence prevents uncontrolled access and is aesthetically pleasing in areas adjacent to residential areas.

Gates will be installed at appropriate locations to provide pedestrian access but prevent entry by bicycles and trail bikes. Lockable gates will be installed where appropriate to provide vehicle access for maintenance and emergency purposes.

5.4.2 Interpretative Signage

Interpretive signage will be installed at key locations in bushland areas to provide the local community and visitors with information relating to the natural environment, orientation and to advise of user restrictions.

Interpretive signage will be an important mechanism in influencing the level of interest and involvement of the community in enhancing the value of the area.

Interesting and informative signage may be installed which provides straightforward information and diagrams describing native fauna, the attributes of native flora, and vegetation patterns.

5.5 Stewardship and Public Participation

5.5.1 Working Groups

Local community interest in the management and appreciation of urban bushland parcels is evidenced by the number of established working groups associated with nearby bushland remnants.

The contribution to generating community interest and enthusiasm in bushland protection and management, brought about by existing community groups or the formation of new groups, is strongly encouraged by The University.

5.5.2 Research Opportunities

As opportunities arise, The University anticipates opportunities to encourage research relevant to the management of the proposed conservation areas. Research may be linked to current studies in this area being undertaken at The University or through other agencies.

Research may include determining and updating methods of weed control, fire management, replanting techniques and identification of appropriate genetic sources of seeds or seedlings to be used in re-vegetation programs. Another element, which will require continued research, will include determining the impact of access on the vegetation and fauna habitats in the conservation area.

5.5.3 Schools

The conservation areas in the current proposal are located in proximity to five schools including Jolimont Primary, Rosalie Primary, Floreat Park Primary, John XXIII College and Shenton College. Some of these schools may have already commenced projects to rehabilitate local bushland areas or

established nurseries to grow local native seedlings and may prefer to utilise other local bushland areas such as Bold Park and Kings Park, which can adequately accommodate educational activities without significant disturbance to the bushland.

The University will however, encourage educational use of the conservation areas on the basis that it does not conflict with the conservation objectives of the bushland.

Activities to promote the conservation area to schools and other institutions may include the following:

- Utilise the conservation area as the focus of demonstrating the theoretical and practical aspects of bush regeneration.
- Provide expert advice and guidance to school groups during theoretical and practical exercises.

5.5.4 Heritage Groups

The University will discuss the management and rehabilitation of the POS and bushland areas with the Nyungah Circle of Elders to ensure any proposals do not conflict with the recognised heritage values of the site.

6. CONCLUSIONS

The current proposal includes two areas of bushland totalling 10ha set aside for conservation purposes and an inter-connecting vegetated POS area covering approximately 1.9ha. The current proposal results in a significantly improved conservation outcome when compared with the original Bulletin 1034 proposal because it:

- Provides for the protection of a larger area of native vegetation than the original Bulletin 1034 proposal;
- Increases the biodiversity in terms of increased number of vegetation associations and fauna values;
- Offers improved opportunities for linkages to Shenton Bushland and Bold Park;
- Protects two populations of the Priority 3 species *Jacksonia sericea*;
- Allows for immediate protection of the *Eucalyptus decipiens* stand; and
- Provides better social amenity with the most elevated portion of the site protected in Public Open Space.

The University will prepare a management plan for Conservation Areas A and B and the POS area, demonstrating its commitment to protecting the area for conservation purposes with some passive recreational use. As a part of implementing the management plan, The University will rehabilitate portions of the Conservation Area and POS areas, further increasing the ecological value of the area.

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FIGURES

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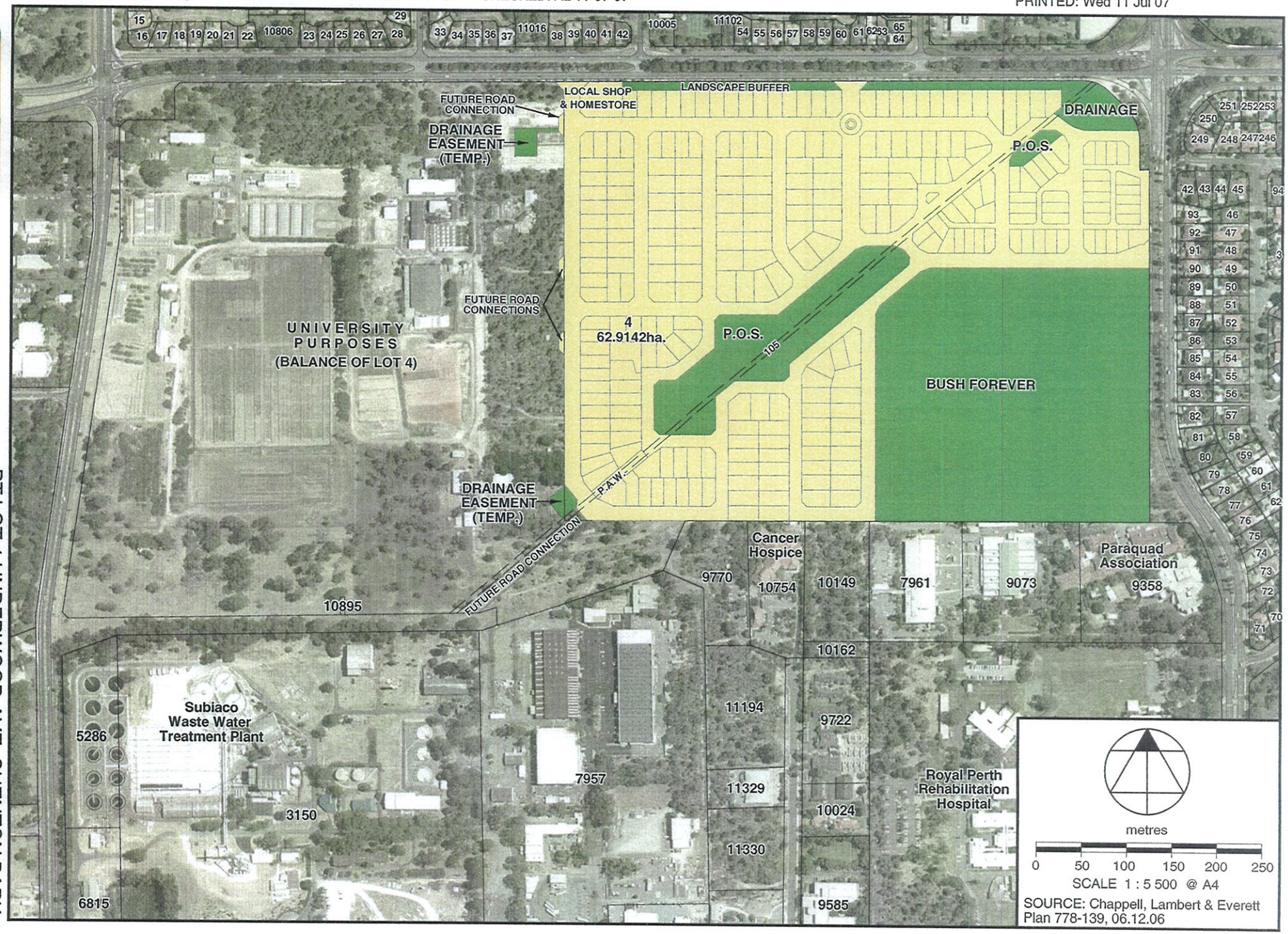
PRINTED: Wed 11 Jul 07

ATA Environmental
environmental scientists

PT LOT 4 UNDERWOOD AVE, SHENTON PARK
2007 DEVELOPMENT & CONSERVATION PROPOSAL:
ENVIRONMENTAL REVIEW REPORT

BULLETIN 1034 PROPOSAL

FIGURE 1



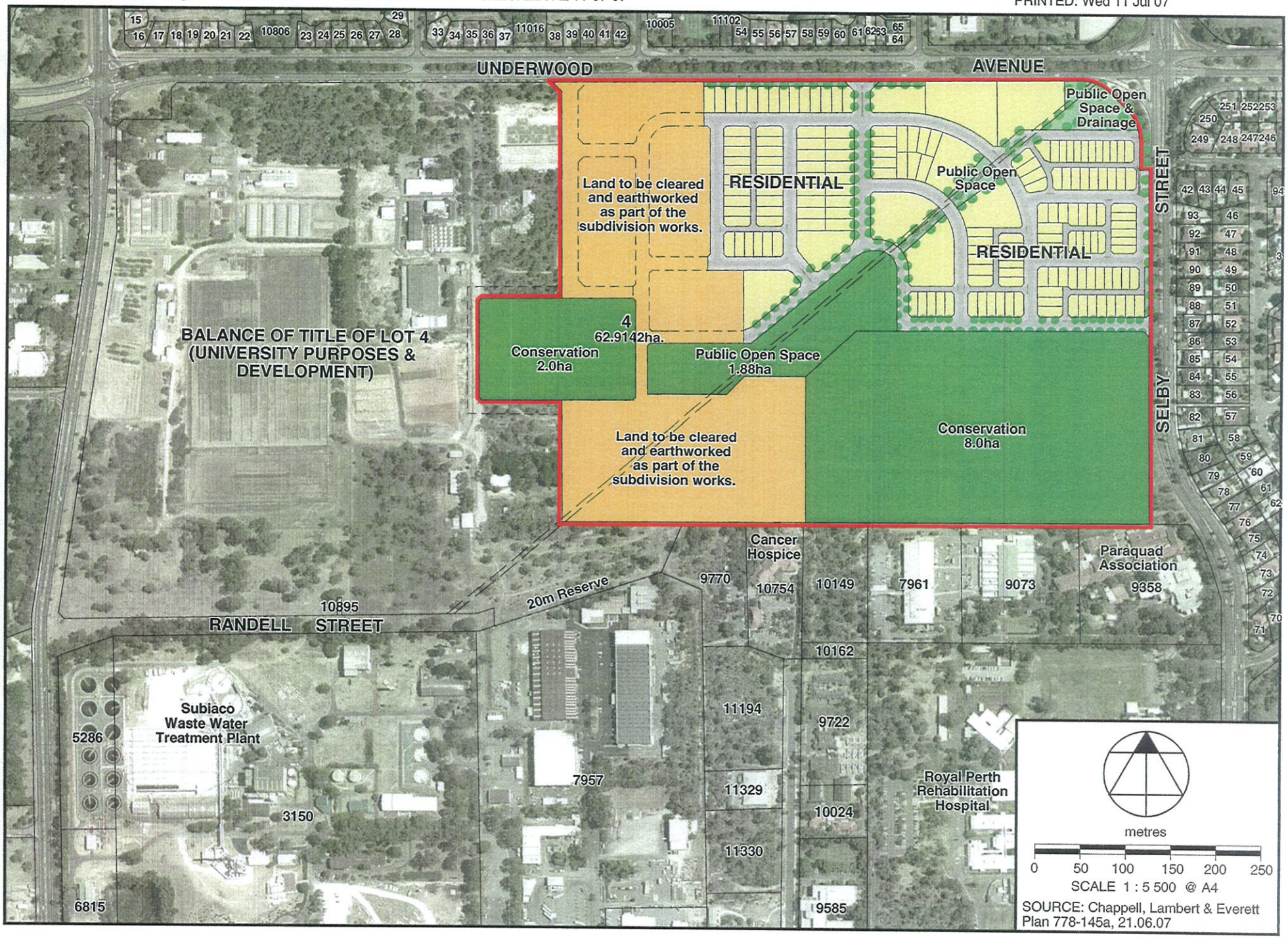
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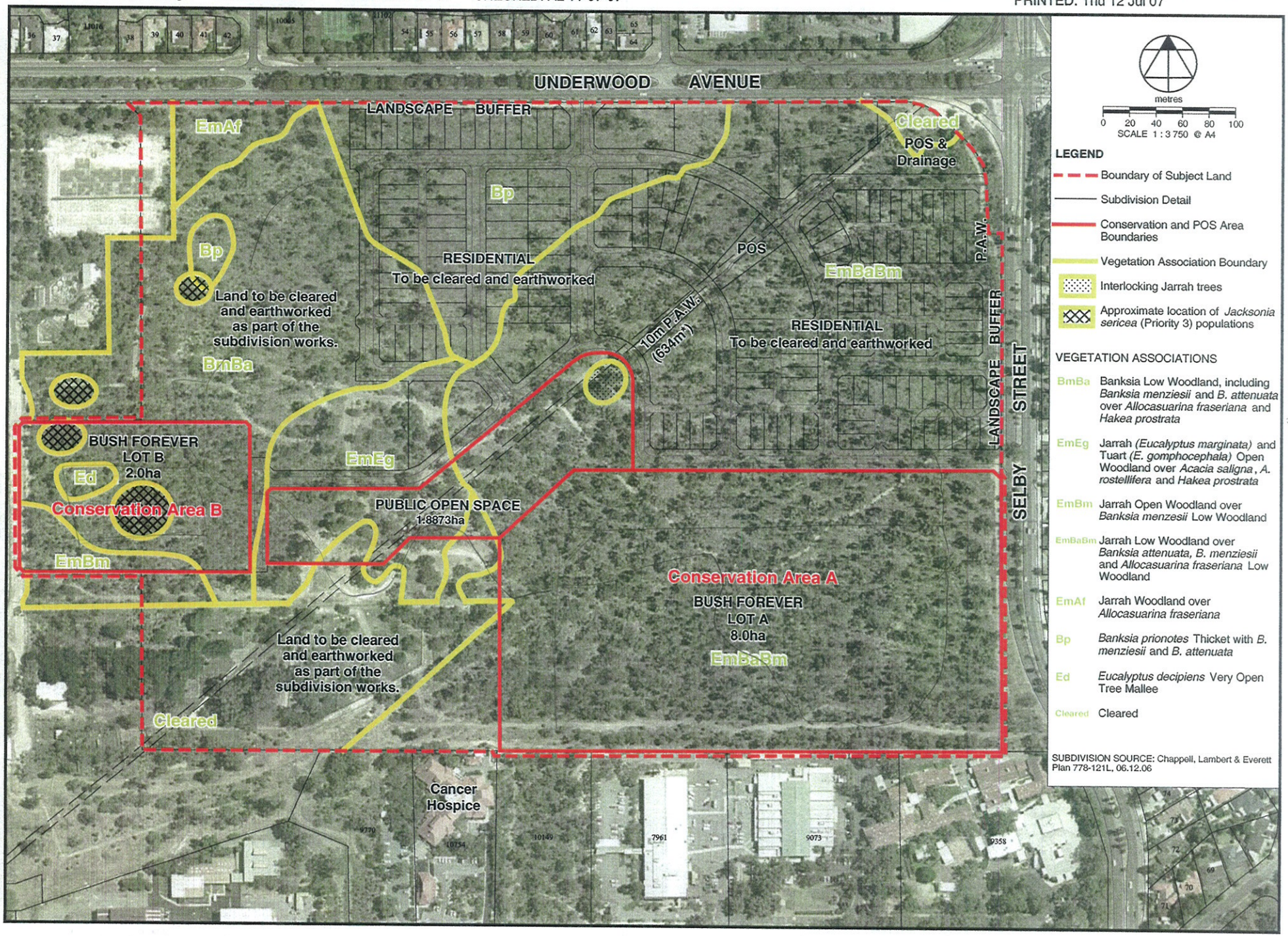
CURRENT PROPOSAL

FIGURE 2



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ENVIRONMENTAL REVIEW REPORT

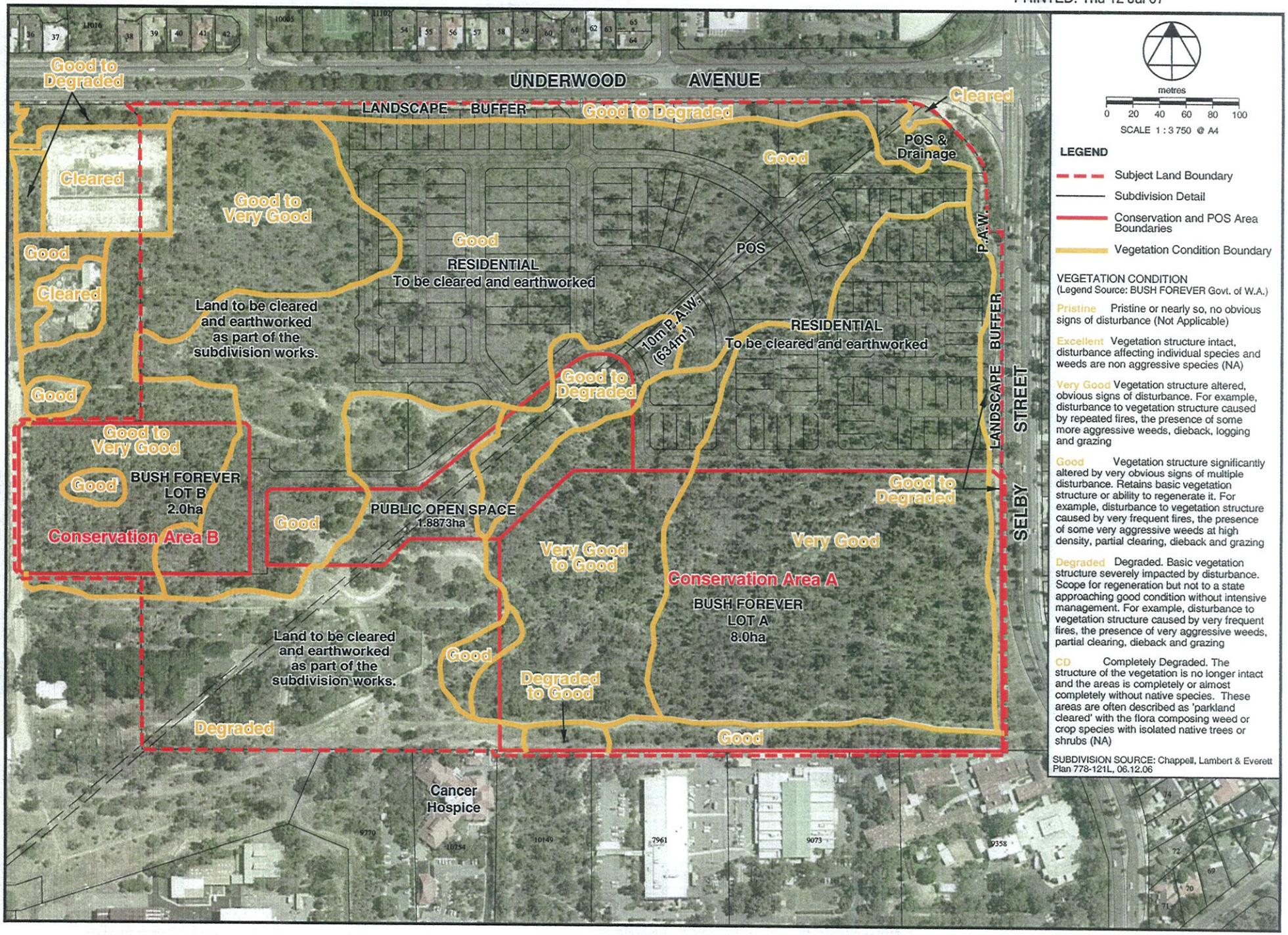
VEGETATION ASSOCIATIONS

FIGURE 3

* B. prion small patch

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environmental scientists



PT LOT 4 UNDERWOOD AVE, SHENTON PARK
2007 DEVELOPMENT & CONSERVATION PROPOSAL:
ENVIRONMENTAL REVIEW REPORT

VEGETATION CONDITION

FIGURE 4

APPENDICES

APPENDIX 1
REHABILITATION RESULTS

ATA ENVIRONMENTAL

APPENDIX 1
REHABILITATION RESULTS
ATA ENVIRONMENTAL

In 2004, The University commenced rehabilitation of an area on Lot 4 that was mapped as 'Degraded'. In 2005, an additional area mapped as 'Degraded' was also rehabilitated.

Rehabilitation involved a seed collection program from Lot 4 involving Aboriginal people and supervised by contract seed pickers. The seed collection program involved educating participants about collection methods, plant species, seed storage and plant propagation.

2004 Rehabilitation

A 0.92ha area within disused animal pens was selected as the first site to be rehabilitated. The site was fenced and had existing irrigation and was in a highly degraded condition. The past land use involving repeated grazing has ensured that the seed store within this site has been substantially depleted and as such, natural regenerative processes were anticipated to be limited. The area also had a very high density of weeds from a variety of species.

Similar pens containing extensive weeds adjacent to the 2004 rehabilitation site are shown in Plate 1. Significant weed control was undertaken on this site prior to revegetation occurring. Plate 2 shows the site prior to planting. The 0.92ha areas was then planted with seedlings grown from the seed collected on site earlier in the year and supplemented by other species, which either were not collected or had unviable seed. Altogether 11,692 seedlings from 29 native species were planted in spring 2004.

Following planting, the rehabilitation area received regular watering over the first summer, which assisted plant establishment. Regular watering also encouraged weed growth, which was monitored and periodically controlled. In densely planted areas, weed species have largely been suppressed. The area is not currently irrigated.

Plate 3 shows the site approximately 1 year after planting. Plates 4 and 5 show the site two years after planting in October 2006. An assessment of the site in on 30 October 2006 identified successful establishment and growth of a number of species. The most common species present in the rehabilitation area are listed in Table 1.

TABLE 1
2004 REHABILITATION ASSESSMENT RESULTS

Common native species	**Height (m)**
Acacia rostellifera	2 – 2.5
Allocasuarina fraseriana	1
Banksia attenuata	0.3 – 0.4
Banksia grandis	0.8
Banksia menziesii	0.6
Banksia prionotes (less common)	0.5 – 1
Eucalyptus decipiens	3
Eucalyptus gomphocephala (Tuart)	4
Gompholobium tomentosum	0.6
Hakea prostrata	1
Hardenbergia comptoniana	Groundcover
Kennedia prostrata	Groundcover
Phyllanthus calycinus	1
Common weed species	
Ehrharta calycina (Veldt Grass)	
Euphorbia terracina (Geraldton Carnation Weed) – occurs mostly at eastern end	
Sonchus oleraceus (Sow Thistle)	
Trifolium campestre and other spp. (Clover)	

Initial irrigation has undoubtedly promoted rapid growth of several species including *Acacia rostellifera, Eucalyptus gomphocephala* and *E. decipiens*.

2005 Rehabilitation

The 2005 rehabilitation site has been treated a little differently to the 2004 rehabilitation site in that it has not be irrigated and the site was ripped prior to planting. In addition, the area was revegetated with a different species composition. The density of overstorey species was reduced, in particular some *Eucalyptus* species and *Acacia* species.

Plate 6 shows the site just after planting in 2005. Plate 7 shows the same site in October 2006. The reduction in weeds present at this site is probably due to the absence of regular watering and controlled spraying. Growth rates are satisfactory given the absence of regular watering and a species composition that includes a greater proportion of slower growing species. Common species in the rehabilitation area are listed in Table 2.

TABLE 2
2005 REHABILITATION ASSESSMENT RESULTS

Common native species	**Height (m)**
Acacia cyclops	0.3
Acacia pulchella	0.5
Allocasuarina fraseriana	0.3
Allocasuarina fraseriana	1
Eucalyptus gomphocephala (Tuart)	0.3
Eucalyptus marginata	0.3
Gompholobium tomentosum	0.4
Hakea prostrata	0.4
Hardenbergia comptoniana	Groundcover
Kennedia prostrata	Groundcover
Common weed species	
Avena fatua (Oats)	
Conyza bonariensis (Fleabane)	
Ehrharta calycina (Veldt Grass)	

Summary of Rehabilitation Results

The results achieved to date for the two areas rehabilitated in 2004 and 2005, demonstrate that The University has made significant progress towards rehabilitating degraded land. Further efforts will concentrate on adding a greater variety of understorey species to the rehabilitation areas. Weeding will continue to remain a management priority. Selected thinning of *Eucalyptus gomphocephala* and possibly *Acacia rostellifera* may be required in the next few years to achieve a more natural density.



Plate 1
Former animal pen adjacent to 2004 rehabilitation site. Note extent of weed invasion.



Plate 2
2004 rehabilitation site prior to planting.



Plate 3
2004 rehabilitation site one year after planting.



Plate 4
2004 rehabilitation site two years after planting.



Plate 5
2004 rehabilitation site two years after planting.



Plate 6
2005 rehabilitation site just after planting.



Plate 7
2005 rehabilitation site one year after planting.

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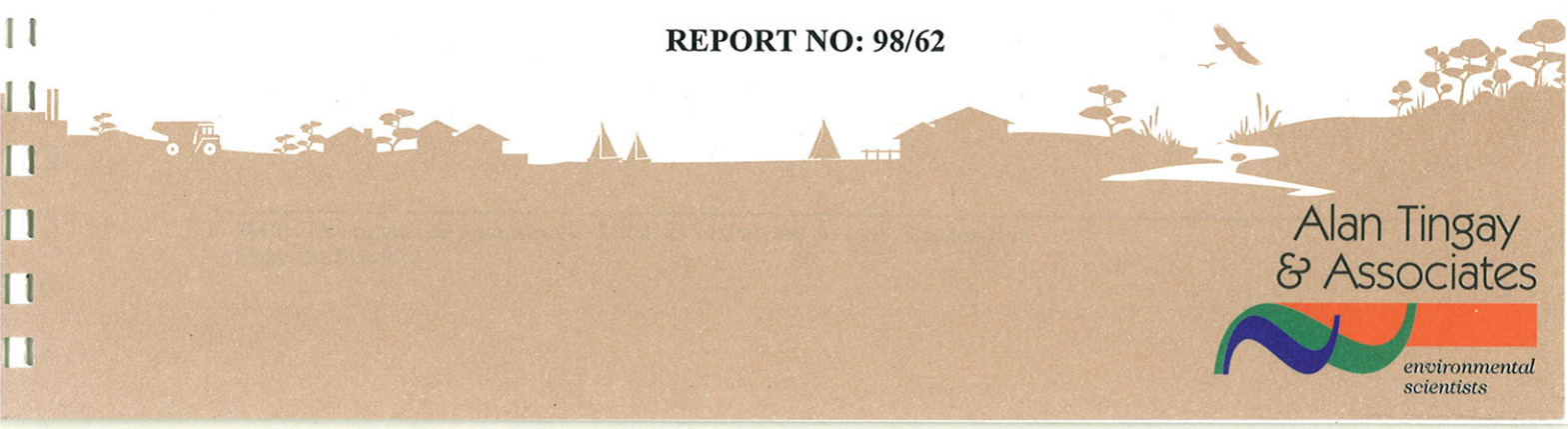
ENVIRONMENTAL ASSESSMENT

LOT 2103 UNDERWOOD AVE SHENTON PARK

ALAN TINGAY & ASSOCIATES

FEBRUARY 1999

REPORT NO: 98/62



LIST OF FIGURES

1. Regional Location

2. Topography

3. Vegetation Associations

4. Vegetation Condition

5. The Concept Plan

LIST OF APPENDICES

1. Pt Lot 2103, Shenton Park Flora List

2. Potential Vertebrate Fauna List for Pt Lot 2103, Shenton Park

3. Flora Lists for Local and Regional Bushland Areas

1. INTRODUCTION

1.1 Background and Scope

Alan Tingay and Associates was commissioned by Warren Tucker Pty Ltd on behalf of The University of Western Australia to conduct a preliminary environmental assessment of Lot 2103 Underwood Avenue, Shenton Park.

The study area is owned by The University of Western Australia (UWA) and is currently used as a research park for botanical, zoological and agricultural studies. The public currently has no access to the site. The site is zoned Urban under the Metropolitan Region Scheme and is a Development Zone under the City of Nedland's Town Planning Scheme No.2. The site was originally intended for a future campus and/or technology park. The study area does not include the turf farm located in the northwestern corner of the site.

This environmental assessment includes an assessment of the vegetation and flora on the site, a desktop review of the vertebrate fauna likely to occur in the area and an assessment of the local and regional significance of the site.

1.2 Location and Surrounding Landuse

The study area encompasses approximately 33ha and is located on Underwood Avenue in Shenton Park, within the City of Nedlands (Figure 1). The site is adjacent to a turf farm and includes a wildlife research site which forms part of the research centres of the Water Corporation and The University of Western Australia. The study area lies adjacent to residential and business developments on the northern boundary and is located less than 1km from Lemnos Street Bushland and within a 5 kilometre radius of Bold Park and Kings Park.

2. EXISTING ENVIRONMENT

2.1 Climate

The study area is characterised by a mild Mediterranean type climate with hot dry summers and mild wet winters. The climate shows marked seasonality, with rainfall, temperature and winds following a well defined annual cycle. Rainfall is concentrated in the winter months with 90% of all rain falling between April and October, and 80% concentrated between May and September.

Temperatures are lowest in July with an average maximum of up to 18°C. The highest temperatures have been recorded in February with an average daily maximum of 31°C.

A typical summer wind pattern exists, with strong easterly winds in the morning swinging to strong southwesterly winds in the afternoon. The winds are strongest during the summer months with 50% of the winds in December exceeding 20 kilometres per hour compared to only 20% in May and 25% in June, July and August (Bureau of Meteorology, 1990).

2.2 Soils and Topography

The study area is comprised primarily of deep calcareous sand of aeolian origin. The soils of the study area are part of the Spearwood Dune System and consist of shallow to deep yellow, medium to fine grained quartz and Pleistocene aeolianite limestone (Semeniuk and Glassford, 1989).

The Spearwood Association can be further divided into the Cottesloe and Karrakatta soil types. Within the study area, the yellow sands of the Karrakatta type soil predominates and at the central ridge the underlying Tamala limestone is partially exposed.

The area rises gently from 15m AHD at the eastern boundary up to 44m AHD at the central ridge and falls gradually to 25m at the western boundary. The outcropping of Tamala limestone at the central ridge provides a vantage point to other prominent regional landmarks including Kings Park, the city and Bold Park. The topography of the study area is shown in Figure 2.

2.3 Hydrology

There are no natural drainage channels or expressions of the groundwater within the study area.

The groundwater in the study area ranges from 6m AHD in the western part of the site to 7m AHD in the eastern part. Depth to groundwater varies from 38m under the central ridge, 17m at the western boundary and a low of 8m depth at the south-east corner of the site (WAWA,

1993). There is a regional groundwater flow of between 50 and 100m per year in the study area towards the south-west corner of the site (WAWA 1986).

A groundwater extraction bore is located adjacent to the study area at the turf farm. This bore is used to extract groundwater for local irrigation purposes and is unlikely to have a significant draw-down effect on the regional groundwater table.

2.4 Flora and Vegetation

2.4.1 Methodology

An initial interpretation of the vegetation of the study site was conducted using a colour aerial photograph (1:1000) to determine the delineation of the vegetation associations.

Field surveys were conducted in January 1998 for the eastern half and early July, 1998 for the western half to record flora, determine the distribution of vegetation units and significant flora present at the site. Field reconnaissance and a number of 10x10m quadrats defined the floristic composition, vegetation condition and weed invasion of each unit.

The description of the vegetation was based on a system devised by Specht and modified by Aplin (1979) which classifies vegetation on the basis of height and cover of the tallest stratum (eg. Low Woodland). Individual plant associations were named according to the dominant species eg. *Banksia attenuata* Low Woodland.

A map of the vegetation associations in the study area was prepared from the aerial photograph taken in January 1997 together with field data and verification.

The condition of the vegetation was assessed and mapped using the following categories:

Undisturbed	Pristine or nearly so, no obvious signs of disturbance.
Slightly Disturbed	Vegetation structure intact, disturbance affecting individual species. Weeds are non-aggressive species. Indications of disturbance includes; damage to trees caused by fire, the presence of non-aggressive weeds and occasional vehicle tracks.
Disturbed	Vegetation structure altered, obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.

Obvious Disturbance Vegetation structure significantly altered by very obvious signs of multiple disturbance. Retains basic vegetation structure or ability to regenerate to it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.

Severely Disturbed Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to the vegetation structure caused by very frequent fires, the presence of very aggressive weeds, clearing, dieback and grazing.

Degraded The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora composed of weed or crop species with isolated native trees or shrubs.

These categories have been modified from the condition scale of Trudgen (1993) and Keighery (1994) as shown in the table below:

TABLE 1

COMPARISON OF VEGETATION CONDITION SCALES

Alan Tingay & Associates	Trudgen (1993)	Keighery (1994)
Undisturbed	Excellent	Pristine
Slightly Disturbed	Very Good	Excellent
Disturbed	Good	Very Good
Obvious Disturbance	Poor	Good
Severely Disturbed	Very Poor	Degraded
Degraded	Completely Degraded	Completely Degraded

Mapping of the vegetation associations was performed using 1:1000 aerial photography. While the vegetation maps show distinct boundaries between the vegetation units, in nature the boundaries between vegetation units are usually ill defined. There is, therefore, some degree of subjectivity in the boundaries shown on the vegetation maps.

2.4.2 Flora

A total of 96 species of vascular plants was recorded at the site (Appendix 1). Of these, 80 are native to the site and 16 are introduced species not native to the area. Approximately two thirds of the species are Dicotyledons. Within the Dicotyledonae the families with the most species were the Proteaceae (*Banksia* family) (11 species), Papilionaceae (Pea family) (11)

and Mimosaceae (Wattles) (7). The dominant Monocotyledonae family was the Poaceae (Grasses) (10).

One species of the Orchidaceae (Orchids) family, *Pterostylis vittata,* was recorded in the eastern region of the study area.

More taxa were recorded in the western portion (84 native species) of Lot 2103 than the 20ha to the east (62 native species) primarily due to the timing of the survey. The eastern section of Lot 2103 was surveyed in January 1997 when less species would be observable. Some species recorded in the July survey would have been dormant during the initial investigation in January.

2.4.3 Declared Rare and Priority Flora

A search was undertaken for the study area of the CALM Threatened Flora database, the Priority Species List and the WA Herbarium specimen database for priority species collected in the general vicinity of the study area. Table 2 shows the conservation status of significant taxa known to occur within a 5 kilometre radius of the study area.

TABLE 2

CONSERVATION STATUS OF SIGNIFICANT TAXA IN THE VICINITY OF THE STUDY AREA

SPECIES	FAMILY	CONSERVATION STATUS	LOCALITY
Acacia ataxiphylla	Mimosaceae	3	Swan River
Acacia benthamii		2	Kings Park, Crawley, Subiaco
Acacia cochlocarpa		1	Swan River
Acacia filifolia		3	Swan River
Acacia retrorsa		2	Swan River
Andersonia gracilis	Epacridaceae	2	Swan River
Angianthus micropodioides	Asteraceae	3	Swan River, East Perth
Picris compacta		1	Claremont, Crawley
Senecio gilbertii		1	Kings park
Aotus cordifolia	Paplionaceae	3	Swan River
Jacksonia sericea		3	Claremont, Shenton Park, Subiaco, Kings Park
Baeckea subcuneata	Myrtaceae	2	Kings Park
Baeckea tenuifolia		3	Swan River
Calytrix sylvana		4	Kings Park
Chamelaucium juniperinum		2	Swan River
Melaleuca diosmifolia		3	South Perth
Verticordia paludosa		4	Swan River
Beyeria cygnorum	Euphorbiaceae	2	Reabold Hill

Approx 4 km
- curved leaf species
- Drummond

BJK 4/5/99
- Paul Collaway up this one
Can we please
- Sarah Barrett CALM Kings Pk Contacted

Conospermum eatoniae	Proteaceae	3	sources of Swan River
Grevillea asparagoides		3	Kings Park
Grevillea curviloba		1	Kings Park
Grevillea granulosa		3	Lake Monger
Grevillea manglesii		2	Kings park
Grevillea pimeleoides		4	South Perth
Grevillea thyrsoides ssp. pustulata		3	South Perth
Grevillea triloba		2	Swan River
Lambertia mulitflora var. darlingensis		3	Swan River
Synaphea acutiloba		3	Swan River
Synaphea drummondii		3	Swan River
Synaphea whicherensis		3	Kings Park
Dodonaea hackettiana	Sapindaceae	4	Kings Park, Swan River, South Perth
Fabronia hampeana	Fabroniaceae	2	Reabold Hill
Geleznowia verrucosa	Rutaceae	3	Swan River
Gratiola pedunculata	Scrophulariaceae	2	Swan River
Hibbertia spicata ssp. leptotheca	Dilleniaceae	3	Leederville, Subiaco, Reabold Hill, Bold Park, Swan River, Cottesloe
Lepidium pseudohyssopifolium	Brassicaceae	1	Herdsman Lake
Restio ornatus	Restionaceae	2	Swan River

R Species that are declared rare
1-3 Species which are poorly known
4 Species which require monitoring

No Declared Rare Flora were located during the botanical survey of the study area. Four populations of the Priority 3 species, *Jacksonia sericea,* were located in the western part of the site. *Jacksonia sericea* has been recorded in other nearby bushland areas, including Lemnos Street bushland to the south, Kings Park and in the *Banksia* Woodlands and Limestone Heath at Bold Park.

The Priority 3 species category is defined as (CALM 1996):

> "Taxa which are known from several populations, at least some of which are not believed to be under immediate threat (ie not currently endangered). Such taxa are under consideration for declaration as 'rare flora' but are in need of further survey".

2.4.4 Vegetation Associations

The vegetation units of the study area are shown in Figure 3.

The bushland on the site is located within the Drummond Botanical sub-district of the Darling Botanical District (Beard, 1980).

The bushland comprises predominantly a *Eucalyptus/Banksia/Allocasuarina* Low Woodland to Open Woodland with species variations in upper and lower stories. The variation in species composition reflects the depth of soil and proximity of limestone to the surface and past fire regimes.

The principal vegetation unit has been divided into three vegetation associations consisting of a *Banksia* Low Woodland, a *Banksia prionotes* Closed Scrub and Jarrah Woodland with significant variation in structure and composition.

Banksia Low Woodland

The *Banksia* Low Woodland is structurally dominated by *B. menziesii* and *B. attenuata* and, less consistently, by *Allocasuarina fraseriana.* In places, there are stunted Jarrah (*Eucalyptus marginata)* or emergent Tuart (*E. gomphocephala).* Species which are common in the understorey of the *Banksia* Low Woodland include *Hakea prostrata* up to 2m and low shrubs of *Mesomelaena pseudostygia, Xanthorrhoea preissii, Petrophile linearis* and *P. macrostachya. Alexgeorgea nitens, Loxocarya flexuosa, Dryandra lindleyana* and several weed species dominate the ground cover.

This association occurs over much of the western region of the study area and contains four populations of the Priority 3 species, *Jacksonia sericea.* In addition, a small population of the mallee *Eucalyptus decipiens* was found on the lower slopes of the site. *Eucalyptus decipiens* is not a Priority or DRF species but is uncommon in the Perth Metropolitan Region.

Banksia prionotes Closed Scrub

The *Banksia prionotes* Closed Scrub dominates the central ridge at the site along Underwood Avenue. This association has been adversely affected by fire as evidenced by the extent of weed invasion, particularly Veldtgrass and the age of the banksias (up to 4 years). Throughout the Closed Scrub are scattered young *Banksia menziesii* and *B. attenuata* and mature or dead Tuart trees. The native species diversity in the Closed Scrub is very low as the understorey layer is dominated by weeds. Other species such as *Acacia saligna* and *Pelargonium capitatum* which are often associated with disturbed areas are present at the periphery of the Closed Scrub.

Jarrah Low Woodland to Open Woodland

The Jarrah Woodlands at the site vary significantly in species composition and density. The eastern area and central ridge at the study area comprises a very open Jarrah Woodland with scattered Tuarts over an *Acacia saligna, A. rostellifera* and *Hakea prostrata* Heath and Closed Scrub. In this area the understorey is dissected by numerous tracks and is limited to an *Acacia* Heath and invasive grasses.

Away from the informal paths, species composition increases to include *Gompholobium tomentosum, Hibbertia hypericoides, Mesomelaena pseudostygia, Lepidosperma leptostachyum* and *Petrophile linearis.*

2.4.5 Vegetation Condition

The vegetation condition of the study area ranges from disturbed (areas identified with a dense understorey dominated by native species) and severely disturbed (open areas sparsely populated by trees and with aggressive weeds in the understorey) to degraded (cleared) as shown in Figure 4. All of the vegetation associations recorded at the site show some signs of disturbance including the presence of non-aggressive and aggressive weeds, partial clearing, frequent fires, and informal tracks.

The understorey and herbaceous layer of the *Banksia* Low Woodland and the Jarrah Woodland associations vary from severely disturbed to disturbed. The understorey in some areas of the woodlands is species rich, however tracks, firebreaks, fires and the proximity of housing have led to extensive weed invasion. The aggressive Veldtgrass weed and other introduced grass species proliferate along the paths and fire breaks. The vegetation towards the western and eastern boundaries of the site is disturbed and is the least degraded region of the site. While the vegetation structure in this area has been altered, the native understorey layer is intact with minimal signs of disturbance. Areas of high disturbance are found at the higher elevations and at the ridge where informal tracks and weeds are numerous as a result of clearing and fires. The installation of Water Corporation infrastructure in the existing easement resulted in some clearing of vegetation in this area.

The UWA Zoology Research centre located in the south-west of the site is extensively cleared with only a few remnant eucalypt and *Acacia* species remaining. The area has been planted with exotics, in particular Flame Trees (*Erythrina indica).*

The eucalypt and *Banksia* species of the study area are in very good condition and do not appear to have been affected by Jarrah dieback (*Phytophthora cinnamomi)* or other pathogenic diseases. Some plants of *Acacia saligna* and *A. rostellifera* have been affected by the borer weevil. A mature Jarrah tree (trunk diameter up to 1.2m) was identified on the central ridge of the study area and immediately adjacent to the Water Corporation easement in the eastern region of the site (Figure 3).

2.5 Vertebrate Fauna

An assessment of the vertebrate fauna likely to occur on the study site was undertaken based on studies conducted at nearby Bold Park and a recent study undertaken in the Shenton Park Bushland in 1997 and 1998 (Berry and Berry, 1998).

The vegetation assessment identified one principal habitat in the study area consisting of *Banksia/Eucalyptus/Allocasuarina* Woodlands and Closed Scrubs. These habitats are not unique or unusual on the Swan Coastal Plain. Fauna likely to be present on the site will be typical of mixed *Banksia* Woodlands within the Perth Metropolitan Area although some species may no longer be represented due to development of surrounding areas and fragmentation of habitat.

A total of 79 species of vertebrate fauna, comprising 5 amphibians, 29 reptiles and 45 birds, are considered possible inhabitants of the site based on the size and range of habitat available, surveys of similar habitats in Lemnos Street bushland and Bold Park and the known distribution and habitat of species. These species are listed in Appendix 2.

Of the three frogs listed only the Turtle Frog is likely to inhabit the site throughout its life cycle as it does not require surface water to breed. The Moaning Frog (*Heleioporus eyrei*) and Pobblebonk or Banjo Frog (*Limnodynastes dorsalis*) may occur at the site provided suitable breeding sites are available in the surrounding area.

Surveys at Bold Park indicated the greatest diversity of herpetofauna was recorded in the *Banksia* woodlands. Therefore the study area is also expected to support a diverse array of reptiles. A total of 28 reptiles are listed as possible for the site.

The avifauna considered likely to inhabit the woodlands at the site consists of 45 species, 42 of which were recorded during surveys of Bold Park between 1986-89 (How and Dell, 1990).

No native mammals are considered likely to inhabit the Shenton Park site. Only the Common Brushtail Possum was recorded in Bold Park during surveys between 1986 to 1989 (How and Dell, 1990). This species is unlikely to occur within the study area due to differing habitats. The possum species was detected in *Eucalyptus rudis* and *E. gomphocephala* woodlands at Bold Park, a habitat which does not occur within the study area. The presence of the White-striped Mastiff-bat (*Tadarida australis*) was suspected at Bold Park during the same surveys but was not confirmed. No additional bat species were detected at Perry Lakes and Bold Park during netting and call monitoring with ultra-sonic detectors in 1990-91 (Wykes pers. comm.).

One of the species listed as likely to occur at the site is declared "in need of special protection" and listed on Schedule 1 of the Wildlife Conservation Act, 1950. The Short-billed Black-Cockatoo (*Calyptorhynchus latirostris*) may utilise the Jarrah and Banksia woodlands of the site for feeding but is not known to breed in the area.

The Black-striped Snake (*Neelaps calonotus*) is listed as "taxa in need of monitoring" (Priority 4) on the Department of Conservation and Land Management's Priority Fauna List. This species has a limited range which is under increasing threat from development.

Both the Short-billed Black-Cockatoo and the Black-striped Snake are present within Bold Park and may occur within the study area.

3. LOCAL AND REGIONAL CONTEXT

This section of the report discusses the attributes of the whole site within the context of current Government Policy on bushland within the Perth Metropolitan Region. The site's local and regional significance is also discussed.

3.1 Government Policy

The State Government released its policy on bushland in the Perth Metropolitan Region in 1995. The Urban Bushland Strategy established the Urban Bushland Advisory Group (UBAG) which advises the WA Planning Commission on the protection of bushland of regional significance within the Perth Metropolitan Region. The Strategy promotes the concept of categorising bushland according to its local or regional significance.

Locally significant bushland is seen to be the responsibility of Local Government and the community, with Local Authorities encouraged to produce local Bushland or District Conservation Strategies. The State Government has responsibility for bushland identified as regionally significant.

The criteria for categorising bushland as locally or regionally significant are shown in Table 3. Based on these criteria, the site may be classified as locally significant and has elements of regional significance.

Notwithstanding this assessment, a portion of Lot 2103 Underwood Avenue (32.1ha) has been nominated as having regional significance in the draft Perth's Bushplan released in November 1998 (Site 119).

Perth's Bushplan is a "whole of Government" report that builds on the System 6 Update and the findings of the Perth Environment Project. Prepared jointly by the Ministry for Planning (MFP), Department of Environmental Protection (DEP), Department of Conservation and Land Management (CALM) and the Water & Rivers Commission, it identifies areas of land worthy of protection to conserve the biodiversity of the Swan Coastal Plain portion of the Perth Metropolitan Region.

TABLE 3

CRITERIA FOR LOCALLY AND REGIONALLY SIGNIFICANT BUSHLAND
(Urban Bushland Strategy, 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 is 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 in 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.

3.2 Significance of the Site's Flora and Vegetation

The study site is a small area of natural bushland in the inner metropolitan area which may be considered locally and regionally significant as it provides a linkage to other areas of bushland, is greater than 4 hectares and contains vegetation which is in good condition. In a local context, the vegetation at Lot 2103 can be related to the much larger areas of vegetation preserved within Bold Park and Kings Park which are located within a 5 kilometre radius.

The study area is predominantly a mixed *Banksia/Eucalyptus* Woodland composed of young and mature *Banksia* and eucalypt species which show some signs of disturbance. The surveys conducted in December 1997 and July, 1998 identified a total of 96 species of flora in the bushland. Of these, 80 are native and 16 are introduced to the area. In addition, populations of the Priority 3 species, *Jacksonia sericea* were found in the study area. The composition of the vegetation associations represents a typical Spearwood soil system, and is found in other local bushland areas of similar soils such as Bold Park and Kings Park.

Botanical studies have been conducted at a number of reserves and open spaces of varying proximity to the Shenton Park site, including Kings Park and Bold Park, Trigg Reserve, Star Swamp, Hepburn Heights and Woodvale Nature Reserve. The flora and vegetation at each of these areas enables the flora and vegetation at the study site to be placed within a local (<5km radius) and regional (>5km radius) context.

Table 4 summarises the area and total number of indigenous species present in each area.

TABLE 4
BUSHLAND AREAS AND NUMBER OF INDIGENOUS SPECIES

BUSHLAND AREA	REFERENCE	SIZE (ha)	NO. OF NATIVE SPECIES
Kings Park	Bennett, 1988; Beard, 1997	400	290
Bold Park	Keighery et al, 1990	221	221
Trigg Reserve	City of Stirling, 1991	120	117
Star Swamp	Bell et al, 1984	100	191
Hepburn Heights	Alan Tingay & Assoc, 1991	55	200
Woodvale Nature Reserve	Langley, 1991	44	165
Lot 2103 Shenton Park	Present study (ATA, 1997, 98)	33	82

A total of 460 native species was recorded from all areas (Appendix 3). A large proportion of these species (43%) were recorded from one area only while nearly 20% occur in all seven areas. The differences between each area may be explained by the soil types found at each site, as shown in Table 5.

TABLE 5
SOIL TYPES OF BUSHLAND AREAS
(percentage of soil type at each area)

BUSHLAND AREA	S	Q	T
Kings Park			100
Bold Park	10	50	40
Trigg Reserve		100	
Star Swamp	10		90
Hepburn Heights			100
Woodvale Nature Reserve			100
Lot 2103, Shenton Park			100

S - Peaty clays of swamp deposits
Q - Sandy soils of the Safety Bay Sand (Quindalup Dunes)
T - Sands derived from Tamala Limestone of the Spearwood Dune System

Most of the species in the study area are typical of the Spearwood Dune system, and have a high probability of occurrence at other locations in that system. Flora lists for Bold Park and Kings Park reveal a high degree of similarity to the flora of the study area, as they all feature soils of the Spearwood Dune System.

The suggestion in Bushplan that the site is of regional significance is related to the Karrakatta - Central and South Vegetation Complex, floristic variation, the diversity of the flora and the presence of flora of special significance.

The Karrakatta Vegetation Complex - Central and South has approximately 5.6% of its original extent included within existing reserves. Conservation initiatives proposed under Bushplan will increase this figure by approximately 2.4% to bring the total to 8% of the original extent currently reserved or proposed for reservation.

In considering the regional significance of the vegetation it is useful to compare the vegetation of the site to nearby reserves. The Jarrah/*Banksia* Woodland vegetation associations at the study site are generally well represented at other local reserves and open spaces. Bold Park is composed of up to 70% (approximately 145ha) *Banksia* Low Woodland and Kings Park is composed predominantly of a mixed *Eucalyptus/Allocasuarina/Banksia* Open Woodland. Jarrah Woodlands are not as well represented locally as there it comprises only 2% (10ha) of the vegetation in Bold Park. Surveys conducted at the nearby Lemnos Street Bushland area (Alan Tingay and Associates, 1993) revealed a similar species composition associated with a Jarrah/*Banksia* Woodland, however of poorer quality than at Lot 2103, Underwood Avenue. Kings Park and Lemnos Street bushland both consist solely of Karrakatta – Central and South vegetation complex.

The condition of the vegetation at Shenton Park is variable and is similar to vegetation associations found at Bold Park and Kings Park. The frequent fires and lack of weed control and management at Shenton Park has led to significant weed invasion on similar scales as at Bold Park and Kings Park.

3.3 Significance of the Site's Vertebrate Fauna

A desktop assessment was conducted to identify potential vertebrate fauna occurring at the site. The principal habitats at Shenton Park, mixed Banksia Woodland and Banksia Closed Scrub, are not unique or unusual on the Swan Coastal Plain. In addition, the relatively small size of the bushland area, past landuses and fire frequency reflects the high degree of habitat alteration it has experienced.

Studies conducted at Bold Park (How & Dell, 1990) recognised two species of significant fauna which may also occur at Shenton Park due to suitable habitats. Further fauna investigations may need to be undertaken to determine whether these species, the Short-billed Black Cockatoo and the Black Stripped Snake, are likely to occur at the study area. No species of significant fauna have been identified at the Lemnos Street bushland site located to the south.

The vegetation within the study area may have significance in terms of its potential for linkage to Bold Park, Perry Lakes, Lemnos Street Bushland and Kings Park for avifauna. Connectivity between these areas enhances the biological integrity of the study area and therefore increase the potential range of associated fauna. Further studies may be required to determine the linkage value of the bushland to fauna.

4. CHAPPELL & LAMBERT CONCEPT PLAN

The present environmental assessment has determined that it is possible to retain current values of the site and meet Bushplan objectives by protecting representative bushland areas in an overall Structure Plan scenario. The surveys conducted in January and July 1998 identified nominal areas worthy of protection, in particular vegetation along Underwood Avenue and Selby Street. This recommendation has been recognised in the Concept Plan.

The Concept Plan for Lot 2103 Selby Street, Shenton Park produced by Chappell & Lambert, as shown in Figure 5, represents an integration of environmental, planning, landscape and engineering objectives. The Concept Plan has achieved a balance between the different sets of objectives, however the retention of bushland in an urban setting has been a primary objective, reflecting in particular the greenbelt initiatives mentioned above.

Overall, the plan provides for the protection of more than 25% of the site (9.75ha of 38.3ha). This protection takes the form of a range of land use options from parkland open space to University research grounds.

Importantly, local open space which would normally be required as a condition of subdivision approval, is included in the 25% figure. This is considered very reasonable as;

i) The land is zoned both "Urban" in the Metropolitan Design Scheme and "Development" zone is the City of Nedlands Scheme. On this basis, the landowner has always had an expectation of ultimate full development on the site. The offer to set aside 25% as non-urban land is, under these circumstances, a substantial compromise.

ii) Land which would constitute subdivisional open space has been located to protect substantial trees on site in a parkland setting. Parkland clearing which will result in the retention of the trees will therefore meet both conservation and recreation objectives.

iii) The site, when developed will be in close proximity to major local recreational open space and sporting facilities including Pat Goodridge Park, Matthews Netball Centre, McGillivray Sportsground and Challenge Stadium. Large grassed park areas are, therefore not required within the subdivisional area.

Aside from local open space forming part of the bushland strategy the other main environmental features of the plan are;

- Retention by the University of Western Australia of approximately 7.0 hectares of good quality Jarrah Woodland along Selby Street for the future establishment of an

environmentally sensitive wildlife research facility which will draw on the existing natural features of the site.

- Creation of a 45m wide open space bushland buffer along Underwood Avenue. This will further enhance the conservation value of the estate and retain a large landscape buffer screening development from Underwood Avenue.

- Retention of the larger populations of the Priority 3 species *Jacksonia sericea* within the future development of the Mixed Educational Activity sites. These areas will be protected where possible through sensitive design of the final development layout for each site.

- Retention of a number of large mature Jarrah trees within well located open space and/or special treatments within the development area.

- The Plan is consistent with the Perth Greenways project which identifies Underwood Avenue and the north eastern boundary of Lot 2103 as a strategic link between Bold Park and Kings Park (Greenway 20). The Plan aims to enhance the integrity of this link by retaining a buffer of between 45 and 125m along Underwood Avenue and Selby Street.

The Concept Plan will maintain the function of the bushland by retaining a significant area of good quality vegetation for conservation purposed and as a potential linkage between Bold Park and Kings Park for avifauna. In addition, the Concept Plan acknowledges the environmental values of the site by allocating Public Open Space and a Research site in accordance with what are considered to be the most important conservation priorities.

5. CONCLUSIONS

Lot 2103 Underwood Avenue, Shenton Park is an area of urban bushland which contains vegetation ranging from good to degraded condition. The species and vegetation types are typical for Spearwood soils on the Swan Coastal Plain. While several species and the vegetation types occurring at the study area are of interest within a local area, none of them are unique to the study site.

The bushland is considered locally significant by the Urban Bushland Advisory Board and is recognised as being within the second percentile ecological ranking (i.e. top 6 to 10%) of vegetation within the Perth Metropolitan Region. The regional significance of the site has been identified under the draft Perth Bushplan. The significance of the site is largely based on the presence of the Karrakatta – Central and South vegetation type and the area's function as a linkage for birds between Bold Park and Kings Park.

It is possible to retain the environmental values of the bushland by formulating an environmentally sensitive subdivision design at the planning stage of the development. This has been achieved in the Chappell & Lambert Concept Plan for the site by retaining areas of vegetation which are representative of the bushland and which are in good to very good condition. The Concept Plan identifies a greenbelt which follows Underwood Avenue in the north and continues around the site boundary in the west, therefore selecting flora representative of the mixed *Banksia/Eucalyptus* Woodland. This landscape design feature preserves the linkage from Bold Park to Kings Park and will assist in the retention of a small pocket of quality urban bushland as well as protecting species of local significance including mature Marri, Jarrah and *Banksia* trees.

The Plan has also retained areas of vegetation that are representative of the Jarrah and *Banksia* Woodlands and are in good to very good condition. Particular attention has been given to retaining mature eucalypts, particularly on the central ridge, with an adequate buffer surrounding the trees. The conservation of mature *Banksia* trees within parkland cleared areas has not been recommended as these species do not survive when isolated or removed from the bushland setting.

Some populations of the Priority 3 species, *Jacksonia sericea,* have been retained in areas of Public Open Space.

The University of Western Australia is committed to regional government initiatives and provides and maintains significant regional facilities at McGillivray Oval and Challenge Stadium (which is leased to the Government at a peppercorn rental). The bushland conservation plan proposed in this report presents a further commitment to regional planning by the University of Western Australia.

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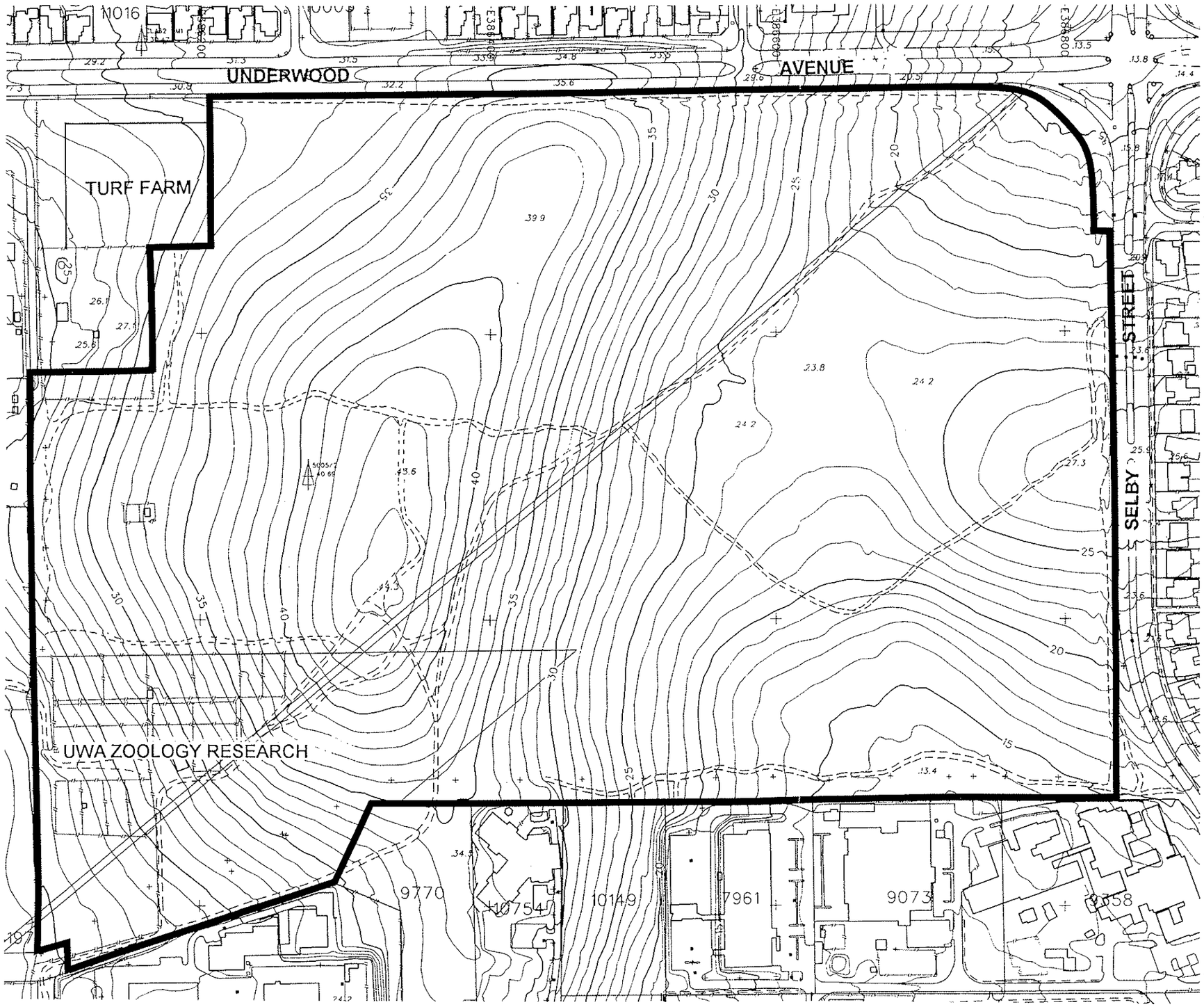
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Date:	24 February, 1999

FIGURES



metres
0 50 100
SCALE 1 : 3,000

LEGEND

- Boundary of subject land
- 30 Topographic contours (m AHD)
- 23.8 Spot height (m AHD)
- Track / firebreak

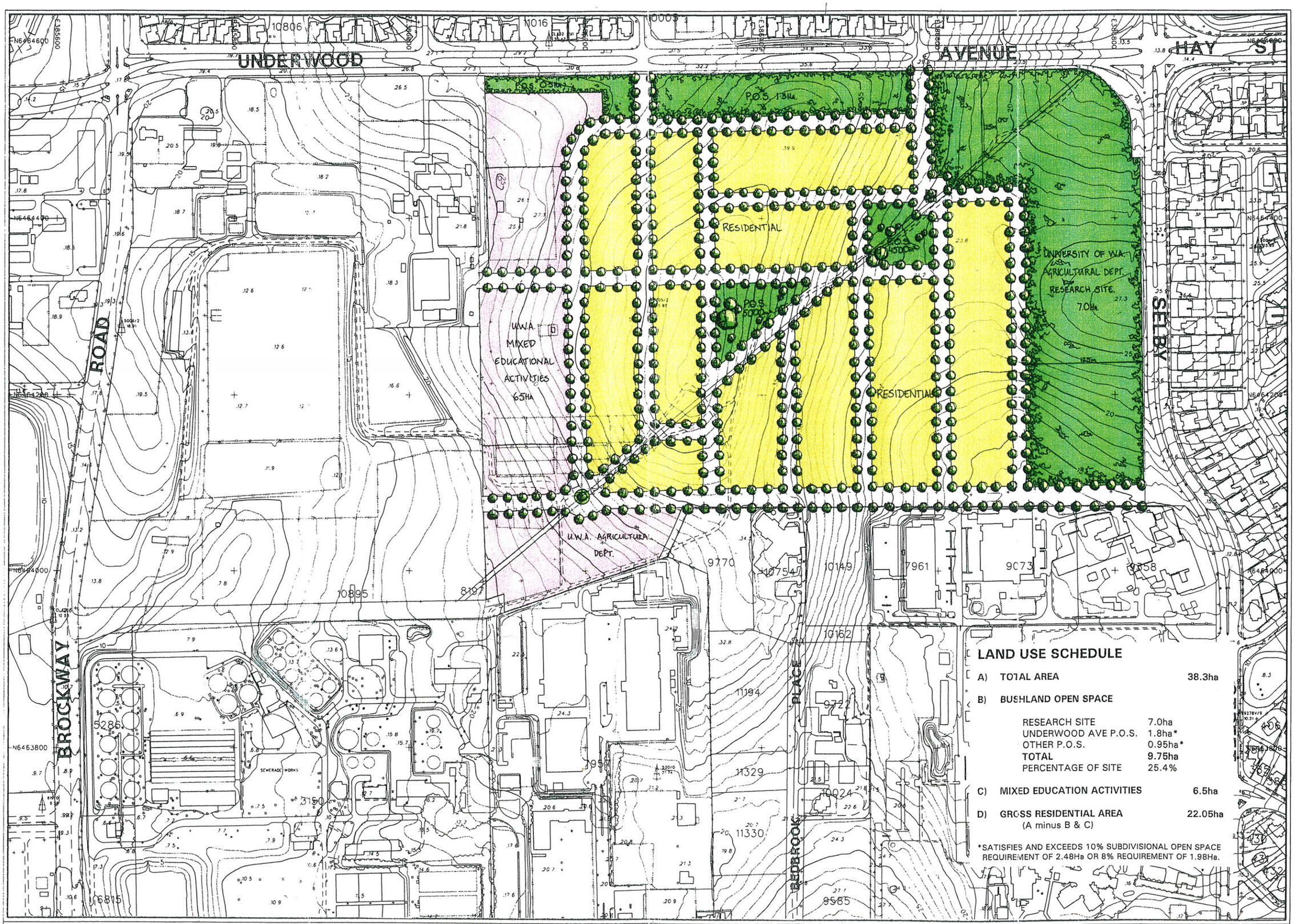
LOT 2103
UNDERWOOD AVE SHENTON PARK
TOPOGRAPHY
FIGURE 2

DRAWN BY: GLM 12-8-98 CHECKED BY: S.M. 19-8-98

98101

SOURCE : McMULLEN NOLAN & PARTNERS

ALAN TINGAY & ASSOCIATES



PRELIMINARY CONCEPT PLAN
U.W.A. - Shenton Park

FIGURE 5

CHAPPELL & LAMBERT
PLANNING CONSULTANTS

SCALE	DATE	COMPILED	REVISED	PLAN Nº
1:2000	01.02.99	C&L MAPS		778-03

APPENDICES

APPENDIX 1

FLORA LIST FOR LOT 2103
UNDERWOOD AVENUE, SHENTON PARK

APPENDIX 1

FLORA LIST FOR LOT 2103
UNDERWOOD AVENUE, SHENTON PARK

GYMNOSPERMS	
ZAMIACEAE	*Macrozamia riedleii*
MONOCOTYLEDONS	
ANTHERICACEAE	*Corynotheca micrantha* *Laxmannia squarrosa* *Lomandra nigricans* *Thysanotus sparteus*
COLCHICACEAE	*Burchardia umbellata*
CYPERACEAE	*Lepidosperma leptostachyum* *Lepidosperma scabrum* *Mesomelaena pseudostygia* *Tetraria octandra*
HAEMODORACEAE	*Anigozanthus humilis* *Conostylis aculeata* *Conostylis aurea* *Conostylis setigera* *Haemodorum laxum* *Haemodorum spicatum*
IRIDACEAE	**Gladiolus sp.*
ORCHIDACEAE	*Pterostylis vittata*
PHORMIACEAE	*Dianella divaricata*
POACEAE	**Avena fatua* **Briza maxima* **Briza minor* **Cynodon dactylon* **Ehrharta calycina* **Ehrharta longiflora* **Lagurus ovatus* **Pennisetum setaceum* **Poa annua* **Stenotaphrum secundatum*

RESTIONACEAE	*Alexgeorgea nitens* *Loxocarya flexuosa* *Lyginia barbata*
XANTHORRHOEACEAE	*Xanthorrhoea preissii* *Xanthorrhoea reflexa*

DICOTYLEDONS

AMARANTHACEAE	*Ptilotus drummondii* *Ptilotus polystachyus*
ASTERACEAE	*Helichrysum cordatum* **Helipterum roseum* **Hypochaeris glabra* *Lagenifera huegelii* *Olearia axillaris* **Ursinia anthemoides*
CASUARINACEAE	*Allocasuarina fraseriana*
DASYPOGONACEAE	*Calectasia cyanea*
DILLENIACEAE	*Hibbertia hypericoides* *Hibbertia huegelii*
DROSERACEAE	*Drosera erythrorhiza*
EPACRIDACEAE	*Astroloma pallidum* *Conostephium pendulum* *Leucopogon parviflorus*
EUPHORBIACEAE	**Euphorbia peplus* *Phyllanthus calycinus*
GERANIACEAE	**Pelargonium capitatum*
GOODENIACEAE	*Scaevola canescens* *Scaevola paludosa*
MIMOSACEAE	*Acacia cyclops* *Acacia huegelii* *Acacia lasiocarpa* *Acacia pulchella* *Acacia rostellifera*

	Acacia saligna
	Acacia stenoptera
	Acacia willidenowiana
MOLLUGINACEAE	*Macarthuria australis*
MYRTACEAE	*Calytrix fraseri*
	**Chamelaucium uncinatum*
	Eucalyptus decipiens
	Eucalyptus gomphocephala
	Eucalyptus marginata
	Hypocalymma robustum
PAPILIONACEAE	*Daviesia divaricata*
	Daviesia nudiflora
	Daviesia triflora
	Gompholobium tomentosum
	Hardenbergia comptoniana
	Hovea trisperma
	Isotropis cuneifolia
	Jacksonia furcellata
	Jacksonia sericea (P3)
	Kennedia prostrata
	Nemcia capitata
POLYGALACEAE	*Comesperma calymega*
PROTEAECEAE	*Banksia attenuata*
	Banksia grandis
	Banksia menziesii
	Banksia prionotes
	Dryandra lindleyana
	Hakea prostrata
	Petrophile linearis
	Petrophile macrostachya
	Petrophile media
	Stirlingia latifolia
	Synaphea polymorpha
RANUNCULACEAE	*Clematis microphylla*
STYLIDIACEAE	*Stylidium repens*
THYMELEACEAE	*Pimelea sulphurea*

*indicates introduced species

APPENDIX 2

POTENTIAL VERTEBRATE FAUNA LIST
LOT 2103, SHENTON PARK

APPENDIX 2

VERTEBRATE FAUNA LIST

AMPHIBIANS

LEPTODACTYLIDAE	
Crinia insignifera	Squelching Froglet
Heleioporus eyrei	Moaning Frog
Limnodynastes dorsalis	Western Banjo Frog/Pobblebonk
Myobatrachus gouldii	Turtle Frog
HYLIDAE	
Litoria adelaidensis	Slender Tree Frog

REPTILES

GEKKONIDAE	
Phyllodactylus marmoratus	Marbled Gecko
Strophurus spinigerus	South Western Spiny Tailed Gecko
PYGOPODIDAE	
Aprasia repens	South Western Sandplain Worm Lizard
Delma fraseri	Fraser's Legless Lizard
Delma grayii	Gray's Legless Lizard
Lialis burtonis	Burton's Legless Lizard
AGAMIDAE	
Pogona minor	Western Bearded Dragon
Tympanocryptis adelaidensis	Western Heath Dragon
VARANIDAE	
Varanus gouldii	Gould's Monitor
Varanus rosenbergi	Southern Heath Monitor
SCINCIDAE	
Cryptobleplagiocephalus	Snake Eyed, fence or sun Skink
Ctenotus falens	West Coast Ctenotus
Ctenotus leseurii	Western Limestone Ctenotus
Hemiergis quadrillineata	Two Toed Earless Skink
Hemiergis peroni	Yellow Bellied Skink
Lerista elegans	West Coast Four Toed Lerista
Lerista lineopuctulata	West Coast Line Spotted Lerista
Lerista praepedita	Western Worm Lerista
Menetia Greyii	Common Dwarf Skink
Morethia lineoocellata	Western Pale Flecked Morethia
Morethia obscura	Southern Pale Flecked Morethia
Tiliqua rugosa	Bobtail

TYPHLOPIDAE	
Ramphotyphlops australis	Southern Blind Snake
ELAPIDAE	
Neelaps bimaculatus	Black Naped Snake
Neelaps calonotus P4	Black Striped Snake
Pseudonaja affinis	Dugite
Simoselaps bertholdi	Jan's Banded Snake
Simoselaps fasciolatus	Narrow Banded Snake
Simoselaps semifasciatus	Southern Half Girdled Snake

BIRDS

ACCIPITRIDAE	
Elanus axillaris	Black Shouldered Kite
FALCONIDAE	
Falco cenchroides	Nankeen Kestrel
COLUMIDAE	
Streptopelia senegalensis	Laughing Turtle Dove
Streptopelia chinensis	Spotted Turtle Dove
CACATUIDAE	
Calyptorhynchus latirostris S1	Short Billed Black Cockatoo
Cacatua roseicapilla	Galah
PSITTACIDAE	
Barnardius zonarius	Australian Ringneck
Purpureicephalus spurius	Red Capped Parrot
CUCULIDAE	
Cuculus pallidus	Pallid Cuckoo
Cacomantis flabelliformis	Fan Tailed Cuckoo
Chrysococcyx lucidus	Shining Bronze Cuckoo
PODARGIDAE	
Podargus strigoides	Tawny Frogmouth
HALCYONIDAE	
Dacelo novaeguineae	Laughing Kookaburra
Todiramphus sanctus	Sacred Kingfisher
MEROPIDAE	
Merops ornatus	Rainbow Bee Eater

MALURIDAE	
Malurus splendens	Splendid Fairy Wren
PARDALOTIDAE	
Pardalotus punctatus	Spotted Pardalote
Pardalotus striatus	Striated Pardalote
Gerygone fusca	Western Gerygone
Acanthiza apicalis	Inland Thornbill
Acanthiza chrysorrhoa	Yellow Rumped Thornbill
MELIPHAGIDAE	
Anthochaera carunculata	Red Wattlebird
Anthochaera chrysoptera	Little Wattlebird
Lichenostomus virescens	Singing Honeyeater
Lichmera indistincta	Brown Honeyeater
Phylidonyris novaehollandiae	New Holland Honeyeater
Phylidonyris nigra	White Cheeked Honeyeater
Acanthorhynchus superciliosus	Western Spinebill
PETROICIDAE	
Petroica multicolor	Scarlet Robin
PACHYCEPHALIDAE	
Pachycephala pectoralis	Golden Whistler
Pachycephala rufiventris	Rufous Whistler
Colluricincla harmonica	Grey Shrike Thrush
DICRURIDAE	
Grallina cyanoleuca	Magpie Lark
Rhipidura fuliginosa	Grey Fantail
Rhipidura leucophrys	Willie Wagtail
CAMPEPHAGIDAE	
Coracina novaehollandiae	Black Faced Cuckoo Shrike
ARTAMIDAE	
Artamus cinereus	Black Faced Woodswallow
Cracticus torquatus	Grey Butcherbird
Gymnorhina tibicen	Australian Magpie
CORVIDAE	
Corvus coronoides	Australian Raven
MOTACILLIDAE	
Anthus novaeseelandiae	Richard's Pipit

DICAEIDAE	
Dicaeum hirundinaceum	Mistletoe Bird
HIRUNDINIDAE	
Hirundo neoxena	Welcome Swallow
Hirundo nigricans	Tree Martin
ZOSTEROPIDAE	
Zosterops lateralis	Silvereye

APPENDIX 3

FLORA LISTS FOR LOCAL AND REGIONAL BUSHLAND AREAS

NAME	Hepburn	Star Swp	Trigg	Kings Pk	Woodvale	Bold Pk	Shenton Pk
NON-FLOWERING PLANTS							
ADIANTACEAE							
Anogramma leptophylla				1			
CYCADACEAE							
Macrozamia riedlei	1	1	1	1	1	1	1
CUPRESSACEAE							
Actinostrobus pyramidalis				1			
Callitris preissii			1	1		1	
FLOWERING PLANTS							
MONOCOTYLEDONS							
ANTHERICACEAE							
Agrostocrinum scabrum				1			
Arnocrinum preissii				1			
Arthropodium capillipes	1	1		1		1	
Caesia micrantha	1				1	1	
C. parviflora		1		1			
Chamaescilla corymbosa				1			
Corynotheca micrantha	1	1	1	1	1	1	1
Laxmannia sp		1					
L. ramosa				1			
L. squarrosus				1	1		1
Sowerbaea laxiflora	1	1	1	1	1	1	
Thysanotus arenarius	1	1		1	1		
Thysanotus sp.					1		
T. dichotomus				1	1		
T. patersonii	1	1		1	1	1	
T.sparteus	1	1		1		1	1
T. thyrsoideus				1			
T. triandrus	1	1	1	1	1		
Tricoryne elatior	1	1		1	1	1	1
CENTROLEPIDACEAE							
Centrolepis drummondiana	1			1	1		
C. pubescens					1		
COLCHICACEAE							
Burchardia umbellata	1	1		1	1	1	1
Wurmbea monantha	1*					1	
COMMELINACEAE							
Cartonema philydroides	1			1		1	
CYPERACEAE							
Baumea juncea		1				1	
Bulboschoenus caldwellii		1				1	
Carex preissii		1					
Caustis dioica						1	

Cyperus alterniflorus						1	
Gahnia trifida		1					
Isolepis carnua	1			1		1	
I. marginata				1	1		
I. nodosa		1	1	1		1	
Lepidosperma angustatum	1		1	1	1	1	
L. costale			1	1			
L. gladiatum			1	1		1	
L. gracile		1	1				
L. longitudinale						1	
L. leptostachyum	1			1		1*	1
L. scabrum				1	1		1
L. tenue		1					
Mesomalaena pseudo stygia	1	1	1	1	1	1	1
M. tetragona					1	1	
Schoenoplectus articulatus		1					
S. validus		1					
Schoenus benthamii				1			
S. brevisetis				1			
S. clandestinus	1				1		
S. curvifollus	1			1	1		
S. grandiflorus	1		1	1	1	1	
S. lanatus						1	
S. latitans				1			
S. subfascicularis			1				
S. trachycarpus		1					
Tetraria octandra	1	1		1		1	1
DASYPOGONACEAE							
Acanthocarpus preissii	1	1	1	1	1	1	
Calectasia cyanea				1			1
Dasypogon bromeliifolius				1			
Lomandra caespitosa	1	1		1	1		
L. hermaphrodita	1	1		1			
L. maritima	1	1		1	1	1	
L. nigricans				1			
L. micrantha				1			
L. preissii	1	1		1		1	
L. purpurea						1	
L. suaveolens	1			1			
HAEMODORACEAE							
Anigoxanthos humilis	1	1		1	1	1	1
A. manglesii	1	1	1	1		1	
Conostylis aculeata	1	1	1	1	1	1	1
C. candicans	1	1	1	1		1	
C. setigera				1			1
C. hybrid				1	1*		
Haemodorum effusum					1		
H. laxum	1			1			1
H. paniculatum	1	1		1	1		
H. spicatum	1	1	1	1	1	1	1
Phlebocarya ciliata				1			

IRIDACEAE							
Orthrosanthus laxus	1	1		1			
Patersonia occidentalis	1	1		1		1	
JUNCACEAE							
Luzula maridionalis	1			1	1		
JUNCAGINACEAE							
Juncus kraussii		1				1	
J. bufonius						1	
J. pallidus				1		1	
Triglochin calcitrapa	1						
T. centrocarpa				1	1		
T. striata						1	
ORCHIDACEAE							
Caladenia arenicola					1		
C. deformis		1		1	1		
C. discoidea				1	1	1	
C. filamentosa		1					
C. flava	1	1	1	1	1	1	
C. hirta			1	1			
C. huegelii	1	1		1	1		
C. latifolia	1	1	1	1	1	1	
C. longicauda ssp. calcigena	1	1		1	1		
C. macrostylis				1			
C. menziesii		1		1	1		
C. reptans				1			
C. sericea				1			
C. gemmata					1		
C. georgei					1		
C. patersonii						1	
Diuris corymbosa					1		
D. longifolia	1	1	1	1	1	1	
Elythranthera brunonsis				1	1		
Eriochilus dilatatus				1	1	1	
Leporella fimbriata				1			
Lyperanthus nigricans	1	1		1	1		
Microtis media					1		
M. unifolia	1	1		1		1	
Paracalaena nigrita				1		1	
Prasophyllum giganteum	1	1		1	1		
Pterostylis barbata				1			
P. nana	1			1	1		
P. recurva	1			1			
P. sanguineus					1		
P. scabra robusta		1		1		1	
P. vittata	1	1	1	1		1	1
Thelymitra fuscolutea fuscolutea				1	1		
T. aff fuscolutea					1		
T. crinita				1			
T. nuda				1			

PHORMIIACEAE							
Dianella revoluta divaricata	1	1	1	1	1	1	1
Stypandra grandiflora		1					
POACEAE							
Agrostis avenacea						1	
A. preissiana						1	
Amphipogon turbinatus	1			1		1	
Bromus arenarius					1*	1	
Danthonia caespitosa	1			1			
D. setacea					1		
Imperata cylindrica		1					
Microlaena stipoides	1			1		1	
Neurachne alopecuroidea				1		1	
Poa. drummondiana	1				1		
P. porphyroclados				1		1	
Spinifex hirsutus			1				
longifolius			1				
Sporobolus virginicus						1	
Stipa compressa	1			1			
S. elegantissima				1		1	
S. flavescens	1	1*		1	1*	1	
S. semibarbata	1			1	1		
Tetrarrhena laevis		1					
POTAMOGETONACEAE							
Potamogeton pectinatus		1					
RESTIONACEAE							
Alexgeorgea arenicola				1			1
A.nitens	1		1		1	1	
Hypolaena exsulca	1			1			
Loxocarya cinerea					1	1	
L. fasciculata	1			1		1	
L. flexuosa	1	1	1	1			1
Lyginia barbata	1			1			1
XANTHORRHOEACEAE							
Xanthorrhoea preisii	1	1		1	1	1	1
DICOTYLEDONS							
AIZOACEAE							
Carpobrotus c.g. modestus (GK 11,518)	1						
C. virescens			1				
AMARANTHACEAE							
Ptilotus drummondii	1	1		1	1	1	1
P. humilis					1		
P. manglesii	1				1		
P. polystachyus	1	1		1	1	1	1
P. stirlingii	1						
P. villosiflorus					1		

APIACEAE							
Centella asiatica		1					
C. cordifolia						1	
Daucus glochidiatus	1	1		1	1	1	
Eryngium pinnatifidum	1	1			1		
E. rostratum				1		1	
Homalosciadium homalocarpum	1	1		1	1	1	
Hydrocotyle diantha						1	
H. hispidula				1	1*		
Trachymene caerulea		1	1	1		1	
T. pilosa	1	1		1	1	1	
Xanthosia huegelii	1	1		1	1	1	
ASTERACEAE							
Arctotis stoechadifolia			1				
Asteridia pulverulenta				1	1	1	
Brachycome iberidifolia		1				1	
Calocephalus brownii			1				
C. angianthoides				1			
Cotula coronopifolia		1					
Craspedia sp		1					
Gnaphalium sphaericum						1	
Helipterum cotula						1	
Helichrysum cordatum		1	1	1		1	1
Lagenifera heugelii		1		1	1	1	1
Millotia myositidifolia					1	1	
M. tenuifolia	1			1			
Olearia axillaris	1	1	1	1		1	1
O. elaiophila				1			
O. rudis						1	
Podolepis gracilis	1	1		1	1		
P. lessonii					1		
P. canescens						1	
Podotheca angustifolia	1	1		1		1	
P. chrysantha	1			1			
Quinetia urvillei	1			1	1		
Roxerus humifusus	1			1			
Senecio hispidulus	1			1			
S. lautus ssp. maritimus	1			1	1	1	
Waitzia citrina				1			
W. aurea						1	
W. suaveolens	1	1		1		1	
BRASSICACEAE							
Stenopetalum robustum						1	
CAMPANULACEAE							
Wahlenbergia preissii	1			1		1	
W. gracilenta					1*		
CARYOPHYLLACEAE							
Tunica prolifera					1		

CASUARINACEAE							
Allocasuarina fraseriana	1	1	1	1	1	1	1
A. humilis	1	1	1	1	1	1	
A. lehmanniana			1				
CHENOPODIACEAE							
Atriplex cinerea				1			
A. isatidea			1				
Rhagodia baccata	1	1		1	1	1	
Threlkeldia diffusa			1				
CLUSIACEAE							
Hypercium gramineum						1	
CRASSULACEAE							
Crassula colorata	1	1	1*	1	1	1	
C. exserta	1	1			1	1	
C. pedicellosa					1		
CUSCUTACEAE							
Cuscuta sp	1						
DILLENIACEAE							
Hibbertia huegelii				1			1
H.cuneiformis						1	
H. hypericoides	1	1	1	1	1	1	1
H. racemosa	1	1	1	1	1	1	
H. spicata						1	
H. subvaginata		1					
DROSERACEAE							
Drosera erythrorhiza	1	1		1	1	1	1
D. glanduligera	1			1		1	
D. macrantha	1	1	1	1	1	1	
D. pallida	1			1	1	1	
D. penicillaris				1			
D. stolonifera	1			1		1	
EPACRIDACEAE							
Acrotriche cordata			1			1	
Astroloma ciliatum		1		1	1	1	
A. microcalyx		1		1		1	
A. pallidum	1	1		1	1	1	1
A. sp		1					
Conostephium pendulum	1	1		1	1	1	1
C. ? minus					1		
C. preissii	1		1	1	1	1	
Leucopogon australis	1					1	
L. insularis						1	
L. parviflorus	1	1	1	1			
L. polymorphus						1	
L. propinquus	1	1	1	1	1	1	
L. racemulosus				1			

L. sprengelioides	1						
Lysinema ciliabum						1	
EUPHORBIACEAE							
Adriana quadripartita		1		1			
Beyeria cinerea						1	
Monotaxis grandiflora	1	1		1	1		
M. megacarpa		1					
Phyllanthus calycinus	1	1	1	1	1	1	1
Poranthera microphylla	1			1	1	1	
Ricinocarpos glaucus	1	1	1	1	1		
FRANKENIACEAE							
Frankenia pauciflora			1				
GERANIACEAE							
Geranium solanderi		1					
GOODENIACEAE							
Dampiera linearis	1	1		1			
Lechenaultia floribunda				1			
L. linarioides	1	1	1			1	
Scaevola canescens	1	1	1	1	1	1	
S. crassifolia		1	1	1		1	
S. holosericea		1	1	1		1	
S. nitida			1	1			
S. paludosa	1	1	1	1			1
S. thesioides	1		1	1		1	
GYROSTEMONACEAE							
Gyrostemon ramulosus			1			1	
Tersonia cyathiflora	1	1	1	1		1	
HALORAGACEAE							
Gonocarpus pithyoides				1			
Gilschrocaryon aureum	1			1			
LAMIACEAE							
Hemiandra linearis			1				
H. pungens	1	1	1	1		1	
Westringia dampieri			1				
LAURACEAE							
Cassytha glabella	1	1*	1	1			
C. racemosa	1			1		1	
C. flava						1	
LOBELIACEAE							
Lobelia alata		1				1	
L. gibbosa		1		1			
L. tenuior	1	1		1	1	1	
Isotoma hypocrateriformis	1				1		
I. scapigera				1			

LOGANIACEAE							
Logania vaginalis		1				1	
Mitrasacme paradoxa				1			
LORANTHACEAE							
Amyema miquelii				1		1	
Nuytsia floribunda	1	1		1			
MIMOSACEAE							
Acacia cochlearis	1	1	1	1		1	
A. cyclops	1	1	1	1	1	1	1
A. huegelii				1			1
A. lasiocarpa	1	1	1	1	1	1	1
A. pulchella	1	1	1	1	1	1	1
A. rostellifera	1	1	1	1	1	1	
A. saligna	1	1	1	1	1	1	1
A. stenoptera		1		1		1	1
A. truncata	1	1	1			1	
A. willdenowiana		1		1	1	1	1
A. xanthina						1	
MOLLUGINACEAE							
Macarthuria australis				1			1
MYOPORACEAE							
Eremophila glabra			1	1		1	
Myoporum apiculatum		1					
M. capraroides						1	
M. insulare	1		1	1		1	
M. tetrandrum		1					
MYRTACEAE							
Baeckea camphorosmae					1		
B. robusta		1					
Calytrix angulata	1			1			
C. flavescens				1			
C. fraseri				1			1
Calothamnus quadrifidus	1		1	1		1	
C. sanguineus		1					
Eremaea pauciflora				1	1		
Eucalyptus calophylla	1	1	1	1	1	1	1
E. decipiens	1	1		1		1	
E. foecunda						1	
E. gomophocaphala	1	1	1	1	1	1	1
E. marginata	1	1	1	1	1	1	1
E. todtiana		1					
Hypocalymma robustum	1			1	1	1	1
Kunzea ericifolia				1			
Melaleuca acerosa	1	1	1	1		1	
M. cardiophylla			1				
M. heugelii		1	1	1		1	
M. incana						1	
M. lanceolata				1			

M. rhaphiophylla		1					
M. scabra		1					
M. teretifolia		1					
Regelia ciliata						1	
Verticordia densiflora				1			
OLACACEAE							
Olax benthamiana	1					1	
OXALIDACEAE							
O. perennans						1	
PAPILIONACEAE							
Bossiaea eriocarpa	1	1		1		1	
B. ornata				1			
Daviesia decurrens	1			1			
D. divaricata	1			1	1	1	1
D. gracilis		1	1		1		
D. incrassata		1					
D. nudiflora	1	1		1	1		1
D. pectinata					1		
D. triflora	1			1	1	1	1
Gompholobium aristatum	1			1			
G. knightianum					1		
G. tomentosum	1	1	1	1	1	1	1
Hovea pungens	1	1	1	1		1	
H. trisperma	1	1	1	1	1	1	1
Hardenbergia comptoniana	1	1		1	1	1	1
Jacksonia furcellata	1	1	1	1	1		1
J. floribunda						1	
J. hakeoides		1					
J. sericea	1	1		1	1	1	
J. sternbergiana	1	1	1	1	1	1	
Isotropis cunenifolia	1	1	1	1	1	1	
Kennedia prostrata	1		1	1	1	1	1
Oxyloblum capitatum	1	1	1	1			1
reticulatum	1	1	1		1		
Sphaerolobium sp	1					1	
S. linophyllum						1	
Templetonia retusa	1	1	1	1		1	
PITTOSPORACEAE							
Pronaya fraseri				1			
Sollya heterophylla				1			
POLYGONACEAE							
Comesperma calymega				1		1	
C. confertum	1					1	
C. integerrinum						1	
PORTULACACEAE							
Calandrinia corrigioloides	1	1		1	1	1	
C. eremaea		1	1*				

C. liniflora	1			1	1	1	
C. brevipedata					1		
Portulaca sp		1					
PROTEACEAE							
Adenanthos barbigerus				1			
A. cygnorum				1			
Banksia attenuata	1		1	1	1	1	1
B. grandis		1	1	1	1	1	1
B. ilicifolia				1			
B. littoralis						1	
B. menziesii	1		1	1	1	1	1
B. prionotes	1		1	1	1	1	1
Conospermum stoechadis				1			
C. triplinervium	1		1	1		1	
Dryandra nivea	1	1	1	1	1	1	1
D. sessilis	1	1	1	1	1	1	1
Grevillea crithmifolia	1	1	1	1		1	
G. pilulifera				1			
G. thelemanniana	1	1	1	1		1	
G. vestita	1	1		1	1	1	
Hakea lissocarpha	1	1		1	1		
H. ruscifolia		1				1	
H. prostrata	1	1	1	1	1	1	1
H. trifurcata				1			
?Isopogon sp					1		
Persoonia saccata	1	1		1	1	1	
Petrophile brevifolia	1	1					
P. linearis	1	1		1	1	1	1
P. macrostachya	1	1		1	1	1	1
P. media				1	1		1
P. aff. serruriae		1	1	1		1	
Stirlingia latifolia	1	1	1	1		1	1
Synaphea spinulosa	1	1		1	1		
RANUNCULACEAE							
Clematis microphylla	1	1	1	1	1	1	1
C. pubescens		1			1		
Ranunculus colonorum		1				1	
RHAMNACEAE							
Cryptandra arbutiflora				1	1*	1	
C. nutans		1					
Spyridium globulosum		1	1	1		1	
S. tridentatum	1			1	1		
Trymalium ledifolium		1	1	1		1	
RUBIACEAE							
Opercularia floribunda			1				
O. hispidula				1		1	
O. vaginata	1	1	1	1	1	1	

RUTACEAE							
Boronia ramosa anethifolia				1			
Eriostemon spicatus	1	1		1	1		
SANTALACEAE							
Anthobolus sp			1				
Exocarpos sparteus	1		1			1	
Santalum acuminatum		1	1			1	
SAPINDACEAE							
Dodonaea hackettiana				1			
D. aptera						1	
Diplopeltis huegelii			1			1	
SOLANACEAE							
Anthocercis ilicifolia	1			1			
A littorea		1	1	1		1	
anum symonii						1	
STACKHOUSIACEAE							
Stackhousia heugelii		1					
Tripetrococcus brunonis	1			1			
STERCULIACEAE							
Lasiopetalum membranaceum				1			
Thomasia cognata			1				
T. foliosa	1						
T. triphylla			1			1	
STYLIDIACEAE							
Levenhookia stipitata	1			1	1		
Stylidium brunonianum	1	1		1	1	1	
S. aff. affine						1	
S. calcaratum	1	1		1	1		
S. carnosum				1			
S. macrocarpum	1					1	
biliferum				1			
S. repens	1	1		1		1	
S. scheonoides	1			1	1		
S. junceum	1		1		1	1	
THYMELAEACEAE							
Pimelea calcicola	1	1				1	
P. leucantha	1			1			
P. rosea		1		1		1	
P. suaveolens		1					
P. sulphurea	1			1	1		1
UTRICACEAE							
Parietaria debilis	1					1	
VIOLACEAE							
Hybanthus calycinus	1	1	1	1	1	1	



5214 WA 3165 (C) METRO REGIONAL AREA & EXT. RUN 9 (5161-5244) 1:2[illegible]00 11-DEC-92 920676



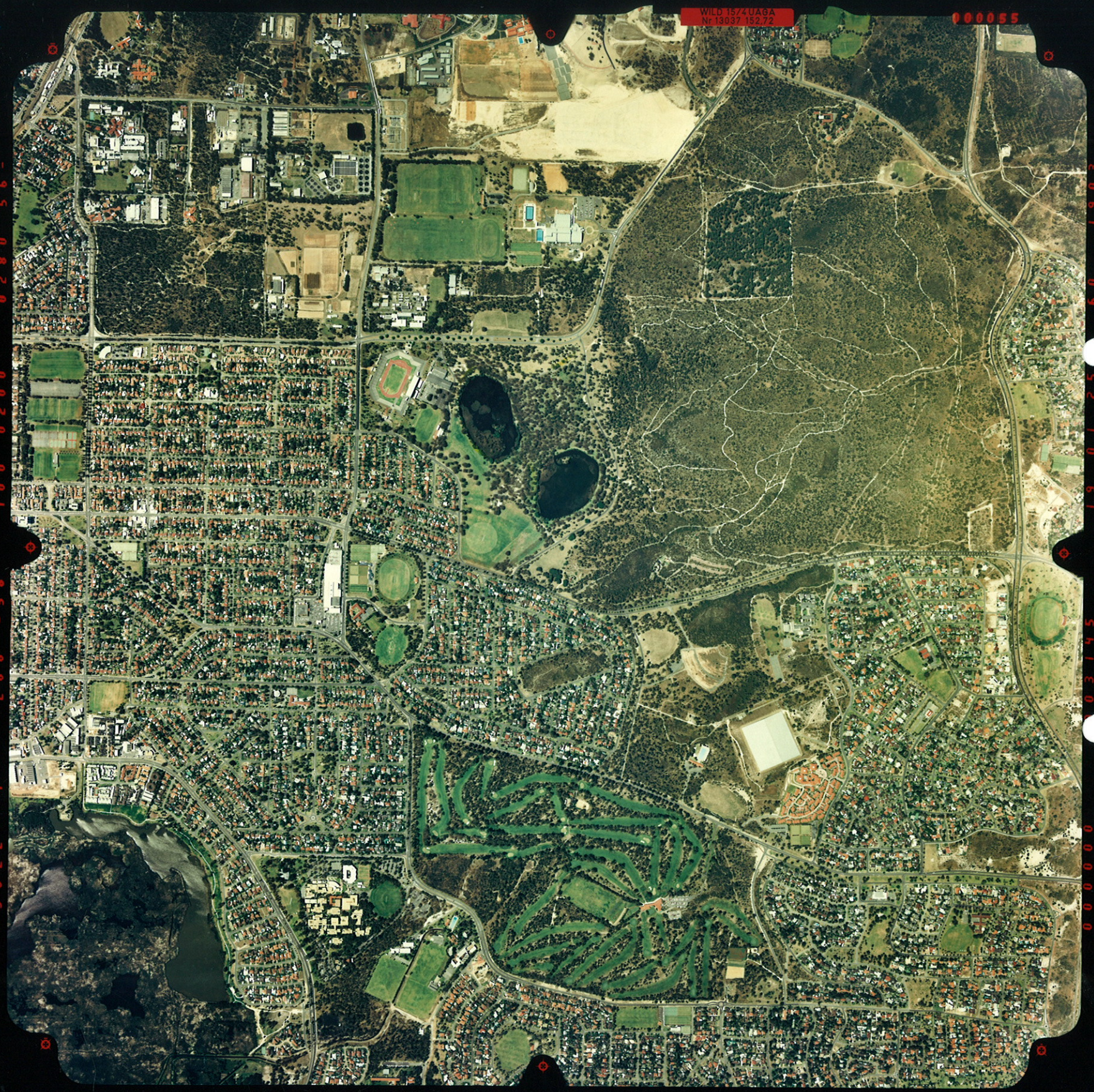
5135 WA 2939(C) METRO STREET DIRECTORY & EXT. RUN 7 (5102-5203) 1:20000 5.1.91 910400



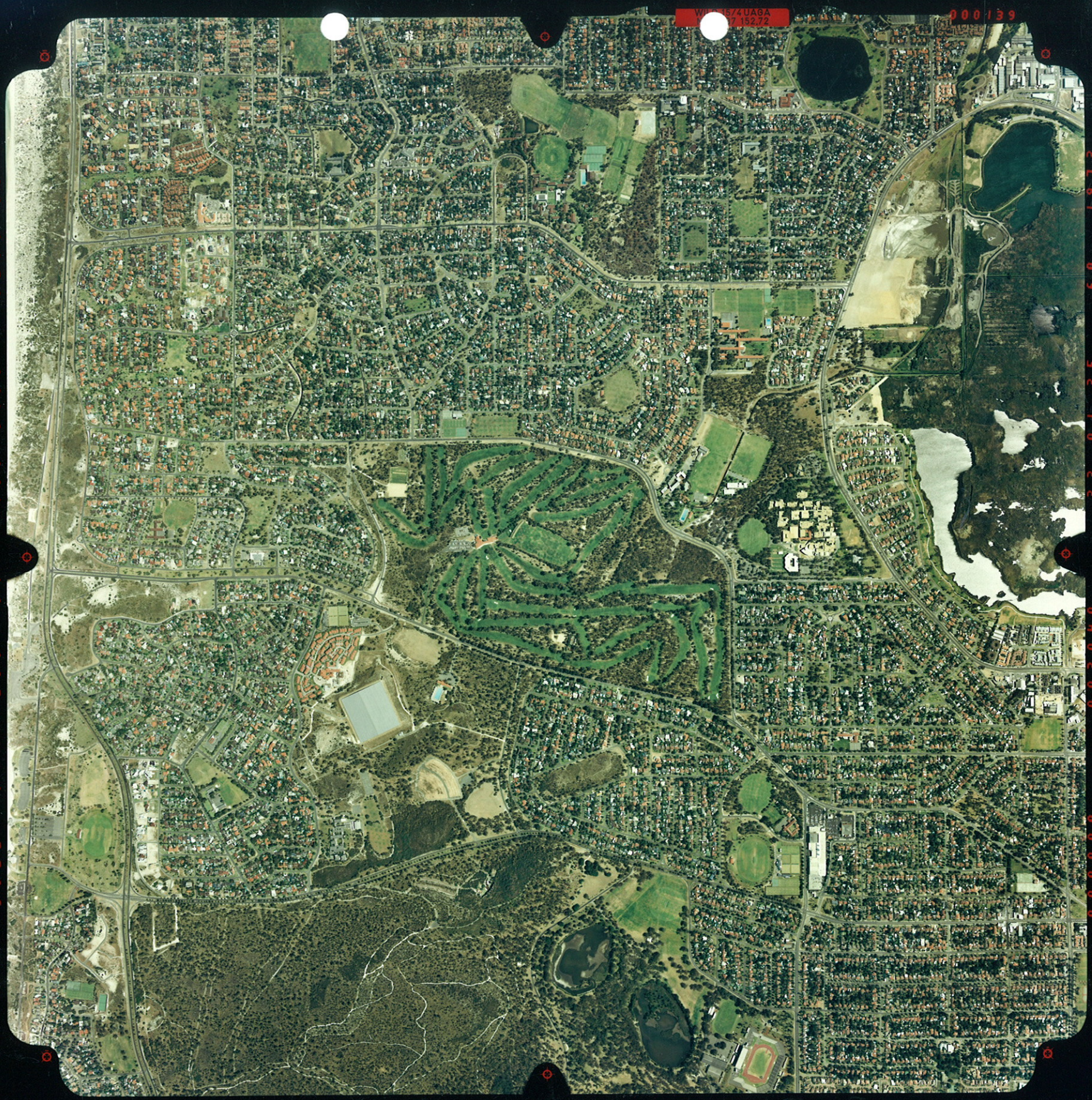
5049 WA 3165 (C) METRO REGIONAL AREA & EXT. RUN 7 (5001-5078) 1:20000 10-DEC-92 920676



5130 WA 3165 (C) METRO REGIONAL AREA & EXT. RUN 8 (5079-5160) 1:20000 11-DEC-92 920676



5131 WA 3165 (C) METRO REGIONAL AREA & EXT. RUN 8 (5079-5160) 1:20000 11-DEC-92 920676



5133 WA 2939(C) METRO STREET DIRECTORY & EXT. RUN 7 (5102-5203) 1:20000 5.1.91 910400



5069 WA 2939(C) METRO STREET DIRECTORY & EXT. RUN 6 (5001-5101) 1:20000 5.1.91 910400