

ENTERED ON GIS

Name: Vegetation Survey and Rare Flora Search
Date: 02/05/2006
Capture Author: Thomas Leong

Comments:

Polygon

Created to match documented study area with acceptable level of accuracy

Accuracy Levels:

- High = Document contained visual and or described spatial references easily copied, resulting in little or no polygon boundary errors
- Acceptable = Document contained visual and or described spatial references with complex boundaries, resulting in minor boundary errors
- Low = Document contained little or no visual and or described spatial references, resulting in polygon boundary errors

Attributes

Report Info – Captured without problems

Custodial/Contact – Captured without problems

Content – Captured without problems

BUSHLAND PLANT SURVEY RECORDING SHEET 1- use pencil only

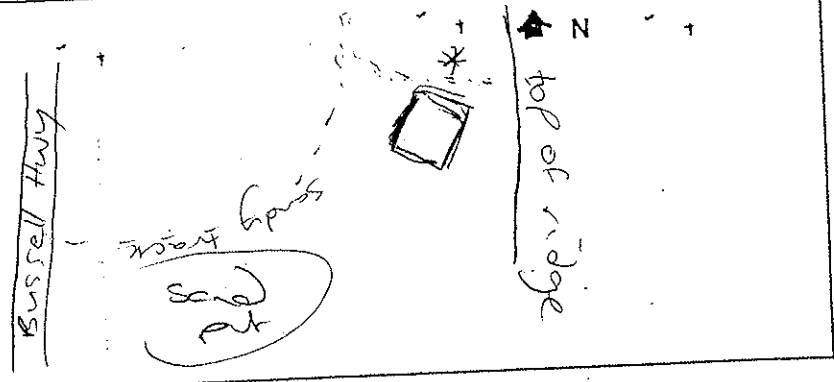
BUSHLAND AREA BUNBURY RIDGE SITE NUMBER RUNB 01
 DATE TRIP 18-10-95 RECORDERS BTK, NAT, BMT
 DATE TRIP _____ RECORDERS _____
 DATE TRIP _____ RECORDERS _____
 BOTANIST _____

From 'Bushland Plant Survey' written by B. Keighery (1994) and published by the Wildflower Society of WA (Inc.), PO Box 4 Nedlands WA 6008.

LOCATION of the QUADRAT

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

* large *Tristramia* 3 fork at base.
 NB fence droppers replaced with surveyors pegs.

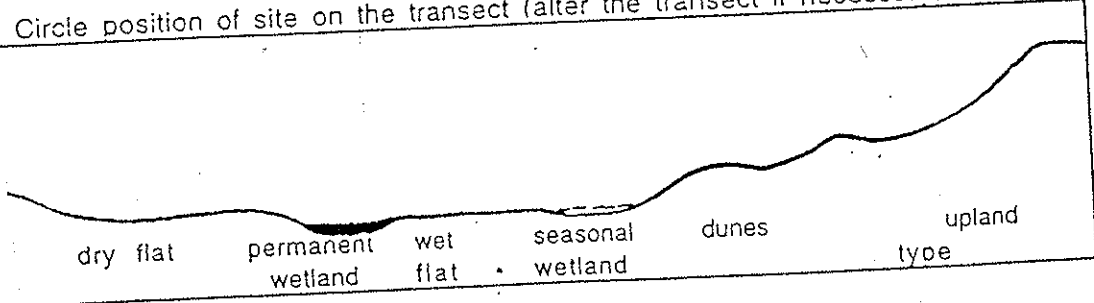


Road Location Sussell Hwy

Geographic Location Latitude 33°23'10" S Longitude 115°38'8" E Altitude EPE ± 57m

Reference Map _____ Photographer's Name WCT Photo No 8

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



Give correct response.

Aspect	N	NE	E	SE	S	(SW)	W	NW	
Soil	sand. alot of humus				Colour		brown		
	% surface				depth to rock		Colour yellow		
	poor depth water		cm		Wet all year		winter/spring		
50-70	% cover		Bare Ground		zero		%cover		
Depth up to 2		cm							

CHECK
 Hyalotella site 02
 check 105 site 01











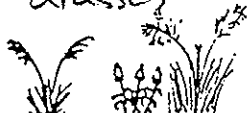


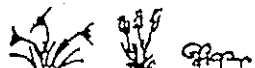
BUSHLAND PLANT SURVEY RECORDING SHEET 2 (Muir)- use pencil only

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

3. VEGETATION STRUCTURE AND COVER

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

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

		TREES			MALLEES	
		over 30m	15-30m	5-15m under 5m	over 8m	under 8m
LIFE FORM						
COVER CLASS (%)				30-70		
DOMINANT SPECIES				<i>B. attenuata</i> <i>Agonis flex</i>		
		SHRUBS			SHRUBS	
		over 2m	2m - 1.5m	1.5 - 1m	1-0.5m	under 0.5m
LIFE FORM						
COVER CLASS (%)						10-30
DOMINANT SPECIES						<i>Hibb hysp</i>
		GRASSES	HERBS	SEDGES	over 0.5m	
LIFE FORM		Very open Grasses 	Herbs 			
COVER CLASS (%)		2-10	30-70			
DOMINANT SPECIES		<i>Briza lax</i>	<i>Cooskylis acut.</i> <i>Ranuncula rosea</i> <i>Hyb. caly.</i>		<i>Lox. flex</i>	

4. VEGETATION CONDITION

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

BUSHLAND PLANT SURVEY RECORDING SHEET 3 - use pencil only

5. SPECIES PRESENCE

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

SITE No *BUND 4/*
 Date *18/10/95*

Record on Sheet

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

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

TREES	No	FI	ID	SHRUBS (cont.)	No	FI	ID	HERBS (cont.)	No	FI	ID
<i>Euc. gomph.</i>								<i>Hyb. calycinus</i>			
<i>Agon. flex.</i>								<i>Isotr. cuneif.</i>			
<i>Bark. att.</i>								<i>Pat. occid.</i>			
<i>Xylom. occid.</i>								<i>Phleb. ciliata</i>			
								<i>Lom. herm.</i>			
								<i>Daucus glochid.</i>			
MALLEES								<i>Warmbea monantha</i>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>
								<i>Tag. hueg.</i>			
				GRASSES				<i>Burch. congest.</i>			
				<i>Braza mex.</i>				<i>Craspedia sp.</i>			
				<i>Ehrh. caly.</i>				<i>Hom. succulent.</i>			
				<i>Avena barbifera</i>				<i>Cham. corym.</i>			
				<i>Aira cany.</i>							
				<i>Microlaena styroides</i>				SEDGES			
				<i>Stipa flavescent.</i>				<i>Lepid. squam. (1g ang)</i>			
SHRUBS								<i>Lox. flex.</i>			
<i>Macro. ried.</i>								<i>Schoenus grand.</i>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>
<i>Hibb. hyp.</i>								<i>Centro. drum.</i>			
<i>Xanth. brun.</i>											
<i>Hard. comp.</i>											
<i>Phyl. calycinus</i>				HERBS							
<i>Astroloma pet. (sterile)</i>				<i>Dicho. cap.</i>				ADJ			
<i>Corya micrantha.</i>				<i>Trid. campestr.</i>				<i>Craspedia sp. (fury)</i>			
<i>Hibb. racem.</i>				<i>Rom. rosea</i>				<i>Reeping Spider</i>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>
<i>Pet. linearis</i>				<i>Ortho. laxus</i>				<i>= Calad. attingens</i>			<input checked="" type="checkbox"/>
<i>Das. divar.</i>				<i>Caladenia flava</i>				<i>ssp attingens</i>			
<i>Ken. prost.</i>				<i>Cono. aculeata</i>							
				<i>Sower. taxif.</i>							
				<i>Hyg. glabra</i>							
				<i>Lom. caespitosa</i>							
				<i>Lier. retrorsum</i>							
				<i>Ast. pulv.</i>							
				<i>Urinia. anthem.</i>							
				<i>Trachymene pilosa</i>							

leave in comment

Caladenia attingens subsp. *attingens*
 found by Nicky Jobidon after specimen returned from A. Brown 12/1/95

**VEGETATION SURVEY AND RARE FLORA SEARCH
WOODCREST RISE, COLLEGE GROVE
CITY OF BUNBURY**

1.0 INTRODUCTION

This report describes methods and presents results of vegetation surveys, condition assessments and searches for rare flora in the bushland part of the proposed Woodcrest Rise, College Grove.

Vegetation and condition sketch maps are included in the report, and an appendix on rare flora is with it.

Surveys and searches were done for Phil Bailey and Tania Sewell, of Bowman Bishop Gorham, on 23 November 2000 and 20 and 21 January 2001.

LOCATION

The Woodcrest Rise study area that is the subject of this report is in the southern part of the City of Bunbury, on the eastern side of Bussell Highway between Washington Avenue and Centenary Road. It borders Bussell Highway, on the west, the Centenary Road reserve, on the south, Somerville Drive and its extension, on the north, and the eastern boundary line.

The study area is mainly native bushland with a number of tracks through it and, in the western part, a weedy land fill area.

OBJECTIVES AND SCOPE OF WORK

The principal objectives of this project were to:

1. Search the property for Declared Rare Flora, Priority Flora and other significant flora recorded from the general area, and possible habitats for them;

2. Describe vegetation units and assess vegetation condition,

3. Prepare a report, giving descriptions of vegetation units and condition and the locations of any rare, or otherwise significant, flora found.

PHYSICAL SETTING

Geology

The 1981 edition of the Geological Survey of Western Australia 1:50 000 scale Bunbury-Urban Geology Map Sheet 2031-III — 2031-II shows the geology of Woodcrest Rise

and associated with Tamala limestone (Qts), high dunes: most of the western slope of the study area;

Median Sand (Qpb), low rounded dunes: covering most of the eastern part of the study area, including all of the most upland part, and

Swamp deposit of mainly peaty sand (Qhw): just east of (or barely in?) the study area, southeast corner.

1.3.2 Wetlands

The 1:50 000 scale Wetland Atlas (Hill *et al.* 1996, Map Sheet 2031 III SE) does not show any wetlands in the study area, but it does show a large sumpland immediately east of the southeastern corner of the study area. This sumpland has Map Identification Number 73.

Hill *et al.* (1996) does not show a Preliminary Wetland Management Category for this wetland, but it has probably been assigned one since 1996.

1.4 VEGETATION

Hedde *et al.* (1980) shows almost all of the study area as being in the Karrakatta Vegetation Complex — Central and South (49), with a narrow strip of Yoongarillup Vegetation Complex (56) along the property's western edge. The Karrakatta Vegetation Complex — Central and South (49) is described as being predominantly open forest of tuart-jarrah-marri and woodland of jarrah — *Banksia* spp., and the Yoongarillup Vegetation Complex (56) is described as being woodland to tall woodland of tuart with peppermint in the understorey (less consistently an open forest of tuart-jarrah-marri).

The Southern River Vegetation Complex (42) is immediately east of the study area, and the Bassendean Vegetation Complex — Central and South (44) is south of the southeastern part of the study area. The Southern River Vegetation Complex is described as being open woodland of marri — jarrah — *Banksia* spp. with fringing woodland of flooded gum — swamp paperbark along creek beds, and the Bassendean Vegetation Complex — Central and South is described as vegetation ranging from woodland of jarrah — sheoak - *Banksia* spp. to low woodland of *Melaleuca* spp. and sedgelands on the moister sites.

Information from the Department of Environmental Protection (Thorning pers. comm. 1996?) indicates that the following percentages and hectares of the original areas on the Swan Coastal Plain of these vegetation complexes remained:

- 24%, or 11,887 ha, of Karrakatta Vegetation Complex — Central and South,
- 25%, or 6167 ha, of Yoongarillup Vegetation Complex,
- 18%, or 10,394 ha, of Southern River Vegetation Complex, and
- 19%, or 16,264 ha, of Bassendean Vegetation Complex — Central and South.

Smith (1974) shows the study area as being Tuart and Peppermint Woodlands, possibly with paperbarks in part of the eastern part. The Smith map is based upon field work done in 1973 and 1974 and upon interpretation of aerial photography flown in 1966.

2.0 METHODS

The vegetation survey, condition assessment and rare flora search comprised the following three stages:

- preparation for fieldwork, particularly preparation of Table A1 in this report (see Appendix A), familiarization with the appearance of the flora to be searched for, and examination of relevant reports, maps and other information;
- fieldwork to determine types, distribution and condition of vegetation units and rare flora habitats, and presence or absence of any rare flora listed in Table A1 and any other significant flora, and
- office and herbarium work done following the periods of fieldwork (1) to check identifications of plant specimens collected and photographed during fieldwork and (2) to prepare this report.

During the traverses driven and walked through the study area by Dr. Arthur Weston on 23 November 2000 and 20 and 21 January 2001, observations on structure and floristic composition of vegetation were recorded and condition of the vegetation was assessed. The system used for recording vegetation structure and the six-point scale for assessing vegetation condition are from Keighery (1994), Muir (1977) and Department of Environmental Protection (1998, *Part A*, Table 11, p. 37) and from Keighery (1994), Trudgen (1991), Western Australian Planning Commission (1998, p. 53) and Department of Environmental Protection (1998, *Part A*, Table 12, p. 40), respectively.

The six-point scale is, basically:

1. Pristine
2. Excellent
3. Very Good
4. Good
5. Degraded
6. Completely Degraded

Hussey *et al.* (1997), Marchant *et al.* (1987) and other floras and field guides were used for tentative plant identifications in the field.

The sketch vegetation and condition maps were drawn as overlays on 1:15 000 (approx.) scale aerial photography provided by Bowman Bishaw Gorham.

3.0 RESULTS AND DISCUSSION

3.1 VEGETATION

3.1.1 Plant Communities and Condition

Five native and one alien plant community units are distinguishable on the basis of vegetation height, density and dominant species. These units, and the symbols used for them on the vegetation map, are:

- Tuart Woodland T
- Marri (-Jarrah, -Candle Banksia) Open Forest M
- Candle Banksia (-Jarrah) Low Woodland to Open Forest B
- Banksia-Peppermint-Tuart Open Forest to Low Open Forest BT
- *Pericalymma ellipticum* (Swamp Teatree) Closed Heath P
- Mixed Alien Tall Open Scrub A

These plant communities are described below, and their boundaries are delineated on the vegetation map.

Sites are given after each title, and a condition assessment is given following each description. The locations of the sites are listed in Appendix B.

Tuart Woodland

Sites L, M, O, Q

The study area's steep western slope supports a Tuart Woodland to Open Forest with trees to more than 20 m tall and a patchy Low Woodland to Low Open Forest understorey of Candle Banksia, especially on middle and lower parts of the slope and where the tuart overstorey is more open. Most of the large tuart trees were logged years ago. Peppermint trees are common to scattered. The Tuart Woodland to Open Forest is on sand associated with Tamala limestone (Qts).

The lower understorey is very weedy, but the natives *Hibbertia cuneiformis*, *Phyllanthus calycinus*, *Rhagodia ?baccata*, *Conostylis ?candicans* and the Priority Two shrub *Lasiopetalum membranaceum* are conspicuous and widespread in it. There are also a few shrubs of *Olearia axillaris*.

The condition of this vegetation is assessed, on the Trudgen/Keighery scale, as mainly Good (4) (Completely Degraded, 6, in some areas), largely due to weediness, although many or most of the larger tuart trees were felled many years ago.

Marri (-Jarrah, -Candle Banksia) Open Forest

Sites F, H, I, Q

There are two relatively small areas of Marri Open Forest in the study area. One is in the southeast corner on the lowest part of the slope and at the base of the slope. The other is low on the western slope and at the base of it, especially in the southwest corner. The southeastern stand is on Bassendean Sand (Qpb) near peaty sand (Qhw), and the southwestern

one is in an area shown on the Bunbury-Burekup Urban Geology Map Sheet as sand associated with Tamala limestone (Qts). The southeastern stand is distinctive enough to be mapped separately, but the southwestern one is narrower, blends with the Tuart Woodland unit, and is included in it.

In the southeastern stand, Marri trees 10 to over 15 m tall provide from under 30% to over 70% cover, with Candle Banksia, sometimes over 10 m tall, providing 10% to 30% cover. There are also a few Jarrah, Peppermint, Bull Banksia, *Banksia ilicifolia*, *Nuytsia floribunda*, *Xylomelum occidentale* and *Melaleuca preissiana* paperbark trees in the stand. *Kunzea ericifolia* shrubs over 2 m tall are patchy, but sometimes very dense, in the understorey. Other typical, smaller understorey species include the shrubs *Adenanthos meisneri*, *Xanthorrhoea brunonis*, *Melaleuca thymoides*, *Leucopogon parviflorus*, *Macrozamia riedlei*, *Hibbertia hypericoides*, *Stirlingia latifolia*, *Boronia* aff. *spathulata* and *Platysace compressa*, the herbaceous natives *Dasypogon bromeliifolius*, *Phlebocarya ciliata*, *Patersonia occidentalis* and *Microtus media*, and the sedges *Lepidosperma squamatum*, *Lyginia imberbis*, *Hypolaena exsulca* and *Desmocladius fasciculatus*.

Both sections have weeds, but the western stand is weedier. Reflecting the weediness, the condition of the western stand's vegetation is assessed, on the Trudgen/Keighery scale, as mainly Good (4) to Completely Degraded (6).

Candle Banksia (-Jarrah) Low Woodland to Open Forest Sites A, B, C, D

The slopes and uplands of the eastern half of the study area support a Candle Banksia (*Banksia attenuata*) Low Open Forest that is, in some areas, over 10 m tall and varies from less than 30% cover to more than 70%. This vegetation unit is on Bassendean Sand (Qpb).

Candle Banksia is the characteristic, abundant tree in the unit, but jarrah is widespread in it, though patchy and usually with less than 10% cover. *Banksia ilicifolia*, *Xylomelum occidentale*, *Persoonia longifolia* and *Nutsia floribunda* are other, smaller trees that are widespread in the unit. Marri, Bull Banksia and Peppermint trees are occasional and patchy in the southern and western parts.

Kunzea ericifolia shrubs to over 4 m tall are patchy, but sometimes very dense, in the understorey. *Melaleuca thymoides* is the dominant shrub in the 1-2 m range, and *Hibbertia hypericoides* and *Calytrix flavescens* are dominant shrubs in the under 1 m range. Other common to scattered and patchy associated species include *Conostephium pendulum*, *Adenanthos meisneri*, *Xanthorrhoea preissii*, *Xanthorrhoea brunonis*, *Jacksonia sparsa*, *Allocasuarina humilis*, *Melaleuca thymoides*, *Petrophile linearis*, *Persoonia saccata*, *Gompholobium tomentosum*, *Macrozamia riedlei* and *Bossiaea eriocarpa* shrubs, the liane *Hardenbergia comptoniana*, the herbaceous natives *Dampiera linearis*, *Conostylis aculeata*, *Dasypogon bromeliifolius*, *Phlebocarya ciliata*, *Patersonia occidentalis*, *Orthrosanthus laxus*, *Burchardia umbellata*, *Tricoryne elatior*, *Drosera* spp. and *Sowerbaea laxiflora*, and the sedges *Lepidosperma squamatum*, *Lyginia imberbis*, *Hypolaena exsulca*, *Desmocladius asper* and *Desmocladius fasciculatus*.

The condition of this vegetation is assessed, on the Trudgen/Keighery scale, as mainly Very Good (3) to Excellent (2) or better. However, many or most of the larger Jarrah trees were felled many years ago.

Banksia-Peppermint-Tuart Open Forest to Low Open Forest Sites J, K, N

On the western crests of the dunes there is what appears to be an overlap of the tuart forest of the west and the banksia forest of the east. Typically, the tallest trees, mainly marri but also jarrah and tuart, form a 10-15 m tall Woodland over a Low Closed Forest of Candle Banksia, Peppermint, young eucalypt trees and, to a lesser extent, Bull Banksia and Woody Pear.

Associated species include *Conostephium pendulum*, *Xanthorrhoea brunonis*, *Jacksonia sparsa*, *Macrozamia riedlei*, *Leucopogon parviflorus*, *Hibbertia hypericoides*, *Hibbertia ?racemosa*, *Phyllanthus calycinus* and *Bossiaea eriocarpa* shrubs, the liane *Hardenbergia comptoniana*, the herbaceous natives *Dampiera linearis*, *Conostylis aculeata*, *Conostylis* sp., *Dasypogon bromeliifolius*, *Phlebocarya ciliata*, *Patersonia occidentalis* and *Orthrosanthus laxu*, and the sedges *Lepidosperma squamatum*, *Lyginia imberbis*, *Hypolaena exsulca*, *Desmocladius asper* and *Desmocladius fasciculatus*.

The condition of this vegetation is assessed, on the Trudgen/Keighery scale, as mainly Very Good (3) to Excellent (2), with some areas only Good (4). Many or most of the larger Jarrah and Tuart trees were felled many years ago.

***Pericalymma ellipticum* (Swamp Teatree) Closed Heath** Site G

A slight depression in the southeast corner of the study area has a Swamp Teatree Closed Heath 1 m to 2 m tall with a patchy overstorey of *Banksia ilicifolia* and *Kunzea ericifolia* between 3 m and 5 m tall. Other species in the stand include *Banksia littoralis*, *Jacksonia furcellata*, *Astartea* aff. *fascicularis*, *Hemiandra pungens*, *Platysace compressa*, *Gompholobium ?tomentosum*, *Dasypogon bromeliifolius*, *Schoenus* sp. (tussock), *Hypolaena exsulca* and *Lyginia imberbis*.

The condition of this stand is assessed, on the Trudgen/Keighery scale, as Excellent (2).

Mixed Alien Tall Open Scrub Site O

The landfill site at the top of the western slope has a Tall Open Scrub community dominated by a variety of weedy shrubs, the most conspicuous and widespread of which is Castor Bean (*Ricinus communis*), with numerous species of other, smaller alien weeds.

The condition of the mixed alien tall open scrub community is off the scale. It is worse than Completely Degraded (>6), because there is no native overstorey left.

3.1.2 Floristic Community Types

The location of the study area and the presence of *Agonis flexuosa*, *Xylomelum occidentale* and *Jacksonia sparsa* (= *Jacksonia* sp. Busselton) suggests that the predominant floristic group represented in the study area, particularly the uplands and eastern slope, is Floristic Community Type 21a, Central *Banksia attenuata* — *Eucalyptus marginata* Woodlands, or 21b, Southern *Banksia attenuata* Woodlands (Gibson *et al.* 1994), or both.

The Tuart-Peppermint woodland covering most of the rest of the study area — mainly the western slope — is probably Floristic Community Type 25, Southern *Eucalyptus gomphocephala* — *Agonis flexuosa* woodlands.

The Reservation Status and Conservation Status given by Gibson *et al.* (1994) for each of these three Floristic Community Types are, respectively:

- Type 21a Well reserved Low risk
- Type 21b Well reserved Susceptible
- Type 25 Poorly reserved Susceptible

3.2 RARE FLORA

Two Priority Flora species were found in the study area: the Priority Four *Jacksonia sparsa* and the Priority Two *Lasiopetalum membranaceum*. The *Jacksonia* was common and widespread in Banksia (-Jarrah) Low Woodland to Open Forest, in the eastern half of the study area. The *Lasiopetalum* was occasional in the Tuart Woodland on the western slope and less common in the Banksia-Peppermint-Tuart Open Forest to Low Open Forest east of it. It is not listed in the CALM printouts for the area.

None of the taxa in the CALM printouts (listed in Table A1) is Declared Rare, but one is Priority One (*Caladenia longicauda* subsp. *clivicola*) and another is Priority Two (*Pithocarpa corymbulosa*). These two taxa are, however, associated with moist jarrah-marri forest and granite outcrops habitats, neither of which is in the study area.

3.3 CONDITION

Assessments of vegetation condition are given with the descriptions of vegetation units in Section 3.1.1. In general and on the Trudgen/Keighery scale, the condition of the upland, banksia bushland vegetation is assessed as Excellent (2) to Very Good (3), and of the Tuart Woodland on the western slope, Good (4).

3.4 LIMITATIONS

It is possible that other significant species are on the property, ones which, like *Lasiopetalum membranaceum*, are not listed in Table A1 and ones which are not identifiable at the times of the searches. For instance, some rare flora species appear and flower only during the first spring or two after a fire.

The vegetation categories described and mapped here are sometimes broad and cover ranges of variation which cannot, for various reasons, be satisfactorily delimited either on the ground or on high resolution aerial photography (which is better than photocopies or digital printouts). And condition ratings are often given as ranges, rather than as specific values, because they also, like vegetation types, cover mosaics and continua.

4.0 ACKNOWLEDGEMENTS

Panairama printouts and other information and assistance were provided by Bowman Bishaw Gorham.

Assistance by staff of the Western Australian Herbarium, particularly Mike Hislop, and other botanists in identifying plant specimens and access to the Western Australian Herbarium collections, which was essential for carrying out the project, are greatly appreciated.

Elisha Mueller assisted with fieldwork.

The quality of superficial groundwater in the area is generally good, with salinity measured in borehole BS5, in the south-west corner of College Grove, at 510mg/L TDS.

The limited occurrence of shallow groundwater at the site suggests that private bores in the superficial formations will not be a feasible source of irrigation water for lots within the site. LandCorp proposes to obtain water for irrigation of parks and gardens by installing a deep bore through the basalt into the Yarragadee Formation. A licence for abstraction from this bore will be required from the Water and Rivers Commission.

The Yarragadee Formation provides a major fresh ground water flow system in the Bunbury Region and is an important aquifer for public water supply in the area. The base of the flow system is an interface with saline or hypersaline groundwater, which often coincides with the contact between the Yarragadee and Cockleshell Gully Formations. This contact of the two formations occurs at approximately 600m in the vicinity of the College Grove site.

2.4 Wetlands

There are no wetlands within the College Grove site. There is, however, a series of sumplands and damplands immediately east of the site. To the west across Bussell Highway, there are extensive damplands, palusplain and a number of sumplands joined by an artificial drainage system which flows north, bypassing Big Swamp before discharging into the ocean west of the Bunbury city centre.

2.5 Vegetation and Flora

Consultant botanist Dr Arthur Weston surveyed the College Grove site in November 2000 and January 2001. A copy of the survey report is provided in Appendix A.

2.4.1 Vegetation Type and Condition

Almost all of the vegetation on the site belongs to the Karrakatta Complex – Central and South (Heddle *et al*, 1990), with a narrow strip of Yoongarillup Complex occurring along the property's western edge. The Karrakatta Complex – Central and South is predominantly an open forest of Tuart-Jarra-Marri and woodland of Jarrah-Banksia spp.,

whilst the Yoongarillup Complex is a woodland to tall woodland of Tuart with Peppermint in the understorey (less consistently an open forest of Tuart-Jarrah-Marri).

Vegetation units on the site were distinguished on the basis of vegetation height, density and dominant species. Five native and one alien plant community were identified during the survey as follows:

- Tuart Woodland
- Marri (-Jarrah, -Candle Banksia) Open Forest
- Candle Banksia (-Jarrah) Low Woodland to Open Forest
- Banksia-Peppermint-Tuart Open Forest to Low Open Forest
- *Pericalymma ellipticum* (Swamp Teatree) Closed Heath
- Mixed Alien Tall Open Scrub.

These plant communities are described below and their boundaries are delineated on Figure 5. Vegetation condition is described using the Trudgen/Keighery scale.

Tuart Woodland

Tuart Woodland to Open Forest occurs on the steep western slope of the site on sands associated with Tamala limestone. This unit is characterised by trees to more than 20m tall and patchy Low Woodland to Low Open Forest understorey of Candle Banksia, especially on middle and lower parts of the slope and where the Tuart overstorey is more open. Most of the large Tuart trees within this unit were logged years ago. Peppermint trees are also common to scattered.

The lower understorey is very weedy, but the natives *Hibbertia cuneiformis*, *Phyllanthus calycinus*, *Rhagodia ?baccata*, *Conostylis ?candicans* and the Priority Two shrub *Lasiopetalum membranaceum* are conspicuous and widespread. There are also a few shrubs of *Olearia axillaris*.

The condition of this vegetation is assessed, on the Trudgen/Keighery scale, as mainly Good (4). In some areas the vegetation condition is Completely Degraded (6), which is largely due to weediness, although the removal of many or most of the larger Tuart trees many years ago also contributes to downgrading of vegetation condition.

Marri (Jarrah, -Candle Banksia) Open Forest

There are two relatively small areas of Marri Open Forest on the site. The first of these occurs on low ground in the southeast corner of the site. The position of this stand corresponds with the Bassendean Sand unit and is distinctive enough to be mapped as a separate vegetation unit.

The other occurs low on and at the base of the western slope, especially in the south-west corner of the site, on sand associated with Tamala limestone. This unit is narrower than the south-eastern unit and blends with the Tuart Woodland.

Both of these areas have weeds, although infestation is higher in the western stand. Reflecting this, the condition of the western stand's vegetation can be assessed as mainly Good (4) to Completely Degraded (6).

Candle Banksia (-Jarrah) Low Woodland to Open Forest

The slopes and uplands of the eastern half of the site support a Candle Banksia (*Banksia attenuata*) Low Open Forest that is in some areas over 10m tall and varies from less than 30% cover to more than 70%. This vegetation unit occurs on Bassendean Sand.

Candle Banksia is the characteristic, abundant tree in the unit, but Jarrah is also widespread, though patchy and usually with less than 10% cover. Many or most of the larger Jarrah trees were felled many years ago. Marri, Bull Banksia and Peppermint trees are occasional and patchy in the southern and western areas of the unit.

The vegetation condition of this unit is mainly Very Good (3) to Excellent (2) or better.

Banksia-Peppermint-Tuart Open Forest to Low Open Forest

On the western crests of the dunes there is what appears to be an overlap of the Tuart forest of the west and the Banksia forest of the east. Typically, the tallest trees, mainly Marri but also Jarrah and Tuart, form a 10-15m tall woodland over a Low Closed Forest of Candle Banksia, Peppermint, young eucalypt trees and, to a lesser extent, Bull Banksia and Woody Pear.

The condition of this vegetation unit is mainly Very Good (3) to Excellent (2), with some areas only Good (4). Many or most of the larger Jarrah and Tuart trees were felled many years ago.

***Pericalymma ellipticum* (Swamp Teatree) Closed Heath**

A slight depression in the southeast corner of the site has a Swamp Teatree Closed Heath 1m to 2m tall with a patchy overstorey of *Banksia ilicifolia* and *Kunzea ericifolia* between 3m and 5m tall.

The condition of this stand is assessed as Excellent (2).

Mixed Alien Tall Open Scrub

The landfill site at the top of the western slope has a Tall Open Scrub community dominated by a variety of weedy shrubs, the most conspicuous and widespread of which is Castor Oil Bean (*Ricinus communis*), with numerous species of other, smaller alien weeds.

The condition of the mixed alien tall open scrub community is Completely Degraded (>6) due to the lack of native overstorey and understorey.

2.5.2 Local and Regional Representation

The vegetation complexes present at College Grove (Karrakatta-Central & South and Yoongarillup) are well represented and well reserved in the Greater Bunbury Region. The Karrakatta-Central & South Complex has 66.7% of its original extent remaining in the region with 31.5% within existing or proposed conservation reserves. The Yoongarillup Complex has 35.2% of its original area remaining with 12.6% in existing or proposed reserves.

State government policy, as expressed in *Bush Forever* (Govt of WA, 2001) and the *Urban Bushland Strategy* (Govt of WA, 1995), is that at least 10% of the original extent of each vegetation complex should be reserved for conservation within each region. Both of the complexes present at College Grove can therefore be considered to be adequately reserved.

2.5.2 Floristic Communities

The location of the site and the presence of *Agonis flexuosa*, *Xylomelum occidentale* and *Jacksonia sparsa* (= *Jacksonia* sp. Busselton) suggest that the predominant floristic group represented on the site, particularly on the uplands and eastern slope, is Floristic Community Type 21a, Central *Banksia attenuata* – *Eucalyptus marginata* Woodlands, or 21b, Southern *Banksia attenuata* Woodlands (Gibson *et al.* 1994), or both.

The Tuart-Peppermint woodland covering the remainder of the site, although predominantly on the western slope, is probably Floristic Community Type 25, Southern *Eucalyptus gomphocephala* – *Agonis flexuosa* woodlands.

The reservation and conservation status given by Gibson *et al.* (1994) for each of these three Floristic Community Types are:

- | | | |
|------------|-----------------|-------------|
| • Type 21a | Well reserved | Low risk |
| • Type 21b | Well reserved | Susceptible |
| • Type 25 | Poorly reserved | Susceptible |

2.5.3 Rare and Significant Species

Two Priority Flora species were located during the site survey: the Priority Four *Jacksonia sparsa* and the Priority Two *Lasiopetalum membranaceum*. *Jacksonia sparsa* was common and widespread in the Banksia (-Jarrah) Low Woodland to Open Forest in the eastern half of the site. *Lasiopetalum membranaceum*, which is not listed on the CALM database as being previously located in the area, was occasional in the Tuart Woodland on the western slope and less common in the Banksia-Peppermint-Tuart Open Forest to Low Open Forest east of it.

2.6 Fauna

2.6.1 Fauna Habitat

Fauna habitat values on the College Grove site are considered to be high given that the site is well connected to adjacent bushland and wetlands to the east and south. Vegetation across the site is generally of good quality and only slightly to moderately disturbed and is likely to support all extant species whose range extends into the site. The habitat value of the western slope is, however, reduced by the loss of much of the understorey.

Large old tuart trees may also provide breeding habitat for hollow-nesting birds.



BUNBURY RIDGE BUNB #1

**WOODCREST RISE ESTATE
AT COLLEGE GROVE, BUNBURY
ENVIRONMENTAL ASSESSMENT**

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The habitat value of the western slope is, however, reduced by the loss of much of the understorey.

Large old tuart trees may also provide breeding habitat for hollow-nesting birds.

2.6.2 Rare and Significant Species

A search of the CALM Threatened Fauna database was completed for an area of about 50km² around College Grove. The search indicated that three Schedule 1 species, one Schedule 4 species and three Priority Taxa species are known to occur within the search area.

Schedule 1 species are fauna that is rare or likely to become extinct. The three species recorded are:

- **Western Ringtail Possum (*Pseudocheirus occidentalis*):** This species occurs at a restricted number of sites in Tuart and Peppermint woodlands.
- **Carnaby's Black-cockatoo (*Calyptorhynchus latirostris*):** This species occurs in the area during the summer and autumn months. It feeds extensively on proteaceous (particularly Banksia) shrublands where they have been retained.
- **Baudin's Black-cockatoo (*Calyptorhynchus baudinii*):** This species previously occurred within the search area but has seldom been recorded on the coastal plain in modern times.

Schedule 4 species are fauna that are otherwise specially protected. The only Schedule 4 species likely to occur at the site is the **Peregrine Falcon (*Falco peregrinus*)**, which may occur as a vagrant in the area either in open woodlands or around developments.

Three Priority Taxa may also occur within the area. These are:

- **Brush-tailed Phascogale (*Phascogale tapoatafa*) - P3:** This species occurs in Tuart and Jarrah-Marri woodlands in the area.
- **Southern Brown Bandicoot or Quenda (*Isodon obesulus fusciventer*) – P4:** This species occurs in Peppermint and Banksia woodlands.

- **Western Brush Wallaby (*Macropus irma*) – P?** : This species is moderately common in discrete areas in Jarrah woodland and coastal heath.

A preliminary survey for the Western Ringtail Possum, a Schedule 1 species, was conducted over the College Grove site by Dr Barbara Jones in January and February 2001. Dr Jones has worked extensively with CALM on population surveys and habitat assessment of Ringtail Possums in the vicinity of Harvey Dam. Vegetation in the area was assessed on the basis of stand structure and composition to determine potential possum habitats. Potential stands were then surveyed on foot and a search made for possum faecal pellets.

Faecal pellets of both the Western Ringtail Possum and the Common Brushtail Possum (*Trichosurus vulpecula*) were located during the survey, indicating the presence of both species at the College Grove site. Most of the Ringtail pellets were found in the better parts of the Banksia-Peppermint-Tuart forest association that occupies the western part of the ridge top, mapped as vegetation type “BT” on Figure 5. A few were also collected in the far north-eastern corner of the site in forest of Banksia-Jarrah with minor peppermints. It is possible that these latter animals have been displaced from more suitable habitat further west in the College Grove North subdivision.

A few Ringtail pellets were also found in small bushland remnants within the College Grove North subdivision. Ringtails are also likely to be present in Tuart-Peppermint forest further to the north.

No Ringtail pellets were found on the western slope of the ridge or in the south-east corner (mapped as “T”, “B”, “M” and “P” on Figure 5), suggesting that these areas are, at least at present, not suitable habitat for the species.

The preliminary survey concluded that the Ringtail population at College Grove probably consists of less than 20 individuals, along with a population of perhaps 120 Brushtails. The Ringtail population is very small compared to other known populations in the region such as at Glen Iris, Harvey River and Ludlow (B. Jones, 2001).

The major threat to the Western Ringtail Possum is predation by dogs and foxes. Although much of the Ringtail’s habitat is subject to disturbance by agriculture and urban development, the species has shown its ability to persist in rural and even residential areas (including Busselton and Dunsborough) provided that pockets of suitable vegetation (including large trees with nesting hollows) are retained and that

sufficient tree canopy persists to allow animals to move around without having to descend frequently to ground level, where they are vulnerable to predation. Ringtails are also able to travel up to 400m through suburbs between viable habitat patches (B. Jones, pers. comm.).

2.7 Landscape

The College Grove site is elevated and occupies a dominant position in the landscape. From Bussell Highway, the site presents an aspect of a steep, wooded slope with medium to tall Tuarts and a weedy, largely cleared understorey. This is the only part of the site that is visible from Bussell Highway.

From Somerville Drive, in the developed area of College Grove, the site presents a view of Tuart, Marri and Banksia woodland with a denser understorey.

Further to the west, long-range views of the ridge crest and the central parts of the site are obtainable from streets in the Usher district.

Views of the site from Bussell Highway, Somerville Drive and Northwood Gardens (1km west) are shown on Figure 6.

To the south and east the site adjoins farmland and as such is not visible to the public.

2.8 Regulatory and Policy Environment

2.8.1 Quarry Noise Buffer

Three basalt quarries operate in Gelorup. The nearest, owned by the Readymix Group, is located on Lot 2644 about 2km south of College Grove. The DEP normally recommends a 1km buffer from hard rock quarries to residential areas. In the case of Gelorup, in view of the very hard rock being quarried and the necessity of frequent blasting, the WAPC has accepted a Department of Minerals & Energy (DME) recommendation for a nominal 2km buffer.

The WAPC approved the existing College Grove Structure Plan subject to a condition that development within the nominal 2km quarry buffer will not be permitted until

scientific studies are undertaken to show that a smaller buffer is sufficient to prevent adverse noise impacts.

The nominal 2km buffer approved by the WAPC includes the southernmost 300m of the College Grove site (an area of about 35ha). About half of this is proposed as Regional Open Space as part of the east-west vegetation corridor and the other half is proposed as residential land (Figure 7).

A study has just been completed under the supervision of a Technical Advisory Group made up of officers of the MfP, DME and DEP to define an acceptable buffer for the Gelorup Quarries. The final report of the study is currently (May 2001) being reviewed by the Technical Advisory Group. Until such time as the recommendations of this report become available, the 2km buffer indicated in the Bunbury Region Structure Plan is the guidance to be used when considering any development within proximity to the quarries (Larry Guise, Ministry for Planning, *pers. comm.*).

Given that subdivision is not currently proposed within the area of College Grove affected by the nominal quarry buffer, it is considered that this issue can be deferred until such time as subdivision in this area is proposed and the findings of the buffer study are known.

2.8.2 South Bunbury Vegetation Corridor

The DEP's System 6 Update identified an east-west vegetated link along Centenary Road as an important part of the regional conservation network.

The draft College Grove Structure Plan (April 1998) showed a 100m corridor along the southern boundary of College Grove. The DEP informally reviewed this alignment and requested that it be increased to 300-500m wide.

The approved Structure Plan shows a corridor 70-270m in width. The draft Greater Bunbury Region Scheme shows a Regional Open Space reservation that reflects the corridor shown in the approved Structure Plan (Figure 7).

The proposed revised Structure Plan expands considerably upon the open space reservations shown in the draft Scheme. The proposed reservations are shown on Figure 8. Specifically:

3.0 ENVIRONMENTAL IMPACTS AND MANAGEMENT

3.1 Vegetation Clearance and Retention

Development of the College Grove site will necessitate the clearance of about 62.5ha of vegetation, comprising 5.5ha of Yoongarillup Complex and 57ha of Karrakatta Complex – Central and South.

Of the remainder, approximately 33.5ha of native vegetation on the southern, western and eastern boundaries and the centre of the site, comprising 9ha of Yoongarillup Complex and 24.5ha of Karrakatta Complex-Central and South, will be permanently reserved as Regional Open Space (ROS) and Public Open Space (POS). These areas, representing about 38% of the total site, are shown on Figure 8. A further 14ha of landscaped active and passive POS will be provided by the rehabilitation of the landfill and the creation of pocket parks throughout the estate.

Botanical surveys show that the vegetation complexes, floristic composition and condition of these reserves are representative of the site's vegetation and that the establishment of reserves in the nominated areas will preserve the full range of site vegetation. All of the Priority species located during the surveys are well represented in the proposed reserves.

3.2 Fauna and Habitat

All fauna habitat types present on the site are represented in the proposed reserves. In particular, the Tuart/Peppermint woodland, which is the primary habitat for the Western Ringtail Possum, is particularly well represented, with approximately 20ha (37% of its existing area) being located in reserves.

The southern vegetation corridor will also preserve the existing habitat linkages (which are interrupted by Bussell Highway and other roads) from the coast, via the Dalyellup, Shearwater and Brook Village green belts to the Preston River. The Regional Open Space will be managed by CALM with an emphasis on habitat protection.

Development in accordance with the revised Structure Plan will reduce the area of available habitat for disturbance-intolerant species by approximately two thirds. The

less mobile, more widely distributed species on the site are likely to suffer a decrease in their population commensurate with the reduction in habitat. However, given the size and variety of the proposed reserves it is likely that all species currently present on the site will persist following development.

The preliminary possum survey completed on the site (Section 2.5.2) suggests that the better quality Tuart/Peppermint woodlands currently hold a population of less than 20 Western Ringtail Possums (B. Jones, pers. comm.). The proposed subdivision of Stage 1 at the northern boundary will have little effect on this population, since the better habitat is mostly to the south. However, later stages of subdivision proposed by the Structure Plan will encroach further into the high quality possum habitat.

Ringtail possums are notoriously difficult to capture for relocation, with a large waste of resources likely to occur if relocation is pursued as the preferred option. Instead, the strategy adopted in the implementation of the structure plan for College Grove will be to maintain a viable Ringtail population within the estate. Experience in Busselton and Dunsborough shows that Ringtails are able to persist in urbanised areas provided that certain habitat parameters, such as peppermint canopies, large nesting trees and habitat linkages, are maintained. Within College Grove, this will be achieved by a combination of:

- retention of large continuous bushland areas such as the southern ROS reserve and the western POS reserve;
- restoration of Ringtail habitat in areas currently unoccupied, including large-scale planting of Peppermints beneath the Tuart woodland on the western face of the ridge and on the rehabilitated landfill;
- retention of “stepping stone” patches of vegetation containing large habitat trees within the subdivision; and
- maintenance of vegetated links between the estate and adjacent bushland areas.

A Fauna Management Plan will be prepared in consultation with CALM to the satisfaction of the Department of Environmental Protection prior to application for subdivision outside of Stage 1. The Plan will include:

- Survey and marking on the ground of reserved areas.

- A detailed population census and habitat assessment of Western Ringtail Possums.
- Review of the Structure Plan to optimise the retention of functional habitat within the estate.
- Staging of clearing and techniques to be used during vegetation removal in order to minimise possum casualties and to enable displaced individuals to migrate into under-utilised habitats in uncleared areas.
- Enhancement of possum habitat in uncleared areas including the planting of peppermint trees.

3.3 Drainage

Sealed surfaces such as roofs and roads within the development will generate runoff. All runoff generated within individual lots will be disposed of fully by infiltration with the lots. Runoff from roads and other sealed surfaces will also be disposed of fully within the subdivision by means of infiltration basins constructed in accordance with Best Management Practices (BMPs) promoted by the Water and Rivers Commission.

Road runoff will contain varying levels of pollutants including suspended solids, nutrients, metals, organic matter and litter. To maximise the removal of nutrients and other contaminants, infiltration basin located on Bassendean Sand in the south-east will be lined with red mud or a similar adsorbent medium. Infiltration basins located on limestone-derived soils in the west of the site will not require lining due to the high ionic adsorption capacity of these soils.

To minimise leaching from the landfill, no infiltration basins will be constructed either over or adjacent to the landfill site.

3.4 Landfill Management

The objectives for management of the landfill are to:

- establish a stable vegetation cover over the area;

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