



PART 2

EXPLANATORY SECTION

-
- PLAN A - Structure Plan (Zoning Plan)**
 - PLAN B - Context Plan**
 - PLAN C - Indicative Detailed Design**
 - PLAN D - Development Levels**
 - PLAN E - Pedestrian / Cycle Network Plan**

- APPENDIX A - Correspondence City of Wanneroo / Department of Education & Training**
- APPENDIX B - Vegetation and Flora Survey**
- APPENDIX C - Threatened Ecological Communities Survey**
- APPENDIX D - Acoustic Report**
- APPENDIX E - Proposed Primary School Layout**
- APPENDIX F - Southern Road Reserve (Roundhouse Parade)**
- APPENDIX G - Pedestrian Access**
- APPENDIX H - Drainage Infrastructure**
- APPENDIX I - Road Access / Car Parking**

PART 2: EXPLANATORY SECTION

1.0 INTRODUCTION

This structure plan report has been prepared on behalf of the landowners of Lot 10 Marmion Avenue, Jindalee, being Westminster Estates Pty Ltd, a company owned and operated by Estates Development Company.

The Structure Plan, which accompanies this report, has been prepared to satisfy the requirements of Part 9.1.1 of City of Wanneroo District Planning Scheme No. 2, which requires the preparation of a Structure Plan for land designated “Urban Development”.

The approval of the Structure Plan will provide certainty to the proponent, the Council and the Department of Education & Training (DET) to allow forward planning to be undertaken in the provision of a primary school for the catchment area (Lot 10 & 12). This is particularly important given Lot 12 will soon be fully developed.

This report provides the following:

- Background information relating to Lot 10 Marmion Avenue, Jindalee;
- A description of the planning considerations of the land; and
- A description of the factors considered as part of the location of Jindalee Primary School site and preparation of the associated Structure Plan.

2.0 BACKGROUND

Lot 10 Marmion Avenue, Jindalee is a 112ha parcel of Urban zoned land in the north-west corridor of the Perth Metropolitan Area and known as the estate of ‘Jindee’. The vision for Jindee is to create a vibrant traditional coastal village that captures the essence of coastal living in Western Australia. Jindee aims to set a new benchmark in land development in Western Australia and is based on the principles of Traditional Neighbourhood Design utilising the Transect methodology to create a compact, walkable, mixed use village that will develop into a tourist, lifestyle and entertainment focus in the north-west corridor of the Perth Metropolitan Area.

The creation of a unique coastal village has been the basis for the establishment of the *Jindee Innovation Agreement*. Parties to the *Jindee Innovation Agreement* are the landowner, the WAPC and the City of Wanneroo. The Agreement proposes the exchange of land currently located on the coast for land located within Lot 10 to enable the creation of a coastal village that is visually and physically linked with the coast.

Jindee has been developed utilising an alternative approach to the traditional planning methods currently used in Western Australia. The use of the Transect and Form Based Codes will ensure Jindee becomes a vibrant coastal village with its own unique sense of place.

The project aims to create an integrated coastal community that provides an alternative to the pattern of urban sprawl prevalent along the Perth metropolitan coastline. The design for Jindee reflects its coastal setting and provides a strong connection to the beach. As a coastal node, it has been designed to have a very active urban beach

front. The close interaction with the beach is critical, ensuring the viability of tourist and commercial activities within the village. Integral to the design is the recognition and preservation of the sites inherent environmental qualities through the protection of significant vegetation and by ensuring that design is topographically sensitive with the intent of optimising the retention of significant landforms which limits the options for the provision of a flat site suitable for a primary school.

The identification of Jindee as a coastal node was first recognised through the 1996 Jindalee Enquiry by Design Workshop, undertaken by the then Ministry for Planning. The project is the result of 10 years of planning, including: the 1996 and 2001 Enquiry by Design workshops; the 2002 Jindee Design Charrette; and the 2004 Jindee Implementation Process and Design Workshops.

3.0 SITE DESCRIPTION

3.1 *Legal Description*

The Structure Plan area forms part of Lot 10 Marmion Avenue, Jindalee in the City of Wanneroo. Lot 10 is contained on Plan 12465 on Certificate of Title Volume 1508 Folio 908.

3.2 *Location*

The Structure Plan area is located approximately 37 kilometres north of the Perth Central Area, approximately 14 kilometres north-west of Joondalup, and 1 kilometre west of the future Brighton Train Station in the north-west corridor of the Perth Metropolitan Area.

Lot 10 is bound by Marmion Avenue to the east, the Indian Ocean to the west, and Lot 9 and 12 Marmion Avenue to the north and south respectively. Residential and business development surrounds the site to the south and east. The Structure Plan area is located in the south east corner of Lot 10.

3.3 *Existing Vegetation/Significant Trees*

A Vegetation and Flora Survey was undertaken by RPS Bowman Bishaw Gorham (2006) across the whole of Lot 10 as part of the investigations for the Metropolitan Region Scheme (MRS) Amendment for the Jindee development (refer Appendix B). No declared Rare Flora were identified through the survey, three priority species were identified as occurring on Lot 10 but were not considered to be threatened.

An additional survey for Threatened Ecological Communities was undertaken in 2008 (Weston, 2008) (Appendix C). The survey concluded that TEC 26a, the community identified as most likely to occur on-site, did not occur on Lot 10.

In the EPA advice provided as part of the assessment of MRS amendment of 10 stated:

“The EPA is satisfied that there are no Declared Rare Flora or Threatened Ecological Communities on Lot 10. Priority flora species do occur on Lot 10 including the areas to be reserved as P&R.”

The EPA approved the MRS amendment concluding that the preservation of the Priority species identified was not warranted. No further vegetation or flora survey work for Lot 10 (including the proposed school site) is considered necessary.

4.0 PLANNING FRAMEWORK

4.1 *Metropolitan Region Scheme*

The Structure Plan area is zoned “Urban” under the Metropolitan Region Scheme (“MRS”). Areas zoned “Urban” under the MRS can accommodate a range of land uses including residential, commercial, recreational, educational, and light industry. Marmion Avenue is zoned “Other Regional Road” under the MRS, and a square portion of land to the west of the structure plan area is reserved under the MRS for “Parks & Recreation”.

There are also two large consolidated parcels of land that are proposed to be reserved ‘Parks and Recreation’ and are currently the subject of an amendment to the MRS: one surrounding the existing Eglinton Hill Reservation; and the other located on the southern portion of Lot 10 adjacent to the coast (refer Plan B). The proposed reservation areas have been determined in consultation with the Department of Environment in order to ensure the best environmental outcome for the site by retaining a larger number of vegetation assemblages than would have been possible under the current reservation and zoning arrangements. The proposed reservations will ensure the most ecologically important areas on Lot 10 are protected for conservation. Subsequently, the eastern extent of the MRS reservation boundary also determines the western extent of the school site boundary.

4.2 *District Planning Scheme No. 2*

The Structure Plan area is zoned “Urban Development” under the City of Wanneroo District Planning Scheme No. 2 (“DPS 2”). Subdivision and development within the Urban Development zone will only be approved if in accordance with an Agreed Structure Plan adopted by the City of Wanneroo.

4.3 *Butler-Jindalee District Structure Plan*

The Butler-Jindalee District Structure Plan (“DSP”) comprises the Structure Plan area and surrounding Jindalee, Butler and Brighton landholdings. The DSP sets out major land uses, the primary transport network, and neighbourhood structure, including the allocation of a district centre, primary schools / high schools, local centres / neighbourhood centres, a rail station, activity corridors, integrator arterial and district distributor roads, public open space allocations, and walkable catchments. The DSP provides the framework for subsequent Local Structure Plans to be prepared for specific precincts within the DSP area.

The Butler-Jindalee DSP identifies a “Government Primary School” at the south-east corner of Lot 10 and adjacent to the adjoining southern Lot 12. The primary school catchment services the southern portion of Lot 10 and the whole of Lot 12 Marmion Avenue.

5.0 JINDALEE PRIMARY SCHOOL STRUCTURE PLAN

5.1 Purpose of Structure Plan

The Jindalee Primary School Structure Plan has been prepared in response to the need to confirm and secure the location of the primary school site to service Lot 10 and Lot 12. The planning for Jindalee is being undertaken in a holistic manner and the uncertainty surrounding the proposed location of the school site has resulted in the need to provide surety to the DET, City of Wanneroo, developers and local community that the school site will be accommodated in the only available location on Lot 10.

The proposed location of the Jindalee Primary School site has been the subject of extensive discussions between the DET, the landowners (Westminster Estates), and the City of Wanneroo over a number of years and was included in the Butler-Jindalee DSP as the dedicated school site for both Lot 10 and 12. Despite forming part of the catchment for the school, structure planning for Lot 12 has been finalised and has not made any provision for a school site, despite the developers paying development contributions for its provision.

School sites are generally required to be located on relatively flat land. The location of the primary school in the south-eastern corner of Lot 10 abutting Marmion Avenue is considered to be the only available relatively flat and most achievable central location within the required school catchment given the following factors:

- As mentioned, no primary school site was proposed under Agreed Structure Plan 36 for Lot 12 despite this land area forming part of the catchment area for the subject proposed primary school. This leaves only Lot 10 to accommodate for the primary school site;
- The Jindalee development involves innovative planning techniques that will retain significant natural landforms, including existing and proposed areas of Regional Open Space as referred to in the proposed Jindalee MRS Amendment, thus making large areas of Lot 10 unsuitable for a school site;
- Land in the northern section of Lot 10 already falls within the catchment area for the proposed primary school in the southern portion of Lot 9.

The factors outlined above demonstrate the limited area of land available that would be considered suitable for the location of a primary school that is generally central to the catchment area and that does not undermine the vision and objectives of the *Jindalee Innovation Agreement* for the development of Lot 10.

The DET has provided advice on the location of the site that confirms that the Department acknowledges the site circumstances within the Jindalee Primary School

catchment and that, subject to the satisfactory design, the current location of the primary school site could be considered acceptable.

In this regard, it is important that this Structure Plan is prepared to provide certainty for the development of the remainder of Lot 10. In dealing with the school site structure plan, it is considered that this will not compromise the future development of Lot 10 and will provide more certainty in the planning process.

5.2 *Layout of the School*

The layout and detailed design for the school site has been the subject of discussions with both DET and the City of Wanneroo. In January 2008, the landowners and Robertsdays met with DET to discuss the acceptability of the school site in its proposed location, and provided an indicative detailed design to demonstrate the layout of the proposed buildings and oval. The proposed layout was also considered by the City of Wanneroo officers in terms of the size of the oval and buffer requirements. Both the City of Wanneroo and the DET formally responded to the proposed design for the primary school (refer Appendix A).

The City of Wanneroo's response relates mainly to the provision of playing fields that will adequately service the local community. After consideration and review of existing and proposed facilities, it was determined that the provision of a junior size oval on the site would be acceptable to the City. Furthermore, the provision of clubrooms was also suggested by the Council officers, which have been incorporated into the indicative detailed design to demonstrate to the City that such facilities can be accommodated on the site. It is not intended that the developer will construct or contribute towards its construction, however, should Council wish to construct clubrooms on this site, the structure plan provides an appropriate location serviced by effective entry and exit points and an adequate area for public carparking.

DET confirmed in the letter dated March 2008 (refer Appendix A) the following matters required further attention to ensure that the proposed location could support a primary school satisfactory to DET requirements:

- Confirmation from the City of Wanneroo that a junior oval is supported in this location;
- Improving the circulation around the school site, including investigating the potential for the Marmion Avenue Road reserve to be utilised to improve entry and exit points and potentially increasing the provision of carparking;
- Provision of a minimum of 3.5 ha (0.5 ha for shared oval facility);
- Noise assessment to be carried out to investigate the impact of traffic noise from Marmion Avenue and to ascertain any noise reduction measures that may need to be taken;
- Potential for contributions from the developer if the site is not suitable to the 'standard model' school design;
- The developer /owner to ensure that bulk earthworks, banks and levels are carried out to deliver a finished site level suitable for development by DET.

Further to the letter from DET regarding the layout of the proposed primary school, DET officers confirmed via email (April 2008) that:

“1. The Department acknowledges the site constraints within the Jindalee primary school catchment; and

2. The Department confirms that, subject to the satisfactory resolution of the design matters identified in our letter of 18.3.08, the current location of the primary school site could be considered acceptable.”

The abovementioned matters have subsequently been further investigated by the landowners planners, architects, traffic engineers and civic engineers and the layout for the school site further refined to resolve the outstanding design issues. This includes:

- The provision of a one way circulation around the perimeter of the school site, utilising the land directly abutting Marmion Avenue road reserve or within the additional capacity of the Marmion Avenue road reserve;
- Additional car parking provided around the perimeter of the site;
- Confirmation from the City of Wanneroo regarding the acceptability of a junior oval in the proposed location (refer Appendix A);
- Provision of a minimum of 3.5 ha for the school – it is noted that the proposed design provides additional land for the school buildings and associated facilities as the 3.5 hectares does not incorporate the shared oval as the boundary is located south of the proposed junior oval;
- The engagement of Herring Storer Acoustics to prepare an assessment of the impact of traffic noise from Marmion Avenue. (Refer Appendix D)

In regard to developer contributions, this will be subject to further discussions between DET and the landowner to ensure the delivery of the school site as required.

5.3 Structure Plan – Detailed Design

All development within the Structure Plan area is to be generally consistent with the detail provided for in Plan C, however may be subject to change to meet the requirements of the DET. The detailed design has been included in the Structure Plan documentation to demonstrate to the regulatory authorities that the site can accommodate a school site that will service the catchment area and provide playing fields for the local community.

The type of playing facilities shown have been the subject of detailed discussions with the City of Wanneroo Recreation Officers after reviewing the existing and proposed recreation facilities for the locality. The final design of the buildings and the layout of school facilities will be determined by DET.

5.4 Public Open Space

The POS to the north of the primary school site comprises an area of 3.2 ha which represents approximately 3% of an assumed total 10% provision for Lot 10. This area of POS will provide for the active recreation needs of those residents in the south-east portion of the development and the primary school students. This larger area of POS is considered appropriate in this location given the dual function it will serve and that residents are located away from the recreational facilities available in the west of Lot 10 due to proximity to the coast / beach.

5.5 Southern Road Reserve (Roundhouse Parade)

An engineering design has been prepared for Roundhouse Parade based upon a road reserve of 20m and a dual carriageway with median breaks to allow for vehicle access to residential lots in Lot 12 (Refer Plan – Appendix F). A meeting was held with the project planners and engineers for the adjoining lot 12 development to discuss the final design for the road on the southern boundary of the school site. Given the need to access the school site (2 access points) and the frontage lots proposed for Lot 12 the southern road will not contain a solid median. A 20 metre road reserve (4.5m carriageways, 2m broken median) combined with the 'drop off / pick up' area for the primary school as depicted on the attached structure plan, will adequately accommodate the projected traffic volumes (approximately 4000 vpd). A 20m road reserve (10m each from Lot 10 & 12) can be accommodated by each landowner.

5.6 Pedestrian Access

Liaison with DET (Richard Bloor) confirmed the catchment for the primary school is wholly located west of Marmion Ave being the whole of Lot 12 and portion of Lot 10 (Refer Appendix G). DET's preferred school site given the catchment boundary is to the south – west in a more westerly location in Lot 12. DET has confirmed no students will be crossing Marmion Ave to access the proposed primary school, based upon the proposed catchment.

Notwithstanding the DET confirmation of the school catchment boundary being located west of Marmion Avenue, pedestrian access options were investigated.

- Mid block pedestrian phase traffic lights – not supported by Main Roads WA due to conflict with Marmion Avenue Access Plan and low volume of pedestrians accessing the school given DET's catchment boundary.
- 'Lollipop' guard crossing point – low level of demand does not meet minimum criteria for provision of a crossing guard.
- Overpass – Financial cost and physical design constraints do not warrant provision based upon low pedestrian numbers to access the school.

In summary if children east of Marmion Avenue need to access the primary school there will be two options;

- i) Children can walk to the school and safely cross Marmion Avenue at the traffic lights (pedestrian phase to be provided) at Kingsbridge boulevard and / or Brighton Boulevard.
- ii) The children are driven to school.

5.7 **Drainage Infrastructure**

The project engineers Wood & Grieve have undertaken a review of the Jindee development in terms of stormwater and drainage catchments. For the primary school site and adjacent POS area a 'Stormwater Drainage Management Plan' has been prepared. (Refer Appendix H).

5.8 **Road Access / Car Parking**

The revised road access and parking locations for the primary school site were reviewed by the project traffic / transport engineer (Bruce Aulabaugh Traffic BAT) and comments provided (refer Appendix I) In summary BAT concluded that the Primary School Structure Plan provides suitable location and spacing of carpark access points and bus parking. The access points into the school site will not result in cars queuing back along the Southern boundary road and impacting upon the operation of Marmion Ave. In terms of parking a meeting was held with DET who confirmed the following parking numbers need to be provided to accord with their requirements, for a school of 460 students.

14 Embayment / short term bays per 100 students	=	65
10 Long term on-site bays per 100 students	=	46
15 pick-up / drop-off bays for pre – primary	=	15
	TOTAL =	126 Bays

The attached structure plan depicts the location of the required 126 car bays.

6.0 **CONCLUSION**

The Jindalee Primary School Structure Plan has been prepared in response to the need to confirm and secure the location of the primary school site to service Lot 10 and Lot 12.

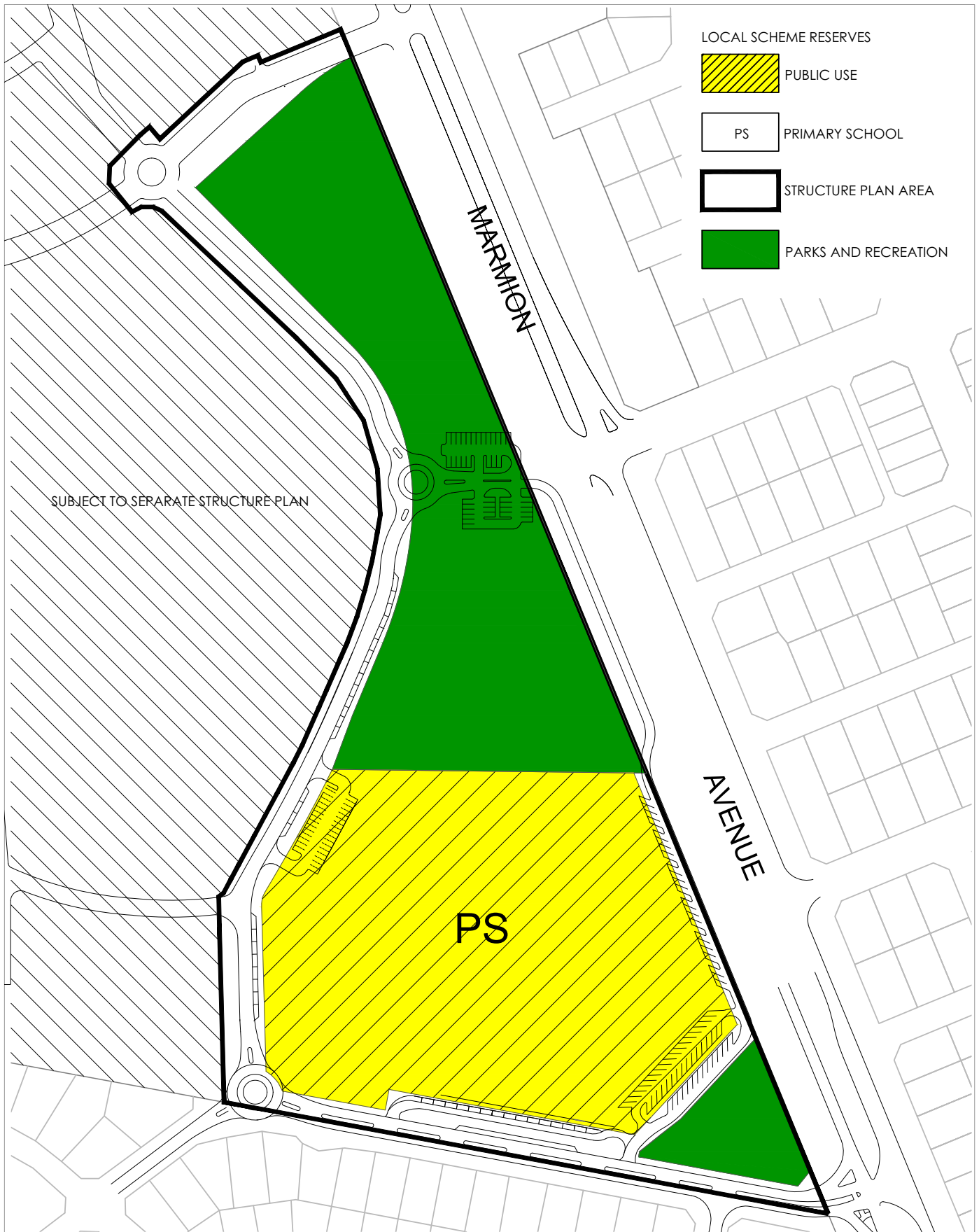
Given that Jindee is proposed as an Innovation Project, innovative solutions are required that recognise the overall strategy for the development of Lot 10 and the unique landform of the whole site. It is therefore important that the proposed site for the Jindalee Primary School is located on the flattest part of the available land within an area that is considered relatively central to the catchment. The proposed structure plan formalises the location of the primary school and indicative layout of the oval size and school facilities on the only suitable site within Lot 10.

The constraints of the site, in particular the location of regional open space and land that contains significant landform and topographic features essential to the innovative planning techniques at Jindee, do not allow for an alternative location that is central to


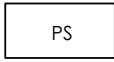


the catchment areas within Lot 10 and Lot 12. It is considered that the Structure Plan will secure this strategic location for the Primary School site, which will assist in providing certainty for the DET, the City of Wanneroo, and the developer.

While it is acknowledged that both the City of Wanneroo and DPI prefer to deal with structure plans for a wider area (i.e. the remainder of Lot 10), in this case, there is no other viable alternative location that can be considered for the primary school. The location of important community infrastructure such as the primary school needs to be determined as soon as possible. Approval of this structure plan will not undermine or affect the planning for the remainder of the site, which will be subject to normal statutory processes, however, will provide the community with assurance regarding the location of the primary school for the catchment area.

PLAN A – STRUCTURE PLAN (ZONING PLAN)



LOCAL SCHEME RESERVES

-  PUBLIC USE
-  PRIMARY SCHOOL
-  STRUCTURE PLAN AREA
-  PARKS AND RECREATION

SUBJECT TO SEPARATE STRUCTURE PLAN

PS

robertsday

perth | sydney | melbourne

Level 1 | 130 Royal Street East Perth
 Western Australia 6004 AUSTRALIA
 T: 08 9218 8700 | F: 08 9218 8701
www.robertsday.com.au

PLAN A - Jindalee Primary School Structure Plan - Zoning Plan
 Lot 10 Marmion Avenue, Jindalee
 City of Wanneroo



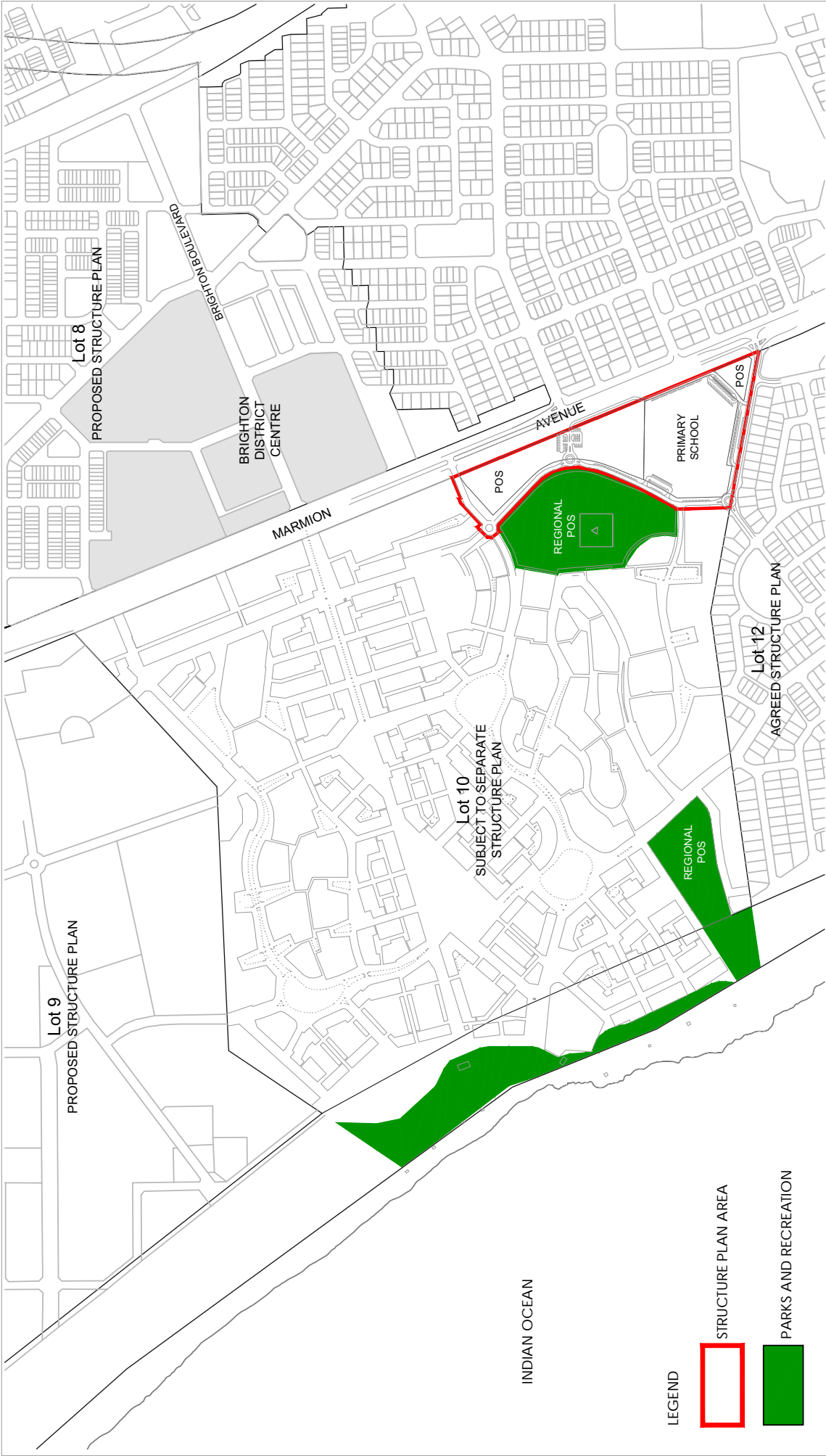
PRELIMINARY

NOTE: ISSUED FOR DESIGN INTENT ONLY. ALL AREAS AND DIMENSIONS ARE SUBJECT TO DETAIL DESIGN AND SURVEY.



REFERENCE NUMBER	DRAWING NUMBER	ISSUE
EDC JIN	STR 02	E

PLAN B – STRUCTURE PLAN (CONTEXT PLAN)

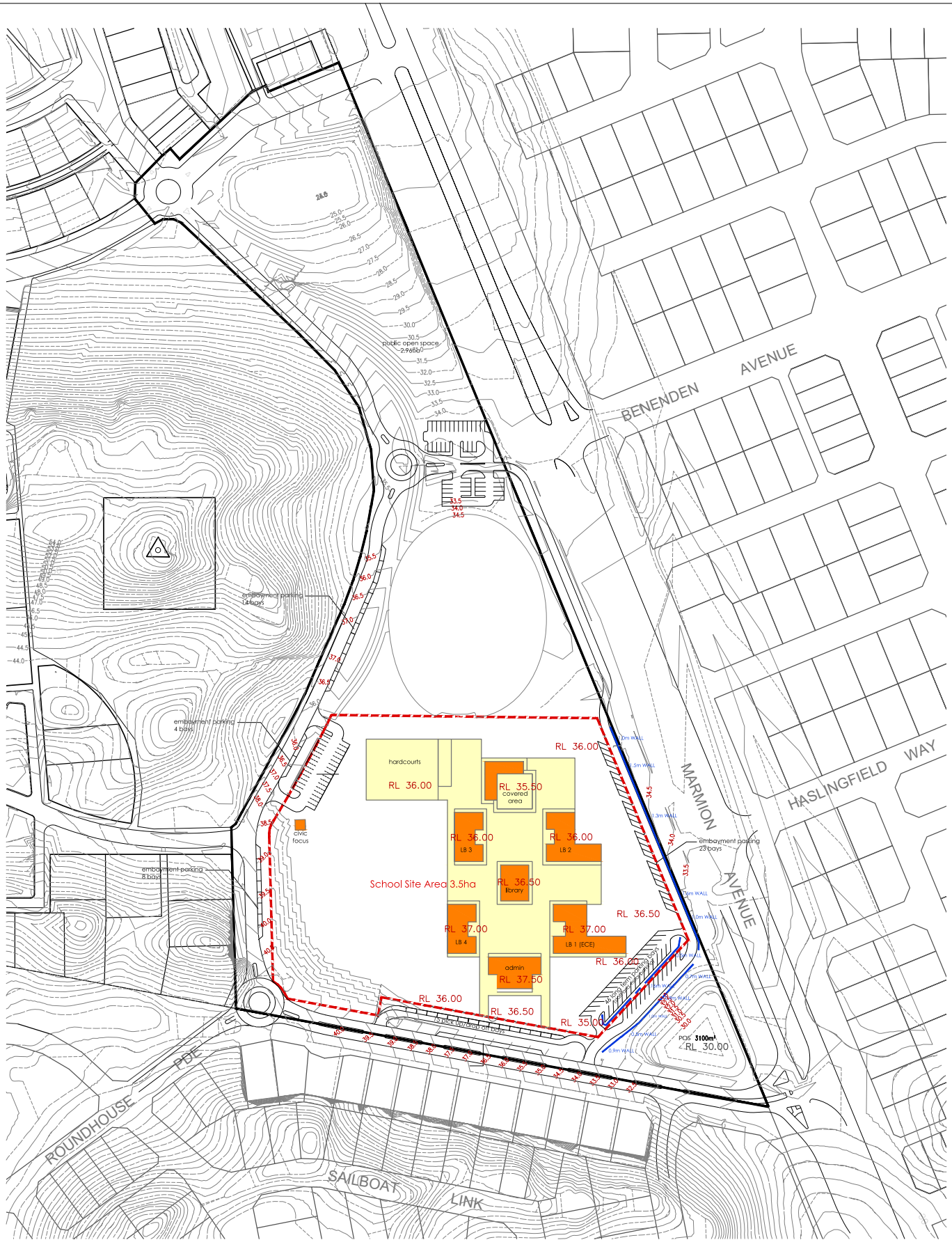


PRELIMINARY
 NOTE: ISSUED FOR DESIGN INTENT ONLY. ALL SUBJECTS TO BE CONFIRMED BY DETAIL DESIGN AND SURVEY.
 REFERENCE NUMBER: EDC JIN
 DRAWING NUMBER: STR 01
 ISSUE: E

PLAN B - Jindalee Primary School Structure Plan - Context Plan
 Lot 10 Marmion Avenue, Jindalee
 City of Wanneroo

- LEGEND**
- STRUCTURE PLAN AREA
 - PARKS AND RECREATION

PLAN C – INDICATIVE DETAILED DESIGN



Plan C - Jindalee Primary School Structure Plan - Indicative Layout

EDC JIN PLA 55H 10.08.11
 scale 1:1000@ A1

46 long term parking bays (staff + visitors)
 94 short term parking bays (79 embayment/ short term + 15 pick-up/ drop-off pre-primary)
140 total parking bays

- STRUCTURE PLAN BOUNDARY
- RETAINING WALLS



* (Location of school buildings are diagrammatic only and subject to development approval)



robertsday studio LPA



MICK ROGERS AND ASSOCIATES

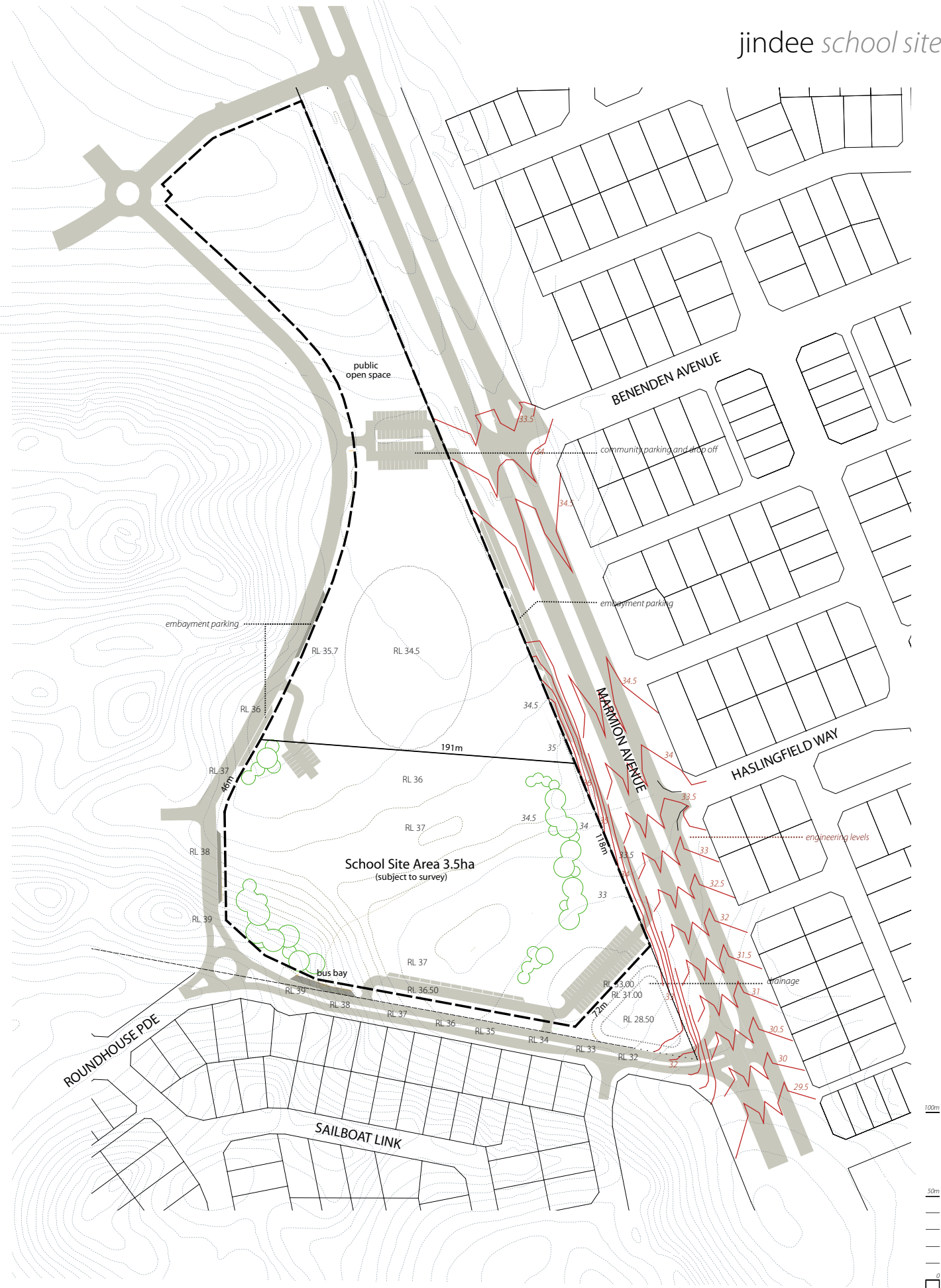
WOOD & GRIEVE ENGINEERS

BRUCE AULABAUGH

BLACKWELL & ASSOCIATES CITY LTD

Duany Plater - Zyberk & Company Architects and Town Planners

PLAN D – DEVELOPMENT LEVELS



School Site Area 3.5ha
(subject to survey)

BENENDEN AVENUE

HASLINGFIELD WAY

MARSTON AVENUE

ROUNDHOUSE PDE

SAILBOAT LINK

100m

50m

0

1:1000@A1

Plan D – Jindalee Primary School Structure Plan – Development Levels

EDC JIN ILL 20C 7.1.09
prepared by robertsday town planning + design

julie harroldarchitects
7 January 2009



robertsday
From vision to venture >



PLAN E – PEDESTRIAN / CYCLE NETWORK PLAN



scale 1:2000 @ A0



PEDESTRIAN / CYCLE NETWORK

New MRS line (as advertised)



JINDALEE

PLAN E PEDESTRIAN / CYCLE NETWORK

DOC JIN-PLA-49A-12.1.09



Studio LPA
WOOD & PARTNER

Burns, Porter, Zwick & Company
ARCHITECTS AND PLANNERS



**APPENDIX A
CORRESPONDENCE FROM THE CITY OF WANNEROO &
DEPARTMENT OF EDUCATION & TRAINING**

File Ref: S07/0089V01 (647343)
Your Ref: EDC JIN
Enquiries: Shane Spinks 9405 5038

23 October 2007

Ms C Evans
Roberts Day
Level 1, 130 Royal Street
EAST PERTH WA 6004

Dear Catherine

RE: PROPOSED JINDEE PRIMARY SCHOOL & COMMUNITY OVAL

I refer to your correspondence dated 12 October 2007 regarding the Proposed Jindee Primary School and Shared Community Oval at Lot 10 Marmion Avenue, Jindalee.

As a result of your meeting with Rod Peake, Manager Smart Growth on 4 October 2007, and subsequent review of the revised concept plan, I can advise that we accept the Indicative Concept Plan (Drawing 2007/SK 1) for the primary school and shared-use oval is approved as a 'local active reserve' serving a local community catchment. It is noted that site footprints have been included for clubroom/changeroom facilities and associated car parking on the northern edge of the shared-use oval, in accordance with the City of Wanneroo Local Active Reserve Model.

From a City of Wanneroo Community Development perspective however, it is disappointing that the location of the public open space is such that it places significant restrictions on the size of the POS available, hence flexibility of the site in relation to its ability to cater for both junior and senior organised sport activity.

Approval of the Indicative Concept Plan is based upon other related issues being adequately addressed, including:

- Effective management of onsite drainage resulting from the surrounding landuses to ensure limited impact on the primary functions of the shared-use oval.
- The installation of effective road reserve treatments along Marmion Avenue to the east of the site in order to ensure the safety of both oval users and vehicles travelling northwards along Marmion Avenue.
- Agreement of the Indicative Concept Plan by the Department of Education & Training.
- Negotiation of a mutually beneficial shared-use agreement between the City of Wanneroo and Department of Education & Training.

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The inherent site restrictions at Jindee Primary School only allow the provision of an active reserve capable of accommodating junior sport. Therefore, it is considered that there will be additional active public open space requirements within Jindalee/Jindee to accommodate senior level sporting pursuits. Subsequently, it is expected that the Landowners, through their planning and/or architectural consultants, work in collaboration with the City's Leisure & Cultural Services Unit to ascertain these requirements and identify a site that can effectively accommodate a senior sized active reserve.

If you have any further queries please do not hesitate to contact me on 9405 5038.

Your Sincerely



Shane Spinks

MANAGER LEISURE & CULTURAL SERVICES

cc: Rod Peake, Manager Smart Growth
Richard Bloor, Principle Consultant Asset Planning, Department of Education and Training.



Department of Education and Training
Government of Western Australia

Your ref:

Our ref: DO08/129897

Enquiries:

Mr James Blitz
Project Manager
Estates Development Company
49 Hampden Road
NEDLANDS WA 6009

Dear James

**PROPOSED JINDEE PRIMARY SCHOOL SITE,
LOT MARMION AVENUE, JINDALEE**

Further to our meeting of 15 January 2008 we confirm our understanding of the matters discussed and outcomes as follows:

The Department provided comment on the Jindee Primary School indicative design (2007/SK1). Some of the major concerns that the Department raised were:

- The City of Wanneroo originally proposed the development of a senior oval on the public open space abutting the school site to the north. The provision of a senior oval in this location would have required the primary school site to be relocated to the west. We now understand from the meeting that the city no longer require a senior oval.
- Traffic circulation and carparking around the school site will be a significant problem as the site only has two road frontages.
- The site has significant level differences which will require careful design and the provision of retaining walls and banks.
- The area of the school site available for buildings and car parking is by our calculations only 2.7ha. This area is normally 3.0ha (3.5ha – 0.5ha for shared oval) where we share the school oval with abutting public open space. It should be noted that in your design this 2.7ha area also has to provide for additional on site car parking (that cannot be located in embayment car parking in the road reserves) thus reducing the area available for the buildings even further.
- The impact of traffic noise from Marmion Avenue needs further investigation to assess what measures need to be taken e.g. berm, noise wall etc.

Our understanding of the outcomes of the meeting relating to these issues are:

- The provision of a shared junior oval is accepted subject to formal confirmation by the City of Wanneroo. EDC are to provide this confirmation.
- It was suggested that a road could be provided along the eastern boundary of the school site parallel to Marmion Avenue linking up with the carpark in the north of the POS. This would improve traffic flow significantly and provide for additional embayment car parking bays. EDC to investigate.
- If the site proceeds in this location, the Department will require that all bulk earthworks, retaining walls and banks necessary to create the finished site levels would be carried out or constructed by the developer.
- One approach to the reduced site area is for the Department to consider a "one-off" design for the site. This design would possibly have to be two storey. The Department does not normally favour this approach due to the significant additional cost (two storey school potential additional cost of \$0.5 million) and issues with supervision of the upper storey classrooms.
- EDC to carry out further investigations of the impact of traffic noise from Marmion Avenue and assess what noise reduction measures need to be taken.

The Department is willing to continue with investigations into how the school site in this location can be developed satisfactorily however we emphasize that at this stage, and in its current configuration, we do not accept the school site location.

Yours faithfully



RICHARD BLOOR
PRINCIPAL CONSULTANT
ASSET PLANNING

18 March 2008

**APPENDIX B
VEGETATION AND FLORA SURVEY**

**LOT 10 JINDEE
VEGETATION AND FLORA SURVEY**

Prepared for:
Estates Development Company
49 Hampden Road
NEDLANDS WA 6009

Prepared by:
RPS Bowman Bishaw Gorham
290 Churchill Avenue
SUBIACO WA 6008
Telephone: (08) 9382 4744
Facsimile: (08) 9382 1177

Report No: L04202 (Version 2)
January 2006

TABLE OF CONTENTS

	Page No.
1.0 INTRODUCTION	1
1.1 Objectives	1
1.2 Location	1
1.3 Level of Survey	1
2.0 METHODS	3
2.1 Preparation for Field Work	3
2.2 Flora	3
2.3 Field Work	3
2.3.1 Flora Survey	3
2.3.2 DRF and Priority Flora Survey	5
2.4 Data Analysis	5
2.5 Limitations	5
3.0 RESULTS	7
3.1 Landforms	7
3.2 Flora	7
3.2.1 Regional Context	7
3.2.2 Native Flora	8
3.2.3 Introduced Flora	8
3.2.4 DRF and Priority Flora	8
3.2.5 Other Significant Flora	10
3.3 Vegetation	10
3.3.1 Vegetation Units	10
3.3.2 Floristic Community Types	17
3.3.3 Vegetation Complexes	19
4.0 CONCLUSION	21
5.0 REFERENCES	22

LIST OF TABLES

Table No.		Page No.
1	Conservation Status of Vegetation Complexes in the Jindee Study Area	19

LIST OF FIGURES

Figure No.	
1	Vegetation map of the Jindee Study Area

LIST OF APPENDICES

Appendix A	FCT Analysis, EA Griffin and Associates
Appendix B	Table of Significant Flora from the Broader Alkimos Area (AS Weston)
Appendix C	Species List and Quadrat and Relve Data
Appendix D	Condition Scale and Structure Classes

1.0 INTRODUCTION

1.1 Objectives

This survey project addresses requirements for flora and vegetation surveys of Jindee (Lot 10 Jindalee).

The specific objectives of the survey project are to:

1. Provide accurate descriptions of flora, floristic community types and vegetation units, and their condition, of the study area, and estimates of the type and size of the areas to be impacted, based upon desktop analyses and field surveys,
2. Determine the presence of Declared Rare Flora (DRF), endangered, priority and other significant species, Threatened Ecological Communities (TEC) and other significant vegetation units.
3. Provide a vegetation map of the area showing vegetation communities, any DRF flora, and any TEC or other significant vegetation,

1.2 Location

Lot 10 Jindalee is shown on Sheet No. SWAN 10 000 BG35/1.4, Locality Quinns Rocks, Alkimos, Mindarie (Valuer General's Office Perth). It is 112.2947 hectares in area and is situated on the northern coastline of Perth in the City of Wanneroo. It is west of the northern suburb of Butler, separated from it by Marmion Avenue.

The total study area varies in length and width, but its longest part is approximately 2.5 km long, east to west, and its widest part is approximately 1.5 km wide, north to south.

1.3 Level of Survey

The EPA's Guidance No. 51 (Environmental Protection Authority 2004) was used in the planning and design of the project and in the presentation and preparation of the reports. As the anticipated scale and nature of the impact on native vegetation and flora in Lot 10 will be High, rather than Low or Moderate, a 3-stage Level 2 Survey, as described on Page 39 of Guidance No. 51, was undertaken. In determining the level of impact

anticipated, the loss/clearing of over 10ha of vegetation on the Swan Coastal Plain was taken into account. This impact is defined in Table 3 (Page 42) of Guidance 51 as being High.

A Level 2 survey consists of three or, in some situations and areas, four stages. The first two stages constitute a Level 1 survey. The required three stages of a Level 2 survey are:

- Background research or ‘desktop’ study,
- Reconnaissance survey, and
- Detailed survey.

The fourth Level 2 stage is Comprehensive survey, which involves surveying both the locality and parts of the local area at the same intensity as required in a Detailed survey, but more structured, over a longer term and with multiple visits.

2.0 METHODS

2.1 Preparation for Field Work

Preparation for field work entailed:

- finding existing vegetation descriptions and maps and flora lists for the study area and the general area; and
- preparing tables of significant flora to be searched for during field work.

Methods and representative sites for field work were initially chosen during this preparation stage.

2.2 Flora

Lists of flora covering the study area and nearby areas were used to get an appreciation of the types and range of plants which might be found in the study area. These lists include ATA Environmental (2003, 2004), Trudgen and Keighery (1990a) and Griffin and Trudgen (1994).

Appendix B has tables that list Declared Rare Flora, Priority Flora and other significant flora with distributions that may include the general area and descriptions of how the tables were compiled. The tables give information about conservation codes and, for Declared Rare and Priority Flora, distributions, localities, growth forms, habitats and flowering times. During preparation of the tables, herbarium specimens in the Western Australian Herbarium of taxa (species, subspecies) listed in the tables were examined for familiarisation with their appearance, habitats, distribution and flowering times.

2.3 Field Work

2.3.1 Flora Survey

The survey was carried out in late 2004, with four 10x10m plots set up and recorded on the 7th and 8th of October and revisited in early summer on the 20th and 21st of December. Five releves were also recorded during the October visits. It is estimated that close to 100% of the flora in the plots were recorded during the two visits, with the

possible exception of early flowering species. Figure 1 highlights the location of these plots and releve points.

Recognising that there can be changes to the schedule of flora with special conservation value over time, further investigation and verification of Declared Rare and Priority Flora for the site was also undertaken in September 2005, to ensure that this report utilises the most up to date information from CALM.

It is estimated that close to 100% of the flora in the plots were recorded during the two visits, with the possible exception of early flowering species.

On the first visit to the study area plots were established at sites chosen from aerial photography. Releves were also described in other vegetation communities. All species in plots were recorded and specimens taken of all species for confirmation of identification. GPS points were fixed using the GDA94 datum, and digital photographs were taken of each plot.

Specimens collected were dried and identifications confirmed by reference to standard texts (eg. *Marchant et al, 1987*), comparison with specimens held in the Western Australian Herbarium and discussion with other botanists.

On the second visit to the plots, all flora was recorded and species not collected previously were collected along with some specimens of previously recorded species.

The vegetation component is based on descriptions of vegetation at the sites chosen, and is representative of vegetation in the study area. Not all the variations in vegetation across the entire study area have been described, but sufficient have been to allow assessment of the vegetation within the existing coastal reserve, proposed Regional Open Space (ROS) areas and the east-west link between these ROS areas.

The vegetation map was produced using existing vegetation mapping of the area (Weston 1998), incorporating updated vegetation mapping from this survey. This has led to a simplified map compared with Dr. Weston's. The mapping has been simplified to represent different interpretations of community definition. Vegetation community definition can vary between botanists, and Trudgen (1999) makes a good point of this when he says "definition of individual plant communities, particularly in the absence of a detailed regional study, is a matter of professional opinion" (Trudgen, 1999, P13). The

main criterion is that an individual plant community should be a basic unit with a recognisable structure and composition, but variation needs to be recognised.

2.3.2 DRF and Priority Flora Survey

Prior to any field work being undertaken, a search was requested of databases held by the Department of Conservation and Land Management. The databases searched were the *Western Australian Herbarium Specimen* database, and CALMs *Threatened (Declared Rare) Flora* and *Declared Rare and Priority Flora* databases, for the coordinates 31 36 00 -31 41 00 E, 115 39 29 – 115 45 00 N. Taxa of interest from the resulting lists were examined in the Reference Herbarium of the WA Herbarium to familiarise the searchers with their appearance. A list of the potential Declared Rare Flora (DRF) species and Priority Flora species or subspecies which may occur in the study area is provided in Section 3.3 of this report.

Transects were walked approximately east to west across the site at a distance of 20-40m apart depending on the vegetation structure and visibility. Areas of dense scrub were avoided after initial forays, as it was found that little understorey occurred in these thickets, and searching was difficult because of their density.

Initially, it was planned to record a GPS point for every Priority species found, but due to the large number of one priority taxon this soon became impractical. Instead, for this taxon, GPS points were recorded at significant points along the transect, and a tally made of specimens observed between the two points. Other priority species found were recorded with a number of specimens observed at a particular GPS point.

2.4 **Data Analysis**

All plot and releve data was analysed by EA Griffin and Associates, using the PATN suite of multivariate analysis programs, against the data used by Gibson *et al* (1994) to establish Floristic Community Types on the Swan Coastal Plain. Two analyses were carried out, one with the releve data and one without.

2.5 **Limitations**

Due to the proposed land exchange for ROS under the Metropolitan Region Scheme, targeted plots and relevés on the vegetation and flora were established in the current Regional Open Space (Bush Forever Site 397) and within the southern portion of the site, which contains the areas proposed for regional open space (Figure 1).

Because of the timing of the survey, it is possible that some earlier flowering ephemeral species were missed. However, it was noticed during a flora survey of an area adjacent to the north (M Henson *pers comm*) that some annual species were present and flowering earlier than usually expected (for example, *Trachymene pilosa*). This was perhaps due to mild winter conditions and may have resulted in some early-flowering species being missed in this study (although the *Trachymene* itself was still present in all plots and nearly all relevés). The number of sites chosen precludes the species list being regarded as complete for this area.

3.0 RESULTS

3.1 Landforms

McArthur and Bartle (1980) is a 1:25 000 scale map of landforms and soils on the Swan Coastal Plain. The landforms and soils shown in the study area are mainly Quindalup Dune System units, with smaller areas of Spearwood Dune System units mainly on the eastern side.

There are small areas of two Spearwood units: Kls – bare limestone and shallow brown sandy soils over limestone – and Ky - Karrakatta sand (yellow phase), often with limestone within two metres of the surface. The Ky unit corresponds more or less to the Banksia woodland of Trudgen and Keighery (1990), and the Kls unit corresponds more or less to their Limestone heath. These Karrakatta units correspond to the current Cottesloe Central and South units.

There are four Quindalup units in the study area: Q2, Q4, Qp and Qs. The Qp unit is of nearly flat or gently undulating landscapes with deep calcareous sands overlying limestone, sometimes/often with steep Q3 parabolic dunes around them. Qs is of shallow calcareous soil over limestone, similar in fact to the Kls unit previously mentioned. The Q2 unit is the second-oldest phase, with some development towards a soil profile. The Q4 unit is the youngest phase, characterised by little soil development (undifferentiated) and a suite of pioneer plant species. This is usually the closest unit to the beach.

3.2 Flora

A total of 83 taxa from 40 different Families were collected from the four plots and five releves described during this survey (see Appendix C), of which twenty-two were introduced species and sixty-one were native species. Bush Forever (Government of Western Australia, 2000) records 83 native taxa and 27 weed taxa from Bush Forever Site 397 which forms the western-most part of the study area.

3.2.1 Regional Context

In comparison, Trudgen and Keighery (1990) found a total of 188 native species on the Quindalup and Cottesloe-Central and South dune Complexes at Alkimos, just north of

Jindalee. Griffin (1993) recorded 313 native taxa from 545 coastal sampling sites between Geraldton and Swanbourne. Trudgen (1988) recorded 305 native taxa from an undisclosed number of sampling sites on the coast of Mandurah, and 119 from the Leschenault Peninsula (Trudgen 1984).

All of these study areas are larger than the Jindee area, covering a greater number of habitats with a greater number of survey sites, so it is not surprising that greater numbers of taxa were recorded. However, given the smaller size of the Jindee study area, the number of taxa collected here appears comparable.

3.2.2 Native Flora

Of the native species fifteen (in eight families) are monocotyledons and forty (from twenty-three families) are dicotyledons. Of the monocotyledons, the *Cyperaceae* had the most species (four). The Families of dicotyledons with most representation were the *Papilionaceae* (six), *Asteraceae* (five) and *Myrtaceae* and *Mimosaceae* (four).

3.2.3 Introduced Flora

Twenty-seven per cent of the flora collected in this survey was introduced. In comparison, Trudgen and Keighery recorded 16% introduced species at Alkimos fifteen years earlier, Trudgen (1988) recorded 8.5% alien taxa at Mandurah and 32% on Leschenault Trudgen (1984). A recent survey at Alkimos (2004-5) recorded 30% introduced species (Dr AS Weston, *pers.comm*). These figures may show an increase in infestation over time (from 16% to 30% at Alkimos) especially if the earlier work is assumed to be more thorough. Based on these studies, the percentage of introduced species at Jindalee does not appear to be unusually high.

3.2.4 DRF and Priority Flora

The Department of Conservation and Land Management (CALM) Rare and Priority Flora Database lists one Declared Rare Flora (DRF) species and five Priority Flora species or subspecies which may occur in the study area:

- *Astroloma microcalyx* (Priority 3)
- *Comesperma acerosum* (Priority 3)
- *Conostylis pauciflora* subsp. *euryrhipis* (Priority 3)

- *Eucalyptus argutifolia* (DRF)
- *Jacksonia sericea* (Priority 4)
- *Stylidium maritimum* (Priority 3)

No DRF were recorded within the site. However, the following Priority Flora were recorded within the site.

Conostylis pauciflora

Conostylis pauciflora has two subspecies; subspecies *euryrhipis* (P3) and subspecies *pauciflora* (P4). Examination of the literature showed that ssp *pauciflora* was thought to only occur near Dawesville, and ssp *euryrhipis* north of Perth, although recently a collection determined as ssp *pauciflora* from the north of Perth has been lodged at the WA Herbarium (Department of Conservation and Land Management, 2005).

The characters used to distinguish between the two subspecies are based mainly on size, of leaves in particular and this is a character that may be open to interpretation because of variation. Consequently, determination of which *Conostylis* subspecies was present was not possible with complete certainty.

Conostylis is thought to hybridise within the genera and *C. pauciflora* itself is thought to be a hybrid between *C. aculeata* and *C. candicans* (Marchant *et al* 1987), and specimens collected during this survey appeared to have characters not attributed to either of the *C. pauciflora* subspecies.

Notwithstanding the almost total identification of *Conostylis pauciflora* north of Perth as ssp. *euryrhipis*, the specimens examined from the site appeared to have more in common with ssp. *pauciflora*.

Bennett (2004) apparently had this same problem at the Alkimos site north of Jindee, as did Weston (2005), who resorted to using the specific epithet rather than defining to subspecies.

A total of 5916 individuals were observed across the site during this search, however this number should not be taken as absolute as it was difficult to accurately record every single individual. Some were observed to be not in flower, and others that were clumped

together may have been recorded as one instead of a number of individuals. It is also possible that both subspecies of *Conostylis pauciflora* were present.

This taxon was mainly observed along the ridges, slopes and shallow swales within the site and was found within both areas proposed for regional open space.

Conostylis bracteata

This Priority three taxon was found in the stands of Banksia woodland on the eastern edge of the site. 117 individuals were observed during this search, with some occurring within the proposed eastern regional open space. This taxon is a new record for the area as it did not show on the database searches.

3.2.5 Other Significant Flora

Two other significant flora species are mentioned in *Bush Forever*. These are; *Melaleuca cardiophylla* (significant, found in Relevés JinR1, 2 and 3) and *Grevillea preissii* (typical Tamala limestone taxa). *Grevillea preissii* was not recorded from any of the sites from this study, but its presence in Bush Forever Site 397 is recorded in *Bush Forever* (Government of Western Australia, 2000).

3.3 **Vegetation**

3.3.1 Vegetation Units

The vegetation of the study area is varied considering the size of the area surveyed, reflecting the topography, distance inland and soils found. The vegetation survey was restricted to areas within the current regional open space (Bush Forever 397) and the southern portion of the site.

Five vegetation units were sampled during the survey (Figures 1 and 2). Structural Classes and Condition Scales are taken from Bush Forever (2000, Volume 2, Tables 11 and 12. See Appendix D). Almost all units suffer from severe localised disturbance in the form of tracks.



MhSp

Melaleuca huegelii, *Spyridium globulosum* Closed Heath on shallow limestone.

Condition: Excellent.

This unit was found at the northern end of the current regional open space above limestone cliffs, with exposed limestone and limestone rocks at the surface. It is in excellent condition possibly due the fact that access, both pedestrian and vehicular, is difficult.



1) Showing lack of understorey and rabbit presence (burrow on left).



2) Showing density of shrub layer.

McSp

Melaleuca cardiophylla, *Acacia rostellifera*, *Spyridium globulosum*, *Olearia axillaris*, *Acacia saligna* Closed Tall Scrub/Closed Heath in swales and lower slopes.

Condition: Good-Very Good

This unit contains largely one stratum of vegetation between 1m and 2m (higher in parts), with some open areas. Because of the density (up to 100%) there is little scope for understorey, and what exists is impacted by rabbits. In density and structure it appears similar to post-fire regrowth but the open patches possibly indicate greater maturity or different origin.

This unit occurred in the south-east corner of the site, in both the existing coastal regional open space and the proposed regional open space. Relevés JinR1, JinR2, JinR3.



AsLSg

Acacia saligna, *Spyridium globulosum*, *Olearia axillaris* Shrubland/Open Shrubland over *Pelargonium capitatum*, *Melaleuca systema* Open Low Heath over *Lomandra maritima* Sedgeland.

Condition: Very Good.

This unit occurs on slopes in the current regional open space and the proposed regional open space located in the eastern portion of the site. Examination of aerial photography shows it is common on slopes throughout Lot 10.



Ef

Eucalyptus foecunda Closed Shrub Mallee over *Acacia saligna* Shrubland over *Scaevola ?globulifera* Low Shrubland over **Anagallis arvensis* Herbland.

Condition: Very Good. Burnt over last 2-3 yrs and still regenerating. Photo taken 9/1/06.

This unit occurs in the proposed ROS located in the eastern portion of the site. Found in Releve JinR4.



XpAs

Xanthorrhoea preissii, *Spyridium globulosum*, *Acacia saligna* Tall Open Scrub/Open Heath over *Leucopogon propinquus*, *Melaleuca systema* Open Shrubland over *Lomandra maritima*, *Lepidosperma squamatum* Open Sedgeland.

Condition: Very Good

.

This unit occurs in the proposed Regional Open Space located within the eastern portion of the site. Plot Jin4.

Vegetation Communities described during fieldwork but not sampled (Figure 1)

AsMsSc

Acacia saligna Shrubland over *Melaleuca systema*, *Alyogyne huegelii*, *Scaevola ?globulifera* Low Open Heath/Open Heath over *Conostylis pauciflora* subsp. ? Very Open Herbland.

This unit occurs partly within the proposed regional open space located within the south-eastern portion of the site.

B

Banksia attenuata, *B. menziesii* Low Woodland over *Dryandra sessilis*, *Macrozamia riedlei* Scattered Shrubs over *Rhagodia baccata*, *Hibbertia hypericoides*, *Leucopogon polymorphus* Low Open Shrubland.

This unit occurs partly within the proposed regional open space located within the eastern portion of the site.

B1

Banksia attenuata, *Banksia menziesii* Low Woodland over **Trachyandra divaricata* Closed Herbland.

D

Dryandra sessilis Closed Tall Scrub over *Macrozamia riedlei* Scattered Shrubs over *Hibbertia hypericoides*, *Jacksonia calcicola* Low Shrubland.

DsSg

Dryandra sessilis Shrubland to Tall Closed Scrub over *Xanthorrhoea preissii* Scattered Shrubs over *Jacksonia calcicola*, *Hibbertia hypericoides*, **Pelargonium capitatum* Low Open Shrubland over *Trachymene pilosa*, **Anagallis arvensis*, **Arctotheca calendula* Herbland.

This unit occurs within the current regional open space and the areas proposed as regional open space.

Mixed

Acacia truncata, *A. cochlearis*, *Spyridium globulosum*, *Olearia axillaris* Closed Shrubland over *Lepidosperma gladiatum* Sedgeland/Open Sedgeland with lianes of *Hardenbergia comptoniana*. Contains a variety of shrubs and herbaceous plants.

This unit occurs within the current regional open space and is impacted in large part by tracks causing severe localised disturbance. The condition of the vegetated parts is generally Very Good to Excellent.

P

Pyrosere communities, consisting largely of *Dryandra sessilis*, *Acacia pulchella*, *Hibbertia hypericoides* Closed Heath/Closed Low Heath.

Sg

Spyridium globulosum Closed/Open Heath over **Trachyandra divaricata*, *Trachymene pilosa*, *Conostylis pauciflora* ssp. ? Herbland.

This unit occurs within the current regional open space.

3.3.2 Floristic Community Types

The most accurate way to determine which floristic community types occur in the Metropolitan Region of the Swan Coastal Plain is to select, sample and analyse Gibson-type, 10 m by 10 m quadrats using the techniques described by Gibson *et al.* (1994) and Keighery (1994). An essential component of these techniques is the compilation of a complete list of species for each quadrat based upon correctly identified plant specimens. This often requires sampling the quadrat more than once.

It should be possible, however, according to *Bush Forever* (Government of Western Australia 2000, Volume 2, p. 487), to infer which floristic community types, at least of the original 43 described by Gibson *et al.* (1994), occur in a study area. Inferences of which FCTs occur in particular Bush Forever sites have been made from “information on the floristics of the area and the area’s geographic location” (Government of Western Australia 2000, Volume 2, p. 487).

The floristic community approach to vegetation classification and description gives equal weight to all vascular plant species in plant community sampling quadrats (or

plots). These plots are, in the case of Swan Coastal Plain floristic surveys, 10m by 10m squares. The presence or absence of individual species in the quadrats is, with the aid of computerised multivariate analysis techniques (specifically, PATN software), used to define floristic community types (FCTs; or other groupings), which are based on shared species and groups of species having high frequencies of co-occurrence, and on absence of species. An essential prerequisite of this method is a complete list of correctly identified species for each plot.

Gibson *et al.* (1994) used analyses of 509 southern Swan Coastal Plain survey quadrats to define 43 FCTs. Subsequent analyses of 613 other quadrats led to 23 additional FCTs being defined, mainly in the Perth Metropolitan Region (*Bush Forever* 2000, Volume 2, pp. 27-31).

Bush Forever lists six Spearwood Dunes FCTs and nine Quindalup Dunes FCTs. The Spearwood Dunes FCTs are FCT 24, FCT 25, FCT 26a, FCT 26b, FCT 27 and FCT 28. The Quindalup Dunes FCTs are FCT 29a, FCT 29b, FCT 30a2, FCT 30c2, FCT 30b, FCT S11, FCT S12, FCT S13 and FCT S14. *Bush Forever* does not indicate which of these FCTs may be restricted to one dune type or the other.

The Department of Conservation and Land Management (CALM) has been identifying and informally listing Threatened Ecological Communities (TECs) for the past eight years. The TEC list is derived in part from vulnerable Gibson *et al.* (1994) vegetation communities for the Swan Coastal Plain, and from additional threatened communities throughout Western Australia.

Of the listed TECs, 19 have been endorsed by the Director of Nature Conservation as Critically Endangered, 11 as Endangered, 19 as Vulnerable, and two as presumed totally destroyed. The remainder are either awaiting endorsement as threatened or are allocated to one of five priority lists.

Data collected from the four quadrats and the five relevés was analysed by EA Griffin and Associates using the PATN suite of programs for multivariate analysis (CSIRO 1987), and their report is included as Appendix A. Using a selection of the programs available, data was compared against the data collected and analysed by Gibson *et al.* (1994) to establish relationships to the Swan Coastal Plain Floristic Community Types (FCTs). Two analyses were carried out, one with the relevé data included and one without it.

Griffin's analysis shows the quadrats as grouping together with Floristic Community Type 29a, although they are closer to each other than to any of the Gibson *et al* sites. Griffin points out the absence of a number of ephemeral genera that are not on the species list that could reasonably be expected to occur. The inclusion of these species, however, may not change the grouping except to draw the Jindalee quadrats closer to other sites.

Bush Forever infers the presence of FCTs 29a and 29b in the study area, and this study confirms that FCT 29a, Coastal shrublands on shallow dunes from Supergroup 4; Uplands centred on Spearwood and Quindalup Dunes, is present and appears to encompass all the vegetation in the study area.

Gibson *et al* (1994) list FCTs 29a and 29b as both being 'poorly reserved and susceptible'. However, these FCTs are not listed on the Department of Conservation and Land Management's TEC Database or the Commonwealth's TEC list.

3.3.3 Vegetation Complexes

Hedde *et al.* (1980) identified and mapped large scale repeating patterns in native vegetation for the entire Darling System of the south- west of Western Australia. The vegetation was grouped into "Complexes" which reflect the influence of landform, soil type and climate. This work shows the study area as supporting remnants belonging to the Cottesloe Complex – Central and South and Quindalup Complex.

Vegetation of the Cottesloe Complex – Central and South is characterised by a closed heath on limestone areas with shrubs such as *Melaleuca huegelii*, *Acacia* species, *Grevillea thelemanniana* and *Trymalium ledifolium*. The deeper sands support a mosaic of Tuart, Jarrah and Marri. *Banksia* species are also common.

Quindalup Complex is a coastal dune complex consisting mainly of the strand and fore-dune alliance, and the mobile and stable dune alliance. Local variations include low closed forest of *Melaleuca lanceolata* – *Callitris preissii* and the closed scrub of *Acacia rostellifera*.

Assessments made in 1998 and quoted in *Bush Forever* (Government of Western Australia, 2000) estimated that some 36% and 47.6% respectively of the original extent of these vegetation complexes remained uncleared at that time. These figures would

have included the remnants mapped for the study area, and give an indication of the significance of the remnants.

Bush Forever (Government of Western Australia, 2000) indicates that the Quindalup Complex and Complex – Central and South have 19.5% and 17.7% proposed protection respectively, which meets the target 10% for complexes within the Swan Coastal Plain portion of the Perth Metropolitan Region. Table 1, below highlights the original extent, remaining areas and the reservation status of these vegetation complexes.

Table 1 Conservation Status of Vegetation Complexes in the Jindalee Study Area (Source: Bush Forever Vol.2 p 83)

Vegetation Complex	Original Extent	Area Remaining (% original extent)	Area currently reserved (% original extent)	Area reserved or proposed for reservation (% original extent)
Quindalup Complex	24 381 ha	11 598 (47.6)	3 527 (14.5)	4 756 (19.5)
Cottesloe Complex; Central and South	34 439 ha	12 362 (36)	5 289 (15.4)	6 085 (17.7)

In 1993 the International Union for the Conservation of Nature (IUCN) recommended that “protected areas cover at least 10 percent of each biome by the year 2000” (IUCN, 1993). A Biome is “a major biotic community characterised by the dominant forms of plant life and the prevailing climate” (<http://www.hyperdictionary.com>) such as Savannah or Tropical Rainforest. Each Biome will contain a diversity of habitat and vegetation types within it, and these units are at a much broader level than the Complexes or Floristic Community Types referred to in this report.

By this measure of 10%, the reservation of the dune Complexes displayed in the table above appears to be adequate, although protection of larger units such as Vegetation Complexes does not necessarily confer protection on smaller component units such as Floristic Community Types. The Environmental Protection Authority, in its Position Statement No. 2 (EPA, 2000) recommends retention of 30% of each ecological community as an appropriate target. As Table 1 shows, the remaining extent of both Complexes present is above this threshold value.

4.0 CONCLUSION

The vegetation within the proposed and existing regional open space at Jindee was surveyed in October and late December 2004, and the results analysed using PATN multivariate analysis software. Further investigation and verification of Declared Rare and Priority Flora for the site was undertaken in September 2005.

No Declared Rare Flora was found during the survey. As discussed in further detail in Section 3.3 of this report Priority species, *Conostylis pauciflora* subsp. *pauciflora* (P4) and/or *Conostylis pauciflora* subsp. *euryrhipis* (P3) and *Conostylis bracteata* (P3) was recorded within the site, which included the areas proposed for regional open space. Priority Taxa are considered to have been adequately surveyed and, whilst being rare, are not threatened by any identifiable factors.

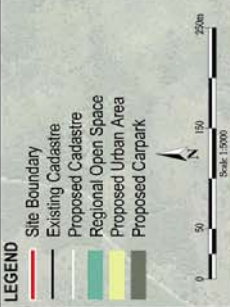
Analysis of the collection data shows the vegetation grouping with Floristic Community Type (FCT) 29a. The presence of this FCT is inferred in *Bush Forever* (Government of Western Australia, 2000) as present in the area. While Gibson *et al* (1994) lists this FCT as 'poorly reserved and susceptible', efforts to increase the reservation status of Vegetation Complexes on the Swan Coastal Plain (for example *Bush Forever*) have resulted in greater security (see Table 1). FCT 29a is not listed on State or Commonwealth Threatened Ecological Community databases.

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FIGURE 1
Vegetation Map of Lot 10 Jindee



- VEGETATION UNITS**
- MhSp *Medicago lupulina*, *Spyridium globulosum* Closed Heath on shallow limestone.
 - McSp *Melaleuca cardiophylla*, *Acacia rostellifera*, *Spyridium globulosum*, *Oleina axillaris*, *Acacia saligna*
 - AsLSg Closed Tall Scrub/Closed Heath in swales and lower slopes.
 - AsLSg *Acacia saligna*, *Spyridium globulosum*, *Oleina axillaris* Shrubland/Open Shrubland over
 - Ef *Palargonium capitatum*, *Melaleuca systena* Open Low Heath over *Lomandra maritima* Sedgeland
 - XpAs *Eucalyptus ficuoides* Closed Shrub Mallee over *Anthoecus fitorea* Shrubland over *Anagallis arvensis* Herbland.
 - AhSg *Xanthorrhoea preissii*, *Spyridium globulosum*, *Acacia saligna* Tall Open Scrub/Open Heath over *Leucopogon propinquus*, *Melaleuca systena* Open Shrubland over *Lomandra maritima*.
 - B *Leucopogon squarretum* Open Sedgeland.
 - B *Alvogone luteicollis*, *Scaevola ?globulifera* Closed Heath/Closed Low Heath over *Comostyle pacificora* sp. ? Very Open Herbland.
 - B *Banksia attenuata*, *B. menziesii* Low Woodland over *Dryandra sessilis*, *Macrozamia reedii* Scattered Shrubs over *Rhagodia baccata*, *Hibbertia hypericoides*, *Leucopogon polymorphus* Low Open Shrubland.
 - B1 *Banksia attenuata*, *Banksia menziesii* Low Woodland over *Trachyanandra divaricata* Closed Herbland.
 - D *Dryandra sessilis* Closed Tall Scrub over *Macrozamia reedii* Scattered Shrubs over *Hibbertia hypericoides*, *Jacksonia calicicola* Low Shrubland.
 - DsSg *Dryandra sessilis* Shrubland to Tall Closed Scrub over *Xanthorrhoea preissii* Scattered Shrubs over *Jacksonia calicicola*, *Hibbertia hypericoides*, *Palargonium capitatum* Low Open Shrubland over *Trachymene pilosa*, *Anagallis arvensis*, *Acrotholone calandula* Herbland.
 - Mixed *Acacia truncata*, *A. cochlearis*, *Spyridium globulosum*, *Oleina axillaris* Closed Shrubland over *Leucopogon gladiatum* Open Sedgeland/Open Sedgeland with lines of *Hardenbergia complanata*. Contains a variety of shrubs and herbaceous plants.
 - P *Proserpine communis*, consisting largely of *Dryandra sessilis*, *Acacia pulchella* Closed Heath/Closed Low Heath.
 - Sg *Spyridium globulosum* Closed/Open Heath over *Trachyanandra divaricata*, *Trachymene pilosa*, *Conostyle pacificora* sp. ? Herbland.

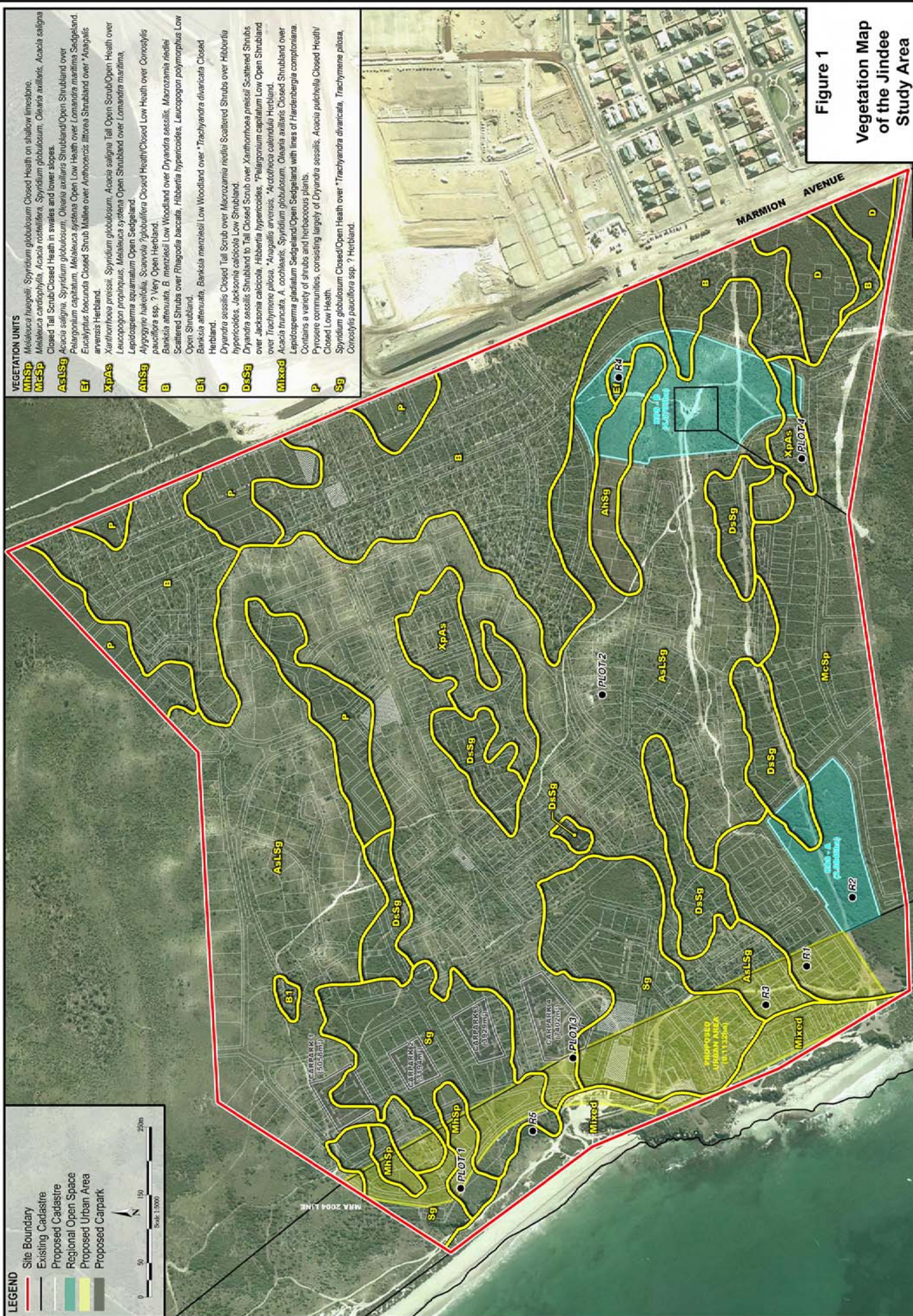
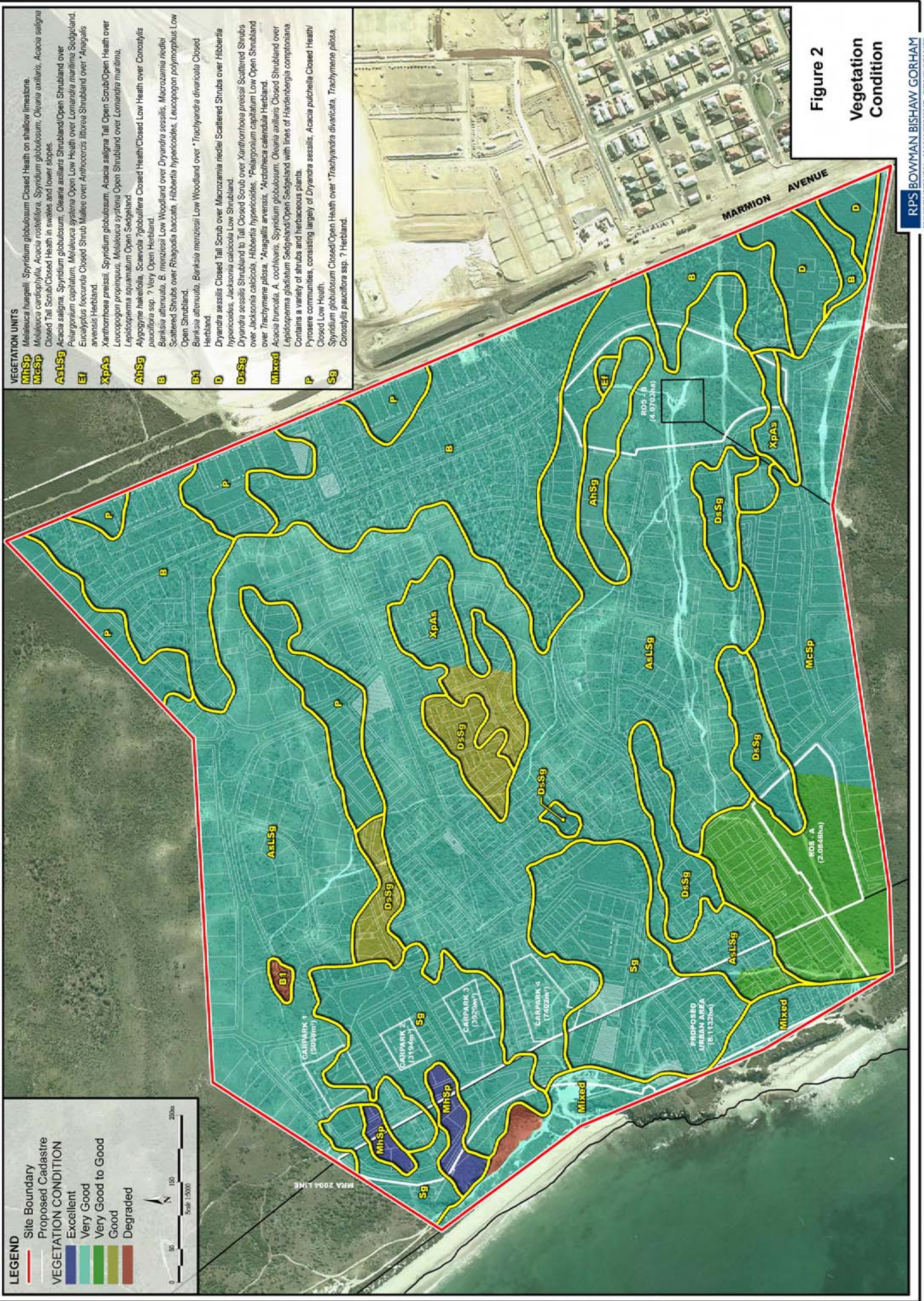


Figure 1
Vegetation Map
of the Jindee
Study Area

FIGURE 2
Vegetation Condition

Figure 2
Vegetation Condition



- VEGETATION UNITS**
- MhSp** *Melaleuca leucadellii*, *Spyridium globulosum* Closed Heath on shallow limestone.
 - MhSp** *Melaleuca leucadellii*, *Acacia rostellata*, *Spyridium globulosum*, *Olearia axillaris*, *Acacia saligna* Closed Tall Scrub/Closed Heath in swales and lower slopes.
 - AsLSg** *Acacia saligna*, *Spyridium globulosum*, *Olearia axillaris* Shrubland/Open Shrubland over *Palaquium capitatum*, *Melaleuca systena* Open Low Heath over *Lomandra maritima* Scageland.
 - Ef** *Eucalyptus foccoides* Closed Shrub Mallee over *Anfiboceros filivosa* Shrubland over *Anigallia anensis* Herbland.
 - XpAs** *Xanthorrhoea preissii*, *Spyridium globulosum*, *Acacia saligna* Tall Open Scrub/Open Heath over *Leucopogon prostratus*, *Melaleuca systena* Open Shrubland over *Lomandra maritima*.
 - AhSg** *Lepidosperma squamatum* Open Scageland.
 - B** *Alyogyne hakeloides*, *Scandelia ?gibbiflora* Closed Heath/Closed Low Heath over *Conostylis pauciflora* sp. ? Very Open Herbland.
 - B1** *Banksia affinis*, *B. menziesii* Low Woodland over *Dryandra sessilis*, *Macrozamia nodiflora* Scattered Shrubs over *Rhagodia barcata*, *Hibbertia hypericoides*, *Leucopogon polymorphus* Low Open Shrubland.
 - D** *Banksia affinis*, *Banksia menziesii* Low Woodland over *Trachyanthra divaricata* Closed Herbland.
 - DsSg** *Dryandra sessilis* Closed Tall Scrub over *Macrozamia nodiflora* Scattered Shrubs over *Hibbertia hypericoides*, *Jacksonia calicicola* Low Shrubland.
 - Mixed** *Dryandra sessilis* Shrubland to Tall Closed Scrub over *Xanthorrhoea preissii* Scattered Shrubs over *Jacksonia calicicola*, *Hibbertia hypericoides*, *Palaquium capitatum* Low Open Shrubland over *Trachymene pilosa*, *Anigallia anensis*, *Arctotheca calendula* Herbland.
 - P** *Acacia truncata*, *A. cochlearis*, *Spyridium globulosum*, *Olearia axillaris* Closed Shrubland over *Lepidosperma glaberrimum* Scageland/Open Scageland with lines of *Hardenbergia comptoniana*. Contains a variety of shrubs and herbaceous plants.
 - Sg** *Pyrosoma* communities, consisting largely of *Dryandra sessilis*, *Acacia pulchella* Closed Heath/Closed Low Heath.
 - Sg** *Spyridium globulosum* Closed/Open Heath over *Trachyanthra divaricata*, *Trachymene pilosa*, *Conostylis pauciflora* sp. ? Herbland.

LEGEND

- Site Boundary
- - - Proposed Cadastre
- VEGETATION CONDITION**
- Excellent
- Very Good to Good
- Good
- Degraded

Scale: 1:5000
0 50 100 200m

APPENDIX A

FCT Analysis, EA Griffin and Associates.

1.0 INTRODUCTION

1.1 Purpose of this report

The current report is intended to help clarify the assignment of Floristic Community type (FCT) designation to vegetation community (site) data. FCTs were defined by Gibson *et al* (1994) based on site data collected from vegetation on the Swan Coastal Plain. In particular, the potential that a Threatened Ecological Community (English and Blyth 1997) is represented by the data collected needs to be clarified.

1.2 Location of Jindalee Sites

The sites were apparently from the coastal dunes in the northern metropolitan area.

1.3 Brief background to floristic analysis of vegetation on the Swan Coastal Plain

Floristic analysis (ie., analysis of variation in vegetation based on the species present, rather than description of structural variation and dominance) as a significant component of the understanding of the variation present in the native vegetation of the Swan Coastal Plain dates to Gibson *et al* (1994 – all references to the SCP survey in the current report refer to this publication), the first publication to document the floristics of the vegetation of a large part of the Swan Coastal Plain. While the SCP survey is based on a very significant amount of work, it must be viewed as a “first pass” survey, limited, in the context of the great variety of vegetation present in the very large area surveyed, by the relatively limited number (509) of sites (quadrats) it is based on. To a limited degree, this limitation has subsequently been addressed in an “update” to the work of the SCP survey (which describes additional units). However, there is no detailed publication of the results of this update available and the additional data used are not readily available in an appropriate form (ie., one that would enable ready comparison of new data to the overall data set).

The units described by the SCP survey are a series of “floristic community types”, a “unit” whose rank is defined by the use within a study. The SCP survey surveyed a very large survey area and defined a relatively small number of floristic community types. Consequently, the floristic community types they have described are of a very high order (see Trudgen 1999, volume 1, for further discussion of this point). This is an extremely important point to fully grasp in interpreting the analysis presented by the SCP survey and in understanding the meaning of analysis of other data sets when they are compared to the floristic community types of the SCP survey.

The important effects of the limited size data set used by the SCP survey and of the relatively small number of floristic community types defined by them, can be summarised by the following points:

1. the definition of all but two of the Threatened Ecological Communities for vegetation on the Swan Coastal Plain (English and Blyth 1997) has been based on the floristic community types of the SCP survey. It therefore follows, that with two exceptions, only vegetation units from one study that are different at a very high order of floristics are treated as rare by Government. No account is taken of other important differences, such as differences in structure and dominance;

2. for the definition of floristic community types to be robust, a sufficient sized database is needed to give adequate precision in their definition. About half of the floristics community types (or sub types) of the SCP survey are based on less than 10 sites. It is likely that with a larger data set there would be significant alteration in the classification of those floristic community types from the SCP survey based on small numbers of sites.
3. as noted above, many (if not most) of the floristic community types defined by the SCP survey are very broad. They contain very significant variation in floristics, structure and dominance. Some (or in more highly cleared parts of the Swan Coastal Plain much) of this variation may be rare by any reasonable definition, but it is currently “buried” within larger groups;
4. there is likely to be significant variation not sampled by the SCP survey. This includes some variation at a high level of floristic difference (see Trudgen 1999, volume 1, for an example of this) and undoubtedly quite significant (large!) amounts of variation at “medium” and “low” levels.
5. the document, and its use by Government, has focussed attention in the environmental impact assessment process on the high level of units described, deflecting attention from the layers of variation beneath these units that also have significant conservation value.

From these points it is obvious that there is a need for a major “upgrade” to the floristic analysis of the vegetation of the Swan Coastal Plain to provide a more detailed floristic classification that considers not only more of the variation present, but explicitly recognises more of the variation present in formally described units.

Obviously, such a reworking would have some effect on what vegetation is considered rare on the Swan Coastal Plain. It needs to be stressed that it would be very unlikely to find that any of the vegetation currently considered to be rare on the basis of the SCP survey’s classification was not rare. On the other hand, it is likely that such a review would very probably consider to be rare some vegetation which is not currently considered rare.

1.4 Data provided

It is very important in comparing different sets of floristic data that they are comparable in the application of names, in the intensity of the survey (ie., the effort of searching resulting in similar proportion of the flora at sites being recorded) and in the size of the site recorded. If the data from different data sets is not comparable in these ways, it reduces the clarity of the results of the analyses carried out. If the discrepancy in the comparability of the data sets is large, the results may become meaningless.

The releves had about a quarter the number of species recorded in the quadrats provided. Thus, an analysis with the releves is unlikely to provide reliable interpretation. While preliminary scanning suggested that the quadrats appeared to have a reasonable number of species, an inspection of the Appendix suggested that there were probably a number of small generally annual species that may have been not recorded. These include species from *Triglochin*, *Isolepis*, *Parietaria*, *Calandrinia*,

Stellaria, Apium and Hydrocotyle. If true, there will be some influence on the interpretation by recording quality.

2.0 METHODS

2.1 Data Preparation

The data from the Jindalee quadrats and releves were provided in a spreadsheet table. These were incorporated into a standard MS Access based database designed for this type of data. One virtue of the database is that the species recorded at each site are stored against standard codes (numbers, those used by the Western Australian Herbarium) for each species. This facilitates ready comparison of data from different surveys stored in the same system.

After the data were incorporated into the database, a process of reconciliation of flora species names with those used in the SCP survey was undertaken. This step was necessary at least because of changes in nomenclature over the last ten years and the potential of survey specific variations in the application of names. The reconciliation involved:

- reducing some infra-specific names to the relevant species name, and
- combining some taxa where confusion is known to have occurred in field observations and identifications.

The reconciliation process was relatively straight forward as most of the names had already been standardised. Most reconciliation was to conform with the methods that the SCP survey used to manage confusing taxa plus some nomenclatural changes.

2.2 Comparability of datasets

It was concluded that the quadrat datasets were probably reasonably compatible in nomenclature but there appeared to be few taxa overlooked in the quadrats and many in the releves.

2.3 Comparisons made

Two separate data sets were analysed; one with quadrats and one with quadrats and releves. This was because it was feared that the presence of the (poor quality) releves might disrupt the classification and increase the difficulty in making a fair interpretation of the quadrats. The analysis of both was only to provide an indication of what the releves might relate to.

The data therefore from the four quadrats plus the 509 sites from the SCP survey of the southern part of the Swan Coastal Plain (south of Gingin) were combined. This enabled various analyses to be performed.

The main purpose was intended to assign the individual sites to the Floristic Community Types (FCTs) defined in the SCP survey. These data are provided in BBG_JIN.mdb.)

2.4 Analyses carried out

The approach was the use of numerical classification techniques (PATN) based on the similarity of the floristic composition of the Jindalee quadrats (or releves) to sites in the SCP survey data set.

2.4.1 PATN

Several modules of the numerical classification package PATN (Belbin 1987) were used for the analyses. The parameter values were the same as used by the SCP survey used to ensure consistency of analysis with that study.

The PATN modules used were ASO (calculation of similarity matrix), FUSE (classification based on the results of ASO), DEND (representation of classification) and NNB (determination of sites most similar to each site – nearest neighbours). The results of the analyses were imported into a database (BBG_JIN.mdb) so that site characteristics and previous classifications (eg., Floristic Community Types derived in earlier classifications) could be associated and various analyses based on these data could be performed.

The assignment of floristic community types to the Jindalee quadrats was made by summarising the results of two different methods:

- the classification, and
- the ten nearest neighbours.

Experience demonstrates that the results of these are likely to vary, but that from nearest neighbours is likely to make more sense for it is not directly influenced by group membership.

To the classification dendrogram of the combined dataset the FCT assigned by the SCP survey was associated with the SCP survey sites. The apparent FCTs were assigned to the Jindalee quadrats by interpreting the position of these sites in the dendrogram (particularly by the way they joined to the SCP sites).

The 10 sites in the combined data set that were most similar to each of Jindalee quadrats were obtained from the nearest neighbour method (NNB). By associating those nearest neighbours from the SCP survey, the most likely FCTs for each of the Jindalee quadrats were determined.

An attempt was then made to reconcile these different assignments of a Floristic Community Type.

3.0 LIMITATIONS

It has been found in earlier projects that the addition of new sites to the SCP survey data set to produce a combined classification disrupts the original classification. The more data added, the higher the level of the disruption. This problem can make it difficult to assign Floristic Community Types to new sites using this method.

Secondly, it is common for new data to group to their cohorts. In some cases this has proven to result from common deficiencies in the data, ie. whole groups of species missing. This absence tend to draw them together. The more sites in the added batch, the tighter they draw together.

The analyses are conducted without personal knowledge of the sites and no photographs were provided.

4.0 RESULTS

4.1 Determination of floristic community type by classification

The emphasis in the interpretation is on the quadrats. A brief presentation is made at the end on the results from the releve analysis.

The classifications indicated that the quadrats appeared to be the same plant community being located in one part of the dendrogram (Figure 1)

Figure 1. Relevant portions of Dendrogram

			05/23/05 05:50:50.96 dend Jindalee SCP Sites 22May05					
			0.2050	0.3656	0.5261	0.6867	0.8472	1.0078
BURN-1	29a	41						
SEAB-8	29a	47						
Jin1		34						
SEAB-4	29a	63						
SEAB-5	29a	56						
NAVB-2	29a	50						
Jin2		40						
Jin3		46						
Jin4		41						
BURN-2	29a	25						

This portion of the dendrogram includes 6 of the 9 SCP quadrats assigned to 29a. This indicates that the presence of the Jindalee sites had a disruptive effect on the classification. The Jin1 grouped with bulk of 29a. Jin2, 3 and 4 appeared a bit removed from 29a, but so did the SCP site BURN-2.

4.2 Determination of floristic community type using Nearest Neighbour method

The nearest neighbour analysis suggests that the quadrats belong to different communities even though they were more similar to each other than any other sites by a modest amount. Some of the similarity values for sites from the SCP data sets were low enough (values less than about 0.55) to give confidence in the analysis (Table 1).

The similarity of the Jindalee quadrats with the FCT quadrats is generally lower than would allow confident assignment to a FCT. Jin1 and Jin2 appeared to be probably FCT 29a but is modestly similar to some 29b quadrats. Jin3 appeared related to FCT 29b or 24 and Jin4 appeared related to 24, 29b or 29a. For Jin3 and 4 the similarity values were not as strong to have confidence that they belonged to a particular FCT.

It needs to be appreciated that some SCP quadrats appear transitional between FCTs so some of the above ambiguity is to be expected.

Table 1. Results of Nearest Neighbour analysis

s	s1	v1	s2	f2	v2	s3	f3	v3	s4	f4	v4	s5	f5	v5
Jin1	Jin4	0.4933	BURN-1	29a	0.52	PB-4	29b	0.5313	SEAB-5	29a	0.5333	Jin3		0.55
Jin2	Jin3	0.2791	Jin4		0.3827	BURN-1	29a	0.5062	PB-4	29b	0.5143	PB-3	29b	0.5455
Jin3	Jin2	0.2791	Jin4		0.4253	PB-4	29b	0.5263	MTB-2	24	0.5294	Jin1		0.55
Jin4	Jin2	0.3827	Jin3		0.4253	Jin1		0.4933	MTB-2	24	0.5	BURN-1	29a	0.5366

Table 1 (cont)

s	s6	f6	v6	s7	f7	v7	s8	f8	v8	s9	f9	v9	s10	f10	v10
Jin1	SEAB-2	29b	0.555	SHE-5	26a	0.5696	NWIL-3	29b	0.5775	PB-5	29b	0.5932	Jin2		0.5946
Jin2	SEAB-3	29b	0.552	cool 08	24	0.5676	PB-2	29b	0.5714	cool 02	24	0.5714	NWIL-1	29b	0.5789
Jin3	PB-3	29b	0.555	BURN-1	29a	0.5632	WHILL-1	29b	0.5682	cool 02	24	0.5789	NWIL-1	29b	0.5854
Jin4	cool 08	24	0.573	PB-4	29b	0.5775	NEER-1	24	0.5862	cool 02	24	0.6056	WHILL-5	26b	0.6082

s – the site being compared

s1 to s10 – the 1st to 10th most similar sites

f1 to f10 – the FCT of the similar sites (only for SCP sites)

v1 to v10 – the dissimilarity value between the site and the similar sites (values above 0.6 tend to indicate low similarity)

4.3 Combining the results

It is common for the classification to indicate a simple result and the nearest neighbour analysis to be less conclusive. This is more a product of the classification process than of inconsistency of the analyses.

The different results are quite consistent, however, the message from the nearest neighbour is probably clearer. The quadrats are largely FCT29 and probably 29a from Jin 1 and Jin2. The others are probably closer to 29a but could be 29b or 24.

The apparently unrecorded annual species may have had an influence on the analysis and caution must be taken in using these interpretations.

4.4 Relevés

The relevés had just a minor effect on the classification of the quadrats. This is largely because they were quite different from the quadrats.

All relevés grouped together and ended in a new cluster somewhat related to FCTs 29 and 30. In doing so they draw the BURN-2 quadrat away from 29a. This result is largely not useful except for confirming that they are coastal communities.

The relationship of the relevés to each other is not easy to determine from these analyses. This is hardly surprising as they had so few species.

Figure 2 Relevant portions of Dendrogram for data set including releves

site	FCT	no	data
			05/23/05 05:58:39.31 dend Jindalee SCP Sites all 22May05
			0.2050 0.3656 0.5261 0.6867 0.8472 1.0078
BURN-1	29a	41) _____
SEAB-8	29a	47) _____ _____
Jin1		34) _____ _
SEAB-4	29a	63) _____
SEAB-5	29a	56) _____ _____ _____
NAVB-2	29a	50) _____ _____
Jin2		40) _____
Jin3		46) _____ _____
Jin4		41) _____ _____ _____
NPRES-1	29b	46) _____
WHILL-1	29b	42) _____ _____
NWIL-1	29b	36) _____
NWIL-3	29b	37) _____
SEAB-7	29b	50) _____ _
SEAB-2	29b	47) _____
SEAB-3	29b	45) _____ _____ _____
PB-2	29b	30) _____
PB-4	29b	30) _____ _____
PB-5	29b	25) _____ _
PB-3	29b	26) _____ _____
WHILL-2	29b	21) _____ _____ _
TRIG-1	29b	25) _____ _____ _____
BURN-2	29a	25) _____
JinR1		8) _____
JinR2		8) _____ _____
JinR5		8) _____ _____
JinR4		7) _____ _____
JinR3		10) _____ _____
GARDEN-1	30a	20) _____

5.0 REFERENCES

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APPENDIX

Tabulation of Species by Quadrats for Jindalee Quadrats and selected ones from SCP selected from Dendrogram (Figure 1)

FCo de	name	BURN-1	SEAB-8	Jin1	SEAB-4	SEAB-5	NAVB-2	Jin2	Jin3	Jin4	BURN-2
026	Triglochin calcitrapum		Y			Y					
026	Triglochin trichophorum		Y								
031	Aira caryophyllea/cupaniana group	Y			Y						
031	Austrodanthonia acerosa		Y								
031	Austrodanthonia occidentalis				Y	Y					
031	Austrostipa flavescens	Y	Y	Y	Y	Y	Y	Y	Y		Y
031	Avena barbata/fatua						Y			Y	
031	Briza maxima						Y				
031	Bromus arenarius				Y			Y	Y	Y	
031	Bromus diandrus	Y	Y	Y		Y	Y	Y	Y	Y	
031	Bromus rubens							Y			
031	Catapodium rigidum	Y		Y			Y	Y	Y	Y	
031	Ehrharta longiflora	Y	Y							Y	Y
031	Lagurus ovatus	Y	Y				Y				
031	Lolium rigidum						Y				
031	Poa drummondiana				Y	Y					
031	Poa poiiformis/porphyroclados	Y	Y		Y	Y	Y				
031	Poa serpentum			Y				Y	Y	Y	
031	Sporobolus virginicus										Y
031	Vulpia bromoides								Y		
031	Vulpia myuros	Y	Y		Y			Y			
032	Carex preissii					Y					
032	Isolepis cernua						Y				
032	Isolepis marginata	Y			Y						Y
032	Isolepis nodosa						Y				Y
032	Lepidosperma angustatum/squamatum				Y						
032	Lepidosperma sp. (Coastal terete BJK &			Y						Y	
032	Lepidosperma squamatum							Y	Y	Y	
039	Desmocladus flexuosus	Y		Y	Y	Y	Y	Y	Y	Y	
054C	Acanthocarpus preissii	Y	Y	Y	Y	Y	Y		Y		
054C	Lomandra maritima	Y		Y	Y	Y	Y	Y	Y	Y	
054D	Xanthorrhoea preissii									Y	
054E	Dianella revoluta				Y						
054F	Thysanotus arenarius				Y						
054F	Thysanotus patersonii/manglesianus		Y	Y	Y	Y			Y		
054F	Thysanotus sparteus					Y					
054F	Tricoryne elatior	Y				Y		Y		Y	
054G	Trachyandra divaricata				Y	Y					
054J	Wurmbea dioica								Y		
055	Conostylis aculeata	Y						Y	Y	Y	Y
055	Conostylis pauciflora		Y		Y	Y		Y			
060	Romulea rosea	Y					Y	Y	Y	Y	
066	Caladenia latifolia				Y	Y					
066	Monadenia bracteata						Y				
088	Parietaria debilis	Y	Y		Y	Y					
090	Dryandra nivea					Y	Y				
090	Dryandra sessilis			Y							Y
090	Grevillea thelemanniana subsp. preissii					Y	Y		Y		
092	Santalum acuminatum				Y						
105	Rhagodia baccata subsp. baccata	Y	Y	Y	Y	Y	Y			Y	

105	Threlkeldia diffusa		Y			Y	Y					
110	Carpobrotus edulis						Y					
110	Carpobrotus virescens					Y						Y
110	Tetragonia decumbens						Y					
111	Calandrinia calyptata		Y		Y		Y					
111	Calandrinia corrigioloides				Y							Y
111	Calandrinia liniflora				Y						Y	
113	Arenaria serpyllifolia	Y										
113	Cerastium glomeratum	Y			Y	Y	Y				Y	
113	Minuartia hybrida								Y	Y		
113	Petrorhagia velutina						Y		Y	Y		
113	Sagina maritima					Y	Y					
113	Silene gallica						Y					
113	Stellaria media						Y					Y
131	Cassytha aurea				Y							
131	Cassytha flava								Y	Y		
131	Cassytha glabella				Y							
131	Cassytha racemosa				Y	Y	Y	Y				Y
138	Heliophila pusilla				Y	Y			Y	Y	Y	
138	Lepidium rotundum		Y									
138	Stenopetalum robustum				Y							
149	Crassula colorata	Y			Y	Y	Y	Y	Y	Y		Y
149	Crassula glomerata	Y	Y	Y				Y	Y	Y	Y	Y
149	Crassula peduncularis						Y					
163	Acacia cyclops	Y				Y				Y		
163	Acacia lasiocarpa		Y			Y						
163	Acacia saligna								Y	Y	Y	
163	Acacia truncata				Y							
165	Chorizema varium				Y	Y						
165	Gompholobium tomentosum				Y	Y			Y	Y		
165	Hardenbergia comptoniana	Y	Y	Y	Y	Y				Y		Y
165	Isotropis cuneifolia									Y		
165	Kennedia coccinea							Y				
165	Kennedia prostrata								Y	Y	Y	
165	Melilotus indicus	Y					Y	Y				
165	Nemcia reticulata	Y	Y			Y	Y	Y	Y			
165	Templetonia biloba		Y									
165	Templetonia retusa	Y			Y	Y	Y					
165	Trifolium arvense						Y					
165	Trifolium campestre				Y							Y
167	Erodium botrys									Y	Y	
167	Erodium cicutarium						Y					
167	Geranium molle				Y							
167	Pelargonium capitatum	Y							Y		Y	Y
173	Zygophyllum fruticulosum		Y									
183	Comesperma confertum				Y							
185	Euphorbia peplus							Y				
185	Phyllanthus calycinus								Y	Y	Y	
185	Poranthera microphylla		Y	Y								
207	Diplopeltis huegelii									Y		
215	Cryptandra mutila								Y			
215	Spyridium globulosum	Y	Y	Y	Y	Y			Y	Y	Y	Y
215	Trymalium albicans					Y	Y					
223	Thomasia cognata		Y				Y					
223	Thomasia triphylla				Y							
226	Hibbertia racemosa								Y	Y		
226	Hibbertia spicata subsp. leptotheca				Y							
236	Frankenia pauciflora							Y				

243	Hybanthus calycinus						Y			
263	Pimelea calcicola			Y						
263	Pimelea ferruginea							Y		
273	Calothamnus quadrifidus									Y
273	Chamelaucium uncinatum					Y				
273	Melaleuca acerosa			Y	Y	Y		Y	Y	Y
273	Melaleuca cardiophylla	Y	Y							
273	Melaleuca huegelii			Y	Y	Y	Y			Y
281	Apium annum	Y					Y			
281	Apium prostratum						Y			
281	Daucus glochidiatus	Y	Y		Y			Y		Y
281	Homalosciadium homalocarpum				Y					
281	Hydrocotyle hispidula		Y		Y	Y				
281	Hydrocotyle tetragonocarpa		Y			Y				
281	Trachymene pilosa	Y	Y	Y	Y	Y		Y	Y	Y
288	Leucopogon insularis							Y	Y	
288	Leucopogon parviflorus	Y	Y	Y	Y		Y	Y	Y	
288	Leucopogon racemulosus				Y					
293	Anagallis arvensis	Y	Y	Y	Y	Y	Y	Y	Y	Y
302	Phyllangium paradoxum		Y							
303	Centaurium erythraea						Y			
307A	Cuscuta epithymum			Y	Y	Y				Y
313	Hemiandra pungens/linearis		Y					Y	Y	
313	Westringia dampieri		Y							
315	Solanum nigrum									Y
316	Bellardia trixago				Y		Y			
316	Dischisma arenarium				Y	Y		Y	Y	Y
316	Parentucellia latifolia				Y					
316	Parentucellia viscosa						Y			
320	Orobanche minor		Y		Y	Y	Y		Y	
326	Eremophila glabra	Y	Y		Y		Y			
326	Myoporum insulare		Y			Y				
331	Galium murale	Y					Y			
331	Opercularia vaginata		Y		Y	Y			Y	
340	Lobelia tenuior									Y
341	Scaevola crassifolia	Y	Y							Y
341	Scaevola thesioides		Y	Y	Y	Y				
343	Stylidium junceum				Y					
345	Gnaphalium indutum		Y							
345	Helipterum corymbosum	Y								
345	Hypochoeris glabra			Y		Y				Y
345	Leptorhynchos scabrus				Y					
345	Millotia tenuifolia				Y	Y				Y
345	Olearia axillaris	Y	Y	Y				Y	Y	Y
345	Podolepis canescens							Y		
345	Podotheca angustifolia		Y							
345	Podotheca gnaphalioides							Y	Y	Y
345	Senecio lautus	Y	Y	Y	Y	Y	Y	Y		
345	Sonchus asper						Y			
345	Sonchus oleraceus	Y	Y	Y		Y	Y			Y
345	Vellereophyton dealbatum						Y			

APPENDIX B

**Tables of Significant Flora from the Broader Alkimos Area
(AS Weston)**

APPENDIX A

Significant Flora with Distributions which may include the Broader Alkimos Area (compiled August 2004 – January 2005)

Introduction

Table A1 lists 12 taxa (species, subspecies, varieties, forms) of Declared Rare and Priority Flora recorded in the broader vicinity of Alkimos, and Table A2 lists 13 other significant taxa (plus four of the Priority Flora taxa listed in Table A1), most of which had been recorded in Alkimos.

Table A1 - Declared Rare and Priority Flora Taxa with Distributions which may include the Broader Alkimos Area (August 2004 - January 2005)

Table A1 also has information about conservation codes of the listed taxa, and localities where they have been recorded and their distributions, growth forms, habitats and flowering times. The basic table was compiled from results of searches of three databases carried out by the Wildlife Branch of Department of Conservation and Land Management in August 2004. These three Department of Conservation and Land Management (CALM) databases are *Threatened (Declared Rare) Flora*, *Declared Rare and Priority Flora List* and *Western Australian Herbarium Specimen (WAHERB)*. The searches were for Declared Rare and Priority Flora taxa. The parameters used for the searches are:

Coordinates:	31 [^] 33'00" - 31 [^] 44'00" and 115 [^] 37'00" – 115 [^] 43 (requested 115 [^] 42'30")
Names:	Alkimos, Clarkson, Burns, Butler, Eglinton (also searched for 'Eglinton'), Jindalee, Merriwa, Mindarie, Quinns, Yanchep

The results of the searches are 13 taxa of Declared Rare and Priority Flora.

The printouts of CALM rare flora database search results provided some information for Table A1 about conservation codes, localities and distributions, plant feature, habitats and flowering times. Additional information for the tables was obtained from examination of herbarium specimens and their labels in the Western Australian Herbarium, consultations with other botanists and information in various publications, principally Paczkowska and Chapman (2000), Atkins (2004), Marchant *et al.* (1987), Olde and Marriott (1995), Brown *et al.* (1998), Hopper *et al.* (1987) and Weston (2003). These references are listed in the report to which this is Appendix A.

The information about distributions, localities, growth forms, habitats and flowering times is not always comprehensive. For instance, the localities are often selections and do not include all of the localities given for a listed species in the CALM printouts, which are often, if not usually, also only selections. Information about habitat and growth form is at least indicative and should be useful in assessing how likely rare flora is to occur in particular habitats and at particular locations in the Alkimos study area and distinguishing it in the field.

Table A2 - Significant Flora which have been recorded in the Alkimos (and Eglinton) Area

Table A2 is based upon the Significant Flora Legend list of 17 taxa that is on ATA Environmental (2004) vegetation maps of Alkimos and Eglinton, and it lists the numbers used there to indicate locations on the maps where these taxa were recorded. The table gives *Bush Forever* significance codes for the 11 of the taxa that are listed in Table 13 of *Bush Forever* (Volume 2, pp. 51-55). The table also has three other taxa that are listed in the *Bush Forever* description of Bush Forever Site 397 as significant ("typical of Tamala Limestone taxa": 'limestone taxon' in the table) and three other taxa that are listed by Trudgen and Keighery (1990a) as "Species of Particular Interest" ('tk' in the table). Four of the taxa in Table A2 are Priority Flora and are also listed in Table A1.

Discussion

Bush Forever also lists a few other taxa as being significant or as typical of Tamala Limestone, including, on p. 383, *Melaleuca huegelii*, *Jacksonia calcicola* and *Acacia xanthina*, and Trudgen and Keighery (1990a, pp. 10-12, and Appendix 2a in ATA Environmental 2003) and ATA Environmental (2003, pp. 58-60) list a few taxa as “Species of particular interest” and “Other Significant Flora”, respectively.

During field work done for preparation of the ATA Environmental (2004) maps, Bennett (pers. comm. 2005) recorded 16 of the 17 taxa of significant flora listed in Table A2, including three Priority Flora taxa that are in the results of the CALM database searches. She did not find the *Crassula*.

The name ‘*Grevillea elongata*’ was in the results of the search of the *Declared Rare and Priority Flora List* database, for the name ‘Butler’, but this species was not entered in Table A1 because it is restricted to the Ruabon-Busselton area (Olde and Marriott 1995, Volume 2), including Butler State Forest.

The name ‘*Astroloma microcalyx*’ (P2) should probably not be in Table A1. Though *Astroloma microcalyx* has been a species since 1845, it did not become conservation coded, as Priority Two, until October 2002, after *Astroloma* sp. Yalgorup had been submerged into *Astroloma microcalyx*. Apparently, by oversight, the conservation code of *Astroloma* sp. Yalgorup was transferred to *Astroloma microcalyx*. *Astroloma microcalyx* has been much better collected south of Fremantle, especially in the Yalgorup area, since 1997, when Trudgen (1997) wrote that it had not previously been recorded south of the Fremantle area.

The name ‘*Thomasia triloba*’ should not be Table A1 either. Its inclusion in the results of the CALM rare searches is based upon misidentified collections of *Thomasia triphylla* from the Yanchep area. *Thomasia triloba* is restricted to very few areas on the south coast (Bennett pers. comm. 2005).

Bush Forever (2000, Volume 2, pp. 51-57) describes ways in which flora may be significant and lists, in the publication’s Table 13, 178 vascular plant taxa (species, subspecies, varieties and forms) in the Swan Coastal Plain part of the Perth Metropolitan Region which are considered to be significant. These are considered significant because they are rare, poorly known or restricted in distribution or for reasons related to aspects of geographical variation or limits and regional ecological preferences. The taxa listed include Declared Rare Flora and Priority Flora taxa. Also, in descriptions of some individual Bush Forever sites, *Bush Forever* lists some taxa not in Table 13 as significant, for instance taxa that are typical of limestone.

Atkins (2004) lists all taxa in Western Australia currently designated as Priority and Declared Rare Flora and gives definitions of the various categories of Declared Rare and Priority. Department of Conservation and Land Management databases can be searched to provide listings of Priority and Declared Rare Flora for specific areas defined by sets of coordinates or by locality names.

ATA Environmental (2004) draft maps of vegetation units of the Alkimos and Eglinton areas list 17 significant species and indicate locations where 16 of them were found during the spring 2004 field work by Eleanor Bennett.

ATA Environmental (2003, pp. 39, 40, 42) recorded two taxa of Priority Three flora in limestone heath vegetation in ROS Amendment Area 5, but only in the vegetation type that ATA Environmental identified as corresponding to FCT 26a, MhMsAt. *Styloidium maritimum* was recorded by ATA only in their westernmost population of MhMsAt, outside of the buffer zones study area. *Hibbertia spicata* subsp. *leptotheca* plants were recorded by ATA Environmental in all three of their hilltop populations of *Melaleuca huegelii*, one of which is partly just inside the Site A buffer zone study area.

Trudgen and Keighery (1990) consider the *Stylidium* and eleven other taxa they found in Alkimos to be of particular interest. One of these 11, *Conostylis pauciflora* subsp. *euryrhipis*, is now Priority Flora (Priority 3) but appears to be largely restricted to Quindalup Dunes. The other taxa appear also to have been found in sandy habitats, and most appear to be of interest for taxonomic reasons, because they are rare or uncommon in Alkimos or because they are at the northern or southern ends of their distributions. Two of the 11, *Veronica* aff. *calycina* and *Petrophile serruriae* subsp. nov., are listed in Table 13 (*Bush Forever* 2000, Volume 2) as significant.

Definitions of Conservation and Significance Codes

CONSERVATION CODES

A summary of Department of Conservation and Land Management definitions of their DECLARED RARE AND PRIORITY FLORA LIST Conservation Codes (Atkins 2004), used in Table A1, is given below.

- R: Declared Rare Flora – Extant Taxa
Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such.
- 1: Priority One – Poorly Known Taxa
Taxa which are known from one or a few (generally <5) populations which are under threat, . . . Such taxa are under consideration for declaration as ‘rare flora’, but are in urgent need of further survey.
- 2: Priority Two – Poorly Known Taxa
Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat, . . . Such taxa are under consideration for declaration as ‘rare flora’, but are in urgent need of further survey.
- 3: Priority Three – Poorly Known Taxa
Taxa which are known from several populations, and the taxa are not believed to be under immediate threat, . . . Such taxa are under consideration for declaration as ‘rare flora’, but are in need of further survey.
- 4: Priority Four – Rare Taxa
Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5-10 years.

SIGNIFICANCE CODES

A summary of *Bush Forever* (2000, Volume 2, pp. 51-55, Table 13) definitions of the Significance Codes used in Table A2 is given below. Some other taxa are listed in *Bush Forever* Site descriptions of Significant Flora, some of which are “typical of Tamala Limestone taxa” (‘limestone taxon’, ‘It’). Others are just ‘significant’.

- P2, P3 Priority 2 and 3: Poorly Known Taxa
e taxa endemic to the Swan Coastal Plain
p considered to be poorly reserved
r populations at the northern or southern limit of their known geographic range
s significant populations
X considered lost in the Perth Metropolitan Region

Other significance codes used in this report are:

- It limestone taxon, typical of Tamala Limestone taxon
tk not listed in *Bush Forever* (2000), but listed in Trudgen and Keighery (1990a; Section 3.4 Species of particular interest); also see ATA Environmental (2003, pp. 58-60).

Table A1 - Declared Rare and Priority Flora Taxa with Distributions which may include the Broader Alkimos Area (August 2004 - January 2005)

WA-HERB	Threat. Flora	DRF & Priority Flora	Species	Family	Cons. Code	Distribution and Localities	Growth Form. Habitat(s).	Flowering Times
1	-	x	<i>Astroloma microcalyx</i> * EPACRIDACEAE		P3	Yanchep - Yalgorup NP, Cervantes	Erect or straggling shrub 0.2-0.6 m tall; fls red, white. Sand over limestone.	Jun-Sep
3	-	-	<i>Comesperma acerosum</i> POLYGALACEAE		P3	Alkimos, Eneabba, Gairdner Range, Badgingarra, Lancelin	Glabr, rigid, erect peren. herb or shrub ~0.5 m tall; lvs linear, erect, pungent, strongly keeled; fls blu, ppl or ppl-red, keel petal horned. Sand over limestone, lateritic gravelly soils, sandplains, lateritic ridges. Alkimos area: dense coastal heath, mainly on limestone ridge slopes; collected in Nov 1996 by ecologia.	Sep-Dec
-	-	x	<i>Conostylis bracteata</i> HAEMODORACEAE		P3	Yanchep, Perth - Lancelin	~ to <i>C. pauciflora</i> (and to <i>C. aculeata</i> ssp. <i>cygnorum</i>) w. hybrids, but robust & <i>C. b.</i> stems are longer, to 20 cm, and lvs longer, 20- 50 cm, and wider, 4-10 mm. Coastal heath on sand, "usually in well-watered depressions in undulating dunes close to limestone" (Hopper <i>et al.</i> 1987, p. 74).	Jul-Sep
2	-	x	<i>Conostylis pauciflora</i> subsp. <i>euryrhypis</i> HAEMODORACEAE		P3	Alkimos, Yanchep-Cervantes, Lancelin, Seabird	Stoloniferous much-branched herb; infl capitulate cymose; fls yl, <10; scape simple, = or > lvs. ~ to <i>C. aculeata</i> but lvs narrower (<2.5 mm), 6-18 (-35) cm long, green, sword-shaped, in flattened broadly fan-shaped clusters, with soft, short, tomentose, fewer marginal bristles.	Jul-Oct
1	2	x	<i>Eucalyptus arguta</i> MYRTACEAE		R V.V	Yanchep-Jurien, W of Lake Clifton	"Common in heath on consolidated dunes between Cervantes and Yanchep" (Hopper <i>et al.</i> 1987, p. 80). Yanchep Mallee. To 3 m tall; lvs thick, glossy; buds 7-11; frs ribbed.	Mar-Apr
-	-	x	<i>Grevillea evanescens</i> PROTEACEAE		P1	Yanchep, Gingin-Lancelin, , mainly ~W of Gingin	Over heath, on shallow sand on limestone ridges and slopes.	
1	-	-	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> DILLINEACEAE		P3	Alkimos, Yanchep, Lancelin - Yalgorup NP, Burns Beach	Erect, 1-stemmed shrub to 4 m tall; lvs simple, 3-4 cm by 4-9 mm, entire, shortly mucronate, veins evident; fls on short, axillary side branches, 8-12, red, styles long, green-tipped. cf. <i>G. obtusifolia</i> . Brown calcareous Spearwood sandy soils on ridges in banksia woodland. Sometimes with <i>G. preissii</i> .	winter, spring -Oct
-	-	x	<i>Lastopetalum membranaceum</i> STERCULEACEAE		P3	Yanchep-Ludlow	Mound or semi-prostrate small shrub. Mainly limestone heath.	Sep-Nov (Jul-Dec)
-	-	x	<i>Lepidium pseudotasmanicum</i> BRASSICACEAE		P4	Yanchep, Wongan Hills-Esperance, eastern states	Small shrub with cordate leaves. Sand, mainly over limestone and in tuart woodland.	Sep-Dec
-	-	x	<i>Sarcosola bicarinata</i> AIZOACEAE		P3	Alkimos, Yanchep, Lancelin, Esperance, S. Aust. (Eyre Penins)	Herb to 50 cm tall. Various habitats, including tuart forest on sand over limestone.	Oct-Jun
1	-	-	<i>Stylidium maritimum</i> STYLIDIACEAE		P3	Alkimos, Yalgorup - Breton Bay, Cervantes, Nilgen	Small erect or semiprostrate, annual or short-lived perennial shrubs, leaves often dull, dark red, triquetrous and densely covered with small warts or pelucid dots, flowers pale pink to white, styles 5 (to 4). Stabilised dunes or limestone; more common after fire.	Aug
-	-	x	<i>Thomasia triloba</i> STERCULIACEAE		P3	Alkimos, Yanchep, Boranup - Walpole Normalup, Esperance	Tufted triggerplant; lvs narrow lanc., 20-40 cm long, 2-5 mm wide, often reddish in autumn, margins curved but not revolute; infl paniculate, 40-55 cm long (incl scape), densely glandular-pubescent; peduncles 3-6 flowered; corolla rose-pink; ~ <i>S. caricifolium</i> and <i>S. affine</i> but allotropic. White coastal dunes and depressions in limestone; low coastal heath. See Lowrie, Coates and Kenneally (1998).	Sep-Dec

Columns 1 and 2: The numbers refer to numbers of specimen labels (in the first column) or populations (in the second column) in the printouts of CALM database search results.

* *Astroloma microcalyx* should probably not be a Priority species (see **Introduction** for reasons why).

Table A2 - Significant Flora which have been recorded in the Alkimos (and Eglinton) Area

T&K 1990a	BF Site 397	Number on ATA maps	Species	Family	Codes Bush Forever Table 13	Notes	Flowering Times
-	-	3	<i>Allocasuarina lehmanniana</i>	CASUARINACEAE	s	A dominant in two ATA Environmental (2004) vegetation types. Alkimos/Eglinton	?
x	-	9	<i>Conospermum triplinervium</i>	PROTEACEAE	p, s	Alkimos/Eglinton	Aug-Jan
x	x	17	<i>Conostylis pauciflora</i> subsp. <i>euryrhypis</i>	PROTEACEAE	P3, p, s	See Table A1. Listed on ATA Environmental (2004) maps of vegetation types as simply <i>Conostylis</i> sp. <i>C. teretifolia</i> subsp. <i>planescens</i> is in Trudgen and Keighery (1990a), but not <i>Bush Forever</i> , as significant, and as found in <i>Banksia</i> woodland. Alkimos	Jul-Oct
-	-	10	<i>Crassula colorata</i> var. <i>miriamiae</i>	CRASSULACEAE	P2, ?X	Listed in <i>Bush Forever</i> Table 13 as subsp. instead of as var. Listed in tables on ATA Environmental (2004) maps of vegetation types as simply <i>Crassula colorata</i> , but it should have been deleted from there. Distribution given in Atkins (2004) is Perth, Stirling Range.	Aug-Oct?
-	x	15	<i>Diplopeltis huegelii</i> subsp. <i>huegelii</i>	SAPINDACEAE	limestone taxon	Listed in tables on ATA Environmental (2004) maps of vegetation types as simply <i>Diplopeltis huegelii</i> . Ningana (listed in Trudgen and Keighery (1990b), but as <i>Diplopeltis huegelii</i>).	Aug-Nov
x	x	8	<i>Grevillea preissii</i>	PROTEACEAE	limestone taxon	Listed in Trudgen and Keighery (1990a) as <i>Grevillea thelemanniana</i> . Alkimos	Jun-Sep
x	-	16	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i>	PROTEACEAE	P3, p, s, e	See Table A1. Listed in Trudgen and Keighery (1990a) as <i>Hibbertia spicata</i> . Listed in tables on ATA Environmental (2004) maps of vegetation types as simply <i>Hibbertia spicata</i> . Alkimos	Sep-Nov (Jul-Dec)
x	x	7	<i>Lechenaultia linearoides</i>	GOODENIACEAE	p	Alkimos	Mar / Jun-Dec
x	-	6	<i>Leptorhynchos scaber</i>	ASTERACEAE	tk	Listed in Trudgen and Keighery (1990a) as <i>Leptorhynchos scaber</i> and as significant.	Aug-Dec
x	x	13	<i>Melaleuca cardiophylla</i>	MYRTACEAE	r, s	Listed in tables on ATA Environmental (2004) maps of vegetation types as <i>Leptorhynchos scaber</i> . Alkimos	Aug-Jan
x	-	12	<i>Persoonia comata</i>	PROTEACEAE	tk	Listed by Trudgen and Keighery (1990a), but not in <i>Bush Forever</i> , as significant. Possibly Alkimos is at near the south end of its range. Alkimos	Nov-Feb
x	-	1	<i>Petrophile serruriae</i> subsp. nov.?	PROTEACEAE	p, s, r	<i>Petrophile serruriae</i> subsp. nov. (GLK 11421), a pink-flowered form of <i>Petrophile serruriae</i> (the 'subsp.' is not now listed in the MAX database)	Jul-Dec?
x	-	11	<i>Pimelea calcicola</i>	THYMELAEACEAE	s	Listed on ATA Environmental (2004) maps of vegetation types as simply <i>Petrophile serruriae</i> . Alkimos	Sep-Nov
-	-	14	<i>Sarcosoma bicarinata</i>		P3, p, s	See Table A1. Listed in tables on ATA Environmental (2004) maps of vegetation types as <i>Carpobrotus</i> sp. Alkimos	Aug
x	-	2	<i>Styliidium aff. repens</i>	STYLIDIACEAE	tk	Listed in tables on ATA Environmental (2004) maps of vegetation types as simply <i>Styliidium repens</i> . Alkimos	Jan-Dec?
x	x	5	<i>Styliidium maritimum</i>		P3, p, s	See Table A1. Listed on ATA Environmental (2004) maps of vegetation types and in Trudgen and Keighery (1990a) as <i>Styliidium maritimum</i> . Alkimos	Sep-Dec
x	x	4	<i>Trymalium ledifolium</i> var. <i>ledifolium</i>	RHAMNACEAE	limestone taxon	Listed in tables on ATA Environmental (2004) maps of vegetation types as <i>Trymalium ledifolium</i> var. <i>ledifolium</i> , and in Trudgen and Keighery (1990a) as <i>Trymalium albicans</i> , "a species of particular interest". It is not in the current MAX database; it has been synonymised with <i>Trymalium ledifolium</i> var. <i>ledifolium</i> . Alkimos	Jul-Nov

Columns 2: Listed in *Bush Forever* description of Bush Forever Site 397 as significant there. 3: The Eleanor Bennett and Significant Flora Legend number on the ATA Environmental (2004) Workplans 2a and 3a. 5: 'tk' = not listed in *Bush Forever* (2000), but listed in Trudgen and Keighery (1990a); Section 3.4 Species of particular interest.

APPENDIX B

Limestone Floristic Community Types Species Table

Table B1 - Taxa to use in distinguishing FCTs 24, 26a, 26b and 27 from each other and other FCTs

(from Gibson *et al.* 1994, Table 12 (pp. 31, 35, 36), pp. 43-46 and Appendix 1; Note: this information may have been updated, though not printed or available, since 1994)

Taxon Name	Species Group	Family	Form	Taxa Frequencies in Plots of Floristic Community Types							Number of other FCTs / = (referred to in Gibson <i>et al.</i> (1994) as:)
				24	26a	26b	27	29a	29b	other highest	
<i>Acacia lasiocarpa</i> var. <i>lasiocarpa</i>	A	163	Sh vs	28	82	16	57	22	85	30c: 67	+ 7 other FCTs (incl. 19: 33)
<i>Acacia rostellifera</i>	A	163	Sh m-t	32	9	16	--	11	54	30b: 38	+ 2 other FCTs (19: 33; 30a: 29)
<i>Acacia truncata</i>	A	163	Sh s	8	36	--	86	--	15	--	in no other FCT
<i>Acanthocarpus preissii</i>	A	054C	He p	40	--	16	--	78	85	30b: 75	+ 4 other FCTs
<i>Astroloma microcaryx</i>	A	288	Sh vs	--	36	16	100	--	8	--	in no other FCT
<i>Austrostipa compressa</i>	Q	031	Gr p	--	55	42	--	--	--	20c: 78	+ 10 other FCTs / = <i>Stipa compressa</i>
<i>Austrostipa flavescens</i>	A	031	Gr p	56	91	42	--	78	92	30b: 63	+ 8 other FCTs / = <i>Stipa flavescens</i>
<i>Conostylis candicans</i>	A	055	He p	24	18	37	--	22	62	30c: 33	+ 2 other FCTs (28: 26; 30a: 14)
<i>Desmodioides flexuosus</i>	Q	039	He p (gr)	72	100	79	100	44	92	21a: 69	+ 15 other FCTs / = <i>Loxocarya flexuosa</i>
<i>Dianella revoluta</i>	A	054E	He p	56	--	32	14	11	8	30c: 100	+ 13 other FCTs
<i>Dryandra sessilis</i>	A	090	Sh t	28	91	42	29	11	--	30c: 67	+ 2 other FCTs (28: 11; 30a: 14)
<i>Grevillea preissii</i>	A	090	Sh vs	40	100	32	100	22	--	30a: 14	+ 28: 3 / = <i>G. thelemanniana</i> subsp. <i>preissii</i>
<i>Hibbertia spicata</i> subsp. <i>leptotheca</i>	A	226	Sh vs	12	9	--	71	11	15	--	in no other FCT
<i>Leucopogon parviflorus</i>	A	288	Sh m	48	64	37	86	67	62	18: 100	+ 7 other FCTs
<i>Lomandra maritima</i>	A	054C	He p (gr)	64	45	37	86	44	92	19: 13	+ 2 other FCTs (30a: 14; 28: 8)
<i>Melaleuca huegelii</i>	A	273	Sh m-t	12	82	11	29	44	--	30a: 14	in no other FCT
<i>Melaleuca systena</i>	A	273	Sh s-m	52	82	68	100	22	92	30a: 14	+ 7 other FCTs / = <i>Melaleuca acerosa</i>
* <i>Petrorhagia dubia</i>	A	113	He a	68	9	26	--	11	--	25: 91	+ 5 other FCTs / = <i>Petrorhagia velutina</i>
<i>Phyllanthus calycinus</i>	A	185	Sh vs	56	45	47	--	--	62	25: 82	+ 9 other FCTs
<i>Rhagodia baecata</i>	A	105	Sh s-m	20	45	21	--	78	77	30b: 88	+ 5 other FCTs
<i>Spyridium globulosum</i>	A	215	Sh m-t	4	9	16	29	78	46	30: >85	(30a: 86, 30b: 100, 30c: 100) + 25: 9
<i>Syridium maritimum</i>	A	343	He p (gr)	--	73	5	--	--	8	--	in no other FCT
<i>Templetonia retusa</i>	A	165	Sh m	20	64	16	86	33	8	30c: 67	+ 4 other FCTs
* <i>Trachyantha divaricata</i>	A	054G	He	4	--	5	--	22	--	30b: 63	+ 2 other FCTs (30a: 57; 25: 9)
<i>Trymalium ledifolium</i> var. <i>ledifolium</i>	A	215	Sh s-m	4	91	11	71	22	8	30a: 14	+ 1 other FCT (28: 3) / = <i>T. albicans?</i>
* <i>Vulpia myuros</i>	Q	031	Gr a	24	100	47	--	44	--	18: 50	+ 17 other FCTs

* Alien sp. **Form:** Gr (grass), He (herb), Sh (shrub), a (annual), p (perennial), gr (graminoid), vs (very small: <0.5m), s (small: 0.5-1m), m (medium: 1-2m), t (tall: 2-4m), vt (very tall: >4m)
FCT 26a *Melaleuca huegelii* - *M. acerosa* shrublands of limestone ridges (Spearwood)
FCT 27 Species poor mallees and shrublands of limestone (mainly Yalgorup area) (Spearwood)
FCT 29a Coastal shrublands on shallow sands (over limestone: Quindalup)
FCT 30a *Callitris preissii* (or *Melaleuca lanceolata*) forests and woodlands (Perth, Quindalup)
FCT 30c Other mallees & scrubs (Quindalup-Spearwood) (on Spearwood dunes: only three plots [*Encalyptus argutifolia* and 2 *Dryandra sessilis* plots], near Swan estuary)

APPENDIX C

Quadrat and Relève Data

PLOT AND RELEVÉ RECORDS FOR LOT 10 JINDALEE

Jin1

50J 0374806

UTM 6498513

Gentle midslope above limestone cliff.

Soil: Dark brown sand with organic matter.

Bare ground: 10%. Limestone outcrop possibly 15-20% of surface.

Condition: Excellent

Vegetation Description

Melaleuca huegelii, *Spyridium globulosum* Closed Heath on shallow limestone.

Species List

Melaleuca huegelii

Spyridium globulosum

Olearia axillaris

Cassytha racemosa forma racemosa

Templetonia retusa

Thomasia triphylla

Dryandra sessilis

Acanthocarpus preissii

Leucopogon parviflorus

Rhagodia baccata subsp baccata

*Geranium molle

Thysanotus patersonii

Crassula glomerata

Calandrinia sp. SW Coastal

*Trifolium campestre

*Anagallis arvensis

*Hypochaeris glabra

Crassulata colorata var colorata

Poranthera microphylla

Senecio pinnatifolius

Hardenbergia comptoniana

Austrostipa flavescens

Poa serpentum

*Sonchus oleraceus

*Bromus diandrus

Desmocladius flexuosus

Scaevola thesioides

Acacia truncata

Melaleuca systema

Jin2

50J 0375530

UTM 6498305

Midslope of stable dune approx 1.4 km from beach.
Soil: Light brown sand.
Bare Ground: 20%
Condition: Very Good – Excellent.

Vegetation Description

Acacia saligna, *Spyridium globulosum*, *Olearia axillaris* Open Heath over
Pelargonium capitatum, *Melaleuca systema* Shrubland over *Lomandra maritima*,
Conostylis pauciflora subsp *pauciflora*.

Species List

Olearia axillaris
Spyridium globulosum
Acacia saligna
**Pelargonium capitatum*
Melaleuca systema
Leucopogon insularis
Hybanthus calycinus
Austrostipa flavescens
Lomandra maritima
Conostylis pauciflora usbsp *pauciflora* P4
**Romulea rosea*
Desmocladius flexuosa
Podotheca gnaphalioides
Trachymene pilosa
**Anagallis arvensis*
Lepidospermum squamatum
Crassula colorata var *colorata*
**Vulpia myuros*
**Bromus arenarius*
**Heliophila pusilla*
Phyllanthus calycinus
**Desmazeria rigida*
**Bromus rubens*
Cassytha flava
Crassula glomerata
Gastrolobium nervosum
Leucopogon parviflorus
Podolepis canescens
Kennedia prostrata

Jin3

50J 0374997
UTM 6498348

Upper northern midslope of stable dune approximately 250 metres from beach.
Soil: White sand.

Bare Ground: 15-20%
Condition: Good – Very Good

Vegetation Description

Spyridium globulosum, *Olearia axillaris* Open Shrubland over *Leucopogon insularis*
Low Open Shrubland over *Lomandra maritima*, *Desmocladius flexuosus* Sedgeland.

Species List

Spyridium globulosum
Olearia axillaris
Leucopogon insularis
Lomandra maritima
Acacia saligna
Leucopogon parviflorus
Thysanotus patersoni
Opercularia vaginata
Hibbertia racemosa
Gastrolobium nervosum
Conostylis pauciflora subsp *pauciflora*
Pimelea ferruginea
Kennedia prostrata
Senecio pinnatifolius
Hardenbergia comptoniana
Acacia cyclops
Diplopeltis huegelii subsp *huegelii*
**Anagallis arvensis*
Phyllanthus calycinus
**Romulea rosea*
Melaleuca systema
Isotropis cuneifolia subsp *cuneifolia*
Crassula glomerata
Trachymene pilosa
Crassula colorata var *colorata*
**Heliophila pusilla*
Desmocladius flexuosus
**Bromus diandrus*
Wurmbea dioica
**Erodium botrys*
**Petrorhagia dubia*

Jin4

50J 0375877
UTM 6498012

Valley floor.
Soil: Grey-brown sand.
Bare ground: 15-20%.

Condition: Good – Very Good.

Vegetation Description

Xanthorrhoea preissii, *Acacia saligna* Open Heath with scattered *Spyridium globulosum* over *Melaleuca systema*, *Leucopogon parviflorus* scattered shrubs over *Lomandra maritima* sedgeland.

Species List

Xanthorrhoea preissii
Acacia saligna
Spyridium globulosum
Melaleuca systema
Leucopogon parviflorus
Rhagodia baccata subsp *baccata*
Lepidosperma ?pubisquameum
**Erodium botrys*
Lomandra maritima
Lepidosperma squamatum
**Pelargonium capitatum*
Calandrinia sp. SW Coastal
Olearia axillaris
**Dischisma arenarium*
Millotia tenuifolia var *tenuifolia*
**Romulea rosea*
**Anagallia arvensis*
Crassula glomerata
**Ehrharta longiflora*
Conostylis aculeata subsp. *aculeata*
**Bromus diandrus*
**Trifolium campestre*
**Hypochaeris glabra*
Trachymene pilosa

RELEVES

JinR1

50J 0375132
UTM 6498005

Melaleuca cardiophylla, *Spyridium globulosum* Closed Scrub over **Anagallis arvensis*, *Trachymene pilosa*, *Desmocladius flexuosus* Open Herbland/Sedgeland.

Spyridium globulosum
Melaleuca cardiophylla
Trachymene pilosa
**Anagallis arvensis*
Desmocladius flexuosus
Ficinia nodosa
**Ehrharta longiflora*
Olearia axillaris

JinR2

50J 0375233

UTM 6497938

Melaleuca cardiophylla, *Acacia rostellifera* Closed Scrub over **Anagallis arvensis*,
Trachymene pilosa, **Ehrharta longiflora* Very Open Herbland/Grassland

Melaleuca cardiophylla
Acacia rostellifera
Spyridium globulosum
Rhagodia baccata subsp *baccata*
Dryandra sessillis
Trachymene pilosa
**Anagallis arvensis*
**Ehrharta longiflora*

JinR3

50J 0375075

UTM 6498065

Spyridium globulosum, *Melaleuca cardiophylla*, *Acacia saligna*, *Olearia axillaris*
Tall Open Heath over *Leucopogon insularis*, *Melaleuca systema* Very Open Shrubland
over *Desmocladius flexuosus*, *Conostylis aculeata* subsp. *aculeata*, *Lomandra*
maritima, *Austrostipa flavescens* Sedgeland/Grassland.

Olearia axillaris
Spyridium globulosum
Melaleuca cardiophylla
Acacia saligna
Leucopogon insularis
Melaleuca systema
Lomandra maritima
Austrostipa flavescens
Conostylis aculeata subsp *aculeata*
**Anagallis arvensis*
Calandrinia sp. SW Coastal

JinR4

50J 0375996

UTM 6498281

Eucalyptus foecunda Woodland.

This site was burnt approx 2-3 years ago and is very degraded.

Eucalyptus foecunda
Anthocercis littorea
Phyllanthus calycinus

*Anagallis arvensis
Spyridium globulosum
Trachymene pilosa
*Pelargonium capitatum

JinR5

50J 0374890
UTM 6498407

Spyridium globulosum, *Olearia axillaris* Open Heath over *Lepidosperma gladiatum*
Very Open Sedgeland over **Bromus diandrus*, **Anagallis arvensis* grassland.

Lepidosperma gladiatum
Spyridium globulosum
Olearia axillaris
Rhagodia baccata subsp baccata
*Bromus arenarius
*Ehrharta longiflora
*Anagallis arvensis
Melaleuca huegelii

APPENDIX D

Condition Scale and Structure Classes

**Vegetation Structure Classes
and
Condition Scale
Tables**

Vegetation Structure Classes (Layers)

These vegetation structure classes are the ones defined and used in *Bush Forever* (2000, Volume 2, Table 11 and p. 493) to describe vegetation in Bush Forever sites, (except that [1] a bracketed name refers to a dominant that has fewer plants and provides significantly less cover than others, and that [2] 'scattered' refers to trees, low trees, tall shrubs and low shrubs that have <2% cover). 'Sedges' are in Table 11 but not on p. 493.

Life Form/ Height Class	Canopy Cover (percentage)			
	100% - 70%	70% - 30%	30% - 10%	10% - 2%
Trees 10-30m	Closed Forest	Open Forest	Woodland	Open Woodland
Trees < 10m	Low Closed Forest	Low Open Forest	Low Woodland	Low Open Woodland
Shrub Mallee	Closed Shrub Mallee	Shrub Mallee	Open Shrub Mallee	Very Open Shrub Mallee
Shrubs > 2m	Closed Tall Scrub	Tall Open Scrub	Tall Shrubland	Tall Open Shrubland
Shrubs 1-2m	Closed Heath	Open Heath	Shrubland	Open Shrubland
Shrubs <1m	Closed Low Heath	Open Low Heath	Low Shrubland	Low Open Shrubland
Grasses	Closed Grassland	Grassland	Open Grassland	Very Open Grassland
Herbs	Closed Herbland	Herbland	Open Herbland	Very Open Herbland
Sedges	Closed Sedgeland	Sedgeland	Open Sedgeland	Very Open Sedgeland

Vegetation Condition Scale

This condition scale is the one used in *Bush Forever* (2000, Volume 2, Table 12 and p. 494) to describe condition of vegetation in Bush Forever sites. Assessment of condition is at least as much of understorey strata as of overstorey.

P	Pristine	No obvious signs of disturbance
E	Excellent	Vegetation structure intact, disturbance affecting individual species [plants?]; weeds are non-aggressive species
V	Very Good	Vegetation structure altered; obvious signs of disturbance
G	Good	Vegetation structure significantly altered by very obvious signs of multiple disturbance; basic vegetation structure or ability to regenerate it is retained
D	Degraded	Basic vegetation structure severely impacted by disturbance; scope for regeneration but not to a state approaching good (sic) condition without intensive management
C	Completely Degraded	Vegetation structure not intact; the area completely or almost completely without native species ('parkland cleared').

**APPENDIX C – THREATENED ECOLOGICAL COMMUNITIES
SURVEY**

**DETERMINATION OF LIKELY PRESENCE OR ABSENCE OF
FLORISTIC COMMUNITY TYPE (TEC/FCT) 26A
IN LOT 10 (JINDEE) JINDALEE**

CITY OF WANNEROO

Prepared for

Ben Hollyock
RPS,
Environmental Management Consultants
Job/Ref No: L07411

(290 Churchill Avenue)
PO Box 465
SUBIACO WA 6904
Tel. (08) 9288 0865, 9382 4744, 0403 790 434
Fax. (08) 9382 1177
Email: hollyockb@rpsgroup.com.au
www.rpsgroup.com.au

Prepared by

Arthur S Weston, PhD
Consulting Botanist
8 Pitt Street
ST JAMES WA 6102
Tel (08) 9458 9738
Email: naomiseg@iinet.net.au

25 March 2008

SUMMARY

On 19 September 2007 A. Weston and M. Henson located two areas on Lot 10 that are more similar than other areas there in terms of vegetation, flora, landform and soil to areas outside of Lot 10 in which the Threatened Ecological Community FCT 26a has previously been recorded. They established two permanent 10 m by 10 m floristic quadrats in the two Lot 10 areas and sampled them floristically on 19 September and 29 November 2007. They identified the sampled plants and listed the identifications for each quadrat.

The PATN analysis and interpretation that was originally expected to be undertaken by E. A. Griffin & Associates had to be replaced by techniques of inferring FCTs because Griffin, when approached to carry out the analysis and interpretation, replied that he was not able to take on new analyses as he would be away and working in Canberra for several months

Techniques of inferring FCTs, especially Methods 7, 10 and 11 listed in Section 3.2, provided results that lead to the conclusion that Lot 10 Quadrats JIN05 and JIN06 are probably not FCT 26a. The results indicate that they are closest to FCT 24 and that they are closer to FCTs 24, 26b, 28 and 29a than they are to FCT 26a.

TABLE OF CONTENTS

	Page
SUMMARY	i
1.0 INTRODUCTION	1
2.0 OBJECTIVES	1
3.0 METHODS	2
3.1 <u>Stages</u>	2
3.2 <u>Inferring FCTs</u>	2
4.0 RESULTS	4
4.1 <u>FCT Inference Method 7</u>	4
4.2 <u>FCT Inference Method 10</u>	5
4.3 <u>FCT Inference Method 11</u>	5
5.0 CONCLUSIONS	5
6.0 LIMITATIONS	5
7.0 ACKNOWLEDGEMENTS	7
8.0 REFERENCES	7

Figure 1 Quadrat Locations Jindee

APPENDIX A Floristic Community Types Tables, Quadrats and Species Lists

**DETERMINATION OF LIKELY PRESENCE OR ABSENCE OF
FLORISTIC COMMUNITY TYPE (TEC/FCT) 26A
IN LOT 10 (JINDEE) JINDALEE**

1.0 INTRODUCTION

Lot 10 (Jindee) Jindalee is a coastal area of approximately 112 ha between Quinns Rocks and Alkimos. It is approximately 2.5 km long at its longest and approximately 1.5 km wide at its widest.

The McArthur and Bartle (1980) description of landforms and soils of Lot 10 is summarised by RPS Bowman Bishaw Gorham (2006) as “mainly Quindalup Dune System units, with smaller areas of Spearwood Dune System units mainly on the eastern side”. RPS Bowman Bishaw Gorham describe and map thirteen vegetation units: mainly heaths and Banksia Low Woodland.

During its spring 2005 study of Lot 10, the RPS Bowman Bishaw Gorham team compiled species lists from four quadrats and five relevés for subsequent PATN analysis by EA Griffin and Associates (RPS Bowman Bishaw Gorham 2006) to determine which Floristic Community Type(s) (FCT) they are most similar to. The analysis concluded that the relevés and quadrats were closer to FCT 29a than to other FCTs.

Because none of the 2005 quadrats (plots) or relevés appeared to be in types of Lot 10 vegetation, landform and soil deemed to be most similar to types in which Threatened Ecological Community (TEC) FCT 26a (*Melaleuca huegelii* – *M. acerosa* shrublands of limestone ridges [Spearwood]), the only TEC that might be represented in Lot 10, has previously been recorded, it was decided to extend the establishment and sampling of plots to such areas.

2.0 OBJECTIVES

The objectives of this supplementary study are to:

- locate the areas on Lot 10 that are most similar in terms of vegetation, flora, landform and soil to areas in which FCT 26a has previously been recorded,
- establish permanent 10 m by 10 m floristic quadrats adequate in number to identify (with PATN analyses) FCTs (as per Gibson *et al.* 1994 and *Bush Forever* 2000) in Lot 10 that are TECs when most, if not all, vascular flora in the quadrats is sampled,
- sample the quadrats and identify and list the species and other taxa in them and near and adjacent to them,
- prepare species lists of the quadrats in forms suitable for PATN analysis by E. A. Griffin & Associates, and
- carry out PATN analyses of the quadrat samples in combination with the dataset of Gibson *et al.* (1994) and interpret the results of the analyses (to be contracted by RPS to E. A. Griffin & Associates).

3.0 METHODS

3.1 Stages

This study was undertaken in the following stages:

Stage 1 Field Work

One day's field work on 19 September, by A. Weston and M. Henson, to:

- search Lot 10 for areas most likely to support FCT 26a,
- set up and sample two permanent 10 m by 10 m quadrats, and
- collect plant specimens as vouchers and for subsequent identification.

Pressing, drying and identifying plant specimens and preparing lists for analysis.

Stage 2 Field Work

One day's field work on 29 November, by A. Weston and M. Henson, to:

- re-sample the quadrats first sampled in September, and
- collect plant specimens as vouchers and for subsequent identification.

Pressing, drying, identifying and labelling plant specimens and preparing lists for analysis.

Stage 3 Analysis and Interpretation

The PATN analysis and interpretation that was originally expected to be undertaken by E. A. Griffin & Associates had to be replaced by techniques of inferring FCTs because Griffin, when approached to carry out the analysis and interpretation, replied that he was not able to take on any new analyses as he would be away and working in Canberra for several months.

Stage 4 Report Preparation

3.2 Inferring FCTs

The most accurate way to determine which floristic community types are in a metropolitan region Swan Coastal Plain study area is to select, sample and analyse Gibson-type, 10 m by 10 m quadrats using the sampling and PATN analysis techniques described by Gibson *et al.* (1994), Keighery (1994) and Griffin (2005a, 2005b). An essential component of these techniques is the compilation of a complete list of species of vascular plants for each quadrat based upon correctly identified plant specimens. This often requires sampling the quadrat more than once.

It should be possible, however, according to Gibson (pers. comm.) and *Bush Forever* (2000, p. 487), to infer, at least tentatively, which floristic community types, at least of the original 43 described by Gibson *et al.* (1994), occur in a study area. Inferences of which FCTs occur

in particular Bush Forever sites have been made from “information on the floristics of the area and the area’s geographic location” (*Bush Forever* 2000, p. 487).

More specifically, inferences can be made by comparing comprehensive lists of species, key species, aerial photography and other information from sites in a study area with:

1. the ‘Thirty Group Classification’ descriptions of floristic community types in Gibson *et al.* (1994, pp. 29-30, 37, 39-45),
2. the sorted two-way table in Gibson *et al.* (1994, Table 12: pp. 31-36), which shows species frequency by community type in Species Groups A through S,
3. the descriptions of community types and maps of locations of their sampling quadrats in Gibson *et al.* (1994, Appendix 1: pp. 74-159),
4. the Table 1 list in Keighery (1997) of floristic community types identified by Gibson *et al.* (1994) plus additional ones identified subsequently by the Department of Environmental Protection (1996 and, specifically, for the Perth Metropolitan Region, *Bush Forever* 2000, Volume 2, pp. 485-486),
5. geomorphologic and land system information about the study area and its vicinity in the 1:50,000 scale Environmental Geology Series maps (e.g. Gozzard 1982 and, in the case of Lot 10 Jindee, the 1:25,000 scale map of McArthur and Bartle 1980) and, to a lesser extent, in the Churchward and McArthur (1980) smaller scale maps,
6. lists of floristic community types, bushland areas and locations of sampling quadrats given in appendices of Gibson *et al.* (1994) and in Keighery (1997),
7. lists of taxa in and descriptions of putative occurrences of FCT 26a and related FCTs,
8. Bushland Plant Survey Recording Sheets for sampled quadrats in similar areas of bushland as near the study area as possible (e.g. in the Weston (2005) and Syrinx (2008) studies),
9. descriptions of Bush Forever sites in *Bush Forever* (2000, e.g. Site 397),
10. the sampling quadrat sites of floristic community types recorded nearest the study area (e.g. in the Weston (2005) and Syrinx (2008) studies), and
11. tabulate occurrences of each species in the quadrat sample list in each of 44 floristic community types and compare the totals (e.g. of the total of 67 species – or more correctly, taxa – recorded in the JIN05 quadrat, one is in FCT 15 and 55 are in FCT 24).

Tables A1 and A2, in Appendix A, were compiled, from Table 12 of Gibson *et al.* (1994), in order to facilitate the comparisons referred to in Method 2 above.

Inferences in Lot 10 relied on most of the techniques listed above, but most heavily on Methods 7, 10 and 11.

Lists and descriptions used in Method 7 comparisons are mainly in Weston and Gibson (1997), Weston (2005) and Griffin (2005a, 2005b, 2008).

Sites looked at for Method 10 comparisons are between Quinns Rocks and Yanchep up to approximately 1 km from the coast, and on limestone at least several kilometres from the coast in Bush Forever Site 381, the Wabbling Hill area and north of Yanchep National Park. The coastal sites have quadrats and releves that were suspected of being FCT 26a before samples from them were analysed and interpreted. They are AL01, EBQ1, EBQ4, EBR1, EBR3 and EBR4 in Alkimos (Weston 2005) and YB01-04, 06-08, 10, YRO5 and YM09 on the southeast side of the town of Yanchep (Syrinx 2008). The second set of sites, all of which are at least several kilometres from the coast, have been analysed and interpreted as FCT 26a or closer to it than to other FCTs.

For Method 11, the taxa in the Lot 10 Quadrats JIN05 and JIN06 were tabulated for 43 Swan Coastal Plain (SCP) FCTs.

4.0 RESULTS

The two sites found in Lot 10 that are closest to Floristic Community Type (FCT) 26a in terms of floristics and substrate are small areas on the lot's highest ridge. One permanent quadrat was established in each of the two areas: Quadrat JIN05 on the eastern slope of the ridge and Quadrat JIN06 on the south side of the track that runs along the crest of the ridge. JIN05 is northeast of the ridge's highest point, shown by Bowman Bishaw Gorham (2001) as approximately 55 m above sea level, and C west of that point. Quadrat JIN05 is between Releve R4 and Plot 4, in Regional Open Space ROS-B, and JIN05 is west of the Regional Open Space, between Releves R4 and R2 (R2, R4, Plot 4 and ROS-B are shown in RPS Bowman Bishaw Gorham 2006, Figure 1). The locations of the two quadrats are shown in Figure 1. Photographs, species lists, location coordinates and other information about JIN05 and JIN06 are given in Appendix A.

The results of tabulations and of comparisons of JIN05 and JIN06 with other, analysed and interpreted quadrats and releves, and their sites, are given below, in Sections 4.1, 4.2 and 4.3.

4.1 FCT Inference Method 7

Inferences from Method 7 comparisons are that JIN05 and JIN06 are less like FCT 26a than is any inland FCT 26a quadrat or any of the four Alkimos quadrats that might be closest to FCT 26a. JIN05 and JIN06 are most similar to Alkimos and Yanchep quadrats analysed and interpreted as being closest to FCT 24, FCT 28 or FCT 29a. Most of the original SCP quadrat samples analysed and interpreted as being FCT 26a are from Yanchep National Park, but not so close to the coast as Lot 10.

The analyses and interpretations by Griffin (2005a, 2005b) of the samples from the Alkimos quadrats and releves are that AL01, EBQ1, EBQ4 and EBR3 are probably closest to FCT 24,

FCT 26A and/or FCT 29a and that EBR1 and EBR4 are probably closest to FCT 24, FCT 29a and/or FCT 29b.

The analyses and interpretations by Griffin (2008) of the samples from the Yanchep quadrats are that most are closest to FCT 24 and the others may be close to FCT 28, FCT 29a or FCT 29b.

4.2 FCT Inference Method 10

On-site observations of near-coastal Alkimos and Yanchep quadrats and relevés listed above and further inland FCT 26a quadrats are that the JIN05 and JIN06 quadrats have substrates and suites of species more like those of FCTs 24, 28 or 29a than of 26a.

4.3 FCT Inference Method 11

The results of tabulations of identified samples of plants (Method 11) in Quadrats JIN05 and JIN06 are listed in tabular form below. Numbers of taxa for each FCT that had forty or more taxa it in at least one of the quadrats are given, and the numbers are given for each quadrat (and FCT) with and without adjacent ('adj': up to 2 m from quadrat) and opportunistic ('opp': slightly further away) taxa.

Quadrat	Total	FCT 24	FCT 25	FCT 26a	FCT 26b	FCT 28	FCT 29a	FCT 29b
JIN05 quad alone	67	51	39	41	46	42	48	37
JIN05 w adj/opp	73	57	42	45	52	46	50	41
JIN06 quad alone	64	45	36	35	37	42	39	31
JIN06 w adj/opp	67	50	38	40	42	45	43	35

In every case, the numbers of FCTs 24, 26b, 28 and 29a taxa are higher than those of FCT 26a.

5.0 CONCLUSIONS

Use of methods to infer FCTs listed above, especially Methods 7, 10 and 11, provides results that lead to the conclusion that Lot 10 Quadrats JIN05 and JIN06 are probably not FCT 26a. The results indicate that they are closest to FCT 24 and that they are closer to FCTs 24, 26b, 28 and 29a than they are to FCT 26a.

Some statements in Gibson *et al.* (1994, pp. 43-45) that support this conclusion are that community type 26 is restricted to large limestone ridges, with 26a on skeletal soils on tops and slopes of the ridges, while types 24 and 29a also include heaths, but generally on deeper soils. Type 29a heaths are mostly on shallow sandy soils over limestone close to the coast, not on skeletal soils, and type 29 is generally on deeper soils.

6.0 LIMITATIONS

The principal limitation to inferring FCTs is that the original set of FCTs was not inferred; it was defined with the use of a particular package of multivariate analyses to sort sets of lists of taxa recorded in plots (quadrats) into a subjectively chosen number of groups and subgroups. The number chosen, 43, “best reflected the scale of pattern seen in the field” (Gibson *et al.* 1994, p. 26). But there are also limitations to using multivariate analysis techniques to assign FCTs. Some of them are discussed below.

Assigning an FCT name to a new quadrat (or, more accurately, a list of taxa recorded in the quadrat: its sample) by analysis requires that, first, the list or data from the new quadrat be combined with the data from the 509 plots in the original SCP survey of the southern part of the Swan Coastal Plain (Gibson *et al.* 1994). Then PATN analyses, using the parameter values used in the original SCP survey, are done to assign the new sample, or samples, to one of the original FCTs (Griffin 2005a, 2005b, 2008 gives more details on the techniques and packages used).

Gibson *et al.* (1994, p. 26) intended that the original Thirty Group (plus 13 subgroups) classification would have new FCTs added to it, and though new FCTs have been defined, they have not been incorporated into the dataset, at least in a form that can include them in analyses of new quadrats. Consequently, as Griffin (2005a) complains, “for the definition of floristic community types to be robust, a sufficient sized database is needed to give adequate precision in their definition. About half of the floristic community types (or sub types) of the SCP survey are based on less than 10 sites. It is likely that with a larger data set there would be significant alteration in the classification of those floristic community types from the SCP survey based on small numbers of sites.”

The Griffin (2005a, 2005b) reports attached to Appendix B of Weston (2005) note difficulties of assigning FCTs with PATN analyses and provides reasons for the difficulties. The assigning of FCTs to the Alkimos quadrat and releve samples are examples of the difficulties. Griffin states that “AL01 is probably close to FCT 29a or 26a, the data can not distinguish. . . . EBQ1 is probably closest to 26a. It is drawn into 29a because of its similarity to AL01 but is probably not 29a. . . . EBR3 and EBQ4 are probably closest to either 26a or 24. . . . EBR4 appears to be somewhere between 29a and 29b. Assignment of FCT for EBR1 is less clear cut. It is drawn to 29a by its similarity to EBR4. It otherwise appears to be related to FCT 24.”

Commonly PATN classification gives simple results while nearest neighbour analyses tend to be less conclusive, a result more of the classification process itself than of inconsistency of analyses. Furthermore, “addition of new sites to the SCP survey data set to produce a combined classification disrupts the original classification. The more data added, the higher the level of the disruption. This problem can make it difficult to assign Floristic Community Types to new sites using this method.” Also, “it is common for new data to group to their cohorts. In some cases this has proven to result from common deficiencies in the data, i.e. whole groups of species missing. This absence tends to draw them together. The more sites in the added batch, the tighter they draw together.”

7.0 ACKNOWLEDGEMENTS

The assistance of R. Davies, M. Hislop, F. Obens, C. Tauss and others in helping to identify specimens and of S. Santich for providing information about Yanchep quadrats is gratefully appreciated.

Access to the Western Australian Herbarium collections was essential for carrying out the survey and is also greatly appreciated.

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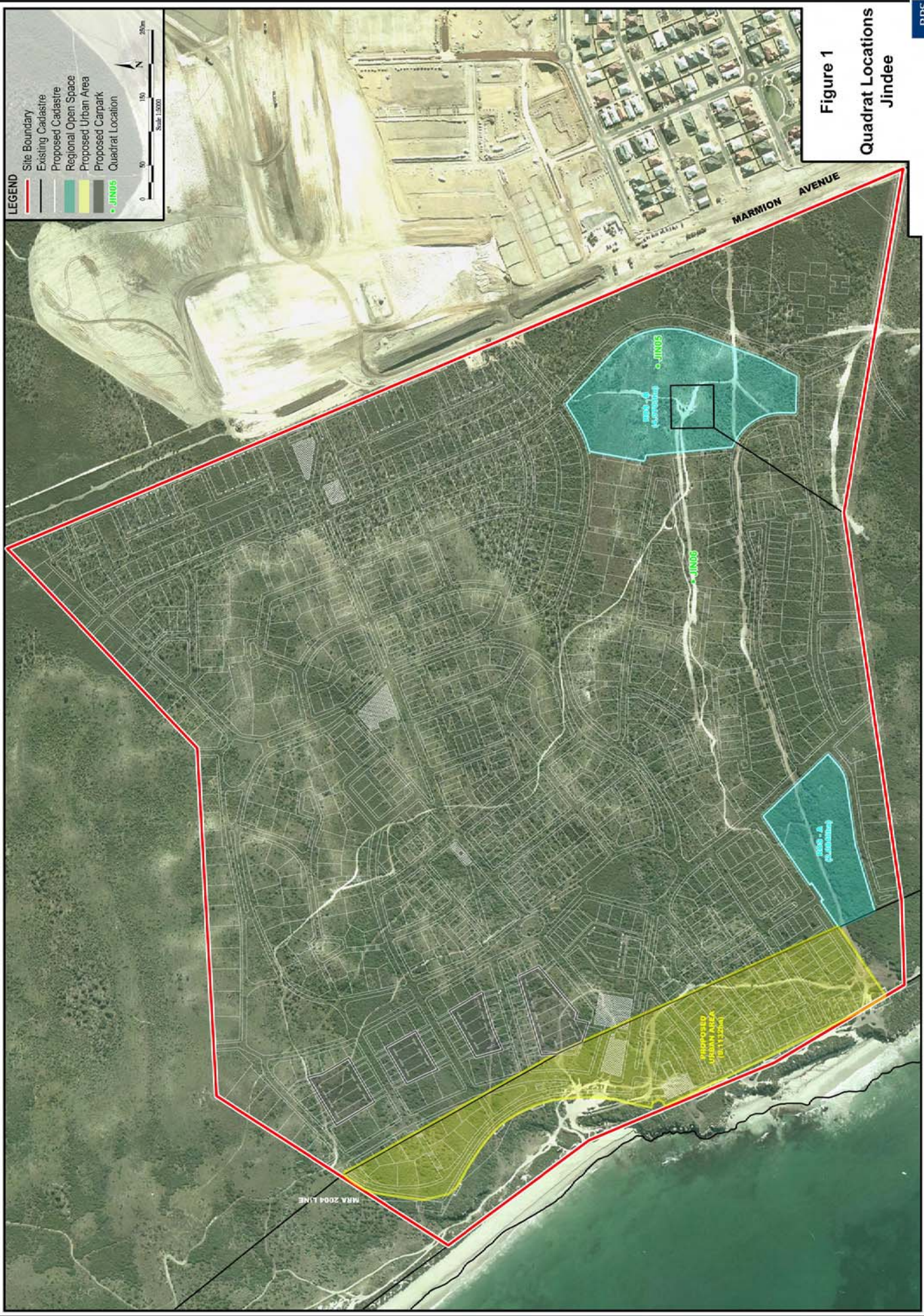
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FIGURES

Figure 1
Quadrat Locations
Jindee



APPENDIX A
FLORISTIC COMMUNITY TYPES TABLES, QUADRATS AND SPECIES LISTS

TABLE OF CONTENTS

	Page
INTRODUCTION	1
Table A1 Taxa to use in distinguishing FCTs 24, 26a, 26b and 27 from each other and other FCTs	2
Table A2 Taxa to use in distinguishing FCTs S11, S13, S14, 29a and 29b from each other and other FCTs	3
Table A3 List of Taxa recorded in Quadrat JIN05	4
Table A4 List of Taxa recorded in Quadrat JIN06	9
PLATE A1 Quadrat JIN05: Looking east over quadrat	14
PLATE A2 Quadrat JIN06: Looking south-west over quadrat	15

APPENDIX A

FLORISTIC COMMUNITY TYPES TABLES, QUADRATS AND SPECIES LISTS

INTRODUCTION

Appendix A has information about Quadrats JIN05 and JIN06, including about floristic community types they may represent and lists of taxa recorded in them. Table A1 is a list of taxa to use in inferring Floristic Community Types (FCTs) 24, 26a, 26b and 27 and in distinguishing them from each other and from other FCTs. Table A2 is a list of taxa to use in inferring FCTs S11, S13, S14, 29a and 29b and in distinguishing them from each other and from other FCTs. Tables A3 and A4 are lists of taxa recorded in Quadrats JIN05 and JIN06, preceded by details about the quadrats and their sites.

The six floristic community types that Quadrats JIN05 and JIN06 come closest to representing, their names and, in brackets, their distributions in relation to the Perth Metropolitan Region (PMR; from *Bush Forever* Volume 2 Table 6) and their species richness (from *Bush Forever* Volume 2 Table 6) are (where 'PMR' = confined to PMR, and +, >, /C, /S, /N and * mean 'predominantly in PMR', 'distribution goes well beyond the PMR', 'PMR is central to distribution', 'the Southernmost - or Northernmost - location is in the PMR' and 'except for isolated occurrences outside normal range', respectively):

FCT 24	Northern Spearwood shrublands and woodlands (PMR*; 39 spp.),
FCT 26a	<i>Melaleuca huegelii</i> – <i>M. acerosa</i> shrublands on Limestone ridges (PMR+; 50 spp., TEC: WA Threatened Species & Communities Unit 2004; English and Blyth 1997),
FCT 26b	Woodlands and mallees on limestone (PMR+ 50 spp.),
FCT 28	Spearwood <i>Banksia attenuata</i> or <i>B. attenuata</i> – <i>Eucalyptus</i> woodlands (>PMR/S; 55 spp.),
FCT 29a	Coastal shrublands on shallow sands (>PMR/C; 34 spp.), and
FCT 29b	<i>Acacia</i> shrublands on taller dunes (>PMR/N*; 34 spp.).

Tables A3 and A4 are lists of taxa recorded in Quadrats JIN05 and JIN06, respectively. The basic list of taxa (Column 2: Taxon Names) is from the Griffin (2005a) table *Tabulation of Species by Sites for Current sites and selected sites from SCP* (Weston 2005 Appendix B Table 1 pp. 89-92; but sorted by taxon name instead of by family code (Column 1: Fam). Where names in Column 2 differ from those in the 1994 SCPS dataset, the SCPS names follow them, non-italicized and in brackets.

Column 4 – JIN05 and JIN06 – numbers are the plant numbers on the quadrat recording sheet plant lists but with a '5' first to indicate the plant was first recorded in Quadrat JIN05 or a '6' if it was first recorded in Quadrat JIN06. A 'y' indicates it was recorded but without a number. 'ADJ' plants were recorded outside the quadrat, within 2 m of it, and 'OPP' plants were more than 2 m outside the quadrat. The numbers in the last column are from the 26a column in Table A1, taxa frequencies in the original Swan Coastal Plain plots of that floristic community type (from Gibson *et al.* 1994, Table 12, pp. 31, 35, 36).

Taxa added to the tables are in bold.

Table A1 Taxa to use in distinguishing FCTs 24, 26a, 26b and 27 from each other and other FCTs

(from Gibson *et al.* 1994, Table 12 (pp. 31, 35, 36), pp. 43-46 and Appendix 1; Note: this information may have been updated, though not printed or available, since 1994)

Taxon Name	Species Group	Family	Form	Taxa Frequencies in Plots of Floristic Community Types							Number of other FCTs / = (referred to in Gibson <i>et al.</i> (1994) as:)
				24	26a	26b	27	29a	29b	other highest	
<i>Acacia lasiocarpa</i> var. <i>lasiocarpa</i>	A	163	Sh vs	28	82	16	57	22	85	30c: 67	+ 7 other FCTs (incl. 19; 33)
<i>Acacia rostellifera</i>	A	163	Sh m-t	32	9	16	--	11	54	30b: 38	+ 2 other FCTs (19; 33; 30a; 29)
<i>Acacia truncata</i>	A	163	Sh s	8	36	--	86	--	15	--	in no other FCT
<i>Acanthocarpus preissii</i>	A	054C	He p	40	--	16	--	78	85	30b: 75	+ 4 other FCTs
<i>Astiloma microcalyx</i>	A	288	Sh vs	--	36	16	100	--	8	--	in no other FCT
<i>Austrostipa compressa</i>	Q	031	Gr p	--	55	42	--	--	--	20c: 78	+ 10 other FCTs / = <i>Stipa compressa</i>
<i>Austrostipa flavescens</i>	A	031	Gr p	56	91	42	--	78	92	30b: 63	+ 8 other FCTs / = <i>Stipa flavescens</i>
<i>Conostylis canadians</i>	A	055	He p	24	18	37	--	22	62	30c: 33	+ 2 other FCTs (28; 26; 30a; 14)
<i>Desmodium flexuosus</i>	Q	039	He p (gr)	72	100	79	100	44	92	21a: 69	+ 15 other FCTs / = <i>Loxocarya fle...</i>
<i>Dianella revoluta</i>	A	054E	He p	56	--	32	14	11	8	30c: 100	+ 13 other FCTs
<i>Dryandra sessilis</i>	A	090	Sh t	28	91	42	29	11	--	30c: 67	+ 2 other FCTs (28; 11; 30a; 14)
<i>Grevillea preissii</i>	A	090	Sh vs	40	100	32	100	22	--	30a: 14	+ 28; 3 / = <i>G. thelemanniana</i> subsp. <i>pr.</i>
<i>Hibbertia spicata</i> subsp. <i>leptotheca</i>	A	226	Sh vs	12	9	--	71	11	15	--	in no other FCT
<i>Leucopogon parviflorus</i>	A	288	Sh m	48	64	37	86	67	62	18: 100	+ 7 other FCTs
<i>Lomandra maritima</i>	A	054C	He p (gr)	64	45	37	86	44	92	19: 13	+ 2 other FCTs (30a; 14; 28; 8)
<i>Melaleuca huegelii</i>	A	273	Sh m-t	12	82	11	29	44	--	30a: 14	in no other FCT
<i>Melaleuca systena</i>	A	273	Sh s-m	52	82	68	100	22	92	30a: 14	+ 7 other FCTs / = <i>Melaleuca acerosa</i>
* <i>Petrorhagia dubia</i>	A	113	He a	68	9	26	--	11	--	25: 91	+ 5 other FCTs / = <i>Pet. velutina</i>
<i>Phyllanthus calycinus</i>	A	185	Sh vs	56	45	47	--	--	62	25: 82	+ 9 other FCTs
<i>Rhagodia baccata</i>	A	105	Sh s-m	20	45	21	--	78	77	30b: 88	+ 5 other FCTs
<i>Spyridium globulosum</i>	A	215	Sh m-t	4	9	16	29	78	46	30: >85	(30a: 86, 30b: 100, 30c: 100) + 25; 9
<i>Stylidium maritimum</i>	A	343	He p (gr)	--	73	5	--	--	8	--	in no other FCT
<i>Templetonia retusa</i>	A	165	Sh m	20	64	16	86	33	8	30c: 67	+ 4 other FCTs
* <i>Trachyandra divaricata</i>	A	054G	He	4	--	5	--	22	--	30b: 63	+ 2 other FCTs (30a; 57; 25; 9)
<i>Trymalium ledifolium</i> var. <i>ledifolium</i>	A	215	Sh s-m	4	91	11	71	22	8	30a: 14	+ 1 other FCT (28; 3) / = <i>T. albicans?</i>
* <i>Vulpia myuros</i>	Q	031	Gr a	24	100	47	--	44	--	18: 50	+ 17 other FCTs

* Alien sp. Form: Gr (grass), He (herb), Sh (shrub), a (annual), p (perennial), gr (graminoid), vs (very small: <0.5m), s (small: 0.5-1m), m (medium: 1-2m), t (tall: 2-4m), vt (very tall: >4m)

FCT 26a *Melaleuca huegelii* - *M. acerosa* shrublands of limestone ridges (Spearwood)

FCT 27 Species poor mallees and shrublands on limestone (mainly Yalgourup area) (Spearwood)

FCT 29a Coastal shrublands on shallow sands (over limestone: Quindalup)

FCT 30a *Callitris preissii* (or *Melaleuca lanceolata*) forests and woodlands (Perth, Quindalup)

FCT 30b Quindalup [southern] Tuart and / or peppermint woodlands

FCT 30c Other mallees & scrubs (Quindalup-Spearwood) on Spearwood dunes: only three plots [1 *Eucalyptus argatifolia* and 2 *Dryandra sessilis* plots], near Swan estuary

Table A2 Taxa to use in distinguishing FCTs S11, S13, S14, 29a and 29b from each other and other FCTs

(from Gibson *et al.* 1994, Table 12 (pp. 31, 35, 36), pp. 43–46 and Appendix 1 (Note: this information may have been updated, though not printed or available, since 1994), Griffin (1993, 1994) and Griffin and Trudgen (1994))

Taxon Name	Species Group	Family	Form	Taxa Presence (!, !, x, +) & Frequencies (%) in Plots of Floristic Community Types					Number of other FCTs; and referred to in Gibson <i>et al.</i> (1994) as:
				S11	S13	S14	29a	29b	
<i>Acacia lasiocarpa</i> var. <i>lasiocarpa</i>	A	163	Sh vs	+	-	-	22	85	+ 10 other FCTs (incl. 30c : 67)
<i>Acacia rostellifera</i>	A	163	Sh m-t	!!	-	-	11	54	+ 5 other FCTs (incl. 30a : 29)
<i>Acacia truncata</i>	A	163	Sh s	-	-	-	-	15	+ 2 other FCT (incl. 26a : 36)
<i>Acanthocarpus preissii</i>	A	054C	He p	!	!	-	78	85	+ 6 other FCTs (incl. 30a: 71)
<i>Austrostipa flavescens</i>	A	031	Gr p	x	-	-	78	92	+ 11 other FCTs (incl. 26a : 91); <i>Stipa flavescens</i>
<i>Conostylis candicans</i>	A	055	He p	-	+	-	22	62	+ 5 other FCTs (incl. 26b : 37)
<i>Desmodioides flexuosus</i>	Q	039	He p (gr)	!	-	-	44	92	+ 19 other FCTs (incl. 27 : 100); <i>Loxocarya fle...</i>
<i>Dischisma arenarium</i>	A	316	He a	+	-	-	33	77	+ 4 other FCTs (incl. 19 : 33)
<i>Ficina (Isolepis) nodosa</i>	-	032	Se p	-	!	-	-	-	-
<i>Lepidosperma gladiatum</i>	A	032	Se p	-	!	-	-	-	+ 6 other FCTs (incl. 19 : 33; 30b : 25)
<i>Lomandra maritima</i>	A	054C	He p (gr)	x	-	-	44	92	+ 6 other FCTs (incl. 27: 86)
<i>Melaleuca huegelii</i>	A	273	Sh m-t	-	-	-	44	-	+ 4 other FCTs (incl. 27 : 29)
<i>Melaleuca systena</i>	A	273	Sh s-m	!!	-	-	22	92	+ 10 other FCTs (incl. 26b : 68); <i>M. acerosa</i>
<i>Myoporum insulare</i>	-	326	Sh m	-	x	-	-	-	-
<i>Olearia axillaris</i>	A	345	Sh m-t	-	!	-	33	62	+ 5 other FCTs (incl. 27: 29)
<i>Poa porphyroclados</i>	A	031	Gr p	P?p x	-	-	67	77	+ 6 other FCTs (incl. 19: 67)
<i>Rhagodia baccata</i>	A	105	Sh s-m	-	+	-	78	77	+ 8 other FCTs (incl. 30a: 57)
<i>Scaevola crassifolia</i>	-	341	Sh s-m	-	!	-	-	-	-
<i>Spinifex longifolius</i>	-	031	Gr p	-	+	!	-	-	-
<i>Spyridium globulosum</i>	A	215	Sh m-t	+	x	-	78	46	30a: 86, 30b: 100, 30c: 100; + 5 other FCTs
<i>Templetonia retusa</i>	A	165	Sh m	-	-	-	33	8	+ 8 other FCTs (incl. 30c: 67)
<i>Tetragonia decumbens</i>	-	110	Sh/He s	-	x	!	-	-	-

Form: Gr (grass), He (herb), Sh (shrub), a (annual), p (perennial), gr (graminoid), vs (very small: <0.5m), s (small: 0.5-1m), m (medium: 1-2m), t (tall: 2-4m), vt (very tall: >4m)

FCT 26a *Melaleuca huegelii* – *M. acerosa* shrublands of limestone ridges (Spearwood)

FCT 27 Species poor mallees and shrublands on limestone (Spearwood)

FCT 29b *Acacia* shrublands on taller dunes (Quindalup)

FCT 30b Quindalup [southern] Tuart and / or peppermint woodlands

FCT S11 Northern *Acacia rostellifera* – *Melaleuca acerosa* shrublands

FCT S14 *Spinifex longifolius* grasslands and low shrublands

FCT 26b Woodlands and mallees on limestone (Spearwood; Cottlesloe unit)

FCT 29a Coastal shrublands on shallow sands (over limestone: Quindalup)

FCT 30a *Callitris preissii* (or *Melaleuca lanceolata*) forests and woodlands (Perth, Quindalup)

FCT 30c Other mallees and scrubs (Quindalup-Spearwood)

FCT S13 Northern *Olearia axillaris* – *Scaevola crassifolia* shrublands

FCT 19 Sedgelands in Holocene dune swa

Table A3 List of Taxa recorded in Quadrat JIN05

Recorded by M. Henson and A. Weston on 19 September and 29 November 2007

at GDA 50J 0376009, 6498216. Photo: ASW 07.VIII.1-007: Plate A1.

Description: East-facing mid-slope with numerous limestone outcrops and 20% bare ground.

Melaleuca huegelii Shrubland over Mixed Low Shrubland in Good Condition.

Note: Though small (only a fraction of the quadrat) the limestone outcrop in JIN05 is larger than any other outcrop of limestone in Lot 10.

Fam	Taxon Name	Current or Collection Name	JIN05	also	f26a
163	<i>Acacia cochlearis</i>				-
163	<i>Acacia cyclops</i>				-
163	<i>Acacia lasiocarpa</i>				16
163	<i>Acacia pulchella</i>				-
163	<i>Acacia rostellifera</i>		506		9
163	<i>Acacia truncata</i>		503		36
054C	<i>Acanthocarpus preissii</i>		514		--
273	<i>Agonis flexuosa</i>				-
031	<i>Aira caryophyllea/cupaniana group (=A. cary.)</i>	<i>Aira caryophyllea</i>	532a		-
031	<i>Aira praecox</i>				-
070	<i>Allocasuarina humilis</i>				-
304	<i>Alyxia buxifolia</i>				-
293	<i>Anagallis arvensis</i>		516		-
055	<i>Anigozanthos manglesii</i>				-
315	<i>Anthocercis ilicifolia</i>				-
281	<i>Apium annuum</i>				-
281	<i>Apium prostratum</i>				-
345	<i>Arctotheca calendula</i>				-
113	<i>Arenaria serpyllifolia</i>				-
288	<i>Astroloma microcalyx</i>				36
288	<i>Astroloma pallidum</i>				-
031	<i>Austrodanthonia acerosa</i>				-
031	<i>Austrodanthonia occidentalis</i>	<i>Austrodanthonia</i> sp.			-
031	<i>Austrostipa compressa</i>				55
031	<i>Austrostipa flavescens</i>		557		91
031	<i>Avena barbata/fatua</i>		558		-
090	<i>Banksia attenuata</i>				-
316	<i>Bellardia trixago</i>				-
165	<i>Bossiaea eriocarpa</i>				-
138	<i>Brassica tournefortii</i>				-
031	<i>Briza maxima</i>		Y		-
031	<i>Briza minor</i>		544		-
031	<i>Bromus arenarius</i>		559		-
031	<i>Bromus diandrus</i>		565		-
031	<i>Bromus rubens</i>		532d		-
054J	<i>Burchardia umbellata</i>	<i>Burchardia congesta</i>			-
054F	<i>Caesia micrantha</i>				-
066	<i>Caladenia flava</i>	<i>Caladenia? flava</i>	550		-
066	<i>Caladenia huegelii</i>				-
066	<i>Caladenia latifolia</i>				-
111	<i>Calandrinia calyprata</i>				-
111	<i>Calandrinia corrigioloides</i>				-
111	<i>Calandrinia liniflora</i>				
111	<i>Calandrinia 'SW estl'</i>	Not <i>C. liniflora</i>	516a	519	-
273	<i>Calothamnus quadrifidus</i>				-
032	<i>Carex preissii</i>				-

Fam	Taxon Name	Current or Collection Name	JIN05	also	f26a
110	<i>Carpobrotus edulis</i>				-
110	<i>Carpobrotus virescens</i>		557		-
131	<i>Cassytha aurea</i>				-
131	<i>Cassytha flava</i>	<i>Cassytha ?flava</i>			
131	<i>Cassytha glabella</i>				-
131	<i>Cassytha racemosa</i>				-
031	<i>Catapodium rigidum</i>	<i>Desmazeria rigida</i>	560		-
303	<i>Centaurium erythraea</i>				-
040	<i>Centrolepis drummondiana</i>				-
113	<i>Cerastium glomeratum</i>		542		-
273	<i>Chamelaucium uncinatum</i>				-
165	<i>Chorizema varium</i>				-
119	<i>Clematis linearifolia</i>		556		-
119	<i>Clematis pubescens</i>				-
183	<i>Comesperma confertum</i>				-
183	<i>Comesperma integerrimum</i>				-
288	<i>Conostephium preissii</i>				-
055	<i>Conostylis aculeata</i>		OPP		-
055	<i>Conostylis aculeata x candicans</i>				-
055	<i>Conostylis candicans</i>				18
055	<i>Conostylis pauciflora</i>	<i>Conostylis ?pauciflora</i>	546		-
055	<i>Conostylis setigera</i>				-
054F	<i>Corynotheca micrantha</i>				-
149	<i>Crassula colorata</i>		523		-
149	<i>Crassula exserta</i>				-
149	<i>Crassula glomerata</i>		529	534	-
149	<i>Crassula peduncularis</i>				-
215	<i>Cryptandra mutila</i>				-
307A	<i>Cuscuta epithymum</i>	Probably <i>Cuscuta planiflora</i>	524		-
281	<i>Daucus glochidiatus</i>		553	554	-
39	<i>Desmocladius fasciculatus</i> (= <i>Loxocarya f a</i>)				-
039	<i>Desmocladius flexuosus</i> (= <i>Loxocarya f a</i>)		518		100
054E	<i>Dianella revoluta</i>				--
207	<i>Diplopeltis huegelii</i>		OPP		-
316	<i>Dischisma arenarium</i>		564		-
316	<i>Dischisma capitatum</i>				-
143	<i>Drosera erythrorhiza</i>				-
143	<i>Drosera macrantha</i>				-
143	<i>Drosera menziesii</i> subsp. <i>penicillaris</i>				-
143	<i>Drosera pallida</i>				-
090	<i>Dryandra nivea</i>	<i>Dryandra lindleyana</i> subsp. <i>lindleyana</i>			-
090	<i>Dryandra sessilis</i>		502		91
031	<i>Ehrharta calycina</i>	<i>Ehrharta ?calycina</i>			-
031	<i>Ehrharta longiflora</i>				-
066	<i>Elythranthera brunonis</i>				-
326	<i>Eremophila glabra</i>				-
066	<i>Eriochilus dilatatus</i>				-
167	<i>Erodium botrys</i>				-
167	<i>Erodium cicutarium</i>		530		-
273	<i>Eucalyptus foecunda</i>				-
185	<i>Euphorbia peplus</i>				-
092	<i>Exocarpos sparteus</i>		ADJ		-
236	<i>Frankenia pauciflora</i>				-
136	<i>Fumaria capreolata</i>				-
331	<i>Galium murale</i>		538		-
060	<i>Gladiolus caryophyllaceus</i>				-
345	<i>Gnaphalium indutum</i>				-

Fam	Taxon Name	Current or Collection Name	JIN05	also	f26a
165	<i>Gompholobium aristatum</i>				-
165	<i>Gompholobium tomentosum</i>		525		-
090	<i>Grevillea crithmifolia</i>				-
090	<i>Grevillea thelemanniana</i> subsp. <i>preissii</i>	<i>Grevillea preissii</i>			100
090	<i>Grevillea vestita</i>				-
090	<i>Hakea lissocarpa</i>				-
090	<i>Hakea prostrata</i>				-
090	<i>Hakea trifurcata</i>				-
165	<i>Hardenbergia comptoniana</i>		512		-
138	<i>Heliophila pusilla</i>		515		-
345	<i>Helipterum corymbosum</i>				-
313	<i>Hemiandra pungens/linearis</i>				-
226	<i>Hibbertia aurea</i>				-
226	<i>Hibbertia hypericoides</i>				-
226	<i>Hibbertia racemosa</i>				-
226	<i>Hibbertia spicata</i> subsp. <i>leptothea</i>				9
226	<i>Hibbertia subvaginata</i>				-
281	<i>Homalosciadium homalocarpum</i>				-
165	<i>Hovea trisperma</i> var. <i>trisperma</i>				-
243	<i>Hybanthus calycinus</i>				-
281	<i>Hydrocotyle diantha</i>		548		
281	<i>Hydrocotyle hispidula</i>				-
281	<i>Hydrocotyle tetragonocarpa</i>				-
345	<i>Hypochaeris glabra</i>		534		-
032	<i>Isolepis cernua</i>				-
032	<i>Isolepis marginata</i>		543		-
032	<i>Isolepis nodosa</i>				-
340	<i>Isotoma hypocrateriformis</i>		561		-
165	<i>Isotropis cuneifolia</i>				-
165	<i>Jacksonia sericea</i>				-
165	<i>Kennedia coccinea</i>				-
165	<i>Kennedia prostrata</i>		ADJ		-
054H	<i>Lachenalia reflexa</i>				-
031	<i>Lagurus ovatus</i>				-
341	<i>Lechenaultia linarioides</i>				-
138	<i>Lepidium rotundum</i>				-
032	<i>Lepidosperma angustatum/squamatum</i> (=L.a.,L.s.)	<i>Lepidosperm squamatum</i>	539		-
032	<i>Lepidosperma gladiatum</i>				-
032	<i>Lepidosperma</i> sp.				-
092	<i>Leptomeria preissiana</i>		503		-
345	<i>Leptorhynchus scabrurus</i>				-
288	<i>Leucopogon insularis</i>		555		-
288	<i>Leucopogon parviflorus</i>		509		64
288	<i>Leucopogon racemulosus</i>				-
031	<i>Lolium rigidum</i>				-
054C	<i>Lomandra maritima</i>		ADJ		45
054C	<i>Lomandra preissii</i>				-
054C	<i>Lomandra suaveolens</i>				-
288	<i>Lysinema ciliatum</i>				-
016A	<i>Macrozamia riedlei</i>				-
273	<i>Melaleuca acerosa</i>	<i>Melaleuca systema</i>	507		82
273	<i>Melaleuca cardiophylla</i>				-
273	<i>Melaleuca huegelii</i>		501		82
165	<i>Melilotus indicus</i>				-
032	<i>Mesomelaena pseudostygia</i>				-
031	<i>Microlaena stipoides</i>				-
345	<i>Millotia myosotidifolia</i>				-

Fam	Taxon Name	Current or Collection Name	JIN05	also	f26a
345	<i>Millotia tenuifolia</i>				-
113	<i>Minuartia hybrida</i>	<i>Minuartia mediterranea</i>	537	549, 563	-
066	<i>Monadenia bracteata</i>				-
060	<i>Moraea flaccida</i>				-
326	<i>Myoporum insulare</i>				-
054B	<i>Myrsiphyllum asparagoides</i>				-
165	<i>Nemcia capitata</i>	<i>Gastrolobium capitatum</i>			
165	<i>Nemcia reticulata</i>	<i>Gastrolobium nervosum</i>			-
345	<i>Olearia axillaris</i>		508		-
331	<i>Opercularia hispidula</i>				-
331	<i>Opercularia vaginata</i>				-
320	<i>Orobanche minor</i>				-
060	<i>Orthrosanthus laxus</i>				-
345	<i>Ozothamnus cordatus</i> (=Helichrysum c...um)				-
316	<i>Parentucellia latifolia</i>		547		-
316	<i>Parentucellia viscosa</i>				-
088	<i>Parietaria debilis</i>				-
167	<i>Pelargonium capitatum</i>		528		-
090	<i>Petrophile macrostachya</i>				-
090	<i>Petrophile serruriae</i>				-
113	<i>Petrorhagia velutina</i>	<i>Petrorhagia dubia</i>	536		9
175	<i>Philothea spicata</i>				-
302	<i>Phyllangium paradoxum</i>				-
185	<i>Phyllanthus calycinus</i>		511		45
345	<i>Picris squarrosa</i>				-
263	<i>Pimelea calcicola</i>				-
263	<i>Pimelea ferruginia</i>				-
031	<i>Poa drummondiana</i>				-
031	<i>Poa poiformis/porphyroclados</i> (=Poa porphyr.)				-
345	<i>Podolepis lessonii</i>		562		-
345	<i>Podotroche angustifolia</i>		522		-
185	<i>Poranthera microphylla</i>				-
066	<i>Prasophyllum calcicola</i>		541		-
066	<i>Pterostylis vittata</i>				-
106	<i>Ptilotus polystachyus</i> var. <i>polystachyus</i>				-
066	<i>Pyrorchis nigricans</i>				-
345	<i>Quinetia urvillei</i>				-
105	<i>Rhagodia baccata</i> subsp. <i>baccata</i> (=R. baccata)		513		-
060	<i>Romulea rosea</i>		520		-
031	<i>Avellinia michelii</i>				-
113	<i>Sagina apetala</i>				-
113	<i>Sagina maritima</i>				-
092	<i>Santalum acuminatum</i>				-
341	<i>Scaevola anchusifolia</i>				-
341	<i>Scaevola canescens</i>				-
341	<i>Scaevola crassifolia</i>				-
341	<i>Scaevola nitida</i>		504		-
341	<i>Scaevola repens</i> var. <i>repens</i>	<i>Scaevola ?repens</i> var. <i>repens</i>			-
341	<i>Scaevola thesioides</i>				-
032	<i>Schoenus clandestinus</i>				-
032	<i>Schoenus grandiflorus</i>				-
032	<i>Schoenus lanatus</i>				-
345	<i>Senecio lautus</i>				-
113	<i>Silene gallica</i>				-
315	<i>Solanum nigrum</i>				-
345	<i>Sonchus asper</i>				-
345	<i>Sonchus oleraceus</i>		531		-

Fam	Taxon Name	Current or Collection Name	JIN05	also	f26a
054F	<i>Sowerbaea laxiflora</i>				-
215	<i>Spyridium globulosum</i>		505		9
215	<i>Spyridium tridentatum</i>				-
113	<i>Stellaria media</i>		545		-
138	<i>Stenopetalum robustum</i>				-
343	<i>Stylidium brunonianum</i>				-
343	<i>Stylidium calcaratum</i>				-
343	<i>Stylidium junceum</i>				-
343	<i>Stylidium macrocarpum</i>				-
343	<i>Stylidium maritimum</i>				73
165	<i>Templetonia biloba</i>				-
165	<i>Templetonia retusa</i>				64
110	<i>Tetragonia decumbens</i>				-
223	<i>Thomasia cognata</i>				-
105	<i>Threlkeldia diffusa</i>				-
054F	<i>Thysanotus arenarius</i>				-
054F	<i>Thysanotus multiflorus</i>				-
054F	<i>Thysanotus patersonii/manglesianus</i> (=T. sp. m./ /p. scps)		517		-
054F	<i>Thysanotus sparteus</i>				-
054G	<i>Trachyandra divaricata</i>				--
281	<i>Trachymene pilosa</i>		533		-
054F	<i>Tricoryne elatior</i>		535		-
165	<i>Trifolium arvense</i>				-
165	<i>Trifolium campestre</i>		551		-
165	<i>Trifolium cernuum</i>				-
165	<i>Trifolium dubium</i>				-
165	<i>Trifolium glomeratum</i>				-
026	<i>Triglochin calcitrapum</i>		526?		-
026	<i>Triglochin centrocarpum</i>	<i>Triglochin nana</i> (=T. c. var. <i>breviscarpum</i>)	527	549	-
026	<i>Triglochin trichophorum</i>				-
202	<i>Tripterococcus brunonis</i>				-
215	<i>Trymalium albicans</i>	<i>Trymalium ledifolium</i> var. <i>ledifolium</i>	510		91
345	<i>Urospermum picroides</i>				-
345	<i>Ursinia anthemoides</i>				-
345	<i>Vellereophyton dealbatum</i>				-
031	<i>Vulpia bromoides</i>				-
031	<i>Vulpia myuros</i>		532bc		100
339	<i>Wahlenbergia capensis</i>				-
339	<i>Wahlenbergia preissii</i>				-
345	<i>Waitzia suaveolens</i>	? <i>Waitzia suaveolens</i>			-
313	<i>Westringia dampieri</i>				-
054J	<i>Wurmbea dioica</i>		552		-
054D	<i>Xanthorrhoea preissii</i>		ADJ		-
281	<i>Xanthosia huegelii</i>				-
173	<i>Zygophyllum fruticosum</i>				-

Table A4 List of Taxa recorded in Quadrat JIN06

Recorded by M. Henson and A. Weston on 19 September and 29 November 2007

at GDA 50J 0375691, 6498164. Photo: ASW 07.VIII.1-009: Plate A2.

Description: Sandy soil on southwest-facing upper to mid-slope with numerous limestone outcrops and 10% bare ground.

Dryandra sessilis Low Shrubland to Open Low Heath in Good Condition (though with many dead leaves).

Fam	Taxon Name	Current or Collection Name	JIN06	also	f26a
163	<i>Acacia cochlearis</i>				-
163	<i>Acacia cyclops</i>				-
163	<i>Acacia lasiocarpa</i>				16
163	<i>Acacia pulchella</i>				-
163	<i>Acacia rostellifera</i>		ADJ		9
163	<i>Acacia truncata</i>		503		36
054C	<i>Acanthocarpus preissii</i>		504		--
273	<i>Agonis flexuosa</i>				-
031	<i>Aira caryophyllea/cupaniana group (=A. cary.)</i>	<i>Aira caryophyllea</i>	631		-
031	<i>Aira praecox</i>				-
070	<i>Allocasuarina humilis</i>				-
304	<i>Alyxia buxifolia</i>				-
293	<i>Anagallis arvensis</i>		516		-
055	<i>Anigozanthos manglesii</i>				-
315	<i>Anthocercis ilicifolia</i>				-
281	<i>Apium annuum</i>				-
281	<i>Apium prostratum</i>				-
345	<i>Arctotheca calendula</i>		Y		-
113	<i>Arenaria serpyllifolia</i>				-
288	<i>Astroloma pallidum</i>				-
031	<i>Austrodanthonia acerosa</i>				-
031	<i>Austrodanthonia occidentalis</i>	<i>Austrodanthonia</i> sp.	631		-
031	<i>Austrostipa compressa</i>				55
031	<i>Austrostipa flavescens</i>		627	41(ADJ)	91
031	<i>Avena barbata/fatua</i>		629		-
090	<i>Banksia attenuata</i>				-
316	<i>Bellardia trixago</i>				-
165	<i>Bossiaea eriocarpa</i>				-
138	<i>Brassica tournefortii</i>				-
031	<i>Briza maxima</i>				-
031	<i>Briza minor</i>				-
031	<i>Bromus arenarius</i>				-
031	<i>Bromus diandrus</i>		626		-
031	<i>Bromus rubens</i>		OPP		
054J	<i>Burchardia umbellata</i>	<i>Burchardia congesta</i>			-
054F	<i>Caesia micrantha</i>				-
066	<i>Caladenia flava</i>	<i>Caladenia?</i> <i>flava</i>	608		-
066	<i>Caladenia huegelii</i>				-
066	<i>Caladenia latifolia</i>				-
111	<i>Calandrinia calyprata</i>				-
111	<i>Calandrinia corrigioloides</i>				-
111	<i>Calandrinia liniflora</i>				-
111	<i>Calandrinia</i> 'SW estl'	Not <i>C. liniflora</i>	637a		-
273	<i>Calothamnus quadrifidus</i>				-
032	<i>Carex preissii</i>				-
110	<i>Carpobrotus edulis</i>				-

Fam	Taxon Name	Current or Collection Name	JIN06	also	f26a
110	<i>Carpobrotus virescens</i>				-
131	<i>Cassytha aurea</i>				-
131	<i>Cassytha flava</i>	<i>Cassytha ?flava</i>	610	633	-
131	<i>Cassytha glabella</i>				-
131	<i>Cassytha racemosa</i>				-
031	<i>Catapodium rigidum</i>	<i>Desmazeria rigida</i>	560		-
303	<i>Centaurium erythraea</i>				-
040	<i>Centrolepis drummondiana</i>				-
113	<i>Cerastium glomeratum</i>		637b		-
273	<i>Chamelaucium uncinatum</i>				-
165	<i>Chorizema varium</i>				-
119	<i>Clematis linearifolia</i>				-
119	<i>Clematis pubescens</i>				-
183	<i>Comesperma confertum</i>				-
183	<i>Comesperma integerrimum</i>				-
288	<i>Conostephium preissii</i>				-
055	<i>Conostylis aculeata</i>				-
055	<i>Conostylis aculeata x candicans</i>				-
055	<i>Conostylis candicans</i>				18
055	<i>Conostylis pauciflora</i>	<i>Conostylis ?pauciflora</i>	640		-
055	<i>Conostylis setigera</i>				-
054F	<i>Corynotheca micrantha</i>				-
149	<i>Crassula colorata</i>		523		-
149	<i>Crassula exserta</i>				-
149	<i>Crassula glomerata</i>		534	?519	-
149	<i>Crassula peduncularis</i>				-
215	<i>Cryptandra mutila</i>				-
307A	<i>Cuscuta epithymum</i>	<i>Cuscuta planiflora</i> (probably)	638		-
281	<i>Daucus glochidiatus</i>		553		-
39	<i>Desmocladus fasciculatus</i> (= <i>Loxocarya f a</i>)		Y		-
039	<i>Desmocladus flexuosus</i> (= <i>Loxocarya f a</i>)		Y		100
054E	<i>Dianella revoluta</i>				- -
207	<i>Diplopeltis huegelii</i>				-
316	<i>Dischisma arenarium</i>				-
316	<i>Dischisma capitatum</i>				-
143	<i>Drosera erythrorhiza</i>				-
143	<i>Drosera macrantha</i>				-
143	<i>Drosera menziesii</i> subsp. <i>penicillaris</i>		606		-
143	<i>Drosera pallida</i>				-
090	<i>Dryandra nivea</i>	<i>Dryandra lindleyana</i> subsp. <i>lindleyana</i>	611	OPP	-
090	<i>Dryandra sessilis</i>		502		91
031	<i>Ehrharta calycina</i>	<i>Ehrharta ?calycina</i>	630		-
031	<i>Ehrharta longiflora</i>		613		-
066	<i>Elythranthera brunonis</i>				-
326	<i>Eremophila glabra</i>				-
066	<i>Eriochilus dilatatus</i>	<i>?Eriochilus dilatatus</i>	614		-
167	<i>Erodium botrys</i>				-
167	<i>Erodium cicutarium</i>				-
273	<i>Eucalyptus foecunda</i>				-
185	<i>Euphorbia peplus</i>				-
092	<i>Exocarpos sparteus</i>				
236	<i>Frankenia pauciflora</i>				-
136	<i>Fumaria capreolata</i>				-
331	<i>Galium murale</i>		538		-
060	<i>Gladiolus caryophyllaceus</i>				-
345	<i>Gnaphalium indutum</i>				-
165	<i>Gompholobium aristatum</i>				-

Fam	Taxon Name	Current or Collection Name	JIN06	also	f26a
165	<i>Gompholobium tomentosum</i>		525		-
090	<i>Grevillea crithmifolia</i>				-
090	<i>Grevillea thelemanniana</i> subsp. <i>preissii</i>	<i>Grevillea preissii</i>	Y		100
090	<i>Grevillea vestita</i>				-
090	<i>Hakea lissocarpha</i>				-
090	<i>Hakea prostrata</i>				-
090	<i>Hakea trifurcata</i>				-
165	<i>Hardenbergia comptoniana</i>		512		-
138	<i>Heliophila pusilla</i>		515		-
345	<i>Helipterum corymbosum</i>				-
313	<i>Hemiandra pungens/linearis</i>				-
226	<i>Hibbertia aurea</i>				-
226	<i>Hibbertia hypericoides</i>				-
226	<i>Hibbertia racemosa</i>				-
226	<i>Hibbertia spicata</i> subsp. <i>leptothea</i>		612		9
226	<i>Hibbertia subvaginata</i>		617		
281	<i>Homalosciadium homalocarpum</i>				-
165	<i>Hovea trisperma</i> var. <i>trisperma</i>				-
243	<i>Hybanthus calycinus</i>				-
281	<i>Hydrocotyle diantha</i>		615		-
281	<i>Hydrocotyle hispidula</i>				-
281	<i>Hydrocotyle tetragonocarpa</i>				-
345	<i>Hypochaeris glabra</i>				-
032	<i>Isolepis cernua</i>				-
032	<i>Isolepis marginata</i>				-
032	<i>Isolepis nodosa</i>				-
340	<i>Isotoma hypocrateriformis</i>				
165	<i>Isotropis cuneifolia</i>				-
165	<i>Jacksonia sericea</i>				-
165	<i>Kennedia coccinea</i>				-
165	<i>Kennedia prostrata</i>		ADJ		-
054H	<i>Lachenalia reflexa</i>				-
031	<i>Lagurus ovatus</i>				-
341	<i>Lechenaultia linarioides</i>				-
138	<i>Lepidium rotundum</i>				-
032	<i>Lepidosperma angustatum/squamatum</i> (=L.a.,L.s.)	<i>Lepidosperm squamatum</i>			-
032	<i>Lepidosperma gladiatum</i>				-
032	<i>Lepidosperma</i> sp.				-
092	<i>Leptomeria preissiana</i>		503	?	
345	<i>Leptorhynchos scabrus</i>				-
288	<i>Leucopogon insularis</i>		609	602	-
288	<i>Leucopogon parviflorus</i>		601		64
288	<i>Leucopogon racemulosus</i>				-
031	<i>Lolium rigidum</i>				-
054C	<i>Lomandra maritima</i>		ADJ		45
054C	<i>Lomandra preissii</i>				-
054C	<i>Lomandra suaveolens</i>				-
288	<i>Lysinema ciliatum</i>		639	604	-
016A	<i>Macrozamia riedlei</i>				-
273	<i>Melaleuca acerosa</i>	<i>Melaleuca systema</i>	507		82
273	<i>Melaleuca cardiophylla</i>				-
273	<i>Melaleuca huegelii</i>				82
165	<i>Melilotus indicus</i>				-
032	<i>Mesomelaena pseudostygia</i>				-
031	<i>Microlaena stipoides</i>				-
345	<i>Millotia myosotidifolia</i>		635	621	-
345	<i>Millotia tenuifolia</i>				-

Fam	Taxon Name	Current or Collection Name	JIN06	also	f26a
113	<i>Minuartia hybrida</i>	<i>Minuartia mediterranea</i>	537		-
066	<i>Monadenia bracteata</i>				-
060	<i>Moraea flaccida</i>				-
326	<i>Myoporum insulare</i>				-
054B	<i>Myrsiphyllum asparagoides</i>				-
165	<i>Nemcia capitata</i>	<i>Gastrolobium capitatum</i>	616		
165	<i>Nemcia reticulata</i>	<i>Gastrolobium nervosum</i>			-
345	<i>Olearia axillaris</i>		508		-
331	<i>Opercularia hispidula</i>				-
331	<i>Opercularia vaginata</i>		636	618	-
320	<i>Orobancha minor</i>				-
060	<i>Orthrosanthus laxis</i>				-
345	<i>Ozothammus cordatus</i>				-
316	<i>Parentucellia latifolia</i>		623		-
316	<i>Parentucellia viscosa</i>				-
088	<i>Parietaria debilis</i>				-
167	<i>Pelargonium capitatum</i>		528		-
090	<i>Petrophile macrostachya</i>				-
090	<i>Petrophile serruriae</i>				-
113	<i>Petrorhagia velutina</i>	<i>Petrorhagia dubia</i>	536		9
175	<i>Philothea spicata</i>				-
302	<i>Phyllangium paradoxum</i>				-
185	<i>Phyllanthus calycinus</i>				45
345	<i>Picris squarrosa</i>				-
263	<i>Pimelea calcicola</i>				-
263	<i>Pimelea ferruginia</i>		605		-
031	<i>Poa drummondiana</i>				-
031	<i>Poa poiformis/porphyroclados (=Poa porphyr.)</i>				-
345	<i>Podolepis lessonii</i>				
345	<i>Podotrochea angustifolia</i>				-
185	<i>Poranthera microphylla</i>				-
066	<i>Prasophyllum calcicola</i>				-
066	<i>Pterostylis vittata</i>				-
106	<i>Ptilotus polystachyus</i> var. <i>polystachyus</i>				-
066	<i>Pyrorchis nigricans</i>				-
345	<i>Quinetia urvillei</i>				-
105	<i>Rhagodia baccata</i> subsp. <i>baccata</i> (=R. <i>baccata</i>)		Y		-
060	<i>Romulea rosea</i>		Y		-
031	<i>Avellinia michelii</i>		632		-
113	<i>Sagina apetala</i>				-
113	<i>Sagina maritima</i>				-
092	<i>Santalum acuminatum</i>				-
341	<i>Scaevola anchusifolia</i>				-
341	<i>Scaevola canescens</i>				-
341	<i>Scaevola crassifolia</i>				-
341	<i>Scaevola nitida</i>				-
341	<i>Scaevola repens</i> var. <i>repens</i>	<i>Scaevola ?repens</i> var. <i>repens</i>	620	625	-
341	<i>Scaevola thesioides</i>		624		-
032	<i>Schoenus clandestinus</i>				-
032	<i>Schoenus grandiflorus</i>				-
032	<i>Schoenus lanatus</i>				-
345	<i>Senecio lautus</i>				-
113	<i>Silene gallica</i>				-
315	<i>Solanum nigrum</i>				-
345	<i>Sonchus asper</i>				-
345	<i>Sonchus oleraceus</i>		531		-
054F	<i>Sowerbaea laxiflora</i>				-

Fam	Taxon Name	Current or Collection Name	JIN06	also	f26a
215	<i>Spyridium globulosum</i>				9
215	<i>Spyridium tridentatum</i>				-
113	<i>Stellaria media</i>		545		-
138	<i>Stenopetalum robustum</i>				-
343	<i>Stylidium brunonianum</i>				-
343	<i>Stylidium calcaratum</i>				-
343	<i>Stylidium junceum</i>				-
343	<i>Stylidium macrocarpum</i>				-
343	<i>Stylidium maritimum</i>				73
165	<i>Templetonia biloba</i>		607?		-
165	<i>Templetonia retusa</i>		OPP		64
110	<i>Tetragonia decumbens</i>				-
223	<i>Thomasia cognata</i>				-
105	<i>Threlkeldia diffusa</i>				-
054F	<i>Thysanotus arenarius</i>				-
054F	<i>Thysanotus multiflorus</i>				-
054F	<i>Thysanotus patersonii/manglesianus</i> (=T. sp. m./	/p. scps)			-
054F	<i>Thysanotus sparteus</i>				-
054G	<i>Trachyandra divaricata</i>				--
281	<i>Trachymene pilosa</i>		533		-
054F	<i>Tricoryne elatior</i>		ADJ		-
165	<i>Trifolium arvense</i>				-
165	<i>Trifolium campestre</i>		621		-
165	<i>Trifolium cernuum</i>				-
165	<i>Trifolium dubium</i>				-
165	<i>Trifolium glomeratum</i>				-
026	<i>Triglochin calcitrapum</i>		526		-
026	<i>Triglochin centrocarpum</i>	<i>Triglochin nana</i> (=T. c. var. <i>breviscarpum</i>)			-
026	<i>Triglochin trichophorum</i>				-
202	<i>Tripterococcus brunonis</i>				-
215	<i>Trymalium albicans</i>	<i>Trymalium ledifolium</i> var. <i>ledifolium</i>	510		91
345	<i>Urospermum picroides</i>				-
345	<i>Ursinia anthemoides</i>				-
345	<i>Vellereophyton dealbatum</i>				-
031	<i>Vulpia bromoides</i>				-
031	<i>Vulpia myuros</i>		628		100
339	<i>Wahlenbergia capensis</i>				-
339	<i>Wahlenbergia preissii</i>				-
345	<i>Waitzia suaveolens</i>	? <i>Waitzia suaveolens</i>	635		-
313	<i>Westringia dampieri</i>				-
054J	<i>Wurmbea dioica</i>				-
054D	<i>Xanthorrhoea preissii</i>				-
281	<i>Xanthosia huegelii</i>				-
173	<i>Zygophyllum fruticosum</i>				-



PLATE A1 Quadrat JIN05: Looking east over quadrat
(Photo ASW 07.VIII.1-007)



PLATE A2 **Quadrat JIN06: Looking south-west over quadrat**
(Photo ASW 07.VIII.1-009)

APPENDIX D – ACOUSTIC REPORT

Rochdale Holdings Pty Ltd A.B.N. 85 009 049 067 trading as:

HERRING STORER ACOUSTICS

Suite 34, 11 Preston Street, Como, W.A. 6152

P.O. Box 219, Como, W.A. 6952

Telephone: (08) 9367 6200

Facsimile: (08) 9474 2579

Email: hsa@hsacoustics.com.au



JINDEE PRIMARY SCHOOL SITE

MARMION AVENUE, JINDEE

AMBIENT NOISE LEVEL ASSESSMENT

ROBERTS DAY

OCTOBER 2008

OUR REFERENCE: 9574-2-08191



DOCUMENT CONTROL PAGE

**AMBIENT NOISE LEVEL ASSESSMENT
JINDEE**

Job No: 08191

Document Reference : 9574-2-08191

FOR

ROBERTS DAY

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CONTENTS

1.	INTRODUCTION	1
2.	CRITERIA	1
3.	ASSESSMENT	1
4.	REQUIRED CONSTRUCTION	2
5.	CONCLUSION	3

APPENDIX

A	Proposed Primary School Layout
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1. INTRODUCTION

Herring Storer Acoustics (HSA) was commissioned by the Roberts Day to undertake a noise level assessment of the noise that would be received at the proposed Jindee Primary School site to be located adjacent to Marmion Avenue (Site Plan is attached in Appendix A). The purpose of the study was to determine appropriate construction requirements to achieve acceptable internal noise levels due to noise received from vehicles travelling along Marmion Avenue.

2. CRITERIA

Australian/New Zealand Standard AS/NZS 2107:2000 "Acoustics – Recommended design sound levels and reverberation times for building interiors" for Educational Buildings lists satisfactory background noise levels. From this standard, the relevant noise levels are :

	Satisfactory	Maximum
- Libraries	40 dB(A)	50 dB(A)
- Teaching Spaces (Primary)	35 dB(A)	45 dB(A)
- Office Areas	40 dB(A)	45 dB(A)

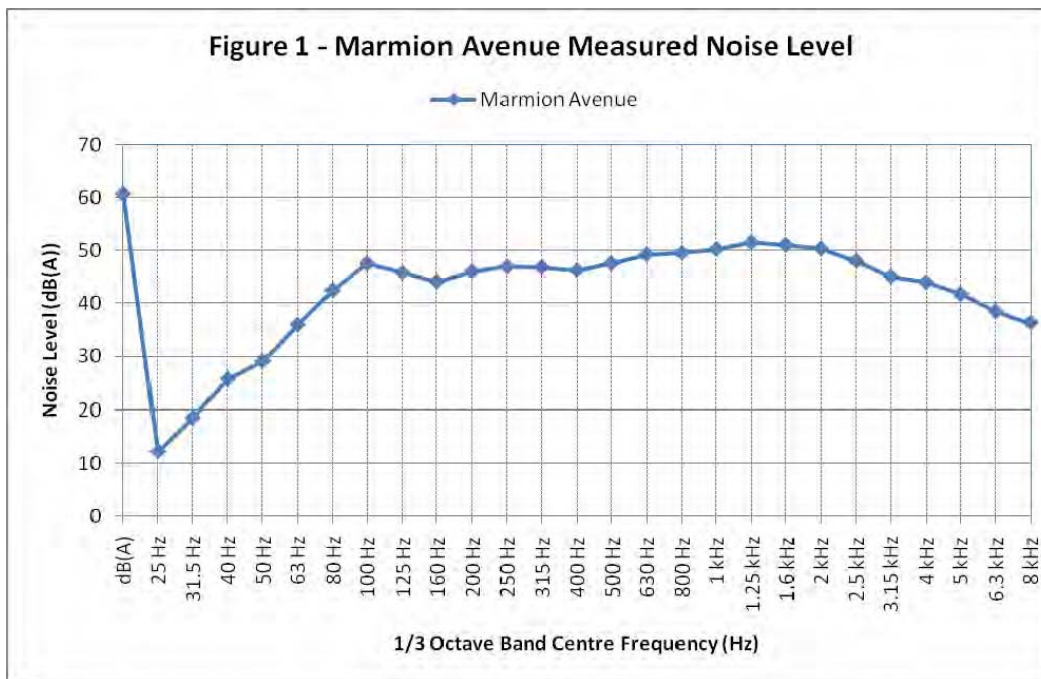
Based on the above it is recommended that an L_{Aeq} of 35 dB(A) be used as the internal design criteria within class rooms and an L_{Aeq} of 40 dB(A) within Office areas and the library.

3. ASSESSMENT

As the section of Marmion Avenue located adjacent to the Primary School has not at this stage been constructed, to assess noise ingress noise level measurements were performed for noise received from vehicles travelling along Marmion Avenue at a section of the road which currently carries approximately the same traffic volumes as predicted for the proposed section.

From information supplied, we believe that the predicted traffic flow (for the year 2026) is 28000 vpd. This volume of traffic correlates to the current traffic flow along Marmion Avenue for the section between Bellville Gardens and Hester Avenue. Therefore, a noise level measurement was carried out for this section of Marmion Avenue, which then formed the bases of the acoustical assessment.

A noise level of 61 dB an L_{Aeq} was recorded at a distance of approximately 40 metres from Marmion Avenue, and used as the bases of the assessment. The 1/3 octave band centre frequency data recorded is shows on Figure 1.



We understand that the closest school building is approximately 100metres from Marmion Avenue. After adjusting the measured noise level for distance, calculations were carried out to determine the Rw rating of the various building element to achieve the recommended internal noise level. The Rw ratings of the various elements should be as listed in Table 3.1.

Table 3.1 – Calculated Rw Rating for External Glazing

Room	Calculated Rw dB(A)
Closest Classrooms	
Wall/Windows facing Marmion Ave	32
Wall/Windows Perpendicular to Marmion Ave	27
Wall/Windows away from Marmion Ave	22
Roof/Ceiling	36
Library	
Wall/Windows facing Marmion Ave	27
Wall/Windows Perpendicular to Marmion Ave	22
Wall/Windows away from Marmion Ave	17
Roof/Ceiling	33
Offices	
Wall/Windows facing Marmion Ave	27
Wall/Windows Perpendicular to Marmion Ave	22
Wall/Windows away from Marmion Ave	17
Roof/Ceiling	33

4. REQUIRED CONSTRUCTION

Where the R_w rating exceeds 20, then depending on other requirements improved constructions may be required. Based on the above R_w rating, the constructions as listed in Tables 4.1 and 4.2 are recommended.

TABLE 4.1 – WINDOW REQUIREMENTS AND CORRESPONDING R_w VALUES

R_w Rating	Description of Construction
36 to 38	Openable – 10.38mm laminated + 6mm in Capral 419 or approved equal frames Fixed - 13mm laminated glass
33 to 35	Openable – 10.38mm laminated glass in awning type windows with mechanical winders closing on compressible seals. Fixed – 10.38mm laminated glass
30 to 32	Openable – 6.38mm laminated glass in awning type windows with mechanical winders closing on compressible seals. Fixed – 6.38mm laminated glass Fixed – 10mm glass
27 to 29	Openable – 6mm glass in awning type windows with mechanical winders closing on compressible seals. Fixed – 6mm glass
22 to 26	Openable - 6mm horizontal sliding window Fixed – 4mm glass

From recent projects, it is our understanding that to comply with the requirements of Section J of the BCA, laminated glass would be required.

TABLE 4.2 – WALL, CEILING/ROOF REQUIREMENTS AND CORRESPONDING R_w VALUES

ELEMENT/ R_w Rating	Description of Construction
WALLS ALL	Double brick construction or similar.
CEILINGS/ROOF 34 to 40	Colourbond, with R3 insulation and two layers of 13mm plasterboard and surface mounted lights.
30 to 34	Colourbond, with R3 insulation and one layer of 13mm plasterboard

We also noted that preferably doors should be located on the far side from Marmion Avenue or at least screening from Marmion Avenue.

Finally, eaves need to be enclosed using 6mm compressed cement sheeting.

5. CONCLUSION

Using AS 2107:2000 as a guide, the internal noise level within the classrooms has been determined to be an L_{Aeq} noise levels of 35 dB(A). Within the office areas and library, an internal L_{Aeq} noise levels of 40 dB(A) is recommended.

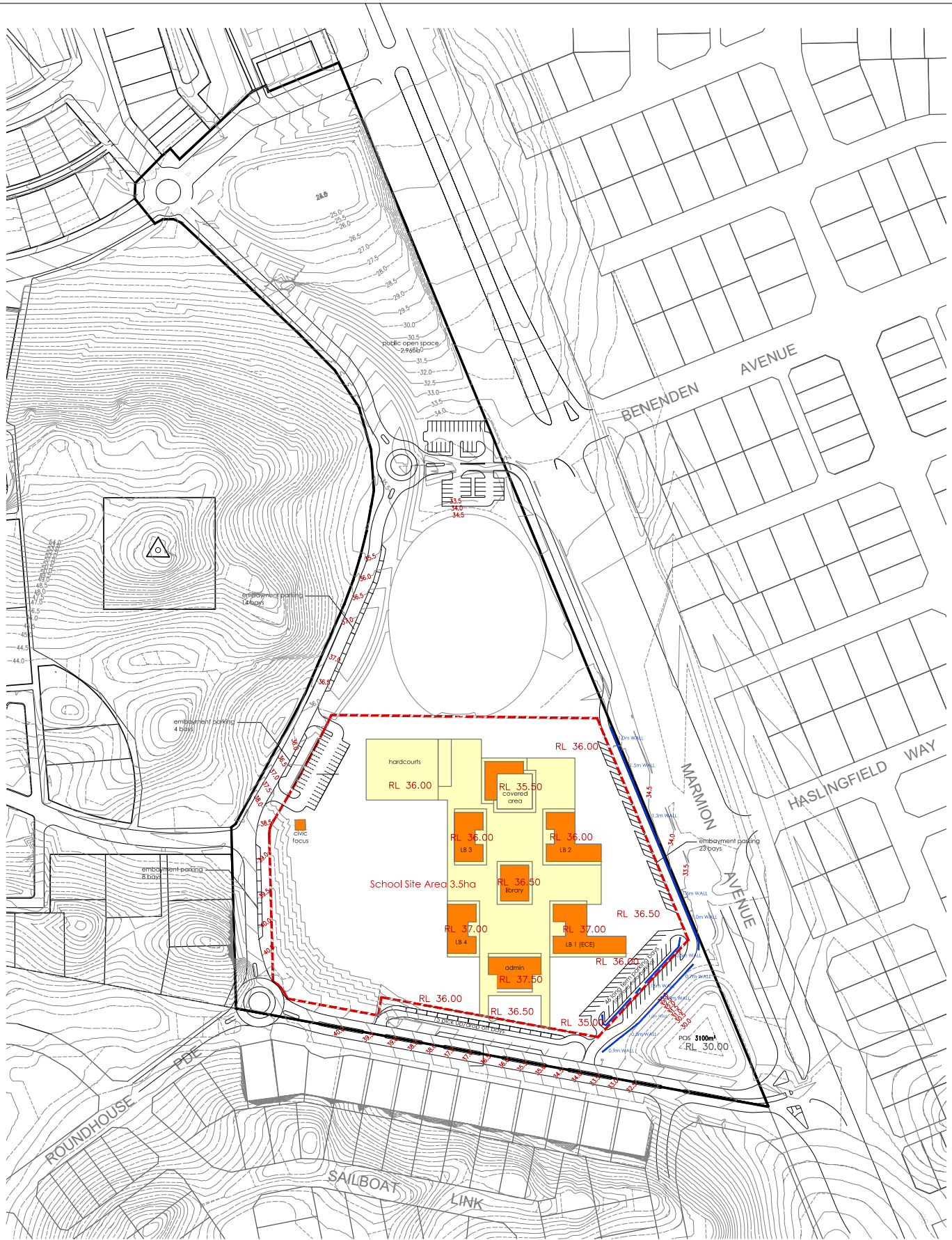
To assess the noise level that would be received at the primary school, a noise level measurement was carried out at a location along Marmion Avenue which currently carries approximately the same volume of traffic that is predicted to pass the primary school in the year 2026. Based on the noise level recorded of L_{Aeq} of 61 dB(A) an assessment of the noise that would be received within the closest classrooms and the library were carried out to determine the minimum constructions required to achieved compliance with the recommended internal noise levels.

We believe that for the walls the required R_w ratings will be achieved standard constructions. However, for windows an improvement on standard construction is required. The required R_w ratings are listed in Table 3.1 with recommended constructions outlined in Section 4 – Required Constructions.

For: **HERRING STORER ACOUSTICS**

Tim Reynolds

APPENDIX E
PROPOSED PRIMARY SCHOOL LAYOUT



Plan C - Jindalee Primary School Structure Plan - Indicative Layout

EDC JIN PLA 55H 10.08.11
 scale 1:1000@ A1

46 long term parking bays (staff + visitors)
 94 short term parking bays (79 embayment/ short term + 15 pick-up/ drop-off pre-primary)
140 total parking bays

- STRUCTURE PLAN BOUNDARY
- RETAINING WALLS



* (Location of school buildings are diagrammatic only and subject to development approval)



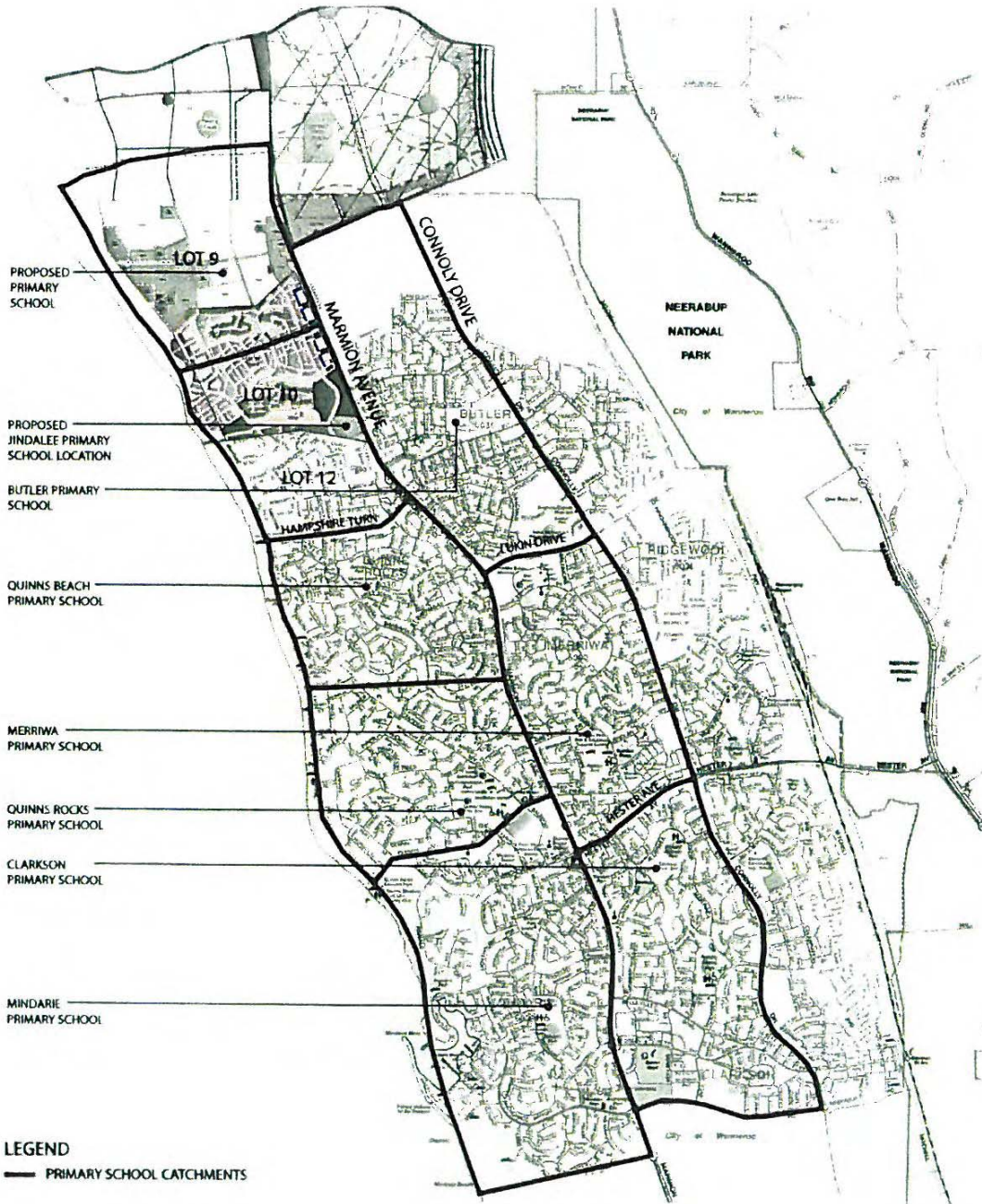
APPENDIX F

SOUTHERN ROAD RESERVE (ROUNDHOUSE PARADE)

APPENDIX G
PEDESTRIAN ACCESS

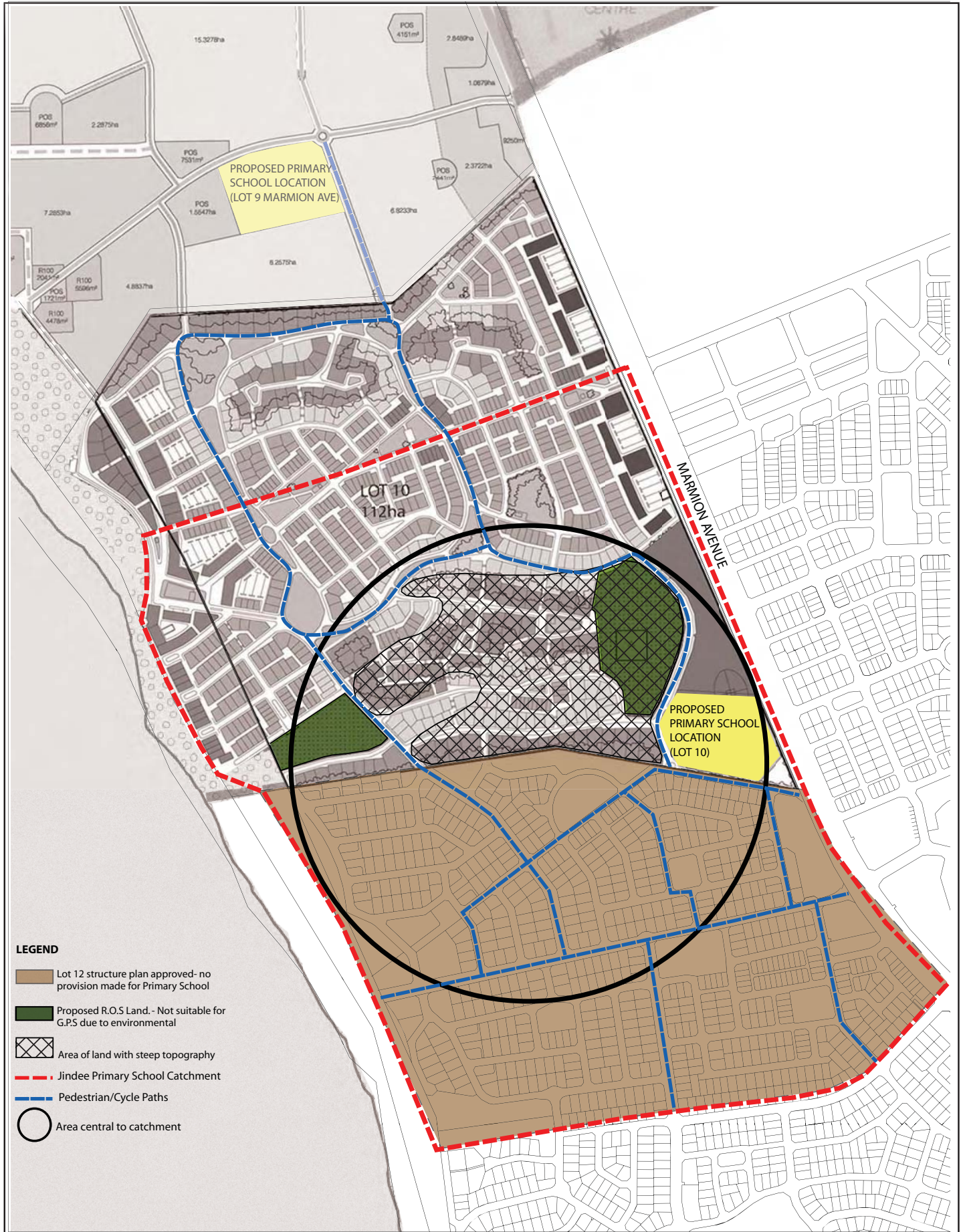
PRIMARY SCHOOL CATCHMENT AREAS

CITY OF WANNEROO



LEGEND

— PRIMARY SCHOOL CATCHMENTS



LEGEND

- Lot 12 structure plan approved- no provision made for Primary School
- Proposed R.O.S Land- Not suitable for G.P.S due to environmental
- Area of land with steep topography
- Jindee Primary School Catchment
- Pedestrian/Cycle Paths
- Area central to catchment

APPENDIX H
DRAINAGE INFRASTRUCTURE

**JINDEE
LOT 10 JINDALEE**

**PRIMARY SCHOOL STRUCTURE PLAN
STORMWATER DRAINAGE MANAGEMENT**

The primary school POS area as depicted on Roberts Day drawing reference EDC JIN PLA 55A forms a portion of the total drainage catchment for Lot 10 as shown on diagram WGE01. The overall drainage strategy will be discussed in our Serving Report to be included in the Lot 10 Structure Plan submission. This interim report addresses drainage management relating to the Primary School Structure Plan only.

The subject area is served by two drainage disposal sites, numbered Catchment 1 and Catchment 11 as shown on Diagram WGE02. The function of these sites is further described as follows:

Catchment 1

Catchment 1 captures 2.55 ha of Lot 10 and 3.23 ha of Marmion Ave, the latter as per Cossill & Webley drawing 5711-01-373 prepared for Marmion Ave extension. Basin No 1 also captures the 5 year piped flow for 1.16 ha of Catchment 11, denoted 11A on Diagram WGE02.

In accordance with City of Wanneroo drainage basin criteria and Liveable Neighbourhoods policy, the basin will be a combination of swales, landscaped area and natural contoured bushland with maximum grades of 1:8 batters. The swale area for the 1 year storm will occupy 2360 square metres to 0.42 metres depth, while the 10 year storm covers 2770 square metres to 0.7 metres. In the event of the 100 year storm, the site will flood to 3560 square metres at a maximum depth of 1.2 metres at RL 26m AHD. Adjoining roads will be a minimum of RL 26.3m AHD.

Catchment 11

Catchment 11 covers an area of 1.99 ha as shown on Diagram WGE01. For the purpose of stormwater management, the catchment is divided into area 11A of 1.16 ha for which the 5 year storm is diverted to Catchment 1, while area 11B of 0.83 ha is piped to basin No 11 with the whole catchment containing the excess of 10 and 100 year events as shown on Diagram WGE02.

Basin No 11 will be formed within a constructed low point adjoining Marmion Ave to comply with City of Wanneroo and Liveable Neighbourhoods principles as for Basin No 1. The swale area for the 1 year storm will be 630 square metres 0.11 deep with the 10 year event at 1120 square metres 0.7 metres deep, while the 100 year flood will occupy 1550 square metres at the maximum depth of 1.2 metres at RL 30.5m AHD which is the lowest design level of the adjoining Roundhouse Pde and Marmion Ave intersection.

Marmion Ave

For the length of Marmion Ave adjoining the Structure Plan area, stormwater is directed to the Kingsbridge Boulevard swale area and the existing fenced basin adjoining Marmion Ave in accordance with approved Cossill & Webley drainage management for Brighton Estate.

LEGEND

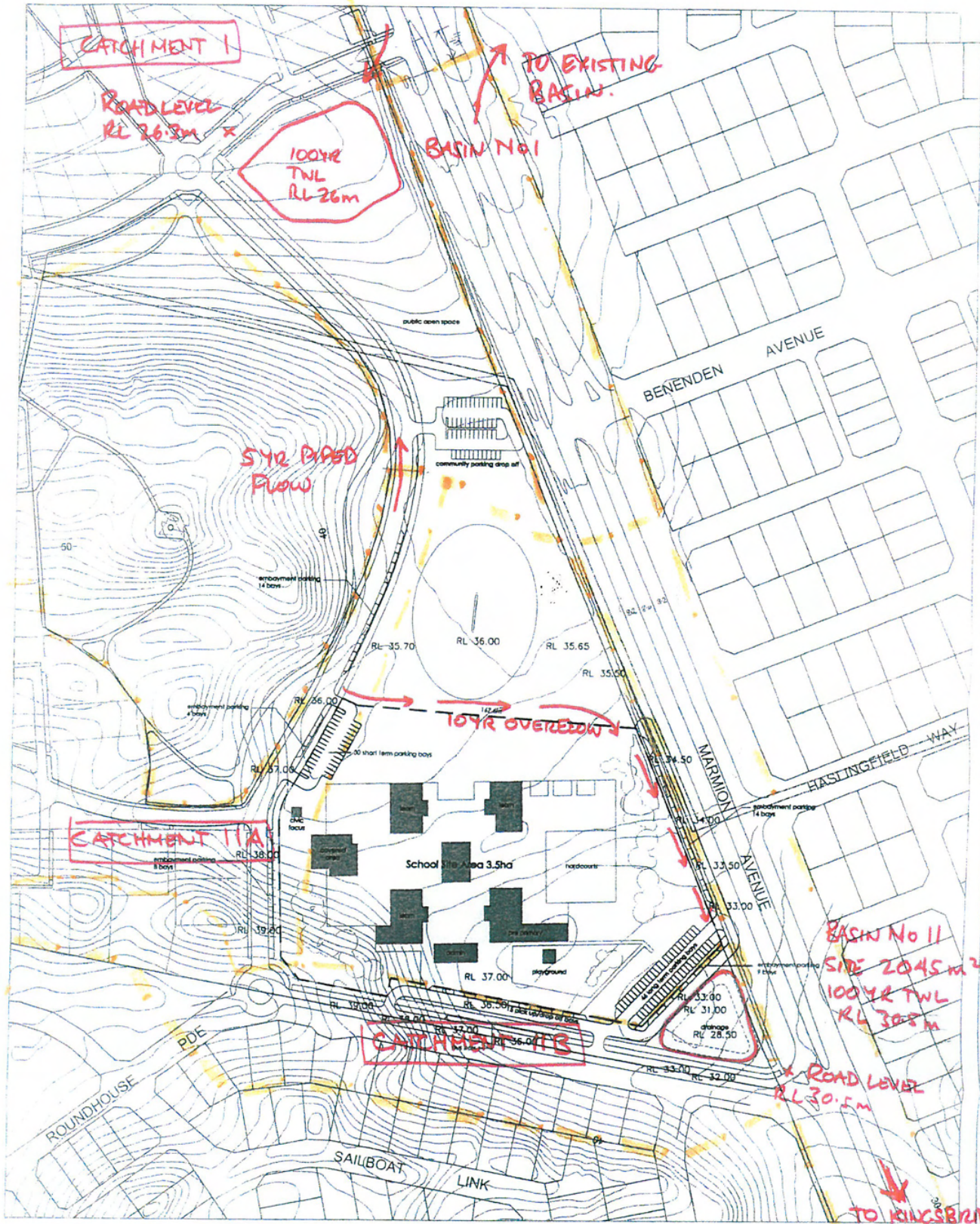
CATCHMENT BOUNDARY

SUMP/BASIN LOCATION

SUMP/BASIN NUMBER



WGE 01



Jindalee Primary School Structure Plan - Indicative Layout 1

EDC / JN PLA 55A 5.5.09
 scale 1:1000 @ A1

46 long term parking bays (staff + visitors)
 80 short term parking bays (65 embayment / short term + 15 pick-up / drop-off pre-primary)

126 total parking bays



DRAINAGE STRATEGY
 WGE 02

APPENDIX I

ROAD ACCESS / CAR PARKING

