System 6 Update - Floristic Community Type Mapping Information **DRAFT ONLY**

AREA INFORMATION

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

Conservation Area	
Nature Reserve	
Reserve No	
National Park	
Reserve No	
Local Government	
Reserve No	
Other	
Proposed Conservation Areas	
Local Government	Shire of Harvey
Reserve No	31900 (Sand pit & rubbish disposal)
Other Private location 5322	DOLA Res 3672, 16681, 23307 31901 unvested

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

TOTAL AREA

Bushland Area	79 375	hectares
Completely Degraded	20 625	
logging, bo regrowth [illegible]		

AREA MAPPED FLORISTIC UNITS

Units	Site (Condition) Code S: YARC	Bound	Area (ha)
36	Φ3(3)	B	52 1875
20b	Φ4(3)	B	6.5625

Boundaries determined by use of

aerial photograph	Metro Street Directory run 11 5085 5/1991
orthophoto	2032 II SE 8/1991
vegetation map	
soil map	Environ Geol S12

MURRAY CATCH

Yarloop I

Facsimile Message

ATTENTION:	Graeme Kininmonth
ORGANISATION:	Cable Sands
FROM:	Gary Whisson
DATE:	November 3, 1997
TELEPHONE:	9222 7171
PAGES:	2 following
SUBJECT:	EPA Threatened or Poorly Reserved Plant Communities

MESSAGE:

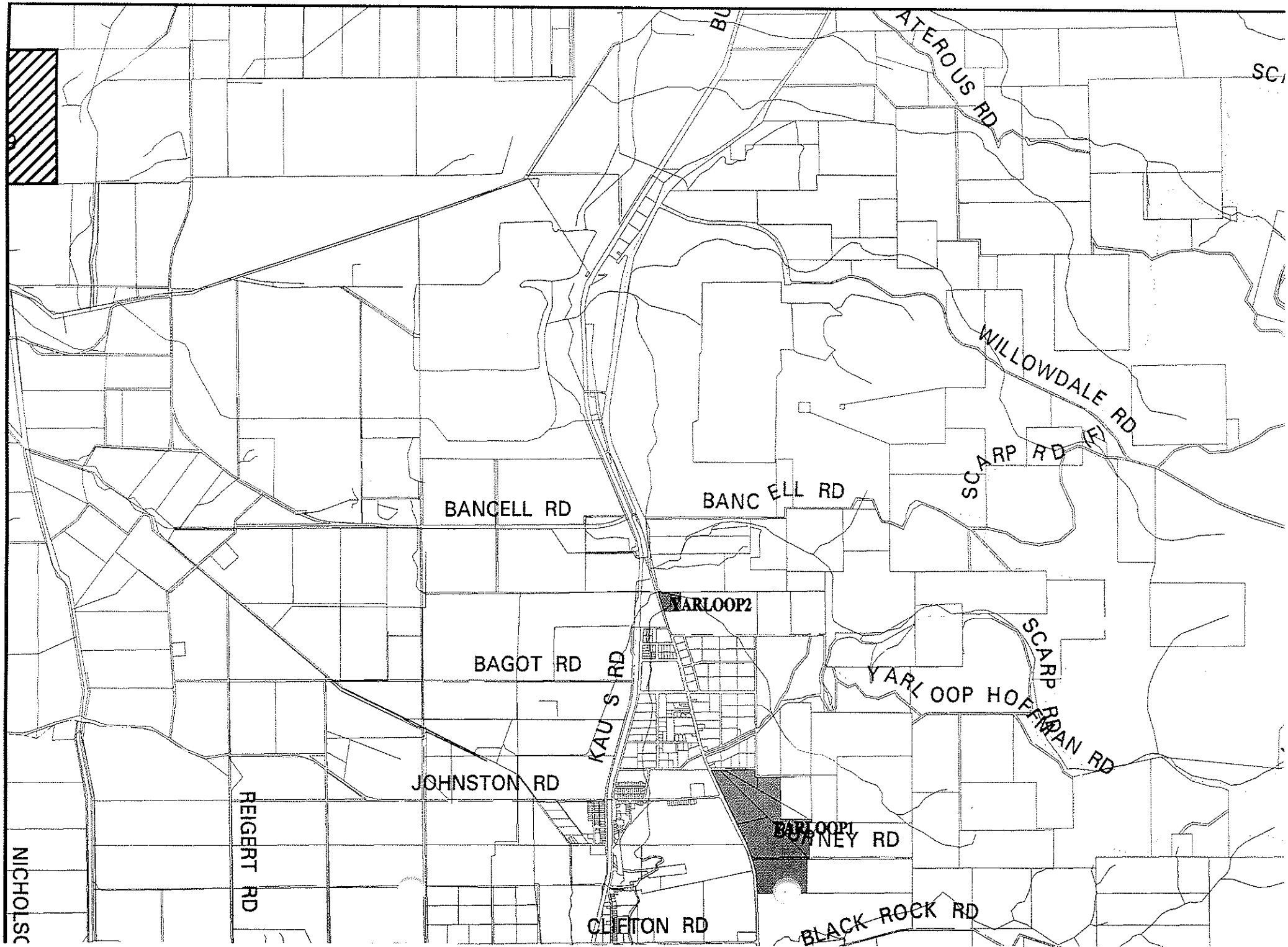
Graeme

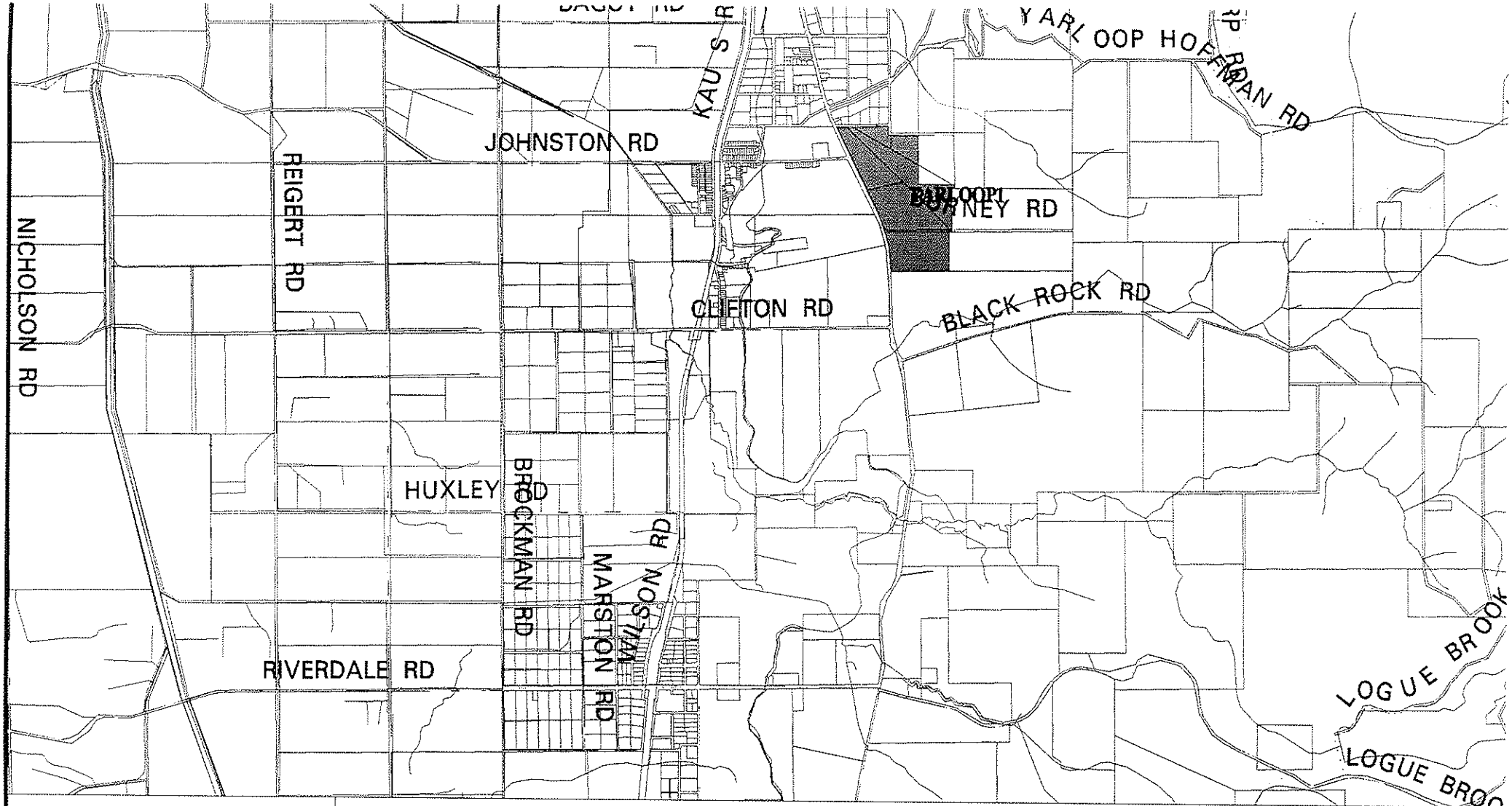
I have had a call from our Bunbury Office indicating that you were seeking a fax copy of the EPA (1995) Threatened or Poorly Reserved Plant Communities map for the Yarloop area.

Please find a copy of the map attached. Let me know if you need an original.

Gary G. Whisson

Department of Environmental Protection
Westralia Square, 141, St Georges Terrace, Perth, Western Australia, 6000.
Facsimile: (09) 322 1598 Telephone: (09) 222 7000


ATEROUS RD
WILLOWDALE RD
SCARP RD (E)
BANCELL RD
BANC ELL RD
YARLOOP2
SCARP RD
YARLOOP HOFFMAN RD
BAGOT RD
KAUS RD
JOHNSTON RD
REIGERT RD
YARLOOP1
BURNEY RD
CLIFTON RD
BLACK ROCK RD



Digital Cadastre data supplied by the Department of Land Administration, Perth Western Australia.

SYSTEM SIX RESERVE RECOMMENDATIONS
Digital data provided by the Department of Environmental Protection.

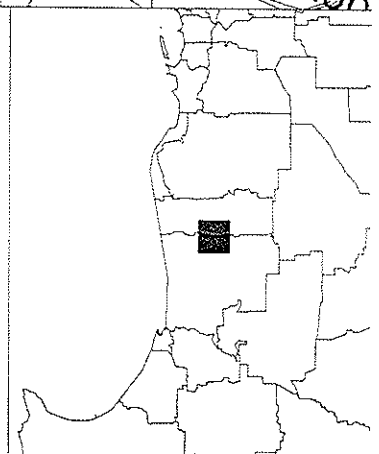
DRAINAGE FOR THE PEEL HARVEY CATCHMENT
Information provided by the Dept of Agriculture.

Early work on the System 6 Update Programme has located some areas that contain threatened or poorly reserved plant communities. Additional areas may be identified as the programme progresses. Most of these areas are small bushland remnants located on the heavily cleared soils of the eastern Swan Coastal Plain.

The Environmental Protection Authority wishes to advise that the value and integrity of areas identified on this map need to be protected. The EPA expects all proposals to clear develop these areas to be referred to it for environmental assessment in the interim until the finalisation of the System 6 Update Programme.

These communities have been identified through two studies; 'Remnant Vegetation on the Alluvial Soils on the Eastern Side of the Swan Coastal Plain' by B Keighery and M Trudgeon, and 'A Floristic Survey of the soi[illegible]n Swan Coastal Plain' by N Gibson, B Keighery, G Keighery, Burbidge and M Lyons.

Enquiries - See the Department of Environmental Protection.



Department of Environmental Protection

Head Office:
8th Floor, Westralia Square
141 St Georges Terrace
Perth, Western Australia 6000
Tel (09) 222 7000 Fax (09) 322 1598

Waste Management Division:
Ground Floor, 32 St Georges Terrace
Perth, Western Australia 6000
Tel (09) 222 0422 Fax (09) 222 0455
or PO Box Y3030, East, St Georges Terrace
Perth, Western Australia 6832

Regional Offices:
Bunbury • Karratha • Kalgoorlie • Kwinana

Graeme Kininmonth
Senior Environmental Officer
Cable Sands (WA) Pty. Ltd.
PO Box 133
BUNBURY WA 6231

Your Ref
Our Ref 67/91
Enquiries N Thorning

Dear Mr Kininmonth

SYSTEM 6 UPDATE FLORA INFORMATION - YARLOOP

As requested in conversation with Gary Whisson, of this Department, on 1 August 1996 I enclose information on the two floristic community types, 3b and 20b, found at Reserves 3672, 16681, 23307, 31901, 31900 and Wellington Location 5322, Yarloop.

Listed below are the other bushland areas at which these floristic community types have been located during the Gibson *et al.* (1994 - CALM) survey and the System 6 Update (Update) survey work.

Floristic community type 3b:
- C52 Kooljerrenup Nature Reserve (CALM)
- C53 Coolup Reserves (CALM)
- Reserve 35773, Dunsborough (CALM)
- M80 Ellis Brook Valley Nature Reserve (Update)
- M83 Cardup Nature Reserve (CALM)
- M85 Serpentine National Park (Update)
- Serpentine AA Lots 22 & 23 Norman Rd - PRIVATE (Update)
- Murray Location 275 Lot 1 Page Rd, Keysbrook - PRIVATE (Update)
- Lots 1 to 4 Rushton Rd, Martin (Update)
- Reserve 6268 Burnside Rd, SE Pinjarra (CALM)

Floristic community type 20b:
- Lambkin Reserve, Serpentine
- Brickwood Reserve (CALM)
- M52 Perth Airport (Update)
- M83 Cardup Nature Reserve (CALM)
- Serpentine AA Lots 22 & 23 Norman Rd - PRIVATE (Update)
- Lots 1 to 4 Rushton Rd, Martin (Update)
- Reserve 6268 Burnside Rd, SE Pinjarra (CALM)

If intending to visit bushland on private land, please be sure to contact the land holders before hand.

Enclosed are distribution maps of these floristic community types listed above. Also enclosed is a site based flora list for each floristic community type using sites

on public land only. This list is print out from a series of amalgamated databases and has not been edited.

The System 6 Update information should be referenced as follows:
Department of Environmental Protection 1994-1995 System 6 Update Programme. Unpublished site and area records.

The conditions for use of the Gibson *et al.* (1994) information are contained in the in the attached letter.

For any additional information please don't hesitate to contact Natalie Thorning (Tel: 222 7051).

Yours sincerely

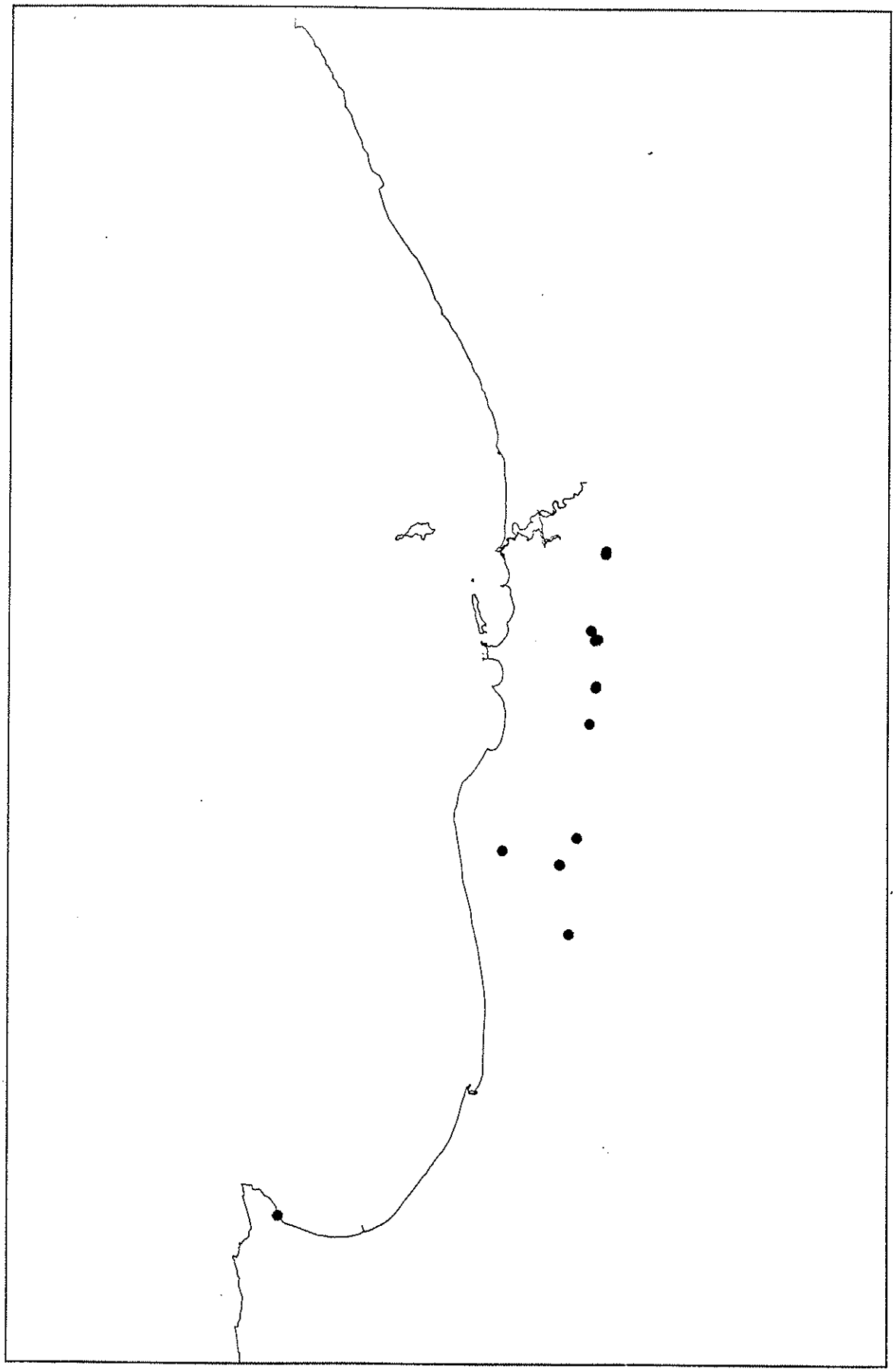
R.A.D. Sippe
DIRECTOR
POLICY COORDINATION DIVISION

13 August 1996

Enc (1) Distribution maps of floristic community types 3b & 20b
(2) Flora lists for publicly owned sites of floristic community types 3b & 20b

Distribution of Floristic Community Type 3b

Department of Environmental Protection Western Australia



Coastline of Western Australia

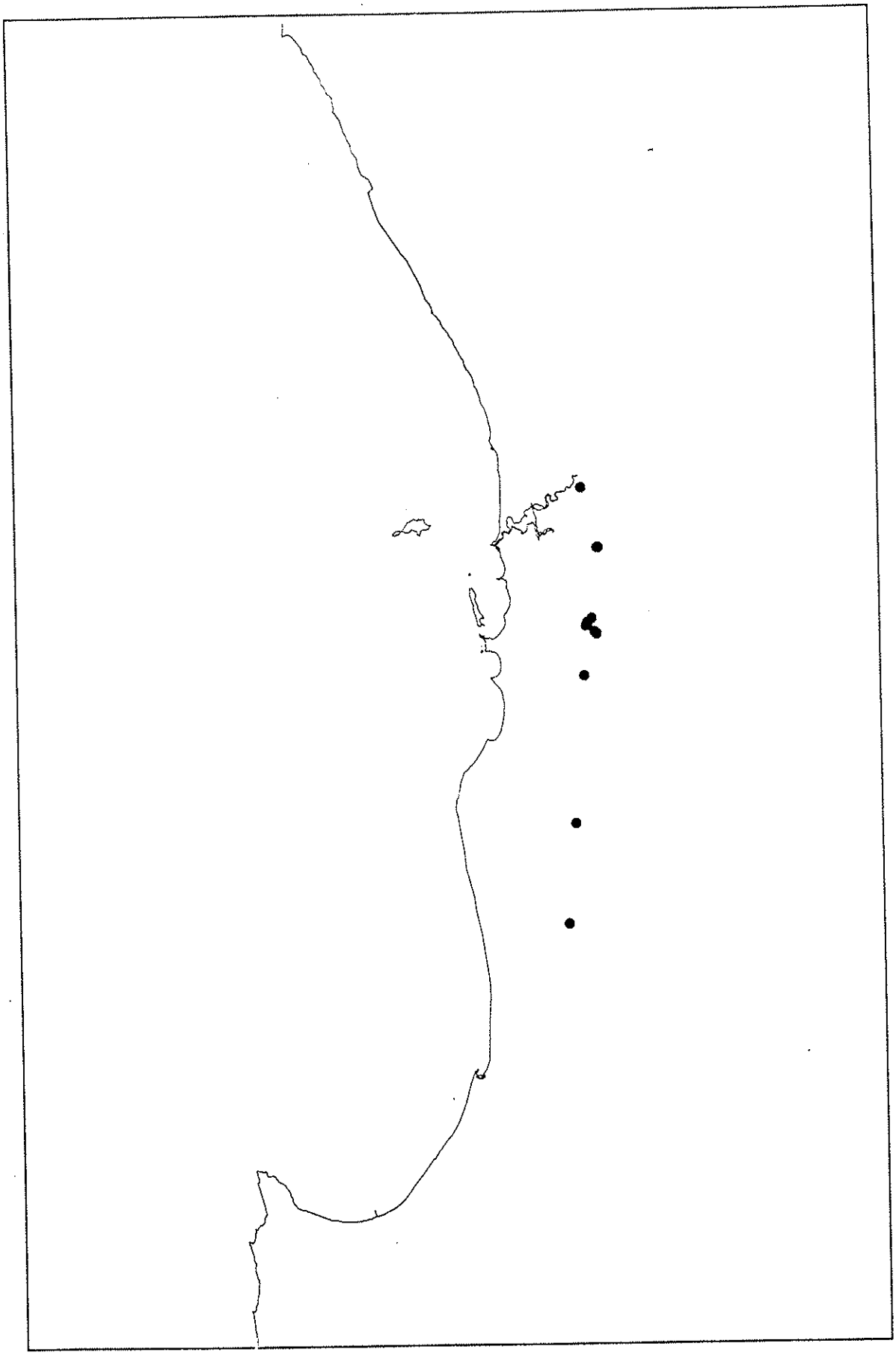
● Floristic Community Type 3b

1:1500000

N

Distribution of Floristic Community Type 20b

Department of Environmental Protection Western Australia

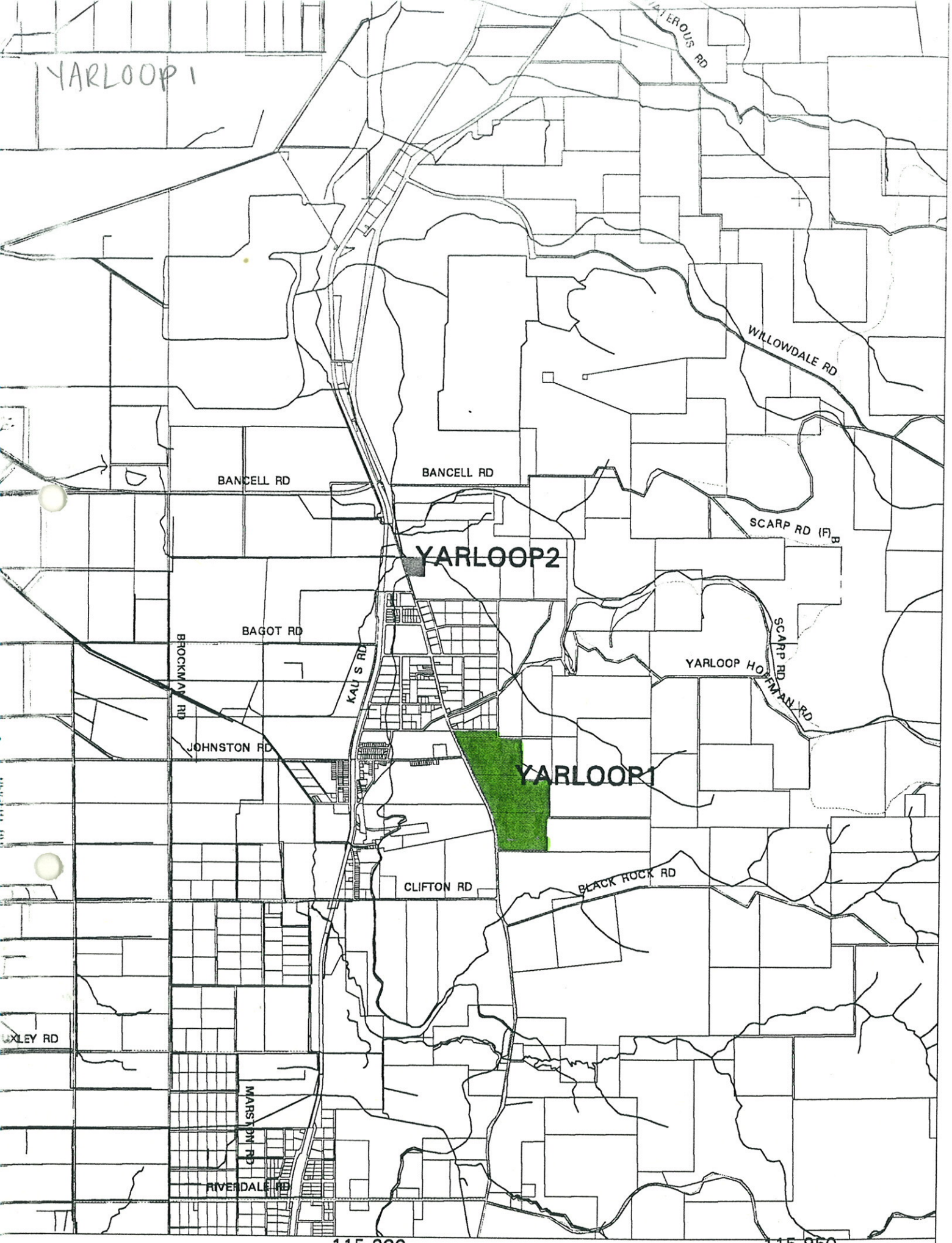


Coastline of Western Australia

Floristic Community Type 20b

1:1500000

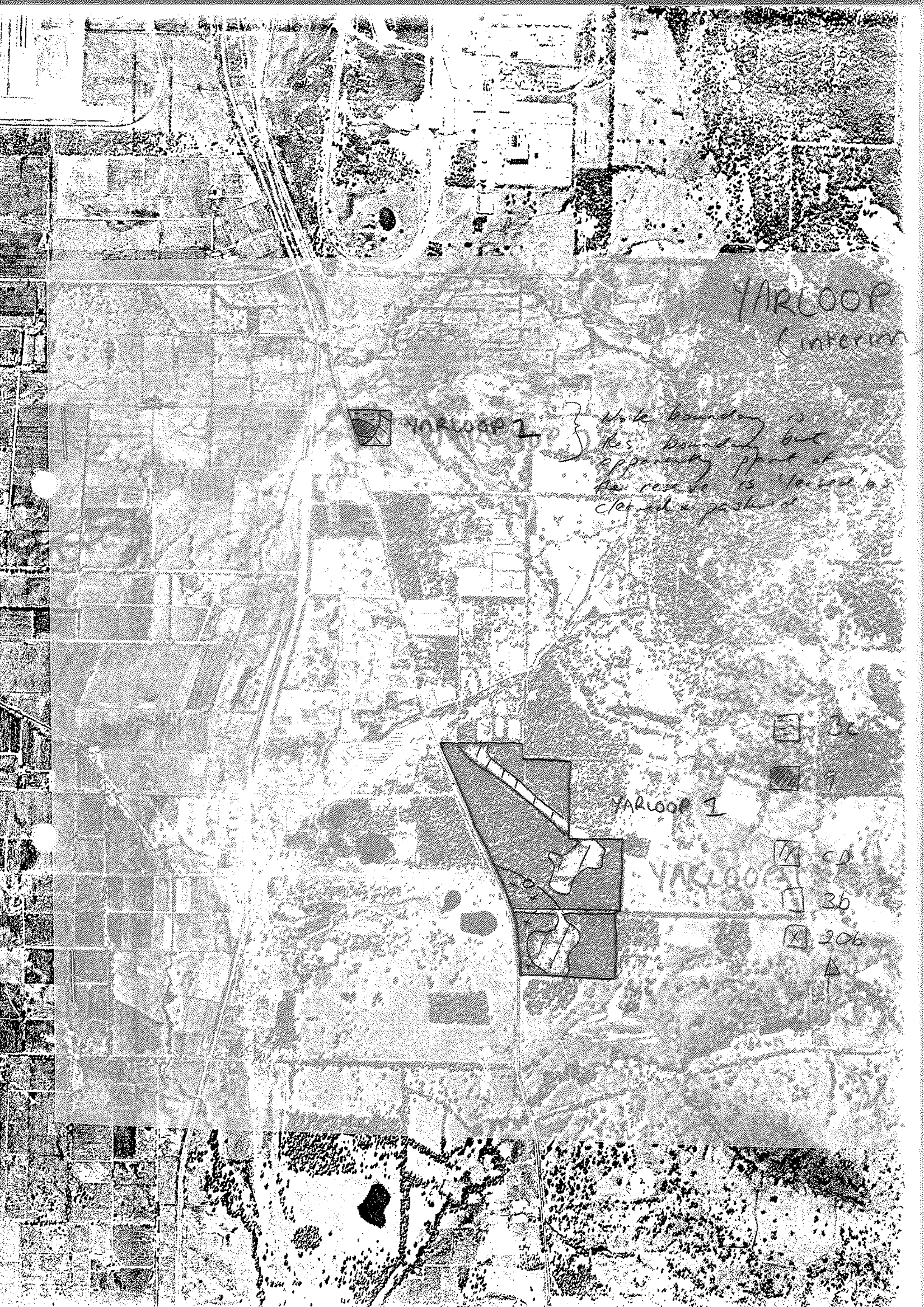
N

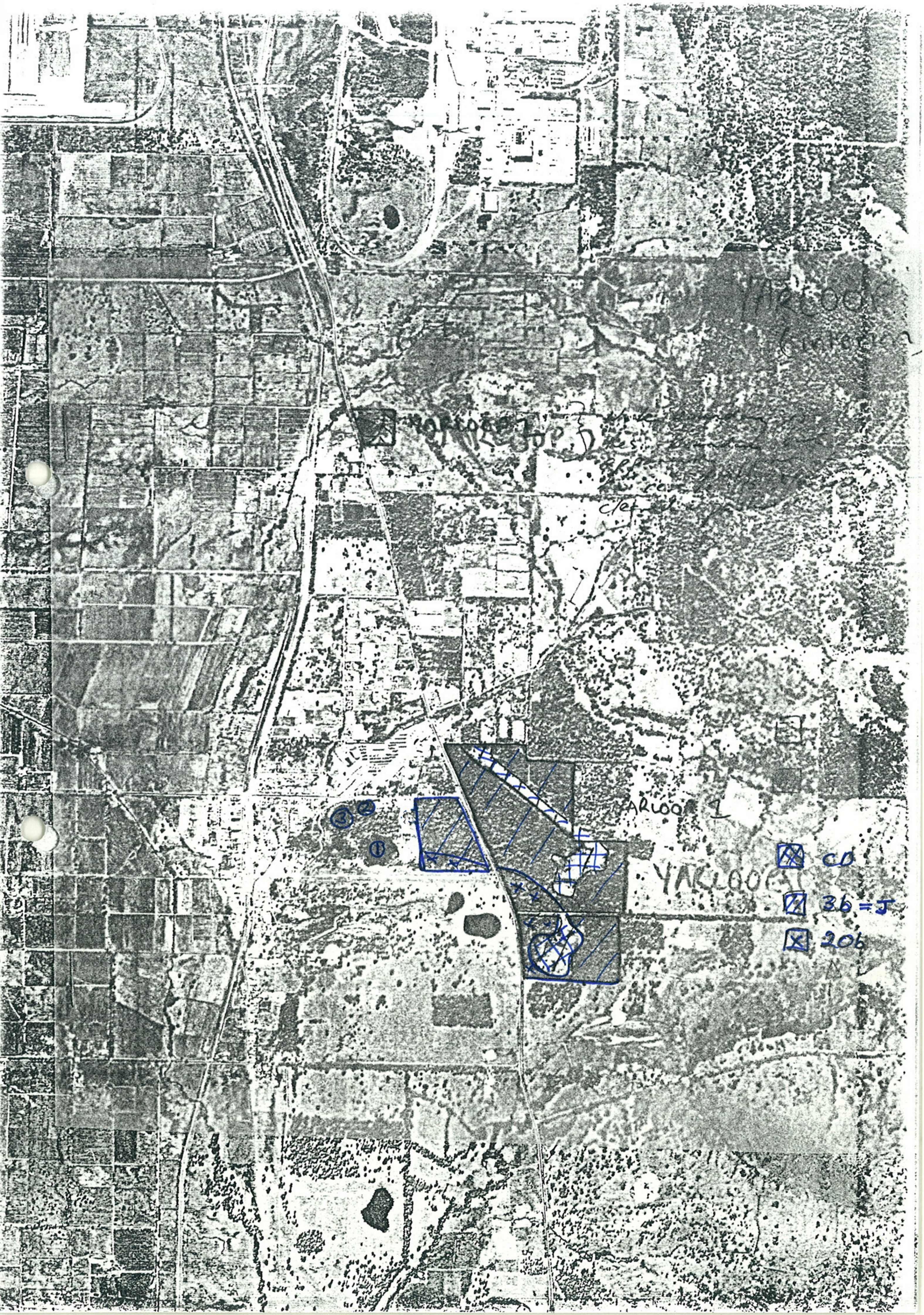


SYSTEM SIX RESERVE RECOMMENDATIONS
Digital data provided by the Department of Environmental Protection.

Digital Cadastre data supplied by the Department of Land Administration, Perth Western Australia.

CHANNEL WETLANDS:
Information provided by the Water Authority of Western Australia 1994


YARLOOP
(interim)
YARLOOP 2
Note boundary is
Res. boundary but
apparently part of
the reserve is
cleared & pastured
YARLOOP 1
3c
9
CD
3b
20b



CD
3b = J
20b

CONTACT DR N. GIBSON CALM WOODVALE for further information.
Flora list for Yarloop1 (extracted from Swan Coastal Plain database, Yarl03,04, 102 taxa, 25/5/1995).

Department of Environmental Protection System 6 Update: Site Based Flora List for Yarloop1
(extracted from the CALM Swan Coastal Plain database, Yarl03,04, 102 taxa, 25/5/95)

Anthericaceae
- Agrostocrinum scabrum
- Caesia micrantha
- Caesia occidentalis
- Chamaescilla corymbosa
- Thysanotus thyrsoideus
- Tricoryne elatior

Apiaceae
- Pentapeltis peltigera
- Xanthosia huegelii

Asteraceae
- * Hypochaeris glabra
- Olearia paucidentata
- Senecio hispidulus
- Trichocline spathulata

Caesalpiniaceae
- Labichea punctata

Casuarinaceae
- Allocasuarina fraseriana

Colchicaceae
- Burchardia umbellata

Cyperaceae
- Lepidosperma aff. angustatum scps
- Mesomelaena graciliceps
- Mesomelaena tetragona
- Mesomelana aff graciliceps yarl 04 scps (BJK&NG 146)
- Tetraria capillaris
- Tetraria octandra

Dasypogonaceae
- Dasypogon bromeliifolius
- Lomandra hermaphrodita
- Lomandra preissii
- Lomandra sericea

Dilleniaceae
- Hibbertia acerosa
- Hibbertia amplexicaulis
- Hibbertia huegelii
- Hibbertia hypericoides

Droseraceae
- Drosera erythrorhiza
- Drosera stolonifera

Epacridaceae
- Astroloma pallidum

Conostephium pendulum

Goodeniaceae
Dampiera linearis
Lechenaultia biloba
Scaevola calliptera
Scaevola phlebopetala

Haemodoraceae
Anigozanthos manglesii
Conostylis juncea
Conostylis setigera
Haemodorum loratum
Haemodorum sp. scps
Phlebocarya ciliata

Iridaceae
Patersonia juncea

Lamiaceae
Hemiandra pungens

Lauraceae
Cassytha micrantha

Loganiaceae
Logania serpyllifolia

Mimosaceae
Acacia lateriticola
Acacia sessilis
Acacia stenoptera

Myrtaceae
Eucalyptus calophylla
Eucalyptus marginata
Scholtzia ciliata

Orchidaceae
Caladenia discoidea
Caladenia flava
Lyperanthus nigricans
Prasophyllum parvifolium
Pterostylis vittata
Thelymitra crinita
Thelymitra sp. scps

Orobanchaceae
* Orobanche minor

Papilionaceae
Bossiaea eriocarpa
Bossiaea eriocarpa (Large flowered form, BJK & NG 229) scps
Daviesia divaricata
Daviesia physodes
Daviesia preissii
Gompholobium knightianum

Gompholobium preissii
Hovea chorizemifolia
Hovea trisperma var. grandiflora
Kennedia coccinea

Phormiaceae
Stypandra glauca

Pittosporaceae
Pronaya fraseri

Poaceae
Amphipogon turbinatus
* Briza maxima
Danthonia occidentalis
Stipa campylachne
Stipa flavescens
Tetrarrhena laevis

Polygalaceae
Comesperma virgatum

Proteaceae
Banksia attenuata
Banksia grandis
Dryandra bipinnatifida
Dryandra nivea
Grevillea quercifolia
Grevillea wilsonii
Hakea cyclocarpa
Hakea ruscifolia
Petrophile linearis
Stirlingia latifolia
Xylomelum occidentale

Restionaceae
Hypolaena exsulca
Loxocarya fasciculata

Rubiaceae
Opercularia hispidula

Rutaceae
Eriostemon spicatus

Stylidiaceae
Stylidium piliferum
Stylidium schoenoides

Thymelaeaceae
Pimelea suaveolens

Tremandraceae
Tetratheca hirsuta

Violaceae
Hybanthus floribundus

Flora list for Yarloop1 (extracted from Swan Coastal Plain database, Yarl03,04, 102 taxa, 25/5/1995).

Xanthorrhoeaceae
- Xanthorrhoea gracilis
- Xanthorrhoea preissii

CONTACT DR N. GIBSON CALM WOODVALE for further information.
Flora list for Yarloop (extracted from Swan Coastal Plain database, Yarl 1-4,147 taxa, 9/5/1995).

Department of Environmental Protection System 6 Update: Site Based Flora List Yarloop

(extracted from the CALM Swan Coastal Plain database, Yarl 1-4, 147 taxa, 9/5/95)

Anthericaceae
- Agrostocrinum scabrum
- Borya scirpoidea
- Caesia micrantha
- Caesia occidentalis
- Chamaescilla corymbosa
- Thysanotus dichotomus
- Thysanotus thyrsoideus
- Tricoryne elatior
- Tricoryne humilis

Apiaceae
- Pentapeltis peltigera
- Xanthosia huegelii

Asparagaceae
- * Myrsiphyllum asparagoides

Asteraceae
- Hyalosperma cotula
- * Hypochaeris glabra
- Olearia paucidentata
- Senecio hispidulus
- Trichocline spathulata

Caesalpiniaceae
- Labichea punctata

Casuarinaceae
- Allocasuarina fraseriana

Centrolepidaceae
- Aphelia cyperoides

Colchicaceae
- Burchardia multiflora
- Burchardia umbellata

Cuscutaceae
- * Cuscuta epithymum

Cyperaceae
- Chorizandra cymbaria
- Cyathochaeta avenacea
- * Cyperus tenellus
- Lepidosperma aff. angustatum scps
- Lepidosperma angustatum
- Lepidosperma squamatum
- Mesomelaena graciliceps
- Mesomelaena tetragona
- Mesomelana aff graciliceps yarl 04 scps (BJK&NG 146)
- Schoenus discifer

Schoenus odontocarpus
Schoenus sp. 2 (GJK 5739) scps
Schoenus subbarbatus "Royce 2872" scps
Tetraria capillaris
Tetraria octandra

Dasypogonaceae
Dasypogon bromeliifolius
Lomandra caespitosa
Lomandra hermaphrodita
Lomandra preissii

Dasypogonaceae
Lomandra purpurea
Lomandra sericea
Lomandra suaveolens

Dilleniaceae
Hibbertia acerosa
Hibbertia amplexicaulis
Hibbertia huegelii
Hibbertia hypericoides
Hibbertia subvaginata

Droseraceae
Drosera erythrorhiza
Drosera gigantea
Drosera stolonifera

Epacridaceae
Astroloma pallidum
Astroloma sp. scps
Conostephium pendulum

Goodeniaceae
Dampiera alata
Dampiera linearis
Lechenaultia biloba
Scaevola calliptera
Scaevola phlebopetala

Haemodoraceae
Anigozanthos manglesii
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Conostylis juncea
Conostylis setigera
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Phlebocarya ciliata

Iridaceae
Patersonia juncea
Patersonia occidentalis

Lamiaceae
Hemiandra pungens

Lauraceae
- Cassytha glabella
- Cassytha micrantha
- Cassytha racemosa

Loganiaceae
- Logania serpyllifolia

Mimosaceae
- Acacia lateriticola
- Acacia pulchella
- * Acacia pycnantha
- Acacia saligna
- Acacia sessilis
- Acacia stenoptera

Myrtaceae
- Astartea aff. fascicularis sthcst
- Eucalyptus calophylla
- Eucalyptus marginata
- Hypocalymma angustifolium
- Melaleuca leptoclada
- Pericalymma ellipticum
- Scholtzia ciliata

Orchidaceae
- Caladenia discoidea
- Caladenia flava
- Lyperanthus nigricans
- Prasophyllum parvifolium
- Pterostylis vittata
- Thelymitra crinita
- Thelymitra sp. scps

Orobanchaceae
- * Orobanche minor

Papilionaceae
- Bossiaea eriocarpa
- Bossiaea eriocarpa (Large flowered form, BJK & NG 229) scps
- Daviesia divaricata
- Daviesia physodes
- Daviesia preissii
- Gompholobium knightianum
- Gompholobium polymorphum
- Gompholobium preissii
- Hovea chorizemifolia
- Hovea trisperma var. grandiflora
- Hovea trisperma var. trisperma
- Kennedia coccinea
- Kennedia prostrata
- Nemcia capitata

Philydraceae
- Philydrella pygmaea

Phormiaceae
Stypandra glauca

Pittosporaceae
Pronaya fraseri

Poaceae
Amphipogon turbinatus
* Briza maxima
Danthonia occidentalis
Stipa campylachne
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Polygalaceae
Comesperma virgatum

Proteaceae
Banksia attenuata
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Dryandra bipinnatifida
Dryandra nivea
Grevillea bipinnatifida
Grevillea quercifolia
Grevillea wilsonii
Hakea cyclocarpa
Hakea ruscifolia
Hakea varia
Petrophile linearis
Stirlingia latifolia
Synaphea petiolaris
Xylomelum occidentale

Restionaceae
Hypolaena exsulca
Loxocarya fasciculata

Rubiaceae
Opercularia hispidula

Rutaceae
Eriostemon spicatus

Stackhousiaceae
Tripterococcus brunonis

Stylidiaceae
Stylidium emarginatum
Stylidium piliferum
Stylidium schoenoides

Thymelaeaceae
Pimelea suaveolens

Tremandraceae
Tetratheca hirsuta

Violaceae
Hybanthus floribundus

Xanthorrhoeaceae
Xanthorrhoea gracilis
Xanthorrhoea preissii

BUSHLAND PLANT SURVEY RECORDING SHEET 1- use pencil only

USHLAND AREA Varloop YTIC 01 SITE NUMBER

ATE TRIP 17/10/97 RECORDERS MM, + BK,

ATE TRIP RECORDERS

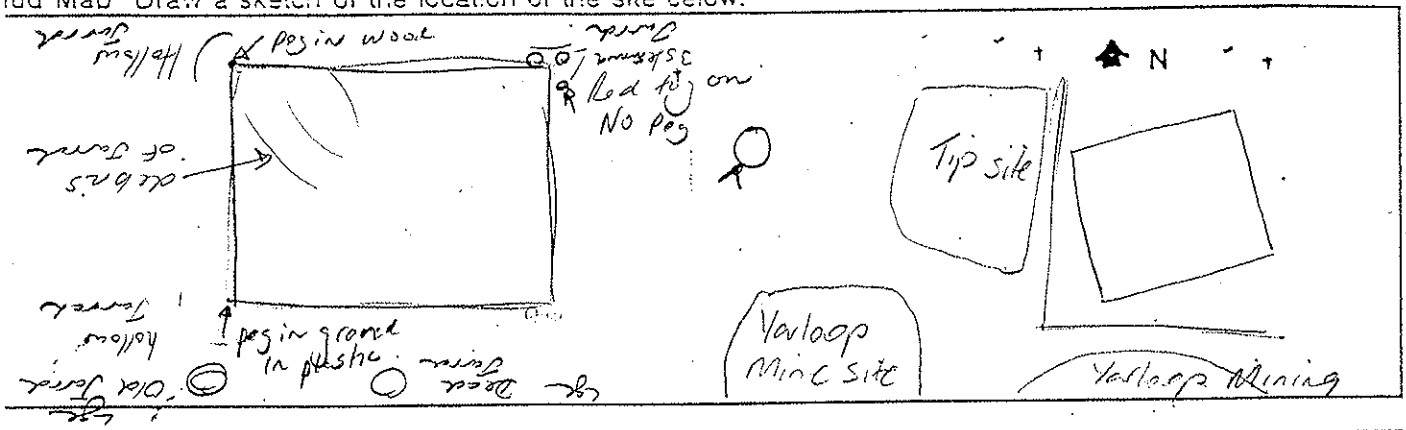
ATE TRIP RECORDERS

OTANIST

From *'Bushland Plant Survey'* written by B. Keighery (1994) and published by the Wildflower Society of WA (Inc.), PO Box 1 Nedlands WA 6008.

. LOCATION of the QUADRAT

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



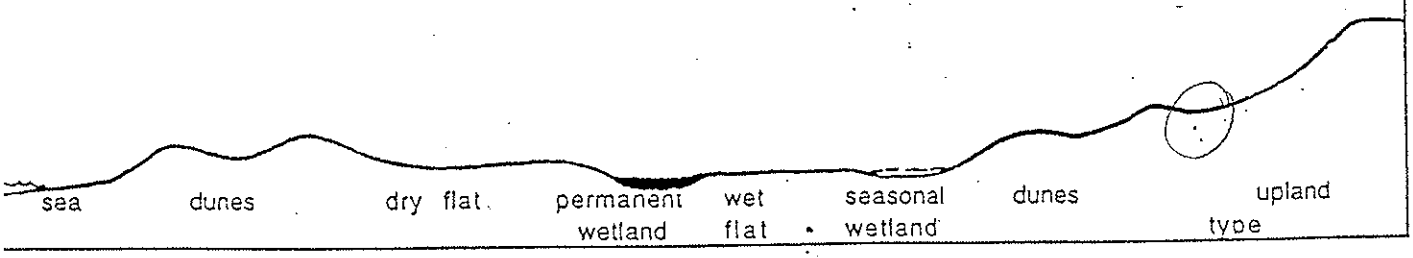
Road Location

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 well drained, dry sandy Colour grey & brown

Exposed rock — type % surface

Sub-surface Soil sand Colour yellow/brown

Rock type depth to rock

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

Litter	80 % cover	Bare Ground	2 %cover
Depth	2-5cm cm		

BUSHLAND PLANT SURVEY RECORDING SHEET 2 (Muir)- use pencil only

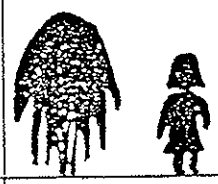
From '*Bushland Plant Survey*' written by B. Keighery (1994) and published by the Wildflower Society of WA Inc., PO Box 64 Nedlands WA 6009.

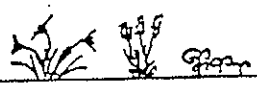
3. VEGETATION STRUCTURE AND COVER

For each layer record - appropriate life form, cover class (see below),and dominant species in each layer.

Cover Class 2-10% 10-30% 30 - 70% over 70%

	TREES			MALLEES	
	over 30m	15 - 30m	5 - 15m ✓ under 5m	over 8m	under 8m
LIFE FORM		Adj Jarrah to 715m. 			30m 10m 
COVER CLASS (%)	—		10-30		
DOMINANT SPECIES			Euc. marg Allo. fras Bank. grand.		

	SHRUBS				SHRUBS
	over 2m	2m - 1.5m	1.5 - 1m	1 -0.5m	under 0.5m
LIFE FORM					2m 1m 
COVER CLASS (%)	—			10-30%	2-10%
DOMINANT SPECIES				Shr. lat	Opera. Hibb. acerosa Hibb hyp.

	GRASSES	HERBS	SEDGES over 0.5m	under 0.5m
LIFE FORM				1m 
COVER CLASS (%)		10-30		30-70%
DOMINANT SPECIES		Dasy. brom Pteb. cil	Tet. oct. Meso. kt. Lax. flac	

4. VEGETATION CONDITION

1 'PRISTINE'	
2 EXCELLENT	)
3 VERY GOOD	
4 GOOD	
5 DEGRADED	

COMMENTS

Trampled, probably kangaroo
little weed invasion (Briza) but
logging burnt too much

BUSHLAND PLANT SURVEY RECORDING SHEET 3 - use pencil only

5. SPECIES PRESCENCE

SITE No YTIP Ø1
Date 17/10/97

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 (19940 and published by the Wildflower Society of WA (Inc.), PO Box 64 Nedlands WA 6008.

TREES	No	Fl	ID
/Euc marg.	1		
/Bank grand.	2		
/Allocas. fras	3		
/Xylomel. occid.	4		
~~MALLEES~~ SHRUBS	5		
/ Gomp (Kuazon) shuttlew.	[illegible]		
/ Dav. physodes	7		
/ Persoonia saccata	8		
/ Petrophile lin	9		
SHRUBS			
/Mac. riedli	10		
/Stir lat.	11		
/Hib. hyp.	12		
/Hib acerosa	13		
/Xanth. gracilis	14		
Daviesia divar	15		
~~Hibb. hyp~~ repeat.	16		
/Labich. punc.	17		
/Pent pelt.	18		
/Hemiandra pungens (hairy)	19		
/Dryandra nivea (lind)	20		
/Grevillea wilsonii	1		
/Hibbertia ?huegelii	2		
/Bossiaea eriocarpa (large)	3		
/Acacia + sessilis.	~~15P~~		✓
/Hibb. amplexicaulis	15P		
Hovea trisperma (lge)	6		
~~Bossiaea~~ ~~ornata~~	7		
~~Bossiaea eriocarpa~~ cpt	8		
/ Eriostemon spicatus	9		

SHRUBS (cont.)	No	Fl	ID
/Stachystemon vermicularis	[illegible]		
/Tetratheca hirsuta SCP	1		
/Operc 'Small' apiciflora	~~15P~~		
/Scaevola repens	3		
/Comph polym.	15P		
~~Allocas prob seedling fras~~	5		
/Dav. divaricata	6		
/Dav. decurrens/preissii P70	[illegible]		
GRASSES			
*/Briza minor	6		
*/Briza max	7		
/Danthonia occid	[illegible]		
*/Aira cary	1		
HERBS			
/Oper. hispid.	2	.	
/Cono. juncea	3		
/Dasy. obliqua	4		
Drosera stolonifera	5		
/Scaevola (?phleb) calliptera	6	15P	
/Thelymitra ?crinita	7	~~15P~~	✓
/Phleb ciliata	8		
/Lom. herm	9	~~15P~~	✓
/Patersonia ?umbrosa (str)	10	~~15P~~	✓
/Caesia micrantha	1	~~15P~~	✓
/Lom. caespitosa	2	~~15P~~	✓
/Cal. flava	3		
*/Lotus angust.	4		

HERBS (cont.)	No	Fl	ID
*Hyp glabra	5		
Stylid. pilif	6		
/Lom sericea	7		
/Damp. lin	8		
/Burch congest	9		
Trachy. pilosa	60		
/Thysan. arbuscula	1		
Chaem. corym	2		
/Paters. juncea	3		
Caladenia sp.	4		
/Los. hues	5		
/Sow. laxiflora	6		
/Mitrasacme paludosa	7		
SEDGES			
/Tet. oct.	8		
/Meso. tetrag.	9		
/Lox. flex	70		
/Hyp. exsulca	1		
/Hyporom fascic.	2		
/(Schoenus) alt. brevisetis	3	~~15P~~	✓
?Tetraria capillaris	4	15P	
/Lepid squam	5	~~15P~~	✓
/Centrolepis ?drumm	6		✓
HERBS			
/Anig ?mang	7		
/Drosera (climbing glab)	8		
*Ursinia anthem	9		
/Waitzia suaveolens	80		
/Hydrocotyle calicarpa	1	~~15P~~	✓
Wahlenbergia preissii	2		
*Sonchus oleraceus	3		

/ Lom. nigricans
ADJ
/ Stipa campylachne

Delete or possibly Hovea tri.

ADDITIONAL SHRUBS

4 Hosea chorizemifolia

5 Astroloma pallidum

6 Olearia paucidentata ~~VSR~~

7 Acacia flabellifolia VSR

8 Melaleuca incana ~~VSR~~ ✓

9 Pro tras

89

BUSHLAND PLANT SURVEY RECORDING SHEET 1- use pencil only

USHLAND AREA YTIC 02 SITE NUMBER

ATE TRIP 17/10/97 RECORDERS MM, & BK,

ATE TRIP RECORDERS

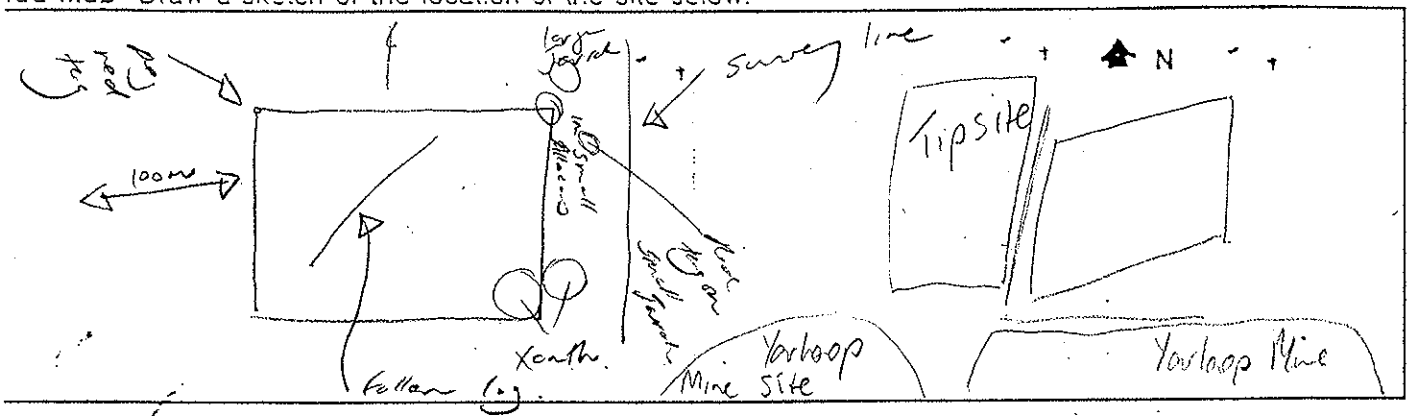
ATE TRIP RECORDERS

OTANIST

From 'Bushland Plant Survey' written by B. Keighery (1994) and published by the Wildflower Society of WA (Inc.), PO Box 51 Nedlands WA 6008.

. LOCATION of the QUADRAT

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



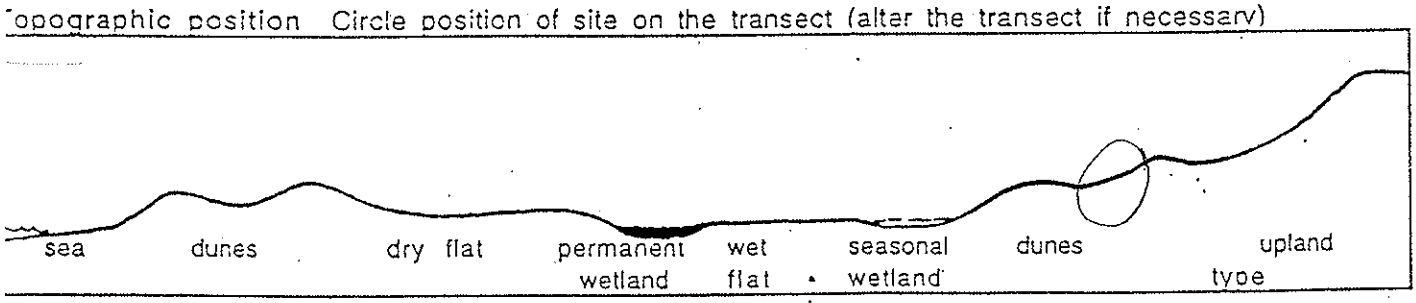
Road Location

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 well drained, dry sandy Colour grey/brown

Exposed rock — type % surface

Sub-surface Soil sand Colour yellow/brown

Rock type depth to rock

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

Litter	95 % cover	Bare Ground	1-0.5 %%cover
Depth	5 cm		

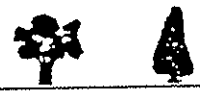
BUSHLAND PLANT SURVEY RECORDING SHEET 2 (Muir)- use pencil only

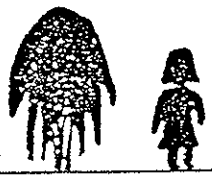
From '*Bushland Plant Survey*' written by B. Keighery (1994) and published by the Wildflower Society of WA (Inc.), PO Box 64 Nedlands WA 6009.

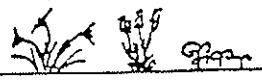
3. VEGETATION STRUCTURE AND COVER

For each layer record - appropriate life form, cover class (see below), and dominant species in each layer.

Cover Class	2-10%	10-30%	30 - 70%	over 70%

	TREES			MALLEES	
	over 30m	15 - 30m ✓	5 - 15m ✓ / under 5m ✓	over 8m	under 8m
LIFE FORM			2-10 Xy. occ. 		30m 10m 
COVER CLASS (%)		10-30%	2-10%		
DOMINANT SPECIES		Euc marg	Allo. bras Bank grand		

	SHRUBS			SHRUBS	
	over 2m	2m - 1.5m	1.5 - 1m	1 -0.5m	under 0.5m
LIFE FORM					2m 1m 
COVER CLASS (%)	—	—	—	10-30	2-10
DOMINANT SPECIES				Shr. lat. Grev. wil.	Dry niv

	GRASSES	HERBS	SEDGES over 0.5m	under 0.5m
LIFE FORM				1m 
COVER CLASS (%)		10-30	→ D 30-70%	
DOMINANT SPECIES		Phleb. cil Desy brom	Tet. oct Lax. Flex	

4. VEGETATION CONDITION

1	'PRISTINE'	
2	EXCELLENT	✓
3	VERY GOOD	
4	GOOD	
5	DEGRADED	

COMMENTS

To excellent = some Φ2.

BUSHLAND PLANT SURVEY RECORDING SHEET 3 - use pencil only

5. SPECIES PRESCENCE

SITE No	YTIP 02
Date	

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	SHRUBS (cont.)	No	Fl	ID	HERBS (cont.)	No	Fl	ID
/Euc. marg	1			/Gomph polym.				/Dianella divar			
/Allocas. fras.	2			/Pronaya 'fras.				Para. nigricans			
/Xyl. occid.				/Damp. linearis				/Haemodorum ?laxum (sler)			
/Bank. grandis (seedling)				/Patersonia ?umbrosa (ster)				/Agrost. scabrum			
				/Hovea trisperma (lge)				/Lom. caespitosa			
				/Thelymitra crinita				/Stylid pilif.			
~~MALLEES~~ SHRUBS				/Astroloma pallidum (ster)				/Tricho. spath			
/Comp preissi VSP				/Tetratheca hirsuta				/Wah. preissii			
/Conospermum virg. VSP				GRASSES				/Pat. ? occidentalis			
/Eriost. spicatus				*/Briz. max.							
/Stachystemon vermicularis				*/Aira cary							
SHRUBS				/Tetra laevis			✓				
/Stirl. lat.				*/Briza minor							
/Grevillea ?quercifolia			✓					SEDGES			
/Persoonia saccata								/Tet oct.			
/Daviesia divaricata								/Meso tet			
/Petrophile linearis								/Lepid squam			
/Labichea punct								Tetraria capillaris			
/Hovea Choriz.				HERBS				/Loxocarya flex			
/Dryandra lind				/Dasy brom				/Lox. fascic			
/Bossiaea erio large				/Lomo. junc.				/Hyp. exsulca			
/Grev. wilsonii				/Chaem. corym.				/Meso tet			
/Xanth. preis				/Dros. erythro							
/Operc (large) hispid				/Phleb. cil.							
/Pent pelt				/Scaevola calliptera CHECK YARLOOP 03 listed as Sphenotoma							
/Gomph 'Kumbon' Shuttle.				/Caladenia flava							
/Hibbertia ?hueg				/Lomandra sericea							
/Hibb. hyp.				* Hyp glab							
/Olearia paucidentata				* Lotus angust (seedling)							
/Dry. lind/nivea				/Caesia micrantha							
/Acacia = 01 lateriticola				/Trachymene pilosa				/ADJ Bank grand.			
/Xanth. gracilis				* Sonch. olerac.							

Additional Taxa Area
E Tip
Terete Lepia

Ken. prost

Thys. thyrsoides

Cono. stoech.

Persoonia elliptica

SW Tip

Weed patches
- Watsonia
- Tagasaste
- Lepl. laev. } Woody Green ?Tip

Tip burnt, flying rubbish

Swan Coastal Plain Survey - SURVEY RECORDING SHEET **Please use pencil**

BUSHLAND AREA: YARLOOP TIMBER RES # 3672

QUADRAT No. YARL 03 VEGETATION TYPE Mani / Jarrah Woodland

DATE TRIP 1/9/93 BOTANIST BDK / NG / ML

VOLUNTEERS

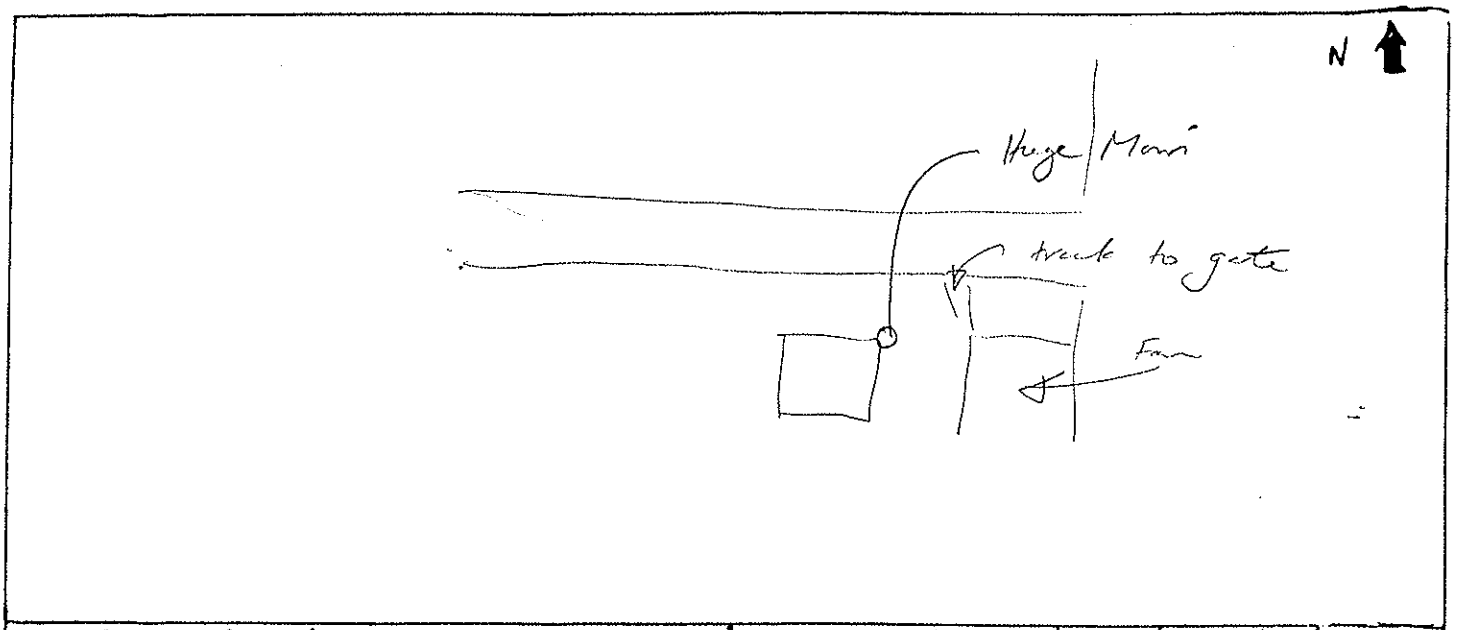
DATE TRIP BOTANIST

VOLUNTEERS

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

1. LOCATION of the QUADRAT

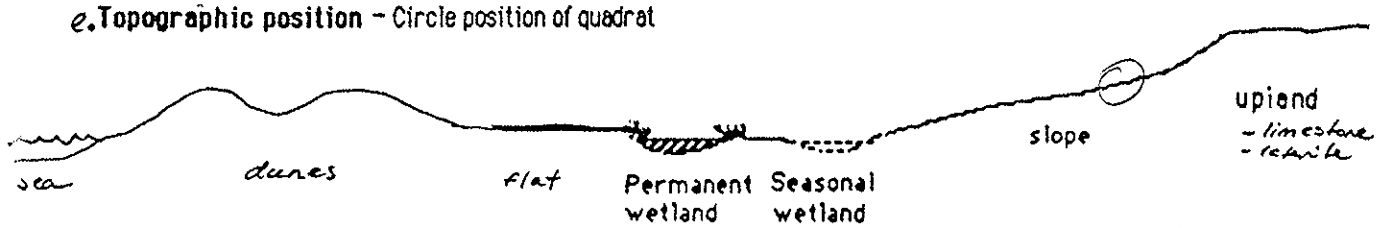
a. Mud Map Draw a sketch of the location of the quadrat



b Road Location	c. Latitude	Longitude
Rifle Range Rd	32° 57' 12.1"	115° 55' 05.5"
		Altitude 60m ± 100m

d. **Photograph** Photographer's name NG Photo No 7

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



2. SITE DATA - Circle the correct response

Slope flat gentle steep

Aspect N NE E SE S SW W NW

Surface soil Humus rich brown sand

Sub-surface soil orange sand EG = 512

Drainage well mod poor

Wet All year winter/spring

Litter (% cover) 99% 100%

% Bare ground 0%

P.T.O.

3. VEGETATION STRUCTURE AND COVER Record appropriate cover class

Cover Class - percentage classes

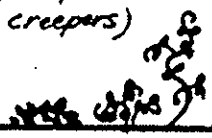
0%	under 2%	2-10%	10-20%	20-30%	30-50%	50-70%	over 70%

LIFE FORM	TREES		MALLEES	
	>15m or 5-15m 	under 5m 	MALLEE SHRUB less than 8m 	MALLEE TREE 8m or more 
COVER CLASS (%)	>15m 20-30% 5-15m	<2%		
Dominant Species	Marri Jarrah	Allo. Gras.		

15m
10m
5m

LIFE FORM	SHRUBS (use the height classes indicated)				SHRUBS
	over 2m 	2.0-1.5m 	1.5-1.0m 	1.0m - .5m 	under .5m 
COVER CLASS (%)			<2%		
Dominant Species			Xant. prei		

3m
2m
1m
Height (metres)

LIFE FORM	BUNCH GRASSES	HERBS	SEDGES	
	under .5m 	under .5m (except creepers) 	over .5m 	under .5m 
COVER CLASS (%)				30-50%
Dominant Species				Lopid ? Meso ht

2.0m
1.5m
1.0m
.5m

4. VEGETATION CONDITION

PRISTINE	
EXCELLENT	
VERY GOOD	✓
GOOD	
DEGRADED	

Comments
Logging, fire

1. SPECIES PRESENCE

1/9/93

QUADRAT No. YARL03

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

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

Trees	No	ID
Marri ✓		
Jarrah ✓		
Allo. fras ✓		

Mallees	No	ID

SHRUBS	No	ID
Xanth preissii ✓		
Xanth gracilis ✓		
Labichea punctata ✓		
Grevillea wilsonii ✓		
Labichea punctata ✓		
Tetratheca hirsuta (not hairy)	VSP	
Dryandra nivea ✓		
Hibbertia hyp ✓		
Hybanthus floribunda ✓	VSP	
Daviesia preissii ✓		
Hakea ruscifolia ✓		
Eriostemon spicatus ✓		
Lechenaultia ~~flo~~ biloba ✓		
Bossiaea eriocarpa large = WAROONA		
Gomph knight. ✓		
Hovea trisperma large ovate leaves ✓		
Grevillea quercifolia ✓		X
Olearia paucidentata ✓	VSP	
Logania serpyllifolia ✓	VSP	+
Acacia lateriticola ✓	~~VSP~~	
Pimelea suaveolens ✓		

SHRUBS	No	ID
14/10/93		
Thysanotus thyr ✓		
Stipa = 044 flav ✓	✓	VSP
Danthonia ocid ✓	✓	VSP
Xanthosia pusilla ✓		
Caesia occid ✓		
Haem = 044 ✓		
Phlebocarya ciliata ✓		
Pentapeltis pelt ✓		
~~Orobanche minor~~		

Bunch Grasses	No	ID
Tetrarrhena laevis ✓	X	
* Briza maxima ✓		

Herbs	No	ID
Scaevola [phlebopetala] ✓		
Burchardia umbellata ✓		
Drosera stolonifera ✓		
Drosera erythrorhiza ✓		
* Hypochaeris glabra ✓		
Haemodorum loratum ✓		
Caladenia flava ✓		
Pentapeltis peltigera ✓		
Prasophyllum frail ✓		
* Orobanche minor ✓		
Caesia micrantha ✓		
Opercularia hispidula ✓		
Senecio no ray florets ✓	VSP 14/10	
Conostylis setosa ✓		
Stylid pilliferum. ✓		
S. hispidulus ✓		

Herbs	No	ID
Thelymitra sp = 044		
Pterostylis vittata ✓		
Tricoryne elatior ✓		
Lomandra sericea ✓		
~~Lomo~~		

Sedges	No	ID
Mesomelaena tetra ✓		
Tetraria oct ✓		
Tetraria capillaris ✓		
Loxocarya fasc ✓		
Lepidosperma sp = ✓	VSP	
ADJ		
Dryandra bipinnat ✓		
Hakea ruscifolia ✓	VSP	
Rd Junct		
(Baeckea) = Schoenus caliste ✓		

New Rec for SCP only known from Nj Moore R MET has dated + got collection

Swan Coastal Plain Survey - SURVEY RECORDING SHEET Please use pencil

BUSHLAND AREA: YARCOOP SAND RES

QUADRAT No. YARC 04 VEGETATION TYPE Jarrah Woodland

DATE TRIP 11/9/93 BOTANIST BJK/MC/NG

VOLUNTEERS /

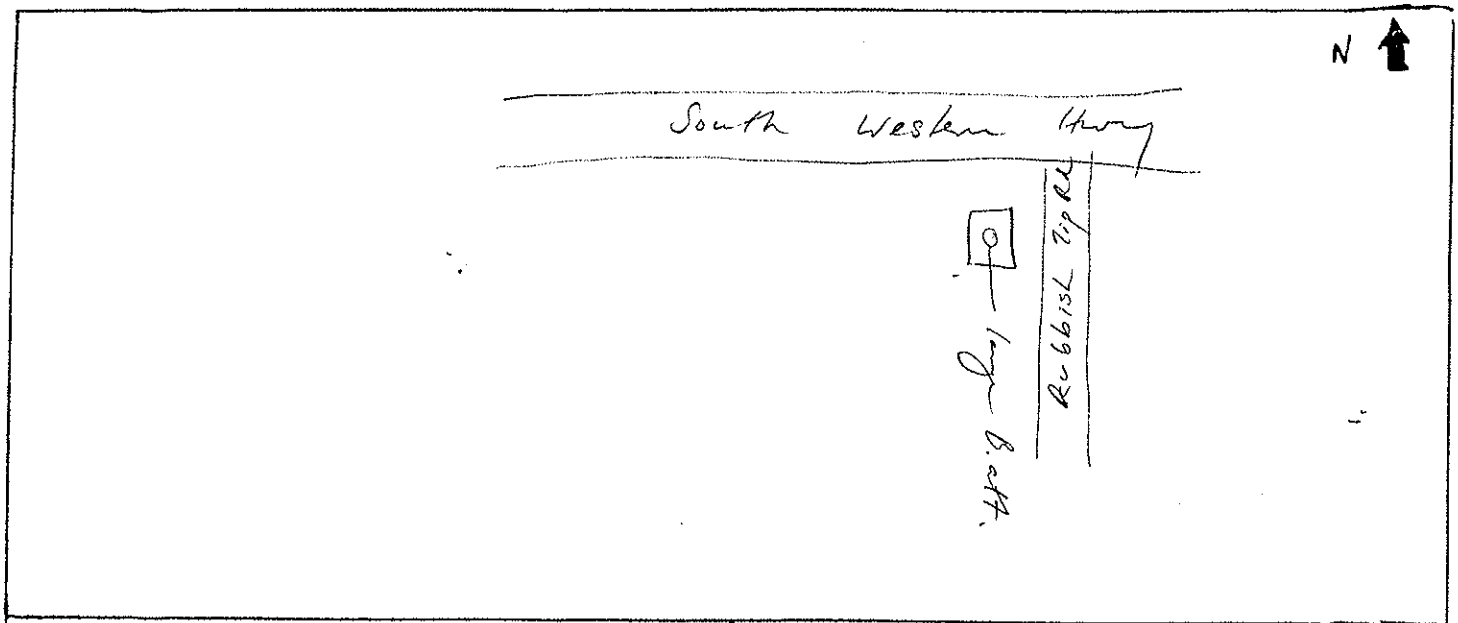
DATE TRIP 14/10/93 BOTANIST

VOLUNTEERS / /

Keighery and Keighery, 1990
Adapted from Griffin and Keighery, 198
MOORE RIVER to JURIEN SANDPLAIN SURVEY. WILDFLOWER SOCIETY of W.A

1. LOCATION of the QUADRAT

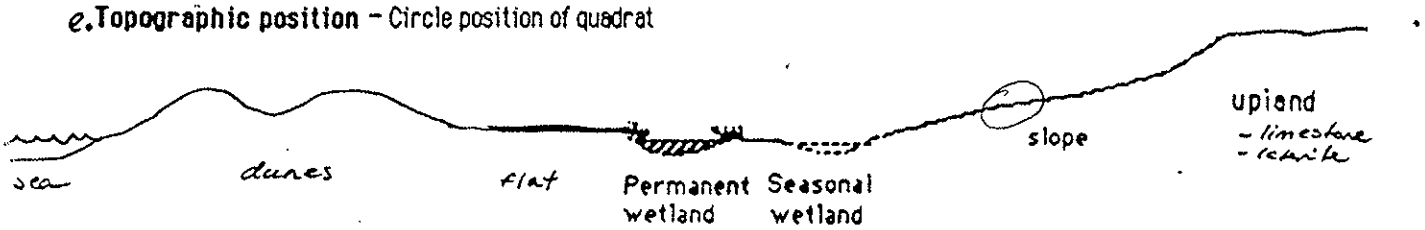
a. Mud Map Draw a sketch of the location of the quadrat



b Road Location	c. Latitude	Longitude
Rubbish Tip Road.	32° 57' 36.3"	115° 54' 55.5"
		Altitude 50m ± 100m

d. Photograph Photographer's name NG Photo No 8

e. Topographic position - Circle position of quadrat



2. SITE DATA - Circle the correct response

Slope flat (gentle) steep

Aspect N NE E SE S SW (W) NW

Surface soil grey brown sand

Sub-surface soil yell-orange sand Environ Geol S12

Drainage (well) mod poor

Wet All year winter/spring

Litter (% cover) 100%

% Bare ground 0%

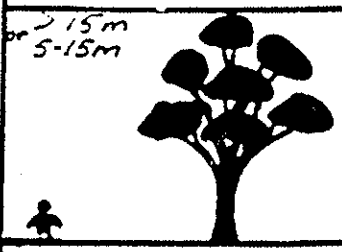
(adj. areas ash beds from fires)

P.T.O.

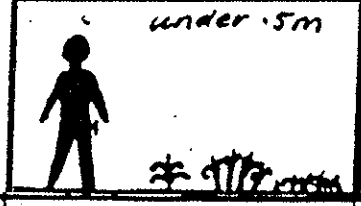
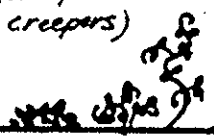
3. VEGETATION STRUCTURE AND COVER Record appropriate cover class

Cover Class – percentage classes

0%	under 2%	2-10%	10-20%	20-30%	30-50%	50-70%	over 70%

LIFE FORM	TREES		MALLEES		
	>15m or 5-15m 	under 5m 	MALLEE SHRUB less than 8m 	MALLEE TREE 8m or more 	15m 10m 5m
COVER CLASS (%)	>15m 5-15m 20-30				
Dominant Species	Tarrak Bank att				

LIFE FORM	SHRUBS use the height classes indicated				SHRUBS	
	over 2m 	2.0-1.5m 	1.5-1.0m 	1.0m - .5m 	under .5m 	3m 2m 1m Height (metres)
COVER CLASS (%)				20-30%		
Dominant Species				and mixed Xanth		

LIFE FORM	BUNCH GRASSES	HERBS	SEDGES		
	under .5m 	under .5m (except creepers) 	over .5m 	under .5m 	2.0m 1.5m 1.0m .5m
COVER CLASS (%)		10-20%		30-50%	
Dominant Species		Com. ser		Meso het Tet. oct.	

4. VEGETATION CONDITION

PRISTINE	
EXCELLENT	
VERY GOOD	✓
GOOD	
DEGRADED	

Comments
Too frequent fires ≤ 3yrs
logging, tracks all over.

SPECIES PRESENCE 1/9/93

QUADRAT No. YARC 04

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

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

Trees

Trees	No	ID
Jarrah ✓		1
Bank. attenuata		2
Allocas fras (sucker) ✓		3

Mallees

pale yel fls Scurfels. D

SHRUBS

SHRUBS	No	ID
Acacia sessilis ✓		4
Stirlingia latifolia ✓		5
Daviesia divaricata ✓		6
Hibb. hyp. ✓		7
Hibb ~~[illegible]~~ hueg. ✓	VSP	8
Pimelea ? suaveolens ✓	VSP	9
Eriostemon spicatus ✓		10
Bossiaea aff erico 'large'		11
Hovea hisp. 'ovate lvs' ✓	VSP	12
Conosteph ? pend ✓		13
Grevillea wilsonii ✓		14
Dryandra nivea ✓		15
✓ Labichea punct.		16
Daviesia physodes ✓		17
Petrophile linearis ✓		18
Xanth prei. ✓		19
Hovea chorizemifolia ✓		20
Hibbertia amplexi ✓		21
Pentapeltis peltigera ✓		22
Astroloma ? pallidum ✓		23
Hemiandra pungens ✓	hairy	24
Bossiaea eriocarpa ✓		25
Hibbertia acerosa ✓		26

SHRUBS	No	ID
Gomph knight ✓		27
Comesperma virg. ✓		28
Gompholobium ? preissii ✓		29
Acacia ~~[illegible]~~ stenocarpa ✓		30
14/10/93		
Thelymitra crinita. ✓	✓	VSP 31
Agrost. scabrum ✓		32
✓ Schoenus = Mesomelaena aff gracilis	VSP	~~33~~
Patersonia [illegible] ✓		34
~~[illegible]~~		
Stipa ? comp. ✓	VSP	35

Bunch Grasses

Bunch Grasses	No	ID
~~Amphipogon~~		
Amphipogon turb. ✓	X	VSP 36
Tetrarrhena laevis		37

Herbs

Herbs	No	ID
Phleb. ciliata ✓		38
Scaevola ~~phlebopet~~ / calliptera		VSP
Lomandra sericea ✓		40
Conostylis juncea ✓		41
Haemodorum ? vittata ✓		42
Caladenia ? flava ✓		43
Drosera erythrorhiza ✓		44
Lomandra preissii ✓		45
Conostylis setigera ✓		46
Stylid piliferum ✓		47
✓ Dampiera linearis ✓		48
Calytrix discoidea ✓		49
Burchardia umbellata ✓		50
Pronaya fras. ✓		51
Dasypogon brom ✓		52

Herbs	No	ID
Caesia micrantha ✓		53
Anigozanthos mang. ✓		54
Thelymitra sp 1 (single)		55
Thelymitra sp 2 (2 leaves)		
Lyperanthus nig. ✓		56
Prasophyllum ✓		57
Chamaescilla corym. ✓		58
Tricoryne spath. ✓		59
Stylidium schoenoides ✓		60
Lom. herm. ✓		61
Haem. ? loratum ✓		62
~~Agg~~ Stypandra glauca ✓		63

Sedges

Sedges	No	ID
Tetraria oct ✓		64
Mesomel. tetrag. ✓		65
Loxocarya fasciculata ✓		66
Hypolaena exsulca ✓		67
✓ Tetraria capillaris ✓		68
Lepidosperma sp = YARC 03		69
Mesomelaena ? gracil. ✓		70

→ 71 large [illegible] = aff. ang.

ADJ

Xyl. occid ✓

Bank grand. ✓

[illegible] occid ✓

[illegible] occ. ✓

Xanth. [illegible] ✓

Yar 97

30-Oct-97 Standard Report

TaxonID	SpCode	Comments	Plot	Date	Rec. no.
5708	EUCMAR		ytip01	17-Oct-97	1
1819	BANGRA		ytip01	17-Oct-97	2
1728	ALLFRA		ytip01	17-Oct-97	3
2331	XYLOCC		ytip01	17-Oct-97	4
3956	GOMSHU	ruabon	ytip01	17-Oct-97	5
3832	DAVPHY		ytip01	17-Oct-97	6
2273	PERSAC		ytip01	17-Oct-97	7
2299	PETLIN		ytip01	17-Oct-97	8
85	MACRIE		ytip01	17-Oct-97	9
2316	STILAT		ytip01	17-Oct-97	10
5135	HIBHYP		ytip01	17-Oct-97	11
5108	HIBACE		ytip01	17-Oct-97	12
1253	XANGRA		ytip01	17-Oct-97	13
3807	DAVDIV		ytip01	17-Oct-97	14
3669	LABPUN		ytip01	17-Oct-97	15
6245	PENPEL		ytip01	17-Oct-97	16
6839	HEMPUN	hairy	ytip01	17-Oct-97	17
16672	DRYLIN		ytip01	17-Oct-97	18
2122	GREWIL		ytip01	17-Oct-97	19
5134	HIBHUE	?	ytip01	17-Oct-97	20
3710	BOSERI	large	ytip01	17-Oct-97	21
3541	ACASES		ytip01	17-Oct-97	22
5109	HIBAMP		ytip01	17-Oct-97	23
3968	HOVTRI	large ✓	ytip01	17-Oct-97	24
4476	ERISPI		ytip01	17-Oct-97	25
4716	STAVER		ytip01	17-Oct-97	26
4535	TETHIR	sep ✓	ytip01	17-Oct-97	27
7345	OPEAPI	small	ytip01	17-Oct-97	28
12585	SCAREP		ytip01	17-Oct-97	29
3954	GOMPOL		ytip01	17-Oct-97	30
3807	DAVDIV		ytip01	17-Oct-97	31
3805	DAVDEC	?preissii	ytip01	17-Oct-97	32
3964	HOVCHO		ytip01	17-Oct-97	33
6334	ASTPAL		ytip01	17-Oct-97	34
8143	OLEPAU		ytip01	17-Oct-97	35
3410	ACALAT	?	ytip01	17-Oct-97	36
4666	MONOCC		ytip01	17-Oct-97	37
3175	PROFRA		ytip01	17-Oct-97	38
245	BRIMIN		ytip01	17-Oct-97	39
244	BRIMAX		ytip01	17-Oct-97	40
293	DANOCC		ytip01	17-Oct-97	41
184	AIRCAR		ytip01	17-Oct-97	42
7348	OPEHIS		ytip01	17-Oct-97	43
1436	CONJUN		ytip01	17-Oct-97	44
1220	DASOBL		ytip01	17-Oct-97	45
3131	DROSTO		ytip01	17-Oct-97	46
7602	SCACAL	?phleb	ytip01	17-Oct-97	47
1705	THECRI	?	ytip01	17-Oct-97	48
1478	PHLCIL		ytip01	17-Oct-97	49
1228	LOMHER		ytip01	17-Oct-97	50
1553	PATUMB	? sterile	ytip01	17-Oct-97	51
1276	CAEMIC		ytip01	17-Oct-97	52
1223	LOMCAE		ytip01	17-Oct-97	53
1592	CALFLA		ytip01	17-Oct-97	54

4059	LOTANG	ytip01	17-Oct-97	55
8086	HYPGLA	ytip01	17-Oct-97	56

TaxonID	SpCode	Comments	Plot	Date	Rec. no.
7774	STYPIL		ytip01	17-Oct-97	57
1243	LOMSER		ytip01	17-Oct-97	58
7454	DAMLIN		ytip01	17-Oct-97	59
12770	BURCON		ytip01	17-Oct-97	60
6280	TRAPIL		ytip01	17-Oct-97	61
1318	THYARB		ytip01	17-Oct-97	62
1280	CHACOR		ytip01	17-Oct-97	63
1546	PATJUN		ytip01	17-Oct-97	64
-1513	CALADSP	?	ytip01	17-Oct-97	65
8097	LAGHUE		ytip01	17-Oct-97	66
1312	SOWLAX		ytip01	17-Oct-97	67
6532	MITPAL		ytip01	17-Oct-97	68
1036	TETOCT		ytip01	17-Oct-97	69
957	MESTET		ytip01	17-Oct-97	70
1094	LOXFLE		ytip01	17-Oct-97	71
1070	HYPEXS		ytip01	17-Oct-97	72
1093	LOXFAS		ytip01	17-Oct-97	73
-1689	SCHAFFBR		ytip01	17-Oct-97	74
1034	TETCAP		ytip01	17-Oct-97	75
945	LEPSQU		ytip01	17-Oct-97	76
1125	CENDRU	?	ytip01	17-Oct-97	77
1411	ANIMAN	?	ytip01	17-Oct-97	78
-1664	DROSSP	? climb glab	ytip01	17-Oct-97	79
8255	URSANT		ytip01	17-Oct-97	80
8282	WAISUA		ytip01	17-Oct-97	81
6226	HYDCAL		ytip01	17-Oct-97	82
7389	WAHPRE		ytip01	17-Oct-97	83
8231	SONOLE		ytip01	17-Oct-97	84
1234	LOMNIG		ytip01	17-Oct-97	85
639	STICAM	adj	ytip01	17-Oct-97	86
5708	EUCMAR		ytip02	17-Oct-97	87
1728	ALLFRA		ytip02	17-Oct-97	88
2331	XYLOCC		ytip02	17-Oct-97	89
1819	BANGRA	seedling	ytip02	17-Oct-97	90
3955	GOMPRE		ytip02	17-Oct-97	91
4564	COMVIR		ytip02	17-Oct-97	92
4476	ERISPI		ytip02	17-Oct-97	93
4716	STAVER		ytip02	17-Oct-97	94
2316	STILAT		ytip02	17-Oct-97	95
2080	GREQUE	?	ytip02	17-Oct-97	96
2273	PERSAC		ytip02	17-Oct-97	97
3807	DAVDIV		ytip02	17-Oct-97	98
2299	PETLIN		ytip02	17-Oct-97	99
3669	LABPUN		ytip02	17-Oct-97	100
3964	HOVCHO		ytip02	17-Oct-97	101
16672	DRYLIN		ytip02	17-Oct-97	102
3710	BOSERI	large	ytip02	17-Oct-97	103
2122	GREWIL		ytip02	17-Oct-97	104
1256	XANPRE		ytip02	17-Oct-97	105
7348	OPEHIS	large	ytip02	17-Oct-97	106
6245	PENPEL		ytip02	17-Oct-97	107
3956	GOMSHU	ruabon	ytip02	17-Oct-97	108
5134	HIBHUE	?	ytip02	17-Oct-97	109
5135	HIBHYP		ytip02	17-Oct-97	110
8143	OLEPAU		ytip02	17-Oct-97	111

16672	DRYLIN		ytip02	17-Oct-97	112
3410	ACALAT	=01	ytip02	17-Oct-97	113

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TaxonID	SpCode	Comments	Plot	Date	Rec. no.
1253	XANGRA		ytip02	17-Oct-97	114
3954	GOMPOL		ytip02	17-Oct-97	115
3175	PROFRA		ytip02	17-Oct-97	116
7454	DAMLIN		ytip02	17-Oct-97	117
1553	PATUMB	? sterile	ytip02	17-Oct-97	118
3968	HOVTRI	large ✓	ytip02	17-Oct-97	119
1705	THECRI		ytip02	17-Oct-97	120
6334	ASTPAL	sterile ✓	ytip02	17-Oct-97	121
4535	TETHIR		ytip02	17-Oct-97	122
244	BRIMAX		ytip02	17-Oct-97	123
184	AIRCAR		ytip02	17-Oct-97	124
667	TETLAE		ytip02	17-Oct-97	125
245	BRIMIN		ytip02	17-Oct-97	126
1218	DASBRO		ytip02	17-Oct-97	127
1436	CONJUN		ytip02	17-Oct-97	128
1280	CHACOR		ytip02	17-Oct-97	129
3095	DROERY		ytip02	17-Oct-97	130
1478	PHLCIL		ytip02	17-Oct-97	131
7602	SCACAL		ytip02	17-Oct-97	132
1592	CALFLA		ytip02	17-Oct-97	133
1243	LOMSER		ytip02	17-Oct-97	134
8086	HYPGLA		ytip02	17-Oct-97	135
4059	LOTANG	seedling	ytip02	17-Oct-97	136
1276	CAEMIC		ytip02	17-Oct-97	137
6280	TRAPIL		ytip02	17-Oct-97	138
8231	SONOLE		ytip02	17-Oct-97	139
8782	DIADIV		ytip02	17-Oct-97	140
1468	HAELAX	? sterile	ytip02	17-Oct-97	141
1261	AGRSCA		ytip02	17-Oct-97	142
1223	LOMCAE		ytip02	17-Oct-97	143
7774	STYPIL		ytip02	17-Oct-97	144
8251	TRISPA		ytip02	17-Oct-97	145
7389	WAHPRE		ytip02	17-Oct-97	146
1550	PATOCC	?	ytip02	17-Oct-97	147
1036	TETOCT		ytip02	17-Oct-97	148
957	MESTET		ytip02	17-Oct-97	149
945	LEPSQU		ytip02	17-Oct-97	150
1034	TETCAP		ytip02	17-Oct-97	151
1094	LOXFLE		ytip02	17-Oct-97	152
1093	LOXFAS		ytip02	17-Oct-97	153
1070	HYPEXS		ytip02	17-Oct-97	154
957	MESTET		ytip02	17-Oct-97	155
1819	BANGRA	adj	ytip02	17-Oct-97	156

Appendix 1: Flora List

Yarl9704.txt 31/10/97 (includes Yarl04 and Ytip sites)

Anthericaceae

1 Agrostocrinum scabrum
2 Caesia micrantha
3 Caesia occidentalis
4 Chamaescilla corymbosa
5 Sowerbaea laxiflora
6 Thysanotus arbuscula

Apiaceae

7 Hydrocotyle callicarpa
8 Pentapeltis peltigera
9 Trachymene pilosa

Asteraceae

* Hypochaeris glabra 1
10 Lagenifera huegelii
1 Olearia paucidentata
* Sonchus oleraceus 2
2 Trichocline spathulata
* Ursinia anthemoides 3
3 Waitzia suaveolens

Caesalpiniaceae

4 Labichea punctata

Campanulaceae

5 Wahlenbergia preissii

Casuarinaceae

6 Allocasuarina fraseriana

Centrolepidaceae

7 Centrolepis drummondiana

Colchicaceae

9 Burchardia congesta
20 Burchardia umbellata

Cyperaceae

1 Lepidosperma aff. angustatum scps
2 Lepidosperma squamatum
3 Mesomelaena graciliceps
4 Mesomelaena tetragona
5 Mesomelana aff graciliceps yarl 04 scps (BJK&NG 146)
6 Schoenus aff. brevifolius/breviculmis/brevisetis scps

7 Tetraria capillaris
8 Tetraria octandra

Dasypogonaceae

9 Dasypogon bromeliifolius
~~Dasypogon obliquifolius~~
30 Lomandra caespitosa
1 Lomandra hermaphrodita

Dasypogonaceae

2 Lomandra nigricans
3 Lomandra preissii
4 Lomandra sericea

Dilleniaceae

5 Hibbertia acerosa
6 Hibbertia amplexicaulis
7 Hibbertia huegelii
8 Hibbertia hypericoides

Droseraceae

9 Drosera erythrorhiza
40 Drosera sp. scps
1 Drosera stolonifera

Epacridaceae

2 Astroloma pallidum
3 Conostephium pendulum

Euphorbiaceae

4 Monotaxis occidentalis
5 Stachystemon vermicularis

Goodeniaceae

6 Dampiera linearis
7 Scaevola calliptera
8 Scaevola repens

Haemodoraceae

9 Anigozanthos manglesii
30 Conostylis juncea
1 Conostylis setigera
2 Haemodorum laxum
3 Haemodorum loratum
4 Phlebocarya ciliata

Iridaceae

5 Patersonia juncea

6 Patersonia occidentalis
7 Patersonia umbrosa

Lamiaceae

8 Hemiandra pungens

Lauraceae

9 Cassytha micrantha

Loganiaceae

60 Mitrasacme palustris

Mimosaceae

1 Acacia lateriticola
2 Acacia sessilis
3 Acacia stenoptera

Myrtaceae

4 Eucalyptus marginata

Orchidaceae

5 Caladenia discoidea
6 Caladenia flava
7 Caladenia sp. scps
8 Lyperanthus nigricans
9 Prasophyllum parvifolium
70 Pterostylis vittata
1 Thelymitra crinita
2 Thelymitra sp. scps

Papilionaceae

3 Bossiaea eriocarpa
4 Bossiaea eriocarpa (Large flowered form, BJK & NG 229) scps
5 Daviesia decurrens
6 Daviesia divaricata
7 Daviesia physodes
8 Gompholobium knightianum
9 Gompholobium polymorphum
80 Gompholobium preissii
1 Gompholobium shuttleworthii
2 Hovea chorizemifolia
3 Hovea trisperma
4 Hovea trisperma var. grandiflora
5 Kennedia coccinea
* Lotus angustissimus 4

Phormiaceae

Dianella divaricata
Stypandra glauca

Pittosporaceae

Pronaya fraseri

Poaceae

* Aira caryophyllea
Amphipogon turbinatus
* Briza maxima
* Briza minor
Danthonia occidentalis
Stipa campylachne
Tetrarrhena laevis

Polygalaceae

Comesperma virgatum

Proteaceae

Banksia attenuata

Proteaceae

Banksia grandis
Dryandra lindleyana
Dryandra nivea
Grevillea quercifolia
Grevillea wilsonii
Persoonia saccata
Petrophile linearis
Stirlingia latifolia
Xylomelum occidentale

Restionaceae

Hypolaena exsulca
Loxocarya fasciculata
Loxocarya flexuosa

Rubiaceae

Opercularia apiciflora
Opercularia hispidula

Rutaceae

Eriostemon spicatus

Stylidiaceae

Stylidium piliferum
Stylidium schoenoides

Thymelaeaceae

2 Pimelea suaveolens

Tremandraceae

3 Tetratheca hirsuta

Xanthorrhoeaceae

4 Xanthorrhoea gracilis
5 Xanthorrhoea preissii

Zamiaceae

6 Macrozamia riedlei

116 Natives.
7 Weeds.

Yarl9704.txt 31/10/97 (includes Yarl04 and Ytip sites)

Anthericaceae

Agrostocrinum scabrum
Caesia micrantha
Caesia occidentalis
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Sowerbaea laxiflora
Thysanotus arbuscula

Apiaceae

Hydrocotyle callicarpa
Pentapeltis peltigera
Trachymene pilosa

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* Hypochaeris glabra
Lagenifera huegelii
Olearia paucidentata
* Sonchus oleraceus
Trichocline spathulata
* Ursinia anthemoides
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Labichea punctata

Campanulaceae

Wahlenbergia preissii

Casuarinaceae

Allocasuarina fraseriana

Centrolepidaceae

Centrolepis drummondiana

Colchicaceae

Burchardia congesta
Burchardia umbellata

Cyperaceae

Lepidosperma aff. angustatum scps
Lepidosperma squamatum
Mesomelaena graciliceps
Mesomelaena tetragona

Mesomelana aff graciliceps yarl 04 scps (BJK&NG 146)
Schoenus aff. brevifolius/breviculmis/brevisetis scps
Tetraria capillaris
Tetraria octandra

Dasypogonaceae

Dasypogon bromeliifolius
Dasypogon obliquifolius
Lomandra caespitosa
Lomandra hermaphrodita

Dasypogonaceae

Lomandra nigricans
Lomandra preissii
Lomandra sericea

Dilleniaceae

Hibbertia acerosa
Hibbertia amplexicaulis
Hibbertia huegelii
Hibbertia hypericoides

Droseraceae

Drosera erythrorhiza
Drosera sp. scps
Drosera stolonifera

Epacridaceae

Astroloma pallidum
Conostephium pendulum

Euphorbiaceae

Monotaxis occidentalis
Stachystemon vermicularis

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Scaevola repens

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Haemodorum loratum
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Patersonia occidentalis
Patersonia umbrosa

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Lauraceae

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Loganiaceae

Mitrasacme palustris

Mimosaceae

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Acacia sessilis
Acacia stenoptera

Myrtaceae

Eucalyptus marginata

Orchidaceae

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Caladenia flava
Caladenia sp. scps
Lyperanthus nigricans
Prasophyllum parvifolium
Pterostylis vittata
Thelymitra crinita
Thelymitra sp. scps

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Bossiaea eriocarpa (Large flowered form, BJK & NG 229) scps
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Daviesia divaricata
Daviesia physodes
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Gompholobium polymorphum
Gompholobium preissii
Gompholobium shuttleworthii
Hovea chorizemifolia
Hovea trisperma
Hovea trisperma var. grandiflora
Kennedia coccinea
* Lotus angustissimus

Phormiaceae

Dianella divaricata
Stypandra glauca

Pittosporaceae

Pronaya fraseri

Poaceae

* Aira caryophyllea
Amphipogon turbinatus
* Briza maxima
* Briza minor
Danthonia occidentalis
Stipa campylachne
Tetrarrhena laevis

Polygalaceae

Comesperma virgatum

Proteaceae

Banksia attenuata

Proteaceae

Banksia grandis
Dryandra lindleyana
Dryandra nivea
Grevillea quercifolia
Grevillea wilsonii
Persoonia saccata
Petrophile linearis
Stirlingia latifolia
Xylomelum occidentale

Restionaceae

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Loxocarya fasciculata
Loxocarya flexuosa

Rubiaceae

Opercularia apiciflora
Opercularia hispidula

Rutaceae

Eriostemon spicatus

Stylidiaceae

Stylidium piliferum
Stylidium schoenoides

Thymelaeaceae

Pimelea suaveolens

Tremandraceae

Tetratheca hirsuta

Xanthorrhoeaceae

Xanthorrhoea gracilis
Xanthorrhoea preissii

Zamiaceae

Macrozamia riedlei

Table 1. Identification of issues requiring Environmental Protection Authority evaluation

Factors	Proposal characteristics	Government Agency Comments	Public Comments	Relevant Factor
Biophysical Impacts				
Water (ground and surface) quantity	1 000 000 m^3/year of ground water to be abstracted from shallow aquifer - 5 bores at depth of 50m.	Bores located outside the South West Coastal Ground water Area. Need to determine ground water abstraction impact on other users or local vegetation. (W&RC)		EPA evaluation required. Item 1 in Table 2
	Dewatering of mine is not required.	What impact will mine dewatering have on surrounding vegetation? (DEP)		EPA evaluation not required.
Flora and fauna	Reserve 31900 currently reserved with Shire of Harvey for sanitary landfill and sand excavation. Direct disturbance by further clearing 6ha of the existing 8ha of vegetation community 3b within Reserve 31900. No Declared Rare Flora species have been found. No Declared Rare Fauna species have been found. Temporary loss of potential habitat in Reserve 31900.	Community 3b is classified "vulnerable"; secured in only 3 conservation reserves (Kooljerrenup Nature Reserve, Cardup Nature reserve and Serpentine National Park. (CALM) The areal extent of community type 3b, both regionally and in total has not yet been determined accurately. (CALM) Flora surveys were not conducted at an optimal time to survey for rare flora. (CALM) Extensive flora surveys have not been undertaken by CALM as indicated by Proponent in CER. (CALM) Need to protect remaining vegetation from degradation by secondary impacts such as vehicle and machinery damage, dieback disease introduction or spread, and changing ground water levels (DEP) No removal of remnant vegetation for mining (community type 3b) from Reserve 31900. (Shire of Harvey)	No removal of remnant vegetation for mining (community type 3b) from Reserve 31900. EPA should advise the Shire of Harvey to refrain from further excavation of vegetation community type 3b. Reserve 31900 should be added to the proposed A class Reserves north of Burney Road. EPA should promulgate a general policy requiring landfill rubbish tip excavation to be in cleared areas only.	Additional information to be provided by Proponent. EPA evaluation required. Item 2 in Table 2.

Factors	Proposal characteristics	Government Agency Comments	Public Comments	Relevant Factor
Biophysical Impacts (continued)				
Rehabilitation	Rehabilitation will be undertaken in accordance with a restoration plan that will be finalised prior to commencing mining. • Pastoral land to pastoral land • Reserve 31900 with compatible species. • Provision of landfill	The rehabilitation of Reserve 31900 should be to criteria accepted by CALM. (DOME)		EPA evaluation required. Item 3 in Table 2
	Diversity of rehabilitation will not be the same but species planted will be compatible to 3b and 20b communities.	Rehabilitation to retain integrity of the 3b vegetation community type. (DEP)		

Factors	Proposal characteristics	Government Agency Comments	Public Comments	Relevant Factor
Pollution Potential				
Noise emissions	Mining activities will increase ambient noise levels. Nearest resident is on the boundary of the mining lease.	Need to monitor and manage noise. (DEP-PPD) Does the noise monitoring take into account tonal and frequency variables which may cause social noise nuisance? (DOME) Need to incorporate a (noise) tonal and frequency monitoring requirement? (DOME)		Noise limits established in the *Noise Abatement (Neighbourhood Noise) Regulations.* Noise monitoring and management can be addressed through DEP works approval and licence. Tonal components and frequency variables need consideration EPA evaluation required. Item 4 in Table 2
Dust emissions	Mining activities will increase ambient dust levels. Nearest resident is on the boundary of the mining lease.	Need to monitor and manage dust. (DEP-PPD)		Dust monitoring and management can be addressed through DEP works approval and licence. EPA evaluation not required.

Factors	Proposal characteristics	Government Agency Comments	Public Comments	Relevant Factor
Pollution Potential (continued)				
Water (surface and ground) quality	Approx 50 ha of slimes dam will be constructed. No management proposed for water collecting in slimes dam.	Slimes dam to be set back a minimum of 50 metres from the creek line. Overflow entrapment and pumpback system to prevent overflows entering the stream. (W&RC) Water collecting on slimes dams to be managed. (DEP-PPD)		Slimes dam water management can be addressed through DEP works approval and licence. EPA evaluation not required
	Flocculant added for separation of fine clay particles. Hydrocarbons kept on site for refuelling earthmoving equipment. 2 plants sites to be constructed, facilities include workshops, store, shed, site office, toilets and lunch room.	Are any chemical additives used in the wet gravity separation process? (DEP-PPD) Stormwater runoff and drainage to be managed. Oil and grease waste to be managed at point of generation. Chemical storage areas to be bunded and comply with statutory requirements. (W&RC) (DEP-PPD)		
		Ground water, local creeks and piezometer quality needs to be monitored. (W&RC)		
Radiation	Mining of mineral sands will reduce the natural background radiation levels.	Post-mining gamma survey to verify that the radiation levels are no greater than those measured for the pre-mining survey needs to be carried out. (HDWA)		Radiation issues addressed under Mines Dept requirements. EPA evaluation not required.
Light spill				Light spill can be addressed through DEP works approval and licence. EPA evaluation not required.

Factors	Proposal characteristics	Government Agency Comments	Public Comments	Relevant Factor
Social Surroundings				
Transport	Transport of HMC via existing transport route to Bunbury.	Will frequency of road/rail freight accessing the Bunbury Port increase? What impact on regional traffic and the City of Bunbury. (DEP)		Use of roads, access points and improvements subject to Main Roads and the Shire of Harvey approval. EPA evaluation not required.
	Burney Road and Black Pool Road intersections with South West Highway	Access point improvements to South Western Highway required. (MRD)		

Table 2. Summary of Environmental Protection Authority recommendations

Factors	Objective	Evaluation Framework	Proponent's Commitments	EPA Recommendations
Biophysical Impacts				
1. Water (ground and surface) quantity	Ensure the impact of ground water abstraction on indigenous vegetation is minimised.	Ground water abstraction outside the South West Coastal Ground water Management Area	To monitor ground and surface waters and vegetation during mining. If mine dewatering is required, will monitor surrounding vegetation, and if necessary provide supplementary water.	Proponent's commitments are considered adequate.
2. Flora and fauna	Protect Declared Rare and Priority flora and ensure no significant loss of locally and regionally significant vegetation associations and habitats.	Compliance with provisions of the *Wildlife Conservation Act*. Vegetation survey to identify Rare and Priority flora to be conducted at an optimal time to survey for this flora, prior to clearing and in consultation with CALM.Affected plant community 3b "threatened and poorly reserved". Areal extent of 3b vegetation to be determined both regionally and totally. Locally important, regionally not known.		Additional information to be supplied by the Proponent. Recommendation 2: No further removal of 3b or 20b community types from within Reserve 31900. Recommendation 3: Shire to adopt alternative site for sanitary landfill, preferably on existing cleared land.
	Protect Threatened and Priority fauna species and significant habitats.	No rare species of fauna identified.		

Factors	Objective	Evaluation Framework	Proponent's Commitments	EPA Recommendations
Biophysical Impacts (continued)				
3. Rehabilitation	To ensure sustainable rehabilitation of the site to the requirements of the land owner and the Commissioner for Soil Conservation.		Restoration plan to be finalised prior to commencing mining	Proponent's commitments are considered adequate - subject to exclusion of mining in vegetated areas of Reserve 31900.
	The rehabilitation prescriptions developed to reflect the environment existing prior to mining		Prescriptions outlined by proponent in CER (S4.4)	

Factors	Objective	Evaluation Framework	Proponent's Commitments	EPA Recommendations
Pollution Potential				
4. Noise emissions	Comply with statutory requirements and DEP guidelines.	*Noise Abatement (Neighbourhood Annoyance) Regulations.*	Monitoring and management addressed by proponent in response to submissions (2.13)	Proponent's commitments are considered adequate provided it is amended to include predicitive noise modelling incorporating tonal and frequency modelling. If commitments are not amended then a recommendation (4) is required. DEP works approval and licence requirements apply.

GWM/ EPA PC

YARLOOP

Council 'no' to calls for tip closure

by HELEN ALLAN

THE Harvey Shire Council has rejected an Environmental Protection Authority call to close its Yarloop tip and set the area aside for nature conservation.

Shire clerk Keith Leece said it would cost too much to close the tip and create a more regional, managed tip, and Harvey people would not be prepared to travel to a new tip.

The Department of Environmental Protection, in rejecting a proposal by Cable Sands to mine the tip site, said the site and surrounding reserves had significant conservation values and should be vested in the National Parks and Nature Conservation Authority.

It called for current dumping and sand excavation to stop immediately at the Yarloop tip to protect the significant remnant vegetation.

The council rejected the call and has appealed to the Environment Minister to reverse the decision.

Shire chief executive officer Keith Leece acknowledged the Yarloop tip was "a disgrace", but said it would take "an enormous amount of money" to rectify the problem.

The council wanted to run with Cable Sand's original plan to mine the area and create a new tip, which the company would manage for the life of the mine.

The council voted to appeal the DEP decision without discussing options for the tip, such as closing it and developing transfer stations, or closing all its small bush tips and creating a regional tip — like the one Bunbury has.

Mr Leece acknowledged other small councils such as Busselton were heading this way and said that in the future the council might discuss such plans.

"The next best thing would be a transfer station but the community does not want that because they would have travel problems," he said.

"If we close the tip the community would react and if we close the tips you can bet your boots people will abuse the bushland that is left by dumping their rubbish there."

He said until the Harvey council got into the "nitty gritty of finding $300 — $400,000" it had to do the best it could with its tips.

At this stage there were no plans for the council to discuss options for the Yarloop tip other than keeping it open.

Mr C D S Davies
General Manager
Cable Sands (WA) Pty Ltd
P O Box 133
BUNBURY WA 6231

Our Ref 125/96 106758
Enquiries D Tuxford

Attention: Mr G Kininmonth

Dear Sir

YARLOOP MINERALS SANDS LEASE: ASSESSMENT OF REMNANT VEGETATION AND RECOMMENDATIONS FOR RESTORATION

Thank you for forwarding the revised document containing the results of your spring 1996 vegetation survey of reserve 31900.

I have noted with interest the identification of those additional plant species that were surveyed during your most recent work, in particular the identification of *Conospermum incurvum*. I ask that you seek clarification from you consultants that this is a correct recording, as currently the most southern known occurence of this species is in the Midland area. If this is a correct identification then this is a signifcant recording from an ecological perspective which contributes to the current knowledge base for this species.

It is not clear from the report where each of your survey sites occurred within Reserve 31900. I would appreciate you agian clarifying this with your consultants and forwarding a map of the site clearly marking all those areas surveyed during November 1996, February 1996 and January 1995.

With regard to *Tetraria australiensis*, the request for a specific search in Reserve 31900 was based on recent recordings of *T. australiensis* in a habitat both near to and similar to that presented in Reserve 31900. Given this, and as there are few specimens in the herbarium, it is unfortunate that you did not seek further guidence from the Department's Conservation Branch prior to deciding that you would not conduct the search as requested. Subsequently the question of whether Declared Rare Flora occurs in the proposed mining area has not been resolved. I trust that you have in place a contingency strategy to ensure that you will be able to meet the obligations of the *Wildlife Conservation Act 1950*. I would appreciate you notifying this Department of these details as soon as possible.

Should you require further clarification of these issues, then please contact either Deanna Tuxford on 222 7135 or Gary Whisson (Manager, Conservation) on 265 3442.

Yours sincerely

K J Taylor
DIRECTOR
EVALUATION DIVISION

Date

cc Mr G Keighery, Department of Conservation and Land Management, Woodvale
Mr N Caporn, Department of Conservation and Land Management, Como

125/96 VegSurv 100397DTu

MEETING No: 50
DATE: 22 August 1996

ENVIRONMENTAL ASSESSMENTS COMMITTEE BRIEFING NOTE

Subject: Mining of Titanium Minerals Yarloop - Cable Sands (WA) Pty Ltd (Assessment 1032)

Stage of Assessment: Assessment strategy; Preparation of assessment report

Briefing Officer(s): Deanna Tuxford (Assessment Officer)
Colin Murray (Manager)

Purpose: Issues, recommendations and conditions and Delegation of the assessment report to the Chairman

1. Background

1.1 The project area is located within the Shire of Harvey, approximately 2 kilometres south east from the township of Yarloop. (see Attachment 1)

1.2 The heavy minerals deposit proposed for mining occurs on post-1899 titles with mineral rights belonging to the State.

1.3 Mining is proposed on 5 separate parcels of land (refer to Attachment 1).

- Reserve 31900 vested in the Shire of Harvey for sand extraction and rubbish disposal. This Reserve contains approximately 8 hectares of remnant vegetation community type 3b, is considered to be "threatened or poorly reserved" and has been recognised by the EPA as an Interim Protection Area under the System 6 review.
Identified as vulnerable community by CALM 1996 – Threatened Ecological Communities Project.
- Locn 816 and part Locn 3156 are owned by Cable Sands and has been extensively cleared of natural vegetation in the past. Currently used for pastoral purposes.
- Part Locn 3156 is privately owned land and has been extensively cleared of natural vegetation in the past. Currently used for pastoral purposes.

2. Important Issues and/or needs statement:

Table 1 in Attachment 2 includes the environmental factors identified by the DEP, as well as those raised in the public submissions. *Tables 1* and *2* provide identification of the issues and proposed EPA recommendations.

Finalisation of the EPA's recommendations is dependent on the proponent's presentation of additional information, as identified during the public submission period. This information relates to:

- determining the current areal extent of vegetation community type 3b both regionally and totally;
- identifying the security/protection of vegetation community type 3b from development;
- determination of occurrence of declared rare and priority flora during a time conducive to the appearance of such species. (little early still for this)

It is expected that this material will be submitted prior to the EAC being briefed. The proponent will explain this material during the EAC briefing.

Two key environmental factors are further discussed below:

2.1 Flora and fauna

Reserve 31900 is 20 hectares in size. Approximately 9 hectares have been disturbed for landfill and extraction purposes. 8 hectares is vegetation type 3b. Vegetation type 20b occurs in the western section of Reserve but is not impacted by the proposal.

Type 3b is considered by the DEP to be "threatened and poorly reserved community type requiring interim protection" and "vulnerable". It is secured in only 3 reserves (Kooljerrenup Nature Reserve, Cardup Nature Reserve and Serpentine National Park. The areal extent regionally and in total is yet to be determined.

The Shire of Harvey's resolution from its meeting on 13 August 1996 does not support the clearing of vegetation type 3b Reserve 31900. The reserve is vested in the Shire of Harvey.

The Proponent considers the ore resource beneath the 3b vegetation to be critical to the viability of the proposal, and has subsequently investigated purchasing land of similar conservation value (private property containing type 3b vegetation) in the immediate area. The proponent has also discussed the provision of alternative landfill sites for the Shire's purpose in the event that mining proceeds. However, these discussions have not proceeded to the extent of securing alternative sites for the future and long term conservation and protection of the 3b vegetation.

2.2. Noise

Existing dwellings neighbour the boundary of the proposed mining area. To date predictive modelling of tonal and frequency components likely to impact on the neighbours has not been completed. The proponent has committed to undertake a noise monitoring and management programme incorporating these elements. This programme should include predictive modelling, based on similar operations in similar locations, prior to the commencement of mining, and incorporate management options in the event that the predictive modelling shows potential non-compliance with the Noise Regulations. The DEP will negotiate a commitment by the proponent to achieve this

Reference Material:

1. Location diagram for proposal.
2. *Table 1: Identification of issues requiring EPA evaluation.*
3. *Table 2: Summary of EPA recommendations.*
4. Summary of proponent commitments (as originally submitted in the *Yarloop Titanium Minerals Mine Consultative Environmental Review*)

Outcomes statement:

1. Approval of the environmental factors, recommendations and conditions by the EPA, and finalisation of the EPA's Report and recommendations, and approval and transmittal to the Minister for the Environment being delegated to the Chairman.

Recommendation to Committee:

The EAC recommends that the EPA endorse the following recommendations for the assessment report for this proposal:

1. Subject to implementation of the EPA's recommendations and the proponent's commitments, as amended through the assessment process, the proposal is environmental acceptable.

2. The area of type 3b vegetation within Reserve 31900 being excluded from ~~clearing~~ further clearing and mining.

3. The Shire establish an alternative site outside Reserve 31900 for landfill and excavation purposes to ensure protection of the significant conservation values of the Reserve.

4. Prior to commencing site works, the proponent should undertake predictive noise modelling, and identify management options if predictive modelling shows possible non-compliance with Noise Regulations.

5. Following endorsement of the above recommendations, finalisation of the assessment report and transmittal to the Minister for the Environment be delegated to the Chairman.

125/96 EAC BN 150896DTu

Shire Tip Relocated to Cable Sands

Cable mines 8 ha of Reserve31900 land

Mined area includes — 6 ha of Type 3b
2 ha of degraded land

Conservation estate increases to

	Current	After Mining	Gain
Type 3b (good condition	99	102	3
Type 20b (good condition)	39	44	5
Compatible Rehabilitated land		12	12

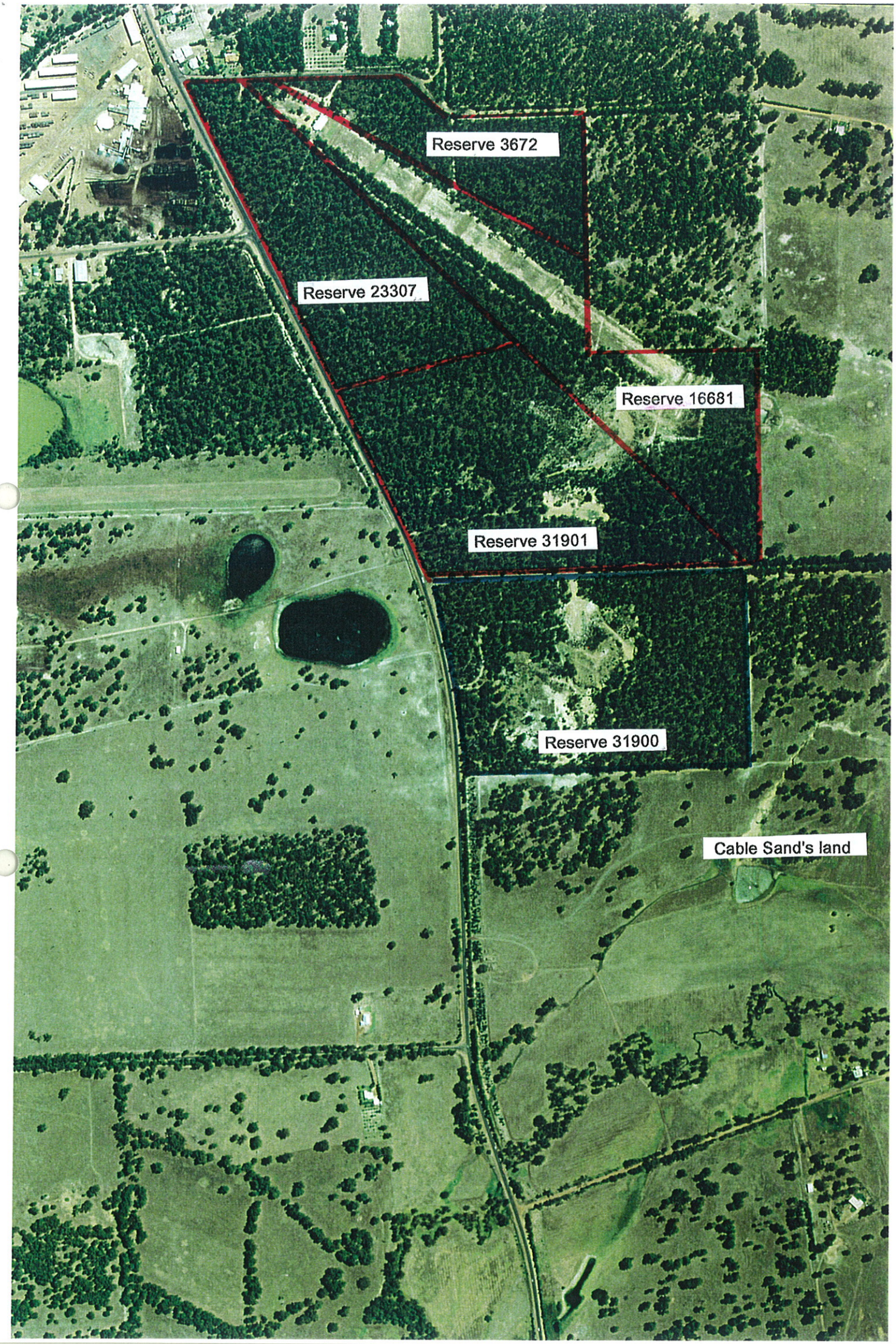
Conservation estate nett gain — 20 ha

No Mining of Reserve - Ongoing Current Use

No increase to conservation estate

Further degradation of Type 3b and Type 20b vegetation

No rehabilitation of existing degraded areas


Reserve 3672
Reserve 23307
Reserve 16681
Reserve 31901
Reserve 31900
Cable Sand's land


Reserve 31901
Type 20b vegetation
Type 3b vegetation
Area impacted by mining

WESTERN AREA OF RESERVE 31900 -INFORMAL TIP

DEGRADED CENTRAL AREA OF RESERVE 31900

DEGRADED CENTRAL AREA OF RESERVE 31900

NEW PARKING BAY IN RESERVE 23307

FAX No 9006 1641

Facsimile message

Department of Environmental Protection

Attention: NEIL GIBSON

From: B. KEIGHERY

Telephone: 9222 7020 No. of sheets following: 4

Date: 12/11/97

Message: NEIL
Amendments as discussed
THANK BRONWEN.

COPY FAXED TO DIRECTOR NATURE CONSERVATION (IDERON MCNAMARA) FOR HIS INFORMATION
BY N. GIBSON
BJK 13/11/97

FAXED.

Westralia Square, 141 St George's Terrace, Perth, WA 6000. Facsimile (09) 322 2850 ☎ (09) 222 7000

DEPARTMENT OF ENVIRONMENTAL PROTECTION

TO:	-	MELINDA PHILLIPS, KIM TAYLOR
FROM:	-	BRONWEN KEIGHERY, GARY WHISSON
SUBJECT:	-	COMMENT ON 'NEW INFORMATION' SUPPLIED TO DEP BY CAPEL SANDS PTY LTD IN REGARDS TO RESERVE 31900, YARLOOP - FRIDAY 26TH SEPTEMBER 1997
DATE:	-	3RD NOVEMBER 1997

Background

Bulletin 838 (Environmental Protection Authority 1996) dealt with a series of relevant environmental factors in respect to a proposed mine in Reserve 31900 and adjacent private lands. The first of these environmental factors was vegetation information. Information on the nature and abundance of the vegetation led to the recommendation that "..mining and further clearing be excluded from Reserve 31900."

Reserve 31900 is located on the Swan Coastal Plain near the southern end of the Ridge Hill Shelf. The Forrestfield Complex (Heddle *et al.* 1980) is found on the Ridge Hill Shelf. This Complex is considered to be 92 - 98% cleared (Environmental Protection Authority 1996). The floristic community types 3b and 20b (after Gibson *et al.* 1994) were considered to be present in the Reserve based on the presence of a plot located by the Gibson *et al.* study in the Reserve (Yar 4) and a plot in the Reserve 3672 (Map 1 and Figure 2, Environmental Protection Authority 1996). Based on soil type, position in the landscape and aerial photo interpretation types 3b and 20b were mapped in the Reserve 31900 for the System 6 Update (Map 2). These floristic community types are two of the floristic grouping considered characteristic of the Ridge Hill Shelf and as a consequence are also heavily cleared.

Subsequent work for Cable Sands (Environmental Survey & Management Pty Ltd and Mattiske Consulting Pty Ltd 1996) identified floristic community types 3b and 20b in Reserve 31900 (Map 3). Further work by Mattiske Consulting Pty Ltd in July 1997 concluded that there was a continuum between the two types in Reserve 31900. On the basis of this 'new information' Cable Sands Pty Ltd considered that the proposal to mine part of Reserve 31900 could be reconsidered (G. Kininmonth pers. comm., 26th September 1997).

Comparison of Studies known from the area of Reserve 31900

Gibson *et al.* (1994) identified floristic community types on the basis of a numerical analysis of over 500 10 X 10m plots across the Swan Coastal Plain. Each plot was marked with four steel pegs. The majority of these plots (over 98%) were visited twice by two botanists experienced in floristic survey on the Plain. One of these plots was located in Reserve 31900 (Yar 04) and another in the Reserve 3672 (Yar 03, see Map 1). These plots were located to sample the best available and accessible structural/floristic units identified on a brief ground check of the area prior to sampling. Mattiske Consulting Pty Ltd (1997) placed a series of 21 plots in the Reserve and two adjacent Reserves based on a 100m grid (Map 4). The size of these plots is not given but it is assumed that they were also 10m X 10m. Plot 4A's location corresponds approximately with that of Yar 04 but there is no corresponding plot to Yar 3. Two 10m X 10m plots located in the same manner as Gibson *et al.* were located by DEP in October 1997 in the area of Mattiske plots 2B (DEP Ytip 02 - Map 1), and 1C (DEP Ytip 01 - Map 1). Both DEP plots were located to be in the area of the mapped ore body.

Species Richness

Information is available on species richness in the area of Reserve 31900 from a series of studies; Gibson *et al.* (1994)/DEP (1997), Environmental Survey & Management Pty Ltd

(1997) and Mattiske Consulting Pty Ltd (1997). This information is compared in Table 1. Table 2 compares species richness on the basis of plot based data. From these Tables it can be seen that there are significant differences in species richness recorded in each of the studies. This is probably related to time of sampling and detail of the study (for example annual species are undersampled in Mattiske Consulting Pty Ltd 1997, as stated on page 14).

Table 1: Total taxa identified in Reserve 31900

Study and location	Plots	Total number taxa
Reserve 31900 - Environmental Survey & management Pty Ltd 1997	not plot based	89
Reserve 31900 - Mattiske Consulting Pty Ltd 1997	11 (1A - C, 2A - C, 3A - C, 4A, B)	113
Reserves 31900 - Gibson *et al.* 1994/DEP 1997	3 (Yar 04, Ytip 01 & 02)	123 (Appendix 1)

Table 2: Species richness per plot

Study and location	Plots	Species richness range	Mean species richness
Type 3b - Gibson *et al.* 1994	8	46 - 78*	61.2*
Type 20b - Gibson *et al.* 1994	9	46 - 74*	62.7*
Reserve 31900, 16681, 22307 & Johnstone Rd - Mattiske Consulting Pty Ltd 1997	21 (1A - C, 2A - C, 3A - C, 4A, B; 5A - F, 6A - C, 7A)	10 - 50	38.1
Reserves 31900 - Gibson *et al.* 1994/DEP 1997	3 (Yar 04, Ytip 01 & 02)	65 - 85	74.6

* taxa found in only one plot (singletons) excluded

Data Analysis and Interpretation

Mattiske Consulting Pty Ltd analysed the data they collected using two association matrices to compare pairs of plots. No detailed community analysis is presented in this report and it is difficult to interpret the data shown from part of an association matrix (N. Gibson pers comm.). It is also not clear why the Jaccard Coefficient was used for the presence/absence data when Gibson *et al.* (1994) used the Czekanowski coefficient to describe regional floristic patterning (N. Gibson pers comm.).

Of added confusion is the allocation of the plots to a floristic community type grouping. The allocation does not match that mapped by Environmental Survey & Management Pty Ltd (1996) as shown by a comparison of Maps 3 and 4. The original determination is attributed to Keighery (1995 in page 4 para 4) and Gibson *et al.* (1994 on Tables 1 and 2, pages 7 & 8), neither of who mapped the distribution of the floristic community types.

A series of preliminary analyses were undertaken of data collected by Mattiske Consulting Pty Ltd (1997, Appendix B) (N. Gibson pers. comm.). This showed that the plot data was not comparable with that analysed in Gibson *et al.* (1994) and floristic community types could not be reliably ascribed to the plots. As a consequence the presence of intergrades could not be tested, by comparison with Gibson *et al.*, to determine the presence of intergrades.

That is the data collection, analysis and its interpretation is not consistent with Gibson *et al.* (1994) and cannot be directly compared with the groupings determined by Gibson *et al.*

Current Status of the Floristic Community Types

The two floristic community types are both considered to be threatened ecological communities after English and Blyth (1997, see Table 3 below). This is consistent with the previous determinations by Gibson *et al.* (1994) and the Threatened and Poorly Reserved Plant

Communities identified by the EPA (1994).

Table 3: Threatened Ecological Communities on the Swan Coastal Plain (English and Blyth 1997).

KEY

CR	Critically Endangered
EN	Endangered
VU	Vulnerable
*	Community further defined by DEP 1996, here as identified by Gibson *et al.* 1994

Floristic Community Types

Supergroup 1 - Foothills/Pinjarra Plain

3b	***E. calophylla* - *E. marginata* woodlands on sandy clay soils**	**VU**

Supergroup 3 - Uplands, centred on Bassendean Dunes and the Dandaragan Plateau

20b	**Eastern *Banksia attenuata* and / or *E. marginata* woodlands**	**EN**

Discussion

The floristic groupings identified by Gibson *et al.* (1994) on the Ridge Hill Shelf have a high species richness. This species richness and the combinations of taxa found in the communities on the Ridge Hill Shelf are fundamental in the definition of the floristic groupings in the analysis. To identify floristic groupings in the context of Gibson *et al.* (1994) sampling must be comparable with that of this study - intensive complete sampling of taxa within a 10m X 10m area. Sampling by Mattiske Consulting Pty Ltd was not comparable in terms of species richness per plot. The determination of a community as in intergrade between two units is not possible if the data is not comparable.

While the data supplied by Mattiske Consulting Pty Ltd is not considered suitable to come to the stated conclusions in comparison to floristic community types 3b and 20b the presence of an intergrade would not change the argument presented in Bulletin 838. If Reserve 31900 contains areas of an intergrade between the two community types, combinations of one, both or three units it is still representative of a landform unit and vegetation complex that is 92 - 98% cleared. The determinations in Bulletin 838 were based on the remaining representation and the proportion of the units in conservation reserves. The significance of Reserve 31900 is in being part of a larger area of two clearly identified threatened ecological communities. As all communities intergrade at some point when they occur together detailed studies of the area will surely identify areas of intergrade. This adds to its value as areas where community types 3b and 20b occur together are rare (Mattiske Consulting Pty Ltd 1996, English and Blyth 1997, Bulletin 838) and so too must be their area of intergrade.

References

Department of Environmental Protection 1997 - ongoing System 6 Update plots and analysis.

Environmental Protection Authority 1994 Maps of 'Threatened and Poorly Reserved Plant Communities'.

Environmental Protection Authority 1996 Mining of titanium minerals, 2km south of yarloop. Bulletin 838.

English, V.J., and Blyth, J., 1997 Identifying and Conserving Threatened Ecological Communities in the South West Botanical Province. Final report in Project Number N702 to Environment Australia by the Department of Conservation and Land Management.

Environmental Survey & Management Pty Ltd 1996 and updated 1997 yarloop Mineral Sands Lease: Assessment of remnant Vegetation and Recommendations for Restoration. . An unpublished report prepared for Cable Sands Pty Ltd.

Gibson, N., Keighery, B.J., Keighery, G.J., Burbidge, A.H. and Lyons, M.N. 1994 A Floristic Survey of the Southern Swan Coastal Plain. Unpublished Report for the Australian Heritage Commission prepared by Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.).

Gibson, N. pers. comm. October/November 1997

Keighery, G.J. 1995 Report on the Floral values of the Bushland in the Yarloop Townsite opposite Johnstone Road. An unpublished Report for the Department of Conservation and Land Management.

Mattiske Consulting Pty Ltd 1996 Review of Local and Regional Significance of Communities 3b and 20b as defined by Gibson *et al.* (1994). . An unpublished report prepared for Cable Sands Pty Ltd.

Mattiske Consulting Pty Ltd 1997 Vegetation Survey of Selected Reserves at Yarloop. An unpublished report prepared for Cable Sands Pty Ltd.

Appendix 1: Flora List derived from Yarl 04 (Gibson *et* al. 1994) and Ytip (DEP) plots.

Anthericaceae
- Agrostocrinum scabrum
- Caesia micrantha
- Caesia occidentalis
- Chamaescilla corymbosa
- Sowerbaea laxiflora
- Thysanotus arbuscula

Apiaceae
- Hydrocotyle callicarpa
- Pentapeltis peltigera
- Trachymene pilosa

Asteraceae
- * Hypochaeris glabra
- Lagenifera huegelii
- Olearia paucidentata
- * Sonchus oleraceus
- Trichocline spathulata
- * Ursinia anthemoides
- Waitzia suaveolens

Caesalpiniaceae
- Labichea punctata

Campanulaceae
- Wahlenbergia preissii

Casuarinaceae
- Allocasuarina fraseriana

Centrolepidaceae
- Centrolepis drummondiana

Colchicaceae
- Burchardia congesta
- Burchardia umbellata

Cyperaceae
- Lepidosperma aff. angustatum scps
- Lepidosperma squamatum
- Mesomelaena graciliceps
- Mesomelaena tetragona
- Mesomelaena aff graciliceps (BJK&NG 146)
- Schoenus aff. brevifolius/breviculmis/brevisetis scps
- Tetraria capillaris
- Tetraria octandra

Dasypogonaceae
- Dasypogon bromeliifolius
- Lomandra caespitosa
- Lomandra hermaphrodita
- Lomandra nigricans
- Lomandra preissii
- Lomandra sericea

Dilleniaceae
- Hibbertia acerosa
- Hibbertia amplexicaulis
- Hibbertia huegelii
- Hibbertia hypericoides

Droseraceae
- Drosera erythrorhiza
- Drosera sp. scps
- Drosera stolonifera

Epacridaceae
- Astroloma pallidum
- Conostephium pendulum

Euphorbiaceae
- Monotaxis occidentalis
- Stachystemon vermicularis

Goodeniaceae
- Dampiera linearis
- Scaevola calliptera
- Scaevola repens

Haemodoraceae
- Anigozanthos manglesii
- Conostylis juncea
- Conostylis setigera
- Haemodorum laxum
- Haemodorum loratum
- Phlebocarya ciliata

Iridaceae
- Patersonia juncea
- Patersonia occidentalis
- Patersonia umbrosa

Lamiaceae
- Hemiandra pungens

Lauraceae
- Cassytha micrantha

Loganiaceae
- Mitrasacme palustris

Mimosaceae
- Acacia lateriticola
- Acacia sessilis
- Acacia stenoptera

Myrtaceae
- Eucalyptus marginata

Orchidaceae
- Caladenia discoidea

Caladenia flava
Caladenia sp. scps
Lyperanthus nigricans
Prasophyllum parvifolium
Pterostylis vittata
Thelymitra crinita
Thelymitra sp. scps

Papilionaceae
Bossiaea eriocarpa
Bossiaea eriocarpa (Large flowered form, BJK & NG 229) scps
Daviesia decurrens
Daviesia divaricata
Daviesia physodes
Gompholobium knightianum
Gompholobium polymorphum
Gompholobium preissii
Gompholobium shuttleworthii
Hovea chorizemifolia
Hovea trisperma
Hovea trisperma var. grandiflora
Kennedia coccinea
* Lotus angustissimus

Phormiaceae
Dianella divaricata
Stypandra glauca

Pittosporaceae
Pronaya fraseri

Poaceae
* Aira caryophyllea
Amphipogon turbinatus
* Briza maxima
* Briza minor
Danthonia occidentalis
Stipa campylachne
Tetrarrhena laevis

Polygalaceae
Comesperma virgatum

Proteaceae
Banksia attenuata

Proteaceae
Banksia grandis
Dryandra lindleyana
Dryandra nivea
Grevillea quercifolia
Grevillea wilsonii
Persoonia saccata
Petrophile linearis
Stirlingia latifolia
Xylomelum occidentale

Restionaceae

Hypolaena exsulca
Loxocarya fasciculata
Loxocarya flexuosa

Rubiaceae
Opercularia apiciflora
Opercularia hispidula

Rutaceae
Eriostemon spicatus

Stylidiaceae
Stylidium piliferum
Stylidium schoenoides

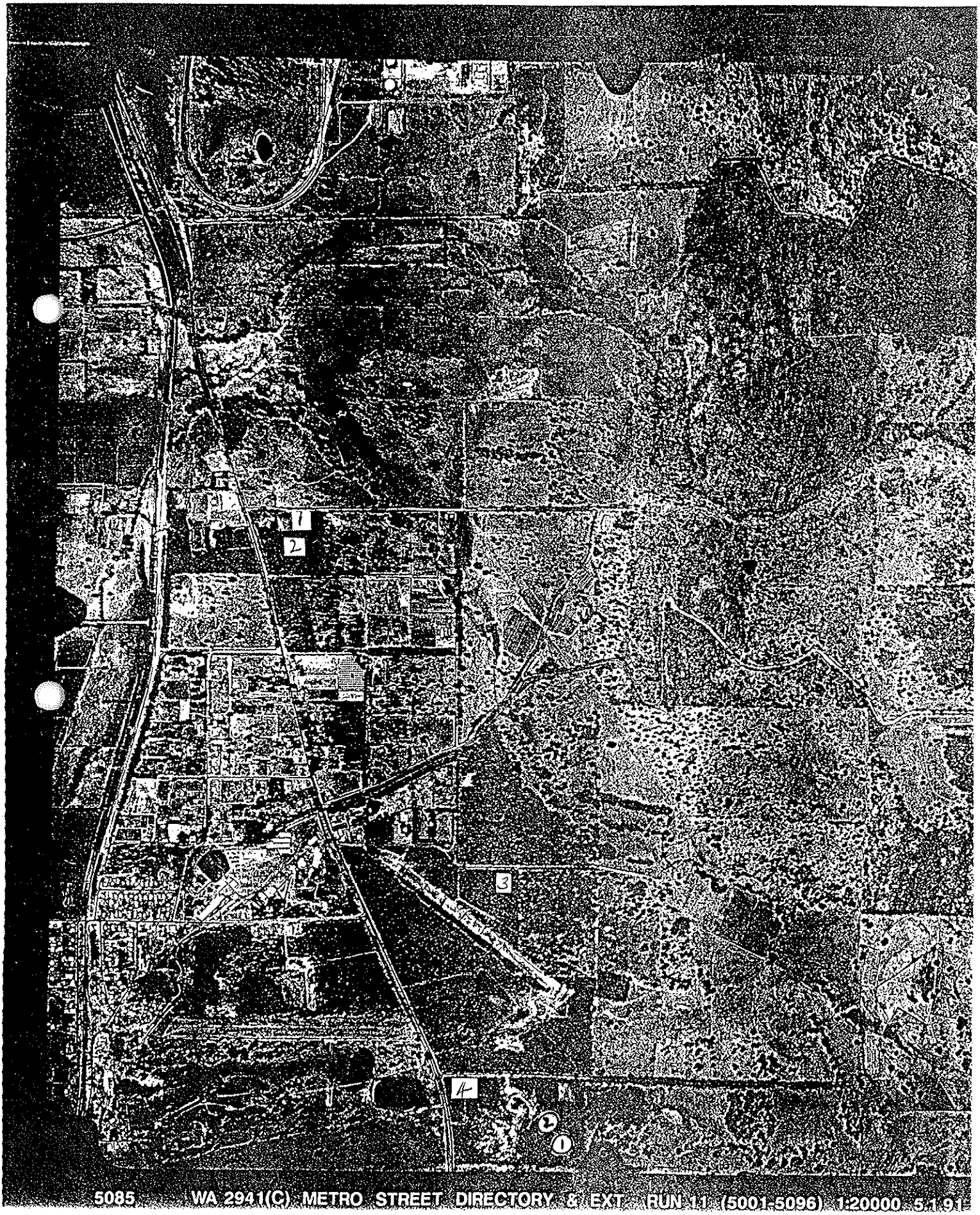
Thymelaeaceae
Pimelea suaveolens

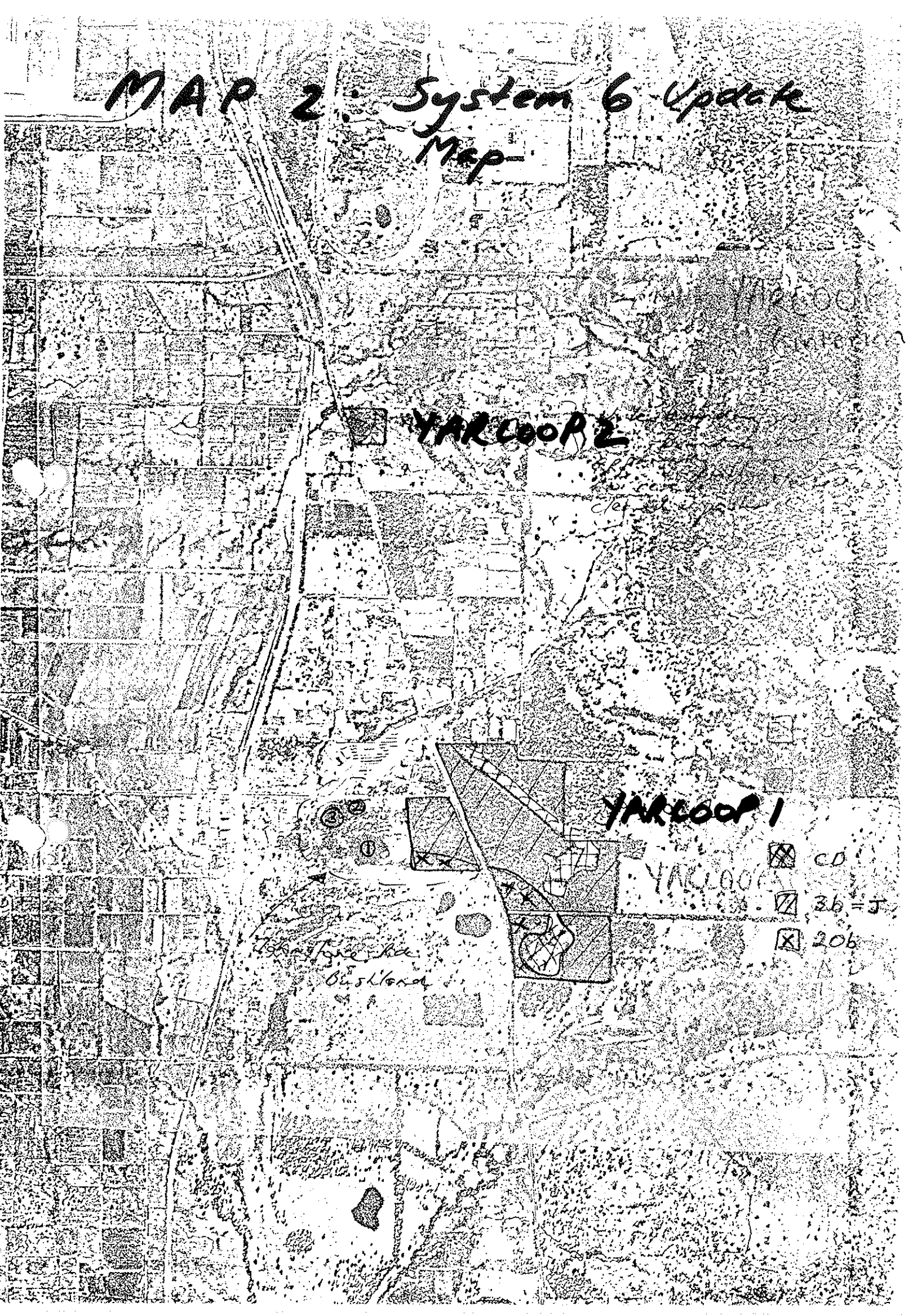
Tremandraceae
Tetratheca hirsuta

Xanthorrhoeaceae
Xanthorrhoea gracilis
Xanthorrhoea preissii

Zamiaceae
Macrozamia riedlei

MAP 1: Floristic plots located by
[1] Gibson et al. (1994) – Yar 01–04
(1) DEP (1997) – Ytip 01–02




MAP 2 System 6 Update
Map
YARLOOP 2
YARLOOP 1
CO
36 = 5
206

MAP 3

FIGURE 3 From Environ. Survey & Man. Pty Ltd 1996/97

The northern section of the mining lease showing the position of the orebody in relation to reserve 31900

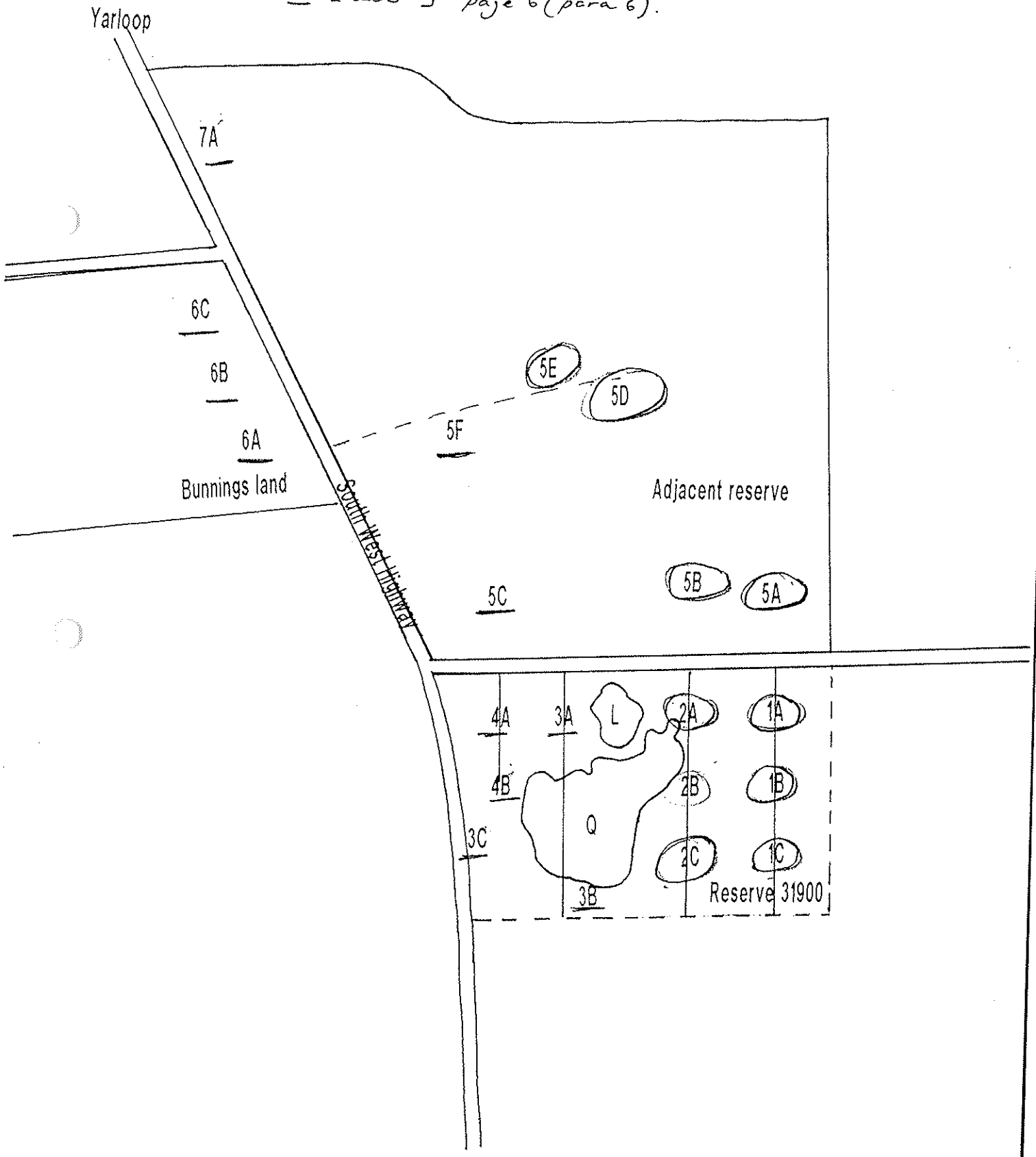
▬	Reserve 31900 boundary
3b	Vegetation types
L	Landfill area
Q	Sand quarry area

MAP 4

APPENDIX D **Position of transects (1-7) and sites (1A-7A) sampled in Reserve 31900, adjacent reserves and Bunnings land.**

L = tip site Q = old sand quarry

○ = 36 — = 206 } after page 4 (para 4), page 6 (para 3) and page 6 (para 6).



DEPARTMENT OF ENVIRONMENTAL PROTECTION

TO:	-	Director - Evaluation Division
FROM:	-	Director - Policy Coordination Division
SUBJECT:	-	Cable Sands - Yarloop Project
DATE:	-	9 September, 1998

1. Gary Whisson and Malcolm Trudgen have raised a concern regarding the above with me.

2. The concern is whether there is sufficient evidence to demonstrate that the "new" proposal of January 1998 constitutes a new proposal under the Act. Apart from the specific law, there are the implications of a precedent to consider.

3. While this is a matter more for your division and the EPA than the Policy Coordination Division, we are very conscious of new proposals involving remnant vegetation of conservation quality will be dealt with in the future.

4. This division recognises that EPA has made a decision that it is a new proposal (through listing it as a PER) and that Crown have advice of 4 February 1998 has been revised.

5. PCD recommend the following:

   (a) Evaluation carries out a specific exercise of identifying and, where possible qualifying the differences between the proposals. (PCD officers will be happy to help in this regard, for remnant vegetation issues);

   (b) A possible way of doing this would be a table with the points of change as the X axis (eg: bigger ore body, anomalies in vegetation, land acquisition) and key steps in defining environmental significance as the Y axis (eg: effect of change on operations, on the environment, a measure of the significance of change - quantified where possible).

   (c) The conclusion regarding a change of proposal will most probably be a combination of these analyses.

6. The above exercise would probably be required for the Assessment Report so it is worth doing. It should be checked against the Crown Law advice.

7. It would have the advantage of providing a level of comfort for departmental advice to EPA during the assessment stage.

CONSERVATION BRANCH
INTRA DEPARTMENTAL ADVICE
NB: For Internal Use Only

TO: Gary Whisson, Michelle Mifka, Tim Gentle
SUBJECT: Mining in Reserve 31900 Yarloop
FROM: Malcolm Trudgen
DATE: 8/10/1998

Acting Manager Conservation Branch 8/10/98

Please could I be provided with a copy of your final advice. Thank you.

A. Comment on the report *Vegetation survey of selected reserves at Yarloop* (Mattiske Consulting December 1997)

This report describes the recording of a number of sites in reserve 31900 and adjoining areas and the conclusions made from the analysis of the data. The main conclusion was that Reserve 31900 has vegetation that is intermediate (a continuum, or transition) between Floristic Community Types 3b and 20b. The methodology section of the report does not describe what type of plot was used (or if a releve, or undefined site, was used). The sampling of most of the plots was carried out on the 23rd of July 1997 and those in Location 5322 on the 3rd of December 1997. The timing of the sampling has reduced the quality of the data obtained through the reduced sampling of cryptophyte (bulbous, cormous) and (particularly) annual species, the sites were only visited once each. This may partly explain the conclusion reached with regard to a continuum; which is at variance with earlier work carried out by CALM, which identified the presence of Floristic Community 20b in the north-west corner of Reserve 31900 and structural mapping of the vegetation which would suggest the likely distribution of floristic community types 3b and 20b in the reserve.

3b 20b Mattiske
61.2/62.7/38.1

"Although the vegetation at Reserve 31900 had been classified as consisting of vegetation types 3b and 20b the current study was unable to readily separate the sample sites into these types, instead a continuum was apparent. This continuum was also present on the adjacent proposed reserves, so was not unique to Reserve 31900." (Mattiske Consulting December 1997, p. i, para 2)

"However in a previous study (Mattiske Consulting Pty Ltd 1996) where several 3b and 20b vegetation types had been surveyed the distinction between the two was clearly apparent." (Mattiske Consulting December 1997, p i, para 3)

"Both vegetation types 3b and 20b were represented in Location 5322, although vegetation type 20 b did not have *Banksia attenuata* which was present in the same vegetation type in Reserve 31900." (Mattiske Consulting December 1997, p. i, para 4)

"Two vegetation types, 3b and 20b (Gibson *et al.*, 1994) have been recorded from Reserve 31900, with a 20b site having been sampled in Reserve 31900 and a 3b site in

the adjacent reserve north of the rifle range (Gibson, pers. comm.). A separation of the two associations in Reserve 31900 was made by G. Keighery (1995) from aerial photographs and from comparison with adjacent areas (Keighery, pers. comm.)." (Mattiske Consulting December 1997, p. 4).

If the vegetation on Reserve 31900 and parts of the adjoining areas is a continuum or transition between Floristic Community Types 3b and 20b, then this would increase the conservation value of the area, as it would represent an aspect of biodiversity that had not previously been recognised as existing. In this regard it should be realised that in general, sites chosen to be recorded for the survey of the Southern Swan Coastal Plain (Gibson *et al* 1994) were chosen to avoid ecotonal areas and so continua are deliberately under represented in the sampling. However, it seems that the area of continuum identified by Mattiske Consulting (December 1997) is of a larger scale than would be avoided by assessment of possible sites, as it would not be obviously apparent as an ecotone. It therefore not only represents (if correctly identified) a previously unrecognised aspect of biodiversity (thus having value in its own right) but also is of significant scientific research interest as an area where the controlling factors of species distribution related to Floristic Community Types 3b and 20b might be studied.

It should be noted, that the authors of Mattiske Consulting (December 1997) are not suggesting that Floristic Community Types 3b and 20b do not exist, in fact they confirm their presence in nearby areas.

The report (Mattiske Consulting December 1997) also comments on the condition of the vegetation on Reserve 13900. "The vegetation of the Reserve varied in quality as a result of the rubbish tip and the degree of weed invasion. The eastern section of the Reserve was less disturbed and had less weed species than other sections of the Reserve. Despite the disturbance and presence of weeds, the vegetation outside the immediate rubbish tip area was in relatively good condition ...." (Mattiske Consulting December 1997, p.5 para 6).

There is a significant issue relating to whether or not the techniques applied by Mattiske Consulting in their report (Mattiske Consulting December 1997) are appropriate to discern the presence or absence of particular floristic community types. In effect what they have done is sample areas that have been assigned to either FCT 3b or 20b previously (some on the basis of computer analysis of plot data using the programmes used to define the FCTs and others on the basis of subjective interpretation) and compare them to nearby areas using two different statistical analysis approaches, both of which differ from the analysis used by Gibson *et al* (1994) to define the floristic community types for the Swan Coastal Plain. This obviously raises questions of what is being compared and at what scale or level of detail (especially what level of data collection). In this context it is important to understand that vegetation analysis is a complex issue that can be approached from different viewpoints that define units on the basis of different factors.

The approaches Mattiske Consulting (December 1997) have used is to look at the vegetation firstly on the basis of the percentage cover (a measure of abundance) of each species present and secondly on the basis of the presence and absence of the species at the sites recorded.

The first approach is a substantially different analysis to that used by Gibson *et al* (1994), which was based on presence and absence of species rather than structure (abundance). The floristic community types defined by Gibson *et al* (1994) are broad regional presence/absence floristic units that often include a range of stuctural units. Therefore, it would not be surprising if an abundance based analysis reached a different conclusion to that reached by Gibson *et al.*

The second approach is obviously more similar to that used by Gibson *et al*, being also based on presence/absence data. There is a significant problem here in the absence of spring recording of the sites recorded by Mattiske Consulting and the consequent near absence of annual species and under representation of cryptophyte species (bulbous, cormous species). It is possible that this may have affected the data to the point that instead of distinguishing floristic community types 3b and 20b at some (or all) of the sites recorded the data seems to indicate a continuum.

In the end, such issues are of secondary importance, as whatever the analysis of vegetation or floristic community types shows, the final assessment of conservation value for the Reserve 31900 and the adjoining reserves will show high values based on the high level of regional clearing and the poor representation of areas on the eastern side of the Swan Coastal Plain in conservation reserves. The presence of a substantial area of a continuum between floristic community types 3b and 20b on Reserve 31900- and adjoining areas would only add to this value, rather than detract from it.

B. Vegetation complex level assessment

The Yarloop reserves and the Bunnings land (which is on the opposite side of the South West Highway) fall within the Forrestfield Vegetation Complex of Heddle *et al* (1980). The distribution of this vegetation complex is the same as that of the Ridge Hill Shelf landform, which has an area of 20,126 ha (DEP 1996a) and which lies at the eastern side of the Swan Coastal Plain. The Forestfield Vegetation Complex has been largely cleared, with DEP figures (N. Thorning pers com) indicating that at the most 7% of the complex remains. This figure is likely to include some areas that have been significantly degraded. For the Perth Metropolitan Area, this figure is similar to estimates made by the Ministry for Planning "Within the Perth Metropolitan Area, the Forrestfield Vegetation Complex is considered to be 92% cleared (Ministry for Planning). Accurate figures are not available beyond the Perth Metropolitan Area but it is estimated that the complex has been subject to more clearing in country areas than in the Metro area. The eastern side of the of the coastal plain, of which the Forrestfield Vegetation Complex is a party (sic, part), has been estimated by CALM to be 97% cleared (DEP 1996a, Attachment 2).

At the vegetation complex level of assessment, the overall bushland remnant at Yarloop (which includes Reserve 31900) would have to be considered to have very high conservation value because of:

- the relatively small amount of the complex remaining uncleared;
- the high level of clearing of the eastern side of the coastal plain where it lies; and
- the large size of the overall remnant at Yarloop, which is the largest remnant of the Forrestfield Vegetation Complex.

C. Floristic community type level assessment
"there is approximately 185 ha of the Ridge Hill Shelf vegetation community Type 3b and 97 ha of Type 20b remaining on the Swan Coastal Plain, of which 100ha and 38 ha respectively are located within existing conservation reserves" (DEP 1996a, Attachment 2, quoting Mr G. Kinnimonth of Cable Sands).

The areas of floristic community types 3b and 20b that remain uncleared are obviously very small and consequently have very high conservation value. It is therefore a matter of fine judgment as to whether or not any further clearing of these floristic community types is environmentally acceptable.

Survey work and analysis carried out for the proponent (Mattiske Consulting, December 1997) suggests (and accepting this unless shown otherwise) that the vegetation on Reserve 31900 and on parts of the adjoining remnant bushland is an area of a continuum between floristic community types 3b and 20b. Given this, then Reserve 31900 and the adjoining areas have particularly high value as they currently have areas of floristic community types 3b, 20b and a continuum between them. This adds significantly to the value of the Yarloop Reserve group, which was already of significance as the largest area of floristic community types 3b and 20b remaining.

<u>This new information (the existence of the continuum) and its implications for the Conservation value of reserve 31900 is of critical significance in making an informed decision as to the acceptability of mining in Reserve 31900</u>. Although the continuum extends into adjoining areas, it is still a very restricted "unit" and as such (particularly as there may be no other surviving example) has very significant conservation value. The small overall areas involved, the low level of reservation and the high degree of clearing of the region would suggest that further loss was unacceptable at the floristic community type level of assessment of the conservation value of the native vegetation at Yarloop.

It should be noted that both Floristic Community Type 3b and Floristic Community Type 20b are considered to be <u>threatened ecological communities</u> by English and Blyth (1997), who rated it Community 3b as "vulnerable" and Community 20b as Endangered.

Average species no/

C. More detailed assessment

The information (or the presentation of it) regarding the vegetation at Yarloop is not highly detailed. The vegetation has been mapped only at the floristic community type level, ie. into broad, regional units which would be expected to have significant variation.

Mattiske Consulting (December 1997) did not map the vegetation but, when carrying out their survey checked (page 3, para 2) that they had sampled the vegetation associations present. That is, they did not consider the vegetation at the plant community level. However, the data presented by Mattiske Consulting (December 1997) was collected at fairly close intervals and therefore has significantly more information in it.

Examination of Table 1 of Mattiske Consulting (December 1997, p. 7) which examines the relationship between pairs of sites using the Bray-Curtis similarity co-efficient indicates significant variation both between sites on Reserve 31900 and between sites on that reserve and adjoining reserves or lots (as well as between sites in those areas). For their report Mattiske Consulting recorded 26 sites, this gives 325 possible pairs of sites that can be contrasted using the Bray-Curtis similarity co-efficient. Table 1 of Mattiske Consulting shows one pair of sites (6B&6C - from the Bunnings land) with a co-efficient of 0.7+, that is very similar to each other (a co-efficient of 1 would indicate they were the same). Four pairs of sites had a co-efficient of 0.6-0.7 (still very similar), two of these pairs were on the Bunnings land and two on Location 5322. Thirty-six pairs had co-efficients between 0.5 and 0.6 (still quite similar) seven of these pairs are between sites on Reserve 31900 (out of a possible 66 pairs on the Reserve). The remaining possible 284 comparisons between sites had co-efficients of less than 0.5. Overall, this supports the suggestion made at the beginning of this paragraph that in fact the data presented by Mattiske Consulting shows significant variation is present on Reserve 31900 and between it and adjoining bushland areas.

Data is also presented in Mattiske Consulting (December 1997, page 7 second last paragraph) on the sites with the greatest dissimilarity using the Bray-Curtis similarity co-efficient. This shows six pairs of sites from Reserve 31900 as having high dissimilarity to each other, again suggesting significant variation on the Reserve. Three pairs of sites with one site from Reserve 31900 and the other from the Bunnings land also had high dissimilarity using the Bray-Curtis similarity co-efficient, suggesting very significant difference between each of the sites on the Bunnings land and sites on Reserve 31900. Similarly, pairs of sites with one member from Reserve 31900 and the other from the other areas of the overall remnant (Reserves 31901 and 23307 and Lot 5322) had high dissimilarity, showing significant variation between Reserve 31900 and parts of the other sections of the overall remnant.

Similar arguments to those made in the two paragraphs above could be made from the data presented in Mattiske Consulting (December 1997, Table 2, page 8) regarding Jaccard similarity co-efficients for their presence and absence data.

Overall, the available data strongly suggest that below the floristic community type and vegetation association level that there is significant variation in both structure and species distribution both on Reserve 31900 and between it and the other components of the overall remnant. The amount of variation that appears to be present would suggest that effective conservation of the variation remaining within the overall remnant would require no significant loss of vegetation in reasonable condition. The loss of the area that Cable Sands proposes to mine would constitute a significant loss in this regard.

D. Impact of the mining proposal

Reserve 31900 has an area of 19.7 ha. The mining proposal would "result in the clearing of approximately 6.1 ha of native vegetation with significant conservation value." (Cable Sands 1998, p34, section 6.1.3, para. 2).

In assessing the impact of the proposal on the Reserve 31900, it is very significant that parts of the reserve are already cleared and that these areas are in the centre of the reserve. The mining would almost double the amount of land cleared, meaning that only about 6.6 ha of the reserve would remain uncleared. Importantly, these areas would be around the edges of the Reserve. Thus it is clear that the mining process would have a substantial impact on the reserve both in terms of the loss of vegetation and the spatial distribution of the loss.

Although the continuum identified by Mattiske Consulting (December 1997) between floristic community types 3b and 20b extends beyond Reserve 31900, the loss of 6.1 ha of this intermediate "unit" would also constitute a high impact.

E. Proposed rehabilitation and land swap

The rehabilitation proposed by Cable Sands of the area that would be mined and the existing degraded areas (the rubbish tip in the reserve and other degraded areas) would be desirable if the mining went ahead, as it would reduce the difficulty of management of the remaining areas and replace some biodiversity values. The critical point however, is whether or not the loss of a further 6.1 ha of native vegetation of high conservation value would compensated for in this way. Given the significant variation in the area shown by the work of Mattiske Consulting (December 1997, see discussion above) it is very unlikely that rehabilitation would replace the vegetation values of the reserve. What would result would be a vegetation of similar but probably more uniform appearance, with lower cover and diversity, the latter especially as measured in smaller areas. Given that no spring survey has been carried out it is still possible that the area may also have flora values that would not be replaced.

Species richness

Gibson (8)	3b	46-78	61.2
(9)	20b	46-74	62.7
Mattiske (24)		10-50	38.1

The proposed land swap also has significant problems. Firstly the area proposed (the Bunnings land) is separated from the other areas of bushland in the overall Yarloop remnant by Southwest Highway. This has significant implications for the continuity of biological processes between this area and the rest of the Yarloop remnant. Movement of animals, particularly in their role as vectors for seed and pollen is substantially constrained by the highway.

Other issues relate to whether or not the proposed swap is actually a net gain, as it is unlikely that permission to clear the area would be given and it is likely to be recommended for protection under the System Six review. A further issue is the condition of the area, as there has apparently recently been dumping of ash and sawdust in the area which may also be being grazed by stock.

E. References

Cable Sands (1998). Mining of Yarloop Reserve 31900. Public Environmental Review. Cable Sands (W.A.) Pty. Ltd.

DEP (1996a). Conservation Branch file material, subject: Mining of titanium minerals, Yarloop (Assessment No. 1032).

English, V.J. and J. Blyth (1997). Identifying and conserving Threatened Ecological Communities in the South West Botanical Province. Final report for Project No. N702 to Environment Australia by the Department of Conservation and Land Management, Western Australia.

Gibson, N., Keighery, B.J., Keighery, G.J., Burbidge, A.H., and Lyons, M.N. (1994). *A Floristic Survey of the southern Swan Coastal Plain.* Unpublished report for the Australian Heritage Commission, prepared by the Department of Conservation and Land Management and the Conservation Council of WA (Inc.)

Heddle, E.M, O.W. Loneragan and J.J. Havel (1980). *Vegetation complexes of the Darling System, Western Australia.* In *Atlas of natural resources Darling System, Western Australia.* Department of Conservation and Environment Western Australia, Perth, 1980.

Mattiske Consulting (December 1997). *Vegetation survey of selected reserves at Yarloop.* Unpublished report by Mattiske Consulting Pty. Ltd., dated December 1997, report CSC003/052/97. Prepared for Cable Sands Pty Ltd.

From: rayc, rayc,
To: bronwen_keighery
CC:
BCC:
Priority: Normal

COPY - ORIGINAL TO MICHELE MIRA

Date sent: 20/4/99 9:51 AM

Yarloop Reserve 31900 PER

Bronwen

I am a masters student at UWA studying Natural Resource Management.

A major case study in our course relates to environmental impact assessment in the mining industry and as part of this we are evaluating the above PER.

As the issue of rare vegetation communities is the major issue, would it be possible for you to meet the students involved to discuss the case (there are only three of us). It should not take too long - an hour at the most.

We have to submit our reports by the 30 April so either later this week or early next week would be suitable. If necessary we could come to the DEP to make it easier for you.

I am contacting you on behalf of David Jasper, our lecturer, who has been trying to contact you for some time.

Thanks.

Ray Creese Telephone 9447 5744

RFC822 header P70

RECEIVED: from SF_Database by POP_Mailbox_-1287520818 ; 20 APR 99 09:47:58 UT
Received: from ENVIRON.WA.GOV.AU by 202.14.151.6
with SMTP (QuickMail Pro Server for MacOS 1.0.3); 20 APR 99 09:47:55 UT
Received: from net1.nw.com.au ([203.18.240.2]) by epagate.environ.wa.gov.au with ESMTP id <13441>; Tue, 20 Apr 1999 09:48:58 +0800
Received: from adam (Jedi-230.nw.com.au [203.33.252.70])
by net1.nw.com.au (8.9.1/8.9.1) with SMTP id KAA05464
for <bronwen_keighery@environ.wa.gov.au>; Tue, 20 Apr 1999 10:11:13 +0800
Message-Id: <3.0.32.19990420095138.006a6270@net1.nw.com.au>
X-Sender: rayc@net1.nw.com.au
X-Mailer: Windows Eudora Pro Version 3.0 (32)
Date: Tue, 20 Apr 1999 09:51:40 +0800
To: bronwen_keighery@environ.wa.gov.au
From: rayc <rayc@net1.nw.com.au>
Subject: Yarloop Reserve 31900 PER
Mime-Version: 1.0
Content-Type: text/plain; charset="us-ascii"

20/4/99

- Consulted with M. Mitka in regard to response, agreed as this is still subject to EPA decision making (Bulletin in prep.) inappropriate to discuss the PER

- Spoke to Ray C as above but Ray was after vegetation information. I directed him to
  - Gibson et al 1994
  - English and Blyth 1997
  - Val English (TECs and legislation)
  - Ban Carr (Soil + Land Conservation Act – MOU)

B. Keighley

MEMO TO: COLIN MURRAY

FROM: KEVIN MCALPINE

DATE: 18 APRIL 1997

SUBJECT: COMMENTS ON THE DRAFT: YARLOOP - NOTICE OF INTENT TO MINE

(Note: Headings are as in the NOI)

2.6 Vegetation

The proposed excavation area includes Reserve 31900 which has been recognised by the EPA to containing threatened or poorly reserved floristic plant communities. The importance of the site must therefore be adequately recognised by Cable Sands.

There is no reference to any comprehensive flora survey having been conducted and the species listed are only a small subset of the species expected on the site. Given the location of the site on the forrestfield soil unit it is likely that priority flora species, perhaps even declared rare flora, may be present and this needs to be properly investigated at the appropriate time of year.

The floristic community types 3b (*Eucalyptus calophylla - E marginata* woodlands on sandy clay soils) and 20b (Eastern *Banksia attenuata* and/or *Eucalyptus marginata* woodlands) (Gibson et al; 1994) have been identified on this reserve. Community type 3b is found in the area proposed for mining and 20b is adjacent to the area proposed for mining.

Regional Significance

(first paragraph)

It is argued that reserve 23307 is in best condition and of primary conservation value and that reserves 31901 and 16681 are of value as a buffer to reserve 23307. Although there is some localised disturbance in these two reserves the condition of the vegetation over the majority of the area is excellent, as is the remnant vegetation covering the eastern half of Reserve 31900 which is mostly proposed to be mined. The vegetation on the western quarter of reserve 31900 is also in at least very good condition.

(second paragraph)

There is no basis for suggesting that the vegetation on these reserves may not be representative of the predominant vegetation that existed on the Ridge Hill Shelf.

There should be some attempt to indicate other locations where these two floristic communities can be found and the area they occupy.

(third paragraph)

Community type 3b was classified as well reserved and vulnerable in Gibson et al and community type 20b as poorly reserved and vulnerable (note: wrongly classified as 'well reserved' on the community description sheet). The criteria used to assess conservation status in this report are now accepted to be misleading.

Since the publication of this report CALM's threatened ecological communities project has begun reviewing the conservation status of WA's biological communities. The review panel is not expected to formally consider floristic community types 3b and 20b until June 1996,

however the panel is likely to endorse the recommendation to it that they be classified as endangered and critically endangered respectively. Although threatened ecological communities have no statutory basis at this stage it does provide a context for considering the regional significance of the vegetation and hence the likely impacts of the proposal.

2.7 Fauna

There is no description of what constituted the fauna assessment. From my knowledge, and that of the staff of the WA Museum it can only concluded to have been very inadequate.

At least the southern brown bandicoot (gazetted rare and/or endangered) is considered likely to be present as is the Brush Wallaby (a priority listed species).

The statements that fauna values of the reserve area are reduced and that only common species would be present are totally unfounded. The vegetation on reserve 31900 forms part of a much larger remnant on the ridge hill shelf. The fauna on these remnants has yet to be studied systematically but some initially work on Talbot road bushland (similar size on ridge hill shelf) indicates a very diverse and significant fauna assemblage, particularly for birds, reptiles and invertebrates. Talbot road bushland is also one of the last locations on the Swan Coastal Plain where Honey Possums have been trapped.

4.3 Flora and Fauna

It has not been demonstrated that this plant community can be rehabilitated. Given the endangered status of the plant community to be mined trials demonstrating that its rehabilitation can be achieved need to be completed before any action to mine the vegetated area is allowed to begin. I would suggest that it was not possible to rehabilitate the community to its former floristic integrity.

4.4 Rehabilitation

As outlined above, trials to demonstrate that rehabilitation of the plant community type is possible need to be completed before consideration is given to mining the vegetated area.

It would be vitally important that seeding and planted seedlings were of appropriate genetic stock to maintain the gene pool of the plant community. This has not been indicated.

Any programme to improve the degraded area west of the mine path needs to be given careful consideration recognising the imminent critically endangered status of the remnant vegetation on the western side of the reserve. This needs to be recognised in the NOI.

In conclusion the NOI has not demonstrated that there will not be significant impact on the very high conservation values of the remnant vegetation. The significance of the loss of the remnant vegetation in reserve 31900 has not been put into a regional context.

The area is of very high conservation value and a formal assessment should be considered for a proposal such as this.

CABLE SANDS (W.A.) PTY. LTD.
A.C.N. 009 137 142

Koombana Drive, North Shore
Bunbury, 6230
Western Australia
Postal Address: P.O. Box 133
Bunbury 6231, Western Australia
Telephone: (097) 21 411
Facsimile: (097) 91 1249
Telex: KATHBUN AA 92854
Telegraphic: CABMINITE Bunbury

FACSIMILE

To: DEP - Evaluation Division

Attn: Colin Murray

From: Graeme Kininmonth

Date: 14th May 1996

Pages: 5

Fax No.: 09 322 1598

Subject: Yarloop NOI

Colin,

As discussed, this fax responds to the points raised by Kevin McAlpine in his memo to you dated 18th April regarding the draft Yarloop NOI.

The responses listed below relate directly to the memo. A copy of this memo is attached for your convenience. There have been some changes made to the NOI based on points raised in Kevin's memo and additional work and discussions since the draft was prepared.

Vegetation

Para 1 Cable Sands recognises that the two floristic communities on Reserve 31900 are poorly represented on the coastal plain and believes that level of response outlined is appropriate.

Para 2 A more comprehensive vegetation assessment is included as an appendix in the final NOI. Surveys have been undertaken in the Yarloop reserves and/or adjoining bushland on four occasions to our knowledge without priority or gazetted rare flora being found. Given this work it seems unlikely that such species will be found in Reserve 31900.

Para 3 Agreed - no comment required.

Regional Significance

Para 4 Reserve 23307 is identified as being in the best condition of the reserves. Reserve 31901 is degraded from clearing (~5%), sand extraction (~5%), topsoil dumping and corresponding plant introduction (~10%) and windblown rubbish(~20%). Reserve 16681 is in generally good condition although its relatively long frontage to the road and to the rifle range has provided access for weed incroachment. In reserve 31900 the eastern half is in good condition and the north western section(~15%) is in similiar condition.

Para 5 The comment that the vegetation on these reserves may not represent the full range of

Ridge Hill Shelf communities is discussed in the vegetation assessment (p3) appended to the NOI.

Para 6 There is some discussion now given in the NOI to the locations of these vegetation types.

Para7 and 8 Cable Sands has used relevant available information in preparation of the NOI and have taken the classifications used in the reports as is. Based on the information in Kevin's report we have mentioned in the NOI that these classifications are subject to review.

Fauna

Para 9 Fauna assessment report is now included as an appendix.

Para10 No evidence of the southern brown bandicoot or the Brush wallaby was found on site. WA Museum fauna data for the locality also did not mention these species. The lack of a dense medium to tall shrub cover (often found along drainage lines) would reduce the likelihood of the southern brown bandicoot being present.

Para11 There are a number of differences between the Talbot Road bushland and Yarloop which would make a comparison of limited use. The Talbot Road bushland is approximately 1.5 kilometres from John Forrest National Park (c.f. 3 kilometres to state forest at Yarloop) and has some relatively well vegetated areas in between, particularly those associated with Jane Brook. The Yarlooop reserves have been isolated from the state forest for a much longer period of time. Clearing at Yarloop occurred in the early part of the century. It is likely with added isolation from the recent housing developments at Swan View that the fauna values will decrease until, given a comparable timeframe to Yarloop, there will be a much poorer faunal assemblage.

Flora and Fauna

Para12 The rehabilitation section af the NOI has been amended. A number of species currently found in Reserve 31900 which are suitable for propagation by seed and by rootstock or stem propagation have been identified and are included in the vegetation assessment. Cable Sands does not suggest that rehabilitation of the site will return the area to its former floristic integrity. The aim of the rehabilitation will be to restore a diverse woodland vegetation and given the restoration plan Cable Sands sees this as a practical outcome.

Rehabilitation

Para13 It is impractical to conduct trials that demonstrate rehabilitation of the community type. A range of species currently found on site have been identified as being suitable for rehabilitation (table 3 and 4 in Appendix 1) and these will form the basis of rehabilitation work.

Para14 Seed and rootstock material will be collected on site prior to clearing.

Para15 Restoration of the degraded area west of the mine path will only proceed following

discussions with CALM. A key component of these discussions will be the potential impact on the Type 20b vegetation adjacent to the highway.

In summary, Cable Sands recognises the significance of the vegetation in Reserve 31900. However, this significance should be viewed in relation to the following relevant points;

* Only 8 ha of Reserve 31900 will be mined and this will be rehabilitated to a diverse woodland habitat.

* Reserve 31900 is currently degraded due to its past and current public landuse. There are no intentions for this situation to change.

* The area to be mined represents only approximately 8% of the vegetation of the combined reserves (10% of Type 3b) of which all but Reserve 31900 are currently being sought by CALM for vesting as A-class reserves.

* Restoration of the degraded area in the western half of Reserve 31900 has the potential to improve the conservation value of the reserve.

If you require any further discussion of these points or any other information, please give me a call.

9/10/98

1.30 pm

Discussions at Rob's office on the harbour.

- Background
- Immediate Situation
- Value of the integrated.

Time Monday 10am

14/10/98

YARLOOP

- Monday 10am EPA

- Cable Sands unable to come.
- Bernard, Libby, Sally EPA members
- Rob S, Kim T, Michelle M, Tim G.

- Tuesday 2pm

- Cable Sands (5 people)
  Gary Cockford (GM)
  Graham Kinnimoth
  Charlie Walker (wrote PER)
  ? Denis Backshall (? role)

- Libby cannot make it on Tuesday

Record of Telephone Call

Call from	Call to	Folio No.
ELEANORE BENNETT	BRONWEN KEIGHERY	
Dept: 257 1625	Dept: MATTISKE CONSULTING	File No.
Subject: YARLOOP	Date: 18 / 8 / 97	Time: 11.30

Details

There are 'E Bs Comments

- Reserve Yarloop (Rubbish Tip Reserve work being done)
- Dunnings 'Area' report by GJKeighery would like copy, should get from CALM
- Concern it 36 in Rubbish Tip area all cleared, boundaries not correct, should be in 206 (ie GJK's map is not correct but is from aerial photos)

Action taken/Recommendation(s) (where applicable)

Advised to get report (GJK) from CALM

Approval (if required)

Department of Environmental Protection
Westralia Square, 8th Floor, 141 St Georges Terrace, Perth WA 6000

19/10/98

Where to from here?

- information on potential mining in RHS.
- CB difficulties
  - thought they could get it through
lost time they got Bunnings land but could not
get this land.
  - Have they got land from Bunnings?
(but this cannot be a condition of the
approval, without land NO negotiation
point NEEDS to be in form commitment

Meeting day

Rob will be late.

Printed By: Bronwen Keighery 31/10/97 9:32 AM Page: 1
From: Melinda Phillips (21/10/97)
To: Bronwen Keighery
CC:
BCC:
Priority: Normal Date sent: 21/10/97 9:06 AM

yarloop

just spoke to graeme from cable sands and he will be preparing a referral document soon

is there anything you would like/need to meet with him about in the near future? anything i can do to assist your assessment of the data?

Meeting Notes

Name: Bronwen Keighery		Folio No.
Branch: Conservation		File No.
Subject: Cable Sands / Yanchep	Date: 20/10/98	Time: 2PM

People in attendance

Items	Action required	Action by
BB 'Sort' of new proposal		
3 issues		
- piece of land for conservation		
- rehab rubbish tip		
- rehab of mine		
Sensitivities		
- little 'good' bushland		
- resource located here		
Determination by EPA of some balance		
Graeme Kinnaath		
- Cable Sands owns land being mined		
- 'modified proposal'		
- hope to get EPA approval		
Total 42ha Cons		
32ha Cons without Quarrys		
?BB Other mining leases		
- leases over adjoining area		
- not expected that these will be active		
?BB what plant community will be removed? NIL		

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L. McArdle spoke at this point. 20/10/98

Vegetation Complex
- <10% representation of this
- complex

McArdle Consulting looked at series
reserves in the area

Gibson et. al 1994
believe this to be a continuum,
as looked at whole area rather
than specific sites

All depends on scale of interpretation

No rare flora (lots days)
No loss species if mined.

Values defined by C Walker / L. McArdle
- Increased values with mining
- lost values through rubbish dump.
- weed infestation to W (Tagasaste + Watsonia both very aggressive)
- short term values lost, conclude values would be increased
- BB been on site
- if mining does not proceed will get worst
- put a line on values

Similarity levels between Burnings / 3/900
- presence /absence data not used
- use similarities BJK (not said
- BJK put line (NOT CORRECT) response question.

20/10/98

Location 5322 - private
- gradient

Location of ore bodies

- Location 826 (will this be mined)

Bunnings Land

Conservation values
- better disturbed area 3/900
- 'no worse than vg across road'
- improved with management
- overall better condition 3/900
- discussion of values

RS what top 3 reasons why EPA change its mind
- offer conservation land
- management reserve detailed (re reduce threatening process)
- reho 6 of the reserve all area

CW little technical interpretation in original, different this time.

Meeting Notes

Name	Folio No.
Bronwen Keighery	
Branch	**File No.**
Conservation Branch	

Subject	Date	Time
Ros 31900 Yarloop / Cable Sands	19/10/98	

People in attendance
B. Bowen, etc see Briefing Notes (see corrections)

Items	Action required	Action by
Background as per Briefing Notes given by Michelle M.		
- no Aboriginal info, significance possible; Company not as yet done		
Discussion		
- outlined survey techniques		
- added info as on briefing notes		
- Westralian Sands adjacent lease.		
Rob's Summary as per meeting MET/BJK/RADS/SW "New Proposal"		
i) Bunnings land - compatibility - need all - Bunnings Position		
ii) Rehabilitation		
iii) Continuum		
How Change		
- (10% left, one largest bits together, possibly larger continuum		
- New info/does not decrease value		
- Variation prob means need both required ie need both		
- precedent mining near Ridge Hill Shelf area,		

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Meeting Notes

Name: BRONWEN KEICHERT		Folio No.
Branch		File No.
Subject: report to indicate not to be reviewed	Date: / /	Time

People in attendance: Graham Kinnimonth (Env Off), Gary Crockford (Ac Manager), Gary Lee Environ Sup, Charlie Welker

Items	Action required	Action by
• Meeting requested by Cable Sands		
• Overview of past process		
• Would like to mine the area		
• Subsequent work by Mattiske Consulting determined that 3b is actually a continuous use basis a 'Forestfield Complex'		
• New information requesting that he re-considered.		
• Technical people look at information see it this is valid		
• Require feel for 'most appropriate way to get re-assessed' (Res 31900)		
• Melinda considered should be 'new proposal'		
• More complete rehabilitation proposal		
• Formal Assessment' determination will be based / rejection BUT needs to be looked at technically	BSK/ CAM	

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Yarloop Mineral Sands 22/6/96

Cable Sands – Chris
– Graham Kinnimonth
– Ryanny

Further veg community mapping.

		3b	202
New Sites. Res.	Cookups Res 14653	13b	
	Wagerup Res 14160	120b	
	Yarloop Tramway Res	2.53b	
	Pinjarra Hot. Valley Road Res	3b	
	Yarloop Res 25P23	3b	20b
Private Land	Herman Rd	3	
Bunnings	Yarloop PL 826	7	3
	Pinjarra Alcoa Access Rd.	10	<1

Propose to mine 3b
Relocate Typ to protect 20b. in this reserve.

Have approached Bunnings they have indicated potential to sell. (Talks yesterday)

Their had mining agreement
Have now changed their mind even recognising the agreement.

RHS areas :— South nave
: — north Yarloop, Bancell Rd — Burnside Rd
: — Serpentine NP ? Cardup/Warrona (Interface)
: — Talbot Rd : Ellis Brook.

Report on the Floral Values of the Bushland in Harvey Townsite

Greg Keighery

INTRODUCTION

This area is in the townsite of Harvey. It lies immediately south of the Mornington District Office of CALM, between the Harvey to Quindanning road, South Western Highway and Logue Road (Figure 1). The area consists of an eastern plateau of laterite which then slopes steeply to a moderately sloping area of colluvial white sand which continues to South Western Highway. An ephemeral creekline runs partially through the area.

VEGETATION PRESENT AND CONDITION

The lateritic plateau has an open woodland of Jarrah (*E. marginata* ssp. *marginata*) this merges downslope into a low open woodland of Ridge Hill Jarrah (*E. marginata* ssp. *elegantella*) and Mountain Marri (*E. haematoxylon*) as there is more sand overlying the laterite. The bottom sandy soils supprted a woodland of Marri. All of these vegeatation types are characteristic of the Ridge Hill Shelf.

The vegetation types were very interesting because of the juxtaposition of the two subspecies of Jarrah and the two closely related species of Marri. There are few areas of Ridge Hill Shelf vegetation left so comparisons are difficult

FLORA

A list of vascular plant species recorded during two brief summer and austumn visits are given in table one. One hundered and sixty species were recorded from the area, mostly being shrubs and trees because of the timing of the survey visits.

Of particular interest were the Proteaceae

CONCLUSIONS

Table One: Vascular Plants Recorded from The Harvey and Yarloop Townsite Reserves

Yarloop Reserves	Harvey	Bancell Rd
Aizoaceae		
Macarthuria apetala		
Amaranthaceae		
	Ptilotus manglesii	*
Anthericaceae		
Arthropodium capillipes	*	*
Agrostocrinum scabrum	*	*
Caesia micrantha	*	*
Caesia occidentalis	*	*
Chaemascilla corymbosa	*	*
Laxmannia sessiliflora	*	
Thysanotus ? manglesianus	*	
	Thysanotus multiflorus	

T	Y/H	Y	H
202	131	39	32

65% Flora in common

Y/H	Y	H
7	1	2

Thysanotus sparteus	*	
Tricoryne elatior	*	
Tricoryne tenella	*	
Apiaceae		
Homalosciadium homalocarpum	*	*
Hydrocotyle callicarpa		
Pentapeltis peltigera	*	*
Trachymene pilosa	*	
	Xanthosia ciliata	
Xanthosia huegelii	*	*
Asteraceae		
*Hypochaeris glabra	*	*
Lagenifera huegelii	*	*
	Olearia paucidentata	
	Podotheca angustifolia	
Campanulaceae		
Wahlenbergia preissii	*	
Casuarinaceae		
Allocasuarina fraseriana		
Allocasuarina humilis		
Caesalpiniaceae		
Labichea punctata	*	
Colchicaceae		
Burchardia umbellata	*	
Cyperaceae		
		Tetraria australiensis
Lepidosperma ?tenue	*	
Lepidosperma squamatum	*	
Mesomelena graciliceps	*	
Mesomelaena tetragona	*	
Tetraria capillaris	*	
Tetraria octandra	*	
	Trichostularia neesii	
Dasypogonaceae		
Calectasia cyanea	*	
Dasypogon bromeliifolius		
	Lomandra brittanii	
Lomandra caespitosa	*	
Lomandra hermaphrodita		
Lomandra preissii		
Lomandra purpurea	*	
Lomandra sonderi		
Lomandra sericea	*	
Lomandra suaveolens		
Dilleniaceae		
Hibbertia acerosa	*	
Hibbertia amplexicaulis	*	

	Y/H	Y	H
37	24	8	5

	Hibbertia cunninghamii
Hibbertia huegelii	
Hibbertia ?montana	*
Hibbertia hypericoides	*
	Hibbertia racemosa
	Hibbertia vaginata
Droseraceae	
Drosera erythrorhiza	*
Drosera stolonifera	*
Epacridaceae	
Astroloma ciliata	*(L)
Astroloma pallidum	*
Constephium pendulum	*
Constephium preissii	*
	Lysinema ciliatum
Styphelia tenuiflora	*
Euphorbiaceae	
Phyllanthus calycinus	*
Stachystemon vermicularis	*
Goodeniaceae	
Dampiera linearis	*
Lechenaultia biloba	*
Goodenia caerulea	*
Lechenaultia floribunda	
Sacaevola calliptera	
Scaevola phelbopetala	*
Scaevola repens	*
Haemodoraceae	
Anigozanthos manglesii	*
Conostylis aculeata	*
Conostylis juncea	
Conostylis setigera	*
Haemodorum laxum	*
Haemodorum loratum	
Haemodorum spicatum	*
Phelocarya ciliatum	*
Phelbocarya filifolia	
Iridaceae	
*Freesia hybrid	
Patersonia juncea	*
Patersonia occidentalis	*
Juncaceae	
Juncus bufonius	
Lamiaceae	
Hemiandra pungens	*
Lauraceae	
Cassytha micrantha	
	Cassytha flava
	Cassytha pomiformis

T	Y/H	Y	H
39	24	9	6

Cassytha racemosa

Lobeliaceae
Lobelia tenuior *

Loganiaceae
Logania serpyllifolia *
Mitrasacme paradoxa *

Loranthaceae
Nuytsia floribunda *

Mimosaceae

Acacia extensa
Acacia huegelii *
Acacia lasiocarpha
Acacia latericola *
Acacia nervosa
Acacia preissiana
Acacia pulchella *
Acacia saligna *
Acacia sessilis *
Acacia stenoptera *

Myrtaceae

Baeckea camphorosmae
Eucalyptus calophylla *
Eucalyptus haematoxylon
Eucalyptus marginata *
Hypocalymma robustum
Kunzea ericifolia *
*Leptospermum laevigatum *
Melaleuca ?scabra
Melaleuca thymiodes *
Scholtzia ciliata

Orchidaceae
Caladenia discoidea
Caladenia flava *
Cryptostylis ovata
Lyperanthus nigricans *
*Monadenia bracteata
Prasophyllum parvifolium
Pterostylis vittata
Pterostylis recurva
Thelymitra crinita *

Orobanchaceae
Orobanche minor *

Papilionaceae
Bossiaea eriocarpa *
Bossiaea sp (229) *
*Cytissus prolifera
Daviesia divaricata *
Daviesia physodes *
Daviesia preissii *
Gompholobium aristatum *

Daviesia comata

T	YH	Y	H
42	25	12	5

Gompholobium confertum	
Gompholobium knightianum	*
Gompholobium marginatum	*
Gompholobium ovatum	
Gompholobium polymorphum	*
Gompholobium preissii	*
Gompholobium shuttleworthii	
Hovea chorizemifolia	*
Hovea trisperma	*
	Jacksonia furcellata
	Jacksonia sternbergiana
Kennedia coccinea	
Kennedia prostrata	*
Nemcia capitatum	*
Pittosporaceae	
Pronaya fraseri	*
Phormiaceae	
Agrostocrinum scabrum	*
Dianella revoluta	*
Stypandra glauca	*
Poaceae	
Amphipogon turbinatus	*
*Briza maxima	*
*Cynodon dactylon	*
Danthonia occidentalis	*
*Eragrostis curvula	*
Neurachne alopecuroidea	*
	Poa drummondiana
	*Pennisetum clandestinum
	*Stenotraphum secundatum
Stipa campylachne	*
Stipa flavescens	
Tetrarrhena laevis	*
Polygalaceae	
Comesperma calymega	*
Comesperma virgatum	*
Proteaceae	
Adenanthos meisneri	*
Banksia attenuata	*
Banksia grandis	*
Conospermum stoechadis	
Dryandra bipinnatifida	*
Dryandra nivea	*
Grevillea quercifolia	
Grevillea wilsonii	*
	Hakea amplexicaulis
Hakea cyclocarpa	*
	Hakea prostrata
Hakea ruscifolia	*
	Isopogon sphaerocephalus
Persoonia elliptica	*
	Persoonia longifolia
Persoonia saccata	*

Total	Yar/Ht	Yar	Har
48	32	7	9

Petrophile linearis	*	
Stirlingia latifolia	*	
		Synaphaea petiolaris
Xylomelon occidentale		
Restionaceae		
		Anarthria prolifera
Hypolaena exsulca	*	
Loxocarya fasiculata	*	
Loxocarya flexuosa	*	
Lyginia barbata	*	
Restio microcodon		
Rubiaceae		
Opercularia apiciflora	*	
Opercularia hispidula		
Rutaceae		
Eriostemon spicatus	*	
Stackhousiaceae		
Stackhousia pubescens	*	
Tripterococcus brunonis	*	
Stylidiaceae		
		Stylidium amoenum
Stylidium brunonianum	*	
Stylidium piliferum	*	
Stylidium schoenoides	*	
Thymeleaceae		
		Pimelea sylvestris
Pimelea suaveolens	*	
Tremandraceae		
Tetratheca hirsuta	*	
Violaceae		
Hybanthus floribundus	*	
Xanthorrhoeaceae		
		Xanthorrhoea acanthostachya
Xanthorrhoea gracilis	*	
Xanthorrhoea preissii	*	
Zamiaceae		
Macrozamia riedlei	*	

Yarloop/Harvey

Total	Sh	Yarl	Harvey
26	19	2	5

Report on the Floral Values of the Bushland in Yarloop Townsite opposite Johnstone Road

Greg Keighery
September, 1995

This area is in the townsite of Yarloop. It lies immediately south of reserves 23307 and 31901, bounded to the north by Johnston Road, south by an aircraft landing strip and the west by a main drain (figure 1).

VEGETATION PRESENT AND CONDITION

The block has a tall woodland to forest of *Eucalyptus marginata* (Jarrah)over *Xylomelon occidentale* on colluvial yellow sands on the northern margins (Marked J in Figure 2). This woodland is in excellent condition and shares 117 of the 135 species of shrubs and perennial herbs presently recorded in the reserves to the north (Table1). This figure will undoubtanbly increase with a spring survey and is considered about 65% complete at present. The most significant species present on the private block is *Scholtzia ciliata,* here a major disjunction south of its normal range. The species is rare in the Yarloop reserves but has a substantial population on the northern boundary of this block.

This woodland merges downslope into a *Banksia attenuata* dominated woodland, with scattered Jarrah and Casuarina trees, as wind blown white-grey sands become deeper. This area has been (and is?) heavily grazed in the past and has significant invasion of annual weedy grasses scattered through the area. The condition deteriorates as one approaches the edges of the block and the cleared areas (Figure2) in the middle. Here perennial pasture grasses and Inkplant (*Phytolacca octandra*) become common. Overall the condition of this vegetation is poor.

The vegetation between the lakes has been severely disturbed by grazing and clearing and consists either of scattered Jarrah, Casuarina, Banksia or *Eucalyptus calophylla* (Marri) trees over pasture grasses with scattered native shrubs such as *Kunzea ericifolia*. The area has been excavated for rubbish disposal, there are bulbous weeds such as Freesias and Watsonia and several car bodies. West of the lakes Marri woodland dominates over Kunzea ericifolia, this appears to have been partially cleared in the past.The condition of this vegetation is poor to degraded, and Dieback disease appears to be widespread.

The three lakes contain most of the species which are not recorded in the Yarloop reserves (Table 1), this is not suprising as they have no wetlands.
Lake 1 (Figure 2) had a fringing woodland of *Melaleuca preissiana* and *M.rhaphiophylla*, however, most of the large trees are dead and a new line of trees are currently establishing around the lake margin. The lake may have been lower in the past. The southern margin contains a diverse herbfield under the trees of native and introduced aquatics and mud dwelling species.

Lake 2 has a fringing woodland of *Melaleuca preissiana* and *Melaleuca rhaphiophylla* with emergent *Eucalyptus rudis* (Flooded Gums).over sedges of *Lepidosperma longitudinale* and *Juncus pallidus*. The lake margins have a herbfield of *Centella cordifolia, Grattiola peruviana* and *Myriophyllum* sp. Weeds such as Blackberries and Watsonia are scattered throughout and there has been substantial rubbish dumping.

Lake 3 had a surrounding low woodland of *Melaleuca preissiana*. The centre was dry and completely covered by the pasture grass *Cynodon dactylon* (Couch) with scattered clumps of dead *Juncus pallidus*.

CONCLUSIONS

The Jarrah vegetation of the northern margin of the block is in excellent condition, and is very similar to the Yarloop reserves. As much of this vegetation should be retained as possible.

The Banksia and Marri woodland and lakes of the western two thirds of the area have very low flora values and are all rated as poor to degraded in condition. Fauna values of the lakes may be significant.

FLORA OF RESERVES 31900, 3672, 16681, 23307 , 31901 AND PRIVATE LAND AT YARLOOP
*= present on private block, name indicates only present on private block

Yarloop Reserves	Private Land
Aizoaceae	
Macarthuria sp	
Amaranthaceae	
	Alternanthera nodiflora
	*Amaranthus lividus
Anthericaceae	
	Arthropodium capillipes
Agrostocrinum scabrum	*
Caesia micrantha	*
Caesia occidentalis	
Chaemascilla corymbosa	*
Thysanotus ? manglesianus	*
Tricoryne elatior	*
Tricoryne tenella	
Apiaceae	
	Centella cordifolia
Homalosciadium homalocarpum	*
Hydroctyle callicarpa	
Pentapeltis peltigera	*
Trachymene pilosa	*
Xanthosia huegelii	*
Caryophyllaceae	
	*Corrigiola littoralis
Casuarinaceae	
Allocasuarina fraseriana	*
Allocasuarina humilis	*
Caesalpiniaceae	
Labichea punctata	*
Colchicaceae	
Burchardia umbellata	*
Cyperaceae	
	Baumea articulata
	Baumea juncea
	*Cyperus tenellus
	Cyperus alterniflorus
	Fimbristylis velleata
	Lepidosperma longitudinale
Lepidosperma ?tenue	*
Lepidosperma squamatum	*
Mesomelena ?graciliceps	*
Mesomelaena tetragona	*

Tetraria capillaris	*
Tetraria octandra	*
Dasypogonaceae	
Calectasia cyanea	*
Dasypogon bromeliifolius	*
Lomandra caespitosa	*
Lomandra hermaphrodita	*
Lomandra preissii	*
Lomandra purpurea	*
Lomandra sonderi	
Lomandra sericea	*
Lomandra suaveolens	*
Dilleniaceae	
Hibbertia acerosa	*
Hibbertia amplexicaulis	
Hibbertia huegelii	*
Hibbertia ?montana	
Hibbertia hypericoides	*
Droseraceae	
Drosera erythrorhiza	*
Drosera stolonifera	*
Epacridaceae	
Astroloma pallidum	*
Constephium pendulum	*
Styphelia tenuiflora	*
Euphorbiaceae	
Phyllanthus calycinus	*
Stachystemon vermicularis	*
Goodeniaceae	
Dampiera linearis	*
Lechenaultia biloba	*
	Lechenaultia ?floribunda
Sacaevola calliptera	
Scaevola phelbopetala	*
Scaevola repens	*
Haemodoraceae	
Anigozanthos manglesii	*
Conostylis juncea	*
Conostylis setigera	
Haemodorum loratum	
Haemodorum spicatum	*
Phelocarya ciliatum	*
Phelbocarya filifolia	
Iridaceae	
	*Freesia hybrid
Patersonia juncea	*
Patersonia occidentalis	*
	*Watsonia bulbillifera
Juncaceae	

	Juncus pallidus
Lamiaceae	
Hemiandra pungens	*
Lauraceae	
Cassytha micrantha	
	Cassytha racemosa
Loganiaceae	
Logania serpyllifolia	*
Mitrasacme paradoxa	
Loranthaceae	
Nuytsia floribunda	*
Mimosaceae	
Acacia huegelii	*
	Acacia ?lasiocarpa
Acacia latericola	
Acacia preissiana	
Acacia pulchella	*
Acacia saligna	*
Acacia sessilis	*
Acacia stenoptera	*
Myrtaceae	
	Astartea fasicularis
Eucalyptus calophylla	*
Eucalyptus marginata	*
	Eucalyptus rudis
	Kunzea ericifolia
	Kunzea recurva
	*Leptospermum laevigatum
	Melaleuca preissiana
	Melaleuca rhaphiophylla
Melaleuca ?scabra	
Melaleuca thymiodes	*
Scholtzia ciliata	*
Orchidaceae	
Caladenia discoidea	
Caladenia flava	
	Cryptostylis ovata
Lyperanthus nigricans	*
	*Monadenia bracteata
Prasophyllum parvifolium	*
Pterostylis vittata	*
Pterostylis recurva	*
Thelymitra crinita	*
Orobanchaceae	
Orobanche minor	*
Papilionaceae	
Bossiaea ericarpa	*
Bossiaea sp (229)	*
*Cytissus prolifera	*

Daviesia divaricata	*
Daviesia physodes	*
Daviesia preissii	*
Gompholobium aristatum	*
	Gompholobium confertum
Gompholobium knightianum	*
Gompholobium marginatum	*
Gompholobium ovatum	*
Gompholobium polymorphum	*
Gompholobium preissii	*
Gompholobium shutleworthii	
Hovea chorizemifolia	*
Hovea trisperma	*
Kennedia coccinea	*
Kennedia prostrata	*
	*Lupinus cosentinii
Pittosporaceae	
Pronaya fraseri	*
Phormiaceae	
Dianella revoluta	*
Stypandra glauca	
Phytolaccaceae	
	Phytolacca octandra
Poaceae	
Amphipogon turbinatus	*
*Briza maxima	*
	*Cynodon dactylon
Danthonia occidentalis	*
	*Digitaria ciliaris
	*Eragrostis curvula
	Eragrostis elongata
Neurachne alopecuroidea	*
	*Pennisetum clandestinum
	*Stenotraphum secundatum
Stipa campylachne	*
Stipa flavescens	*
Tetrarrhena laevis	*
Polygalaceae	
Comesperma calymega	*
Comesperma virgatum	
Polygonaceae	
	*Rumex sp
Proteaceae	
Adenanthos meisneri	*
Banksia attenuata	*
Banksia grandis	*
	Banksia illicifolia
Conospermum stoechadis	*
Dryandra bipinnatifida	*
Dryandra nivea	*
Grevillea quercifolia	*

Grevillea wilsonii	*
Hakea cyclocarpa	
Hakea prostrata	
Hakea ruscifolia	*
Hakea varia	
Persoonia elliptica	*
Persoonia saccata	*
Petrophile linearis	*
Stirlingia latifolia	*
Xylomelon occidentale	*
Restionaceae	
Hypolaena exsulca	*
Leptocarpus sp	
Loxocarya fasiculata	*
Loxocarya flexuosa	*
Lyginia barbata	*
Restio microcodon	
Rosaceae	
*Rubus fruticosus	
Rubiaceae	
Opercularia apiciflora	
Opercularia hispidula	*
Rutaceae	
Eriostemon spicatus	*
Scrophulariaceae	
Grattiola peruviana	
Solanaceae	
*Solanum ammericanum	
Stylidiaceae	
Stylidium piliferum	*
Stylidium schoenoides	
Thymeleaceae	
Pimelea suaeveolens	*
Tremandraceae	
Tetratheca hirsuta	*
Violaceae	
Hybanthus floribundus	*
Xanthorrhoeaceae	
Xanthorrhoea gracilis	*
Xanthorrhoea preissii	*

Review of Local and Regional Significance of

Communities 3b and 20b as defined by Gibson et al. (1994)

No map
No condition scales

Prepared by: Mattiske Consulting Pty Ltd

Prepared for: Cable Sands (W.A.) Pty Ltd

August 1996

CSC001/231/96

TABLE OF CONTENTS

Ellinor Bennett

CALM Threatened Communities

1. SUMMARY

Mattiske Consulting Pty Ltd was commissioned by Cable Sands (W.A.) Pty Ltd to determine the approximate areas of two Floristic Community Types 3b and 20b (Gibson *et al.* (1994)). These communities are restricted to the sand and sandy loam soils at the base of the Darling Scarp and are considered by Gibson *et al.* (1994) to be vulnerable. It is these soils which have been developed extensively for agriculture resulting in only a small area of the Floristic Community Types still remaining compared to what would originally have been present.

Cable Sands (W.A.) Pty Ltd have identified that these two communities occur in Reserve 31900 which they wish to include in their proposed mining lease near Yarloop. The total area of Reserve 31900 is 19.4ha of which 8ha is type 3b Floristic Community Type and less than 4ha is Floristic Community Type 20b.

After surveying known areas, and locating additional areas, a total area of approximately 185ha of Floristic Community Type 3b has been located of which approximately 89.5ha occurs in reserves, and a total area of approximately 102ha of Floristic Community Type 20b has been located of which 64ha occurs in reserves. The remaining areas are privately owned.

2. INTRODUCTION

Mattiske Consulting Pty Ltd was commissioned by Cable Sands (W.A.) Pty Ltd to survey the area between Armadale and Yarloop to locate populations of Floristic Community Types 3b and 20b as defined by Gibson *et al.* (1994). Most of this landform has been cleared for agriculture resulting in the remnant vegetation generally occurring on the scarp and lower slopes having conservational importance. Cable Sands (W.A.) Pty Ltd were requested to provide further information on the known areas of Floristic Community Types 3b and 20b prior to the development of their lease at Yarloop, in particular that of the Yarloop rubbish tip area, Reserve 31900.

Reserve 31900 was identified by Gibson *et al.* (1994) as including Floristic Community Types 3b and 20b although it is intended to only develop part of the eastern section. This section has been identified as Floristic Community Type 3b. Type 20b is restricted to the western section of Reserve 31900 and is remote from the proposed mining. Gibson *et al.* (1994) concluded that community reservation of Floristic Community Types 3b and 20b were well reserved but vulnerable, and poorly reserved and vulnerable respectively.

No reference to CALM Threatened Comm. lists

3. OBJECTIVES

The objectives of this report were:

- to locate additional areas of Floristic Community Types 3b and 20b
- to estimate the size of each of the Floristic Community Types 3b and 20b located.

4. METHODS

Information on the locations of all known areas of occurrence of Floristic Community Types 3b and 20b were obtained. Additional information on these communities to that listed in Gibson *et al.* (1994) was provided by the Department of Environmental Protection and by the Department of Conservation and Land Management.

The area of several of the communities had already been assessed by Ms V. English at the Department of Conservation and Land Management so no additional assessment was made of these areas. Those which had not been assessed for size were located and categorised and in addition other areas of the same communities were to be located.

Community 3b occurs on sandy clay soils and Community 20b on sandy soils at the base of the Darling Scarp so Reserves and any vacant land found occurring in these soils were to be assessed for the Floristic Community Type. Floristically Group 3b is distinguished according to Gibson *et al.* (1994) by "....most sites are dominated by both *Eucalyptus calophylla* and *Eucalyptus marginata*. Species such as *Bossiaea eriocarpa* and *Conostylis juncea* differentiate this subgroup". Floristically Group 20b is distinguished by "...Most sites in this community were *Eucalyptus marginata - Banksia attenuata* woodlands but Banksia woodlands and heaths were also found. Species that differentiated this subgroup included *Hakea stenocarpa, Conostylis setosa* and *Johnsonia* aff. *pubescens*..".

August 15th 1996 was devoted to assessing the size of the known areas of the two types and searching unrecorded areas for additional locations. A botanist from Mattiske Consulting Pty Ltd and the Senior Environmental Officer from Cable Sands (W.A.) Pty Ltd undertook the search and floristic analysis.

Condition scales NOT given what is
Excellent / V. good / good / moderate / degraded / very degraded.

5. RESULTS

Cable Sands (W.A.) Pty Ltd has assessed the area of the Yarloop Rubbish tip reserve (Reserve 31900) for each Floristic Community Type. Of the total reserve area of 19.4ha, 8ha is degraded by sand excavation and rubbish tip, type 3b occupies 8ha, 20b less than 4ha. However the company is required to assess the remaining area of these two Floristic Community Types.

Information was provided by the Department of Environmental Protection for 10 bushland areas with Floristic Community Type 3b and 7 bushland areas with Floristic Community Type 20b. Of these some had previously been surveyed for area by Ms V. English from the Department of Conservation and Land Management. These will be discussed later and finally all areas surveyed are summarised in Table 1.

5.1 Areas Surveyed on 16/8/1996

Several bush areas were sampled but many were not found to be representative of the communities sought. Those areas located are listed below together with the estimated area of the Floristic Community Type dominant and characteristic species located.

5.1.1 Privately Owned

Those areas with Floristic Community Type 3b are listed before those with Floristic Community Type 20b.

Serpentine AA Lots 22 and 23 Norman Road
Floristic Community Type: 3b
Estimated area: 25ha
Condition: Moderate to very degraded.
Eucalyptus calophylla - Eucalyptus marginata woodland
Selected associated species:
Trees: *Nuytsia floribunda*
Shrubs: *Dryandra armata, Dryandra lindleyana, Hibbertia hypericoides, Kingia australis, Xanthorrhoea preissii*
Herbs: *Mesomelaena tetragona*

Murray Location 275 Lot 1 Page Road, Keysbrook
Floristic Community Type: 3b
Estimated area: 1-2ha
Condition Very good
Eucalyptus calophylla - Eucalyptus marginata woodland
Selected associated species:
Trees: -

Shrubs: *Dryandra lindleyana, Eremaea pauciflora, Hibbertia hypericoides, Kingia australis, Leschenaultia biloba*
Herbs: *Cyathochaeta avenacea, Mesomelaena tetragona*

Alcoa Access Road adjoining and including Social Club Road
Floristic Community type: 3b
Estimated area: 10ha
Condition: Degraded due to grazing
Eucalyptus calophylla - Eucalyptus marginata woodland
Selected associated species:
Trees: -
Shrubs: *Kingia australis, Xanthorrhoea preissii*
Herbs: *Mesomelaena tetragona*

Lots 1-4 Rushton Road, Martin (privately owned)
Floristic Community Type: 3b
Area: 2ha
Condition: Good to moderate some degraded
Eucalyptus calophylla - Eucalyptus marginata woodland
Selected associated species:
Trees: -
Shrubs: *Acacia pulchella, Conospermum sp.* affin *stoechadis, Grevillea wilsonii, Hakea undulata*
Herbs: *Mesomelaena tetragona*

Herron Road, off South West Highway (South of Coolup)
Floristic Community Type: 3b
Estimated area: 3ha
Condition: Good to degraded
Eucalyptus calophylla - Eucalyptus marginata woodland
Selected associated species:
Trees: -
Shrubs: *Baeckea camphorosmae, Kingia australis, Scaevola pilosa*
Herbs: *Arthropodium capillipes, Cyathochaeta avenacea, Mesomelaena tetragona, Tetraria octandra*

Serpentine AA Lots 22 and 23 Norman Road
Floristic Community Type: 20b
Estimated area: 20ha
Condition: Very good to moderate.
Banksia attenuata - Eucalyptus marginata woodland
Selected associated species:
Trees: *Xylomelum occidentale*
Shrubs: *Hibbertia hypericoides, Hypocalymma robustum, Stirlingia latifolia*
Herbs: *Mesomelaena tetragona*

Alcoa Access Road adjoining and including Social Club Road
Floristic Community type: 20b
Estimated area: <1ha
Condition: Very degraded plus additional planting of non-local species.
Banksia attenuata - Eucalyptus marginata woodland.
Selected associated species:
Trees: *Xylomelum occidentale*
Shrubs: *Bossiaea eriocarpa, Xanthorrhoea preissii*

Lots 73-74, South West Highway, Yarloop (privately owned)
Floristic Community Type: 20b
Area: 3-4ha
Condition: Excellent
Eucalyptus marginata woodland
Selected associated species:
Trees: *Banksia grandis*
Shrubs: *Bossiaea eriocarpa, Conospermum stoechadis, Eriostemon spicatus, Grevillea wilsonii, Hibbertia hypericoides, Labichea punctata, Pronaya elegans, Xanthorrhoea gracilis, Xanthorrhoea preissii*
Herbs: *Anigozanthos manglesii, Cyathochaeta avenacea, Dasypogon bromeliifolius, Lepidosperma squamatum, Mesomelaena tetragona*

Lots 1-4 Rushton Road, Martin (privately owned)
Floristic Community Type: 20b
Area: 6ha
Condition: Good to moderate some degraded
Eucalyptus marginata woodland
Selected associated species:
Trees: *Acacia saligna*
Shrubs: *Acacia drummondii, Allocasuarina humilis, Baeckea camphorosmae, Conospermum sp.* affin. *stoechadis, Conostephium pendulum*
Herbs: *Mesomelaena tetragona.*

5.1.2 CALM, Shire or other Reserves

Those reserves with Floristic Community Type 3b are listed before those with Floristic Community Type 20b.

M85 Serpentine Falls National Park
Floristic Community Type: 3b
Estimated area: 14ha
Condition: Very good
Eucalyptus calophylla - Eucalyptus marginata woodland

Selected associated species:
Trees: *Eucalyptus lane-poolei*
Shrubs: *Baeckea camphorosmae, Calothamnus sanguineus, Dryandra armata, Dryandra lindleyana, Eriostemon spicatus, Grevillea pilulifera, Hakea lissocarpha, Hakea undulata, Hibbertia hypericoides, Hypocalymma angustifolium, Kingia australis, Leucopogon capitellatus, Xanthorrhoea preissii*
Herbs: *Chamaescilla corymbosa, Borya scirpoides, Drosera stolonifera, Hypolaena exsulca, Lepidosperma brunonis, Neurachne alopecuroidea, Patersonia occidentalis, Lomandra hermaphrodita, Mesomelaena tetragona, Patersonia occidentalis, Stylidium piliferum, Tetraria octandra*

Coolup Nature Reserve C53 and area to NE adjoining Coolup Nature Reserve
Floristic Community Type: 3b
Estimated area: 4ha
Condition: Good
Eucalyptus calophylla - Eucalyptus marginata woodland
Selected species present:
Trees: -
Shrubs: *Bossiaea eriocarpa, Eriostemon spicatum, Grevillea wilsonii, Kingia australis, Leschenaultia biloba, Xanthorrhoea preissii*
Herbs: *Anigozanthos manglesii, Loxocarya fasciculata, Mesomelaena tetragona*

Hotham Valley Railway between Williams-Pinjarra Road and Napier Road
Floristic Community Type: 3b
Estimated area: 4ha, <1ha in good condition
Condition: Good to degraded with Watsonia.
Eucalyptus calophylla - Eucalyptus marginata woodland
Selected associated species:
Trees: *Nuytsia floribunda*
Shrubs: *Kingia australis, Xanthorrhoea preissii*
Herbs: *Mesomelaena tetragona*

Reserve 1453, South West Highway
Floristic Community Type: 3b
Estimated area: <1ha
Condition: Degraded
Eucalyptus calophylla - Eucalyptus marginata woodland
Selected associated species:
Trees: -
Shrubs: *Baeckea camphorosmae, Xanthorrhoea preissii*
Herbs: *Cyathochaeta avenacea, Drosera gigantea, Mesomelaena tetragona*

Reserve 20585, Waroona
Floristic Community Type: 3b
Area: 7.5ha
Condition: Very good
Eucalyptus calophylla- Eucalyptus marginata woodland
Selected associated species:
Trees: *Banksia grandis*
Shrubs: *Acacia pulchella, Baeckea camphorosmae, Bossiaea eriocarpa, Conospermum stoechadis, Dryandra lindleyana, Eriostemon spicatus, Grevillea pilulifera, Hibbertia hypericoides, Kennedia prostrata, Kingia australis*
Herbs: *Anigozanthos manglesii, Chamaescilla corymbosa, Cyathochaeta avenacea, Drosera stolonifera, Hypolaena exsulca, Lepidosperma squamatum, Mesomelaena tetragona, Patersonia* affin. *sericea, Sowerbaea laxiflora*

Reserves 1599, 31437, 31438, 31459 - Railway Reserve, South West Highway
Floristic Community Type: 3b
Area: 5ha
Condition: Good to degraded
Eucalyptus calophylla - Eucalyptus marginata woodland
Selected associated species:
Trees: -
Shrubs: *Baeckea camphorosmae, Hibbertia hypericoides, Kingia australis, Xanthorrhoea preissii*
Herbs: *Cyathochaeta avenacea, Loxocarya fasciculata, Hypolaena exsulca*

Reserve 25823, Yarloop, Shire of Harvey Reserve
Floristic Community Type: 3b
Area: 1ha
Condition: Excellent
Eucalyptus calophylla - Eucalyptus marginata woodland
Selected associated species:
Trees: *Banksia grandis*
Shrubs: *Bossiaea eriocarpa, Conospermum stoechadis, Conostephium pendulum, Eriostemon spicatus, Grevillea quercifolia, Grevillea wilsonii, Hakea ruscifolia, Hibbertia hypericoides, Kennedia coccinea, Labichea punctata, Pronaya elegans, Xanthorrhoea gracilis, Xanthorrhoea preissii*
Herbs: *Anigozanthos manglesii, Mesomelaena tetragona*

Tramway Reserve, Hoffman Road, Yarloop
Floristic Community Type: 3b
Area: 2-3ha
Condition: Very good
Eucalyptus calophylla - Eucalyptus marginata woodland

Selected associated species:
Trees: -
Shrubs: *Acacia drummondii, Acacia pulchella, Dryandra lindleyana, Grevillea quercifolia, Grevillea wilsonii, Hibbertia hypericoides, Hybanthus floribundus, Labichea punctata, Pronaya elegans*
Herbs: *Anigozanthos manglesii, Burchardia umbellata, Chamaescilla corymbosa, Mesomelaena tetragona, Neurachne alopecuroidea, Tetraria octandra*

Lambkin Reserve, Serpentine
Floristic Community Type: 20b
Estimated area: 1-1.5ha
Condition: Very good to slightly degraded
Eucalyptus marginata woodland
Selected associated species:
Trees: *Eucalyptus calophylla*
Shrubs: *Acacia pulchella, Adenanthos meisneri, Allocasuarina humilis, Bossiaea eriocarpa, Calytrix flavescens, Daviesia nudiflora, Dryandra lindleyana, Eriostemon spicatus, Hakea ruscifolia, Hakea stenocarpa, Nemcia capitata, Grevillea pilulifera, Templetonia biloba, Xanthorrhoea preissii*
Herbs: *Amphopogon turbinatus, Anigozanthos humilis, Chamaescilla corymbosa, Dasypogon bromeliifolius, Mesomelaena tetragona*

Coolup Nature Reserve C53 and area to NE adjoining Coolup Nature Reserve
Floristic Community Type: 20b
Estimated area: 7ha
Condition: Excellent
Banksia attenuata - Eucalyptus marginata woodland and *Eucalyptus marginata* woodland.
Selected associated species:
Trees: *Xylomelum occidentale*
Shrubs: *Adenanthos meisneri, Bossiaea eriocarpa, Eriostemon spicatum, Grevillea wilsonii, Kingia australis, Leschenaultia biloba, Xanthorrhoea preissii*
Herbs: *Anigozanthos manglesii, Loxocarya fasciculata, Mesomelaena tetragona*

Reserve 20585, Waroona
Floristic Community Type: 20b
Area: <1ha
Condition: Very good
Eucalyptus marginata woodland
Selected associated species:
Trees: *Banksia grandis*
Shrubs: *Acacia pulchella, Bossiaea eriocarpa, Conospermum stoechadis, Dryandra lindleyana, Eriostemon spicatus, Grevillea pilulifera, Hibbertia hypericoides, Kennedia prostrata, Kingia australis, Phyllanthus calycinus*

Herbs: *Anigozanthos manglesii, Chamaescilla corymbosa, Cyathochaeta avenacea, Dasypogon bromeliifolius, Drosera stolonifera, Hypolaena exsulca, Lepidosperma squamatum, Mesomelaena tetragona, Patersonia* affin. *sericea, Sowerbaea laxiflora*

Reserve 11160, Wagerup
Floristic Community Type: 20b
Area: 1ha
Condition: Moderate
Eucalyptus calophylla - Eucalyptus marginata woodland
Selected associated species:
Trees: -
Shrubs: *Dryandra armata, Grevillea wilsonii, Hakea prostrata, Hakea stenocarpa, Hibbertia hypericoides, Labichea punctata*
Herbs: *Dasypogon bromeliifolius, Mesomelaena tetragona*

Reserve 25823, Yarloop, Shire of Harvey Reserve
Floristic Community Type: 20b
Area: 12ha
Condition: Excellent
Eucalyptus marginata woodland
Selected associated species:
Trees: *Banksia attenuata, Banksia grandis, Persoonia elliptica, Xylomelum occidentale*
Shrubs: *Bossiaea eriocarpa, Conospermum stoechadis, Conostephium pendulum, Eriostemon spicatus, Grevillea quercifolia, Hakea ruscifolia, Hibbertia hypericoides, Labichea punctata, Pronaya elegans, Xanthorrhoea gracilis, Xanthorrhoea preissii*
Herbs: *Anigozanthos manglesii, Dasypogon bromeliifolius, Lepidosperma squamatum, Mesomelaena tetragona*

5.2 Areas Surveyed by CALM

Of the bushland area supplied by the Department of Environmental Protection Ms V. English from the Department of Conservation and Land Management had previously assessed five of type 3b and three of type 20b.

Floristic Community Type 3b Reserves

C52 Kooljerrenup Nature Reserve (CALM)	36ha ±10ha
Reserve 35773 Dunsborough	0.9ha ±0.1ha
M83 Cardup Nature Reserve (CALM)	6ha ±3ha
Reserve 6268 Burnside Road, SE Pinjarra	9ha ±3ha

Floristic Community Type 20b		
Brickwood Reserve (CALM)		2ha ±0.5ha
M83 Cardup Nature Reserve (CALM)		12ha ±3ha
	and	20ha ±5ha
Reserve 6268 Burnside Rd, SE Pinjarra		8ha ±3ha

5.3 Areas of Floristic Community Types 3b and 20b in Proposed Mining Lease

Reserves 31900, 31901, 23307, 16681, 3672 Yarloop, were surveyed and mapped by Mr G. Keighery (CALM) for the vegetation communities present. The area occupied by these two vegetation communities was then determined by Mr G. Kininmonth from Cable Sands (W.A.) Pty Ltd (pers. comm.) using G. Keighery's information. The total area occupied by Community 3b was 51.2ha and by 20b, 11.5ha. The land opposite the proposed mined which is owned by Bunnings has an area of 7ha of Community 3b stated by Keighery (1995) as "in excellent condition" and 3ha of Community 20b stated by Keighery (1995) as "this vegetation is poor". Cable Sands is intending to mine only the eastern portion of Reserve 31900 which is a portion of Community 3b.

5.4 Table indicating the area of assessed Floristic Community Types 3b and 20b

In the following table all the surveyed areas are brought together and the approximate area surveyed of these Floristic Community Types assessed.

Table 1: Area of Floristic Community Types 3b and 20b as assessed up to16/8/1996

SEC 56ha ±13 33±8.5 TOTAL COMP

BUSHLAND AREAS	AREA OF COMMUNITY TYPE 3b (ha) GJK EB	AREA OF COMMUNITY TYPE 20b (ha)	
Bunnings Land, Yarloop	7 E	3 D	10
Serpentine Lots 22, 23 Norman Rd	VG 25 M	20 VG/M	45
Lot 1 Page Rd, Keysbrook	~~E~~/VG 1-2 VG		
Alcoa Access Rd Degraded	~~10~~ D	<1	
Lots 73-74 Yarloop		3-4 E	
Lots 1-4 Rushton Rd, Martin	2 G/M	6	8
Herron Rd, Coolup	3 G/D		
M85 Serpentine Falls SEC	14 VG		
Napier Rd	4 G/D		

* Secure

EXPLORATION

*

BUSHLAND AREAS	AREA OF COMMUNITY TYPE 3b (ha)	AREA OF COMMUNITY TYPE 20b (ha)
Reserves 23307, 3672, 15581, 31901, 31900	51.2 % lost = 16%	11.5 % lost = 35%
Reserve 1453	<1 D	
Coolup Nature Reserve C53, Reserve 20585, Railway Reserves 1599, 31437, 31438, 31459	11.5 (4+7.5) E/G/D +3ha	7a NOT THIS.
* C52 Kooljerrenup Nature Reserve (CALM)	E/G 36 ±10	
* M83 Cardup Nature Reserve (CALM)	E/G 6 ± 3 E	E/G 32 ±8 E
Reserve 6268 Burnside Rd., SE Pinjarra (CALM)	E/G 9 ± 3	G/G 8 ±3
Brickwood Reserve (CALM)		2 ± 0.5
Reserve 25823, Yarloop	1 E	12 E
Tramway Reserve, Yarloop	2-3 VG	
* Lambkin Reserve, Serpentine		1-1.5 VG/D
Reserve 20585, Waroona		<1 VG
Reserve 11160, Waggerup		1 M
TOTAL	**±184.7**	**±101.5**

66.7

38

17

13

Deaths

≈ 1ha maximum amount. ± 20ha, 10ha is not appropriate

6. DISCUSSION

Cable Sands (W.A.) Pty Ltd requires to develop a portion of Reserve 31900. However the reserve contains the vulnerable Floristic Community Types 3b and 20b. Of the total reserve area of 19.4ha, 8ha is degraded by sand excavation and rubbish tip, 8ha is Floristic Community Type 3b and less than 4ha is Floristic Community Type 20b. Concern had been expressed about the reservation of these communities so a survey was undertaken of the known occurrences and a search to find additional occurrences.

A total area of approximately 185ha of Floristic Community Type 3b has been located of which approximately 89.5ha occurs in reserves and a total area of approximately 102 ha of Floristic Community Type 20b of which 64 ha occurs in reserves. The remaining areas are on private land.

56ha secure

33ha secure.

Reserves have very little protection

7 co-occurrences Yarloop Reserves = greatest single occurrence followed by Norman Road which is private land.

7. ACKNOWLEDGEMENTS

Assistance from the following is acknowledged:

Mr G. Whisson and Mrs B. Keighery - Department of Environmental Protection

Ms V. English - Department of Conservation and Land Management

8. REFERENCES

Cable Sands (WA) Pty Ltd (1996)
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LICENCE CONDITIONS FOR PUTRESCIBLE LANDFILL CLASS II

FOR THE SHIRE OF HARVEY

YARLOOP WASTE MANAGEMENT FACILITY

Western Australia

Department of Environmental Protection

Environmental Protection Act 1986

CONDITIONS OF LICENCE

LICENCE NUMBER: 6998 **FILE NUMBER: L185/97**

PREAMBLE

The statements in this preamble either paraphrase sections of the *Environmental Protection Act 1986* or provide relevant background information for the licensee. They should not be regarded as conditions of licence.

The licensee shall take all reasonable measures to prevent pollution of the environment.

The licensee should inform the Department of the Environmental Protection at least 24 hours prior to the commencement of any planned non-standard operations which may have the potential to cause pollution.

The licensee should be aware these conditions do not exempt other statutory obligations under the *Environmental Protection Act 1986* or the *Health Act 1911*. This includes the licensee's obligations under the *Environmental Protection Amendment Regulations 1991*- regulations to control storage and disposal of tyres, *Health (Asbestos) Regulations 1992* as amended and the *Noise Abatement (Neighbourhood Annoyance) Regulations 1992* or its replacement. Where there is conflict between the conditions set in this licence and any Act or Regulation, the latter takes precedence.

Where appropriate, the licensee should be aware and endeavour to comply with the following policy documents issued by the DEP:

i. 'Landfill Waste Classification and Waste Definitions 1996';

ii. Code of Practice 'Rural Landfill Management';

iii. Code of Practice 'Management of Clinical and Related Wastes';

iv. Guideline 'Disposal of Asbestos Waste for Landfill Operators'; and

v. Guideline 'Groundwater Monitoring at Municipal Landfill Sites' issued by Department of Minerals and Energy (Geological Survey of WA).

Where the licensee is unable to comply to any of the above, the Director should be contacted.

The site is approved as a class II landfill as defined in the document titled 'Landfill Waste Classification and Waste Definitions 1996'.

The licensee should be aware of State and national objectives in relation to waste management issues and seek to implement these objectives and goals. In particular adopting the waste management hierarchy and implementing these objectives. One of the State's objectives is to divert segregated green waste from landfills by the year 2000. The licensee should endeavour to implement strategies that will meet this objective.

The Director acknowledges the licensee's commitments to manage and operate the site in accordance with the management plan for the site.

In the past landfills have caused significant offsite impacts on adjacent land which have resulted in restrictions being placed on their operations. To minimise these impacts, a 35 metre internal buffer zone has been set in this licence, however this is not considered adequate and the buffer distance set in the code of practice 'Rural Landfill Management' should be followed. Where these buffer distances cannot be maintained and protected in the local authority's town planning scheme it can be expected that the internal buffer distance will be increased to compensate the for the loss of the buffer distance.

Western Australia

Department of Environmental Protection

Environmental Protection Act 1986

CONDITIONS OF LICENCE

LICENCE NUMBER: 6998 **FILE NUMBER: L185/97**

PREAMBLE (CONT'D)

The licensee should be aware that this Department considers that the Yarloop landfill is not appropriately sited. Further discussions will be undertaken over the next few months to ascertain the appropriate action regarding the reserve reclassification. It is therefore suggested that, as discussed, the licensee should review management practices to rationalise landfills within the Shire. This licence will be issued for an initial period extending until 31 March 1998.

DEFINITIONS

In these conditions of licence, unless inconsistent with the text or subject matter:

'approved' means approved in writing from time to time;

'approval' means approval in writing from time to time;

'greenwaste' means waste that originates from trees or plants;

'internal buffer distance' means a distance from the boundary of the site to the putrescible waste cell;

'Landfill Waste Classification and Waste Definitions' 1996, means the document issued by the Chief Executive Officer of the Department of Environmental Protection;

'hazardous waste, 'low hazard waste', 'special waste', 'putrescible' means waste as defined in the document titled 'Landfill Waste Classification and Waste Definitions' 1996;

'municipal waste' means waste collected at the kerbside by the local authority collection vehicle or its contractor;

'premises' means residential, industrial or other premises of any kind whatsoever and includes land, water and equipment;

'NATA' means National Association of Testing Authorities;

'DEP Officer' means an officer authorised under the *Environmental Protection Act 1986*;

'DEP' means the Department of Environmental Protection;

'Director' means the Director of the Waste Management Division of the Department of Environmental Protection for and on behalf of the Chief Executive Officer as delegated under Section 20 of the *Environmental Protection Act 1986*;

'Director' or 'Department of Environmental Protection' for the purposes of correspondence means-

Director, Waste Management Division
Department of Environmental Protection
141 St Georges Terrace
PERTH WA 6000

Telephone: (08) 9265 3265
Facsimile: (08) 9265 3144

GENERAL CONDITIONS

LICENCE THROUGHPUT

G1 The licensee shall ensure the quantity of refuse disposed of at this premise does not exceed 500 tonnes per year.

CONDITIONS OF LICENCE

LICENCE NUMBER: 6998 **FILE NUMBER: L185/97**

GENERAL CONDITIONS (CONT'D)

PERSONS IN CHARGE TO HAVE ACCESS TO CONDITIONS

G2(a) The licensee shall ensure persons placed in charge of the premises are aware of these conditions of licence and have reasonable access at all times to these conditions or copies thereof.

G2(b) The licensee shall inform any person(s) who operate equipment, or are required to perform certain tasks covered by this licence, of the requirements of this licence.

WASTE ACCEPTANCE

G3 The licensee shall only accept inert wastes, putrescible wastes, low hazard wastes type 1 (in compliance with maximum criteria defined in table 1) and special waste type 1 as defined in the document titled 'Landfill Waste Classification and Waste Definitions' 1996.

G4 The licensee shall ensure the following procedures are in place for managing low hazard wastes:

i. where the licensee is notified or is aware of the disposal of low hazard waste, the waste should be inspected and identified for the potential level of hazard;
ii. where such loads are identified, record the nature of the load, the delivery vehicle's registration number, driver's name and volume delivered; and
iii. any identified low hazard waste will be accompanied by documentary evidence that it meets the 'Landfill Waste Classification and Waste Definitions 1996' either from a laboratory which is NATA registered or has been approved by the Director.

G5 The licensee shall, where the licensee is notified or is aware of the disposal of asbestos waste, ensure the following procedures are in place for managing asbestos wastes:

i. before entry to the site, any asbestos material is wrapped in heavy duty plastic or material approved by the Director;
ii. the disposal area(s) for any more than one cubic metre of asbestos material is defined by grid references on the site plan;
iii. a copy of the site plan marked with the locations used for asbestos disposal as described in G5 ii. above, should be kept as a permanent record and made available for viewing by the Director on his request;
iv. a representative of the licensee is available to witness the burial of the asbestos waste under at least 1 metre of fill or putrescible waste as soon as practicable after placement in the landfill and sign a bound, numbered register within 2 hours of the burial to attest that it has been buried in accordance with these procedures.

MONITORING AND REPORTING

G6 The licensee shall submit a monitoring report for the previous calendar year to the Director for assessment by **1 February each year** providing the following information and where appropriate, the control measures and their success:

i. effectiveness of wind blown waste control;
ii. the number and severity of fire outbreaks;
iii. the number and type of complaints received; and
iv. the results of any environmental monitoring undertaken.

CONDITIONS OF LICENCE

LICENCE NUMBER: 6998 **FILE NUMBER: L185/97**

GENERAL CONDITIONS (CONT'D)

G7 The licensee shall keep a written record of all complaints received concerning the environmental impact of the premises. The record must be in a form of a bound volume with numbered pages and must record the following:

i. name, address and telephone number of complainant (if known);
ii. date and time of complaint;
iii. location from which the complaint arose (if known);
iv. general description nature of complaint;
v. wind direction and temperature at the time of the complaint;
vi. likely source of the complaint; and
vii. action taken by the licensee.

BUFFER DISTANCES

G8 The licensee shall establish and maintain an internal buffer distance of 35 metres or more.

FILL METHOD

G9 The licensee shall place waste within a defined trench or within an area enclosed by earth bunds.

ACTIVE FACE

G10 The licensee shall ensure that the tipping area is less than 30 metres in length.

COVER MATERIAL

G11(a) The licensee shall ensure putrescible waste is covered with a minimum of 230 millimetres of cover material at the completion of the tipping of the regular municipal waste pickup or at the end of each week.

G11(b) The licensee shall ensure a stockpile is maintained containing sufficient cover material to allow waste to be covered in accordance with the terms of this licence for a period of two weeks.

FENCING

G12(a) The licensee shall maintain a wire fence around the perimeter of the site or around the putrescible face to effectively control wind blown waste.

G12(b) The licensee shall fence the site and allow one only public entry point

WIND BLOWN WASTE

G13(a) The licensee shall ensure the implementation of procedures designed to contain windblown waste within the site boundaries.

G13(b) The licensee shall remove windblown waste from access roads and fences on a weekly basis.

Western Australia

Department of Environmental Protection

Environmental Protection Act 1986

CONDITIONS OF LICENCE

LICENCE NUMBER: 6998 **FILE NUMBER: L185/97**

WATER POLLUTION CONTROL CONDITIONS

SEPARATION DISTANCE FROM WATER BODIES

W1 The licensee shall maintain an undisturbed separation distance of at least 3 metres below the base of the deepest excavation and the highest seasonal level of the groundwater.

W2 The licensee shall maintain a distance of at least 100 metres from the waste disposal site to any surface water body.

STORMWATER

W3 The licensee shall divert stormwater away from any filled areas by drains or other appropriate means to dedicated stormwater drains.

AIR POLLUTION CONTROL CONDITIONS

DUST SUPPRESSION

A1 The licensee shall take all reasonable steps to suppress dust from the open landfill face or trench, stockpiled areas and transport activities, so that no visible dust emissions cross the boundary of the premises.

BURNING OF WASTE

A2(a) The licensee shall not allow the burning of putrescible waste at the premises.

A2(b) The licensee shall ensure that when greenwaste is burnt on site:

i. greenwaste is dry and seasoned for two months before burning;
ii. the greenwaste is burnt in a dedicated area at least 25 metres from any boundary or putrescible fill area;
iii. an adequate water supply and distribution system is available during control burns;
iv. burning is performed in such a manner which minimises the generation of smoke;
v. the waste is burnt in windrows or trenches;
vi. the volume of waste burnt is restricted to an amount which can be completely burnt during daylight hours; and
vii. the fire is attended by the licensee or his nominee until it is extinguished.

.....

NOEL DAVIES
ASSISTANT DIRECTOR WASTE DISPOSAL
WASTE MANAGEMENT DIVISION

Officer delegated under Section 20
of the *Environmental Protection Act 1986*

Date: Thursday, 31 July 1997

from G. Kininmonth 29/6/98 rp Copy for BJ/C

VEGETATION SURVEY OF SELECTED RESERVES AT YARLOOP

Prepared for: Cable Sands Pty Ltd

Prepared by: Mattiske Consulting Pty Ltd

CSC003/052/97

December 1997

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APPENDICES

TABLES

SUMMARY

Mattiske Consulting Pty Ltd was commissioned by Cable Sands Pty Ltd to undertake a vegetation survey of selected reserves and private land at Yarloop. These were Yarloop Reserve 31900, the adjacent proposed A Class reserves to the north of Reserve 31900, the Bunnings Land on the western side of South West Highway Yarloop and Location 5322. Reserve 31900 includes the active Yarloop rubbish tip.

Although the vegetation at Reserve 31900 had been classified as consisting of vegetation types 3b and 20b the current study was unable to readily separate the sample sites into these types, instead a continuum was apparent. This continuum was also present on the adjacent proposed reserves, so was not unique to Reserve 31900. Only 23% of all species recorded from Reserve 31900 were specific to vegetation site 3b or 20b, with most occurring throughout the whole reserve. The vegetation of the eastern section of the reserve was of a higher quality as there was very little weed infestation.

However in a previous study (Mattiske Consulting Pty Ltd 1996) where several 3b and 20b vegetation types had been surveyed the distinction between the two was clearly apparent. All of the 3b vegetation type had *Eucalyptus marginata* and *Corymbia calophylla* as the dominant trees. Most of the 20b vegetation type had *Eucalyptus marginata* and *Banksia attenuata* as the dominant trees but some had only *Eucalyptus marginata*. However, the understorey between the two vegetation types was markedly different.

Location 5322, which adjoined the rifle range, was relatively undisturbed bushland and was less disturbed than the vegetation on Reserve 31900. Both vegetation types 3b and 20b were represented in Location 5322, although vegetation type 20b did not have *Banksia attenuata* which was present in the same vegetation type in Reserve 31900. Vegetation type 20b covered more area in Location 5322 than did vegetation type 3b.

Rehabilitation is an important aspect if permission to mine is granted. Seed collection methods, propagation techniques and rehabilitation methods were outlined. Possibly the method having the most success at present is the smoke treatment, preferably on site, which has been developed by Kings Park and Botanic Garden.

LIST OF PARTICIPANTS

Principal Ecologist:	Dr. E. Mattiske
Principal Botanist:	Dr. E. Bennett
Biologist:	Mr W. Evans
Data Processing:	Mr D. Bright
Word Processing:	Mrs J. Barrett

ACKNOWLEDGEMENTS

Mr. G. Kinninmonth is thanked for his assistance with providing the placement of the proposed mine and the provision of previous reports on the vegetation of Yarloop Reserve 31900.

1. INTRODUCTION

Mattiske Consulting Pty Ltd was commissioned by Cable Sands Pty Ltd in July 1997 to undertake an assessment of the vegetation at Yarloop Reserve 31900, the adjacent proposed A Class reserves (to the north of Reserve 31900) and the Bunnings Land (on the western side of South West Highway) and in December 1997 to assess Location 5322. Cable Sands Pty Ltd proposes to mine a section of Yarloop Reserve 31900 if permission is granted.

Yarloop Reserve 31900 is just south of the Yarloop townsite and is bounded on the western side by the South West Highway, to the north by Burney Road and to the east and south by privately owned land. Yarloop is included in the Drummond Subdistrict of the Darling Botanical District of the South-West Botanical Province (Beard, 1980). This vegetation of this subdistrict is described as mainly banksia low woodland on leached sands with *Melaleuca* swamps where ill-drained; woodland of tuart (*Eucalyptus gomphocephala*), jarrah (*Eucalyptus marginata*) and marri (*Corymbia calophylla*) on less leached soils.

A floristic survey of the Swan Coastal Plain undertaken by Gibson *et al.* (1994) identified four "supergroups". Yarloop Reserve 31900 is included in Group 1 which comprises sites almost entirely restricted to the Pinjarra Plain and Ridge Hill Shelf. These areas are concentrated on the eastern side of the plain and the alluvial soils bordering the Peel-Harvey estuary. A significantly higher species richness was recorded for this group than all other groups with a significantly higher rainfall, reflecting its position at the base of the Darling Scarp. There has been widespread clearance of this land system for agricultural use.

In the vegetation complexes mapped by Heddle *et al.* (1980) Yarloop Reserve 31900 is included in the Forrestfield vegetation complex. Heddle *et al.* (1980) in defining the Forrestfield vegetation complex included three main structural formations within this complex, namely an open forest of marri-wandoo-jarrah on the clay-loam soils, an open forest of marri-jarrah-*Banksia* spp. on the sandier soils and an open forest of jarrah-marri-sheoak on the sandy-gravel soils. These forests are dissected by a woodland of *Eucalyptus rudis - Melaleuca rhaphiophylla* on drainage lines. The forest communities have to a large degree been logged or grazed and therefore the structural component now reflects these disturbances as most areas within this complex are now structurally a woodland. This earlier work recognised the significance of variation within this complex and also the relationship of the vegetation to underlying soils. Other associated species on the Forrestfield complex included *Banksia grandis, Xylomelum occidentale, Dryandra sessilis, Macrozamia riedlei, Xanthorrhoea preissii* and *Hibbertia* species on the gravelly end of the soil spectrum and *Banksia attenuata, Banksia grandis, Stirlingia latifolia, Mesomelaena tetragona* and *Nuytsia floribunda* on the sandier end of the soil spectrum.

Previous botanical assessments have identified the presence of two Vegetation Community Types 3b and 20b (Gibson *et al.*(1994)) both of which are considered vulnerable. Community Type 3b occurs on sandy clay soils and is dominated by

Eucalyptus marginata - Corymbia calophylla woodlands with understorey species such as *Bossiaea eriocarpa* and *Conostylis juncea* differentiating this subgroup. It is recorded from the better drained sites on the eastern side of the plain as well as from the alluvial soils near the Peel-Harvey estuary. Community type 20b was found on sands at the base of the Darling Scarp between Byford and Yarloop. This community was again very species rich. Most sites were *Eucalyptus marginata-Banksia attenuata* woodlands but can also be *Banksia* woodlands and heaths. *Mesomelaena pseudostygia* was common and other species which differentiated this subgroup were *Hakea stenocarpa, Conostylis setosa* and *Johnsonia* aff. *pubescens*. However there is a considerable species overlap between the two community types and it is not the individual species which are representative of the particular associations but the combination of species.

In a previous survey, undertaken by Mattiske Consulting Pty Ltd for Cable Sands Pty Ltd (Mattiske Consulting Pty Ltd, 1996), several areas of Community Types 3b and 20b were located on reserves and private land between Cannington and Yarloop.

2. OBJECTIVES

The objectives of this survey were:

- to undertake a detailed recording of the flora and vegetation on Reserve 31900 on a 100 metre grid basis.
- establish selected sites on the adjacent reserves and Bunnings land on the west side of the South West Highway to enable a detailed comparison of species richness, similarity indices and plant community composition on the adjacent reserves as compared with the Reserve 31900 and in particular the 6 hectare area of mineral potential.
- establish selected sites on Location 5322 and to record the flora and vegetation.
- compare the conservation values of the respective areas, including particular reference to the proposed mining area and the adjacent reserve areas.
- review the Community Type 3b location and Forrestfield Complex areas within the survey areas.
- review the species suitable for rehabilitating in the disturbed areas, which includes the rubbish tip and the proposed mining areas.

3. METHODS

The majority of the field work was undertaken by two botanists from Mattiske Consulting Pty Ltd on 23rd July 1997. The whole of Reserve 31900 was sampled on a 100 metre grid from north to south. Appendix D illustrates the positions of all these transects. Mr G. Kinninmonth from Cable Sands Pty Ltd flagged the area of the proposed mine area prior to the commencement of the survey.

The first transect was 50m west of the Reserve boundary and the second was 150m west. For each transect, sites were recorded at 50m, 150m and 250m south of Burney Road. When returning to Burney Road a transect was walked at 50m west of the transect to ensure the vegetation associations were the same and to record any additional plant species. The transect at 150m nearly bordered the current tip area so due to the disturbance recorded the third transect was placed 50m west of the tip and the fourth transect 100m west of the tip. A site was recorded at 50m on the third transect, but at 75m the edge of the degraded sand quarry would have been sampled so this transect was aborted and a site to the south, behind the tip was sampled. The fourth transect had sites recorded at 50m and 150m. An additional site was sampled about 50m in from the South West Highway as it was the only area observed with *Melaleuca thymoides*, *Acacia alata* and *Jacksonia sternbergiana*.

In the adjacent reserves three sites were sampled, one opposite the first, second and fourth transects undertaken in Reserve 31900. An additional three sites were also recorded along the fire break beside the adjacent reserves and the rifle range. These were at 400m, 300m and 100m east along the firebreak from the South West Highway. Three sites were sampled in the Bunnings land parallel to the South West Highway.

Location 5322 was surveyed on 3rd December 1997. Two sites were sampled in the 3b vegetation type and three sites in the 20b vegetation type.

At each site a GPS reading was taken, the approximate age since fire, litter type and cover (%), bare ground (%) and soil colour and structure ratio was recorded. Each species was listed and the height recorded, together with the percentage of each species alive and dead. Samples were collected of those plants whose identity needed to be confirmed and these were checked with the collections at the Western Australian Herbarium.

All the sites were compared for similarity using Bray-Curtis similarity coefficient to compare the percentage cover of each species present and Jaccard binary similarity coefficient to compare the presence absence of the different species between each sampled site.

4. RESULTS

4.1 Reserve 31900

4.1.1 Flora

Transects 1,2,3 and 4 making a total of 11 sites were sampled from this reserve.

A total of 113 vascular plant species from 72 genera were recorded from Reserve 31900. As the field work was undertaken in July some of the annual species (e.g. species of the family - Orchidaceae) are not included in this list of species. Further studies could be undertaken in spring months to cover these additional species. Environmental Survey and Management Pty Ltd (1996) in a survey undertaken in May 1996, recorded a total of 87 vascular plant species from 67 genera and 28 families. The vegetation of the eastern section of the reserve was of a higher quality as there was very little weed infestation. However surrounding the tip and the old sand pit the weed invasion was extensive.

4.1.2 Declared Rare and Priority Flora

No declared rare or priority flora as defined by the Department of Conservation and Land Management (1997) were located during the current survey work.

4.1.3 Vegetation

Two vegetation types, 3b and 20b (Gibson *et al.*, 1994) have been recorded from Reserve 31900, with a 20b site having been sampled in Reserve 31900 and a 3b site in the adjacent reserve north of the rifle range (Gibson, pers. comm.). A separation of the two associations in Reserve 31900 was made by G. Keighery (1995) from aerial photographs and from comparison with adjacent areas (Keighery, pers. comm.). Below are listed the dominant species as given by Gibson *et al.* (1994) and also located during the current field work. Sites 1A, 1B, 1C, 2A, 2B, 2C have previously been mapped as 3b and sites 3A, 3B, 3C, 4A and 4B as 20b.

Vegetation Type 3b

Trees:	*Eucalyptus marginata, Corymbia calophylla* (occasional sites), *Allocasuarina fraseriana, Xylomelum occidentale*
Shrubs:	*Xanthorrhoea preissii, Xanthorrhoea gracilis, Stirlingia latifolia*
Herbs:	*Phlebocarya ciliata, Mesomelaena tetragona, Drosera erythrorhiza*

Vegetation Type 20b

Trees:	*Banksia attenuata, Eucalyptus marginata, Allocasuarina fraseriana*
Shrubs:	*Grevillea wilsonii, Xanthorrhoea gracilis, Hibbertia hypericoides*
Herbs:	*Tetraria octandra, Mesomelaena tetragona, Lomandra sericea*

Vegetation type 20b can be a *Eucalyptus marginata* woodland or a *Eucalyptus marginata - Banksia attenuata* woodland whereas vegetation type 3b is defined as a

Eucalyptus marginata - Corymbia calophylla woodland (Gibson *et al.* 1994). *Corymbia calophylla* was not a dominant species present for vegetation type 3b and was only located to the southern and western extremity of the vegetation type. *Xylomelum occidentale* is recorded by Gibson *et al.*(1994), as a common tree in the 20b vegetation type and as only occasionally being present in the 3b vegetation type but was common throughout the eastern section and therefore in the 3b vegetation type. Heddle *et al.* (1980) stated that *Xylomelum occidentale* is one of the remnant species occurring in the marri-wandoo-jarrah forest, an association equivalent to vegetation type 3b.

Species only recorded for vegetation type 3b are: *Acacia pulchella* var. *pulchella* (1 site); *Astroloma pallidum* (1 site); *Conostylis setosa* (1 site); *Cyathochaeta avenacea* (1 site); *Daviesia incrassata* (1 site); *Gompholobium preissii* (1 site); *Hibbertia commutata* (1 site); *Hibbertia racemosa* (2 sites); *Hovea chorizemifolia* (1 site); *Lepidosperma tenue* (3 sites); *Lomandra brittanii* (1 site); *Lomandra hermaphrodita* (2 sites); *Lomandra preissii* (1 site); *Olearia elaeophila* (1 site); *Olearia paucidentata* (2 sites); *Patersonia occidentalis* (1 site); *Pimelea lehmanniana* (1 site); *Sowerbaea laxiflora* (2 sites); *Tetratheca hirsuta* (1 site); *Trichocline spathulata* (3 sites).

Species only recorded for vegetation 20b are: *Comesperma virgatum* (2 sites); *Daviesia preissii* (1 site); *Hibbertia pachyrrhiza* (1 site); *Jacksonia sternbergiana* (1 site); *Macarthuria apetala* (1 site); *Melaleuca thymoides* (1 site); *Pterostylis sanguinea* (1 site); *Trachymene pilosa* (1 site); *Xanthosia huegelii* (1 site).

Although some species were recorded as being vegetation type specific, the number of sites from which they were recorded was minimal. *Trichocline spathulata* and *Lepidosperma tenue* were recorded from 50% of the 3b sites and *Comesperma virgatum* from 40% of the 20b sites. *Mesomelaena tetragona*, which is listed as an indicator species for vegetation type 3b (Gibson *et al.* 1994) occurred throughout all the sites.

It would appear from the above information that it is impossible to distinguish between vegetation types 3b and 20b in this reserve due to the large overlap of species common between the two vegetation types. Only 28 species out of a total of 113 (23%) recorded for the reserve were specific to either 3b or 20b vegetation type.

The vegetation on the Reserve varied in quality as a result of the rubbish tip and the degree of weed invasion. The eastern section of the Reserve was less disturbed and had less weed species present than other sections of the Reserve. Despite the disturbance and the presence of weeds, the vegetation outside the immediate rubbish tip area was in relatively good condition as compared with the adjacent stands of remnant vegetation on the private property to the east, west and south. In these remnant areas the overstorey was relatively intact, although the understorey consisted primarily of weed or introduced species.

4.2 Adjoining Reserves to North of Reserve 31900

4.2.1 Flora

A total of 86 vascular plant species from 62 genera was recorded from the reserves adjoining Reserve 31900. This reserve had been burnt in the summer of 1995, whereas Reserve 31900 had not been burnt for many years.

4.2.2 Declared Rare and Priority Flora

No declared rare or priority flora species (Department of Conservation and Land Management 1997) were located during the current survey work.

4.2.3 Vegetation

The vegetation consists of the two types as in Reserve 31900. Vegetation type 3b is restricted to the eastern section and 20b to the western side. Sites 5A, 5B, 5D, 5E, were assessed as being vegetation type 3b and sites 5C, 5F and 7A as vegetation type 20b. There appears to be even less distinction between these two vegetation types than was observed in Reserve 31900 with most species occurring throughout both vegetation types.

4.3 Bunnings Land

4.3.1 Flora

A total of 68 vascular plant species from 52 genera was recorded from the Bunnings land opposite Reserve 31900.

4.3.2 Declared Rare and Priority Flora

No declared rare or priority flora species (Department of Conservation and Land Management 1997) were located during the current survey work.

4.3.3 Vegetation

The vegetation type recorded from this area is 20b. Sites 6A, 6B and 6C were located here.

4.4 Location 5322

The vegetation consists of the vegetation types 3b and 20b. Vegetation 3b is restricted to the eastern edge of the block and vegetation type 20b, which was more widespread, occurred on the western edge. The variation between these two vegetation types was apparent in the field, with vegetation type 3b (Sites 8A, 8E) recording the tree species *Eucalyptus marginata* and *Corymbia calophylla*. Vegetation type 20b (Sites 8B, 8C, 8D) recorded *Eucalyptus marginata* only, but several small trees of *Xylomelum occidentale*. In addition the understorey species differed with vegetation

type 3b recording more shrub species than vegetation type 20b, but sedges were still the dominant plants of the understorey in both vegetation types.

The vegetation on Locality 5322 was less disturbed and had less weed species cover than the vegetation on Reserve 31900 to the south.

4.5 Similarity Between the Sampled Sites

Table 1: Summary of Bray-Curtis % similarity using the vegetation cover of all sites sampled

Bray-Curtis % similarity	Comparable Sites	Gibson *et al.* Vegetation Types
0.7 +	6B&6C;	20b
0.6-0.7	6A&6B; 6A&6C; 8B&8C; 8B&8D;	20b
0.5-0.6	1A&1C; 1B&1C; 2B&2C; 2A&2C; 5A&5B; 8A&8E;	3b
	2A&4A; 2A&5A; 2A&5C; 2A&5D; 2B&2C; 2A&5F; 2A&7A; 5A&3A; 5A&3B; 5A&4A; 5B&4B; 5A&5C; 2C&3A;	3b & 20b
	1C&3A; 3A&4A; 4A&5C; 4A&5D; 4A&6A; 4A&6B; 4A&6C; 5C&5F; 5C&6A; 5C&7A; 5D&7A; 4A&8D; 8A&8B; 8A&8D; 8C&8E; 8D&8E; 8C&8E	20b

Using Bray-Curtis similarity coefficients, sites which have the same percentage cover of each species would record a similarity coefficient of 1. From Table 1 it can be seen that the sites 6A, 6B and 6C and sites 8B, 8C and 8D recorded the highest similarity. Transect 6 which included sites 6A, 6B and 6C were all on the Bunnings land and sites 8B, 8C and 8D were on Loc. 5322. All were of Vegetation Type 20b. Only 10 sites classified by Gibson *et al.*(1994) as being 3b had a similarity of >0.5.

The sites showing the greatest dissimilarity using Bray-Curtis are 1A&4B; 1A&5E; 1C&4B; 2B&4B; 2B&5E; 2C&5E; 3C&5A; 3C&5B; 2B&8D; 3B&8A; 3B&8D; 3C&8A,8B,8C,8D,8E; 4B&8A (mix of 3b and 20b) and 3B&4B; 3C&4A; 3C&5D; 3C&5E; 3C&7A; 4B&2C; 4B&6A; 4B&6B; 4B&6C (all 20b).

Using only the presence/absence of species for each site, Table 2 illustrates the similarity between the sites. Using only the presence/absence data the Bunnings land sites only 6A&6C, 6B&6C had an equivalent similarity, and that was at the 0.45-

0.5% level. Site 6C was more similar to 4A, another 20b vegetation type, and 2A a 3b vegetation type, rather than to 6A and 6B. Sites 1B&1C, 1A&1B and 8A and 8E recorded reasonable similarity using both the above methods.

Using the Jaccard, presence/absence data Site 4B showed the greatest dissimilarity with all the sites. This site was the most disturbed of all those recorded, having the greatest number of weed species and recording the most disturbance. It was also the site recording the least number of species.

Table 2: Summary of Jaccard % similarity for presence/absence of species in all sites sampled

Jaccard % similarity	Sites	Gibson et al. Vegetation Types
0.5-0.6	1B&1C;	3b
	2A&6C;	3b & 20b
	4A&6C;	20b
0.45-0.5	1A&1B; 1A&1C;	3b
	1A&6C; 2A&5C; 5B&6C;	3b &20b
	2C&3B; 3A&4A; 4A&6B; 6A&6C; 6B&6C; 8B&8D	20b
0.4-0.45	1A&2A; 1C&2A; 1C&5A; 2A&2C; 8A&8E	3b
	2A&5A; 2A&5B; 5A&5B; 2C&4A; 2C&5F; 2C&5F; 2C&6C; 8A&8C; 8B&8E	3b & 20b
	1A&3B; 1A&4A; 1B&3B; 1C&3B; 1C&6B; 2A&3A; 2A&3B; 2A&5F; 2A&6B; 2B&4A; 3B&4A; 4A&5C; 4A&5F; 5B&6B; 5C&6C; 5F&6C; 6A&6B; 8B&8C; 8C&8D	20b

It is apparent from all the above information that it is very difficult to separate the vegetation types 3b and 20b on the presence/absence of species or the density of the species at each site. From the above it would appear that Reserve 31900 and the adjacent reserves consist of a continuum and a mixture of species representative of both vegetation types 3b and 20b. From the remaining species fringing the rubbish tip it is possible this could have been an example of vegetation type 3b. The southern and south eastern edge is fringed by *Corymbia calophylla* (vegetation type 3b), whereas *Banksia attenuata* (vegetation type 20b) is located on the western edge.

However sites 8A and 8E at Location 5322 both vegetation type 3b and 8B, 8C and

8D all vegetation type 20b did separate more distinctly using the presence absence data did the other areas. These were readily distinguishable in the field as sites 8A and 8E both had *Corymbia calophylla* present whereas this species was not present in the other sites. The presence of *Corymbia calophylla* is a distinguishing feature of the 3b vegetation type and not of vegetation type 20b.

4.6 Introduced Species

Typically the bushland had very little weed invasion, except where the bushland surrounds the current tip and disused sand quarry. More of a problem is the blowing of rubbish and the occasional dumping of rubbish throughout the bushland.

Most of the weed species located at Reserve 31900 can be readily killed with a total herbicide. However some of the cormous, bulbous and rhizomatous species eg Watsonia, Arum Lily require direct application of the herbicide, making it a very labour intensive process. Care must be taken when using a total herbicide to ensure that none of the poison is wiped on the native species. The removal of the perennial grass species can be undertaken with a selective grass spray eg fusilade as this is very specific and has been proven to cause limited damage to a few native grasses but not to affect other monocotyledons.

Some of the common introduced species located were:

SCIENTIFIC NAME	COMMON NAME
Acacia longifolia	Sydney Wattle
Briza maxima	Blow Fly Grass
Cytisus proliferus	Tagasaste
Ehrharta calycina	Perennial Veldt Grass
Ehrharta longiflora	Annual Veldt Grass
Hypochaeris glabra	Flat Weed
Narcissus tazetta	Jonquil
Oxalis pes-caprae	Soursob
Oxalis purpurea	Large Flower Wood Sorrel
Pennisetum clandestinum	Kikuyu Grass
Ricinus communis	Castor Oil Tree
Solanum nigrum	Blackberry Night Shade
Sonchus oleraceus	Milk Weed
Watsonia bulbillifera	Bulbil Watsonia
Watsonia meriana	Watsonia
Zantedeschia aethiopica	Arum Lily

5. REHABILITATION

5.1 Preparation of Tip Area

Large items of rubbish (eg. concrete house slabs) are currently lying on the periphery of both the tip and sand quarry sites. The whole degraded area would need to be bulldozed and the larger items pushed into the base of the pits. The surrounding sand, dug out during the establishment of the pits, should then be pushed in to fill the hole. As mentioned above, the pit and quarry areas are full of weed species, so after preparation the whole of the pit area should be sprayed with a total herbicide to remove the perennial species. If the soil dug out in the original establishment of the pit is to be the surface soil, it should be spread over the prepared area and allowed to remain until after weeds have germinated with the onset of winter. It should then be sprayed with a total herbicide to kill all germinating plants. Only after this process has occurred should the seed be sown or the seedlings planted. Preferably the pit should be filled in during April and May to ensure there is no blowing of the sand and subsequent erosion.

During the mining process topsoil supporting native vegetation from the area to be mined should be removed and stockpiled for later use or preferably should be utilised immediately over degraded sites. This should be undertaken through a double stripping operation, thereby separating the upper topsoil layer from the slightly deeper topsoil layer. If overburden from the mining process either within the disturbed part of the Reserve or from adjacent areas is to be added to the tip area this should only be done after the area has been sprayed for weeds. As mining progresses the areas where mining has been completed should have the topsoil from former less disturbed areas within the Reserve applied on the surface. This will ensure that any seeds or rhizomes of native species in the soil could possibly become established, thus improving the rehabilitation of the area.

5.2 Seed Collection

A seed collecting programme must be in place prior to mining. This should ensure that seed is collected from as many plants as possible from the area to be mined. Each collection must be labelled and stored in paper bag's not plastic containers.

Some fruits retain the seed for several months eg eucalypts and banksias, and the fruit can be collected at any time of the year. Eucalypts shed their seed once the fruit is picked and left, but banksias require heat treatment. Banksia fruits should be burnt in a fire, removed once the valves are seen to open and then plunged in cold water. This should open the valves fully, if not the process should be repeated.

Peas and wattles shed their seeds with force, spreading the seeds for some distance. Timing to collect these seeds can be a problem as the fruits rapidly open in hot weather or take a lot longer to open when the weather is cool. A method used by several seed collectors is to place a sheet under each plant to collect the seed as it is shed. However a regular check must be kept on these plants and the seed collected as soon after shedding as possible as ants carry away quite a lot of pea and wattle

seeds.

Another technique which can be used for many different plants, including peas and wattle is to place a cloth or paper bag over the developing fruit. This will ensure that when the seed is shed it will be collected in the bag.

If insufficient seed is collected from the proposed mine area, permission should be sought to collect seed from the adjacent reserves. The same method should be applied.

5.3 Propagation Methods

By referring to Appendix C the usual method of propagation of the species recorded from Reserve 31900 is given. Most are readily propagated from seed or cuttings. A few plants eg *Macrozamia riedlei* and *Xanthorrhoea* spp. should be transplanted into the area to be rehabilitated.

Propagation by cuttings, requires the taking of cutting material, its treatment with hormone before planting in soil. Regular watering, preferably misting, should then occur and once the cuttings have developed roots they should be transferred into a large pot and grown on. Once well established they should be planted in the area for rehabilitation, preferably at the break of season.

Where it has been suggested that the parent plant can be divided it is suggested that this is most successful after fire (B. Dixon, pers. com.). Thought could be given to burning the proposed mine site area prior to the commencement of work and then divisions undertaken of several of the plants, especially the sedges (Cyperaceae) and twine rushes (Restionaceae).

However with the smoke technique recently developed by Kings Park and Botanic Garden, some species which previously proved difficult to propagate can now be propagated successfully. Research undertaken has shown that 77 species out of a total of 200 tested have shown a positive germination response (Ecoplan News 22 (1997)).

The methods of treatment:

- Smoke water. Smoke water is made by bubbling smoke from fresh plant material through water. In the field smoke water can be applied to the soil surface at about 1 litre per square metre to large areas to stimulate the soil seed bank. Another method using smoke water is to soak the seeds in smoke water for 3-4 hours. The soaked seed is dried and then sow immediately as it does not store after treatment.

- Apply smoke directly to the seeds for about 1 hour. This is achieved by having a fire in an enclosed container and placing the exposed seed away from the fire so they do not get burnt.

- Smoke can be applied to punnets with sown seed for one hour in a smoke filled tent. An old camping tent can be used.

- In the field a tent can be used to stimulate germination in small areas by lighting a fire on a raised container and allowing the smoke to fill the area. Again an old tent can be used for the purpose.

All smoke treatment in the field should be done before the onset of winter rains. It has been shown that smoke treatment can reduce predation by insects as well as improving seed germination and seedling growth.

Conventional methods would require the preparation of a seed mix of species found in the respective areas to be rehabilitated and scattering these over the surface. Pea and wattle seed should be scarified prior to sowing to increase their water uptake and subsequent germination percentage.

5.4 Rehabilitation of the Area Between the Tip and South West Highway

The area between the sand quarry and the South West Highway has patches of excellent bushland still remaining with some weed invasion, especially of *Watsonia* spp. and *Cytisus proliferus* and areas of dense mixed weed species. It was in this area that *Melaleuca thymoides, Jacksonia sternbergiana*, *Adenanthos meisneri* and *Acacia alata* were recorded. As this was unique bush for Reserve 31900 it is important that is area be preserved and rehabilitated in the areas where it is necessary in addition to rehabilitating the rubbish tip and mined area.

Watsonia spp. can reproduce by several methods including seed, cormlets in the flower axils as well as cormlets in the corm axils, but this species can be controlled by a total herbicide applied just before flowering. However it is an extremely time and personnel intensive process. *Cytisus proliferus* is a member of the pea family and will reproduce from seeds which are viable in the soil for many years. The mature trees can be cut at ground level and a total herbicide applied to kill them, but with the longevity of the seed the area will need to be weeded to remove seedlings for several years.

6. DISCUSSION

From the field work undertaken and the statistical analyses run on the data Reserve 31900 has a continuum of vegetation types, a combination of 3b and 20b (Gibson *et al.* 1994). The proposed reserve on the north side of Burney Road also mirrored the associations present in Reserve 31900, but a direct comparison was very difficult due to the different times that the areas had been burnt. The adjoining reserves had been burnt within the last 2 years, whereas Reserve 31900 had not been burnt for many years. In addition, due to the timing of the survey it was very difficult to compare Loc. 5322 with the data obtained previously from the other areas.

In Reserve 31900 only 23% of the species recorded were specific to either the 3b or 20b vegetation types. In most instances those species were only recorded from one site. *Trichocline spathulata* and *Lepidosperma tenue* were recorded from 50% of the 3b sites and *Comesperma virgatum* from 40% of the 20b sites. (Gibson *et al.*1994) listed *Mesomelaena tetragona* as an indicator species for vegetation type 3b but this was recorded from most sites. Sites 4B, 5A, 5D and 7A were the only sites which did not record this species. A similar result was found for the sites sampled in Loc. 5322 where the distinction between Vegetation Types 3b and 20b were distinct.

In the previous survey of vegetation sites 3b and 20b (Mattiske Consulting Pty Ltd 1996) undertaken in several reserves and privately owned land, the variation between the two vegetation types was distinct. The 3b vegetation types sampled all had *Corymbia calophylla* and *Eucalyptus marginata* present, and the 20b vegetation type was either *Eucalyptus marginata* woodland or *Eucalyptus marginata* and *Banksia attenuata* woodland. Typically the understorey of vegetation type 3b is more representative of scarp species and that of 20b of the sandplain species. However with Reserve 31900, the adjacent reserves and the Bunnings land the variation between the two vegetation types was not distinct.

Using the Bray-Curtis similarity coefficients for density of the species and Jaccard similarity coefficients for the presence/absence of the different species no correlation could be reached between those sites previously identified as 3b and those as 20b. A few 3b sites separated together as did some of the 20b sites but there were more sites of identified 3b which separated with 20b sites. The three sites along transect 6, all in Bunnings land, did separate as a group, indicating these are the most similar of all the sites.

Using Jaccard similarity coefficients for the presence/absence of species in the sites there was no clear grouping. Again as found with the Bray-Curtis method, some 3b and 20b sites separated together, but on the whole 3b sites would separate with 20b sites.

This leads to the conclusion that Reserve 31900 and the adjoining reserves do not have distinct representation of vegetation types 3b and 20b but are a continuum between the two types. The original vegetation type of the current rubbish tip is unclear but due to the *Corymbia calophylla* trees on the southern edge it is possible it could have been a better example of 3b but this is unclear.

However sites 8A and 8E at Loc 5322 both vegetation type 3b and 8B, 8C and 8D all vegetation type 20b did separate more distinctly than for the other areas, using the Jaccard similarity coefficients for presence absence data. This was expected as in the field they were readily distinguishable in the field on the presence or absence of *Corymbia calophylla*.

The variation in interpretations between this report and the earlier work of Gibson *et al.* (1994) is not surprising in view of the gradient of soils from west to east through the Reserve. On the western fringes there is a higher component of pale sands and hence *Banksia* species and on the eastern fringes there is a higher component of gravels in the sandy-gravel soils. Consequently, as in other studies in the northern Jarrah forest undertaken by Havel (1975a and 1975b) the vegetation locally reflects the underlying subtleties in the underlying soils. If one compared the site-vegetation types P and S as defined by Havel (1975a) for the northern jarrah forest one would come up with a similar scenario in terms of a continuum. If one sampled at the sandy-gravel end of the soil continuum the area would be dominated by the site-vegetation type P which supports an open forest of jarrah-marri-sheoak with sandier soil indicators such as *Loxocarya* spp., *Lechenaultia biloba, Adenanthos barbiger* and *Grevillea wilsonii*. If one sampled at the gravelly end of the soil continuum then the area would be dominated by an open forest of jarrah-marri- *Banksia grandis* with gravel indicators such as *Leucopogon verticillatus, Adenanthos barbiger, Leucopogon capitellatus* and *Hovea chorizemifolia*. In between these extremes within the jarrah forest there is continuum which reflects parts of both extremes. The concept of a continuum reflecting underlying soil conditions is therefore not restricted to the Forrestfield vegetation complex and it becomes an issue of scale and regularity of data collection and analysis.

One of the main differences in the two studies relates to the mode of field data collection. It appears that Gibson *et al.* (1994) have tended to sample the extreme sites while Mattiske Consulting Pty Ltd in this project have sampled on a grid basis thereby allowing for coverage of the vegetation on the soil continuum between the two floristic communities defined previously by Gibson *et al.* (1994). The latter raises a few questions in relation to values and how one assesses locally and regionally these values. In recent months the work by Safstrom and Craig (1996) has been applied to similar projects. Although the latter work was written to define the principles and criteria for appraising land clearing proposals, many of the criteria are not available to the State agencies let alone consultants in a form that is easily accessible. For example, if one considers the regional representation of Forrestfield in the formal and informal reserve situation within the South-West neither the Ministry for Planning (who currently only cover the metropolitan areas of Perth) or the Department of Conservation and Land Management (who more recently are undertaking the RFA forest assessment process in the South-West forest areas) have accurate coverage of all of the Forrestfield complex (which in fact has been re-visited in part by Mattiske and Havel (in prep.) as part of the RFA forest assessment process). Therefore only estimates can be used in the review process. Despite some of these discrepancies and lack of easy data access issues there is no doubt that the majority of the Forrestfield complex has been cleared or modified by logging and grazing.

One of the key aspects missing from the review of local and regional significance is the concept of time and therefore other processes, such as the dynamic state of most plant communities and the number of threatening processes to smaller areas of native vegetation.

As the field work was undertaken in July some of the annual species (e.g. species of the families Orchidaceae) are not included in this list of species. Further studies could be undertaken in late winter and spring months to cover these additional species.

The methods for preparation of the area before and during rehabilitation were discussed. The smoke treatment developed by Kings Park and Botanic Garden would seem a method worthy of trial. However seed must be collected from the proposed mine area before mining occurs and must be stored safely for use. Any top soil removed in the mining process should be placed immediately on areas for rehabilitation allowing any storage roots and rhizomes to grow and seed to germinate. In addition seed will need to be sown and possibly seedlings planted.

If insufficient seed is collected, permission should be obtained to collect seed from the adjacent reserves and Bunnings land and then sown the next winter.

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APPENDIX A: VASCULAR PLANT SPECIES YARLOOP RESERVE 31900, ADJACENT RESERVES, BUNNINGS LAND AND LOC. 5322

FAMILY		GENUS	SPECIES
ZAMIACEAE		*Macrozamia*	*riedlei*
POACEAE		*Amphipogon*	*turbinatus*
		Austrostipa	*campylachne*
		Austrostipa	*semibarbata*
		Austrostipa	sp.
	*	*Briza*	*maxima*
	*	*Ehrharta*	*calycina*
	*	*Ehrharta*	*longiflora*
	*	*Pennisetum*	*clandestinum*
		Tetrarrhena	*laevis*
CYPERACEAE		*Cyathochaeta*	*avenacea*
		Lepidosperma	*squamatum*
		Lepidosperma	*squamatum (narrow)*
		Lepidosperma	*tenue*
		Mesomelaena	*gracilipes*
		Mesomelaena	*tetragona*
		Schoenus	*cruentus*
		Tetraria	*capillaris*
		Tetraria	*octandra*
ARACEAE	*	*Zantedeschia*	*aethiopica*
RESTIONACEAE		*Hypolaena*	*exsulca*
		Loxocarya	*cinerea*
		Loxocarya	*fasciculata*
		Lyginia	*barbata*
DASYPOGONACEAE		*Dasypogon*	*bromeliifolius*
		Lomandra	*brittanii*
		Lomandra	*hermaphrodita*
		Lomandra	*nigricans*
		Lomandra	*preissii*
		Lomandra	*purpurea*
		Lomandra	*sericea*
		Lomandra	sp.
XANTHORRHOEACEAE		*Xanthorrhoea*	*brunonis*
		Xanthorrhoea	*gracilis*
		Xanthorrhoea	*preissii*
PHORMIACEAE		*Dianella*	*revoluta*
		Stypandra	*glauca*

APPENDIX A: VASCULAR PLANT SPECIES FOR THE LOONGANA LIME PTY LTD MINING LEASE M69/16 AT RAWLINNA

Family		Genera	Species
MIMOSACEAE		*Acacia*	*acuminata ssp. acuminata*
		Acacia	*oswaldii*
		Acacia	*tetragonophylla*
CAESALPINIACEAE		*Senna*	*artemisioides ssp. artemisioides*
		Senna	*artemisioides ssp. filifolia*
PAPILIONACEAE		*Cullen*	*cinereum*
		Lotus	*cruentus*
GERANIACEAE	*	*Erodium*	*botrys*
OXALIDACEAE	*	*Oxalis*	*perennans* — native! (possibly a mis-id anyway!)
ZYGOPHYLLACEAE		*Zygophyllum*	*eremaeum*
EUPHORBIACEAE		*Euphorbia*	*drummondii*
		Euphorbia	*tannensis ssp. eremophila*
MALVACEAE		*Abutilon*	*leucopetalum*
		Lavatera	*plebeia*
		Lawrencia	*squamata*
	*	*Malvastrum*	*americanum*
		Sida	*calyxhymenia*
		Sida	*spodochroma*
APIACEAE		*Daucus*	*glochidiatus*
GENTIANACEAE	*	*Centaurium*	*erythraea*
ASCLEPIADACEAE		*Marsdenia*	*australis*
CONVOLVULACEAE		*Convolvulus*	*erubescens*
		Rhyncharrhena	*linearis*
LAMIACEAE		*Teucrium*	*racemosum*
SOLANACEAE	*	*Lycium*	*ferocissimum*
		Solanum	*lasiophyllum*
	*	*Solanum*	*nigrum*
MYOPORACEAE		*Eremophila*	*alternifolia*
		Eremophila	*longifolia*

APPENDIX A: VASCULAR PLANT SPECIES FOR THE LOONGANA LIME PTY LTD MINING LEASE M69/16 AT RAWLINNA

Family		Genera	Species
		Eremophila	*maculata*
		Myoporum	*platycarpum*
PLANTAGINACEAE		*Plantago*	*turrifera*
CUCURBITACEAE	*	*Citrullus*	*lanatus*
CAMPANULACEAE		*Wahlengerbia*	sp.
GOODENIACEAE		*Goodenia*	*pinnatifida*
		Scaevola	*spinescens*
ASTERACEAE		*Angianthus*	*conocephalus*
	*	*Carthamus*	*lanatus ssp. creticus*
	*	*Centaurea*	*melitensis*
		Cephalipterum	*drummondii*
		Chthonocephalus	*pseudevax*
		Eremophyllum	*ramosum ssp. ramosum*
		Erodiophyllum	*elderi*
		Ixiolaena	*leptolepis*
	*	*Osteospermum*	*calendulaceum*
		Rhodanthe	*floribunda*
		Rhodanthe	*nullarborensis*
		Senecio	*lautus ssp. dissectifolius*
		Trichanthodium	*skirrophorum*
		Vittadinia	*nullarborensis*

APPENDIX B: DISTRIBUTION OF PLANT SPECIES IN THE SAMPLED SITES

Species	Sites																								
	1a	1b	1c	2a	2b	2c	3a	3b	3c	4a	4b	5a	5b	5c	5d	5e	5f	6a	6b	6c	7a	8a	8b	8c	8d	8e
Acacia alata									+																	
Acacia applinata																		+	+	+						
Acacia lateriticola															+							+	+	+	+	+
Acacia pulchella									+																	+
Acacia sessilis	+		+					+											+							
Acacia stenoptera	+						+											+								+
Acacia willdenowiana																					+					
Adenanthos meisneri										+	+							+								
Agrostocrinum scabrum																										
Allocasuarina fraseriana		+	+	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Amphipogon turbinatus																		+								
Anigozanthos manglesii			+			+		+				+							+		+	+				
Astroloma pallidum	+																	+	+	+						
Austrostipa campylachne																						+				+
Austrostipa semibarbata																						+				
Austrostipa sp.																				+						
Baeckea camphorosmae																										
Banksia attenuata								+			+															
Banksia grandis	+	+	+		+	+		+			+	+	+	+	+	+	+	+	+	+	+			+		
Bossiaea eriocarpa		+	+		+		+		+							+						+		+		+
Bossiaea ornata				+		+	+	+		+				+	+		+			+		+			+	
Briza maxima																				+		+				
Burchardia congesta	+	+	+		+		+			+		+		+		+		+		+		+				+
Caladenia sp.	+		+									+	+			+					+					
Chamaescilla corymbosa		+	+	+		+	+		+			+	+	+	+	+	+	+	+	+						
Comesperma virgatum							+			+										+				+		
Conospermum aff. canaliculatum	+	+		+								+	+	+						+				+		
Conostephium pendulum							+	+	+	+				+	+		+		+							
Conostylis ?juncea														+					+							
Conostylis juncea		+	+						+		+	+			+											
Conostylis serrulata						+				+																
Conostylis setosa					+																					
Corymbia calophylla					+	+																+		+		+
Craspedia variabilis		+																								
Cyathochaeta avenacea	+																									

APPENDIX B: DISTRIBUTION OF PLANT SPECIES IN THE SAMPLED SITES

Species	Sites																								
	1a	1b	1c	2a	2b	2c	3a	3b	3c	4a	4b	5a	5b	5c	5d	5e	5f	6a	6b	6c	7a	8a	8b	8c	8d	8e
Dampiera linearis	+					+	+		+	+			+	+			+	+	+	+	+	+		+		
Dasypogon bromeliifolius	+	+		+	+	+	+	+	+	+		+	+	+	+		+	+	+	+	+		+	+		
Daviesia costata																	+				+		+		+	+
Daviesia divaricata	+	+	+	+	+	+	+	+	+	+		+	+	+		+	+	+	+	+			+			
Daviesia incrassata																										
Daviesia physodes					+		+		+	+		+			+					+						
Daviesia preissii							+									+										+
Desmocladus flexuosus					+																					
Dianella revoluta			+	+					+																	
Drosera erythrorhiza	+	+	+	+	+	+	+	+		+		+	+	+	+	+	+	+	+	+						
Drosera huegelii																										
Drosera sp.															+											
Drosera sp. climbing	+					+				+										+						
Dryandra bipinnatifida																					+		+	+	+	
Dryandra lindleyana	+	+	+	+	+		+	+		+		+		+	+		+	+	+	+	+	+	+	+	+	+
Eriostemon spicatus					+		+		+	+			+		+	+		+	+	+	+					+
Eucalyptus marginata	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Glischrocaryon aureum																										
Gompholobium aristatum																		+								
Gompholobium marginatum												+			+											
Gompholobium polymorphum	+			+		+	+			+					+								+			
Gompholobium preissii		+																								
Gompholobium shuttleworthii																								+		
Goodenia caerulea																							+			
Grevillea bipinnatifida																										
Grevillea quercifolia						+							+			+			+	+		+	+		+	+
Grevillea wilsonii	+	+	+	+	+	+	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Haemodorum laxum							+							+				+		+		+	+			+
Haemodorum spicatum														+												
Haemodorum sp.			+	+			+					+							+							
Hakea cyclocarpa																								+	+	
Hakea ruscifolia		+	+																			+	+	+		+
Hakea stenocarpa																					+					
Hemiandra pungens						+	+										+									
Hibbertia acerosa	+		+			+	+					+										+		+		+

APPENDIX B: DISTRIBUTION OF PLANT SPECIES IN THE SAMPLED SITES

Species	Sites																								
	1a	1b	1c	2a	2b	2c	3a	3b	3c	4a	4b	5a	5b	5c	5d	5e	5f	6a	6b	6c	7a	8a	8b	8c	8d	8e
Hibbertia amplexicaulis	+					+							+										+			
Hibbertia commutata						+											+			+				+		+
Hibbertia cunninghamii							+								+											
Hibbertia huegelii	+	+	+			+		+			+	+	+		+				+							
Hibbertia hypericoides	+	+	+	+	+	+	+	+		+			+		+		+	+	+	+		+	+	+	+	+
Hibbertia pachyrrhiza									+																	
Hibbertia racemosa					+	+																				
Hibbertia sp.																		+								
Hovea chorizemifolia			+														+									
Hovea trisperma																					+					
Hybanthus floribundus	+									+		+	+			+	+		+	+			+			
Hypochaeris glabra					+		+				+			+								+				
Hypolaena exsulca	+	+	+	+	+	+	+	+		+							+									
Jacksonia sternbergiana									+																	
Kennedia coccinea	+	+								+			+						+			+				
Kennedia prostrata			+	+			+	+	+	+		+	+	+	+				+							
Labichea lanceolata																	+									
Labichea punctata	+	+	+	+	+	+	+	+	+	+			+	+	+			+	+	+	+	+	+	+	+	+
Lagenifera huegelii	+	+	+			+	+	+				+														
Lepidosperma squamatum	+	+	+	+		+	+	+	+	+			+	+		+	+	+	+	+	+	+	+	+	+	+
Lepidosperma squamatum (narrow)			+																			+	+	+	+	+
Lepidosperma tenue				+	+	+										+	+	+	+			+	+	+		
Leschenaultia biloba																						+				
Leucopogon australis															+											
Lomandra brittanii				+									+						+	+						
Lomandra hermaphrodita		+	+										+			+			+	+						
Lomandra nigricans		+				+		+	+				+		+	+		+								
Lomandra preissii			+																							
Lomandra purpurea																						+				
Lomandra sericea	+	+	+	+	+	+	+	+		+		+	+	+	+	+	+			+	+	+	+	+	+	+
Lomandra sp.					+																					
Lotus angustissimus																										
Loxocarya cinerea		+							+		+															
Loxocarya fasciculata	+		+	+		+	+			+			+	+			+	+	+	+		+		+	+	
Lyginia barbata														+	+											

APPENDIX B: DISTRIBUTION OF PLANT SPECIES IN THE SAMPLED SITES

Species	Sites																								
	1a	1b	1c	2a	2b	2c	3a	3b	3c	4a	4b	5a	5b	5c	5d	5e	5f	6a	6b	6c	7a	8a	8b	8c	8d	8e
Macarthuria apetala									+																	
Macrozamia riedlei		+	+		+	+		+																		
Melaleuca thymoides									+																	
Mesomelaena gracilipes							+																			
Mesomelaena tetragona	+	+	+	+	+	+		+	+	+			+	+		+	+	+	+	+		+	+	+	+	+
Olearia elaeophila																										+
Olearia paucidentata				+		+							+				+			+		+		+		
Opercularia apiciflora	+			+		+	+								+					+		+		+		
Opercularia hispidula		+			+	+		+	+	+		+														
Orchidaceae sp. (leaf only)												+														
Patersonia aff. juncea													+													
Patersonia occidentalis					+																			+		
Patersonia pygmaea																										
Patersonia umbrosa															+		+									
Patersonia umbrosa subsp. umbrosa																								+		
Pentapeltis peltigera	+	+	+	+		+	+	+		+		+	+	+		+	+	+	+	+		+		+	+	
Persoonia elliptica			+																							
Persoonia saccata	+				+	+		+							+										+	
Petostylis sanguinea																		+								
Petrophile linearis		+	+		+		+			+					+				+				+	+		+
Phlebocarya ciliata	+			+	+	+		+	+	+		+	+					.		+		+				
Phyllanthus calycinus			+			+		+				+	+													+
Pimelea lehmanniana							+									+										
Pimelea suaveolens																										
Platytheca verticillata																	+									
Poaceae sp.						+												+								
Poaceae sp. (seedlings)		+																								
Prasophyllum parvifolium																		+								
Pronaya fraseri					+	+				+			+						+			+	+	+	+	+
Pterostylis recurva												+	+			+										
Pterostylis sanguinea										+				+	+						+					
Pyrorchis nigricans	+			+	+			+						+	+				+		+					
Scaevola calliptera				+	+	+				+		+	+	+			+	+	+	+	+	+	+	+		+
Schoenus cruentus												+	+		+											
Senecio diaschides																						+				

APPENDIX B: DISTRIBUTION OF PLANT SPECIES IN THE SAMPLED SITES

Species	Sites																								
	1a	1b	1c	2a	2b	2c	3a	3b	3c	4a	4b	5a	5b	5c	5d	5e	5f	6a	6b	6c	7a	8a	8b	8c	8d	8e
Sonchus oleraceus																										
Sowerbaea laxiflora				+	+							+	+							+						
Stachystemon vermicularis							+			+					+								+	+	+	
Stirlingia latifolia	+	+	+	+	+	+	+	+	+	+		+		+			+	+	+	+						
Stylidium piliferum	+	+	+			+	+							+				+		+		+	+			
Stypandra glauca								+																		
Styphelia tenuiflora																					+			+		
Templetonia biloba																		+								
Tetraria capillaris	+	+	+	+		+						+							+	+	+	+	+	+	+	+
Tetraria octandra	+	+	+	+	+	+	+	+		+		+	+	+	+		+	+	+	+	+					
Tetrarrhena laevis				+			+					+	+	+								+			+	
Tetratheca hirsuta					+										+		+		+			+	+	+		
Thysanotus multiflorus																								+		
Thysanotus patersonii																								+	+	
Thysanotus sparteus																						+			+	
Trachymene pilosa							+																			
Trichocline spathulata		+	+	+																						
Tricoryne elatior																		+				+				
Tripterococcus brunonis																						+		+		
Watsonia ? bulbillifera											+															
Watsonia bulbillifera								+																		
Watsonia sp.		+							+					+												
Xanthorrhoea brunonis																									+	
Xanthorrhoea gracilis	+	+	+	+				+		+		+	+	+	+	+				+	+	+	+	+	+	+
Xanthorrhoea preissii	+	+	+	+		+	+			+		+	+		+			+	+	+	+	+			+	+
Xanthosia huegelii							+								+		+					+				
Xylomelum occidentale	+	+	+	+	+	+	+	+		+		+				+	+	+	+	+			+	+	+	
	43																									

APPENDIX C: SPECIES RECORDED FROM ALL SITES AND THEIR METHOD OF PROPAGATION

Species	Method of Propagation
Acacia alata	Scarified seed
Acacia applinata	Scarified seed
Acacia lateriticola	Scarified seed
Acacia pulchella	Scarified seed
Acacia pulchella var. pulchella	Scarified seed
Acacia sessilis	Scarified seed
Acacia stenoptera	Scarified seed
Acacia willdenowiana	Scarified seed
Adenanthos meisneri	Seed
Allocasuarina fraseriana	Seed
Amphipogon turbinatus	Seed and division of parent plant
Anigozanthos manglesii	Treated seed and division of parent plant
Astroloma pallidum	Seed - often difficult to propagate
Banksia attenuata	Seed
Banksia grandis	Seed
Bossiaea eriocarpa	Scarified seed
Bossiaea ornata	Scarified seed
Burchardia congesta	Seed and underground bulbs
Caladenia sp.	Seed and underground bulbs
Chamaescilla corymbosa	Seed and underground bulbs
Comesperma virgatum	Seed
Conospermum affin. canaliculatum	Seed
Conostephium pendulum	Seed - often difficult to propagate
Conostylis juncea	Seed and division of parent plant
Conostylis serrulata	Seed and division of parent plant
Conostylis setosa	Seed and division of parent plant
Corymbia calophylla	Seed
Craspedia variabilis	Seed
Cyathochaeta avenacea	Seed and division of parent plant
Dampiera linearis	Seed and division of parent plant
Dasypogon bromeliifolius	Seed and division of parent plant
Daviesia costata	Scarified seed
Daviesia divaricata	Scarified seed
Daviesia incrassata	Scarified seed
Daviesia physodes	Scarified seed
Daviesia preissii	Scarified seed
Desmocladus flexuosus	Seed and division of parent plant
Dianella revoluta	Seed and division of parent plant
Drosera erythrorhiza	Seed and underground bulb
Drosera huegelii	Seed and underground bulb
Drosera sp.	Seed and underground bulb
Drosera sp. climbing	Seed and underground bulb
Dryandra bipinnatifida	Seed
Dryandra lindleyana	Seed

APPENDIX C: SPECIES RECORDED FROM ALL SITES AND THEIR METHOD OF PROPAGATION

Species	Method of Propagation
Eriostemon spicatus	Seed
Eucalyptus marginata	Seed
Gompholobium aristatum	Scarified seed
Gompholobium marginatum	Scarified seed
Gompholobium polymorphum	Scarified seed
Gompholobium preissii	Scarified seed
Grevillea bipinnatifida	Seed. Cuttings
Grevillea quercifolia	Seed. Cuttings
Grevillea wilsonii	Seed
Haemodorum laxum	Seed and underground bulb
Haemodorum spicatum	Seed and underground bulb
Haemodorum sp.	Seed and underground bulb
Hakea ruscifolia	Seed
Hakea stenocarpa	Seed
Hemiandra pungens	Seed
Hibbertia acerosa	Seed - very difficult to propagate. Cuttings
Hibbertia amplexicaulis	Seed - very difficult to propagate. Cuttings
Hibbertia commutata	Seed - very difficult to propagate. Cuttings
Hibbertia cunninghamii	Seed - very difficult to propagate. Cuttings
Hibbertia huegelii	Seed - very difficult to propagate. Cuttings
Hibbertia hypericoides	Seed - very difficutl to propagate. Cuttings
Hibbertia pachyrrhiza	Seed - very difficult to propagate. Cuttings
Hibbertia racemosa	Seed - very difficult to propagate. Cuttings
Hibbertia sp.	Seed - very difficult to propagate. Cuttings
Hovea chorizemifolia	Seed
Hovea trisperma	Seed
Hybanthus floribundus	Seed. Cuttings
Hypolaena exsulca	Seed - very difficult to propagate. Division of parent plant
Jacksonia sternbergiana	Scarified seed
Kennedia coccinea	Scarified seed
Kennedia prostrata	Scarified seed
Labichea punctata	Scarified seed
Lagenifera huegelii	Seed. Underground swoollen root.
Lepidosperma squamatum	Seed - very difficult to propagate. Division of parent plant.
Lepidosperma squamatum narrow	Seed - very difficult to propagate. Division of parent plant.
Lepidosperma tenue	Seed - very difficult to propagate. Division of parent plant.
Leucopogon australis	Seed - can be difficult to propagate.
Lomandra brittanii	Seed. Division of parent plant
Lomandra hermaphrodita	Seed. Division of parent plant
Lomandra nigricans	Seed. Division of parent plant
Lomandra preissii	Seed. Division of parent plant
Lomandra sericea	Seed. Division of parent plant
Lomandra sp.	Seed. Division of parent plant
Loxocarya cinerea	Seed. Division of parent plant

APPENDIX C: SPECIES RECORDED FROM ALL SITES AND THEIR METHOD OF PROPAGATION

Species	Method of Propagation
Loxocarya fasciculata	Seed. Division of parent plant
Lyginia barbata	Seed. Division of parent plant
Macarthuria apetala	Seed
Macrozamia riedlei	Seed. Very slow grower. Can be transplanted.
Melaleuca thymoides	Seed
Mesomelaena gracilipes	Seed. Division of parent plant
Mesomelaena tetragona	Seed. Division of parent plant
Olearia paucidentata	Seed. Cuttings
Opercularia apiciflora	Seed. Cuttings
Opercularia hispidula	Seed. Cuttings
Orchidaceae sp.	Bulb
Patersonia aff. juncea	Seed. Division of parent plant
Patersonia occidentalis	Seed. Division of parent plant
Patersonia pygmaea	Seed. Division of parent plant.
Patersonia umbrosa	Seed. Division of parent plant.
Pentapeltis peltigera	Seed
Persoonia elliptica	Seed - can be difficult to propagate
Persoonia saccata	Seed - can be difficult to propagate
Petrophile linearis	Seed
Phlebocarya ciliata	Seed. Division of parent plant
Phyllanthus calycinus	Seed
Pimelea lehmanniana	Seed - can be difficult to propagate. Cuttings
Pimelea suaveolens	Seed - can be difficult to propagate. Cuttings
Platytheca verticillata	Seed
Prasophyllum parvifolium	Seed. Underground bulb
Pronaya fraseri	Seed
Pterostylis recurva	Seed. Underground bulb
Pterostylis sanguinea	Seed. Underground bulb
Pyrorchis nigricans	Seed. Underground bulb
Scaevola calliptera	Seed. Cuttings
Schoenus cruentus	Seed. Division of parent plant
Sowerbaea laxiflora	Seed. Underground swoolen roots
Stachystemon vermicularis	Seed. Cuttings
Stipa sp.	Seed. Division of parent plant
Stirlingia latifolia	Seed.
Stylidium piliferum	Seed. Division and/or removal of parent plant
Stypandra glauca	Seed. Division of parent plant
Styphelia tenuiflora	Seed. Cuttings
Templetonia biloba	Scarified seed
Tetraria capillaris	Seed. Division of parent plant
Tetraria octandra	Seed. Division of parent plant
Tetrarrhena laevis	Seed. Division of parent plant
Tetratheca hirsuta	Seed. Cuttings
Trachymene pilosa	Seed

APPENDIX C: SPECIES RECORDED FROM ALL SITES AND THEIR METHOD OF PROPAGATION

Species	Method of Propagation
Trichocline spathulata	Seed. Underground storage tap root
Tricoryne elatior	Seed. Cuttings
Xanthorrhoea gracilis	Treated seed. Can be transplanted
Xanthorrhoea preissii	Treated seed. Can be transplanted
Xanthosia huegelii	Seed
Xylomelum occidentale	Seed

APPENDIX D Position of transects (1-7) and sites (1A-7A) sampled in Reserve 31900, adjacent reserves and Bunnings land.

L = tip site Q = old sand quarry