


Protection

NOTE: THE FILE NUMBER, CRN (COMPUTER REGISTER NUMBER) AND OFFICERS NAME OR INITIALS MUST BE QUOTED ON ALL OUTGOING CORRESPONDENCE.

File Number	
179/95 Vol 1	
File Title	
INTERIM PROTECTION AREAS (46) - WONNERUP1	
Relevant Files	Volume created: 3/8/95

Not for Yogganup
to CAM today
Yogganup the first
Propose to start later
1997/98

Off ^{to} Left
L Bussell the
of first step Cephal T.S.
300M to @ TR
into Cephal... Post the
Bethany Betty to Jenkins
Red (to left) into processing
Plat site Main Office - Trang
Centre - Non ~~Blankett~~

ACTION
(3) RESPONSE

ALS (3) RESPONSE

ACTION	(3) RESPONSE

ACTION	(3) RESPONSE

DIRECTIONS FOR COMPLETION OF ACTION DIRECTION COLUMNS

CLOSE VOLUME AT 200 FOLIOS

OFFICER — The person to whom the next action should be referred
The bring-up date can also be included

AREA INFORMATION

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

WONNEKAMP 1

Conservation Area	
Nature Reserve	
Reserve No	
National Park	
Reserve No	
Local Government	
Reserve No	
Other	
Proposed Conservation Areas	
Local Government	Shire of Bunelton
Reserve No	↑ 12969
Other	↑ 33269 NPACA, ↑ 12969 Minister for Railways

Conservation Area

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

TOTAL AREA

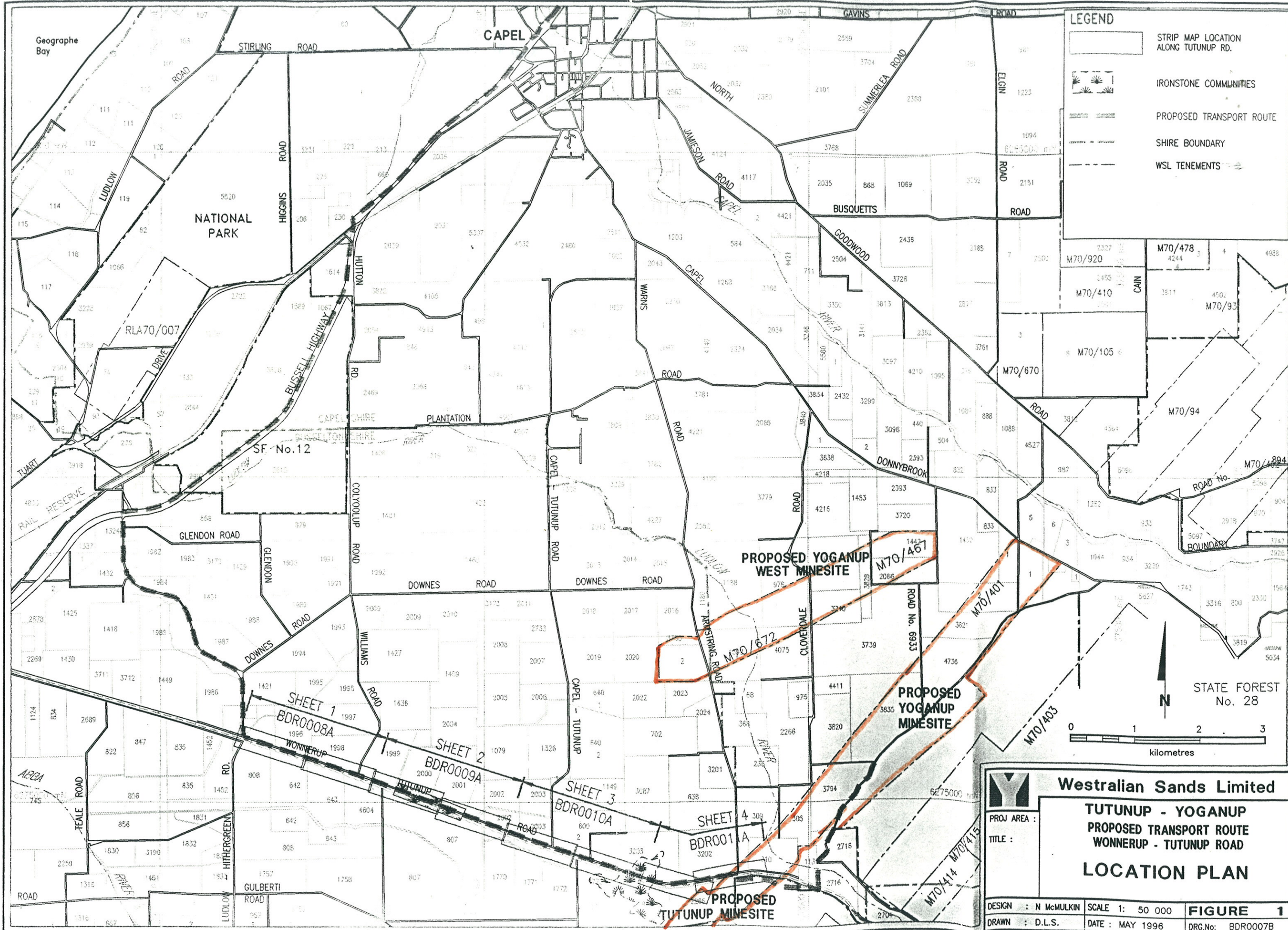
Bushland Area	96.17	hectares
Completely Degraded	3.375 ha	
needs along edges ? rabbits		

AREA MAPPED FLORISTIC UNITS

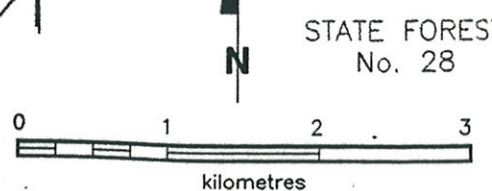
Units	Site (Condition)	Code	A. WONA	Bound	Area (ha)
1a	01 (State Forest)				
1b	02			B	9.672
9	03			B	11.531
7a				B	8.5
10b	04	05 (2)	06 (2)	B	27.28
			G: RUAB		
7	04 (3-2 to 4)			B	0.5
13	03			B	7.5
21b	01 (3)	02 (3-5)		B	27.25

Boundaries determined by use of

aerial photograph	Swan Coastal Plain run 8 S110
orthophoto	2030 W SW
vegetation map	
soil map	



- LEGEND**
- STRIP MAP LOCATION ALONG TUTUNUP RD.
 - IRONSTONE COMMUNITIES
 - PROPOSED TRANSPORT ROUTE
 - SHIRE BOUNDARY
 - WSL TENEMENTS



Westralian Sands Limited

**TUTUNUP - YOGANUP
PROPOSED TRANSPORT ROUTE
WONNERUP - TUTUNUP ROAD
LOCATION PLAN**

PROJ AREA :
TITLE :

DESIGN : N McMULKIN	SCALE 1: 50 000	FIGURE 1
DRAWN : D.L.S.	DATE : MAY 1996	DRG.No: BDR0007B

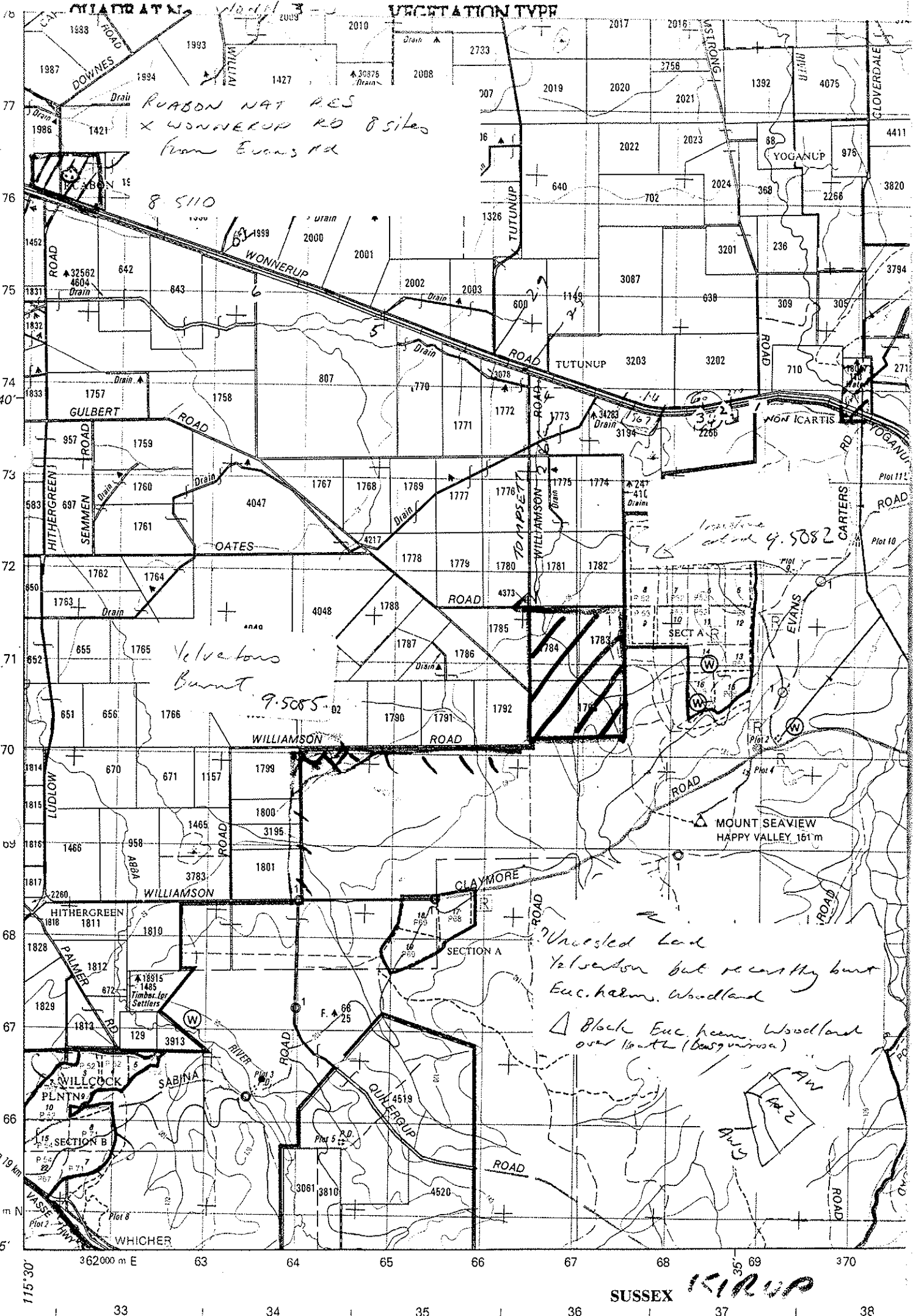


WON M EIAUK

Dyke



Take 7/10% for roads and fire breaks
Condition is variable



VEGETATION TYPE

RUBBON NAT RES
X WONNERUP RD 8 sites
from Evans rd

8 5110

Velveton
Burnt

9.5085

Unweeded Land
Velveton but recently burnt
Euc. halms. Woodland

Black Euc. from Woodland
over 10m (Banyan)

15110

SUSSEX

115°30'
33°45'

362000 m E 63 64 65 66 67 68 69 370

33 34 35 36 37 38



LONDON RD

COOLUP RD

CARL TUTUNUP RD

DOWNES RD

WILLIAMS RD

WONNERUP1

TUTUNUP RD

ARMSTRONG RD

LUDLOW-HITHERGREEN RD

OATES RD

OATS1

WILLIAMSON RD

WILLCOCK RD(F)

IRONSTONE01

WILLIAMSON RD

BANKSIA ROAD

SABINA RD (F)

QUILLUP RD (F)

CONTACT DR N. GIBSON CALM WOODVALE for further information.

Flora list for Wonnerup I (extracted from Swan Coastal Plain database, Ruab 1-4, Wonn 1-6, 334 taxa, 9/5/1995).

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

(extracted from the CALM Swan Coastal Plain database, Ruab 1-4, Wonn 1-6, 334 taxa, 9/5/95)

Anthericaceae

Agrostocrinum scabrum
Borya scirpoidea
Caesia micrantha
Caesia micrantha "blue" scps (GJK 10857)
Chamaescilla corymbosa
Dichopogon preissii
Johnsonia acaulis
Laxmannia sessiliflora subsp. australis
Thysanotus manglesianus
Thysanotus multiflorus
Thysanotus patersonii
Thysanotus sp. scps
Thysanotus sparteus
Thysanotus tenellus
Thysanotus thyrsoides
Tricoryne elatior

Apiaceae

Eryngium "subdecumbens" scps
Hydrocotyle alata
Hydrocotyle callicarpa
Hydrocotyle hispidula
Hydrocotyle sp. scps
Schoenolaena juncea
Trachymene pilosa
Xanthosia ciliata
Xanthosia huegelii

Asteraceae

Angianthus aff. drummondii "sth small grey" scps (BJK&NG 013)
Angianthus preissianus
Asteridea pulverulenta
Blennospora aff. drummondii (golden bracts) scps bjk&ng 20
Brachyscome bellidioides
* Cotula turbinata
Gnephosis tenuissima - drummondii complex
Hyalosperma cotula
* Hypochaeris glabra
Millotia tenuifolia
Myriocephalus helichrysoides
Pithocarpa achilleoides
Podolepis gracilis
Podolepis gracilis swamp (GJK 13126)
Podolepis lessonii
Pogonolepis stricta
Quinetia urvillei
Senecio quadridentatus
Siloxerus filifolius
Siloxerus humifusus
Waitzia citrina

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Flora list for Wonnerup1 (extracted from Swan Coastal Plain database, Ruab 1-4, Wonn 1-6, 334 taxa, 9/5/1995).

Waitzia suaveolens

Brassicaceae

* Heliophila pusilla

Caesalpiniaceae

Labichea punctata

Centrolepidaceae

Aphelia cyperoides

Brizula drummondii

Brizula muelleri

Brizula nutans

Centrolepis alepyroides

Centrolepis aristata

Centrolepis caespitosa

Centrolepis drummondiana

Centrolepis glabra

Centrolepis humillima

Centrolepis mutica

Centrolepis polygyna

Chenopodiaceae

Halosarcia halocnemoides

Colchicaceae

Burchardia multiflora

Burchardia umbellata

Commelinaceae

Cartonema philydroides

Crassulaceae

Crassula colorata

* Crassula natans

Crassula pedicellosa

Cyperaceae

Baumea vaginalis

Caustis dioica

* Cyperus tenellus

Isolepis cernua

* Isolepis marginata

Isolepis oldfieldiana

Lepidosperma angustatum

Lepidosperma eastern terete scps (BJK&NG 232)

Mesomelaena stygia

Mesomelaena tetragona

Schoenus asperocarpus

Schoenus discifer

Schoenus elegans

Schoenus odontocarpus

Schoenus sculptus

Schoenus sp. 2 (GJK 5739) scps

Schoenus tenellus

Tetraria octandra

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Dasypogonaceae

Dasypogon bromeliifolius
Dasypogon hookeri
Kingia australis
Lomandra caespitosa
Lomandra hermaphrodita
Lomandra preissii
Lomandra purpurea
Lomandra sericea
Lomandra suaveolens

Dilleniaceae

Hibbertia acerosa
Hibbertia aurea
Hibbertia cunninghamii
Hibbertia hypericoides
Hibbertia stellaris
Hibbertia subvaginata
Hibbertia vaginata

Droseraceae

Drosera gigantea
Drosera glanduligera
Drosera macrantha sthcest subsp. macrantha ms
Drosera marchantii subsp. marchantii
Drosera menziesii subsp. menziesii
Drosera menziesii subsp. penicillaris
Drosera neesii
Drosera nitidula
Drosera pallida
Drosera rosulata
Drosera tubaestylis

Epacridaceae

Andersonia aff. latifolia "iron" scps bjk&ng 227
Conostephium pendulum
Leucopogon aff. polymorphus south scps (BJK&NG 158)
Leucopogon conostephioides
Leucopogon glabellus
Lysinema ciliatum

Euphorbiaceae

Amperea ericoides
Monotaxis occidentalis

Gentianaceae

* Cicendia filiformis

Goodeniaceae

Dampiera linearis
Goodenia micrantha
Scaevola calliptera

Haemodoraceae

Conostylis aculeata

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Conostylis setigera
Conostylis sp. scps
Phlebocarya ciliata
Tribonanthes violacea

Haloragaceae

Haloragis tenuifolia
Myriophyllum echinatum

Hypoxidaceae

Hypoxis occidentalis

Iridaceae

Patersonia occidentalis
Patersonia occidentalis (swamp form) sthst
Patersonia umbrosa var. xanthina
* Romulea rosea
* Watsonia meriana

Juncaceae

* Juncus capitatus

Juncaginaceae

Triglochin calcitrapum
Triglochin procerum

Lamiaceae

Hemiandra pungens

Lauraceae

Cassytha glabella
Cassytha pubescens scps
Cassytha racemosa

Lemnaceae

Lemna disperma

Lentibulariaceae

Polypompholyx multifida
Utricularia violacea

Lindsaeaceae

Lindsaea linearis

Loganiaceae

Mitrasacme paradoxa

Loranthaceae

Nuytsia floribunda

Lycopodiaceae

Phylloglossum drummondii

Menyanthaceae

Villarsia albiflora
Villarsia capitata

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Flora list for Wonnerup 1 (extracted from Swan Coastal Plain database, Ruab 1-4, Wonn 1-6, 334 taxa, 9/5/1995).

Villarsia parnassifolia

Mimosaceae

Acacia extensa
Acacia flagelliformis
Acacia huegelii
Acacia pulchella
Acacia saligna
Acacia stenoptera
Acacia willdenowiana

Myrtaceae

Agonis flexuosa
Astartea aff. *fascicularis* sthst
Baeckea camphorosmae
Calothamnus aff. *quadrifidus* "iron" scps (bjk&ng 230)
Calothamnus lateralis
Calothamnus sanguineus
Calytrix flavescens
Calytrix sp. scps
Chamelaucium roycei "iron" scps
Darwinia oederoides
Eucalyptus calophylla
Eucalyptus haematoxylon
Eucalyptus marginata
Eucalyptus rudis
Hypocalymma angustifolium
Hypocalymma robustum
Kunzea aff. *micrantha* "purple" scps (BJK&NG 040)
Kunzea ericifolia
Melaleuca cuticularis
Melaleuca lateritia
Melaleuca leptoclada
Melaleuca rhapsiophylla
Melaleuca thymoides
Melaleuca uncinata
Melaleuca viminea
Pericalymma ellipticum
Verticordia plumosa

Orchidaceae

Caladenia "georgei" scps
Caladenia aphylla
Caladenia flava
Caladenia marginata
Caladenia sp. scps
Diuris carinata
Diuris laxiflora
Elythranthera brunonis
Eriochilus dilatatus
Eriochilus multiflorus
Leporella fimbriata
Lyperanthus nigricans
Microtis media warr subsp. *media*
Pterostylis aff. *nana* scps
Pterostylis aff. *sanguinea* scps

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Flora list for Wonnerup1 (extracted from Swan Coastal Plain database, Ruab 1-4, Wonn 1-6, 334 taxa, 9/5/1995).

Thelymitra aff. pauciflora scps
Thelymitra campanulata
Thelymitra crinita
Thelymitra flexuosa
Thelymitra sp. scps

Oxalidaceae

Oxalis perennans

Papilionaceae

Aotus gracillima
Bossiaea eriocarpa
Bossiaea pulchella
Daviesia preissii
Eutaxia virgata
Gompholobium capitatum
Gompholobium confertum
Gompholobium knightianum
Gompholobium marginatum
Hovea trisperma var. trisperma
Jacksonia sp. Busselton (G.J. Keighery 4482) PN
* Lotus angustissimus
* Lotus sp. scps
Nemcia capitata
Sphaerolobium grandiflorum
Sphaerolobium medium
Viminaria juncea

Philydraceae

Philydrella drummondii
Philydrella pygmaea

Pittosporaceae

Billardiera candida
Billardiera variifolia
Pronaya fraseri

Poaceae

* Aira caryophyllea
* Aira cupaniana
Amphibromus neesii
Amphipogon amphipogonoides
Amphipogon turbinatus
* Anthoxanthum odoratum
* Briza maxima
* Briza minor
Danthonia setacea
* Glyceria maxima
* Hordeum leporinum
* Poa annua
Polypogon tenellus
Stipa compressa
Tetrarrhena laevis
* Vulpia myuros
* Vulpia sp. scps

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Flora list for Wonnerup I (extracted from Swan Coastal Plain database, Ruab 1-4, Wonn 1-6, 334 taxa, 9/5/1995).

Polygalaceae

- Comesperma flavum
- Comesperma virgatum

Portulacaceae

- Calandrinia granulifera

Primulaceae

- Samolus junceus

Proteaceae

- Adenanthos intermedius scps
- Adenanthos meisneri
- Adenanthos obovatus
- Banksia attenuata
- Banksia grandis
- Banksia ilicifolia
- Banksia meisneri var. ascendens
- Conospermum "pedunculatum" ms scps
- Conospermum caeruleum subsp. "spathulatum" (Benth) EM Bennett scps
- Conospermum capitatum
- Dryandra aff. nivea "iron" scps (GJK 6622)
- Dryandra nivea
- Dryandra sp. "iron" scps (sp. 30 aff. squarrosa, ASG 11657)
- Grevillea elongata ms plist
- Grevillea manglesioides
- Grevillea quercifolia
- Grevillea trifida
- Hakea ceratophylla
- Hakea cyclocarpa
- Hakea marginata
- Hakea ruscifolia
- Hakea sulcata
- Hakea varia
- Hakea varia "scp ironstone - yellow flowers" scps (BJK&NG 226)
- Isopogon scaber
- Petrophile latericola ms plist
- Petrophile linearis
- Stirlingia latifolia
- Synaphea "fish road" sparse flw single lvs scps
- Synaphea petiolaris
- Xylomelum occidentale

Restionaceae

- Anarthria laevis
- Anarthria prolifera
- Hypolaena exsulca
- Hypolaena ramosissima
- Leptocarpus coangustatus
- Leptocarpus roycei ms sthst
- Leptocarpus sp. scps
- Leptocarpus tenax
- Lepyrodia aff. macra "iron" scps (GJK 9848)
- Loxocarya cinerea
- Loxocarya fasciculata
- Loxocarya flexuosa

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Flora list for Wonnerup I (extracted from Swan Coastal Plain database, Ruab 1-4, Wonn 1-6, 334 taxa, 9/5/1995).

Loxocarya magna "ironstone sp" scps
Loxocarya pubescens
Lyginia barbata
Restio tremulus

Rhamnaceae

Cryptandra arbutiflora

Rubiaceae

Opercularia vaginata
Opercularia vaginata "iron" scps (BJK&NG 238)

Rutaceae

Boronia spathulata
Eriostemon spicatus

Scrophulariaceae

Gratiola peruviana
* *Parentucellia latifolia*

Selaginellaceae

Selaginella gracillima

Stackhousiaceae

Stackhousia monogyna

Sterculiaceae

Thomasia grandiflora

Stylidiaceae

Levenhookia pusilla
Stylidium aff. *bulbiferum* "iron" scps
Stylidium amoenum
Stylidium calcaratum
Stylidium carnosum
Stylidium dichotomum
Stylidium ecorne
Stylidium emarginatum
Stylidium guttatum
Stylidium inundatum
Stylidium junceum
Stylidium mimeticum
Stylidium petiolare
Stylidium piliferum
Stylidium pulchellum
Stylidium repens
Stylidium schoenoides
Stylidium sp. "pink, glandular spathulate lvs" scps
Stylidium striatum
Stylidium utricularioides

Tremandraceae

Platytheca galioides
Tetratheca hirsuta

Xanthorrhoeaceae

FOR INTERNAL USE ONLY **from Gibson *et.al* 1994**

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Flora list for Wonnerup1 (extracted from Swan Coastal Plain database, Ruab 1-4, Wonn 1-6, 334 taxa, 9/5/1995).

Xanthorrhoea preissii

Zamiaceae

Macrozamia riedlei

SITE LOCATION

Suggested name of area (1996)

System 6 (1984)

Some Other Commonly used Names:

Wonnerup Rd Threatened &/or poorly res..., Capel

Area (ha):

Total 115 plus 4.5 km reserve to west of Ruabon, bushland 100% (GIS) 100% (MRA 11/90 run8 5110, 5081 aerial photo)

Zoning (MRS & town planning)

Local Authorities (Suburb)

Shire of Busselton

Ownership categories: Street name, Lot number

NPNCA: Hithergreen Road 14,15,16 Reserve 33269

Local authority: Reserve 32205

Westrail: Reserve 12969

Reserve Status

Ruabon NR

LANDFORM AND SOIL

Landscape features: vegetated wetlands, vegetated uplands, ironstones

Geomorphology and soils

Foothills

Colluvial deposits (Qc :Smg)

Yoganup Formation (Qpr: S12)

Pinjarra Plain

Alluvial/colluvial deposit (Pinjarra Plain / Ridge Hill) (Qha/Qc: FS3)

Bassendean Dunes

Bassendean sands (Qpb: S8)

Bassendean Dunes/Pinjarra Plain

Bassendean sands over Guildford Formation (Qpb/Qpa:S10)

Wetlands (within the Bassendean Dunes and Pinjarra Plain)

Holocene swamp deposits (Qhw: Spc)

REGIONAL VEGETATION AND FLORA

Vegetation Complex

Pinjarra Plain

Abba Complex

(Combinations of Bassendean Dunes/Pinjarra Plain/Spearwood Dunes

Southern River Complex)

Floristic Community Types (* type inferred)

Supergroup 1 - Foothills/Pinjarra Plain

1a *E. haematoxylon* - *E. marginata* woodlands on Whicher foothills

1b Southern *E. calophylla* woodlands on heavy soils

2* Southern wet shrublands (some of Marri Woodlands to west of Ruabon)

Supergroup 2: Seasonal Wetlands

7 Herb rich saline shrublands in clay pans

9 Dense shrublands on clay flats

10b Shrublands on southern ironstones

13 Deeper wetlands on heavy soils

16 Highly saline seasonal wetlands

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

21b Southern *Banksia attenuata* woodlands

REGIONAL WETLAND

Wetland Types: sumpland, dampland, palusplain

Consanguineous suite not mapped

Wetland Management Objective: not mapped

Lake EPP: none identified

THREATENED COMMUNITIES/SPECIES

Critically Endangered (floristic community type 10b), Vulnerable (floristic community type 1b, 7, 9)

AREA DESCRIPTION

Vegetation and Flora

Structural units: (detailed survey), (mapping)

Eucalyptus calophylla Forest to Woodlands, *Eucalyptus calophylla* and *E. marginata* Forest to Woodlands, *E. haematoxylon* Woodlands, *Banksia attenuata* Woodland, *Melaleuca preissiana* Woodland, *M. raphiophylla* Woodland, *Viminaria* Shrubland, *Pericalymma* Shrubland, *Melaleuca* Shrubland, Herblands and Sedgeland.

Vegetation Condition: >75% Excellent to Very Good with <25 % Good to Degraded, with areas of severe localised disturbance.

Total Flora: 334 taxa, (site generated list only) (estimated >50% expected flora)

DRF/Priority - GIS: *Tetraria australiensis* (R), *Caladenia huegelii* (R), *Chamelauum roycei* ms (R), *Drakea elastica* (R), *Petrophile latericola* ms (R), *Verticordia plumosa* var. *vassensis* (1), *Myriophyllum echinatum* (1), *Stylidium mimeticum* (1), *Dryandra squarrosa subsp argillacea* ms (1), *Verticordia attenuata* (1), *Verticordia demiflora* var

pedunculata (1), *Isopogon scaber* (1), *Haloragis tenuifolia* (1), *Grevillea elongata* ms (2), *Loxocarya magna* ms (3), *Banksia meisneri* var. *ascendens* (4), *Acacia flagelliformis* (4), *Drosera marchantii* subsp. *marchantii* (4)

DRF/Priority and significant flora - survey

Haloragis tenuifolia (1), *Dryandra squarrosa* subsp. *argillacea* (1), *Verticordia plumosa* var. *vassensis* (1), *Tripterococcus paniculatus* Ms (1), *Pithocarpa achilleoides* (2), *Loxocarya magna* MS (3), *Myriophyllum echinatum* (3), *Stylidium mimeticum* (3), *Acacia semitrullata*, *Dryandra nivea* subsp. *uliginosa* (3), *Drosera marchantii* subsp. *marchantii* (4), *Acacia flagelliformis* (4), *Banksia meisneri* var. *ascendens*, *Franklandia triaristata* (4), *Chamelaucium roycei* MS (R), *Centrolepis caespitosa* (R), *Tetraria australiensis* (R), *Caladenia huegellii* (R), *Eryngium subdecumbens* MS (1), *Jacksonia sparsa* MS (3), *Blennospora* sp. Ruabon (3), *Banksia meisneri* var. *ascendens* (4)
Hakea varia (BJK&NG 226), *Stylidium utricularioides*, *Calothamnus* aff. *quadrifidus*, *Isopogon scaber*, *Andersonia* aff. *latifolia*, *Adenanthos intermedius*, *Myriocephalus helichrysoides*,

Fauna

Mammals: not surveyed

Linkage: bushland linkage to east (Whicher Plateau) and west (claypans and then adjacent Tuart Forest), both areas of state forest/National Park.

Special Attributes:

Only known transect of the eastern side of the Swan Coastal Plain connecting foothills to the western sand dunes and associated wetlands, Threatened and/or poorly reserved plant communities (EPA, 1995).

INTERNATIONAL AND NATIONAL SIGNIFICANCE

Not listed

CONSERVATION RECOMMENDATIONS

Criteria met for inclusion:

Constraints:

Recommendation:

Draft ONLY

Wanrowup - Tutteenup Rd Upgrade - Westshore roads

Jan Clarke / Neil H

- Alternatives Routes
- Siebark issue - Siebark pre gravel proposed - More testing required
- Management rd + gravel
- Drainage.
- Management / Maintenance of Rd / Rdker.
- Inductions / Incentives / penalties for contractors.
- Future Rd management / More Agreement to design + future maintenance in compatible way.

File Note : Wonnerup Road, Shire of Busselton
Interim Protected Area No 77

13.6.96

In response to information that CALM had received notice to take DRF from this area I contacted:

Bunbury Office of DEP Robert Griffiths (097 214 814)
Busselton Shire John Bettink, Engineering Department (097 521011)
Main Roads, Bunbury Neil McCarthy (097 255 677)
Neil McMulkin, Rehabilitation Adviser with Westralian Sands (097 271 200)

The road is a shire road, not a Main Roads Department road and is called Wonnerup Road rather than Tutunup Road as stated on our maps.

Westralian Sands want to widen the road for the transport of mineral sands. Their original proposal was to widen it just to the shoulder but because it is a shire road, the shire requirements for safety purposes are for a wider road which should also be upgraded.

Westralian Sands wrote to Ken Atkins regarding DRF and he told them it would most likely need DEP/EPA approval as well.

I said that we valued this land very highly and Neil Gibson had already informed him that his likely recommendation for the reserve would be that it become an A class reserve.

Neil McMulkin has worked as the Rehabilitation officer at Eenabba and has an appreciation of the floristic value of the area. He is however concerned that there are some land holders there who tend to burn every year. He would like to have a meeting with all concerned (CALM, Shire, Us) to look at all the constraints and possibilities. It may be possible for Westralian Sands to take a role in the ongoing management of the reserve.

He will forward a copy of their proposal to us within the week and inform us of the meeting date.

A handwritten signature in black ink, appearing to read "Margo O'Byrne". The signature is written in a cursive style with a long horizontal flourish extending to the right.

Meeting Notes

Name B. Keighy		Folio No.
Branch Conservation		File No.
Subject WONNERUP ROAD	Date 14 / 1 / 97	Time
People in attendance K. Sippe, K. Taylor, C. Middle, K. Sanders, B. JK.		
Items	Action required	Action by
<ul style="list-style-type: none"> • Issue BJK being consultant to DEP and WILDFLOWER Soc discussed and acknowledged • Values of verge/rail discussed noted most significant verge in the area of Busseton (DRF/Connection of longer blocks/Rare Communities NO OTHER AREA) • RAPS's summation that while the impact is minimal (few plants) potential impact is great and Westreton Sands controls do not apply to other impacts ∴ Should use an alternative route • Treet through Section 106B (?negotiation with CEO) and request another road be used if only suitable use decide on formal or informal later in light of above (formal advantages = community voice + binding legal conditions) 	✓	KS



MEMO TO: KIM TAYLOR/ COLIN MURRAY
FROM: GARY WHISSON
SUBJECT: APPEALS RE WONNERUP-TUTUNUP RD WIDENING 96/134-5
DATE: 31 DECEMBER 1996

This proposal illustrates nicely one of the deficiencies in the EPAct. The proposal has been put together in a comprehensive way by Westralian Sands with significant attention to detail of DRF and management issues BUT the environmental acceptability of the proposal is dependent on the proponent managing the road widening to a very high standard and maintaining ongoing commitments to use and management of the road in accordance with their proposal.

The Wonnerup-Tutunup road provides the only remaining largely contiguous representation of native plant communities across the full width of the Swan Coastal Plain south of Perth. It also supports a wide range of DRF and priority listed flora and an endangered plant community. In these respects it is arguably a unique feature of the southern Swan Coastal Plain and is of exceptional conservation significance.

While there is every indication that the company is genuine in its commitment to the appropriate management of project, the vegetation along the Wonnerup-Tutunup road is of exceptional value and it will require a very high standard of project management to carry out the widening to the standards proposed to ensure that significant environmental damage is not done. Without enforceable conditions the Department/EPA has no comeback on these issues.

Moreover, the company has made significant commitments to the ongoing management of the road and the vegetation on the road reserve, which are equally important to ensure that appropriate management is maintained. Who is to say that in a few years time company personnel and its policy to an ongoing commitment of funds to the management of the road and vegetation will not change? Again we cannot enforce these commitments without formally assessing the proposal.

Westralian Sands main concern in relation to formal assessment is the time delay. They have a legitimate need to complete the road widening before the winter rains or the project will be delayed until dry soil conditions are regained. A rapid CER - perhaps based on a public meeting discussing the Westralian Sands proposal and commitments, and proposed draft EPA conditions leading to finalisation of EPA recommendations could be the answer.

This approach would also reflect the EPA commitment to formal assessment of proposals involving System 6 or Threatened or Poorly Reserved Plant Communities

BJK - additional issues

- alternatives roads not developed
- consultation with community (not discussed)
- other threats/uses to rail/road verge be encouraged if not formal (describes as M53 experience)

Section
106 B - look alternatives
CEO to register

- see Kim,
- get views of
Rob
- independent 3rd party
audit following completion
of work - letters to

SITE LOCATION

Suggested name of area (1996)

System 6 (1984)

Some Other Commonly used Names:

Wonnerup Rd Threatened &/or poorly res..., Capel

Area (ha):

Total 115 plus 4.5 km reserve to west of Ruabon, bushland 100% (GIS) 100% (MRA 11/90 run8 5110, 5081 aerial photo)

Zoning (MRS & town planning)

Local Authorities (Suburb)

Shire of Busselton

Ownership categories: Street name, Lot number

NPNCA: Hithergreen Road 14,15,16 Reserve 33269

Local authority: Reserve 32205

Westrail: Reserve 12969

Reserve Status

Ruabon NR

LANDFORM AND SOIL

Landscape features: vegetated wetlands, vegetated uplands, ironstones

Geomorphology and soils

Foothills

Colluvial deposits (Qc :Smg)

Yoganup Formation (Qpr: S12)

Pinjarra Plain

Alluvial/colluvial deposit (Pinjarra Plain / Ridge Hill) (Qha/Qc: FS3)

Bassendean Dunes

Bassendean sands (Qpb: S8)

Bassendean Dunes/Pinjarra Plain

Bassendean sands over Guildford Formation (Qpb/Qpa:S10)

Wetlands (within the Bassendean Dunes and Pinjarra Plain)

Holocene swamp deposits (Qhw: Spc)

REGIONAL VEGETATION AND FLORA

Vegetation Complex

Pinjarra Plain

Abba Complex

(Combinations of Bassendean Dunes/Pinjarra Plain/Spearwood Dunes

Southern River Complex)

Floristic Community Types (* type inferred)

Supergroup 1 - Foothills/Pinjarra Plain

1a *E. haematoxylon* - *E. marginata* woodlands on Whicher foothills

1b Southern *E. calophylla* woodlands on heavy soils

2* Southern wet shrublands (some of Marri Woodlands to west of Ruabon)

Supergroup 2: Seasonal Wetlands

7 Herb rich saline shrublands in clay pans

9 Dense shrublands on clay flats

10b Shrublands on southern ironstones

13 Deeper wetlands on heavy soils

16 Highly saline seasonal wetlands

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

21b Southern *Banksia attenuata* woodlands

REGIONAL WETLAND

Wetland Types: sumpland, damppland, palusplain

Consanguineous suite not mapped

Wetland Management Objective: not mapped

Lake EPP: none identified

THREATENED COMMUNITIES/SPECIES

Critically Endangered (floristic community type 10b), Endangered (floristic community type 2), Vulnerable (floristic community type 1b, 7, 9)

AREA DESCRIPTION

Vegetation and Flora

Structural units: (detailed survey), (mapping)

Eucalyptus calophylla Forest to Woodlands, *Eucalyptus calophylla* and *E. marginata* Forest to Woodlands, *E. haematoxylon* Woodlands, *Banksia attenuata* Woodland, *Melaleuca preissiana* Woodland, *M. raphiophylla* Woodland, *Viminaria* Shrubland, *Pericalymma* Shrubland, *Melaleuca* Shrubland, Herblands and Sedgeland.

Vegetation Condition: >75% Excellent to Very Good with <25 % Good to Degraded, with areas of severe localised disturbance.

Total Flora: 334 taxa, (site generated list only) (estimated >50% expected flora)

DRF/Priority - GIS: *Tetraria australiensis* (R), *Caladenia huegelii* (R), *Chamelauaum roycei* ms (R), *Drakea elastica* (R), *Petrophile latericola* ms (R), *Verticordia plumosa* var. *vassensis* (1), *Myriophyllum echinatum* (1), *Stylidium*

Dry. rd. susp. cutis (R)

Plus Calothamnus aff. ~~quadricolor~~ ^{crassus P1}

mimeticum (1), Dryandra squarrosa subsp. argillacea ms (1), Verticordia attenuata (1), Verticordia demiflora var pedunculata (1), Isopogon scaber (1), Haloragis tenuifolia (1), Grevillea elongata ms (2), Loxocarya magna ms (3), Banksia meisneri var ascendens (4), Acacia flagelliformis (4), Drosera marchantii subsp marchantii (4)

DRF/Priority and significant flora - survey

Haloragis tenuifolia (1), Dryandra squarrosa subsp. argillacea (1), Verticordia plumosa var. vassensis (1), Tripterococcus paniculatus Ms (1), Pithocarpa achilleoides (2), Loxocarya magna MS (3), Myriophyllum echinatum (3), Stylidium mimeticum (3), Acacia semitrullata, Dryandra nivea subsp. uliginosa (3), Drosera marchantii subsp. marchantii (4), Acacia flagelliformis (4), Banksia meisneri var. ascendens, Franklandia triaristata (4), Chamelaucium roycei MS (R), Centrolepis caespitosa (R), Tetraria australiensis (R), Caladenia huegellii (R), Eryngium subdecumbens MS (1), Jacksonia sparsa MS (3), Blennospora sp. Ruabon (3), Banksia meisneri var. ascendens (4) Hakea varia (BJK&NG 226), Stylidium utricularioides, Calothamnus aff. quadricolor, Isopogon scaber, Andersonia aff. latifolia, Adenanthos intermedius, Myriocephalus helichrysoides,

Fauna

Mammals: not surveyed

Linkage: bushland linkage to east (Whicher Plateau) and west (claypans and then adjacent Tuart Forest), both areas of stste forest/National Park.

Special Attributes:

Only known transect of the eastern side of the Swan Coastal Plain connecting foothills to the western sand dunes and associated wetlands, Threatened and/or poorly reserved plant communities (EPA, 1995).

INTERNATIONAL AND NATIONAL SIGNIFICANCE

Not listed

CONSERVATION RECOMMENDATIONS

Criteria met for inclusion:

Constraints:

Recommendation:

CE, Brachysema
CE, Darwinia sp
Search for Darwinia sp
No reference to protected communities
Additional taxa
seedlings to H. Williams

CE Petrophile latericola MS R
Isopogon formosus ssp dasylopis P3
Anderson sp Ironstone (= scaber)

Threatened Community

Changed threat level

- Dryandra nivea ssp uliginosa R
- Cal. quad = sp Whicher P1
- [Andersonia sp Ironstone P1] ✓
- [Hakea sp Williamson P1] ✓ not changed = ott. varia

Questions/Issues needing to be considered based on "Application to "Take" Declared Rare Flora, Notice of Intent and Submission on the Level of Assessment for the Reconstruction of the Wonnerup/Tutunup Road prepared by Westralian Sands B.J. Keighery 14/2/97

CONSERVATION SIGNIFICANCE OF THE TRANSECT:

• The area of road under discussion is part of the only vegetated transect from the Plateau through Pinjarra Plain, Bassendean Sands to the Spearwood Sands (State Forest via Wonnerup/Tutunup Road to the Ludlow Tuart Forest and adjacent State Forest). *Map 1*

• The combination of plant community types represented on the transect is unique (see above):

Supergroup 1 - Foothills/Pinjarra Plain

1a *E. haematoxylon* - *E. marginata* woodlands on Whicher foothills

#1b Southern *E. calophylla* woodlands on heavy soils

#2* Southern wet shrublands (some of Marri Woodlands to west of Ruabon)

Supergroup 2: Seasonal Wetlands

#7 Herb rich saline shrublands in clay pans

#9 Dense shrublands on clay flats

#10b Shrublands on southern ironstones

13 Deeper wetlands on heavy soils

16 Highly saline seasonal wetlands

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

21b Southern *Banksia attenuata* woodlands

Supergroup 4 - Uplands centred on Spearwood and Quindalup Dunes

25* Southern *E. gomphocephala* - *Agonis flexuosa* woodlands

*10 Communities
inc 5 Threatened Community
CALM*

Key

* inferred floristic community type

in Wonnerup/Tutunup section

Threatened Community CALM

• Over 400 taxa will occur along the transect (list for Ruabon Nature Reserve at mid transect contains 390 native taxa).

• A series of threatened species occur along the transect (listed below, but only DRF for entire transect). Some of these have not been searched for along the road reserve to be disturbed

Key:

searched

need to be searched

Tetraria australiensis (R), *Caladenia huegelii* (R), *Chamelauaum roycei* ms (R), *Drakea elastica* (R), *Petrophile latericola* ms (R), *Grevillea elongata* ms (R), *Centrolepis caespitosa* (R)

Dryandra squarrosa subsp. *argillacea* (R)

Possible DRF: *Darwinia* sp. Williamson, *Brachysema papillio*

*Many populations of several sp DRF
P DRF
+ 2 possible*

Verticordia plumosa var. *vassensis* (1), *Tripterococcus paniculatus* Ms (1), *Myriophyllum echinatum* (1), *Stylidium mimeticum* (1), *Dryandra squarrosa* subsp. *argillacea* ms (1), *Verticordia attenuata* (1), *Verticordia demiflora* var. *pedunculata* (1), *Isopogon formosus* subsp. *dasylepis* (= *I. scaber* , 1), *Haloragis tenuifolia* (1), *Eryngium subdecumbens* MS (1), *Hakea* sp. Williamson (= *aff. varia* , BJK&NG 226), *Calothamnus* sp Whicher (= *aff. quadrifidus*), (1), *Andersonia* sp. Ironstone (BJK & NG 227) (1), *Calothamnus aff. crassus* (1)

13 priority

Pithocarpa achilleoides (2)

Loxocarya magna ms (3), *Blennospora* sp. Ruabon (3),

1 priority 2

Banksia meisneri var. *ascendens* (4), *Acacia flagelliformis* (4), *Drosera marchantii* subsp. *marchantii* (4)

*2 p 3
3 p 4*

•Wetlands (Supergroup 2: Seasonal Wetlands above and below) have not been given Management Objectives but according to criteria used in work done on the Plain these would be Conservation Category AND of high priority for conservation, that is this proposal should go the Waters and Rivers Commission (Work has been done by C. Semeniuk in the area).

Wetland Types: sumpland, dampland, palusplain

Consanguineous suite not mapped

Wetland Management Objective: not mapped

Lake EPP: none identified

Threats to the flora

- Dieback - the communities and many of the threatened species are or appear to be susceptible to dieback (considered in reports)
- Fire - the communities and many of the threatened species are fire sensitive. A high proportion of the threatened taxa are re-seeders and a series of fires in close proximity over time would effectively remove these taxa from the community and change the community.

QUESTIONS/ISSUES

The transect is irreplaceable! The broader issues are not considered such as the entire transect, management of Westrail lands etc. Road verges are very vulnerable and all management parties need to be coordinated when a changed use is proposed.

Many of the Threatened Taxa have their only significant populations along the Wonnerup/Tutunup Road this aspect of the populations has not been considered, only in relation to the population along the road.

Additional Taxa should be searched for along the transect (*Petrophile latericola*, *Darwinia* sp. Williamson, *Brachysema papillio* and *Andersonia* sp. Ironstone). These either grow along the road or in the vicinity.

What is the position of the Waters and Rivers Commission?

What is the incidence of accidents on heavy haulage roads?

What is the probability that these accidents will cause fire?

Will improving this road lead to it becoming the local "drag strip"?

Visibility on the road is hampered by overhanging vegetation, the Busselton Shire is to be responsible for "maintaining verges" (Page 11, 12 Notice of Intent) but this is not detailed and Appendix 3 with the detail of agreements is not included.

Why has Westralian Sands not placed a covenant on their area of Community 10b when they recognise its significance?

*State Forest
to Not PK in
open road*

SELECTION OF THE ROAD

QUESTIONS/ISSUES

The alternatives detailed do not include some obvious routes, see Map 2.

The consideration of alternatives routes is approach from the position of justifying Wonnerup/Tutunup Road rather than a balanced look at all the alternatives. Letter from DEP does not state that DEP would like to negotiate an alternative.

Selection of roads does not appear to rate conservation as highly as other issues, except when it applies to the alternatives. For example single species of DRF were used to discount other road options (there are a suite of these species on Wonnerup/Tutunup Road).

Community Consultation

QUESTIONS/ISSUES

This a nationally and regionally significant conservation area, only local groups were consulted.

The appealant did not have access to the Notice of Intent.

A detailed consideration of alternative routes based on a series of set needs to part

There is no doubt that the reserves included in this transect require management BUT they have survived until now. ALL cases I have observed of changes to road usage have resulted in degradation of the verge. This changed usage of this area of outstanding conservation significance and allowing a changed use such as this without the conditions being legally binding and without the opportunity for community input after perusal of the proposals does not recognise significance of the area.

- Impacts not just knocking over a few plants - ~~not potential~~
 - change in use of road - heavy haulage long term
 - ↑ potential for calls to ↑ width of ~~right~~ shoulder.
- Need for full review of alternatives - Not afraid of chosen alternative
- Mangrove security of Commitments
- Major ^{heavy haulage} road will change future usage
inc Moon factor wide straight road

* Ready to sign contract to start after Winter
ie building road next summer

COPY AS REQUESTED 10/10/97

Ian Clarke
Planning Manager
Westralian Sands
PO Box 96
CAPEL WA 6271

Our Ref 25/92
Enquiries Karen Sanders

Dear Mr Clarke

Proposal: Reconstruction of the Wonnerup - Tutunup Road through an area of regionally significant vegetation
Location: Wonnerup Road between Hithergreen Rd and the proposed Tutunup minesite
Proponent: Westralian Sands Limited
Assessment: Informal review with public advice

The Department of Environmental Protection (DEP) offers the following advice and comments on the proposal to reconstruct and widen the Wonnerup - Tutunup Rd. The proposal also includes the management of the vegetation in the road reserve identified by the Environmental Protection Authority (EPA) as being regionally significant.

Dieback management

It is understood that Westralian Sands have made a number of commitments in relation to the management of dieback in the road reserve. These include:

- the undertaking of additional dieback surveys to define in more detail the areas infected. The Department of Conservation and Land Management (CALM) will be involved in assessing the results of the surveys;
- Dieback free gravel will be used for the reconstruction of the road and where appropriate limestone or marl will be used;
- All employees and contractors will be given a comprehensive induction on CALM hygiene standards for the control of dieback; and
- The standards will be used for ongoing maintenance of the road.

These measures are supported by the DEP. In addition, the road should be designed prevent excessive waterlogging and minimise impacts on the existing drainage regime where possible.

Weed management

The commitment to develop a long-term plan for the eradication of exotic plants and weeds in the road reserve is supported. The re-introduction of native species into the road reserve would serve to improve the condition of the reserve. Liaison with CALM and the Shire of Busselton is encouraged, particularly as the Shire will have management responsibilities following the cessation of mining operations.

Declared Rare Flora

The measures proposed by Westralian Sands to protect the Declared Rare Flora should provide adequate protection of the flora. The assistance in research and development will be a significant contribution towards the conservation of flora.

CALM and the Kings Park Board should be consulted on the flora relocation plan. It is expected that CALM's requirements for the protection of Declared Rare Flora will be stated in the conditions on the "Permission to Take", which Westralian sands will be required to comply with.

The location and importance of the Declared Rare Flora should be stressed to any contractors and employees working on the construction or maintenance of the road. The positive performance incentives proposed would be beneficial in this aspect. It is understood that these matters will be included in the Environmental Management Plan.

Environmental Management Plan

The Environmental Management Plan should address at least the above environmental concerns and be prepared in consultation with, and to the satisfaction of, CALM and the Shire of Busselton. It is understood that Westralian Sands has agreed to consult with the Wildflower Society on the Environmental Management Plan.

Environmental Management System

The Minister for the Environment requested that the DEP (Bunbury Regional Office) assist the Shire of Busselton in developing an Environmental Management System to manage and monitor impacts of road construction, maintenance and on-going road use. The Minister suggested that the Shire consult with Westralian Sands, CALM and local interest groups on this matter. Westralian Sands' involvement in the preparation of the Environmental Management System is seen as beneficial to environmental protection for the road reserve.

Westralian Sands is to be commended on the quality of work undertaken for this project.

The purpose of this advice is to help protect the environment. The advice is not legally binding.

Yours faithfully

K J Taylor
DIRECTOR
EVALUATION DIVISION

11 July 1997

cc Shire of Busselton
CALM, Wildlife Branch, Attn: Mike O'Donoghue
CALM, Busselton District Office, Attn: Roger Banks
DEP, Bunbury Regional Office
Wildflower Society
Conservation Council

WonTutIRPAKs110797

QUADRAT No. Wonn 1 VEGETATION TYPE _____
 DATE FIRST TRIP 16/4/92 VOLUNTEERS _____
 DATE SECOND TRIP 13/10/92 VOLUNTEERS _____
 BOTANIST BJK GJK

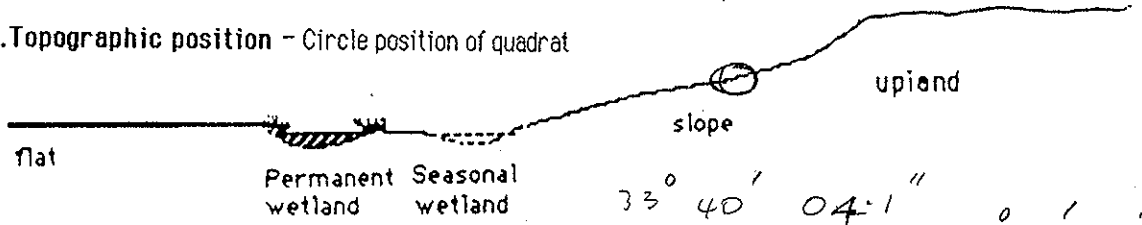
Wonn

1. LOCATION of the QUADRAT

a. Mud Map Draw a sketch of the location of the quadrat the back of this sheet. →

b. Photograph Photographer's name BJK

c. Topographic position - Circle position of quadrat



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

2. SITE DATA - Circle the correct response

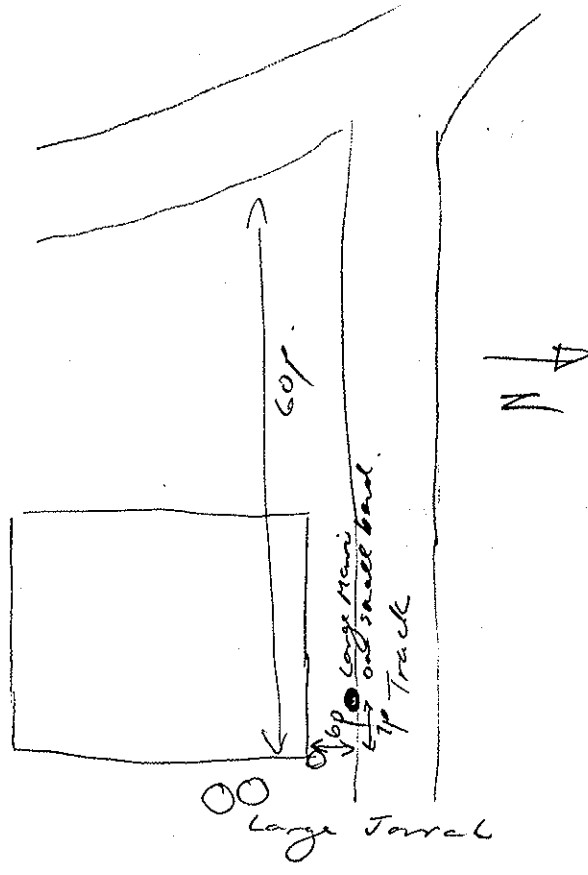
Slope flat gentle steep Aspect (N) NE E SE S SW W NW

% Bare ground 0% Drainage (well) mod poor Wet All year winter/spring *adj to C.H.W.*

Litter (% cover) 90% Surface soil grey-brown clayey sd Sub-surface soil over ? loamite clayey light brown clayey sd

3. VEGETATION STRUCTURE AND COVER Record appropriate cover class

Cover Class - percentage classes	over 70%	TREES <i>A. Javanica (5) Morri (5) B. grandis</i>				MALLEES		Height (metres)
	50-70%	LIFE FORM <i>> 15m or 5-15m</i>		under 5m <i>Xyla. occid.</i>		MALLEE SHRUB <i>less than 8m</i>	MALLEE TREE <i>8m or more</i>	
	30-50%	COVER CLASS (%) <i>> 15m A 30-50 5-15m B 20-30</i>		<i>< 2% (adj to 2-10%)</i>		<i>0%</i>	<i>0%</i>	
20-30%	SHRUBS <i>Xanth (20) Dasy (5) 30-50%</i>							
10-20%	LIFE FORM <i>over 2m</i>		<i>2.0-1.5m</i>		<i>1.5-1.0m</i>	<i>1.0m - .5m</i>	<i>under 5m</i>	
2-10%	COVER CLASS (%) <i>0%</i>		<i>0%</i>		<i>2-10%</i>	<i>2-10%</i>	<i>2-10%</i>	
0%	BUNCH GRASSES <i>under .5m</i>		HERBS <i>under .5m (except creepers)</i>		SEDGES <i>over .5m</i>		<i>Hyp exsul</i>	
	COVER CLASS (%) <i>< 2%</i>		<i>? 2-10%</i>		<i>0%</i>		<i>20-30%</i>	



OATS.

Nanua? reti

Pterostylis vitt

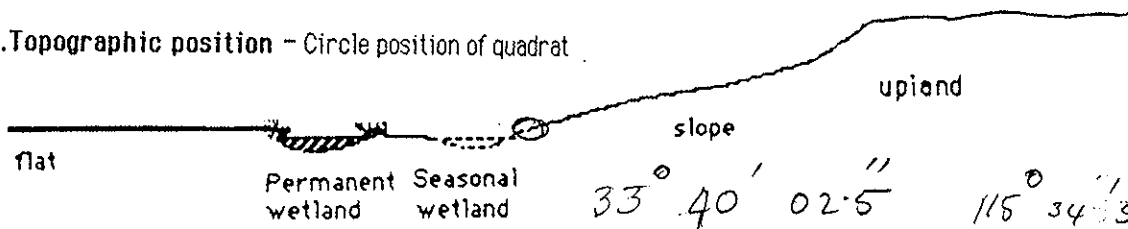
QUADRAT No. W00N2 VEGETATION TYPE _____
 DATE FIRST TRIP 16/4/92 VOLUNTEERS _____
 DATE SECOND TRIP 13/10/92 VOLUNTEERS _____
 BOTANIST BJK, CTK / BJK, NS

1. LOCATION of the QUADRAT

a. Mud Map Draw a sketch of the location of the quadrat the back of this sheet. →

b. Photograph Photographer's name _____

c. Topographic position - Circle position of quadrat



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

2. SITE DATA - Circle the correct response

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

% Bare ground 2% Drainage well mod poor Wet All year winter/spring

Litter (% cover) 50% Surface soil grey clay Sub-surface soil grey-cream sandy clay

3. VEGETATION STRUCTURE AND COVER. Record appropriate cover class

Make - Euc trees all low in quadrat, adj to 75m

Cover Class - percentage classes	over 70%	<p>TREES</p> <p>B Euc haens</p> <p>MALLEES</p>				Height (metres)
	50-70%	<p>LIFE FORM</p> <p>> 15m or 5-15m</p>	<p>under 5m</p> <p>bank grasses</p> <p>Xylo occid.</p>	<p>MALLEE SHRUB less than 8m</p>	<p>MALLEE TREE 8m or more</p>	
	30-50%	<p>COVER CLASS (%)</p> <p>> 15m</p> <p>5-15m (< 5m) 2-10%</p>	2-10%	0%	0%	
	20-30%	<p>SHRUBS</p> <p>Yan prei (10) 2000</p> <p>Pum brush (3)</p> <p>hook. over 2m</p> <p>Mixed mreed</p> <p>Ac elipt</p> <p>Ac ext up</p> <p>Ac pul</p> <p>Ac meiss</p> <p>Hak hyl (5)</p> <p>Col Sang (5)</p>				
10-20%	<p>LIFE FORM</p> <p>hook. over 2m</p>	<p>2.0-1.5m</p> <p>Hak cut (1)</p> <p>Mel High (2)</p> <p>Hak wae (2)</p> <p>Crev mang (1)</p>	<p>1.5-1.0m</p>	<p>1.0m - .5m</p>	<p>under 5m</p>	
2-10%	<p>COVER CLASS (%)</p> <p>10-20%</p>	2-10%	30-50	< 2%		
under 2%	<p>BUNCH GRASSES</p> <p>under .5m</p> <p>HERBS</p> <p>under .5m (except creepers)</p> <p>SEDGES</p> <p>over .5m</p> <p>Amorpha</p> <p>Tetaria</p>					
0%	<p>LIFE FORM</p> <p>under .5m</p>	<p>under .5m (except creepers)</p>	<p>over .5m</p>	<p>under .5m</p>		
0%	<p>COVER CLASS (%)</p> <p>< 2%</p>	<p>COVER CLASS (%)</p> <p>< 2%</p>	<p>COVER CLASS (%)</p> <p>20-50%</p>	<p>COVER CLASS (%)</p> <p>20-50%</p>		

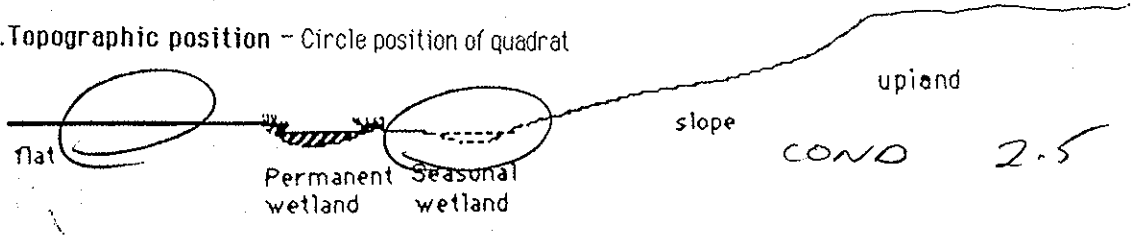
QUADRAT No. WONNERUP 3 VEGETATION TYPE heath
 DATE FIRST TRIP 28/5/92 VOLUNTEERS GJK BJK
 DATE SECOND TRIP 13/10/92 VOLUNTEERS BJK NG
 BOTANIST: 9/11/92 GK/NG/ BM

1. LOCATION of the QUADRAT 33° 40' 02.2 115° 34' 49.5
 (20m ±100)

a. Mud Map Draw a sketch of the location of the quadrat the back of this sheet →

b. Photograph Photographer's name GK

c. 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

% Bare ground 30/50 Drainage well mod poor Wet All year winter/spring

Litter (% cover) 10 Surface soil red brown clay loam Sub-surface soil ironstone

3. VEGETATION STRUCTURE AND COVER. Record appropriate cover class

Cover Class - percentage classes
 over 70%
 50-70%
 30-50%
 20-30%
 10-20%
 2-10%
 under 2%
 0%

LIFE FORM	TREES	MALLEES	
	> 15m or 5-15m 	Under 5m 	MALLEE SHRUB less than 8m
COVER CLASS (%)	> 15m 5-15m	N/A	N/A

LIFE FORM	SHRUBS	MELALEUCA UNCIINATA / KUNZEA MICRANTHA				
		over 2m 	2.0-1.5m 	1.5-1.0m 	1.0m - .5m 	under 5m
COVER CLASS (%)	30/50	30/50				

LIFE FORM	BUNCH GRASSES	HERBS	SEDGES	HYPOLAENA RAMOSISSIMA
		under .5m 	under .5m (except creepers) 	over .5m
COVER CLASS (%)				30/50

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

Wonn

SPECIES PRESENCE

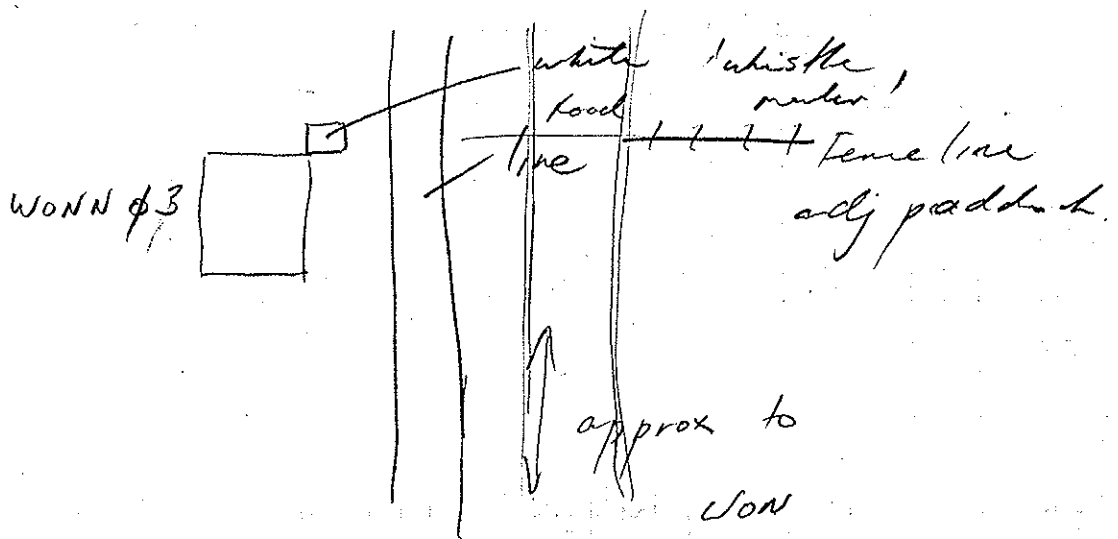
- work systematically through the vegetation; start with the tallest stratum, i.e. trees
- within each stratum try to record the most common species first and the most uncommon last.
- as each species is collected label it with a numbered tag and use this number on your recording sheet
- Indicate if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

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

QUADRAT No.
 Mornup 13

Trees		No	ID	SHRUBS		No	ID	Herbs		No	ID
				9/11/92				13/10/92			
X				X Hydrocotyle calicarpa				X Myriophyllum echinatum			
X				X Diuris carinata				X Sphalochin Drosera			
								X Gratiola peruviana			
Mallees								9/11/92			
								X Centrolepis drum			
								X Stylid. pinnud. truncatus			
								X Sphalochin proc. got			
								X Stylid. utricularioides			VSP
								X Stylid. idc			
								X Redolepis gracilis			
								X Centrolepis varstata			
				Schoenus lennethus				X Schoenus pedunculatus			VSP
SHRUBS				Bunch Grasses				X Leptobromus = G.P. got			
X Mel. vacinata								X Centrolepis glabra			
X Kunzea aff. micrantha (VSP) 13/0								X Centrolepis nubca			
X Mel. leptoclada								X Schoenus lennethus			
X Mel. viminea								X Schoenus otonta			
X Astelia aff. fascicularis								Sedges			
X Leucostemum mangroisoides VSP 13/0								X Limnolobos angust			
X Acacia saligna								X Hypolaena ramulosa (rounded shrub)			
X Hakea aff. variana (row) VSP ✓				Herbs				X Loxocarya sp. (Swicostol) (row)			
Two star com				X Cassytha (pubescens)							
				X Oxalis perennans							
								ADJ			
								X Greivillia mang			
								X Villarsia cypripet.			

87



QUADRAT NO. WONNERUP 4 VEGETATION TYPE Calothamnus/Loxocarya
 DATE TRIP 28/5/92 BOTANIST NG, GK, BM, O
 VOLUNTEERS 13/10/92 BJK NG

Waller's sedges

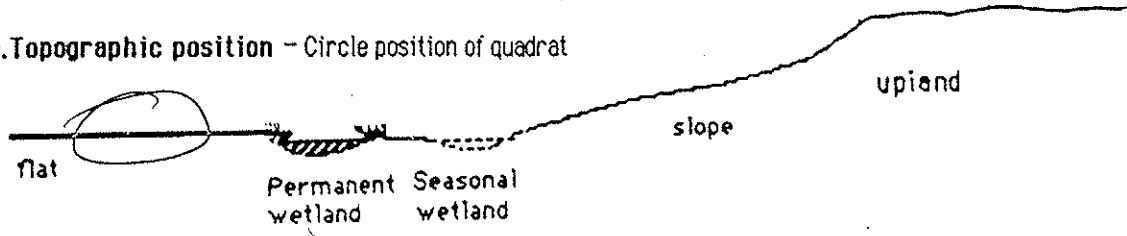
1. LOCATION of the QUADRAT

(±100m) 33°40'01.1" 115°34'12.4"

a. Mud Map Draw a sketch of the location of the quadrat the back of this sheet. →

b. Photograph Photographer's name GK

c. Topographic position - Circle position of quadrat



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

2. SITE DATA - Circle the correct response

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

% Bare ground 30 Drainage well mod poor Wet All year winter/spring

Litter (% cover) 10 Surface soil red laterite clay loam Sub-surface soil sheet laterite

3. VEGETATION STRUCTURE AND COVER Record appropriate cover class

1 Euc. rudis seedling.

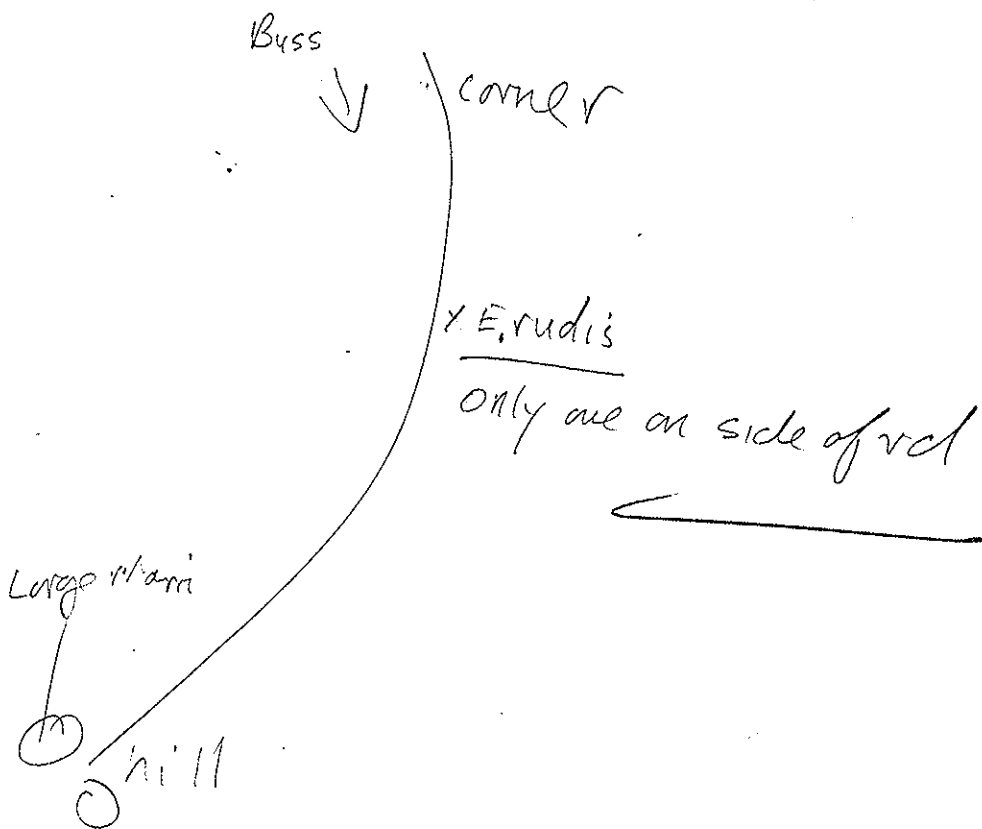
Cover Class - percentage classes	over 70%	TREES				MALLEES				Height (metres)		
	50-70%	LIFE FORM		under 5m		MALLEE SHRUB less than 8m		MALLEE TREE 8m or more				
	30-50%	COVER CLASS (%)										
	20-30%	SHRUBS: <i>Calothamnus quadrifidus</i> (0-2)				SHRUBS						
10-20%	LIFE FORM		over 2m		2.0-1.5m		1.5-1.0m		1.0m - .5m		under 5m	
2-10%	COVER CLASS (%)				10/20				2-10			
0%	LIFE FORM		MAT PLANTS under 10cm		BUNCH GRASSES under .5m		HERBS under .5m (except creepers)		SEDGES <i>Loxocarya</i> s.p			
	COVER								over .5m (MONSTONE) under 5m			

50/70

Stop at *E. rudis* on road

Direct S to flyover railway line, then N to seedling *E. rudis* (1st peg).

• 890 m from *Mel. uncinata* site



Tompsett Rd 2.1 km

(1.2 k. further on)

SPECIES PRESENCE

- 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 JURIE SANDPLAIN
SURVEY. WILDFLOWER SOCIETY of WA

QUADRAT No.
WONNERUP 4

Trees	No	ID	SHRUBS	No	ID	Herbs	No	ID
Euc. rudis			Stylidium off bulbifera			Podolepis ? aristata 'CLAY' mkn?		
			5 Calceotenus - sporad pink	✓	✓	Phyllorella pygmaea	✓	
			Isolepis margin	✓	✓	Calceotenus ? aristata	✓	
			Siloxenus ? hughesii	✓	✓			
			Phyllorella pygmaea	✓	✓	13/10/92		
			Hypocotyle alata	✓	✓	Cyperus tenuis		
			Centrolepis aristata	✓	✓	Damp linearis	✓	
			brachycome belid.	✓	✓	Polypogon sp. multi	✓	
			Opakalane 'Vago Iron'	✓	✓	Asphodelia sp cyp.	✓	
			Angioanthus myke husing	✓	✓	Chaem corym	✓	
			Tagliochon calotropus	✓	✓	Caesia parviflora	✓	
			Telymitra flexuosa	✓	✓	† Eriochilus multiflorus	✓	VSP
			* Briza mex	✓	✓	Telymitra blue	✓	VSP
			Podolepis lessonae	✓	✓	Diana ? carinata	✓	VSP
			* Helophila pusilla	✓	✓	* Briza mex	✓	
						Tribonanthes violacea	✓	VSP
			Bunch Grasses			Hydroaspis acutata (small)	✓	VSP
			* Panchuelia lat	✓	✓	Stylidium	✓	
			* Hyp Jglebr	✓	✓	Villarsia capitata	✓	VSP
			Calce off part	✓	✓	Microtis media	✓	VSP
			* Hira cespitosa	✓	✓			
			Vellide dimicrantha	✓	✓	Sedges		
			Myriophyllum echinatum	✓	✓	Loxocarp sp. (monstr)	✓	
						Lygma lanata	✓	
			Herbs			Loxocarpa fasciculata	✓	
			Hypochaeris glabra	✓	✓	" pubescens	✓	
						Lepidosperma (? name) eastern	✓	
			Stylidium off bulbifera 2	✓	✓	Loxocarpa off flexuosa	✓	VSP
			Thysanotus patersonii	✓	✓	Lepidosperma sp.	✓	VSP
			* Romulea rosea	✓	✓			
			* Drosera bulbosa tubaestylis	✓	✓			
			Conostylis aculeata	✓	✓	12/10/92 * Lotus angustif	✓	
			Microtis media	✓	✓	* Heliphila pusilla	✓	
			Chamaesclera corymbosa	✓	✓	Asphodelia cyperoides	✓	
			Paterosonia occidentalis (Suff)	✓	✓	Schoenus ? sulphur	✓	
			Opsecularia vaginata	✓	✓	Brizula nutans	✓	X
						Isolepis oldfield	✓	X
			13/10/92 Schoenus odonto	✓	✓	calandera margin	✓	X
			patersonia lanuolia	✓	✓	Brizula nutans	✓	

Mallees

SHRUBS

- Calathamus aff. quadrilobus
- Kunzea micrantha
- Acacia pulchella
- Uiminon juncea
- Lycerillea brevicuspis - ADJ
- Acacia stenoptera
- Chamaedaucum roylei
- Hemiantra pungens upright
- 13/10
- Acacia stenoptera

- 9/11/92
- Podolepis grac white
- Centrolepis drum
- Asphodelia cyperoides
- Schoenus
- Isolepis oldfieldian
- Cyperus tenuis

- 13/10/92
- Danthonia setacea
- * Polypogon lernethus

IRON
IRON
IRON

CLAY
COT
COT

13/10/92

NEIL Acacia steep = tetrayn

⑧ *Drosera bulbosa* on Ironstone = *Drosera tubaestylis*

QUADRAT No. WAVI 05 VEGETATION TYPE Vim over *Perocarpus* etc

DATE FIRST TRIP 16/10/92 VOLUNTEERS _____

DATE SECOND TRIP 18/11/92 VOLUNTEERS _____

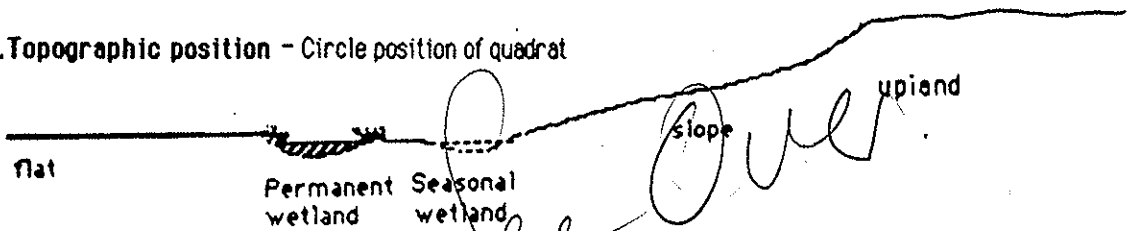
BOTANIST: BJK, NG

1. LOCATION of the QUADRAT

a. Mud Map Draw a sketch of the location of the quadrat the back of this sheet. →

b. Photograph Photographer's name _____

c. Topographic position - Circle position of quadrat



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

2. SITE DATA - Circle the correct response

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

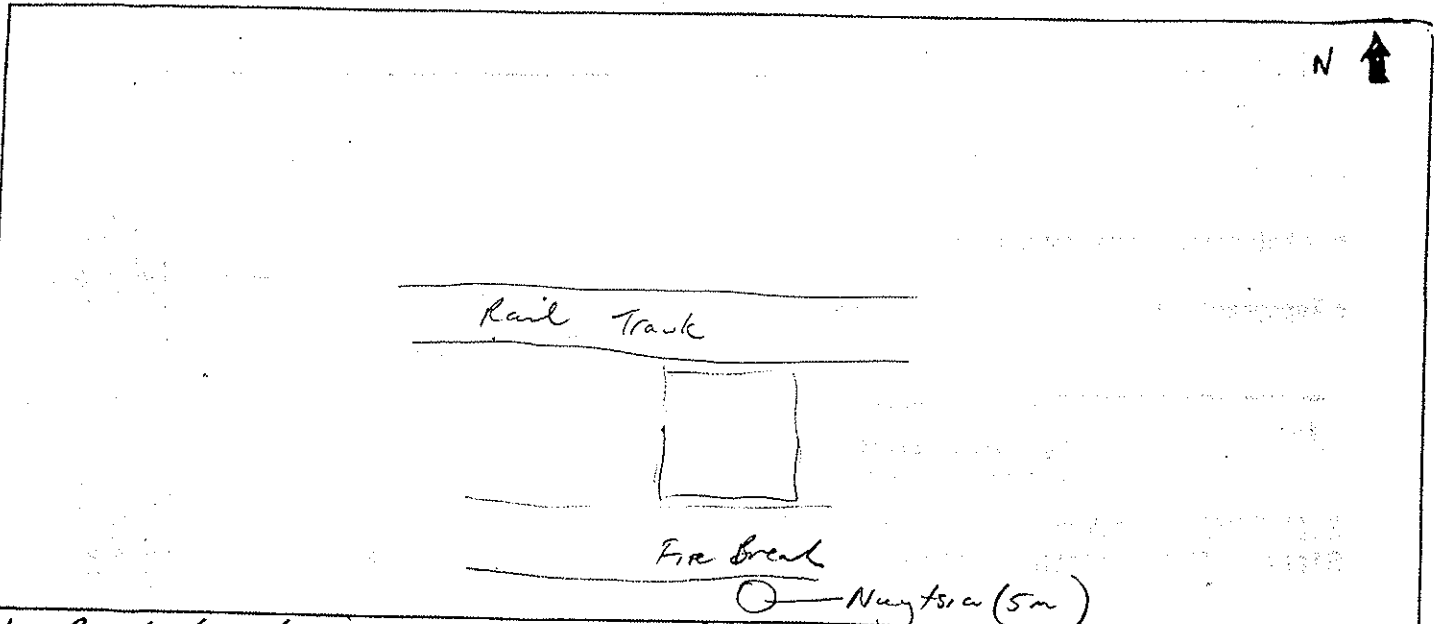
% Bare ground _____ Drainage well mod poor Wet All year winter/spring

Litter (% cover) _____ Surface soil _____ Sub-surface soil _____

3. VEGETATION STRUCTURE AND COVER Record appropriate cover class

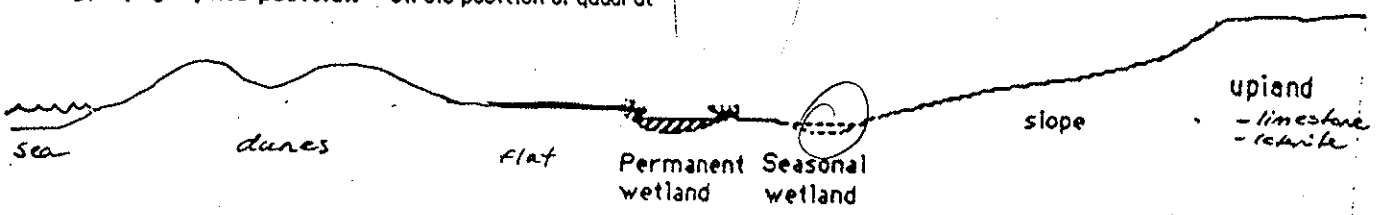
Cover Class - percentage classes	over 70%	TREES				MALLEES				Height (metres)
	50-70%	LIFE FORM > 15m or 5-15m 		Under 5m 		MALLEE SHRUB less than 8m 		MALLEE TREE 8m or more 		
	30-50%	COVER CLASS (%) 2-15m 5-15m								
20-30%	SHRUBS									
10-20%	LIFE FORM Vim <i>Juncus</i> over 2m 		2.0-1.5m Hal Sudcatu 		1.5-1.0m Parie ellip 		1.0m - .5m 		under 5m 	
2-10%	COVER CLASS (%) 2-10%		77%							
0%	BUNCH GRASSES		HERBS		SEDGES					
under 2%	LIFE FORM under .5m 		Ground Hb under .5m (except creepers) 		Restio trun over .5m 		under .5m 			
under 2%	COVER CLASS (%) 2-10% (M.L.C.)		50-70%							

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



b Road Location		c. Latitude	Longitude
Warrump Rd		33° 39' 30.6"	115° 32' 25.7"
4.4km W Evans Rd.			
d. Photograph Photographer's name		Photo No	Altitude
NG		± 100	40m

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 Red/brown clay sand

Sub-surface soil brown sandy clay (ironstone not at 5cm)

Drainage well mod poor

Wet All year winter/spring

Litter (% cover) 10%

% Bare ground 5%

4. VEGETATION CONDITION

EXCELLANT		Comments weeds along edge very few in the vegetation
VERY GOOD	✓	
GOOD		
POOR		
VERY POOR		

2

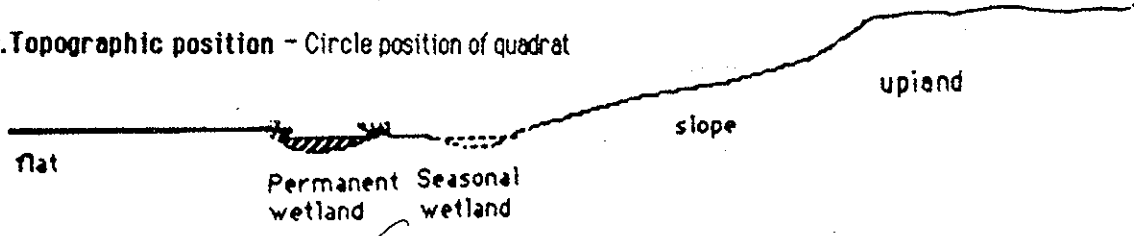
QUADRAT No. WONN 66 VEGETATION TYPE _____
 DATE FIRST TRIP 16/10/92 VOLUNTEERS BJK NG
 DATE SECOND TRIP 8/11/92 VOLUNTEERS BJK NG
 BOTANIST: BJK, GSK NG

1. LOCATION of the QUADRAT

a. Mud Map Draw a sketch of the location of the quadrat the back of this sheet. →

b. Photograph Photographer's name _____

c. Topographic position - Circle position of quadrat



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

2. SITE DATA - Circle the correct response
 Slope flat gentle steep Aspect Over N NE E SE S SW W NW

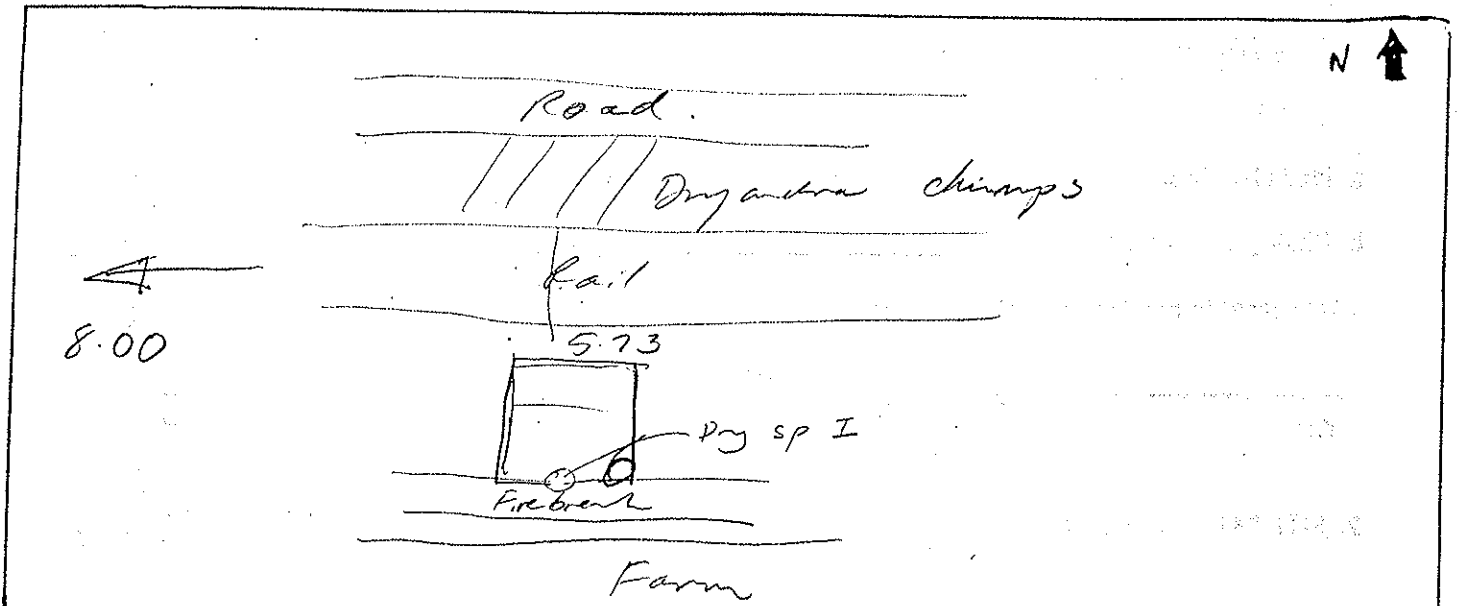
% Bare ground _____ Drainage well mod poor Wet All year winter/spring

Litter (% cover) _____ Surface soil _____ Sub-surface soil _____

3. VEGETATION STRUCTURE AND COVER Record appropriate cover class

Cover Class - percentage classes	over 70%	TREES				MALLEES				Height (metres)
	50-70%	LIFE FORM		COVER CLASS (%)		LIFE FORM		COVER CLASS (%)		
	30-50%	> 15m 5-15m 		Under 5m 		MALLEE SHRUB less than 8m 		MALLEE TREE 8m or more 		
	20-30%	> 15m 5-15m								
10-20%	SHRUBS									
2-10%	LIFE FORM		COVER CLASS (%)		LIFE FORM		COVER CLASS (%)			
0%	over 2m 2.0-1.5m 1.5-1.0m 1.0m - .5m under 5m Vm junceae / Dry sp I 		2-10% - 1/20 to 70% all too narrow 10x10 or on verge		Dry or Riv Pen ellip Chambr 					
	BUNCH GRASSES		HERBS		SEDGES					
	LIFE FORM		COVER CLASS (%)		LIFE FORM		COVER CLASS (%)			
	under .5m 		2-10% (except creepers) 		Restio sp Lox sp over .5m 		under .5m 			

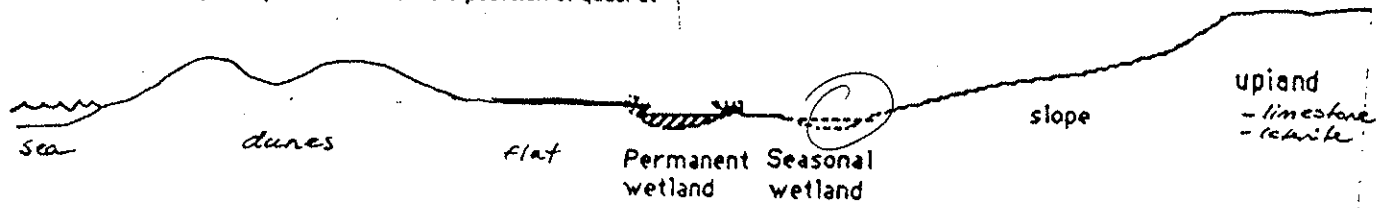
a. Mud Map Draw a sketch of the location of the quadrat:



b Road Location	c. Latitude	Longitude
Wonnemup Rd, 5.73 km W of Evans Rd	33° 39' 18.5"	115° 31' 36.0"
		Altitude 40

d. Photograph Photographer's name NG Photo No 26 1/100m

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 red/brown loamy sand

Sub-surface soil ironstone - ironstone capping

Drainage well mod poor

Wet All year winter/spring

Litter (% cover) 20%
(moss to 60%)

% Bare ground 5%

4. VEGETATION CONDITION

EXCELLANT		comments Patches disturbed? <u>subsets</u> birra major <u>1/4</u> <u>1/4</u> animal <u>ped.</u>
VERY GOOD	<input checked="" type="checkbox"/>	
GOOD		
POOR		
VERY POOR		

25/92
109/97

WESTRALIAN SANDS LIMITED

TECHNICAL REPORT

WSL-TR-97/63

**ENVIRONMENTAL MANAGEMENT PLAN
WONNERUP/TUTUNUP ROAD RECONSTRUCTION**

BY

I CLARKE & N McMULKIN

DATE: 24 November 1997

AUTHOR KEYWORDS:

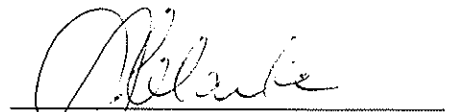
COPY NO:

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AUTHORS SIGNATURE:

AUTHORISING SIGNATURE:



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- Appendix A - Informal Environmental Assessment
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- Appendix C - ISO 9002-1994, Certificate of Registration
- Appendix D - Quality Plan Index - Brierty Contractors
- Appendix E - Organisation Chart - Brierty Contractors
- Appendix F - Description of Responsibilities - Brierty Contractors

FIGURES

- Figure 1 - Site Plan
-

1. INTRODUCTION

Westralian Sands Limited has a number of Mining Leases in the Yoganup/Yoganup West/Tutunup area that are planned to be mined over the ensuing 15 years.

The Wonnerup/Tutunup Road will be used to haul the Heavy Mineral Concentrate (HMC) from the minesites to the Capel Separation plant.

The Wonnerup/Tutunup Road is a typical country road with a minimal seal width and a base course that will not support the weight of the HMC trucks.

The project involves the re-construction of the Wonnerup/Tutunup Road, as well as other associated feeder roads to ensure the HMC trucks and other general traffic can use the road safely.

The road sits parallel to a number of reserves.

The totality of all the reserves are of regional significance as a continuous vegetation transect showing the catena of original vegetation types that existed prior to European settlement.

The reserves are largely undisturbed and contain remnant populations of floristic communities that have been heavily cleared throughout the South West of WA. The most notable of these communities is the "Southern Ironstone".

In addition, in a number of Declared Rare Flora (DRF) and priority species occur in the reserve area.

After the submission of an Notice of Intent (NOI), the level of assessment was set as 'informal' by the EPA. (Appendix A)

An "Application to 'take' Declared Rare Flora" was submitted to CALM. Approval was granted based on specific conditions being observed. (Appendix B)

Westralian Sands Limited has voluntarily committed itself to specific actions in relation to the road re-construction as well as an ongoing involvement in the preservation and upgrading of the floristic values of the reserves.

The commitments in relation to the re-construction includes the requirement to develop an Environmental Management Plan (EMP).

2. OBJECTIVE OF THE 'ENVIRONMENTAL MANAGEMENT PLAN'

The objective of the 'Environmental Management Plan' is -

"to minimise the disturbance to all native flora within the road reserve during the re-construction of the Wonnerup/Tutunup Road, thereby maintaining the long term integrity of the vegetation and its type by ensuring appropriate objectives, strategies, tasks and monitoring techniques are implemented."

The intention of this document is to outline the procedures for minimising the risk of disturbance to the native flora, as well as outlining the monitoring process and the documentation required.

3. CONTRACTOR SELECTION

Brierty Contractors have been selected to carry out the road reconstruction.

A prime selection criteria to determine the successful tenderer was the ability for the contractor to demonstrate a commitment to positive environmental performance, and a system to support that commitment.

Brierty Contractors are the holders of ISO 9002-1994 Certificate of Registration No. QEC 3500. (Appendix C).

All work is carried within a Quality System which is made up of a -

- Quality Manual
- Quality Assurance Procedures Manual
- Quality Plan
- Works Instructions Manual

The Quality Plan incorporates and interlinks the safety and environmental requirements of the contract. (The index of the Quality Plan is attached as Appendix D).

The requirements of the Environmental Management Plan are an integral component of the Quality Plan.

This Plan provides a comprehensive guide and checklist as well as audit trail for everyone involved in the road re-construction.

The road has been divided up into a number of discrete lengths which are called 'lots'. Each lot is a discrete working area and will have its own set of documentation that relates to the Quality System.

4. RESPONSIBILITIES

The road reconstruction contract has been awarded to Brierty Contractors.

BSD Consultants will be managing the work on behalf of Westralian Sands Limited.

Appendix E details the intended organisation chart for Brierty Contractors for this project.

The responsibilities of each of the Brierty staff are outlined in Appendix F. These responsibilities are an integral part of the Quality System.

The following will be responsible for the various roles as described in AS 2124 -

- | | | | |
|---|---|---|------------|
| • | Principal's Representative (WSL) | - | G Dawes |
| • | Principal's Environmental Officer (WSL) | - | N McMulkin |
| • | Superintendent's Representative (BSD) | - | M Boynes |

5. ENVIRONMENTAL MANAGEMENT PLAN

5.1 Preliminaries

5.1.1 Inductions

Inductions are to be carried out for all personnel that will be working on the site.

They will include -

- BSD Project management team
- WSL Project management team
- Brierty management team involved in the project
- CALM (Busselton) personnel
- Brierty employees
- All sub-contractors
- All truck drivers delivering road base to the site
- Any other personnel who have the potential to disturb the vegetation because of their activities on-site.

It is not intended that persons delivering stores to the site be inducted, as often they will be a 'one-off' visit. However protocols are to be put in place by Brierty for all delivery personnel to be aware of the environmental sensitivity of the site. In addition they are to be met and guided by trained Brierty personnel at pre-arranged locations which will not cause any risk to the vegetation.

Inductions will follow three phases -

- *management, supervision, survey, pruning and fencing crews*

This will ensure there is an understanding and commitment from the top down of the project, and that the supervision is aware of their need to 'lead' in environmental awareness.

The personnel involved in the initial stages of the project will be inducted at this stage as well.

- *road construction phase*

Personnel involved in the actual road reconstruction, including the road base truck drivers

- *road sealing*

Personnel required for the sealing of the road as well as those involved in the final road presentation.

The inductions will cover the Environmental Management Plan, the need for the plan and the positive attitude that will be required of all personnel working on the contract. Inductions will also cover the specifics of the particular tasks to be carried out with those individuals that will carry out that task.

In addition to the induction, environmental 'tool box' meetings will be held when it is considered necessary to ensure job details are understood and complied with.

Objective: to ensure everyone understands and appreciates the environmental values of the reserve and therefore the need for the specific 'rules and controls' that will be applied to the project.

Management Strategy: ensure everyone undergoes an on-site induction

Task & Responsibilities: appointed WSL Environmental Co-ordinator to be responsible for preparation and presentation of inductions, assisted by Brierty Environmental Officer.

Brierty management to fully demonstrate need to work to rules and be supportive of them - knowing that any risks to vegetation will take precedence over productivity.

Monitoring/Performance Indicators:	No incidents to be caused or exacerbated by lack of environmental knowledge or awareness by anyone on site.
Responsible Person(s):	WSL Environmental Officer, BSD Superintendent, Brierty Environmental Liaison Officer and Brierty Project Manager
Reporting Review:	Brierty Project Manager to keep BSD Superintendent informed of the cause of all incidents as soon as practical. BSD Superintendent to include causes of all Environmental Incidents in weekly site meeting minutes. Review of incidents at weekly BSD site meeting as well as end of any specific phase.
Corrective Action:	Additional inductions to be held where necessary. Personnel who do not demonstrate the appropriate awareness to attend additional inductions, and also be specifically counselled by Brierty management at the earliest opportunity

5.1.2 Communications

(i) Onsite Communications

The management and supervisors of Brierty Contractors will be equipped with mobile phones. Brierty may also have a satellite phones on the site for facsimile communication.

The BSD Superintendent, the WSL Principal's Representative and the WSL Environmental Officer will have mobile phones.

Brierty Contractors use mobile CB radios on all their equipment. The road base truck drivers also uses CB radios.

Communication with all personnel can therefore be immediate.

(ii) Contractual Communications

The BSD Superintendent will issue daily instructions as allowed under the contract.

Weekly meetings will be held between the BSD Superintendent and the Brierty site management team.

The weekly meetings will be minuted and forwarded to CALM and the Busselton Shire.

(iii) *Landowner/Road User Liaison*

WSL has been liaising with the immediate landowners to keep them informed of the progress of the project.

Negotiations have been carried out with some landowners for equipment turn around areas to be set up on their property.

Brierty Contractors will continue liaising with the landowners as well as other road users (school bus, milk tankers etc) to keep them informed of -

- project progress
- use of turn around areas
- potential delays in relation to specific work
- receiving any concerns that may arise

(iv) *Press Releases*

To keep the general public informed a press release will be made immediately prior to the commencement of the project.

Other press releases will be made if and when required.

The intent of the press releases is to raise the local awareness of the reserves' environmental importance.

5.1.3 Establishment

Prior to re-construction work on the road commencing, the following works will be undertaken -

i. Drawing Information/Survey Control

A number of steps will be taken prior to construction commencing on site. These will include -

- ensuring all drawing information (including environmental information) is up to date.

- ensuring survey control is in place and the continuing updating of that control will not have an impact on the environment.

ii. Setting up of the Camp Site

The camp site will be set up on WSL land on Tompsett Road. The land has been cleared for pasture previously.

The camp site will be set up with dieback and environmental hygiene management as a pre-requisite. Specific areas will be set up for employee and sub-contractor parking.

iii. Erection of Project Signs

Project signs will be erected along the road length. They will be placed in areas where native flora will not be disturbed.

iv. Installation of Bore Water Supply

All water used on the project will be supplied from a bore at the camp site on Tompsett Road, and a bore at the Yoganup minesite.

v. Turn around areas

On a standard road building exercise trucks and equipment would normally turn around on the construction area within the road reserve area. The Wonnerup/Tutunup road area is not wide enough to allow the trucks to turn without impacting on the vegetation.

Turn around areas will be established at 11 locations along the road. These will be established on privately owned and cleared land adjacent to the road reserve.

They will be developed using dieback free gravel, and fenced to maintain all movement on them. They will be rehabilitated after completion of the road re-construction if required by the individual property owners.

All trucks and equipment will continue to the next available turn around area to allow them to change direction.

The turn around areas have been located to match dieback free areas.

5.1.4 *Transplanting/pruning Vegetation Along the Side of the Road*

Transplanting and pruning along the road will be undertaken prior to road re-construction work commencing in that area. This will ensure that the focus can be on the vegetation - with appropriate supervision.

All vegetation to be transplanted will be identified using a specific coloured flagging tape.

Vegetation to be pruned will be tagged by the WSL Environmental Officer using a different coloured flagging tape.

Vegetation will be pruned utilising specialist equipment for the task. This will be undertaken prior to erecting the 'no-go' fence. (See section 5.1.5 below). Where necessary hand pruning will be undertaken.

It is intended the pruning line be 300mm from the toe of the batter, and angled at 60°. This will ensure that regrowth will not grow back onto the road in the immediate future, thereby reducing repetitive pruning.

Liaison will be maintained with CALM who will direct what cuttings are required from the native vegetation and who the cuttings are to be delivered to.

Objective: to complete work on vegetation at startup to minimise the need to address any flora work during the construction phase, thereby focussing individuals minds on their specific tasks

Management Strategy: to address the physical aspects related to the vegetation early in the project phase to enable a continuous 'no-go' barrier to be set up

Task & Responsibilities: delineation and liaison with CALM - WSL Environmental Officer.

actual cutting will be overseen by WSL Environmental Officer with close attendance by Brierty Environmental Liaison Officer

all transplant work to be carried out by WSL Environmental Officer

Monitoring/ Performance Indicators:	work to be carried out to the satisfaction of CALM number of DRF pruned to be compatible with WSL estimates in NOI/Application to 'Take'
Responsible Person(s):	WSL Environmental Officer, Brierty Environmental Liaison Officer and Brierty Project Manager
Reporting Review:	number of DRF pruned and/or transplanted to be reported at weekly BSD site meeting, as well as a description of the cuttings forwarded to CALM. A specific report to be forwarded to CALM on the cuttings collected
Corrective Action:	immediate cessation of work if requested by WSL Environmental Officer or by CALM personnel CALM fines can also be imposed

5.1.5 Placing 'No-go' Fence Along Road Verge

Brierty Contractors will be placing a fence along the length of the Wonnerup/Tutunup Road.

The fence will be placed on the edge of the road re-construction area, 300mm from the clearing line.

The fence will be constructed of 'star' pickets with fencing wire run between the pickets. Barricade tape and reflective devices will be used where appropriate to make the fence more visible.

It is not intended the fence be a substantial physical barrier but be a constant visual reminder to all road users.

Objective:	to provide both a physical and visual barrier to edge of road that cannot be crossed without knowledge or intent
Management Strategy:	to provide a physical, obvious 'no go' line for all road users, including the public
Task & Responsibilities:	Brierty Project Manager responsible to install fencing, positioned according to survey of road alignment

Monitoring/ Performance Indicators:	all instances of fence being crossed where crossings have not been authorised by WSL Environmental Officer and Brierty Environmental Liaison Officer to be reported and investigated
Responsible Person(s):	Brierty Project Manager and Brierty Site Supervisor
Reporting Review:	Brierty Site Supervisor to keep BSD Superintendent informed of the cause of all incidents in relation to fence breaches as soon as practical review of incidents where fence is crossed or breached to be noted at weekly BSD site meeting as well as end of any specific phase
Corrective Action:	incidents of fence crossings to be investigated to ascertain where improvements to system can be made personnel to be counselled when required

5.2 Earthworks

5.2.1 Dieback Hygiene

Investigations undertaken by WSL with CALM show that dieback is prevalent along the length of the Wonnerup/Tutunup Road. All work will comply with the CALM Dieback Hygiene Manual.

Dieback free gravel will be used for the entirety of the road length to minimise the potential to exacerbate the dieback problem.

The gravel will be sourced from a CALM certified dieback free pit.

The quarry from which the gravel is sourced will be inspected by the WSL Environmental Officer and BSD Superintendent prior to any gravel being delivered.

A 'dieback free' certificate will be obtained from the quarry management by Brierty and forwarded to WSL prior to the delivery of any gravel to site.

All truck drivers coming to site will receive an induction.

All equipment brought on-site will be cleaned prior to being used on the project. Any equipment not deemed to be clean will be sent off site and refused entry until it passes inspection by the WSL Environmental Officer.

A daily record of equipment brought on-site will be maintained by Brierty Contractors. This will be available to BSD and WSL for visual equipment checks and audits.

The present road pavement and base will be broken up and re-used where practical. In undertaking this work the spread of in-situ material will be minimised to that locale. No gravel from the current road will be allowed to cross the dieback free boundaries.

The two major ironstone areas will be declared as 'dieback free' zones. Specific procedures will be adopted for movement of construction traffic over these areas.

Water carts will be used to add water to the road works. They will also assist in keeping the dust down. No additives will be used in the water.

The spray bars on the water carts will be adjusted to keep the spray on the road pavement and not to over spray onto the surrounding vegetation.

All turn around areas will be constructed of dieback free material, and fenced, to minimise the risk of picking up the fungi from the paddock area.

Objective:	to minimise the impact of dieback along the Wonnerup/Tutunup Road
Management Strategy:	to utilise dieback free gravel along the entirety of the road length
	to ensure equipment is clean before coming on site
Task & Responsibilities:	supply of 'dieback free' certificate to WSL - Brierty Project Manager
	inspection of gravel pits - WSL Environmental Officer and BSD Superintendent
	adjustment of water sprays - Brierty Project Manager
	inspection of equipment for cleanliness - Brierty Site Supervisor/Environmental Liaison Officer
Monitoring/ Performance Indicators:	audit of equipment cleanliness by WSL Environmental Officer visual check of spray bars by WSL Environmental Officer and Brierty Environmental Liaison Officer

Responsible Person(s):	Brierty Site Supervisor, Brierty Environmental Liaison Officer
Reporting Review:	list of equipment on-site to be available at all times to the BSD Superintendent and to WSL Environmental Officer all equipment leaving site to be reported to the BSD Superintendent all equipment movements, both on and off site, as well as the lot worked in, to be recorded on the daily log sheets any change in gravel source must be preceded by a certificate and an inspection .
Corrective Action:	any equipment found on-site through a check, and found to be not clean will be removed from site immediately if equipment is found to be dirty from off site dirt it will be treated as an Environmental Incident and therefore relate to the Environmental Incentive Scheme

5.2.2 Fuel Handling/Hydrocarbon Spill

All equipment is to be re-fuelled at a turn around bay or at the camp site with appropriate safety measures in place.

Even though re-fuelling will not occur along or on the road, strict precautions will be maintained at the turn arounds and camp site.

To minimise the chance of a hydrocarbon spill occurring from a hydraulic hose bursting or a leaking fuel line, equipment coming on site will be checked for -

- leaks
- condition of hoses

If equipment breaks down while on the job and cannot be transported to the camp site, a sump will be dug in the nearest turn around area and lined with plastic into which any oils will be dropped. The oil will be pumped out of the sump after the completion of the repair.

Any soils contaminated by hydrocarbons will be picked up and transported to a remedial site at the WSL North Capel site.

Objective:	to minimise the potential for hydrocarbons to impact on the vegetation
Management Strategy:	to minimise the risk - re-fuelling and greasing of machines is to be conducted away from the road re-construction area
Task & Responsibilities:	all employees to be informed of the requirements for re-fuelling, and the actions to be taken in the event of a spill, at the induction - Brierty Environmental Liaison Officer
Monitoring/ Performance Indicators:	Place of re-fuel for all equipment to be recorded on the daily re-fuel log sheets
Responsible Person(s):	Brierty Site Supervisor
Reporting Review:	All log sheets to be available for audit
Corrective Action:	If re-fuelling occurs on the road it is to be viewed as an environmental incident and therefore relate to the Environmental Incentive Scheme. Any spillage is to be reported and cleaned up immediately

5.2.3 Culverts

A number of culverts and drainage lines have to be installed along the length of the road.

All material dug from the drains will be initially stockpiled at the camp site area for later disposal of at the minesite.

The culverts and drainage lines will be inspected for native vegetation by the WSL Environmental Officer prior to any work commencing. CALM will be contacted for advice if any species are encountered that are either listed as rare or are on the priority list. The culverts and drainage lines have been positioned after consideration of the location of DRF and priority species, so it is anticipated there will not be a high potential for this to occur.

Any work undertaken will minimise disturbance to all flora.

The fence along the edge of the road re-construction area will allow temporary access to the culverts.

These access areas will be flagged to ensure personnel do not mistake an area as a potential spot to turn around.

The culvert work will take place in front of the actual road pavement works.

Objective: to minimise the amount of native vegetation disturbed when clearing for the culverts and drainage lines

Management Strategy: check areas thoroughly prior to excavation works commencing

culvert work to be closely supervised

Task & Responsibilities: areas to be checked - WSL Environmental Officer

close supervision - Brierty Site Supervisor

Monitoring/ Performance Indicators: reports in respect of vegetation to be disturbed to be written for CALM prior to disturbance. Actual disturbance to be compared against report - for CALM review

Responsible Person(s): WSL Environmental Officer, Brierty Site Supervisor

Reporting Review: culvert and drainage line work to be included in weekly meeting minutes

Corrective Action: immediate liaison with CALM if any vegetation is damaged other than that which was predicted

rehabilitation of area to be undertaken

5.2.4 Excavation/Subgrade

A stabilising machine will be used to pulverise and mix the existing pavement and sub course.

Additional material will be added and mixed in-situ to form the base course layer.

This is a very controlled activity that will occur within the fenced area.

There is minimal environmental risk associated with this activity.

5.2.5 Base Course

The base course requires the cartage of imported gravel to site.

The gravel will be carted by the gravel supplier. All trucks will be inspected for cleanliness on the first run of the day. The gravel supplier will be required to keep the same trucks on the run so the level of dieback hygiene is maintained.

All truck drivers will attend an environmental induction.

Their job routine will include radioing to the Brierty supervisor prior to entering the road works. They will then be instructed where to dump their load, and what number turn around to use.

Objective: to maintain dieback hygiene through use of the same 'clean' trucks

to ensure vegetation is maintained through Giacci truck drivers demonstrating a positive environmental awareness

Management Strategy: to strictly control entry of the gravel supplier's trucks onto site by use of the CB radio network

Task & Responsibilities: inspection of the gravel supplier's trucks - Brierty Site Supervisor

communication with truck drivers by CB - Brierty Site Supervisor

Monitoring/ Performance Indicators: visual check that all trucks are dumping in correct position and use the required turn around area

Responsible Person(s): Brierty Site Supervisor

Reporting Review: trucks coming on-site to be recorded daily and record to be available for review by BSD Superintendent

Corrective Action: any truck driver not following instruction to be banned from site

The trimming of the gravel base to the required level by the grader will result in some gravel spilling under the fence and into the drain.

Brierty Contractors will have 'stringers' operating with the grader.

They will be responsible for pulling the gravel back from the drain using a 'levelling' rake, and where necessary shovelling the gravel back from the drain.

The 300mm between the fence and pruned vegetation will allow this to occur with minimal impact.

Objective:	to minimise gravel spillage into the native vegetation area
Management Strategy:	personnel will be used to hand rake the gravel from the drain specific instructions will be given to the grader operator to be aware of gravel rills when working the edge of the road shoulder
Task & Responsibilities:	Brierty employees will be used to rake the gravel from the drain
Monitoring/ Performance Indicators:	visual checks for gravel in the drain and vegetated area
Responsible Person(s):	Brierty Site Supervisor
Reporting Review:	audits of drains to be conducted daily by Brierty Environmental Liaison Officer and included in daily log book
Corrective Action:	any large spillages to be reported immediately to Brierty Environmental Liaison Officer. Job procedure to be reviewed with grader operator for improvement any gravel in vegetation area to be removed carefully, by hand if necessary, after seeking advice from WSL Environmental Officer

5.3 Bituminous Sealing

Road sealing will be undertaken by a specific contract crew that will be undertaking the work under sub-contract. They will undergo a specific induction that will relate to their work.

The bituminous surface will be a two coat seal consisting of a 7mm primer and a 10mm seal.

The specific risks to the environment from this work are -

- bitumen sprayed indiscriminately over vegetation

- spray truck nozzles and lines cleaned on the verge
- sealing paper thrown into drain/bush

The fence will be left up to ensure there is a visual barrier for the crew.

The areas to be sprayed will be coordinated with the turn around areas to allow the spray truck to turn in quickly once an individual run is completed.

The clean out of nozzles will be allowed in the turn around area.

All sealing paper is to be collected after completion of use for destruction by incineration off site by WSL.

Minimum aggregate coverage will be used on the final seal.

The turn around areas will be used for the storage of screenings.

Objective:	to ensure all bituminous sprays and associated hydrocarbons do not impact on the surrounding vegetation or enter the drainage system
Management Strategy:	specific induction to be given to spray crew close supervision
Task & Responsibilities:	close supervision - Brierty Site Supervisor
Monitoring/ Performance Indicators:	visual inspection of spray work no bitumen in drains or on vegetation
Responsible Person(s):	Brierty Site Supervisor
Reporting Review:	Spray sheets to indicate where clean out occurred and whether sisal craft collected
Corrective Action:	immediate request to change practice or system of work when or if required

5.4 Post Construction

5.4.1 Cleanup/Guide Posts/Line marking

After the completion of construction there is the requirement to carry out cleanup work. This will be undertaken prior to the removal of the fence.

This work will include -

- 'brooming' the shoulders
- placement of guide posts
- marking of lines

There is minimal environmental risk associated with these tasks.

5.4.2 Fence Removal

The removal of the fence will require additional vigilance by operators and supervision to ensure the 'no-go' area is not entered.

Objective:	to ensure that damage to vegetation does not occur during the final clean-up phase as the fence will be removed - taking away that physical and visual barrier
Management Strategy:	ensure where practical all major works are undertaken prior to removal of fence. All other tasks are to be undertaken by personnel who have had the potential environmental impacts reinforced with them
Task & Responsibilities:	prior to the removal of the fence, all tasks to be completed after removal of the fence are to be reviewed by the BSD Superintendent, Brierty Project Manager and WSL Environmental Coordinator as to the procedures to be followed
Monitoring/ Performance Indicators:	continuing visual inspection
Responsible Person(s):	Brierty Project Manager, Brierty Site Supervisor, Brierty Environmental Liaison Officer
Reporting Review:	to be reviewed on a daily basis with BSD Superintendent and WSL Environmental Officer
Corrective Action:	dependent on incident type

5.5 Fire Control

The road re-construction work will be undertaken during the summer period when the surrounding bush is extremely dry.

The construction of the fence will stop any equipment coming into contact with any vegetative combustible material within the road reserve.

The equipment will be running on the prepared road surface at all times, therefore the risk of a bush fire being started by equipment is seen as low.

All equipment will have its exhaust checked prior to coming onsite.

All road construction equipment shall carry an appropriate fire extinguisher.

If a fire does start, whether it be a result of road construction activities or from any other reason, then WSL and Brierty will do everything that can be safely done to contain it. The appropriate authorities will be asked for assistance by Brierty management immediately.

Objective:	to minimise the potential for a bush fire in the road reserve
Management Strategy:	to keep all road construction equipment on the road construction area
	to keep all exhausts in good condition
Task & Responsibilities:	all equipment exhausts to be checked before coming on site and appropriate work carried out where necessary - Brierty Project Manager
	check and maintain all fire extinguishers and other fire fighting equipment in working order
	obey all instructions regarding equipment use on days of high fire risk
Monitoring/ Performance Indicators:	continuing visual checks of exhausts
Responsible Person(s):	Brierty Project Manager, Brierty Site Supervisor
Reporting Review:	equipment defects to be reported to Brierty Site Supervisor
Corrective Action:	any defective equipment to be repaired immediately

6. EMPLOYEE INCENTIVE SCHEME

A pro-active incentive payment scheme will be implemented to provide a reward for positive environmental performance by all persons working on the site.

It is intended that a substantial sum of money be made available to each full time employee if the road re-construction is completed without any environmental incidents occurring. Any person not working full time on the site will receive a pro-rata amount.

The amount will be halved if one incident occurs - and by another half if an additional incident occurs.

The arbitrators of any environmental incident will be the WSL Environmental Officer and the Brierty Environmental Liaison Officer.

It is anticipated that each employee will be sufficiently motivated by the potential reward they will be pro-actively ensuring all others working on the road are working towards the same goals - no environmental incidents.

APPENDIX A

Informal Environmental Assessment

APPEAL DECISION SUMMARY

APPEAL NOS: 96/134

APPELLANT: CONSERVATION COUNCIL OF WA

PROPONENT: WESTRALIAN SANDS LTD

PROPOSAL: RECONSTRUCTION OF THE WONNERUP/TUTUNUP ROAD, BETWEEN WONNERUP & TUTUNUP (THROUGH AREA OF REGIONALLY SIGNIFICANT VEGETATION)

NATURE OF APPEAL:

The appeal is lodged in objection to the level of assessment as set at Informal Review with Public Advice by the Environmental Protection Authority for the above proposal.

GROUNDINGS OF APPEAL:

- 1 The area was nominated in the System 6 Update. It is highly valued by the community and any proposal which will devalue the area should be formally assessed with full public input.
- 2 The area has rare species and is a Threatened Ecological Community according to CALM's classification. It was identified in "A Floristic Survey of the southern Swan Coastal Plain" by Gibson, Keighery et al.
- 3 In the absence of formal assessment and legally binding conditions there are no formal requirements for ongoing management of the proposal. In particular, the risk of spreading dieback and increasing the likelihood of weeds cannot be addressed through informal assessment.

DECISION OF THE MINISTER: DISMISSED

DATE OF DECISION: 11 June 1997

APPEAL DECISION SUMMARY

APPEAL NOS: 96/135

APPELLANT: WILDFLOWER SOCIETY OF WESTERN AUSTRALIA (Inc.)

PROPONENT: WESTRALIAN SANDS LTD

PROPOSAL: RECONSTRUCTION OF THE WONNERUP/TUTUNUP ROAD, BETWEEN WONNERUP & TUTUNUP (THROUGH AREA OF REGIONALLY SIGNIFICANT VEGETATION)

NATURE OF APPEAL:

The appeal is lodged in objection to the level of assessment as set at Informal Review with Public Advice by the Environmental Protection Authority for the above proposal.

GROUNDINGS OF APPEAL:

- 1 The area was nominated in the System 6 Update. It is highly valued by the community and any proposal which will devalue the area should be formally assessed with full public input.
- 2 The Wonnerup/Tutunup Road bushland is of outstanding conservation value and has been recognised by all regional surveys on the Swan Coastal Plain done by the Department of Conservation and Land Management, the Australian Heritage Commission and the Conservation Council (WA); and the EPA as part of the System 6 Update as a 'threatened and poorly reserved plant community'.

It is of regional significance as it is one of the last two remaining continuous vegetated transects on the Swan Coastal Plain showing the catena of original vegetation types of the eastern side of the plain. It forms an almost continuous corridor of bushland linking the Ruabon Nature Reserve and the Ludlow Tuart Forest to the Whicher Range.

It is a site of major floristic significance containing Declared Rare and Priority Listed Flora.

DECISION OF THE MINISTER: DISMISSED

DATE OF DECISION: 11 June 1997

APPENDIX B

Approval to 'take' Declared Rare Flora

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT
WESTERN AUSTRALIA

WILDLIFE CONSERVATION ACT 1950 AS AMENDED - SECTION 23F

PERMIT TO TAKE DECLARED RARE FLORA

The undermentioned person may take Declared Rare Flora as shown below for the purpose described subject to the terms and conditions of this permit. Please note: DRF in this permit = Declared Rare Flora.

1. PERMIT NO: 39/97
2. PERMIT HOLDER: Mr Neil McMulkin
ADDRESS: Rehabilitation Advisor
Westralian Sands Limited
3. DESCRIPTION OF PLANT:
 - 3.1 SCIENTIFIC NAME: *Chamelaucium roycei* and *Grevillea elongata*
 - 3.2 PARTS TO BE TAKEN: Whole plants
 - 3.3 QUANTITY: Minimum number required to complete road reconstruction, as detailed in the Westralian Sands application to take rare flora.
4. PURPOSE OF TAKING: Road upgrade
5. METHOD OF TAKING: Machine operation
6. AREA TO WHICH PERMIT RELATES: Wonnerup-Tutunup Road, from intersection of Hithergreen Ludlow Road to edge of scarp south to the east.
7. PERIOD FOR WHICH PERMIT IS VALID: From date of signature below to completion of the road works.
8. CONDITIONS:
 - 8.1 Removal of DRF material by road upgrade activities shall be limited to that detailed in 3.3 above. If a larger quantity of material is required a further application shall be made to the Executive Director, Department of Conservation and Land Management.
 - 8.2 In areas within the zone of potential *Phytophthora* dieback occurrence, dieback hygiene measures are to be undertaken when entering DRF habitat.
 - 8.3 Only dieback free gravel, may be utilised in road building/upgrading activities in areas containing DRF where infections are not currently identified, as determined by CALM's District Manager at Busselton.
 - 8.4 The licensee shall liaise with CALM's District Manager at Busselton and obtain approval to source gravel to be used in all known areas containing DRF.
 - 8.5 No spoil material is to be dumped into vegetated road reserves known to contain DRF, and all waste material shall be removed from the site and located in areas as approved by CALM's District Manager at Busselton.
 - 8.6 No original DRF material taken under authority of this permit, shall be used for commercial purposes.
 - 8.7 Copies of any report or publication on the DRF covered by this permit shall be provided to the Executive Director, Department of Conservation and Land Management.
 - 8.8 The location of DRF populations shall be treated as confidential and under no circumstances disclosed to other persons without the written permission of the Executive Director, Department of Conservation and Land Management.
 - 8.9 Within one month of the completion of the road upgrade activity details concerning the quantity of DRF taken plus a completed Rare Flora Report Form for each population affected by the works shall be provided to the Executive Director, Department of Conservation and Land Management, via the Administrative Officer Wildlife Branch.
 - 8.10 The Licensee shall advise CALM's District Manager at Busselton at least 7 working days prior to the taking of any DRF material.

COPY

K. W. O.
.....
INITIAL OF DELEGATE OF THE
MINISTER FOR THE ENVIRONMENT

(FURTHER CONDITIONS DETAILED ON PAGE TWO)

PERMIT TO TAKE DECLARED RARE FLORA NO. 39/97

(CONDITIONS CONTINUED)

COPY

- 8.11 The Licensee shall arrange for all DRF plants to be tagged within the vegetated road reserve (described in 6 above) to differentiate those that may be taken from those to be protected, and ensure that no damage occurs to those plants identified to be protected. All contractors working in the area are to receive appropriate training to ensure that DRF are not accidentally damaged. All tagging devices are to be removed at the completion of the road upgrade.
- 8.12 This permit also covers the activities of other persons involved in the road upgrade activity under the supervision of the permit holder.
- 8.13 The Executive Director, Department of Conservation and Land Management reserves the right to remove any material from the DRF species detailed in this permit.

K. J. McDonnell
.....
DELEGATE OF THE MINISTER
FOR THE ENVIRONMENT
(in accordance with section 133(1) of the
CALM Act 1984)

DATE: *4/7*...../1997

APPENDIX C

ISO 9002-1994, Certificate of Registration



Quality
Endorsed
Company

Certificate of Registration

BRIERTY CONTRACTORS

ACN 009 021 970

3 Carole Road Maddington WA 6109

The above licensee has been assessed and registered by Quality Assurance Services Pty Limited as having the capability to control the quality of goods or services provided in accordance with the conditions of Licence Agreement number QEC 3500 at or from the addresses shown in Schedule 1 to the Licence Agreement, under a quality system complying with the requirements of:

ISO 9002:1994

AS/NZS ISO 9002:1994

Quality systems-Model for quality assurance in production, installation and servicing

Issue Date: 29 February 1996

Licence No.: QEC 3500

(Original Date of Issue: 25 January 1994)

Frank Urban
Strategic Marketing Manager
Quality Assurance Services

Authorised Local Signatory QAS



QUALITY ASSURANCE SERVICES

APPENDIX D

Quality Plan Index - Brierty Contractors

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Level Check - Form C2
Culvert As Constructed - Form C3

App IV TRAFFIC MANAGEMENT PLAN

MRWA Traffic Management for Roadworks General
Field Guide
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Daily Traffic Plan - Form A2

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ITP 15 - Dieback Management

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App VIII

CHECKLISTS

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Check 0	Prelimineries
Check 1	Site Preparation - Clearing
Check 2	Turnaround Tracks
Check 3	Earthworks - Topsoil
Check 4	Earthworks - Cut and Fill
Check 5	Earthworks - Excavation
Check 6	Borrow Pits
Check 7	Culvert Construction
Check 8	Subgrade Preparation
Check 9	Basecourse
Check 10	Bituminous Surfacing
Check 11	Concrete Kerbing
Check 12	Miscellaneous (Signs, Guide Posts etc.)
Check 13	Drill and Blast
Check 14	Environmental Management
Check 15	Dieback Management
Check 16	Temporary Traffic Control

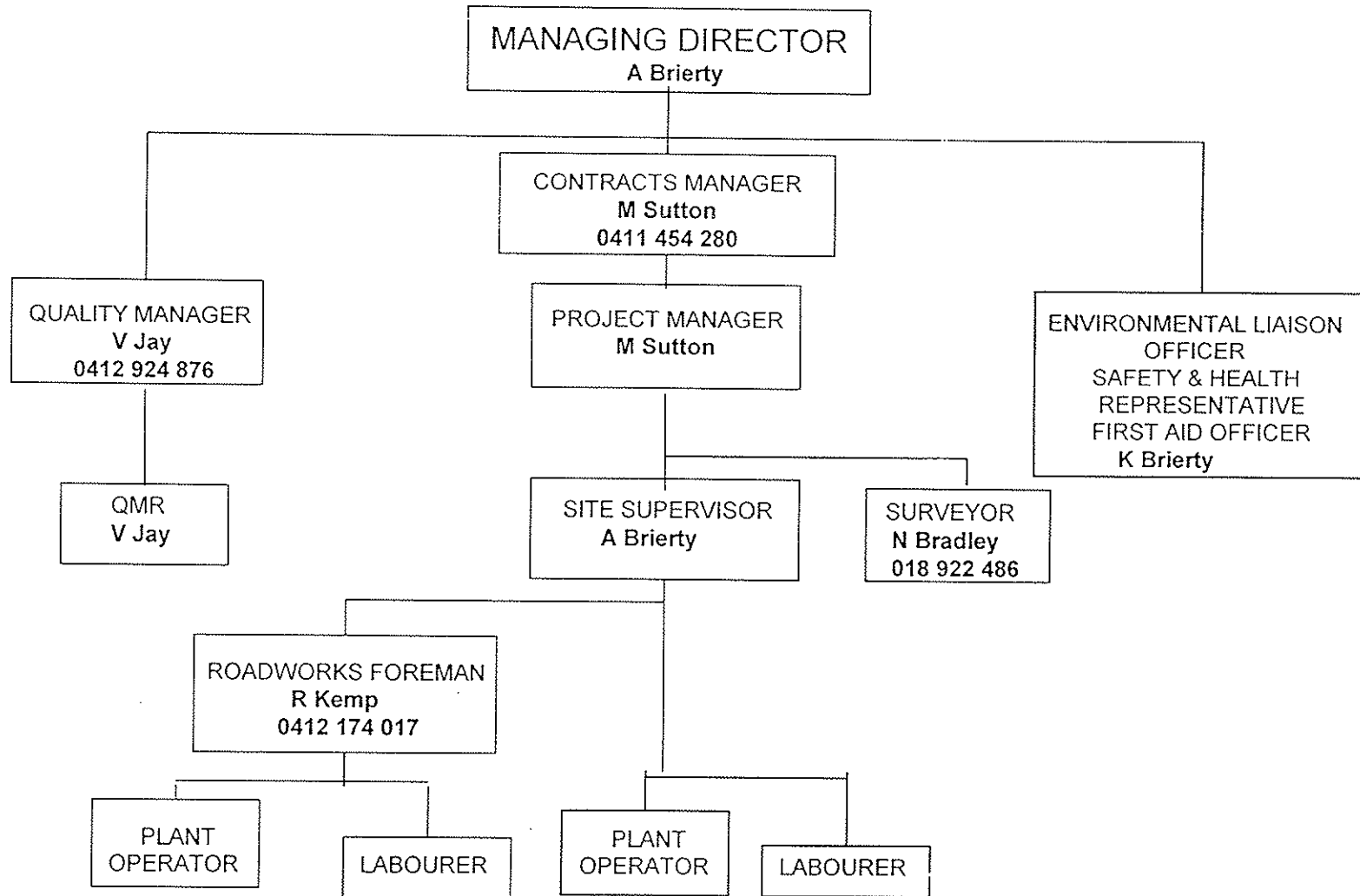
APPENDIX E

Organisation Chart - Brierty Contractors

ORGANISATION CHART

CONTRACT NO 397/97

YOGANUP



APPENDIX F

Description of Responsibilities - Brierty Contractors

QUALITY PLAN

This Quality Plan has been prepared to meet the specific requirements of the contract in accordance with the company's existing Quality System which has been formulated to meet the requirements of AS/NZS ISO 9002.

the Quality System comprises:

- Quality Manual
- Quality Assurance Procedures Manual
- Quality Plan (Contract Specific)
- Work Instructions Manual

The responsibilities of company personnel are defined in these system elements. Those responsibilities which specifically relate to this contract are defined as follows:

CONTRACTS MANAGER

The Contracts Manager reports directly to the Managing Director and is responsible for the overall management of this project.

PROJECT MANAGER

The Project Manager reports to the Contracts Manager and is responsible for the management and control of site activities of this project.

- Participating in the Contract Review Meeting.
- Assigning the tasks arising from the Contract Review Meeting
- Assisting the Quality Manager with the development of a Quality Plan for the project
- Co-ordinate Implementing a Dieback Management Plan, Environmental Management Plan, Traffic Management Plan, Health and Safety Plan
- Co-ordinating resources - plant and personnel
- Liaising with the Client and the Client's Representative
- Liaising and monitoring sub-contractor activities
- Programme development and approval
- Monitoring all construction activities to enable the execution of the contract to be performed in a professional, timely and cost effective manner.
- On site training/briefing, industrial relations and safety
- Reporting activities specifically for presentation to a Management Review Meeting

ENVIRONMENTAL LIAISON OFFICER

The Environmental Liaison Officer reports directly to the Contracts Manager and is responsible for the following functions:

- a) Environmental Management
- b) Health and Safety Management
- c) First Aid
- d) Traffic Management
- e) Public Relations

His/her specific responsibilities include:

- Liaison with WSL and CALM on environmental matters
- Liaison with the residents and road users on traffic management, construction activities, safety and other issues
- Participating in the Contract Review Meeting.
- On site meetings/briefings with construction staff on environmental, health and safety, traffic and other matters
- Implementing an Environmental Management Plan
- Monitoring site activities in accordance with the Environmental Management Plan, Traffic Management Plan, Health and Safety Plan
- Reporting activities specifically for presentation to a Management Review Meeting

QUALITY MANAGEMENT REPRESENTATIVE

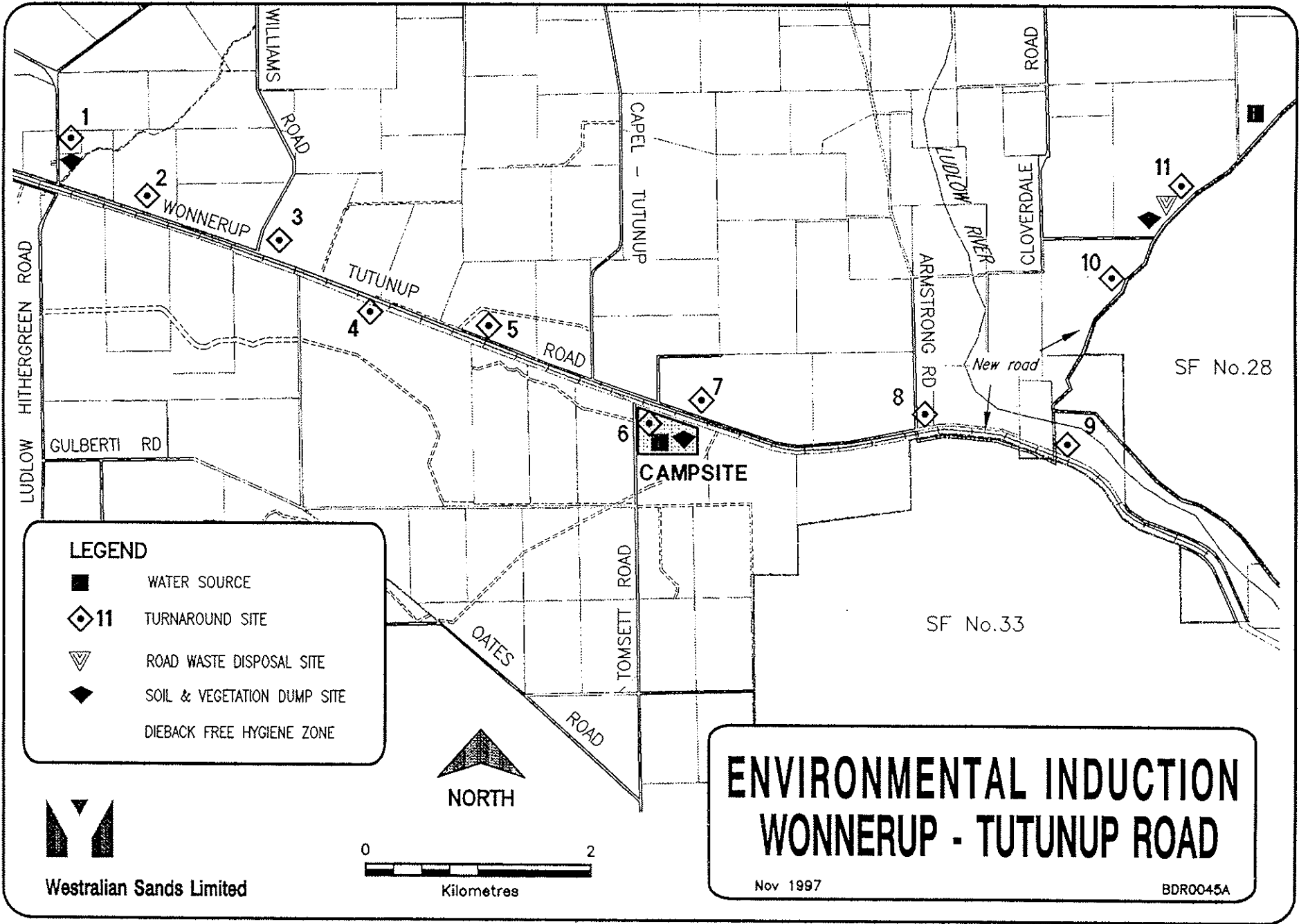
The QMR reports directly to the Project Manager but will also have an independent reporting function as required under the company's Quality System.

His/her specific responsibilities include:

- Assists in the development of the Quality Plan.
- Verifies by Checklists that the sequence and activities contained in the Quality Assurance Procedures have been adequately carried out.
- Initiates inspection and testing plans
- Controls all quality assurance documentation
- Maintains a lot status register
- Involves in internal, client and third party auditing as per the respective audit schedules

FIGURES

Figure 1 - Site Plan



LEGEND

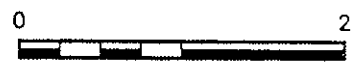
- WATER SOURCE
- ◊11 TURNAROUND SITE
- ▽ ROAD WASTE DISPOSAL SITE
- ◆ SOIL & VEGETATION DUMP SITE
- DIEBACK FREE HYGIENE ZONE



Westralian Sands Limited



NORTH



Kilometres

**ENVIRONMENTAL INDUCTION
WONNERUP - TUTUNUP ROAD**

Nov 1997 BDR0045A

WESTRALIAN SANDS LIMITED

TECHNICAL REPORT

WSL-TR-96/33

WONNERUP/TUTUNUP ROAD

RECONSTRUCTION

NOTICE OF INTENT

BY

PLANNING DEPARTMENT

DATE: September 1996

AUTHOR KEYWORDS:

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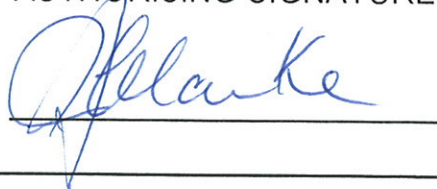


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SUMMARY

Westralian Sands Limited holds a number of mining tenements over three Heavy Mineral (HM) deposits in the vicinity of the Wonnerup/ Tutunup Road. The Company wishes to haul Heavy Mineral Concentrate (HMC) from these deposits along Wonnerup/Tutunup Road, and from there along the Ludlow/Hithergreen Road to the Bussell Highway.

The base of the Wonnerup/Tutunup Road requires reconstruction to adequately support the heavy haulage trucks, and the existing shoulders need sealing to a width of 7 metres to allow traffic to pass safely.

The road reserve sits within or adjacent to other reserves that, in total, form a width of between 80 - to 95 metres along its length.

A number of authorities have an interest in or are responsible for the reserves.

The Shire of Busselton is responsible for the road surface, the verge and the road reserve itself.

In discussions with the Shire of Busselton, Westralian Sands Limited has agreed to fund the reconstruction of the road and will be responsible for the ongoing maintenance of the road seal over the time the Company hauls HMC along it.

The Shire will continue to be responsible for the maintenance of the shoulders, the verge and the reserve itself.

Even though a number of authorities have an interest in the reserve there has been no specific remedial work undertaken to improve the conservation values of it.

The reconstruction work has been designed to have minimal impact on the Declared Rare Flora. The design itself is discussed in the "Application to 'Take' ".

A number of issues were considered in relation to the reconstruction works. They included -

- the development of an Environmental Management Plan
- minimizing the spread of dieback
- minimizing the numbers of DRF 'taken', and the potential to transplant those that are lifted
- drainage along the length of the road

Issues considered in relation to ongoing use of the road were -

- road shoulder maintenance
 - road verge maintenance
 - road surface maintenance
-

- drainage
- overall reserve integrity

Consultations were held with a number of groups. They included -

- local residents
- Busselton Naturalists Club
- Busselton Dunsborough Environment Centre
- SW Environment Centre
- local politicians

The consultation showed the majority of persons were not against the reconstruction as long as what was planned is carried out, recognising there was potential for a positive environmental impact if there was a co-ordinated approach to ongoing management of the reserve.

Two issues that were raised were -

- potential for impact on the fauna through increased traffic on the road
- safety in relation to school bus use

In liaison with the Shire of Busselton and CALM Busselton, Westralian Sands Limited will commit itself to the following -

- development of a comprehensive environmental management plan for the reconstruction phase of the road
- take responsibility for the ongoing maintenance of the road surface over the time it is hauling HMC over it, and develop appropriate guidelines under which this maintenance will be carried out
- undertake an liaison and education process with the immediate local community
- assist with control measures for dieback affected areas
- develop a long term plan for the eradication of exotic plants and weeds
- assist in research and development into the 'smoke' treatment to germinate seeds from species along the corridor
- undertake fauna studies

The reconstruction of the road will have a positive environmental impact on the reserve through -

- development of an integrated reserve management plan with the various authorities
 - control of, and removal of exotic species, particularly watsonia
 - replanting of native species
 - R&D trials into regermination of native species
 - control of vermin, such as rabbits, cats and foxes
-

1.0 INTRODUCTION

Westralian Sands Limited holds mining tenements over areas known as -

- Yoganup
- Yoganup West
- Tutunup

It is planned that the Yoganup deposit be mined when the Yoganup North deposit at Boyanup is completed. It is currently anticipated this will occur in August/September 1997.

The Yoganup deposit was mined in the 1970's. Mining and rehabilitation was not completed because of a downturn in the mineral sands market. The mining of the Yoganup deposit will incorporate final rehabilitation of the area.

After the Yoganup deposit has been mined and rehabilitated the plant will successively move to the Yoganup West and Tutunup deposits.

Each mine produces a heavy mineral concentrate (HMC) that is separated into its individual products at the Dry Plant located in Capel.

There is a need to establish a truck haulage route to transport the HMC from each of these minesites to Capel.

The route via the Wonnerup/Tutunup, Ludlow/Hithergreen Roads and then onto the Bussell Highway provides a single centralized route for each of the future deposits.

This route is favoured because of the balance between -

- - safety
- environmental impacts
- social impacts
- economics
- timing

The Wonnerup/Tutunup Road will require upgrading both in seal width and road formation to allow it to carry HMC trucks safely over the life of the mining areas.

Reconstruction of the road will require a number of Declared Rare Flora (DRF) and Priority species to be disturbed. An "Application to 'Take' " was forwarded to CALM in July 1996.

2.0 BACKGROUND

2.1 Location and History

The Wonnerup/Tutunup Road is located in the Shire of Busselton close to the northern boundary with the Shire of Capel. (See Figure 1)

The overall reserve width varies over its length.

The widths of the various sections of the reserves from the Ludlow/Hithergreen Road intersection to Williams Road are shown in Table 1 and illustrated in Figure 2.

Table 1 Reserve Widths - Ludlow/Hithergreen Road Area		
Reserve Type	Description	Width
Drainage Reserve	Abba Sub 'A'	14 metres
Wonnerup/Tutunup Road		20 metres
Rail reserve		62 metres
	<i>TOTAL</i>	<i>96 metres</i>

Note - the widths are estimated from DOLA digital cadastre data

The Drainage Reserve stops at Williams Road. It appears from the DOLA digital cadastre data that the drainage reserve is absorbed into the road reserve but gradually tapers away to zero width over the distance to the next drain that goes to the north. (See Figure 2)

Close to Armstrong Road the estimated widths of the reserve are shown in Table 2.

Table 2 Reserve Widths - Armstrong Road Area	
Reserve Type	Width
Wonnerup/Tutunup Road	20 metres
Rail Reserve	60 metres
<i>TOTAL</i>	<i>80 metres</i>

Note - the widths are estimated from DOLA digital cadastre data

The road runs in parallel with a rail reserve on its southern edge for its entire length. The rail reserve is vested in Westrail. The line presently on the rail reserve is no longer in use and in fact is contracted out to a private company for removal. The long term use of the rail reserve is unknown. The rail reserve has significant regrowth along its length. (Figure 3)

Theoretically, from the DOLA 1:25,000 plan series (Figure 4); a road reserve also exists on the southern side of the rail reserve. The 1996 DOLA cadastre data does not show this reserve being in existence. It is assumed it has been historically absorbed into the Rail Reserve.

Two dirt tracks run along each side of the railway line. They have regrowth along them but not sufficient to stop a vehicle driving along them. Traditionally Westrail have maintained this type of access as a fire break. (Figure 5)

Historically, the Shire of Busselton has been responsible for the road reserve and the maintenance of it.

The sealed section of the Wonnerup/Tutunup Road commences at Armstrong Road and continues in a westerly direction until it intersects the Ludlow/Hithergreen Road. The total distance is approximately 8 kilometres.

It has been constructed with a 3.5 metre seal with gravel shoulders and a spoon drain on the edges. (Figure 6)

Over time the spoon drain has filled with gravel graded from the shoulder and some native species have opportunistically recolonized themselves within this loose material.

The width of the seal requires passing traffic to run on the gravelled shoulders to ensure they can pass safely. The road is used by milk tankers and farmers with stock trucks - cars passing these frequently run close or into the spoon drain to ensure they pass the trucks safely, allowing them the majority of the bitumen. This traffic does destroy or damage some of the regrowth on or near the spoon drain.

The school bus also uses the road.

The Wonnerup /Tutunup Road was constructed many years ago. It was built to service the local farming community and was not intended for heavy haulage.

It also provides an east/west intersect for north/south traffic from the Capel/Tutunup Road and Tompsett Road.

Traffic numbers along the road are limited.

2.2 Conservation Values of the Total Reserve

CALM have recognised the reserves running along the length of the Wonnerup/Tutunup Road, and then continuing along the Ruabon Road, and meeting up with the Bussell Highway, as being regionally significant.

The total reserve is of regional significance as a continuous vegetation transect showing the catena of original vegetation types that existed prior to European settlement. This community is very rich containing a large number of annuals and geophytes.

The reserve is recognised as being only one of two continuous east/west corridors within the Swan Coastal plain - the other being in the Serpentine area.

2.3 Ironstone Community

In addition the reserve includes areas of ironstone formations that have been extensively cleared across the Swan Coastal plain, leaving isolated remnants only. The flora within these ironstone communities is unique.

In 1995 the DEP recommended an Interim Protection Order (IPO) be placed on this area because of their recognition of its uniqueness. (Appendix 1, *'Threatened or Poorly Reserved Plant Communities Requiring Interim Protection'*, C Sanders, DEP, 12 June 1995)

Westralian Sands Limited purchased land (Wellington Location 3194) abutting the reserve in 1994. (See Figure 7) This land contained an extensive area of surface ironstone, which although had been open to grazing was relatively untouched.

The importance of this large remnant area of ironstone community was recognised by the Company prior to the question of the road reconstruction being raised and assistance was offered to Dr Neil Gibson of CALM to map the flora within in it. In addition over 50 hectares of land has been fenced off by Westralian Sands Limited to stop further cattle incursions thereby ensuring the integrity and the floristic values of this ironstone community are maintained.

Westralian Sands Limited has contacted the Kings Park and Botanic Gardens Research Department with a view to commencing smoke treating areas that have been heavily grazed and are inside the fenced off area. This is intended as one part of the total management plan of the area.

If Westralian Sands Limited had not purchased this land it is probable that the area would have continued to be left open to cattle degradation

and burn offs by the local community to reduce the risk of fire transfer from this area to the surrounding grazing land.

2.4 Declared Rare Flora and Priority Species

A number of plant species were recognized by CALM as being on the potentially endangered list in work principally undertaken between 1992 and 1995. This work was reported on in -

- *'Floristic Survey of the Southern Swan Coastal Plain'*, (Gibson et al. 1994); and
- *'Remnant Vegetation on the Alluvial Soils on the Eastern Side of the Swan Coastal Plain'* (Keighery and Trudgen, 1992)

The current categories of the various species is listed in Table 3 below.

Table 3 Current List of Endangered Species		
Category	Botanical Name	Description
DRF	Chamelaucium roycei	Shrub to two metres. Known from four locations in the South West.
Priority 1	Hakea aff. varia	Tall shrub to four metres. Known from a number of locations in the South West.
	Calothamnus aff. crassus	Bushy shrub to two metres. Also known from the Albany area.
	Dryandra squarrosa ssp. argillacea	Tall shrub to three metres. Known from a number of locations in the South West.
Priority 2	Grevillea elongata	Bushy shrub to four metres. Known from a few Iron Stone locations.
Priority 3	Dryandra nivea ssp. uliginosa	Bushy shrub to one metres. Known from a few Iron Stone locations.

3.0 EXISTING MANAGEMENT OF THE CORRIDOR

A number of different authorities have an interest in the corridor. They are-

- Shire of Busselton
- Westrail
- Telstra
- Water Corporation
- CALM
- DEP

The Shire of Busselton is responsible for the maintenance of the road, its shoulders and the drainage along its length.

Westrail is responsible for the rail reserve, and in theory the control of regrowth within the area relative to rail traffic. The rail reserve is disused with no rail traffic having used the line for a number of years. A contract has been let for the total removal of the rail line and sleepers. The long term potential for the continuing use of the reserve for rail traffic is unknown.

Telstra has installed an in ground cable on the southern side of the road reserve adjoining the rail reserve. There is a cleared track along the length of the corridor, it is assumed Telstra use this as maintenance access to the cable. It is not clear whether the cable is on the road or rail reserve.

The Water Corporation is responsible for drainage from the surrounding land and in particular for the maintenance of the drainage system.

CALM has no vested responsibility for any of the reserves, but of course has responsibility for the flora and fauna of the corridor, and in the protection of DRF species.

The DEP has placed an Interim Protection Order (IPO) over the reserve.

Although there are a number of authorities responsible for the reserves there has been no specific remedial work undertaken to improve the conservation value of it, or to Westralian Sands Limited's knowledge any funding set aside by for it.

CALM (Busselton) believe there has been some improvement in the reserve since the IPO was placed through a reduction in the activities of the landowners on the reserve.

In discussions with the local landowners and related authorities the following comments were made -

- hay is carted between properties in open back trailers with significant losses along the way, thereby increasing weed encroachment
- cattle are driven on foot along the length of the reserve increasing the potential for dieback and weed spread
- in burning the reserve it has got out of control, burning substantially more than intended
- watsonia is regarded by some locals as 'colourful' (Figure 8)
- the reserve has been 'ploughed' as a fire break in one area, rather than it being done within the property boundary (Figure 9)
- an area has been created on the edge of the road reserve and into the bush to enable the turning of a horse pacing spider
- road repairs have been carried out with encroachment into the bush
- there has been no land use management action taken by Westrail or the Shire
- drain clearing activities are being planned by the Water Corporation on the easement immediately to the north of the reserve (Abba Sub Drain A).
- when known CALM has prevented burn-offs and road maintenance activities (including opposing the removal of the railway line and sleepers) to preserve the flora species

4.0 ROAD DESIGN

The design of the road has been detailed in the "Application to 'Take'".

In summary, the road has been re-designed with a 7 metre seal over the majority of its length. This will allow two trucks to pass without leaving the seal. In the areas where the DRF's are more prolific the seal width has been reduced to 6 metres to minimize the number of DRF species that would be disturbed.

Kerbing will also be considered, where necessary, to minimize the shoulder/table drain widths.

A dieback survey was undertaken in liaison with CALM. Botanical surveys were also undertaken. These are also detailed in the "Application to 'Take'". Further dieback work will be undertaken along the road to assist in the planning of the removal and reconstruction of the formation

The total number of plants that will be disturbed are specified in Table 4.

DRF and priority species	Number of plants affected by proposal		Approximate number of plants in reserve (between Ludlow-Hithergreen Rd and the scarp)	Number of plants affected as a percentage of the total reserve	SAFETY CONTINGENCY Percentage of reserve population affected if additional disturbance 0.5 metres outside designed maximum shoulder width
	Disturbed	Pruned			
Calothamnus aff. crassus (P1)	1	1	>60	0.2%	<3%
Chamelaucium roycei (DRF)	20	4	>4300	0.6%	<1%
Dryandra nivea ssp. uliginosa (P3) **	0	0	>280	0.0%	<1%
Grevillea elongata (P2)**	4	2	>1250	0.5%	<2%
Calothamnus aff. quadrifidus *	22	18	>4530	0.8%	<4%
Dryandra squarrosa spp. argillacea (P1)	25	9	>450	5.3%	<10%
Hakea aff. varia (P1)	0	2	>150	1.3%	<3%

* Recommended for inclusion as Priority 1 Flora

** Recommended for inclusion as Declared rare Flora

As discussed with Dr K Atkins (Senior Botanist, Wildlife Branch, CALM), Table 4 also demonstrates the percentage of plants that will be impacted, if for any reason the road width is extended by a further 0.5 metres past the design shoulder - over the length of the entire road reconstruction. It must be emphasised that this number is included only to demonstrate the impacts - it is not planned or intended to be carried out.

5.0 ISSUES

5.1 Road Reconstruction Issues

5.1.1 *Environmental Management Plan during Reconstruction*

A comprehensive Environmental Plan will be developed for the road reconstruction works to be undertaken.

The objectives of the Environmental Plan are to ensure -

- all personnel, (whether contracted personnel or Westralian Sands Limited employees), are aware of the environmental issues and what their responsibilities are in respect of those issues
- methods used to reconstruct the road take account of the practical issues in minimizing any impacts
- the risks of the spread of dieback are minimized
- minimal disturbance occurs to DRF's, Priority species and other flora, including transplanting where practical

Westralian Sands Limited has employed BSD Consultants to advise on the detail of the Environmental Plan. A draft of the Plan is attached. (Appendix 2). This will be finalized in liaison with the Shire of Busselton and CALM Busselton.

This plan will be included as part of the tender and final contract.

5.1.2 *Dieback*

A number of dieback surveys have been undertaken. (Section 4)

The surveys have shown that dieback is present along the reserve but has not been conclusive as to it being continuous along its length.

Further surveys will be undertaken prior to construction commencing to define in more detail the areas infected. CALM Busselton will be involved in assessing the results of these surveys

It is intended dieback free gravel will be used for the reconstruction of the road. If appropriate, limestone or marl will be used in the construction process to assist in minimizing dieback.

All plant and machinery will be cleaned prior to working on the site to minimise the spread of dieback and any materials removed from the road will be picked up from that spot and not spread along the length of the road.

5.1.3 *Disturbance of Rare Flora*

Westralian Sands Limited will be responsible for inspecting the site and defining all DRF's and Priority species that will be impacted by the reconstruction and reporting the numbers 'taken' to the appropriate CALM department.

Consideration will be given to the potential for transplanting all plants, however it must be recognized that it will be difficult to 'lift' plants successfully because the root systems will be intertwined in the ironstone. Some of the smaller seedlings should be able to be readily transplanted.

CALM Busselton will inspect the road reconstruction on a weekly basis to ensure work is being carried out to plan, and to offer technical advice as necessary.

5.1.4 *Drainage*

Drainage along the edge of the reconstructed road has been included in the road design.

Where possible the design ensures -

- water does not bank up on one side of the road. This will be achieved through the use of culverts under the road. There are minimal culverts in the present road resulting in flow of water across the road after it banks up.
- water flows along the road edge to a drainage point instead of ponding.

The surrounding land is, to all intents and purposes, a 'flood plain' during the winter. The general flat profile means it is difficult to get the water to drain away.

It is therefore impossible to state that radical improvements in the drainage along the road can be achieved.

Where areas are known to be subject to inundation, the road formation will be constructed using cement as a stabilizer - this will minimize the potential for the road to deteriorate during winter.

Westralian Sands Limited will also maintain a stockpile of heavy mineral concentrate near the Capel Separation Plant and will truck from those stockpiles when the road is under water. Again, this will maximize the life of the road by minimizing the 'stressing' of the road while it is flooded.

5.2 Future Reserve Management

5.2.1. Road Verge Maintenance

The Shire of Busselton accepts it is responsible for the continuing maintenance of the road reserve, but specifically the -

- shoulders
- verge maintenance.
- intersections, and
- property access

(See Appendix 3)

Grading of the shoulder will not be possible because of its minimal width. It is also not seen as acceptable as windrowing of loose material on the outside edge of the shoulder will re-create problems similar to that being experienced in relation to the drainage of the current road drains.

It is planned the shoulder be mowed rather than be graded. The Shire will be reviewing how and when it will achieve this, recognising there are other road verge areas within the Shire that will have to be treated similarly.

Over time plant growth will intrude onto the road with the potential to be a safety problem.

This growth will be pruned using a tractor mounted cutter bar. Pruning of this growth will not adversely affect the health of the plants that are cut back. This is not anticipated to be an annual event.

The Shire of Busselton will draft procedures for all works undertaken along this road reserve and employees trained in the need to follow them.

CALM (Busselton) will participate in the review of these procedures.

There is the potential for DRF's to be pruned during the road verge maintenance. The requirement to obtain the necessary approvals in a timely manner will form part of the road verge maintenance procedures

5.2.2 Road Surface Maintenance

Theoretically the Shire of Busselton will be responsible for the maintenance of the road seal. In discussion with Shire staff Westralian Sands Limited has accepted responsibility to keep in good repair -

- the road surface
- the seal edges, and
- kerbing (where applicable)

for that period of time that heavy mineral concentrate is hauled on it.

The Company does not have the experience, expertise or equipment to carry out this work itself. It will therefore contract the work out to an appropriately experienced company. Specifications will be prepared for this work to be carried out in accordance with Shire requirements and to meet the ongoing environmental management commitments.

Procedures will be developed by Westralian Sands Limited with the Shire of Busselton, and available for review by CALM (Busselton) to ensure that all maintenance works are carried out in a manner that will not impact on the reserve.

5.2.3. Drainage Maintenance

It will be important during the winter that the drains along the sides of the roads and the culverts under the road are kept clear. If they are not kept clear flooding will occur. This in turn will impact on the potential deterioration of the road - so it will be in the Company's interests to take the responsibility for keeping them clean.

The minesite workforce will be charged with this responsibility.

Procedures will be written in a similar manner to sections 5.2.1 and 5.2.2.

The Company will liaise with the Water Corporation to ensure the main drains in the area are kept free of any impediments to water draining freely.

This will be done subject to DRF surveys being completed, and if required "permission to 'take' " being received.

5.2.4 Overall Reserve Integrity

As stated previously, a number of authorities have land within the reserve directly vested to them, or hold other interests in the reserves.

Some of these interests are in conflict with the total reserve being a conservation corridor -

- planting of native species within the drainage reserves will not necessarily complement the Water Corporation's objectives
- the concept of a future rail link along the reserve is not compatible with it being a conservation corridor.

Westralian Sands Limited is prepared to commit itself to carrying out the works outlined in Section 7, however if the various authorities cannot come to an agreement on the end use and are not willing to give the Company access to carry out the various works then Westralian Sands Limited will not be able to guarantee an optimal outcome.

The Company is prepared to be involved in and facilitate meetings to resolve this problem and carry out any work that it is allowed access to do.



6.0 PUBLIC CONSULTATION

6.1 Residents

A total of eight residents who either lived along the road or lived just off it were consulted in terms of the upgrade Westralian Sands Limited is planning for the road.

The eight residents expressed positive views about the upgrade. In general they were not aware of the significance of the reserve.

The following comments or requests were made, together with a comment on the potential outcome in brackets, -

- Could Tompsett Road intersection be made into a T junction to improve its safety? (Included in the design, the Shire requires all intersections to be sealed and kerbed)
- Would it be possible to continue to drive cattle along the road? (The Shire has certain rules relative to this being done - it is seen as a continuing education program with the local farmers)
- Would it be possible to install signs warning motorists to look out for children as this is an area for school bus pickups? (Signs to be installed as part of the road reconstruction)
- Will the level of the road be lifted as any thing that could be done to decrease the road flooding would be a positive step? (As commented previously this will be part of the design)
- WSL wished luck in removing the watsonia.
- Asked if white lines would be placed on the road? (Centre and side lines will be placed)

One of the immediate residents was at the Busselton Naturalists Club meeting. Her specific views are discussed in section 6.2.2.

6.2 Busselton Naturalists Club

6.2.1 *On site visit by President*

The President of the Busselton Naturalists Club, B Masters, was given a presentation at WSL's offices, followed by a site visit. The following comments were made by B Masters -

- The road design should take into account the width of the reserve on either side of the road. As the northern side is relatively small, then where possible any incursions into the reserve, (because of the road reconstruction), should be into the thinner side. The rationale is that the wider a section of reserve the easier it is to keep out exotic plants/weeds. Thin areas allow the weeds to more easily infiltrate across its entire width.

WSL said it accepted this philosophy, however it needed to balance the maturity of the plant growth on the northern side, (developed because of a much less frequent fire regime), versus the immaturity of the plant growth on the southern side of the reserve. This is due to a history of more regular burns on the southern side. The plants on the northern side will have the ability to re-seed the southern side and therefore allow re-establishment if another fire occurred on that southern side.

- re-look at the road design at the most eastern end to see if the trees near the edge of the road can be retained. These are some of the older and larger marris along the length of the road.

WSL said the design will be re-visited in this respect.

6.2.2 Presentation by WSL to Monthly Meeting

WSL were invited to give a presentation to the Busselton Naturalists Club at their monthly meeting. It was estimated that there were approximately 40 members present.

In general the meeting was quite positive about the project and believed that WSL had undertaken a thorough assessment of the impacts on the flora.

One resident who lives along the road runs a wildlife refuge through the auspices of FAWNA. She expressed concern about the potential impact on native fauna along the route.

The meeting moved that a letter be sent to WSL requesting a fauna survey be undertaken.

Further discussions were held with the resident after the meeting, and at her house later in the same week. She expressed concern

that she had tried to obtain assistance to maintain the integrity of the reserve for the 18 years she had lived there without any success. She stated she had watched the growth of the watsonia and was at the point of believing she would have to tackle it singlehandedly, though she was not sure how she would succeed. In addition she had watched with despair burn offs occurring along the length of the reserve resulting in its slow degradation.

In essence WSL believes she is not anti the road reconstruction but is concerned about the impact the additional traffic will have on the native fauna.

WSL invited the Club to undertake a visit to the ironstone community on WSL's land along the Wonnerup/Tutunup Road at a convenient time. This occurred two weeks later as part of the Club's annual wildflower excursion.

6.3 Busselton Dunsborough Environment Centre

The Busselton Dunsborough Environment Centre in Prince St Busselton was visited to ascertain who should represent the Centre on a site visit. The woman present indicated that B Masters was the President of the group and that he should be contacted.

As indicated in section 6.2 above, B Masters therefore visited the site in a dual capacity.

A copy of the "Application to 'take'." was given to B Masters.

It is understood the project has been since brought up at their monthly meeting.

6.4 South West Environment Centre.

The South West Environment Centre is based in Victoria St in Bunbury.

Brendan Kelly is the convenor of the group. Both he and Jason Smith were shown over the site. Immediately after the site visit they continued to Busselton where they participated in a meeting of personnel from the various Environment Centre in the South West. It is understood the issue of the road reconstruction was raised at this meeting.

No specific feedback from the South West Environment Centre has been received to date.

A copy of the "Application to 'take'" was sent to B Kelly.

6.5 Local Politicians

B House, MLC, Member for the South West, has been shown over the site and WSL's intentions explained.

This was done to keep him informed of activities within his electorate.

The project has been discussed with B Blaikie, MLA, Member for Vasse, over the telephone. He has been invited to look over the project.

B Blaikie was concerned that additional heavy mineral concentrate haulage on the Bussell Highway would create further congestion on top of the 1.0 million tonnes being hauled from Jangardup and Beenup. He believed the government should be placing a high priority on immediately developing the Bussell Highway into a four lane highway, from the Sues Road intersection through to Capel.

He also stressed that trucks should not be using the Wonnerup/Tutunup Road at the same time the school buses are on the road.

Committed
from WSL?

6.6 Others

WSL has been informed the Capel Chamber of Commerce is potentially interested in kindling tourist interest in a wildflower route incorporating the Wonnerup/Tutunup Road, particularly since the Capel bypass has severely curtailed the numbers of people who now visit or use the services of those businesses in Capel.

WSL will be approaching the Capel Chamber of Commerce with a view to giving a presentation to them of the road reconstruction project.

Capel Shire officers have been kept informed, (and were invited to the "Application to 'Take'" presentation) even though the road is outside of their Shire boundary.

Busselton Shire officers have been involved in the project as they are responsible for the Wonnerup/Tutunup Road and the Road Reserve.

7.0 COMMITMENTS BY WSL

WSL has an obligation to pay for any works associated with the reconstruction of the Wonnerup/Tutunup Road, and undertake those works such that any impacts on the Reserve are minimal; and that any ongoing maintenance of the road over the life of the minesites in the area must be carried out in a similar sympathetic manner.

The management of the total reserve is not seen as a responsibility the Company should be required to shoulder - the invasion of weeds, the continued expansion of the watsonia, the spread of dieback, the burning off of the reserve - all these will continue to occur if the Company does not use the road, they will not be exacerbated by the reconstruction of the road .

It is the responsibility of the Government, through those authorities who have the various reserves within the corridor vested to them - to manage the reserve. ✓

Westralian Sands Limited recognises the importance of the corridor to the Swan Coastal Plain and is therefore prepared to commit itself to the following -

Road Reconstruction

Further work to identify where disturbance is present + attempt to remove. All attempts to remove are minimal is insufficient - further to address.

- the reconstruction be professionally designed with approval by the Shire of Busselton
- development of a comprehensive Environmental Management Plan that meets the requirements of CALM Busselton and the Busselton Shire
- minimizing the impact on flora, including DRF, priority species, trees and all other native species
- transplanting plants that are disturbed and have some potential for survival to an immediate adjacent area; or to King Park if there may be potential benefits in understanding how to re-establish them
- use of die-back free gravel in the construction of the road, and the use of die back hygiene measures with machinery.
- drainage issues to be addressed where practical, within the road design
- kerb and seal intersections

15/11

Shire of Busselton / Road

Safety

- in conjunction with the Shire of Busselton, approach the MRD for 80 kph speed limits (and signs) to be approved for the Wonnerup/Tutunup Road, and for the appropriate signs to be erected.
- painting of centre and sidelines to delineate the carriageway
- development of a policy with the Shire of Busselton, the HMC haulage operator and local residents on the use of the road during school bus times. ✓

Ongoing Road Maintenance

- WSL will be responsible for the maintenance of the road surface and culverts over the period of time HMC is hauled along it. (The Shire of Busselton will continue to be responsible for the road verge table drains and outlet drainage.)
- all maintenance work will be carried out under strict guidelines (similar to the construction EMP). These guidelines will be developed in conjunction with the Shire of Busselton, and for the review of CALM Busselton.
- any roadworks will be undertaken using die-back free gravel. ✓
- no haulage will occur when the road is subject to inundation

Liaison and Education

- facilitating the development of a management plan for the totality of the reserve, under the auspices of CALM Busselton; but incorporating all the 'owners'; ie Shire of Busselton, Westrail, Telstra, Water Corporation, local adjoining land owners, local Bushfire Brigade and other interested parties such as the Busselton Naturalists Club. ✓
It is anticipated this will require 12 to 18 months because of the number of authorities involved.
- develop an education program with the aim of helping the local community understand the environmental significance of the reserve ✓
- develop a fire management policy with the local Bushfire Brigade, CALM and the Shire of Busselton, including contingency plans if an unplanned fire does take hold in the Reserve. ✓

Exotic plants and weeds

- development of a long term plan to eradicate the watsonia over the Wonnerup/Tutunup Road length of the reserve. It is anticipated this will require significant time and resources and will therefore extend over 5 to 10 years. ✓
- removal of exotic plants and trees at various locations over the reserve ✓
- removal of other weed species from infested areas. ✓
- planting of local tree and shrub species in areas cleared of weed species. ✓

Research and Development

- assist in the development of techniques to establish germination of seeds without the requirement of fire (ie the use of 'smoke' techniques) ✓

- assist in the development of and use of dieback control measures along the reserve. ✓
- assist in the identification, maintenance and research into the species contained within the ironstone formation on WSL owned land. ✓

Fauna

- undertake a continuing fox and feral cat baiting program along the length of the reserve and liaise with the local LCDC to develop a wider based program
- undertake a continuing rabbit control program
- undertake fauna surveys over a 10 to 15 year time frame to determine faunal types and numbers
- place road signs warning drivers to be aware and take care of fauna

8.0 NET ENVIRONMENTAL IMPACTS

The reconstruction of the road by Westralian Sands Limited will result in a net positive impact in relation to the overall reserve.

This will occur as the reconstruction of the road has a minimal impact on the flora along the road, including the Declared Rare Flora, but the commitments that Westralian Sands Limited has made will result in improvements to the reserve through -

- development of an integrated reserve management plan with the various authorities
- control of, and removal of exotic species, particularly watsonia
- replanting of native species
- R&D trials into regermination of native species
- control of vermin, such as rabbits and foxes will assist in native fauna numbers increasing

In addition the net benefits that may accrue are -

- the road construction issue and the need for a rigorous management plan will further highlight the need for policy makers to vest the total area as a Nature Reserve
- the flora and fauna information collected by Westralian Sands Limited will provide the detail for the long term management plan, which in turn may assist in improved management of other reserves
- through education, landowners adjoining the reserve may curtail their activities that are detrimental
- local residents and/or community groups may become involved in the Reserve management, thereby enhancing their knowledge and - raising the status of the reserve in their eyes, thereby giving it an extra measure of protection
- a reduction in CALM funding requirements through a lesser financial input into noxious weed removal, feral animal control, fencing and signage

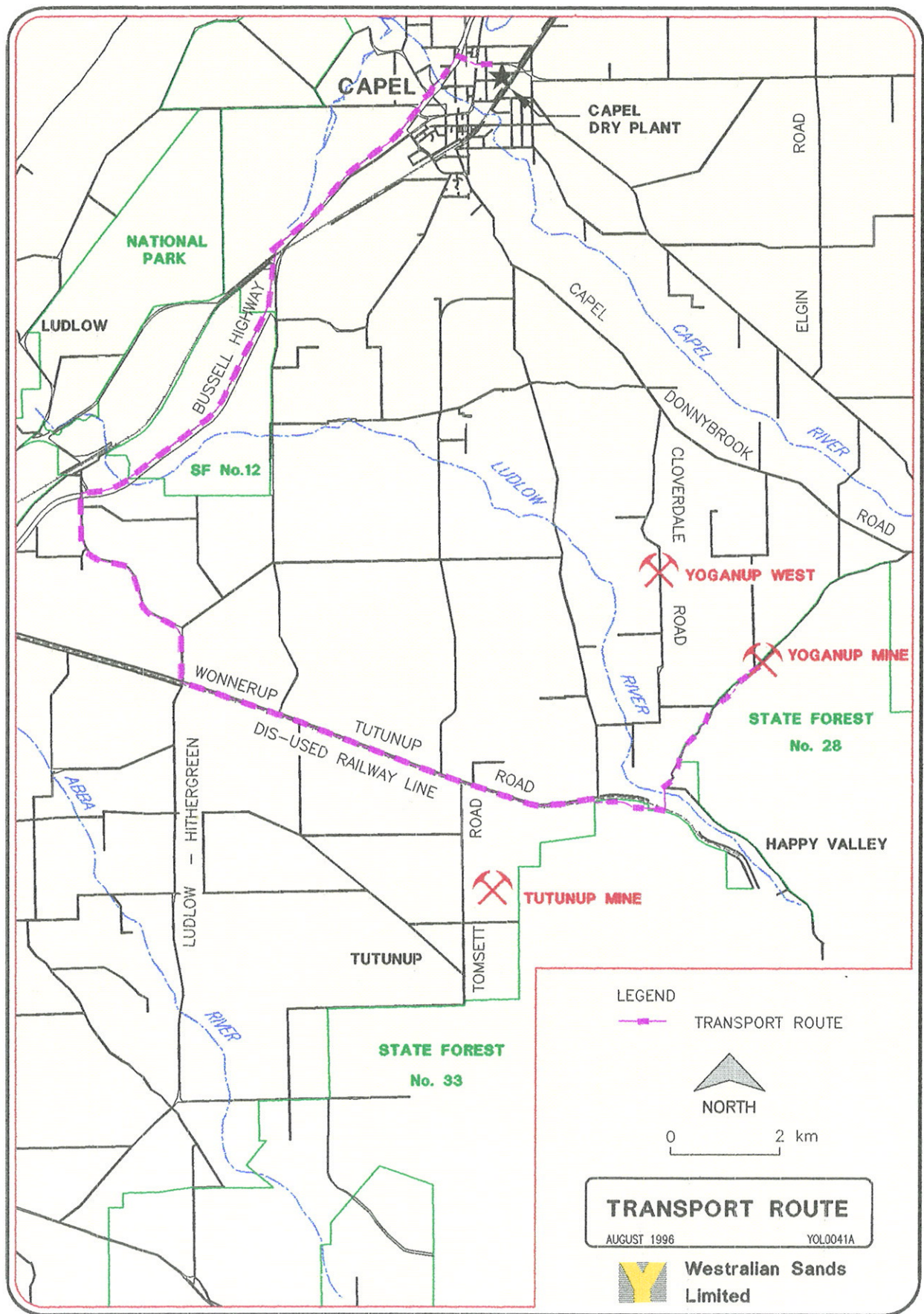
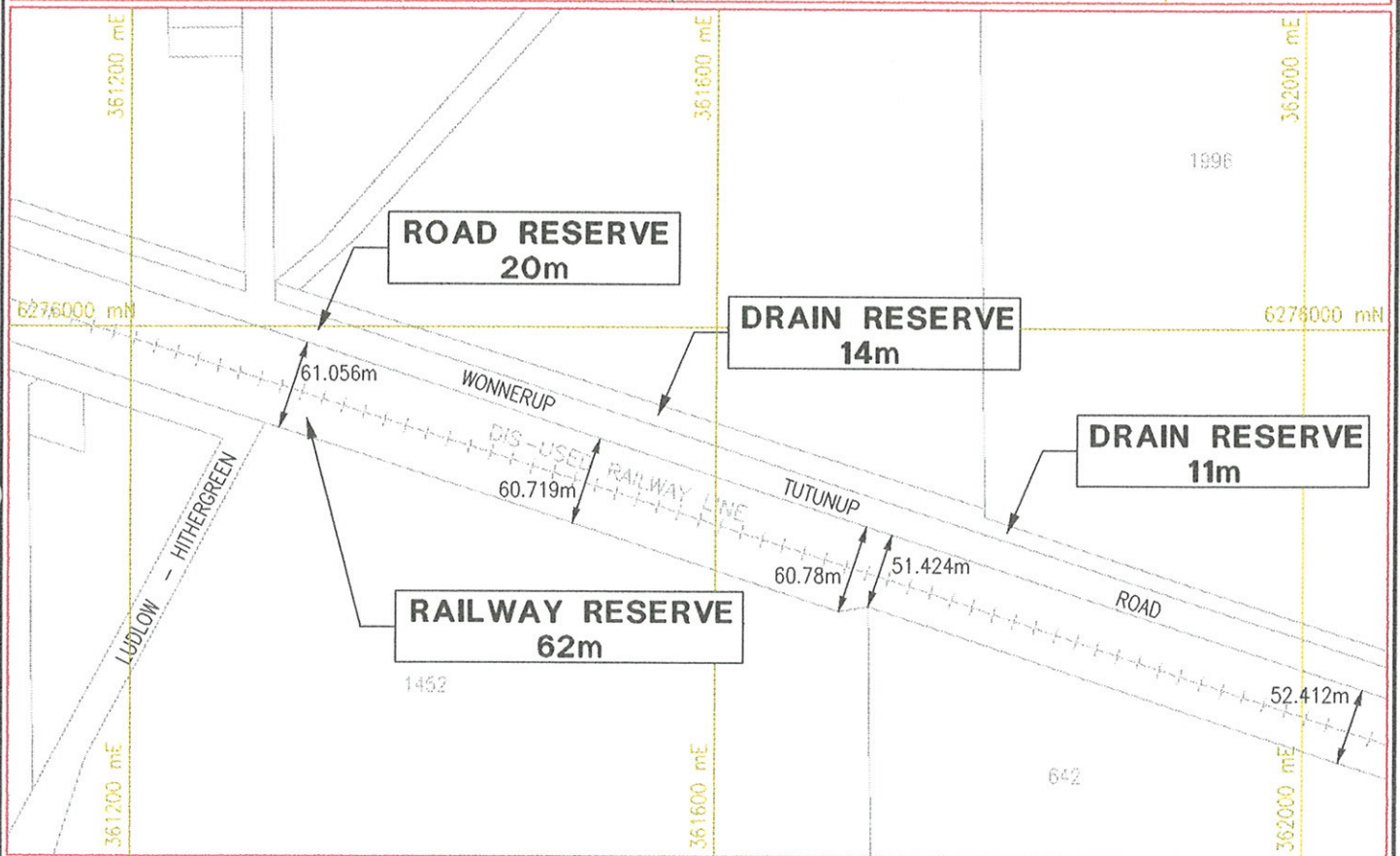
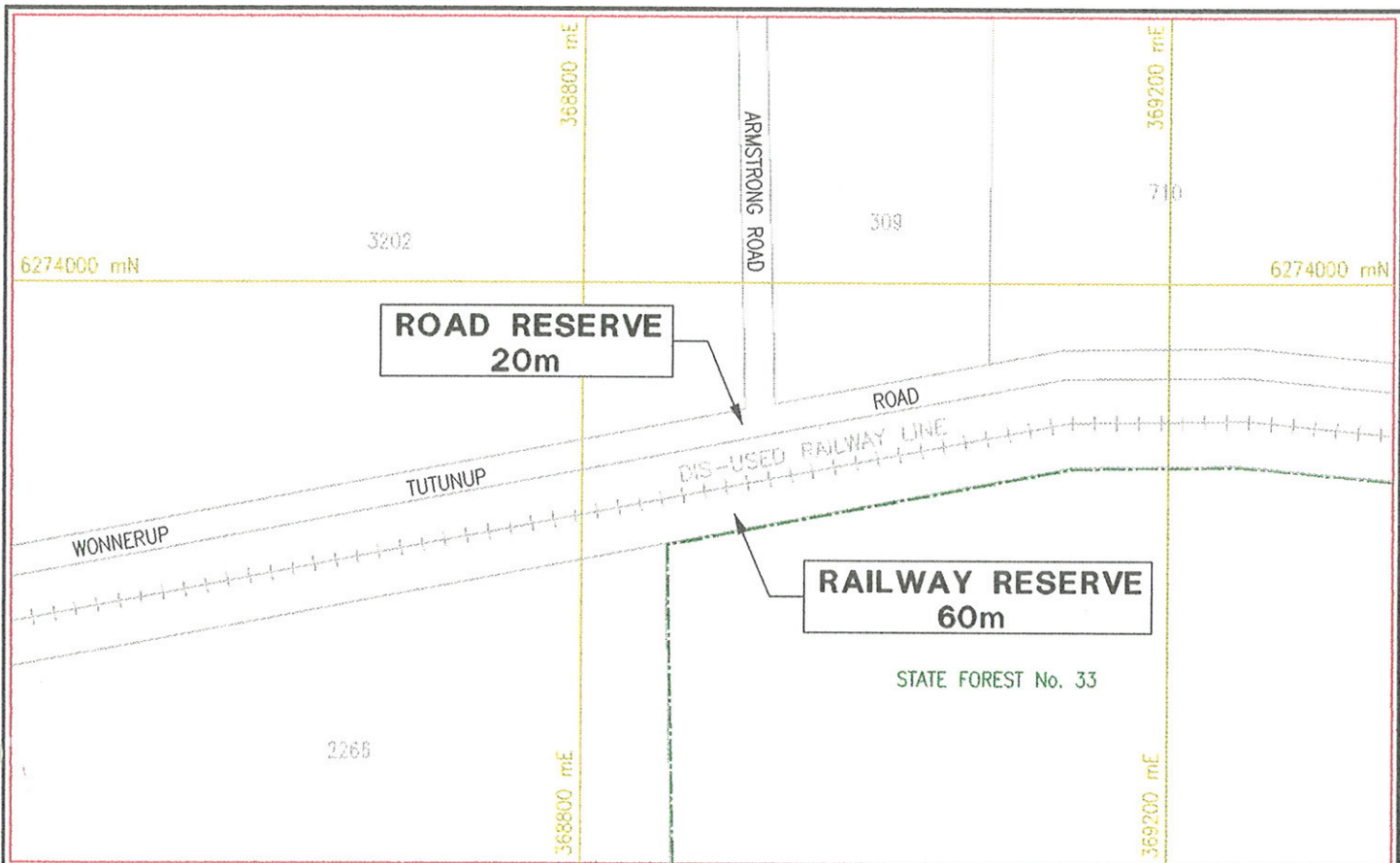


FIGURE 1



Westralian Sands Limited
TUTUNUP-YOGANUP

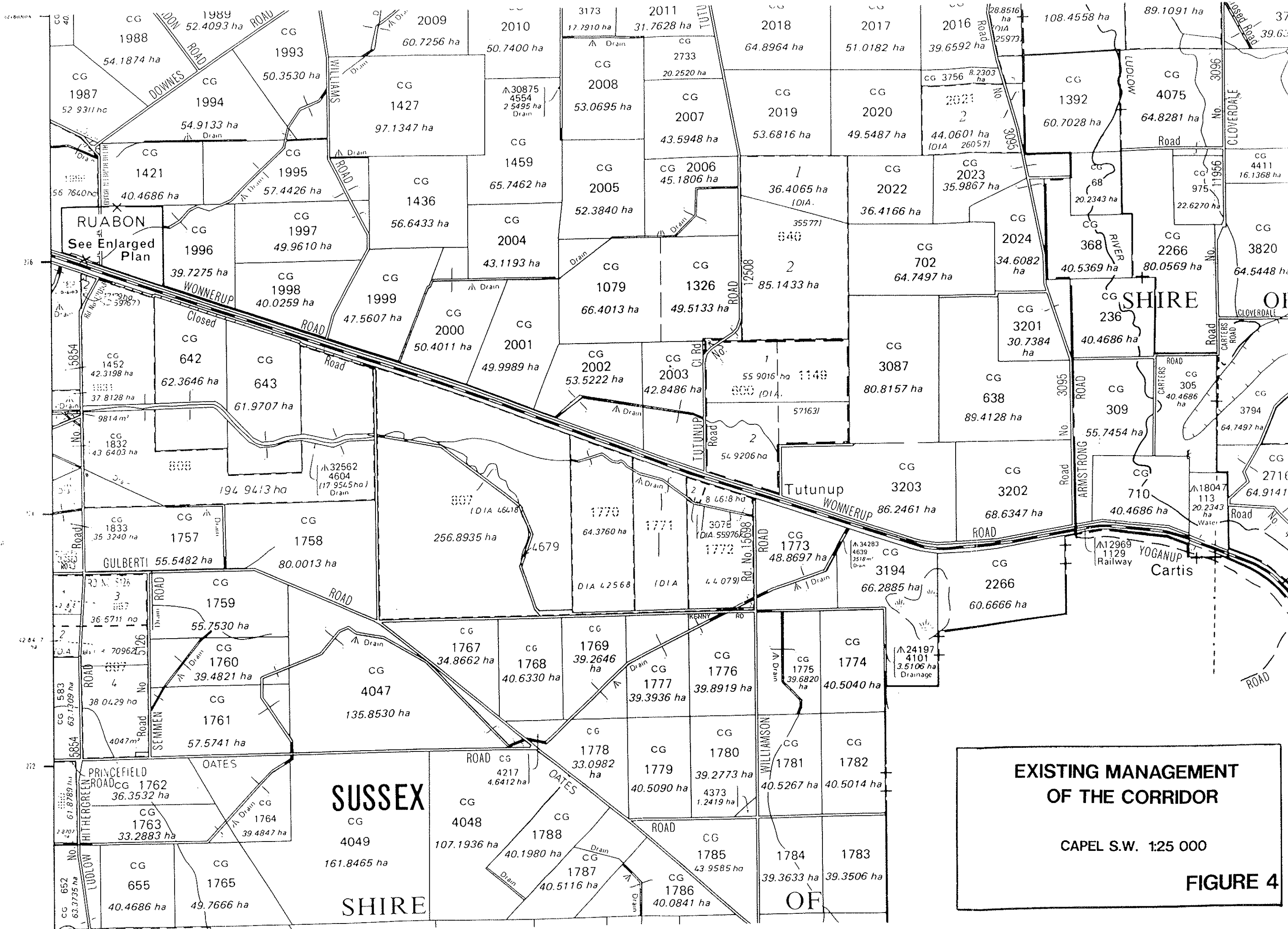
PROJ AREA :
 TITLE :

WONNERUP - TUTUNUP ROAD RESERVE WIDTHS

DESIGN : I.J.C.	SCALE 1: 5 000	FIGURE NO: 2
DRAWN : J.C.H.	DATE : 23 SEP 1996	DRG.No: BDL0054A



FIGURE 3 Bush Regeneration on Rail Reserve



**EXISTING MANAGEMENT
OF THE CORRIDOR**

CAPEL S.W. 1:25 000

FIGURE 4



FIGURE 5 Dirt Tracks/Firebreaks on Northern & Southern Side of Rail Reserve

PHOTOGRAPH SHOWING ROAD PROFILES
THROUGH IRONSTONE COMMUNITY AT
CHAINAGE 6400m ON WONNERUP - TUTUNUP RD.



FIGURE 6



LEGEND

- IRONSTONE COMMUNITY
- OTHER NATIVE VEGETATION
- NEW POPULATION - *C. roycei*
- SURVEYED FENCES
- SURVEYED FENCED AREAS
- FENCED OFF REMNANT VEGETATION

Scale: 0 200 400 600 METRES

North Arrow: N

Westralian Sands Limited

TUTUNUP
SUSSEX LOCATIONS 1773 & 3194

**FENCED IRONSTONE COMMUNITIES
WSL OWNED LAND**

PROJ AREA :
TITLE :

MAP REF : CAPEL 2030-IV 1:50 000

DESIGN: I.J.C.	SCALE 1: 10 000	FILE REF : 7
DRAWN : J.C.H.	DATE : 25 SEP 1996	DRG.No: TTR002A



FIGURE 8 Watsonia Infestation



FIGURE 9 Fire Breaks on Road Reserve

APPENDIX 1

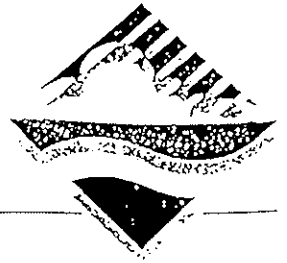
CALM Correspondence

“Threatened or Poorly Reserved Plant
Communities Requiring Interim Protection”

C Sanders, 12 June 1995

Department of Environmental Protection

DEPT OF CONSERVATION
& LAND MANAGEMENT
13 JUN 1995
BUSSELTON



District Manager
CALM
Capes District
14 Queens Street
BUSSELTON WA 6280

Your Ref
Our Ref 67/91
Enquiries K McAlpine

Dear Sir

THREATENED OR POORLY RESERVED PLANT COMMUNITIES REQUIRING INTERIM PROTECTION

As you may already know initial work collating information for the update of the System 6 Red Book recommendations has identified areas of remnant bushland at 36 locations on the coastal plain between Gingin and Dunsborough that contain plant communities which are considered to be threatened or poorly reserved.

Most areas are located on the highly cleared soils associated with the eastern side of the coastal plain. These areas were initially recognised through two recent reports (Floristic Survey of the Southern Swan Coastal Plain (Gibson *et al.* 1994) and Remnant Vegetation on the Alluvial Soils on the Eastern Side of the Swan Coastal Plain (Keighery and Trudgen 1992).

The Environmental Protection Authority has decided that the integrity and values of the communities need some protection until the System 6 update programme is completed. Most of these bushland remnants are small and the plant communities represented could be lost before any protection could be provided through the updated System 6 report. The EPA recognises that there are important environmental issues to be considered for these areas and wishes to advise that until the System 6 update programme has been completed all proposals to clear or develop them should be referred to it for environmental assessment.

I have enclosed a copy of the maps relevant to your district, as requested by Dr Neil Gibson, showing the bushland areas identified for your information and reference. If you have any further enquiries please do not hesitate to contact Mr G Whisson (Ph 222 7153) or Mr K McAlpine (222 7055) of the DEP.

Yours faithfully

Colin Sanders
DIRECTOR
POLICY AND STRATEGIC STUDIES

12 June

Enc

CB

NOTE	ACTION
B	GO
BK	CHS
3702	
RECORD No.	965

J
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Ensure
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APPENDIX 2

Draft Environmental Management Plan (BSD Consultants)

- Provide work instructions for prevention of damage to roadside areas.
- Describe clearly the reasons for the need for specific site management techniques.
- Describe Dieback and its management.
- Provide a booklet summarising the Induction Course content. This booklet to be provided to each worker.

Road Construction

- All areas to have vegetation removed and disturbed to be clearly delineated.
- Trucks are to be restricted to the current road. Turning must be controlled by use of farm paddocks for turning circle. Westralian Sands to liaise with landowners to obtain approval to use paddocks and gates.
- Trucks and other road users may be required to use a circuit system with no turning/reversal of direction.
- Trucks will only carry nominated loads thus reducing material spillage. Trucks to be fitted with hungry boards to provide freeboard to prevent spillage.
- All rubbish and waste materials to be removed from site.
- Vehicle servicing within road reserve to be prohibited.
- Clean up of accidental spillage of hydrocarbons or other liquids (eg. hydraulic hose breakage), to be co-ordinated with CALM and remediation cost to be borne by contractor.
- All water required for construction to be sourced off-site. (Diabata Free)
- All pavement materials to be stored off-site.
- Sisalcraft used during bitumen spraying to be immediately removed after use and disposed at an approved Council disposal site.
- An Environmental Officer will be present during all site activities to ensure no damage to endangered flora in excess of that approved to "take" by CALM.
- A financial incentive (bonus system) to be set-up for all site staff and all constructors as a reward system for compliance in relation to appropriate flora management.
- Culverts to be located at non DRF areas.
- All plant and machinery to be cleaned prior to commencing any site work (to minimise the spread of Dieback "*Phytophthora*") and develop appropriate hygiene measures during road construction.
- Movement of soil and root material to be kept to a minimum (to minimise spread of Dieback "*Armillaria*" spp).

- Advise local residents/farmers of disease status during road construction.
- Grader and other earthmoving operators to be provided with specific personal instruction on the need to remain within the approved boundaries.

Flora Management

- On-going site inspection by nominated Environmental Officer (Neil McMulkin) and monitoring of flora (May 1997) to maintain integrity of rare flora.
- Discussion with CALM about possibility of translocation of plants (seedlings - specifically DRF and Priority 1 species) to be 'taken' and transplanted in similar habitat chosen by CALM.
- Noxious weeds will be cleared in the management of the reserves. Staff involved in clearing will be aware of rare flora located in these areas.
- CALM is to be invited on site on a regular basis to inspect the works program and assist in the program management, where necessary.



Keith Lindbeck
Associate Director
Manager - Environment

12 September, 1996

APPENDIX 3

Correspondence - Shire of Busselton

SHIRE OF BUSSELTON

SOUTHERN DRIVE, BUSSELTON, WESTERN AUSTRALIA

Telephone (097) 81 0444, Facsimile: (097) 52 4958

Office Hours: Monday to Friday, 8.30am - 4.30pm

All Communications to the Chief Executive Officer
P.O. BOX 84, BUSSELTON, W.A. 6280



Our Ref: TUT548 (4473)

Your Ref:

Enquiries: Jon Bettink

15 October, 1996

Department of Environmental Protection
Westralia Square
141 St Georges Terrace
PERTH WA 6000

ATTENTION: K. SANDERS (ENVIRONMENTAL OFFICER)

Dear Ms Sanders,

RE: RECONSTRUCTION OF THE WONNERUP/TUTUNUP ROAD

Westralian Sands Limited have held discussions with the Shire of Busselton and various other bodies with the objective of gaining approval to reconstruct the Wonnerup/Tutunup Road.

The reconstruction of this road will allow the safe and efficient haulage of Heavy Mineral Concentrate from the Yoganup/Tutunup deposits to their Separation plant in Capel.

The Wonnerup/Tutunup Road is vested in the Shire of Busselton. The Shire therefore accepts its present and future responsibilities in respect of the road reserve and the ongoing maintenance of it and the road.

The proposal put forward by Westralian Sands Limited to reconstruct the Wonnerup/Tutunup Road is acceptable to the Shire of Busselton contingent on the Company:

- ✧ Developing the design of the reconstruction to the standards required by the Shire;
- ✧ Accepting its responsibilities as outlined in the Notice of Intent.

The Shire will continue to be specifically responsible for the road verge maintenance, and Westralian Sands Limited will be responsible to the Shire for the road surface maintenance, culverts, and drainage over the time period that Heavy Mineral Concentrate is hauled over the road - as outlined in the Notice of Intent.

Please do not hesitate to contact the undersigned if you require any additional information.

Yours faithfully


Jon Bettink
DIRECTOR TECHNICAL SERVICES

cc Nigel Bancroft - Manager, Strategic Planning

*Escape
to the Cape*

**FLORISTICS OF RESERVES AND BUSHLAND AREAS
IN THE BUSSELTON REGION (SYSTEM 1)
PART III: FLORISTICS OF THE RUABON NATURE RESERVE.**

G.J. Keighery, B.J. Keighery and I.M. Gibson.

July 1996

INTRODUCTION

The Ruabon Nature Reserve is found at the junction of Wonnerup Road and Ludlow - Hithergreen Road (Map 1). The Nature Reserve was a townsite reserve lying to the north of the Ruabon rail siding on the now abandoned Ludlow to Evans railway. In the heavily cleared areas of the south west, such as the Swan Coastal Plain and the Wheatbelt, old townsites are often the only significant areas of uncleared land. The land around Ruabon Nature Reserve has been cleared for many years and the Ruabon townsite has been a focus for botanical collectors in the area. However there is some confusion as to the location of some of the collections as the road on the southern boundary of the Reserve has been referred to as Ruabon Road (Bussel Highway to Ruabon) and Tutunup Road (Ruabon east). Both are currently known as Wonnerup Road.

SURVEY METHOD

One of the authors (G.J. Keighery) has been regularly collecting at Ruabon since 1973 but the detailed survey work was performed over four flowering seasons in 1992, 1993, 1994 and 1995. The area was visited over two of these years by a group of conservation volunteers as part of the Swan Coastal Plain Survey (Keighery, Keighery and Gibson 1995).

Seven sites were located in the Reserve (Map 2, Appendix 1) to sample the range of plant communities identified using aerial photographs and field interpretation. Of these sites four 100 m² study sites were permanently located using four steel pegs (Map 2, Appendix 1). Information was collected in a set format on physical location, vegetation structure and density and the total flora of the permanent study sites (Keighery 1994, Keighery, Keighery and Gibson 1995). The sites were sampled on two occasions over one season (1992).

The four permanent sites were included in a detailed floristic survey of the Swan Coastal Plain (Gibson *et al.* 1994).

Opportunistic plant collections, that is collections from outside the sites, were made during foot transects of the bushland areas at various times of the year over the four years of survey. Identification of plant collections was made and verified at the W.A. Herbarium. Herbarium records were also checked for additional records for the Reserve (April 1996). It is considered that approximately 90% of the flora have been documented.

GEOMORPHOLOGY AND SOILS

The Ruabon Nature Reserve is located on the Swan Coastal Plain where the Pinjarra Plain is the predominant land surface. The Pinjarra Plain is a "flat to very gently undulating plain comprising predominantly Pleistocene fluvial sediments and some Holocene alluvium" (Van Gool 1990). Substantial areas of the Pinjarra Plain are overlain by shallow Bassendean sands and in some areas low Bassendean Dunes occur as deeper sands. While the area is mapped as deeper Bassendean Dunes and shallow Bassendean sands over alluvium (Belford 1987) there are substantial areas of the southern boundary of the Reserve where the alluvium is exposed and the soils have a high percentage of clay (Appendix 1). Also there are areas of ironstone to the south east along the Wonnerup Road indicating the presence of an impeding layer at varying depths along the south eastern section of the Reserve. This relationship between the sands, ironstone and underlying Pinjarra Plain appears to be the basis for the occurrence of floodplain, palusplain, damplands and sumplands (after Semeniuk 1987) in the Reserve. The soils have also been mapped by Tille and Lantzke (1990) who map

- a central sandy dune of deep bleached sands
- wet flats (palusplain) and depressions (damplands and sumplands) with sandy grey brown duplex and gradational soils to the north east and south west
- very wet poorly drained depressions (damplands and sumplands) and flats (floodplain and palusplain) with areas becoming saline in summer with shallow sands over clay.

In addition there is a poorly defined drainage line running from the central western boundary into the wet flats and depressions on the southern boundary.

VEGETATION

The Vegetation Map

The vegetation map (Map 2) shows the distribution of the principal plant communities. The distribution of the communities is based on the structural units described in the Reserve (Appendix 1). Three principal plant communities are mapped: *Banksia* Woodland, Marri (*Eucalyptus calophylla*) Woodland

and Wetland Mosaic areas.

***Banksia* Woodland**

On the central sandy ridge *Banksia attenuata* Woodland is found (mapped as bW, Map 2). *Banksia ilicifolia* and *Agonis flexuosa* are relatively common in this community and at times are codominants with the *B. attenuata*. *Kunzea ericifolia*, *Melaleuca thymoides*, *Leucopogon conostephioides*, *Jacksonia sparsa*, *Phlebocarya ciliata*, *Lyginia barbata* and *Loxocarya flexuosa* are characteristic of the understorey.

Marri Woodlands

Marri Woodlands are characteristic of the sandy clays (mapped as mW, Map 2) that are associated with the margins of the wet depressions and flats. Jarrah (*Eucalyptus marginata*) is associated with these woodlands and is scattered through some areas. *Persoonia longifolia*, *Persoonia spongiocaula*, *Xylomelum occidentale*, *Agonis flexuosa* and *Banksia grandis* are found in some areas. These woodlands have a diverse and dense understory of shrubs, herbs and sedges. Characteristic species of the understorey are: *Kingia australis*, *Xanthorrhoea preissii*, *Hibbertia hypericoides*, *Acacia extensa* and *Mesomelaena tetragona*. These Marri Woodlands grade into the plant communities of the wet flats in the western block of the Reserve but in the eastern block the wetlands are more defined (occurring in depressions or sumplands Semeniuk 1987) as is the area of Marri Woodland.

Wetland Mosaic

A series of communities can be distinguished in the seasonally inundated and waterlogged areas. These range from Marri Open Woodland through Low Open Woodlands dominated by either *Melaleuca preissiana*, *M. raphiophylla* or *M. cuticularis*, mixed Heaths and Shrublands, dominated by a series of *Melaleuca* species and *Regelia ciliata*, to Sedgeland and Herblands. These units occur individually or most commonly in combination with some of the other units (Appendix 1) and, as a consequence are best termed a Wetland Mosaic (mapped as WM, Map 2). Within the wetland mosaic four larger units are able to be mapped in some areas (Map 2, Appendix 1 & 2). The mosaic nature of these plant communities is a feature of the heavy soil wetlands on the Swan Coastal Plain (Keighery and Trudgen 1992; Gibson *et al.* 1994; Keighery and Keighery 1991, Keighery, Keighery and Gibson 1996). The presence of the different communities is related to the surface and subsurface soils and the degree and duration of winter inundation.

The soils of the dampland and sumpland (seasonally waterlogged or inundated depressions, (Semeniuk 1987) range from sandy clays to clays. On the sandy clays *Melaleuca preissiana* and *Melaleuca raphiophylla* Low Open Woodlands are found generally associated with a tall sedge layer of *Leptocarpus royceii*. Areas of shrublands dominated by *Pericalymma spongiocaula* and *Regelia*

ciliata are associated with these Low Woodlands (mapped as mpW and mrW respectively, Map 2). On the soils with a higher percentage of clay *Melaleuca uncinata*, *M. raphiophylla*, *M. incana* and *M. viminea* occur as dominants forming Tall Scrub to Shrublands depending on the period of time since the last fire (mapped as muS or WM, Map 2). An area of *Melaleuca cuticularis* Low Open Woodland is associated with a distinctive community (mapped as mcW, Map 2). The *Melaleuca cuticularis* Low Open Woodland and the *Melaleuca* Shrublands are associated with areas areas of Herbland and Sedgeland rather than a dense shrub and sedge layer.

On the wet flats or palusplain (seasonally waterlogged flats, Semeniuk 1987) Open Marri Woodland occurs and the understorey ranges from that characteristic of the wetflats to that of the better drained Marri areas (mapped within mW, Map 2).

Floristic Community Types

The regional study of the floristic variation of the Swan Coastal Plain by Gibson *et al.* (1994) identified three floristic community types in the Ruabon Reserve (Table 1): type 7 (Herb rich saline shrublands in clay flats), type 13 (Deeper wetlands on heavy soils) and type 21b (Southern *Banksia attenuata* woodlands). One other floristic community type: type 1b (Southern *Eucalyptus calophylla* woodlands on heavy soils) is also considered to be present as indicated by the the floristics of the areas (Table 1, Appendix 1 & 2).

Table 1: Floristic Community Types in the Study Area.

The relationship between the structural units used for mapping and the floristic units determined in the regional survey (Gibson *et al.* 1994). An * indicates the floristic community type is inferred.

Vegetation Mapping Unit	Floristic Community Type
Bushland area	
Marri Woodland	
Sites 5*	1b* (Southern Marri woodlands on heavy soils)
Banksia Woodland	
Site 1 & 2	21b (Southern <i>Banksia attenuata</i> woodlands)
Wetland Mosaic	
<i>Melaleuca cuticularis</i> Low Woodland	
Site 4	7 (Herb rich saline shrublands in clay flats)
<i>Melaleuca uncinata</i> Tall Shrubland	
Site 7*	7* (Herb rich saline shrublands in clay flats)
<i>Melaleuca preissiana</i> Low Open Woodland	
Sites 3	13 (Southern wet shrublands)
<i>Melaleuca raphiopylla</i> Low Open Woodland	
Sites 6*	13* (Southern wet shrublands)

FLORA

The bushland contains a vascular flora of 444 taxa (Appendix 2). Of these 388 are natives and 46 are weeds. Six of these taxa are non-flowering vascular plants, 175 are monocotyledons (153 natives and 22 weeds) and 253 are dicotyledons (230 native and 23 weeds). The Myrtaceae (34 taxa), Cyperaceae (32 taxa including 2 weeds), Poaceae (23 taxa, 12 weeds), Asteraceae (27 taxa, 6 weeds), Anthericaceae (18 taxa), Orchidaceae (28 taxa, 1 weed), Papilionaceae (31 taxa, 6 weeds), Proteaceae (32 taxa), Stylideaceae (17 taxa), Dasypogonaceae (13 taxa), Haemodoraceae (15 taxa) and the Restionaceae (13 taxa) are the most species diverse families.

Thirty taxa present in the Ruabon Nature Reserve (Appendix 2) are characteristic of the heavier soils of the southern side (or eastern side of the Plain north of Busselton) of the Swan Coastal Plain. There are also at least twelve taxa (Appendix 2) that are only recorded on the Swan Coastal Plain to the south of Capel.

Significant Flora

Three species of Declared Rare Flora are recorded for Ruabon Nature Reserve; Royce's Chamelaucium (*Chamelaucium roycei* ms), the sedge *Tetraria australiensis* and the Grand Spider Orchid (*Caladenia huegeli*).

Royce's Chamelaucium is to be named in recognition of R.D. Royce, a former Curator of the WA Herbarium who in his early employment with the Department of Agriculture collected extensively in the Busselton District. His collections include many previously unrecognised taxa, many of which will be named for him. Royce's Chamelaucium is an attractive upright low shrub with a red tinge to its older foliage with small white flowers that age to pinkish red. While locally common in the Nature Reserve and adjacent bushland this is the only significant population of the species. Plants are killed by fire and regenerate abundantly after fire from seed. Too frequent fires in the Reserve are a threat to the species.

Tetraria australiensis is a perennial sedge and is difficult to locate in bushland until the first summer after a fire when it flowers *en masse*. It is present at other times but is relatively inconspicuous. *Tetraria australiensis* was considered to be extinct until rediscovered near Mundijong in 1993. The sedge was located in the Ruabon Nature Reserve in summer after a fire in the previous year.

The Grand Spider Orchid grows in the *Banksia* Woodlands and is widespread though uncommon on the Swan Coastal Plain.

Twelve rare taxa are also present in the Ruabon Nature Reserve (Atkins 1995, Appendix 2). Ten taxa are endemic to the Swan Coastal Plain and restricted to the southern side of the Plain (or eastern side of the Plain north of Capel).

Other Taxa of Interest

Acacia paradoxa

An uncommon taxon on the Swan Coastal Plain generally found associated with riverine banks of several geomorphological systems. Gibson *et al.* 1994 found that the vegetation of these areas was so degraded that it is not possible to sample the community in which this taxon occurred. However this taxon was found in Ruabon Nature Reserve and further study of the community in which it occurs is now possible.

Banksia meisneri var. *ascendens*

This shrubby *Banksia* is found in the sandy clay wet flats beside the clay areas. This taxon is very uncommon on the Swan Coastal Plain, Ruabon Nature Reserve being the only known record. Populations also occur on the Whicher Range and escarpment and on the Scott River Plains. It appears that dieback is impacting on the population at Ruabon Nature Reserve as the numbers of plants been significantly reduced (to half) over the last five years. This is a rare taxon (Priority 4, Atkins 1995).

Baxteria australis

This rather unusual plant with its stiff leaves and prickly flowers is often overlooked or thought to be a sedge. However it is relatively common in the damplands around Busselton extending north to Capel (the northern limit of the specie's range).

Blennospora sp. Ruabon

This taxon was first recognised in the Gibson *et al.* (1994) study in eight populations from community types 7, 10a and 18. While this taxon is related to *Blennospora drummondii*, it can be distinguished from it by the golden corolla lobes that do not age brown and the involucre bracts. Typical *Blennospora drummondii* was only found in the north of Perth. *Blennospora* sp. Ruabon is a rare taxon (Priority 3, Atkins 1995).

Chamaescilla aff. *spiralis* (GJK 12501)

This taxon was first recognised at the Brixton Street Wetlands (Keighery and Keighery 1991). This taxon differs from *C. spiralis* in having straight not spirally twisted leaves, pale blue flowers and it grows and flowers in inundated claypans (clay based sumplands). This is a rare taxon and should be listed on the CALM priority flora list.

Conospermum flexuosum subsp. *laevigatum*

This distinctive pale blue flowered *Conospermum* is a recently recognised subspecies (Bennett 1995). It is found from Capel to Busselton on the Plain and east to Nannup with isolated occurrences to the north along the Scarp and Plateau (Waroona and Jarrahdale area).

Drosera zonaria

A relatively common but rarely collected *Drosera*.

Dryandra nivea subsp. *uliginosa*

This recently recognised taxon is one of the two 'mound' forms of *Dryandra nivea* (George 1996). This dome shaped shrub is largely confined to the southern Swan Coastal Plain ironstone shrublands (and associated soils) and ironstones in the Scott River area. This taxon is both highly susceptible to dieback and fire, regenerating only from seed. This is a rare taxon and Gibson et al. (1994) recommended its gazettal as Declared Rare Flora (current listing, Priority 3, Atkins 1995)..

Angianthus drummondii - *preissianus* - *micropodioides* Group

In the Gibson et al. (1994) study five taxa were clearly distinguished in this group in the field: *A. aff. drummondii*, *A. drummondii*, green prostrate and upright forms of *A. preissianus* and *A. micropodioides*. Both *A. aff. drummondii* and the green prostrate *A. drummondii* are found at Ruabon Nature Reserve. Identifications of specimens in the herbarium are confused and this group needs to be re-examined (P.S. Short, pers. comm.).

Grevillea brachystylis subsp. *brachystylis*

This semi-prostrate red flowered *Grevillea* is common in the low shrublands on the wet flats. However this taxon is confined to the Busselton area and outside of Ruabon Nature Reserve and Ambergate Reserve. (Keighery, Keighery and Gibson 1996) is only found in a few roadside populations. This is a rare taxon (Priority 2, Atkins 1995).

Franklandia triaristata

This unusual Proteaceous species with its white star shaped chocolate/vanilla perfumed flowers is found uncommonly on sands of the foothills of the Whicher Range and the Swan Coastal Plain from south of Bunbury to Ruabon. Growing in a series of disjunct populations this species has the potential to be severely impacted by dieback and the species is in urgent need of survey to see if it should be reinstated as Declared Rare Flora.

Haloragis tenuifolia

A rarely collected semi-aquatic species growing in seasonally inundated areas but flowering once the areas have dried out and are waterlogged. This is a rare taxon (Priority 1, Atkins 1995).

Jacksonia sparsa ms

This open shrub *Jacksonia* is a dominant understorey plant in the *Banksia* Woodlands of the Busselton Region both on the Plain and on the Blackwood Plateau. While locally common in these areas its reservation status would need to be carefully considered before its status as a rare species was changed (current listing, Priority 3, Atkins 1995).

Johnsonia lupulina

This striking plant with its large drooping flower heads is another species that is uncommon on the Swan Coastal Plain and is found from Capel southward in Marri Woodlands on the southern side of the Plain, extending along the Darling Range near the Scarp to Dwellingup.

Myriophyllum echinatum

This is a small inconspicuous species growing in inundated areas but flowering in waterlogged soils. This poorly collected species is only found on the seasonally inundated heavy soils of the Pinjarra Plain. This is a rare taxon (Priority 3, Atkins 1995).

Patersonia occidentalis (swamp form)

This thin leafed and stemmed free flowering variety of *Patersonia occidentalis* is commonly found on the Swan Coastal Plain growing in damp areas. While distinctive in the field and commonly cultivated this form is difficult to distinguish taxonomically, as *Patersonia occidentalis* is a variable species.

Podolepis gracilis (Swamp form)

A robust glabrous form of this species with large pink or white flowers from the seasonally inundated heavy soils of the Pinjarra Plain from Gingin to Busselton. Further studies on this form are required to establish if it can be distinguished taxonomically.

Strangea stenocarpoides

This species occurs uncommonly on the Plain where it grows in Marri Woodlands in the Busselton area.

Synaphaea petiolaris ssp. *simplex*

This subspecies is confined to clay soils of the southern Swan Coastal Plain between Ruabon and Elgin. The record from Ruabon is the only record on a conservation reserve. This taxon should be

surveyed for gazettal as declared rare flora.

Trachymene coerulea

The white flowered form of this taxon in the Reserve appears to be significantly different from the better known blue flowered form of the species. This form from Ruabon will probably be recognised as a subspecies confined to the eastern (or southern sides south of Busselton) of the Swan Coastal Plain, south of Capel.

Tripterococcus paniculatus ms.

This is the most southern record of this rare species which is associated with the seasonally waterlogged flats on sandy clays.

Weeds

Forty six weeds are recorded for the Ruabon Nature Reserve (Appendix 2). Many of these species are annual species which have limited impact on the bushland. However a series of species occur in significant densities on the edges of the tracks and drains where the soil is continually disturbed and areas which have been partially cleared and/or grossly disturbed by past grazing. A series of the species recorded are known to become established in significant densities in intact bushland (Dixon and Keighery 1995). Of greatest concern are:

- bulbous and tuberous species: Arum Lily (*Zantedeschia aethiopica*), Bridal Creeper (*Asparagus asparagoides*), Freesias (*Freesia* aff. *leichtlinii*), *Watsonia versfeldii*, *Chasmanthe floribunda* and *Sparaxis bulbifera* which have the potential to further invade the bushland

- annual herbs: *Lotus angustifolius* in the clay areas along the drain on the southern boundary where grazing appears to have occurred in the past

- perennial grass: Love Grass (*Eragrostis curvula*) along the disturbed roadsides and drain banks.

Some of these species (Arum Lily, Bridal Creeper, Freesias, *Watsonia versfeldii* and *Chasmanthe floribunda*) that have become weeds appear to have been introduced as plantings in an old settlement on the eastern boundary. *Chasmanthe floribunda* has spread both vegetatively (bulbs) and sexually (seed) into the bushland. While *Pinus pinaster* is also present in this area it is not listed or considered a weed as all the trees are remnants of previous plantings. However this species has been recorded as weed and should be removed as should the few plants of Tagasaste (*Cytissus prolifer*).

Vegetation Condition

The vegetation of the Ruabon Nature Reserve is generally in excellent to very good condition. However there are a series of areas in a degraded condition (Map 2) where severe localised disturbance associated with the drains, tracks, grazing and clearing has severely impacted on the vegetation. It is in these areas that the weed species have become established. These nodes of severe weed infestations can act as foci for invasion of weeds into the intact vegetation. The potential of these weed species to invade bushland areas is increased with the level of disturbance of the bushland. Present disturbance in the Ruabon Nature Reserve is associated with the rubbish tip, rabbit grazing, soil disturbance associated with track and drain maintenance, too frequent fires and dieback infestations. Of particular concern is the rubbish tip located in the centre of the Reserve in the highest position in the landscape. The rubbish dumped in the tip (and outside the tip) has the potential to introduce new weeds. Also, the tip appears to be the source of nutrient enrichment of the northern wetland (resulting in dense algal growth in the water) and could easily be a source of further dieback infestations.

DISCUSSION

Vegetation

All remaining natural vegetation on the eastern (and southern side south of Busselton) of the Swan Coastal Plain has conservation value (Keighery and Trudgen 1992, Gibson *et al.* 1994, Keighery, Keighery and Gibson 1995). The regional floristic survey of the Plain (Gibson *et al.* 1994) recommended that:

"As a consequence of the small amount of remnant vegetation on the eastern side* of the plain, all such remnants in the study area with the basic vegetation intact or able to be regenerated are of high conservation value."

*includes the southern side, south of Busselton.

The location, condition and size of the Ruabon Nature Reserve identifies the area as being of regional conservation value. Also two of the four floristic community types, type 1b and type 7, were identified as being "vulnerable" (Table 2). Indicating that the community type is likely to move into the endangered category in the near future if factors leading to the loss of this community type continue to operate.

Also the vegetation of the Ruabon Nature Reserve has further significance as together with the vegetation of the Wonnerup Road road and rail reserve it forms an almost continuous corridor of

bushland from the Ludlow Tuart Forest to the Whicher Range. Along Wonnerup Road this corridor includes a series of Wetland Mosaic communities, including southern ironstone communities, and Marri Woodlands. Gibson *et al.* (1994) identified this reserve from Ruabon Nature Reserve east as being of particular regional conservation significance being

"one of the last two remaining continuous vegetated transects in the study area showing the catena of original vegetation types on the eastern side of the Plain."

In response to this regional study and as part of the update of the System 6 recommendations (Department of Conservation and Environment 1983) the Department of Environmental Protection identified the Ruabon Bushland as being a "Threatened and Poorly Reserved Community in need of interim protection" (Department of Environmental Protection 1994, Map 1). This study identifies the further significance of this corridor with its western extension.

Table 2:
Regional Conservation Status of the Floristic Community Types from Gibson *et al.* 1994.

Floristic Community Type	Reservation Status#	Conservation Status
Marri Woodland		
1b Southern Marri woodlands on heavy soils	Present in two or more Cons. Reserves	Vulnerable
Banksia Woodland		
21b* Southern <i>Banksia attenuata</i> woodlands	Present in two or more Cons. Reserves	Susceptible
Wetland Mosaic		
<i>Melaleuca uncinata</i> Tall Shrubland/ <i>Melaleuca cuticularis</i> Low Woodland		
7 (Herb rich saline shrublands in clay flats)	Present in two or more Cons. Reserves	Vulnerable
<i>Melaleuca preissiana</i> Low Open Woodland/ <i>Melaleuca raphiopylla</i> Low Open Woodland		
13 (Southern wet shrublands)	Present in two or more Cons. Reserves	Low Risk

* floristic community type inferred.

Conservation Reserves are National Parks or Nature Reserves

Consideration of the the plant communities present in the Ruabon Nature Reserve further identifies the conservation value of the remnant.

***Banksia* Woodlands**

The *Banksia* Woodland is from floristic community type 21b and is restricted to sand sheets at the base of the Whicher Scarp, the sand sheets on elevated ridges or the sand plain south of Bunbury. Again a series of southern taxa such as *Acacia extensa* and *Jacksonia sparsa* help to identify this group.

Marri Woodland

The flora of these Marri Woodlands indicates a close association with the Whicher Plateau and the south coast as a series of the species commonly thought to be absent from the Plain are present in the

Ruabon Nature Reserve. At least twelve of these taxa are present in the Reserve (Appendix 2), some examples are: *Bacteria australis*, *Johnsonia lupulina*, *Jacksonia sparsa*, and *Strangea stenocarpoides*. This southern element contributes to the nature of floristic community type 1b which is restricted to the area of the Plain south of Capel.

Wetland Mosaic

The series of communities distinguished in the seasonally inundated and waterlogged areas contain a series of

- rare taxa
- southern taxa
- taxa confined to the heavy soils of the Swan Coastal Plain.

Flora

The flora of the of the Ruabon Nature Reserve shows a high level of species diversity (Appendix 2). The Marri Woodlands and the *Melaleuca* Shrublands contain a particularly diverse shrub, sedge and herb flora. Regionally community type 1b has the highest mean species richness recorded on the Swan Coastal Plain having a mean species richness 67.8 species per 100 m² quadrat.

The *Banksia* Woodlands were not as diverse as the Marri Woodlands but with 61.3 taxa per 100 m² quadrat their diversity was also high.

The wetland community types with mean species richness per 100 m² quadrat ranging from 17.4 (community type 13) to 46.4 (community type 7).

The diversity of the flora of these woodlands and the presence of the substantial wetland areas contribute to the areas diversity of flora. Associated with this diverse flora area are a series of declared rare, rare and restricted taxa that contribute to the area's significance.

CONCLUSION

Ruabon Nature Reserve contains the largest remaining areas of the *Banksia* Woodland associated with Marri Woodlands and wetlands of the eastern side of the Plain in the Busselton/Capel area. The Reserve contains a series of plant communities, and their associated flora, that are now rare on the Plain. Also together with the Wonnerup Road road and rail reserve it forms one of only two corridors of vegetation across the eastern side of the Swan Coastal Plain.

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Appendix 1: Vegetation Descriptions and Condition

General Information

Broad mapping units are used for the vegetation mapping (Map 2). The determination of these units is based on vegetation descriptions from the sites. The actual location of the sites is indicated on the map. The vegetation descriptions for each of the mapped units are from the areas considered to best illustrate these units, being 'typical' and in the best condition.

Sites are grouped on the basis of the mapping units and the floristic community type. An * indicates that the floristic community type for the unit and/or site has been inferred from the floristics.

Keys to the terminology used for the vegetation descriptions and specific condition ratings are given in the first paper in this series Keighery, Keighery and Gibson (1996), in this volume.

Woodlands

Mapping Unit - mW (Marri Woodland) Floristic Community Type *1b

Site 5

Marri Open Forest to Woodland over *Xanthorrhoea preissii*, *Kingia australis*, *Acacia extensa*, *Melaleuca thymoides* and *Hakea ruscifolia* Shrubland over *Hibbertia hypericoides* and *Opercularia hispidula* Low Shrubland over *Tetraria octandra* and *Lepidosperma tenue* Sedgeland, mixed Very Open Herbland and *Lindsaea linearis* Fernland.

Comments: Jarrah is scattered through this community.

Condition Rating Excellent

Soil: grey clay over clay, S10 (Belford 1987), Aw (Tille and Lantzke 1990)

Drainage: moderate Aspect: flat

Mapping Unit - bW (Banksia Woodland) Floristic Community Type 21b

Site 1 (RUAB 1 Gibson *et al.* 1994)

Banksia attenuata, *B. ilicifolia* and *Agonis flexuosa* Low Open Forest over *Kunzea ericifolia* Tall Open Shrubland to Tall Open Scrub over *Melaleuca thymoides* Open Heath over *Calytrix flavescens* Low Shrubland over *Phlebocarya ciliata* Open Herbland over *Loxocarya flexuosa* Open Sedgeland.

Condition Rating Very good

Soil: pale grey sand over white sand, S8 (Belford 1987), Ad2 (Tille and Lantzke 1990)

Drainage: well Aspect: gentle to the south

Site 2 (RUAB 2 Gibson *et al.* 1994)

Banksia attenuata Low Open Forest over *Kunzea ericifolia* Tall Open Shrubland to Tall Open Scrub over *Melaleuca thymoides* Shrubland over *Calytrix flavescens* Low Open Shrubland over *Phlebocarya ciliata* Open Herbland over *Lyginia barbata* Open Sedgeland.

Condition Rating Very good

Soil: pale grey sand over white sand, S8 (Belford 1987), Ad2 (Tille and Lantzke 1990)

Drainage: well Aspect: gentle to the south west

Wetland Mosaic

Mapping Unit - mcW (*Melaleuca cuticularis* Low Woodland) Floristic Community Type 7

Site 4 (RUAB 4 Gibson *et al.* 1994)

Melaleuca cuticularis Low Open Woodland over *M. uncinata*, *Astartea* aff. *fascicularis* and *Hakea marginata* Shrubland over exotic annual Very Open Grassland, *Myriocephalus helichrysoides*, *Polypomphlyx multifida* and *Brachyscome belidoides* Closed Herbland and annual Sedgeland.

Note: In late spring dominant herbs change to *Angianthus* species and *Stylidium* species.

Condition Rating Very good

Comment: Past grazing and possibly fires have impacted on the herb and sedge layer, introducing a grass layer. Adjacent area and patches in the site have a layer of *Lotus angustatus*. Drain along boundary to the south.

Soil: brown clay over clay and ironstone in patches at 50 -60 cm, Cps1 (Belford 1987)

Drainage: poor, water to 2 cm Aspect: flat

**Mapping Unit - muS (*Melaleuca uncinata* Tall Shrubland)
Floristic Community Type 7***

Site 7

Melaleuca uncinata, *M. viminea* and *M. incana* Tall Open Scrub over *Hakea marginata*, *Astartea* aff. *fascicularis* and *Aotus gracillima* Open Heath over *Lepidosperma longitudinale* Sedgeland.

Condition Rating Very good

Soil: brown clay over clay and ironstone in patches at 50 -60 cm, Cps1 (Belford 1987)

Drainage: poor, water to 2 cm Aspect: flat

**Mapping Unit - mpW (*Melaleuca preissiana* Low Open Woodland)
Floristic Community Type 13***

Site 6

Melaleuca preissiana Low Woodland over scattered *Xanthorrhoea preissii* and *Kingia australis* over scattered areas of *Regulia ciliata* Closed heath over *Pericalymma spongiocaula* Closed Heath over *Leptocarpus roycetti* and *Leptocarpus aristatus* Open Sedgeland and *Phlebocarya ciliata* and *Conostylis acidealana* Open Herbland.

Comments: *Melaleuca raphiophylla* Low Woodland occurs in the wettest areas of these wetlands (see description below).

CONDITION

Rating Excellent

Soil: grey sandy clay over clay, S10 (Belford 1987), Aw (Tille and Lantzke 1990)

Drainage: poor Aspect: gentle slope to the east

**Mapping Unit - mrW (*Melaleuca raphiophylla* Low Open Woodland)
Floristic Community Type 13**

Site 3 (RUAB 3 Gibson *et al.* 1994)

Melaleuca raphiophylla Low Woodland over *Hakea varia* Tall Open Shrubland over *Leptocarpus roycetti* Closed Sedgeland.

Condition Rating Excellent

Soil: grey clay over clay, S10 (Belford 1987), Aw (Tille and Lantzke 1990)

Drainage: poor, water to 1m in winter Aspect: flat

Appendix 2: Flora List

Key

Column 1 Family, Conservation Status (Atkins 1995) and Regional distributions

- R** = Declared Rare Flora
1 = Priority 1: Poorly Known Taxa
2 = Priority 2: Poorly Known Taxa
3 = Priority 3: Poorly Known Taxa
4 = Priority 4: Rare Taxa

Regional ecological preferences

- H** = taxa characteristic of clays and sandy clay soils on the eastern side (southern side north of Busselton) of the Swan Coastal Plain
s = taxa characteristic of sandy soils on the eastern side (southern side north of Busselton) of the Swan Coastal Plain
E = eastern side of the Plain taxa (southern side north of Busselton)
e = endemic to the eastern (southern side north of Busselton) side of the Plain

Geographical Location (range ends)

- N** = population at the northern limit of their known geographic range
S = taxa found on the Plain south of Capel
D = populations disjunct from their known geographic range

Column 2 Taxon

Names follow Gibson *et al.* (1994) unless indicated otherwise. A * preceding the name indicates a weed.

Columns 3 - 8

- M** = Marri Woodland to Forest
B = *Banksia* Woodland
mp = *Melaleuca preissiana* Low Open Woodland
mu = *Melaleuca uncinata* Tall Shrubland
mr = *Melaleuca rhapsiophylla* Low Open Woodland
mc = *Melaleuca cuticularis* Low Open Woodland
D = degraded areas (road sides, track edges, drains)

Ruabon Flora List		M	B	mp	mu	mr	mc	D
Alliaceae								
*	<i>Ipheion uniflorum</i>						•	
Anthericaceae								
H	<i>Agrostocrinum scabrum</i>	•						
	<i>Arthropodium preissii</i>						• •	
	<i>Caesia micrantha</i>	•						
	<i>Caesia occidentalis</i>			•	•			
	<i>Chamaescilla corymbosa</i>		•					
eH	<i>Chamaescilla</i> aff. <i>spiralis</i> GJK 12501				•			
	<i>Johnsonia acaulis</i>		•					
S	<i>Johnsonia lupulina</i>	•						
	<i>Laxmannia minor</i>				•			
	<i>Laxmannia sessiliflora</i> subsp. <i>australis</i>	•	•					
	<i>Sowerbaea laxiflora</i>	•						
	<i>Thysanotus multiflorus</i>	•	•					
	<i>Thysanotus patersonii</i>		•					
	<i>Thysanotus sparteus</i>		•					
	<i>Thysanotus thyrsoides</i>	•						
	<i>Thysanotus triandrus</i>	•						
	<i>Tricoryne elatior</i>	•	•					
	<i>Tricoryne tenella</i>	•		•				
Apiaceae								
H	<i>Actinotus glomeratus</i>	•						
eH	<i>Eryngium subdecumbens</i> ms				•			
	<i>Hydrocotyle alata</i>	•						
	<i>Hydrocotyle callicarpa</i>	•						
	<i>Hydrocotyle pilifera</i>	•						
N	<i>Platysace haplosciadea</i>		•	•				
	<i>Schoenolaena juncea</i>						•	
	<i>Trachymene coreulea</i>	•		•				
	<i>Trachymene pilosa</i>		•					
	<i>Xanthosia huegelii</i>		•					
Araceae								
*	<i>Zantedeschia aethiopica</i>	•						
Asparagaceae								
*	<i>Asparagus asparagoides</i> (<i>Myrsiphyllum asparagoides</i> in Gibson <i>et al.</i> 1994)	•		•			•	
Asteraceae								
H	<i>Angianthus</i> aff. <i>drummondii</i> BJK & NG 013						•	
H	<i>Angianthus preissianus</i> "flat green"						•	
*	<i>Arctotheca calendula</i>							•
*	<i>Aster subulatus</i>					•		
	<i>Asteridea pulverulenta</i>		•					
3H	<i>Blennospora</i> sp. Ruabon (<i>B.</i> aff. <i>drummondii</i> (golden bracts) BJK&NG 20 in Gibson <i>et al.</i> 1994)				•			

Ruabon Flora List	M	B	mp	mu	mr	mc	D
Brachyscome bellidioides						*	
* Conyza albida							*
Cotula australis						*	
Cotula coronopifolia						*	
* Dittrichia graveolens							*
Gnaphalium gymnocephalum	*						
Gnephosis tenuissima						*	
Hyalosperma cotula				*			
* Hypochaeris glabra	*	*		*			
Lagenifera huegelii	*						
eEH Myriocephalus helichrysoides				*			
H Podolepis gracilis 'Swamp' GJK 13126						*	
Pogonolepis stricta						*	
Quinetia urvillei						*	
Senecio hispidulus				*			
Senecio quadridentatus	*	*					
Siloxerus humifusus	*			*			
H Trichocline spathulata	*						
* Ursinia anthemoides		*					*
Waitzia citrina		*					
Waitzia suaveolens	*						
Brassicaceae							
* Heliophila pusilla				*			
Campanulaceae							
Wahlenbergia preissii	*	*					
Caryophyllaceae							
* Corrigiola litoralis							*
Casuarinaceae							
Allocasuarina humilis	*	*		*			
Centrolepidaceae							
Aphelia cyperoides			*	*			
Brizula drummondii				*			
Centrolepis alepyroides				*			
Centrolepis aristata	*	*			*		
Centrolepis drummondii	*	*					
Centrolepis glabra				*			
Centrolepis inconspicua				*			
Centrolepis polygyna				*			
Chenopodiaceae							
* Chenopodium macrospermum							*
Halosarcia halocnemoides						*	
Colchicaceae							
Burchardia multiflora	*			*			
Burchardia congesta (Burchardia umbellata in Gibson <i>et al.</i> 1994)	*	*					

Ruabon Flora List	M	B	mp	mu	nr	me	D
<i>Lomandra sonderi</i>	•						
<i>Lomandra suaveolens</i>		•					
Dilleniaceae							
<i>Hibbertia aurea</i>	•						
<i>Hibbertia hypericoides</i>	•	•					
<i>Hibbertia racemosa</i>		•					
<i>Hibbertia rhadinopoda</i>			•				
<i>Hibbertia stellaris</i>			•				
<i>Hibbertia vaginata</i>	•	•					
Droseraceae							
<i>Drosera erythrorhiza</i>	•						
<i>Drosera gigantea</i>			•				
<i>Drosera glanduligera</i>			•	•			
<i>Drosera macrantha</i> subsp. <i>macrantha</i>	•	•					
<i>Drosera menziesii</i> subsp. <i>penicillaris</i>		•					
<i>Drosera pallida</i>	•	•					
<i>Drosera rosulata</i>						•	
eH <i>Drosera tubaestylis</i>			•	•			
<i>Drosera zonaria</i>		•					
Epacridaceae							
<i>Andersonia micrantha</i>	•						
<i>Conostephium pendulum</i>		•					
<i>Leucopogon australis</i>			•				
<i>Leucopogon conostephioides</i>		•					
<i>Leucopogon glabellus</i>		•					
<i>Leucopogon striatus</i>		•					
<i>Lysinema ciliatum</i>		•					
S <i>Needhamiella pumilio</i>			•				
Euphorbiaceae							
<i>Monotaxis occidentalis</i>	•	•					
<i>Monotaxis grandiflora</i>	•		•				
<i>Poranthera microphylla</i>		•					
Gentianaceae							
* <i>Cicendia filiformis</i>				•			
Geraniaceae							
* <i>Pelargonium domesticum</i>							•
Goodeniaceae							
<i>Dampiera linearis</i>	•	•					
<i>Dampiera pedunculata</i>							
<i>Goodenia micrantha</i>				•	•		
<i>Goodenia pulchella</i>				•			
<i>Lechenaultia expansa</i>	•						
<i>Scaevola phlebopetala</i>	•						
<i>Velleia trinervis</i>	•						

Ruabon Flora List

M B mp mu mr me D

Lauraceae							
	<i>Cassytha racemosa</i>						•
Lemnaceae							
	<i>Lemna trisulca</i>						•
Lentibulariaceae							
	<i>Polypompholyx multifida</i>						•
	<i>Utricularia inaequalis</i>						•
	<i>Utricularia menziesii</i>						•
H/n	<i>Utricularia simplex</i>						•
	<i>Utricularia violacea</i>						•
Lindsaeaceae (Ferns)							
	<i>Lindsaea linearis</i>		•				
Lobeliaceae							
	<i>Lobelia tenuior</i>						•
*	<i>Monopsis debilis</i>						• •
Loganiaceae							
	<i>Logania serpyllifolia</i>		•				
	<i>Mitrasacme paradoxa</i>						• •
Loranthaceae							
	<i>Nuytsia floribunda</i>		•				• •
Lycopodiaceae							
	<i>Phylloglossum drummondii</i>						•
Lythraceae							
*	<i>Lythrum hyssopifolia</i>						•
Menyanthaceae							
	<i>Villarsia albiflora</i>						•
	<i>Villarsia capitata</i>						•
	<i>Villarsia parnassifolia</i>						•
	<i>Villarsia submersa</i>						•
Mimosaceae							
	<i>Acacia applanata</i>						•
	<i>Acacia extensa</i>		•				•
4E	<i>Acacia flagelliformis</i>						•
	<i>Acacia huegelii</i>						•
	<i>Acacia incurva</i>						•
	<i>Acacia myrtifolia</i>						•
	<i>Acacia pulchella</i>						• • •
• 3	<i>Acacia semitrullata</i>		•				
	<i>Acacia stenoptera</i>		•				•
Myrtaceae							
S/H	<i>Actinodium cunninghamii</i>						•

Ruabon Flora List		M	B	mp	mu	mr	mc	D
	<i>Agonis flexuosa</i>	•	•					
	<i>Astartea fascicularis</i>						•	
	<i>Baeckea camphorosmae</i>	•	•					
	<i>Calothamnus lateralis</i>			•				
	<i>Calothamnus sanguineus</i>	•						
	<i>Calytrix angulata</i>	•						
	<i>Calytrix flavescens</i>		•					
ReH	<i>Chamelaucium roycei</i> ms			•	•			
S/H	<i>Darwinia oederoides</i>	•		•				
	<i>Eucalyptus calophylla</i>	•						
	<i>Eucalyptus marginata</i>	•						
	<i>Eucalyptus rudis</i>						•	
	<i>Hypocalymma angustifolium</i>			•				
S	<i>Hypocalymma ericifolium</i>			•				
	<i>Hypocalymma robustum</i>	•	•					
	<i>Kunzea ericifolia</i>		•					
	<i>Kunzea recurva</i>			•				
S	<i>Kunzea</i> aff. <i>micrantha</i> BJK & NG 040						•	
	<i>Melaleuca cuticularis</i>				•			
H	<i>Melaleuca incana</i>			•				
	<i>Melaleuca lateritia</i>						•	
	<i>Melaleuca leptoclada</i>			•		•		
	<i>Melaleuca preissiana</i>			•				
	<i>Melaleuca raphiophylla</i>						•	
	<i>Melaleuca thymoides</i>		•	•				
H	<i>Melaleuca uncinata</i>				•			
H	<i>Melaleuca viminea</i>				•		•	
	<i>Pericalymma spongiocaula</i>			•	•			
	<i>Regelia ciliata</i>			•				
	<i>Verticordia attenuata</i>				•			
	<i>Verticordia densiflora</i>			•				
	<i>Verticordia pennigera</i>							
I/eH	<i>Verticordia plumosa</i> var. <i>vassensis</i>				•			
Onagaracea								
	<i>Epilobium hirtigerum</i>					•	•	
Orchidaceae								
	<i>Caladenia attigens</i>	•						
	<i>Caladenia chapmanii</i> ms		•					
	<i>Caladenia flava</i>	•	•					
R	<i>Caladenia huegelii</i>		•					
	<i>Caladenia longicauda</i>		•					
	<i>Caladenia marginata</i>	•						
	<i>Caladenia paludosa</i> ms	•	•					
	<i>Cyrtostylis heugelii</i>	•						
	<i>Diuris longifolia</i>	•						
	<i>Drakaea glyptodon</i>		•					
	<i>Elythranthera brunonis</i>	•	•					
	<i>Eriochilus dilatatus</i>	•						
	<i>Leporella fimbriata</i>		•					

Ruabon Flora List	M	B	mp	mu	nr	mc	D
<i>Lyperanthus nigricans</i>	•	•					
<i>Lyperanthus serratus</i>	•						
<i>Microtis atrata</i>				•			
<i>Microtis media</i> subsp. <i>media</i>		•	•				
* <i>Monadenia bracteata</i>	•	•					
<i>Paracaleana nigrita</i>		•					
<i>Praecoxanthus aphyllus</i> ms		•					
<i>Prasophyllum fimbria</i>	•		•				
<i>Prasophyllum parvifolium</i>		•					
<i>Pterostylis recurva</i>	•	•					
<i>Pterostylis vittata</i>	•	•					
<i>Pterostylis</i> aff. <i>nana</i>		•					
<i>Pterostylis</i> aff. <i>sanguinea</i>		•					
<i>Thelymitra benthamiana</i>	•						
<i>Thelymitra crinita</i>	•	•					
<i>Thelymitra flexuosa</i>						•	
<i>Thelymitra pauciflora</i>			•				
Orobanchaceae							
<i>Orobanche australiana</i>		•					
Oxalidaceae							
* <i>Oxalis glabra</i>							
* <i>Oxalis purpurea</i>							
Papilionaceae							
<i>Aotus epacridoides</i>			•				
<i>Aotus ericoides</i>			•				
<i>Bossiaea eriocarpa</i>		•					
* <i>Cytissus prolifera</i>							•
<i>Daviesia hakeoides</i>			•				
<i>Daviesia incrassata</i>			•				
<i>Daviesia physodes</i>	•	•					
<i>Daviesia preissii</i>	•						
<i>Dillwynia cinerascens</i>			•				
<i>Euchilopsis linearis</i>			•				
<i>Eutaxia virgata</i>					•		
<i>Gompholobium capitatum</i>	•						
<i>Gompholobium polymorphum</i>	•						
<i>Gompholobium shuttleworthii</i>				•			
<i>Hardenbergia comptoniana</i>	•						
<i>Hovea pungens</i>	•						
<i>Hovea trisperma</i>		•					
<i>Jacksonia furcellata</i>		•					
<i>Jacksonia lehmannii</i>				•			
3/S <i>Jacksonia sparsa</i> ms	•	•					
<i>Kennedia coccinea</i>	•						
<i>Kennedia prostrata</i>		•					
* <i>Lotus angustifolius</i>							•
* <i>Lupinus consentinii</i>							
* <i>Lupinus angustifolius</i>							
<i>Nemcia capitata</i>	•						

Ruabon Flora List	M	B	mp	mu	mr	mc	D
<i>Pultenaea reticulata</i>						•	
* <i>Trifolium campestre</i> var <i>campestre</i>				•			•
<i>Sphaerolobium medium</i>	•						
* <i>Vicia sativa</i>				•			•
<i>Viminaria juncea</i>			•	•			
Philydraceae							
<i>Philydrella pygmaea</i>			•	•			
Pittosporaceae							
<i>Billardiera variifolia</i>	•						
<i>Pronaya fraseriana</i>		•					
Poaceae							
<i>Agrostis avenacea</i>						•	
* <i>Aira cupaniana</i>		•					
H <i>Amphibromus nesii</i>						•	
<i>Amphipogon amphipogonoides</i>	•						
<i>Amphipogon turbinatus</i>		•					
* <i>Anthoxanthum odoratum</i>							•
* <i>Avena barbata</i>							•
* <i>Briza maxima</i>	•	•	•				•
* <i>Briza minor</i>				•			
<i>Danthonia occidentalis</i>		•		•			
<i>Danthonia setacea</i>	•		•	•			
* <i>Digitaria sanguinalis</i>					•		•
* <i>Ehrharta longiflora</i>							•
* <i>Eragrostis curvula</i>							•
* <i>Holcus lanatus</i>						•	•
<i>Microlaena stipoides</i>		•					
* <i>Pentachistis airoides</i>		•					
* <i>Polypogon monspeliensis</i>				•			
<i>Polypogon tenellus</i>				•			
<i>Stipa compressa</i>		•					
<i>Stipa semibarbata</i>	•						
<i>Tetrarrhena laevis</i>	•						
* <i>Vulpia myuros</i>		•		•			
Polygalaceae							
<i>Comesperma calymega</i>	•	•					
<i>Comesperma ciliatum</i>						•	
<i>Comesperma virgatum</i>			•			•	
<i>Persicaria prostrata</i>						•	
Polygonaceae							
<i>Polygonum salicifolia</i>						•	
* <i>Rumex crispus</i>							•
Portulacaceae							
<i>Calandrinia composita</i>				•			
<i>Calandrinia granulifera</i>						•	

Ruabon Flora List		M	B	mp	mu	nr	mc	D
Primulaceae								
*	<i>Anagallis arvensis</i>						•	•
	<i>Samolus junceus</i>						•	
Proteaceae								
	<i>Adenanthos meisneri</i>	•						
	<i>Adenanthos obovatus</i>				•			
	<i>Banksia attenuata</i>		•					
	<i>Banksia grandis</i>	•						
	<i>Banksia ilicifolia</i>		•					
	<i>Banksia littoralis</i>				•			
• 4/Dn	<i>Banksia meisneri</i> var. <i>ascendens</i>				•			
	<i>Conospermum caeruleum</i> subsp. <i>debile</i>					•		
	<i>Conospermum capitatum</i> subsp. <i>glabratum</i>	•			•			
	<i>Conospermum flexuosum</i> subsp. <i>laevigatum</i> (Bennet 1995)	•			•			
3eH	<i>Dryandra nivea</i> subsp. <i>uliginosa</i> (George 1996, D. aff. <i>nivea</i> GJK 6622 in Gibson <i>et al.</i> 1994)				•			
	<i>Dryandra lindleyana</i> subsp. <i>lindleyana</i> (George 1996, D. <i>nivea</i> GJK 6622 in Gibson <i>et al.</i> 1994)	•						
• 4s	<i>Franklandia triaristata</i>		•					
2eE	<i>Grevillea brachystylis</i> subsp. <i>brachystylis</i>					•		
	<i>Grevillea manglesioides</i>				•		•	
	<i>Hakea ceratophylla</i>				•	•		
	<i>Hakea marginata</i>					•		
	<i>Hakea sulcata</i>					•		
	<i>Hakea varia</i>					•	•	
	<i>Isopogon scaber</i>				•			
	<i>Persoonia elliptica</i>	•						
	<i>Persoonia longifolia</i>	•						
	<i>Petrophile linearis</i>		•					
H	<i>Petrophile media</i> var. <i>juncifolius</i>					•		
	<i>Petrophile seminuda</i>						•	
	<i>Petrophile</i> aff. <i>squamata</i>					•	•	
	<i>Stirlingia latifolia</i>		•		•			
E/S	<i>Strangea stenocarpoides</i>	•						
	<i>Synaphea floribunda</i>	•						
	<i>Synaphea petiolaris</i> subsp. <i>triloba</i> (George 1995)	•	•					
	<i>Synaphea petiolaris</i> subsp. <i>simplex</i> (George 1995)	•						
	<i>Xylomelum occidentale</i>	•						
Restionaceae								
H	<i>Anarthria laevis</i>				•	•		
	<i>Anarthria prolifera</i>	•						
	<i>Hypolaena exsulca</i>		•					
	<i>Leptocarpus coangustatus</i>						•	
	<i>Leptocarpus elegans</i> ms						•	

Ruabon Flora List	M	B	mp	mu	mr	mc	D
<i>Leptocarpus roycei</i> ms						•	
<i>Lepyrodia macra</i>			•				
<i>Loxocarya cinerea</i>		•					
<i>Loxocarya fasciculata</i>	•						
<i>Loxocarya flexuosa</i>		•					
<i>Loxocarya pubescens</i>				•			
<i>Lyginia barbata</i>		•					
<i>Restio leptocarpoides</i>				•			
Rubiaceae							
<i>Opercularia apiciflora</i>	•						
<i>Opercularia hispidula</i>	•						
<i>Opercularia vaginata</i>	•		•				
Rutaceae							
<i>Boronia crenulata</i>							
var. <i>pubescens</i>	•						
<i>Boronia dichotoma</i>	•						
<i>Boronia ramosa</i>		•					
<i>Boronia spathulata</i>	•		•				
<i>Eriostemon spicatus</i>	•	•					
Scrophulariaceae							
<i>Gratiola peruviana</i>						•	
* <i>Parentucellia latifolia</i>						•	
* <i>Parentucellia viscosa</i>			•				
Selaginellaceae							
<i>Selaginella gracillima</i>			•	•			
Solanaceae							
* <i>Solanum nigrum</i>							•
Stackhousiaceae							
<i>Stackhousia pubescens</i>		•					
<i>Tripterooccus brunonis</i>						•	
leE <i>Tripterooccus paniculatus</i> ms						•	
Sterculiaceae							
<i>Thomasia grandiflora</i>						•	
Stylidiaceae							
<i>Levenhookia pusilla</i>						•	
<i>Stylidium</i> aff. <i>bulbiferum</i>	•						
<i>Stylidium calcaratum</i>						•	
<i>Stylidium carnosum</i>					•		
<i>Stylidium crassifolium</i>	•		•				
<i>Stylidium dichotomum</i>						•	
<i>Stylidium ecorne</i>						•	
<i>Stylidium guttatum</i>					•		
<i>Stylidium inundatum</i>					•	•	
<i>Stylidium junceum</i>	•	•					
IH <i>Stylidium mimeticum</i>					•	•	
<i>Stylidium petiolare</i>						•	

Ruabon Flora List

	M	B	mp	mu	nr	me	D
<i>Stylidium piliferum</i>		•					
<i>Stylidium repens</i>		•					
<i>Stylidium schoenoides</i>		•					
<i>Stylidium striatum</i>		•					
<i>Stylidium utricularioides</i>					•		
Thymeleaceae							
<i>Pimelea hispida</i>					•		
<i>Pimelea preissii</i>					•		
Tremandraceae							
<i>Platytheca galioides</i>		•					
<i>Tetratea hirsuta</i>		•					
Xanthorrhoeaceae							
<i>Xanthorrhoea preissii</i>	•	•	•				
Zamiaceae							
<i>Macrozamia riedlei</i>		•					

Map 1: Ruabon Nature Reserve Location.

Key



Ludlow Tuart Forest/State Forest areas



Areas of bushland identified by the Department of Environmental Protection (1994 - ongoing) as being "...threatened and poorly reserved community types requiring interim protection.."



Additional bushland corridor along Wonnerup Road



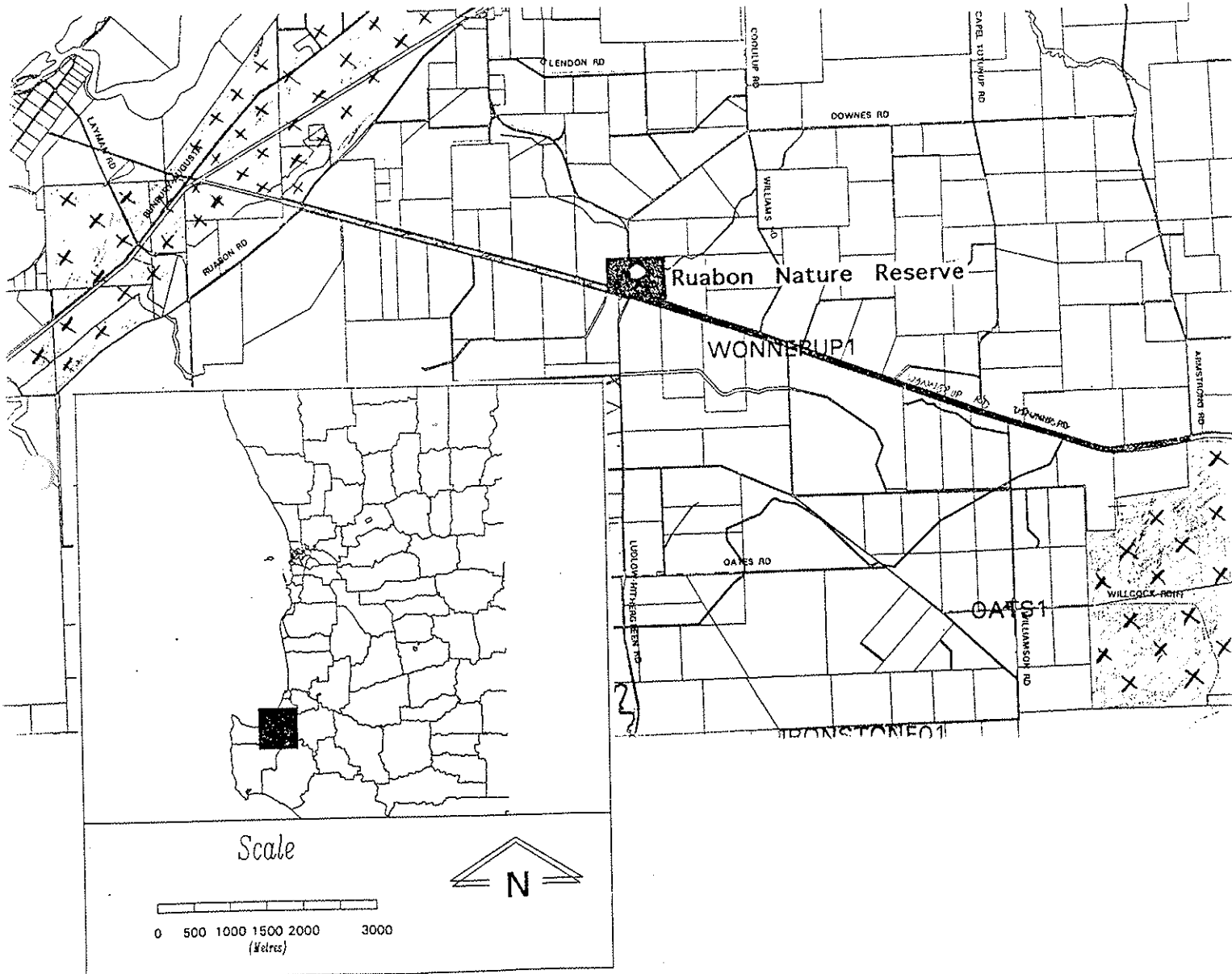
Cadastre



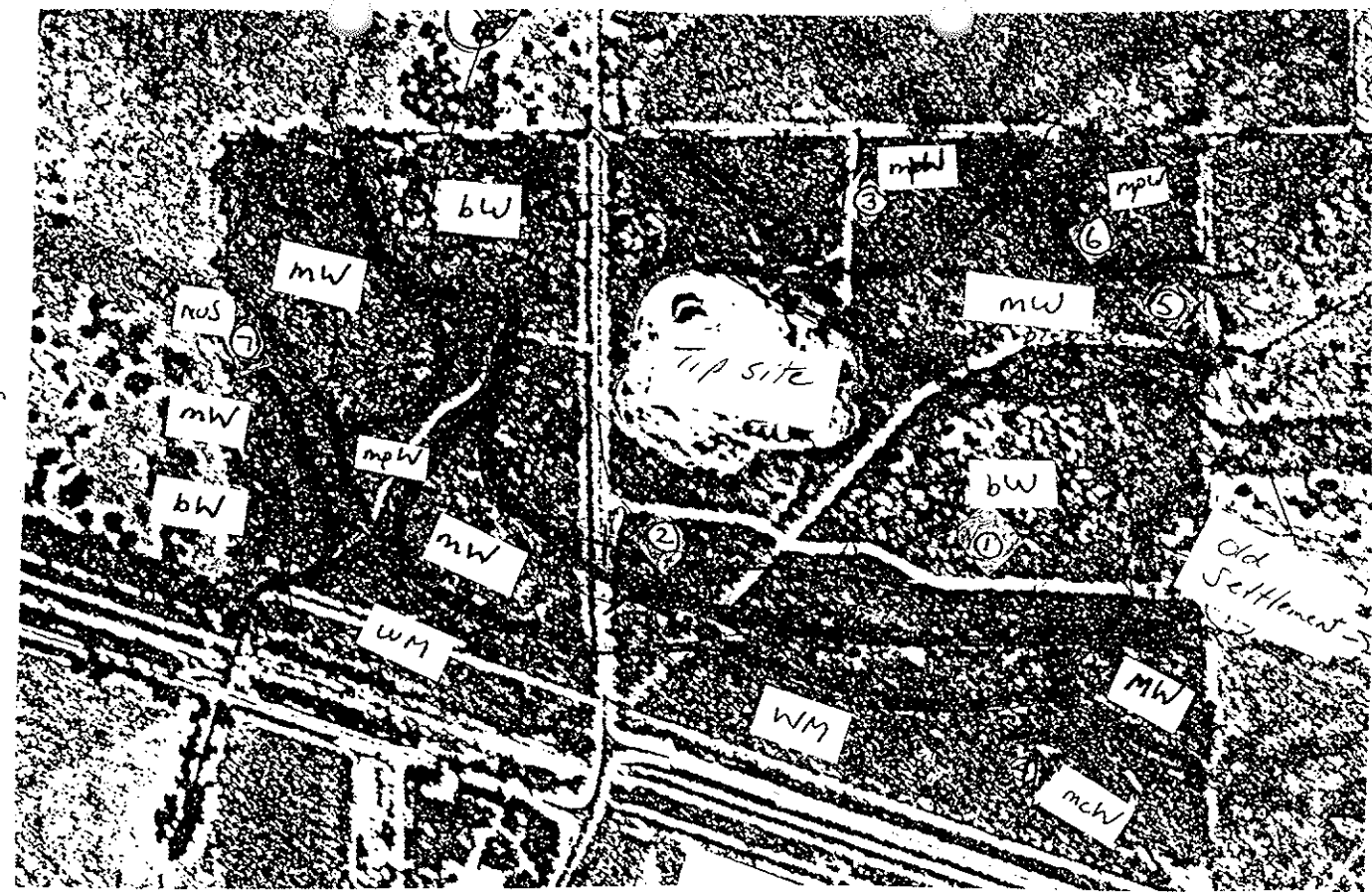
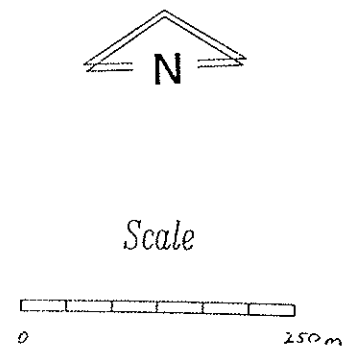
Drainage lines



Major and secondary roads



Map 2: Ruabon Nature Reserve Vegetation



Key

-  Bushland
-  degraded areas (road sides, track edges)
-  plant community boundary
-  Site location (see Appendix 1)

Woodlands

- bW = Jarrah and *Banksia* Woodland
- mW = Marri Woodland

Wetland Mosaic

- WM = Wetland Mosaic (combination of the four communities below and others changing at fine scale, see Vegetation)
- mpW = *Melaleuca preissiana* Low Woodland
- mrW = *Melaleuca raphiophylla* Low Woodland
- mcW = *Melaleuca cuticularis* Low Woodland
- muS = *Melaleuca uncinata* Tall Shrubland
- D = degraded areas - road sides, track edges, transmission line

